Global Environment Outlook

GEO 4

environment for development

United Nations Environment Programme
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Chapter 7

Vulnerability of People and the Environment: Challenges and Opportunities

Coordinating lead authors: Jill Jüger and Marcel T.J. Kok

Lead authors: Jennifer Clara Mohamed-Katerere, Sylvia I. Karlsson, Mathias K.B. Lidike, Geoffrey D. Dobieko, Frank Thonon; Indra de Soysa, Munyaradzi Cherije, Richard Filcak, Liza Koshy, Marybeth Long Martello,
Vikram Mathur, Ana Rosa Moreira, Vishal Narain, and Diono Sietz

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

In memory of Gerhard Petschel-Held

Chapter review editor: Katharina Thywissen

Chapter coordinator: Munyaradzi Cherije
Main messages

Vulnerability, determined by exposure, sensitivity to impacts and the ability or inability to cope or adapt, is now at the heart of most environmental and development policies and strategies. A key element of the 2005 World Summit outcomes is the need to address the needs and concerns of the most vulnerable groups. The 2005 World Summit outcomes provide a framework for action at all levels, and the challenges facing vulnerable people and environments require sustained and immediate attention.

Despite significant improvements in human well-being, a billion people still live on less than $1 per day. This highlights the importance of tackling poverty and inequality, which are fundamental to reducing vulnerability and achieving sustainable economic growth.

International trade has helped increase income and productivity, but it can also exacerbate poverty and inequality, particularly in developing countries. The management of trade policies is crucial to ensuring that the benefits of trade are shared fairly.

Exposure to natural hazards has increased in recent years, with the risk of more frequent and intense disasters. The impacts of natural disasters are often felt in poor and vulnerable communities, which are already facing other challenges such as climate change and poverty.

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 health care. This highlights the importance of addressing social inequalities and ensuring that all people have access to basic services.

Significant improvements in human well-being have been achieved over the last 20 years, but more needs to be done to ensure that these improvements are shared by all people. The Millennium Development Goals (MDGs) provide a framework for international cooperation to achieve these goals.

An analysis of patterns of vulnerability shows that the distribution of risks is not even, with some groups facing higher risks than others. This highlights the importance of targeted interventions to reduce vulnerability and improve resilience.

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 it is also a critical aspect of human rights. It is essential for reducing vulnerability and achieving sustainable use of the environment.

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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 policies 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 wellbeing and vulnerability. Understanding how environmental and non-environmental changes affect human wellbeing and vulnerability is the critical foundation for addressing challenges to and the opportunities for improving human wellbeing 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 wellbeing (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 wellbeing 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 wellbeing.

GLOBAL CONTEXT OF VULNERABILITY
A number of factors shape the vulnerability of people and the environment including poverty, health, globalisation, trade and aid, conflict, changing levels of governance and science and technology.

Poverty
Poverty (see Chapter 11) reduces the ability of individuals to respond and adapt to environmental change. Although the multi-dimensional 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) of 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

North East Asia, South East Asia, South Pacific

Central and Eastern Europe and Central Asia

Latin America and the Caribbean

Goal: 2015

Path to goal

(b) Proportion and number of undernourished people by region

For each undernourished (MDG)

Number of undernourished individuals (WFS)

Note: Some graphs not strictly presented according to GEO regions

Source: World Bank 2006

Source: FAO 2005b
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 inequality is high, including in some of the transition countries such as Europe and Central Asia, economic growth does not necessarily translate into less poverty (WRI 2003; 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 2003). Structural economic adjustment, ill health, and poor governance affect progress in some regions, including sub-Saharan Africa (Kalinda 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 (Drezner 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 underwater 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

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

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<td>West Asia</td>
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Source: GEC Data Point, compiled from UNDP 2007
Table 7.1 Estimated attributable and avoidable burden of 10 leading selected risk factors

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<th>Developing countries low mortality (per cent)</th>
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<td>Unsafe sex</td>
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<tr>
<td>2.0</td>
<td>1.8</td>
<td>0.8</td>
</tr>
<tr>
<td>Cholesterol</td>
<td>Unsafe water, sanitation and hygiene</td>
<td>Iron deficiency</td>
</tr>
<tr>
<td>1.9</td>
<td>1.8</td>
<td>0.7</td>
</tr>
</tbody>
</table>

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 at 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, these figures suggest a blank

Figure 7.3 Foreign direct investment and aid dependency

a) Regional average FDI inflows

b) Regional levels of aid dependence

Notes: West Asia data does not include data for Iraq from 1996-2004 and for OIT 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: OECD Data Panel, compiled from World Bank 2003
realities. 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 (IMF 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). 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 (Staid 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 2005. Externally-induced armed conflicts (conflicts between an independent state and non-state groups outside its own territory) has disappeared by the mid-1970s. Interstate armed conflicts (civil conflicts on conflicts between a government and an organized internal rebel group) rose steadily until 1992, after which they declined steeply. Internationalized interstate conflicts (intranstate conflicts with armed intervention from other governments) have been frequent since the early 1990s. The lower threshold for conflicts recorded was 25 battle-related deaths in a given year.

