Key Environmental Indicators

Indicators help to assess the overall outcomes of complex interactions between people and the environment. The latest environmental data and trends show progress in addressing stratospheric ozone depletion, the uptake of renewable energy technologies, and the increasing use of environmental certification schemes. Global carbon dioxide emissions are still rising. Pressures on ecosystems from natural resource use persist, with notable impacts in terms of biodiversity loss.

Indicators can help tell us if problems are getting better or worse and if policy measures appear to be having an effect. For example, the rate of melting of mountain glaciers tells us something about atmospheric warming, while reduced production of ozone depleting substances indicates that countries are successfully phasing them out. However, indicators are no more than that—they indicate trends or report on the state of a single environmental component such as forest cover. Indicators do not explain underlying causes, nor does a lack of significant change mean that no efforts have been made to address a problem. However, indicators can point out where further examination is needed.

Indicators are measures—generally quantitative—that can be used to illustrate and communicate complex phenomena in a simple way, including trends and progress over time (EEA 2005).

Index is a composite of several indicators.

Data source refers to the organization which prepared and provided the data.

MDG An indicator that is included in the suite of indicators to track progress towards achieving the Millennium Development Goals (MDGs).

Regular indicator-based assessments continue to be pivotal for presenting the bigger picture in regard to progress made towards achieving environmental sustainability. Every five years, the UNEP Global Environment Outlook (GEO) takes a comprehensive look at the state of and trends in the environment.

An overview of major global and regional trends is presented in this section, illustrated with 20 specially prepared graphics. According to the overall picture that emerges, in a few areas—such as stratospheric ozone depletion, renewable energy use and forest certification—there are signs of progress. Nevertheless, many pressures on the environment are continuing to persist. The rapid loss of both terrestrial and marine biodiversity is of particular concern, as highlighted in a number of recent publications (Butchard et al. 2010, SCBD 2010).

As in the case of the MDGs, this type of `global environmental snapshot' can serve to draw attention to the most pressing issues and monitor major trends in areas such as climate change, freshwater quality, use of natural resources, biodiversity loss and environmental governance. Poor availability of environmental data—especially from developing countries—is one of the major constraints on identifying global environmental trends.

Depletion of the ozone layer

Since the establishment of the Montreal Protocol in the late 1980s, the world has succesfully phased out human-made ozone depleting substances (**Figure 1**). Although the problem of stratospheric ozone depletion is often seen as more or less controlled, production and consumption of certain ozone depleting substances continues through the substitution of substances such as hydrochlorofluorocarbons (HCFCs) as well as through permissions or exemptions, such as those for use of methyl bromide in agriculture. Illegal use of certain substances and of existing stockpiles is also an issue.

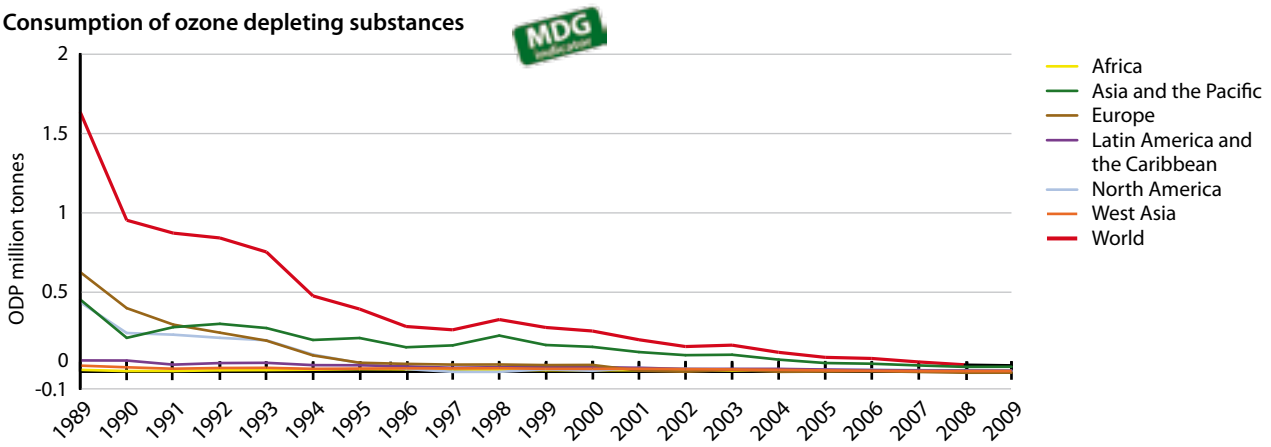
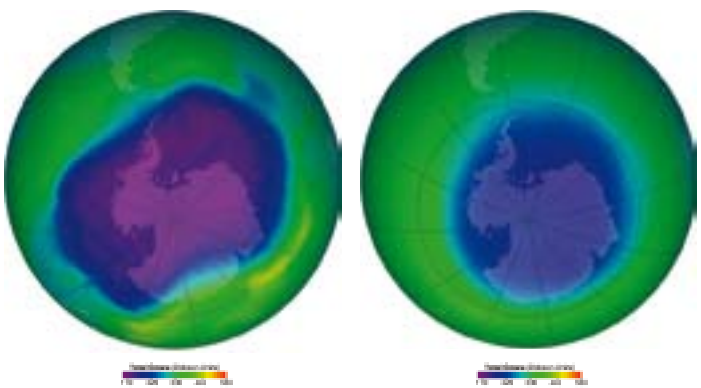


Figure 1: Consumption of ozone depleting substances expressed as million tonnes of ozone depletion potential (ODP), 1989-2009. ODP is a number that refers to the amount of ozone depletion caused by a chemical substance. Consumption of ozone depleting substances has largely been reduced in the past 20 years. *Data source: GEO Data Portal, compiled from the UNEP Secretariat for the Vienna Convention and the Montreal Protocol (UNEP 2010)*



24 September 2006 September 2010

The largest ozone hole over the Antarctic since measurements began occurred in September 2006. It is estimated that by 2015 the width of the ozone hole will have been reduced by 1 million square kilometres out of 25 million square kilometres. Complete recovery is not expected until the year 2050 or later. *Source: NOAA (2010)*

Climate change

Carbon dioxide (CO_2) is one of the main anthropogenic greenhouse gases responsible for climate change. Globally, total CO_2 emissions continue to increase although regional differences are apparent (**Figure 2**). Emissions per capita vary greatly by region (**Figure 3**). While the climate negotiations have focused heavily on CO_2 emissions, the role of some common air pollutants as climate forcers is becoming clearer. Black carbon or soot is an important contributor to global warming. This pollutant, measured in terms of levels of particulate matter (**Figure 4**), is also a major health concern. Fine suspended particulates of 10 micrometres or less in diameter (PM_{10}) are capable of penetrating deep into the respiratory tract.

