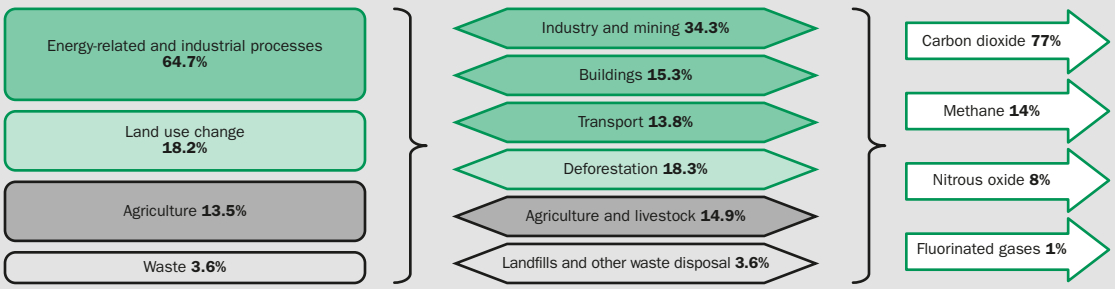
ENVIRONMENT

Climate change by the numbers

Greenhouse gas emissions by sector and by activity 3a



Source: World Resources Institute 2005.

Numbers tell the story. The natural climate has changed, and the change is accelerating as our planet warms. The rate of warming has been nearly twice as fast in the last 50 years as in the last 100 years, with the 13 warmest years since 1880 experienced in the last 15 years. Since 1978 annual mean arctic sea ice has been declining. Temperatures at the top of the permafrost have increased by up to 3 degrees centigrade. Sea levels rose more from 1993 to 2003 than in the previous 30 years. Concentration of atmospheric carbon dioxide, the main cause of global warming, increased one-third faster in the last decade than over the last 50 years (IPCC 2007a).

Climate change poses risks for the environment and for development in most economies, disproportionately affecting those with the lowest capacity to adapt to such impacts. That makes climate change a development issue critical to poverty reduction. It is also an environmental issue vital to sustaining growth and preserving the ecosystem. Countries need measures to mitigate it—and to adapt to its unavoidable outcomes.

Knowledge about climate change has grown greatly in the last few years. The most comprehensive treatment is in the Fourth Assessment Report of the Intergovernmental Panel on Climate Change (IPCC), which presents the findings of hundreds of experts in the field:

- All greenhouse gas concentrations—the main causes of climate change—have increased since the start of the industrial revolution. From 1750 to 2005 carbon dioxide grew from 280 parts per million to 379, methane from 715 parts per billion to 1,774, and nitrous oxide from 270 parts per billion to 319.
- Warming of the climate system is unequivocal—now evident in global averages of air, surface, and ocean temperatures; in widespread melting of snow and ice; and in rising global mean sea level.
- The likely consequences of climate change are uneven across regions, with more profound negative impacts for developing countries and for more vulnerable socioeconomic groups.
- It is very likely (90+ percent confidence) that human activities are causing global warming.
- Changes in technology, management, and behavior can mitigate climate change.
- Even with mitigation, climate change will continue, and adaptation will be needed.

Why the natural climate has changed

The IPCC's assessment concluded that global greenhouse gas emissions have drastically increased since preindustrial times, with a 70 percent increase between 1970 and 2004. More than 75 percent of these emissions come from carbon dioxide, mainly from burning fossil fuels, manufacturing cement, and cutting forests. Carbon dioxide emissions grew by about 80 percent, accelerating in recent years (a 28 percent increase since 1990).

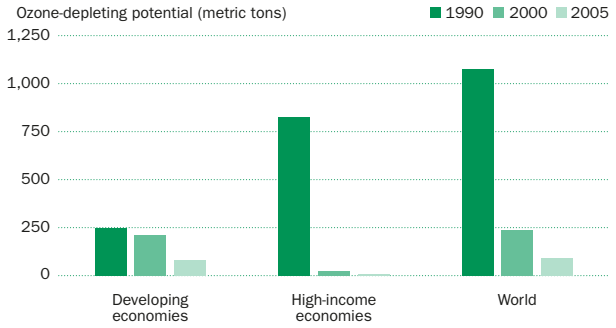
The other major greenhouse gases are methane and nitrous oxide, mainly from agriculture, energy use, industrial processes, waste, and savannah burning (see figure 3a for a schematic representation of greenhouse gas emissions). Their emissions have grown as well (table 3.9). But emissions of ozone-depleting substances, also greenhouse gases, have declined significantly since the 1990s, controlled under the international treaty known as the Montreal Protocol. By 2005 consumption of these substances was less than 10 percent of their 1990 level (figure 3b).

Global energy intensity declined 33 percent during 1970–2004. But the favorable impact on carbon dioxide emissions has been more than offset by per capita income growth (67 percent) and population growth (73 percent).

Country trends and contributions to climate change vary substantially, with the United States and China contributing most (figure 3c and tables 3.7 and 3.8). The average resident of a rich country produces far more carbon dioxide than does the average resident of a low- and middle-income country. Per capita emissions of carbon dioxide in 2004 averaged 0.9 metric tons in low-income countries, 4.0 metric tons in middle-income countries, and 13.2 metric tons in high-income countries (figure 3d). High-income economies, with 15 percent of the world's people, produced 55 percent of global GDP (in purchasing power parity terms) and emitted nearly half of the global carbon dioxide emissions in 2004 (figure 3e and table 3.8).

