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(Eds.)

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Coping with Global Environmental Change, Disasters and Security

Threats, Challenges, Vulnerabilities and Risks

Springer

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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.

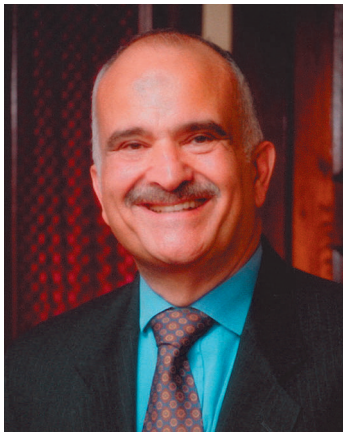
This book, with 95 chapters, reviews the conceptual debate on security threats, challenges, vulnerabilities and risks. It analyses military and political hard and soft security dangers and concerns in West Africa and assesses environmental and human security issues in North Africa. The main parts deal 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

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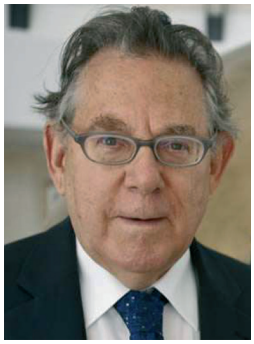


The Anthropocene: Geology by Mankind

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>.

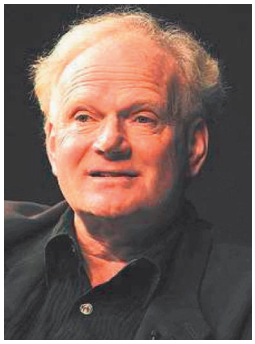
sion for Nuclear Non-proliferation and Disarmament (ICNND), co-chaired by the former Foreign Ministers of Australia and Japan, point to advocacy of a 'minimization' point of over 1,000 nuclear warheads by 2025, while President Obama says "perhaps not in my lifetime".

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.

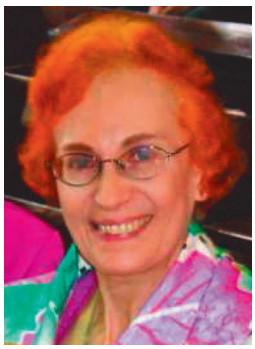
An initial defect lies in regarding risk more or less or even exclusively as an ally, but failing to perceive it as an *unreliable* ally and not at all as a potential antagonist, as a force hostile both to nation state power as well as to global capital. Surprisingly the research traditions of Douglas 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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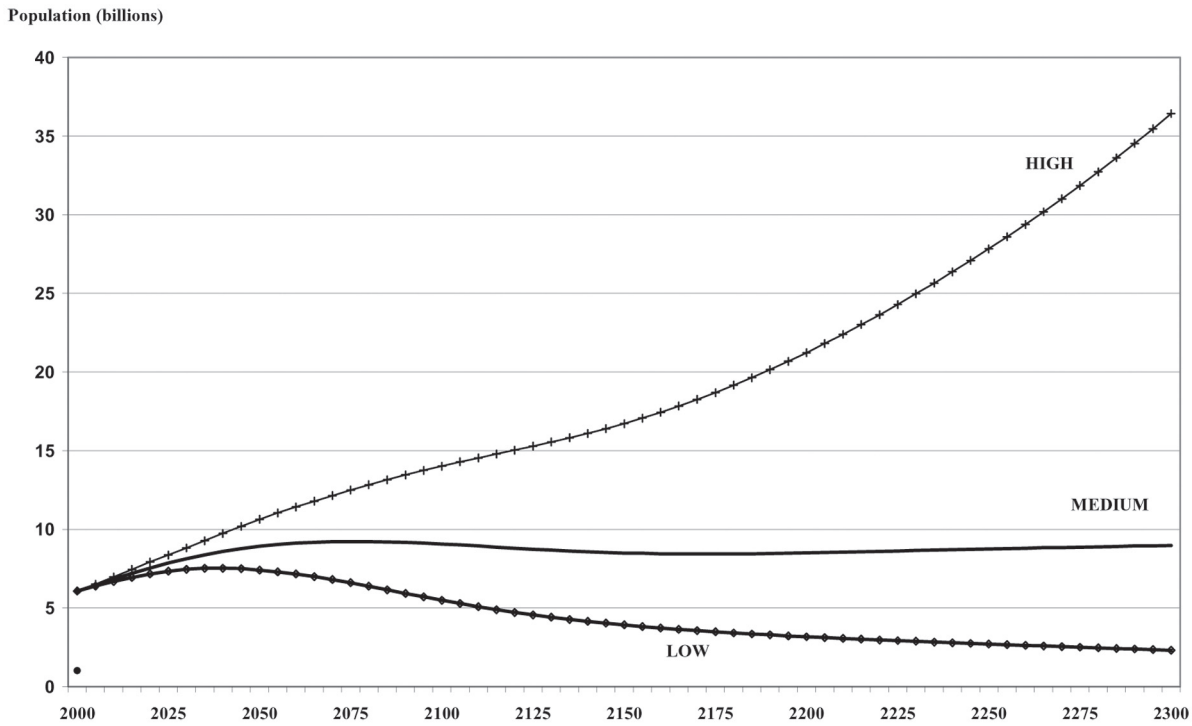
1 The views and opinions expressed in this essay are those of the author and do not necessarily represent those of the United Nations.

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.

