VITAL GEO GRAPHICS

United Nations Environment Programme

UNEP

Our "shrinking" Earth

Notes: Numbers next to images of Earth reflect hectare of land per capita.

Sources: FAOSTAT 2006, GEO-4 Chapter 9 population projection, GEO Data Portal compiled from UNPD 2007-low estimate

VITAL GEO GRAPHICS

United Nations Environment Programme

UNEP

The United Nations Environment Programme (UNEP), as the world's leading intergovernmental environmental organization, is the authoritative source of knowledge on the current state of, and trends shaping the global environment. The mission of UNEP is to provide leadership and encourage partnership in caring for the environment by inspiring, informing, and enabling nations and peoples to improve their quality of life without compromising that of future generations. More: www.unep.org

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Vital GEO Graphics
Published by UNEP/GRID-Arendal based on UNEP's "*Global Environment Outlook: environment for development (GEO-4)*".

ISBN - 978-92-807-2974-0
Job No: DEW/1099/NA

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Cartography: Bounford.com, UNEP/GRID-Arendal
Pictures: StillPictures (http://www.stillpictures.com/) unless otherwise stated

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Introduction

The Global Environment Outlook (GEO) is the flagship of UNEP's integrated environmental assessment and reporting. It is a practical tool to implement UNEP's mandate to keep under review the world environmental situation in order to ensure that emerging environmental problems of wide international significance are prioritized and receive appropriate and adequate consideration by Governments. The GEO report series aims to keep track of the state and trends of the world's environment, identify and raise awareness of emerging issues that require international attention and provide guidance for policy making, action planning and resource allocation. GEO is both a process and a series of reports supporting capacity building for integrated environmental assessment at global and sub-global levels.

"Global Environment Outlook: environment for development (GEO-4)", the fourth issue of the GEO reporting series, was published in late 2007, exactly 20 years after the World Commission on Environment and Development (Brundtland Commission) released its seminal report, *Our Common Future*. The year 2007 was the year of a major milestone in analyzing what has been achieved in the area of sustainable development, and the halfway point to the implementation of some of the internationally recognized development targets including the Millennium Development Goals.

"Vital GEO Graphics" is an electronic booklet that is based on *GEO-4*. This is one of many publications produced within the popular Vital Graphics series – an initiative started by UNEP/GRID-Arendal with the aim to promote communication of scientific findings in accessible easily readable and environmentally friendly format.

The electronic booklet is organized around UNEP's six cross-cutting thematic priorities specified in the UNEP Medium-term Strategy 2010–2013[1]: climate change, disasters and conflicts, ecosystem management, environmental governance, harmful substances and hazardous waste, resource efficiency – sustainable consumption and production. The strategy was designed to evolve UNEP into a more efficient, focused, effective and result-based environmental body of the United Nations better equipped to deal with the challenges of the 21st century. Delivering tangible results against each of the priorities will be the focus of UNEP's efforts in the period 2010–2013.

Graphics from the *GEO-4* assessment not only illustrate the scientific findings, which underpin the crosscutting thematic priorities of UNEP but also point out many interlinkages between them.

Vital GEO Graphics tries to make the presentation of underlying scientific data and assessment findings more dynamic by means of using modern electronic presentation tools. The publication is based on maps and graphics (some of them animated), which are associated with the story line, and video clips. Most graphics are downloadable and may be used in presentations with appropriate credit given to the source.

Target audiences include the UNEP Governing Council, Multilateral Environmental Agreements, other UN organizations, intergovernmental and non-governmental organizations, civil society, scientific communities, media, the private sector and the general public. Particularly, it is hoped that *Vital GEO Graphics* can be used as an e-learning resource for on-line education and awareness-raising of both global environmental issues and the UNEP Medium-term Strategy.

1 UNEP/GCSS.X/8

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PACIFIC
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135°
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40°

Section 1

Climate Change

Anthropogenic Pressure on the Earth's Climate System

Being Vulnerable to Climate Change

Climate Change Interlinkages

Tackling the Issue

Scenarios for the Future

Anthropogenic Pressure on the Earth's Climate System

The last few decades have seen climate disruption unprecedented over the recent millennia. The trend towards global warming is virtually certain, with 11 of the 12 years to 2006 ranking among the 12 warmest years since 1850, the year when systematic temperature recording began.

The Earth's surface temperature has increased by about 0.74°C since 1906 and there is a strong consensus among scientists that the globally averaged net effect of human activities since 1750 has been one of warming. The heating up of the earth in the last few decades has been exceptionally rapid in comparison to the changes in climate during the past two millennia. The Earth's climate has now entered a state that has no parallel in recent prehistory.

The greatest direct human pressure on the climate system arises from the emission of greenhouse gases, pre-eminent of which is CO_2, mainly originating from burning fossil fuels. Since 1987 annual global emissions of CO_2 have risen by about one-third. However, the per capita emissions figures clearly illustrate large differences among regions.

Observed warming over the 20th century compared with climate model calculations

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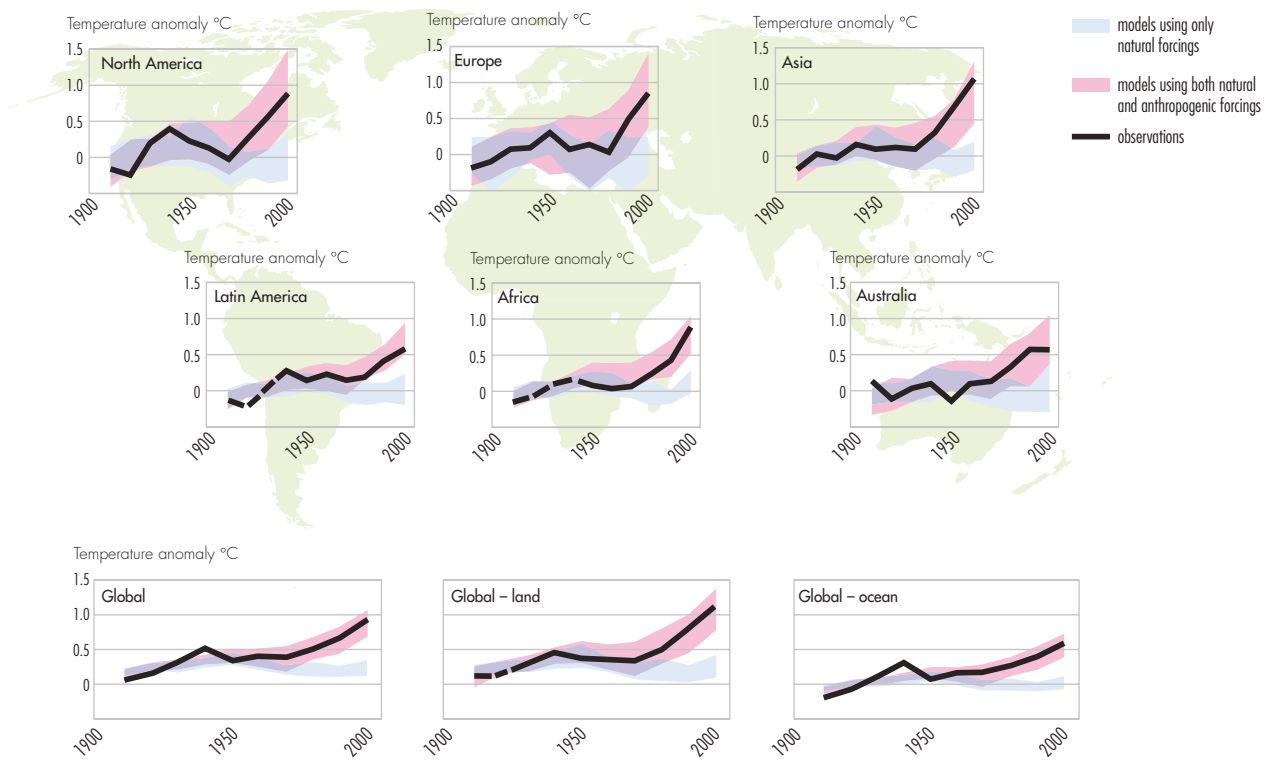

Source: IPCC 2007

CO_2 emissions from fossil fuels by region

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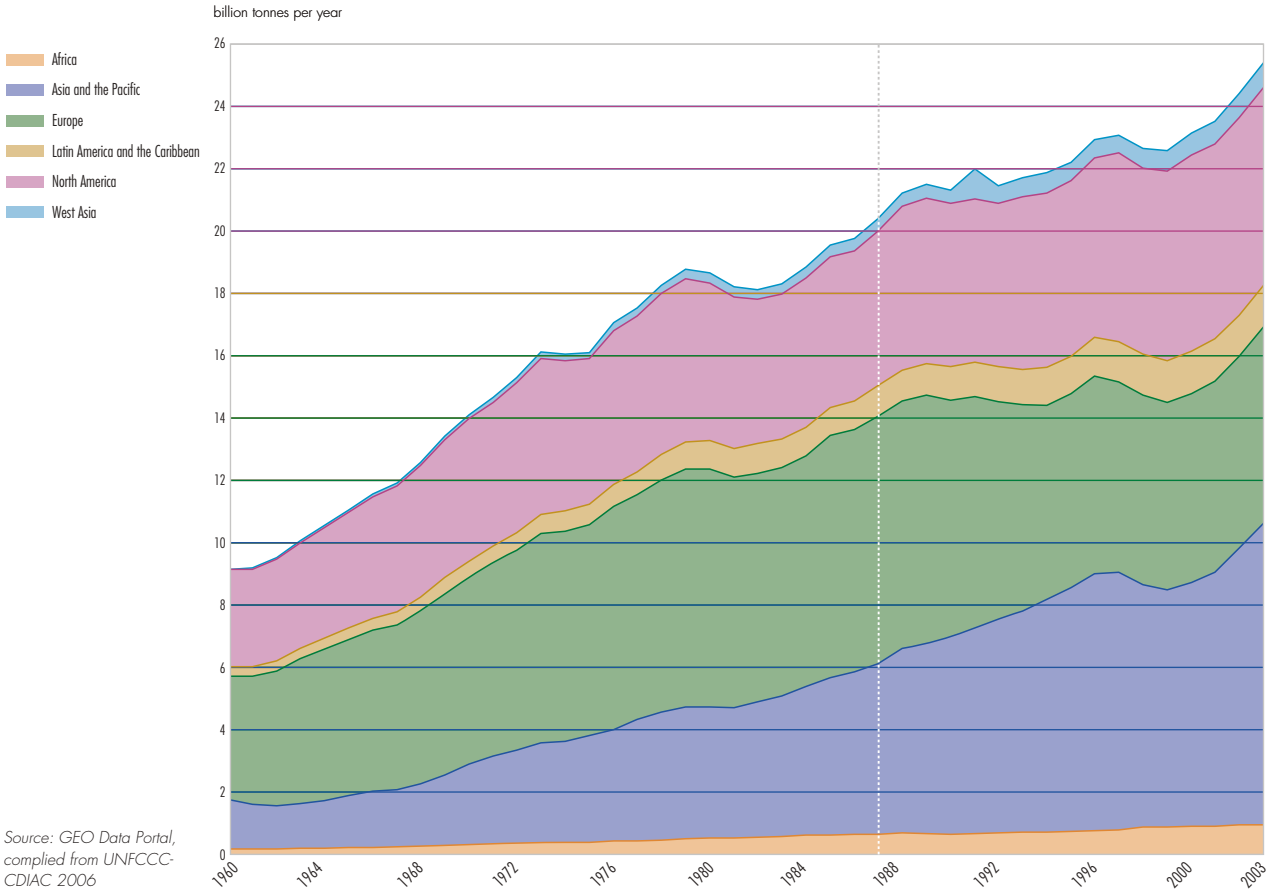

Source: GEO Data Portal, complied from UNFCCC-CDIAC 2006

Per capita CO_2 emissions at the regional level in 2003

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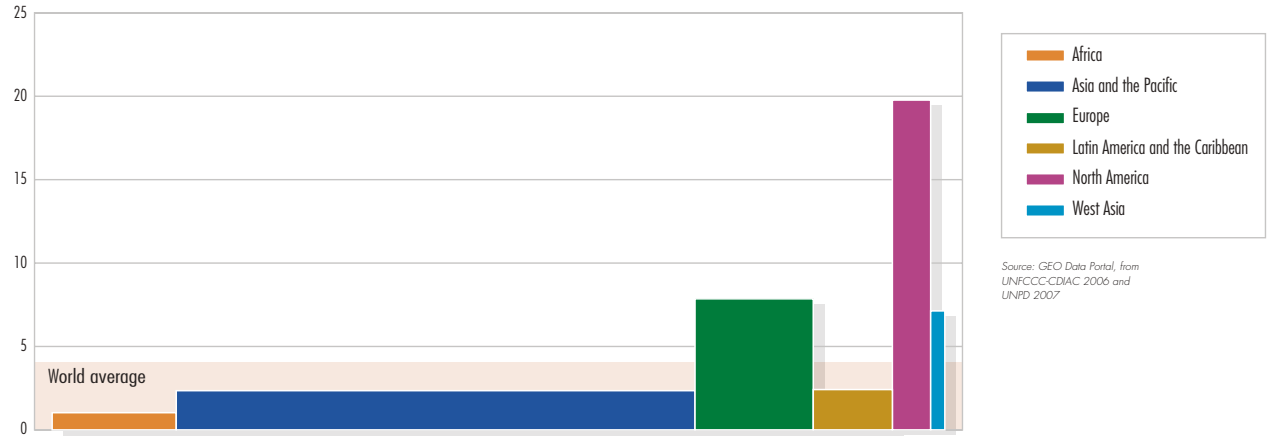
CO_2 emissions in tonnes per capita

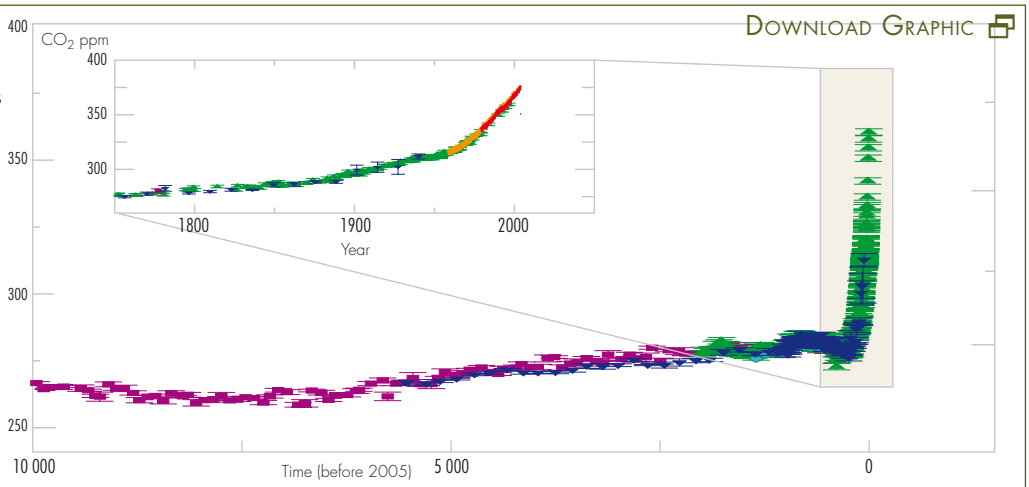


Source: GEO Data Portal, from UNFCCC-CDIAC 2006 and UNPD 2007

Notes: The width of each bar reflects regional population, and thus the area of each bar represents the total regional CO_2 emissions. Land–use change emissions are not included.

The concentration of CO_2 in the atmosphere has now reached an unprecedented 380 parts per million (ppm), compared with 280 ppm in pre-industrial times.

Atmospheric concentrations of CO_2 over the last 10 000 years



Note: Measurements of CO_2 are shown from ice cores (symbols with different colours for different studies) and atmospheric samples (red lines).

Source: IPCC 2007

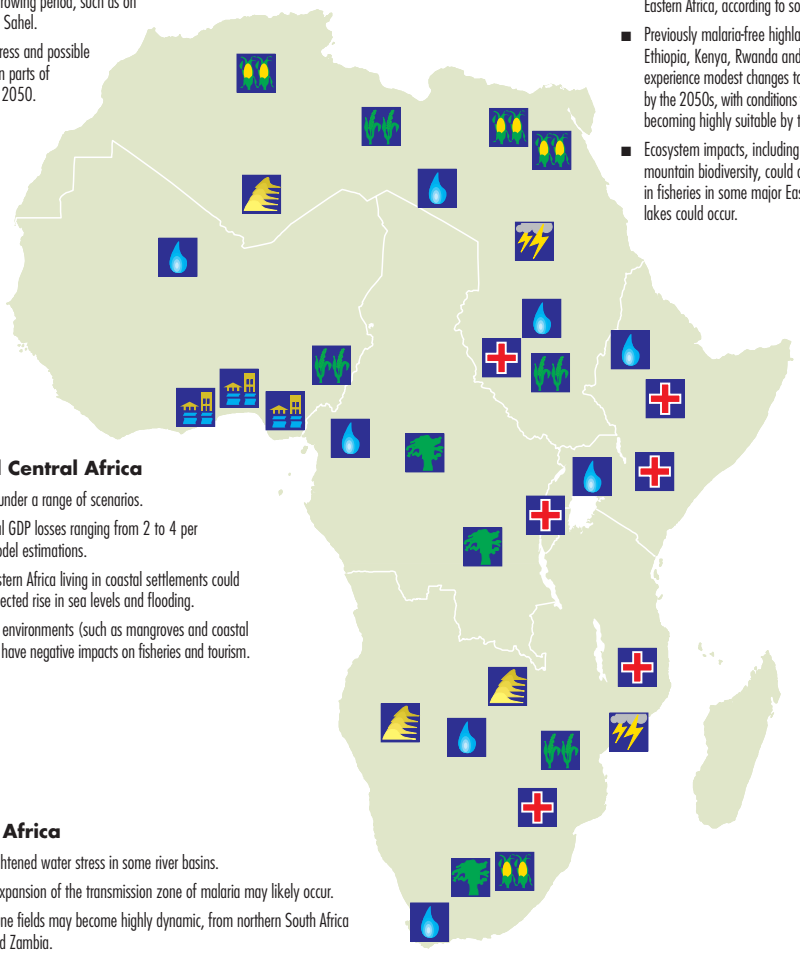
Examples of current and possible future impacts and vulnerabilities associated with climate variability and change in Africa

Northern Africa

- Climate change could decrease mixed rain-fed and semi-arid systems, particularly the length of the growing period, such as on the margins of the Sahel.
- Increased water stress and possible run-off decreases in parts of Northern Africa by 2050.

Eastern Africa

- Rainfall is likely to increase in some parts of Eastern Africa, according to some projections.
- Previously malaria-free highland areas in Ethiopia, Kenya, Rwanda and Burundi could experience modest changes to stable malaria by the 2050s, with conditions for transmission becoming highly suitable by the 2080s.
- Ecosystem impacts, including impacts on mountain biodiversity, could occur. Declines in fisheries in some major Eastern African lakes could occur.



- Agricultural changes (such as millet, maize)
- Changes in ecosystem range and species location
- Changes in water availability coupled to climate change
- Possible changes in rainfall and storms
- Desert dune shifts
- Sea-level rise and possible flooding in megacities
- Changes in health possibly linked to climate change

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Western and Central Africa

- Impacts on crops, under a range of scenarios.
- Possible agricultural GDP losses ranging from 2 to 4 per cent with some model estimations.
- Populations of Western Africa living in coastal settlements could be affected by projected rise in sea levels and flooding.
- Changes in coastal environments (such as mangroves and coastal degradation) could have negative impacts on fisheries and tourism.

Southern Africa

- Possible heightened water stress in some river basins.
- Southward expansion of the transmission zone of malaria may likely occur.
- By 2099, dune fields may become highly dynamic, from northern South Africa to Angola and Zambia.
- Food security is likely to be further aggravated by climate variability and change.

Note: These are indications of possible change and are based on models that currently have recognized limitations.

Source: Adapted from Boko and others 2007

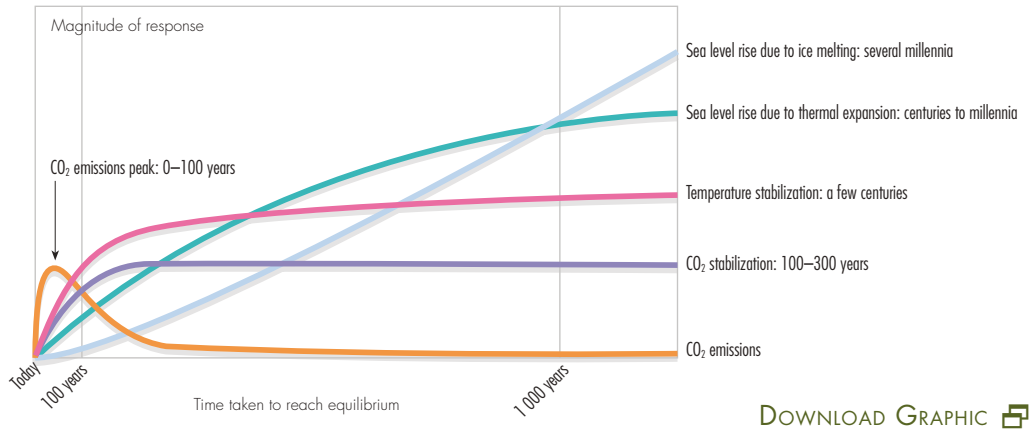
Being Vulnerable to Climate Change

Every region of the world will feel the effects of changes in the global climate. But it is the poor or vulnerable who will suffer most. Poor people in tropical countries will be particularly vulnerable to climate change impacts, such as water shortages, declining crop yields and disease.

Sea level rise will impact millions of people and major economic centres in coastal areas. Both ecosystems and human well-being are very vulnerable. Coasts and rapidly growing coastal settlements and infrastructure in countries such as Bangladesh, China, India, Myanmar and Thailand are at risk from any increase in coastal flooding and erosion due to sea level rise. Impacts on coastal regions might also include the degradation of wetlands and coastal lowlands. In this connection the South Pacific island states are extremely vulnerable to climate change. In a number of islands vital infrastructure and major concentrations of settlements are very likely to be at risk. In some extreme cases, migration and resettlement outside national boundaries might have to be considered. In addition, climate change is projected to exacerbate health problems, such as heat-related illness, cholera, dengue fever and biotoxin poisoning, placing additional stress on the already overextended health systems of most small island states.

Sea levels have been rising at a rate of about 3 mm/year since 1993, compared to less than 2 mm/year over the previous century. Projections of the sea level rise vary, however the majority of the impact will be post - 2100.

Time scales and sea level rise



Note: Even if CO_2 emissions decline over a period of a couple of centuries, sea level rise will continue for several centuries to millennia.

Source: IPCC 2001a

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Polar bears depend on sea ice for hunting, and use ice corridors to move from one area to another.
Credit: Norwegian Polar Institute

The rate at which polar ice sheets are contributing to sea level rise is faster than previously predicted: some experts say a full collapse of the West Antarctic Ice Sheet is conceivable this century. Were this to happen, the sea level would rise by about 6 meters.

Global glacier mass – annual variability and cumulative values

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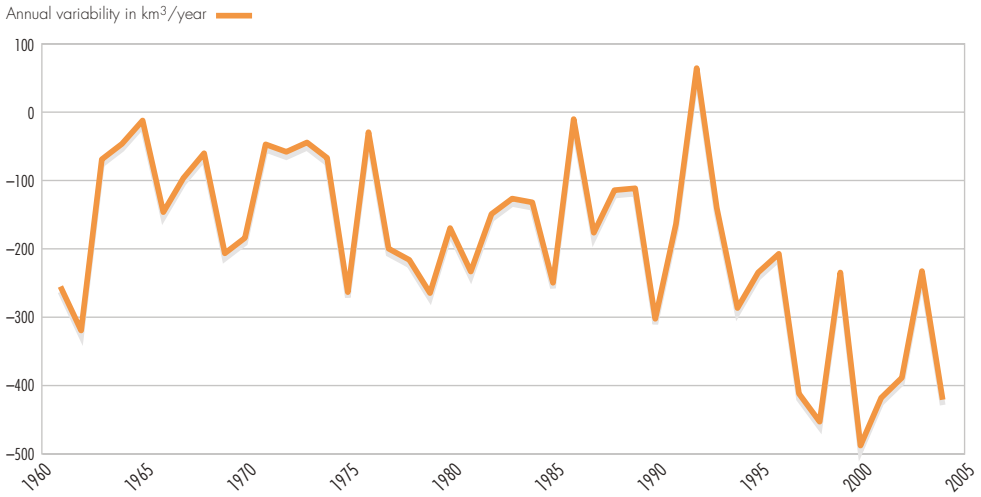

Source: adapted from Dyurgerov and Meier 2005

The potential impact of a 5-metre sea level rise in Florida (left) and Southeast Asia (right)

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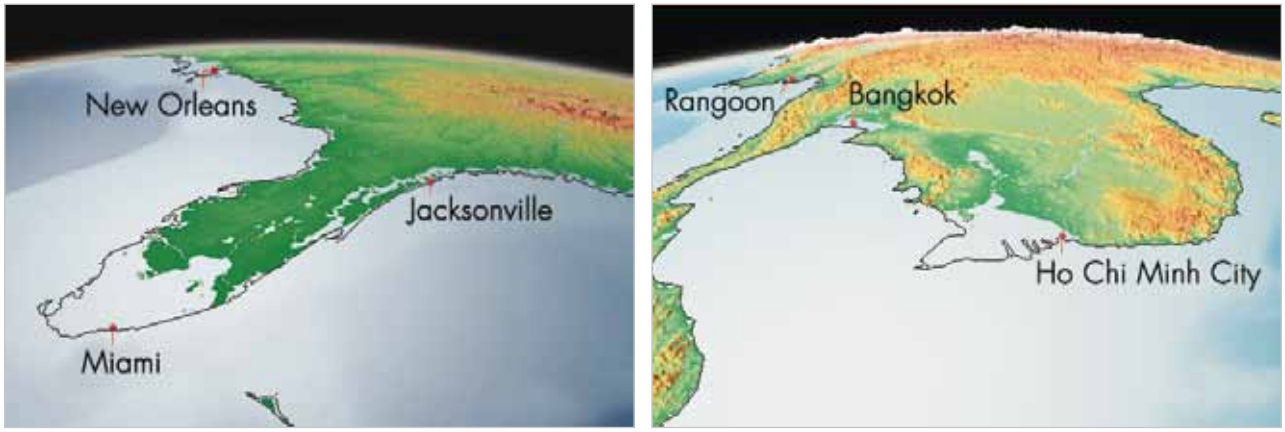


Note: The black lines show the current coast lines. The reconstruction shows that with a 5-metre sea level rise the coastlines would recede drastically, and cities such as Bangkok, Ho Chi Minh City, Jacksonville, Miami, New Orleans and Rangoon would disappear from the land map.

Credit: W. Haxby/Lamont- Doherty Earth Observatory

Climate Change Interlinkages

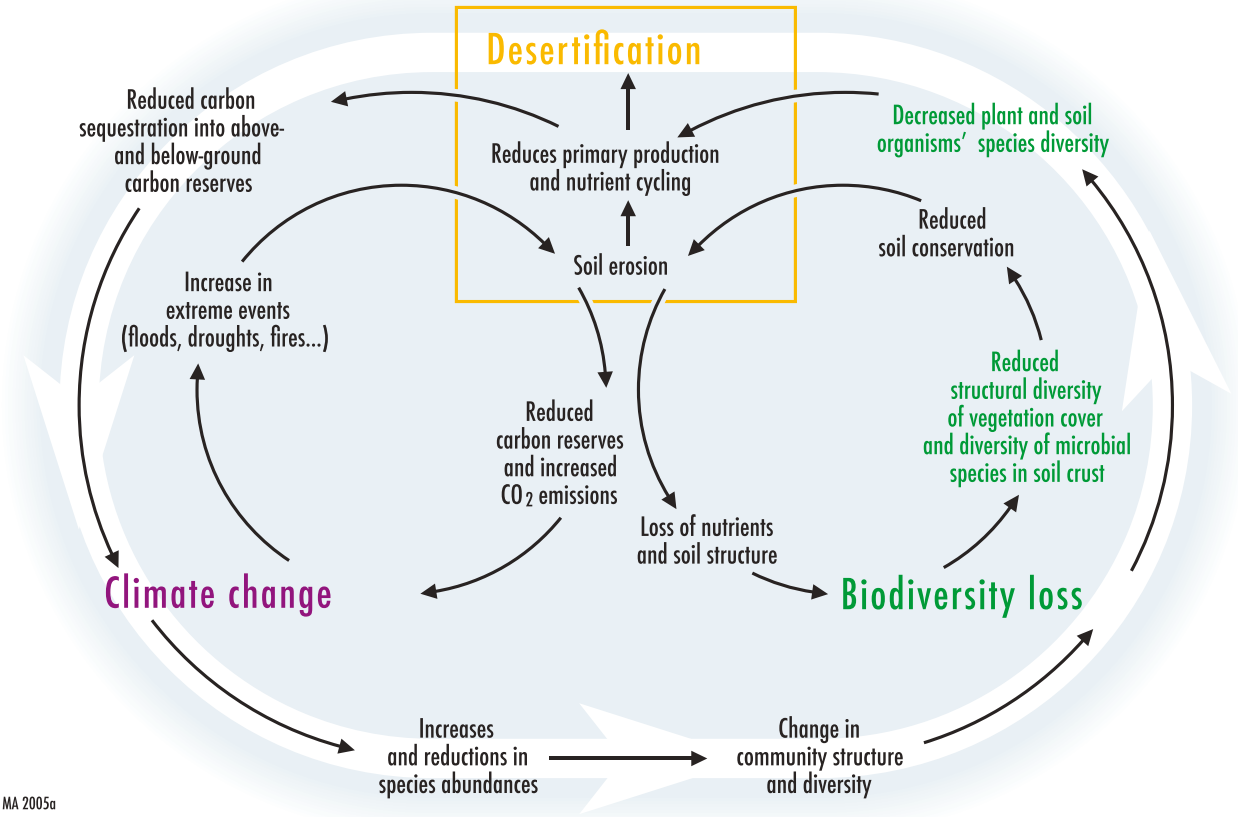
The links between climate change and biodiversity – both aquatic and terrestrial – are illustrative of the links between land, water and atmosphere. Biodiversity is, in many instances, under multiple pressures. These can include land degradation, land and water pollution, and invasive alien species. Changes in climate exert additional pressures, which have affected biodiversity.

