

Global Environment Outlook

# GEO<sub>4</sub>

*environment for development*



United Nations Environment Programme

# Vulnerability of People and the Environment: Challenges and Opportunities

**Coordinating lead authors:** Jill Jäger and Marcel T.J. Kok

**Lead authors:** Jennifer Clare Mohamed-Katerere, Sylvia I. Karlsson, Matthias K.B. Lüdeke, Geoffrey D. Dabelko, Frank Thomalla, Indra de Soysa, Munyaradzi Chenje, Richard Filcak, Liza Koshy, Marybeth Long Martello, Vikrom Mathur, Ana Rosa Moreno, Vishal Narain, and Diana Sietz

**Contributing authors:** Dhari Naser Al-Ajmi, Katrina Callister, Thierry De Oliveira, Norberto Fernandez, Des Gasper, Silvia Giada, Alexander Gorobets, Henk Hilderink, Rekha Krishnan, Alexander Lopez, Annet Nakyyeyune, Alvaro Ponce, Sophie Strasser, and Steven Wonink

In memory of Gerhard Petschel-Held

**Chapter review editor:** Katharina Thywissen

**Chapter coordinator:** Munyaradzi Chenje



# Main messages

Vulnerability depends on exposure, sensitivity to impacts and the ability or inability to cope or adapt. It needs to be seen within a global context of demographic change, patterns of poverty, health, globalization, conflict and governance. Broad representative patterns of vulnerability to environmental and socio-economic changes are identified in this chapter. This provides a basis for an analysis of the interacting pressures. It shows opportunities for reducing vulnerability and increasing human well-being, while protecting the environment. The following are the main messages:

**Significant improvements in human well-being have been achieved over the last 20 years. However, there are more than 1 billion poor people. They are found in all regions. They lack essential services, making them vulnerable to environmental and socio-economic changes.** Many countries will not meet the Millennium Development Goals' 2015 targets. But, dealing with vulnerability provides opportunities to meet these goals.

**Analysis of patterns of vulnerability shows the unequal distribution of risks for specific groups of people.** The most vulnerable groups include the poor, indigenous populations, women and children in both developing and developed countries.

**Improving human well-being – the extent to which individuals have the ability to live the kind of lives they value, and the opportunities to achieve their potential – is at the heart of development.** This is not just a moral imperative, but is also a critical aspect of human rights. It is essential for reducing vulnerability and achieving sustainable use of the environment.

**Gains in life expectancy and per capita health expenditures, as well as declines in child mortality have been systematically**

**greater in those countries with more equitable income distribution and access to medical treatment.** It is, however, paradoxical that opulence and consumerism, as well as relative poverty, contribute to ill health in many wealthier societies.

**International trade has helped increase income, and has helped millions of people out of poverty, but it is also sustaining unequal patterns of consumption.** Outsourcing the extraction of natural resources, as well as production and manufacturing to developing countries, means they must struggle to deal with their resulting hazardous wastes and other environmental impacts.

**Conflicts, violence and persecution regularly displace large civilian populations, forcing millions of people into marginal ecological and economic areas within countries and across international boundaries.** This undermines, sometimes for decades, sustainable livelihoods and economic development as well as the capacities of societies and nations. The resulting poverty, often tied to shortages or degradation of natural resources, contributes directly to lower levels of human well-being and higher levels of vulnerability.

**Exposure to natural hazards has increased as a result of climate change and such actions as the destruction of mangroves that protect coasts from tidal surges. Risks are also increasing as a result of the continuing concentration of people in highly-exposed areas.** Over the past 20 years, natural disasters have claimed more than 1.5 million lives, and affected more than 200 million people annually. More than 90 per cent of the people exposed to disasters live in the developing world, and more than half of disaster deaths occur in countries with a low human development index. Capacity to adapt is being eroded through, for example,

reduced state social protection schemes, undermining of informal safety nets, poorly built or maintained infrastructure, chronic illness and conflict.

**Poverty must be addressed in all countries if vulnerability to both environmental and socio-economic changes is to be reduced.** Relative poverty is increasing in many countries despite general affluence. Improved access to material assets at the household level (income, food, drinking water, shelter, clothing, energy, natural and financial resources) and at the societal level (physical and service infrastructure) can help break the cycle of impoverishment, vulnerability and environmental degradation. This means that being poor need not mean staying poor.

**To achieve sustainable development, governance must be integrated from the local to the global levels, across a range of sectors, and over a longer time frame for policy making.** Over the past 20 years, governance has become increasingly multi-level, with more interaction and interdependence. Local governments, community-based groups and other non-governmental actors now engage more widely in international cooperation, contributing to a better grounding of global policy in experiences of local vulnerability.

**Integrating development, health and environment policies provides an opportunity, since health and education are the cornerstones of human capital.** Continued investment remains critical for increasing the capacity to adapt to environmental and other changes. While under-five mortality rates have improved considerably, large regional differences still exist.

**Empowering women not only contributes to the widely-shared objective of equity and justice, but also makes good economic, environmental and social sense.** Practice shows that finance schemes that especially target women can have higher than usual payoffs. Better access to education increases maternal health, creating a better starting point for the next generation. Gender-sensitive poverty alleviation in both rural and urban

settings is a central component of strategies to address environment and health issues.

**Environmental cooperation creates an effective path to peace by promoting sustainable resource use and equity within and between countries.** Investing in cooperation is an investment in the future, because both scarcity and abundance of environmental resources can exacerbate existing tensions, and contribute to conflict between groups, especially in societies that lack the capacity to effectively and equitably manage competition for control over resources.

**Official development assistance must be stepped up to meet the agreed global target of 0.7 per cent of GNI.** The decline in support for agriculture and infrastructure investment must be reversed if developing countries are to build their economies and increase their capacity to adapt to environmental and socio-economic change. Making international trade fairer, and including environmental concerns will also increase such adaptive capacity.

**The potential for science and technology to reduce vulnerability is still very unevenly distributed worldwide. Partnerships that deliver, and increased investments could improve this situation.** However, science and technology have also undoubtedly added to the risks faced by people and the environment, particularly by driving environmental change.

**There are strong synergies between improving human well-being and reducing vulnerability from environment, development and human rights perspectives.** The call for action to protect the environment needs to be strongly focused on human well-being. It also underlines the importance of implementing existing obligations made by governments at the national and international levels.

## INTRODUCTION

There are strong causal relationships among the state of the environment, human well-being and vulnerability. Understanding how environmental and non-environmental changes affect human well-being and vulnerability is the critical foundation for addressing challenges to and the opportunities for improving human well-being while also protecting the environment.

Vulnerabilities are often driven by actions taken at a great distance, highlighting worldwide interdependencies. Within the context of vulnerability, the chapter illustrates how current policies on mitigation, coping and adaptive capacity support the contribution of environmental policies to internationally agreed development goals, particularly the Millennium Development

Goals (MDGs). This analysis also evaluates whether environmental governance adequately links with other relevant policy domains, such as poverty alleviation, health, science, and technology and trade. It underlines the need for mainstreaming environment into these domains to reduce vulnerability. This provides strategic directions for policy making to reduce vulnerability and enhance human well-being (see Chapter 10).

As the World Commission on Environment and Development (Brundtland Commission) stated in *Our Common Future*, "A more careful and sensitive consideration of their (vulnerable groups) interests is a touchstone of sustainable development policy" (WCED 1987). The vulnerability approach applied here (see Box 7.1) shows the potential for strong negative consequences for well-being of, for example, reduced access to resources, such as food and drinking water, and the existence of thresholds beyond which health and survival are severely threatened. Patterns of vulnerability to environmental and socio-economic changes, here referred to as "archetypes," describe the impacts of these changes on human well-being.

### Box 7.1 The concept of vulnerability

Vulnerability is an intrinsic feature of people at risk. It is multidimensional, multidisciplinary, multisectoral and dynamic. It is defined here as a function of exposure, sensitivity to impacts and the ability or lack of ability to cope or adapt. The exposure can be to hazards such as drought, conflict or extreme price fluctuations, and also to underlying socio-economic, institutional and environmental conditions. The impacts not only depend on the exposure, but also on the sensitivity of the specific unit exposed (such as a watershed, island, household, village, city or country) and the ability to cope or adapt.

Vulnerability analysis is widely used in the work of many international organizations and research programmes concerned with poverty reduction, sustainable development and humanitarian aid organizations. These include FAO, the Red Cross and Red Crescent Societies, UNDP, UNEP and the World Bank. This kind of work helps to identify the places, people and ecosystems that may suffer most from environmental and/or human-induced variability and change, and identifies the underlying causes. It is used to develop policy relevant recommendations for decision-makers on how to reduce vulnerability and adapt to change.

The concept of vulnerability is an important extension of traditional risk analysis, which focused primarily on natural hazards. Vulnerability has become a central aspect of studies of food insecurity, poverty and livelihoods and climate change. While earlier research tended to regard vulnerable people and communities as victims in the face of environmental and socio-economic risks, more recent work increasingly emphasizes the capacities of different affected groups to anticipate and cope with risks, and the capacities of institutions to build resilience and adapt to change.

The complementary concept of resilience has been used to characterize a system's ability to bounce back to a reference state after a disturbance, and the capacity of a system to maintain certain structures and functions despite disturbance. If the resilience is exceeded, collapse can occur.

*Sources: Bankoff 2001, Birkmann 2006, Blaikie and others 1994, Bohle, Downing and Watts 1994, Chambers 1989, Chambers and Conway 1992, Clark and others 1998, Diamond 2004, Downing 2000, Downing and Patwardhan 2003, Hewitt 1983, Holling 1973, Kasperson and others 2005, Klein and Nicholls 1999, Pimm 1984, Prowse 2003, Watts and Bohle 1993, Wisner and others 2004*

## GLOBAL CONTEXT OF VULNERABILITY

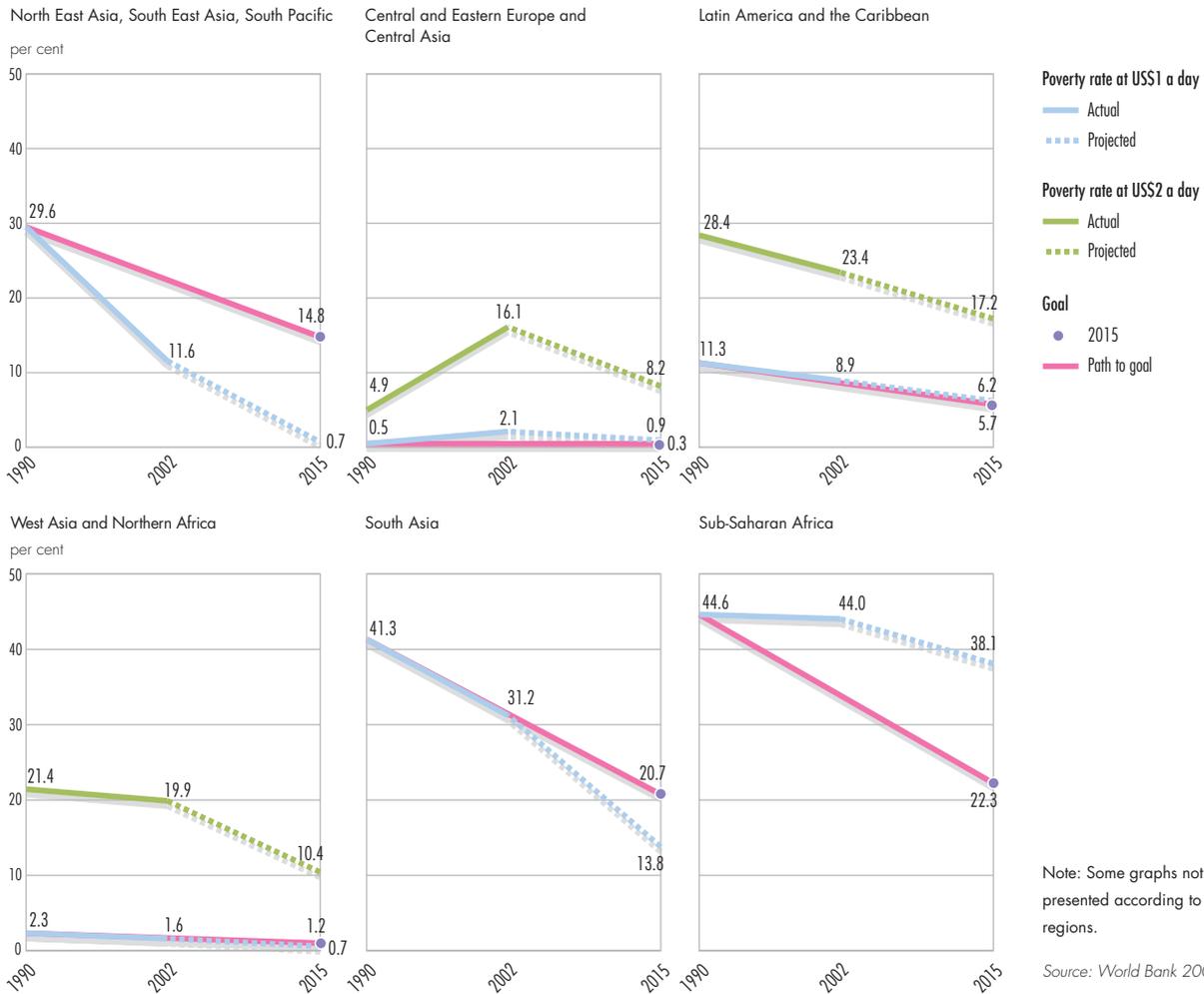
A number of factors shape the vulnerability of people and the environment, including poverty, health, globalization, trade and aid, conflict, changing levels of governance, and science and technology.

### Poverty

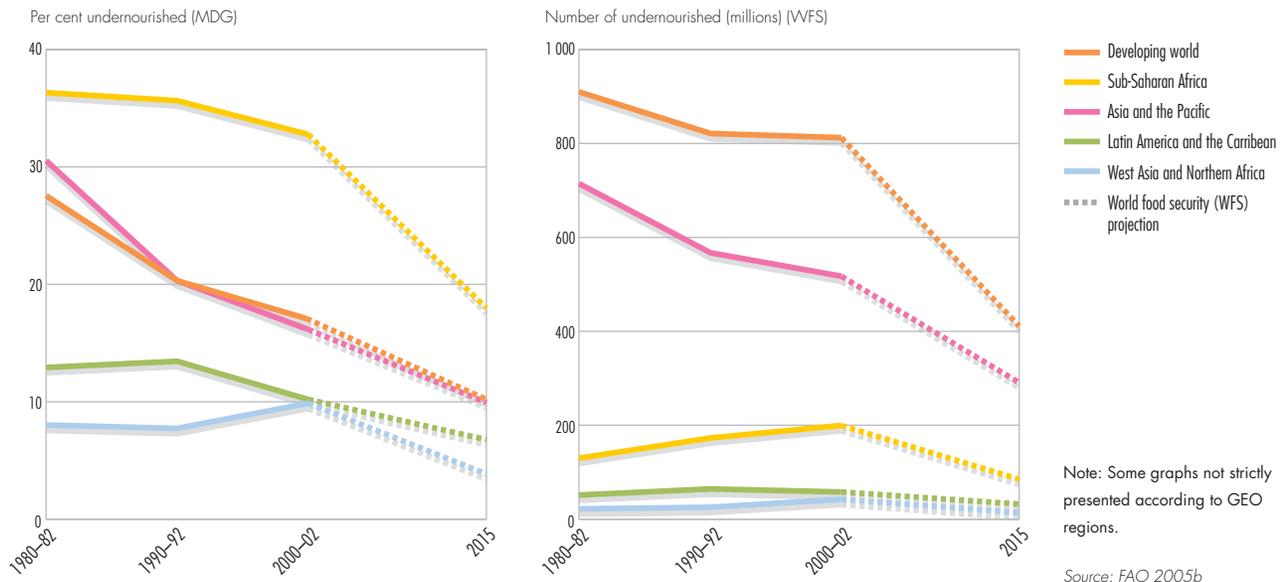
Poverty (see Chapter 1) reduces the ability of individuals to respond and adapt to environmental change. Although the multidimensional nature of poverty is widely recognized, income and consumption remain the most common measures. Most regions have made progress in meeting the first Millennium Development Goal (MDG 1) on reducing extreme poverty and hunger (see Figure 7.1), although many will not achieve the 2015 targets. In developing countries, extreme poverty (those living on less than US\$1/day) fell from 28 per cent in 1990 to 19 per cent in 2002. Actual numbers decreased from 1.2 billion to just over 1 billion in 2002 (World Bank 2006). The percentage of people in the world with insufficient food to meet their daily needs has declined, but actual numbers

**Figure 7.1 Progress to meeting MDG 1**

a) Share of people living on US\$1 or US\$2 a day and path to the MDG goal by region



b) Proportion and number of undernourished people by region



increased between 1995 and 2003 (UN 2006), when about 824 million people suffered chronic hunger. Sustained growth in China and India has contributed to sharp decreases in extreme poverty in Asia (Dollar 2004, Chen and Ravallion 2004). Where inequity is high, including in some of the transition countries of Europe and Central Asia, economic growth does not necessarily translate into less poverty (WRI 2005, World Bank 2005). In many countries, relative poverty is increasing despite general affluence. In the United States, for example, the number of people living below the national poverty line has risen since 2000, reaching almost 36 million in 2003 (WRI 2005). Structural economic adjustment, ill health, and poor governance affected progress in some regions, including sub-Saharan Africa (Kulindwa and others 2006).

### Health

Health is central to the achievement of the MDGs because it is the basis for job productivity, the capacity to learn, and the capability to grow intellectually, physically and emotionally (CMH 2001). Health and education are the cornerstones of human capital (Dreze and Sen 1989, Sen 1999). Ill health reduces the capacity to adapt to environmental and other changes. Under-five mortality rates have improved considerably, though there are still large regional differences (see Figure 7.2), and more than 10 million children under five still die every year – 98 per cent of

them in developing countries. Some 3 million die due to unhealthy environments (Gordon and others 2004).

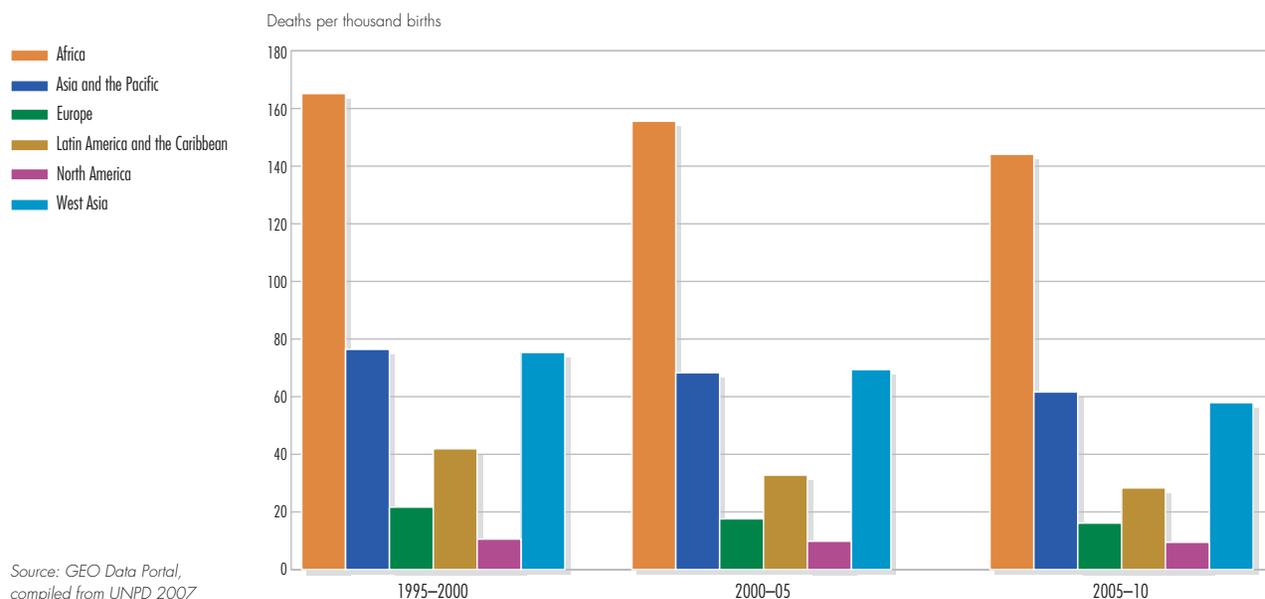
WHO identified the major health risks for developing and developed countries, as shown in Table 7.1. They include traditional risks associated with underdevelopment (such as underweight, unsafe water and lack of sanitation), and those associated with consumptive lifestyles (such as obesity and physical inactivity).

Health gains are unequal across regions and within population groups. In the least favourable health situations, people suffer persistent communicable diseases associated with deficient living conditions, including poverty and progressive environmental degradation. AIDS has become a leading cause of premature deaths in sub-Saharan Africa, and the fourth largest killer worldwide (UN 2006). By the end of 2004, an estimated 39 million people were living with HIV/AIDS. The epidemic has reversed decades of development progress in the worst-affected countries, contributing to strong increases in vulnerability.

### Globalization, trade and aid

The rapid growth of trade and financial flows is creating more global interdependence. The trade and development agendas have so far not been reconciled, and the gulf between the rich and the poor is still growing. Poor countries are moving to market solutions and pragmatic arrangements for increasing

**Figure 7.2 Regional trends and projections for 2005–10 in under-five mortality rates**



**Table 7.1 Estimated attributable and avoidable burdens of 10 leading selected risk factors**

Developing countries high mortality (per cent)		Developing countries low mortality (per cent)		Developed countries (per cent)	
Underweight	14.9	Alcohol	6.2	Tobacco	12.2
Unsafe sex	10.2	Blood pressure	5.0	Blood pressure	10.9
Unsafe water, sanitation and hygiene	5.5	Tobacco	4.0	Alcohol	9.2
Indoor smoke from solid fuel	3.6	Underweight	3.1	Cholesterol	7.6
Zinc deficiency	3.2	Overweight	2.4	Overweight	7.4
Iron deficiency	3.1	Cholesterol	2.1	Low fruit and vegetable intake	3.9
Vitamin A deficiency	3.0	Low fruit and vegetable intake	1.9	Physical inactivity	3.3
Blood pressure	2.5	Indoor smoke from solid fuel	1.9	Illicit drugs	1.8
Tobacco	2.0	Iron deficiency	1.8	Unsafe sex	0.8
Cholesterol	1.9	Unsafe water, sanitation and hygiene	1.8	Iron deficiency	0.7

Note: percentage causes of disease burden expressed in Disability Adjusted Life Years.

Source: WHO 2002

trade and foreign direct investment (FDI) to create more jobs and alleviate poverty (Dollar and Kraay 2000, UNCTAD 2004). The outcomes are highly uneven (see Figure 7.3). The failure of the Doha round of the WTO talks continues to hurt the poorest of the poor who often depend on agricultural markets.

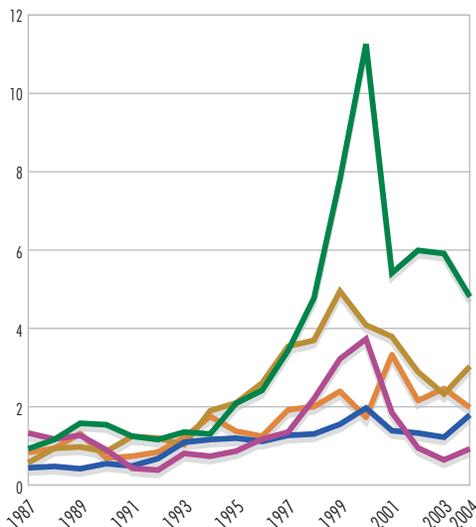
With the growing interest in markets, the aid agenda has also changed. Most of the recent increases in aid have been used to cancel debt, and meet humanitarian and reconstruction needs following

emergencies (UN 2006). The share of total official development assistance (ODA) going to basic human needs has doubled since the mid-1990s, but the share going to agriculture and physical infrastructure has diminished. These two sectors need support if countries are to feed their own people, build their economies (UN 2006), and increase their adaptive capacity. Africa remains the most aid dependent region by far, while West Asia's dependence on aid has varied considerably over the past 20 years (see Figure 7.3). Together the figures suggest a bleak

**Figure 7.3 Foreign direct investment and aid dependency**

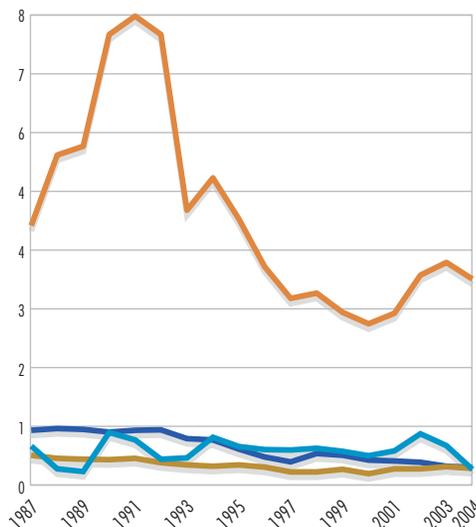
**a) Regional average FDI inflows**

per cent of GDP



**b) Regional levels of aid dependence**

per cent of GNI



- Africa
- Asia and the Pacific
- Europe
- Latin America and the Caribbean
- North America
- West Asia

Notes: West Asia data does not include data for Iraq from 1994–2004 and for OPT before 1993.

Gross National Income (GNI) is the sum of value added by all resident producers plus any product taxes (less subsidies) not included in the valuation of output plus net receipts of primary income (compensation of employees and property income) from abroad.

Source: GEO Data Portal, compiled from World Bank 2005

reality. FDI, which is productive capital, is a great deal lower than aid in many regions. In 2005, the 191 million migrants worldwide (up from 176 million in 2000) contributed in excess of US\$233 billion to productive capital of which US\$167 billion went to developing countries (IOM 2005).

### Conflict

The end of the Cold War in the late 1980s has reduced the threat of nuclear war from great power rivalry, although fears of continued nuclear proliferation among states and non-state actors remain (Mueller 1996). Civil conflicts continue to be the biggest threat, although incidences have decreased dramatically in recent years (see Box

7.2 and Figure 7.4). International involvement in civil wars, primarily in peacemaking and peacekeeping capacities, is at an all-time high due to humanitarian pressures. The increase in the number of formal democracies is unprecedented; this trend may contribute to the decreasing incidence of civil wars, although the transition to democracy is often a highly unstable period (Vanhanen 2000). All regions of the world have seen a decrease in armed violence except for sub-Saharan Africa and West Asia (Strand and others 2005).

Despite the positive global trends in armed violence, persistent conflicts have very negative impacts on well-being. More than 8 million people

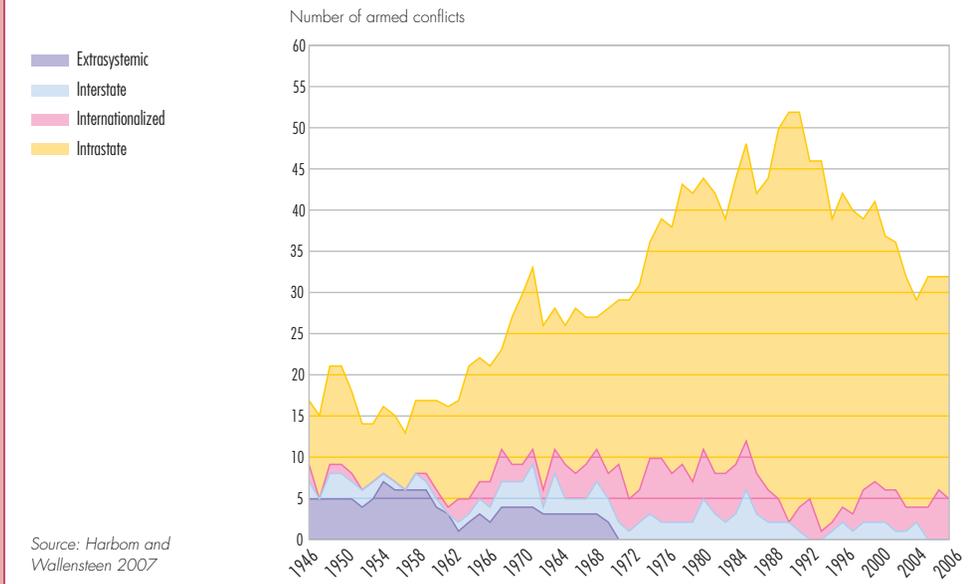
#### Box 7.2 A less violent world

Since World War II, the number of interstate armed conflicts (conflicts between states) has remained relatively low, and no such conflict has been recorded since 2003. Extrasystemic armed conflicts (colonial conflicts and other conflicts between an independent state and non-state groups outside its own territory) had disappeared by the mid-1970s. Intrastate armed conflicts (civil conflicts or conflicts between a government and an organized internal rebel group) rose steadily until 1992, after which they declined steeply. Internationalized intrastate conflicts (intrastate conflicts with armed intervention from other

governments) have been frequent since the early 1960s. The lower threshold for conflicts recorded here is 25 battle-related deaths in a given year. The graph does not include state violence against unorganized people ('one-sided violence' or genocide and politicide) or violence between groups where the government is not a party to the fighting ('non-state violence' or communal violence). It is a stacked graph, meaning that the number of conflicts in each category in a given year is indicated by the height in that year of the area of a particular colour.

Source: Harbom and Wallensteen 2007

Figure 7.4 Number of armed conflicts by type



have died directly or indirectly as a result of war in Africa since 1960 (Huggins and others 2006). Conflicts, violence and fear of persecution regularly displace large civilian populations, forcing millions of people into marginal ecological and economic areas within countries and across international boundaries. The UNHCR estimates that there were 11.5 million refugees, asylum seekers and stateless persons, and 6.6 million internally displaced persons globally in 2005 (UNHCR 2006). The forced movement of people into marginal areas undercuts, sometimes for decades, sustainable livelihoods, economic development, and societal and state capacities. The resulting poverty, often tied to shortages or degradation of natural resources, contributes directly to lower levels of well-being and higher levels of vulnerability.

### Changing levels of governance

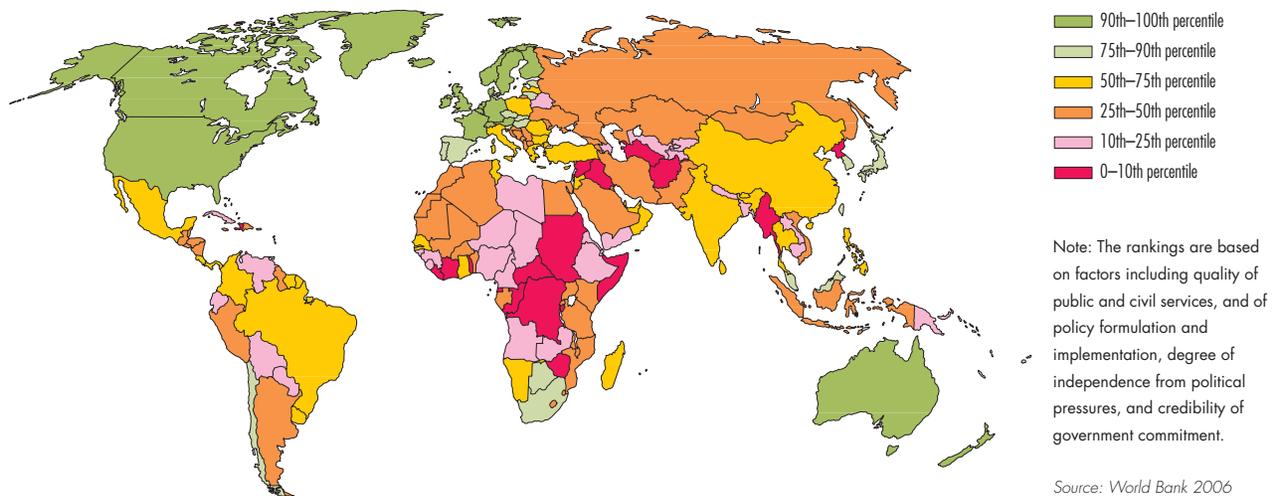
Over the past 20 years, governance has become increasingly multi-level, with more interaction and interdependence between different levels. The effectiveness of national policies (see Figure 7.5) remains mixed, but the capacity and political will of governments to take action has increased. In combination, these trends increase opportunities to reduce vulnerability. The early years after the end of the Cold War witnessed a renewed optimism in multilateralism and global governance. In parallel, regional cooperation made significant progress around the world, even if its forms and intensity differ.

There has also been a trend towards political and fiscal decentralization from national to sub-national levels, including in countries of the Organisation for Economic Cooperation and Development (OECD) (Stegarescu 2004) and in Africa and Latin America (Stein 1999, Brosio 2000). This may not necessarily mean that local authorities have been empowered, as decentralization without devolution of power can be a way to strengthen the presence of the central authority (Stohr 2001). Local governments, community-based groups and other non-governmental actors now engage more widely in international cooperation, contributing to a better grounding of global policy in experiences of local vulnerability. Global corporations' influence has extended beyond the economic arena (De Grauwe and Camerman 2003, Graham 2000, Wolf 2004), and many choose to develop voluntary environmental codes, and to increase self regulation (Prakash 2000).

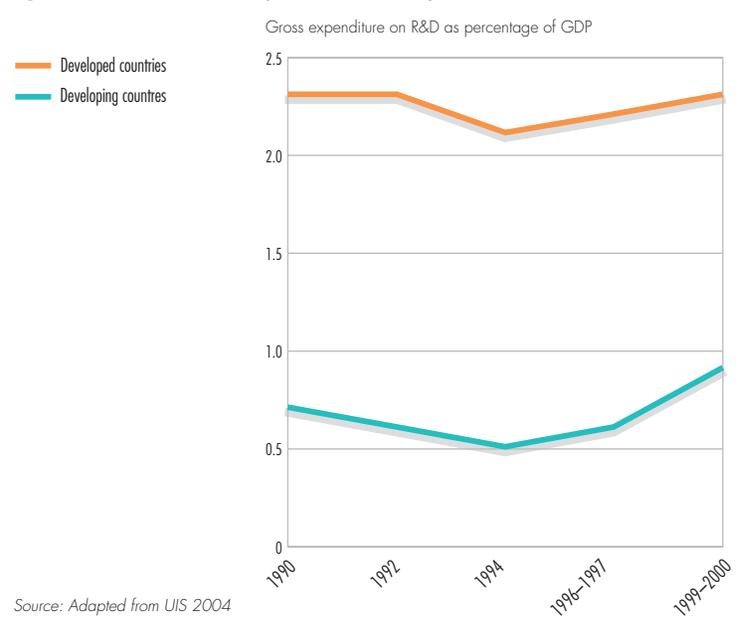
### Science and technology

Developments in science and technology have helped reduce human vulnerability to environmental and non-environmental change, although the pace and levels at which different regions achieve progress vary widely (UNDP 2001). Expenditures on research and development in OECD countries between 1997 and 2002 were 2.5 per cent of GDP compared to 0.9 per cent of GDP in developing countries (UNDP 2005). While the number of researchers was 3 046 per million people in OECD countries between 1990 and

**Figure 7.5 Government effectiveness (2005)**



**Figure 7.6 Research and development (R&D) intensity**



2003, it was 400 per million in developing countries (UNDP 2005). The potential for science and technology to reduce vulnerability remains very unevenly distributed worldwide (see Figure 7.6). This illustrates the need to improve technology transfers between regions.

For example, new farming technologies and practices since 1960 increased food production, and decreased food prices, addressing undernutrition and chronic famine in many regions, but access to these technologies remains unevenly distributed. In the 1980s, oral rehydration therapies and vaccines suitable for use in developing countries were critical in reducing under-five mortality. New information and communication technologies give unprecedented opportunities for early warning systems, and for generating local entrepreneurship. However, science and technology have undoubtedly also added to the risks faced by people and the environment, particularly by driving environmental change.

## HUMAN WELL-BEING, ENVIRONMENT AND VULNERABILITY

### Development challenges

Improving human well-being – the extent to which individuals have the ability to live the kind of lives they value, and the opportunities they have to achieve their potential – is at the heart of development. This is not just a moral imperative, but also a critical aspect of

fundamental human rights (UN 1966, UN 1986, UN 2003), and is essential for reducing vulnerability and achieving sustainable use of the environment.

