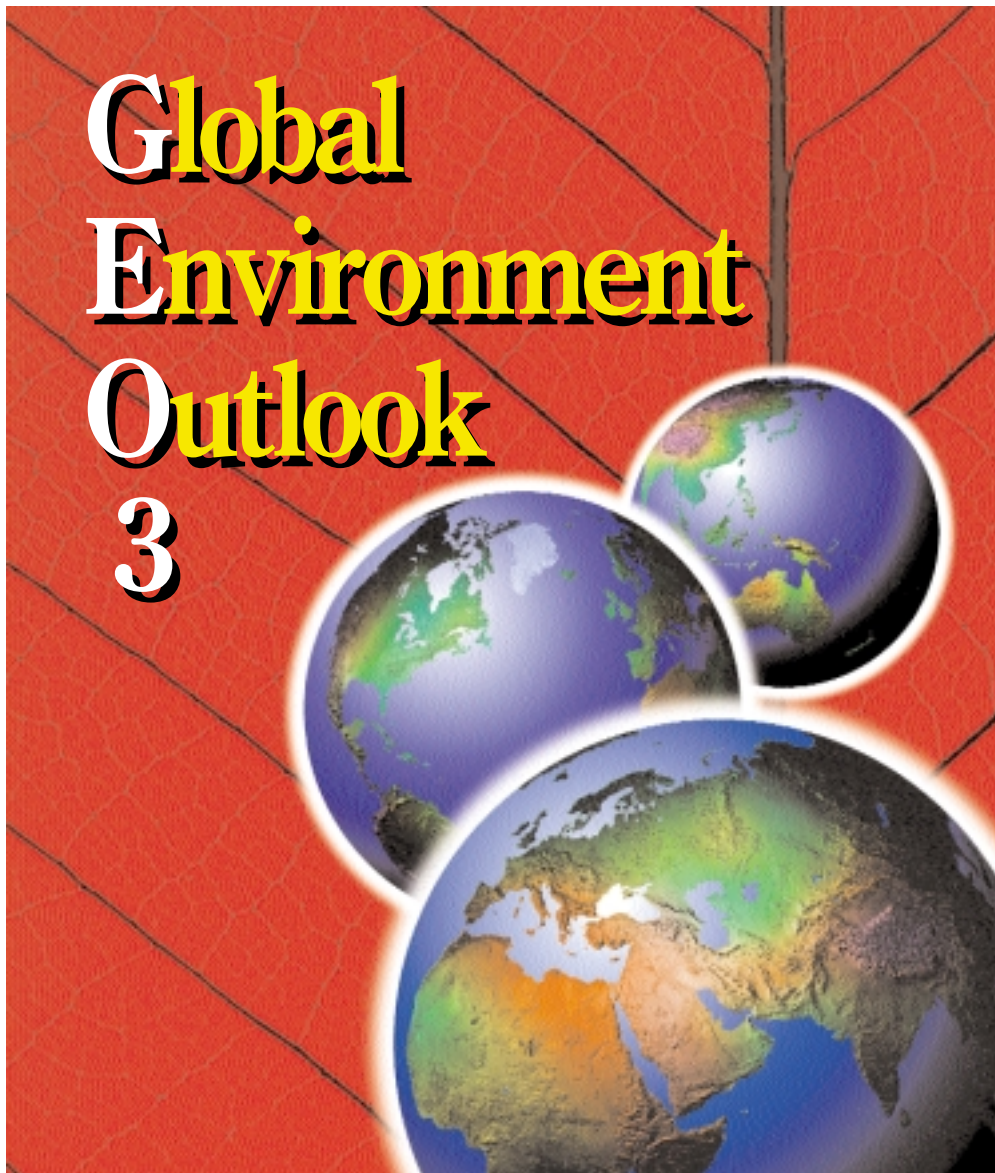


# SYNTHESIS GEO-3

## Global Environment Outlook 3



*Past, present and future perspectives*



EARTHSCAN



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Produced by the UNEP GEO team

Division of Early Warning and Assessment (DEWA)  
United Nations Environment Programme  
P. O. Box 30552  
Nairobi, Kenya

Tel: +254 2 623562  
Fax: +254 2 623943/44  
E-mail: [geo@unep.org](mailto:geo@unep.org)  
Web site: <http://www.unep.org>

Design and production: [bounford.com](http://bounford.com)

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## Synthesis

The year 1972 stands as a watershed in modern environmentalism. The first international conference on the environment — the United Nations Conference on the Human Environment — was convened in Stockholm in that year, bringing together 113 nations and other stakeholders to discuss issues of common concern. In the 30 years since then, the world has made great strides in placing the environment on the agenda at various levels — from international to local. Phrases such as ‘think global and act local’ have galvanized action at many different levels. The result has been a proliferation of environmental policies, new legislative regimes and institutions, perhaps an unspoken acknowledgement that the environment is too complex for humanity to address adequately in every sense.

Decisions made since Stockholm now influence governance, business and economic activity at different levels, define international environmental law and its application in different countries, determine international and bilateral relations among different countries and regions, and influence individual and society lifestyle choices.

But there are problems: some things have not progressed, for example, the environment is still at the periphery of socio-economic development. Poverty and excessive consumption — the twin evils of humankind that were highlighted in the previous two GEO reports — continue to put enormous pressure on the environment. The unfortunate result is that sustainable development remains largely theoretical for the majority of the world’s population of more than 6 000 million people. The level of awareness and action has not been commensurate with the state of the global environment today; it continues to deteriorate.

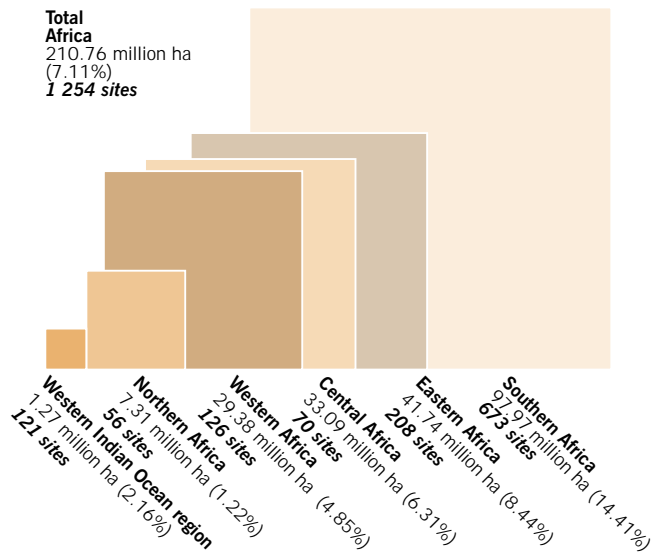
*GEO-3* provides an overview of the main environmental developments over the past three decades, and how social, economic and other factors have contributed to the changes that have occurred.

## State of the environment and policy responses, 1972–2002

### Land

Since 1972, the main driving force leading to pressure on land resources has been increasing food production. In 2002, food is needed for some 2 220 million more people than in 1972. The trend during the decade 1985–95 showed population growth racing ahead of food production in many parts of the world. While irrigation has made an

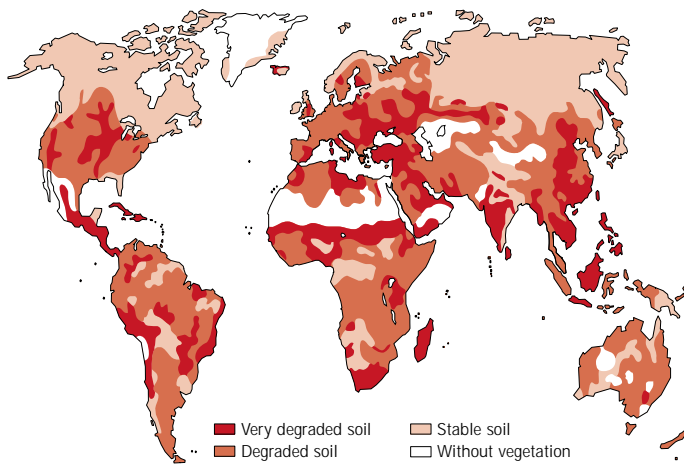
### Protected areas: Africa



### Regional highlights: Africa

The increasing numbers of African countries facing water stress and scarcity, and land degradation, are major environmental issues in the region. The rising costs of water treatment, food imports, medical treatment and soil conservation measures are not only increasing human vulnerability and health insecurity but are also draining African countries of their economic resources. The expansion of agriculture into marginal areas and clearance of natural habitats such as forests and wetlands has been a major driving force behind land degradation. The loss of biological resources translates into loss of economic potential and options for commercial development in the future. These negative changes, however, have been tempered by Africa's impressive wildlife conservation record, including a well-established network of protected areas and the region's commitment to multilateral environmental agreements. African countries also participate in many regional and sub-regional initiatives and programmes. Notable achievements include the 1968 African Convention on the Conservation of Nature and Natural Resources (currently being updated) and the 1991 Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Waste within Africa.

