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(Editors)

# **Facing Global Environmental Change**

## **Environmental, Human, Energy, Food, Health and Water Security Concepts**

With Forewords by R.K. Pachauri, Director General, The Energy and Resources Institute (TERI), Chairman, Intergovernmental Panel on Climate Change (IPCC); Achim Steiner, Executive Director of UNEP, UN Under-Secretary General; Joy Ogwu, former Foreign Minister of Nigeria, Permanent Representative of Nigeria to the UN; Stavros Dimas, Commissioner for the Environment, European Union

With Prefaces by Luc Gnacadja, Executive Secretary, UNCCD Secretariat; Sálvano Briceño, Director, Secretariat of the International Strategy for Disaster Reduction; Michael Zammit Cutajar, former Secretary General, Secretariat of the UN Framework Convention on Climate Change; Vandana Shiva, Alternative Nobel Prize

With 249 Figures, 135 Tables and 27 Boxes

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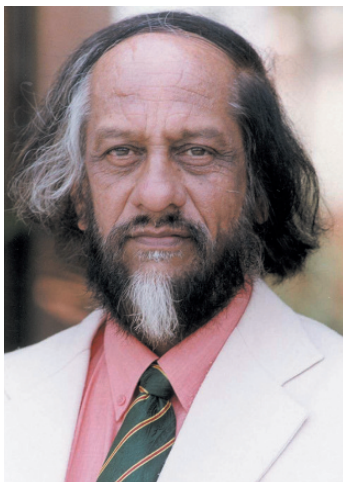
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## Foreword

The year 2007 could perhaps accurately be described as the year when climate change finally received the attention that this challenge deserves globally. Much of the information and knowledge that was created in this field during the year was the result of the findings of the Fourth Assessment Report (AR4) of the Intergovernmental Panel on Climate Change (IPCC), which were disseminated on a large scale and reported extensively by the media. This was the result not only of a heightened interest on the part of the public on various aspects of climate change, but also because the IPCC itself proactively attempted to spread the findings of its AR4 to the public at large.

The interest generated on the scientific realities of climate change was further enhanced by the award of the Nobel Peace Prize to the IPCC and former Vice President of the US, Al Gore. By taking this decision in favour of a leader who has done a great deal to create awareness on climate change, and a body that assesses all scientific aspects of climate change and disseminates the result of its findings, the Norwegian Nobel Committee has clearly drawn the link between climate change and peace in the world.

There are several reasons why unmitigated climate change can be considered as a potential source of conflict and disruption of peace. The impacts of climate change are varied and can become serious unless effective steps are taken to stabilize the earth's atmosphere and the consequent changes in climate that would occur in the absence of such actions. Firstly, there is now adequate evidence to show that several extreme events are becoming more frequent and more intense. These include extreme precipitation events, heat waves, floods as well as droughts. Impacts of climate change include sea level rise which threatens several low lying islands as well as coastal areas. Melting of ice bodies such as glaciers across the globe and impacts on human health as well as on biodiversity are also projected to become much more serious over time. Climate change can also cause irreversible changes such as a threat to extinction of several species. Of all those species that were assessed by the IPCC, 20 to 30 percent were seen to face the threat of extinction with temperature increases of over 1.5 to 2.5 °C. Impacts on agriculture could also be serious, and there is already some evidence of a decline in productivity and yield of some species as a result of climate change. Recent research in India shows such a trend in the case of wheat productivity.

All of this means that human society could suffer serious consequences as a result of climate change which could not only result in conflict over resources such as water, exhibiting increasing scarcity in several parts of the world, but also lead to displacement of populations linked with these factors. Particularly vulnerable are the megadeltas in Asia, which include cities like Shanghai, Dhaka and Calcutta. These are centers not only of large populations, but also substantial assets of property and infrastructure. The threat of coastal flooding can, therefore, have high magnitude impacts on these megadeltas.