Since the 1987 Brundtland Commission report emphasized the environment-development link, different policy statements and multilateral environmental agreements, including the 1992 Rio Declaration (Principle 1) and the conventions on biological diversity and climate change, have highlighted the opportunities the environment holds for development (see Chapter 1). Increased convergence between these international approaches and those at national level is evident from the highest-level recognition of environmental rights as human rights (Ncube and others 1996, Mollo and others 2005). Importantly, environmental rights approaches have moved from a focus on environmental quality to incorporating basic needs, development, and intergenerational and governance concerns (UN 2003, Gleick 1999, Mollo and others 2005). However, progress in meeting development objectives has been uneven.

### Improvements in well-being – for some

Despite significant improvements in well-being over the last 20 years, with gains in income, nutrition, health, governance and peace, there are many ongoing challenges (see global context section and Chapters 1–6) (UNDP 2006). Millions of people across all regions are poor, and lacking essential services that are now common among the wealthy. Many countries will not meet the MDGs' 2015 targets (UN 2006, World Bank 2006). But the environment provides opportunities to meet these goals, and to enhance well-being through the various goods-and-services it provides.

The link between environment and well-being is complex, non-linear and influenced by multiple factors, including poverty, trade, technology, gender and other social relations, governance, and the different aspects of vulnerability. Global interconnectedness – through a shared natural environment and globalization – means that achieving human well-being in one place may be affected by practices elsewhere.

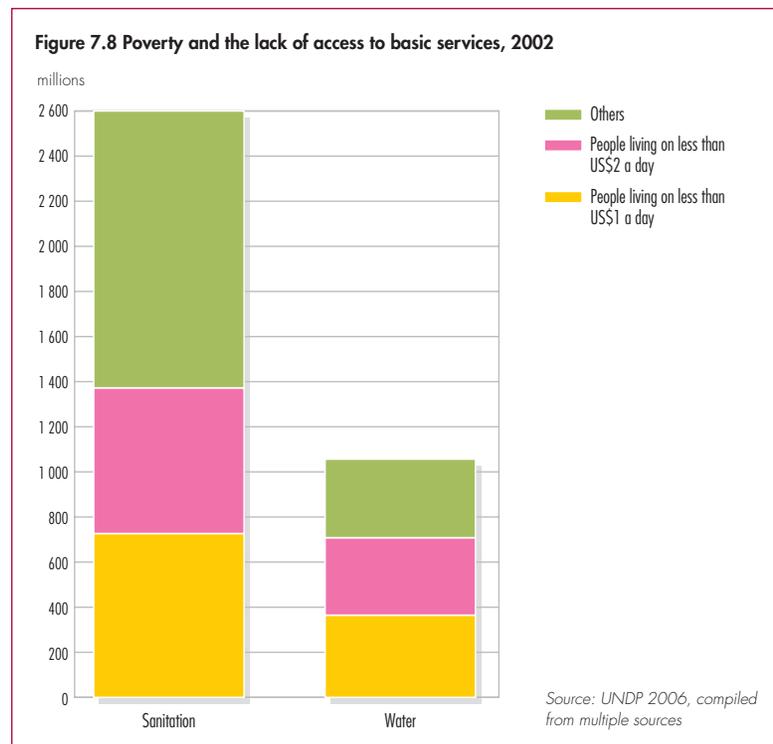
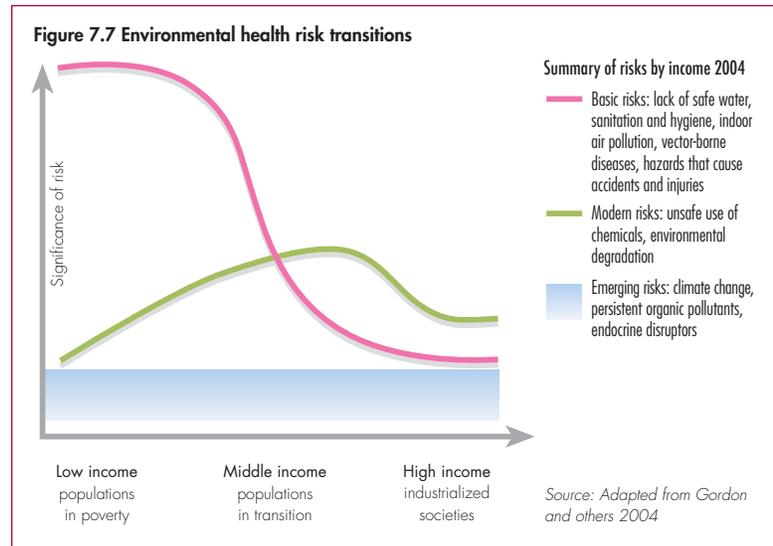
How people actually live and the opportunities they have are closely connected to the environment (Prescott-Allen 2001, MA 2003) (see Chapters

1–6). As the Brundtland Commission warned, environmental degradation contributes to “the downward spiral of poverty” and amounts to “a waste of opportunities and of resources” (WCED 1987). Good health, for example, is directly dependent on good environmental quality (see Chapters 1–6) (MA 2003). Many national constitutions now recognize a healthy environment as a fundamental human right. Despite some improvements, pollution continues to be a problem, sometimes spurred on by factors outside the control of its victims (see global commons and contaminated sites archetypes). Associated risks and costs are unevenly distributed across society (see Figure 7.7). Although the incidence of ill health has been reduced globally, the costs remain monumental.

Notwithstanding improvements in access to water and sanitation (see Figure 4.3), the poorest people suffer the greatest water deficit as a result of location, poor infrastructure and lack of financial resources (see Figure 7.8). Consequently, they experience ill health and indignity (UNDP 2006). In many developing countries, poor people in cities pay more for water than wealthier inhabitants.

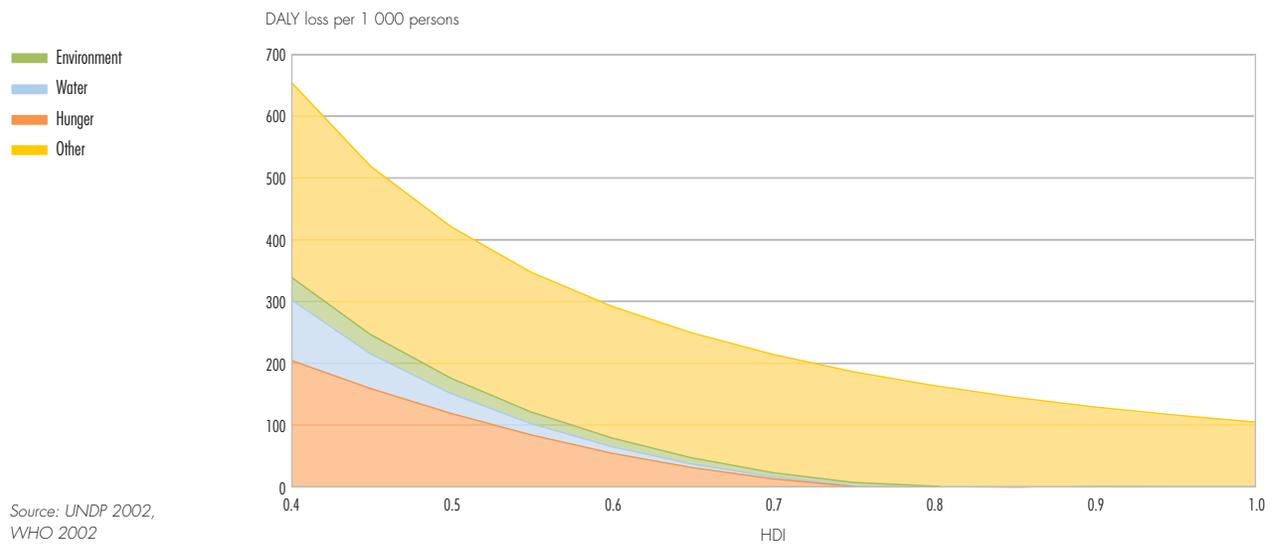
Poor access to material assets at the household level (income, food, water, shelter, clothing, energy, natural and financial resources) and at the societal level (physical and service infrastructure) is part of a cycle of impoverishment, vulnerability and environmental change. It is part of a sequence of becoming poor and staying poor (Brock 1999, Chronic Poverty Centre 2005). In developed countries too, relative poverty, age and gender are critical factors in the distribution of benefits. The energy archetype illustrates the vulnerabilities that arise through lack of access to energy, as well as those related to dependency on energy imports. Investing in physical and service infrastructural development can improve well-being by increasing marketing opportunities, security, and access to energy, clean water and technologies for efficient and sustainable natural resources use.

In countries with a low human development index, people also live shorter lives (see Figure 7.9), because they have reduced health, due to hunger, unsafe water, sanitation and hygiene (lack of water), and suffer from other environmental problems, such



as indoor and outdoor air pollution (see Figure 2.12 in Chapter 2), lead exposure, and climate change. Gains in life expectancy, child mortality and per capita health expenditures have been systematically greater in those countries with more equitable income distribution and access to medical treatment (PAHO 2002). Costa Rica, for example, has a higher average life expectancy than the United States. In many wealthier societies, opulence and consumerism, as well as relative poverty, contribute to ill health.

**Figure 7.9 Disability Adjusted Life Years (DALY) and Human Development Index**



***Investing in human and social capital reduces vulnerability***

Environmental assets can provide important opportunities for improving well-being but, as shown in the archetypes, too often the benefits from these resources do not reach the most vulnerable. The distribution of environmental benefits is affected by access to networks (for example NGOs, governments and the private sector) and relations of trust, reciprocity and exchange (Igoe 2006). Development processes that arbitrarily extinguish local rights (see technological approaches archetype) and degrade the environment, as well as global trade regimes are also important factors influencing distribution.

Several policy interventions respond to these challenges, but slow progress in achieving the MDGs in many countries suggests that not enough has been done. The Convention on Biological Diversity (CBD), for example, emphasizes the importance of more equitable sharing of conservation benefits. Agenda 21, the Rio Declaration, and the CBD all prioritize public participation as essential for sustainable development. Increasing income from benefit sharing may strengthen efforts to meet MDG 1, and as household resources increase, the education and health-related MDGs may be more achievable. Countries with low access to improved drinking water have lower equity in access to education. Worldwide, girls and women spend about 40 billion hours collecting water – equivalent to a

year’s labour for the entire workforce in France (UNDP 2006). In many developing countries, women and girls spend more than 2 hours a day collecting water (UNICEF 2004b). There are strong positive linkages between progress on the different MDGs, with, for example, improved access to water (MDG 7), resulting in girls spending less time collecting water, and increasing their opportunities to attend school (MDG 3) (UNICEF 2004b, UNDP 2006). For many countries, effectively implementing an interlinkages approach is challenging (see Chapter 8).

Meeting basic needs, such as education and health, provides the basis for valued choices, and enhances the day-to-day capacity of individuals, including that for environmental management (Matthew and others 2002). Education and access to technology are particularly important in poor communities, where they provide a potential route to a better situation and reduced vulnerability (Brock 1999).

Basic capabilities and rights to be treated with dignity, to have access to information, to be consulted and to be able to give prior informed consent where one’s livelihood or assets are affected, are increasingly recognized as social and economic rights (UN 1966, UN 1986). The 1986 UN Declaration on the Right to Development represents a global consensus, but for many, these rights are inaccessible as a result of weak national and regional governance systems, undercutting

capacity and opportunities. Women remain particularly disadvantaged. Notwithstanding improvements in maternal health (MDG 5) resulting, for example, from improved access to technologies and energy in rural hospitals, and access to education (MDG 3) in all regions since 1990, women continue to be among the most disadvantaged. They are under-represented in the economy and decision making (UN 2006).

Women are under-represented in important parts of society, due to a combination of factors. Socio-cultural attitudes, education, employment policies, and a lack of options for balancing work and family responsibilities and for family planning affect opportunities for employment and participation in community affairs (UN 2006).

Personal security – being protected from or not exposed to danger, and the ability to live a life one values (Barnett 2003) – may be threatened by declining social cohesion, poor living standards, inequity, unfair distribution of benefits and

environmental change (Narayan and others 2000). In some circumstances, environmental change creates a security challenge for entire cultures, communities, countries or regions (Barnett 2003). Where (cultural) identities are closely associated with natural resources, as in the Arctic and many Small Island Developing States (SIDS), social conflict and breakdown may be directly linked to habitat destruction or decreasing availability of environmental services. Other contributing factors include low levels of rural growth, high income inequity, ill health (especially HIV prevalence), climatic factors, such as drought, and environmental degradation (see Chapters 3 and 6, and Box 7.11).

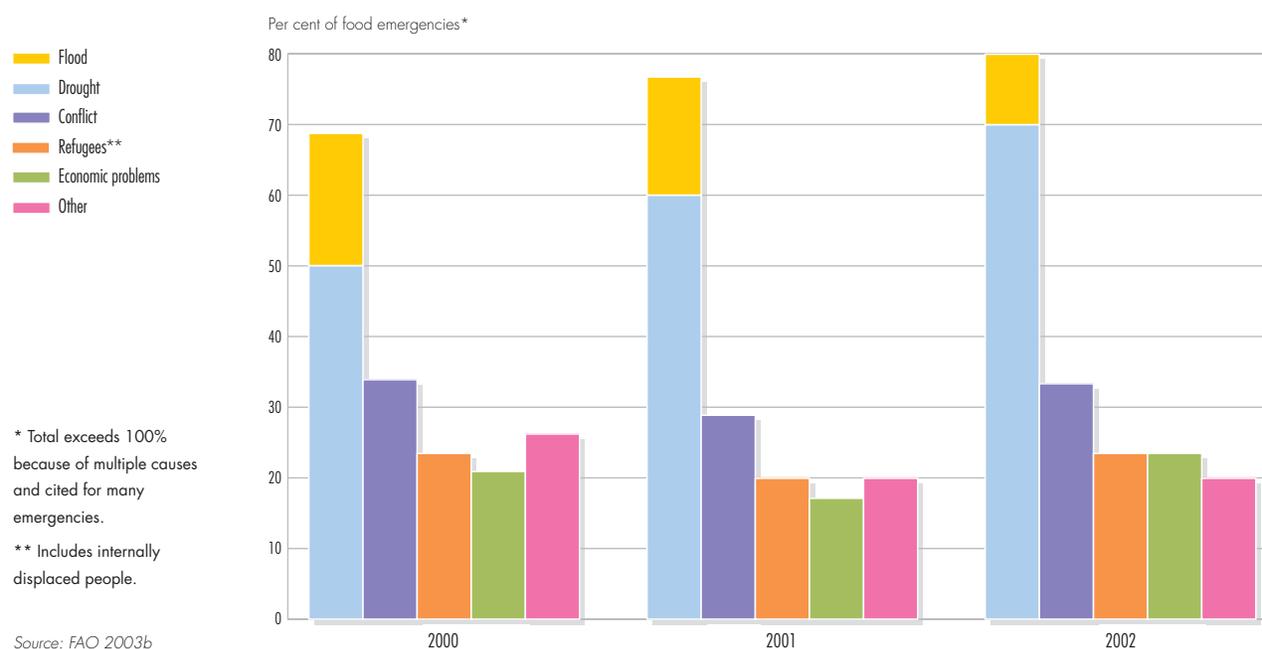
Conflict also affects food security because of its long-lasting disruption of the productive base, and its impact on overall human well-being (Weisman 2006). In many cases, countries involved in conflict, and those with high levels of inequity, experience higher than expected levels of food emergencies (FAO 2003b) (see Figure 7.10).

Personal security is threatened by poor living standards. Below, makeshift houses such as these grow and spread along flooded estuaries exposing residents to grave risks.

*Credit: Mark Edwards/Still Pictures*



**Figure 7.10 Causes of food emergencies in developing countries**



Investing in good social relations, building social capital through better governance, improving cooperation, and empowering women not only supports conservation efforts, but builds opportunities for peace, development and improving well-being. Developed countries' experiences suggest a number of factors that help hedge the

impact of disasters: a well-financed government, an insurance industry, transport and communication infrastructure, democratic participation and personal affluence (Barnett 2003) (see Boxes 7.3 and 7.11). Improving capacity and access to technology, as envisaged under the Johannesburg Plan of Implementation (JPOI) and the Bali Strategic Plan for Technology Support and Capacity Building (BSP), can improve coping capacity. However, progress towards developing the global partnership to support this access remains slow (see Figure 7.27). More far-sighted and equitable approaches to the movement of resources, goods and people are critical to address the new levels of stress the most vulnerable communities will face as a result of environmental change (see the archetypes on drylands, SIDS and global commons).

### Box 7.3 Environmental justice

Over the last three decades, a substantial environmental justice movement has emerged, although not always under that name. It was propelled by community struggles against unequal treatment and discrimination in the distribution of adverse environmental effects. The demand for environmental justice is closely linked to environmental rights: the right of every individual to an environment adequate for his/her well-being. A just system requires policies that protect people from harm, counter the tendency to maximize profits at the environment's expense, and distribute opportunities, risks and costs in a fairer way. It requires accessible institutions (courts), and fair processes. Governments have responded to this need by broadening laws and policies to include the polluter-pays-principle, environmental impact assessments, principles of good neighbourliness, environmental taxes, redistributive mechanisms, participatory and inclusive processes, access to information and right to know provisions, and compensation (see Chapter 10).

### Aspects of vulnerability

Although vulnerability is context and site specific, certain common elements can be observed across various regions, scales and contexts. Overarching vulnerability issues, such as equity, the export and import of vulnerability from one place or generation to another, and the causal relationships with conflict, hazards and the environment, deserve special attention, since they represent strategic entry points for effective vulnerability reduction and policy making.

### *Inequalities, equity and vulnerable groups*

Vulnerability varies across categories, including among men and women, poor and rich, and rural and urban, as can be observed in all archetypes. Refugees, migrants, displaced groups, the poor, the very young and old, women and children are often the groups most vulnerable to multiple stresses. Factors such as ethnicity, caste, gender, financial status or geographical location underlie processes of marginalization and disempowerment, which all lower the capacity to respond to changes. For example, the access of women and children to health care is often inequitably distributed, resulting in unfair and unjust outcomes that entrench disadvantage. Gender inequalities, reflected, for example, in male and female differences in wages, nutrition and participation in social choice, are illustrated in the contaminated sites archetype. Addressing MDG 3, to promote gender equality, empower women and eliminate gender disparity in primary and secondary education, is essential for increasing women's opportunities, reducing their vulnerability, and improving their ability to create sustainable and sufficient livelihoods.

One response by communities and governments to the unequal distribution of vulnerability and the impacts of multiple stressors on human well-being has been to focus on issues of environmental justice (see Box 7.3).

### *Export and import of vulnerability*

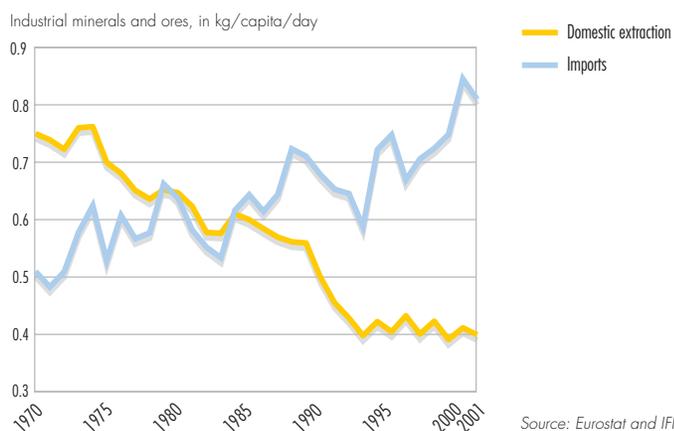
Vulnerability is created or increased remotely, in many cases, through cause-and-effect relationships that persist over long distances in space or time. Many vulnerability archetypes demonstrate the phenomenon of "vulnerability export." Decreasing the vulnerability of some, for example through provision of shelter, increases the vulnerability of others far away, for example through land degradation and contamination around mining areas for building materials (Martinez-Alier 2002). At the same time, many people in industrialized nations, and the new consumers in the developing countries do not feel most of the impacts on the environment that result from their behaviour. These negative effects on the environment and well-being (especially health, security and material assets) are felt most strongly by those, especially the poor, living where the resources are extracted or the waste is dumped. This is illustrated in Figure 7.11, which shows the declining mineral extraction in

the European Union, and the increasing import of minerals. The emissions and land degradation associated with extraction and processing of the materials are increasing in developing countries, while the high-value end products are consumed in industrialized countries. Similarly, food imports often mean that environmental degradation and social impacts occur in the producing land, rather than where the goods are consumed (see, for example, Lebel and others 2002).

Vulnerability is imported where, for example, there is agreement to import waste and hazardous materials to locations where it cannot be safely disposed of or managed (see Chapters 3 and 6). The vulnerability of local populations is created or reinforced by poor governance and a lack of capacity to deal with the hazardous materials. Inadequate storage and poor stock management often result from insufficient storage capacity for pesticides, inappropriate storage conditions, insufficient training of responsible staff in stock management, poor distribution systems, inappropriate handling during transport, and unavailability of analytical facilities (FAO 2001).

While international trade can lead to increases in income, and has helped millions of people out of poverty, it is also sustaining unequal patterns of consumption, and in outsourcing the extraction of natural resources, much of the production and manufacturing, and also the generation and disposal of their hazardous wastes (Grether and de Melo 2003, Schütz and others 2004).

**Figure 7.11 Domestic extraction used in EU-15 compared to imports of industrial minerals and ores**



Recently, however, there have been some attempts to include the external impacts of trade policies into decision making processes, for example, through sustainability impact assessments in the European Union.

#### ***Vulnerability, environment and conflict***

Many of the patterns of vulnerability represent a potential for or have already led to conflict. The relationship between environmental problems and international and civil conflict has been the subject of a great deal of academic research in the post-Cold War period (Diehl and Gleditsch 2001, Homer-Dixon 1999, Baechler 1999, Gleditsch 1999). Both scarcity and abundance of environmental resources can exacerbate existing tensions, and contribute to conflict between groups, especially in societies that lack the capacity to effectively and equitably manage competition for control over resources (Homer-Dixon 1999, Kahl 2006). These dynamics tend to be most common in the developing world. However, the export of vulnerability (see above) from developed to developing countries, can mean that even conflicts that appear localized have critical external connections.

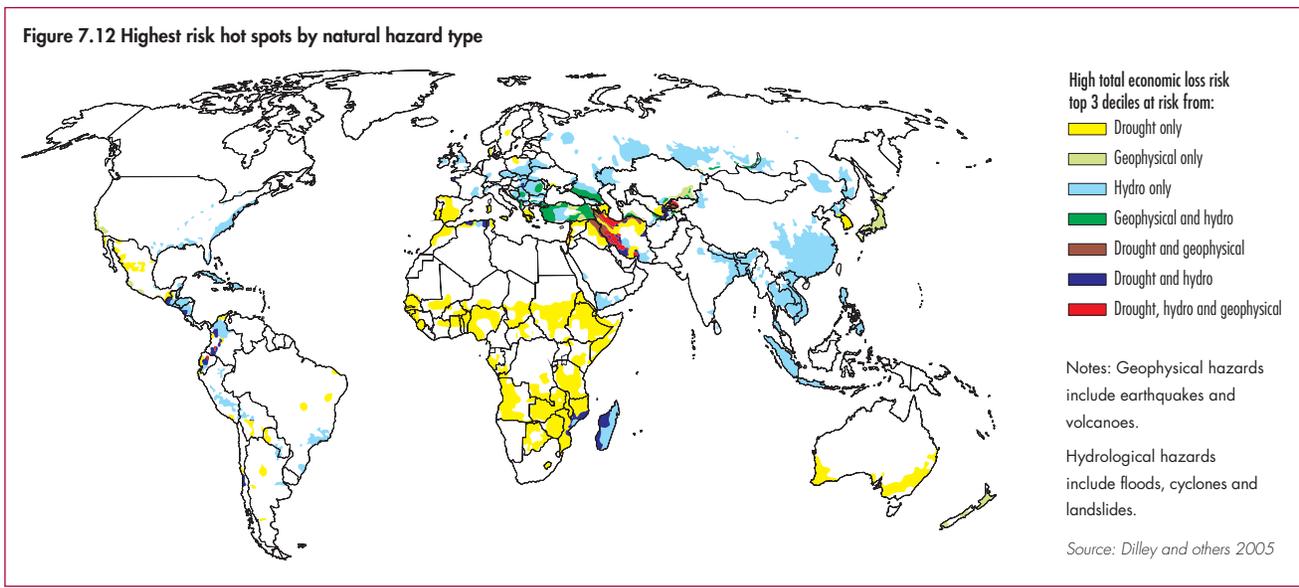
A combination of environmental change, resource capture and population growth decreases the per capita availability of natural resources, and can threaten well-being for large segments of societies, particularly the poorest who depend on these natural resources for survival. The resulting social effects – migration, intensified unsustainable behaviour and social sub-grouping – strain the state's ability to meet its citizens' demands, and can contribute to violent outcomes (Homer-Dixon 1999, Kahl 2006). In the dryland archetype, conflict potential is related to unequal access to scarce water, forest and land resources, exacerbated by desertification and climate variability. Migration, a traditional coping strategy, sometimes heightens conflict when migrants create new competition for resources, or upset tenuous cultural, economic or political balances in the receiving area (Dietz and others 2004). In other cases, the scarcities heighten tensions between nomadic and pastoralist communities. Where this migration occurs across international boundaries, it can contribute to inter-state tension and new civil strife. Even when a state's natural resource base is high, conflict can

erupt over control of these valuable resources, if the potential cost of waging war is lower than the potential gains associated with securing access to the resources for export.

In the archetype on technological approaches to water problems, conflicts and tensions surrounding the distribution, access and quality of water resources arise. Megaprojects, such as dam construction, often carry considerable costs, including forced displacement for riparian dwellers, who may receive few of the resulting benefits (WCD 2000). These costs may include tensions between the state and riparian users, as well as between upstream and downstream riparian groups. The overexploitation of global commons, such as fisheries, the focus of another archetype, brings smaller-scale fisher groups and their governments into conflict with transnational or foreign-flagged ships that venture into exclusive economic zones from the depleted commons. Future energy generation and climate change directly link to security concerns for both oil-importing and oil-exporting countries. In rapidly urbanizing coastal zones and SIDS, conflicts emerge over competition for the environment for tourism-related activities, or for its environmental services associated with marine ecosystems and local livelihoods. Greater attention to proper management of ecosystems and valuable resources promises lower vulnerability to violence and greater overall well-being.

#### ***Vulnerability, well-being and natural hazards***

Over the past 20 years, natural disasters have claimed more than 1.5 million lives, and affected more than 200 million people annually (Munich Re 2004b). One of the main drivers of increased vulnerability to hazards is global environmental change. Natural hazards, such as earthquakes, floods, droughts, storms, tropical cyclones and hurricanes, wildfires, tsunamis, volcanic eruptions and landslides threaten everyone. Proportionally, however, they hurt the poor most of all. Global datasets on extreme events indicate that the number of natural hazards is increasing (EM-DAT, Munich Re 2004b, Munich Re 2006). Two-thirds of all disasters are hydrometeorological events, such as floods, windstorms and extreme temperatures. Between 1992 and 2001, floods were the most frequent natural disaster, killing nearly 100 000 and affecting more than 1.2 billion people worldwide (Munich Re 2004b). More than 90 per cent of the people



exposed to disasters live in the developing world (ISDR 2004), and more than half of disaster deaths occur in countries with a low human development index (UNDP 2004a). Figure 7.12 shows the global distribution of highest-risk hot spots.

The consequences of disasters can have a lasting impact, threaten achievements in development and undermine resilience. Natural hazards affect food security, water supply, health, income and shelter (Brock 1999). These impacts are illustrated in several of the archetypes. Insecurity is driven by a multiplicity of environmental, political, social and economic factors, and is also closely related to issues of material access and social relations. Inefficient and poor governance, as well as inadequate or inefficient early warning and response systems, exacerbate vulnerability and the risks associated with environmental change and natural disasters. In some cases, short-term disaster relief even contributes to increasing long-term vulnerability.

Exposure to hazards has increased as a result of climate change and, for example, destruction of mangroves that protect coasts from tidal surges, but also through the continuing concentration of population in highly exposed areas. Adaptive capacity is also being eroded through, for example, reduced state social protection schemes, undermining of informal safety nets, poorly built or maintained infrastructure, chronic illness and conflict (UNDP 2004a).

### PATTERNS OF VULNERABILITY

Recurring patterns of vulnerability can be found in numerous places around the world, including industrialized and developing regions, and urban and rural areas. With the recognition of the relevance of multiple pressures, and the close interlinkages among local, regional and global scales, vulnerability analyses become increasingly complex. For detailed local vulnerability case studies, there is the question of their relevance for other parts of the world, but it is possible to recognize some similarities between cases and to draw policy-relevant lessons from them.

A limited number of typical patterns or so-called “archetypes of vulnerability” are distinguished in this chapter (see Table 7.2 for an overview). An archetype of vulnerability is defined as a specific, representative pattern of the interactions between environmental change and human well-being. They do not describe one specific situation, but rather focus on the most important common properties of a multitude of cases that are “archetypical.” The approach is inspired by the syndrome approach, which looks at non-sustainable patterns of interaction between people and the environment, and unveils the dynamics behind them (Petschel-Held and others 1999, Haupt and Müller-Boker 2005, Lüdeke and others 2004). The archetype approach is broader, as it includes opportunities offered by the environment to reduce vulnerability and improve human well-being (Wonink and others 2005) (see Table 7.4).

The archetypes presented here are simplifications of real cases, to show the basic processes whereby vulnerability is produced within a context of multiple pressures. This may allow policy-makers to recognize their particular situations in a broader context, providing regional perspectives and important connections between regions and the global context, and insights into possible solutions. The patterns

of vulnerability are not mutually exclusive. In some ecosystems, countries, sub-regions, regions and globally, a mosaic of these and other patterns of vulnerability may exist. This makes policy response a complex challenge.

The archetypes of vulnerability have been identified through the GEO-4 assessment, ensuring regional

**Table 7.2 Overview of archetypes analysed for GEO-4**

Archetype	Linkages to other chapters	Key human well-being issues	Key policy messages
Contaminated sites	Chapter 3 Chapter 6 - Asia Pacific – waste management - Polar – persistent toxics - Polar – industry and related development activities	Health hazards – main impacts on the marginalized in terms of people (forced into contaminated sites) and nations (hazardous waste imports)	- Better laws and better enforcement against special interests - Increase participation of the most vulnerable in decision-making
Drylands	Chapter 3 Chapter 6 - Africa – land degradation - West Asia – land degradation and desertification	Worsening supply of potable water, loss of productive land, conflict due to environmental migration	- Improve security of tenure (for example through cooperatives) - Provide more equal access to global markets
Global commons	Chapters 2 and 5 Chapter 6 - LAC * – degraded coasts and polluted seas - LAC – shrinking forests - Polar – climate change - West Asia – degraded coasts	Decline or collapse of fisheries, with partly gender-specific poverty consequences Health consequences of air pollution and social deterioration	- Integrated regulations for fisheries and marine mammal conservation and oil exploration - Use the promising persistent organic pollutants policies for heavy metals
Securing energy	Chapter 2 Chapter 6 - Europe – energy and climate change - LAC – energy supply and consumption patterns - North America – energy and climate change	Affects material well-being, marginalized mostly endangered by rising energy prices	- Secure energy for the most vulnerable, let them participate - Foster decentralized and sustainable technology - Invest in the diversification of the energy-systems
Small Island Developing States	Chapter 4 Chapter 6 - LAC – degraded coasts and polluted seas - Asia Pacific – alleviating pressures on valuable ecosystems	Livelihoods of users of climate-dependent natural resources most endangered, migration and conflict	- Adapt to climate change by improving early warning - Make economy more climate independent - Shift from “controlling of” to “working with nature” paradigm
Technology-centred approaches to water problems	Chapter 4 Chapter 6 - Asia Pacific – balancing water resources and demands - North America – freshwater quantity and quality - West Asia – water scarcity and quality	Forced resettlement, uneven distribution of benefits from dam building, health hazards from water-borne vectors	- The World Commission on Dams (WCD) framework, and the UNEP Dams and Development Project (WCD and UNEP-DDP) path of stakeholder participation should be further followed - Dam alternatives, such as small-scale solutions and green engineering, should play an important role
Urbanization of the coastal fringe	Chapter 6 - North America – urban sprawl - LAC – growing cities - LAC – degraded coasts - West Asia – degradation of coastal and marine environments - West Asia – management of the urban environment	Lives and material assets endangered by floods and landslides, health endangered by poor sanitary conditions due to rapid and unplanned coastal urbanization, strong distributional aspects	- Implementation of the Hyogo Framework of action - Bring forward green engineering solutions that integrate coastal protection and livelihood opportunities

\* LAC = Latin America and the Caribbean.

relevance and balance. The seven archetypes presented here are not meant to provide an exhaustive overview of all possible patterns of vulnerability. However, they provide a good basis for identifying challenges and exploring opportunities for reducing vulnerability while protecting the environment.

### Exposing people and the environment to contaminants

The archetype concerns sites at which harmful and toxic substances occur at concentrations:

- above background levels and pose or are likely to pose an immediate or long-term hazard to human health or the environment; or
- exceed levels specified in policies and/or regulations (CSMWG 1995).

As shown in Chapters 3 and 6, people and ecosystems are exposed to widespread contamination due to persistent organic pollutants and heavy metals, urban and industrial sites, military activity, agro-chemical stockpiles, leaking oil pipelines and waste dumps.

#### Global relevance

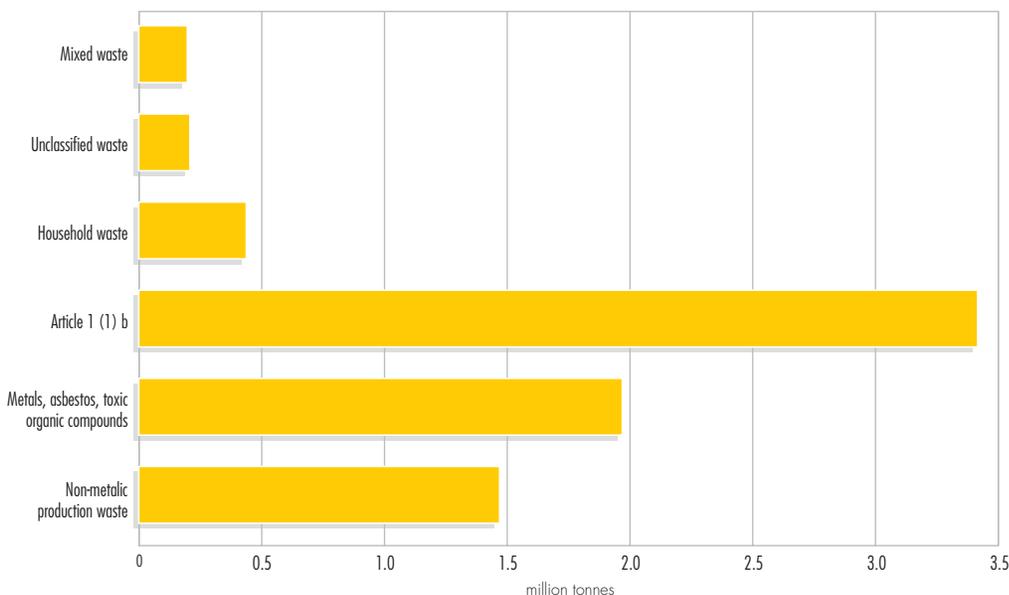
Much work is still needed to quantify the extent of contamination due to toxic and hazardous substances, and to make governments and civil society aware of the problems. However, a considerable amount of contamination has been documented.

In addition to contamination generated in particular locations, transport and deposition of waste is a major threat. More than 300 million tonnes of waste, including hazardous and other wastes, were generated worldwide in 2000, of which less than 2 per cent was exported. About 90 per cent of the exported waste was classified as hazardous, with about 30 per cent believed to be persistent organic pollutants (POPs) (FAO 2002). The principal waste export (see Figure 7.13) by volume was lead and lead compounds, bound for recycling (UNEP 2004).