The graph does not include state violence against organized people (one-sided violence, adolescent, and police) or violence between groups where the government is not a party, or the fighting (non-state violence or communal violence). It is a stacked graph, meaning that the number of conflict in each category in a given year is indicated by the height in that year of the area of a particular colour.

---

**Figure 7.4 Number of armed conflicts by type**

---

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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 undercut their capacity to change the livelihoods, economic development, society, and state capacities. The resulting poverty and lack of resources contribute to lower levels of wellbeing and higher levels of vulnerability.

Changing levels of governance

Over the past 10 years, governance has become increasingly multilevel 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 subnational levels, including in countries of the Organisation for Economic Cooperation and Development (OECD) [Siegarscu 2004] and in Africa and Latin America [Stein 1999; Brassia 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 (Stahl 2001). Local governments, community-based groups, and other nongovernmental 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 Graauwe and Cameron 2003; Graham 2000; Wool 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 nonenvironmental 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)

Note: The rankings are based on factors including quality of public and civil services, and of policy formulation and implementation, degree of independence from political pressures, and credibility of government commitment.

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; Molla 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; Gleich 1999; Molla 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 market 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, apatite and consumerism as well as relative poverty contribute to ill health.
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 2004a, 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 1996). 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. Sociocultural 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 inequality, 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, make-shift houses such as these grow and spread along flooded estuaries exposing residents to grave risks. Credit: Mark Edwards/ Specialist Pictures]
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 influence (Barrett 2003) (see Boxes 7.3 and 7.11) Improving capacity and access to technology, as envisaged under the Johannesburg Plan of Implementation (IPOI) 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).

**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.

<table>
<thead>
<tr>
<th>Figure 7.10 Causes of food emergencies in developing countries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Per cent of food emergencies</strong></td>
</tr>
<tr>
<td>Fluid</td>
</tr>
<tr>
<td>Drought</td>
</tr>
<tr>
<td>Conflict</td>
</tr>
<tr>
<td>Religious</td>
</tr>
<tr>
<td>Economic problems</td>
</tr>
<tr>
<td>Other</td>
</tr>
<tr>
<td><strong>Total exceeds 100% because of multiple causes and cited for many emergencies</strong></td>
</tr>
<tr>
<td><strong>Includes internally displaced people</strong></td>
</tr>
</tbody>
</table>

Source: FAO 2003b

<table>
<thead>
<tr>
<th>Year</th>
<th>2000</th>
<th>2001</th>
<th>2002</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Drought</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Conflict</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Religious</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Economic problems</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

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 minimize profits at the environment’s expense, and distribute opportunities, risks, and costs in a fair way. It requires accessible institutions, courts, and fair processes. Governments have responded to this need by broadening laws and policies to include the pollution-pays-principle, environmental impact assessments, principles of good neighbours, environmental taxes, redistributive mechanisms, participatory and inclusive processes, access to information and right to know provisions, and compensation (see Chapter 10).
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 three groups most vulnerable to multiple stressors. Factors such as ethnicity, caste, gender, financial status, and geographical location underlie processes of marginalization and disempowerment which 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 wellbeing 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 wellbeing (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.

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

<table>
<thead>
<tr>
<th>Year</th>
<th>Domestic Extraction</th>
<th>Imports</th>
</tr>
</thead>
<tbody>
<tr>
<td>2010</td>
<td>0.9</td>
<td>0.8</td>
</tr>
<tr>
<td>2009</td>
<td>0.8</td>
<td>0.7</td>
</tr>
<tr>
<td>2008</td>
<td>0.6</td>
<td>0.6</td>
</tr>
<tr>
<td>2007</td>
<td>0.5</td>
<td>0.5</td>
</tr>
<tr>
<td>2006</td>
<td>0.4</td>
<td>0.4</td>
</tr>
<tr>
<td>2005</td>
<td>0.3</td>
<td>0.3</td>
</tr>
</tbody>
</table>