The growing impacts of climate change make it essential for communities and countries to adapt to the impacts of climate change. However, these impacts and the costs of adaptation will increase disproportionately as the impacts become more severe. Hence, an essential policy that would be required for minimizing the negative impacts which would otherwise take place in the future would be to carry out effective mitigation of greenhouse gas (GHG) emissions. The IPCC has clearly brought out several measures and options by which mitigation can take place with existing technologies and methods, but these would have to be supported by appropriate policies to be put in place by governments, including agreements at the global level. Fortunately, the costs of mitigation have been assessed as being very low and the co-benefits in the form of lower levels of local pollution, higher levels of energy security, improved health etc. would make these mitigation options far more attractive than has been believed by certain sections of society which have been resistant to action.

This book serves an extremely useful purpose, because it covers several critical elements of climate change and the challenges that are thrown up by consideration of the impacts of climate change and security issues related to it. Such a volume is not only highly readable for a very wide audience, but also contains valuable information and research based analysis that would provide a valuable reservoir of knowledge to researchers and students working in this field.

New Delhi, September 2008

R. K. Pachauri  
Director General, The Energy and  
Resources Institute (TERI)  
Chairman, Intergovernmental Panel  
on Climate Change (IPCC)  
Peace Nobel Laureate, 2007



## Foreword

International discourse on the link between declining natural resources and instability, tensions and even conflicts has reached a new and urgent level in the early 21<sup>st</sup> century.

This is in part as a result of growing understanding that on many of the sustainability indicators humanity is pushing the limits – if not pushing past the limits – on many key fronts.

UNEP's latest Global Environment Outlook-4 puts these sobering realities into sharp focus.

- In 1987, around 15 per cent of global fish stocks were classed as collapsed. GEO-4 says this has roughly doubled to 30 per cent.
- 20 years ago around a fifth of fish stocks were deemed over-exploited this has now risen to about 40 per cent.
- Land use intensity, with links to land degradation, soil erosion, water scarcity, nutrient depletion and pollution has increased. In 1987, a hectare of cropland yielded 1.8 tonnes. Now the intensity is 2.5 tonnes.
- In Latin America and the Caribbean, desertification – caused by deforestation, over grazing and inadequate irrigation – affects a quarter of the region.
- Available freshwater resources are declining; by 2025, close to two billion people are likely to live with 'absolute' water scarcity.
- Populations of freshwater vertebrates have declined on average by nearly 50 per cent since 1987 as compared with an around 30 per cent decline for terrestrial and marine species.
- About 40 per cent of big estuaries in the United States including those that link to the Gulf of Mexico and Chesapeake Bay suffer severe eutrophication – which can lead to deoxygenated 'dead zones' – because of nitrogen enrichment.
- In the Caribbean, over 60 per cent of economically important coral reefs are threatened by sediments, pollution and over-fishing.
- War and conflict has raised the number of refugees and internally displaced people in West Asia to about four million.

On top of these come the ever more worrying impacts of climate change, outlined in the 4<sup>th</sup> assessment of the Intergovernmental Panel on Climate Change (IPCC).

It is not by chance that the IPCC – jointly established by UNEP and the World Meteorological Organisation – jointly won the Nobel Peace Prize.

How indeed will the world cope with the millions of people on small islands and in low lying areas such as Bangladesh who are set to lose their land, livelihoods and their homes?

What will tens of million – if not hundreds of millions – of people in Asia, Africa and Latin America do when the glaciers melt away turning many of the world's mighty rivers into seasonal, rather all year round runs.

It is for these very reasons that climate change and security was placed in 2007 and for the first time, on the agenda on the UN Security Council.

Also why it has begun animating leading members of the military in countries such as Australia, the United States and the United Kingdom.

There is clearly an urgent need to bring more intelligence and creative solutions to the way we manage the world's ecosystems and the nature-based assets that fundamentally underpin human well-being while also investing in a new and more sustainable energy mix.

The returns, both economic and social, are potentially enormous from overcoming poverty and providing the food and livelihoods for over six billion people – shortly rising to nine billion – and at the same time delivering equity and stability to communities and countries across the globe: in short a peace policy for the new millennium.

So I welcome this *Security Handbook for the Anthropocene – Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts* and its 100 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, September 2008

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



## Foreword

This volume – *Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts* – is of utmost importance for Africa. I am pleased that one of the coeditors is a Kenyan and 15 authors come from, live or worked on problems related to the challenges facing the African continent during this century.