These include disruption in timing of the reproduction process of animals and plants, migration patterns of animals, the length of the growing season, species distribution and abundance of pole-ward and upward shifts in the ranges of plant and animal species, and the frequency of pest and disease outbreaks.

Changes in regional temperatures have contributed to changes in stream-flow, and the frequency and intensity of extreme climatic events, such as floods, droughts and heat waves. These changes have affected biodiversity and ecosystem services.

Download Graphic

Linkages and feedback loops among desertification, global climate change and biodiversity loss



Source: MA 2005a

Notes: Green text: major components of biodiversity involved in the linkages.
Bold text: major services impacted by biodiversity losses. The major components of biodiversity loss (in green) directly affect major dryland services (in bold). The inner loops connect desertification to biodiversity loss and climate change through soil erosion. The outer loop interrelates biodiversity loss and climate change. On the top section of the outer loop, reduced primary production and microbial activity reduce carbon sequestration and contribute to global warning. On the bottom section of the outer loop, global warming increases evapotranspiration, adversely affecting biodiversity; changes in community structure and diversity are also expected because different species will react differently to the elevated CO_2 concentrations.

Tackling the Issue

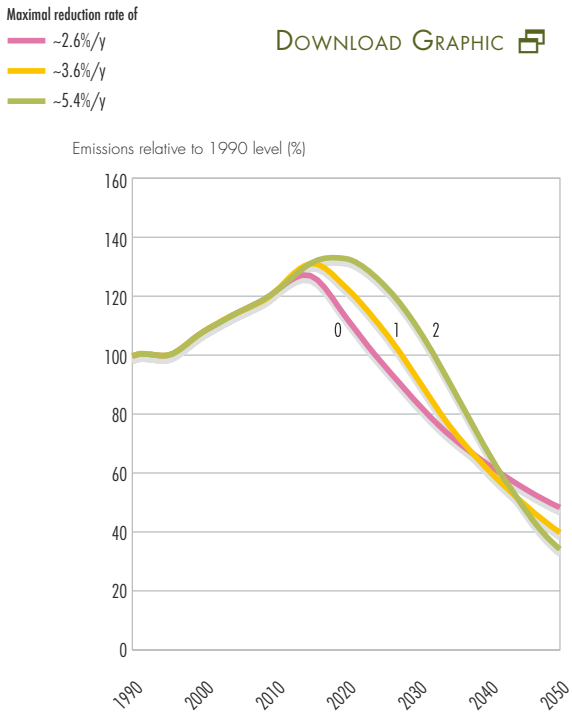
Climate change presents a threat whose precise magnitude is unknown but is potentially massive. The impact of decisions made now will continue to be felt for decades or centuries. Various analysts have identified a 2°C increase in the global mean temperature above pre-industrial levels as a threshold beyond which climate impacts become significantly more severe and the threat of major, irreversible damage becomes more plausible.

Staying under the 2°C threshold will require very stringent measures on greenhouse gas emissions, and the longer the delay in implementation, the steeper the reduction trajectory required.

Various policies and measures to mitigate climate change have been implemented worldwide. They make up a crucial first wave in efforts to limit greenhouse gas emissions and to ultimately switch from the carbon intensive economies. Many important actions have been taken but the net effect is still woefully inadequate.

Mainstreaming climate concerns in development planning is urgent, especially in sectors such as energy, transport, agriculture, forests and infrastructure development, at both policy and implementation levels. Adaptation to anticipated climate change is now a global priority.

Paths to reach a 400 ppm CO_2-equivalent greenhouse gas concentration target (Kyoto gas emissions plus land use CO_2)



Notes: The risk of overshooting a 2° threshold increases rapidly if greenhouse gas concentrations are stabilized much above 400 ppm CO_2-equivalent in the long term.

Path 2 postpones the peak in global emissions until about 2020, but requires subsequent annual emissions reductions at an exceptionally challenging pace of more than 5 per cent/year.

Source: Den Elzen and Meinshausen 2005

The clearance of forested land and its subsequent use for cattle and crop production, releases carbon stored in the trees and soils, and depletes its potential as a CO_2 sink.
Credit: Ngoma Photos

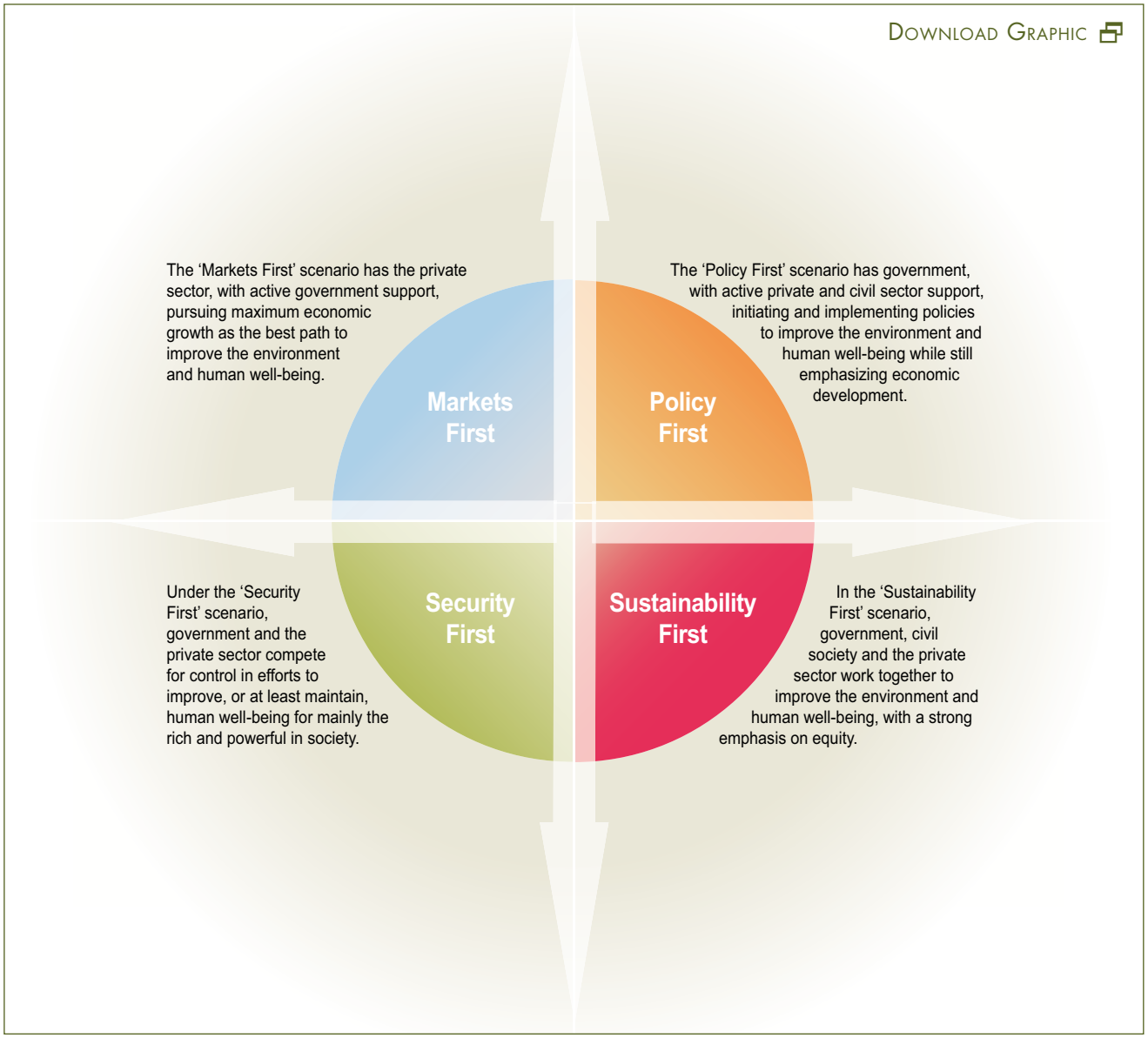
Scenarios for the Future

In the face of climate change and other challenges to the environment, GEO-4 analyses four scenarios, which could potentially develop over future years, depending on decisions taken today.

Notwithstanding different carbon emission pathways all scenarios show a distinct increase in CO_2 concentrations in the atmosphere and an increase in the global mean temperature, ranging from about 1.7°C above pre-industrial levels in 2050 in 'Sustainability First' to about 2.2°C in 'Markets First'.

In general, 'Markets First' and 'Security First' have the worst impacts across a wide range of measures, including anthropogenic greenhouse gas emissions. 'Sustainability First' comes out best across a number of indicators. Even here, climate change continues to be a persistent problem and it is not possible to avoid potentially significant warming and sea level rise.

Yet under the 'Sustainability First' scenario, there is hope. While achieving environmental and human well-being goals is a complex business, investing in environmental and social sustainability does not impair economic development. Integrating policies at all levels and across all sectors and time is a key step along the way.



Global total equivalent carbon emissions from anthropogenic sources by sector

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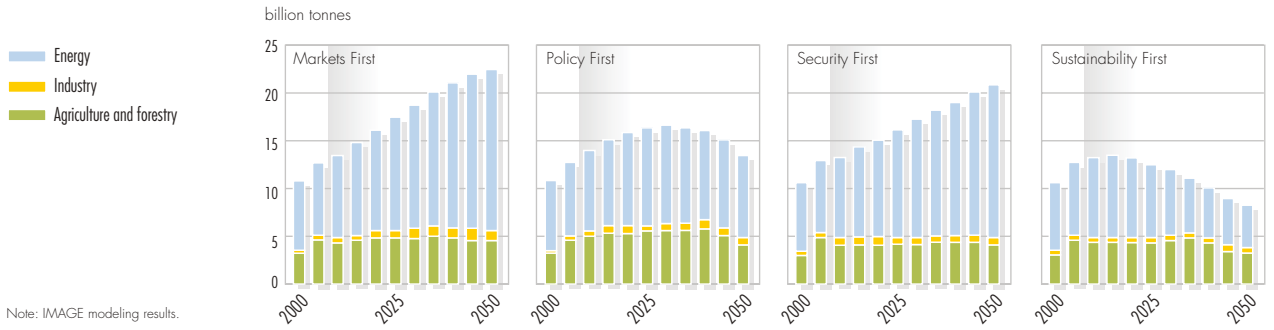

Note: IMAGE modeling results.

Atmospheric concentration of CO_2

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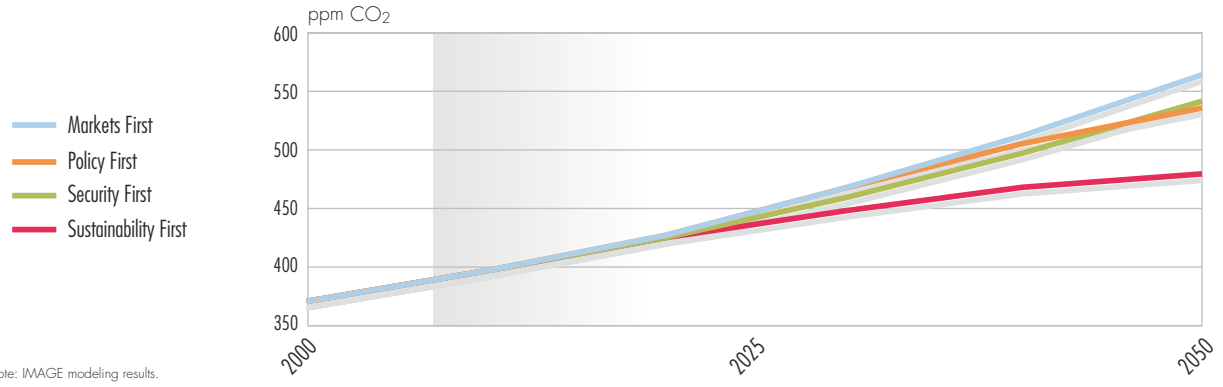


Note: IMAGE modeling results.

Section 2

Disasters and Conflicts

Exposure

Vulnerability

Threatened Livelihoods

Options for Action

Exposure

Over the past 20 years, natural disasters have claimed more than 1.5 million lives and have affected more than 200 million people annually.

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. More than 90 per cent of the people exposed to disasters live in the developing world, and more than half of natural disaster deaths occur in countries with a low human development index.

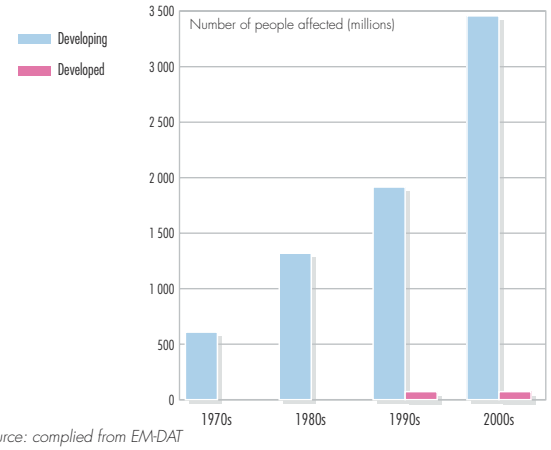
Developing countries often lack the capacity to cope with extreme climatic events such as floods, droughts, heat waves and storm surges. About 2 billion people were affected by such disasters in the 1990s: 40 per cent of the population in developing countries, compared to a few per cent in developed countries.

In some areas exposure to natural hazards has increased as a result of climate change and human actions such as the destruction of mangrove forests that protect coastal areas from tidal surges. Risks are also increasing as a result of the continuing concentration of population in highly-exposed areas.

The consequences of disasters can threaten achievements in development and undermine resilience. The capacity to adapt is often being eroded by, for example, reduced state social protection schemes, undermining of informal safety nets, poorly built or maintained infrastructure, chronic illness and conflict.

Download Graphic

Number of people affected by climate-related disasters in developing and developed countries



Source: complied from EM-DAT

Conflicts, violence and persecution regularly displace large civilian populations, forcing millions of people into marginal ecological and economic areas within countries and across international boundaries.

The United Nations High Commission for Refugees estimated that there were 11.5 million refugees, asylum seekers and stateless persons globally in 2005, plus another 6.6 million internally displaced persons. The resulting poverty, often tied to shortages or degradation of natural resources, contributes directly to lower levels of well-being and higher levels of vulnerability.

Highest risk hot spots by natural hazard type

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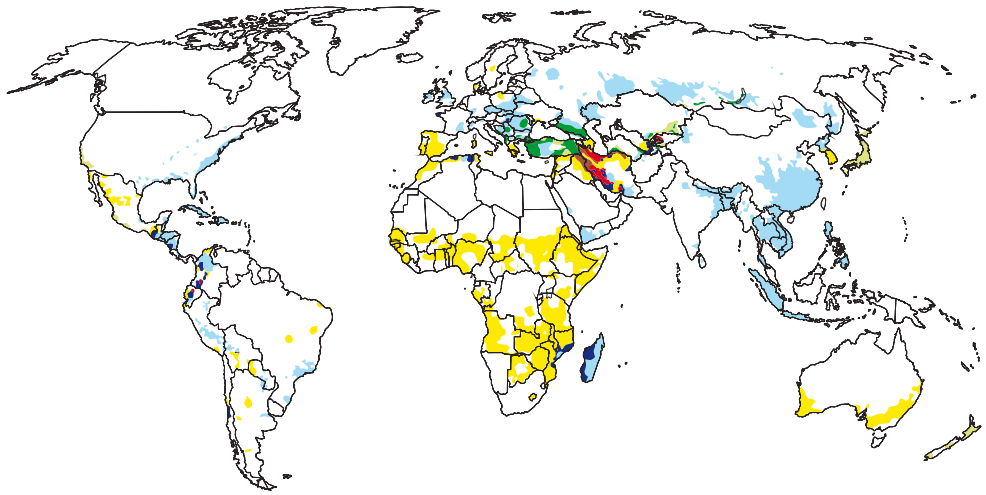


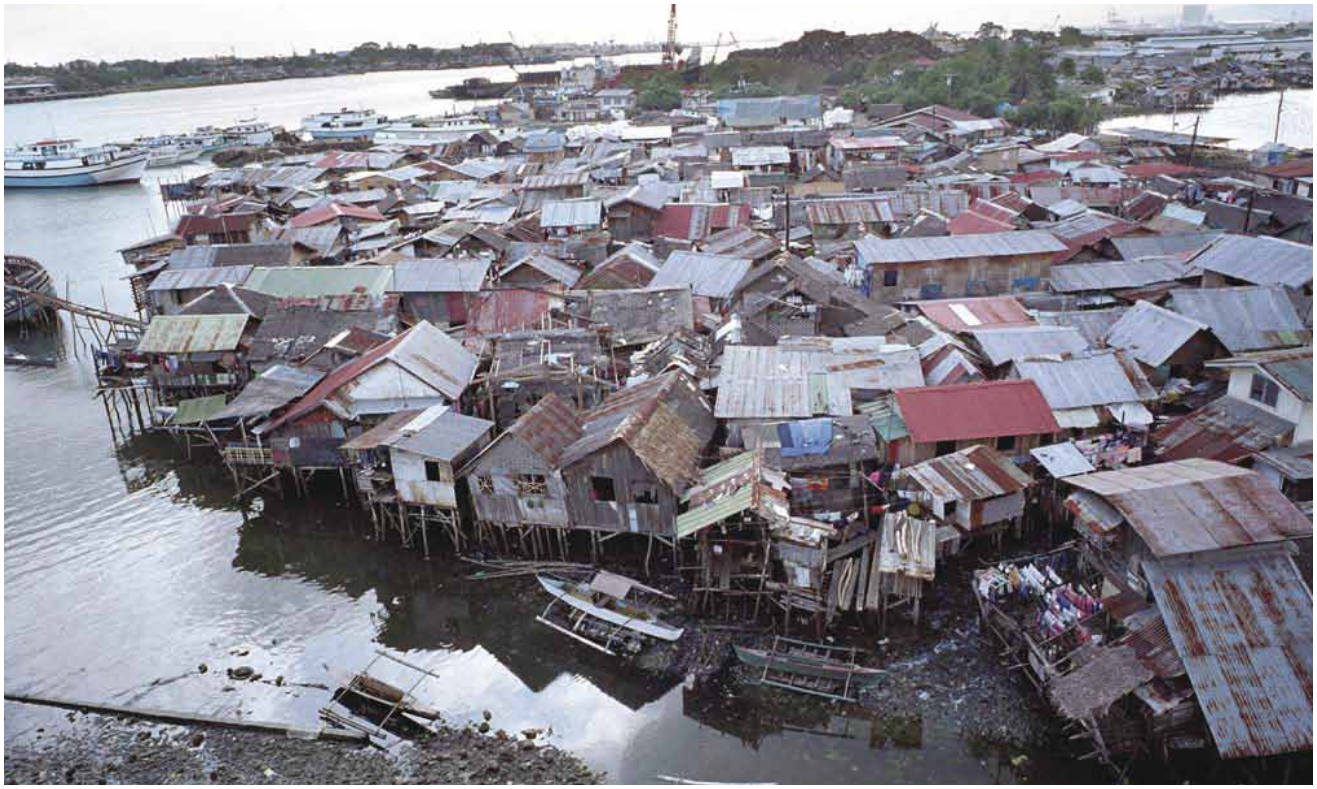
High total economic loss risk top 3 deciles at risk from:

- Drought only
- Geophysical only
- Hydro only
- Geophysical and hydro
- Drought and geophysical
- Drought and hydro
- Drought, hydro and geophysical

Notes: Geophysical hazards include earthquakes and volcanoes.

Hydrological hazards include floods, cyclones and landslides.

Source: Dilley and others 2005



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

Vulnerability

The impacts of extreme weather events fall disproportionately on developing countries, such as Small Island Developing States (SIDS), as well as poor people in all countries.

Number of people affected by disasters of natural origin in SIDS

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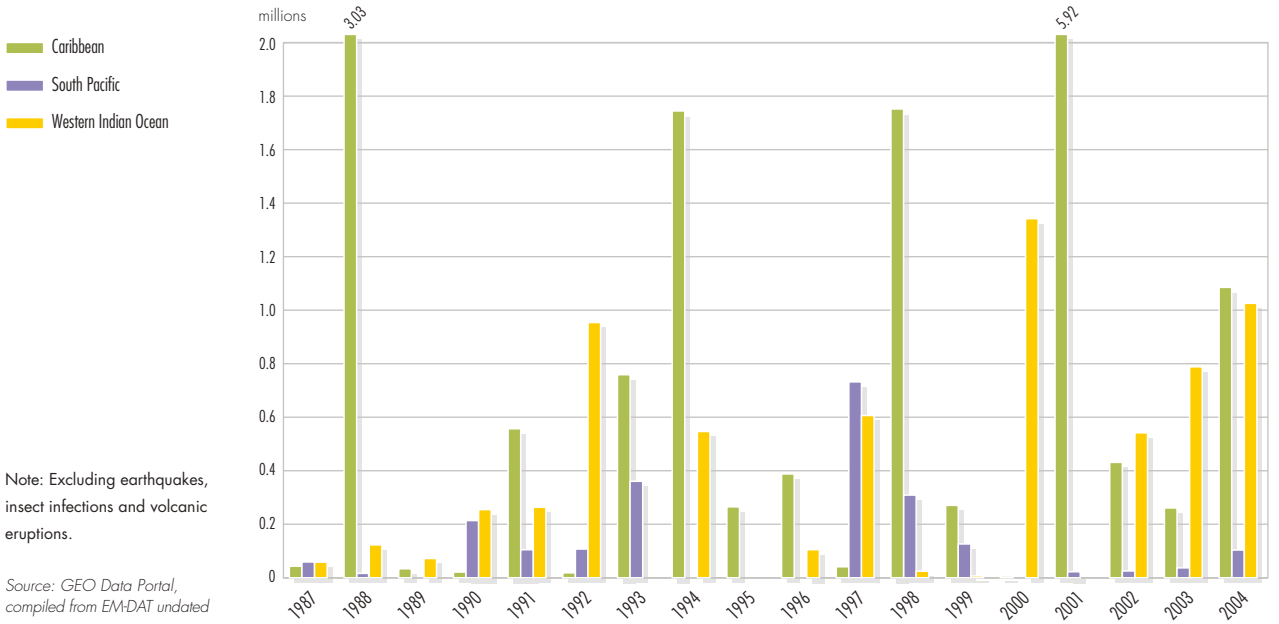


Note: Excluding earthquakes, insect infections and volcanic eruptions.

Source: GEO Data Portal, compiled from EM-DAT undated

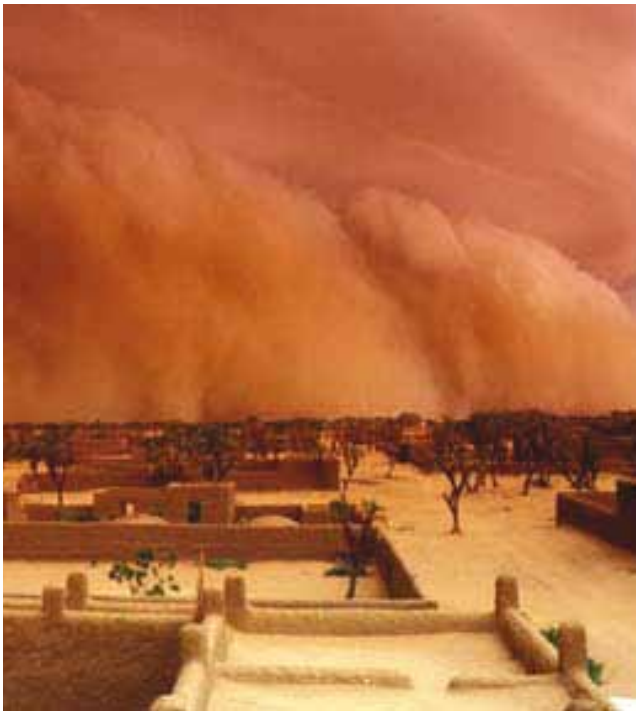
Millions of people continue to be displaced and to be negatively affected by conflict, which reduces societal capacity to adapt to environmental change, while making sustained environmental management difficult. *Credit: UN Photo Library*

During hurricane Katrina in the US in 2005, impoverished people without access to private transport were unable to leave the city of New Orleans. People in poor health or lacking bodily strength were less likely to survive the Indian Ocean tsunami of 2004 – in villages in North Aceh, Indonesia, women accounted for up to 80 per cent of deaths. In Sri Lanka the same tsunami caused a high mortality rate among children and the elderly.

Climate change is likely to increasingly upset various ecological balancing forces, resulting in a growth in the frequency and intensity of extreme weather events around the globe. This will cause greater insecurity for much of the world's population.

Droughts are likely to have a severe impact on growing numbers of people. Those living in drylands in industrialized countries – such as in Australia and the US – typically have a diversity of livelihood options and can adapt more to land degradation and water scarcity. But those in developing countries who directly depend on environmental resources for their livelihoods are most vulnerable.

Where there is high agricultural dependency, droughts may undercut food security and economic performance, lessening the opportunity to meet Millennium Development Goal (MDG) 1 on poverty and hunger.



Sandstorm in Gao, Mali.
Credit: BIOS Crocetta Tony/StillPictures

Vulnerability to drought and impacts on well-being

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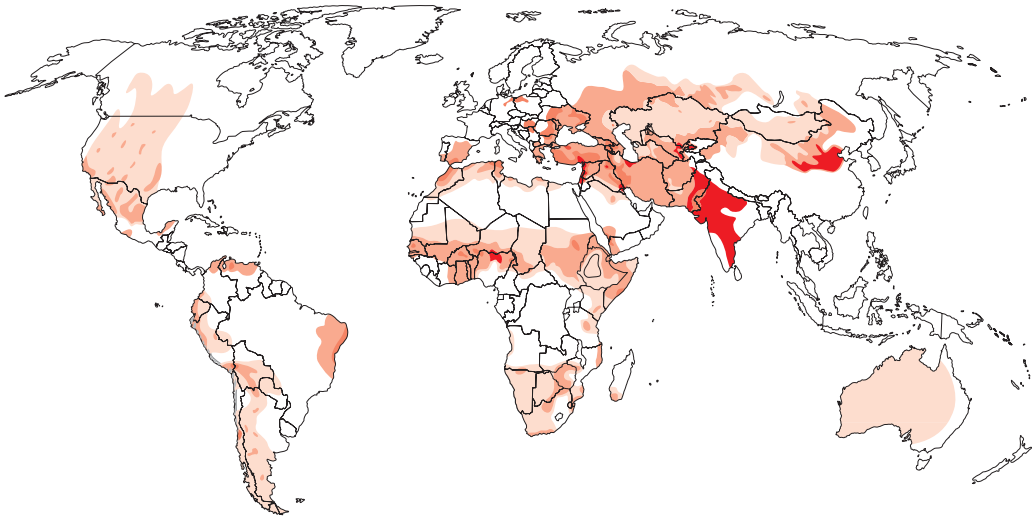
a) Drylands populations are concentrated in developing countries

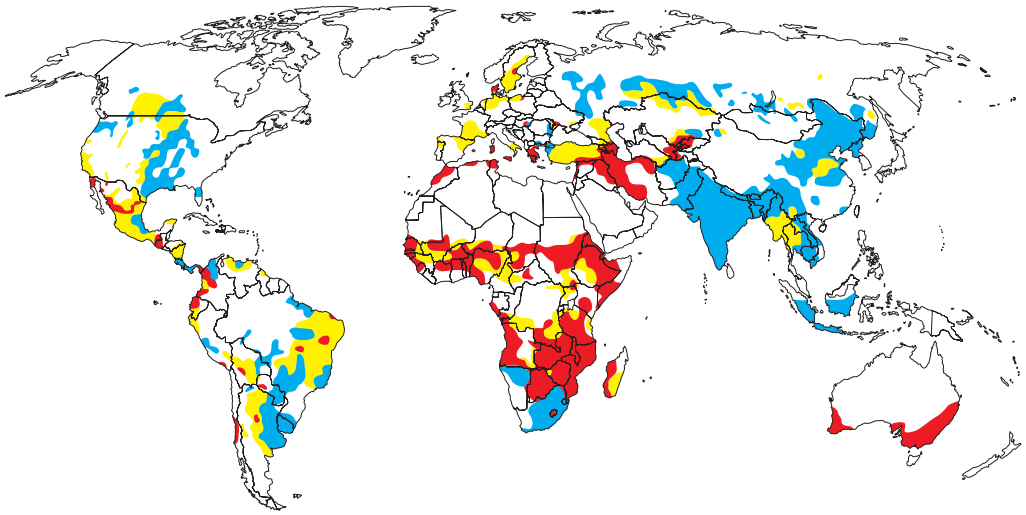


Persons per km²

- < 5
- 5–50
- 51–100
- 100 >

Source: WRI 2002

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

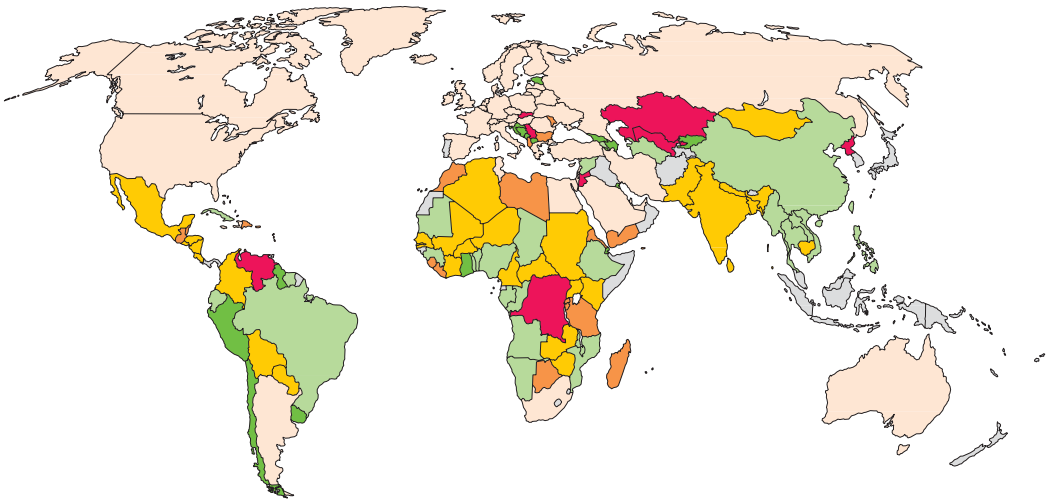


Drought total economic loss risk deciles

- 1st–4th
- 5th–7th
- 8th–10th

Source: Dilley and others 2005

c) Progress towards MDG target on food security



- Already reached MDG target
- Strong progress
- Moderate progress
- Set-back
- Severe setback
- Continuously very low undernourishment
- No data

Source: FAO 2006

Threatened Livelihoods

A number of factors are bringing about an increased risk of natural disasters, threatening hundreds of thousands of people and their livelihoods.