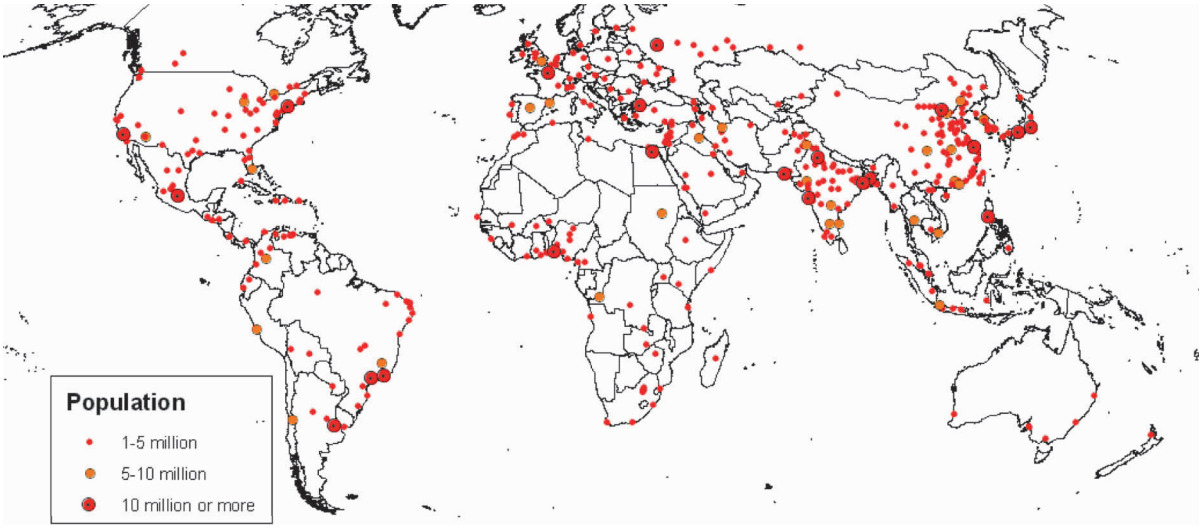
A third of all urban inhabitants (1.1 billion) live in small urban localities with populations below 100,000. Another 0.6 billion live in urban centres with populations ranging between 100,000 and 500,000 inhabitants. In all, 52 per cent of the urban population lives in urban centres with fewer than 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.

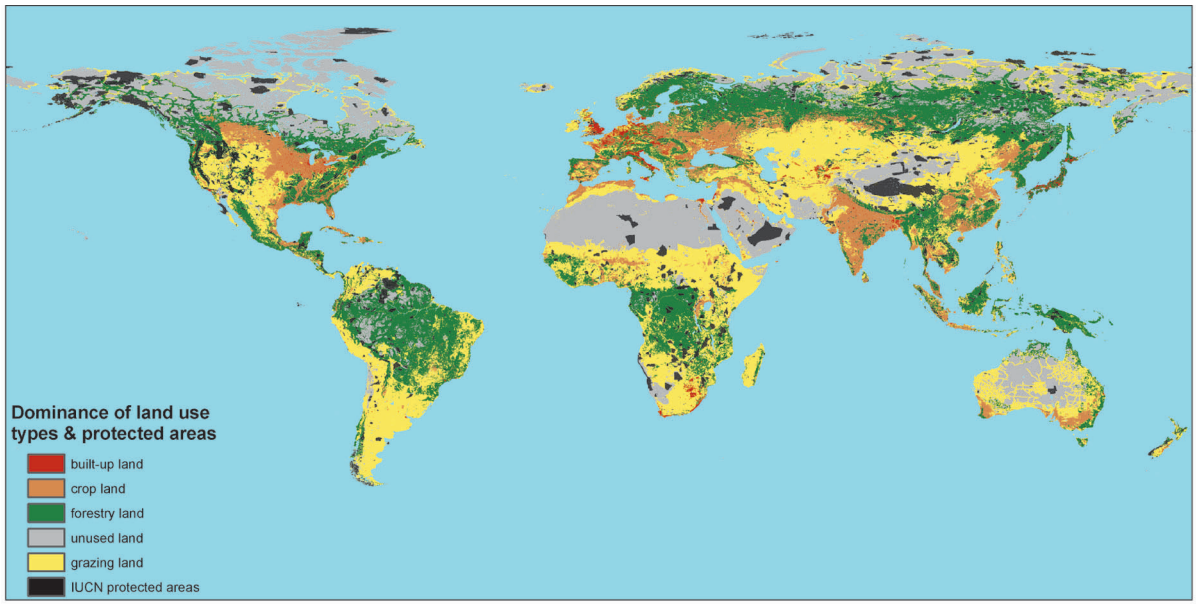
Water scarcity may be technically overcome by improved desalination. However, this depends on the availability of clean energy as well as on future cost reductions for desalination technologies. Aquaculture has the potential to provide an increasing share of world food supplies, but it is not without 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]