Source: Eurostat and EF 2004

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. 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).
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, environmental 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, Buechler 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, Koh 2000). 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 behavior, and social subgrouping—strain the state’s ability to meet its citizens’ demands and can contribute to violent outcomes (Homer-Dixon 1999, Koh 2000). In the climatic 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 tenous cultural, economic, or political balances in the receiving area (Drezir 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 interstate 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 of technological approaches to water problems, conflicts and tensions surrounding the distribution, access, and quality of water resources arise. Megaprojects such as dams 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, is the focus of another archetype of small-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 2004a). 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 in achieving 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 coastal areas 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 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 connections 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 (Pethel-Held and others 1999; Haupt and Müller-Baker 2005; Ludeke and others 2004). The archetype approach is broader as it includes opportunities offered by the environment to reduce vulnerability and improve human well-being (Wanink 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 policymakers 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, subregions, 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>
<thead>
<tr>
<th>Archetype</th>
<th>Linkages to other chapters</th>
<th>Key human well-being issues</th>
<th>Key policy messages</th>
</tr>
</thead>
</table>
| Contaminated sites         | Chapter 3                  | Health hazards: main impacts on the marginalized in terms of people forced into contaminated sites and rivers (hazardous waste imports) | - Better laws and better enforcement against special interests  
- Increase participation of the most vulnerable in decision-making |
|                            | Chapter 6                  |                                                                               |                                                                                     |
|                            | Asia Pacific - waste management |                                                                               |                                                                                     |
|                            | Polar - persistent toxins  |                                                                               |                                                                                     |
|                            | Polar - industry and related development activities |                                                                               |                                                                                     |
| Drylands                   | Chapter 3                  | Watering supply of potable water lost due to productive land conflict due to environmental migration | - Improve security of tenure (for example, through cooperatives)  
- Provide more equal access to global markets |
|                            | Chapter 6                  |                                                                               |                                                                                     |
|                            | Africa - land degradation  |                                                                               |                                                                                     |
|                            | Asia - Asia - land degradation and desertification |                                                                               |                                                                                     |
| Global commons             | Chapters 2 and 5            | 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 |
|                            | Chapter 6                  |                                                                               |                                                                                     |
|                            | UAC - degraded coastal and polluted seas |                                                                               |                                                                                     |
|                            | UAC - shrinking forests   |                                                                               |                                                                                     |
|                            | Polar - climate change     |                                                                               |                                                                                     |
|                            | West Asia - degraded coastal and polluted seas |                                                                               |                                                                                     |
| Securing energy            | Chapter 2                  | 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 |
|                            | Chapter 6                  |                                                                               |                                                                                     |
|                            | Europe - energy and climate change |                                                                               |                                                                                     |
|                            | UAC - energy supply and consumption patterns |                                                                               |                                                                                     |
|                            | North America - energy and climate change |                                                                               |                                                                                     |
| Small Island Developing States | Chapter 4                  | 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" to "working with nature" paradigm |
|                            | Chapter 6                  |                                                                               |                                                                                     |
|                            | UAC - degraded coastal and polluted seas |                                                                               |                                                                                     |
|                            | Asia Pacific - alleviating pressures on vulnerable ecosystems |                                                                               |                                                                                     |
| Technology-centred approaches to water problems | Chapter 4                  | 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 |
|                            | Chapter 6                  |                                                                               |                                                                                     |
|                            | Asia Pacific - balancing water resources and demands |                                                                               |                                                                                     |
|                            | North America - freshwater quantity and quality |                                                                               |                                                                                     |
|                            | West Asia - water scarcity and quality |                                                                               |                                                                                     |
| Urbanization of the coastal fringe | Chapter 6                  | Lives and material assets endangered by floods and landslides  
Health endangered by poor sanitation conditions due to rapid and unplanned coastal urbanization strong distributional aspects | - Implementation of the Kyogoku Framework of action  
- Bring forward green engineering solutions that integrate coastal protection and livelihood opportunities |
|                            | North America - urban sprawl |                                                                               |                                                                                     |
|                            | UAC - growing cities       |                                                                               |                                                                                     |
|                            | UAC - degraded coastal and polluted seas |                                                                               |                                                                                     |
|                            | West Asia - degradation of coastal and marine environments |                                                                               |                                                                                     |
|                            | West Asia - management of the urban environment |                                                                               |                                                                                     |

* UAC = 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 archetypal 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 (CSWVG 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 disposal 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. Government face problems of holding polluters accountable for site cleanups. Therefore clean-up costs are imposed on state budgets or on people from surrounding areas exposed to health risks and environmental degradation.

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.
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 (Yonez 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 (Euratist and IFF 2004). Health effects, such as cancer and neurological disorders, have been reported around smelters (Benedetti and others 2001; Calderon and others 2001). For example, in Torreon, Mexico, 77 per cent of the children living closest to a lead smelter had lead levels twice as high as the reference level (Yonez and others 2002).

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

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**Box 7.4 Contamination in Central Asia’s Ferghana-Osh-Khujand area**

The Ferghana-Osh-Khujand 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 for this area 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 reactivated.

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**Figure 7.14 Radioactive, chemical and biological hazards in Central Asia**

![Diagram](image)

Source: UNEP and others 2003.
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 Straten 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, chlordane, and HCH, which have been withdrawn or banned for human health and/or environmental reasons (WHO 1995) are still found in dumps particularly in developing countries. Long-term exposure to pesticides can increase the risk of developmental and reproductive disorders and disrupt 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) and in some Chinese cities where electronic waste is recycled, sediment samples had heavy metal concentrations for above the guidelines of the US Environmental Protection Agency (Bao Action Network 2002). Similarly, workers are exposed to contaminants that pose serious risk to their health in locations where ships are broken up for recycling (Bao 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 (UNHRC).

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 depend 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 cleanup;
- 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 low- or no-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 2003). 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, conflict and social instability;
- interlinkages between dryland and non-dryland areas through migration, remittances and trade; and
- global governance regimes (Safriel and others 2003; Dabe 2001; Giffen and others 2001; Maynard and others 2005; Dade 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

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Box 7.8: 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). Hazard 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 adverse 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 region, with only intermediate infrastructure restrictions and infant mortality.