Contaminated sites are also legacies of past industrial and economic development, and a heritage of present production and consumption patterns that affect both current and future generations. Abandoned industrial sites can present a serious risk to people and the environment. Governments face problems of holding polluters accountable for site clean-ups. Therefore, clean-up costs are imposed on state budgets, or on people from surrounding areas exposed to health risks and environmental deterioration.

Sometimes, abandoned industrial sites are in relatively isolated areas around former factories or mines, and, sometimes, whole regions are affected by the problem (see Box 7.4). Short-term profit interests, lack of regulations or corruption, and weak law enforcement

**Figure 7.13 Composition of transboundary waste reported by the parties to the Basel Convention in 2000**



Note: Article 1(1) b concerns wastes that are defined as, or are considered to be, hazardous wastes by the domestic legislation of the Party of export, import or transit, such as contaminated soil or sewage sludge.

Source: UNEP 2004, compiled by UNEP/GRID-Arendal, based on Basel Convention reports

are among the factors that have led and may still lead to the creation of present and future environmental hazards from contaminated sites (UNEP 2000).

### Vulnerability and human well-being

In developing countries, chemical mixtures in the vicinity of small-scale enterprises, such as smelters, mines, agricultural areas and toxic waste disposal sites, are often a human health hazard (Yanez and others 2002). For example, about 60 per cent of the smelters of the world are located in developing

countries, while developed countries import the metals (Eurostat and IFF 2004). Health effects, such as cancer and neuropsychological disorders, have also been reported around smelters (Benedetti and others 2001, Calderon and others 2001). For example, in Torreón, Mexico, 77 per cent of the children living closest to a lead smelter had lead levels twice as high as the reference level (Yanez and others 2002).

Mercury contamination associated with small-scale gold mining and processing presents a

## Box 7.4 Contamination in Central Asia's Ferghana-Osh-Khudjand area

The Ferghana-Osh-Khudjand area in Central Asia (also referred to as the Ferghana Valley) is shared by Uzbekistan, Kyrgyzstan and Tajikistan (see Figure 7.14). The region is a typical example of former centrally planned economies, where development plans paid little attention to local conditions (especially environmental), and social progress was planned to be achieved through large-scale industrial projects. In the Ferghana Valley, the construction of enormous irrigation schemes made the region a major cotton producer. It also became a heavy industrial area, based on mining and oil, gas and chemical production. Discoveries of uranium ore led to extensive mining, and it became an important source of uranium for the former Soviet Union's civilian and military nuclear projects.

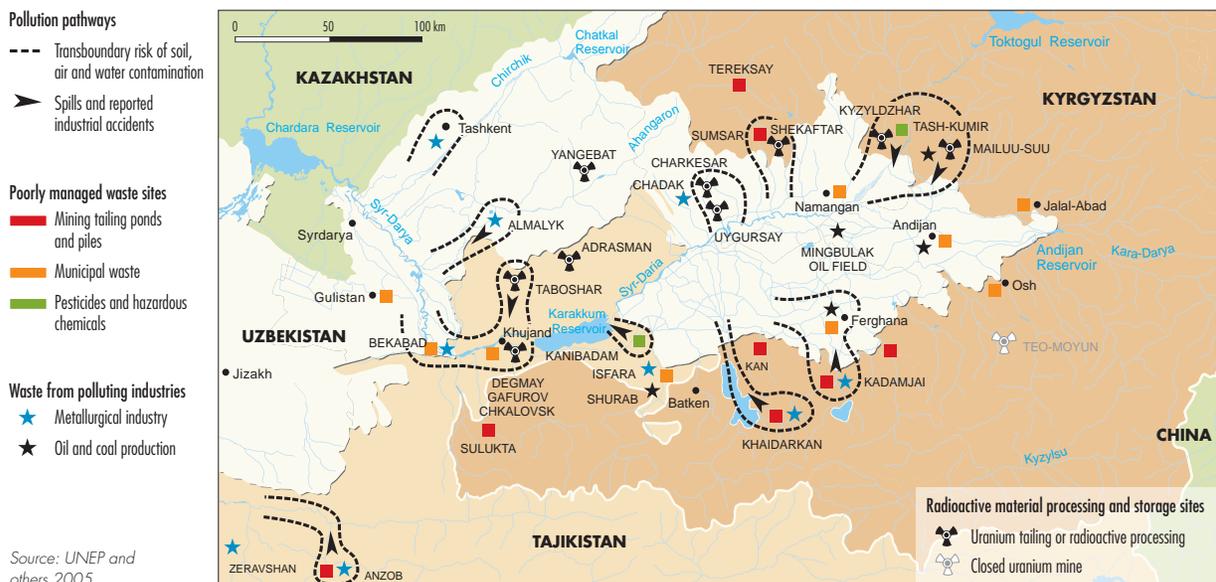
Several factors – population density in disaster-prone areas, high overall population growth, poverty, land and water use, failure to comply with building codes, and global climate change – make the region particularly vulnerable to natural as well as human-made hazards. Cumulative risks from different industrial facilities, deteriorating

infrastructure and contaminated sites threaten not only the inhabitants living directly in the polluted zones, but also have transboundary impacts in the three countries that share the valley. Even though past spills and accidents have created tensions among the countries, officials do not consistently regard environmental pollution by existing facilities as a security problem.

In the immediate wake of the breakup of the Soviet Union, pollution and, particularly, shared water resources in this newly internationalized river basin, created tensions among the new states. Officials point to the potential this area has to serve as an example of international cooperation in addressing legacies of the past. However, without extensive international aid, this task is impossible for the local governments. Also, in the absence of alternative development plans and access to environmentally-friendly technologies and management practices, some of the abandoned facilities may be reopened.

Source: UNEP and others 2005

Figure 7.14 Radioactive, chemical and biological hazards in Central Asia



major hazard for environment and human health in at least 25 countries in Africa, Asia and the Pacific, and Latin America and the Caribbean, (Malm 1998, Appleton and others 1999, van Straaten 2000). Harmful health effects have been reported for individuals exposed to mercury in gold mining areas (Lebel and others 1998, Amorin and others 2000).

Pesticides can contribute to water pollution, and seriously threaten the health of both rural and urban residents, especially the poorest people. Organochlorine compounds, such as DDT, dieldrin and HCH, which have been withdrawn or banned for human health and/or environmental reasons (FAO 1995), are still found in dumps, particularly in developing countries. Long-term exposure to pesticides can increase the risk of developmental and reproductive disorders, disruption of the immune and endocrine systems, and can impair the function of the nervous system, and is associated with the development of certain cancers. Children are at higher risk from exposure than are adults (FAO and others 2004).

The international traffic in hazardous wastes exposes local populations to health risks. For example, in 1998, about 2 700 tonnes of industrial waste, containing high levels of toxic compounds such as mercury and other heavy metals, were shipped illegally to Sihanoukville, Cambodia. An estimated 2 000 residents were exposed to the waste and at least six deaths and hundreds of injuries were associated with the incident (Hess and Frumkin 2000).

An emerging issue is the great volume of electronic waste exported to developing countries, where it is recycled by workers who often lack protection. They are exposed to mercury, lead, cadmium and other toxic chemicals (see Chapter 6). In one Chinese city where electronic waste is recycled, sediment samples had heavy metal concentrations far above the guidelines of the US Environmental Protection Agency (Basel Action Network 2002). Similarly, workers are exposed to contaminants that pose serious risks to their health in locations where ships are broken up for recycling (Basel Action Network 2006).

Abandoned factories and industrial sites are most likely to be found in poor communities,

which can be home to marginalized newcomers. Contamination of air, water and land decreases land productivity, making agricultural products unsuitable for markets. Children are particularly at risk from contaminated sites (as places of play and work), and women are especially at risk for physiological reasons. A survey conducted in the United Kingdom (Walker and others 2003) about the social status of people living close to integrated pollution control sites (IPC), confirmed that in England there is strong evidence of a socially unequal distribution of IPC sites and their associated potential impacts. Out of about 3.6 million people living in one-kilometre radius of an IPC site, there were six times more people from the most deprived groups than from the least deprived groups.

### **Responses**

Over the years, a series of measures have been adopted to deal with the risks that hazardous materials and chemicals pose for both people and the environment. Principle 14 of the Rio Declaration, calls on countries to “effectively cooperate to discourage or prevent the relocation and transfer to other States of any activities and substances that cause severe environmental degradation or are found to be harmful to human health.” The UN Commission on Human Rights has appointed a special rapporteur on adverse effects of the illicit movement and dumping of toxic and dangerous products and wastes on the enjoyment of human rights (UN).

Responses to the problem of contaminants now include 17 multilateral agreements (see Chapter 3), together with numerous intergovernmental organizations and coordination mechanisms. They include the 1989 Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal, the 1998 Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals, the 2001 Stockholm Convention on Persistent Organic Pollutants, as well as the 2006 Strategic Approach to International Chemicals Management.

Other responses to contamination have created opportunities for building trust in post-conflict societies. For example, joint scientific assessment of threats from radioactive contamination in the Russian northwest provided an opportunity for Russian, Norwegian, and American exchange as the Cold

War ended and the superpowers began to develop links for confidence building among scientists and military personnel. The low politicization of environmental issues actually facilitated face-to-face dialogue among military foes in a highly militarized and sensitive region.

The success of the existing instruments for dealing with contamination depends strongly on institutional capacity and political will (see Chapter 3).

Important areas for future action include:

- strengthening the ability of international organizations to monitor and enforce multilateral agreements, such as the Basel and Rotterdam conventions;
- promoting global environmental and social standards to avoid dumping;
- investing in technology and technology transfer for improved risk assessment, monitoring, information and communication, and clean-up;
- increasing corporate social and environmental responsibility;
- investing in assets, especially skills and knowledge, to avoid exposure or to mitigate health effects from exposure to hazardous material;
- improving state capacity to monitor and enforce laws, as this may reduce risk, and improve local coping capacity;
- providing opportunities for participation, and addressing the social situation of people affected by contaminated sites;
- better incorporation of established international legal principles – including the precautionary approach, producer liability, polluter pays, prior informed consent and right to know – into national, regional and global frameworks;
- increasing support for research on causes and effects (especially cumulative effects) of industrial production and chemicals; and
- increasing support for life cycle analyses and environmental impact assessments.

In situations of contaminated sites, formal institutions, better laws at national and international levels, and better enforcement of existing laws are crucial for reducing vulnerability. This requires strong and well-functioning states, with law-making, implementation and enforcement branches working towards the same goals (Friedmann 1992). Measures that strengthen the capacity of states can also help strengthen coping

capacity at local levels, if this is supported by higher levels of governance.

Increasing the participation of the most vulnerable groups in planning and governance, and giving both local and higher levels of governance opportunities to articulate their challenges is a major factor in strengthening their coping capacity. Giving the vulnerable a voice requires that they be actively empowered to raise their voices, for example by having access to relevant environmental information – as enshrined in Principle 10 of the Rio Declaration – and capacity building for taking part in the governance process. The 1992 UN Conference on Environment and Development (UNCED) provided the basic institutional change for increasing participation in environment-related decision making. This has been reinforced, for example, in the Aarhus Convention (UNECE 2005). The Basel and Rotterdam conventions are important for giving countries a voice in the context of vulnerability to contamination.

#### **Disturbing the fragile equilibrium in drylands**

In this archetype, current production and consumption patterns (from global to local levels) disturb the fragile equilibrium of human-environment interactions that have developed in drylands, involving sensitivity to variable water supplies and resilience to aridity. The result is new levels of vulnerability. For thousands of years, drylands populations have been dependent on the proper functioning of these ecosystems for their livelihoods (Thomas 2006). These resilient ecosystems have considerable productive potential – supporting, for example, 50 per cent of the world's livestock (Allen-Diaz and others 1996) – but are increasingly at risk. Moreover, governance and trade patterns mean that much dryland wealth remains hidden or poorly used, constituting missed opportunities for improving well-being.

#### **Global relevance**

Drylands are widespread, occur in developed and developing countries, and support significant populations (see Chapter 3). Worldwide, 10–20 per cent of drylands are degraded, directly affecting well-being of drylands populations, and indirectly affecting people elsewhere through biophysical (see Chapter 3) and socio-economic impacts. Globally-driven

processes, including climate change, have direct impacts on well-being in drylands (Patz and others 2005).

### Vulnerability and human well-being

There are a number of factors that influence the vulnerability of dryland communities, including:

- biophysical features, especially water availability;
- access to natural and economic resources, levels of development, and conflict and social instability;
- interlinkages between dryland and non-dryland areas through migration, remittances and trade; and

- global governance regimes (Safriel and others 2005, Dobie 2001, Griffin and others 2001, Mayrand and others 2005, Dietz and others 2004).

People in the drylands of industrialized countries – such as in Australia and the United States – typically have a diversity of livelihood options, and can adapt more to land degradation and water scarcity more easily than can rural people in drylands in developing countries who directly depend on environmental resources for their livelihoods. They are most vulnerable. Although high land productivity and a strong manufacturing sector, such as in North

### Box 7.5 Analysing different types of vulnerability in drylands

Systematic analysis of the diverse socio-economic and natural conditions in drylands enhances understanding of the specific patterns of vulnerability. The global distribution of vulnerability is investigated here using a cluster analysis.

The following indicators were used to characterize the main underlying processes of vulnerability:

- water stress, to show the relationship between water demand and availability;
- soil degradation;
- human well-being as indicated by infant mortality;
- availability of infrastructure, indicated by road density; and
- the climatic and soil potential for agriculture.

The table legend to the map shows the qualitative values of the indicators that are typical for the eight clusters:

+ = high value for the specific indicator

– = low value for the specific indicator

0 = intermediate value for the specific indicator

Together these indicators cluster into eight constellations, or “clusters of socio-economic and natural conditions” in drylands, depicted by colours ranging from bright red for the most vulnerable, to neutral grey for the least vulnerable cluster (see Figure 7.15). Humid regions are shown in white.

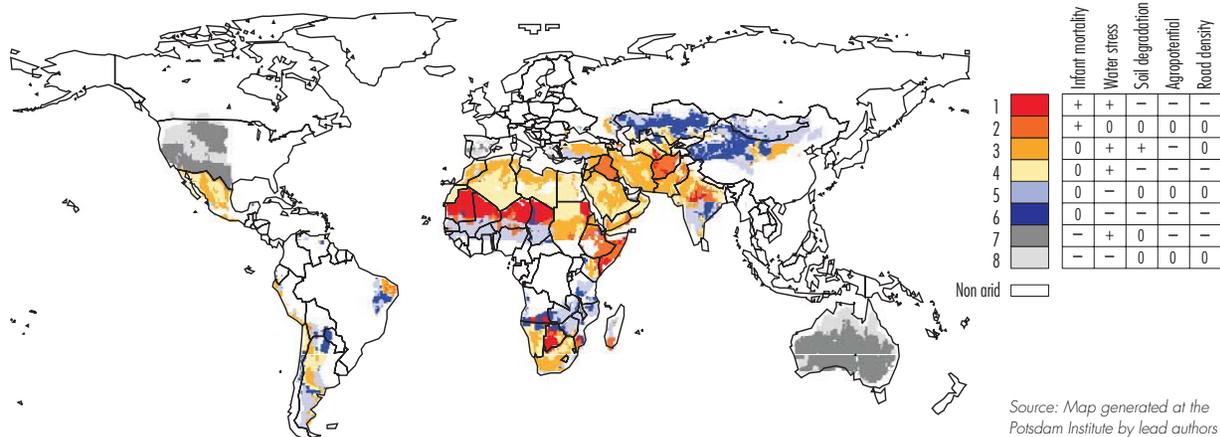
The analysis shows a need for the wise and efficient use of resources, based on best available knowledge and technological options: Clusters 1 to 6 are all vulnerable (with low to medium levels of well-being). Clusters 1 and 2 are most problematic, with high water stress, soil degradation and infant mortality, low agricultural potential, and intermediate infrastructure.

Clusters 3 and 4 are large areas, which exhibit a better level of human well-being compared to clusters 1 and 2 under very similar levels of exploitation of the water and, in some places, even more severe overuse of soil resources. This shows that the worst expressions of vulnerability are not a necessary fate. Clusters 5 and 6 illustrate that improved water use on its own does not guarantee improved well-being.

Clusters 7 and 8, in contrast, are the least vulnerable regions, with only intermediate infrastructure restrictions and infant mortality.

Sources: Alcamo and others 2003, ArcWorld ESRI 2002, CIESIN 2006, GAEZ 2000, Kulshreshtha 1993, Murtagh 1985, Oldeman and others 1991

Figure 7.15 Spatial distribution of typical forms of the dryland archetype



Source: Map generated at the Potsdam Institute by lead authors of this chapter

America, can decrease vulnerability, the distribution of access to natural and economic resources, and participation in decision making trigger the vulnerability pattern (see Box 7.5).

Desertification (see Chapter 3) is a challenge for development and improving well-being. Globally, some 60 000 square kilometres of productive land and about US\$42 billion in income are lost annually, due to declining agricultural productivity (UNDP and GEF 2004). Since 1975, the incidence of drought has increased fourfold from 12 to 48 episodes (UNDP and GEF 2004). Where there is high agricultural dependency, droughts may undercut food security and economic performance, lessening the opportunity to meet MDG 1 (see Figure 7.16). In Pakistan, for example, drylands are increasingly threatened by declining soil fertility and flash floods – early warnings of a looming crisis (UNDP and GEF 2004).

The seemingly low production potential of drylands has made them less favoured for the systematic investments (in water and land) needed to offset negative effects of land use and sustain their productive capacity (see Chapter 3). Freshwater availability in drylands is projected to be further reduced from an average of 1 300 cubic metres/person/year in 2000, which is already below the threshold of 2 000 m<sup>3</sup> required for minimum human well-being and sustainable development (Safriel and others 2005). In arid and semi-arid areas, water shortages are predicted to be the most significant constraint for socio-economic development (Safriel and others 2005, GIWA 2006) (see Chapter 4). In some countries, the reduced supply of potable water will mean women and girls will be forced to travel longer distances to collect water.

The high number of transboundary aquifers under stress (GIWA 2006) may, in some instances, add a regional dimension to the risk of tensions related to water scarcity. In some situations, adaptation strategies, such as irrigation of water-intensive crops, lead to clashes between rural and urban users, as well as between agriculturalists and pastoralists. In the US southwest for example, multistakeholder dispute resolution mechanisms, including judicial systems and significant technological and financial resources, keep most of these conflicts from turning violent. In areas with higher vulnerability, such as the Sahel, shortages of arable land and water, particularly in drought periods, have sometimes led to violent conflicts along a number of

lines of division: rural-urban, pastoralist-agriculturalist and ethnic group-ethnic group (Kahl 2006, Lind and Sturman 2002, Huggins and others 2006).

Movement of “dryland refugees” to new areas, including cities, has the potential to create local and regional ethnic, social and political conflict (Dietz and others 2004). Seasonal and cyclic migrations are important coping strategies for pastoral dryland peoples. Pastoral societies (found in all regions) are critically exposed to ecosystem change, which can increase their vulnerability, affect their capital stocks, hinder coping strategies, decrease the productive performance of livestock and generate tensions with other herder and host farmer communities (Nori and others undated).

### Responses

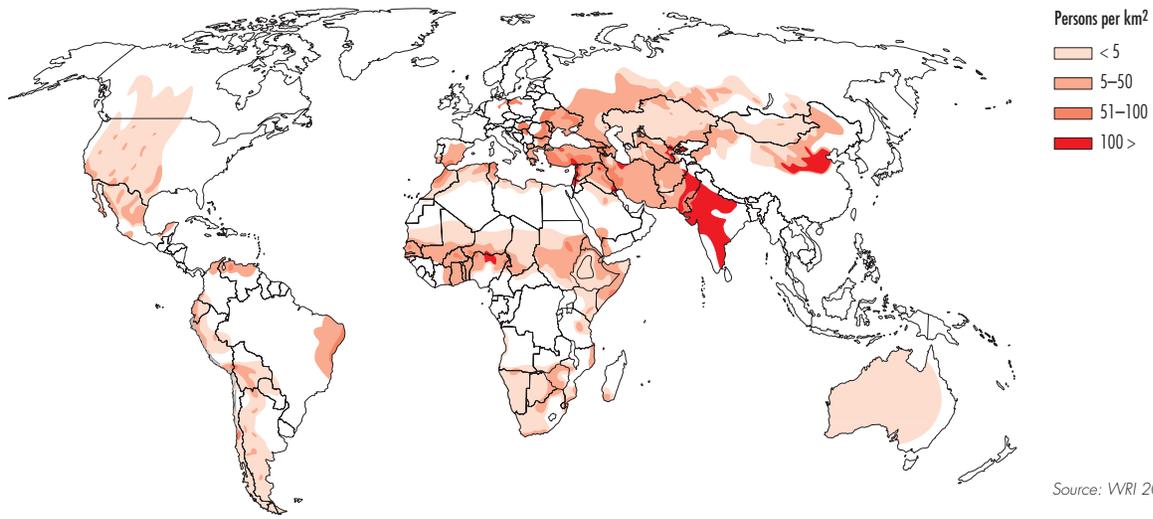
Given the extent of drylands, the roughly 2 billion people they support and the biological diversity they hold, the maintenance and restoration of their ecosystem functions is essential for achieving the CBD 2010 biodiversity targets and the MDGs. The UN Convention to Combat Desertification (UNCCD) provides the overall framework for addressing land degradation (see Chapter 3). It is complemented by the CBD, UNFCCC, Agenda 21, WSSD and other multilateral agreements.

The UNCCD supports national action to combat desertification and improve opportunities from land management. This includes the development of national (NAP), sub-regional (SRAP) and regional (RAP) action programmes. By 2006, a significant number of countries had developed NAPS, with 34 in Africa, 24 in Asia, 21 in Latin America and the Caribbean, and eight in Europe. The CBD provides for management based on equitable benefit-sharing, which helps to increase local resource-based income. Successful applications in drylands include co-management initiatives for wildlife (Hulme and Murphree 2001), and the development of markets for non-timber forest products (NTFPs) (Kusters and Belcher 2004). Intergovernmental initiatives, including the WSSD, UNCCD and the UNEP-led BSP, that focus on capacity building and transfer of technology to enhance management, production and marketing, offer opportunities for building on these successes.

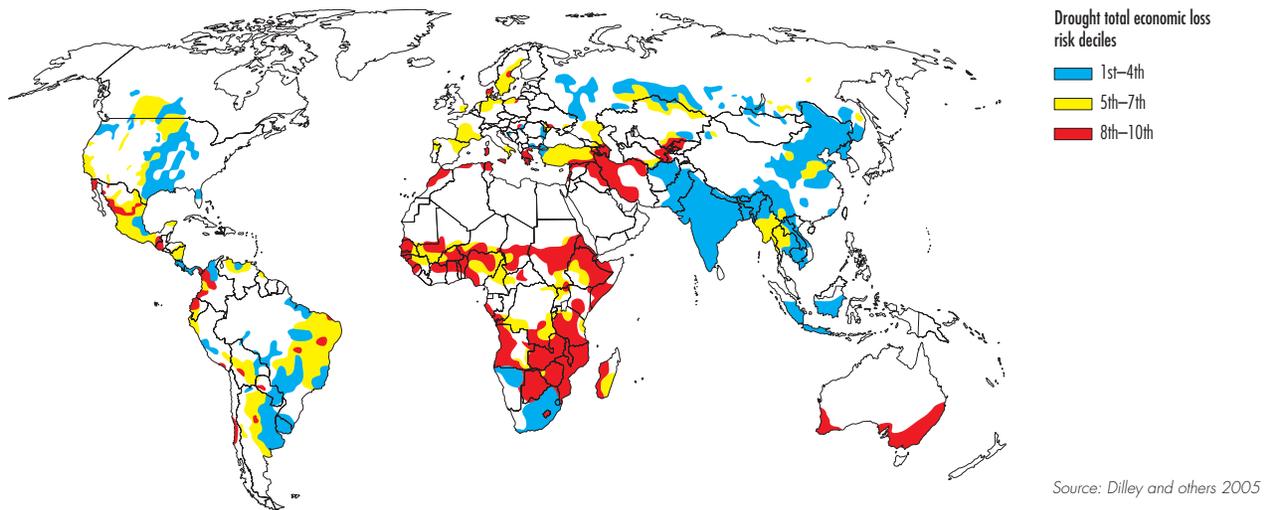
Early warning systems (EWS) are widely used to improve the ability to respond to environmental

**Figure 7.16 Vulnerability to drought and impacts on well-being**

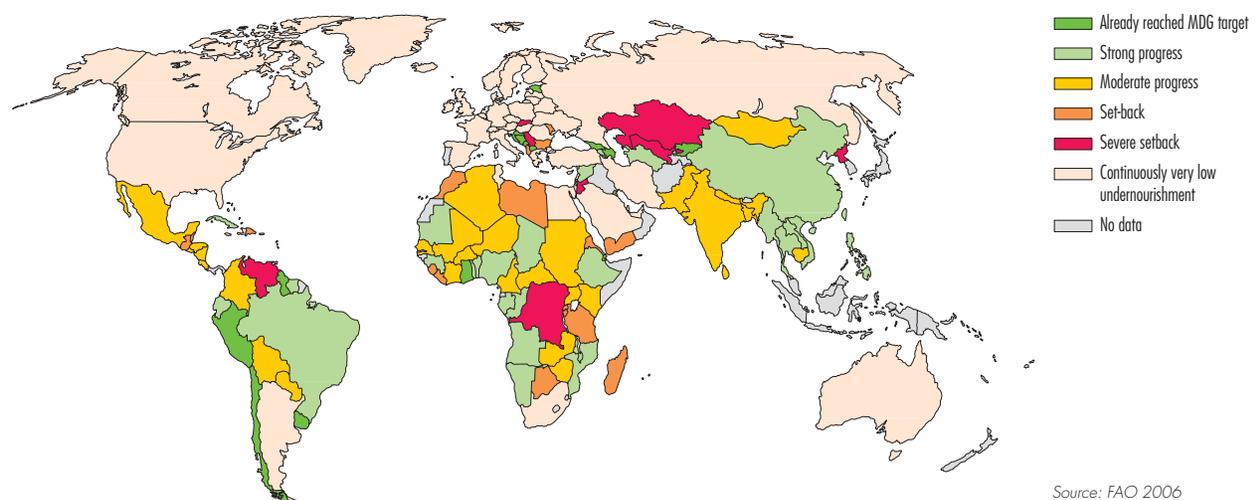
a) Drylands populations are concentrated in developing countries



b) Drought-related economic loss as a proportion of GDP density



c) Progress towards MDG target on food security



pressures. The UNEP/FAO Land Degradation Assessment in Drylands (LADA) systematically observes land degradation to increase understanding of drought and desertification processes and their effects. In addition, national, sub-regional and global EWS enhance capacity to respond to potential food insecurity. In Eastern Africa, for example, the Intergovernmental Authority on Development (IGAD) links conflict monitoring (through its Conflict Early Warning and Response Mechanism) to environmental EWS (through its Drought Monitoring Centre), because drought and other environmental pressures may trigger pastoral conflict.

Effective responses to the multiple and complex drivers of land degradation demands interlinked approaches, adequate funding and sufficient capacity (see Box 7.6). For example, attempts to reverse water degradation trends are constrained by a number of factors. They include: poverty, slow economic development, deficiencies in the technical, administrative and managerial capacity of water management institutions, weak national and regional legal frameworks, and a lack of international cooperation (GIWA 2006) (see Chapter 4). Developing systems for managing water scarcity, which deal with rainwater and run-off, and mediating between competing water claims, including environmental claims, has proved difficult. The failure to harness different kinds of knowledge, including

traditional farming knowledge, in management and policy means that the full range of options for improving dryland farming is not taken up (Scoones 2001, Mortimore 2006). Insufficient funding, including for NAPs (White and others 2002), and failure to respond to early warnings (FAO 2004a), are constraints.

Experience shows that financial investments and loans to dryland farmers can produce significant returns, but this approach continues to be underused (Mortimore 2006). Although women play a pivotal role in environmental and agricultural management, they have limited support. Institutional and governance factors, coupled with insufficient capacity, limit the financial benefits that producers reap from drylands products, such as crops and NTFPs (Marshall and others 2003, Katerere and Mohamed-Katerere 2005). In 2005, UNCCD COP 7 acknowledged that insufficient decentralization and insecure tenure undermine management and reduce opportunities. Potential income is lost to intermediaries: in Namibia, devil's claw (*Harpagophytum* species) producers receive just a fraction of the retail price, ranging from 0.36 per cent, when dealing with intermediaries, to 0.85 per cent when selling directly to exporters (Wynberg 2004).

Global trade regimes, particularly protectionist tariffs and agricultural subsidies in developed country markets (Mayrand and others 2005), affect income of drylands producers in developing countries. These tariffs and subsidies have, for example, reduced the competitiveness of developing country cotton, even though developing countries are among the lowest-cost producers (Goreux and Macrae 2003). Conflict can also be an important factor inhibiting product and market development in drylands (UNDP 2004b).

Addressing these constraints can improve opportunities for increasing well-being. Options include (see Chapter 3):

- improving tenure, and recognizing the value of traditional knowledge to encourage farmer investments in soil and water conservation, which lead to more profitable agriculture;
- addressing resource-related conflicts through multi-level environmental and development cooperation, including bringing all stakeholders together to negotiate sharing benefits from interdependent resources, such as transboundary water. This helps to build trust through cooperative environmental management; and

#### Box 7.6 Institutional reform for poverty alleviation in drylands

Long-term social and ecological transformation in Machakos District in Kenya is widely cited as a success story of how a combination of efforts can lead to improved well-being in dryland areas. This involved dealing with a series of interconnected domains:

- ecosystem management (conservation of biodiversity, soil and water management);
- increasing land productivity (increased market access to agricultural products, improved crop yields, increased value and price of products);
- land investments; and
- social welfare (investments in education, diversification of employment and income opportunities, and stronger linkages to urban centres).

Between the 1930s and the 1990s, despite a sixfold increase in the population, erosion had been largely brought under control on private farmlands through small investments and extension support. During the same period, the value of agricultural production per capita increased sixfold. This was due to developments in agricultural technology, increased emphasis on livestock production, intensive farming, integration of crops with livestock production, and improved production and marketing of higher-value commodities, such as fruit, vegetables and coffee. This was done in tandem with investments in education, and the provision of employment opportunities outside the district.

Source: Mortimore 2005

- ensuring more equitable access to global markets, to improve opportunities for agriculture and livelihood diversification.

### Misusing the global commons

Another archetype is a pattern of vulnerability resulting from misuse of the global commons, which include the deep oceans and seabed beyond national jurisdiction and the atmosphere. In some contexts biodiversity (where species concerned are found in the global commons) and Antarctica are also included in the list of global commons, but the focus here is on the oceans and the atmosphere. The misuse of these global commons leads to the exposure of people and the environment to pollution (such as heavy metals and persistent organic pollutants in the Arctic), to resource depletion (such as in fisheries) and to environmental changes (in particular as a result of climate change). Very often those that are extremely vulnerable to the changes resulting from misuse of the commons are not responsible for the misuse itself.

### Global relevance

Resources that cannot be governed under the normal governance framework of national sovereignty are usually referred to as 'global commons.' The global commons physically envelop the globe and humanity. The oceans have the character of both a common

(re)source – for example, providing large amounts of fish – and a common 'sink' – receiving large amounts of pollution from ships, land and the atmosphere (see Chapter 4). The atmosphere is a decisive (re)source for life on this planet, both because it protects people from the harmful rays of the sun and provides the climate system, and because the oxygen in its lower parts is also the source of the air most organisms need to sustain life. The atmosphere is heavily misused as a sink for pollution from a wide range of human activities (see Chapter 2).

### Vulnerability and human well-being

Marine living resources provide a significant proportion of protein in the human diet (see Chapter 4). Two-thirds of the total food fish supply is from capture fisheries in marine and inland waters (WHO 2006b). However, fisheries are declining, formerly abundant species are now rare, food webs are being altered, and coastal ecosystems are being polluted and degraded (Crowder and others 2006). In some cases, fisheries have collapsed, and the livelihoods of entire communities have been destroyed. A well-known example is the collapse of much of the Canadian cod fishery. In the early 1980s, the Canadian catches of Atlantic groundfish peaked, and then declined rapidly. This is illustrated in Figure 7.17 in Box 7.7, which also shows the sharp decline in the number of fishers (Higashimura 2004).

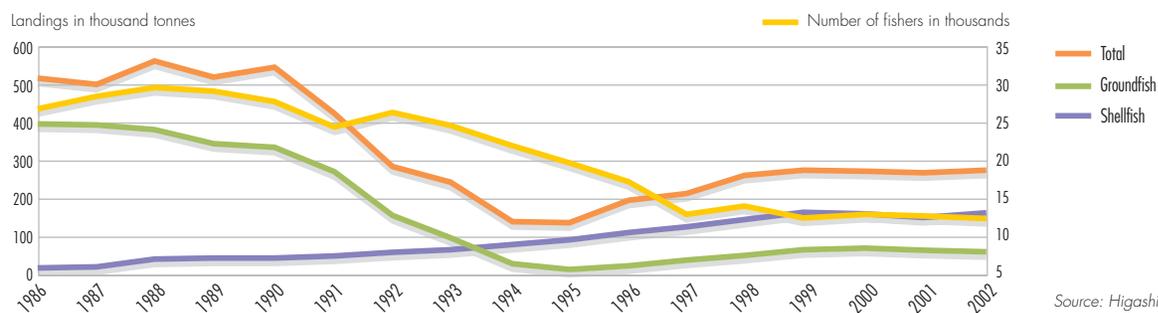
#### Box 7.7 Conflicts over marine resources

At the international level, conflict can occur between states acting on behalf of vulnerable local users and the states of large industrial users of the global commons. One example occurred in 1995 between Canada and Spain on the Grand Banks, a rich fishing zone just off Canada's east coast. Industrial foreign trawlers were fishing for turbot, a resource also used by local fishermen in Newfoundland, a Canadian province. The Canadian government was under great domestic political pressure from the local

fishers, who claimed their way of life was threatened because fishers from countries fishing the Grand Banks, including Spain, did not respect catch quotas. Canada forcibly boarded a Spanish fishing trawler in international waters and arrested its crew after the Canadians alleged repeated incursions into Canada's 200-mile Exclusive Economic Zone. The Spanish referred to this incident as an act of piracy, touching off a series of high seas encounters and diplomatic clashes referred to as the "Turbot War."

Sources: McDonald and Gaulin 2002, Soroos 1997]

Figure 7.17 Fish catch landings of Newfoundland and Labrador



Source: Higashimura 2004

The Mediterranean Sea is currently part of the global commons, since many surrounding countries have not exercised their right to establish 200-mile exclusive economic zones. As a result of overfishing and pollution in the Mediterranean, catches of the high-value bluefin tuna reached a high of 39 000 tonnes in 1994, but had dropped by nearly half that amount by 2002 (FAO 2005a).

More recently, after the decline of traditional stocks, such as cod, attention has turned to deep-sea fishing (deeper than about 400 m), where fish are particularly vulnerable to overfishing because of their slow ability to reproduce (see Chapter 4). Several deep-sea stocks are now heavily exploited, and, in some cases, severely depleted (ICES 2006). A very small number of countries land most of the fish catch from the high seas (see Figure 7.18).

Many coastal communities have no capacity to fish in the global commons of the high seas, and are

thus deprived of the food and revenue the resource provides. The disruption of small-scale fisheries by high-technology competition often leads to a vicious cycle of fisheries depletion, poverty, and loss of cultural identity. It can also lead to conflict (see Box 7.7).