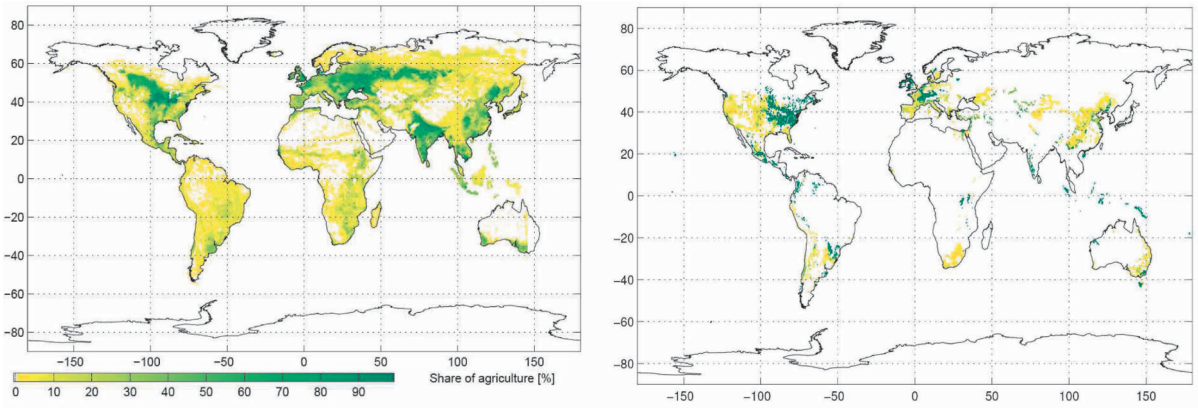


a. Currently protected areas and restricted management areas were captured by overlaying data sets on IUCN protected areas category I to VI, i.e. nature reserves and wilderness areas, national parks, natural monuments, habitat/species management areas, protected landscapes, and protected areas sustainable 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.

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).

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) • Ministry of Justice • Ministry of Foreign Affairs • Ministry of Defence	• -Subsidiary units of ministries of interior responsible for civil protection	
		• 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 Jägerskög* (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.

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.

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).

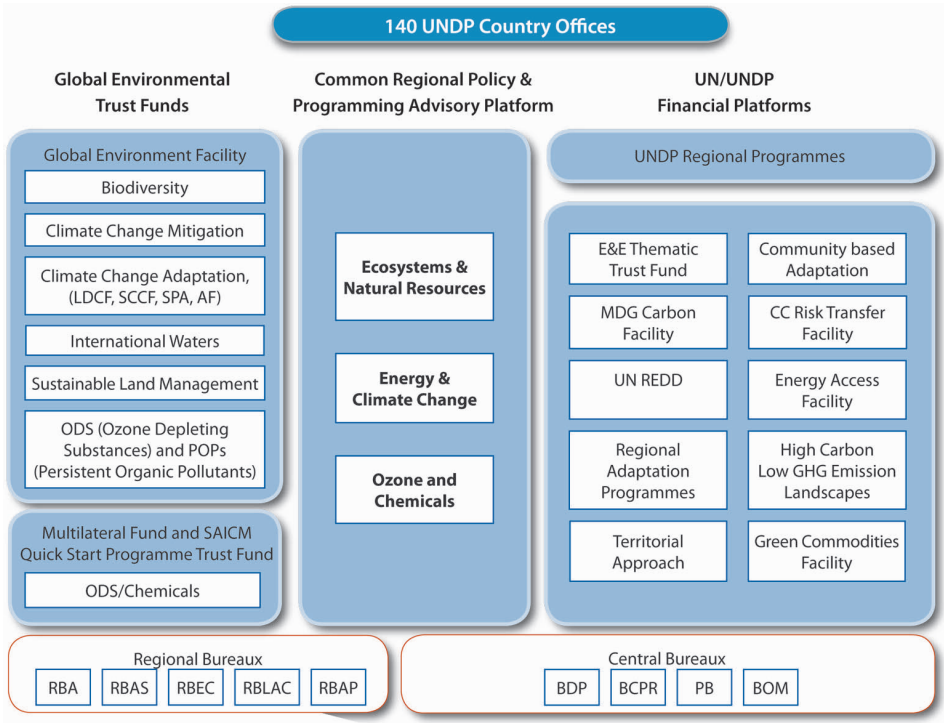
A number of major international events and agreements confirm the unequivocal consensus by the political, business, scientific, and advocacy communities to agree on a future climate change agreement as was stressed by the decisions of the UN Secretary-General's High Level Event (2007) and Summit on Climate 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.

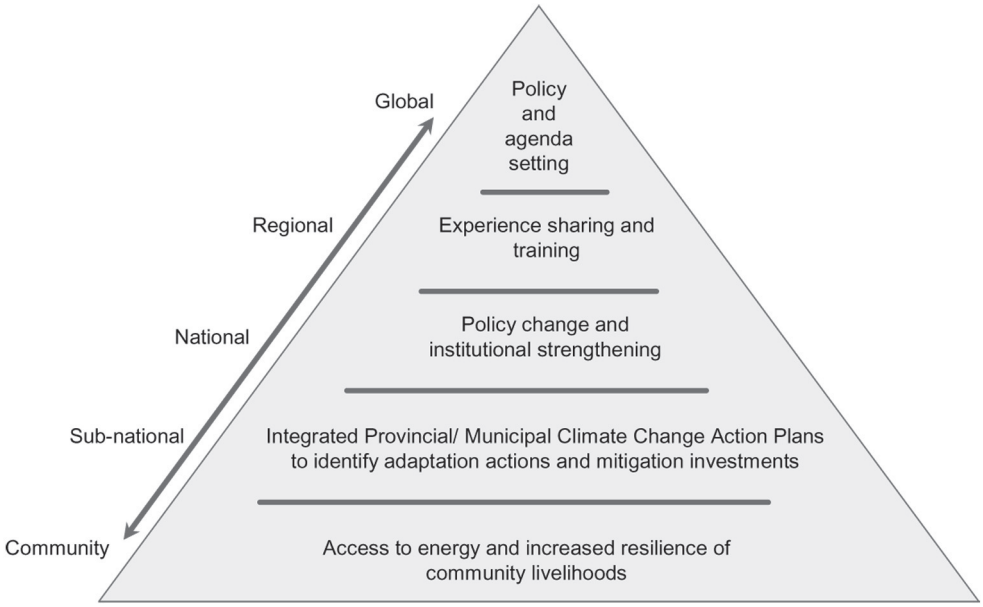
With widespread country office presence, UNDP has mobilized approximately $1.58 billion (and $3 billion in co-financing for the period 2004–2007) in over 140 countries through a diverse project portfolio that supports climate change responses at the global, regional, national, sub-national, and community/local 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>.