Growing global population means there is an ever-increasing strain on food supplies and environmental resources. Ever larger numbers of people are settling in coastal areas, which are exposed to hurricanes, tidal surges and rising sea levels.

As population pressures in coastal areas increase, many coastal and marine ecosystems – and most freshwater ecosystems – have continued to be heavily degraded, with many completely lost, some irreversibly.

Natural hazards have severe adverse impacts on lives and socio-economic development in SIDS and low-laying costal areas in other developing countries. Hurricanes and tidal waves that hit Bangladesh and Burma in recent years not only resulted in thousands being killed but also significantly affected economic development.

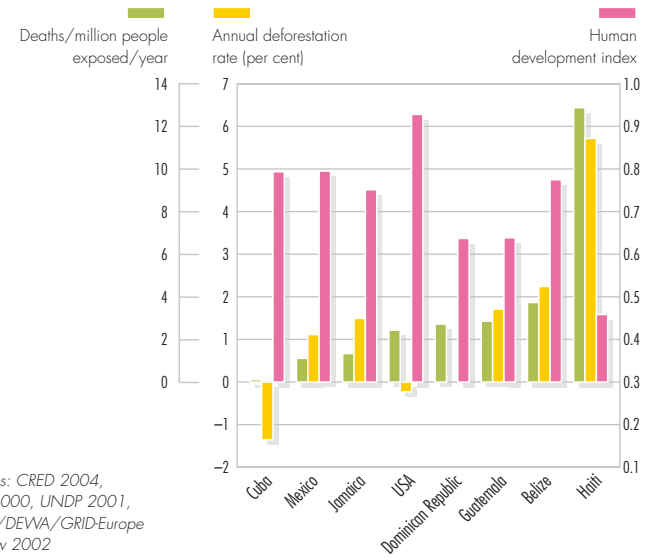
The economies of SIDS are particularly vulnerable to the adverse impact of hurricanes. Sea level rise and the increasing frequency and severity of extreme events threaten livelihoods and limit adaptation options. Rising seas are also likely to induce large-scale migration among the SIDS in the longer term, which could lead to conflict.

Abandoning islands would also result in the loss of sovereignty and highlights the need to reconsider traditional development issues as matters of national and regional security.

Disaster preparedness and well-being DOWNLOAD GRAPHIC

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

Caribbean casualties due to hurricanes



Sources: CRED 2004, FAO 2000, UNDP 2001, UNEP/DEWA/GRID-Europe Preview 2002

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

Credit: NASA 2002

Environmental change can also raise security issues by changing or threatening supplies of food and other goods. Scarcity of shared resources, such as fresh water, has been a source of conflict and social instability.

Natural resources have often been a means of funding war as it was in Liberia and Sierra Leone in the 1990s. Armed conflicts have also been used as a means to gain access to resources, and they can destroy or result in severe degradation of environmental resources.

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 causes heavy damage to the environment. It reduces societal capacity to adapt to global environmental change, while making sound environmental management difficult.

Conflict in Sierra Leone and Liberia, and refugee settlement in Guinea

DOWNLOAD GRAPHIC

Natural resources, including diamonds and timber, helped fuel civil war in Liberia and Sierra Leone during the 1990s. Diamonds were smuggled from Sierra Leone into Liberia and onto the world market. In the mid-1990s, Liberia's official diamond exports ranged between US$300 and US$450 million annually. These diamonds have been referred to as "blood diamonds," as their trade helped finance rebel groups and the continued hostilities. By the end of the war in 2002, more than 50 000 people had died, 20 000 were left mutilated and three-quarters of the population had been displaced in Sierra Leone alone.

As civil wars raged in Sierra Leone and Liberia, hundreds of thousands of refugees fled to safety in Guinea. In 2003, about 180 000 refugees resided in Guinea. Between Sierra Leone and Liberia, there is a small strip of land belonging to Guinea known as the "Parrot's Beak," because of the parrot shape contour of the international border between the countries (depicted as a black line on both images). This strip is where refugees constituted up to 80 per cent of the local population.

Sources: Meredith 2005, UNEP 2005b, UNHCR 2006a

The 1974 image shows small, evenly spread, scattered flecks of light green in the dark green forest cover of the Parrot's Beak and surrounding forests of Liberia and Sierra Leone. These flecks are village compounds, with surrounding agricultural plots. The dark areas in the upper left of the image are most likely burn scars.

In the 2002 image Parrot's Beak is clearly visible as a more evenly spread light grey and green area surrounded by darker green forest of Liberia and Sierra Leone. The light colours show deforestation in the "safe area" where refugees had set up camp. Many of the refugees integrated into local villages, creating their own family plots by cutting more trees. As a result the isolated flecks merged into one larger area of degraded forest. The forest devastation is especially obvious in the upper left part, where areas that were green in 1974 now appear grey and brown, also due to expanded logging.

Credit: UNEP 2005b

Green engineering can help to protect coastlines using mangroves.
Credit: BIOS- Auteurs Gunther Michel/StillPictures

Options for Action

Insecurity caused by bad governance or war can contribute to environmental degradation. World security requires the current and future availability of environmental goods-and-services, through good governance, mechanisms for conflict avoidance and resolution, and for disaster prevention, preparedness and mitigation.

Development policies balanced by a more equitable societal approach can significantly reduce the social and economic impacts of natural disasters. The implementation of sustainable and more equitable development policies can also help reduce the probability of conflicts.

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. While conflicts can arise as a result of environmental factors, such as disagreements over trans-national water resources, it has become clear in recent years that joint management of environmental matters is necessary in order to facilitate cooperation across societal and international boundaries.

Policies and measures will require a combined focus on ecosystem management, sustainable livelihoods and local risk management.

For example, in coastal environments, preservation of reefs and sea grasses is vital, not only for the maintenance of biodiversity but to ensure the livelihoods of millions.

Restoring mangroves in cyclone prone areas increases physical protection against storms, creates a reservoir for carbon sequestration and increases livelihood options by generating much needed income for local communities. Although the evidence is varied, communities hit by the 2004 tsunami in South Asia reported less damage in areas with healthy mangrove forests than those with few natural sea defences.

India and Bangladesh have come to recognize the importance of preserving mangrove forests in the Gulf of Bengal, not only as a source of livelihood for fishing communities but also for coastal protection.

Since 1994, the Vietnam National Chapter of the Red Cross has worked with local communities to plant and protect mangrove forests in northern Vietnam. Nearly 120 square km. of mangroves in the area have been planted, with substantial resulting benefits. Although planting and protecting the mangroves cost about US$1.1 million, it saves US$7.3 million a year in dyke maintenance.

During the devastating typhoon Wukong in 2000, project areas remained unharmed, while neighbouring provinces suffered huge losses in lives, property and livelihoods. Thousands of households have benefited from mangrove rehabilitation. Family members can now earn additional income from selling crabs, shrimp and mollusks, while increasing the protein in their diets.

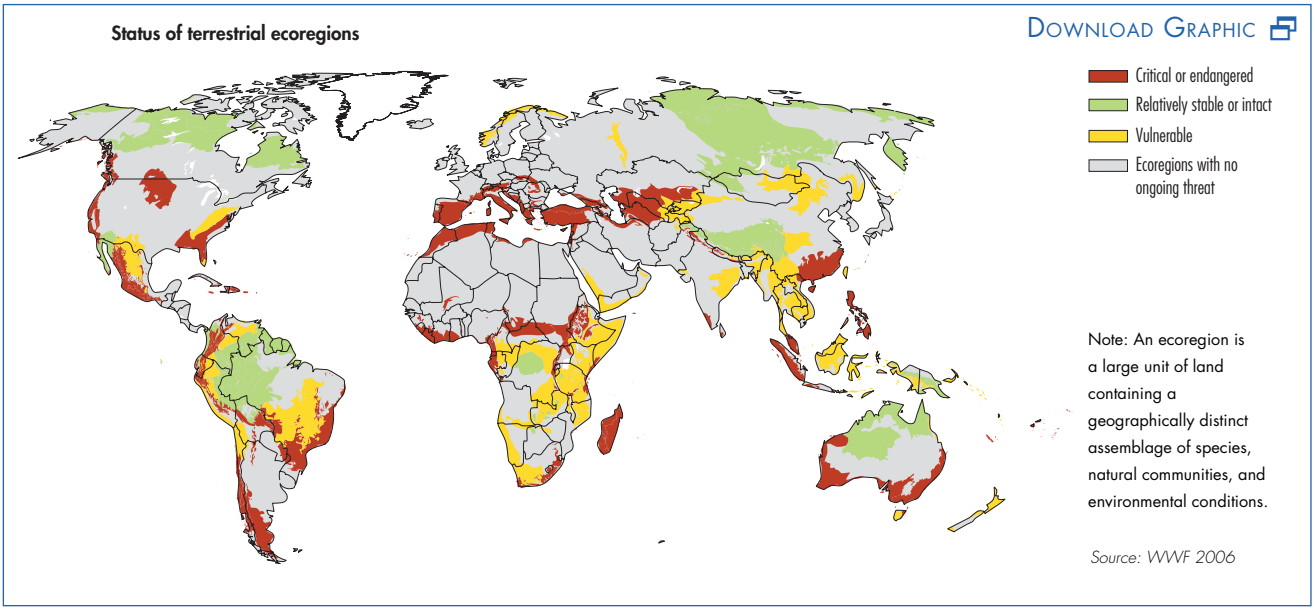
Section 3

Ecosystem Management

Ecosystems in Peril

Impacts on Human Health

Valuing Is Vital



Ecosystems in Peril

Ecosystems – whether they are in coastal regions or in fresh water areas, in tropical jungles or in mountain ranges – provide life-supporting services to human beings. Yet the provision of such services is under threat as the world's terrestrial and aquatic ecosystems are modified and fragmented at an unprecedented rate.

Unsustainable land use drives land degradation which, in the form of contamination and pollution, soil erosion, nutrient depletion, water scarcity, salinity and disruption of biological cycles, is a fundamental and persistent problem. Land degradation diminishes productivity, biodiversity and other ecosystem services, and contributes to climate change.

Soil erosion is now widespread in Africa, affecting food production and food security.
Credit: Christian Lambrechts

National responses have been directed towards legislation, information, credits and subsidies, or specific conservation programmes. Local responses to the problem have been generated by land users themselves, or introduced by projects.

Soil and water management measures against erosion and water scarcity.
Left: Micro-basins; Centre: Mulch; Right: Conservation tillage. *Credit: WOCAT*

Soil erosion in Pampas

Soil erosion by water is the main form of land degradation in Latin America. The more extensive the area under cultivation, the more serious the erosion, even in the fertile Pampas. It has been an intractable problem, leading to the abandonment of farmland, for example, in northwest Argentina.

The most promising development has been the large-scale adoption of conservation tillage, which increases infiltration of rain into the soil compared to conventional ploughing. The area under conservation tillage in Latin America increased from almost zero in the 1980s to 250 000 km^2 in 2000, with an adoption rate of 70–80 per cent among large, mechanized farms in Argentina and Brazil, although the adoption rate by small farms is lower.

Sources: FAO 2001, KASSA 2006, Navone and Maggi 2005

In the Pampas, rills form during rainstorms when ground cover is sparse, and gradually turn into large gullies.

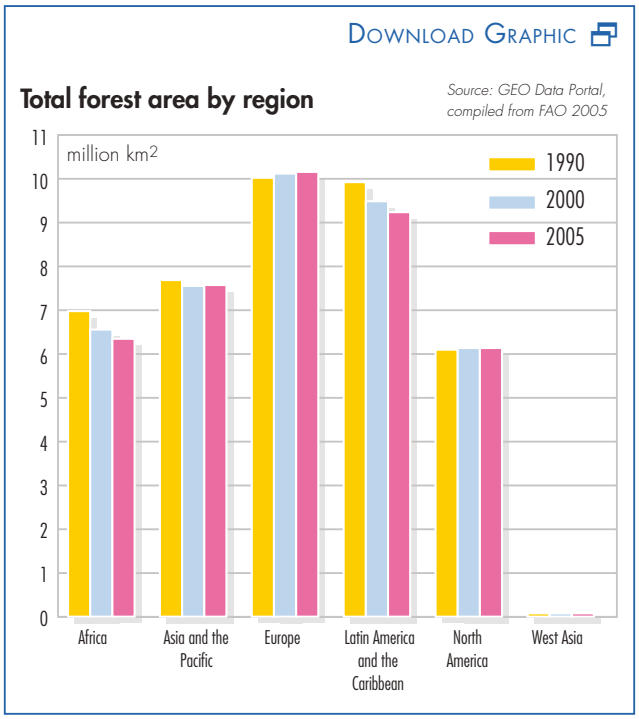
Credit: J.L. Panigatti

Sand encroachment and land reclamation in China. Top, 2000; Bottom, 2004 planted with Xinjiang poplar (*Populus alba*). *Credit: Yao Jianming*

When land degradation processes, acting locally, combine to affect large areas in drylands, desertification occurs. Some 2 billion people depend on drylands, 90 per cent of them in developing countries. Six million km^2 of drylands bear a legacy of land degradation. It is hard to deal with the problem, because of cyclical swings in rainfall, land tenure that is no longer well adjusted to the environment, and because of other driving forces.

The international response to desertification has been led since 1994 by UN Convention to Combat Desertification (UNCCD), which has been ratified by 191 countries. 79 countries have drawn up National action programmes, there are 9 sub-regional programmes targeting trans-boundary issues and 3 regional thematic networks.

Forests provide a range of valuable ecosystem services, such as soil and water protection, absorption of pollution, and climate regulation through carbon fixation. Forest ecosystems are also a great source of biodiversity.

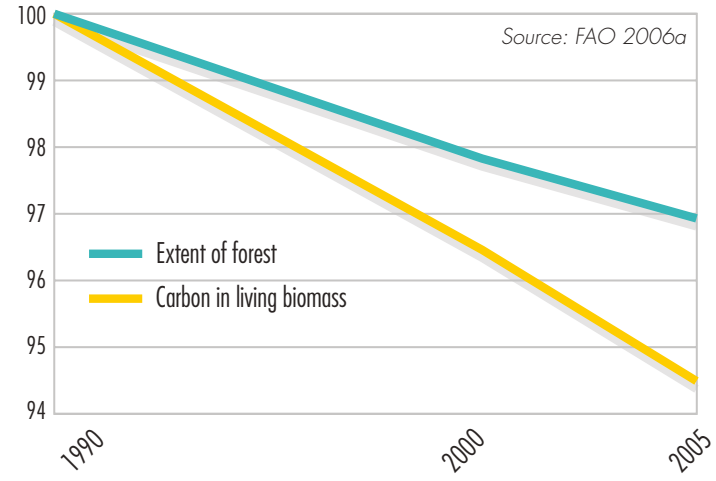


However, these services have been reduced by the decline in total forest area and by continued forest degradation, especially in production and multipurpose forests. Despite the fact that more and more forest areas are being designated for conservation and protection, the unsustainable harvesting of forest products is putting these areas under severe pressure jeopardizing valuable ecosystem services. For example, the rate of decline in fixed carbon has been greater than the rate of decline in forest area. Between 1990 and 2005 the global forest area shrank at an annual rate of about 0.2 per cent: there were losses in areas of primary forest while there were gains in areas of planted and semi-natural forest.

DOWNLOAD GRAPHIC

Declines in carbon in living biomass and in extent of forest

1990 = 100

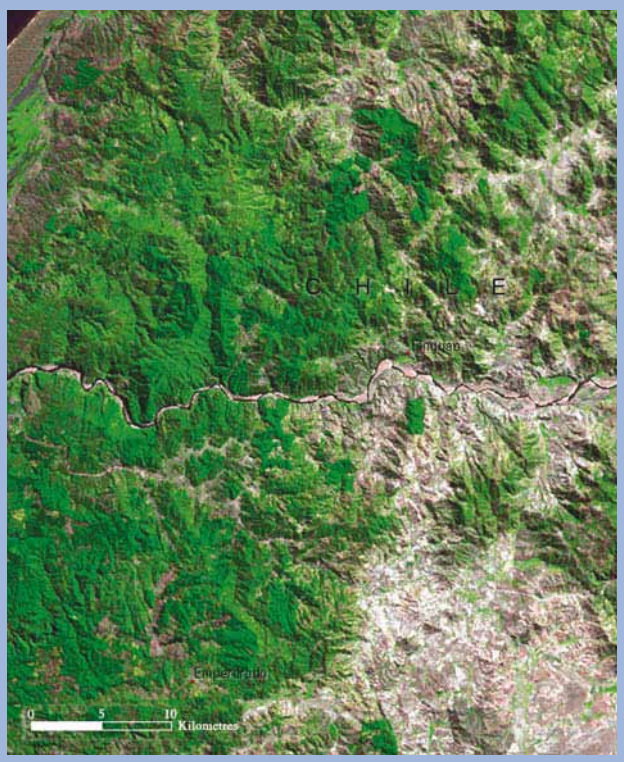


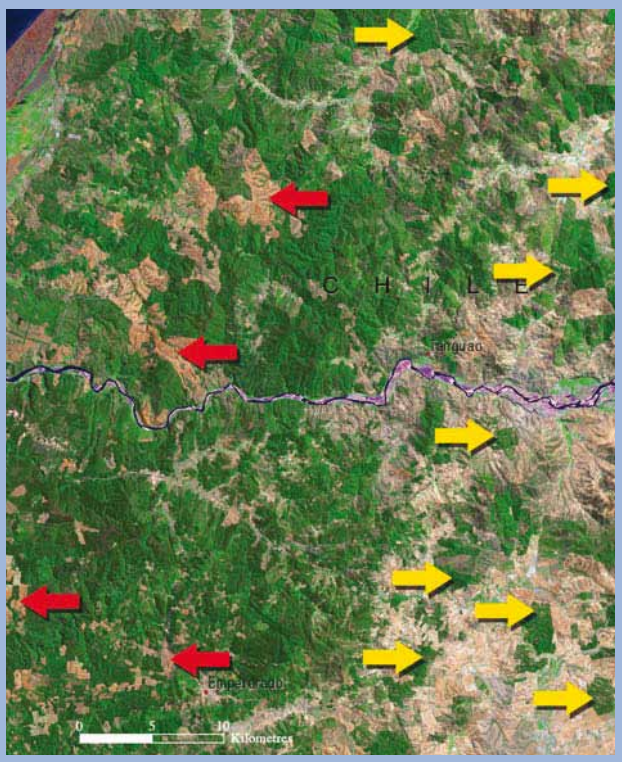
Trade, growth and the environment

DOWNLOAD GRAPHIC

In recent years, Chile has been considered one of the most economically competitive countries in Latin America and the Caribbean. Rapid growth in Chile's production and export of forest products is based on the expansion and management of exotic species in newly planted forests over the past 30 years. To do so, the traditional land-use practices in small-scale logging of native forests, livestock raising and agricultural cultivation have been replaced by large-scale timber production. Many endangered tree and shrub species have been affected by this growth of planted forest, which has also led to a dramatic reduction of landscape diversity as well as goods-and-services from forests. The two images, taken in 1975 (left) and 2001 (right), show clear reductions in forested land on the one hand (red arrows), and new forest areas on the other (yellow arrows).

Source: UNEP 2005b



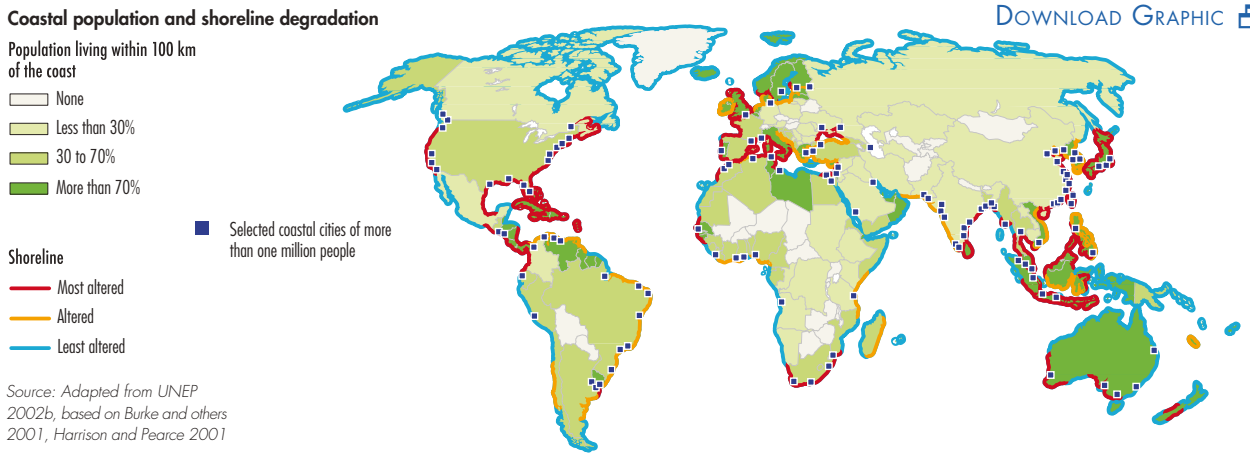


Credit: UNEP 2005b

Ecosystems in coastal regions are under severe pressure as a result of a number of factors. One of these factors is the rapid and poorly planned urbanization around the world in ecologically sensitive coastal areas that often increases vulnerabilities to coastal hazards and climate change impacts. The average population density in coastal areas is now twice as high as the global average. 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.

Coastal population and shoreline degradation

DOWNLOAD GRAPHIC



Source: Adapted from UNEP 2002b, based on Burke and others 2001, Harrison and Pearce 2001

Physical destruction of coastal aquatic ecosystems in Meso-America

DOWNLOAD GRAPHIC

Coastal development represents one of the main threats to the Meso-American coral reefs and mangroves. Construction and the conversion of coastal habitat has destroyed sensitive wetlands (mangroves) and coastal forests, and led to an increase in sedimentation. The effects of coastal development are compounded by insufficient measures for the treatment of wastewater.

Tourism

Tourism, particularly when it is coastal- and marine-based, is the fastest growing industry in the region. The state of Quintana Roo in Mexico is experiencing significant growth in the tourism infrastructure all along the Caribbean coast to Belize. The conversion of mangrove forest into beachfront tourist resorts along the Mayan Riviera, south of Cancun, has left coastlines vulnerable. Playa del Carmen, at 14 per cent, has the fastest growth in tourism infrastructure in Mexico. Threats to the aquifers come from increasing water use, of which 99 per cent is withdrawn from groundwater, and wastewater disposal. Much of the attraction of the Quintana Roo coast is provided by its cavern systems, and their preservation is a major challenge. This trend is echoed in Belize, where ecotourism appears to be giving way to large-scale tourism development, involving the transformation of entire cays, lagoons and mangrove forests to accommodate cruise ships, recreational facilities and other tourism demands.

Aquaculture

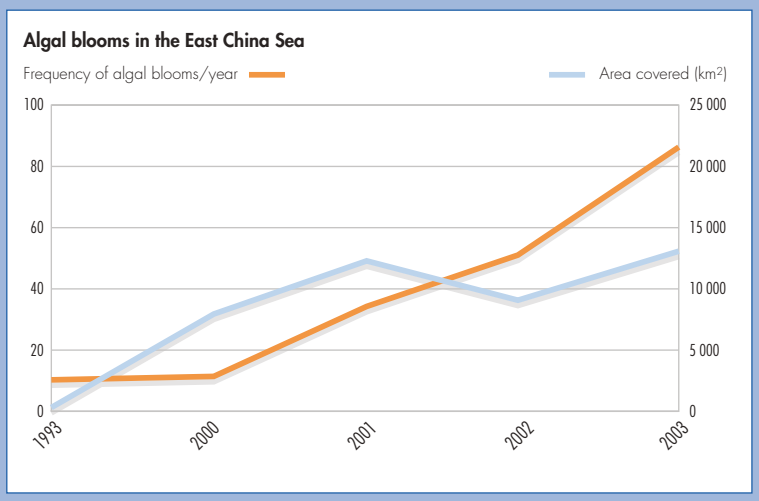
The rapid growth of shrimp aquaculture in Honduras has had serious impacts on the environment and local communities. The farms deprive fishers and farmers of access to the mangroves, estuaries and seasonal lagoons; they destroy the mangrove ecosystems and the habitats of fauna and flora, thus reducing the biodiversity; they alter the hydrology of the region and contribute to degraded water quality; and they contribute to the decline of fish stocks through the indiscriminate capture of fish for feed.

Sources: CNA 2005, INEGI 2006, UNEP 2005b, World Bank 2006

Credit: UNEP 2005b

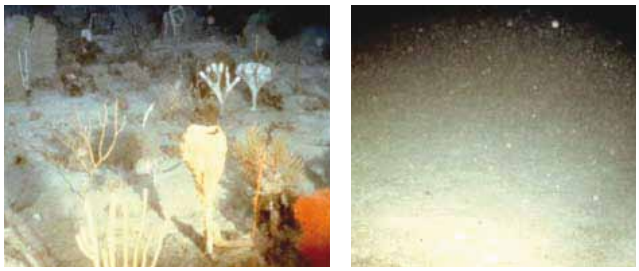
Increasing frequency and area of harmful algal blooms (HABs) in the East China Sea DOWNLOAD GRAPHIC

In the East China Sea, the number of harmful algal blooms increased from 10 in 1993 to 86 in 2003, when they covered an area of 13 000 square kilometres. Fertilizer application in the sea's catchment area has increased by as much as 250 per cent, notably in the upstream and coastal provinces of Anhui and Jiangsu, contributing a high nutrient load to the sea. The blooms, which mostly occur in the inner shelf of the Yangtze River, have a range of human well-being and ecosystem implications. High mortality rates of fish and benthic organisms have also been observed.



Source: UNEP-GIWA 2006a

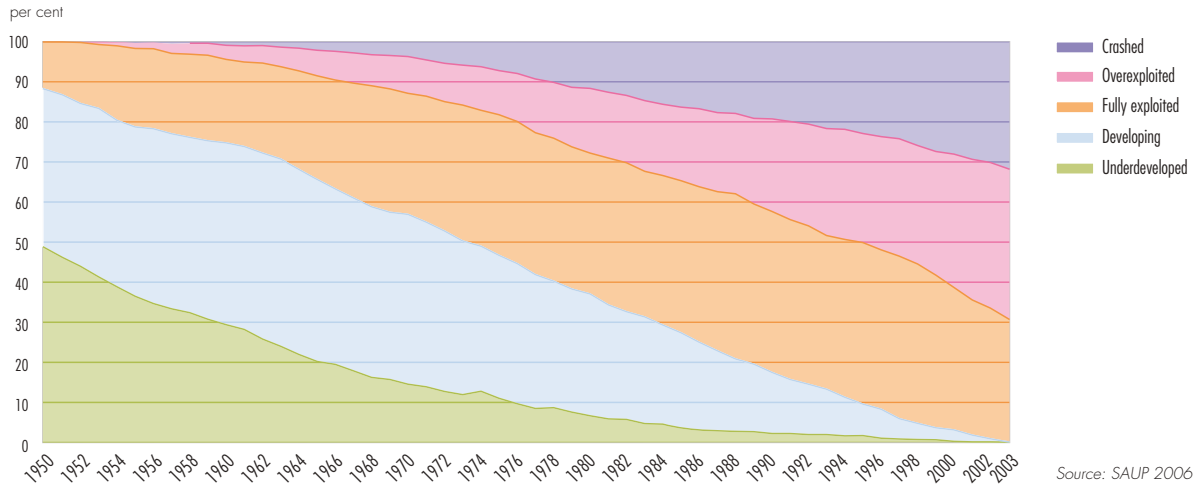
Declines in the volumes of global marine and freshwater fisheries are dramatic examples of large-scale ecosystem degradation related to overfishing, pollution, habitat disturbance and losses. The worldwide fishing fleet grew rapidly in the mid 20th century, with many stocks of fish either being over-exploited or crashing altogether. Many of the more valuable species of fish have been subject to particularly sharp declines and marine ecosystems have been severely damaged.