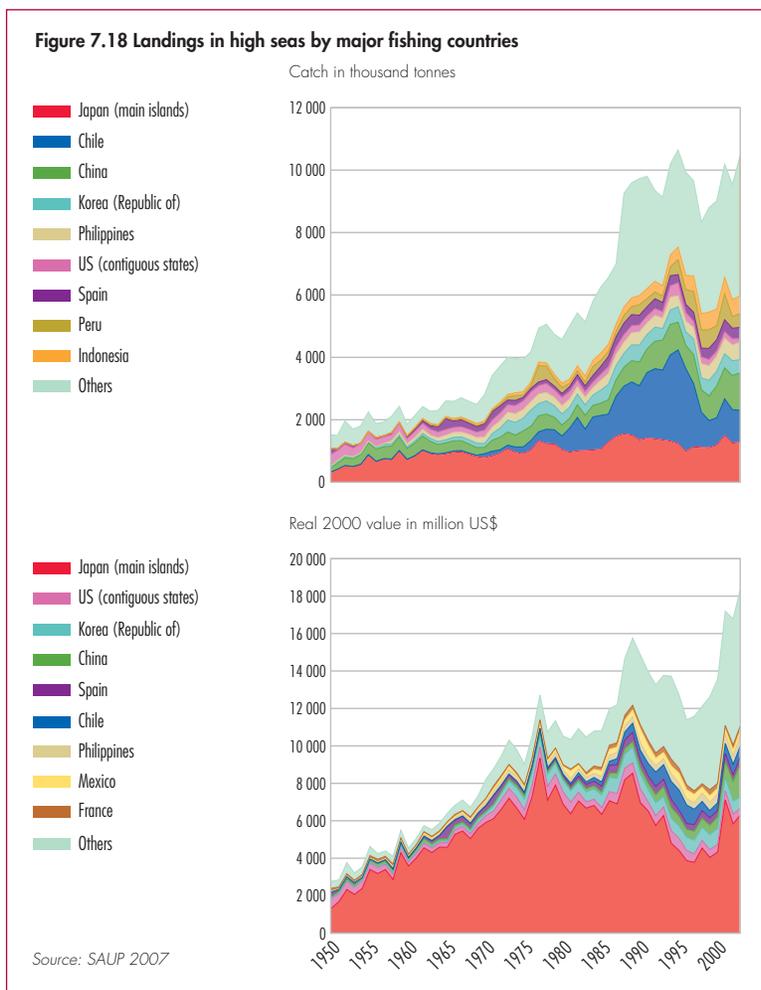
An example of the impacts on human well-being from air pollution is the long-range transport (via air and oceans) of persistent organic pollutants (POPs) and heavy metals, which disproportionately affect indigenous people of the Arctic (see Box 7.8, Figure 7.19, and Polar Regions section in Chapter 6). These same communities are also vulnerable to the adverse impacts of climate change.

### Responses

People from more than 190 countries use the global commons, but no global authority exists to enforce a management regime. Agreements built around consensus are often very weak. In some cases, countries do not sign or accede to the agreements, leading to the “free rider” problem. The multilateral agreements covering the atmosphere are listed in Table 2.4, Chapter 2, and agreements on the oceans are discussed in Chapter 4.

The wide range of agreements now covering the use of ocean resources beyond national jurisdiction includes the UN Convention on the Law of the Sea (UNCLOS), the UN Agreement on Straddling Fish Stocks and Highly Migratory Fish Stocks, the Convention on Biological Diversity, the International Plan of Action on Illegal, Unreported and Unregulated Fishing, and a range of regional fisheries agreements. However, management responses have been unable to keep pace with the repeated pattern in deep-sea fishing of exploration, discovery, exploitation and depletion. Gaps in the high seas governance regime contribute to the depletion of deepwater fish stocks (IUCN 2005). There is a strong need for integrated approaches instead of separate regimes for fisheries, aquaculture, marine mammal conservation, shipping, oil and gas, and mining. A multiplicity of sectoral agreements cannot deal with conflicts across sectors, or with cumulative effects (Crowder and others 2006).

Over the past decade, multilateral agreements have been adopted to deal with persistent organic pollutants (Eckley and Selin 2002). The global Stockholm Convention on POPs (2001) and the regional UNECE/CLRTAP POPs protocol (1998)



both seek to phase out the production and use of a number of harmful substances. POPs are also subject to strong policy actions under the European Union, the Convention on the Protection of the Marine Environment of the Baltic Sea Area, the Convention for the Protection of the Marine Environment of the North-East Atlantic (OSPAR), and the North American Agreement on Environmental Cooperation (NAAEC). These overlapping international agreements, together with increasing domestic regulations have, in many cases, resulted in declining pollution levels and reduced threats to human health.

There is no global heavy metals (HM) agreement. The HM agreement with the largest geographical coverage is the 1998 UNECE/CLRTAP Heavy Metals Protocol. HMs are also subject to regulations under the European Union, HELCOM, and OSPAR. Mercury is also targeted under the NAAEC. Global efforts to address mercury led to a mercury assessment (UNEP 2002a), and the UNEP Mercury Programme. HM emission reductions measures, such as limiting allowed emissions from major stationary sources and bans on lead in gasoline, have helped to reduce emissions. Despite these actions, environmental levels of some HMs do not seem to be declining, and in some cases, are even increasing, raising concerns for human health (Kuhnlein and Chan 2000).

It has been possible to misuse the oceans and the atmosphere for long periods of time with only slowly emerging visible repercussions. Their volumes are very large, their composition very complex, the lag times between cause-and-effect are long, and their physical "location" can be distant from people. Furthermore, the response capacity of the international community has been predominantly low, with exception of protecting the stratospheric ozone layer. It has been difficult to overcome the challenges, and to manage these global commons as collective resources of humankind, because of the weak institutional architecture at the global level.

Despite these challenges, international treaty regimes to protect global commons signal an unprecedented level of international cooperation, and are giving rise to a number of policy innovations in global environmental governance, such as emissions trading schemes (the Kyoto Protocol) and shared revenues from using resources (UNCLOS). But reducing vulnerability related to the degradation of global commons requires

a number of responses beyond international treaties alone. Some of the opportunities that deserve closer attention are:

- integrating governance from the local to the global level by supporting governance measures at all levels, and going beyond providing resources and capacity building for

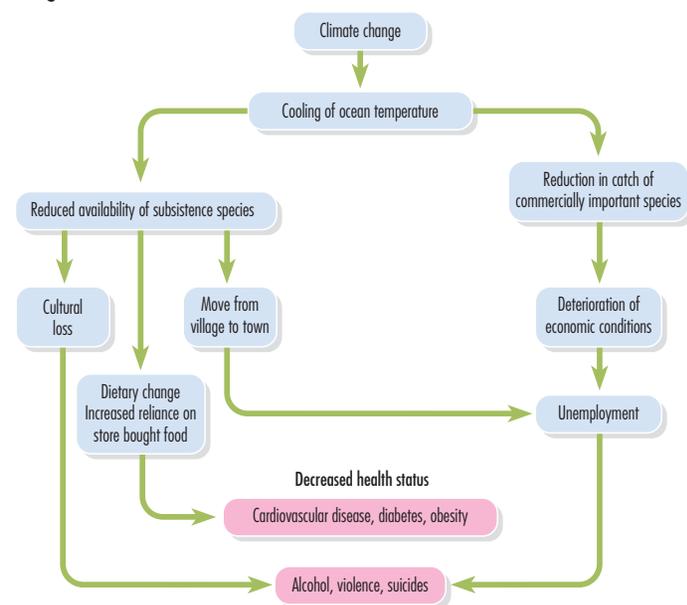
### Box 7.8 Indigenous Arctic Peoples

While many Arctic residents would not receive a high human development index score, they do not consider their quality of life as inferior to that of other societies. About 400 000 indigenous peoples living in the Arctic contribute very little to climate change, yet they are already experiencing its effects. Countries emitting large amounts of greenhouse gases essentially export climate change to the Arctic where, according to the *Arctic Climate Impact Assessment*, climate change is occurring sooner and more rapidly than in other regions, with many large changes projected for the future. Indigenous peoples make up a small percentage of the region's nearly 4 million residents, but they form the main group in many parts of the region. They are the Arctic inhabitants most directly affected by current and future effects of climate change (see Figure 7.19) (see Chapters 6 and 8).

The exposure of the Arctic population to POPs and heavy metals (HMs) is likely to have a severe impact on human well-being, indigenous cultures and food security. POPs and HMs have been associated with a number of human health risks, which include negative effects on the development and maintenance of female characteristics of the body (oestrogenic effects), disruption of endocrine functions, impairing the way the immune system works and affecting reproduction capabilities. Evidence suggests that exposure of people to levels of POPs and HMs found in traditional foods may adversely affect human health, particularly during early development (see Chapter 1).

Sources: ACIA 2004, ACIA 2005, AHDR 2004, Ayotte and others 1995, Colborn and others 1996, Hild 1995, Kuhnlein and Chan 2000

Figure 7.19 Links between climate-related changes and human health in Greenland's indigenous communities



Source: ACIA 2005

national agencies in charge of implementing global agreements;

- strengthening the voices of vulnerable communities in global processes, helping to bridge different types of knowledge, and to build a culture of responsibility for action;
- institutionalizing longer time horizons and intergenerational equity in research efforts, impact assessments, decision making and law, which is essential for reversing the pattern of misuse of the global commons, and which will need consistent incremental decisions and policies over years and decades to effect change;
- paying attention to mitigation and adaptation to help the communities most vulnerable to degradation of the global commons in ways that are sensitive to their local cultures, for example in the global treaties that until now have their strongest focus on reducing the degradation of the commons; and
- resolving conflicts with stronger multilateral fish stock management.

#### Securing energy for development

This archetype is about vulnerabilities as a consequence of efforts to secure energy for development, particularly in countries that depend on energy imports. The dramatic increase in energy use in the last 150 years (Smil 2001) has been a key factor in economic and social development. In those countries and sectors of population that do not yet benefit from modern energy, development is hindered and energy security and increasing energy access are therefore high on the national agendas. Vital societal functions depend on reliable energy supply. The dominating energy production patterns (centralized production systems, fossil fuel dominance and lack of diversification) have created increased technical and political risks for disrupted supplies as well as a host of negative health and environmental effects.

#### Global relevance

Since the 1970s, each 1 per cent increase in GDP in industrialized countries has been accompanied by a 0.6 per cent increase in primary energy consumption (IEA 2004). A further increase of over 50 per cent in energy use – mostly in developing countries – is expected in 2–3 decades (IEA 2004, IEA 2005). In 2000, about 1.6 billion people had no access to electricity while 2.4 billion people still relied on

traditional uses of biomass, a burden that falls mainly on women (IEA 2002). Although there are no MDGs for energy access, the WSSD warned that without access to modern energy supplies, and fundamental changes in energy use, poverty reduction and sustainable human development would be difficult to realize (UN 2002).

Oil and gas are expected to remain the dominant sources of energy over the next 2–3 decades, if current trends continue (IEA 2006). Energy supply security is becoming a problem, due to increasing competition for oil and natural gas among Europe, the United States and the rapidly-growing economies in Asia. Among the factors affecting supply security are (IEA 2007):

- oil exports are from a smaller number of countries;
- geo-political tensions;
- uncertainty over when the global resource base for oil and gas may become critical, with mainstream energy analysis suggesting this is unlikely in the next 2–3 decades, while others believe that oil production already is peaking; and
- the impacts of extreme weather events on energy production, such as the heat wave in Europe in 2003, and hurricanes in the Gulf of Mexico in 2005.

About 90 per cent of the global anthropogenic greenhouse gas emissions are energy related, and dramatic shifts towards low greenhouse gas emitting production and consumption systems are necessary to address climate change problems, especially in developed and rapidly developing countries (Van Vuuren and others 2007).

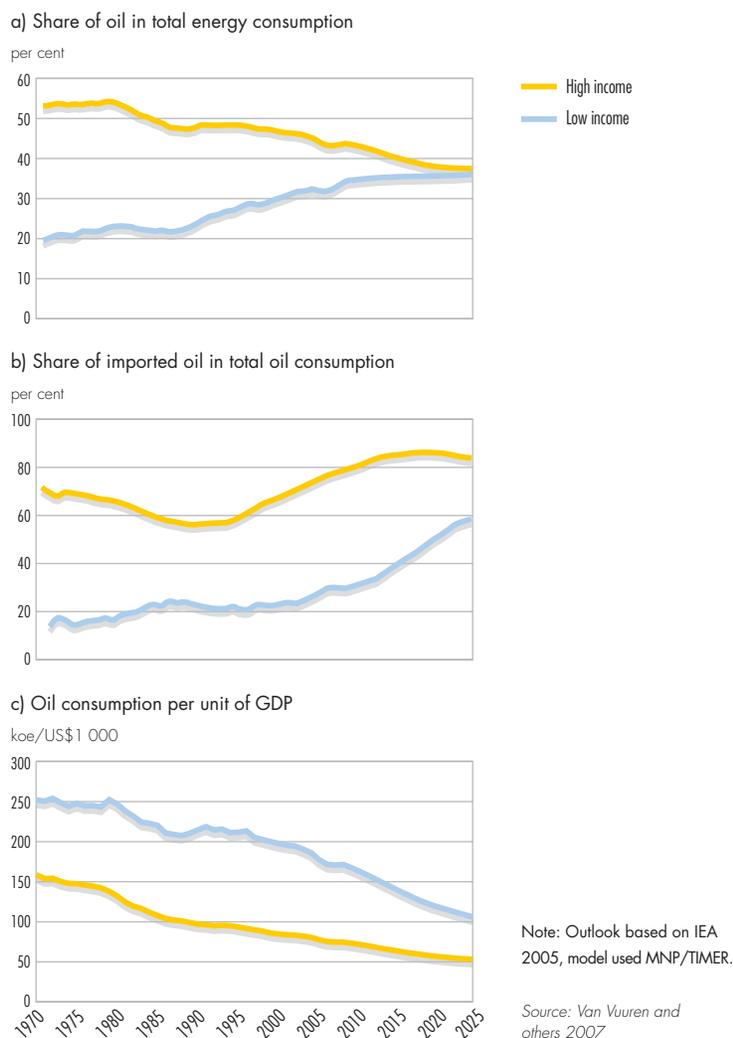
Oil has become increasingly important in total energy consumption of low-income regions (see Figure 7.20a). In contrast, in high-income countries, the share of oil in energy use has declined, although absolute consumption of oil still increases. The share of oil that is imported is increasing in both high- and low-income countries, following a decline in the 1970s and 1980s due to the oil crises (see Figure 7.20b). Since the early 1970s, oil intensity has almost halved in high-income regions. Although oil intensity is declining in low-income regions, the ratio is significantly higher, indicating that oil price shocks are having a far greater impact on their economies (see Figure 7.20c).

### Vulnerability and human well-being

Impacts of energy use on human well-being due to air pollution and climate change, as well as the importance of energy for realizing the MDGs are analysed in Chapter 2. For energy-importing countries, securing the supply of affordable energy is directly linked with human well-being. There could be a “vulnerability paradox” regarding energy: the less vulnerable a country’s energy sector becomes, the greater the impacts could be from energy problems (see Box 7.9). Since society has become very dependent on energy, there could even be a “double vulnerability paradox.” Both the decreased vulnerability of the energy supply as well as the increased dependency on a reliable energy supply contribute to an increasing vulnerability of society to disturbances in the energy supply (Steetskamp and van Wijk 1994). For households, energy becomes an issue of concern with increasing energy prices. This especially affects lower-income groups in industrialized and developing countries. For instance, the United Kingdom has had a fuel poverty strategy since 2001 (DTI 2001) that recognizes that fuel poverty is caused by a combination of low income, lack of energy efficiency measures and unaffordable energy, especially for the elderly (Burholt and Windle 2006).

For developing countries without fossil fuel reserves, the security of supply is an even more pressing problem. Again, this affects the poorer population groups, because transport and food prices are affected most. Rural areas are especially vulnerable, as are small

**Figure 7.20 Trends and projections in oil security for energy-importing high- and low-income regions**



### Box 7.9 The resource paradox: vulnerabilities of natural resource rich, exporting countries

Oil-exporting countries have a different set of human well-being and vulnerability challenges connected to fossil fuels. Populations living near points of extraction often suffer direct health effects, or indirectly, as a result of degraded ecosystems. On a national scale, the lucrative single commodity often lowers incentives to diversify the economies, while offering considerable financial incentives for poor governance and corruption.

The “natural resource curse” describes the large number of resource-abundant economies that exhibit high levels of corruption in the public and private sectors. This overdependence on natural resource abundance in a weak or corrupt political system lowers economic growth. It can underlie the generation of human vulnerability and ill-being, and even result in violent conflict.

Taking the “problem” of resource wealth out of the political sphere is thought to be a healthy if difficult approach. For oil-exporting countries, diversification of their economies would reduce their dependency on import revenues. Countries such as Norway managed the problem of large resource rents by creating a fund for health and education, managed by an independent central bank. Botswana introduced social transparency policies to effectively and equitably manage its mineral wealth. The World Bank’s transparency and social investment conditions put onto the Chad-Cameroon oil pipeline illustrates how more equitable sharing of resource rents is pursued. Not spending resource wealth for a poor country makes little sense, but it is generally argued that equitable and transparent spending of the revenue is possible without deindustrializing a nation’s economy through an increase in the exchange rate.

Sources: Auyt 2001, Bulle, Damania, and Deacon 2005, Collier and others 2003, De Soysa 2002a, De Soysa 2002b, De Soysa 2005, Lal and Mynt 1996, Leite and Weidmann 1999, Papyrakis and Gerlagh 2004, Ross 2001, Sachs and Warner 2001, Sala-i-Martin 1997

and medium enterprises that often cannot cope with the volatility of oil prices (ESMAP 2005). Rises in energy prices also result in macro-economic losses, indirectly affecting human well-being. In OECD countries, although oil intensity is already decreasing, an increase of US\$10/barrel is estimated to result in 0.4 per cent in lost GDP in the short-term (IEA 2004). For the poorest countries, IEA (2004) estimates are about a 1.47 per cent GDP loss per US\$10 rise per barrel. Some of the lowest-income countries suffer losses of up to 4 per cent of GDP (ESMAP 2005).

### Responses

Countries have pursued a variety of options to improve their energy security, including diversifying energy supply, improving regional energy trade arrangements, reducing dependence on imports by promoting energy efficiency, using domestic sources and alternative options, including renewable energy (see Box 7.10). In most countries, the buildup of energy infrastructure is extensively regulated by governments. With liberalization in many industrialized and developing countries over the last decade, this situation has changed. The internal market in Europe had two opposing effects with respect to energy security and the environment. It improved the overall efficiency of the energy system, and created a market for more energy-saving technologies. However, it also made investments that require large capital input, or have long payback times. R&D became more short-term oriented, and budgets were reduced and often not aligned with sustainable development objectives.

Public support remains necessary to stimulate new technologies (European Commission 2001). Many

development strategies treat energy only in the context of large-scale infrastructure projects, where energy access issues are usually ignored, and the focus is on electricity, neglecting fuel availability and rural energy development. Out of 80 MDG country reports, only 10 mention energy outside discussions in relation to environmental sustainability (MDG 7). Only one-third of Poverty Reduction Strategy Papers allocate financial resources to national energy priorities (UNDP 2005). Implementation of sustainable energy systems is hindered by a number of issues, including a finance gap, subsidies biased towards fossil fuels, lack of stakeholder involvement, and regulatory and sector management problems (IEA 2003, Modi and others 2005).

Energy has long been considered the exclusive prerogative of national governance, and with the exception of nuclear energy, has lacked both an organizational home and a coherent normative framework in the UN system. This has begun to change in recent years with energy for sustainable development being discussed as a theme by the Commission on Sustainable Development in 2001 and 2006–07. At the World Summit on Sustainable Development (WSSD), energy received high priority in the action plan. Converging agendas seem to be pushing for strengthened global governance of energy through its links to climate change, poverty (especially MDG 1), health and security (CSD 2006). Following the WSSD, a number of multistakeholder partnerships were established to implement various elements of the international energy agenda. As a follow-up to the 2005 G8 Gleneagles energy initiative, the World Bank completed in 2006 an investment framework for clean energy and sustainable development. There has also been some efforts to create mechanisms for coordinating energy work, most recently through UN-Energy, an interagency mechanism established to support the implementation of WSSD energy-related decisions (UN-Energy).

The policies to move away from oil dependence have had some impacts in industrialized countries (see Figure 7.20). One of the reasons for the limited impact of policies is the long lifespan (40–50 years and longer) of energy infrastructure. This means that technology and investment decisions from decades ago have created a path dependency for today's production and consumption patterns. It also means that the decisions made today will have major impacts for decades

#### Box 7.10 The ethanol programme in Brazil

Pró-Alcool, the Brazilian ethanol programme, was launched in 1975 to respond to the declining trend in sugar prices and the increasing cost of oil. Brazil has since developed a large ethanol market, and widely uses ethanol produced from sugar cane as a transport fuel. With higher oil prices, ethanol became a cost-effective substitute for gasoline, and the official alcohol programme was phased out. The programme helped to reduce dependency on imported oil, saved about US\$52 billion (January 2003 US\$) between 1975 and 2002 in foreign exchange, created 900 000 relatively well-paid jobs, considerably reduced local air pollution in the cities, and cut greenhouse gas emissions. With the possible increase of ethanol exports from countries such as Brazil to Europe, the United States and Japan, concerns are increasing about the sustainability of large-scale biomass production, especially in terms of competition for land for food production, biodiversity and energy crops.

Source: La Rovere and Romeiro 2003

to come, and there are few incentives in place for considering the well-being of future generations.

Given the large scope for synergies among policies related to energy security, health and air pollution and climate change (see Chapter 2), there are many opportunities to reduce vulnerability of people and communities, including:

- focusing energy policies on improving access to appropriate energy services for the most vulnerable, such as women, the elderly and children, as part of broad development planning;
- improving the opportunities for the most vulnerable to have voice in energy issues, for instance, in designing new energy systems;
- investing in the diversification of both centralized and decentralized technologies, with technology transfer playing an important role; and
- strengthening the capacity for sustainable energy technology innovation and production in cooperation with vulnerable communities, as a way to create jobs and increase coping capacity.

### Coping with multiple threats in Small Island Developing States

#### Developing States

Small Island Developing States (SIDS) are vulnerable to climate change impacts in the context of external shocks, isolation and limited resources, creating another archetype of vulnerability. SIDS are highly prone to natural disasters, such as tropical storms and storm surges (IPCC 2007, UNEP 2005a, UNEP 2005b, UNEP 2005c). Limited institutional, human and technical capacities highly constrain their ability to adapt and respond to climate change, variability and extremes (IPCC 2007). Current vulnerabilities are further exacerbated by growing populations. For example, the total fertility rate of most Pacific islands is greater than four. The international trading regime and WTO compliance are increasingly demanding for SIDS. With eroding access to protected markets for their export commodities, such as sugar, bananas and tuna, and with declines in commodity prices triggering economic volatility, they are highly sensitive to globalization and trade liberalization (Campling and Rosalie 2006, FAO 1999, Josking 1998).

#### Global relevance

SIDS are located in the Pacific, Indian and Atlantic Oceans, and the Wider Caribbean and South China Seas. In UNEP regional terms, 6 SIDS are in Africa, 23 in Latin America and the Caribbean,

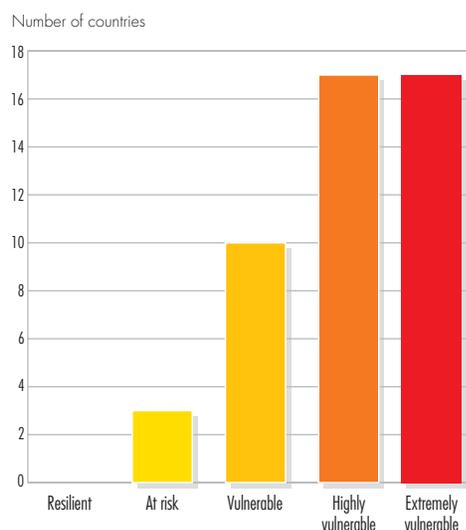
and 22 in Asia and the Pacific. The Environmental Vulnerability Index (EVI) scores for 47 SIDS illustrate that none are ranked resilient and almost three-quarters are highly (36 per cent) or extremely (36 per cent) vulnerable (Figure 7.21). EVI was prepared by various organizations, including UNEP.

#### Vulnerability and human well-being

Natural hazards have severe adverse impacts on lives and socio-economic development in SIDS. A high proportion of the total population of 56 million (UNEP 2005d) is frequently exposed to natural hazards. For example, in 2001 nearly 6 million people were affected by natural disasters in the Caribbean (see Figure 1.2 in Chapter 1). In 1988, the cumulative economic damage attributed to disasters was as high as 43 per cent of GDP in Latin America and the Caribbean (Charveriat 2000).

Sea-level rise, and the increasing frequency and severity of extreme events threaten livelihoods and limit adaptation options. These pressures have forced some people to abandon their homes and assets, and to migrate to other countries. New Zealand, for example, amended its Government Residence Policy in March 2006 to allow a small number of citizens from Tonga, Tuvalu, Kiribati and Fiji to immigrate each year (NZIS 2006). Sea-level rise is likely to induce large-scale migration in the longer term, and large migrations have at times led to conflict (Barnett 2003, Barnett and Adger 2003). Abandoning islands would also result in

Figure 7.21 Environmental vulnerability scores for SIDS

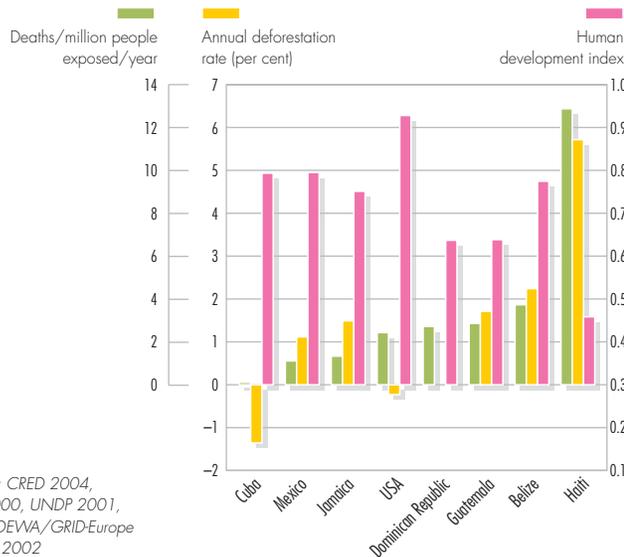


Source: SOPAC and UNEP

### Box 7.11 Disaster preparedness and well-being

The graph below illustrates linkages between vulnerability to natural disasters and poverty (Figure 7.22). With more money to spend, a country can better prepare its people against disaster. Looking at more detailed statistics, in 2004, Hurricane Jeanne claimed more than 2 700 victims in Haiti, while in the Dominican Republic fewer than 20 lost their lives. This was no coincidence. Dominicans are, on average, four times richer, are better prepared in terms of education and training, and benefit from improved infrastructure and housing.

Figure 7.22 Caribbean casualties due to hurricanes



The satellite image below illustrates another factor, that of environmental degradation. The Dominican Republic has over 28 per cent forest cover, while Haiti had reduced its forest cover from 25 per cent in 1950 to 1 per cent by 2004. In the image, deforested Haiti is to the left, while the Dominican Republic is the greener area to the right. This environmental aspect is significant, because many victims drowned or died in mudflows, phenomena strongly influenced by land cover change.



Credit: NASA 2002

the loss of sovereignty, and highlights the need to reconsider traditional development issues as matters of national and regional security (Markovich and Annandale 2000), as well as issues of equity and human rights (Barnett and Adger 2003).

Climate-related hazards cause socially differentiated impacts, and tend to affect the poor and disadvantaged groups disproportionately. Most exposed to hazards are people living on atolls and low-lying islands, and in high-risk coastal settlements with substandard housing and infrastructure. The livelihoods most affected include those depending on climate-sensitive natural resources, such as subsistence and commercial farming, and on coastal tourism (Douglas 2006, FAO 2004b and 2005b, UNICEF 2004a, Nurse and Rawleston 2005, Pelling and Uitto 2001).

The most severe impacts on human well-being include the loss of livelihood assets, displacement, increased water- and vector-borne diseases, and the loss of life in natural disasters. The loss of livelihood assets is predominantly caused by reduced or lost ecosystem services due to recurring natural hazard impacts, loss of productive land due to coastal erosion, salinization of land and irrigation water, estuaries and freshwater systems (IPCC 2007), and other forms of environmental degradation, such as deforestation (see Box 7.11 and Figure 7.22). In addition, degradation and overexploitation harm resources such as coral reefs, seagrass beds and mangroves that provide a natural coastal protection as well as the basis for subsistence and commercial activities (see Chapter 5). Hoegh-Guldberg and others (2000) estimate that coral bleaching will reduce future GDP by 40–50 per cent by 2020 in smaller Pacific islands. Furthermore, SIDS are faced with biodiversity loss and impacts on agriculture, due to invasive alien species.

Deteriorating resource access has led to growing competition at community, national and regional levels, though pressures are spatially variable (IPCC 2007, Hay and others 2004, UNEP 2005a, UNEP 2005b, UNEP 2005c). Further stresses, including social pressures from eroding customary resource tenure and security of land titles, have been highlighted as key issues for the management of some marine ecosystems (Cinner and others 2005, Graham and Idechong 1998, Lam 1998).

Higher exposure to natural hazards can have negative impacts on tourist infrastructure and investments, and can reduce tourism income. At the same time, tourism adds to increased pressures on ecosystems (Georges 2006, McElroy 2003). In some coastal locations, inappropriate development in risk-prone areas, due to inadequate consideration of impacts of natural hazards and climate change effects, demonstrates a failure to adapt.

### Responses

Recognizing the vulnerabilities of SIDS, the Barbados Programme of Action for the Sustainable Development of Small Island Developing States was adopted internationally in 1994. The Commission on Sustainable Development reviewed the implementation of the Barbados Programme of Action in 1996 and 1998. In 2005, the programme was reviewed at a UN Conference in Mauritius, at which the opening statement pointed out that a decline of international support and resources had hindered implementation. The Mauritius Strategy was adopted at the 2005 conference, laying out a comprehensive multilateral agenda for the sustainable development of SIDS.

The Cooperative Initiative on Invasive Alien Species (IAS) on Islands deals with invasive species that threaten biodiversity, as well as agriculture and human well-being. Innovative initiatives also link ecotourism with eradication of IAS (see Box 7.12).

While some adaptation options are already being implemented in SIDS, specific adaptation strategies offer opportunities for more efficient adaptation, including the use of traditional knowledge based on typical regional or cultural conditions. For example, traditional food preservation techniques, such as burying and smoking food for use in drought periods, can improve food security in rural areas. Box 7.13 illustrates an example of community-based marine resource management that improves both coastal resources and human-well-being. Traditional building materials and designs help reduce infrastructure damage and loss from natural hazards. Renewable resources, such as biofuels (such as bagasse), wind and solar power, show a great potential for energy diversification, and for improving the energy resource potential and energy supply for SIDS. This can also increase resilience in the face of recurring extreme events.

### Box 7.12 Ecotourism: paying the costs of invasive alien species control

In many SIDS, tourism is the main economic activity. Seychelles has created a win-win situation for development and environment by linking ecotourism and indigenous species restoration.

Two invasive species, *Rattus rattus* and *R. norvegicus*, have a significant impact on Seychelles' endemic biodiversity. In central Seychelles (41 islands) six species and one subspecies of land birds are endangered and threatened by rats. Rat eradication is essential for re-establishing indigenous bird populations that support ecotourism.

Protected area status is sought after by the ecotourism sector. By linking the awarding of protected area status to the ability to maintain predator-free islands, the government has successfully brought the private sector into IAS management. With the lure of potential future ecotourism revenue, operators in three islands participated in an eradication programme, funding their own costs of nearly US\$250 000.

Source: Nevill 2001

### Box 7.13 Twinning marine protection and resource replenishment in community-based conservation in Fiji

Coastal marine resources in many parts of Fiji are being overfished by both commercial fishing and subsistence harvesting. These practices have largely affected rural communities – about half of Fiji's population of 900 000 – that rely on communal marine resources for their traditional subsistence-based livelihoods. Food security and accessibility have been reduced. Women gleaning off mudflats, for instance, expend more fishing effort for subsistence species such as clams. Some 30–35 per cent of rural households in Fiji live below the national poverty line.

In response to these concerns, Fijians have established Locally Managed Marine Areas (LMMA), and strengthened traditional marine resource management to replenish marine stock. Communities work with *Qoliqoli* (officially recognized customary fishing rights areas), imposing temporary closures of these fishing zones, and *tabu* (no-take for certain species). Communities typically set aside 10–15 per cent of the village's fishing waters to protect spawning and overexploited areas for resource recovery. While the communities receive external technical expertise, they make the decisions, making an LMMA significantly different from a marine reserve or marine protected area. Prized local species, such as mangrove lobster, have increased up to 250 per cent annually, with a spillover effect of up to 120 per cent outside the *tabu* area in the village of Ucuivanua. The establishment of LMMAs has increased household income and improved nutrition.

As a result of the success of Fiji's LMMAs, villagers have been increasing the pressure on the government to return legal ownership of the country's 410 *qoliqolis* to their traditional owners.

Source: WRI 2005

To achieve this overarching goal of successfully improving human well-being in SIDS, vulnerability and adaptation assessments need to be further mainstreamed into national policies and development activities at all levels and scales. A number of options are available to reduce vulnerability, and to build capacities in SIDS:

- enhancing early warning systems to support disaster preparedness and risk management systems (IFRCRCS 2005) helps adaptation to short-term variability (Yokohama Strategy and Plan of Action for a Safer World 1994 and the Hyogo framework) (see Box 7.14);
- improving integrated planning for climate-robust, long-term development, especially that of livelihood assets, improves access to resources for local people. Water resource and Integrated Coastal Zone Management (ICZM) can contribute to improving the long-term adaptive capacity of vulnerable communities (UNEP 2005a, UNEP 2005b, UNEP 2005c). This requires governance systems that take possible long-term changes into account;
- using participatory approaches to integrate traditional ecological knowledge in conservation and resource management empowers communities for disaster preparedness and resource management;
- developing technologies for reducing vulnerability can shift from a “controlling nature” to a “working with nature” paradigm. This includes the technology and capacity to assess impacts and adaptation options, document traditional coping mechanisms and develop alternative energy solutions;
- investing in improved regional cooperation can better address environmental challenges and improve coping capacity. An example would be development and strengthening of global and regional bodies, such as Alliance of Small Island States (AOSIS) and the Indian Ocean Commission, to build early warning systems for environmental stresses;
- strengthening of cooperation and partnerships at the national, regional and international levels, including pooling of resources for the implementation of activities and Multilateral Environmental Agreements (MEAs) (Hay and others 2003, IPCC 2001, Tompkins and others 2005, Smith and others 2000, Reilly and Schimmelpfennig 2000, IFRC 2005); and
- recognizing in international negotiations that basic rights laid down in the Universal Declaration of Human Rights are at risk in the case of climate change effects on atoll countries (Barnett and Adger 2003).

#### Taking technology-centred approaches to water problems

Poorly planned or managed large-scale water projects that commonly involve massive reshaping of the natural environment can create another archetype of vulnerability. Examples include certain irrigation and drainage schemes, the canalization and diversion of rivers, large desalination plants and dams. Dam projects are prominent and important examples, although many of the conclusions often apply to other vulnerability-inducing water management schemes. Dams

#### Box 7.14 The Hyogo Framework for action

Disaster reduction strategies have the potential to save lives and protect livelihoods by even the simplest of measures. Acknowledging this and recognizing that much more needs to be done to reduce disasters, governments adopted in January 2005, the Hyogo Framework for Action 2005–2015, Building the Resilience of Nations and Communities to Disasters. This framework defines strategic goals and five priorities for disaster reduction. Priority Four deals with environmental and natural resource management to reduce risk and vulnerability. It encourages the sustainable use and management of ecosystems, and the integration of climate change concerns into the design of specific risk reduction measures.

Source: UNISDR

For the MDGs to be realized, the burden of natural disasters needs to be reduced. Disaster risk reduction policies should be incorporated into development plans and programmes, and into multilateral and bilateral development assistance, particularly that related to poverty alleviation, natural resource management and urban development. The implementation of disaster risk reduction is promoted through the International Strategy for Disaster Reduction (ISDR), a partnership between governments, non-governmental organizations (NGOs), UN agencies, funding institutions, the scientific community and other relevant stakeholders in the disaster reduction community.

have both positive and negative impacts: they satisfy human needs (water for food security and renewable energy), and protect existing resources by providing flood control. However, they may have severe impacts on the environment through river fragmentation (see Chapters 4 and 5), and on social structure. Some dams provide benefits without major negative effects. But many do not due to the inadequate consideration given to social and ecological impacts from poor dam planning and management. This is a result of the prevailing technology-centred development paradigm (WBGU 1997). Reducing vulnerability here means either to reduce the negative consequences of these projects, or to find alternative means to fulfil the demand for energy, water and flood protection (see Box 1.13 in Chapter 1 on restoration of ecosystems through decommissioning of dams).