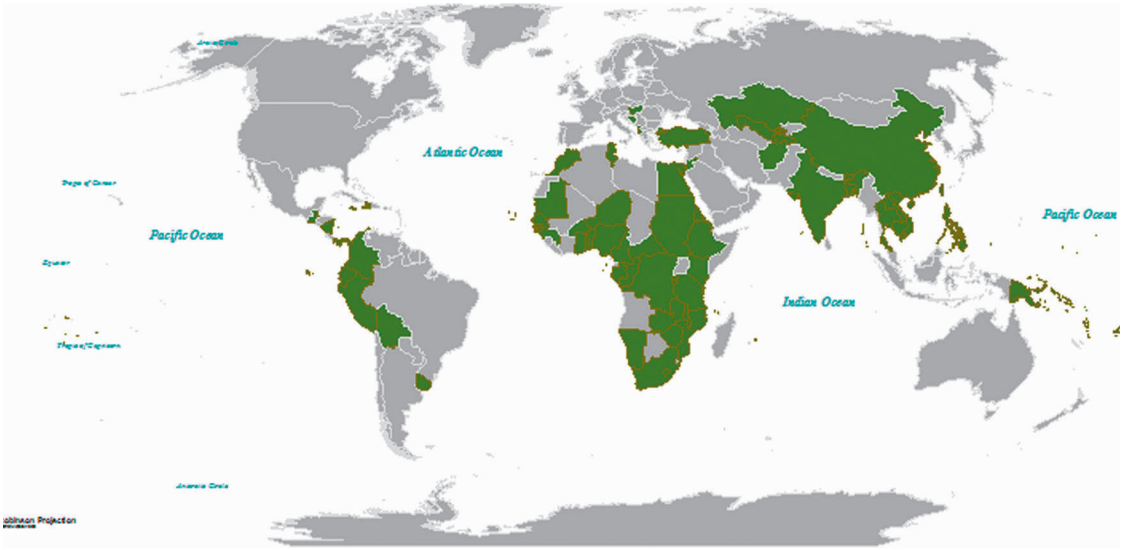
By 2010, the Multilateral Fund for Implementation of the Montreal Protocol on Substances that Deplete the Ozone Layer (MLF), as a whole, has prevented the equivalent of between 9.7 and 12.5 gigatonnes of CO_2 from entering the atmosphere. The acceleration of the phase-out of the last group of substances – 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/climate-change/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.

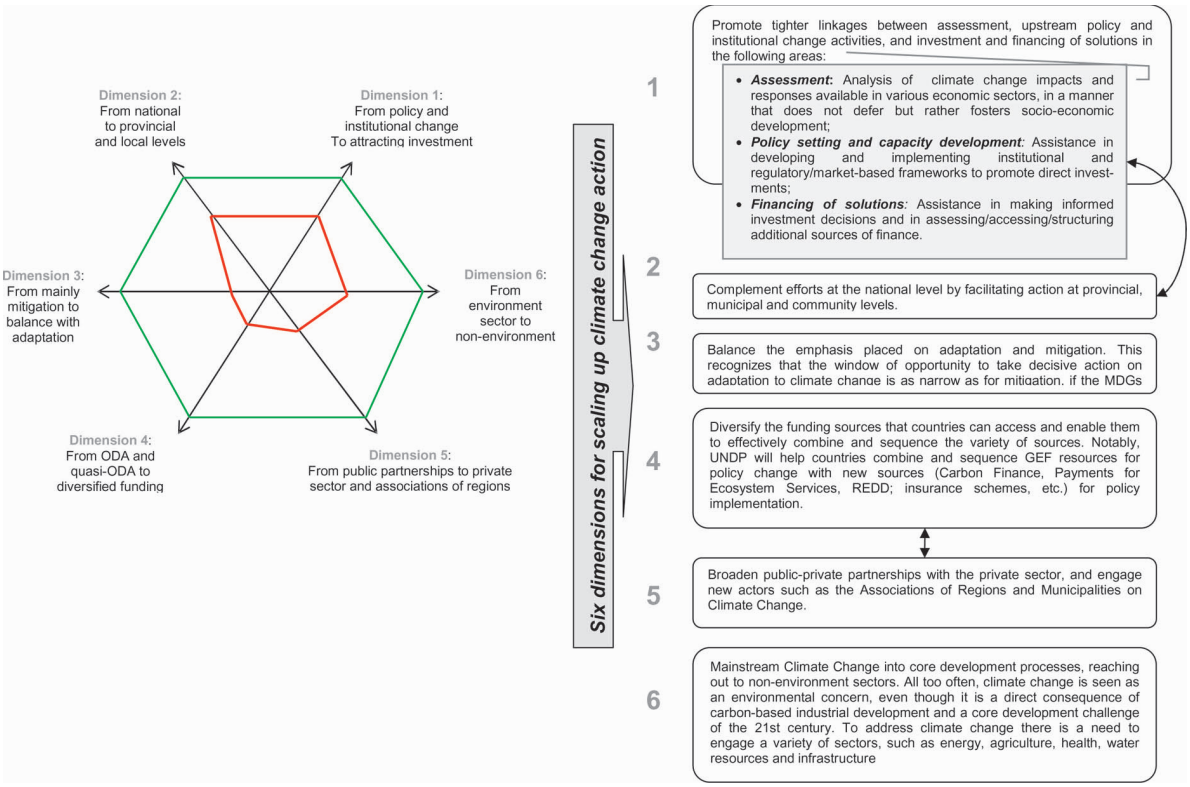
82.4.1 Six Key Dimensions for Scaling Up Climate Change Action

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).