This scientific peer-reviewed volume with 100 chapters contributes to global dialogue and learning based on topical new evidence from several disciplines and mutual respect for cultural diversity. Africa has already been severely affected by the effects of global environmental change during the 20<sup>th</sup> century due to progressing desertification, drought, famine as well as floods and heat waves that have killed and affected or forced millions of Africans to leave their homes.

This book deals in detail with these natural hazards and their often severe impacts Africa has been facing. Chapters in this book discuss the severe food insecurity and the impact of HIV/AIDS and of other pandemics on national and human health security and the need for a sustainable energy system. Problems of water security in the Nile Basin and in other parts of Africa have triggered cooperative solutions, as with the Nile Basin Initiative. In the past environmental security problems have repeatedly contributed to conflicts in Sub-Sahara Africa and they stress an urgent need for Pan-African as well as national human and environmental, water, food and health security approaches across Africa and elsewhere

The fourth IPCC Assessment Report of 2007 has stressed that climate change will have many negative impacts for the African people regarding their access to clean water, sufficient food, stable health conditions, ecosystem resources, and security of settlements. In the view of the IPCC there is also high confidence that many semi-arid areas, e.g. 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.

Climate change will not only affect food security, but also exacerbate malnutrition. By 2020, in some African countries, yields from rain-fed agriculture could be reduced by up to 50 per cent. Agricultural production and access to food will be severely compromised. Africa is also likely to be strongly affected by climate change, because of its limited adaptive capacity to projected climate change impacts. Furthermore, several African mega-deltas, due to large populations and high exposure to sea level rise, storm surges, and river flooding will also suffer from the impacts of global environmental and climate change to which Africans have historically contributed little.

This huge volume of excellent scholarship from all parts of the world helps to sensitize policy makers but also a young generation of professors and students globally but specifically in the most affected countries in the South for the need for proactive and cooperative action and for a global science partnership to reduce the worst impacts of the projected trends in business as usual strategies.



This book deserves many readers in all parts of the world, but especially in those countries where university and research libraries are unable to afford such references books. It is my sincere hope that this high-quality and multidisciplinary study and reference book and its key messages will be made available with the support of private foundations and public donors to the young generation in the global South that will face these challenges to their security in the 21<sup>st</sup> century. 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, September 2008

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



## Foreword

The title of this volume – *Facing Global Environmental Change: Environmental, Human, Energy, Food, Health and Water Security Concepts* – sums up many of the dilemmas and challenges facing policy-makers today. First, environmental change is global; no part of the world is spared. Second, we have to face change now; ignoring the challenge is not an option if our children are to thrive. Third, in an increasingly connected world, security is more than just the absence of war; it depends on diverse, but linked – indeed, often competing – factors such as political, social, economic, and environmental interests. Central to these, as the title of this book suggests, is the environment.

As a large and economically powerful union, the EU enjoys economies of scale. These can be exploited to address environmental threats – at local, national, and Union levels. It is sobering to recall, however, that even the enlarged EU is not autonomous and that the health of the European environment also depends on policies and practices in other parts of the world. Nowhere is this more evident than with climate change. Changes and challenges are now global, and thus our policy responses must be global too. Our security is indivisible, but our responses remain all too clearly fractured and divided.

Second, the concept of 'sustainable development' shows that time is a crucial factor in environmental security. The future can only be secured insofar as we act responsibly now; prevarication will have costs which future generations will pay. This implies urgent choices now. Fortunately, the developing science of costing environmental goods and services suggests that taking action on the environment not only has costs, but also has significant short- to medium-term financial and other benefits. Nonetheless, questions remain as to when best to take action and how such action can accommodate political and economic timetables.

Third, the environment is indeed a key component of modern security. Environmental degradation may destabilize societies by reducing economic opportunity. Degraded environments can be breeding grounds for other social ills, such as impaired human health or declining social cohesion. Developing countries with populations directly dependent on environmental resources are also particularly vulnerable to conflict over access to limited or declining resources. Environment is thus central to modern security, but also needs to be integrated with other factors such as energy, mobility, and food requirements. The question for policy-makers is how, in practical terms, to align these diverse interests.