#### ***Global relevance***

The dynamics described here occur worldwide. Important examples are the planned Ebro water scheme in Spain, large-scale water management schemes in the US southwest, the Narmada in India, the Nile in Africa and the Three Gorges Dam in China. Major irrigation schemes built in the 20th century and new, multifunctional mega-dams (over 60 m in height) have had significant impacts on water resources. There are more than 45 000 large dams in 140 countries, about two-thirds of these in the developing world (WCD 2000). The actual trend is characterized by a decline in the annual number of new large dams, while no decline is observed for the mega-dams. The geographical distribution of new dam construction continues to shift from the industrialized countries to the newly industrialized and developing countries (ICOLD 2006). The effects of these large-scale installations are rarely confined to the local area, but can assume far-reaching and even international proportions (see Chapter 4).

#### ***Vulnerability and human well-being***

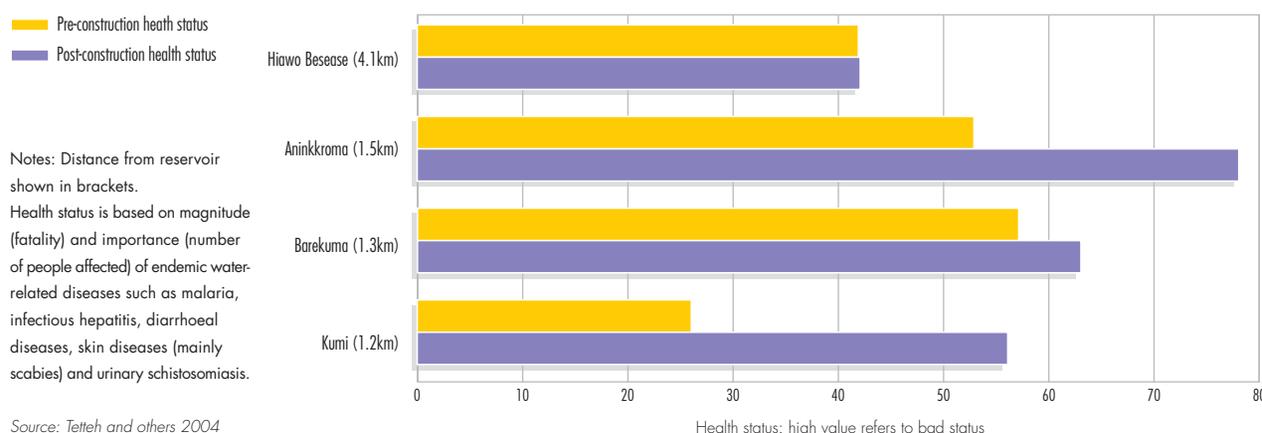
Currently, large dams are typically built in remote areas of developing countries. The integration of such peripheral regions into the world market through dam projects leads to an extensive transformation of social conditions for the indigenous population. Consideration must be given to the social consequences, which may range from resettlement of the local population, to

intensification of economic disparities, and domestic and international conflicts (McCully 1996, Pearce 1992, Goldsmith and Hildyard 1984). According to estimates (WCD 2000), 40–80 million people have been forced to leave their homes since 1950 because of large dam projects. Forced resettlement, lack of stakeholder participation in planning and decision making, and lack of sharing in the benefits of the projects may marginalize and victimize the local people in development (see for example, Akindele and Senyane 2004). The distribution of the benefits gained from dam construction (power generation and irrigated agriculture) can be very uneven, reinforcing the widening of social and economic disparities and poverty.

Tensions may build up, and can escalate into national and international conflicts (Bächler and others 1996). Although widespread organized violence is rare, local protests against large water projects are common. Despite high levels of political attention to future “water wars” between states, cooperation between states has been more common than conflict over the last half of the 20th century. A comprehensive analysis of bilateral and multilateral state-to-state interactions over water between 1948 and 1999 found that of more than 1 830 events, 28 per cent were conflicts, 67 per cent were cooperative, and the remaining 5 per cent were neutral or not significant (Yoffe and others 2004). International water cooperation institutions, such as basin commissions, have fostered international cooperation, for example in the cases involving the Itaipu and Corpus Christi dams in Argentina, Brazil and Paraguay. In some cases, a key to fostering cooperation appears to be moving parties, often through external facilitation, from asserting competing rights to water to identifying needs for water, and finally to negotiating the sharing of the benefits of water (Sadoff and Grey 2002). Further examples of cooperation involve the Zambezi, Niger, Nile and Rhine rivers.

Other negative impacts on human well-being are health hazards in the form of water-based vectors (for example, mosquitoes and snails), which occur due to the changes in the run-off regimes. This exacerbates the risk of malaria and other diseases in many subtropical and tropical regions. Figure 7.23 shows the relationship between the distance from a dam and the occurrence of water-related

**Figure 7.23 Health status of four villages near the Barekese Dam in Ghana**



diseases in four villages near the Barekese Dam in Ghana (Tetteh and others 2004). In Hiawo Besease Village, more than 4 km from the dam, there was hardly any change in health status after the dam was built. In the other three villages, located only 1.2–1.5 km from the dam, the health status declined after the dam was built.

#### Responses

In 2000, the international multi-stakeholder World Commission on Dams (WCD) evaluated the development effectiveness of large dams, and developed international guidelines for dam building. Their final report (WCD 2000) identified five core values, and formulated seven strategic priorities (see Table 7.3).

Building synergies between biodiversity concerns (as in the CBD, RAMSAR Convention on Wetlands and the Convention on Migratory Species), and development is an important concern. As a follow-up to the WCD framework, the UNEP Dams and Development Project (UNEP-DDP) was launched in 2001. Recognizing that for many developing countries hydropower and

irrigation remain priorities to meet energy and food security needs, UNEP-DDP focuses on how to support building and management of dams sustainably. At national and sub-regional levels, countries have responded by increasingly accepting social and environmental impact assessments (EIAs) of large dam projects prior to construction (Calcagno 2004). The trend towards shared river management, acknowledged in the 1997 UN Convention on the Non-Navigational Uses of International Watercourses, has created new opportunities for addressing such concerns.

Nevertheless, the effectiveness of these measures is mixed. In some places, it is evident that stakeholder expectations regarding participation, transparency and accountability in dam planning and development is changing. The WCD recommendations provided a new, authoritative reference point for NGOs trying to influence government decisions, but has had different levels of success. The value of cooperation between states is increasingly recognized, but in practice this has played out in different ways. For example, the controversial Ilisu Dam project in Turkey came to a halt in 2001 when the European construction

**Table 7.3 Some findings of the World Commission on Dams**

Five core values were identified	Seven strategic priorities were formulated
<ul style="list-style-type: none"> <li>■ Equity</li> <li>■ Efficiency</li> <li>■ Participatory decision making</li> <li>■ Sustainability</li> <li>■ Accountability</li> </ul>	<ul style="list-style-type: none"> <li>■ Gaining public acceptance</li> <li>■ Comprehensive options assessment</li> <li>■ Addressing existing dams</li> <li>■ Sustaining rivers and livelihoods</li> <li>■ Recognizing entitlements, and sharing benefits</li> <li>■ Ensuring compliance</li> <li>■ Sharing rivers for peace, development and security</li> </ul>

Source: WCD 2000

firms withdrew from the project, citing outstanding economic and social issues, and the difficulty of meeting conditions imposed on their effort to procure a US\$200 million export credit guarantee from the British government. In contrast, the World Bank and the African Development Bank forged ahead with the controversial US\$520 million Bujagali Dam project in Uganda despite strong transnational NGO opposition, and the earlier withdrawal from the project by bilateral funding agencies in the United Kingdom, France, Germany, Sweden and the United States (IRN 2006).

Several relevant international policy initiatives deal with problems of insufficiently and inequitably fulfilled water demand (see Chapter 6). One important aspect of MDG 7 on ensuring environmental sustainability is to “reduce by half the proportion of people without sustainable access to safe drinking water.” The implementation plan calls for an approach to “promote affordable and socially and culturally acceptable technologies and practices.” These needs can be met, as suggested by the World Water Vision (World Water Council 2000), through a mix of large and small dams,

groundwater recharge, traditional, small-scale water storage techniques and rainwater harvesting, as well as water storage in wetlands (see Box 7.15).

It is clear that maladapted and mainly supply-oriented technological approaches will, at least in the medium-term, fail to realize the desired development benefits.

Well-planned water management can reduce vulnerability, and contribute to development. There are a number of options (see Chapter 4):

- improving access to water as an essential asset for household needs and agricultural production. Distributional aspects should be given much more attention;
- increasing opportunities for more effective local participation in basin and catchment management, as local rights and values may be in conflict with those held by the state. This requires supportive and inclusive institutions, and governance processes;
- trading, including the import of “virtual water” via food imports, may substitute for irrigation water consumption in arid regions;

#### Box 7.15 Substituting micro-catchment for large-scale water projects

A promising alternative to large reservoirs for irrigation is micro-catchment management, which uses natural run-off directly, and in a decentralized way. A good example is the water-harvesting technique used in Tunisia, consisting of ancient terraces and recharge

“jessour” wells. These decentralized techniques allow for the cultivation of olive trees in arid zones while conserving and even ameliorating the soil. Furthermore, the efficient control of sediment flows reduces the danger of floods downstream.

Source: Schiettecatte 2005



Traditional terracing to harvest water and control overland flow near Tataouine in Southern Tunisia.

Credit: Mirjam Schomaker

- improving cooperative water basin management can increase development opportunities, and reduce potential for conflict. Developing transboundary river basin institutions offers important opportunities for building on environmental interdependence to foster collaboration and contribute to conflict prevention. The SADC Water Protocol of 2000, the Nile Basin Initiative (NBI) and the Niger Basin Authority (NBA) are good examples in Africa of riparian dwellers and stakeholders developing shared visions for water and development, while integrating international legal norms, such as prior notification and causing no significant harm; and
- investing in local capacities and employing alternative technologies can improve water access and use. This strategy is an important way to enhance coping capacities, and ensure consideration of a broader range of alternatives to conventional, large-scale solutions (see Box 7.15).

#### Rapidly urbanizing the coastal fringe

Rapid and poorly planned urbanization in often ecologically sensitive coastal areas increases vulnerabilities to coastal hazards and climate change impacts. In recent decades, many of the world's coastal areas have experienced significant and sometimes extremely rapid socio-economic and environmental changes. Limited institutional, human and technical capacities have led to severe hazard impacts, and constrain the ability of many coastal communities, particularly those in the developing world, to adapt to changing conditions.

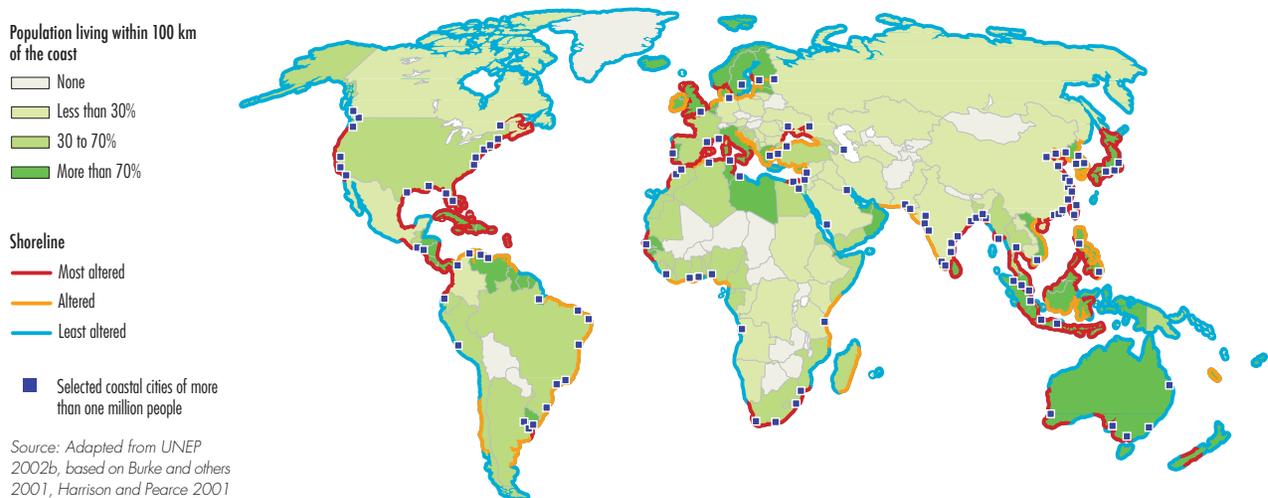
#### Global relevance

Many of the world's coastal areas have been experiencing rapidly-growing concentrations of people and socio-economic activities (Bijlsma and others 1996, WCC'93 1994, Sachs and others 2001, Small and Nicholls 2003). The average population density in coastal areas is now twice as high as the global average (UNEP 2005d). Worldwide, more than 100 million people live in areas no more than 1 m above sea level (Douglas and Peltier 2002). Of the world's 33 mega-cities, 26 are located in developing countries, and 21 are in coastal areas (Klein and others 2003). Figure 7.24 shows coastal population and shoreline degradation.

Much of this development has been occurring in low-lying floodplains, river deltas and estuaries that are highly exposed to coastal hazards, such as storms, hurricanes, tidal surges, tsunamis and floods. In many cities, major rezoning of former industrial waterfront areas is being undertaken in flood-prone locations to accommodate the tremendous requirement for housing. Examples include Brooklyn and Queens in New York (Solecki and Leichenko 2006), and the Thames Gateway, a 60-km-long corridor along the Thames River between London and the Thames Estuary that is currently undergoing considerable urban regeneration.

Poor urban planning and inappropriate development in highly exposed coastal locations, in combination with rapid population growth, sea-level rise and other climate change impacts, have led to a considerable increase in socio-economic impacts

**Figure 7.24 Coastal population and shoreline degradation**



from coastal hazards. The EM-DAT global datasets on extreme events indicate (see Figure 7.25) that annual economic losses from extreme events have increased tenfold from the 1950s to the 1990s. In the decade between 1992 and 2001, floods were the most frequent natural disaster, killing nearly 100 000 people and affecting more than 1.2 billion people. Munich Re (2004a) documented an increasing concentration of the loss potential from natural hazards in mega-cities. Only a small proportion of these losses were insured.

Environmental change is expected to exacerbate the exposure of many coastal urban areas to natural hazards from rising sea levels, increased erosion and salinity, and the degradation of wetlands and coastal lowlands (Bijlsma and others 1996, Nicholls 2002, IPCC 2007). There is also a concern that climate change might, in some areas, increase the intensity and frequency of coastal storms and hurricanes (Emanuel 1988), but there is no scientific consensus (Henderson-Sellers and others 1998, Knutson and others 1998). In a recent global assessment of storm surges, Nicholls

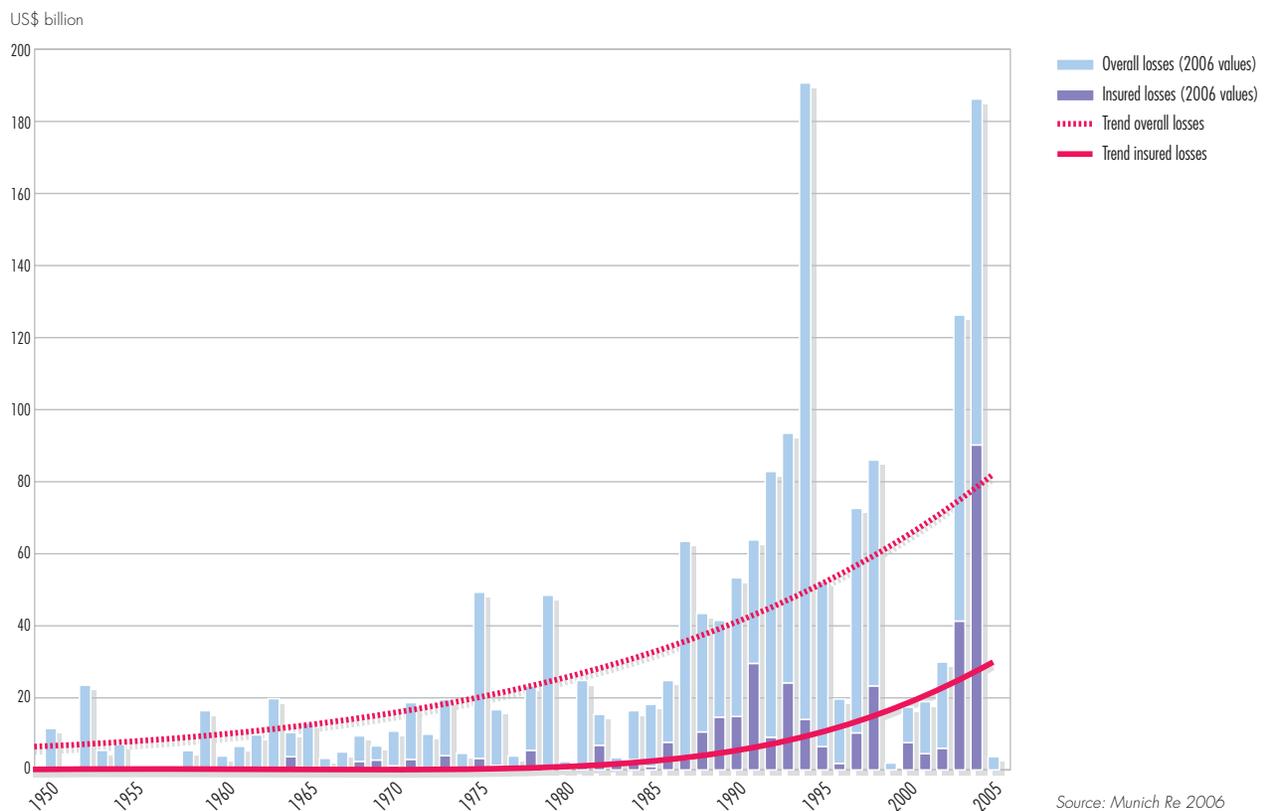
(2006) estimated that in 1990 some 200 million people were living in areas vulnerable to storm surge flooding. The North Sea, the Bay of Bengal and East Asia are considered as notable hot spots, but other regions, such as the Caribbean, and parts of North America, Eastern Africa, Southeast Asia and Pacific states are also vulnerable to storm surges (Nicholls 2006).

Increasing development in coastal areas causes fragmentation of coastal ecosystems and conversion to other uses, including infrastructure and aquaculture development, and rice and salt production (see Chapter 4). This negatively affects the condition and functioning of ecosystems, and their ability to provide ecosystem services. An assessment of the status of the world's mangroves FAO (2003a) found that their extent has been reduced by 25 per cent since 1980 (see Chapters 4 and 5).

#### *Vulnerability and human well-being*

The relationship between increasing urbanization and growing vulnerability to natural hazards is most

**Figure 7.25 Overall losses and insured losses due to natural hazards**



pronounced, but not exclusive (see Box 7.16) in developing countries due, to a large extent, to rural-urban migration (Bulatao-Jayme and others 1982, Cuny 1983, Mitchell 1988, Mitchell 1999, Smith 1992, Alexander 1993, Bakhit 1994, Zoleta-Nantes 2002). This often affects cities facing severe constraints on their institutional, human, financial and technical capacities to develop integrated approaches to urban planning. As a result of the lack of affordable housing options, poor migrants tend to inhabit informal settlements, which are often located in the most undesirable and hazardous areas of the city. According to UN Habitat (2004), more than 750 million of the world's more than 1 billion poor people live in urban areas, without adequate shelter and basic services. Unsafe living conditions, the lack of secure livelihoods and access to resources and social networks, and exclusion from decision making processes limit the capacity of poor urban people to cope with a range of hazards.

Estimates of the number of additional people at risk from coastal flooding in the future vary widely, but

all indicate a considerable increase. For example, Nicholls (2006) estimates that the number of people living in areas vulnerable to storm surge flooding to increase by nearly 50 per cent (or 290 million) by the 2020s compared to 1990, while Parry and others (2001) estimate about 30 million more people at risk from coastal flooding due to climate change by the 2050s and 85 million more by the 2080s.

#### **Response**

In recent decades, particularly since the 1990s, the dramatic increase of losses and suffering due to natural disasters has brought the issue of disaster risk reduction increasingly onto the political agenda. From the International Decade for Natural Disaster Reduction (IDNDR) to the International Strategy for Disaster Reduction (ISDR), to the Hyogo Framework of Action (see Box 7.14), the disaster risk reduction community has been calling for renewed commitment, and the integration of disaster risk reduction, with the pursuit of sustainable development as a strategic goal.

The Hyogo Framework calls for the incorporation of disaster risk assessments into the urban planning and management of disaster-prone human settlements. It prioritizes the issues of informal or non-permanent housing, and the location of housing in high-risk areas. This reflects the ISDR (2002) estimate that 60–70 per cent of urbanization in the 1990s was unplanned. One consequence of this framework is that international organizations, like UNESCO, reviewed their present activities with respect to the suggested actions for disaster risk reduction.

Most of the urbanization challenges are still the result of a lack of integrated environmental and urban planning. Policies for more sustainable patterns of urbanization are frequently not implemented. Short-sighted concessions for economic gain, weak institutions and corruption are major factors in the proliferation of planning "oversights," "exceptions" and other forms of inappropriate development in urban areas.

Networks such as the African Urban Risk Analysis Network (AURAN) aim at mainstreaming disaster risk reduction in the management of urban planning and governance in Africa. Here, community-based action research is supported. Projects like "Engaging in awareness-raising activities and household surveys on local perceptions of flood risk in flood-prone districts of

#### **Box 7.16 Increasing disaster vulnerability in urban areas: the New Orleans flood of 2005**

The scenario of a major hurricane striking the US Gulf Coast had been extensively researched and rehearsed among scientists and emergency managers. Many called New Orleans "a disaster waiting to happen." There had been tremendous loss of coastal salt marshes in the Gulf Coast, particularly in the Mississippi Delta, with estimates of up to 100 square kilometres/year. This meant that many urban areas were increasingly exposed to high winds, water levels and waves. There was an increased flood risk from a combination of land subsidence caused by drainage and soil compaction, and about 80 per cent of the city lies below sea level. There was also the accelerated loss of sediment from salt marshes and barrier islands, the modification of waterways and a rising sea level.

While all of these factors had gradually increased the city's hurricane risk over recent decades, it was the catastrophic failure of the engineered flood protection infrastructure in the face of Hurricane Katrina in 2005, in combination with high social and institutional vulnerability that contributed to the largest natural disaster in recent US history. Cutter and colleagues (2006) demonstrate that there are clear patterns of losses related to the lack of access to resources and to social disadvantage.

An estimated 21.4 per cent of the city's residents did not heed evacuation messages, because they did not have the means to escape. As the hurricane struck before welfare payments at the end of the month, many poor people were short of money. Despite a growing awareness of the increasing physical exposure to coastal hazards, the socially created vulnerabilities had been largely ignored. This was true for New Orleans, and is the case for many other places. It arises at least in part from the difficulty of measuring and quantifying the factors that contribute to social vulnerability.

*Sources: America's Wetland 2005, Blumenthal 2005, Cutter 2005, Cutter and others 2006, Fischetti 2001, Travis 2005*



Saint Louis, Senegal” reduce vulnerabilities locally, and generate transferable knowledge for other cases.

Science increasingly recognizes the importance of sustainable resource management and biodiversity for ecological resilience and livelihood security in the face of extreme environmental shocks (Adger and others 2005). For example, the detrimental consequences of the loss of coastal ecosystems and their buffering capacity against natural hazards has recently been documented in relation to the 2004 Indian Ocean Tsunami (Liu and others 2005, Miller and others 2006, Solecki and Leichenko 2006) and the impacts of Hurricane Katrina on New Orleans (see Box 7.16).

Environmental actions that reduce vulnerability are seldom promoted in disaster reduction strategies, and many opportunities to protect the environment and reduce disaster risk are missed. Integrated coastal zone management (ICZM) and even further integrated coastal area and river basin management (ICARM) are important tools in reconciling multiple uses of coastal resources and promoting ecological resilience. They provide an institutional framework to implement, enforce, monitor and evaluate policies for the protection and restoration of coastal ecosystems, and to place more value on the goods-and-services (cultural values, natural protection of coastal zones, recreation and tourism and fisheries) they provide. There are significant opportunities to reduce hazard vulnerability:

- integrating of risk reduction and adaptation strategies with existing sectoral development policies in areas such as integrated coastal zone management, urban planning, health care planning, poverty reduction, environmental impact assessment and natural resource management (Sperling and Szekely 2005, IATF Working Group on Climate Change and Disaster Reduction 2004: Task Force on Climate Change, Vulnerable Communities and Adaptation 2003, Thomalla and others 2006);
- strengthening education and awareness raising to deal with the multiple risks associated with rapid coastal urbanization, and with possible response options;
- providing more opportunities for local participation in urban development. The challenge for institutional development is to be responsive to change. One approach is to focus on processes in which local users become active “makers and shapers” of the rights, management and use regimes upon which their livelihoods are based (Cornwall and Gaventa 2001). Participation of women is a critical component in such approaches (Jones 2006); and
- green engineering can help to protect coastlines using mangroves and reefs. It can help to maintain forests and protect soils to avoid the risk posed by landslides, floods, drought and tsunamis.

Green engineering can help to protect coastlines using mangroves.

*Credit: BIOS- Auteurs Gunther Michel/Still Pictures*

## CHALLENGES POSED BY PATTERNS OF VULNERABILITY

The seven patterns of vulnerability show how environmental and non-environmental changes affect human well-being. Some of the different human-environment systems throughout the world share certain vulnerability-creating conditions. The different patterns reflect vulnerabilities across the full range of geographic and economic contexts: developing and industrialized countries, and countries with economies in transition. This allows putting particular situations within a broader context, providing regional perspectives, and showing important connections between regions and globally, as well as possible opportunities to address the challenges in a more strategic manner. Furthermore, the analysis of the archetypes underlines findings of other vulnerability research:

- Research on the underlying causal structures of human vulnerability to environmental change increasingly recognizes that vulnerability arises through complex interactions of multiple socio-political, ecological and geophysical processes that operate in different areas and at different times, resulting in highly differentiated impacts in and across regions (Hewitt 1997), social groups (Flynn and others 1994, Cutter 1995, Fordham 1999) and individuals.
- Environmental risks affect a wide range of natural, economic, political and social activities and processes. Therefore, vulnerability reduction should be integrated as a strategic goal into overall development planning across many sectors, including education, health, economic development and governance. Reducing vulnerability in one area often results in increasing vulnerabilities far away, or moving it into the future, which needs to be taken into account.
- Environmental change has the potential to spur conflict. However, managed environmental change (for example conservation and cooperation) can also make tangible contributions to conflict prevention, de-escalation and post-conflict reconstruction (Conca and Dabelko 2002, Haavisto 2005).
- Human vulnerability and livelihood security are closely linked to biodiversity and ecosystem resilience (Holling 2001, Folke and others 2002, MA 2005). Sustainable environmental and resource management is important in poverty and

vulnerability reduction. Extreme events, such as the Indian Ocean Tsunami, show that environmental degradation and poorly planned development activities increase communities' vulnerability to shocks (Miller and others 2005).

- Vulnerability is determined, to a large extent, by a lack of options, due to the unequal distribution of power and resources in society, including the most vulnerable population groups throughout the world, such as indigenous people, and the urban or rural poor. Economic sectors heavily dependent on environmental services are also vulnerable. Resilience increases with diversification of livelihood strategies, and with access to social support networks and other resources.
- For successful use of vulnerability research findings, the policy arena should recognize that vulnerability arises from multiple stressors, which are dynamic over space and time. If vulnerability is reduced to a static indicator, the richness and complexity of the processes that create and maintain vulnerability over time are lost.
- The analysis of the patterns of vulnerability also helps identify a number of opportunities to reduce vulnerability and improve human well-being. Taking these opportunities would also support reaching the MDGs and examples of this are given in Table 7.4, which also illustrates how vulnerability works against the achievement of the goals.

## OPPORTUNITIES FOR REDUCING VULNERABILITY

Policy-makers can use vulnerability analysis to target policies for groups that most need them. Vulnerability analysis helps to examine the sensitivity of a human-environment system (such as a watershed or coastal town) to various social and environmental changes, and its ability to adapt or accommodate such changes. Therefore, evaluations of vulnerability include attention to exposure, sensitivity and resilience to multiple pressures. The evaluations consider the degree to which a system is affected by particular pressures (exposure), the degree to which a set of pressures affect the system (sensitivity), and the ability of the system to resist or recover from the damage (resilience). Policies can address each of these components of vulnerability. The analysis, which is most often at the sub-national level is, however, frequently hampered by lack of and/or unreliable data, as well as the challenges of showing the links between environmental degradation and human well-being.

**Table 7.4 Links between vulnerability and the achievement of the MDGs, and opportunities for reducing vulnerability and meeting the MDGs**

MDGs and selected targets	Vulnerability affects potential to achieve the MDGs	Adopting strategies to reduce vulnerability contributes to reaching the MDGs
<p><b>Goal 1</b> Eradicate extreme poverty and hunger</p> <p><b>Targets:</b> Halve the proportion of people living on less than US\$1/day. Halve the number of people who suffer from hunger.</p>	<ul style="list-style-type: none"> <li>■ Contaminated sites damage health and thus the ability to work; this undercuts opportunities to eradicate extreme poverty and hunger.</li> <li>■ In drylands land degradation, insufficient investments and conflict contribute to low agricultural productivity, threatening food security and nutrition.</li> </ul>	<ul style="list-style-type: none"> <li>■ Improving environmental management and restoring threatened environments will help protect natural capital, and increase opportunities for livelihoods and food security.</li> <li>■ Improving governance systems – through wider inclusion, transparency and accountability – can increase livelihood opportunities as policies and investments become more responsive to the needs of poor people.</li> </ul>
<p><b>Goal 2</b> Achieve universal primary education</p> <p><b>Target:</b> Ensure that all boys and girls complete a full course of primary school</p>	<ul style="list-style-type: none"> <li>■ Children are particularly at risk when they play, live or attend school near contaminated sites. Lead and mercury contamination presents specific risks for child development.</li> <li>■ The time-consuming activity of fetching water and fuelwood reduces school attendance, particularly for girls.</li> </ul>	<ul style="list-style-type: none"> <li>■ Sustainable resource management can decrease the environmental health risks children face, and thus increase school attendance.</li> <li>■ Improved and secure access to energy supports learning at home and at school. It is essential for access to IT-based information, and opportunities to engage in scientific and other experimentation.</li> </ul>
<p><b>Goal 3</b> Promote gender equality and empower women</p> <p><b>Target:</b> Eliminate gender disparity in primary and secondary education</p>	<ul style="list-style-type: none"> <li>■ Women with poor access to education are at greater risk of ill health than men. For example, in many SIDS, more women than men have HIV.</li> <li>■ Women play a pivotal role as resource managers, but are marginalized in decision making, often have insecure tenure rights and lack access to credit.</li> </ul>	<ul style="list-style-type: none"> <li>■ Redressing inequities – in access to health care and education – is critical in improving coping capacity.</li> <li>■ Strategies that link health and housing, nutrition, education, information and means increase opportunities for women, including in decision making.</li> </ul>
<p><b>Goal 4</b> Reduce child mortality</p> <p><b>Target:</b> Reduce by two-thirds the under-five child mortality</p>	<ul style="list-style-type: none"> <li>■ Contaminated sites affect mortality of all, but children are particularly vulnerable to pollution-related diseases.</li> <li>■ Some 26 000 children die annually from air pollution-related diseases.</li> </ul>	<ul style="list-style-type: none"> <li>■ Interlinked environment-development-health strategies, improved environmental management and ensuring access to environmentally derived services can contribute to reducing child mortality and reducing vulnerability.</li> </ul>
<p><b>Goal 5</b> Improve maternal health</p> <p><b>Target:</b> Reduce by three-quarters the maternal mortality ratio</p>	<ul style="list-style-type: none"> <li>■ The accumulation of POPs in food sources affects maternal health.</li> <li>■ Dams may increase the risk of malaria, which, in turn, threatens maternal health. Malaria increases maternal anaemia, threatening healthy foetal development.</li> </ul>	<ul style="list-style-type: none"> <li>■ Improved environmental management can improve maternal well-being by improving nutrition, reducing risks from pollutants and providing essential services.</li> <li>■ Integrated environment-health strategies can contribute to achieving this goal by reducing vulnerability.</li> </ul>
<p><b>Goal 6</b> Combat HIV/AIDS, malaria and other diseases</p> <p><b>Targets:</b> Halt and begin to reverse the spread of HIV/AIDS Halt and begin to reverse the incidence of malaria and other major diseases</p>	<ul style="list-style-type: none"> <li>■ Contaminated sites are a huge risk for individuals already exposed to HIV/AIDS, potentially further compromising their health.</li> <li>■ Climate change is likely to increase the disease burden of poor people, including the incidence of malaria.</li> </ul>	<ul style="list-style-type: none"> <li>■ Integrated environment-health planning and management is critical.</li> <li>■ Acknowledging and acting on the shared responsibility of developed and developing countries for the adverse impacts of climate change on the most vulnerable is essential.</li> </ul>
<p><b>Goal 7</b> Ensure environmental sustainability</p> <p><b>Targets:</b> Integrate the principles of sustainable development into planning and programmes Reduce by half the proportion of people without access to safe drinking water Achieve significant improvement in the lives of at least 100 million slum dwellers</p>	<ul style="list-style-type: none"> <li>■ Water contamination from dumps, industry and agriculture, water-borne diseases, and growing water scarcity threaten well-being at all levels.</li> <li>■ The lack of access to energy limits opportunities for investment in technologies, including those for water provisioning and treatment.</li> </ul>	<ul style="list-style-type: none"> <li>■ Improving governance systems, including strengthening institutions and laws and policies, and adopting interlinked strategies, are critical to contributing to environmental sustainability and reducing vulnerability.</li> <li>■ Securing energy is critical to improving the living conditions of the growing number of slum dwellers.</li> </ul>

**Table 7.4 Links between vulnerability and the achievement of the MDGs, and opportunities for reducing vulnerability and meeting the MDGs *continued***

MDGs and selected targets	Vulnerability affects potential to achieve the MDGs	Adopting strategies to reduce vulnerability contributes to reaching the MDGs
<p>Goal 8 Develop a global partnership for development</p> <p>Targets: An open trading and financial system Cancellation of official bilateral debt, and more generous ODA In cooperation with the private sector, ensure developing countries have access to the benefits of new technologies Address the special needs of landlocked developing countries and SIDs</p>	<ul style="list-style-type: none"> <li>■ Unfair trade regimes reduce earnings from agricultural products in developing countries. Low-income countries rely on agriculture for close to 25 per cent of GDP.</li> <li>■ Poor access to energy undermines the investments and technologies that can be used in productive land and natural resource management.</li> <li>■ Sea-level rise is threatening the security and socio-economic development of SIDS and low-lying coastal areas. More than 60 per cent of the global population lives within 100 km of the coastline, and 21 of the world's 33 megacities are located in coastal zones in developing countries.</li> </ul>	<ul style="list-style-type: none"> <li>■ Transparent and fair global processes, especially in trade, are essential to increasing opportunities in developing countries, and can help increase local investments in environmental capital.</li> <li>■ Massive investments, and technology-sharing in clean energy and transport systems can reduce poverty, increase security and stabilize greenhouse gas emissions. It has been estimated that about US\$1.6 trillion will be required for global infrastructure investment in the energy sector in less than 25 years.</li> <li>■ Building partnerships for addressing climate change, and honouring technology transfer promises are essential for increasing adaptive and coping capacity in low-lying areas.</li> </ul>

The archetypes of vulnerability described above highlight responses that have been taken, primarily at the global or regional level, to address patterns of vulnerability. They also point to opportunities for addressing vulnerability by reducing exposure and sensitivity, and through enhancing adaptive capacity. Many of these opportunities are not directly related to environmental policy processes but to poverty reduction, health, trade, science and technology, as well as to general governance for sustainable development. This section pulls together the opportunities to provide strategic directions for policy making to reduce vulnerability and improve human well-being.