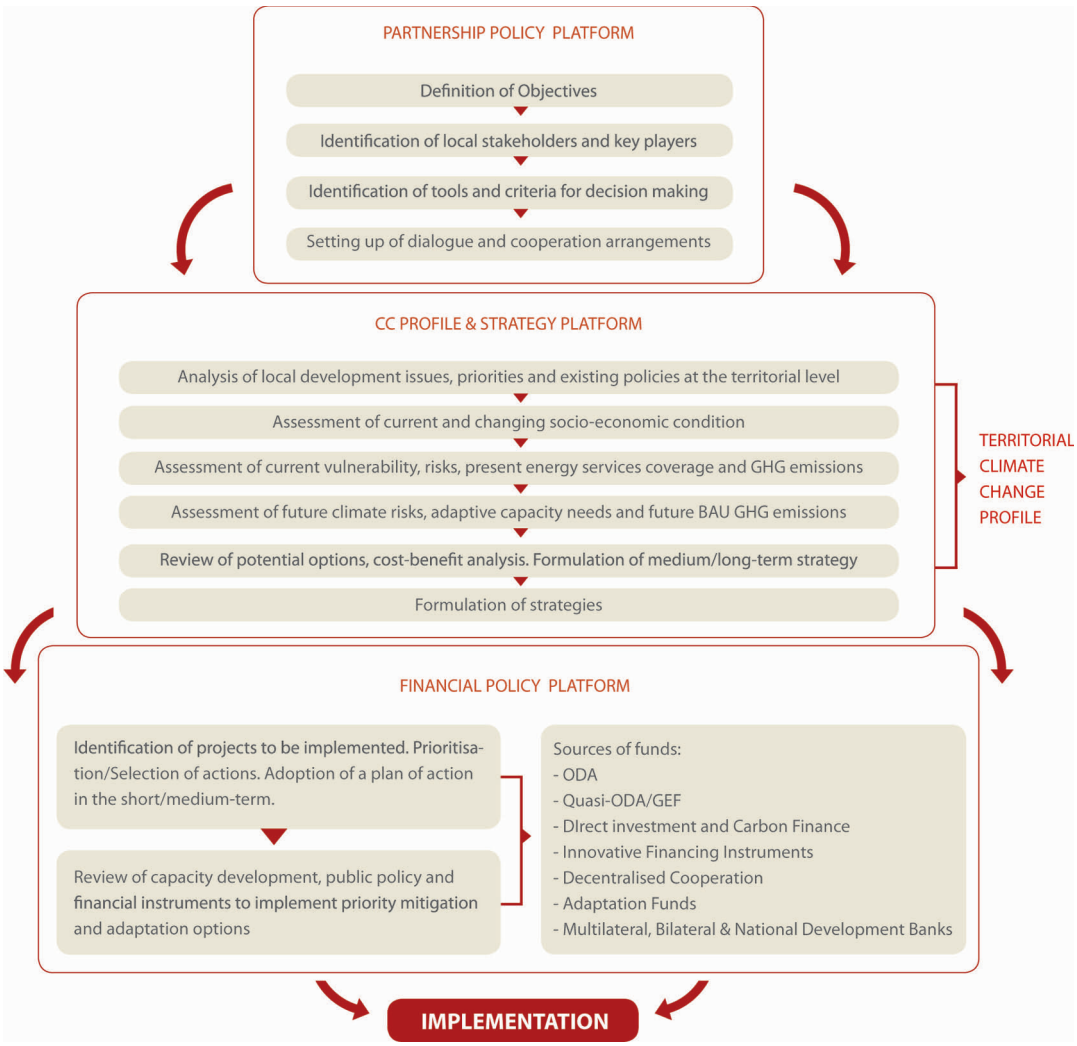
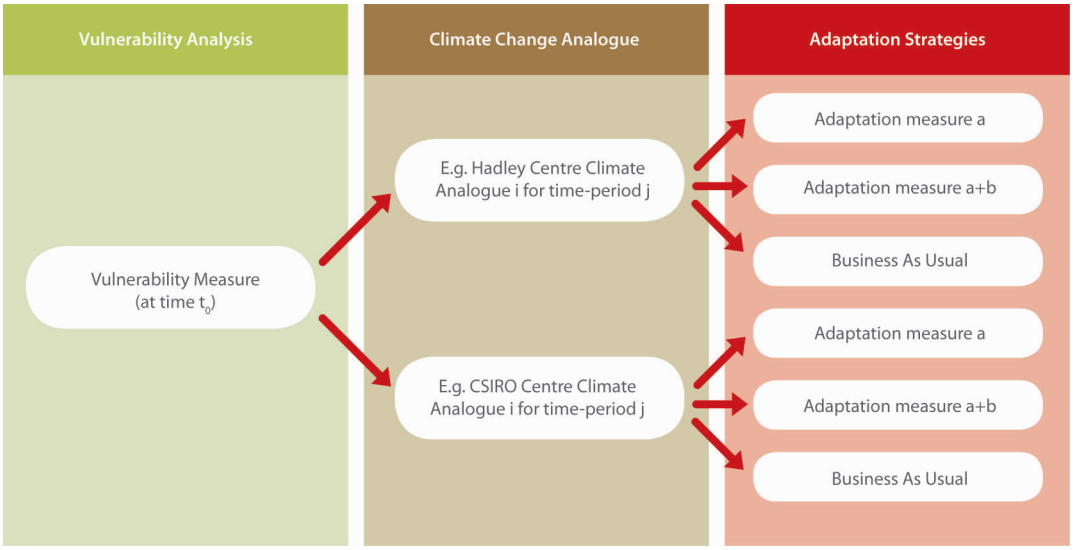