Note: number of protected areas includes those in IUCN categories I-VI Source: compiled from UNEP-WCMC 2001b



Map shows the location of degraded soils in the world

Source: UNEP 1992 and GRID Arendal 2001

land issues was reiterated in the review prepared for the UN Millennium Summit. This review identifies the threats to future global food security arising from problems of land resources.

### Forests

Deforestation over the past 30 years has been the continuation of a process with a long history. By the time of the Stockholm Conference, much forest cover had already been removed. Major direct causes of forest clearance and degradation include expansion of agricultural land, overharvesting of industrial wood, fuelwood and other forest products, and overgrazing. Underlying drivers include poverty, population growth, markets and trade in forest products, as well as macroeconomic policies. Forests are also damaged by natural factors such as insect pests, diseases, fire and extreme climatic events.

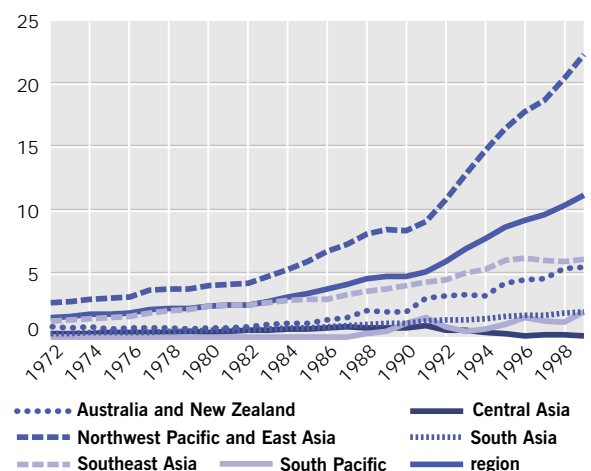
The net loss in global forest area during the 1990s was about 94 million ha (equivalent to 2.4 per cent of total forests). This was the combined effect of a deforestation rate of 14.6 million ha annually and a rate of reforestation of 5.2 million ha annually. Deforestation of tropical forests is almost 1 per cent annually. In the 1990s, almost 70 per cent of deforested areas were changed to agricultural land, predominantly under permanent rather than shifting systems. A recent study using globally comprehensive and consistent satellite data estimated that the extent of the world's remaining closed natural forests (where crown cover is more than 40 per cent) in 1995 was

important contribution to agricultural production, inefficient irrigation schemes can cause waterlogging, salinization and alkalization of soils. In the 1980s, it was estimated that about 10 million ha of irrigated land were being abandoned annually. Human activities contributing to land degradation include unsuitable agricultural land use, poor soil and water management practices, deforestation, removal of natural vegetation, frequent use of heavy machinery, overgrazing, improper crop rotation and poor irrigation practices. The 1992 Earth Summit took a step forward in focusing attention on problems associated with land resources. National needs at times linked with *Agenda 21* have provided a basis for land resources policy, and the importance of

### Regional highlights: Asia and the Pacific

Overpopulation, poverty and lack of enforcement of policy measures have compounded environmental problems in many parts of the region. Biological resources have long been of subsistence importance, and have been increasingly exploited for trade. About three-quarters of known or suspected species extinctions have occurred on isolated islands in the region. Protected areas constitute only 5 per cent of the total area, compared to the IUCN benchmark of 10 per cent. Discharge of sewage and other wastes has heavily polluted freshwater. Sedimentation in rivers and reservoirs caused by large-scale deforestation has also resulted in big economic losses. Urbanization, industrialization and tourism, coupled with a growing coastal population, have degraded many coastal areas. More than 60 per cent of Asia's mangroves have been converted to aquaculture farms. Air pollution levels in some cities are among the highest in the world. While most environmental trends have been negative, positive changes have included improvement in governance by public authorities, growing environmental awareness and public participation, and increasing environmental awareness in industry.

### Annual aquaculture production per capita (kg)



Source: compiled from Fishstat 2001 and United Nations Population Division 2001

2 870 million ha, about 21.4 per cent of the land area of the world.

The Stockholm Conference recognized forests as the largest, most complex and self-perpetuating of all ecosystems, and emphasized the need for sound land and forest use policies, ongoing monitoring of the state of the world's forests and the introduction of forest management planning. Today, the Stockholm Conference recommendations relating to forests remain valid and unfulfilled, in many ways, because of conflicting interests in managing forests for environmental conservation and economic development.



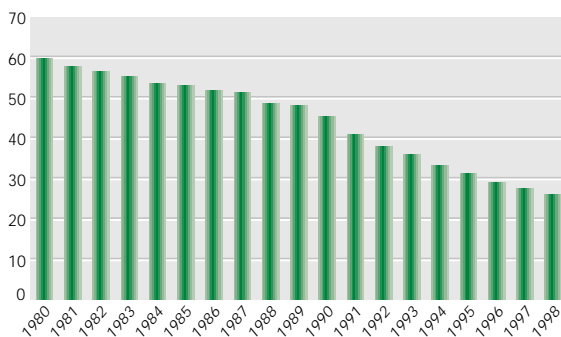
Forest fires in Australia, Brazil, Ethiopia, Indonesia (photo), the eastern Mediterranean, Mexico and western United States have raised concern about wildfires, catalysed national policy responses and mobilized initiatives for fire prevention and suppression

Source: UNEP, Paulus Suwito, Topham Picturepoint

## Biodiversity

Global biodiversity is being lost at a rate many times higher than that of natural extinction due to land conversion, climate change, pollution, unsustainable harvesting of natural resources and the introduction of exotic species. Land conversion is most intensive in tropical forests and less intensive in temperate, boreal and arctic regions; atmospheric nitrogen deposition is largest in northern temperate areas close to cities; introduction of exotic species is related to patterns of human activity. Human population growth together with unsustainable patterns of consumption, increasing production of waste and pollutants, urban development and international conflict are further contributory factors to biodiversity loss. Over the past three decades, decline and extinction of species have emerged as major environmental issues. Although insufficient information is available to determine precisely how many species have become extinct in the past three decades, about 24 per cent (1 130) of mammals and 12 per cent (1 183) of bird species are currently regarded as globally threatened.

### SO<sub>2</sub> emissions in EMEP countries (million tonnes/year)



Over the period 1980–98, SO<sub>2</sub> emissions in countries that are members of the Co-operative Programme for Monitoring and Evaluation of the Long-Range Transmission of Air Pollutants in Europe (EMEP) have been reduced by 56 per cent

Source: Vestreng and Støren 2000

### Regional highlights: Europe

The environmental situation is mixed: there have been some noticeable improvements over the past 30 years (for example, emissions to air); the state of biodiversity and forests has not changed greatly; and other situations have undergone marked degradation (freshwater, and some coastal and marine areas). By the 1990s, the European atmosphere had generally improved significantly. Increasing efforts to safeguard natural areas and biodiversity may signal a turnaround in species protection. Freshwater stocks are unevenly distributed, with parts of southern, western and southeastern Europe being noticeably water stressed. The health of coastal and marine areas has noticeably worsened, particularly in southern and western Europe and the Mediterranean coastline. Geographically, there has been an amelioration of some environmental problems in Western Europe, and a common (but far from universal) deterioration in Central and Eastern Europe, with recent signs of a broad recovery in many countries. The development of strong environmental policies in the European Union promises continuing progress in the area.