Since the end of the Cold War, the security debate has changed fundamentally. A study which addresses the new challenges and suggests responses will therefore be a welcome addition to the policy-maker's toolkit. For this reason, I warmly welcome this volume.

A handwritten signature in dark ink, appearing to read 'Stavros Dimas'.

Brussels, September 2008

Stavros Dimas  
Commissioner for the  
Environment, European Union

We the eight editors from eight countries

coming from four continents:

Hans Günter Brauch (Germany)  
Navnita Chadha Behera (India)  
Béchir Chourou (Tunisia)  
John Grin (The Netherlands)  
Patricia Kameri-Mbote (Kenya)  
Heinz Krummenacher (Switzerland)  
Czeslaw Mesjasz (Poland)  
Úrsula Oswald Spring (Mexico)

dedicate this volume to  
our children or godchildren  
representing all children of the globe  
who will experience  
during the 21<sup>st</sup> century  
whether  
the messages of these  
joint scientific efforts will become reality.

For

*Ananya, Anna, Chloe, Hela,  
Ian, Ivo, Janusz, Karin,  
Melanie, Micha, Natalia, Nathan,  
Omar, Serena Eréndira, Slim, Ulrike*

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*recipient of the Right Livelihood Award (Alternate Nobel Prize) in 1993*

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- Box 9.1: Number of Refugees and Migrants Globally. Source: Dow/Carr (2005).
- Box 9.2: Eighth Proposal by the German Advisory Council on Global Change for Managing migration through cooperation and further developing international law. Source: WBGU summary; at: <[http://www.wbgu.de/wbgu\\_jg2007\\_kurz\\_engl.html](http://www.wbgu.de/wbgu_jg2007_kurz_engl.html)>.

In chapter 10, Ali Ghazi is grateful to Hans Günter Brauch who added the following seven figures to illustrate his chapter that are all in the public domain (FAO, UNEP).

- *Figure 10.1:* NOAA Satellite Image of Algeria. Source: FAO Country Profiles and Mapping Information System, Algeria; at: <<http://www.fao.org/countryprofiles/Maps/DZA/19/im/index.html>>. This FAO document is in the public domain.
- *Figure 10.2:* Map of Land Cover in Algeria. Source: FAO, at: <<http://www.fao.org/countryprofiles/maps.asp?iso3=DZA&lang=en>>.
- *Figure 10.3:* Precipitation in Algeria. Source: FAO Country Profiles and Mapping Information System, Algeria; at: <<http://www.fao.org/countryprofiles/Maps/DZA/06/pp/index.html>>.
- *Figure 10.4:* Districts in Algeria. Source: FAO Country Profiles and Mapping Information System, Algeria; at: <<http://www.fao.org/countryprofiles/Maps/DZA/16/ad/index.html>>.
- *Figure 10.5:* Farming Systems in Algeria. Source: FAO Country Profiles and Mapping Information System, Algeria; at: <<http://www.fao.org/countryprofiles/Maps/DZA/01/fs/index.html>>.
- *Figure 10.6:* Water and Wind Erosion in Algeria. Source: UNEP/ISRIC, CRU/UEA; at: <<http://lada.vrtualcentre.org>>.
- *Figure 10.7:* Salinization and chemical deterioration severity in Algeria. Source: UNEP/ISRIC, CRU/UEA; at: <<http://lada.vrtualcentre.org>>.

Two tables are in the public domain relying on data by the Algerian government:

- *Table 10.1:* Overview of the areas affected by Silting.
- *Table 10.2:* Sensitivity of Administrative Districts in Steppe Land to Desertification.