Figure 82.6: Key Steps in Assessing Adaptation Options **Source:** Kurukulasuriya/Mendelsohn (2008). Kurukulasuriya/Glemarec/Retiere (UNDP 2009: 103).



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.

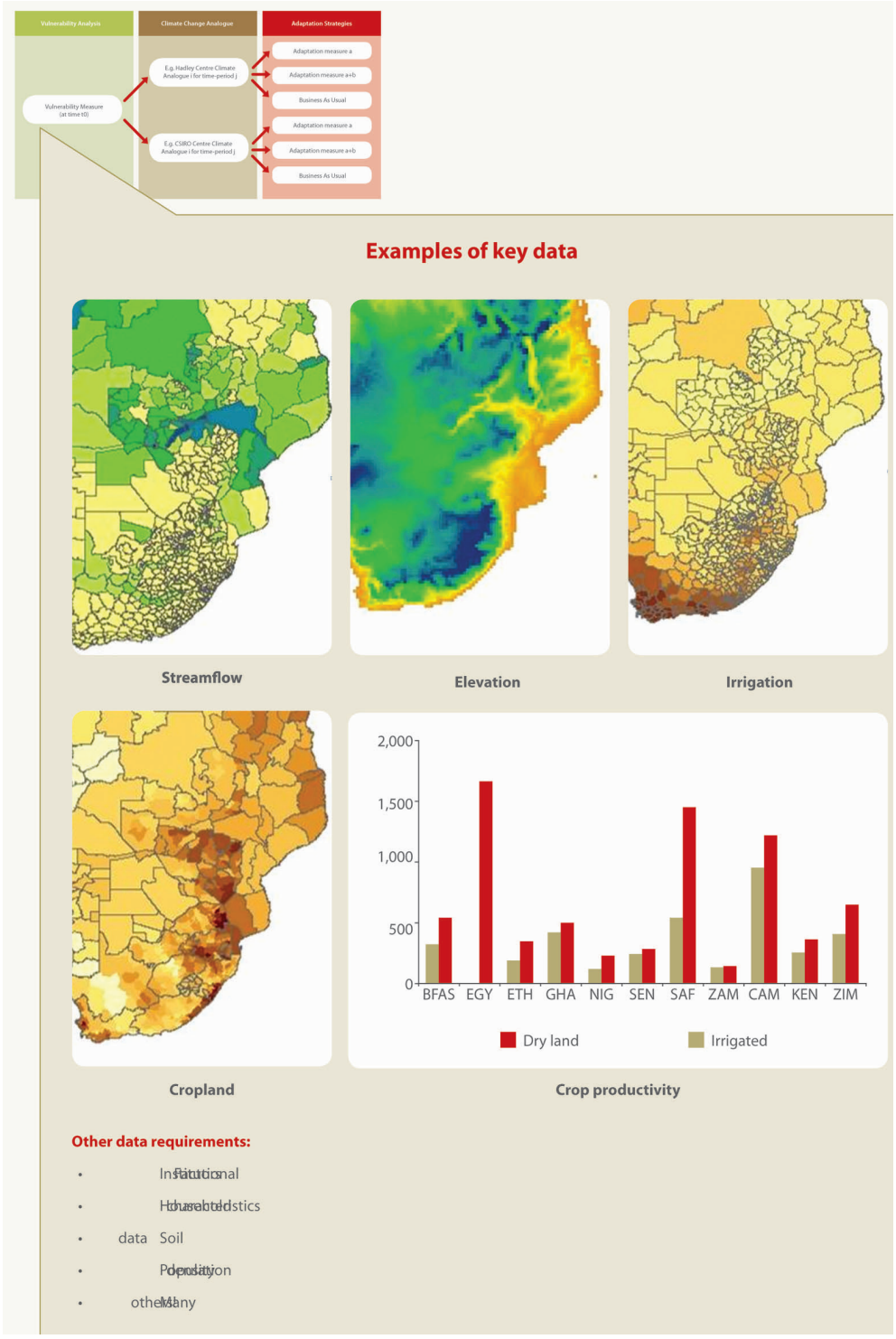
This set of actions will help countries and territories identify and prioritize short-term 'no regrets' adaptation measures, such as use of drought tolerant crops, revised land-use plans, and enhanced emergency preparedness.

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).