### Globally threatened vertebrate species by region

	Mammals	Birds	Reptiles	Amphibians	Fishes	Total
Africa	294	217	47	17	148	723
Asia and the Pacific	526	523	106	67	247	1 469
Europe	82	54	31	10	83	260
Latin America and Caribbean	275	361	77	28	132	873
North America	51	50	27	24	117	269
West Asia	0	24	30	8	9	71
Polar	0	6	7	0	1	14

Note: 'Threatened species' include those categorized by IUCN in 2000 as Critically Endangered, Endangered and Vulnerable (Hilton-Taylor 2000); adding totals for each region does not give a global total because a species may be threatened in more than one region

Source: compiled from the IUCN Red List database (Hilton-Taylor 2000) and the UNEP-WCMC species database (UNEP-WCMC 2001a)

The past three decades have been marked by the emergence of a concerted response to the biodiversity crisis. Civil society, including a hugely diverse and increasingly sophisticated NGO network, has been a major driving force behind this. Increased stakeholder participation relating to conservation action has seen the emergence of partnerships between NGOs, governments and the private sector. A number of international conventions have been developed that deal specifically with conservation of threatened species. These include the 1973 Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) and the 1979 Convention on the Conservation of Migratory Species of Wild Animals (CMS). A major policy response of the 1990s is the adoption, ratification and implementation of the Convention on Biological Diversity (CBD).

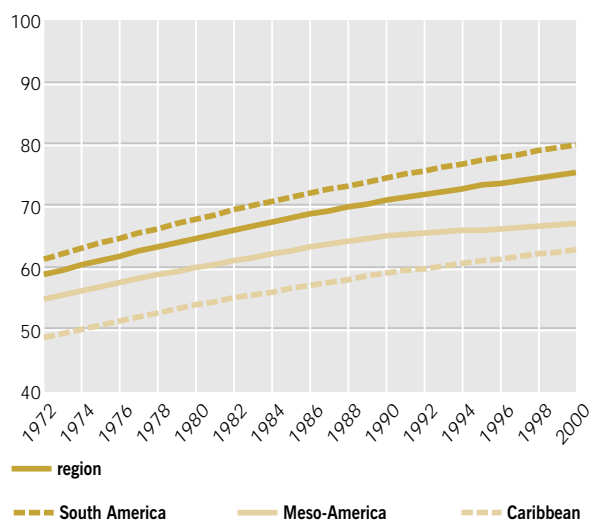
### Freshwater

About one-third of the world's population lives in countries suffering from moderate-to-high water stress — where water consumption is more than 10 per cent of renewable freshwater resources. Some 80 countries, constituting 40 per cent of the world's population, were suffering from serious water shortages by the mid-1990s. Increasing water demand has been caused by population growth, industrial development and the expansion of irrigated agriculture. For many of the world's poorer populations, one of the greatest environmental threats to health remains the continued use of untreated water. While the percentage of people served with improved water

### Regional highlights: Latin America and the Caribbean

Environmental degradation in Latin America and the Caribbean has increased over the past 30 years. The main pressures on the environment and natural resources are the rising population, increasing inequality of incomes, limited planning, especially in urban areas, and the high dependence of many economies on natural resources exploitation. More than 300 million ha of land have been degraded and almost 30 per cent of the reefs in the Caribbean are considered to be at risk. Of the more than 400 million ha of natural forest lost worldwide over the past 30 years, more than 40 per cent was in the region. Urban environmental problems, especially air pollution, water contamination and inadequate waste disposal, are having severe health impacts on people living in cities, currently 75 per cent of the population. The increasing frequency and intensity of natural disasters, possibly linked to climate change, is having a high human and financial cost. The poorest populations, especially urban ones, are the most vulnerable to such disasters.

### Urban population (percentage of total): Latin America and the Caribbean



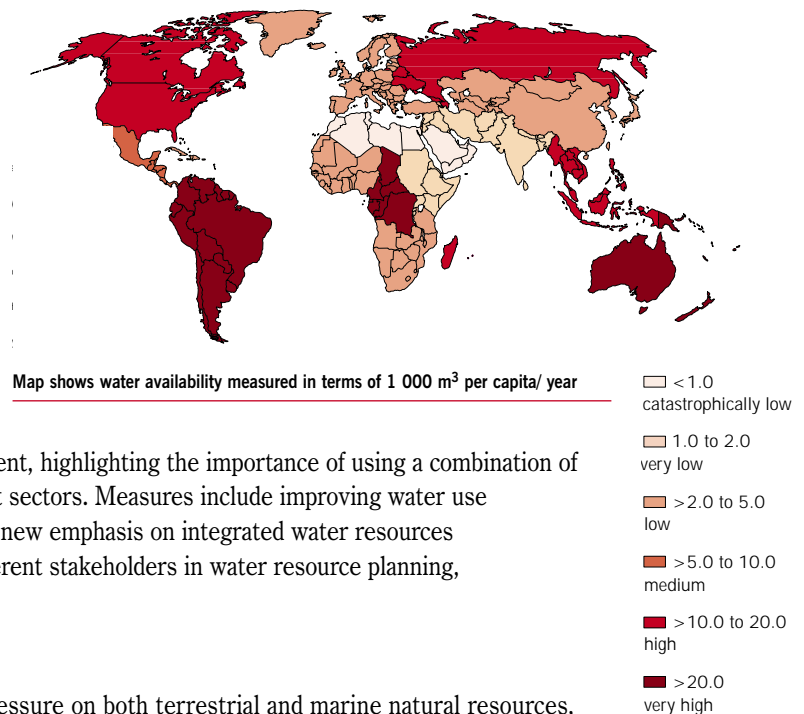
Graph shows the high levels of urbanization in the region

Source: compiled from United Nations Population Division 2001

supplies increased from 79 per cent (4.1 billion) in 1990 to 82 per cent (4.9 billion) in 2000, 1.1 billion people still lack access to safe drinking water and 2.4 billion lack access to adequate sanitation. Most of these people are in Africa and Asia. Lack of access to safe water supply and sanitation results in hundreds of millions of cases of water-related diseases, and more than 5 million deaths, every year. Large, but poorly quantified adverse impacts on economic productivity have been noted in many developing countries. Emphasis on water supply, coupled with weak enforcement of regulations, has limited the effectiveness of water resource management, particularly in developing regions. Policy makers have now shifted from supply to demand management, highlighting the importance of using a combination of measures to ensure adequate supplies of water for different sectors. Measures include improving water use efficiency, pricing policies and privatization. There is also a new emphasis on integrated water resources management (IWRM), which takes into account all the different stakeholders in water resource planning, development and management.

### Coastal and marine areas

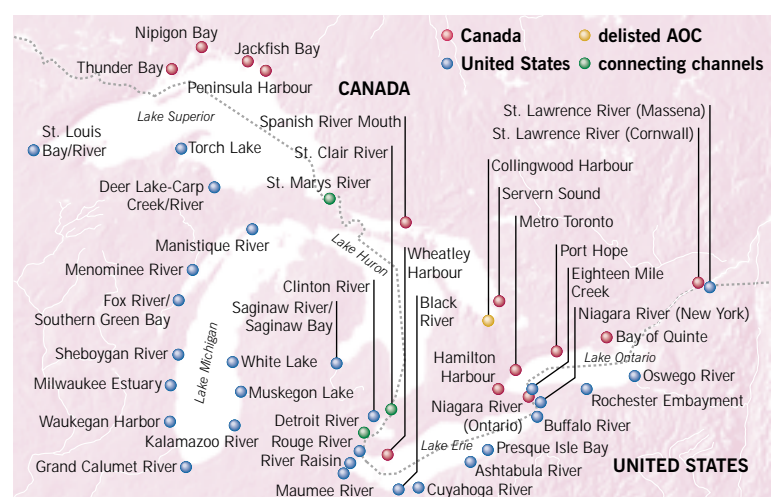
Marine and coastal degradation is caused by increasing pressure on both terrestrial and marine natural resources, and on the use of the oceans to deposit wastes. Population growth and increasing urbanization, industrialization and tourism in coastal areas are root causes of this increased pressure. In 1994, an estimated 37 per cent of the global population lived within 60 km of the coast — more people than inhabited the planet in 1950. The effects of population are multiplied by both poverty and human consumption patterns. Globally, sewage remains the largest



### Regional highlights: North America

North America is a major consumer of the world's natural resources and producer of its wastes, and its per capita impact on the global environment is larger than that of any other region. Resource conservation in North America has been less successful than pollution abatement, and per capita consumption has increased steadily since 1972. There has been significant progress in controlling some forms of air and water pollution and in continuing a trend to set aside protected areas. During the 1990s, North American free trade strengthened the economic ties between Canada and the United States. At the same time, regional environmental degradation led to an increased recognition of the interdependent nature of cross-border ecosystems. The two countries strengthened cooperative measures to address transboundary pollution, agreeing to more aggressive NO<sub>x</sub> emission controls, for example. They also undertook to conserve the continent's wetland habitats to protect waterfowl and other migratory species. The impact of introduced exotic species on biological diversity became of increasing environmental concern with the liberalization of trade.