Carbon dioxide emissions

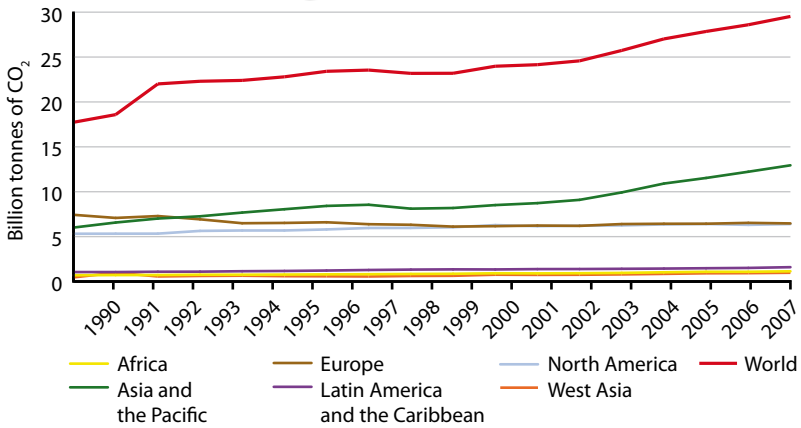


Figure 2: Carbon dioxide emissions from solid fuel consumption, expressed in billions of tonnes of CO_2, 1989-2007. Although emissions from fossil fuel consumption are stabilizing in Europe and North America, they are increasing in Asia and the Pacific. *Data sources: GEO Data Portal, compiled from the Carbon Dioxide Information Analysis Center (CDIAC), Boden et al. (2010)*

Carbon dioxide emission per capita

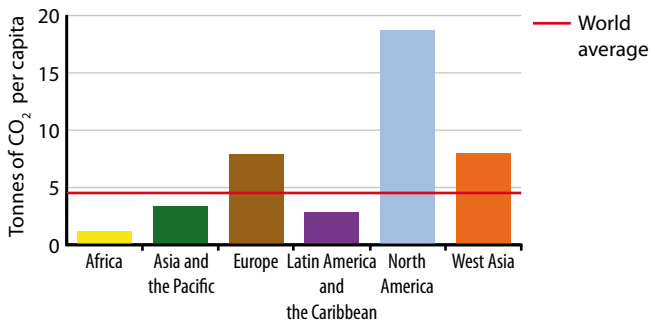


Figure 3: The latest data available on CO_2 emissions per capita, from 2007, show that there are large differences between regions. Emissions per capita are lowest in Africa. Those in North America, Europe and West Asia are well above the 2007 global average of 4.4 tonnes. *Data source: GEO Data Portal, compiled from the Carbon Dioxide Information Analysis Center (CDIAC), Boden et al. (2010)*

Concentration of particulate matter (PM_{10})

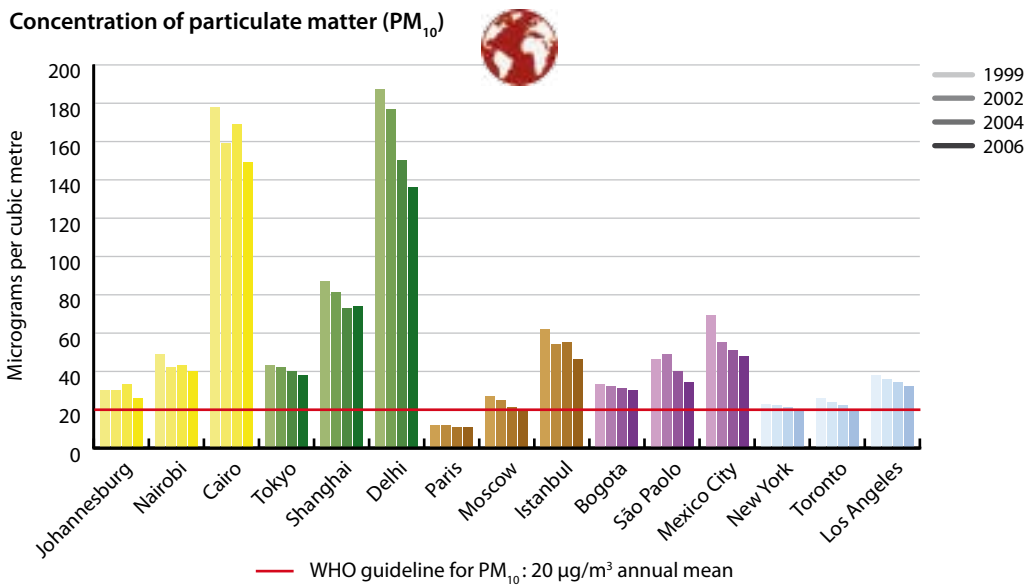


Figure 4: Estimated concentrations of particulate matter10 micrometres or less in size (PM_{10}) per cubic metre in selected cities. These estimates represent average annual exposure to outdoor particulate matter by urban residents away from 'hotspots' such as industrial areas or transport corridors. In many parts of the world, air quality in major cities exceeds the WHO guideline of 20 µg/m³. *Data source: GEO Data Portal, compiled from the World Bank (2006, 2008 and 2010), Pandey et al. (2006)*