Sources: Ataco and others 2000; AEA World FSR 2002; CIESIN 2002; FAO EVA 2000; Kobesikiro 1993; Monserud 1985; Oldeman and others 1991

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Figure 7.15 Spatial distribution of typical forms of the dryland archetype

[Map showing the distribution of vulnerability clusters around the world, with different colors and symbols indicating varying levels of vulnerability and well-being.]
America can decrease vulnerability of 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 kilometers 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 1.2 to 4.8 episodes (UNDP and GEF 2004). Where there is high agricultural dependency, drought 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 favored 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 meters/person/year in 2000, which is already below the threshold of 2,000 m³ required for the minimum human well-being and sustainable development (Safriel and others 2005). In arid and semi-arid regions, water shortages are predicted to be the most significant constraint for socioeconomic 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, multi-stakeholder 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, sometimes lead to violent conflicts along a number of lines of division: rural-urban, pastoralist-agriculturalist, and ethnic group-ethnic group (Kahl 2006; Lind and Staunton 2002; Higgins 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). Severe 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. If their capital stocks hinder coping strategies, decrease the productive performance of livestock and generate tensions with other harder and host farmer communities (Nori and others unpubl).

Responses

Given the extent of drylands, the roughly 2 billion people they support and the biodiversity 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 (NAPs) and subregional (SAPs) and regional (RAP) action programs. 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 benefits sharing, which helps to increase local resource-based income. Successful applications in drylands include co-management initiatives for wildlife (Huime 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

Source: WR 2002

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

Source: Dayo and others 2005

c) Progress towards MDG target on food security

Source: FAO 2006
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 to the subregional and global ENVIS enhanced capability 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 monitoring (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 demand integrated approaches that address 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 administrative and managerial capacity of water management institutions, weak national and regional legal frameworks, and lack of international cooperation (GWAR 2005; see Chapter 4). Developing systems for managing water scarcity, which deal with rainwater and runoff and mediate 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 (Scouros 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; Katurera and Mohamed-Katurera 2005). In 2005, UNCCD COP 7 acknowledged that insufficient decentralization and insecure tenure undermine management and reduce opportunities. Potential income is lost to intermediaries, who charge high fees, reduce returns, and export direct to exporters (Wynberg 2004).

Global trade regimes, particularly protectionist tariffs and agricultural subsidies in developed country markets (Maynard 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 (Gareux and Mascie-Taylor 2003). Conflict can also be an important factor inhibiting producer 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 multilevel 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

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**Box 7.6: Institutional reforms 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;
- 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 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 and intensive farming, increased integration of crops with livestock production, and improved production and marketing of high-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.

Missing 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 (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 
degradation (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

(resource – 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 resource 
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 
for their. The atmosphere is also increasingly under 
pressure 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 (FAO 2006b). However, 
fisheries are declining, formerly abundant species 
are now rare, and fishing areas are often 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 
many of the Canadian cod fisheries. In the early 1980s, 
the Canadian catches of Atlantic codfish 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 fisheries (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 cod, 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 fisheries 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 “Tubal War.”

Figure 7.17 Fish catch landings of Newfoundland and Labrador

<table>
<thead>
<tr>
<th>Year</th>
<th>Fish Catch Landings in Thousand Tonnes</th>
</tr>
</thead>
<tbody>
<tr>
<td>1950</td>
<td>1000</td>
</tr>
<tr>
<td>1955</td>
<td>700</td>
</tr>
<tr>
<td>1960</td>
<td>400</td>
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<td>1965</td>
<td>200</td>
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<td>25</td>
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<td>1985</td>
<td>15</td>
</tr>
<tr>
<td>1990</td>
<td>10</td>
</tr>
<tr>
<td>1995</td>
<td>5</td>
</tr>
</tbody>
</table>

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 (and 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 Boxes 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 decades, 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's 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 (NAEAC). 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/CRTAP 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 (Kühnlein and Chan 2000).

It has been possible to measure 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 log 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 the global community 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

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**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 gasses 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 5 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).


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

- Climate change
- Cooling of ocean temperature
- Reduced availability of subsistence species
- Global war
- Guinea worm
- Unemployment
- Decreased health status
- Alcohol, violence, suicide

Source: ACA 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 these 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 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;

- geopolitical tensions;

- uncertainty over when the global resource base for oil and gas may become critical with mainstream energy analyst 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-income 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 wellbeing

Impacts of energy use on human wellbeing due to air pollution and climate change as well as the importance of energy for realizing the MDGs are analyzed in Chapter 2. For energy-importing countries, securing the supply of affordable energy is directly linked with human wellbeing. 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 (Steenkamp 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 example, the United Kingdom has had a fuel poverty strategy since 2001 (DfT 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 (Burthol 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

![Diagram](image)

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

(a) Share of oil in total energy consumption

<table>
<thead>
<tr>
<th>Year</th>
<th>High income</th>
<th>Low income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>50</td>
<td>30</td>
</tr>
<tr>
<td>2000</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>2010</td>
<td>30</td>
<td>10</td>
</tr>
<tr>
<td>2020</td>
<td>20</td>
<td>0</td>
</tr>
</tbody>
</table>