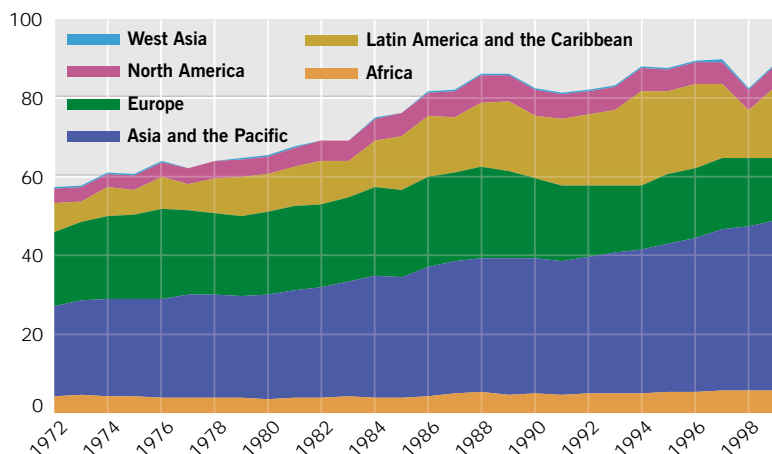
### Areas of concern (AOC) in the Great Lakes



In 1987, Remedial Action Plans were developed to clean up 43 areas of concern in the Great Lakes basin in both Canada and the United States

Source: EC 2000

## Annual fish, mollusc and crustacean catch (million tonnes) by region



Global fish, mollusc and crustacean catch seems to have stabilized at around 90 million tonnes; note Latin American variations due to fluctuations in the Peruvian anchovy fishery.

Source: compiled from Fishstat 2001 and United Nations Population Division 2001

source of contamination, by volume, of the marine and coastal environment, and coastal sewage discharges have increased dramatically in the past three decades.

Marine and coastal eutrophication from elevated nitrogen inputs has emerged as a worrying trend not foreseen three decades ago. There is increasing evidence that blooms of toxic or otherwise undesirable phytoplankton are increasing in frequency, intensity and geographic distribution. Severe eutrophication has occurred in several enclosed or semi-enclosed seas, including the Black Sea. Human-induced changes in the natural flow of sediment have emerged since the Stockholm Conference as a major threat to coastal habitats. Urban and industrial development drives the construction of residential and industrial infrastructure which, depending on its nature, can alter sediment flow.

There is particular concern about the possible effects of global warming on coral reefs. During the intense El Niño of 1997-98, extensive coral bleaching occurred on coral reefs worldwide. While some reefs

quickly recovered, others, particularly in the Indian Ocean, Southeast Asia, the far western Pacific and the Caribbean, suffered significant mortality, in some cases more than 90 per cent.

Progress in protecting the marine and coastal environment over the past 30 years has generally been confined to relatively few, mostly developed countries, and to a relatively few environmental issues. Overall, coastal and marine environmental degradation not only continues but has intensified.

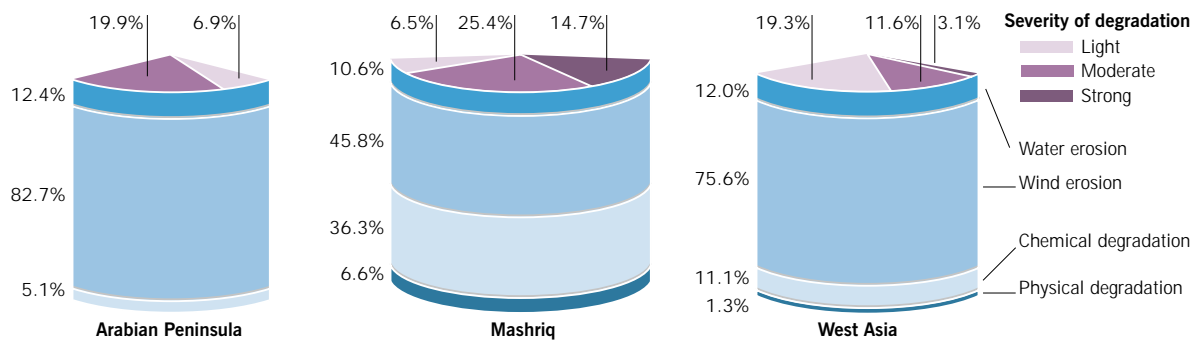
## Regional highlights: West Asia

Conservation and protection of freshwater resources is a top priority, particularly on the Arabian Peninsula where water deficits are being met mainly through exploitation of groundwater resources. Countries are developing water policies to manage water scarcity by increasing both water supply and conservation, and introducing more efficient irrigation. Land degradation and food security continue to be key environmental issues. The region's seas include some of the busiest shipping areas of the world, making the marine environment susceptible to pollution events such as oil spills. Per capita hazardous waste production is among the highest in the world due to the types of industry in the region. Air emissions from power stations, desalination plants and industrial installations are also of concern.

## Land degradation in West Asia: severity and causes (%)

Charts show the severity (percentage of total land area) and the causes (percentage of total degradation) for the region and the two sub-regions. Note the prevalence of wind erosion

Source: compiled from Marcoux 1996



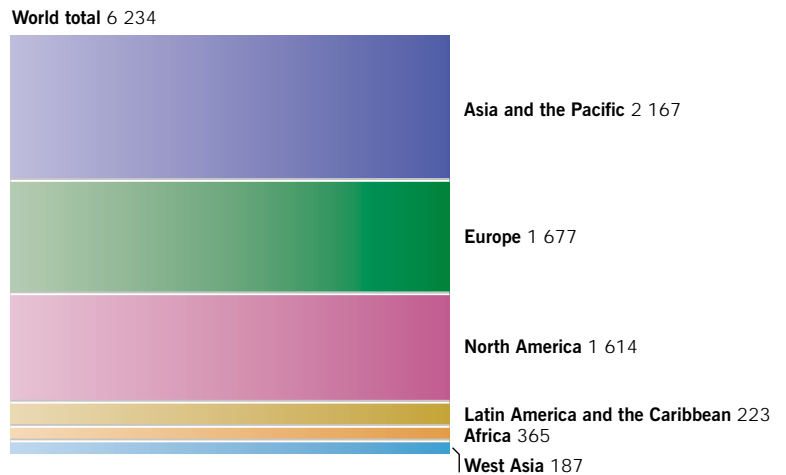


## Atmosphere

Acid precipitation has been one of the most prominent environmental concerns over the past decades, especially in Europe and North America, and more recently also in China. Thousands of lakes in Scandinavia lost fish populations due to acidification from the 1950s to the 1980s. Significant damage to forests in Europe became a high priority environmental issue around 1980. Air pollutant emissions have declined or stabilized in most industrialized countries, largely as a result of abatement policies developed and implemented since the 1970s. Initially, governments tried to apply direct control instruments but these were not always cost-effective. In the 1980s, policies were directed more towards pollution abatement mechanisms that relied on a compromise between the cost of environmental protection measures and economic growth. Stricter environmental regulation in industrialized countries has triggered the introduction of cleaner technology and technological improvements, especially in the power generation and transport sectors.