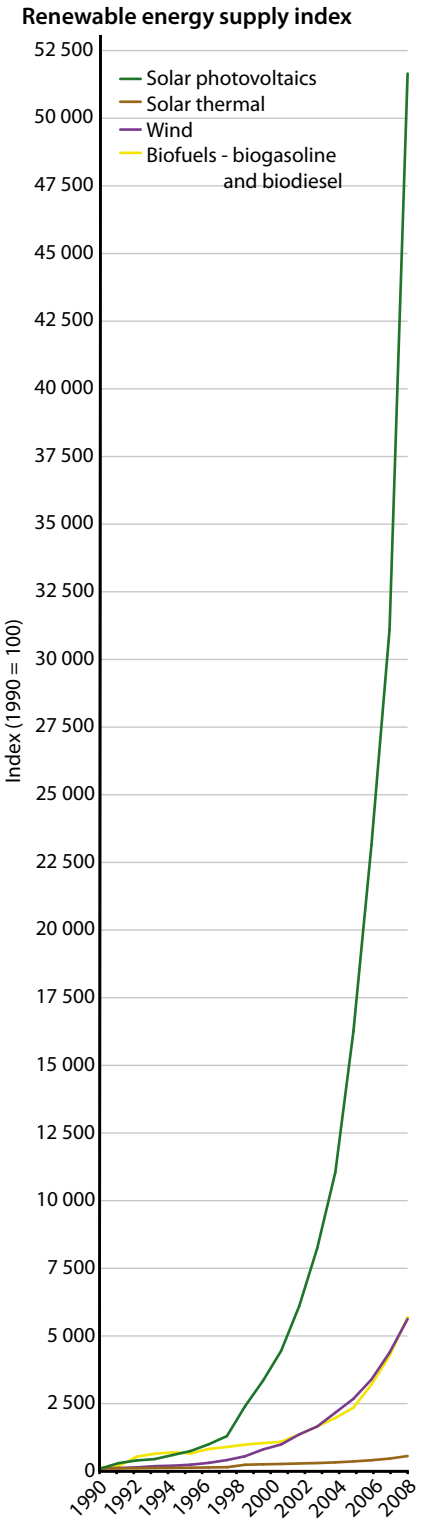


Figure 5: Renewable energy supply index (1990=100), 1990-2008. Although use of renewable energy is still modest compared to that of fossil fuels, at13 per cent in 2008, recent increases are significant. Use of solar energy, particularly photovoltaics, has grown exponentially over the last years. Global use of other forms of renewable energy also continue to increase, with the exception of energy generated from tide, waves and the ocean. *Data source: GEO Data Portal, compiled from the International Energy Agency (IEA 2010)*

Both CO_2 and black carbon emissions result largely from fossil fuel combustion. The search for renewable energy is therefore fundamental for transitioning towards a greener economy (**Figure 5**). To track the effects of emissions already released and atmospheric processes under way as a result of past and current contributions, one of the key indicators used is the ice thickness change, or mass balance, of glaciers (**Figure 6**).

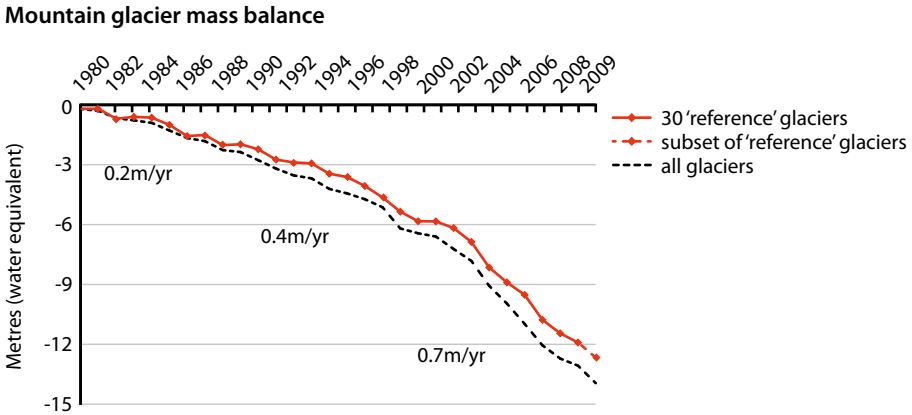


Figure 6: Cumulative loss of ice thickness in mountain glaciers in metres of water equivalent, 1980-2009. Over the past three decades, the global average of available measurements shows a strong ice loss which has accelerated to 0.7 metre water equivalent during the past decade. *Data source: World Glacier Monitoring Service (WGMS 2010)*

Photovoltaic array at the National Solar Energy Center, Jacob Blaustein Institutes for Desert Research, in the Negev Desert of Israel. *Credit: David Shankbone*

Natural resource use

Natural resources provide a livelihood for billions of people and are the basis of large parts of countries' economies. Sustainable use is essential to ensure the long-term availability of living resources such as forests and fish. Scientists have repeatedly expressed concern about the depletion of fish stocks (**Figure 7**), particularly in regard to heavily fished commercial species such as tuna (**Figure 8**).

Annual marine fish catch

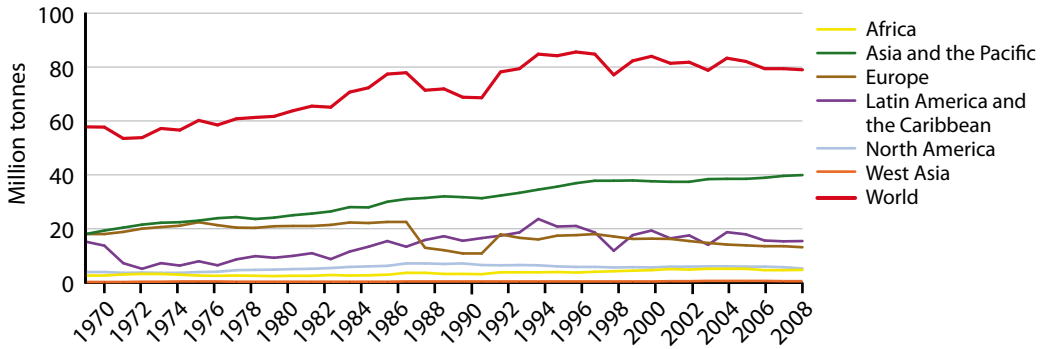


Figure 7: Annual marine fish catch in millions of tonnes, 1969-2008. Depletion of marine fish stocks is one of the most pressing environmental issues. With a global marine fish catch of approximately 80 million tonnes per year, pressure on marine ecosystems as a result of the exploitation of commercial fish species remains high. *Data source: GEO Data Portal, compiled from the Food and Agriculture Organization of the United Nations (FAO 2010a)*