(b) Share of imported oil in total oil consumption

<table>
<thead>
<tr>
<th>Year</th>
<th>High income</th>
<th>Low income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>70</td>
<td>0</td>
</tr>
<tr>
<td>2000</td>
<td>60</td>
<td>0</td>
</tr>
<tr>
<td>2010</td>
<td>50</td>
<td>0</td>
</tr>
<tr>
<td>2020</td>
<td>40</td>
<td>0</td>
</tr>
</tbody>
</table>

(c) Oil consumption per unit of GDP

<table>
<thead>
<tr>
<th>Year</th>
<th>High income</th>
<th>Low income</th>
</tr>
</thead>
<tbody>
<tr>
<td>1990</td>
<td>100</td>
<td>0</td>
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<tr>
<td>2000</td>
<td>90</td>
<td>0</td>
</tr>
<tr>
<td>2010</td>
<td>80</td>
<td>0</td>
</tr>
<tr>
<td>2020</td>
<td>70</td>
<td>0</td>
</tr>
</tbody>
</table>

Note: Outlook based on IEA 2003 model using ANP/ANL.

Source: Van Vuuren and others 2007

---

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

Energy-exporting countries face a different set of human wellbeing 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 economy, 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 resources abundance in a weak or corrupt political system lowers economic growth, which endures the generation of human vulnerability and ill-being, and even results in violent conflict.

Taking the "resource" 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: All 2001; Bulko, Diamant, and Decour 2003; Collier and others 2003; De Soto 2000a; De Soto 2000b; De Soto 2000c; Ed and Myer 1998; Duffy and Windle 2000; Feenstra and others 2004; Feenstra 2001; Sachs and Warner 2001; Sahn and Warner 1990.
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 $44/ton of oil 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 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 supplies, improving 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 electrifying, 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; Moel 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 2005–07. 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 all 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.
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

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. The proportion of the total population of 56 million (UNEP 2005c) is frequently exposed to natural hazards. For example, in 2001 nearly 6 million people were affected by natural disasters in the Caribbean. In 1988, the cumulative economic damage attributed to disasters was as high as 43 per cent of GDP in Latin America and the Caribbean (Cheuvront 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). Abandoning islands would also result in

Figure 7.21 Environmental vulnerability scores for SIDS

Number of countries

Source: SOAC and UNEP

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

Climaterelated 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 lowlying islands and in highrisk coastal settlements with substandard housing and infrastructure. The livelihoods most affected include those depending on climate-sensitive natural resources such as subsistence and commercial fishing and on coastal tourism (Douglas 2006; FAO 2004b and 2005b; UNICEF 2004a; Nurse and Rawlerson 2003; Pelling and Utta 2001).

The most severe impacts on human well-being include the loss of livelihood assets, displacement, increased water and vectorborne 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 4050 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 Itoechong 1998; Lam 1998).

Figure 7.22 Caribbean casualties due to hurricanes

<table>
<thead>
<tr>
<th>Deaths/million people exposed/year</th>
<th>Annual deratization rate (per cent)</th>
<th>Human development index</th>
</tr>
</thead>
<tbody>
<tr>
<td>14</td>
<td>7</td>
<td>0.0</td>
</tr>
<tr>
<td>12</td>
<td>6</td>
<td>0.0</td>
</tr>
<tr>
<td>10</td>
<td>5</td>
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</tr>
<tr>
<td>6</td>
<td>4</td>
<td>0.0</td>
</tr>
<tr>
<td>6</td>
<td>3</td>
<td>0.0</td>
</tr>
<tr>
<td>4</td>
<td>2</td>
<td>0.0</td>
</tr>
<tr>
<td>2</td>
<td>1</td>
<td>0.0</td>
</tr>
<tr>
<td>0</td>
<td>0</td>
<td>0.0</td>
</tr>
<tr>
<td>-1</td>
<td>-1</td>
<td>0.0</td>
</tr>
<tr>
<td>-2</td>
<td>-2</td>
<td>0.0</td>
</tr>
</tbody>
</table>

Source: CARIC 2004; FAO 2000; UNDP 2001; UNEP/OCHA/GRID/Europe; Pelling 2002

The satellite image below illustrates another factor, that of environmental degradation. The Dominican Republic has lost 28 per cent forest cover, while Haiti had reduced its forest cover from 23 per cent in 1950 to 3 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

SECTION D. HUMAN DIMENSIONS OF ENVIRONMENTAL CHANGE
Higher exposure to natural hazards can have negative impacts on tourism infrastructure and investments, and can reduce tourism income. At the same time, tourism adds to increased pressures on ecosystems (Georges 2006; McClay 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) and 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 Ecosystems, buying 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 funds of potential future ecotourism revenue, operators in three islands participated in an eradication programme, funding their own costs of nearly US$250,000.

Source: New 2001

Box 7.13 Twisting 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 coastal marine resources for their traditional subsistence-based livelihoods. Food security and accessibility have been reduced. Women, cleaning off mudflats, for instance, expend more 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 stocks. Communities work with Galjaq (officially recognized customary fishing rights areas), imposing temporary closures of these fishing zones, and tabu (taboo 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 additional technical assistance, they make the decisions, making an LMMA significantly different from a marine reserve or marine protected area. Prazied local species, such as mangrove lobsters, 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 Ucunivai. The establishment of LMMA's has increased household income and improved nutrition.