Since the industrial revolution, the concentration of CO<sub>2</sub>, one of the major greenhouse gases, in the atmosphere has increased significantly, contributing to the greenhouse effect known as 'global warming'. The increase is largely due to anthropogenic emissions of CO<sub>2</sub> from fossil fuel combustion and to a lesser extent land-

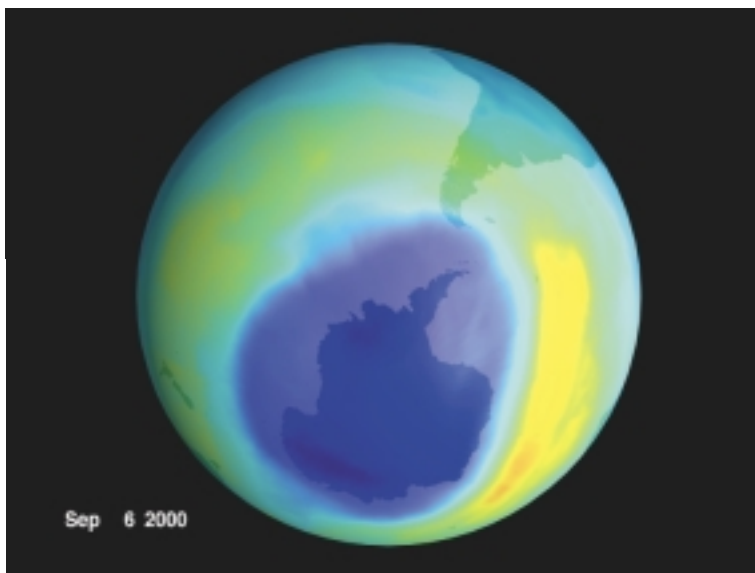
### Carbon dioxide emissions by region, 1998 (million tonnes carbon/year)



Anthropogenic greenhouse gas emissions are unevenly distributed between regions — most emissions come from industrialized regions. Figures include emissions from fuel consumption, gas flaring and cement production

Source: compiled from Marland, Boden and Andres 2001

### The Antarctic ozone hole breaks a new record



The ozone hole reached a record size in September 2000 — 28.3 million km<sup>2</sup>, three times the size of the United States. Dark blue areas denote high levels of ozone depletion

Source: NASA 2001

### Regional highlights: the Polar Regions

The major environmental issues in the polar regions include the depletion of the stratospheric ozone layer, the long-range transport of air pollutants, warming associated with global climate change, the decline of several bird, mammal and fish species, and pollution of major rivers. In the Arctic, average yearly ozone levels in the 1990s had declined by 10 per cent from the late 1970s, increasing the risk of snow blindness and sunburn. Climate change is expected to be more extreme in the polar regions than anywhere else. Human activities are major threats to biodiversity in the Arctic. The warming trend is reducing the ice habitat for species such as the polar bear and walrus. In the Antarctic, sealing and whaling have reduced populations in the Southern Ocean. Eutrophication is a recent problem in several lakes in Scandinavia. One of the major developments in the Arctic is public opposition to dam construction, particularly in the Nordic countries. For example, in 2001 Iceland's National Planning Agency rejected plans for a hydroelectric power project that would have dammed two of the three main rivers flowing from Europe's largest glacier and destroyed an extensive wilderness.

use change, cement production and biomass combustion. Greenhouse gas emissions are unevenly distributed between countries and regions. Organization for Economic Cooperation and Development (OECD) countries contributed more than half of CO<sub>2</sub> emissions in 1998, with a per capita emission of about three times the world average. However, the OECD's share of global CO<sub>2</sub> emissions has decreased by 11 per cent since 1973. Climate change represents an important additional stress on those ecosystems already affected by increasing resource demands, unsustainable management practices and pollution. The United Nations Framework Convention on Climate Change and the Kyoto Protocol are the key policy instruments adopted by the international community to try to address the problem of greenhouse gases emissions.

The protection of the ozone layer has presented one of the major challenges over the past 30 years, spanning the fields of environment, trade, industry, international cooperation and sustainable development. The depletion of the ozone layer has now reached record levels, especially in the Antarctic and recently also in the Arctic. In September 2000, the Antarctic ozone hole covered more than 28 million km<sup>3</sup>. Continuous efforts by the international community have resulted in a marked decrease in the consumption of ozone-depleting substances. The ozone layer is predicted to start recovering in the next one or two decades and to return to pre-1980 levels by the middle of the 21st century— if the control measures of the protocols to the Vienna Convention are adhered to by all countries.

### Urban areas

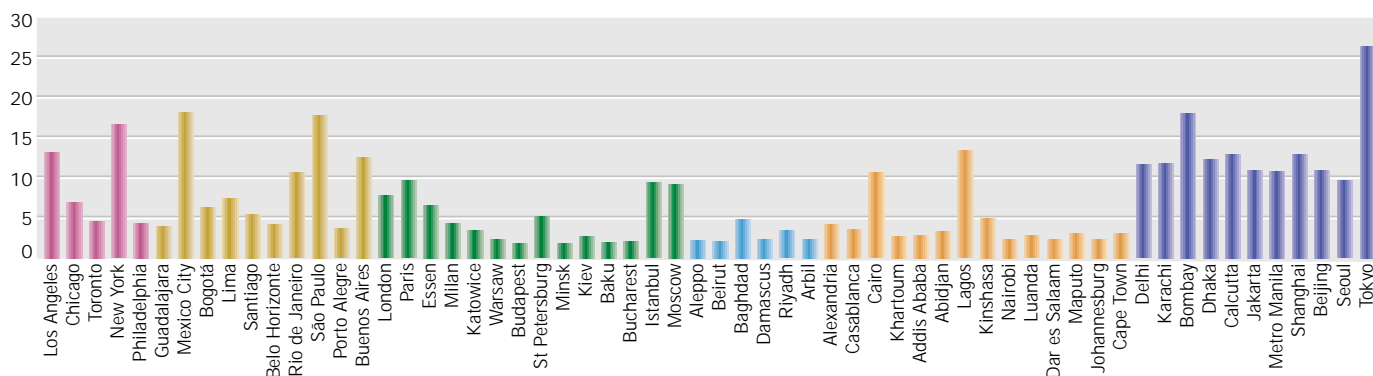
About half of the world's population (47 per cent) now lives in urban areas, compared to little more than one-third in 1972. The accumulation of people, their consumption patterns, travel behaviour and their urban economic activities impact the environment in terms of resource consumption and waste discharges. Some 70 per cent of the world's urban population live in Africa, Asia or Latin America. The urban population is expected to grow by 2 per cent per year during 2000–15, and to reach an overall 65 per cent by 2050.

The implications of rapid urban growth include increasing unemployment and poverty, inadequate urban services, overburdening of existing infrastructure, lack of access to land, finance and adequate shelter, and environmental degradation. Managing the urban environment sustainably will therefore become one of the major challenges for the future.

Poverty is among the major drivers of urban environmental degradation. The urban poor, who are unable to compete for scarce resources or protect themselves from harmful environmental conditions, are most affected by the negative impacts of urbanization. It is estimated that one-quarter of the urban population lives below the poverty line and that female-headed households are disproportionately affected.

Inadequate waste collection and waste management systems are the cause of serious urban pollution and health hazards, especially in cities in developing countries. Cities in industrialized countries also face the consequences of past environmentally damaging production techniques and inadequate waste disposal. Well-planned, densely populated settlements can reduce the need for land conversion, provide opportunities for energy savings and make recycling more cost-effective.

Population (in millions) of some of the largest cities in the world, by region



## Disasters

People and the environment are suffering increasingly from the effects of natural disasters due to high population growth and density, migration and unplanned urbanization, environmental degradation and possibly global climate change. The number of people affected by disasters rose from an average of 147 million a year in the 1980s to 211 million a year in the 1990s. While the number of geophysical disasters has remained fairly steady, the number of hydrometeorological disasters (such as droughts, windstorms and floods) has increased. In the 1990s, more than 90 per cent of those killed in natural disasters lost their lives in hydrometeorological events. While floods accounted for more than two-thirds of people affected by natural disasters, they are less deadly than many other types of disaster, accounting for only 15 per cent of deaths. The most expensive disasters in purely economic terms are floods, earthquakes and windstorms but events such as drought and famine can be more devastating in human terms. While earthquakes accounted for 30 per cent of estimated damage, they caused just 9 per cent of all fatalities due to natural disasters. In contrast, famine killed 42 per cent but accounted for just 4 per cent of economic damage over the past decade. Among the least developed countries, 24 of the 49 face high levels of disaster risk; at least six of them have been affected by between two and eight major disasters per year in the past 15 years, with long-term consequences for human development. Since 1991, more than half of all the disasters reported occurred in countries with medium levels of human development. However, two-thirds of those killed came from countries with low levels of human development, while just 2 per cent came from highly developed countries.