More than two-thirds of tuna is caught in the Pacific Ocean. The Indian Ocean contributes more than the Atlantic and the Mediterranean Sea combined (20.4 and 9.5 per cent, respectively, in 2008). *Credit: National Atmospheric and Oceanographic Administration (NOAA)*

Global tuna catches

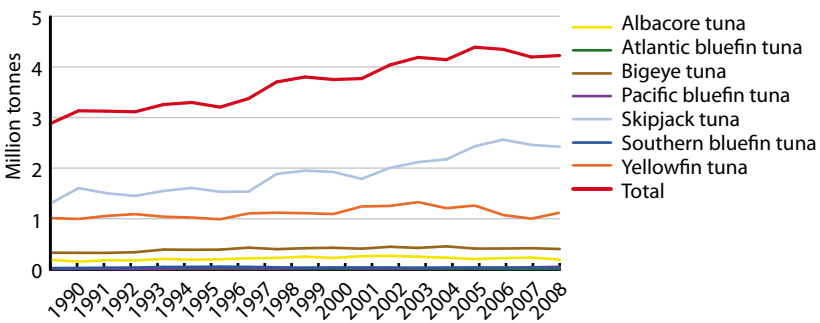


Figure 8: Global catches of tuna and tuna-like species, 1989-2008. Economically important fish such as tuna are traded worldwide. Global production has increased from less than 0.6 million tonnes in 1950 to over 4 million tonnes today. A number of tuna species are overexploited. Although such deterioration could eventually lead to reduced catches, countries have been unable to come to an agreement on limiting trade in certain species. *Data source: GEO Data Portal, compiled from the Food and Agriculture Organization of the United Nations (FAO 2010a)*

Forest cover change (**Figure 9**) and the rate of harvesting of roundwood (**Figure 10**) are important indicators of the state of land ecosystems. While the extent of forest cover alone provides only limited information about forest biodiversity, afforestation efforts throughout the world have begun to show results and are building up carbon stock. Voluntary forest certification schemes, such as that established by the Forest Stewardship Council, take other ecosystem services into account (**Figure 11**). However, the impact of such schemes can be difficult to ascertain.

Proportion of land area covered by forest

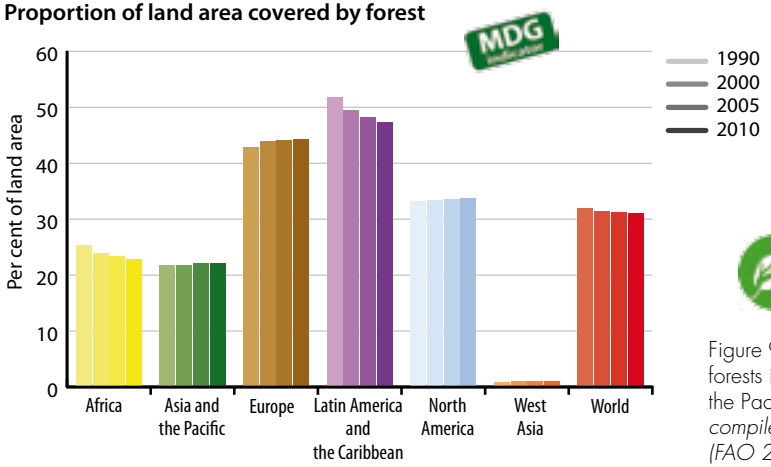
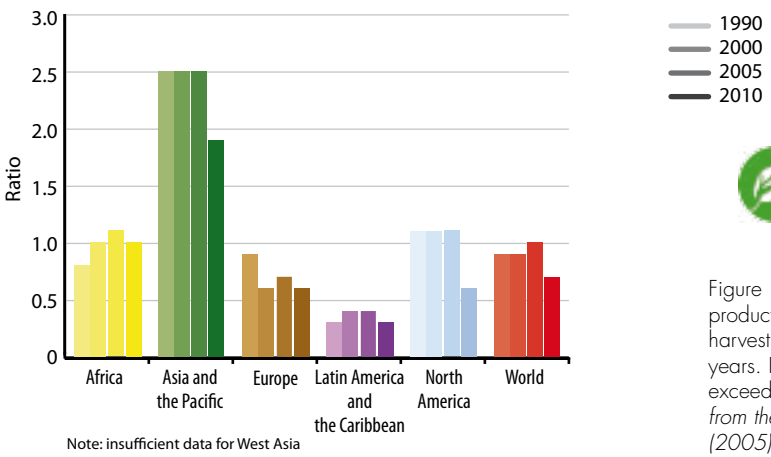


Figure 9: Proportion of land area covered by forest. Although the extent of forests is decreasing globally, there have been steady increases in Asia and the Pacific, Europe and North America. *Data source: GEO Data Portal, compiled from the Food and Agriculture Organization of the United Nations (FAO 2010b and c)*

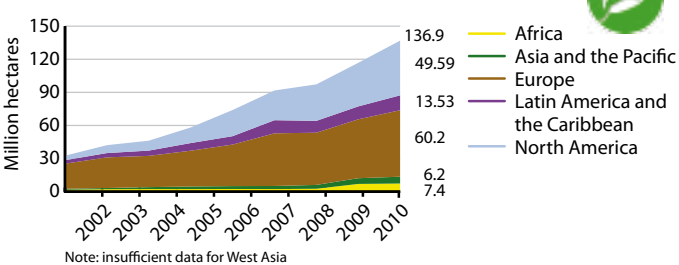
Ratio of roundwood production and growing stock in forests



Note: insufficient data for West Asia

Figure 10: Forest harvest rates expressed as the ratio of roundwood production and growing stock in forests. After decades of increases, harvesting of roundwood from forests appears to have levelled off in recent years. In Asia and the Pacific roundwood production is very high and exceeds growth of forest stock. *Data source: GEO Data Portal, compiled from the Food and Agriculture Organization of the United Nations: FAO (2005) for 1990, 2000 and 2005; FAO (2010b) for 2010*

Forest area FSC-certified



Note: insufficient data for West Asia

Figure 11: Total forest area certified by the Forest Stewardship Council (FSC), 2001-2010. The amount of forest certified with the FSC label is still modest in developing countries, but is growing rapidly in nothern regions. Globally, FSC certified forest represents 3.4 per cent of all forest area. FSC certification of a forest site means that an independent evaluation by an FSC accredited certification body has found that its management conforms to the internationally recognized FSC Principles and Criteria of Forest Stewardship. *Data source: GEO Data Portal, compiled from Forest Stewardship Council (FSC 2010)*

Biodiversity loss

In 2002, the world community established the target of significantly reducing biodiversity loss by 2010. Although this target was not met, a spotlight was focused on data insufficiency and the importance of biodiversity monitoring to measure results. Citizens and NGOs play a major monitoring role and are forming partnerships to undertake scientific and other joint activities, with the International Union for Conservation of Nature (IUCN) leading efforts in regard to threatened species (**Figure 12**). The UNEP World Conservation Monitoring Centre tracks, in collaboration with IUCN, the establishment of protected areas, a major policy response to help conserve biodiversity (**Figure 13**).