Given the localized nature of vulnerability to multiple stresses, opportunities exist for national decision-makers to target the most vulnerable groups. Decision-makers should clearly identify provisions in their own policies that create and reinforce vulnerability in their countries, and deal with them. At the same time, collaboration at regional and international levels plays a supportive and important role. The opportunities underline the importance of increasing awareness worldwide about the consequences of policy choices for people and the environment in other countries.

**Integrating governance across levels and sectors**

Increasing the coping and adaptive capacity of the most vulnerable people and communities requires integration of policies across governance levels and sectors, and over time to address the coping and adaptive capacities of future generations.

A consistent focus on increasing the well-being of the most vulnerable can involve costs for other actors, but it helps promote equity and justice. For some issues, there are clearly win-win situations between short- and long-term goals and priorities, but for many there are considerable trade-offs, not necessarily on a societal level, but clearly for certain groups or sectors in society, and even for individuals. Opportunities include the integration of knowledge and values to underpin and support institutional design and compliance. This involves integrating local and global knowledge, for example on impact and adaptation, and integrating concern for neighbours with concern for all humanity and future generations.

Strengthening coping and adaptive capacity, and reducing the export of vulnerability require much more cooperation among different governance levels and sectors. Such integrated governance requires mutually supportive policies and institutions at all governance levels, from the local to the global (Karlsson 2000). This can be a considerable challenge, as illustrated repeatedly in the implementation of MEAs. In many cases, it requires higher governance levels to provide the resources, knowledge and capacity at lower levels to implement plans and policies. This is in line with the Bali Strategic Plan on Technology Support and Capacity Building (BSP), as well as other capacity-building initiatives. For example, adaptation to climate change among vulnerable communities in the Arctic needs support from national governments and regional organizations. To facilitate successful

adaptation, stakeholders must promote and enable adaptive measures. In addition, governments should consider revising policies that hinder adaptation. Self-determination and self-government, through ownership and management of land and natural resources, are important for empowering indigenous Arctic peoples to maintain their self-reliance, and to face climate change on their own terms (see Chapter 6, Polar Regions) (ACIA 2005). Another related strategy of integrating governance across levels is special organizational forms that facilitate cross-level interaction, such as co-management of natural resources (Berkes 2002).

Different sectoral priorities should be reconciled and integrated through cooperation and partnership, especially when there are trade-offs between them and these affect vulnerability. One strategy is to integrate, in organizational terms, a focus on strengthening coping capacity and reducing export of vulnerability. For example, when councils, task forces, even ministries are set up, their mandates should cover inter-related sectors, and their staff should have the appropriate training and attitudes to implement broader mandates. Another strategy has been to “mainstream” attention to vulnerability through policy. Mainstreaming of the environment has been tried at various governance levels, including in the UN system, with varying degrees of success (Sohn and others 2005, UNEP 2005e). A third strategy is to ensure that planning and governance processes include all relevant stakeholders from various sectors, as in successful integrated coastal zone management (see Chapter 4). A fourth strategy is to address integration between environment and other sectors, using economic valuation, which raises the parity of natural capital in comparison with other types of capital (see Chapter 1).

The integration of longer time horizons in governance is an even larger challenge given that decision making in governments and other sectors of society tends to be biased towards much shorter time horizons than sustainable development and the well-being of future generations require (Meadows and others 2004). Strategies that change the time horizon of decision-makers should be further explored. Such strategies can include: setting clear long-term goals and intermittent targets, extending the time horizons considered in formal planning, developing indicators and

accounting measures that illustrate intergenerational impacts, and the institutionalization of long-term liability from harmful activities. These strategies are unlikely to be implemented, however, unless people across societies expand their time horizons for development.

### **Improving health**

The well-being of present and future generations is threatened by environmental change and social problems, such as poverty and inequity, which are contributing to environmental degradation. Preventive or proactive solutions for many contemporary health problems need to address the links among environment, health and other factors that determine well-being. Opportunities include better integration of environment and health strategies, economic valuation, targeting the most vulnerable, education and awareness, and the integration of environment and health into economic and development sectors.

Measures to ensure ecological sustainability to safeguard ecosystem services will benefit health, so these are important in the long-term. The emphasis on environmental factors has been a central part of the public health tradition. In recent years, several international policies made provisions for improved consideration of health in development. Global initiatives include the World Health Organization’s 2005 recommendations for health impact assessment. At the regional level, the Strategic Environmental Assessment Protocol (1991) to the UNECE Convention on Environmental Impact Assessment emphasizes consideration of human health. More effective impact assessment procedures are needed in both developed and developing countries.

Economic valuation can help ensure that environment and health impacts are given adequate consideration in policy. An integrated economic analysis of such impacts can capture the hidden costs and benefits of policy options, as well as the synergies and institutional economies of scale that may be achieved through complementary policies that support sustainable development.

In most countries, mainstreaming of environment and health considerations into all government sectors and economic endeavours remains a challenge (Schütz and others (in press)). Policies and practices regarding health, environment, infrastructure and

Millions of people continue to be displaced and to be negatively affected by conflict, which reduces societal capacity to adapt to environmental change, while making sustained environmental management difficult.

*Credit: UN Photo Library*



economic development should be considered in an integrated manner (UNEP and others 2004). As environmental pollutants affect health through a variety of pathways, environmental monitoring and epidemiological surveillance systems should be strengthened. Health indicators and strategies are needed for specific groups at risk, such as women and children, the elderly, the disabled and the poor (WHO and UNEP 2004).

It is important to raise awareness not only in the health sector, but also in sectors such as energy, transport, land-use development, industry and agriculture, through information on the likely health consequences of decisions. Not only health professionals, but also all other stakeholders need the means to evaluate and influence policies that have impacts on health. A better understanding of the dynamic linkages between ecosystems and public health is leading to new and diverse opportunities for interventions early in processes that could become direct threats to public health (Aron and others 2001). Building awareness about environment and health problems, tools and policy options requires sustained and comprehensive communication strategies.

#### **Resolving conflict through environmental cooperation**

Despite the decrease in civil wars globally in recent years, millions of people continue to be displaced and negatively affected by violent conflict. Armed conflict often, but not always, causes heavy damage to the environment. It reduces societal capacity to adapt to global change, while making sustained environmental management difficult. Reducing violent conflict, whether related to natural resources or not, would reduce a major source of vulnerability, and

would better support human well-being in many parts of the world. Environmental cooperation offers several opportunities for achieving these ends.

Policy tools aimed at identifying the contribution of the environment to violent conflict and breaking those links would help redress key stresses. Developing and deploying such tools requires collaboration across a range of environment, development, economic, and foreign policy institutions, including the UN agencies. Such collaboration recognizes interlinkages across the biophysical components of the environment as well governance regimes (also see Chapter 8). Environmental assessment and early warning activities by UNEP and other stakeholders can play an active role in collecting and disseminating lessons learned. This may support the implementation of the UN Secretary-General's call during the UN General Assembly in 2006 for integrating environmental considerations in conflict prevention strategies.

Environmental cooperation has historically had two main areas of focus. At the international level, emphasis has been on multilateral treaties aimed at mitigating the effects of global change. At the sub-regional level, cooperation has focused on equitable sharing of natural resources, such as regional seas (Blum 2002, VanDeveer 2002) and shared water resources (Lopez 2005, Swain 2002, Weinthal 2002), as well as on improving conservation, through transboundary conservation areas (also known as transfrontier parks), to support integration and development-related activities such as tourism (Ali 2005, Sandwith and Besançon 2005, Swatuk 2002). Environmental cooperation – for conflict avoidance and peacemaking – could be employed across all levels of political organization.

In the rush to pursue policy interventions to sever the links between environment and conflict, analysts and practitioners alike have neglected the prospect for building upon environmental interdependencies to achieve confidence building, cooperation and, perhaps, peace (Conca and Dabelko 2002, Conca and others 2005). Environmental peacemaking is a strategy for using environmental cooperation to reduce tensions by building trust and confidence between parties in disputes. Environmental peacemaking opportunities will remain untested and underdeveloped until more systematic policy attempts are made to achieve these windfalls in a larger number of cases across resource types and across political levels.

Pursuing environmental pathways to confidence building would capitalize on environmental interdependence, and the need for long-term, iterated environmental cooperation to reduce conflict-induced vulnerability and improve human-well-being. Such policy interventions could:

- help prevent conflict among states and parties;
- provide an environmental lifeline for dialogue during times of conflict;
- help end conflicts with environmental dimensions; and
- help restart economic, agricultural and environmental activities in post-conflict settings.

Not all environmental cooperation lowers vulnerability and increases equity. Systematic assessment of experiences can increase opportunities. Comparing lessons learned across environmental peacemaking cases helps identify environmental management approaches that instigate, rather than ameliorate conflict, such as early examples of transboundary peace parks that neglected wide consultation with local peoples (Swatuk 2002). The ultimate goal of pursuing environmental peacemaking opportunities is reduction of vulnerability and assaults on human well-being created by the still-numerous local, national, and regional conflicts.

Pursuing environmental peacemaking opportunities will require focusing on local, national and regional institutional settings, rather than the historical emphasis on multilateral environmental agreements. Trying to capture these environmental and conflict prevention benefits requires considerable capacity building among stakeholders, including public and private interests in the conflict, as well as facilitators, such as bilateral donors or UN entities.

### Strengthening local rights

The fast-paced changes of social and political values create challenges for developing effective responses that address human vulnerability and well-being, while ensuring complementarity among priorities. Strengthening local rights can offer opportunities for ensuring that local and national conservation and development priorities are recognized at higher levels of decision making.

Globalization has resulted in a growing emphasis on free exchange of commodities and ideas, and individual ownership and rights. In some circumstances, this may not support national or regional development goals (Round and Whalley 2004, Newell and Mackenzie 2004). Changing values associated with gender, traditional institutions, and democracy and accountability make the management of environmental resources extremely complex, and present challenges for institutional development. For example, the authority and right of both the state and traditional institutions to manage are increasingly contested. This is evident in conflicts around conservation areas (Hulme and Murphree 2001), water (Bruns and Meizin-Dick 2000, Wolf and others 2003) and forests (Edmonds and Wollenberg 2003). Such conflicts often have negative consequences for conservation and livelihoods, and may also have regional implications, where resources are shared.

Mediating these different interests and perspectives requires responses at the national, regional and global levels. Developing more inclusive institutions that recognize the rights and values of local natural resource users can be an effective response, and can facilitate the inclusion of local concerns into governance processes at a higher level (Cornwall and Gaventa 2001). This can also lead to better information sharing, and more equitable distribution of financial and other resources (Edmonds and Wollenberg 2003, Leach and others 2002). Inclusive processes can reduce the tension between local values and rights, and those held by state institutions (Paré and others 2002). Making these approaches effective requires investing in capacity building. Scaling these approaches up to the national or regional level can be appropriate, particularly where resource use has implications for users elsewhere, as in the case of water management (Mohamed-Katerere and van der Zaag 2003). Recognizing existing local institutions,

including common property institutions, instead of creating new institutions, may be environmentally and socially beneficial, especially where they have a high degree of local legitimacy.

Building better links between local aspirations and the strategies and policies adopted at the global level is more challenging. It is constrained by international law and governance, but is not impossible (Mehta and la Cour Madsen 2004). Building negotiating capacity can be an important strategy for increasing the development focus of international governance systems (Page 2004). In some sectors, regional cooperation has proved effective in creating synergies between global governance and development objectives.

#### **Promoting freer and fairer trade**

Trade has far-reaching effects on livelihoods, well-being and conservation. Freer and fairer trade can be a useful tool for promoting growth and reducing poverty (Anderson 2004, Hertel and Winters 2006), improving resilience through transfer of food and technology (Barnett 2003), and improving governance.

Environmental and equity issues should be at the centre of global trade systems (DfID 2002). This is particularly important to ensure that poor people are not taken advantage of when it comes to trade, especially in products, such as hazardous materials that threaten well-being. The trade regime, particularly in agriculture and textiles, is characterized largely by preferential trade agreements (PTAs), bilateral agreements and quotas. High-income countries negotiate bilateral PTAs with poor countries, but such agreements cause more harm than good (Krugman 2003, Hertel and Winters 2006).

Poor countries, which have abundant labour, are expected to gain from access to larger markets elsewhere, and high-income countries should ensure them such market access. Since small countries have smaller internal markets, lowering trade barriers would provide them with opportunities to exploit economies of scale, so that the poor can garner employment and better wages. Most models show the liberalization of trade under the current Doha round in the World Trade Organization is expected to reduce poverty, particularly if developing countries adjust their policies accordingly (Bhagwati 2004).

Trade facilitates learning-by-doing, which can drive higher productivity and industrialization (Leamer and

others 1999). Contact between industrialized and developing countries can be an effective vehicle for diffusion of best practices, through the transfer of capital and knowledge. As poor countries, particularly primary commodity exporters, are vulnerable to price shocks and other market failures, diversification is a good option for reducing vulnerability (UNCTAD 2004), and may contribute to sustainable natural resource use.

Higher levels of income, sophisticated markets and the increased power of non-state actors may enhance the prospects for democracy and liberty (Wei 2000, Anderson 2004). Since trade requires large amounts of arm's-length transactions, better institutions are required for it to work smoothly (Greif 1992). Trade may not only raise incomes, but also indirectly and directly promotes better international governance, societal welfare (Birdsall and Lawrence 1999), and international and civil peace, which reinforces and is reinforced by prosperity (Barbieri and Reuveny 2005, De Soysa 2002a, De Soysa 2002b, Russett and Oneal 2000, Schneider and others 2003, Weede 2004).

Trade, like almost all other economic activity, creates winners and losers, and carries externalities. For some, adjustment costs of increased competition can be high (see section on export and import of vulnerability). These problems could be addressed by compensating losers, and encouraging increased adaptation through better public investment in education and infrastructure (Garrett 1998, Rodrik 1996). Trade contributes most to increasing incomes when combined with good governance (Borrmann and others 2006). Good governance, local capacities to regulate trade, and the regulation of industry in ways that encourage the adoption of best practices all help mitigate externalities, including those stemming from disposal of hazardous waste and pollution from increased consumption.

#### **Securing access to and maintaining natural resource assets**

For many people in developing countries as well as indigenous peoples, farmers and fishers in developed countries, secure entitlements to productive assets, such as land and water, are central to ensuring sustainable livelihoods (WRI 2005, Dobie 2001). Continued natural resource availability and quality, involving good conservation practices, is essential for the livelihoods of many in developing countries. Existing policies often compromise this. Strengthening access regimes can offer opportunities for poverty



Continued natural resource availability and quality, involving good conservation practices, is essential for the livelihoods of many in developing countries.

*Credit: Audrey Ringler*

eradication, as well as improving conservation and long-term sustainability. This national level action can be important for attaining globally agreed objectives, such as those in the MDGs, the CBD and UNCCD.

Secure entitlement refers to conditions under which users are able to plan and manage effectively. Secure access to natural resources can be an important stepping stone out of poverty, as it provides additional household wealth, which may support investments in health and education (WRI 2005, Pearce 2005, Chambers 1995). Moreover, it may contribute to better natural resource management by supporting long-term vision that keep future generations and options in mind, and may encourage investment (Hulme and Murphree 2001, Dobie 2001, UNCCD 2005). Specifically addressing women's tenure rights is vital, as they play key roles in managing natural resources, and are particularly affected by environmental degradation (Brown and Lapuyade 2001). Intergovernmental initiatives, such as dam development, should not undercut local resource rights by shifting responsibility from the local to the national or regional level (Mohamed-Katerere 2001, WCD 2000). To be effective, secure access rights may need to be complemented by addressing other barriers to sustainable and productive use, such as global trade regimes, insufficient access to capital and information, inadequate capacity and lack of technology. Valuation strategies, including payment for environmental services, can help ensure greater returns for local resource managers. Ensuring access to credit for small farmers and those directly reliant on ecosystem services is extremely important. Practice shows that finance schemes that especially target women can have higher than usual payoffs. Credit schemes, such as the Grameen banks in Bangladesh, can be designed to compensate those who ensure that environmental services are maintained.

Improved local authority over natural resources can help diversify livelihood options, reducing pressures on

resources that are under threat (Hulme and Murphree 2001, Edmonds and Wollenberg 2003). Devolution of authority is one such mechanism (Sarin 2003). Despite a growing trend towards decentralization and devolution since the 1980s, and a broad policy commitment to give users greater authority, the institutional reform required to improve livelihoods is often lacking (Jeffrey and Sunder 2000). Devolution needs to be complemented by capacity building and empowerment initiatives, improved tenure, and better trade and value-adding options.

#### **Building and bridging knowledge to enhance coping capacity**

The roles of knowledge, information and education in reducing vulnerability converge around the learning process. The strengthening of learning processes for three specific objectives emerges as a key strategy to increasing coping capacity in a rapidly changing and complex environment.

Building knowledge about the environmental risk that threatens well-being, both among vulnerable communities themselves and among decision-makers at higher levels, is important. This involves both improved monitoring and assessment of the environmental, social and health-related aspects of pollution. It also involves mechanisms such as early warning systems (EVVS) and indicators (for example, the Environmental Vulnerability Index) (see Gowrie 2003) for communicating and disseminating information on environmental change. These systems should be integrated into mainstream development. One tool that has proved useful in this regard is poverty mapping (see Figure 7.26). Poverty maps are spatial representations of poverty assessments. Poverty maps also allow easy comparison of indicators of poverty or well-being with data from other assessments, such as availability and condition of natural resources. This can assist decision-makers in the targeting and implementation of development projects, and the communication of

information to a wide range of stakeholders (Poverty Mapping 2007). The map in Figure 7.26 shows the amount of resources needed to raise the population in each area to lift the poor out of poverty. It shows the uneven distribution of poverty density in Kenya. Most of the administrative areas in Kenya's arid and semi-arid lands require less than 4 000 Kenya Shillings (US\$ 57 at US\$1 = Ksh70) per square kilometre per month as a result of the low density of people. In contrast, at least 1.5 times that amount is needed in the densely populated areas west of Lake Victoria.

Bridging knowledge for better decision making is also key. This includes vulnerable communities learning about and from the national and global science advisory and decision making processes, and learning to raise their voices in these arenas, as illustrated in Box 7.17. At the same time, the scientists and decision-makers should learn to listen to and to talk with these communities, and consider their unique, specialized knowledge that centres on human-environment relationships and the use of natural resources (see for example Dahl 1989), even if it is not cast in the language of science.

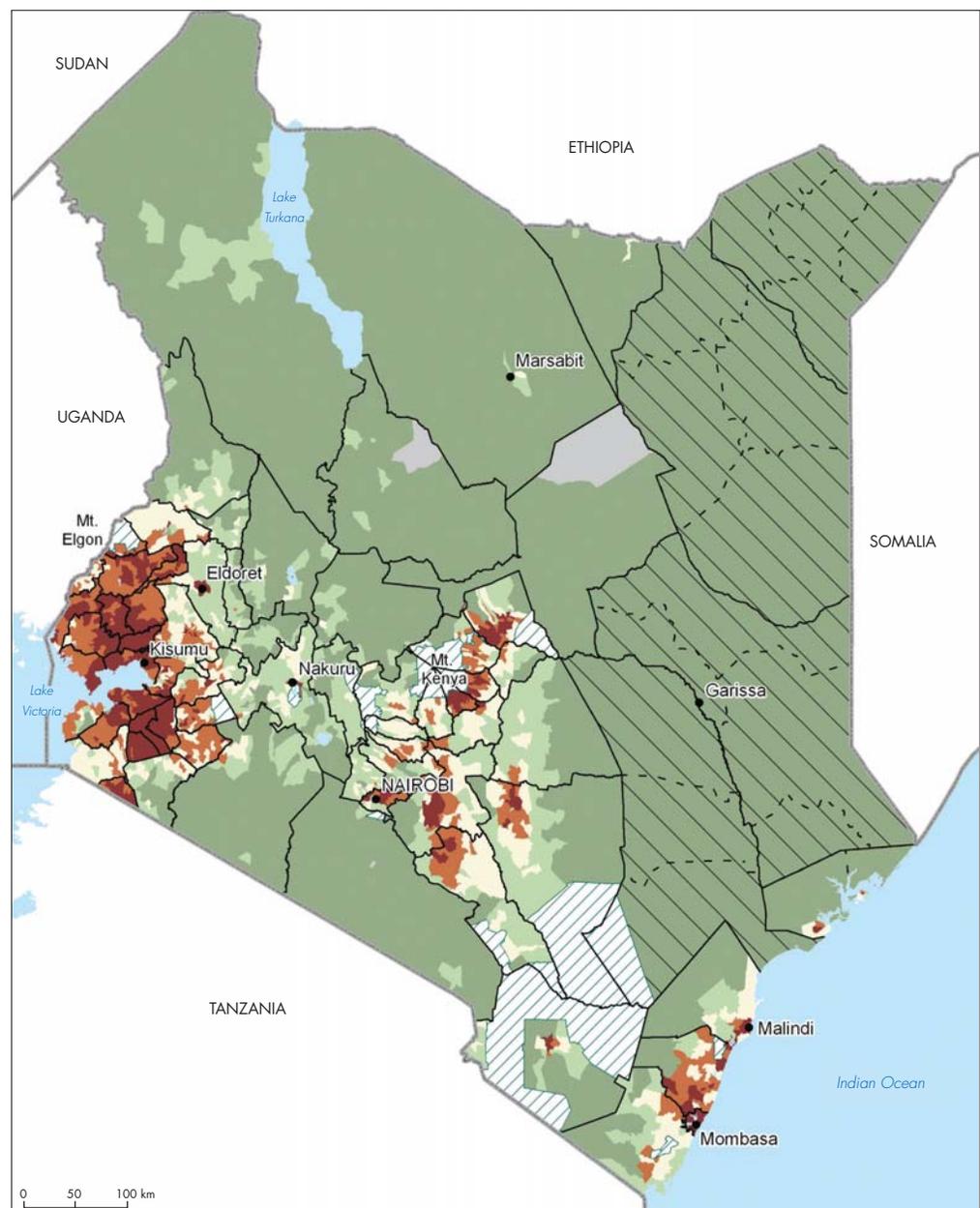
**Figure 7.26 Example of a poverty map for Kenya**

Theoretical investment to fill the poverty gap  
 Kenyan shillings per month per sq. km

- > 60 000
- 28 000–60 000
- 12 000–28 000
- 4 000–12 000
- < = 4 000
- No data
- Data calculated by Constituency

Other features

- District boundaries
- Constituency boundaries
- Selected national parks and reserves
- Water bodies



Note: The urban estimates are based on a poverty line of KSh2 648/month while the rest of the country is based on the rural poverty line of KSh1 239/month.  
 US\$1 = KSh 70

Source: WRI 2007

The most vulnerable should learn competencies and skills that enable them to adapt and cope with risks. The foundation for this and the learning processes above lies in a good basic education, as set out in MDG 2. This increases the ability both to understand information from public awareness and early warning campaigns about specific sources of vulnerability and to develop coping and adaptation strategies. For example, it was the poorest and least educated groups who did not heed the evacuation warnings for Hurricane Katrina in 2005 (Cutter and others 2006). Educating the most vulnerable groups improves their coping capacities, and is also important for equity reasons. For example, the education of girls is one of the key means to break the intergenerational cycle of poverty. It is strongly associated with healthier children and families (UN Millennium Project 2005), and more sustainable environmental management.

#### **Investing in technology for adaptation**

Science, technology, and traditional and indigenous knowledge are important resources for reducing vulnerability. Policies that facilitate the development, application and transfer of technology to vulnerable communities and areas can improve access to basic materials, enhance risk assessment practices and EVVS, and foster communication and participation. Policies should support technologies that ensure equitable access and the safety of water, air and energy, and that provide transportation, housing and infrastructure. They should be socially acceptable in the local context. The opportunity lies in investing in a diversity of technologies, including small-scale technologies that allow decentralized solutions. Some types of technology can also be important resources for promoting social connectedness, stability and equality through democratization. Policies that facilitate communication, education and governance via information technologies, and that improve the status of underprivileged groups, are particularly valuable.

Developing countries stand to derive many benefits from technologies developed elsewhere, but they also face the greatest challenges in accessing these technologies and managing their risks. Commitments made in the Johannesburg Plan of Implementation (JPOI) remain largely unfulfilled. Computer and information and communications technologies, biotechnology, genetics and nanotechnology (UNDP 2001) remain unavailable to vast numbers of people in the developing world. Past experience has shown the importance of attending to the appropriateness of technology's multiple connections with broader society,

its fit (or lack thereof) in particular social, cultural and economic contexts, and its implications for gender. An important strategy to ensure this is to invest much more in capacity building in the countries for technology innovation and production. See Figure 7.6, which illustrates in global context how big a leap many countries need to make. The UN Task Force on Science, Technology and Innovation made a number of recommendations including: focusing on platform technologies, existing technologies with broad economic impacts (for example biotechnology, nanotechnology, and information and communication technology); providing adequate infrastructure services as a foundation for technology; investing in science and technology education; and promoting technology-based business activities (UNMP 2005).

#### **Building a culture of responsibility**

The export and import of vulnerability is a recurring feature of the seven archetypes, meaning that many people – individually and collectively – contribute, often inadvertently, to the suffering of others while improving their own well-being. In this context, vulnerable communities need support to cope and adapt, so there is a need to build a stronger culture of “responsibility to act.” Educating people about how their production and consumption patterns export vulnerability to other areas, continents and generations, and how this affects the prospects for living together at local scales, can contribute to a culture of responsibility. UNESCO's Education for All emphasizes the need to expand the view of education to include learning “life skills,” such as learning “to live together” and learning “to be” (UNESCO 2005).

However, the chain of interactive drivers is far too complex to allow individual and collective actors to be aware of their own contributing roles and to feel more responsible to act (Karlsson 2007). In addition, the institutional frameworks for addressing legal responsibilities to protect the global commons are often weak, particularly when issues cross international borders and happen over different time frames. A response strategy is needed where a culture of responsibility is based more on global solidarity for present and future generations as a way of integrating neighbourhood values with global solidarity (Mertens 2005). Such solidarity can be actively nurtured through, for example, education (Dubois and Trabelsi 2007), processes of cooperative interaction (Tasioulas 2005), or the design of institutions that strengthen cosmopolitan aspirations and commitments (Tan 2005).

Education for the purpose of learning to care for and feel empathy for neighbours, and through this build a culture of responsibility to act can be readily integrated into the overall strategy for both formal and informal education. Enabling learners to participate directly in environmental problem solving is one effective way to enhance conservation behaviour (Monroe 2003). Examples of teaching environmentally-relevant life skills include the education initiatives related to the Earth Charter and various programmes on global and world citizenship and human rights (Earth Charter Initiative Secretariat 2005).

### Building institutions for equity

There is very little equity or justice in who is vulnerable to environmental change. The poor and marginalized are almost always hit hardest by the degrading environment (Harper and Rajan 2004, Stephens 1996).

Poor governance, social exclusion and powerlessness limit the opportunities poor people have to participate in the decision making related to a country's resources and environment and how these have an impact on their well-being (Cornwall and Gaventa 2001). Improved governance and tenure regimes may not work for the poorest people if the opportunities for their participation are not specifically strengthened. Improving opportunities for participation in governance and planning processes at local and higher levels of governance can help strengthen their coping capacity. Box 7.17 gives an example of a recent initiative of Arctic indigenous communities and SIDS to combine their voices in the face of climate change.

#### Box 7.17 Many Strong Voices – building bonds

Many Strong Voices is a project, launched at the 2005 Conference of the Parties to the UN Framework Convention on Climate Change, which aims to build strategies for climate change awareness raising and adaptation among the vulnerable in the Arctic and Small Island Developing States (SIDS).

The purpose of this project is to link the vulnerable in the Arctic and SIDS to stimulate a dialogue that will:

- support regional initiatives in education, training and public awareness raising;
- develop partnerships that will allow people in these areas to exchange information about efforts underway to raise awareness about, and to develop adaptation strategies for climate change;
- support efforts of local inhabitants so they will be able to influence the debate on, and participate in, decisions on adaptation; and
- facilitate regional efforts to influence global efforts on adaptation and mitigation.

The UN Conference on Environment and Development (Rio conference) provided the basic institutional change for increasing participation in environment-related decision making. However, having a voice without being listened to and having an impact on outcome can lead to greater estrangement. Weaknesses in this aspect is a recurring complaint, for example, in the multistakeholder dialogues at the global level (IISD 2002, Hiblin and others 2002, Consensus Building Institute 2002). Existing responses need to be strengthened, and active strategies to empower the most vulnerable could be developed by, for example, improving access to relevant environmental information, as provided for in Principle 10 of the Rio Declaration. This has already been implemented in many countries (Petkova and others 2002, UNECE 2005). Capacity building is also essential.

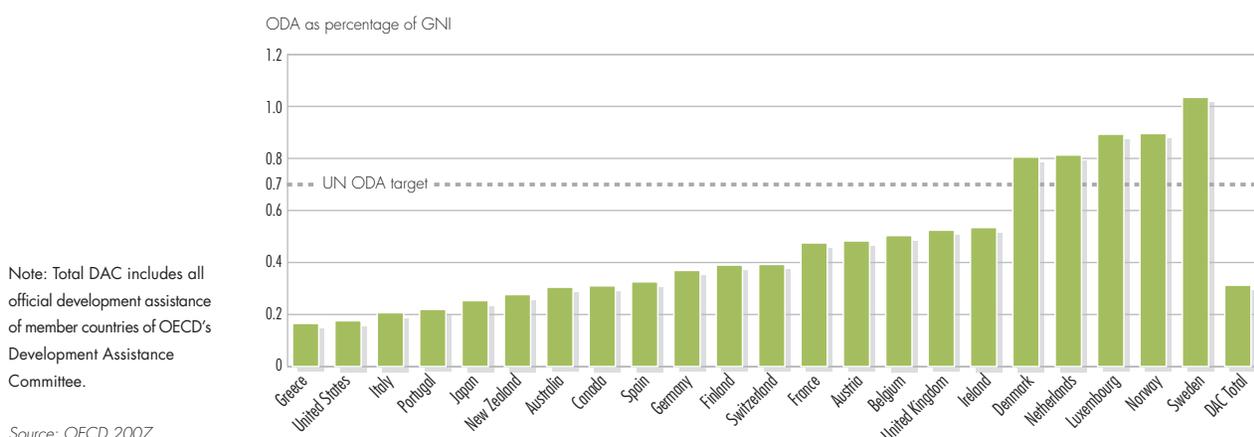
Putting a strong focus on the equity aspects of the outcome of governance is another essential aspect of enhancing coping capacity and the legitimacy of governance. Equity-centred strategies involve identifying the most vulnerable groups and communities, assessing the impacts of suggested policies first and foremost on these groups, and taking measures to improve equity in access to resources, capital and knowledge.

### Building capacity for implementation

"Implementation failure" is common. There are many elaborate regional and global level multilateral agreements and action plans that have not been successfully implemented at the national level. The reasons behind the implementation failure are complex, and there are no simple solutions. Addressing this requires a multilevel approach. Three important opportunities can be identified: improving funding, investing in capacity, and developing effective monitoring and evaluation of existing plans and policies. International partnership is critical to success.

Increased financial commitment is essential to promote adaptation activities, increase human capability, support the implementation of MEAs and stimulate development. In developing countries, where financial resources are often constrained, creating better synergies between environment and development objectives is important. For example, there could be more interlinked health-environment strategies or poverty-environment initiatives (Kulindwa and others 2006). The incorporation of environment into Poverty Reduction Strategy Papers

**Figure 7.27 Net ODA as a percentage of GNI in 2006**



is one opportunity that can be more effectively used (Bojö and Reddy 2003, WRI 2005).

Official development assistance (ODA) continues to lag behind agreed targets. At the 1992 Rio conference, most countries pledged to increase ODA towards the UN target of 0.7 per cent of GNI (Parish and Looi 1999). In 1993, the average level of ODA was 0.3 per cent of GNI (Brundtland 1995). Describing the international redistributive system as is “in shameful condition,” Brundtland emphasized that “the cost of poverty, in human suffering, in the wasteful use of human resources, and in environmental degradation, has been grossly neglected” (Brundtland 1995). The 2002 Monterrey Consensus recommitted developed countries to meeting the UN target. Since then, there has been a steady increase in aid, and by 2004 average ODA was 0.42 per cent of GNI. However, only five countries have met the UN target and by 2006 the average was down to 0.3 per cent again (see Figure 7.27). The IMF’s 15 richest member states have agreed to allocate at least 0.51 per cent of GNI by 2010, increasing this share to 0.7 per cent by 2015 (Gupta and others 2006).

Investing in capacity building and necessary technology support, as envisaged in the JPOI and the BSP, can enhance ability to develop and implement required measures. Targeting capacity building at the right level is essential. Improved land management might require local capacity building, whereas addressing illegal movement of hazardous waste will require capacity building of the relevant agencies. In some areas, such as biodiversity management, capacity of some developed and developing countries to develop and implement interlinked strategies is

lacking (CBD 2006). Pooling resources, sharing best practices and collaborating in joint capacity building at the regional level have been successful.

Improving monitoring and evaluation capacity also hinges on increased investment in capacity building, and appropriate institutional and governance development. In some situations, there is a need for stronger government institutions, as well as national and international laws to ensure that standards are abided by. Better institutional and governance mechanisms, including measures to ensure access to relevant information and the courts, are necessary to support people in safeguarding their interests.

## CONCLUSION

The patterns of vulnerability to environmental and socio-economic changes that have been highlighted are not mutually exclusive, nor are they the only ones that exist within countries, in and across regions, and globally. They present an environment and development paradox for decision-makers at different levels: millions of people remain vulnerable to multiple and interacting pressures in a world of unprecedented wealth and technological breakthroughs. Addressing the challenges presented by the patterns of vulnerability will, however, contribute to overall human well-being and to meeting the MDGs. There is a range of strategic approaches, many of them not in the environmental policy domain that could be taken. At the same time, implementation of obligations already made in a wide range of policy domains, ranging from basic human rights to development aid, trade and to environment, would reduce vulnerability and increase human well-being.