The seafloor off Northwest Australia showing dense populations of corals and sponges before trawling (left) and after trawling (right).
Credit: Keith Sainsbury, CSIRO

The greatest threat to biodiversity in deep sea areas is bottom-trawling. This type of high seas fishing is most damaging to seamounts and the coldwater corals they sustain, which are home for several commercial bottom-dwelling fish species.

Figure 4.13 Exploitation status of marine fish stocks DOWNLOAD GRAPHIC



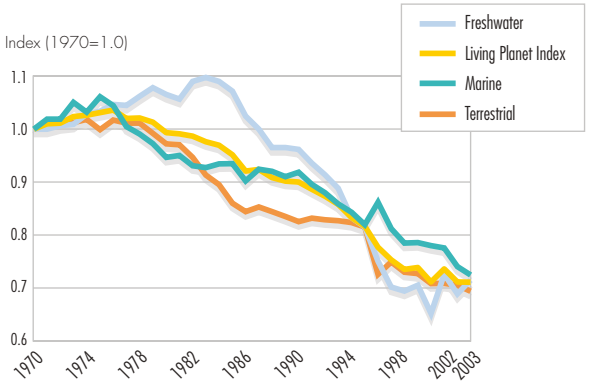
Source: SAUP 2006

In light of the globalization of agriculture, global market demand for high value commodities such as; soybeans, coffee, cotton, oil palm, horticultural goods and biofuel related crops has resulted in substantial habitat conversion and ecosystem degradation.

Species loss is accelerating, with talk of a sixth major extinction event being underway. In the past, these events were caused by natural hazards and planetary change. The current losses are due mainly to human activities. Fragmentation of ecosystems is particularly damaging to migratory species, which need a contiguous network of sites for their migratory journeys and to species which rely on particular micro-habitats or to those which require multiple types of habitat during different life cycle stages.

DOWNLOAD GRAPHIC

The Living Planet Index measures trends in the abundance of species for which data is available. This indicator has been adopted by the Convention on Biological Diversity to measure progress towards the 2010 target



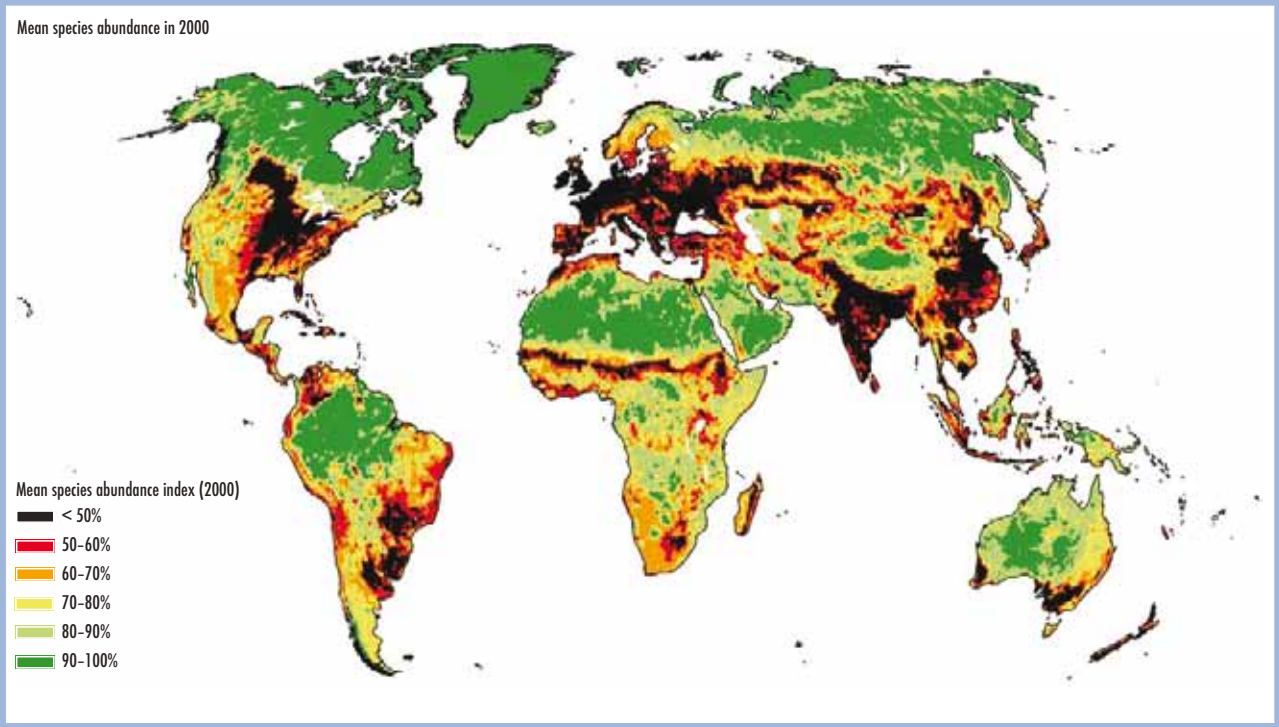
Source: Loh and Goldfinger 2006

Pita, Aechmea magdalane, a thorny-leaved terrestrial bromeliad, grows naturally in lowland forests of southeast Mexico. It is harvested for the commercial extraction of fibre used in the stiching and embroidering of leatherwork. One hectare of forest can provide up to 20 kilogrammes of pita fibre per year, generating an average cash income of US$1 000/ha.
Credit: Elaine Marshall

Defining and measuring biodiversity

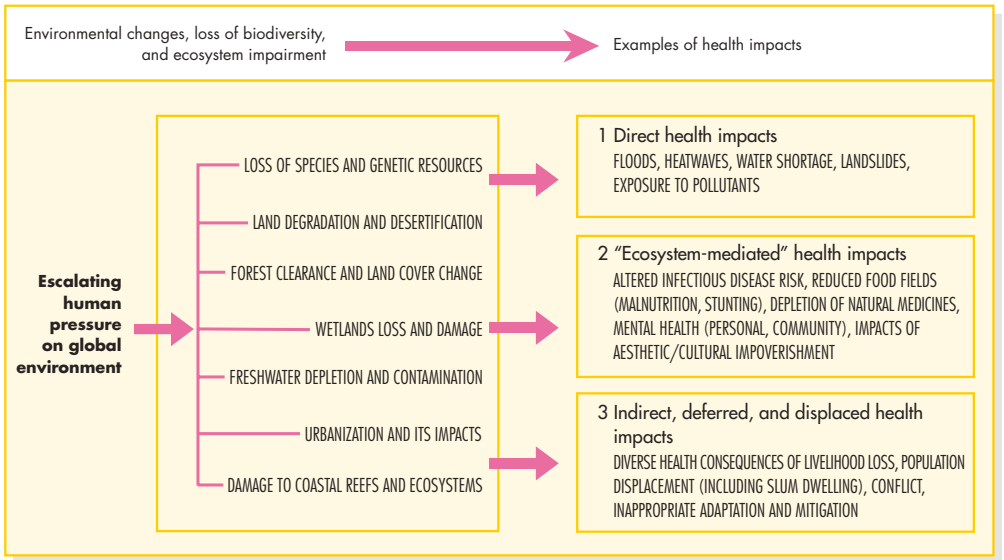
DOWNLOAD GRAPHIC

Biodiversity as defined by the Convention on Biological Diversity encompasses the diversity of genes, species and ecosystems. One terrestrial measure of species-level diversity is the average remaining abundance of each individual species belonging to an ecosystem, or "mean original species abundance" (MSA). MSA represents the remaining abundance of native species, relative to a natural state. For example, if a forest is cleared, then the MSA is based on the surviving forest species. MSA is modelled on a relative scale from 0 per cent (ecosystem destroyed) to 100 per cent (ecosystem intact).



DOWNLOAD GRAPHIC

Harmful effects of ecosystem changes on human health



Note: This figure describes the causal pathway from escalating human pressures on the environment through to ecosystem changes resulting in diverse health consequences. Not all ecosystem changes are included. Some changes can have positive effects (such as food production).

Source: Adapted from WHO 2005

Impacts on Human Health

About one billion people around the world live a subsistence lifestyle and any loss of ecosystem productivity – through declines in soil fertility, drought or overfishing and other factors – can rapidly lead to malnutrition, stunted childhood growth and increased susceptibility to disease.

The conceptual links between broader environmental changes and human health are well understood. Changes to ecosystems and their services, especially freshwater sources, food-producing systems and climatic stability, have been responsible for significant adverse impacts on human health in the past 20 years, predominantly in poor countries.

Changes in land use, invasive alien-species, many forms of intensive animal production and the international wildlife trade can result in an increased risk from infectious diseases.

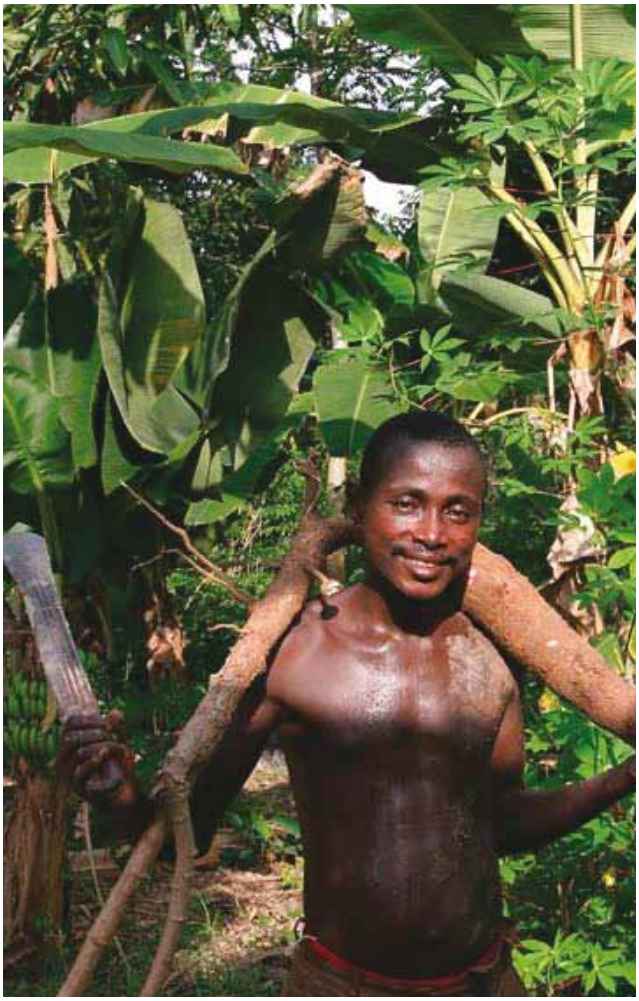
As ecosystems are lost or degraded, their capacity to remove harmful pollutants from the environment is reduced. Local and sometimes global pollutant accumulation is the result. Examples include the accumulation of particles and gases in the air and of microbial contaminants, inorganic chemicals, heavy metals, radioisotopes and persistent organic pollutants in water, soil and food. Such harmful substances have a wide range of negative health impacts.

Ecosystems and their associated biodiversity are also the source of many health cures. In 2002-2003, 80 per cent of new chemicals introduced globally as drugs could be traced to or were inspired by natural products. Traditional medicines mainly derived from plants, are a staple of primary health care for a significant proportion of the population in developing countries.

Valuing Is Vital

Ecosystems such as forests, grasslands and mangroves provide valuable environmental services. They include provisioning services that furnish food, water, timber and fibre; regulating services that affect climate, floods, disease, wastes and water quality; cultural services that provide recreational, aesthetic and spiritual benefits; and supporting services, such as soil formation, photosynthesis and nutrient cycling. The maintenance of healthy ecosystems and sustaining the diversity of goods and ecological services they provide is of vital importance to the lives of millions and for global food security.

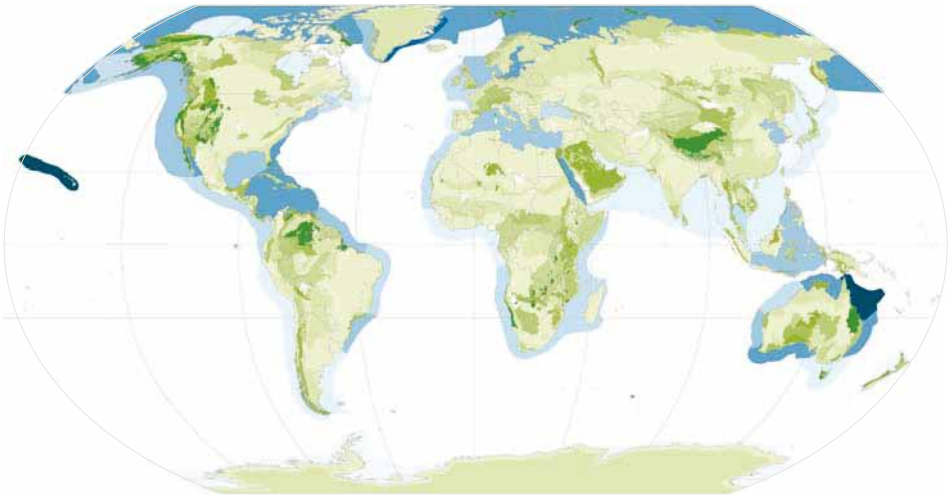
Losses of biodiversity, such as the erosion of genetic variability in a population, are often gradual and not seen or fully recognized until it is too late. The global nature of ecosystems and of many biodiversity values often means the impacts of degradation and loss are often felt across national boundaries: this means that efforts to curtail such losses can be hampered by political and territorial considerations.



Agriculture in a rain forest in Ghana, growing cassava and fruits such as bananas and papayas.
Credit: Ron Giling/StillPictures

Degree of protection of terrestrial ecoregions and large marine ecosystems (per cent)

Download Graphic



Note: All IUCN protected area management categories combined.

Source: UNEP-WCMC 2006a

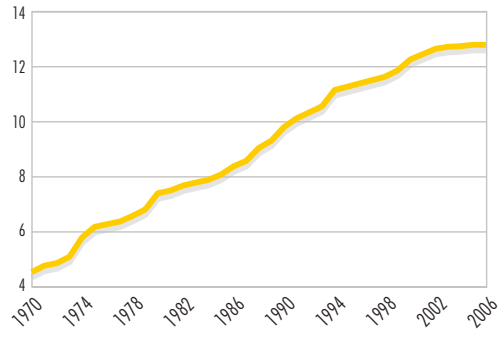
Ecosystem protection measures have been undertaken in many regions but current environmental degradation trends must be reversed in order to sustain the health and productivity of the world's ecosystems.

Responses are varied, and include further designation of land and areas of water within protected areas, and increasingly, the improved management for biodiversity in production landscapes and seascapes. During the past 20 years, the number of protected areas grew by over 22 000 and currently stands at more than 115 000. Roughly 12 per cent of the world's land surface is included within some kind of protected area, but less than one per cent of the world's marine ecosystems are protected.

Download Graphic

Total area under protected status

Protected area ratio to total territorial area (per cent)



Source: GEO Data Portal, compiled from UNEP-WCMC 2006

Threats to ecosystems and the consequent loss of biodiversity continue because values of such resources are not properly recognized by political and market systems. Society can only develop without further loss of biodiversity if shortcomings in market mechanisms and policy framing and implementation are corrected, including undervaluation of biological resources, failure to include environmental costs in pricing structures and failure to recognize global values at the local level. The economic value of ecosystem goods-and-services needs to be fully recognized, and countries need to strengthen their national policies to fully incorporate these values.

Economic growth and environmental protection are not mutually exclusive; efforts towards poverty alleviation and environmental protection can be mutually reinforcing. Reducing extreme poverty and hunger, the first Millennium Development Goal, requires work, which refers, among others, to the sustainable management of land, water and biodiversity resources.

The economic valuation of ecosystem services in relation to water resources is seen as a key driver of developmental policy. Several large-scale water related restoration projects have been undertaken in different regions, such as reforesting the Panama Canal Watershed and restoration of Mesopotamian marshes in Iraq.

Payments for ecosystem services: reforesting the Panama Canal Watershed

An April 2005 cover article in The Economist entitled "Rescuing Environmentalism" led with a analysis of the work by PRORENA, a Panamanian NGO, to establish a diverse native forest cover across extensive areas of deforested lands in the Panama Canal watershed. There has been heavy support from the reinsurance industry, which sees that a regular water flow is necessary for the long-term working of the canal. The project works with local communities to identify a mix of useful tree species, and to research optimal rearing and planting options. It provides income streams for the communities, while improving water retention and flow dynamics for the canal region. It has demonstrated that large-scale ecological restoration in the tropics is technically feasible, socially attractive and financially viable.

Source: The Economist 2005

Large water impoundments in Iraq have created new habitats for resident and migrating species, especially birds. More than 20 per cent of the original Mesopotamian marshes in the Iraq area were re-flooded between May 2003 and March 2004, with the marshlands exhibiting a 49 per cent extension of wetland vegetation and water surface area in 2006, compared to that observed in the mid-1970s.

Invertebrates, including butterflies, comprise the vast majority of species.
Credit: Ngoma Photos

Restoration of the Mesopotamian marshes in Iraq

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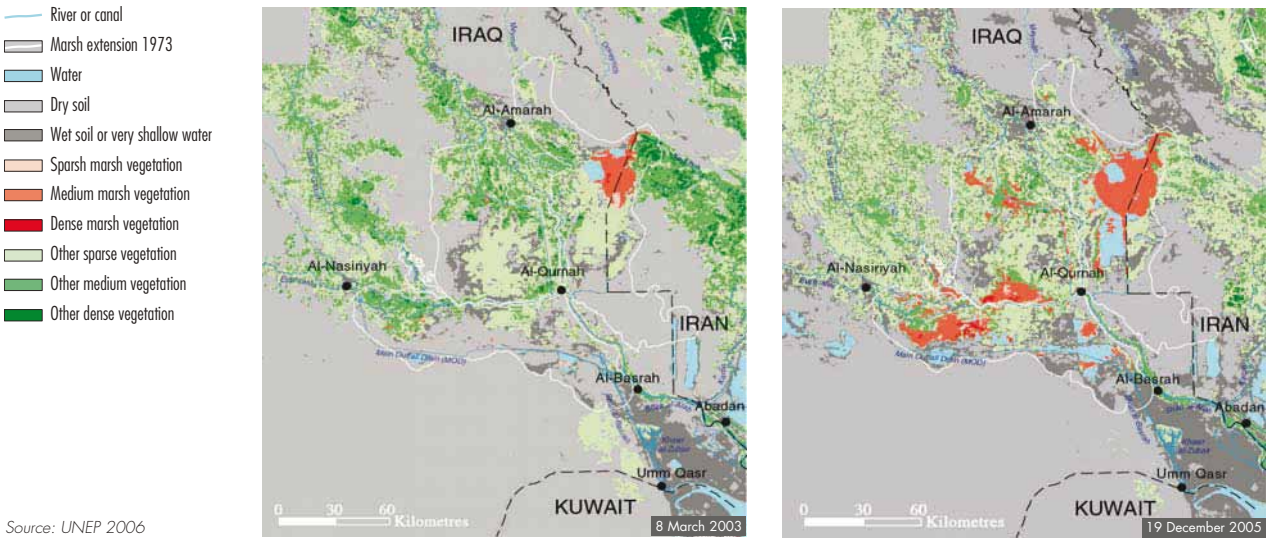

Source: UNEP 2006

Section 4

Environmental Governance

Governance on a Global Scale

Interlinkages

Cooperation and Integration Are Essential

The Outlook for the Future

Mapping environmental problems according to management and reversibility

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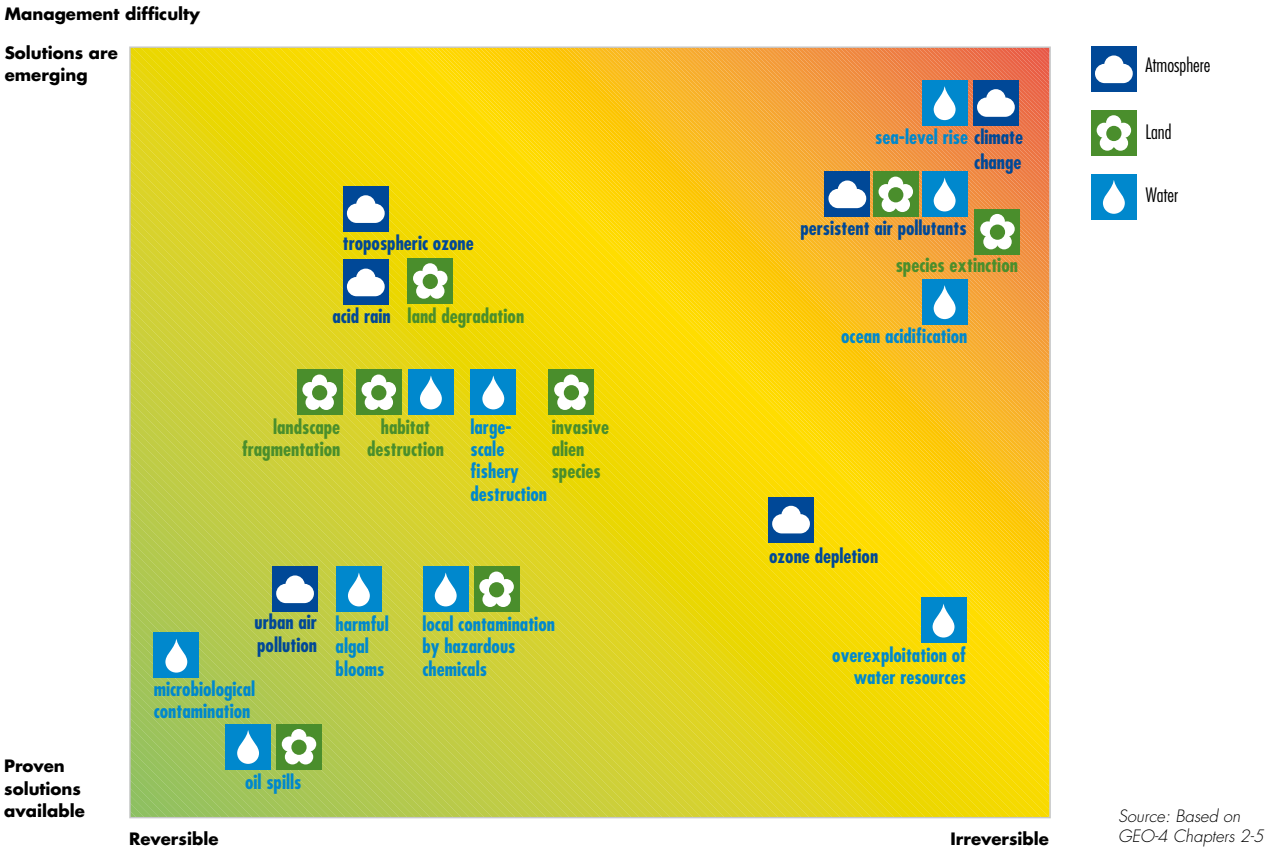


Source: Based on GEO-4 Chapters 2-5

Governance on a Global Scale

Environmental problems appear as impacts on nature and human well-being, through the atmosphere, in fresh and marine water, and on land. Environmental problems vary in terms of the difficulty of management, and the extent to which the problems can be seen as having reversible or irreversible consequences, making local, regional or even global environments progressively uninhabitable.

An overview of the landscape of environmental governance over the last 20 years shows that states have created a growing number of institutions, authorities, treaties, laws and action plans to conserve and safeguard the environment, and more recently, to respond to new understanding of the extent and implications of global environmental change.

Regional institutions and mechanisms

Regional integration agreements can harmonize standards among member countries (such as the European Union's new Sustainable Development Strategy 2007), and implement programmes that foster regional cooperation in, for example, fisheries, chemicals and hazardous waste management (such as NEPAD's Action Plan of the Environment Initiative).

Regional MEAs or implementation mechanisms can bridge international and national levels (such as Africa's Bamako Convention in response to the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal). They can reinforce and translate international commitments (such as the Andean Community's Regional Biodiversity Strategy to implement the Convention on Biological Diversity).

Regional ministerial arrangements, such as the African Ministerial Conference on the Environment (AMCEN) and the Tripartite Environment Ministers' Meetings (TEMM) between China, Korea and Japan, are high-level political fora that can set regional priorities and agendas, and raise awareness of regional concerns.

Mechanisms attached to regional trade agreements, such as NAFTA's Commission for Environmental Cooperation (CEC) and the ASEAN Agreement on Transboundary Haze Pollution, can address cross-border environmental issues through intergovernmental cooperation.

Regional or sub-regional environment and development organizations, such as the UN regional economic commissions, regional development banks, and the Central American Commission on Environment and Development (CCAD), can play an important role in data collection and analysis, capacity building, and resource allocation and management.

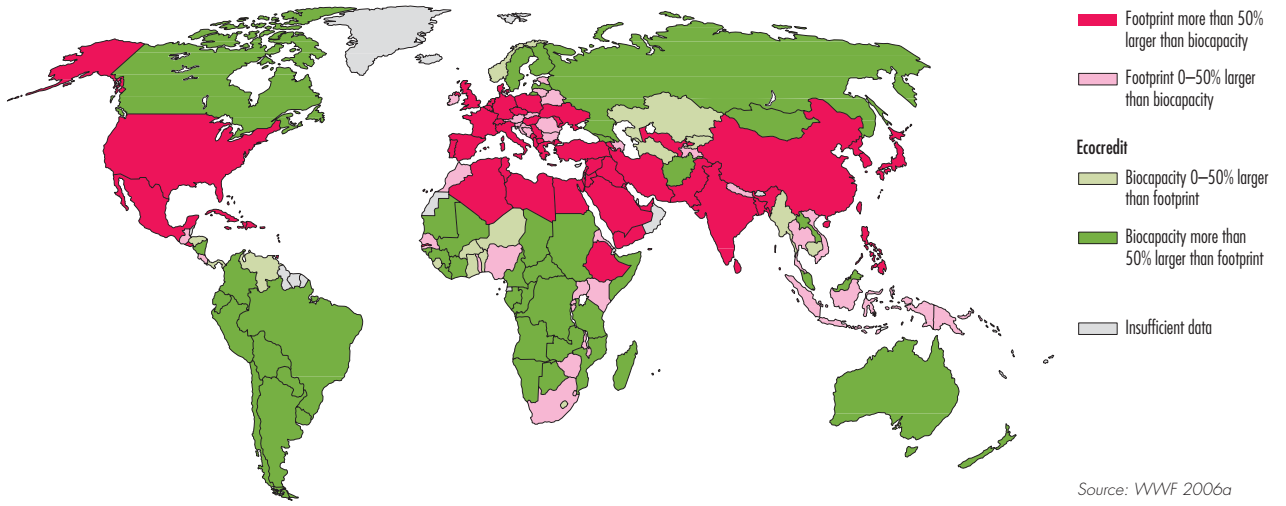
Transboundary or bioregion-based plans and programmes, such as the Mekong River Commission, the Pacific Regional Environment Programme (SPREP) and UNEP's Regional Seas Programme, are important for data collection, analysis and dissemination, sectoral and resource assessment, policy development, capacity development and monitoring.

There are examples of good environmental governance and investments in new technologies that provide models for other regions. However, progress on the environmental front in developed countries is often achieved at the expense of developing countries. This imbalance is expressed by the notion of "ecological debt." Thus the outsourcing of energy, food and industrial production can increase efficiency in one region at the expense of others through the displacement of impacts.

At both global and local levels there has been progress in achieving environmental targets, although the situation is uneven. In terms of water, for example, clear targets exist concerning access to piped water and basic sanitation, which are linked to the broader objective of reducing the most pressing aspects of poverty. By contrast, although the objective of integrated watershed management is almost equally widespread, targets concerning how to implement it are rare.

Overexploitation, pollution of water and degradation of aquatic ecosystems directly affect human well-being. Although the situation has improved, an estimated 2.6 billion people are without improved sanitation facilities. If the trend from 1990 to 2002 continues, the world will miss the sanitation target of the MDG by half a billion people.