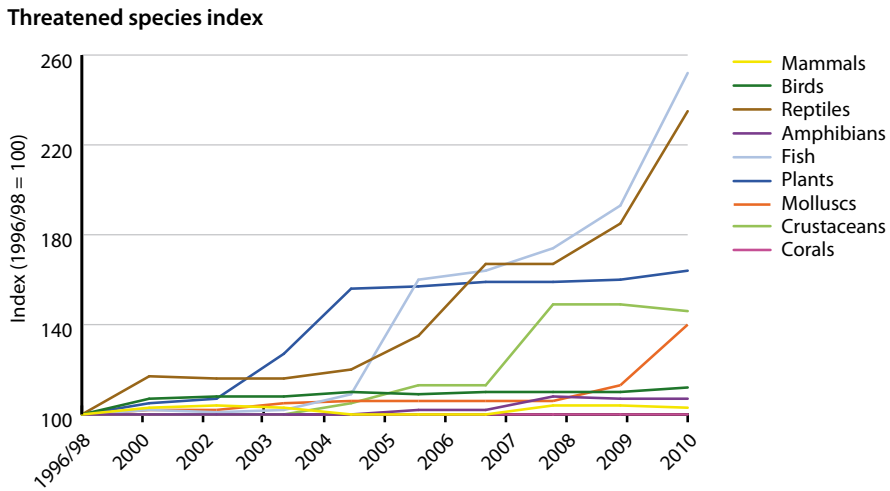


Figure 12: The threatened species index (1996/98=100) shows a consistent increase for all major groups of organisms studied between 1996 and 2010. Biodiversity loss continues to be of major concern, with species threatened at historically unprecedented rates. *Data source: GEO Data Portal, compiled from the International Union for Conservation of Nature (IUCN 2010)*

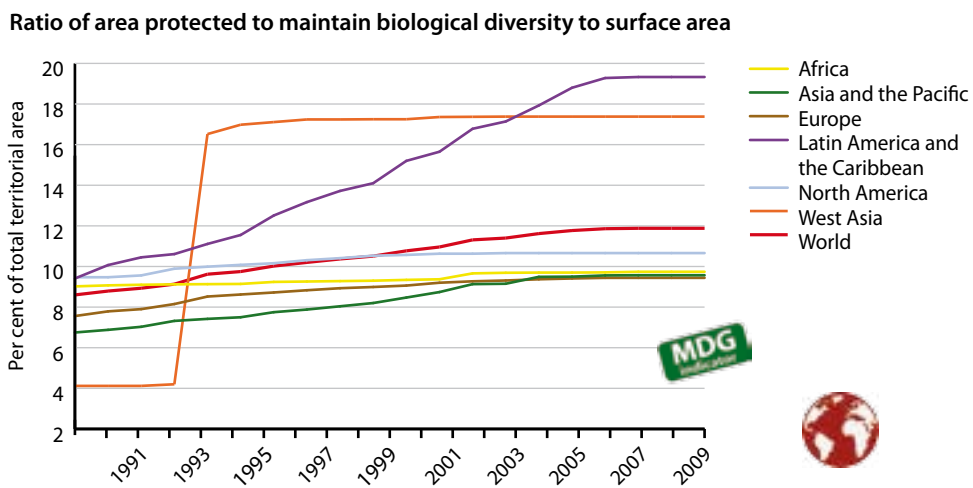


Figure 13: Ratio of area protected to maintain biological diversity to surface area, expressed as percentage of total territorial area, 1989-2009. Terrestrial and marine areas are combined. The extent of protected areas has increased during the past decade, particularly in Latin America and the Caribbean, where it doubled to almost one-fifth of the territorial area. Overall, about 12 per cent of the territorial area is currently protected. The Conference of the Parties to the Convention on Biological Diversity agreed in 2010 to a target of protecting 17 per cent of terrestrial and inland water areas, and 10 per cent of coastal and marine areas by 2020. *Data source: GEO Data Portal, compiled from UNEP-World Conservation Monitoring Centre (UNEP-WCMC 2010)*

Waste

A number of indicators have been developed for waste, but data availability is a major concern. Data on municipal waste collection are scarce, especially for developing countries (**Figure 14**). Transboundary movements of hazardous waste are monitored, but insufficient data are available to show global or regional trends.

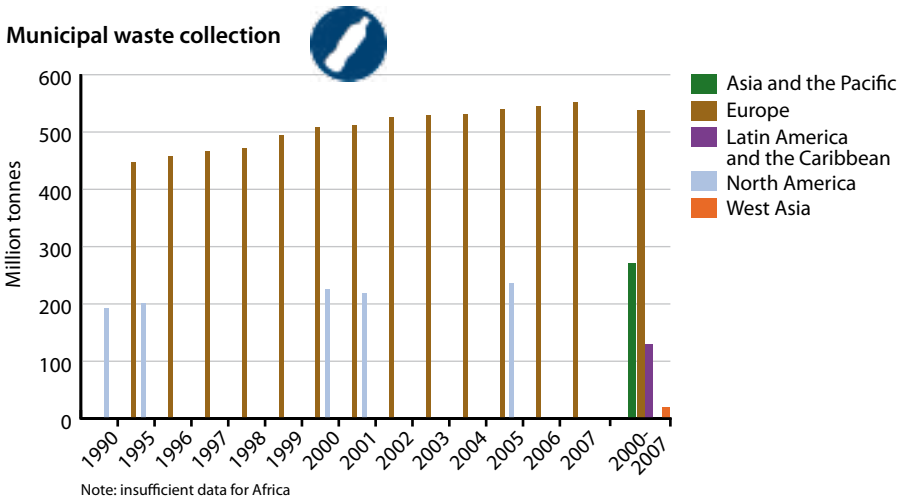


Figure 14: Municipal waste collected in millions of tonnes, 1990-2007. The population served by private waste collectors or municipalities varies among regions. The limited data available at regional level suggests that the rate of municipal waste collection is highest in Europe and is steadily growing in that region, but information is very sparse and intermittent. Regional data alone hardly allow reliable conclusions to be drawn. *Data source: GEO Data Portal, compiled from UNSD/UNEP (2006), OECD/Eurostat (2008) and UNSD (2010)*