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

Source: WWF 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 (IFRC/RECS 2003) helps adaptation to short-term variability (Tokohama 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 2009 Reilly and Schimmelpfenning 2000 IRC 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 small 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...

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**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

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For the MOGs 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 those 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 dams 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 multipurpose mega-dams (over 60 m in height) have had significant impacts on water resources. There are more than 4,000 large dams in 140 countries (see 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 wellbeing**

Currently, large dams are typically built in remote areas of developing countries. The integration of such peripheral regions into the world market through dams 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 Sanyea 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 (Yaffe and others 2004). International water cooperation institutions such as basin commissions have fostered international cooperation, for example in the cases involving the Ithios 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 (Sccot 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...
diseases in four villages near the Barekese Dam in Ghana (Teitel and others 2004). In Hiaowa Besase 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 followup 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 (Calderon 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>
<thead>
<tr>
<th>Table 7.3 Some findings of the World Commission on Dams</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Five core values were identified</strong></td>
</tr>
<tr>
<td>- Equity</td>
</tr>
<tr>
<td>- Efficiency</td>
</tr>
<tr>
<td>- Participatory decision making</td>
</tr>
<tr>
<td>- Sustainability</td>
</tr>
<tr>
<td>- Accountability</td>
</tr>
<tr>
<td><strong>Seven strategic priorities were formulated</strong></td>
</tr>
<tr>
<td>- Gaining public acceptance</td>
</tr>
<tr>
<td>- Comprehensive options assessment</td>
</tr>
<tr>
<td>- Addressing existing dams</td>
</tr>
<tr>
<td>- Sustaining rivers and livelihoods</td>
</tr>
<tr>
<td>- Recognizing entitlements and sharing benefits</td>
</tr>
<tr>
<td>- Ensuring compliance</td>
</tr>
<tr>
<td>- Sharing rivers for peace, development, and security</td>
</tr>
</tbody>
</table>

Source: WCD 2000
firms withdraw 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 Buyagoli 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 (RN 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

“Jezoir” 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: Scherrer 2006.

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

Credit: Megan Schieder
- improving cooperative water basin management can increase development opportunities and reduce potential for conflict. Developing transboundary river basin institutions offers important opportunities for building an 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 socioeconomic 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 socioeconomic activities (Blisna and others 1996; WCC 93 1994; Sahra and others 2001; Small and Nicholls 2003). The average population density in coastal areas is now twice as high as the global average (UNEP 2005a). Worldwide, more than 100 million people live in areas no more than 1m above sea level (Douglas and Pelter 2002). Of the world’s 33 megacities, 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 reworking 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 Leichentiko 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 socioeconomic impacts.

Figure 7.24 Coastal population and shoreline degradation

<table>
<thead>
<tr>
<th>Populations living within 300 km of the coast</th>
</tr>
</thead>
<tbody>
<tr>
<td>None</td>
</tr>
<tr>
<td>Less than 30%</td>
</tr>
<tr>
<td>30 to 70%</td>
</tr>
<tr>
<td>More than 70%</td>
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<table>
<thead>
<tr>
<th>Shoreline</th>
</tr>
</thead>
<tbody>
<tr>
<td>Most altered</td>
</tr>
<tr>
<td>Abandoned</td>
</tr>
<tr>
<td>Least altered</td>
</tr>
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</table>

<table>
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<tr>
<th>Selected coastal cities of more than one million people</th>
</tr>
</thead>
</table>

Source: Adapted from UNEP 2005a, based on Burke and others 2001; Harrison and Persson 2001
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 12 million people. Munich Re (2004a) documented an increasing concentration of the loss potential from natural hazards in megacities. 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). 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 hotspots, 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% 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](chart.png)

Source: Munich Re 2006

Vulnerability of People and the Environment: Challenges and Opportunities
pronounced but not exclusive (see Box 7.16) in developing countries due to large extent to rural-urban migration (Bulatao-Jyme and others 1982; Curry 1983; Mitchell 1988; Mitchell 1999; Smith 1992; Alexander 1993; Bakhti 1994; Zoleta-Natividad 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 Pyne 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 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...”
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 (Ipu and others 2005; Miller and others 2006; Soëfack and Lechtenf 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 (Spaling 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 2005).