Ecological creditors and debtors



Source: WWF 2006a

The situation in relation to (a) drinking water and (b) sanitation coverage, 2004

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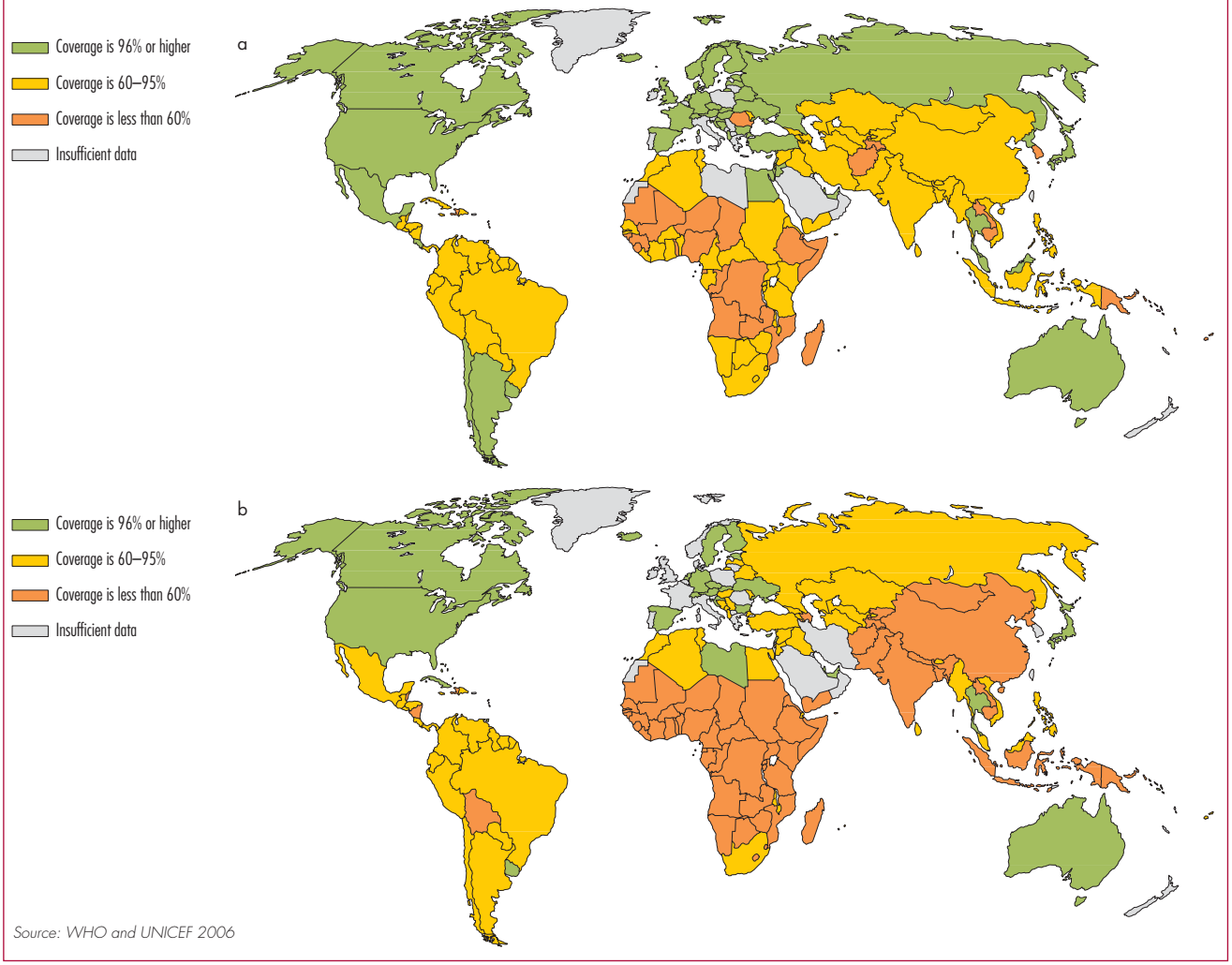

Source: WHO and UNICEF 2006

There are clear, widespread targets already embedded in decision making concerning urban air pollution, but this is not the case for indoor air pollution.

The degree to which policy targets are supported by monitoring and evaluation procedures varies considerably. For stratospheric ozone depletion, for example, there is a robust monitoring programme that measures the atmospheric concentration of ozone-depleting substances (ODS), ozone layer thickness, and trends in consumption of ODS. By contrast, most of the biodiversity protection targets lack baseline benchmarks and the kind of regular monitoring that would permit tracking of trends.

Most targets aim at improving generic capacities (including adoption of plans, creation of policy frameworks, conducting assessments and setting priorities), or at reducing pressures (lowering emissions, extraction or conversion). It is less common to find targets that aim at reducing drivers or at achieving specific states.

There are some biodiversity targets that target drivers. Regional air pollution in Europe is the best-developed example of a targeting process that focuses on environmental states (in this case, levels of deposition relative to critical loads).

Global and regional targets and monitoring programmes DOWNLOAD GRAPHIC

Issue	Targets	Monitoring
Biodiversity loss		
Climate change		
Degradation and loss of forests		
Indoor air pollution		
Integrated Water Resources Management (IWRM)		
Land contamination and pollution		
Land degradation/desertification		
Large-scale marine fisheries		
Long-range air pollution		
POPs		
Stratospheric ozone protection		
Water and sanitation		
Water security		

Targets	Monitoring
No targets Quantitative, time-bound targets; not legally binding Legally-binding, quantitative, time-bound targets *Exception: Long-range air pollution assigned yellow; legally-binding targets in Europe only*	No regular monitoring Some monitoring takes place, but is less than complete Relevant monitoring taking place globally

Source: GEO-4 Chapters 2-5

The last 20 years has also seen a growth in the number of intergovernmental processes and scientific assessments. As a result, a diversity of multilateral environmental agreements (MEAs) have been adopted.

However, some international negotiations have stalled over questions of equity and responsibility sharing. Action has been limited on some issues, for example, on climate change, persistent organic pollutants, fisheries management, invasive alien species and species extinction.

Mechanisms to address transboundary environmental issues, such as acid rain or dust and sandstorms, are still not in place, despite these problems assuming serious dimensions.
Credit: sinopictures/viewchina/StillPictures

Multiple environmental changes and their effects on human well-being constituents and determinants

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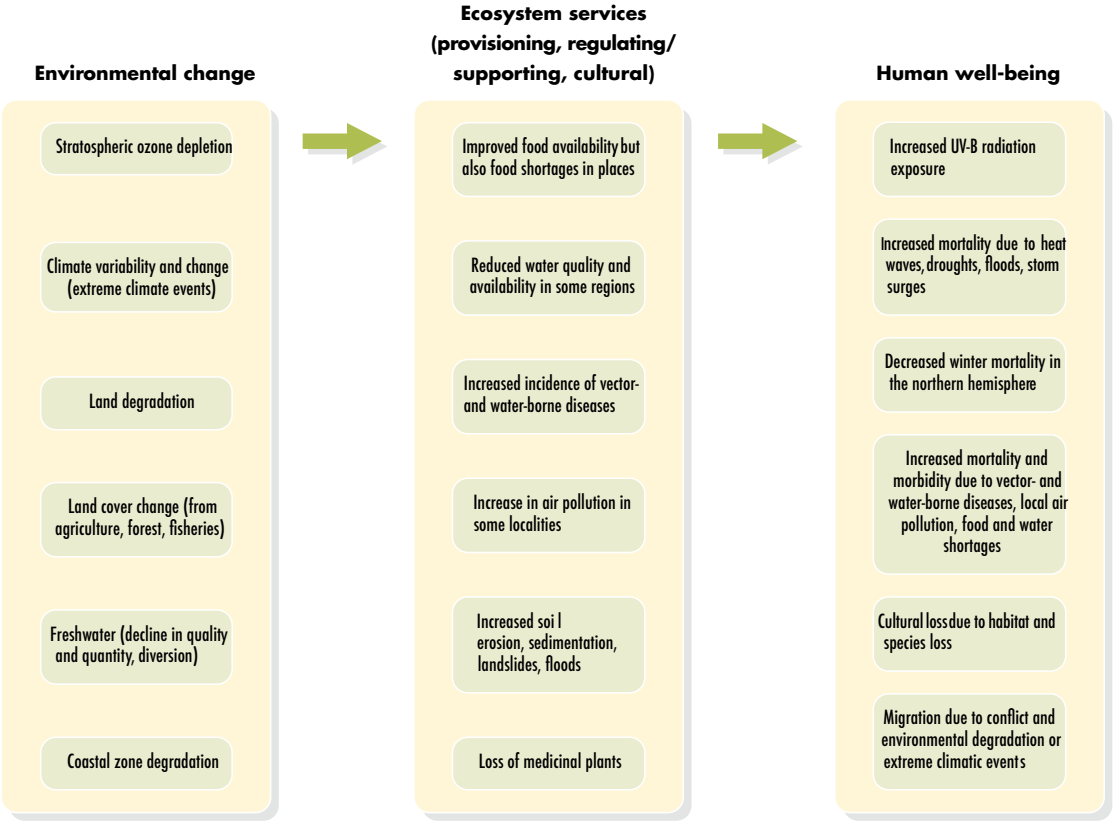


Source: based on WHO 2003

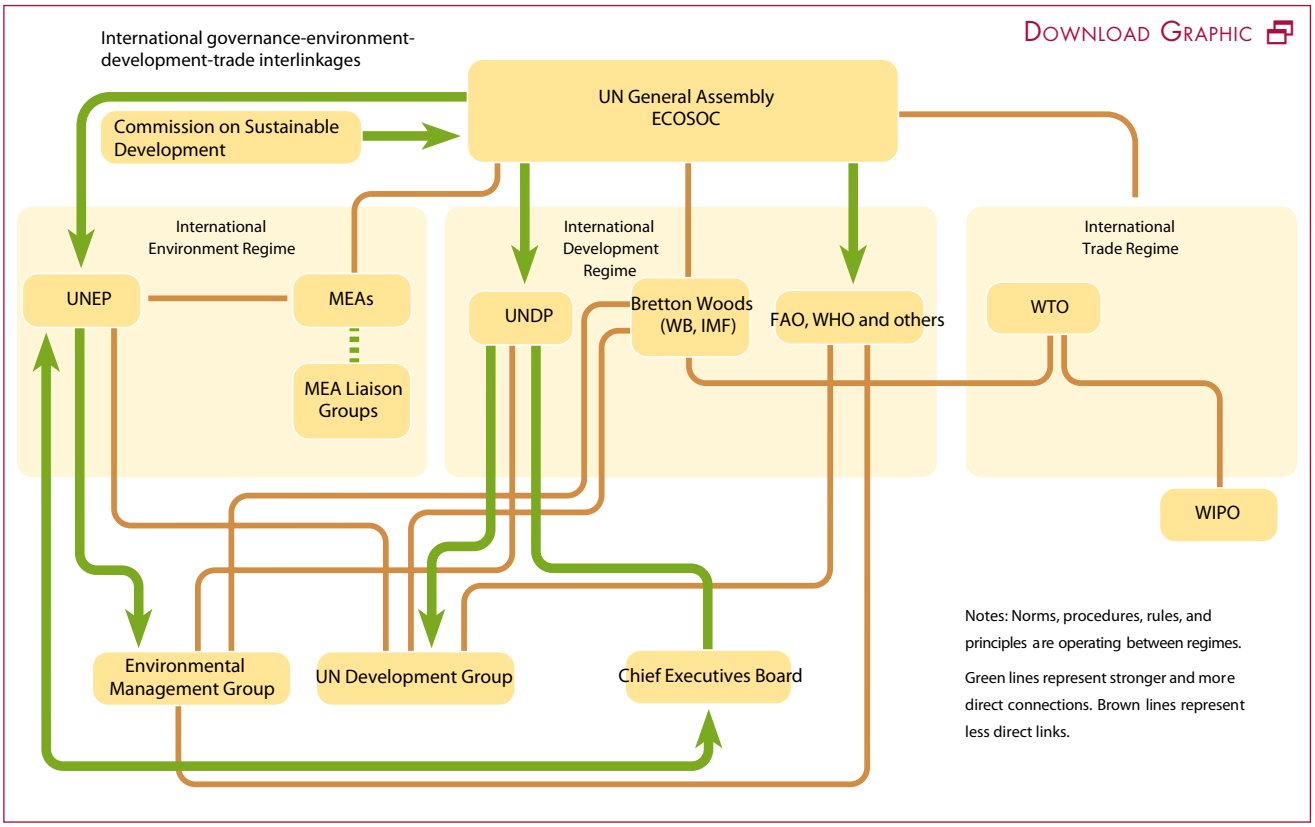
The role of women in environmental management and sustainable development is vitally important and increasingly recognized. Above, women planting trees in Kenya as part of the Green Belt Movement. *Credit: William Campbell/Still Pictures*

Interlinkages

Environmental change may affect human well-being in more than one way. For example, emissions of carbon dioxide contribute both to climate change and to acidification of the oceans. In addition, land, water and atmosphere are linked in many ways, particularly through carbon, nutrient and water cycles, so that one form of change leads to another.

Environmental risks affect a wide range of natural, economic, political and social activities and processes. Therefore, vulnerability reduction should be integrated as a strategic goal in overall development planning in order to achieve the Millennium Development Goals. Analyzing patterns of vulnerability helps identify a number of opportunities to reduce such vulnerability and improve human well-being.

Links between vulnerability and the achievement of the MDGs, and opportunities for reducing vulnerability and meeting the MDGs		
MDGs and selected targets	**Vulnerability affects potential to achieve the MDGs**	**Adopting strategies to reduce vulnerability contributes to reaching the MDGs**
Goal 1 Eradicate extreme poverty and hunger Targets: Halve the proportion of people living on less than US$1/day. Halve the number of people who suffer from hunger.	■ Contaminated sites damage health and thus the ability to work; this undercuts opportunities to eradicate extreme poverty and hunger. ■ In drylands land degradation, insufficient investments and conflict contribute to low agricultural productivity, threatening food security and nutrition.	■ Improving environmental management and restoring threatened environments will help protect natural capital, and increase opportunities for livelihoods and food security. ■ 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.
Goal 2 Achieve universal primary education Target: Ensure that all boys and girls complete a full course of primary school	■ Children are particularly at risk when they play, live or attend school near contaminated sites. Lead and mercury contamination presents specific risks for child development. ■ The time-consuming activity of fetching water and fuelwood reduces school attendance, particularly for girls.	■ Sustainable resource management can decrease the environmental health risks children face, and thus increase school attendance. ■ Improved and secure access to energy supports learning at home and at school. It is essential for access to IT-based information, and opportunities to engage in scientific and other experimentation.
Goal 3 Promote gender equality and empower women Target: Eliminate gender disparity in primary and secondary education	■ 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. ■ Women play a pivotal role as resource managers, but are marginalized in decision making, often have insecure tenure rights and lack access to credit.	■ Redressing inequities – in access to health care and education – is critical in improving coping capacity. ■ Strategies that link health and housing, nutrition, education, information and means increase opportunities for women, including in decision making.
Goal 4 Reduce child mortality Target: Reduce by two-thirds the under-five child mortality	■ Contaminated sites affect mortality of all, but children are particularly vulnerable to pollution-related diseases. ■ Some 26 000 children die annually from air pollution-related diseases.	■ Interlinked environment-development-health strategies, improved environmental management and ensuring access to environmentally derived services can contribute to reducing child mortality and reducing vulnerability.
Goal 5 Improve maternal health Target: Reduce by three-quarters the maternal mortality ratio	■ The accumulation of POPs in food sources affects maternal health. ■ Dams may increase the risk of malaria, which, in turn, threatens maternal health. Malaria increases maternal anaemia, threatening healthy foetal development.	■ Improved environmental management can improve maternal well-being by improving nutrition, reducing risks from pollutants and providing essential services. ■ Integrated environment-health strategies can contribute to achieving this goal by reducing vulnerability.
Goal 6 Combat HIV/AIDS, malaria and other diseases Targets: Halt and begin to reverse the spread of HIV/AIDS Halt and begin to reverse the incidence of malaria and other major diseases	■ Contaminated sites are a huge risk for individuals already exposed to HIV/AIDS, potentially further compromising their health. ■ Climate change is likely to increase the disease burden of poor people, including the incidence of malaria.	■ Integrated environment-health planning and management is critical. ■ 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.
Goal 7 Ensure environmental sustainability Targets: Integrate the principles of sustainable development into planning and programmes Reduce by half the proportion of people without access to safe drinking water Achieve significant improvement in the lives of at least 100 million slum dwellers	■ Water contamination from dumps, industry and agriculture, water-borne diseases, and growing water scarcity threaten well-being at all levels. ■ The lack of access to energy limits opportunities for investment in technologies, including those for water provisioning and treatment.	■ Improving governance systems, including strengthening institutions and laws and policies, and adopting interlinked strategies, are critical to contributing to environmental sustainability and reducing vulnerability. ■ Securing energy is critical to improving the living conditions of the growing number of slum dwellers.
Goal 8 Develop a global partnership for development Targets: An open trading and financial system Cancellation of official bilateral debt, and more generous ODA In cooperation with the private sector, ensure developing counties have access to the benefits of new technologies Address the special needs of landlocked developing countries and SIDs	■ 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. ■ Poor access to energy undermines the investments and technologies that can be used in productive land and natural resource management. ■ Sea-level rise is threatening the security and socio-economic development of SIDS and low-lying coastal areas. More than 60 per cent of the global population lives within 100 km of the coastline, and 21 of the world's 33 mega-cities are located in coastal zones in developing countries.	■ 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. ■ Massive investments, and technology-sharing in clean energy and transport systems can reduce poverty, increase security and stabilize greenhouse gas emissions. It has been estimated that about US$16 trillion will be required for global infrastructure investment in the energy sector in less than 25 years. ■ Building partnerships for addressing climate change, and honouring technology transfer promises are essential for increasing adaptive and coping capacity in low-lying areas.

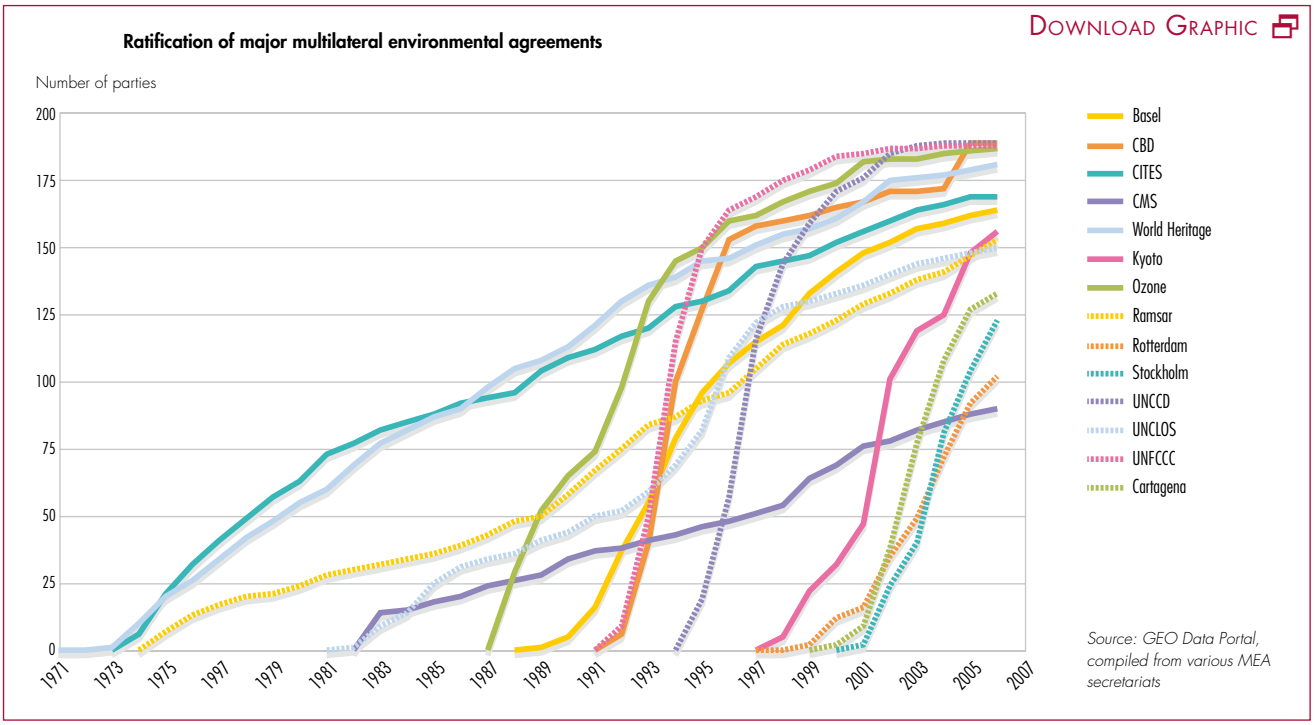


Cooperation and Integration Are Essential

There are strong synergies between improving human well-being and reducing vulnerability from environment, development and human rights perspectives. In order 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.

Interlinked environment-development challenges require effective and coherent governance and policy responses within the framework of sustainable development. At the international level, the key governance and management actors relevant to the environment are the United Nations, MEAs and regimes dealing with development, trade, finance and other international related fields. The linkages among these bodies are complex and the systems have been described as fragmented and overlapping.

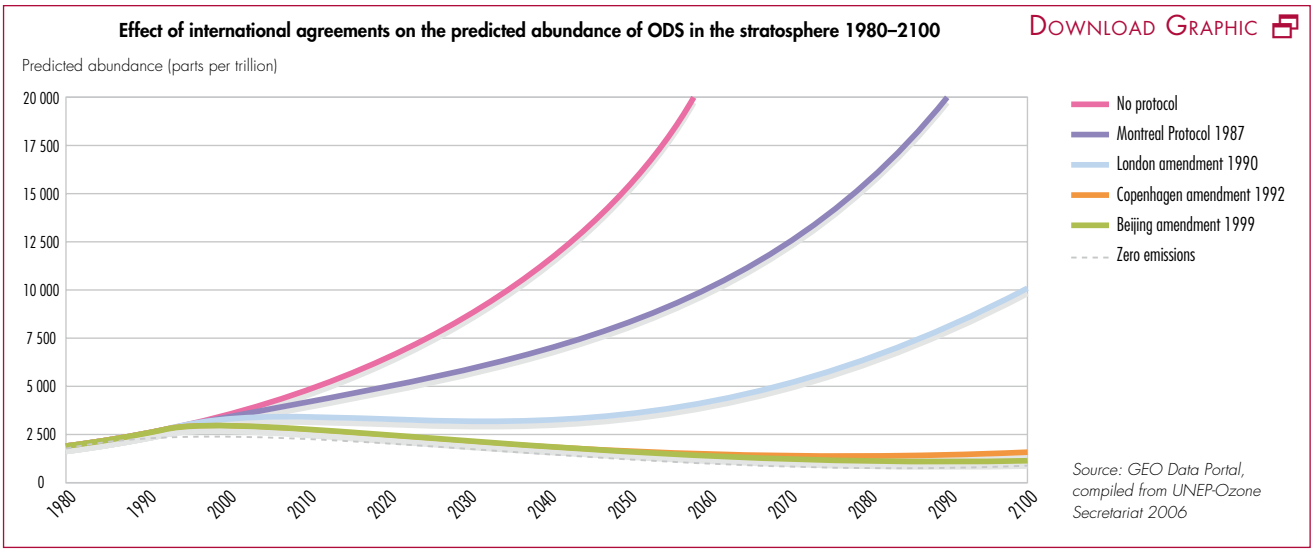
With the growth of the number and diversity of actors and organizations, inter-agency mechanisms, such as the Environmental Management Group, UN Development Group and the liaison groups between MEA secretariats, have been created to bridge independent agencies and promote greater cooperation. The UN Economic and Social Council and the UN General Assembly play major roles in coordination, as well as promoting cooperation with other institutions, such as the WTO and Bretton Woods institutions.



The Outlook for the Future

Economic, political and social integration, combined with good governance, is making Europe a leader in trans-boundary environmental decision-making. North America is a model in providing access to superior quality environmental information, and investments in research and development. Africa, Asia and the Pacific, Latin America and the Caribbean and West Asia have also made great strides in tackling some of their environment and development challenges.

There is a mix of both worrying developments and substantial progress in global environmental governance systems. For example, there is continuing concern about the state of the stratospheric ozone layer that gives protection from harmful ultraviolet radiation. On the positive side, precautionary action on stratospheric ozone depletion was introduced by some industrialized countries, before the impacts were evident. Their leadership was key to making reductions in the manufacture and consumption of ODS a global success story.



Recommendations from some recent UN environmental governance reform processes

DOWNLOAD GRAPHIC

	The International Environmental Governance (IEG) Initiative (UNEP 2002c)	The 2005 World Summit Outcome (UN 2005)	Selected recommendations of the Secretary-General's High-level Panel on UN System-wide Coherence (UN 2006)
UNEP and the environment in the UN	A Strengthened UNEP through: ■ improved coherence in international environmental policy making – the role and structure of the Governing Council/ Global Ministerial Environment Forum; ■ strengthening the role and financing of UNEP; and ■ strengthening the scientific capacity of UNEP.	More efficient UN environmental activities through: ■ enhanced coordination and improved policy advice and guidance; and ■ strengthened scientific knowledge, assessment and cooperation.	■ strengthen and improve IEG coherence by upgrading UNEP with a renewed mandate and improved funding; and ■ UNEP's technical and scientific capacity should be strengthened for monitoring, assessing and reporting on the state of the global environment.
UN system-wide coherence	■ enhanced coordination across the UN system – the role of the Environmental Management Group.	■ stronger system-wide coherence within and between the policy and operational activities of the United Nations, in particular in the areas of humanitarian affairs, development and environment; and ■ agreement to explore the possibility of a more coherent institutional framework. including a more integrated structure.	■ UN Development Policy Operations Group within the Chief Executives Board for Coordination framework bringing together heads of all UN organizations working on development; ■ more effective cooperation among UN agencies, programmes and funds working in different thematic areas of the environment; and ■ an independent assessment of the current UN system of IEG should be commissioned.
MEAs	■ improved coordination among and effectiveness of multilateral environmental agreements (MEAs).	■ better treaty compliance, while respecting the legal autonomy of the treaties.	■ more efficient and substantive coordination to support effective implementation of the major MEAs.
Country-level operations	■ capacity-building, technology transfer and country-level coordination for the environmental pillar of sustainable development.	■ better integration of environmental activities in the broader sustainable development framework at the operational level, including through capacity building.	■ One UN Country Programme to deliver as one at the country level; ■ UNEP to provide substantive leadership and guidance at the country level, including building capacity and mainstreaming environmental costs and benefits into policy making; and ■ UN Sustainable Development Board, reporting to ECOSOC, to oversee the performance of the One UN at country level.

Collaboration across existing governance regimes can strengthen the integration of environmental concerns into the wider development agenda. Significant opportunities in this respect are offered by the UN reform process, due to its particular focus on systems-wide coherence in the area of the environment and the "One UN" approach at the country level.

The governance approaches should be flexible, collaborative and learning-based. Such approaches may be responsive, adaptive, and able to cope with the challenges of integrating environment and development. They should also be well placed in order to address complex interlinkages, and to manage uncertainty and periods of change. Such measures are likely to result in incremental and cost-effective evolution of institutional structures and reduce the need for more fundamental institutional restructuring. Tools for dealing with interlinkages, such as assessments, valuation techniques and integrated management approaches that link environment to development, provide a critical foundation for adaptive governance.

Greater integration of policies across levels, sectors and time, strengthening local rights, and building capacity will help achieve environmental and human well-being goals.

The future success of efforts to control atmospheric emissions will heavily depend on the involvement of stakeholders at all levels.
Credit: Mark Edwards/Still Pictures

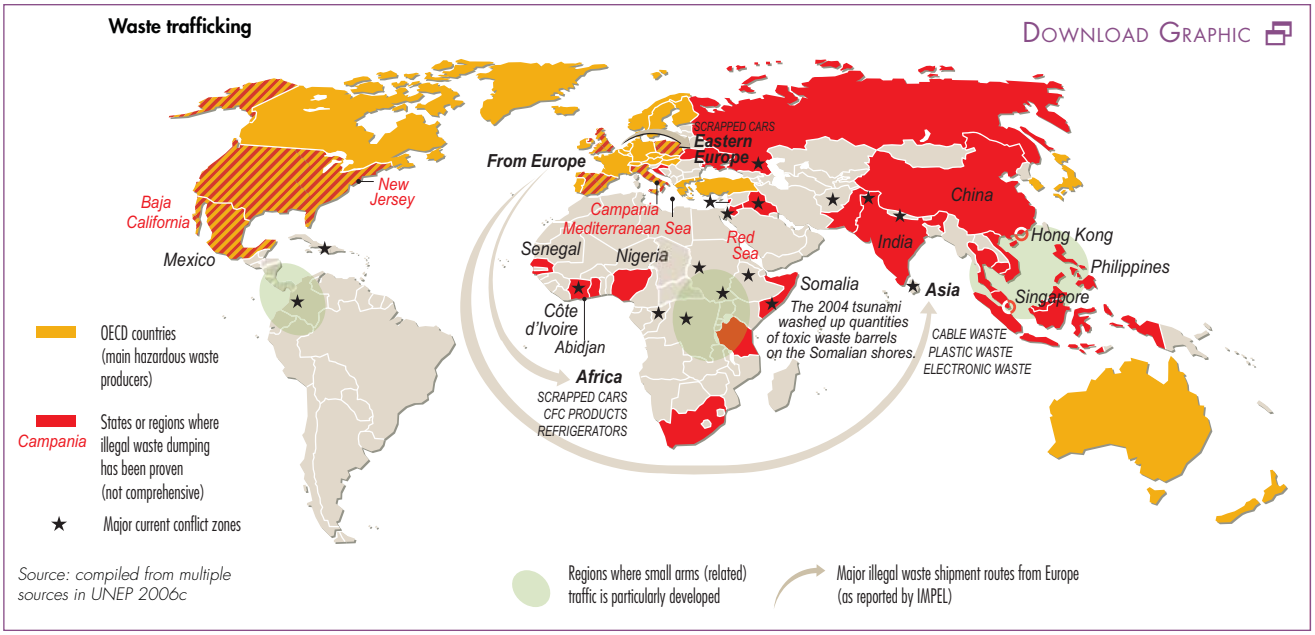
Section 5

Harmful Substances and Hazardous Waste

Growing Problems

Interlinkages

Current Action and Outlook for the Future



Growing Problems

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. However about 90 per cent of that exported waste was classified as hazardous, with about 30 per cent believed to be persistent organic pollutants (POPs). The principal waste export by volume was lead and its compounds, bound for recycling.

Responses to the problem include, among others, the Basel Convention on the Control of Transboundary Movement of Hazardous Wastes and their Disposal. However, lack of human resources, training and equipment are some of the barriers, which have prevented effective implementation of the Convention.

There has also been an inadequate industry response to treat, recycle, re-use and dispose of wastes at source and an inadequate information network and alert systems to assist with the detection of illegal traffic in hazardous wastes.

New issues arise quickly, and can have important human health impacts before existing policies can be used, or new policies put in place to address them. Examples of such new issues include electronic waste (e-waste), with a high content of hazardous materials, such as heavy metals, which are fuelled by a rapid increase in the consumption of personal electronic devices such as mobile phones.