Water

The proportion of freshwater used for agriculture, industry and domestic purposes is monitored fairly well (**Figure 15**), but there are significant limitations to water quality monitoring in terms of regional or global use (**Figures 16** and **17**). Access to improved water supply and sanitation is probably one of the indicators for which reporting has been best carried out by individual countries (**Figure 18**). This indicator has important health as well as environmental relevance.

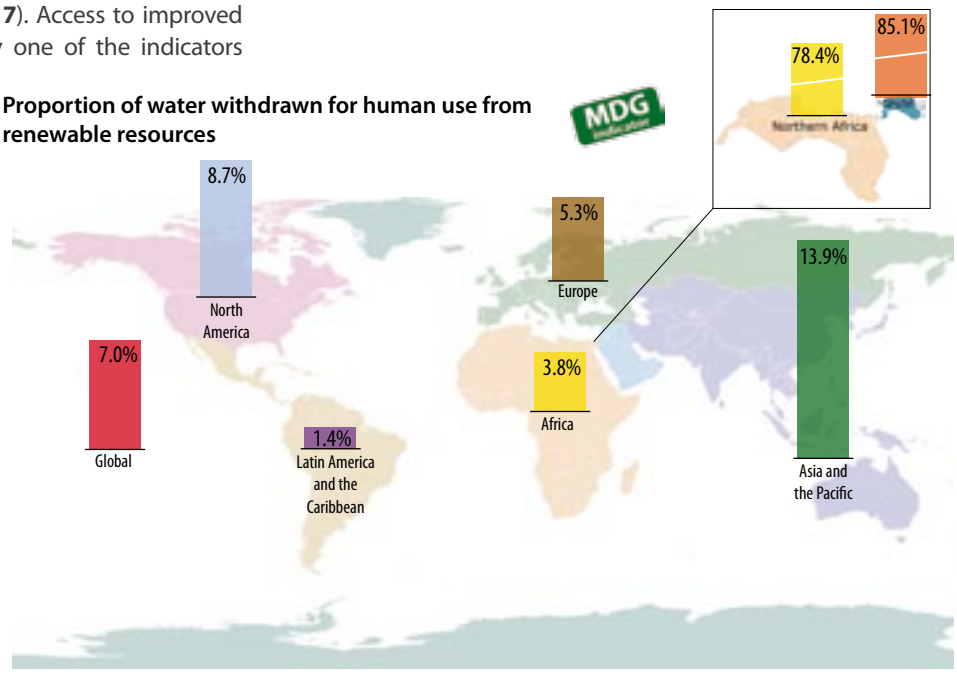


Figure 15: Human use of groundwater and surface water in the domestic, agricultural and industrial sectors, expressed as a percentage of the total volume of freshwater available annually through the hydrological cycle. Measurements from different countries in the period 1998-2002. It shows that the proportion of available water used by humans is highest in Asia and the Pacific, although there are extremely high percentages (up to 85 per cent) in North Africa and the Mashriq sub-region of West Asia. Irrigation represents the largest share, averaging about 70 per cent of all water used by humans. *Data source: GEO Data Portal, compiled from the Food and Agriculture Organization of the United Nations (FAO 2010d)*

Levels of dissolved oxygen in surface waters

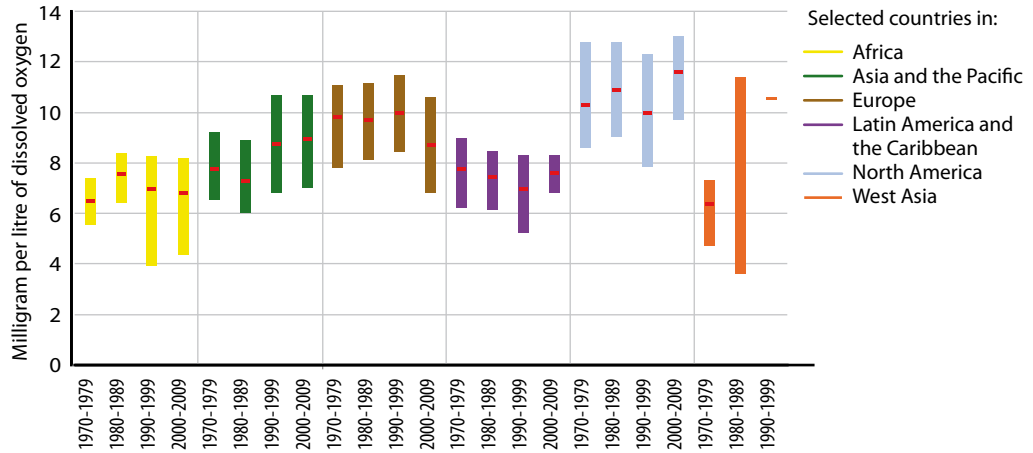


Figure 16: Levels of dissolved oxygen in surface waters expressed in milligrams per litre (mg/l) in selected countries, aggregated by regions. The data suggest that dissolved oxygen concentrations are generally within the widely accepted levels of 6 mg/l in warm water to 9.5 mg/l in cold water, as set, for example, in Australia (ANZECC 1992), Brazil (1986) and Canada (CCME 1999 and 2003). Data are supplied voluntarily by a wide range of contributors and are characterized by large statistical variations. They are not representative of all waters in these regions, or of each decade. *Data source: UNEP-GEMS/Water (2010)*

Figure 17: Countries in which dissolved oxygen measurement points were located for the water quality indicator in the period 2000-2009. The map shows the limited number of data points per region.