In chapter 11, *Úrsula Oswald Spring* and *Hans Günter Brauch* rely on boxes, figures and tables that are in the public domain:

- *Box 11.1:* Ministerial Declaration of The Hague on Water Security in the 21st Century, 22 March 2000. Source: <[http://www.worldwatercouncil.org/fileadmin/wwc/Library/Official\\_Declarations/The\\_Hague\\_Declaration.pdf](http://www.worldwatercouncil.org/fileadmin/wwc/Library/Official_Declarations/The_Hague_Declaration.pdf)>.
- *Box 11.2:* Principles for Effective Water Governance. Source: GWP IWRM Toolbox; at: <[http://www.gwpforum.org/gwp/Media/Toolbox/main\\_features.pdf](http://www.gwpforum.org/gwp/Media/Toolbox/main_features.pdf)>.
- *Table 11.3:* 'Virtual Water': Average requirement of water in productive activities. Source: FAO (2000). This table is in the public domain.

or for which permission was granted by one of the authors or the copyright holder:

- *Table 11.1:* Fundamental policy directions and water security perspectives. Source: Falkenmark and Rockström (2005: 22). Permission was granted by the author.
- *Table 11.2:* Distribution of Freshwater Resources in the World. Source: Shiklomanov (2005: 11). Permission was granted by the author.
- *Figure 11.1:* Environmental Water Scarcity Index by River Basin. Source: World Resource Institute (2003); at: <<http://www.iucn.org/themes/wani/eatlas/html/gm16.html>>. The WRI was informed three times and did not object the reproduction under the fair use clause.

Úrsula Oswald Spring obtained the permission from her Mexican colleagues to reproduce their figures she used and modified in her previous Spanish book published in 2005.

- *Figure 11.4:* Logic of the Values of Water. Source: Ramos (2004), modified by Oswald Spring (2005: 147).
- *Figure 11.5:* Sustainable Economy of Water. Source: Sandoval 2000, modified by Oswald Spring (2005: 153).

The International Food Policy Research Institute, Washington, D.C. granted permission for Rosegrant, Cai, and Cline (2002c) to use the following tables and figures from their publication:

- *Table 11.4:* Scenarios for rain-fed and business as usual production. Source: Rosegrant/Cai/Cline (2002c: 21, table 2).

- *Table 11.5*: Irrigation water supply reliability index by regions. Source: Rosegrant/Cai/Cline (2002c: 7, table 1).
- *Figure 11.2*: Per capita domestic water consumption in 1995 and 2025. Source: Rosegrant/Cai/Cline (2002c: 5, figure 4).
- *Figure 11.3*: Water consumption by sector in 1995 with projections to 2025. Source: Rosegrant/Cai/Cline (2002c: 6, figure 5).
- *Figure 11.8*: Total water consumption for irrigation with projections to 2025. Source: Rosegrant/Cai/Cline (2002c: 2, figure 2).
- *Figure 11.9*: Potential irrigation consumption with projections to 2025. Source: Rosegrant/Cai/Cline (2002c: 6, figure 6).
- *Figure 11.10*: Irrigation and rain-fed production in cereals Source: Rosegrant/Cai/Cline (2002c: 8, figure 8).
- *Figure 11.11*: Sustainable consumption of water in rural and urban areas. Source: Rosegrant/Cai/Cline (2002c: 15, figure 15).

The WBGU granted permission to use the following figures from its Flagship Report of 2007/2008:

- *Figure 11.6*: Conflict constellation 'climate-induced degradation of freshwater resources: key factors and interactions'. Source: WBGU (2008: 83)
- *Figure 11.7*: Conflict constellation 'climate-induced increase in storm and flood disasters: key factors and interactions'. Source: WBGU (2008: 109).

In chapter 12, *Wolfgang Lutz* based his figures and tables on UN sources that are in the public domain and used his own calculations or previously co-authored publications:

- *Figure 12.1*: Average annual population growth rates of selected world regions, 1950-2050. Source: United Nations 2003 (medium variant).
- *Figure 12.2*: Proportion of population above age 80 in Western Europe. Author's calculation.
- *Figure 12.3*: Population (in millions) aged 20-65 by level of education, according to the 'ICPD' scenario in four megaregions, 2000-2030. Source: Goujon/Lutz 2004: 138.
- *Table 12.1*: Life expectancy at birth and total fertility rates by selected regions (1950-2050). Source: United Nations 2003 (medium variant).
- *Table 12.2*: Population (in millions) aged 20-65 by education and gender in 2000 and in 2030 according to the 'constant' and the 'ICPD' scenarios. Source: Author's calculations (together with Anne Goujon).