A great volume of e-waste is exported to developing countries. More than 90 per cent of the 20-50 million tonnes of the e-waste generated every year in the world ends up in Bangladesh, China, India, Myanmar and Pakistan. Seventy per cent of e-waste collected at recycling units in New Delhi was exported from or dumped by other countries.

Recycling electronic goods involves exposure to heavy metals, such as lead, mercury and cadmium which can be toxic to humans and ecosystems if they are improperly handled or disposed of.

Mobile phones, per 1 000 people, by region

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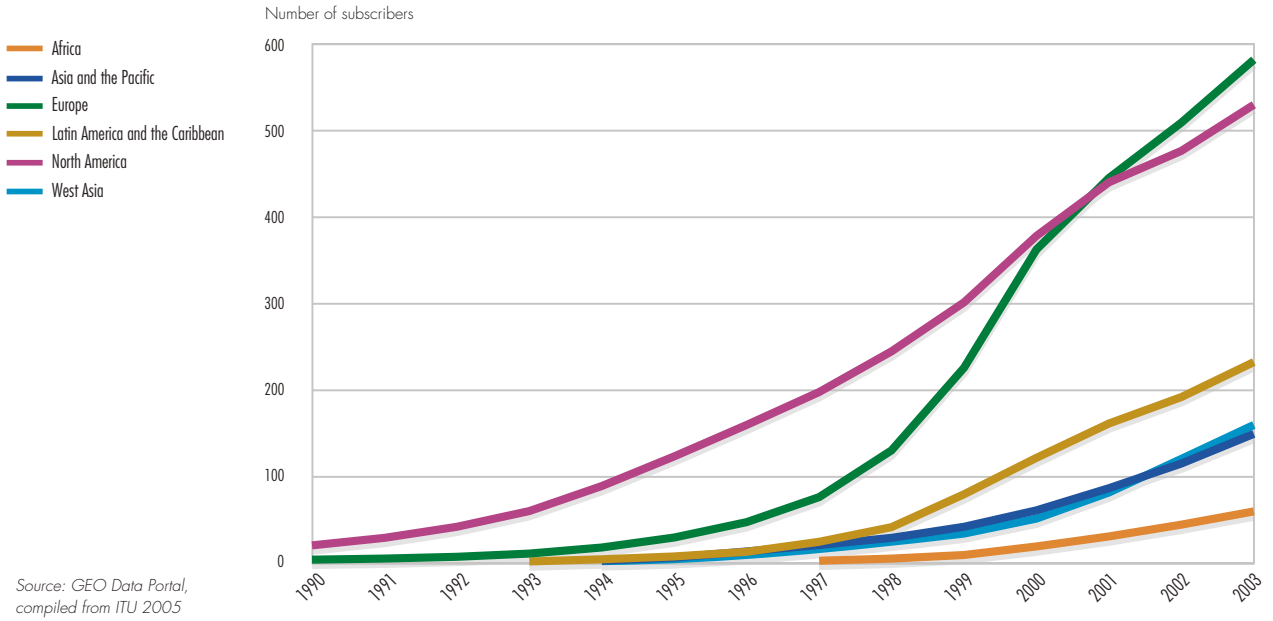

Source: GEO Data Portal, compiled from ITU 2005

The production and use of chemicals has not always been accompanied by adequate safety measures. Releases, by-products and degradation of chemicals, pharmaceuticals and other commodities contaminate the environment and there is growing evidence of their persistence and their detrimental effects on ecosystems, human and animal health.

Many industrial chemicals persist in the environment, circulating between air, water, sediments, soil and biota. Some pollutants travel long distances to supposedly pristine areas. Chemical emissions to the atmosphere often become fallout on land or water, for example polychlorodibenzodioxins (PCDD) in Europe.

Contaminants affect people in even the remotest regions. For example, contaminants reach the Arctic from all over the world through wind, air and water currents, entering the food chain. Inuit populations in the eastern Canadian Arctic and Greenland have among the highest exposures to POPs and mercury from a traditional diet of populations anywhere.

PCDD (dioxin) in the atmosphere and deposition, 2003

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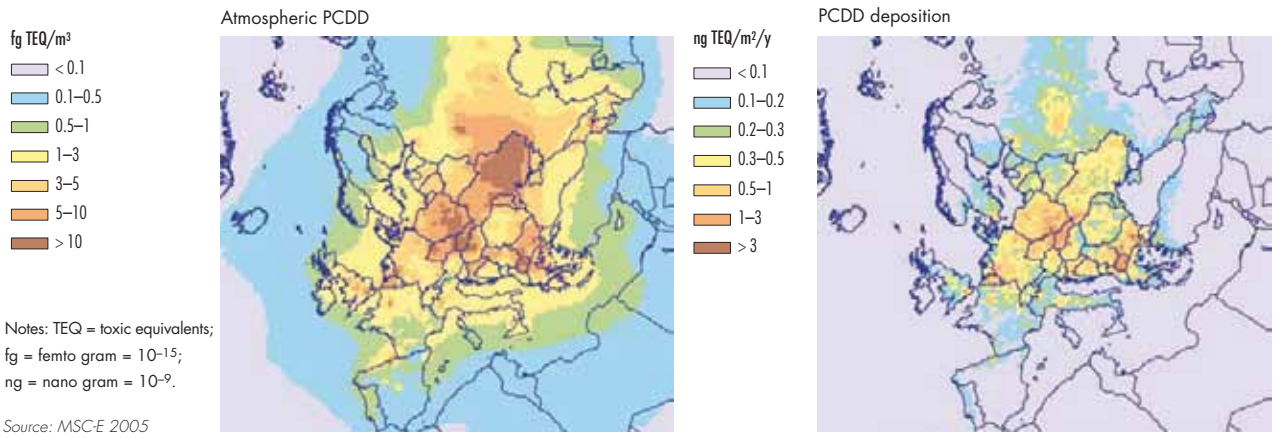
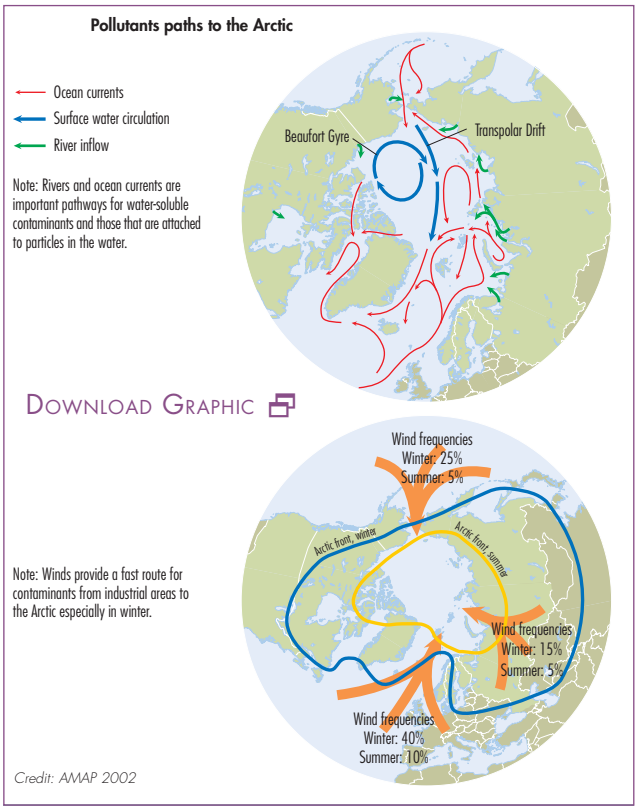


Notes: TEQ = toxic equivalents; fg = femto gram = 10^{-15}; ng = nano gram = 10^{-9}.

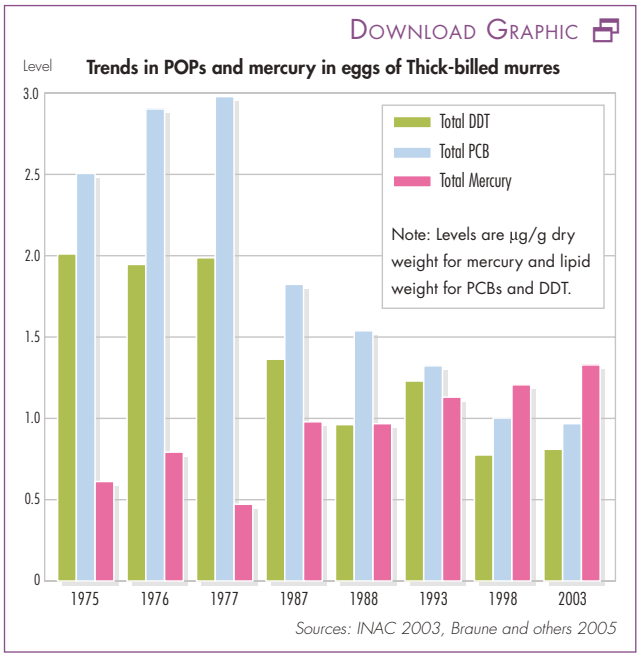
Source: MSC-E 2005



Persistent organic pollutants such as DDT and PCBs are long-lived, fat-soluble chemicals that build up to higher levels through the food chain. Arctic animals are especially vulnerable, since they store fat to survive when food is not available.

In the past 20-30 years, DDT and PCBs have generally declined in Arctic animals, while mercury has risen in some species and regions, and remained unchanged in others. Rising mercury levels may be from anthropogenic sources, from ecosystem changes related to climate warming, or a combination of these factors.

Children and their parents work all day sifting through rubbish for scraps to sell.
Credit: Mark Edwards/Still Pictures



Interlinkages

Issues of development and poverty are inextricably linked to the problems associated with waste. In the developing world it is usually the poor who deal with waste and recycling and are forced to live close to waste dumping sites. The vulnerability of local populations is often created or reinforced by poor governance and a lack of capacity to deal with the hazardous materials.

In addition to contamination generated for example by industrial or mining sites, the transport and deposition of waste is a major threat. 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.

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.

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. Sometimes, whole regions are affected by the problem.

Contamination in Central Asia's Ferghana-Osh-Khudjand area DOWNLOAD GRAPHIC

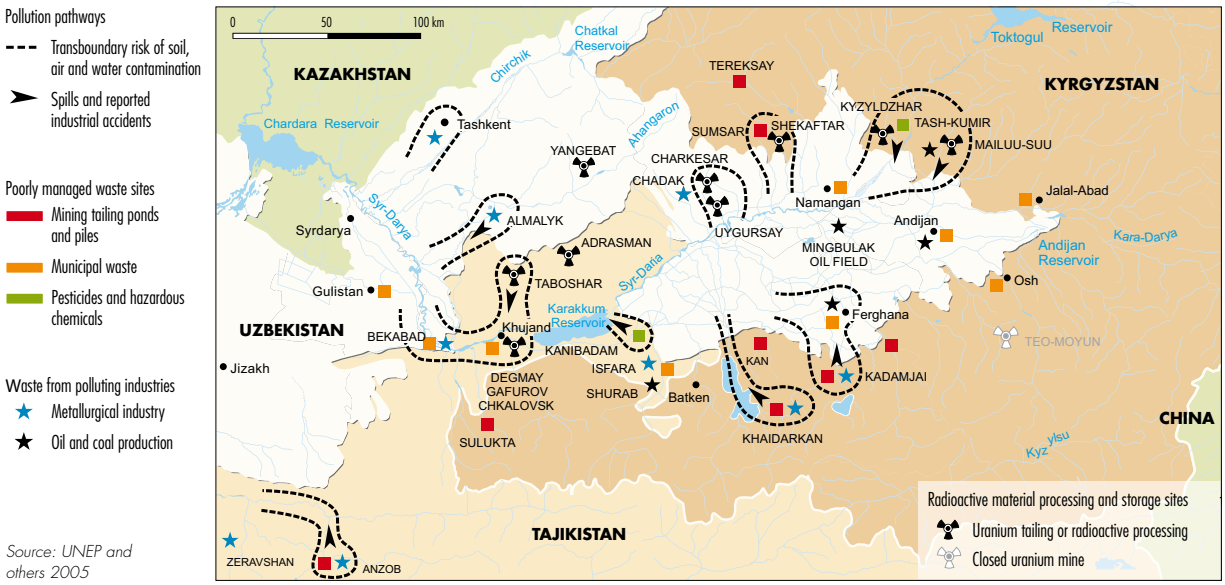
Legacies of past economic planning also impact on waste issues and development. The Ferghana-Osh-Khudjand area in Central Asia is shared by Uzbekistan, Kyrgyzstan and Tajikistan. The region is a typical example of former centrally planned economies, where development plans paid little attention to local conditions (especially environmental) and social progress was planned to be achieved through large-scale industrial projects.

The construction of enormous irrigation schemes made the region a major cotton producer. The area also became a zone of heavy industry, based on mining and oil, gas and chemical production. Discoveries of uranium ore led to extensive mining and the valley 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.

Source: UNEP and others 2005

Radioactive, chemical and biological hazards in Central Asia



Source: UNEP and others 2005

Current Action and Outlook for the Future

Chemicals are used in every aspect of life, including industrial processes, energy, transport, agriculture, pharmaceuticals, cleaning and refrigeration. More than 50 000 compounds are used commercially, hundreds are added every year and global chemical production is projected to increase by 85 per cent over the 2000-2020 period.

The risks associated with chemicals and the transboundary movements of pollutants are widely recognized. There are 17 multilateral agreements, together with numerous intergovernmental organizations and coordination mechanisms addressing different aspects of the problem. They include the Basel Convention on the Control of Transboundary Movements of Hazardous Waste and Their Disposal, the Rotterdam Convention on Prior Informed Consent Procedure for Certain Hazardous Chemicals, the Stockholm Convention on Persistent Organic Pollutants, as well as the 2006 Strategic Approach to International Chemicals Management.

Regional agreements include the Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa and the European Union's REACH.

The new REACH legislation (Registration, Evaluation, Authorisation and Restriction of Chemicals), that entered into force in June 2007, requires manufacturers and importers of chemicals to prove that substances in widely used products, such as cars, clothes or paint, are safe, while the properties of chemicals produced or imported into the European Union have to be registered with a central agency.

Existing multilateral and regional agreements offer an opportunity to arrest and eventually reverse the increasing releases of hazardous chemicals. For successful implementation, various actions need to be taken including:

- full integration of a precautionary approach in marketing chemicals;
- development of adequate chemicals-management infrastructure in all countries, including laws and regulations and monitoring capacities;
- substitution with less-hazardous materials, adoption of best available technologies and environmental practices;
- encouragement of innovation in manufacturing non-chemical alternatives in agriculture and waste avoidance and minimization.

Effective waste management strategies are lacking or are inadequate in many countries.
Credit: Ngoma Photos

Removal of contaminated sludge from electroplating tanks in Al-Qadissiya.
Credit: UNEP/Post Conflict Branch 2006

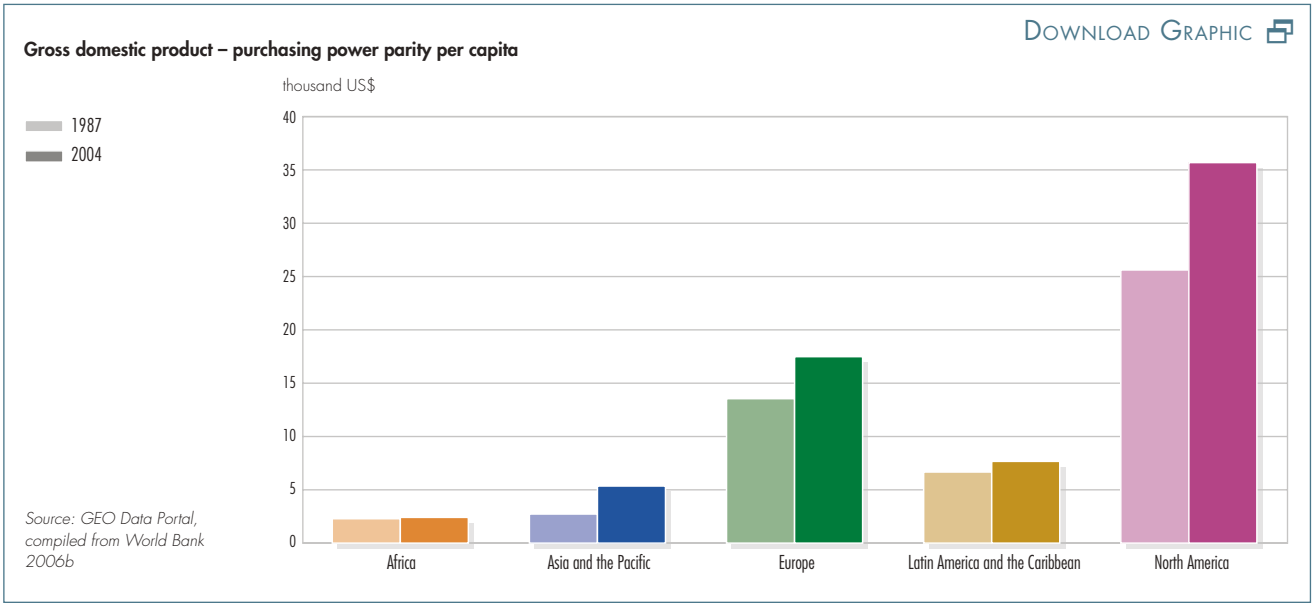
Section 6

Resource Efficiency - Sustainable Consumption and Production

Natural Resource Use and Growth and Development

Action

The Future



Natural Resource Use and Growth and Development

Global economic growth has been spectacular during the last two decades. Gross domestic product per capita (at purchasing power parity) increased by almost 1.7 per cent annually. Population and economic growth, and contemporary consumption and production patterns fuel increased demand for natural resources and place increasing pressure on the environment.

The wealthier the society, the more resources it tends to use and the more waste it generates. However, long-term development can only be achieved through sustainable management of various assets: financial, material, human, social and natural. Serious and persistent barriers to sustainable development remain as environmental degradation is undermining development and threatens future development progress.

In developed countries, the goods-and-services that cause the highest environmental impacts through their life cycles have been identified as housing, food and mobility. The dominant stage with respect to impacts differs significantly between different goods-and-services. For food and beverages, the majority of environmental impacts are related to agricultural or industrial production activities, while for personal transport the majority of the impacts are in the use phase, when driving in a car or flying in an aircraft. In general, patterns of consumption are changing, with the food component decreasing and the shares for transport, communication, housing, recreation and health care on the rise.

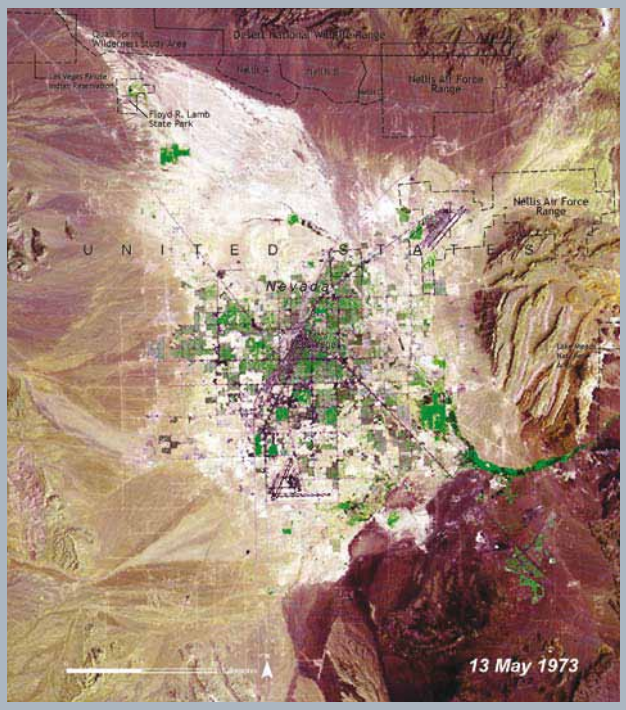
Urban sprawl, Las Vegas

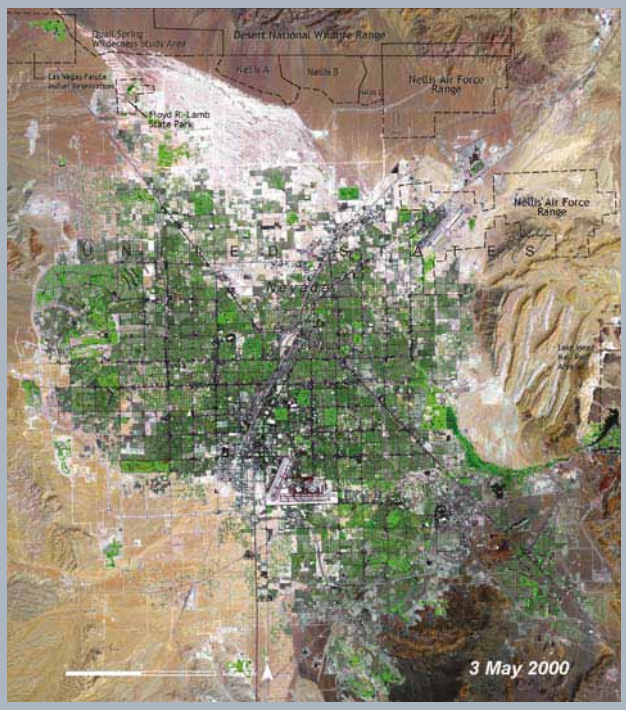
DOWNLOAD GRAPHIC

Las Vegas, the fastest growing metropolitan area in the United States, exemplifies the problems of rampant urban sprawl. As the gaming and tourism industry blossomed, so has the city's population. In 1985, Las Vegas was home to 557 000 people, and was the 66th largest metropolitan area in the United States. In 2004, the Las Vegas-Paradise area was ranked 32nd in size, with a permanent population nearing 1.7 million. According to one estimate, it may double by 2015. Population growth has put a strain on water supplies.

Satellite imagery of Las Vegas provides a dramatic illustration of the spatial patterns and rates of change resulting from the city's urban sprawl. The city covers the mainly green and grey areas in the centre of these images recorded in 1973 and 2000. Note the proliferation of roads and other infrastructure (the rectangular pattern of black lines) and the dramatic increase in irrigated areas.

Source: UNEP 2005b





Credit: UNEP 2005b

However, consumption patterns in developing regions are also changing with the emergence of new economies and powers such as China, India, Brazil, South Africa and Mexico. For example, vehicle ownership patterns illustrate the impact of changing consumption patterns. People put a high preference on car ownership as they become more affluent. Moreover, there has been a shift to heavier cars, equipped with an increasing number of energy demanding features, such as air conditioning and power windows, which add to a greater than expected growth in the use of energy by the transport sector. The growing trend in vehicle ownership affects urban air quality, which has clear consequences for human health.

Number of passenger cars, by region

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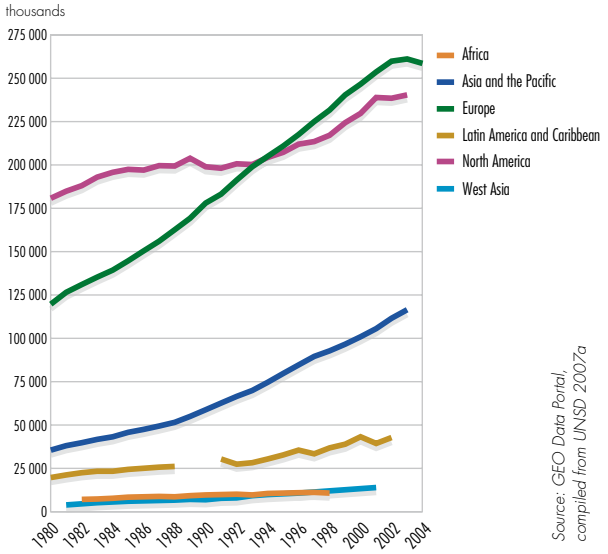


Source: GEO Data Portal, compiled from UNSD 2007a

Population increases, income growth and the global liberalization of trade in goods-and-services all stimulate an increase in energy demand. The world is facing twin threats: inadequate and insecure supplies of energy at affordable prices, and environmental damage due to overconsumption of energy. Global demand for energy keeps growing, placing an ever-increasing burden on natural resources and the environment.

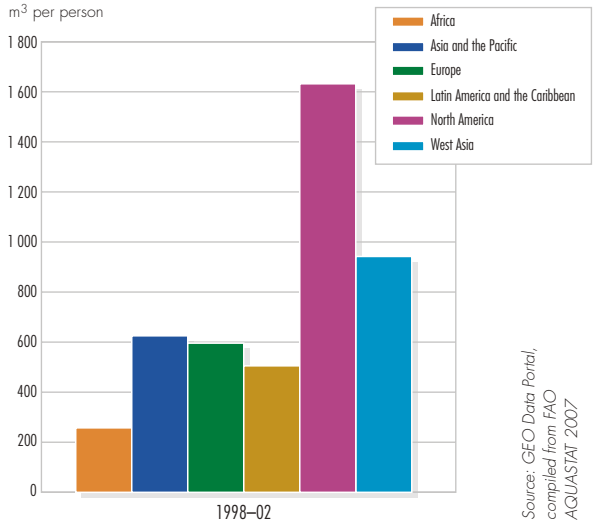
For about three decades, world primary energy demand grew by 2.1 per cent annually, rising from 5 566 million tonnes oil equivalent (Mtoe) in 1971 to 11 204 Mtoe in 2004. Over two-thirds of this increase came from developing countries, but OECD countries still account for almost 50 per cent of world energy demand. For example in 2004, primary energy use per capita in OECD countries was still 10 times higher than in sub-Saharan Africa.

The past 20 years have seen increasing water use for food and energy production to meet the demands of a growing population and to enhance human well-being, a continuing global trend. However, the changes in the way water is used have significant adverse impacts, which require urgent attention to ensure sustainability.

The North America region is the highest per capita water user in the world. One of the key reasons is its low cost, the lowest among the world's industrialized countries, given the subsidies to industry, agriculture and municipalities. Another reason is that North America is a net exporter of food, and thus the world's biggest exporter of "virtual water," which is the water contained in the food.

Download Graphic

Comparison of per capita water use by region



Source: GEO Data Portal, compiled from FAO AQUASTAT 2007

Total primary energy supply by energy source

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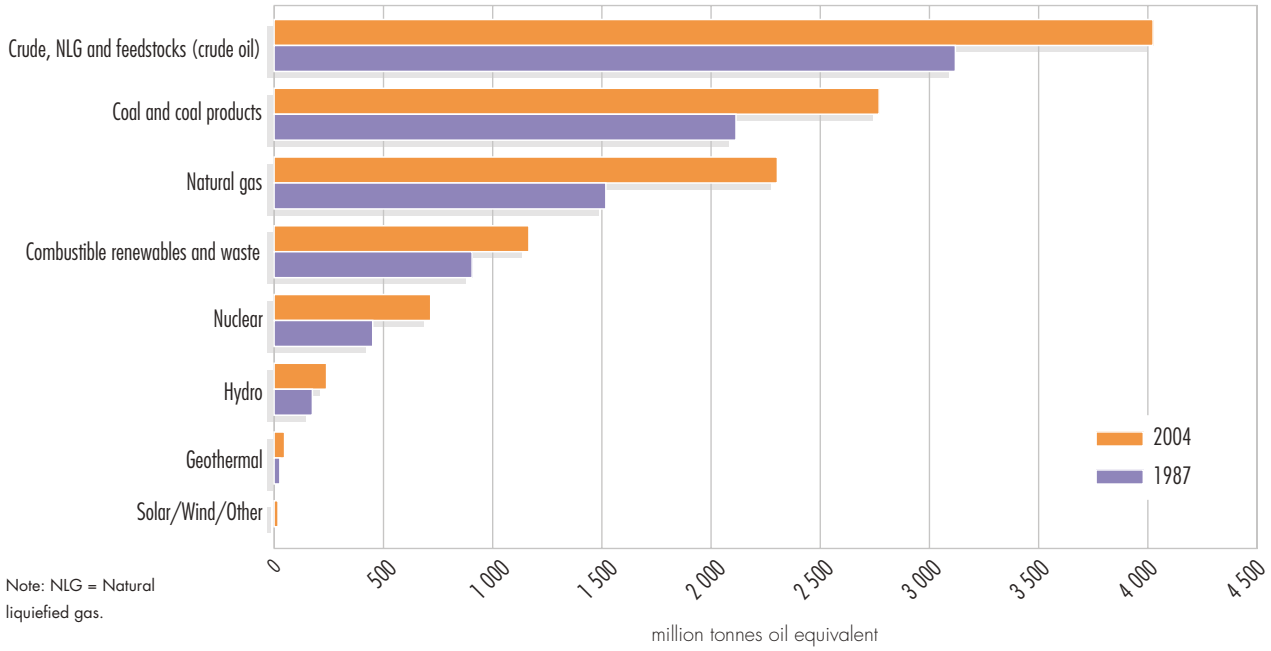


Note: NLG = Natural liquiefied gas.