Some experts link the recent trend in extreme weather events to an increase of the global mean temperature. Many parts of the world have suffered major heat waves, floods, droughts and other extreme weather events. A number of major accidents involving chemicals and radioactive materials have drawn attention worldwide to the dangers of mismanagement, particularly in the transport, chemical and nuclear power sectors. These events often have impacts that transcend national boundaries; they also emphasize the fact that issues of technological safety concern more than just the developed countries.

## Conclusions

There has been immense change in both human and environmental conditions over the past 30 years. In an unprecedented period of population increase, the environment has been heavily drawn upon to meet a multiplicity of human needs. In many areas, the state of the environment is much more fragile and degraded than it was in 1972. The result is that the world can now be categorized by four major divides:

- **The Environmental Divide** — characterized by a stable or improved environment in some regions, for example Europe and North America, and a degraded environment in the other regions, mostly the developing countries;
- **The Policy Divide** — characterized by two distinct dimensions involving policy development and implementation with some regions having strength in both and others still struggling in both areas;
- **The Vulnerability Gap** — which is widening within society, between countries and across regions with the disadvantaged more at risk to environmental change and disasters; and
- **The Lifestyle Divide** — partly a result of growing poverty and of affluence. One side of the lifestyle divide is characterized by excesses of consumption by the minority one-fifth of the world population, which is responsible for close to 90 per cent of total personal consumption; the other side by extreme poverty where 1.2 billion live on less than US\$1 per day.

The four gaps are a serious threat to sustainable development.

## Human vulnerability to environmental change

### Vulnerable groups

Everyone is vulnerable to environmental impacts of some kind but the ability of people and societies to adapt to and cope with change is very varied. People in developing countries, particularly the least developed, have less capacity to adapt to change and are more vulnerable to environmental threats and global change, just as they are more vulnerable to other stresses. Poverty is generally recognized as one of the most important causes of vulnerability to environmental threats, on the basis that the poor tend to have much lower coping capacities, and therefore they bear a disproportionate burden of the impact of disasters, conflict, drought, desertification and pollution. But poverty is not the only reason.

### Vulnerable places

Human exposure to environmental threats is unevenly distributed. Some locations, such as high latitudes, floodplains, river banks, small islands and coastal areas, pose more risk than others. Of the projected 1 billion new urban dwellers by 2010, most will probably be absorbed by cities in developing countries that already face multiple problems such as shortages of adequate housing, infrastructure, potable water supplies, adequate sanitation and transportation systems as well as environmental pollution.

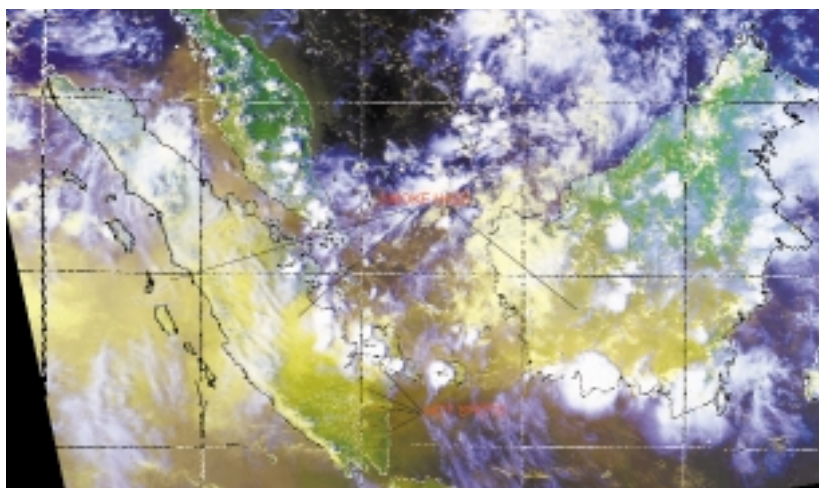
### Environmental change

Degradation of natural resources such as land, fresh and marine waters, forests and biodiversity threatens the livelihood of many people but especially the poor. The 'sink' function of the environment operates through such processes as nutrient recycling, decomposition, and the natural purification and filtering of air and water. When these functions are impaired or overburdened, health can be jeopardized by contaminated water supplies including groundwater, and by urban air pollution and agrochemical pollution. Human health is increasingly determined by environmental conditions. For example:

- Deteriorating environmental conditions are a major contributory factor to poor health and a reduced quality of life.
- Poor environmental quality is directly responsible for some 25 per cent of all preventable ill-health, with diarrhoeal diseases and acute respiratory infections heading the list.
- Air pollution is a major contributor to a number of diseases.
- Globally, 7 per cent of all deaths and diseases are due to inadequate or unsafe water, sanitation and hygiene. Approximately 5 per cent are attributable to air pollution.

Satellite image shows extensive smoke haze over Indonesia and neighbouring areas on 20 October 1997. Hot spots are probable areas of forest fires. Smoke haze had severe effects on the health of people over a wide area of Southeast Asia

Source: Meteorological Service of Singapore 2002



## Responding to human vulnerability

The cumulative evidence for increasing human vulnerability to environmental change calls for a significant policy response and action on several fronts. Governments need to assess and map national threats due to environmental change, particularly those that may be growing, and to institute early warning, mitigation and response measures to reduce the human and economic costs of disasters that are in part avoidable.

### *Reducing vulnerability*

There is a large and widening vulnerability gap between well-off people, with better all-round coping capacity, who are becoming gradually less vulnerable, and the poor who grow increasingly so. It is vital to the sustainable development effort that this gap is addressed, as well as vulnerability itself. For the most significant improvements, priority should go to policies that reduce the vulnerability of the poor as part of general strategies for poverty reduction.

### *Adapting to threat*

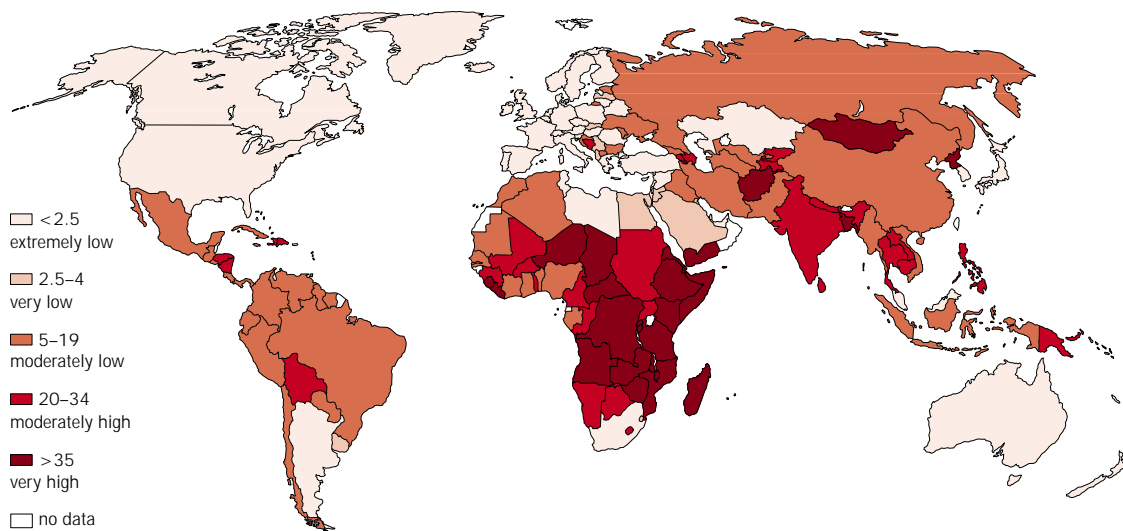
Where a threat cannot be reduced or eliminated, adapting to it can be an effective response. Adaptation refers both to physical adjustments or technical measures (such as constructing a higher sea wall) and to changing behaviour, economic activities and social organization to be more compatible with existing or emerging conditions or threats. The latter requires adaptive capacity, including the ability to develop new options and to deliver them to vulnerable populations.

### *Early warning*

One of the most effective responses to human vulnerability to environmental change is to strengthen mechanisms for early warning. Many actions can be taken to protect life and property if warning is received in time. While some threats are inherently unpredictable, many of those arising from environmental degradation and mismanagement, and from human activities, can now be anticipated with some precision.