## References

- ACIA (2004). *Impacts of a Warming Arctic: Arctic Climate Impact Assessment*. Cambridge University Press, Cambridge
- ACIA (2005). *Arctic Climate Impact Assessment*. Arctic Council and the International Arctic Science Committee. Cambridge University Press, Cambridge <http://www.acia.uaf.edu/pages/scientific.html> (last accessed 27 June 2007)
- Adger, N., Hughes, T.P., Folke, C., Carpenter, S.R. and Rockström, J. (2005). *Social-Ecological Resilience to Coastal Disasters*. In *Science* 309:1036-1039
- Akande, F. and Senaye, R. (eds.) (2004). *The Irony of "White Gold"*. Transformation Resource Centre, Morija <http://www.trc.org.ls/publications/> (last accessed 14 June 2007)
- Alcama, J., Doll, P., Henrichs, T., Kaspar, F., Lehner, B., Röschi, T. and Siebert, S. (2003). Global estimation of water withdrawals and availability under current and "business as usual" conditions. In *Hydrological Science* 48 (3):339-348
- Alexander, D. (1993). *Natural disasters*. Chapman and Hall, New York, NY
- Ali, Saleem H. 2005. "Conservation and Conflict Resolution: Crossing the Policy Frontier." *Environmental Change and Security Program Report* (11):59-60
- Allen-Diaz, B. (1996). *Rangelands in a changing climate: Impacts, adaptations, and mitigation*. Cambridge University Press, Cambridge
- America's Wetland (2005). *Wetland Issues Exposed in Wake of Hurricane Katrina*. America's Wetland, Press Releases <http://www.americaswetland.com/article.cfm?id=292&catid=28&pageid=16> (last accessed 27 April 2007)
- Anderson, K. (2004). Subsidies and Trade Barriers. In *Global Crises, Global Solutions* (ed. B. Lomborg). Cambridge University Press, Cambridge
- Appleton, J.D., Williams, T.M., Breward, N., Apostol, A., Miquel, J. and Miranda, C. (1999). Mercury contamination associated with artisanal gold-mining on the island of Mindanao, The Philippines. In *Sci. Total Environment* 228:95-109
- ArcWorld ESRI (2002) *ESRI Data & Maps 2002*. CD-ROM
- Aron J.L., Ellis J.H. and Hobbs B.F. (2001). Integrated Assessment. In *Ecosystem Change and Public Health. A Global Perspective*, Aron, J.L. and Patz, J.A. (eds.). The Johns Hopkins University Press, Baltimore and London
- Amarin, M.I., Mergier, D., Bahia, M.O., Dubeau, H., Miranda, D., Lebel, J., Burbano, R.R. and Lucotte, M. (2000). Cytogenetic damage related to low levels of methyl mercury contamination in the Brazilian Amazon. In *Ann. Acad. Bras. Cienc.* 72:497-507
- Ayotte, P., Dewailly, E., Bruneau, S., Careau, H. and A. Vezina (1995). Arctic Air-Pollution and Human Health - What Effects Should Be Expected. In *Science of the Total Environment* 160/161:529-537
- AHRC (2004). *Arctic Human Development Report*. Stefansson Arctic Institute, Akureyri
- Auty, R. M., ed. (2001). *Resource Abundance and Economic Development*. UNU/WIDER studies in development economics. Oxford University Press, Oxford
- Bächler, G., Böge, V., Klätzli, S., Libiszewski, S. and Spillmann, K. R. (1996). *Kriegsursache Umweltzerstörung: Ökologische Konflikte in der Dritten Welt und Wege ihrer friedlichen Bearbeitung*. Volume 1. Rüegger, Chur, Zürich
- Baechler, G. (1999). Internationale und binnenstaatliche Konflikte um Wasser. *Zeitschrift für Friedenspolitik* 3:1-8
- Bakhtit, A.H. (1994). Mubrooka: a study in the food system of a squatter settlement in Omdurman, Sudan. In *Gaejournal* 34 (3):263-268
- Bankoff, G. (2001). Rendering the world unsafe: 'vulnerability' as Western discourse. In *Disasters* 21(1):19-35
- Barbieri, K. and Reuveny, R. (2005). Economic Globalization and Civil War. In *Journal of Politics* 67 (4)
- Barnett, J. (2003). Security and Climate Change. In *Global Environmental Change* 13(1):7-17
- Barnett, J. and Adger, N. (2003). Climate Dangers and Atoll Countries. In *Climatic Change* 61(3):321-337
- Basel Action Network (2002). *Exporting harm: the high tech trash of Asia*. Basel Action Network, Seattle <http://www.ban.org/E-waste/technotrashfinalcomp.pdf> (last accessed 13 June 2007)
- Basel Action Network (2006). *12 Human Rights/Green Groups Call for an Immediate Halt on Scuttling of "Toxic Ships" Following Recent Findings of Death and Disease in India*. Toxic Trade News. [http://www.ban.org/ban\\_news/2006/060914\\_immediate\\_halt.html](http://www.ban.org/ban_news/2006/060914_immediate_halt.html) (last accessed on 24 August 2007)
- Benedetti, M., Lavarone, I., Combe, P. (2001). Cancer risk associated with residential proximity to industrial sites: A review. In *Arch. Environ. Health* 56:342-349
- Berkes, F. (2002). Cross-Scale Institutional Linkages: Perspectives from the Bottom Up. In *The Drama of the Commons*, Ostrom, E., Dietz, T., Dolsak, N., Stern, P. C., Stonich S. and Weber, E.U. (eds.) National Academy Press, Washington, DC
- Bhagwati, J. (2004). *In Defense of Globalization*. Oxford University Press, Oxford
- Bijlsma, L., Ehler, C.N., Klein, R.J.T., Kulshrestha, S.M., McLean, R.F., Mimura, N., Nicholls, R.J., Nurse, L.A., Perez Nieto, H., Stakhiv, E.Z., Turner, R.K. and Warick, R.A. (1996). Coastal Zones and Small Islands. In *Impacts, Adaptations and Mitigation of Climate Change: Scientific Technical Analyses*, Watson, R.T., Zinyowera, M.C. and Moss, R.H. (eds.). Cambridge University Press, Cambridge
- Birdsall, N. and Lawrence, R. Z. (1999). Deep Integration and Trade Agreements: Good For Developing Countries? In *Global Public Goods: International Cooperation in the 21st Century*, Kaul, I. Grunberg, I. and Stern, M. (eds). Oxford University Press, Oxford
- Birkmann, J. (ed.) (2006). *Measuring Vulnerability to Natural Hazards: towards disaster resilient societies*. United Nations University Press, Tokyo
- Blacksmith Institute (2006). *The World's Worst Polluted Places. The Top Ten*. Blacksmith Institute, New York, NY <http://www.blacksmithinstitute.org/get10.php> (last accessed 27 April 2007)
- Blaikie, P., Cannon, T., Davis, I. and Wisner, B. (1994). *At Risk: Natural Hazards, People's Vulnerability and Disasters*. Routledge, London
- Blum, Douglas W. (2002). Beyond Reciprocity: Governance and Cooperation around the Caspian Sea. In *Environmental Peacemaking*, Conca, K. and Dabelko, G.D. (eds). The Woodrow Wilson Center Press and the Johns Hopkins University Press, Washington, DC and Baltimore
- Bojo, J. and Reddy, R.C. (2003). *Status and Evolution of Environmental Priorities in the Poverty Reduction Strategies: An Assessment of Fifty Poverty Reduction Strategy Papers*. Environment Economic Series Paper No. 93. The World Bank, Washington, DC
- Borrmann, A., Busse M., Neuhaus S. (2006). Institutional Quality and the Gains from Trade. In *Kyklos* 59(3):345 - 368
- Blumenthal, S. (2005). No-one Can Say They Didn't See It Coming. In *Spiegel International* 31 August 2005
- Bohle, H. G., Downing, T. E. and Watts, M. (1994). Climate Change and Social Vulnerability: The Sociology and Geography of Food Insecurity. In *Global Environmental Change*: 4 (1):37-48
- Brock, K. (1999). *It's not only wealth that matters — it's peace of mind too: a review of participatory work on poverty and ill-being*. Voices of the Poor Study paper. The World Bank, Washington, DC
- Brosio, G. (2000). *Decentralization in Africa*. Africa Department of the International Monetary Fund, Washington, DC
- Brown, K. and Lapuyade S. (2001). A livelihood from the forest: Gendered visions of social, economic and environmental change in southern Cameroon. In *Journal of International Development* 13:1131-1149.
- Brundtland, G.H. (1995). *A Shameful condition*. Progress of Nations. United Nations Children's Fund, New York, NY <http://www.unicef.org/pon95/aid-0002.html> (last accessed 27 April 2007)
- Bruns, B.R. and Meizin-Dick, R. (2000). Negotiating Water Rights in Contexts of Legal Pluralism: Priorities for Research and Action. In *Negotiating Water Rights*, Bruns, B.R. and Meizin-Dick, R. (eds.). Intermediate Technologies Publications, London
- Bulatov-Joyce, Fr.J., Villavieja, G.M., Domdom, A.C. and Jimenez, D.C. (1982). Poor urban diets: causes and feasible changes. In *Geog. Suppl. Iss.* 4:3-82
- Bulte, E.H., Damania, R. and Deacon, R.T. (2005). Resource Intensity, Institutions, and Development. In *World Development* 33 (7):1029-1044
- Burholt, V. and Windle, G. (2006). Keeping warm? Self-reported housing and home energy efficiency factors impacting on older people heating homes in North Wales. In *Energy Policy* (34):1198-1208
- Calderon, J., Navarro, M.E., Jimenez-Capdeville, M.E., Santos-Diaz, M.A., Golden, A., Rodriguez-Leyva, I., Bonja-Aburto, V.H. and Diaz-Barriga, F. (2001). Exposure to arsenic and lead and neuropsychological development in Mexican children. In *Environ. Res.* 85:69-76
- Calagno, A.T. (2004). *Effective environmental assessment: Best practice in the planning cycle*. Comprehensive options assessment [http://www.un.org/esa/sustdev/sds/energy/op/hydro\\_calagno\\_envirion\\_assessment.pdf](http://www.un.org/esa/sustdev/sds/energy/op/hydro_calagno_envirion_assessment.pdf) (last accessed 27 April 2007)
- Campbell, L. and Rosalie, M. (2006). Sustaining social development in a small island developing state? The case of the Seychelles. In *Sustainable Development* 14(2):115-125
- CBD (2006). *Report of the Eighth Meeting of the Parties to the Convention on Biological Diversity*. UNEP/CBD/COP/8/31. Convention on Biological Diversity <http://www.cbd.int/doc/meeting.aspx?mtg=cop08> (last accessed 15 June 2007)
- Chambers, R. (1989). Vulnerability, coping and policy. Institute of Development Studies, University of Sussex. In *IDS Bulletin* 20:1-7
- Chambers, R. (1995). Poverty and livelihoods: Whose Reality counts. In *Environment and Urbanization* 1(7):173-204
- Chambers, R. and G. R. Conway (1992). *Sustainable rural livelihoods: Practical concepts for the 21st century*. Discussion Paper 296, Institute of Development Studies, Sussex
- Charveriat, C. (2000). *Natural Disasters in Latin America and the Caribbean: An Overview of Risk*. Inter-American Development Bank (IADB), Washington, DC
- Chen, S. and Ravallion, M. (2004) How have the World's Poorest Fared since the early 1980s? In *World Bank Research Observer*, v. 19 (2):141-70
- Chronic Poverty Research Centre (2005). *Chronic Poverty Report 2004-05*. Chronic Poverty Research Centre, Oxford
- CIESIN (2006). *Global distribution of Poverty. Infant Mortality Rates*. [http://sedac.ciesin.org/povmap/ds\\_global.jsp](http://sedac.ciesin.org/povmap/ds_global.jsp) (last accessed 10 May 2007)
- Cinner, J.E., Marnane, M.J., McClanahan, T.R., Clark, T.H. and Ben, J. (2005). Trade, Tenure, and Tradition: Influence of Socio-cultural Factors on Resource Use in Malaysia. In *Conservation Biology* 19(5):1469-1477
- CMH (2001). *Macroeconomics and Health: Investing in Health for Economic Development*. Commission on Macroeconomics and Health, World Health Organization, Geneva
- Colborn, T., Dumanoski, D. and Myers, J. P. (1996). *Our Stolen Future*. Dutton, New York, NY
- Collier, P., Elliot, L., Heger, H., Hoeffler, A., Reynal-Querol M. and Sambanis, N. (2003). *Breaking the Conflict Trap: Civil War and Development Policy*. Oxford University Press, Oxford
- Conca, K. and Dabelko, G.D. (eds.) (2002). *Environmental Peacemaking*. The Woodrow Wilson Center Press and the Johns Hopkins University Press, Washington, DC and Baltimore
- Conca, K., Carius, A. and Dabelko, G.D. (2005). Building peace through environmental cooperation. In *State of the World 2005: Redefining Global Security*. Worldwatch Institute, Norton, New York, NY
- Consensus Building Institute (2002). *Multi-stakeholder Dialogues: Learning From the UNCSO Experience*. Background Paper No. 4. United Nations Department of Economic and Social Affairs. Commission on Sustainable Development Acting as the Preparatory Committee for the World Summit on Sustainable Development. Third Preparatory Session. 25 March - 5 April 2002, New York, NY
- CSMWG (1995). *Definition of a Contaminated Site*. Contaminated Sites Management Working Group of the Canadian Government. [http://www.ec.gc.ca/etad/csmwg/en/index\\_e.htm](http://www.ec.gc.ca/etad/csmwg/en/index_e.htm) (last accessed 27 April 2007)
- Cornwall, A. and Gaventa, J. (2001) *From Users and Choosers to Makers and Shapers: Repositioning Participation in Social Policy*, IDS Working Paper 127, Institute for Development Studies, Brighton
- Crowder, L.B., Osherenko, G., Young, O., Airame, S., Norse, E.A., Baron, N., Day, J.C., Dauverre, F., Ehler, C.N., Halpern, B.S., Langdon, S.J., McLeod, K.L., Ogden, J. C., Peach, R.E., Rosenberg, A.A. and Wilson, J.A. (2006). Resolving mismatches in U.S. Ocean Governance. In *Science* 313:617-618
- CSD (2006). *14th Session of the Commission on Sustainable Development*. Chairman's Summary. <http://www.un.org/esa/sustdev/csd/csd14/documents/chairSummaryPart1.pdf> (last accessed 27 April 2007)
- Cuny, 1983 and Cuny, F.C. (1983). *Disasters and development*. Oxford University Press, New York, NY
- Cutter, S.L. (1995). The forgotten casualties: women, children and environmental change. In *Global Environmental Change* 5(3):181-194
- Cutter, S.L. (2005). The Geography of Social Vulnerability: Race, Class, and Catastrophe. In *Understanding Katrina: Perspectives from the Social Sciences*. Social Science Research Council <http://understandingkatrina.ssrc.org/Cutter/> (last accessed 27 April 2007)
- Cutter, S.L., Emrich, C.T., Mitchell, J.T., Buraff, B.J., Gall, M., Schmidlein, M.C., Burton, C.G. and Melton, G. (2006). The Long Road Home: Race, Class, and Recovery from Hurricane Katrina. In *Environment* 48(2):8-20
- Dahl, A. (1989). Traditional environmental knowledge and resource management in New Caledonia. In *Traditional Ecological Knowledge: a Collection of Essays* R.E. Johannes (ed.). IUCN, Gland and Cambridge <http://islands.unep.ch/thradknc.htm> (last accessed 13 June 2007)
- De Grauwe, P. and Camerman, F. (2003). How Big Are the Big Multinational Companies? In *World Economics* 4(2):23-37
- DFID (2002). *Trade and Poverty*. Background Briefing Trade Matters Series. UK Department for International Development. <http://www.dfid.gov.uk/pubs/files/bg-briefing-tradeandpoverty.pdf> (last accessed 13 June 2007)
- De Soysa, I. (2002a). Ecoviolence: Shrinking Pie or Honey-Pot? In *Global Environmental Politics* 2(4):1-34
- De Soysa, I. (2002b). Paradise is a Bazaar? Greed, Creed, and Governance in Civil War, 1989-1999. *Journal of Peace Research* 39(4):395-416
- De Soysa, I. (2005). Filthy Rich, Not Dirt Poor! How Nature Nurtures Civil Violence. In *Handbook of Global Environmental Politics*, P. Dauvergne (ed). Edward Elgar, Cheltenham

- Diamond, J. (2004). *Collapse: How Societies Choose to Fail or Succeed*. Penguin Books, London
- Dielh, P.F. and Gleditsch, N.P. (eds.) (2001). *Environmental Conflict*. Westview Press, Boulder, CO
- Dietz, A.J., Ruben, R. and Verhagen, A. (2004). *The Impact of Climate Change on Drylands*. Kluwer Academic Publishers, Dordrecht
- Dilley, M., Chen, R., Deichmann, U., Lerner-Lam, A.L. and Arnold, M. (with Agwe, J., Buy, P., Kjekstad, O., Lyon, B. and Yetman, G.) (2005). *Natural Disaster Hotspots: A Global Risk Analysis. Synthesis Report*. The World Bank, Washington, DC and Columbia University, New York, NY
- Dobie P. (2001). *Poverty and the Drylands. The Global Drylands Development Partnership*. United Nations Development Programme, Nairobi
- Dollar, D. (2004). *Globalization, poverty, and inequality since 1980*. Policy Research Working Paper Series 3333. The World Bank, Washington, DC
- Dollar, D. and Kraay, A. (2000). *Trade, Growth, and Poverty*. Development Research Group, The World Bank, Washington, DC
- Douglas, B.C. and Pelhier, W.R. (2002). The puzzle of global sea-level rise. In *Physics Today* 55:35-41
- Douglas, C.H. (2006). Small island states and territories: sustainable development issues and strategies - challenges for changing islands in a changing world. In *Sustainable Development* 14(2):75-80
- Downing, T.E. (Ed.) (2000). *Climate, Change and Risk*. Routledge, London
- Downing, T. E. and Patwardhan, A. (2003). Technical Paper 3: Assessing Vulnerability for Climate Adaptation. In UNDP and GEF *Practitioner Guide, Adaptation Policy Frameworks for Climate Change: Developing Strategies, Policies and Measures*. Cambridge University Press, Cambridge
- Dreze, J. and Sen, A. (1989). *Hunger and Public Action*. Clarendon Press, Oxford
- DTI (2001). *Fuel Poverty*. UK Department of Trade and Industry, London <http://www.dti.gov.uk/energy/fuel-poverty/index.html> (last accessed 27 April 2007)
- Dubois, J.-L. and Trabelsi, M. (2007). Social Sustainability in Pre- and Post-Conflict Situations: Capability Development of Appropriate Life-Skills. In *International Journal of Social Economics* 34
- Earth Charter Initiative Secretariat (2005). *Bringing Sustainability into the Classroom*. An Earth Charter Guidebook for Teachers. The Earth Charter Initiative International Secretariat, Stockholm and San José <http://www.earthcharter.org/resources/> (last accessed 27 April 2007)
- European Commission (2001). *Towards a European strategy for the security of energy supply*. Green Paper. European Commission, Brussels
- Eckley, N. and Selin, H. (2002). The Arctic Vulnerability Study and Environmental Pollutants: A Strategy for Future Research and Analysis. Paper presented at the *Second AMAP International Symposium on Environmental Pollution of the Arctic, Rovaniemi, Finland, 1-4 October, 2002*
- Edmonds, D. and Wollenberg, E. (2003). Whose Devolution is it Anyway? Divergent Constructs, Interests and Capacities between the Poorest Forest Users and the States. In *Local Forest Management. The Impacts of Devolution Policies*, Edmonds, D. and Wollenberg, E. (eds). Earthscan, London
- Emanuel, K.A. (1988). The Dependency of Hurricane Intensity on Climate. In *Nature* 326:483 - 485
- EM-DAT. *The International Disaster Database*. <http://www.em-dat.net/> (last accessed 13 June 2007)
- ESMAP (2005). *ESMAP Annual Report 2005*. Energy Sector Management Assistance Program. International Bank for Reconstruction and Development, Washington, DC
- Eurostat and IFF (2004). *Economy-wide Material Flow Accounts and Indicators of Resource Use for the EU-15: 1970-2001, Series B*. Prepared by Weisz, H., Amann, Ch., Eisenmenger, N. and Krausmann, F. Eurostat, Luxembourg
- FAO (1995). *Prevention of accumulation of obsolete pesticide stocks*. Food and Agriculture Organization of the United Nations, Rome <http://www.fao.org/docrep/v7460e/v7460e00.htm> (last accessed 27 April 2007)
- FAO (1999). *Trade issues facing small island developing states*. Food and Agriculture Organization of the United Nations, Rome <http://www.fao.org/docrep/meeting/X1009E.htm> (last accessed 27 April 2007)
- FAO (2001). *Baseline study on the problem of obsolete pesticide stocks*. Food and Agriculture Organization of the United Nations, Rome
- FAO (2002). *Stockpiles of obsolete pesticides in Africa higher than expected*. Food and Agriculture Organization, Rome <http://www.fao.org/english/newsroom/news/2002/9109-en.html> (last accessed 13 June 2007)
- FAO (2003a). *Status and trends in mangrove area extent worldwide*. By Wilkie, M.L. and Fortuna, S. Forest Resources Assessment Working Paper No. 63. Forest Resources Division. Food and Agriculture Organization of the United Nations, Rome (Unpublished)
- FAO (2003b). *The State of Food Insecurity in the World; monitoring progress towards the World Food Summit and Millennium Development Goals*. Food and Agriculture Organization of the United Nations, Rome
- FAO (2004a). *Advance Funding for Emergency and Rehabilitation Activities*. 127th Session Council. Food and Agricultural Organization of the United Nations, Rome <http://www.fao.org/docrep/meeting/008/3631e.htm> (last accessed 27 April 2007)
- FAO (2004b). *FAO and SIDS: Challenges and Emerging Issues in Agriculture, Forestry and Fisheries*. Food and Agriculture Organization, Rome
- FAO (2005a). *Mediterranean fisheries: as stocks decline, management improves*. Food and Agriculture Organization, Rome <http://www.fao.org/newsroom/en/news/2005/105722/index.html> (last accessed 21 June 2007)
- FAO (2005b). *The state of food security in the world 2005; eradicating world hunger - key to achieving the Millennium Development Goals*. Food and Agricultural Organization of the United Nations, Rome
- FAO (2006). *Progress towards the MDG target*. Food security statistics. Food and Agriculture Organization of the United Nations, Rome [http://www.fao.org/es/ess/foostat/foodsecurity/FSMap/mdgmap\\_en.htm](http://www.fao.org/es/ess/foostat/foodsecurity/FSMap/mdgmap_en.htm) (last accessed 27 April 2007)
- FAO, UNEP and WHO (2004). *Pesticide Poisoning: Information for Advocacy and Action*. United Nations Environment Programme, Geneva
- Fischetti, M. (2001). Drowning New Orleans. In *Scientific American* 285(4):76-85
- Flynn, J., Slovik, R. and Mertz, C.K. (1994). Gender, race and perception of environmental health risks, Oregon. In *Decision Research* March 16
- Folke, C., Carpenter, S., Elmqvist, Th., Gunderson, L., Holling, C. S. and Walker, B. (2002). Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations. In *Ambio* 31(5):437-440
- Fordham, M.H. (1999). The intersection of gender and social class in disaster: balancing resilience and vulnerability. In *International Journal of Mass Emergencies and Disasters* 17(1):15-37
- Friedmann, J. (1992). *Empowerment: The politics of alternative development*. Blackwell Publishers, Cambridge, MA
- GAEZ (2000). *Global Agro-Ecological Zones*. Food and Agricultural Organization of the United Nations and International Institute for Applied Systems Analysis, Rome <http://www.fao.org/og/ag/ogj/gaez/index.htm> (last accessed 13 June 2007)
- Garrett G. (1998). Global Markets and National Politics: Collision Course or Virtuous Circle? In *International Organization* 52(4):787-824
- Georges, N.M. (2006). Solid Waste as an Indicator of Sustainable Development in Tortola, British Virgin Islands. In *Sustainable Development* 14:126-138
- GEO Data Portal. *UNEP's online core database with national, sub-regional, regional and global statistics and maps, covering environmental and socio-economic data and indicators*. United Nations Environment Programme, Geneva <http://www.unep.org/geo/data> or <http://geodata.grid.unep.ch> (last accessed 1 June 2007)
- GIWA (2006). *Challenges to International Waters; Regional Assessments in a Global Perspective*. United Nations Environment Programme, Nairobi <http://www.giwa.net/publications/finalreport/> (last accessed 13 June 2007)
- Gleditsch, N.P. (ed.) (1999). *Conflict and the Environment*. Kluwer, Dordrecht, Boston, London
- Gleick, P. (1999). The Human Right to Water. In *Water Policy* 1(5):487-503
- Goldsmith, E. and Hildyard, N. (1984). *The Social and Environmental Effects of Large Dams*. Sierra Club Books, San Francisco
- Gordon, B., Mackay, R. and Rehuuss, E. (2004). *Inheriting the World. The Atlas of Children's Health and the Environment*. World Health Organization, Geneva
- Goreux, L. and Macroe, J. (2003). *Reforming the Cotton Sector in Sub-Saharan Africa*. Africa Regional Working Paper Series 47. The World Bank, Washington, DC. <http://www.worldbank.org/afr/wps/wp47.pdf> (last accessed 27 April 2007)
- Gowrie, M. N. (2003). Environmental vulnerability index for the island of Tobago, West Indies. In *Conservation Ecology* 7(2):11 <http://www.consecol.org/vol7/iss2/art11/> (last accessed 27 April 2007)
- Graham, Edward, M. (2000). *Fighting the Wrong Enemy: Antiglobal Activists and Multinational Enterprises*. Institute for International Economics, Washington, DC
- Graham, T. and Idechong, N. (1998). Reconciling Customary and Constitutional Law - Managing Marine Resources in Palau, Micronesia. In *Ocean and Coastal Management* 40(2):143-164
- Greif, A. (1992). Institutions and International Trade: Lessons from the Commercial Revolution (Historical Perspectives on the Economics of Trade). In *AEA Papers and Proceedings* 82(2):129-133
- Grether, J.M. and De Melo, J. (2003). *Globalization and Dirty Industries: Do Pollution Havens Matter?* NBER Working Papers 9776, National Bureau of Economic Research, Cambridge, MA
- Griffin, D.W., Kellogg, C.A. and Shinn, E.A. (2001). Dust in the wind: Long range transport of dust in the atmosphere and its implications for global public and ecosystem health. In *Global Change & Human Health* 2(1)
- Gupta, S., Patillo, C. and Wagh, S. (2006). *Are Donor Countries Giving More or Less Aid?* Working Paper WP/06/71. International Monetary Fund, Washington, DC <http://www.imf.org/external/pubs/ft/wp/2006/wp0601.pdf> (last accessed 27 April 2007)
- Hoavisto, P. (2005). Environmental impacts of war. In *State of the World 2005: Redefining Global Security* Worldwatch Institute, Norton, New York, NY
- Harbom, L. and Wallerstein, P. (2007). Armed Conflict, 1989-2006. In *Journal of Peace Research* 44(5) <http://www.uicp.uu.se> (last accessed 29 June 2007)
- Harper, K. and Rajan, S.R. (2004). *International Environmental Justice: Building Natural Assets for the Poor*. Working Paper Series, 87. Political Economy Research Institute, <http://www.peri.umass.edu/Publication.236+MS3cb8b79b72.0.html> (last accessed 13 June 2007)
- Harrison, P. and Pearce, F. (2001). *AAAS Atlas of Population and Environment*. American Association for the Advancement of Science. University of California Press, California <http://www.ourplanet.com/aaas/pages/about.html> (last accessed 27 April 2007)
- Haupt, F., Muller-Böker, U. (2005). Grounded research and practice - PAMS - A transdisciplinary program component of the NCCR North-South. In *Mountain Research and Development* 25(2):101-103
- Hay, J.E., Mimura, N., Campbell, J., Fifita, S., Koshy, K., McLean, R.F., Nakalevu, T., Nunn, P. and de Wet, N. (2003). *Climate Variability and change and sea-level rise in the Pacific Islands Region: A resource book for policy and decision makers, educators and other stakeholders*. SPREP, Apia, Samoa
- Henderson-Sellers, A., Zhang, H., Berz, G., Emanuel, K., Gray, W., Landsea, C., Holland, G., Lighthill, J., Shieh, S.-L., Webster, P. and McGuffie, K. (1998). Tropical Cyclones and Global Climate Change: A Post-IPCC Assessment. In *Bulletin of the American Meteorological Society* 79:19-38
- Hertel, T.W. and Winters, A.L. (eds.) (2006). *Poverty and the WTO: Impacts of the Doha Development Agenda*. The World Bank, Washington, DC
- Hess, J. and Frumkin, H. (2000). The International trade in toxic waste: The case of Sihanoukville, Cambodia. In *Int J Occup Environ Health* 6:263-76
- Hewitt, K. (1983). *Interpretations of Calamity: from the viewpoint of human ecology*. Allen and Unwin, St Leonards, NSW
- Hewitt, K. (1997). *Regions of Risk. A geographical introduction to disasters*. Addison Wesley Longman, Harlow, Essex
- Hiblin, B., Dadds, F. and Middleton, T. (2002). Reflections on the First Week - Prep. Comm. II Progress Report. Outreach 2002, 4th February, 1-2
- Higashimura, R. (2004). Fisheries in Atlantic Canada after the collapse of cod. *Proceedings Twelfth Biennial Conference of the International Institute of Fisheries Economics & Trade (IIFET)*, July 20-30, 2004, Tokyo
- Hild, C.M. (1995). The next step in assessing Arctic human health. In *The Science of the Total Environment* 160/161:559-569
- Holling, C.S. (1973). Resilience and stability of ecological systems. In *Annual Review of Ecology and Systematics* 4:1-23
- Holling, C.S. (2001). Understanding the Complexity of Economic, Ecological and Social Systems. In *Ecosystems* 4:390-405
- Homer-Dixon, T.F. (1999). *Environment, Scarcity, and Violence*. Princeton University Press, Princeton, NJ
- Hoegh-Guldberg, O., Hoegh-Guldberg, H., Stout, D., Cesar, H. and Timmerman, A. (2000). *Pacific in Peril: Biological, Economic and Social Impacts of Climate Change on Pacific Coral Reefs*. Greenpeace, Amsterdam
- Huggins, C., Chenje, M. and Mohamed-Katerere, J.C. (2006). Environment for Peace and Regional Cooperation. In UNEP (2006). *Africa Environment Outlook 2. Our Environment, Our Wealth*. United Nations Environment Programme, Nairobi
- Hulme, D. and Murphree, M. (eds.) (2001) *African Wildlife and Livelihoods: The promise and performance of community conservation*. James Curry, Oxford
- IATF (2004). Report of the Tenth Session of the Working Group on Climate Change and Disaster Reduction, 7-8 October 2004. Inter-Agency Task Force on Disaster Reduction, Geneva
- ICES (2006). *Is time running out for deepsea fish?* <http://www.ices.dk/marineworld/deepseefish.asp>
- ICOLD (2006). *Proceedings of the 22nd ICOLD Congress of the International Commission on Large Dams*, 18-23 June 2006, Barcelona
- IEA (2002). *World Energy Outlook 2002*. International Energy Agency, Paris
- IEA (2003). *World Energy Outlook 2003*. International Energy Agency, Paris
- IEA (2004). *World Energy Outlook 2004*. International Energy Agency, Paris