Proportion of population with sustainable acces to an improved water source and with access to improved sanitation

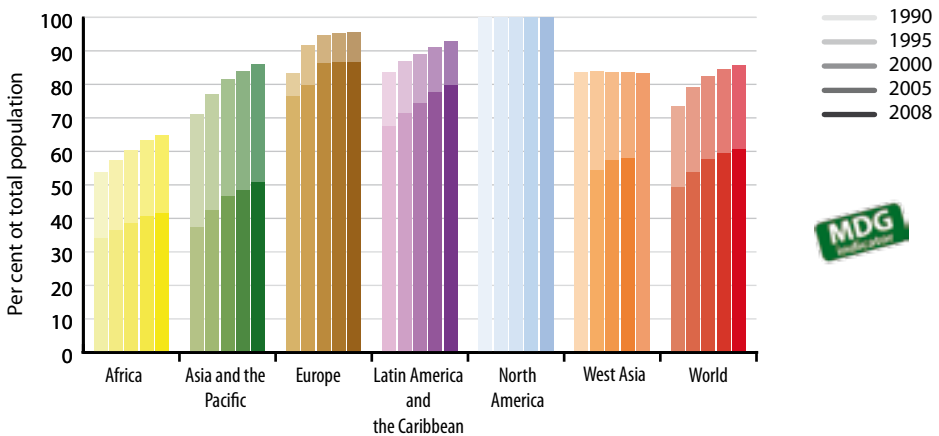


Figure 18: Improved drinking water (back) and improved sanitation coverage (front) as a percentage of the total population. While access to safe water supply continues to improve, challenges remain, notably in rural areas. Overall access to basic sanitation services also continues to improve in all parts of the world, although only about half the population of the developing world is using improved sanitation. *Data source: GEO Data Portal, compiled from WHO/UNICEF (2010)*

Environmental governance

Effective environmental governance is critical to respond in a timely fashion to emerging environmental challenges and address agreed environmental priorities. The number of signatories to environmental conventions is used as an indicator to track progress with regard to international environmental governance (**Figure 19**) (**Table 1**). However, this indicator also demonstrates the fragmentation of the environmental governance landscape. Looking more specifically at environmental management in companies and organizations, the number of voluntary ISO 14001 certifications is inceasing (**Figure 20**). The overall goal of this international standard is to minimize harmful effects on the environment and improve environmental performance.

Number of parties to multilateral environmental agreements

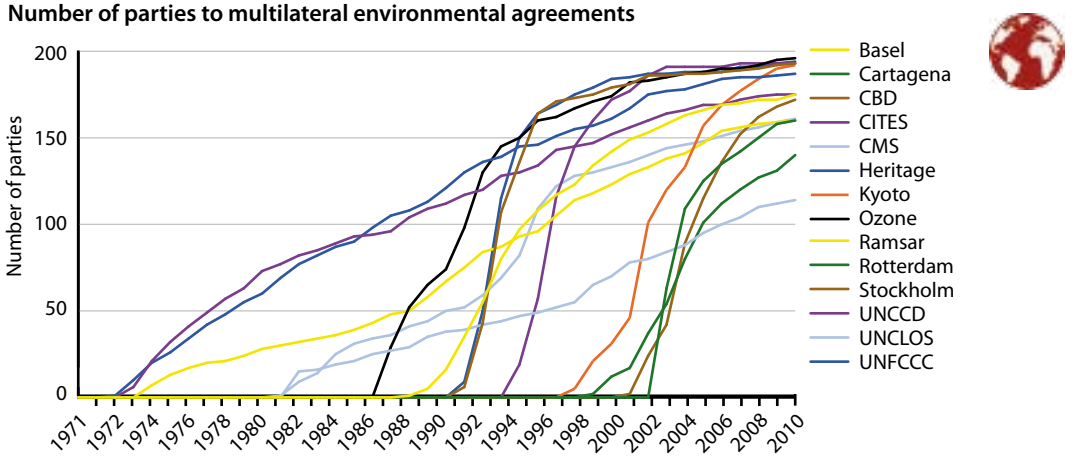


Figure 19: Number of parties to multilateral environmental agreements (MEAs), 1971-2010. These agreements comprise a major part of the international environmental governance system. The number of parties to the MEAs is the number of countries and political and/or economic integration organizations that have deposited instruments of ratification, accession, acceptance or approval for the 14 major MEAs shown here. The number of parties continues to increase, and many agreements are reaching the maximum number of countries. In all, the number of parties to these 14 MEAs has increased to 88 per cent of the maximum. *Data sources: GEO Data Portal, compiled from various MEA secretariats (see table below for details)*

Table 1: Number of parties to multilateral environmental agreements

Region (total number of countries)	Basel	Cartagena	CBD	CITES	CMS	Heritage	Kyoto	Ozone	Ramsar	Rotterdam	Stockholm	UNCCD	UNCLOS	UNFCCC	Sum	Potential	Per cent
Africa (53)	49	48	53	52	41	52	53	53	47	40	51	53	45	53	690	742	93
Asia and the Pacific (45)	36	35	46	33	15	41	45	46	30	25	38	46	34	46	516	630	81.9
Europe (50)	49	43	49	48	42	49	49	51	47	39	43	49	44	49	651	686	94.9
Latin America and the Caribbean (34)	30	28	33	32	12	32	33	33	27	26	30	33	28	33	410	476	86.1
North America (2)	1		1	2		2	1	2	2	1	1	2	1	2	18	24	75
West Asia (12)	10	6	11	8	4	11	11	11	7	9	9	10	9	11	127	168	75.6
Global (196)	**175**	**160**	**193**	**175**	**114**	**187**	**192**	**196**	**160**	**140**	**172**	**193**	**161**	**194**	**2 412**	**2 730**	**88.4**

Data source: GEO Data Portal, compiled from the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal (Basel), Cartagena Protocol of Biosafety to the CBD, CBD, CMS, CITES, Convention Concerning the Protection of the World Cultural and Natural Heritage (World Heritage), Kyoto Protocol to the UNFCCC (Kyoto), Vienna Convention for the Protection of the Ozone Layer and its Montreal Protocol on Substances that Deplete the Ozone Layer (Ozone), Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar), Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (Rotterdam), Stockholm Convention on Persistent Organic Pollutants (Stockholm), UN Convention to Combat Desertification (UNCCD), UN Convention on the Law of the Sea (UNCLOS) and UNFCCC