## Assessing and measuring vulnerability

Vulnerability assessment measures the seriousness of potential threats on the basis of known hazards and the level of vulnerability of societies and individuals. It can be used to translate early warning information into preventive action and is a necessary element in early warning and emergency preparedness. Assessments of vulnerability can be made for both people and the environmental systems that provide goods and services. They should identify the location of vulnerable populations, the threats to their well-being and the extent of their vulnerability, the risks to the environmental capacity to provide goods and services, and the preventive steps that can be taken to improve environmental conditions and reduce the negative impacts of human action on the environment.



Vulnerability to hunger is reflected in this map of the global state of undernourishment. Undernourished people are unable to obtain the food they need from production or imports, either because it is not available or because they cannot afford it

Source: FAO 2000

## Outlook 2002–2032

*GEO-3* emphasizes that the next 30 years will be as crucial as the past 30 for shaping the future of the environment. Old troubles will persist and fresh challenges will emerge as increasingly heavy demands are placed upon resources that, in many cases, are already in a fragile state. The increasing pace of change and degree of interaction between regions and issues has made it more difficult than ever to look into the future with confidence. *GEO-3* uses four scenarios to explore what the future could be, depending on different policy approaches. The scenarios, which span developments in many overlapping areas, including population, economics, technology and governance, are described in the boxes that follow. They are:



### Markets First

Most of the world adopts the values and expectations prevailing in today's industrialized countries. The wealth of nations and the optimal play of market forces dominate social and political agendas. Trust is placed in further globalization and liberalization to enhance corporate wealth, create new enterprises and livelihoods, and so help people and communities to afford to insure against — or pay to fix — social and environmental problems. Ethical investors, together with citizen and consumer groups, try to exercise growing corrective influence but are undermined by economic imperatives. The powers of state officials, planners and lawmakers to regulate society, economy and the environment continue to be overwhelmed by expanding demands.



### Policy First

Decisive initiatives are taken by governments in an attempt to reach specific social and environmental goals. A coordinated pro-environment and anti-poverty drive balances the momentum for economic development at any cost. Environmental and social costs and gains are factored into policy measures, regulatory frameworks and planning processes. All these are reinforced by fiscal levers or incentives such as carbon taxes and tax breaks. International 'soft law' treaties and binding instruments affecting environment and development are integrated into unified blueprints and their status in law is upgraded, though fresh provision is made for open consultation processes to allow for regional and local variants.



### Security First

This scenario assumes a world of striking disparities where inequality and conflict prevail. Socio-economic and environmental stresses give rise to waves of protest and counteraction. As such troubles become increasingly prevalent, the more powerful and wealthy groups focus on self-protection, creating enclaves akin to the present day 'gated communities'. Such islands of advantage provide a degree of enhanced security and economic benefits for dependent communities in their immediate surroundings but they exclude the disadvantaged mass of outsiders. Welfare and regulatory services fall into disuse but market forces continue to operate outside the walls.



### Sustainability First

A new environment and development paradigm emerges in response to the challenge of sustainability, supported by new, more equitable values and institutions. A more visionary state of affairs prevails, where radical shifts in the way people interact with one another and with the world around them stimulate and support sustainable policy measures and accountable corporate behaviour. There is much fuller collaboration between governments, citizens and other stakeholder groups in decision-making on issues of close common concern. A consensus is reached on what needs to be done to satisfy basic needs and realize personal goals without begging others or spoiling the outlook for posterity.

## Environmental implications

Some of the global and regional environmental implications arising out of the four scenarios are highlighted below.

The absence of effective policies to reduce emissions of carbon dioxide and other greenhouse gases in the *Markets First* and *Security First* scenarios leads to significant increases over the next 30 years. However, the policy actions taken under a *Policy First* scenario, notably carbon taxes and investments in non-fossil-fuel energy sources, effectively curb growth in global emissions and lead to actual reductions starting around 2030. The behavioural shifts under *Sustainability First*, together with improved production and conversion efficiencies, result in a rapid levelling off of emissions and a decline by the middle of the 2020s.

Biodiversity will continue under threat if there is no strenuous policy action to curb human activity. Continued urban and infrastructure expansion, plus the increased impacts of climate change, severely deplete biodiversity in most regions in all scenarios. Pressures will also increase on coastal ecosystems in most regions and scenarios.

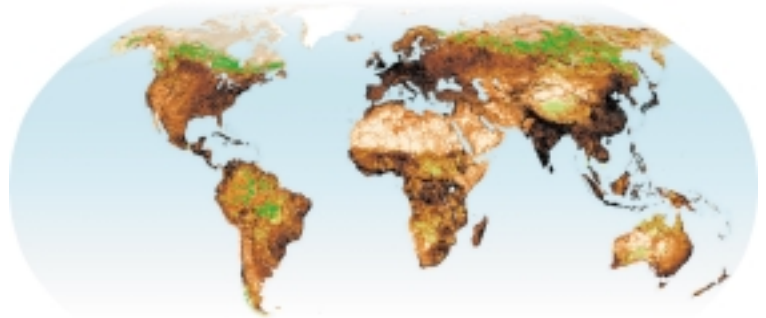
The scenarios carry important implications for the provision of basic human needs. Growing populations and increased economic activity, particularly in agriculture, will lead to increased demand for freshwater in most scenarios. Similarly, the demands for food and the ability to meet them in the different scenarios reflect a combination of shifts in supply and demand, influenced by social, economic and environmental policies. In *Markets First*, even with a decrease in the percentage of the population facing hunger, the total number affected changes relatively little and even increases in some regions as populations grow. Under *Policy First* and *Sustainability First* the targeting of hunger reduction as a key goal, and the emphasis on more balanced development between regions, help to achieve dramatic reductions in the percentages and total numbers of people affected. The sharp increases in most regions in *Security First* points to the unsustainability of such a scenario in terms of social acceptability.

In Africa, there is increasing risk of land degradation. In *Policy First* and *Sustainability First*, easier access to support services helps farmers to manage soils better and policies based on integrated land management become commonplace in the region. At the other end of the spectrum, in a *Security First* scenario, while reasonable conditions are maintained in the protected areas serving the land-owning elite, the high concentration of people elsewhere contribute to severe land degradation and soil erosion. Similar problems arise in *Markets First* as better quality agricultural land is taken over for commodity and cash crop production.

Under the *Markets First* scenario in Asia and the Pacific, water withdrawals are expected to increase in all sectors, leading to an expansion of areas with severe water stress in South and Southeast Asia. Slower economic growth under *Security First* tempers growth in demand. With effective policies and lifestyle changes under the *Policy First* and *Sustainability First* scenarios, water withdrawals remain at current levels or even decrease in most of the region.

The ability of Europe to address the issues of large-scale air pollution and greenhouse gas emissions will depend heavily upon developments in the areas of energy use and transportation. Extremely active policies to improve public transportation and energy efficiency can be expected in *Policy First* and *Sustainability First* worlds, but not in *Security First* or even *Markets First* circumstances.

Land and forest degradation as well as forest fragmentation remain among the most relevant environmental issues in Latin America and the Caribbean in all scenarios. Significant loss of forest area occurs in a *Markets First* scenario. In a *Security First* world, the control over forest resources by transnational companies that create cartels in association with the national groups in power, promotes the growth of some forest areas, but this is not enough to stop net deforestation. More effective management ameliorates some of these problems in *Policy First*. Unsound deforestation stops almost completely in a world of *Sustainability First*.