In chapter 13, *Ben Wisner and Juha Uitto* used in their tables UN sources that are in the public domain and a variety of other cited sources.

- *Table 13.1*: Population of megacities with 10 million inhabitants (1950-2015). Source: UN Populations Division (2006).
- *Table 13.2*: Comparison of Four Megacities. Sources: *Manila and Tokyo*: Fuchs/Brennan/Chamie/Lo/Uitto 1994; Yeung/Lo 1996; Tayag 1999, Velasquez/Uitto/Wisner/Takahashi 1999; *Tokyo*: Takahashi 1998, 1999; Tokyo Metropolitan Government 1995; *Manila*: Tayag 1999; Asian Development Bank (ADB) 2000, 2002; Bankoff 2003b; *Mexico City*: Cruz 1993; Gilbert 1994, 1996; Roland/Gordon 1996; Puente 1999a, 1999b; *Los Angeles*: Wisner 1999a, 1999b, 2003a; Bolin/Stanford 1998; General: U.N. 1999.

Most tables are based on both authors' field work:

- *Table 13.3*: Groups Perceived by Disaster Management Professionals to be Highly Vulnerable to Disasters (per cent of officials).
- *Table 13.4*: Knowledge of Vulnerable Groups and Planning of Programmes to Reduce Vulnerability In Mexico City and Los Angeles (per cent of officials).
- *Table 13.5*: Groups Perceived by Disaster Management Professionals to be Highly Vulnerable to Disasters (per cent of officials).

- *Table 13.6:* Knowledge of Vulnerable Groups and Planning of Programmes to Reduce Vulnerability (per cent of officials).
- *Table 13.7:* Social Capital and Trust Matrix.

In chapter 16, *Nana K. Poku and Bjorg Sandkjaer*, drafted these diagrams and table based on their own data or on data by UN organizations that are in the public domain:

- *Figure 16.1:* Percentage of Africans living on less than a dollar a day. Source: UN (2005).
- *Figure 16.2:* Number of People Living with HIV/AIDS in Sub-Saharan Africa. Source: World Bank (2005).
- *Figure 16.3:* Impact of HIV/AIDS on population growth for selected southern African states. Source: UN/DESA Population Division (2005).
- *Figure 16.4:* Impact of HIV/AIDS on life expectancy at birth, 1970-2015. Source: UN/DESA Population Division (2005).
- *Figure 16.7:* Conceptual framework for impacts of HIV/AIDS on democratic processes. Source: Authors.
- *Table 16.1:* Human Development in selected African countries. Source: UNDP 2006.

The following two diagrams by the authors rely on other data that are cited.

- *Figure 16.5:* Women in Parliament 2004. Source: Population Reference Bureau (2005).
- *Figure 16.6:* Number of Adults Receiving Antiretroviral Treatment in sub-Saharan Africa. Source: Simulation based on Salomon/Hogan/Stover/Stanecki/Walker/Ghys/Schwarländer (2005).

In chapter 17, *Sophia Benz* added two tables and a figure that are based on her own research Benz (2005):

- *Figure 17.1:* The Final Theoretical Model.
- *Table 17.1:* Results of Final OLS Regression Analyses (with HIV-Prevalence as the dependent variable)
- *Table 17.2:* Measurement and Data Sources (all variables)

In chapter 18, *Janos J. Bogardi, Jörn Birkmann, Niklas Gebert and Neysa J. Setiadi* included six figures that rely on their own research and on previous publications for which they obtained the permission from the respective copyright holders:

- *Box 18.2:* 14 Indicators for assessing emergency planning for the city government.
- *Figure 18.1:* The BBC conceptual framework. Source: Birkmann 2006: 34, based on Bogardi/Birkmann (2004) and Cardona (1999, 2001).
- *Figure 18.2:* The Risk Hierarchy. Source: Adapted from Cannon (2006: 11).
- *Figure 18.3:* Map of recent and plausible future sources of Sumatran tsunami. Source: Borrero/Sieh/Chlich/Synolakis (2006: 19674).
- *Figure 18.4:* Indices of the household preparedness level in three different hazard zones. Source: Own figures based on data from Hidayati/Permana/Pribadi/Ismail/Meyers/Widayatun/Handayani/Bustami/Daliyo/Fitranita/Nagib/Ngadi/Kumoro/Rafliana/Argo (2006).
- *Figure 18.5:* The knowledge and attitude index based on different levels of education. Source: Own figures based on data from Hidayati/Permana/Pribadi/Ismail/Meyers/Widayatun/Handayani/Bustami/Daliyo/Fitranita/Nagib/Ngadi/Kumoro/Rafliana/Argo (2006).
- *Figure 18.6:* Sources of information about tsunami and earthquakes from specific sources. Source: Own figures based on data from Hidayati/Permana/Pribadi/Ismail/Meyers/Widayatun/Handayani/Bustami/Daliyo/Fitranita/Nagib/Ngadi/Kumoro/Rafliana/Argo (2006).

Permission was granted by the authors to use the text in this box:

- *Box 18.1*: Questionnaire contents for households. Source: Authors based on Hidayati/Permana/Pribadi/Ismail/Meyers/Widayatun/Handayani/Bustami/Daliyo/Fitranita/Nagib/Ngadi/Kumoro/Rafliana/Argo 2006. Summary of the authors based on components of the study's questionnaire.

In chapter 19, *Imtiaz Ahmed* is grateful to the respective copyright holders for permission to reproduce several photos, maps and tables.

- *Figure 19.1*: Maps of Bangladesh, A: Climate-related Natural Events, and B: Internal Migration. Sources: A: Ericksen/Ahmad/Chowdhury (1996: 264); B: Ericksen/Ahmad/Chowdhury (1996: 245). Permission was granted by Springer-Verlag, the successor of Kluwer Academic Publishers.
- *Figure 19.2*: Map of Bangladesh. Source: Official map of the government of Bangladesh that is in the public domain.
- *Figure 19.3*: A snake charmer among the 213 people stranded at Satgachi, West Bengal, pleads for food, 4 February 2003. Source: *Frontline*, 20,4 (February 2003): 15-28. Reprinted with permission.
- *Figure 19.4*: Indian government's construction of a fence on the Indo-Bangladesh border. Source: BBC News/South Asia, Tripura, Tuesday, 28 June, 2005; at: <www.bbc.com>; Photos by Bapi Roy Choudhury that are reprinted with permission of the photographer.
- *Figure 19.5*: The fence on the Indo-Bangladesh border. Source: Photos by Bapi Roy Choudhury and Shubhashish Roy that are reprinted with permission of the photographers.
- *Table 19.1*: Reasons for leaving Bangladesh (multiple responses).
- *Table 19.2*: Original home of environmental refugees. Source: Author's calculation from a survey conducted by Ranabir Samaddar of Maulana Azad Institute of Asian Studies, Calcutta (1996).
- *Table 19.3*: Incidence of Distress Selling (percentage of villages). Source: Sen/Hashemi/Ahmed (1998); also Ahmed (1999b: 38). Reprinted with permission of the publisher.

In chapter 20, *Thomas Homer-Dixon* and *Tom Deligiannis* three figures were drafted by the authors for this volume and the fourth is taken from a previous publication by one author:

- *Figure 20.1*: Supply-induced scarcity.
- *Figure 20.2*: Demand-induced scarcity.
- *Figure 20.3*: Structural scarcity.
- *Figure 20.4*: The Toronto Group's Core Model of the Causal Links between Environmental Scarcity and violence. Source: Homer-Dixon (1999). Reprinted with permission of the author.

In chapter 21, *Simon J.A. Mason*, *Tobias Hagmann*, *Christine Bichsel*, *Eva Ludi* and *Yacob Arsano* reproduced a map with the permission of the copyright holder and compiled a table based on data by UN organizations that are in the public domain:

- *Figure 21.1*: Countries of the Nile Basin. Source: From Amer et al. (2005) © EAWAG, Duebendorf, 2005; reproduced with permission of Eawag.
- *Table 21.1*: Food security in the Nile Countries, Source: Mason 2004, based on data from: a) FAO (2000b); b) FAO (2000a); c) FAO (2000c); d) UNDP (2000); and e) UNFPA (2002) that are in the public domain.