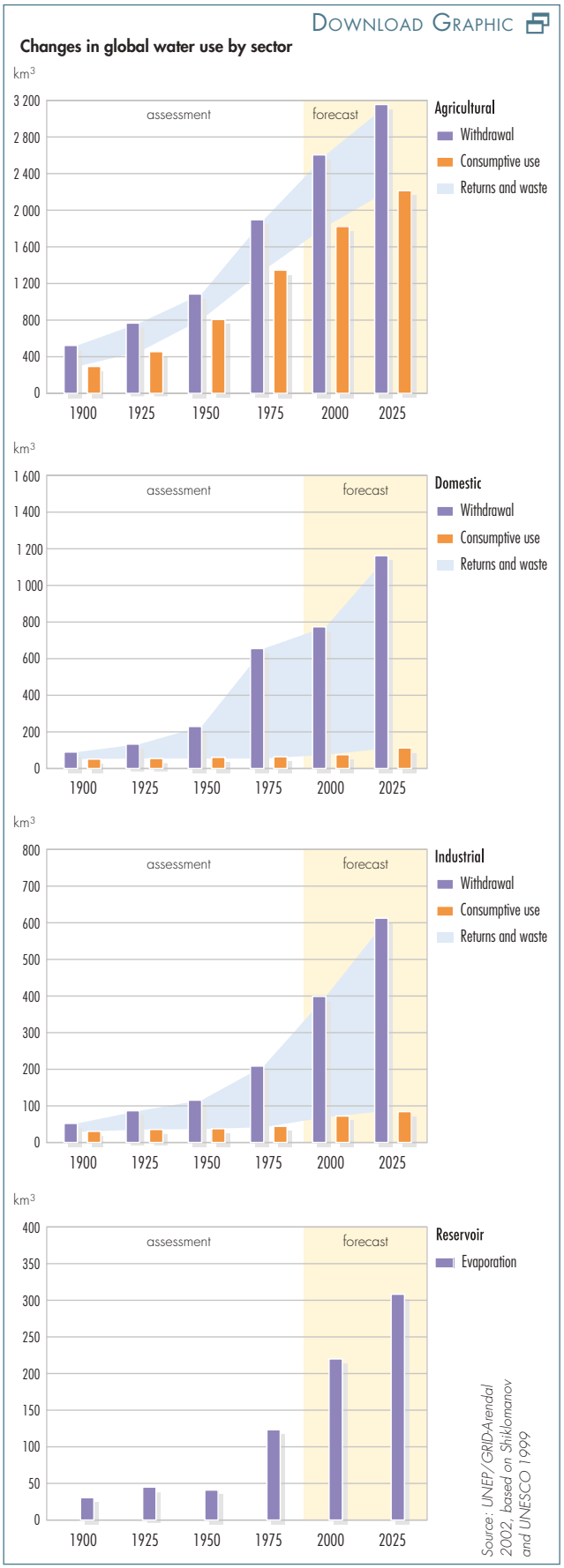
Source: GEO Data Portal, compiled from IEA 2007a

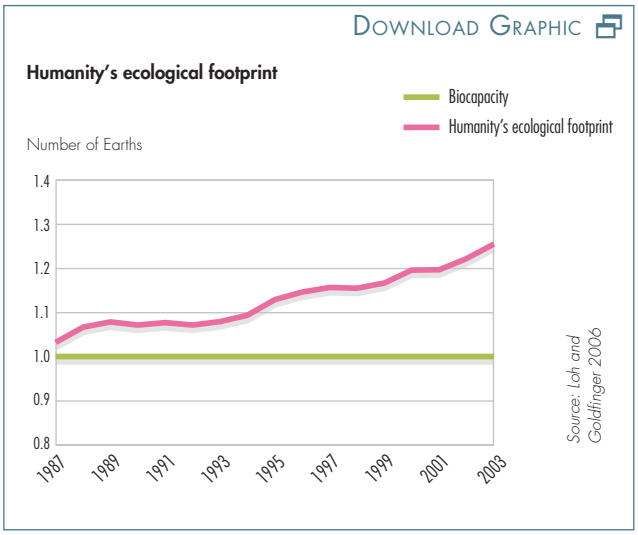
Agriculture is by far the biggest user of water. The expansion of hydropower generation and irrigated agriculture, now happening mostly in developing countries, is vital for economic development and food production. But, the consequent changes in land and water use by agriculture, as well as for urban and industrial growth, have major adverse impacts on freshwater and coastal ecosystems. Agricultural run-off containing nutrients and agrochemicals is the main source of water pollutants in many countries. In addition to agricultural demands, pressures on water resources are compounded by the physical alteration and destruction of habitats by urban and industrial development.

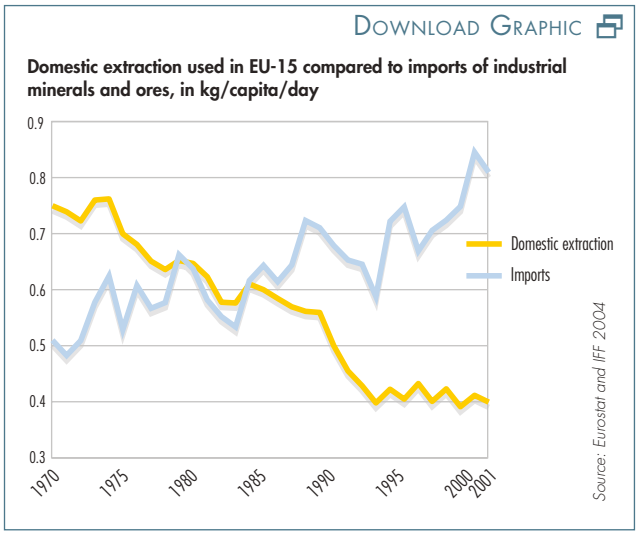
Increasing water withdrawals for irrigation increases the likelihood of salinity when there is inadequate drainage to carry the salt out of the soil. This is a threat to livelihoods and food security in dry areas, where most farm production is from irrigation and farmers use whatever water is available, however marginal, even on land with a high, saline water table. In the long run, this renders the land unproductive. Salinity will increase unless the efficiency of irrigation networks, in particular, is greatly improved.

Worldwide, some 20 per cent of irrigated land (450 000 km^2) is salt-affected, with 2 500–5 000 km^2 lost from production every year as a result of salinity.

Salinity induced by irrigation in the Euphrates basin in Syria.
Credit: Mussaddak Janat, Atomic Energy Commission of Syria



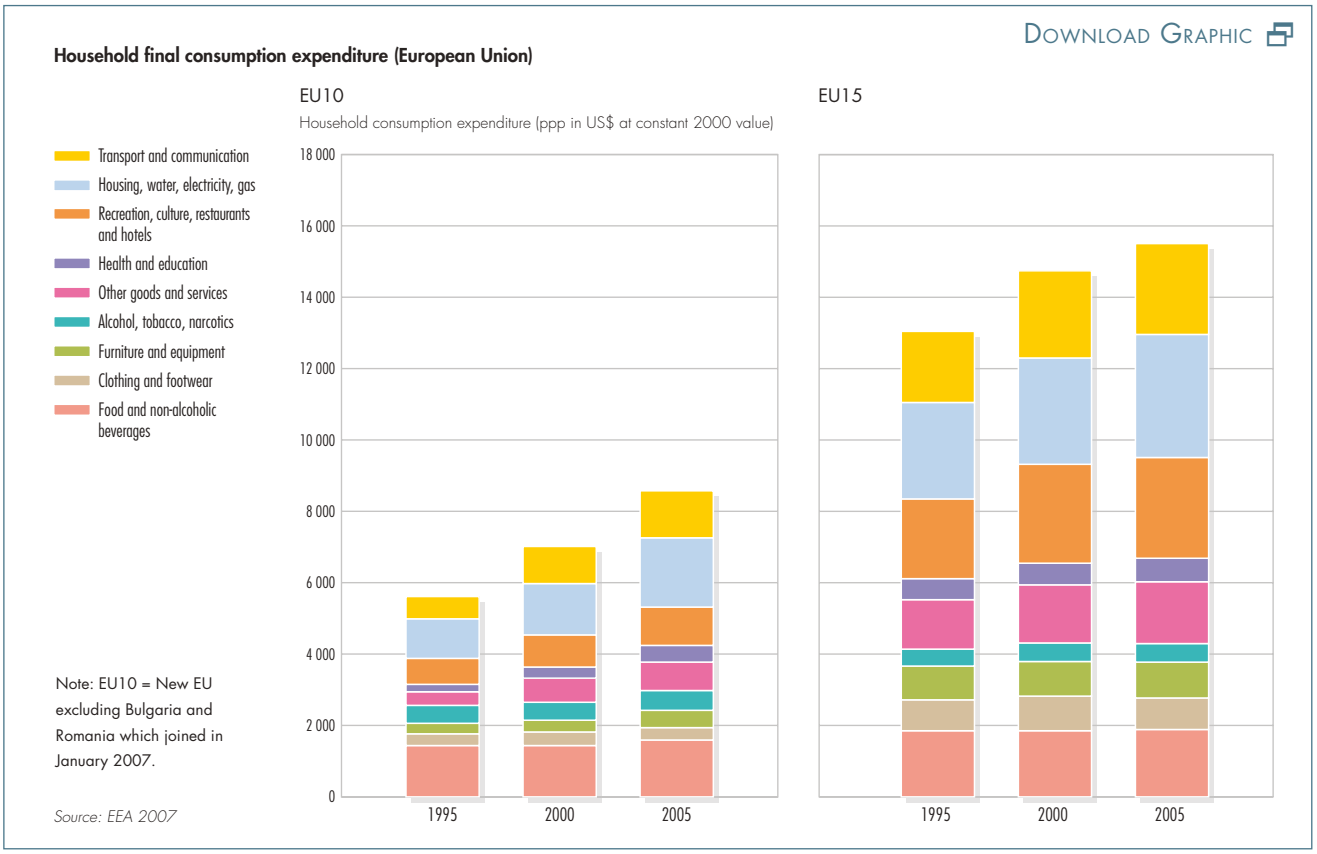




Overall, humanity's ecological footprint indicates that consumption is rapidly and unsustainably increasing.

There has been an encouraging decoupling of environmental pressures from economic growth in some areas. However, globalization has contributed to the achievement of environmental progress in some developed regions at the expense of developing countries through the outsourcing of energy, food and industrial production and the subsequent relocation of related environmental and social impacts.

At the same time, many people in industrialized nations, and the new consumers in the developing countries do not feel most of the impacts on the environment that result from their behaviour. These negative effects on the environment and well-being (especially health, security and material assets) are felt most strongly by those, especially the poor, living



where the resources are extracted or the waste is dumped. For example, the declining mineral extraction in some developed regions is often associated with the increasing import of minerals. The emissions and land degradation associated with extraction and processing of the materials are increasing in developing countries, while the high-value end products are consumed in industrialized countries.

The European Union has made important progress in decoupling resource use from economic growth. However, absolute reduction in resource use has not been achieved. Improvements have also been made in eco-efficiency but attempts to change consumption patterns have had only limited success. Household consumption expenditure is steadily increasing throughout Europe.

Action

Recognition of the need for integration of environmental concerns into public and private social and economic sector institutions has increased tremendously over the last decade at both national and international levels. A key approach to integration of environment into development is achieving more sustainable patterns of consumption and production (SCP), as facilitated through the Marrakech process on sustainable consumption and production, which was established after the 2002 Johannesburg summit.

Sustainable consumption and production: the Marrakech Process

Sustainable consumption involves the choices consumers make, and the design, development and use of products and services that are safe, and energy and resource-efficient. It considers the full lifecycle impacts, including the recycling of waste and use of recycled products. It is the responsibility of all members of society, and includes informed consumers, government, business, labour, consumer and environmental organizations. Instruments to promote sustainable consumption include sustainable or green procurement, economic and fiscal instruments to internalize environmental costs, and use of environmentally sound products, services and technologies.

Sustainable and cleaner production is "the continuous application of an integrated preventive environmental strategy to processes, products, and services to increase overall efficiency, and reduce risks to humans and the environment. Cleaner production can be applied to the processes used in any industry, to products themselves and to various services provided in society." This broad term encompasses such concepts as eco-efficiency, waste minimization, pollution prevention, green productivity and industrial ecology. Cleaner production is not anti-economic growth, but is pro-ecologically sustainable growth. It is also a "win-win" strategy that aims to protect the environment, the consumer and the worker while improving industrial efficiency, profitability and competitiveness.

Central to such efforts is the global, multistakeholder Marrakech Process, which supports regional and national initiatives to promote the shift towards sustainable consumption and production (SCP) patterns. The process responds to the call of the WSSD Johannesburg Plan of Implementation to develop a 10-Year Framework of Programmes on Sustainable Consumption and Production (10YFP). UNEP and UNDESA are the leading agencies of this global process, with the active participation of national governments, development agencies, the private sector, civil society and other stakeholders. The Commission on Sustainable Development will review the theme of SCP during its 2010–2011 two-year cycle.

Activities under the Marrakech Process are undertaken through voluntary task forces led by governments, with the participation of experts from developing and developed countries. Through a Cooperation Dialogue with other partners, they commit themselves to carrying out a set of concrete activities at national or regional level that promote a shift to SCP patterns. The task forces are carrying out activities such as:

- an eco-labelling project in Africa;
- national action plans on SCP;
- developing tools and supporting capacity building to promote sustainable public procurement;
- projects and networks on product policy to encourage more innovation on product eco-design and performance;
- projects on sustainable buildings focusing on energy efficiency;
- the promotion of sustainable lifestyles and education through demonstration projects; and
- developing policy tools and strategies for sustainable tourism.

Another important mechanism for implementing SCP is collaboration with development agencies and regional banks. The Cooperation Dialogue aims to highlight the contribution of SCP policies and tools to poverty reduction and sustainable development, including the MDGs, and better integration of SCP objectives in development plans. A key priority is to contribute to poverty reduction through the promotion of sustainable consumption and production, which is especially relevant for developing countries.

Sources: UNEP 2006f, UNEP 2007b, UNEP 2007c

Reduce, Reuse, Recycle (3R)

Reduce, Reuse, Recycle (3R) Policy in Japan seeks to lower waste volume. In addition to calling for greater recycling, disposal and collecting facilities, the regulation assigns an extended producer responsibility (EPR) to businesses that produce and sell products. EPR functions through a take-back requirement, deposit refund schemes and the shifting of financial and/or physical responsibility of a product at the post-consumer stage upstream to the producer.

A policy on EPR has been introduced for containers, packaging and some household appliances. The achievements of the policy so far have been encouraging, with an increase in the number of units recovered (post-consumer use) at designated collection sites in 2003 and 2004, of 3 and 10 per cent respectively compared with 2002.

Table 10.2 Quantitative targets for Japan's 3R Policy for 2000–2010

Item	2000 Indicator	2010 Target
Resource productivity	280 000 yen (US$2 500) per tonne	390 000 yen (US$3 500) per tonne (40% improvement)
Target for cyclical use rate	10%	14% (40% improvement)
Target for final disposal amount	56 million tonnes	28 million tonnes (50% reduction)

Source: MOEJ 2005

Sustainable consumption and production is becoming a priority for countries worldwide and there are many initiatives and programmes in addition to the Marrakech Process at national and regional levels (for example the EU Action Plan on Sustainable Consumption and Production).

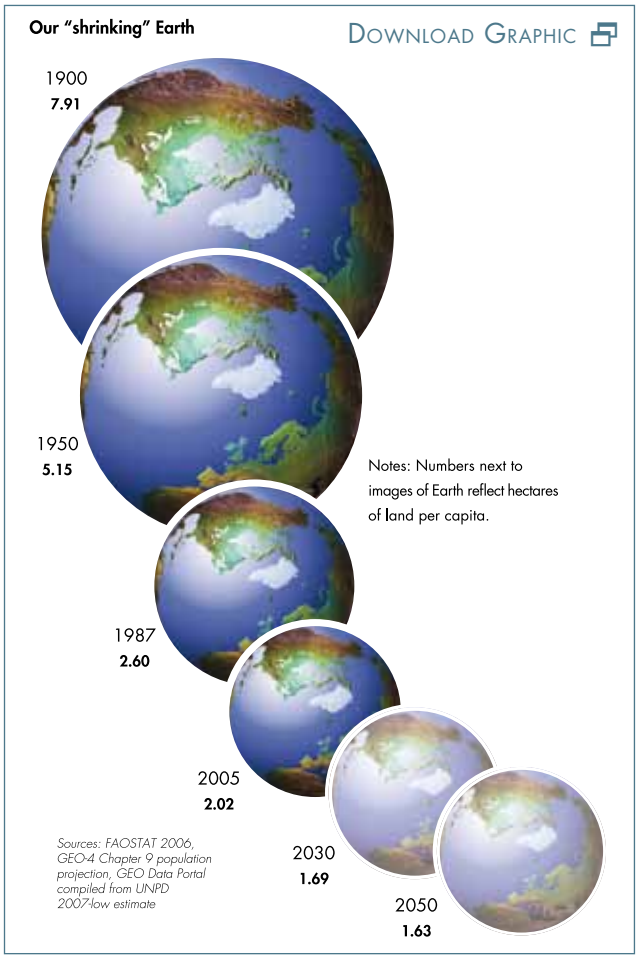
It is often necessary to look at innovative measures to meet (material) needs, and develop new innovative product and service systems. This is especially important when considering the new emerging "global consumer class," with large groups of middle-class consumers showing increasingly similar consumption patterns in rapidly-developing countries.

The Future

From a human perspective, the world is becoming smaller. For example, the amount of land per capita has been reduced to about one-quarter of what it was a century ago due to population growth and it can be expected to be further reduced to about one-fifth of the 1900 level by 2050.

Natural capital, including ecosystem services, is critical to the development of nations. It is the basis of subsistence in many poor communities. Yet depletion of energy resources, forests, agricultural land and watersheds and damage from air and water pollutants is not recorded in the national accounts as depreciation. Yet all these sectors, through their respective activities, create unwanted negative impacts.

A "Northern" development model still prevails (one sign is the accelerating growth of urban development based on car dependency), and despite progress on some fronts there is too much evidence of development to the detriment of environment,

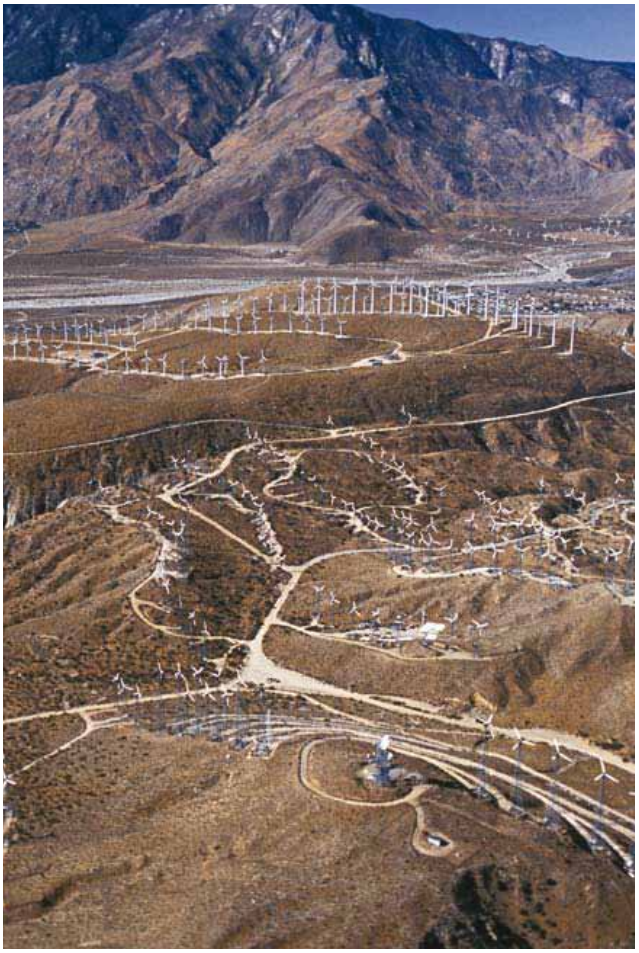


and too few signs of environment for development. For example, sustainable use of energy resources is vital not only in order to tackle environmental problems but also for economic development. A number of pan-regional plans have been initiated to develop common energy policy objectives, promote more sustainable energy production and consumption and ensure stability of supply. However, the emergence of new markets, such as for the use of wind and solar energy, requires political will, a long-term and integrated strategy and favourable conditions such as for innovation.

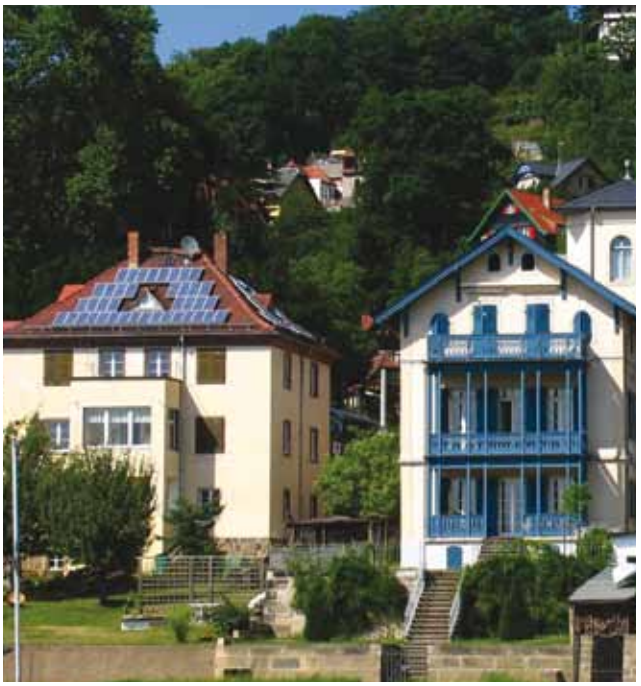
Both poverty and consumption are factors in environmental degradation. All people – rich and poor, urban and rural, and in all the world's regions – depend on environmental goods-and-services. The over-arching objective is to decouple economic growth from environmental damage in both the developed and developing countries. The challenge is to foster "environment for development" in the developing world, while simultaneously slowing consumption in the developed world.

One of the main messages in developing policies for SCP is that one single instrument will not fix the problem; it is necessary to design a package of different instruments, including regulatory frameworks, voluntary measures and economic instruments. Likewise, it is important to actively involve all stakeholders: government, industry, business, advertising, academia, consumer associations, environmental NGOs, trade unions and the general public. In addition, there is a need for sectoral approaches in order to modify the unsustainable systems of consumption and production.

Identifying interlinkages offers opportunities for more effective responses at the national, regional and global levels and provides the basis for applying measures where they are most effective, based on trade-offs among different interests in society and in a complementary manner. Such measures may facilitate the transition towards a more sustainable society.



The emergence of lead markets, such as for the use of wind energy, requires political will, a long-term and integrated strategy and favourable conditions such as for innovation.
Credit: Jim Wark/Still Pictures



Innovative solar power has promoted the use of renewable energy.
Credit: Frans Ijserinkhuijsen

Glossary

This glossary is compiled from citations in different chapters, and draws from glossaries and other resources available on the websites of the following organizations, networks and projects: American Meteorological Society, Center for Transportation Excellence (United States), Charles Darwin University (Australia), Consultative Group on International Agricultural Research, Convention on Wetlands of International Importance especially as Waterfowl Habitat, Europe's Information Society, European Environment Agency, European Nuclear Society, Food and Agriculture Organization of the United Nations, Foundation for Research, Science and Technology (New Zealand), Global Footprint Network, GreenFacts Glossary, Intergovernmental Panel on Climate Change, International Centre for Research in Agroforestry, International Comparison Programme, International Research Institute for Climate and Society at Columbia University (United States), International Strategy for Disaster Reduction, Lyme Disease Foundation (United States), Millennium Ecosystem Assessment, Illinois Clean Coal Institute (United States), National Safety Council (United States), Natsource (United States), The Organisation for Economic Co-operation and Development, Professional Development for Livelihoods (United Kingdom), SafariX eTextbooks Online, Redefining Progress (United States), The Edwards Aquifer Website (United States), TheFreeDictionary.com, The World Bank, UN Convention to Combat Desertification in Countries Experiencing Serious Drought and/or Desertification, Particularly in Africa, UN Development Programme, UN Framework Convention on Climate Change, UN Industrial Development Organization, UN Statistics Division, US Department of Agriculture, US Department of the Interior, US Department of Transportation, US Energy Information Administration, US Environmental Protection Agency, US Geological Survey, Water Quality Association (United States), Wikipedia and World Health Organization.

Term	**Definition**
Abundance	The number of individuals or related measure of quantity (such as biomass) in a population, community or spatial unit.
Acidification	Change in environment's natural chemical balance caused by an increase in the concentration of acidic elements.
Adaptation	Adjustment in natural or human systems to a new or changing environment, including anticipatory and reactive adaptation, private and public adaptation, and autonomous and planned adaptation.
Alien species (also nonnative, non-indigenous, foreign, exotic)	Species introduced outside its normal distribution.
Aquaculture	The farming of aquatic organisms in inland and coastal areas, involving intervention in the rearing process to enhance production and the individual or corporate ownership of the stock being cultivated.
Aquatic ecosystem	Basic ecological unit composed of living and non-living elements interacting in an aqueous milieu.
Aquifer	An underground geological formation or group of formations, containing usable amounts of groundwater that can supply wells and springs.
Benthic organism	The biota living on or very near the bottom of the sea, river or lake.
Biocapacity	The capacity of ecosystems to produce useful biological materials and to absorb waste materials generated by humans, using current management schemes and extraction technologies. The biocapacity of an area is calculated by multiplying the actual physical area by the yield factor and the appropriate equivalence factor. Biocapacity is usually expressed in units of global hectares.

Biodiversity (a contraction of biological diversity)	The variety of life on Earth, including diversity at the genetic level, among species and among ecosystems and habitats. It includes diversity in abundance, distribution and in behaviour. Biodiversity also incorporates human cultural diversity, which can both be affected by the same drivers as biodiversity, and itself has impacts on the diversity of genes, other species and ecosystems.
Biofuel	Fuel produced from dry organic matter or combustible oils from plants, such as alcohol from fermented sugar, black liquor from the paper manufacturing process, wood and soybean oil.
Biomass	Organic material, both above ground and below ground, and both living and dead, such as trees, crops, grasses, tree litter and roots.
Capital	Resource that can be mobilized in the pursuit of an individual's goals. Thus, we can think of natural capital (natural resources such as land and water), physical capital (technology and artifacts), social capital (social relationships, networks and ties), financial capital (money in a bank, loans and credit), human capital (education and skills).
Carbon sequestration	The process of increasing the carbon content of a reservoir other than the atmosphere.
Catchment (area)	The area of land bounded by watersheds draining into a river, basin or reservoir.
Climate change	Any change in climate over time, whether due to natural variability or as a result of human activity. (The UN Framework Convention on Climate Change defines climate change as "a change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.")
Climate variability	Variations in the mean state and other statistics (such as standard deviations and the occurrence of extremes) of the climate on all temporal and spatial scales beyond that of individual weather events. Variability may be due to natural internal processes in the climate system (internal variability), or to variations in natural or anthropogenic external forcing (external variability).
Conservation tillage	Breaking the soil surface without turning over the soil.
Coping capacity	The degree to which adjustments in practices, processes or structures can moderate or offset the potential for damage, or take advantage of opportunities.
Cross-cutting issue	An issue that cannot be adequately understood or explained without reference to the interactions of several dimensions that are usually treated separately for policy purposes. For example, in some environmental problems economic, social, cultural and political dimensions interact with one another to define the ways and means through which society interacts with nature, and the consequences of these interactions for both.
Cultural services	The non-material benefits people obtain from ecosystems, including spiritual enrichment, cognitive development, recreation and aesthetic experience.
Deforestation	Conversion of forested land to non-forest areas.
Desertification	This is land degradation in arid, semi-arid and dry sub-humid areas resulting from various factors, including climatic variations and human activities. It involves crossing thresholds beyond which the underpinning ecosystem cannot restore itself, but requires ever-greater external resources for recovery.
Drylands	Areas characterized by lack of water, which constrain two major, interlinked ecosystem services: primary production and nutrient cycling. Four dryland sub-types are widely recognized: dry sub-humid, semi-arid, arid and hyper-arid, showing an increasing level of aridity or moisture deficit. Formally, this definition includes all land where the aridity index value is less than 0.65. See also Aridity index.
Ecological footprint	An index of the area of productive land and aquatic ecosystems required to produce the resources used and to assimilate the wastes produced by a defined population at a specified material standard of living, wherever on Earth that land may be located.
Ecosystem	A dynamic complex of plant, animal and micro-organism communities and their non-living environment, interacting as a functional unit.
Ecosystem management	An approach to maintaining or restoring the composition, structure, function and delivery of services of natural and modified ecosystems for the goal of achieving sustainability. It is based on an adaptive, collaboratively developed vision of desired future conditions that integrates ecological, socio-economic, and institutional perspectives, applied within a geographic framework, and defined primarily by natural ecological boundaries.