Infrastructure affects 72 per cent of the world's land area (black and red areas are the worst affected) by the year 2032 under a *Markets First* scenario

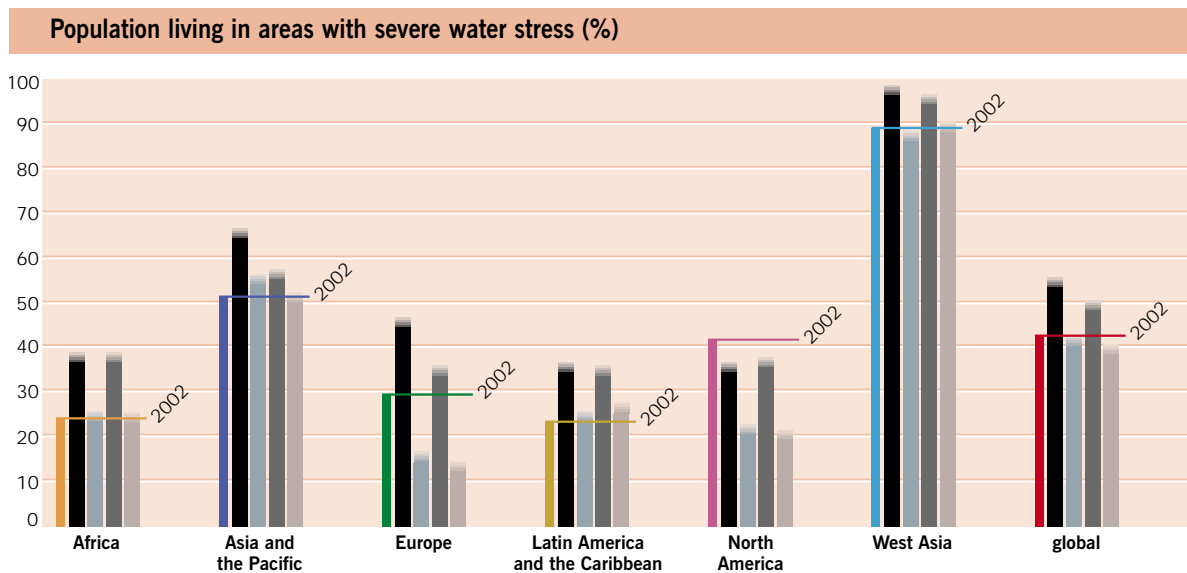
Source: GLOBIO

## Key to chart



When more than 40 per cent of the renewable water resources of a river basin are being withdrawn for human use the river basin is considered to be under severe water stress

Source:  
WaterGAP 2.1 (see  
technical annex)



As the world's biggest emitter of greenhouse gases, North America plays a major role in determining the future climate of the planet. In *Markets First*, the region's refusal to participate significantly hampers international efforts to control the emissions of these gases, and per capita and absolute emissions remain high. The collapse of parts of the transport infrastructure and restrictions on fossil-fuel vehicle ownership in *Security First* result in even greater increases in emissions in this scenario. Under *Policy First*, emissions are reduced through increased fuel efficiency and greater use of public transport but most spectacular results are achieved in *Sustainability First*.

West Asia is one of the most water-stressed regions of the world, with more than 70 million people living in areas under severe water stress. Under the *Markets First* and *Security First* scenarios, population and economic growth lead to strong increases in withdrawals for households and industry, resulting in an increase in areas with severe water stress and affecting over 200 million people by 2032. A range of policy initiatives help to counteract additional demands related to economic growth in both *Policy First* and *Sustainability First*. Although total withdrawals drop in both scenarios, water scarcity persists and demand continues to exceed available water resources.

Fish and other marine stocks are a key area of concern in the polar regions. Under *Markets First*, massive increase in commercial harvesting and abandonment of targeted fisheries leads to some fish populations crashing. Illegal, unregulated and unreported fishing activities cease in *Security First* under direct pressure from powerful regulatory interests, but controlled exploitation rises to very high levels. Total collapse of any single fishery is averted under *Policy First* by enforcement of stringent harvesting quotas and other regulatory systems. In *Sustainability First*, fish and marine mammals are rigorously defended against overexploitation.

The environmental implications of the various scenarios illustrate the legacy of past decades and the level of effort that will be needed to reverse powerful trends. One of the major policy lessons from the scenarios is that there can be significant delays between changes in human behaviour, including policy choices, and their environmental impacts, specifically:

- Much of the environmental change that will occur over the next 30 years has already been set in motion by past and current actions.
- Many of the effects of environmentally relevant policies put into place over the next 30 years will not be apparent until long afterwards.



## Options for action

The world is currently plagued by increasing poverty and continually widening divisions between the haves and the have-nots. These divisions — the environmental divide, the policy divide, the vulnerability gap and the lifestyle divide — all threaten sustainable development. They must be addressed urgently, and with greater success than has often been the case in the past. Certain key areas of attention have been identified for global action at all levels to ensure the success of sustainable development. Prime among them are alleviating poverty for the world's have-nots, reducing excessive consumption among the more affluent, reducing the debt burden of developing countries, and ensuring adequate governance structures and funding for the environment.

Underlying this action, however, must be the greater provision of and access to information in all its forms as the fundamental basis of successful planning and decision-making. The information revolution holds the possibility of providing cheap and reliable information in appropriate forms to all stakeholders in the environment — decision makers, local communities, the general public — thus enabling them to participate more meaningfully in decisions and actions that determine the courses of their daily lives and of those of succeeding generations.

The final section of *GEO-3* presents possible policy options for the future based on UNEP experience, the *GEO-3* assessment and wide consultations at different levels. The suggestions are intended as a check-list from which to make appropriate selections for action. The overriding need in policy development is for a balanced approach towards sustainable development. From the environment perspective, this means bringing the environment in from the margins to the heart of development. The fields where action is suggested cover the need to:

- Rethink environmental institutions because they need to adapt to new roles and partnerships to fulfil present obligations and confront emerging environmental challenges.
- Strengthen the policy cycle so that it becomes more rigorous, systematic, integrated and able to develop policies that are better attuned to specific localities and situations.
- Provide an enhanced international policy framework to overcome the fragmentation and duplication inherent in the present system.
- Use trade more effectively for the benefit of sustainable development to capitalize on the new opportunities provided by trade liberalization.
- Harness technology for the environment and manage the associated risks to maximize the potential of new technologies to deliver substantial environmental and social gains.
- Adjust and coordinate policy instruments, including various legal frameworks, and measures such as valuing environmental goods and services, ensuring that markets work for sustainable development and promoting voluntary initiatives, to develop appropriate packages that work more effectively for the environment.
- Monitor policy performance with the aim of improving levels of implementation, enforcement and compliance.
- Re-define and share roles and responsibilities between local, regional and global levels to provide efficient solutions to managing complex and varied situations at a variety of scales.



## The GEO Project

The UNEP Global Environment Outlook (GEO) project was initiated in response to the environmental reporting requirements of *Agenda 21* and to a UNEP Governing Council decision of May 1995 which requested the production of a comprehensive global state of the environment report.

### The GEO process

The coordinated global network of collaborating centres (CCs) is at the core of the GEO process. These centres have played an increasingly active role in preparing GEO reports. Regional centres are now responsible for almost all the regional inputs, combining top-down integrated assessment with bottom-up environmental reporting. Other institutions provide specialized expertise on cross-cutting or thematic issues.

Working groups provide advice and support to the GEO process, particularly on integrated assessment methodologies and process planning.

Other United Nations agencies contribute to the GEO process, mainly by providing substantive data and information on the many environmental and related issues that fall under their individual mandates. They also participate in the review process.

### GEO report series

The GEO reports are produced using a regional and participatory approach. Input is solicited from a wide range of sources throughout the world, including the collaborating centre network, United Nations organizations and independent experts.

Working together with the GEO Coordinating Team in Nairobi and the regions, the CCs research, write and review major parts of the report. During the preparation of the report, UNEP organizes consultations inviting policy makers and other stakeholders to review and comment on draft materials. Drafts also undergo extensive peer review. This iterative process is designed to ensure that the contents are scientifically accurate and policy relevant to users in different parts of the world and with different environmental information needs.

Previous reports published are *GEO-1* in 1997 and *GEO-2000* in 1999. The third in the series, *GEO-3*, places major emphasis on providing an integrated assessment of environmental trends over the 30 years since the 1972 Stockholm Conference.

### Other outputs

Other outputs include regional, sub-regional and national environmental assessments, technical and other background reports, a Web site, products for young people (GEO for Youth) and a core database – the GEO Data Portal.

### The GEO Data Portal

The GEO Data Portal provides report producers with easy access – via the Internet – to a common and consistent set of datasets from primary sources (UN and others), while covering a broad range of environmental and socio-economic themes. The Portal addresses one of the major concerns expressed ever since the start of the GEO project – the need for reliable, harmonized data for global and regional level environmental assessment and reporting. As of March 2002, the Portal gives access to some 300 statistical and geographical datasets at national, sub-regional, regional and global levels. State-of-the-art functionality for on-line data visualization and exploration are available for creating graphs, tables and maps.

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