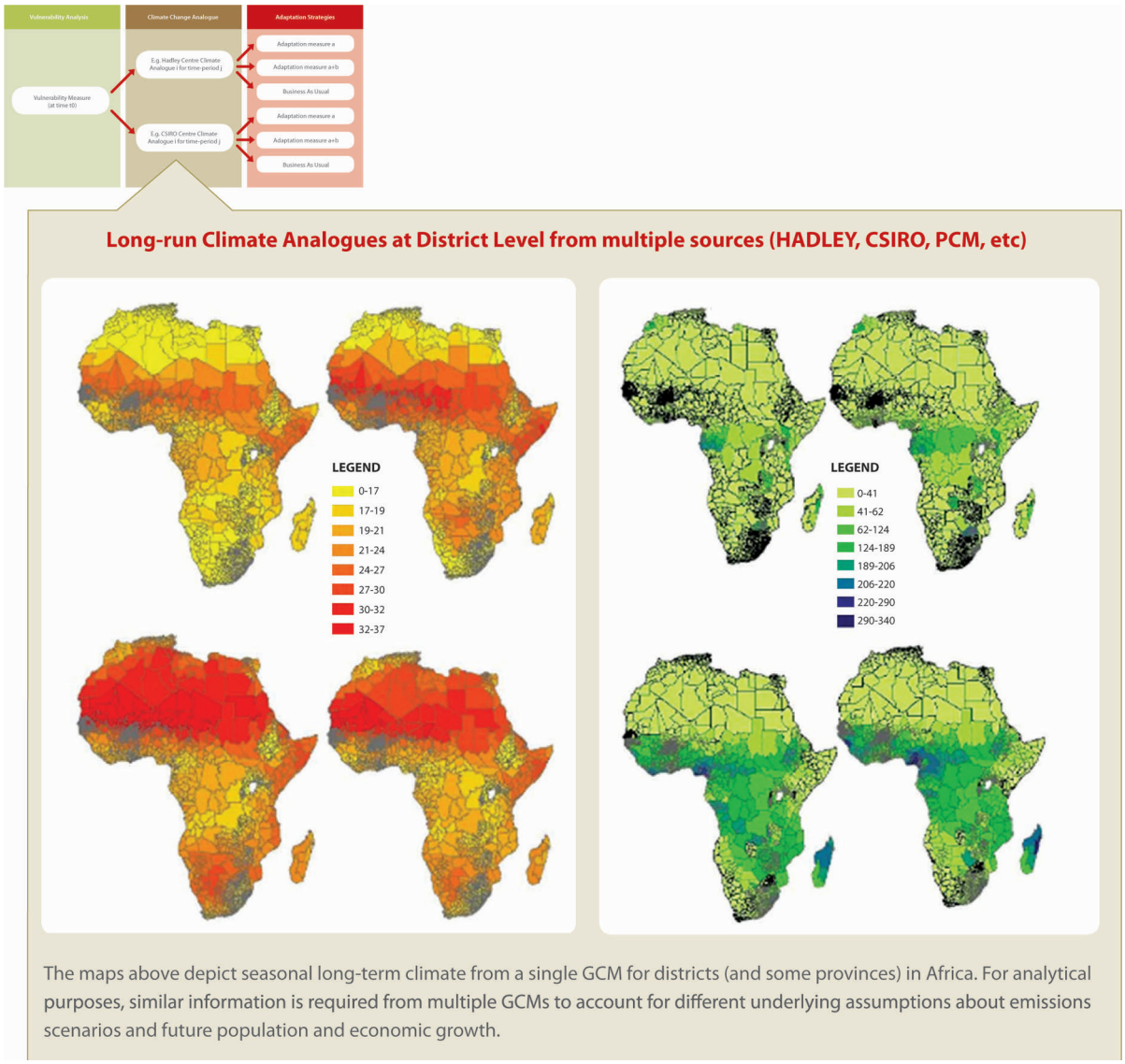
Figure 82.6 illustrates key steps in characterizing future climatic conditions using global climate models to develop climate projections and identifying climate analogues in others, following the approach suggested by Hallegatte et al (2007: 47). Assessing adaptation options requires: (i) a vulnerability 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).