- IEA (2005). *World Energy Outlook 2005*. International Energy Agency, Paris
- IEA (2006). *World Energy Outlook 2006*. International Energy Agency, Paris
- IEA (2007). *Energy Security and Climate Change Policy*. International Energy Agency, Paris [http://www.iea.org/Textbase/publications/free\\_new\\_Desc.asp?PUBS\\_ID=1883](http://www.iea.org/Textbase/publications/free_new_Desc.asp?PUBS_ID=1883) (last accessed 15 June 2007)
- IFPRI (2006). *2006 Global Hunger Index. A Basis for Cross-Country Comparisons*. International Food Policy Research Institute, Washington, DC
- IFRCRS (2005). *World Disasters Report*. International Federation for the Red Cross and Red Crescent Societies, Geneva
- Igoe, J. (2006). Measuring the Costs and Benefits of Conservation to Local Communities. In *Journal of Ecological Anthropology* 10:72-77
- ISD (2002). WSSD PrepCom II Highlights: Monday, 28 January 2002. Earth Negotiations Bulletin. International Institute for Sustainable Development, Winnipeg
- IOM (2005). *World Migration 2005: The Costs and Benefits of International Migration*. International Organization for Migration, Geneva
- IPCC (2001). *Climate Change 2001 – Impacts, Adaptation and Vulnerability*. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change. McCarthy, J.J., Canziani, O.F., Leary, N.A., Dokken, D.J. and White, K.S. (eds). Cambridge University Press, Cambridge and New York, NY
- IPCC (2007). *Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability, Summary for Policymakers*. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Geneva <http://www.ipcc.ch/SPM6av07.pdf> (last accessed 27 April 2007)
- IRN (2006). *IRN's Bujagali Campaign*. International River Network <http://www.irn.org/programs/bujagali/> (last accessed 14 June 2007)
- ISDR (2002). *Natural disasters and sustainable development: understanding the links between development, environment and natural disasters*. United Nations International Strategy for Disaster Reduction (ISDR), Geneva
- ISDR (2004). *Living with Risk: A global review of disaster reduction initiatives*. International Secretariat for Disaster Reduction, Geneva
- IUCN (2005). Constraints to the sustainability of deep sea fisheries beyond national jurisdiction. *IUCN Committee on Fisheries. Twenty-sixth Session, Rome, Italy, 7–11 March 2005*
- Jeffrey, R. and Sunder, N. (2000). *A New Moral Economy for India's Forests? Discourses of Community and Participation*. Sage Publications, New Delhi
- Jones, R. (2006). *Slum politics: how self-government strategies are improving futures for slum-dwellers*. Association for Women's Rights in Development. <http://www.awid.org/go.php?stid=1584> (last accessed 27 April 2007)
- Josking, T. (1998). Trade in Small Island Economies: Agricultural Trade Dilemmas for the OECs. Paper prepared for *IICA/NCAP Workshop on Small Economies in the Global Economy, Grenada*
- Kahl, C. (2006). *States, Scarcity, and Civil Strife in the Developing World*. Princeton University Press Princeton, NJ
- Karlsson, S. (2000). *Multi-layered Governance. Pesticides in the South - Environmental Concerns in a Globalised World*. PhD Dissertation, Linköping University, Linköping
- Karlsson, S. (2002). The North-South Knowledge Divide: Consequences for Global Environmental Governance. In *Global Environmental Governance: Options and Opportunities*, Esty, D.C. and Ivanova, M.H. (eds). Yale School of Forestry and Environmental Studies, New Haven
- Karlsson, S.I. (2007). Allocating Responsibilities in Multi-level Governance for Sustainable Development. *International Journal of Social Economics* 34
- Kasperson, J.X., Kasperson, R.E., Turner II, B.L., Hsieh, W. and Schiller, A. (2005). Vulnerability to Global Environmental Change. In *The Human Dimensions of Global Environmental Change*, Rosa, E. A., Diekmann, A., Dietz, T., Joeger, C.C. (eds.) MIT Press, Cambridge MA
- Katerere, Y. and Mohamed-Katerere, J.C. (2005). From Poverty to Prosperity: Harnessing the Wealth of Africa's Forests. In *Forests in the Global Balance – Changing Paradigms*, Mery, G., Alfaro, R., Kanninen, M. and Lobovikov, M. (eds.). IUFRO World Series Vol. 17. International Union of Forest Research Organizations, Helsinki
- Klein, R. J. T. and Nicholls, R. J. (1999). Assessment of Coastal Vulnerability to Climate Change. In *Ambio* 28:182-187
- Klein, R.J.T., Nicholls, R.J. and Thomalla, F. (2003). Resilience to Weather-Related Hazards: How Useful is this Concept? In *Global Environmental Change Part B: Environmental Hazards* 5:35-45
- Knutson, T.R., Tuleya, R.E. and Kurihara, Y. (1998). Simulated Increase in Hurricane Intensities in a CO2-Warmed Climate. In *Science* 279:1018–1020
- Krugman, P. (2003). *The Great Unraveling: Losing Our Way in the New Century*. Norton, New York, NY
- Kuhnlein, H. V. and H. M. Chan (2000). Environment and contaminants in traditional food systems of northern indigenous peoples. In *Annual Review of Nutrition* 20:595-626
- Kulindwa, K., Kamen-Mbote, P., Mohamed-Katerere and J.C., Chenje, M. with Sebukeera, C. (2006). The Human Dimension. In *Africa Environment Outlook 2. Our Environment, Our Wealth*. United Nations Environment Programme, Nairobi
- Kubshreshita, S.N. (1993). *World water resources and regional vulnerability. Impact of future changes*. RR-93-10. International Institute for Applied Systems Analysis, Laxenburg.
- Kusters, K. and Belcher, B. (Eds.) (2004). *Forest products, livelihoods and conservation: case studies of non-timber forest product systems. Vol. 1, Asia*. Center for International Forestry Research, Bogor
- Lal, Deepak and Mynt, Hla (1996). *The Political Economy of Poverty, Equity, and Growth*. Clarendon, Oxford
- Lam, M. (1998). Consideration of Customary Marine Tenure System in the Establishment of Marine Protected Areas in the South Pacific. In *Ocean and Coastal Management* 39(1):97-104
- Leach, M., Scoones, I. and Thompson, L. (2002). Citizenship, science and risk: conceptualising relationships across issues and settings. In *IDS Bulletin* 33(2):83-91. Institute of Developing Studies, University of Sussex, Brighton
- Leamer, E.E., Maul, H., Rodriguez, S. and Schott, P.K. (1999). Does Natural Resource Abundance Increase Latin American Income Inequality. In *Journal of Development Economics* 59:3–42
- Lebel, J., Mergier, D., Branches, F., Lucotte, M., Amorim, M., Larrie, F., Dolbec, J. (1998). Neurotoxic effects of low-level methyl mercury contamination in the Amazonian Basin. In *Environ. Res.* 79:20-32
- Lebel, L., Tri, N.H., Saengnong, A., Pasang, S., Bucatama, U. and Thoa, L.K. (2002). Industrial transformation and shrimp aquaculture in Thailand and Vietnam: Pathways to ecological, social and economic sustainability? In *Ambio* 31(4):311-323
- La Rovere, E.L. and Romeiro, A.R. (2003). *Country study Development and Climate: Brazil, COPPE/UFRJ and UNICAMP/EMBRAPA, Rio de Janeiro*, <http://www.developmentfirst.org/Publications/BrazilCountryStudy.pdf>
- Leite, C. and J. Weidmann (1999). *Does Mother Nature Corrupt? Natural Resources, Corruption, and Economic Growth*, International Monetary Fund, Washington, DC
- Lind, J. and Sturman, K. (eds.). (2002). *Scarcity and Surfeit - The ecology of Africa's conflicts*, African Centre for Technology Studies and Institute for Security Studies, South Africa
- Liu, P. F., Lynett, P., Fernando, H., Jaffe, B. E., Fritz, H., Higman, B., Morton, R., Goff, J. and Synalakis C. (2005). Observations by the International Tsunami Survey Team in Sri Lanka. In *Science* 308(5728):1595
- Lopez, P. D. (2005). *International Environmental Regimes: Environmental Protection as a Means of State Making?* No. 242. Oficina do CES, Centro de Estudos Sociais. Coimbra <http://www.ces.ucp.pt/publicacoes/oficina/242/242.php> (last accessed 15 June 2007)
- Lüdeke, M. K. B., Petschelt-Held, G. and Schellhuber, J. (2004). Syndromes of global change: The first panoramic view. In *GAIA* 13(1)
- Malm, O. (1998). Gold mining as a source of mercury exposure in the Brazilian Amazon. In *Environ. Res.* 77:73-78
- Markovich, V. and Annandale, D. (2000). Sinking without a life-jacket? Sea Level Rise and the Position of Small Island States in International Law. In *Asia-Pacific Journal of Environmental Law* 5(2):135-154
- Marshall, E., Newton, A. C. and Schrekenberg, K. (2003). Commercialization of non-timber forest products: first steps in the factors influencing success. In *International Forestry Review* 5(2):128-137
- Martinez-Alier, J. (2002). *Environmentalism of the poor*. Edward Elgar, Cheltenham
- Matthew, R., Halle, M. and Switzer, J. (2002). *Conserving the Peace: Resources, Livelihoods, and Security*. International Institute for Sustainable Development and IUCN – The World Conservation Union, Winnipeg
- Mayrand, K., Paquin, M. and Dionne, S. (2005). *From Boom to Dust? Agricultural Trade Liberalization, Poverty and Desertification in Rural Drylands: The Role of UNCCD*. [http://www.unisfara.org/?id\\_article=216&pu=1&ln=1](http://www.unisfara.org/?id_article=216&pu=1&ln=1) (last accessed 27 April 2007)
- McCully, P. (1996). *Silenced Rivers: The Ecology and Politics of Large Dams*. Zed Books, London, New Jersey
- McDonald, B. and Gaulin, T. (2002). Environmental Change, Conflict, and Adaptation: Evidence from Cases. Presented at the *Annual Meeting of the International Studies Association, March 24-27, 2002*
- McElroy, J.L. (2003). Tourism Development in Small Islands Across the World. In *Geografiska Annaler* (86):231-242
- Meadows, D., Randers, J. and Meadows, D. (2004). *Limits to Growth. The 30-Year Update*. Green Publishing Company, White River Junction, Vermont, Chelsea
- Mertens, T. (2005). International or Global Justice? Evaluating the Cosmopolitan Approach. In *Real World Justice*, Follesdal, A. and Pogge, T. (eds.). Springer, Dordrecht
- Metha, L. and La Cour Madsen, B. (2004). Is the WTO after your water? The General Agreement on Trade in Services (GATS) and poor people's right to water. In *Natural resources forum: a United Nations Journal* 2 (2):154-164
- Miller, F., F. Thomalla and J. Rockström (2005). Paths to a Sustainable Recovery after the Tsunami. In *Sustainable Development Update* 5(1)
- Miller, F., Thomalla, F., Downing T. E. and Chadwick, M. (2006). Resilient Ecosystems, Healthy Communities: Human Health and Sustainable Ecosystems after the Tsunami. In *Oceanography* 19(2):50-51
- MA (2003). *Ecosystems and Human Well-being: a framework for assessment*. Island Press, Washington, DC
- MA (2005). *Ecosystems and Human Well-being: Synthesis*. Island Press, Washington, DC
- Mitchell, J.K. (1988). Confronting natural disasters: an international decade for natural hazard reduction. In *Environment* 30 (2):25-29
- Mitchell, J.K. (1999). *Crucibles of hazard: mega-cities and disasters in transition*. United Nations University Press, New York, NY
- Moati, V., McDade, S., Lallemant, D. and Saghir, J. (2005). *Energy and the Millennium Development Goals*. Energy Sector Management Assistance Programme, United Nations Development Program, UN Millennium Project, and The World Bank, New York, NY
- Mohamed-Katerere, J.C. (2001). *Review of the Legal and Policy Framework for Transboundary Natural Resource Management in Southern Africa*. Paper No 3, IUCN-RDSA Series on Transboundary Natural Resource Management. IUCN – The World Conservation Union, Harare
- Mohamed-Katerere, J.C. and Van der Zaag, P. (2003). Untying the knot of silence – making water law and policy responsive to local normative systems. Hassan, F.A. Reuss, M. Trattier, J. Bernhardt, C. Wolf, A.T. Mohamed-Katerere, J. C. and Van der Zaag, P. (eds.). In *History and Future of Shared Water Resources*. UNESCO-International Hydrological Programme, Paris
- Mollo, M., Johl, A., Wagner, M., Popovic, N., Lador, Y., Hoenninger, J., Seybert, E. and Walters, M. (2005). Environmental Rights Report. Human Rights and the Environment. Materials for the 61st Session of the United Nations Commission on Human Rights, Geneva, March 14 – April 22, 2005. Earthjustice, Oakland
- Monroe, M. C. (2003). Two Avenues for Encouraging Conservation Behaviours. In *Human Ecology Review* 10(2):113-125
- Mortimore, M. (2005). Dryland development: success stories from West Africa. In *Environment* 47:8-21
- Mortimore, M. (2006). Why invest in drylands? Synergies and strategy for developing ecosystem services. In *Drylands' hidden wealth. Integrating Dryland Ecosystem Services into National Development Planning. Conference Report. Amman, Jordan, 26 – 27 June 2006* [http://www.iucn.org/themes/CEM/documents/drylands/amman\\_drylands\\_wreport\\_noopt\\_sept2006.pdf](http://www.iucn.org/themes/CEM/documents/drylands/amman_drylands_wreport_noopt_sept2006.pdf) (last accessed 27 April 2007)
- Mueller, H. (1996). *Nuclear Non-Proliferation Policy 1993-1995*. Peter Lang Publishing
- Munich Re (2004a). *Megacities – Megarisks: Trends and Challenges for Insurance and Risk Management*. Munich Re Group, Munich
- Munich Re (2004b). *Topics 2/2004. IFRS – New Accounting Standards: Flood Risks. Rising Costs of Bodily Injury Claims*. Munich Re Group, Munich
- Munich Re (2006). *Topics Geo Annual Review: Natural Catastrophes 2005*. Munich Re Group, Munich
- Murtagh, F. (1985). *Multidimensional Clustering Algorithms*. Physico-Verlag
- Narayan, D., Chambers, R., Shah, M. and Patesch P. (2000). *Voices of the Poor – Crying Out for Change*. Oxford University Press, New York, NY
- NASA (2002). Haitian Deforestation. Goddard Space Flight Center. <http://svs.gsfc.nasa.gov/vis/000000/a002600/a002640/> (last accessed 14 June 2007)
- Ncube, W., Mohamed-Katerere, J. C. and Chenje, M. (1996). Towards the Constitutional Protection of Environmental Rights in Zimbabwe. In *Zimbabwe Law Review*
- Nevill, J. (2001). Ecotourism as a source of funding to control invasive species. In *Invasive Alien Species: A Toolkit of Best Prevention and Management Practices*, Wittenberg, R. and Cock, M.J.W. (eds.). CAB International, Wallingford
- Newell, P. and Mackenzie, R. (2004). Whose rules rule? Development and the global governance of biotechnology. Centre for the Study of Globalisation and Regionalisation, University of Warwick. In *IDS Bulletin* 35(1):82-92
- Nicholls, R. J. (2002). Analysis of global impacts of sea-level rise: A case study of flooding. In *Physics and Chemistry of the Earth* 27:1455-1466
- Nicholls, R.J. (2006). Storm Surges in Coastal Areas. In *Natural Disaster Hotspots - Case Studies*, Arnold, M., Chen, R.S., Deichmann, U., Dilley, M., Lerner-Lam, A.L., Pullen, R.E. and Tronhis, Z. (eds.). The World Bank, Washington, DC

- Nori, M., Switzer, J. and Crawford, A. (no date). *Herding on the Brink. Towards a Global Survey of Pastoral Communities and Conflict*. Occasional Working Paper. IUCN Commission on Environmental, Economic and Social Policy. IUCN – The World Conservation Union and International Institute for Sustainable Development, Gland
- Nurse, L. and Rowlestone, M. (2005). Adaptation to Global Climate Change: An Urgent Requirement for Small Island Developing States. In *REGEL* 14(2):100-107
- NZIS (2006). *Immigration New Zealand Online Operations Manual, April 2006 Update*. New Zealand Immigration Service, Wellington [www.immigration.govt.nz/migrant/general/generalinformation/operationsmanual](http://www.immigration.govt.nz/migrant/general/generalinformation/operationsmanual) (last accessed 27 April 2007)
- OECD (2007). *Reference DAC Statistical Tables. Net ODA in 2006 (updated April 2007)*. Organisation for Economic Cooperation and Development, Paris <http://www.oecd.org/dataoecd/12/8/38346276.xls> (last accessed 15 June 2007)
- Oldeman, L.R., Hakkeling, R.T.A. and Sombroek, W.G. (1991) *World map of human-induced soil degradation: A brief explanatory note*. ISRIC and United Nations Environment Programme, Wageningen
- Page, S. (2004). Developing Countries in International Negotiations: how they influence Trade and Climate change Negotiations. University of Sussex, Institute of Development Studies, Brighton. In *IDS Bulletin* 35(1) *Globalization and Poverty*
- PAHO (2002). *Health in the Americas, 2002 Edition*. Pan-American Health Organisation [http://www.paho.org/English/DD/PUB/HIA\\_2002.htm](http://www.paho.org/English/DD/PUB/HIA_2002.htm) (last accessed 27 April 2007)
- Papayrakis, E. and Gerlagh, R. (2004). The Resource Curse Hypothesis and its Transmission Channels. In *Journal of Comparative Economics* 32:181–193
- Paré, L., Robles, C. and Cortéz, C. (2002). Participation of Indigenous and Rural People in the Construction of Development and Environmental Public Policies in Mexico. Development Studies Institute, University of Sussex, Brighton. In *IDS Bulletin* 33(2) *Making Rights Real: Exploring Citizenship, Participation and Accountability*
- Parish, F. and Looi, C.C. (1999). *Mobilising financial support from bilateral and multilateral donors for the implementation of the Convention*. Ramsar COP7 DOC. 20.4. The Ramsar Convention on Wetlands, Gland [http://www.ramsar.org/cop7/cop7\\_doc\\_20.4\\_e.htm](http://www.ramsar.org/cop7/cop7_doc_20.4_e.htm) (last accessed 15 June 2007)
- Parry, M. L., Amell, N., McMichael, T., Nicholls, R., Martens, P., Kovats, S., Livemore, M., Rosenzweig, C., Iglesias, A. and Fischer, G. (2001). Millions at Risk: Defining Critical Climate Change Threats and Targets. In *Global Environmental Change* 11(3):181-83
- Patz, J.A., Campbell-Lendrum, D., Holloway, T. and Foley, J.A. (2005). Impact of regional climate change on human health. In *Nature* 438(7066):310-317
- Pearce, D. (2005). *The Critical Role of Environmental Improvement in Poverty Reduction*. Report prepared for the Poverty Environment Partnership Peg Md7 Initiative of the United Nations Development Programme and United Nations Environment Programme, Washington, DC and Nairobi
- Pearce, F. (1992). *The Dammed – Rivers, Dams, and the Coming World Water Crises*. The Bodley Head, London
- Pelling, M. and Utto, J.I. (2001). Small Island Developing States: Natural Disaster Vulnerability and Global Change. In *Environmental Hazards* 3:49-62
- Petkova, E., Maurer, C., Henninger, N. and Irwin, F. (2002). *Closing the Gap: Information, Participation and Justice in Decision-making for the Environment*. World Resources Institute, Washington, DC
- Petsche-Held, G., Block, A., Cossel-Gintz, M., Kropp, J., Lüdeke, M.K.B., Moldenhauer, O. and Reusswig, F. (1999). Syndromes of global change, a qualitative approach to assist global environmental management. In *Environmental Modelling and Assessment* 4:315-326
- Pimm, S.L. (1984). The complexity and stability of ecosystems. In *Nature* 307:321-326
- Poverty Mapping (2007). <http://www.poverty-map.net> (last accessed 14 June 2007)
- Prakash, A. (2000). Responsible Care: An Assessment. In *Business & Society* 39(2):183-209
- Prescott-Allen, R. (2001). *The Well-being of Nations. A Country-by-Country Index of Quality of Life and the Environment*. Island Press, Washington DC
- Prowse, M. (2003). *Towards a clearer understanding of "vulnerability" in relation to chronic poverty*. University of Manchester, Chronic Poverty Research Centre, WP24, Manchester
- Reilly, J. and Schimmelpenninck, D. (2000). Irreversibility, Uncertainty, and Learning: Portraits of Adaptation to Long-Term Climate Change. In *Climate Change* 45(1), pp. 253-278(26)
- Rodrik, D. (1996). *Why Do More Open Countries Have Bigger Governments?* National Bureau of Economic Research, Cambridge, MA
- Round, J. and Whalley, J. (2004). *Globalisation and Poverty: Implications of South Asian Experience for the Wider Debate*. Centre for the Study of Globalisation and regionalisation, University of Warwick, *IDS Bulletin* 35(1):1-19
- Ross, M.L. (2001). Does Oil Hinder Democracy? In *World Politics* 53:325–361
- Russett, B. and Oneal, J. (2000). *Triangulating Peace: Democracy, Interdependence, and International Organizations*. The Norton Series in World Politics. W.W. Norton and Company, London
- Sachs, J. D. and Warner, A. (2001). The Curse of Natural Resources. In *European Economic Review* 45(4-6):827–838
- Sadoff, C.W. and Grey, D. (2002). Beyond the river: the benefits of cooperation on international rivers. In *Water Policy*, 4, 5:389-403
- Safriel, U., Adeel, Z., Niemeijer, D., Puigdefabres, J., White, R., Lal, R., Wierslow, M., Ziedler, J., Prince, S., Archer, E and King, C. (2005). *Dryland Systems*. In *MA* (2005). State and Trends. Volume 1.
- Sala-i-Martin, X.X. (1997). I Just Ran Two Million Regressions (What Have We Learned From Recent Empirical Growth Research?). In *AEA Papers and Proceedings* 87(2):178-183
- Sandwith, T. and Besançon, C. (2005). Trade-offs among multiple goals for transboundary conservation. In *Environmental Change and Security Program Report* 11:61-62
- Sarin, M. (2003). *Devolution as a threat to democratic decision-making in forestry? Findings from three states in India*. Working Paper 197. Overseas Development Institute, London
- SAUP (2007). *Landings in High Seas*. Web Products: High Seas Areas. <http://www.seaaroundus.org/eez/SummaryHighseas.aspx?EEZ=0> (last accessed 26 April 2007)
- Schiettecatte, W., Ouassarb, M., Gabrielsa, D., Tanghe, S., Heirmana, S. and Abdellilb, F. (2005). Impact of water harvesting techniques on soil and water conservation: a case study on a micro catchment in southeastern Tunisia. In *Journal of Arid Environments* 6:297–313
- Schneider, G., Barbien, K. and Gleditsch, N. P. (eds.) (2003). *Globalization and Armed Conflict*. Rowman and Littlefield, Oxford
- Schütz, H., Brängezu, S. and Moll, S. (2004). *Globalisation and the shifting environmental burden. Material trade flows of the European Union*. Wuppertal Institute, Wuppertal
- Schütz G., Hacon, S., Moreno AR and Nagatani K. Principales marcos conceptuales para indicadores de salud ambiental aplicados en América Latina y Caribe. *Revista de la Organización Panamericana de la Salud*. (In press)
- Scoones, I (ed.) (2001). *Dynamics and Diversity. Soil fertility and farming livelihoods in Africa*. Earthscan, London
- Sen, A. (1999). *Development as Freedom*. Alfred A. Knopf, New York, NY
- Small, C. and Nicholls, R.J. (2003). A Global Analysis of Human Settlement in Coastal Zones. In *Journal of Coastal Research* 19(3):584 – 599
- Smil, V. (2001). *Enriching the Earth*. MIT Press, Cambridge MA
- Smith, K. (1992). *Environmental hazards: assessing risk and reducing disaster*. Routledge, New York, NY
- Smith, B., Burton, J., Klein, R.J.T., Wandel, J., (2000). An Anatomy of Adaptation to Climate Change and Variability. In *Climatic Change* 45(1):223-251
- Sohn, J., Nakhodo, S. and Baumert, K. (2005). *Mainstreaming Climate Change Considerations at the Multilateral Development Banks*. World Resources Institute, Washington, DC
- Solecki, W.D. and Leichenko, R.M. (2006). Urbanisation and the Metropolitan Environment: Lessons from New York and Shanghai. In *Environment* 48(4):6 – 23
- SOPAC and UNEP. *Environmental Vulnerability Index - EVI Results*. South Pacific Applied Geoscience Commission and United Nations Development Programme, Suva [http://www.vulnerabilityindex.net/EVI\\_Results.htm](http://www.vulnerabilityindex.net/EVI_Results.htm) (last accessed 14 June 2007)
- Soroos, M.S. (1997). The Canadian-Spanish 'Turbot War' of 1995: A Case Study in the Resolution of International Fishery Disputes. In *Conflict and the Environment* Gleditsch, N.P. (ed). Kluwer Publishers, Dordrecht
- Sperling, F. and Szekeley, F. (2005). Disaster Risk Management in a Changing Climate. Informal discussion paper prepared on behalf of the Vulnerability and Adaptation Resource Group (VARG) for the World Conference on Disaster Reduction in Kobe, Japan, 18–22 January 2005
- Stegarescu, D. (2004). *Public Sector Decentralization: Measurement Concepts and Recent International Trends*. Discussion Paper 04-74, Zentrum für Europäische Wirtschaftsforschung <http://ftp.zew.de/pub/zew-docs/dp/dp0474.pdf> (last accessed 27 April 2007)
- Steetskamp, I. E. and Van Wijk A. (1994). *Stroomloos. Kwetsbaarheid van de samenleving; gevolgen van verstoringen van de elektriciteitsvoorziening* (In Dutch). Rathenau Instituut, The Hague
- Stephens, C. (1996). Review Article: Healthy cities or Unhealthy Islands? The health and social implications of urban inequalities. In *Environment and Urbanization* 8(2):9-30
- Stein, E. (1999). Fiscal Decentralization and Government Size in Latin America. In *Journal of Applied Economics* 12(2):357-91
- Stohr, W. (2001). Introduction. In *Decentralization, Governance and the New Planning for Local-Level Development*, Stohr, W., Edralin, J. and Mani, D. (eds.). Greenwood Press, Westport
- Strand, H., Carlsen, J., Gleditsch, N.P., Hegre, H., Ormhaug, C. and Wilhelmssen, L. (2005). *Armed Conflict Dataset Codebook*. Version 3-2005 <http://www.prio.no/csw/armedconflict> (last accessed 27 April 2007)
- Swain, A. (2002). Environmental Cooperation in South Asia. In *Environmental Peacemaking*, Conca K. and Dabelko, G.D. (eds.). The Woodrow Wilson Center Press and the Johns Hopkins University Press, Washington, DC and Baltimore
- Swatuk, L. (2002). Environmental cooperation for regional peace and security in Southern Africa. In *Environmental Peacemaking*, Conca K. and Dabelko, G.D. (eds.). The Woodrow Wilson Center Press and the Johns Hopkins University Press, Washington, DC and Baltimore
- Tan, K.-C. (2005). Boundary Making and Equal Concern. In *Global Institutions and Responsibilities: Achieving Global Justice*, Barry, C. and Pogge, T.W. (eds.). Blackwell Publishing, Oxford
- Tasioulas, J. (2005). Global Justice Without End? In *Global Institutions and Responsibilities: Achieving Global Justice* Barry, C. and Pogge, T.W. (ed.). Blackwell Publishing, Oxford
- Tetteh, I.K., Frempong, E. and Awuah, E. (2004). An analysis of the environmental health impact of the Berekese Dam in Kumasi, Ghana. In *Journal of Environmental Management* 72:189–194
- Thomalla, F., Downing, T.E., Spangier-Siegfried, E., Han, G. and Rockström, J. (2006). Reducing Hazard Vulnerability: Towards a Common Approach Between Disaster Risk Reduction and Climate Adaptation. In *Disasters* 30(1):39-48
- Thomas, D. (2006). *People, deserts and drylands in the developing world. Policy Briefs*. Science and Development Network <http://www.sdenvet.org/dossiers/index.cfm?> (last accessed 27 April 2007)
- Tompkins, E.L., Nicholson-Cole, S.A., Hurlston, L., Boyd, E., Hodge, G.B., Clarke, J., Gray, G., Tritz, N. and Varlock, L. (2005). *Surviving Climate Change in Small Islands – A Guidebook*. Tyndall Centre for Climate Change Research, University of East Anglia, Norwich
- Travis, J. (2005). Hurricane Katrina: Scientists' Fears Come True as Hurricane Floods New Orleans. In *Science* 309:1656-1659
- UIS (2004). A Decade of Investment in Research and Development (R&D): 1990-2000. In *UIS Bulletin on Science and Technology Statistics* 1. UNESCO Institute for Statistics, Paris <http://www.uis.unesco.org/template/pdf/S&T/BulletinNo1EN.pdf> (last accessed 26 June 2007)
- UN. *Terms of reference for the special rapporteur on the effects of illicit movement and dumping of toxic and dangerous products and waste on the enjoyment of human rights*. UN Office of the High Commissioner on Human Rights, New York, NY <http://www.unhcr.ch/html/menu2/7/b/toxr.htm> (last accessed 14 June 2007)
- UN (1966). *International Covenant on Economic, Social and Cultural Rights*. Office of the High Commissioner for Human Rights. United Nations, New York and Geneva [http://www.unhcr.ch/html/menu3/b/a\\_escr.htm](http://www.unhcr.ch/html/menu3/b/a_escr.htm) (last accessed 27 April 2007)
- UN (1986). *Declaration on the Right to Development*. Office of the High Commissioner for Human Rights. United Nations, New York and Geneva <http://www.unhcr.ch/html/menu3/b/74.htm> (last accessed 15 June 2007)
- UN (2002). Plan of Implementation of the World Summit on Sustainable Development. In *Report of the World Summit on Sustainable Development*. Johannesburg, South Africa, 26 August - 4 September. A/CONF.199/20. United Nations, New York, NY
- UN (2003). *Substantive Issues Arising in the Implementation of the International Covenant on Economic, Social and Cultural Rights. General Comment No. 15 (2002). The Right to Water (arts. 11 and 12)*. E/C.12/2002/11. Committee on Economic, Social and Cultural Rights Twenty-ninth session, Geneva, 11-29 November 2002. Economic and Social Council, United Nations, Geneva [http://www.unhcr.ch/tbs/doc.nsf/0/a5458d1d1bbd713fc1256cc400389e94/\\$FILE/G0340229.pdf](http://www.unhcr.ch/tbs/doc.nsf/0/a5458d1d1bbd713fc1256cc400389e94/$FILE/G0340229.pdf) (last accessed 27 April 2007)
- UN (2005). *The Millennium Development Goals Report*. United Nations, New York, NY
- UN (2006). *Millennium Development Goals Report 2006*. United Nations, New York, NY
- UNCCD (2005). *The consequences of desertification*. Fact Sheet 3. United Nations Convention to Combat Desertification, Berlin <http://www.unccd.int/publicatio/factsheets/showFs.php?number=3> (last accessed 27 April 2007)
- UNCTAD (2004). *Trade Performance and Commodity Dependence: Economic Development in Africa*. United Nations Conference on Trade and Development, Geneva
- UNDP (2001). *Human Development Report 2001: Making New Technologies Work for Human Development*. United Nations Development Programme, New York, NY
- UNDP (2004a). *Reducing disaster risk: A challenge for development*. United Nations Development Programme, New York, NY [http://www.undp.org/bcp/whats\\_new/ldr\\_english.pdf](http://www.undp.org/bcp/whats_new/ldr_english.pdf) (last accessed 19 June 2007)

- UNDP (2004b). *Analysis of conflict as it relates to the production and marketing of drylands products. The case of Turkana (Kenya) and Karamoja (Uganda) cross-border sites. Baseline Survey Results*. [http://www.undp.org/drylands/docs/marketaccess/BaselinesConflict\\_and\\_Markets\\_Report.doc](http://www.undp.org/drylands/docs/marketaccess/BaselinesConflict_and_Markets_Report.doc) (last accessed 27 April 2007)
- UNDP (2005). *International cooperation at a crossroads: Aid, trade and security in an unequal world. Human Development Report*. United Nations Development Programme, New York, NY
- UNDP (2006) *Human Development Report 2006. Beyond scarcity: Power, poverty and the global water crisis*. United Nations Development Programme, New York, NY
- UNDP and GEF (2004). *Reclaiming the Land Sustaining Livelihoods*. United Nations Development Programme and Global Environment Facility, New York, NY
- UNECE (2005). *Aarhus Convention. Synthesis Report on the Status of Implementation of the Convention*. ECE/MP.PP/2005/18. United Nations Economic Commission for Europe, Geneva <http://www.unece.org/env/documents/2005/pp/ece/ece.mpp.pp.2005.18.e.pdf> (last accessed 15 June 2007)
- UN-Energy. *Welcome to UN-Energy, the interagency mechanism on energy*. <http://esa.un.org/un-energy/> (last accessed 14 June 2007)
- UNEP (2000). *Post-Conflict Environmental Assessment—Albania*. United Nations Environment Programme, Nairobi
- UNEP (2002a). *Global Mercury Assessment*. United Nations Environment Programme, Geneva <http://www.chem.unep.ch/MERCURY/Report/GMA-report-TOC.htm> (last accessed 15 June 2007)
- UNEP (2002b). *Vital Water Graphics. Coastal population and shoreline degradation*. UNEP/GRID-Arendal Maps and Graphics Library <http://maps.grida.no/go/collection/CollectionID/70E05480-E824-413F-9B63-A5914EA7CCA1> (last accessed 27 April 2007)
- UNEP (2004). *Vital Waste Graphics. Composition of transboundary waste reported by the Parties in 2000*. The Basel Convention, United Nations Environment Programme, and UNEP/GRID-Arendal <http://maps.grida.no/go/collection/CollectionID/17F46277-1AFD-4090-A68B-86C7D31FD7E7> (last accessed 15 June 2007)
- UNEP (2005a). *Atlantic and Indian Oceans Environment Outlook*. Special Edition for the Mauritius International Meeting for the 10-year Review of the Barbados Programme of Action for the Sustainable Development of Small Island Developing States. United Nations Environment Programme, Nairobi
- UNEP (2005b). *Pacific Environment Outlook*. Special Edition for the Mauritius International Meeting for the 10-year Review of the Barbados Programme of Action for the Sustainable Development of Small Island Developing States. United Nations Environment Programme, Nairobi
- UNEP (2005c). *Caribbean Environment Outlook*. Special Edition for the Mauritius International Meeting for the 10-year Review of the Barbados Programme of Action for the Sustainable Development of Small Island Developing States. United Nations Environment Programme, Nairobi
- UNEP (2005d). *GEO Year Book 2004/5. An Overview of Our Changing Environment*. United Nations Environment Programme, Nairobi
- UNEP (2005e). *Report of the High-Level Brainstorming Workshop for Multilateral Environmental Agreements on Mainstreaming Environment Beyond Millennium Development Goal 7*. United Nations Environment Programme, Nairobi
- UNEP, UNDP, OSCE and NATO (2005). *Environment and Security: Transforming risks into cooperation – Central Asia Feighana / Osh/ Khujand area*. United Nations Environment Programme, United Nations Development Programme, Organization for Security and Co-operation in Europe and the North Atlantic Treaty Organization, Geneva [http://www.osce.org/publications/eea/2005/10/16671\\_461\\_en.pdf](http://www.osce.org/publications/eea/2005/10/16671_461_en.pdf) (last accessed 15 June 2007)
- UNESCO (2005). *Contributing to a More Sustainable Future: Quality Education, Life Skills and Education for Sustainable Development*. <http://unesdoc.unesco.org/images/0014/001410/141019e.pdf>
- UNHCR (2006). *The State of the World's Refugees*. UN High Commission on Refugees, Geneva
- UNICEF (2004a). *Children's Well-being in Small Island Developing States and Territories*. United Nations Children's Fund, New York, NY
- UNICEF (2004b). *State of the World's Children 200. Childhood under threat*. United Nations Children's Fund, New York, NY [http://www.unicef.org/publications/index\\_24433.html](http://www.unicef.org/publications/index_24433.html) (last accessed 27 April 2007)
- UNISDR. *Hyogo Framework for Action 2005-2015: Building the resilience of nations and communities to disasters (HFA)*. <http://www.unisdr.org/eng/hfa/hfa.htm> (last accessed 14 June 2007)
- UNMP (2005). *Environment and human well-being: a practical strategy*. Report of the task force on environmental sustainability. UN Millennium Project. Earthscan, London
- UNPD (2007). *World Population Prospects: The 2006 Revision*. UN Population Division, New York, NY (in GEO Data Portal)
- VanDeveer, S.D. (2002). Environmental Cooperation and Regional Peace: Baltic Politics, Programs, and Prospects. In K. Conca and G.D. Dabelko (eds.). *Environmental Peacemaking*. The Woodrow Wilson Center Press and the Johns Hopkins University Press, Washington, DC and Baltimore
- Vanhanen, T. (2000). A New Dataset for Measuring Democracy, 1810–1998. In *Journal of Peace Research* 37(2):251–265
- Van Straaten, P. (2000). Mercury contamination associated with small-scale gold mining in Tanzania and Zimbabwe. In *Sci. Total Environment* 259:95-109
- Van Vuuren, D., M. den Elzen, P. Lucas, B. Eickhout, B. Strengers, B. van Ruijven, S. Wainik, R. van Hout (2007). *Stabilizing Greenhouse Gas Concentrations at Low Levels: An Assessment of Reduction Strategies and Costs*. Climatic Change (accepted for publication)
- Walker, G., Fairburn, J., Smith, G. and Michell, G. (2003). *Environmental Quality and Social Deprivation*. Environment Agency, Bristol
- Watts M. J. and Bohle H. G. (1993). The space of vulnerability: The causal structure of hunger and famine. In *Progress in Human Geography* 17(1):43-67
- WBGU (1997). *World in Transition: Ways Towards Sustainable Management of Freshwater Resources*. German Advisory Council on Global Change. Springer Verlag, Heidelberg
- WCC'93 (1994). Preparing to Meet the Coastal Challenges of the 21st Century. *Report of the World Coast Conference, Noordwijk/November 1–5, 1993*. Ministry of Transport, Public Works and Water Management, The Hague
- WCD (2000). *Dams and Development. A New Framework for Decision Making*. Report of the World Commission on Dams. Earthscan, London
- WCED (1987). *Our Common Future*. World Commission on Environment and Development. Oxford University Press, Oxford and New York, NY
- Weede, E. (2004). On Political Violence and Its Avoidance. In *Acta Politica* 39:152-178
- Wei, S. (2000). *Natural Openness and Good Government*. National Bureau of Economic Research, Cambridge, MA
- Weinthal, E. (2002). The Promises and Pitfalls of Environmental Peacemaking in the Aral Sea Basin. In *Environmental Peacemaking*, Conca, K. and Dabelko, G.D. (eds). The Woodrow Wilson Center Press and the Johns Hopkins University Press, Washington and Baltimore
- Weisman, D. (2006). *Global Hunger Index. A basis for cross-country comparisons*. International Food Policy Research Institute, Washington, DC
- White, R.P., Tunstall, D. and Henninger, N. (2002). *An Ecosystem Approach to Drylands: Building Support for New Development Policies*. Information Policy Brief 1. World Resources Institute, Washington, DC
- WHO (2002). *The world health report 2002, reducing risks, promoting healthy life*. World Health Organization, Geneva.
- WHO (2006b). Global and regional food consumption patterns and trends. Chapter 3 In *Diet, Nutrition and the Prevention of Chronic Diseases*. Report of the Joint WHO/FAO Expert Consultation. WHO Technical Report Series, No. 916 (TRS 916). World Health Organization, Geneva <http://www.who.int/dietphysicalactivity/publications/trs916/download/en/index.html> (last accessed 15 June 2007)
- WHO and UNEP (2004). *The health and the environment linkages initiative*. World Health Organization, Geneva
- Wisner, B., Blaikie, P., Cannon, T. and Davis, I. (2004). *At Risk: Natural Hazards, Peoples Vulnerability and Disasters*, 2nd edition. Routledge, London
- Wolf, M. (2004). *Why Globalization Works: The Case for the Global Market Economy*. Yale University Press, New Haven
- Wolf, A.T., Yoffe, S.B. and Giordano M. (2003). International waters: Identifying basins at risk. In *Water Policy* 5:29-60
- Wonink, S.J., Kok, M.T.J. and Hildeink, H.B.M. (2005). *Vulnerability and Human Well-being*. Report 500019003/2005. Netherlands Environmental Assessment Agency, Bilthoven
- World Bank (2005). *The World Development Report 2006. Equity and Development*. Oxford University Press, Oxford and The World Bank, Washington, DC
- World Bank (2006). *World Development Indicators 2006*. The World Bank, Washington, DC (in GEO Data Portal)
- World Water Council (2000). *World Water Vision: Making Water Everybody's Business*. <http://www.worldwatercouncil.org/index.php?id=961&L=0> (last accessed 27 April 2007)
- WRI (2002). *Drylands, People, and Ecosystem Goods and Services: A Web-based Geospatial Analysis*. World Resources Institute. <http://www.wri.org> (last accessed 27 April 2007)
- WRI (2005). *World Resources. The Wealth of the Poor – Managing Ecosystems to Fight Poverty*. World Resources Institute in collaboration with United Nations Development Programme, United Nations Environment Programme and The World Bank, Washington, DC
- WRI (2007). *Nature's Benefits in Kenya. An Atlas of Ecosystems and Human Well-Being*. World Resources Institute, Department of Resource Surveys and Remote Sensing, Ministry of Environment and Natural Resources, Kenya, Central Bureau of Statistics, Ministry of Planning and National Development, Kenya, and International Livestock Research Institute. World Resources Institute, Washington, DC and Nairobi
- Wynberg, R. (2004). Achieving a fair and sustainable trade in devil's claw (*Hapagophyllum* spp.). In *Forest Products, Livelihoods and Conservation*. Case Studies of Non-Timber Forest Products. Vol. 2 – Africa. Sunderland, T. and Ndaye, O. (eds). Centre for International Forestry Research, Bogor
- Yanez, L., Ortiz, D., Calderon, J., Batres, L., Carizales, L., Mejia, J., Martinez, L., Garcia-Nieto, E. and Diaz-Bariga, F. (2002). Overview of Human Health and Chemical Mixtures: Problems facing developing countries. In *Environmental Health Perspectives* 110 (6):901 – 909
- Yoffe, S.B., Fiske, G., Giordano, M., Giordano, M.A., Larson, K., Stahl K. and Wolf, A.T. (2004). Geography of international water conflict and cooperation: Data sets and applications. In *Water Resources Research* 40(5):1-12
- Yokohama Strategy and Plan of Action for a Safer World (1994). *International Strategy for Disaster Reduction* [http://www.unisdr.org/eng/about\\_isdr/bd-yokohama-strat-eng.htm](http://www.unisdr.org/eng/about_isdr/bd-yokohama-strat-eng.htm) (last accessed 15 June 2007)
- Zoleta-Nantes, D. (2002). Differential Impacts of Flood Hazards among the Street children, the Urban Poor and Residents of Wealthy Neighborhood in Metro Manila, Philippines. In *Journal of Mitigation and Adaptation Strategies for Global Change* 7(3):239-266