- 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 Gleave 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.
CHALLENGESPOSEDPATTERNSOFPATTERNSOF 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, political, 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 (Kiehl et al. 1997) social groups (Flynn et al. 1994 Cutler 1993 Fordham 1999) and individuals.
- Environmental risks affect a wide range of natural resource 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 (Carra and Dabelko 2002 Haverstock 2003).
- Human vulnerability and livelihood security are closely linked to biodiversity and ecosystem resilience (Huntington 2001 Falk 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) and 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>
<thead>
<tr>
<th>MDGs and selected targets</th>
<th>Vulnerability affects potential to achieve the MDGs</th>
<th>Adapting strategies to reduce vulnerability contributes to reaching the MDGs</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Goal 1</strong> Eradicate extreme poverty and hunger</td>
<td>Contaminated sites damage health and thus the ability to work, thus reducing opportunities to eradicate extreme poverty and hunger.</td>
<td>Improving environmental management and restoring threatened environments will help protect natural capital and increase opportunities for livelihoods and food security.</td>
</tr>
<tr>
<td><strong>Targets:</strong></td>
<td>To alleviate land degradation and insufficient investments and conflict contribute to low agricultural productivity, threatening food security and nutrition.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Goal 2</strong> Achieve universal primary education</td>
<td>Children are particularly at risk when they play in contaminated sites lead and mercury contamination presents specific risks for child development.</td>
<td>Sustainable resource management can decrease the environmental health risks children face and thus increase school attendance.</td>
</tr>
<tr>
<td><strong>Target:</strong></td>
<td>The time-consuming activity of fetching water and fuelwood reduces school attendance, particularly for girls.</td>
<td>Improved and secure access to energy supports learning at home and at school. It is essential for access to filtered information and opportunities to engage in scientific and other experimentation.</td>
</tr>
<tr>
<td><strong>Goal 3</strong> Promote gender equality and empower women</td>
<td>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.</td>
<td>Reducing inequities – in access to health care and education – is critical in improving coping capacity.</td>
</tr>
<tr>
<td><strong>Target:</strong> Eliminate gender disparity in primary and secondary education</td>
<td>Women play a pivotal role as resource managers but are marginalized in decision making, often have insecure tenure rights and lack access to credit.</td>
<td>Strategies that link health and housing, nutrition, education information and means increase opportunities for women, including in decision making.</td>
</tr>
<tr>
<td><strong>Goal 4</strong> Reduce child mortality</td>
<td>Contaminated sites affect mortality of all but children are particularly vulnerable to pollution-related diseases.</td>
<td>Interlinked environment/development/health strategies improved environmental management and ensuring access to environmentally derived services can contribute to reducing child mortality and reducing vulnerability.</td>
</tr>
<tr>
<td><strong>Target:</strong> Reduce by two-thirds the under-five child mortality</td>
<td>Some 26,000 children die annually from air pollution-related diseases.</td>
<td>Improved environmental management can improve maternal well-being by improving nutrition, reducing risks from pollutants and providing essential services.</td>
</tr>
<tr>
<td><strong>Goal 5</strong> Improve maternal health</td>
<td>The accumulation of POPs in food sources affects maternal health.</td>
<td>Integrated environment/health planning and management is critical.</td>
</tr>
<tr>
<td><strong>Target:</strong> Reduce by three-quarters the maternal mortality ratio</td>
<td>Dams may increase the risk of malaria which in turn threatens maternal health. Malaysia increases maternal anaemia threatening healthy fetal development.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Goal 6</strong> Combat HIV/AIDS, malaria and other diseases</td>
<td>Contaminated sites are a huge risk for individuals already exposed to HIV/AIDS potentially further compromising their health.</td>
<td>Integrated environment/health planning and management is critical.</td>
</tr>
<tr>
<td><strong>Target:</strong></td>
<td>Climate change is likely to increase the disease burden of poor people including the incidence of malaria.</td>
<td>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.</td>
</tr>
<tr>
<td><strong>Goal 7</strong> Ensure environmental sustainability</td>
<td>Water contamination from dumps, industry and agriculture waterborne diseases and growing water scarcity threaten well-being at all levels.</td>
<td>Improving governance systems including strengthening institutions and laws and policies and adopting interlinked strategies are critical to contributing to environmental sustainability and reducing vulnerability.</td>
</tr>
<tr>
<td><strong>Targets:</strong></td>
<td>The lack of access to energy limits opportunities for investment in technologies, including those for water provisioning and treatment.</td>
<td>Securing energy is critical to improving the living conditions of the growing number of slum dwellers.</td>
</tr>
</tbody>
</table>
### Table 7.4 Links between vulnerability and the achievement of the MDGs, and opportunities for reducing vulnerability and meeting the MDGs continued

<table>
<thead>
<tr>
<th>MDGs and selected targets</th>
<th>Vulnerability affects potential to achieve the MDGs</th>
<th>Adopting strategies to reduce vulnerability contributes to reaching the MDGs</th>
</tr>
</thead>
<tbody>
<tr>
<td>Goal 8</td>
<td>■ 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.</td>
<td>■ 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.</td>
</tr>
<tr>
<td></td>
<td>■ Poor access to energy undermines the investments and technologies that can be used in productive land and natural resource management.</td>
<td>■ Massive investments in clean energy and transport systems can reduce poverty, increase security and mitigate greenhouse gas emissions. It has been estimated that about US$16 trillion will be required for global infrastructure investment in the energy sector in less than 35 years.</td>
</tr>
<tr>
<td></td>
<td>■ Sea-level rise is threatening the safety and socioeconomic 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 on coastal areas in developing countries.</td>
<td>■ Building partnerships for addressing climate change and enhancing technology transfer promises are essential for increasing adaptive and coping capacity in low-lying areas.</td>
</tr>
<tr>
<td>Target</td>
<td>Address the special needs of landlocked developing countries and SIDS.</td>
<td></td>
</tr>
</tbody>
</table>