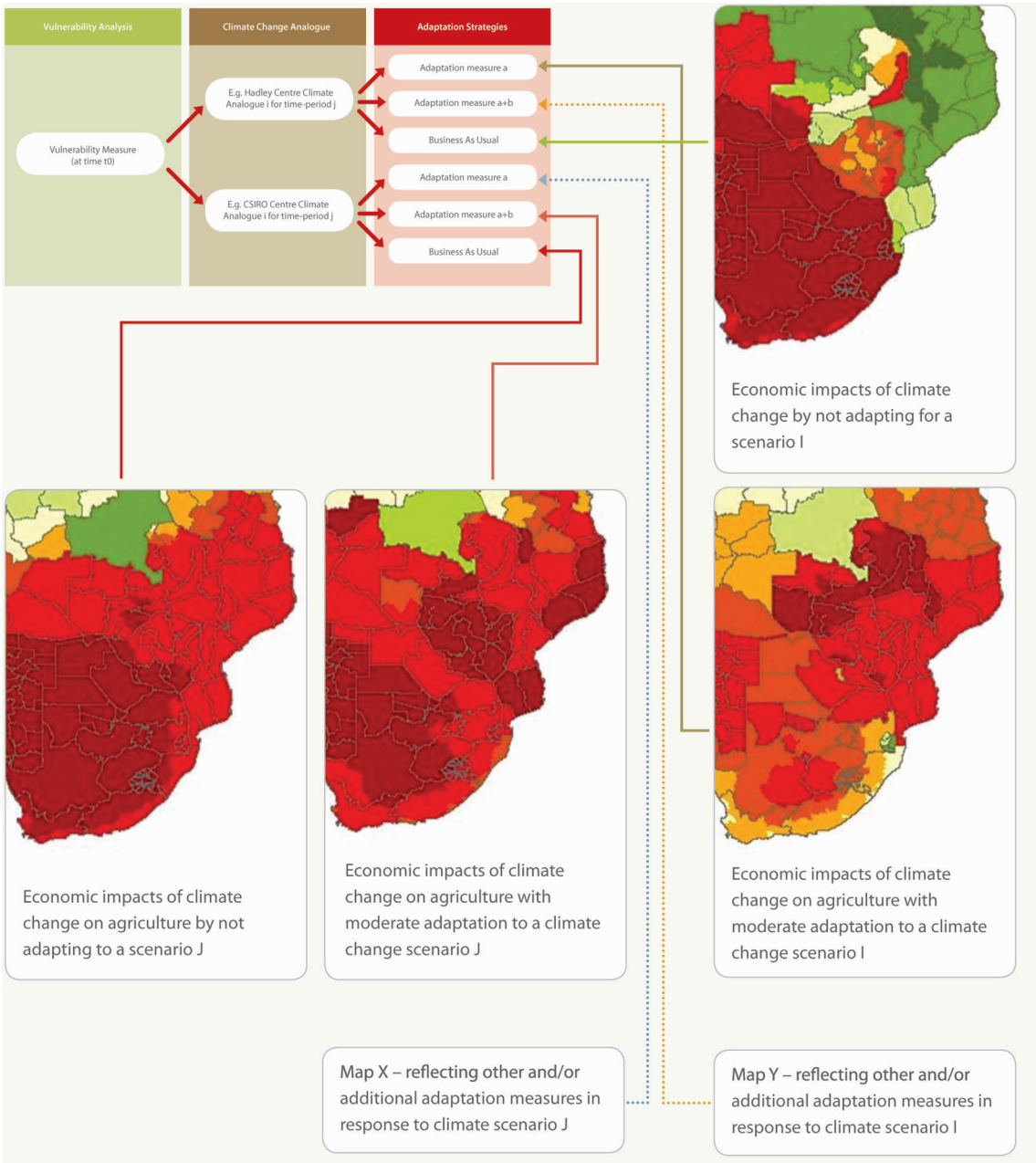


82.4.2.3 Strategic Priority 3: Enhancing the Capacity of Developing Countries to Attract and Drive Direct Private and Public Investment towards Lower Carbon Technologies and Sustainable Land Use Practices

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).

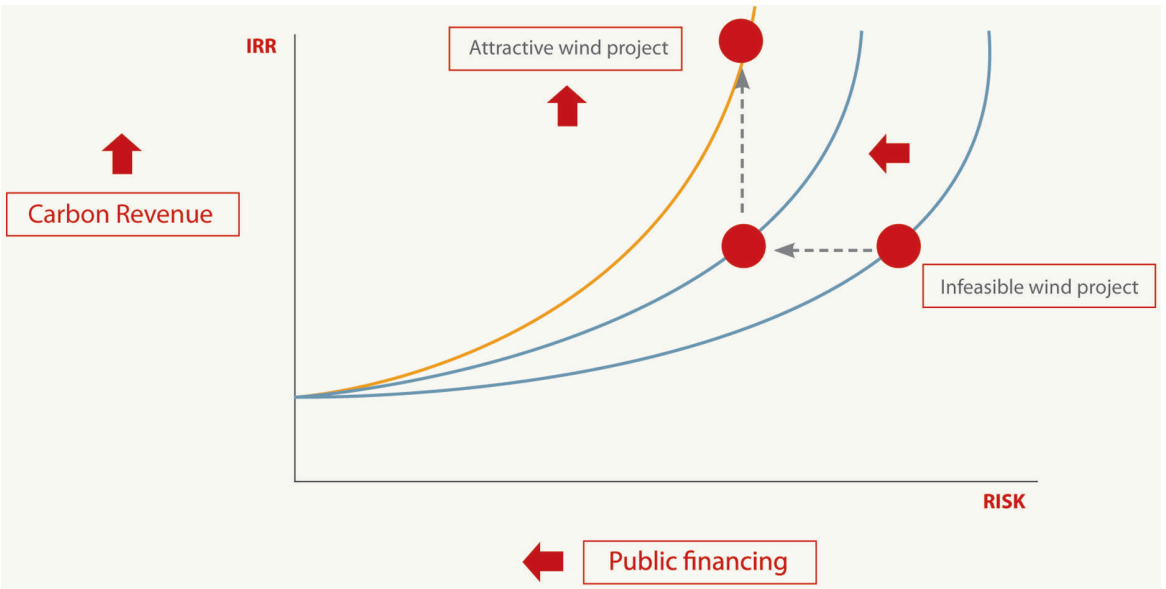
Furthermore, developing countries will need capacity development support to meet the challenge of driving massive shifts in investment patterns in a wide range of sectors, including power generation (box 82.8), industry, waste management, transport, buildings, agriculture and forestry.

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.

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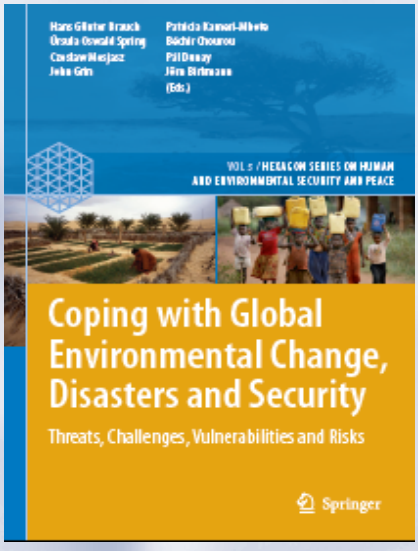

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