Ecosystem services	The benefits people obtain from ecosystems. These include provisioning services, such as food and water, regulating services, such as flood and disease control, cultural services, such as spiritual, recreational and cultural benefits, and supporting services, such as nutrient cycling, that maintain the conditions for life on Earth. Sometimes called ecosystem goods-and-services.
Endangered species	A species is endangered when the best available evidence indicates that it meets any of the criteria A to E specified for the endangered category of the IUCN Red List, and is therefore considered to be facing a very high risk of extinction in the wild.
Energy efficiency	Using less energy to achieve the same output or goal.
Environmental assessment (EA)	An environmental assessment is the entire process of undertaking a critical and objective evaluation and analysis of information designed to support decision making. It applies the judgment of experts to existing knowledge to provide scientifically credible answers to policy relevant questions, quantifying where possible the level of confidence. It reduces complexity but adds value by summarizing, synthesizing and building scenarios, and identifies consensus by sorting out what is known and widely accepted from what is not known or not agreed. It sensitizes the scientific community to policy needs and the policy community to the scientific basis for action.
Environmental health	Those aspects of human health and disease that are determined by factors in the environment. It also refers to the theory and practice of assessing and controlling factors in the environment that can potentially affect health. Environmental health includes both the direct pathological effects of chemicals, radiation and some biological agents, and the effects (often indirect) on health and well-being of the broad physical, psychological, social and aesthetic environment. This includes housing, urban development, land use and transport.
Environmental policy	A policy initiative aimed at addressing environmental problems and challenges.
Environmental problems	Environmental problems are human and/or natural influences on ecosystems that lead to a constraint, cutback or even a cessation of their functioning. They may be broadly categorized into environmental problems with proven solutions, and problems with emerging solutions. See also conventional environmental problems and persistent environmental problems.
Equity	Fairness of rights, distribution and access. Depending on context, this can refer to resources, services or power.
Evapotranspiration	Combined loss of water by evaporation from the soil or surface water, and transpiration from plants and animals.
E-waste (electronic waste)	A generic term encompassing various forms of electrical and electronic equipment that has ceased to be of value and is disposed of. A practical definition of e-waste is "any electrically powered appliance that fails to satisfy the current owner for its originally intended purpose."
Forest	Land spanning more than 0.5 hectares with trees higher than 5 metres and a canopy cover of more than 10 per cent, or trees able to reach these thresholds in situ. It does not include land that is predominantly under agricultural or urban land use.
Forest degradation	Changes within the forest that negatively affect the structure or function of the stand or site, and thereby lower the capacity to supply products and/or services.
Fossil fuel	Coal, natural gas and petroleum products (such as oil) formed from the decayed bodies of animals and plants that died millions of years ago.
Global (international) environmental governance	The assemblage of laws and institutions that regulate society-nature interactions and shape environmental outcomes.
Global warming	Changes in the surface air temperature, referred to as the global temperature, brought about by the enhanced greenhouse effect, which is induced by emission of greenhouse gases into the air.
Globalization	The increasing integration of economies and societies around the world, particularly through trade and financial flows, and the transfer of culture and technology.
Governance	The manner in which society exercises control over resources. It denotes the mechanisms through which control over resources is defined and access is regulated. For example, there is governance through the state, the market, or through civil society groups and local organizations. Governance is exercised through institutions: laws, property rights systems and forms of social organization.
Green procurement	Taking environmental aspects into consideration in public and institutional procurement.

Greenhouse gases (GHGs)	Gaseous constituents of the atmosphere, both natural and anthropogenic, that absorb and emit radiation at specific wavelengths within the spectrum of infrared radiation emitted by the Earth's surface, the atmosphere and clouds. This property causes the greenhouse effect. Water vapor (H_2O), carbon dioxide (CO_2), nitrous oxide (N_2O), methane (CH_4) and ozone (O_3) are the primary greenhouse gases in the Earth's atmosphere. There are human-made greenhouse gases in the atmosphere, such as the halocarbons and other chlorine and bromine containing substances. Beside CO_2, N_2O and CH_4, the Kyoto Protocol deals with sulphur hexafluoride (SF_6), hydrofluorocarbons (HFCs) and per-fluorocarbons (PFCs).
Groundwater	Water that flows or seeps downward and saturates soil or rock, supplying springs and wells. The upper surface of the saturate zone is called the water table.
Habitat	(1) The place or type of site where an organism or population naturally occurs. (2) Terrestrial or aquatic areas distinguished by geographic, abiotic and biotic features, whether entirely natural or semi-natural.
Hazard	A potentially damaging physical event, phenomenon or human activity that may cause the loss of life or injury, property damage, social and economic disruption or environmental degradation.
Hazardous waste	By-products of society that can pose a substantial or potential hazard to human health or the environment when improperly managed. Substances classified as hazardous wastes possess at least one of four characteristics: ignitability, corrosivity, reactivity or toxicity, or appear on special lists.
Heavy metals	A group name for metals and semimetals (metalloids), such as arsenic, cadmium, chromium, copper, lead, mercury, nickel and zinc, that have been associated with contamination and potential toxicity.
High seas	The oceans outside of national jurisdictions, lying beyond each nation's exclusive economic zone or other territorial waters.
Human health	A state of complete physical, mental and social well-being, and not merely the absence of disease or infirmity.
Human well-being	The extent to which individuals have the ability to live the kinds of lives they have reason to value; the opportunities people have to achieve their aspirations. Basic components of human well-being include: security, material needs, health and social relations.
Institutions	Regularized patterns of interaction by which society organizes itself: the rules, practices and conventions that structure human interaction. The term is wide and encompassing, and could be taken to include law, social relationships, property rights and tenurial systems, norms, beliefs, customs and codes of conduct as much as multilateral environmental agreements, international conventions and financing mechanisms. Institutions could be formal (explicit, written, often having the sanction of the state) or informal (unwritten, implied, tacit, mutually agreed and accepted). Formal institutions include law, international environmental agreements, bylaws and memoranda of understanding. Informal institutions include unwritten rules, codes of conduct and value systems. The term institutions should be distinguished from organizations.
Integrated water resources management (IWRM)	A process which promotes the coordinated development and management of water, land and related resources, in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.
Interlinkages	The cause-effect chains that cross the boundaries of current environmental and environment-development challenges.
Invasive alien species	An alien species whose establishment and spread modifies ecosystems, habitats or species.
Kyoto Protocol	A protocol to the 1992 UN Framework Convention on Climate Change (UNFCCC) adopted at the Third Session of the Conference of the Parties to the UNFCCC in 1997 in Kyoto, Japan. It contains legally binding commitments, in addition to those included in the UNFCCC. Countries included in Annex B of the protocol (most OECD countries and countries with economies in transition) agreed to control their national anthropogenic emissions of greenhouse gases (CO_2, CH_4, N_2O, HFCs, PFCs and SF_6) so that the total emissions from these countries would be at least 5 per cent below 1990 levels in the commitment period, 2008 to 2012. The protocol expires in 2012.
Land cover	The physical coverage of land, usually expressed in terms of vegetation cover or lack of it. Influenced by, but not synonymous with, land use.
Land degradation	The loss of biological or economic productivity and complexity in croplands, pastures and woodlands. It is due mainly to climate variability and unsustainable human activity.

Land use	The human use of land for a certain purpose. Influenced by, but not synonymous with, land cover.
Lead markets for environmental innovations	Countries that are earlier in the introduction of environmental innovation and with more widespread diffusion of the innovations. If these countries serve as an example or model for other countries and their innovations are distributed elsewhere as well, these countries are lead markets.
Mainstreaming	Mainstreaming the environment into development policy making means that environmental considerations are considered in the design of policies for development.
Mitigation	Structural and non-structural measures undertaken to limit the adverse impact of natural hazards, environmental degradation and technological hazards.
Monitoring (environmental)	Continuous or regular standardized measurement and observation of the environment (air, water, soil, land use, biota).
Multilateral environmental agreements (MEAs)	Treaties, conventions, protocols and contracts among several states to jointly agree on activities regarding specified environmental problems.
Natural capital	Natural assets in their role of providing natural resource inputs and environmental services for economic production. Natural capital includes land, minerals and fossil fuels, solar energy, water, living organisms, and the services provided by the interactions of all these elements in ecological systems.
Nitrogen deposition	The input of reactive nitrogen, mainly derived from nitrogen oxides and ammonia emissions, from the atmosphere into the biosphere.
Nutrient loading	Quantity of nutrients entering an ecosystem in a given period of time.
Nutrients	The approximately 20 chemical elements known to be essential for the growth of living organisms, including nitrogen, sulphur, phosphorous and carbon.
Organizations	Bodies of individuals with a specified common objective. Organizations could be political organizations (political parties, governments and ministries), economic organizations (federations of industry), social organizations (NGOs and self-help groups) or religious organizations (church and religious trusts). The term organizations should be distinguished from institutions.
Overexploitation	The excessive use of raw materials without considering the long-term ecological impacts of such use.
Ozone layer	Very dilute atmospheric concentration of ozone found at an altitude of 10-50 kilometres above the earth's surface.
Ozone-depletion potential	A relative index indicating the extent to which a chemical may cause ozone depletion. The reference level of 1 is the potential of CFC-11 and CFC-12 to cause ozone depletion.
Ozone-depleting substance (ODS)	Any substance with an ozone depletion potential greater than 0 that can deplete the stratospheric ozone layer.
Persistent environmental problems	Some of the basic science about cause-and-effect relationships is known, but often not enough to predict when a turning point or a point of no return will be reached, or exactly how human well-being will be affected. The sources of the problem are quite diffuse and often multisectoral, potential victims are often quite remote from the sources, extremely complex multi-scale ecological processes may be involved, there may be a long time between causes and impacts, and there is a need to implement measures on a very large scale (usually global or regional). Examples include global climate change, stratospheric ozone depletion, persistent organic pollutants and heavy metals, extinction of species, ocean acidification, and introduction of alien species.
Persistent organic pollutants (POPs)	Chemicals that remain intact in the environment for long periods, become widely distributed geographically, accumulate in the fatty tissue of living organisms and are toxic to people and wildlife. POPs circulate globally and can cause damage wherever they travel.
Policy	Any form of intervention or societal response. This includes not only statements of intent, such as a water policy or forest policy, but also other forms of intervention, such as the use of economic instruments, market creation, subsidies, institutional reform, legal reform, decentralization and institutional development. Policy can be seen as a tool for the exercise of governance. When such an intervention is enforced by the state, it is called public policy.
Pollutant	Any substance that causes harm to the environment when it mixes with soil, water or air.

Pollution	The presence of minerals, chemicals or physical properties at levels that exceed the values deemed to define a boundary between "good or acceptable" and "poor or unacceptable" quality, which is a function of the specific pollutant.
Poverty	The pronounced deprivation of well-being.
Precautionary approach	The management concept stating that in cases "where there are threats of serious or irreversible damage, lack of full scientific certainly shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation."
Prediction	The act of attempting to produce a description of the expected future, or the description itself, such as "it will be 30 degrees tomorrow, so we will go to the beach."
Primary energy	Energy embodied in natural resources (such as coal, crude oil, sunlight or uranium) that has not undergone any anthropogenic conversion or transformation.
Projection	The act of attempting to produce a description of the future subject to assumptions about certain preconditions, or the description itself, such as "assuming it is 30 degrees tomorrow, we will go to the beach."
Provisioning services	The products obtained from ecosystems, including, for example, genetic resources, food and fibre, and freshwater.
Purchasing power parity (PPP)	The number of currency units required to purchase the amount of goods and services equivalent to what can be bought with one unit of the currency of the base country, for example, the US dollar.
Reforestation	Planting of forests on lands that have previously contained forest, but have since been converted to some other use.
Regulating services	The benefits obtained from the regulation of ecosystems processes, including, for example, the regulation of climate, water and some human diseases.
Resilience	The capacity of a system, community or society potentially exposed to hazards to adapt by resisting or changing in order to reach and maintain an acceptable level of functioning and structure.
Rules and norms	A part of the umbrella concept of institutions. While the distinction is a bit thin, rules could be considered to be directions for behavior that can both be explicit or implicit. Norms are an accepted standard or a way of behaving or doing things that most people agree with.
Run-off	A portion of rainfall, melted snow or irrigation water that flows across the ground's surface and is eventually returned to streams. Run-off can pick up pollutants from air or land and carry them to receiving waters.
Sahel	A loosely defined strip of transitional vegetation that separates the Sahara desert from the tropical savannahs to the south. The region is used for farming and grazing, and because of the difficult environmental conditions that exist at the border of the desert, the region is very sensitive to human-induced land cover change. It includes parts of Senegal, the Gambia, Mauritania, Mali, Niger, Nigeria, Burkina Faso, Cameroon and Chad.
Salinization	The buildup of salts in soils.
Scale	The spatial, temporal (quantitative or analytical) dimension used to measure and study any phenomena. Specific points on a scale can thus be considered levels (such as local, regional, national and international).
Scenario	A description of how the future may unfold based on "if-then" propositions, typically consisting of a representation of an initial situation, a description of the key drivers and changes that lead to a particular future state. For example, "given that we are on holiday at the coast, if it is 30 degrees tomorrow, we will go to the beach".
Security	Relates to personal and environmental security. It includes access to natural and other resources, and freedom from violence, crime and war, as well as security from natural and human-caused disasters.
Sediment	Solid material that originates mostly from disintegrated rocks and is transported by, suspended in or deposited from water.
Sedimentation	Strictly, the act or process of depositing sediment from suspension in water. Broadly, all the processes whereby particles of rock material are accumulated to form sedimentary deposits. Sedimentation, as commonly used, involves not only aqueous but also glacial, aeolian and organic agents.

Species	An interbreeding group of organisms that is reproductively isolated from all other organisms, although there are many partial exceptions to this rule in particular taxa. Operationally, the term species is a generally agreed fundamental taxonomic unit, based on morphological or genetic similarity that once described and accepted is associated with a unique scientific name.
Species diversity	Biodiversity at the species level, often combining aspects of species richness, their relative abundance and their dissimilarity.
Species richness/ abundance	The number of species within a given sample, community or area.
Surface water	All water naturally open to the atmosphere, including rivers, lakes, reservoirs, streams, impoundments, seas and estuaries. The term also covers springs, wells or other collectors of water that are directly influenced by surface waters.
Sustainability	A characteristic or state whereby the needs of the present and local population can be met without compromising the ability of future generations or populations in other locations to meet their needs.
Sustainable development	Development that meets the needs of the present generation without compromising the ability of future generations to meet their own needs.
Technology	Physical artefacts or the bodies of knowledge of which they are an expression. Examples are water extraction structures, such as tube wells, renewable energy technologies and traditional knowledge. Technology and institutions are related. Any technology has a set of practices, rules and regulations surrounding its use, access, distribution and management.
Technology transfer	A broad set of processes covering the flows of know-how, experience and equipment among different stakeholders.
Threshold	A point or level at which new properties emerge in an ecological, economic or other system, invalidating predictions based on mathematical relationships that apply at lower levels.
Traditional use (of natural resources)	Exploitation of natural resources by indigenous users, or non-indigenous residents using traditional methods. Local use refers to exploitation by local residents.
Urban sprawl	The decentralization of the urban core through the unlimited outward extension of dispersed development beyond the urban fringe, where low density residential and commercial development exacerbates fragmentation of powers over land use.
Urbanization	An increase in the proportion of the population living in urban areas.
Vulnerability	An intrinsic feature of people at risk. It is a function of exposure, sensitivity to impacts of the specific unit exposed (such as a watershed, island, household, village, city or country), and the ability or inability to cope or adapt. It is multi-dimensional, multidisciplinary, multisectoral and dynamic. The exposure is to hazards such as drought, conflict or extreme price fluctuations, and also to underlying socio-economic, institutional and environmental conditions.
Wastewater treatment	Any of the mechanical, biological or chemical processes used to modify the quality of wastewater in order to reduce pollution levels.
Water quality	The chemical, physical and biological characteristics of water, usually in respect to its suitability for a particular purpose.
Water scarcity	Occurs when annual water supplies drop below 1 000 m^3 per person, or when more than 40 per cent of available water is used.
Water stress	Occurs when low water supplies limit food production and economic development, and affect human health. An area is experiencing water stress when annual water supplies drop below 1 700 m^3 per person.
Wetland	Area of marsh, fen, peatland, bog or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water to a depth at low tide that does not exceed 6 metres.

Acronyms & Abbreviations

AIDS	acquired immunodeficiency syndrome
AMCEN	African Ministerial Conference on the Environment
ASEAN	Association of Southeast Asian Nations
CBD	Convention on Biological Diversity
CEC	Commission for Environmental Cooperation (under NAFTA)
CFC	chlorofluorocarbon
CITES	Convention on International Trade in Endangered Species of Wild Fauna and Flora
CMS	Convention on the Conservation of Migratory Species of Wild Animals
CO	carbon monoxide
CO_2	carbon dioxide
DDT	dichlorodiphenyltrichloroethane
DESA	Department of Economic and Social Affairs
DEWA	Division of Early Warning and Assessment (UNEP)
EU	European Union
FAO	Food and Agriculture Organization of the United Nations
GDP	gross domestic product
GEO	Global Environment Outlook
GIWA	Global International Waters Assessment
GRID	Global Resource Information Database
HIV	human immunodeficiency virus
IEG	International Environmental Governance
IFF	Intergovernmental Forum on Forests
IMF	International Monetary Fund
INEGI	Instituto Nacional de Geografia Estadistica e Informatica (Mexico)
IPCC	Intergovernmental Panel on Climate Change
IUCN	World Conservation Union (International Union for the Conservation of Nature and Natural Resources)
IWRM	integrated water resources management
MA	Millennium Ecosystem Assessment
MDGs	Millennium Development Goals
MEA	multilateral environmental agreement
MSC	Marine Stewardship Council
NAFTA	North American Free Trade Agreement
NGO	non-governmental organization
ODS	ozone-depleting substance
OECD	Organisation for Economic Co-operation and Development
PCB	polychlorinated biphenyls
POPs	persistent organic pollutants
SCP	sustainable consumption and production
SIDS	Small Island Developing State or States

TOE	tonnes of oil equivalent
UN	United Nations
UNCCD	United Nations Convention to Combat Desertification
UNCLOS	United Nations Convention on the Law of the Sea
UNDP	United Nations Development Programme
UNEP	United Nations Environment Programme
UNEP-WCMC	United Nations Environment Programme-World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific and Cultural Organization
UNFCCC	United Nations Framework Convention on Climate Change
UNHCR	United Nations High Commission for Refugees
UNICEF	United Nations Children's Fund
US	United States
UV	ultraviolet (A and B)
WHO	World Health Organization
WIPO	World Intellectual Property Organization
WSSD	World Summit on Sustainable Development
WTO	World Trade Organization
WWF	World Wide Fund for Nature

References

AMAP (2002). Persistent Organic Pollutants, Heavy Metals, Radioactivity, Human Health, Changing Pathways. Arctic monitoring and Assessment Programme, Oslo

Boko, M., I. Niang, A. Nyong, C. Vogel, A. Githeko, M. Medany, B. Osman-Elasha, R. Tabo and P. Yanda, 2007: Africa. Climate Change 2007: Impacts, Adaptation and Vulnerability. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, M.L. Parry, O.F. Canziani, J.P. Palutikof, P.J. van der Linden and C.E. Hanson, Eds., Cambridge University Press, Cambridge UK, 433-467.

Braune, B. M., Outridge, P. M., Fisk, A. T., Muir, D. C. G., Helm, P. A., Hobbs, K., Hoekstra, P. F., Kuzyk, Z. A., Kwan, M., Letcher, R. J., Lockhart, W. L., Norstrom, R. J., Stern, G. A. and Stirling, I. (2005). Persistent organic pollutants and mercury in marine biota of the Canadian Arctic: an overview of spatial and temporal trends. In Science of the Total Environment 4(56):351-352

Burke, L., Kura, Y., Kassem, K., Revenga, C., Spalding, M., and McAllister, D. (2001). Pilot Analysis of Global Ecosystems: Coastal Ecosystems. World Resources Institute, Washington, DC

CNA (2005). Information provided by the Comisión Nacional del Agua (National Water Commission, Mexican government) from their Estadísticas del Agua en México

CRED (2004). The OFDA/CRED International Disaster Database (in GEO Data Portal). Université Catholique de Louvain, Brussels

Den Elzen, M. G. J. and Meinshausen, M. (2005). Meeting the EU 2-C climate target: global and regional emission implications. RIVM report 728007031/2005. The Netherlands Environmental Assessment Agency, Bilthoven

Dilley, M., Chen, R., Deichmann, U., Lerner-Lam, A.L. and Arnold, M. (with Agwe, J., Buy, P., Kjekstad, O., Lyon, B. and Yetman, G.) (2005). Natural Disaster Hotspots: A Global Risk Analysis. Synthesis Report. The World Bank, Washington, DC and Columbia University, New York, NY

Dyurgerov, M.B. and Meier, M.F. (2005). Glaciers and the Changing Earth System: A 2004 Snapshot. INSTAAR, University of Colorado at Boulder, Boulder, CO

EEA (2007). Europe's Environment: the Fourth Assessment. European Environment Agency, Copenhagen

EM-DAT (undated). The International Disaster Database http://www.em-dat.net/ (last accessed 10 July 2007)

Eurostat and IFF (2004). Economy-wide Material Flow Accounts and Indicators of Resource Use for the EU-15: 1970-2001, Series B. Prepared by Weisz, H., Amann, Ch., Eisenmenger, N. and Krausmann, F. Eurostat, Luxembourg

FAO (2000). The Global Forest Resources Assessment 2000 (FRA 2000). Food and Agriculture Organization of the United Nations, Rome

FAO (2001). Conservation Agriculture Case Studies in Latin America and Africa. Soils Bulletin 78. Food and Agriculture Organization of the United Nations, Rome

FAO (2005). Global Forest Resources Assessment 2005 (FRA 2005) database. Food and Agriculture Organization of the United Nations, Rome (in GEO Data Portal)

FAO (2006). The State of Food Insecurity in the World 2006. Food and Agriculture Organization of the United Nations, Rome

FAO (2006a). Global Forest Resources Assessment 2005 – Progress Towards Sustainable Forest Management. Forestry Paper 147. Food and Agriculture Organization of the United Nations, Rome

FAO AQUASTAT (2007). FAO's Information System on Water in Agriculture. Food and Agriculture Organization of the United Nations, Rome (in GEO Data Portal)

FAOSTAT (2006). FAO Statistical Databases. Food and Agriculture Organization of the United Nations, Rome http://faostat.fao.org/faostat/ (last accessed 10 July 2007)

GEO Data Portal. UNEP's online core database with national, sub-regional, regional and global statistics and maps, covering environmental and socio-economic data and indicators. United Nations Environment Programme, Geneva http://www.unep.org/geo/data or http://geodata.grid.unep.ch (last accessed 1 June 2007)

Harrison, P. and Pearce, F. (2001). AAAS Atlas of Population and Environment. American Association for the Advancement of Science. University of California Press, California http://www.ourplanet.com/aaas/pages/about.html (last accessed 27 April 2007)

IEA (2007a). Energy Balances of OECD Countries and Non-OECD Countries 2006 edition. International Energy Agency, Paris (in GEO Data Portal)

INAC (2003). Canadian Arctic Contaminants Assessment Report II. Indian and Northern Affairs Canada, Ottawa

INEGI (2006). II Conteo de población y vivienda. Resultados definitivos, 2005. Instituto Nacional de Geografía Estadística e Informática, Mexico, DF
http://www.inegi.gob.mx/est/default.aspx?c=6789 (last accessed 2 April 2007)

IPCC (2001a). Climate Change 2001: Synthesis Report. Intergovernmental Panel on Climate Change. Cambridge University Press, Cambridge

IPCC (2007). Climate Change 2007: Climate Change Impacts, Adaptation and Vulnerability, Summary for Policymakers. Contribution of Working Group II to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change, Geneva http://www.ipcc.ch/SPM6avr07.pdf (last accessed 27 April 2007)

ITU (2005). ITU Yearbook of Statistics. International Telecommunication Union (in GEO Data Portal).

KASSA (2006). The Latin American Platform. CIRAD, Brussels

Loh, J. and Goldfinger, S. (eds.) (2006). Living planet report 2006. World Wide Fund for Nature, Gland

MA (2005a). Ecosytems and Human Well-being. Synthesis. Island Press, Washington, DC

Meredith, M. (2005).The State of Africa: A history of fifty years of independence. Free Press, London

MOEJ (2005). Japan's Experience in the Promotion of the 3Rs: For the Establishment of a Sound Material-Cycle Society. Global Environment Bureau, Ministry of Environment, Tokyo

MSC-E (2005). Persistent Organic Pollutants in the Environment. EMEP Status Report 3/2005. Meteorological Synthesising Centre-East, Moscow and Chemical Coordinating Centre, Kjeller

Navone, S. and Maggi, A.J. (2005). La Inundación del Año 2001 en el Oeste de la Prov. De Buenos Aires: Potencial Productivo de las Tierras Afectadas y las Consecuencias Sobre la Produción de Granos Para el Periodo 1993-2002. Fundación Hernandarias, Buenos Aires

Shiklomanov, I.A. and UNESCO (1999). World Water Resources: Modern Assessment and Outlook for the 21st Century. Summary of World Water Resources at the Beginning of the 21st Century. Prepared in the framework of IHP-UNESCO

SAUP (2006). Sea Around Us Project.
http://www.seaaroundus.org (last accessed 26 March 2007)

The Economist (2005). Saving Environmentalism and Are you being served. In The Economist 23 April 2005: 75-78

UNDP (2001). Human Development Report 2001. United Nations Development Programme, New York, NY

UNEP (2002b). Vital Water Graphics. Coastal population and shoreline degradation. UNEP/GRID-Arendal Maps and Graphics Library
http://maps.grida.no/go/collection/CollectionID/70ED5480-E824-413F-9B63-A5914EA7CCA1 (last accessed 27 April 2007)

UNEP (2005b). One Planet Many People: Atlas of our Changing Environment. United Nations Environment Programme, Nairobi

UNEP (2006). Iraq Marshlands Observation System. UNEP Division of Early Warning and Assessment/GRID-Europe http://www.grid.unep.ch/activities/sustainable/tigris/mmos.php (last accessed 31 March 2007)

UNEP (2006c). Vital Waste Graphics Update. United Nations Environment Programme, Nairobi and Arendal http://www.vitalgraphics.net/waste2/download/pdf/VWG2_p36and37.pdf (last accessed 10 July 2007)

UNEP (2006f). Sustainable Consumption and Production. How Development Agencies make a difference. Review of Development Agencies and SCP-related projects. DRAFT. UNEP Division of Technology, Industry and Economics, Paris http://www.uneptie.org/pc/sustain/reports/general/Review_Development_Agencies.pdf (last accessed 11 July 2007)

UNEP (2007b). Cleaner Production – Key Elements. UNEP Division of Technology, Industry and Economics, Paris http://www.unep.fr/pc/cp/understanding_cp/home.htm (last accessed on 11 July 2007)

UNEP (2007c). United Nations Guidelines for Consumer Protection: Section G. Promotion of Sustainable Consumption. UNEP Division of Technology, Industry and Economics, Paris
http://www.uneptie.org/pc/sustain/policies/consumser-protection.htm (last accessed 11 July 2007)

UNEP/GRID-Arendal (2002). Vital Water Graphics. An overview of the State of the World's Fresh and Marine Waters. United Nations Environment Programme, Nairobi
http://www.unep.org/vitalwater/ (last accessed 31 March 2007)

UNEP/GCSS.X/8. Proposed Medium-term Strategy 2010–2013. Working document for the tenth special session of the Governing Council/Global Ministerial Environment Forum, Monaco, 20-22 February 2008
http://www.unep.org/gc/gcss-x/working_docs.asp (last accessed 1 October 2009)

UNEP-GIWA (2006a). Challenges to International Waters – Regional Assessments in a Global Perspective. Global International Waters Assessment Final Report. United Nations Environment Programme, Nairobi http://www.giwa.net/publications/finalreport/ (last accessed 31 March 2007)

UNEP, UNDP, OSCE and NATO (2005). Environment and Security: Transforming risks into cooperation – Central Asia Ferghana/ Osh/ Khujand area. United Nations Environment Programme, United Nations Development Porgramme, Organization for Security and Co-operation in Europe and the North Atlantic Treaty Organization, Geneva http://www.osce.org/publications/eea/2005/10/16671_461_en.pdf (last accessed 15 June 2007)

UNEP-WCMC (2006). World Database of Protected Areas. World Conservation Monitoring Centre, UK (in GEO Data Portal)

UNEP-WCMC (2006a). World Database on Protected Areas. www.unep-wcmc.org/wdpa/index.htm (last accessed 8 May 2007)

UNFCCC-CDIAC (2006). Greenhouse Gases Database. United Nations Framework Convention on Climate Change, Carbon Dioxide Information Analysis Centre (in GEO Data Portal)

UNHCR (2006a). Statistical Yearbook 2004 Country Data Sheets: Guinea. United Nations High Commission for Refugees, Geneva

UNPD (2007). World Population Prospects: The 2006 Revision (in GEO Data Portal). UN Population Division, New York, NY http://www.un.org/esa/population/unpop.htm (last accessed 4 June 2007)

UNSD (2007a). Transport Statistical Database (in GEO Data Portal)

WHO (2003). Climate change and human health: risks and responses. Summary. World Health Organization, Geneva http://www.who.int/globalchange/climate/en/ccSCREEN.pdf (last accessed 11 July 2007)

WHO (2005). Ecosystems and Human Well-being: Health Synthesis. Millennium Ecosystem Assessment. World Resources Institute, Washington, DC

WHO and UNICEF (2006). Joint Monitoring Programme for Water Supply and Sanitation (in GEO Data Portal). World Health Organization, Geneva and United Nations Children's Fund, New York, NY

WMO and UNEP (2006). Executive Summary of the Scientific Assessment of Ozone Depletion: 2006. Scientific Assessment Panel of the Montreal Protocol on Substances that Deplete the Ozone Layer, Geneva and Nairobi http://ozone.unep.org/Publications/Assessment_Reports/2006/Scientific_Assessment_2006_Exec_Summary.pdf (last accessed 14 April 2007)

World Bank (2006). Measuring Coral Reef Ecosystem Health: Integrating Social Dimensions. World Bank Report No. 36623 –GLB. The World Bank, Washington, DC

World Bank (2006b). Where is the Wealth of Nations? Measuring Capital for the 21st Century. The World Bank, Washington, DC

WRI (2002). Drylands, People, and Ecosystem Goods and Services: A Web-based Geospatial Analysis. World Resources Institute. http://www.wri.org (last accessed 27 April 2007)

WWF (2006). Conservation Status of Terrestrial Ecoregions. World Wide Fund for Nature, Gland http://www.panda.org/about_wwf/where_we_work/ecoregions/ maps/index.cfm (last accessed 8 May 2007)

WWF (2006a). Living Planet Report. World Wide Fund for Nature, Gland http://assets.panda.org/downloads/living_planet_report.pdf (last accessed 4 June 2007)

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ISBN - 978-92-807-2974-0