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 the 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 a comprehensive approach across governance levels and sectors. This is particularly important in times of crisis, when national governments and regional organizations need to facilitate successful integration of policies across governance levels and actors, and over time to address the coping and adaptive capacities of future generations.
adoption, 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 face climate change on their own terms (see Chapter 6, Polar Regions) (ACIA 2005). Another related strategy of integrating governance across levels is through 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 those affect vulnerability. One strategy is to integrate in organizational terms 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 (Solnit 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 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 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 health. 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 have been established to promote consideration of health in development. Global initiatives include the World Health Organization's 2003 recommendations for health impact assessment. At the regional level, the Strategic Environmental Assessment Protocol (1991) to the UNCED 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
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 (Arora 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 address key stressors. 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, Weimert 2002), as well as on improving conservation through transboundary conservation areas (also known as transfronter or parks), to support integration and development-related activities such as tourism (Ali 2005, Sandwith and Besancon 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 et al. 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 interdependencies and the need for long-term related 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 lifetime 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 integrate, rather than ameliorate, conflict such as early examples of transboundary peace parks that neglected wider consultation with local peoples (Swatuk 2002). The ultimate goal of pursuing environmental peacemaking opportunities is reduction of vulnerability and assault on human wellbeing created by the silo-like 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 (Burns and Melzke-Dick 2000), wolf and others (2003) and forests (Edmonds and Wolfenberg 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 Governo 2001). This can also lead to better information sharing, more equitable distribution of financial and other resources (Edmonds and Wolfenberg 2003; Teach 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 strategic and political interests at the global level is more challenging. It is constrained by international law and governance but is not impossible (Metcalfe and la Cour Madsen 2004). Building negotiating capacity can be an important strategy for increasing the development dynamics 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. Haggard and Winters 2006). Improving resilience through transfer of food and technology (Barrett 2003) and improving governance.

Environmental and equity issues should be at the center of global trade systems (DND 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. Haggard 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 (Birdsell and Lawrence 1999) and international civil peace which reinforces and is reinforced by prosperity (Barbier and Ruvinsky 2005. De Soysa 2002a. De Soysa 2002b. Russett and Oneal 2000. Schneider and others 2003. Weller 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 adoption through better public investment in education and infrastructure (Gore 1998. Rodrik 1996). Trade contributes most to increasing incomes when combined with good governance (Bartmann 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 2000. 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
eradication as well as improving conservation and long-term sustainability. This national level action can be important for achieving 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 (VRIS 2005; Page 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; Dabre 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 land degradation (Brown and Lapsyade 2001). Interagency initiatives such as land development should not undercut local resource rights by shifting responsibility from the local to the national or regional level (Mohamed; Karakere 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 microfinance 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 Wallenberg 2003). Devolvement of authority is one such mechanism (Sanin 2003). Despite a growing trend towards decentralization and devolution since the 1980s, a broad policy commitment to give users greater authority, the institutional reform required to improve livelihoods is often lacking (Jeffery and Sunder 2000). Devolution needs to be complemented by capacity building and empowerment initiatives such as improved tenure, and better market 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 wellbeing, 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 (EWS) and indicators (for example the Environmental Vulnerability Index; see Gowde 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 wellbeing 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 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 Dahir 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
- 20,000-60,000
- 10,000-20,000
- 4,000-10,000
- $<4,000

No data

Data collected by Constituency

Other features

- District boundaries
- " " Constituency boundaries
- Selected rural posts and reserves
- Water bodies

Note: The urban estimates are based on a poverty line of KShs 6,410/month while the rest of the country is based on the rural poverty line of KShs 2,379/month. US$1 = KSh 70.

Source: WB 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 (Guter 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 EWS and foster communication and participation. Policies should support technologies that ensure equitable access and the safety of water, air and energy, and that provide transport, 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 (JPII) remain largely unfulfilled. Computer and information 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.

Building a culture of responsibility
The export and import of vulnerability is a recurring feature of all 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 (Martins 2003). Such solidarity can be actively nurtured through, for example, education (Dubois and Trubelita 2007) processes of cooperative interaction (Tocqueville 2003) 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 2003).

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 Raman 2004, Stephens 1996).

Poor governance, social exclusion and powerlessness limit the opportunities that 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 wellbeing (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 government can help strengthen their coping capacity. Box 7.17 gives an example of a recent initiative of Arctic indigenous communities and SSDs 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 2003 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 outcomes can lead to greater alienation. Weaknesses in this aspect is a recurring complaint for example in the multistakeholder dialogues of the global level (ISU 2002, Hohn 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 (Prilko 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. These 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

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is one opportunity that can be more effectively used (Booj 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 (Florin 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 it is in current 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 rededicated 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 at the relevant agencies. In some cases such as biodiversity management, capacity of some developed and developing countries to develop and implement interlinked strategies is lacking (CBD 2000). 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 socioeconomic 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.


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UNEP (2005): Environmental governance and the human dimension of ecosystem services: experiences from implementation of the World Summit on Sustainable Development, Montréal, Canada.