Number of certifications of the ISO 14001 standard

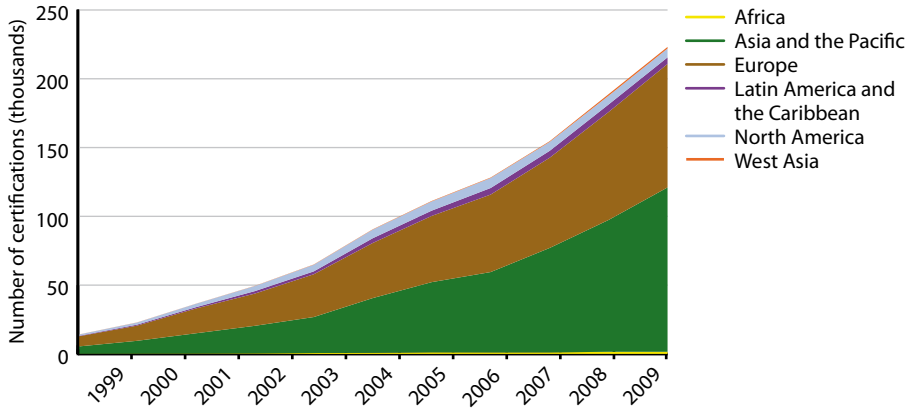


Figure 20: Number of ISO 14001 environmental management certifications, 1998-2009. This international standard is concerned with what companies and other organizations do to minimize the harmful effects of their activities on the environment and to achieve continual improvement in their environmental performance. The number of these certifications has grown considerably, particularly in Europe and Asia and the Pacific. The total number exceeded 200 000 in 2010. Although this increase can be seen as a positive development, certification only indicates the extent to which a company or organization conforms to its own stated environmental policy. *Data source: GEO Data Portal, compiled from the International Organization for Standardization (ISO 2010)*

Analyzing global and regional indicators

Considering all these indicators together—while bearing in mind that they represent an incomplete snapshot of the global environment—a mixed global picture emerges, with some promising signs of progress in areas such as renewable energy, forest certification, phasing out of ozone depleting substances, access to drinking water and ratification of environmental conventions. Huge challenges remain if trends are to be reversed in levels of greenhouse gas emissions, overexploitation of fish stocks and biodiversity loss. There is a need to address the underlying causes of environmental degradation.

Each indicator contributes a part of the story of ecosystem health and of efforts to work towards a green economy and an effective international environmental governance regime. Some research groups are working on concepts for combining the information provided through individual indicators into a single index (**Box 1**). Whereas trend analyses can be carried out for individual indicators or clusters of indicators, any forward-looking conclusion on overall environmental trends is constrained by the uncertainties and resilience associated with natural systems and human behaviour, their interactions, and the lack of reliable, comprehensive and up-to-date data.

Constructing such a set of key indicators or composite indices is challenging, with overall data quality and availability still alarmingly poor and scarcely improving overall. Lack of good-quality data and consistent time-series for many environmental issues—such as water and air quality, waste collection and land degradation—severly hampers efforts to provide a sound basis for environmental decision-making, develop effective response strategies, and measure the impact of these strategies.

Policy makers are nevertheless continuously expected to take decisions related to the environment. Hence, it is critical to make available the most recent data on environmental pressures, state and trends. **Table 2** aims to do so by giving an overview of the latest data available for each of the key environmental indicators presented in this section. Where possible, data are presented at global and regional levels. Further information and technical notes are available from www.unep.org/yearbook/2011 and the GEO Data Portal (2010).

Table 2: Latest data for key environmental indicators

Indicator	Latest year on record	World	Africa	Asia and the Pacific	Europe	Latin America and the Caribbean	North America	West Asia	Unit of measurement
Carbon dioxide emissions	2007	29.5	1.1	12.9	6.5	1.6	6.4	0.97	*billion tonnes of CO_2*
Stratospheric ozone depletion	2009	38 656	2 651	30 249	-7 036	5 166	4 558	3 069	*million tonnes ODP*
Annual marine fish catch	2008	79.0	4.7	39.9	13.1	15.4	5.2	0.5	*million tonnes*
Forest harvest rate	2010	0.7	1.0	1.9	0.6	0.3	0.6		*per cent*
Forest coverage	2010	31.0	22.8	22.1	44.3	47.2	33.7	0.9	*per cent of land area*
Protected areas	2009	11.9	9.7	9.6	9.4	19.3	10.7	17.4	*per cent of total territorial area*
Forest certification	2010	136.9	7.4	6.2	60.2	13.5	49.6		*million hectares*
Water use	1998-2002	7.0	3.8	13.9	5.3	1.4	8.7		*per cent*
Access to safe water	2008	85.9	64.9	86.2	95.6	93.0	99.1	83.3	*per cent of total population*
Access to sanitation	2008	60.6	41.7	50.9	86.7	79.9	100.0		*per cent of total population*
ISO14001 certification	2009	223 149	1 536	119 480	89 745	4 793	6 446	1 149	*number of certifications*

Renewable energy	Latest year on record	Total all renewables (including waste)	Solar photovoltaics	Solar thermal	Wind	Hydro	Geothermal	Biofuels – total (liquid, solid, gas)	Biofuels – biogasoline and biodiesel	Tide, wave and ocean	
	2008	141.3	51 650.0	562.2	5 626.0	149.6	171.9	133.4	5 691.7	92.2	*Index (1990=100)*

Threatened species	Latest year on record	Mammals	Birds	Reptiles	Amphibians	Fishes	Plants	Molluscs	Crustaceans	Corals	
	2010	103.2	112.0	234.8	107.2	252.2	163.7	140.0	146.4	100.0	*Index (1990=100)*

Note: For certain indicators, no global or regional figures can be provided due to the local nature of the phenomenon or the lack of sufficient data. Examples include water quality, air pollution in cities and glacier change. The negative value for stratospheric ozone depletion in Europe is due to export, destruction or feedstock use of ozone depleting substances.