In chapter 22, *Saleem H. Ali* produced a new table based on his own analysis.

- *Table 22.1*: Divergent Arguments on Sustainability of Mineral Extraction Activities.

In chapter 23, *Klaus-Dietmar Jacoby* relies in his tables and figures on official IEA data for which permission was granted by IEA to reproduce them in this volume:

- *Figure 23.1*: IEA Gulf War Contingency Response Plan.
- *Figure 23.2*: Stock release and increased production, 2005 IEA Collective Action.
- *Figure 23.3*: Oil import dependence in IEA.
- *Figure 23.4*: Natural gas import dependence in IEA.
- *Table 23.1*: Total IEA Response, 2005 IEA Collective Action.
- *Table 23.2*: World Primary Energy Demand in the Reference Scenario (Mtoe).
- *Table 23.3*: World Oil Production in the Reference Scenario (million barrels per day).

The Copyright for the IEA figures and tables remains with IEA.

In chapter 24, *Leo Schrattenholzer* used three tables from previous publications to which he was a co-author and a table and figure of colleagues at IIASA for which permission was obtained.

- *Figure 24.1*: Annual Production and Known Reserves of Crude Oil and Natural Gas (1945-1995). Source: Nakicenovic/McDonald/Grübler (1998).
- *Table 24.1*: Typology of Long-Term Energy-Economy-Environment Scenarios according to IPCC-SRES. Source: Nakicenovic/Swart (2000); Metz/Davidson/Swart/Pan (2001). Permission was granted by the IPCC. This table was taken from the IPCC Special Report on Emissions Scenarios (2001) that was published by Cambridge University Press.
- *Table 24.2*: Selected results and indicators of sustainable development scenarios. Indicators of long-term energy security are emphasized. Source: Schrattenholzer/Miketa/Riahi/Roehrl/Strubegger/Totschnig/Zhu (2004).
- *Table 24.3*: Selected results and indicators of CO<sub>2</sub> mitigation scenarios. Indicators of long-term energy security are emphasized. Source: Schrattenholzer/Miketa/Riahi/Roehrl/Strubegger/Totschnig/Zhu (2004).
- *Table 24.4*: Selected results and indicators of high-impact scenarios. Indicators of long-term energy security are emphasized. Source: Schrattenholzer/Miketa/Riahi/Roehrl/Strubegger/Totschnig/Zhu (2004).

In chapter 25, *Werner Zittel and Joerg Schindler* in six figures and one table provided their own analysis that are partly based on other cited statistical sources:

- *Figure 25.1*: Oil production of countries/regions outside OPEC and FSU. Estimates for 2005 based on government statistics, analysis and projection by LBST. Source: IHS 2003; BP St. Rev. 2005
- *Figure 25.2*: Annual gas production 1920-2004 and extrapolation. Source: History: IHS Energy (2005); projection: LBST (Schindler/Zittel 2006).
- *Figure 25.3*: Gas production forecast for Russia. Source: Laherrere (2003), LBST estimate (2004).
- *Figure 25.4*: Worldwide Gas production according to LBST Scenario Calculations. Source: IHS Energy (2005); BP Statistical Review of Energy (2005); Projection: LBST (2005).
- *Figure 25.5*: 'High fossil' scenarios of future production of fossil and nuclear fuels. Source: for oil and gas: Campbell/ASPO (2005); coal and nuclear scenario: LBST (Schindler/Zittel 2006).
- *Figure 25.6*: 'Low fossil' scenario of future production of fossil and nuclear fuels. Source: for oil, gas, coal, and nuclear scenario: LBST (Schindler/Zittel 2006).
- *Figure 25.7*: Possible market penetration of renewable energy sources. Sources: LBST (Schindler/Zittel 2006).
- *Table 25.1*: Remaining proven oil reserves for 'ME Five'. Sources: [1] O&GJ, 19 December 2005 (for 1 January 2006); [2] BP, June 2005 (until end of 2004); [3] ASPO Newsletter, 62, February 2006; [4] Bakhtiari, February 2006.