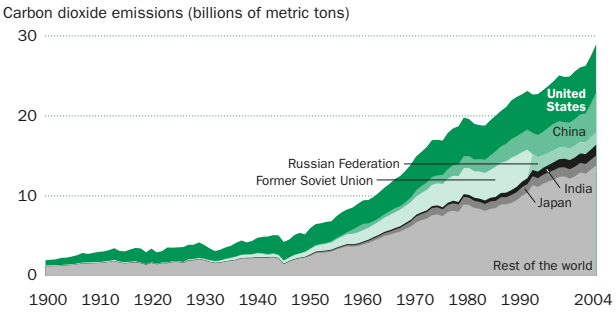
Global trends in emissions of greenhouse gas sources also vary substantially. The power sector contributes almost a quarter of global greenhouse gases, and transport, industry, buildings, and other energy-related activities account for another 41 percent (figure 3f). The biggest growth between

Use of ozone-depleting substances has dropped substantially since 1990 3b



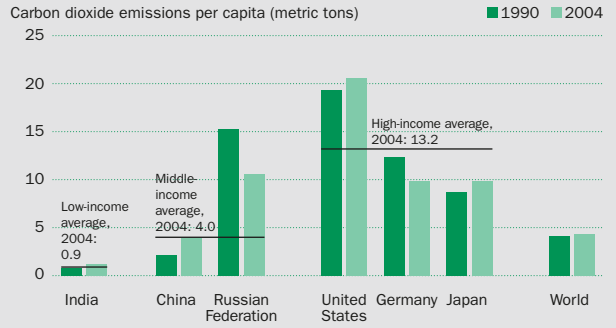
Source: United Nations Millennium Development Goals database.

The United States and China lead the world in carbon dioxide emissions 3c



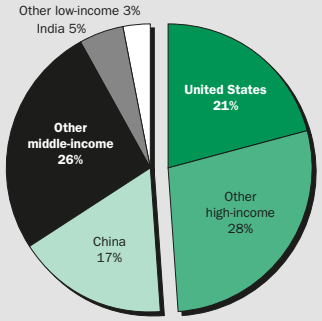
Source: Carbon Dioxide Information Analysis Center.

High-income countries produce far more carbon dioxide emissions per capita than low- or middle-income countries 3d



Source: Table 3.8.

High-income economies emitted half the global carbon dioxide emissions in 2004 3e



Source: Table 3.8 and Carbon Dioxide Information Analysis Center.

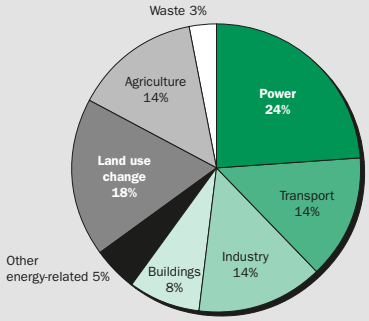
1970 and 2004 was from power generation (145 percent) followed by transport (120 percent). Fossil fuels account for three-quarters of the energy used in the power sector, with coal dominant (figure 3g and table 3.10). Coal is responsible for the majority of emissions from the power sector (figure 3h). Almost half the electricity and heat produced is used in buildings (residential and commercial), and around one-third in industry (WRI 2006).

North America accounts for by far the largest amount of power sector emissions (3 gigatons of carbon dioxide equivalent), followed by China (1.7 gigatons), European Union (1.6 gigatons), and transition economies (1.4 gigatons). North America also has among the highest emissions per capita (7 tons of carbon dioxide per person), more than twice those of the European Union and six times those of China (WRI 2006).

Transport accounts for 14 percent of global greenhouse gas emissions, behind power and land use change but about the same as agriculture (see figure 3f). Most of these emissions are from road transport (76 percent) and aviation (12 percent; figure 3i). By far the largest source of transport emissions is North America, producing 37 percent of the global total. This partly reflects the fact that the United States has the highest vehicle ownership in the world (814 vehicles per 1,000 people, compared with 604 in the European Union and 15 in China) and also lags in fuel efficiency, which is about two-thirds that in the European Union (An and Sauer 2004).

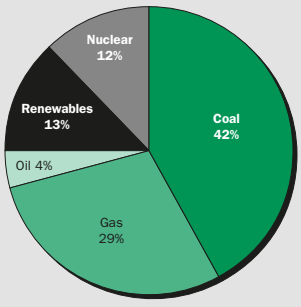
Agriculture and deforestation are responsible for one-third of greenhouse gas emissions. In many countries soil degradation, along with the loss of agricultural land through urbanization and population growth, has led to substantial deforestation. The global forested area in 2005 was about 4 billion hectares, covering 30 percent of total land area (table 3.4). But deforestation continues at about 13 million hectares a year. Reforestation reduced the net loss of forest areas to 7.3 million hectares a year during 2000–05, an improvement from losses of 8.9 million hectares a year during 1990–2000. Sub-Saharan Africa and Latin America continued to have the largest forest loss after 1990.

Power generation and land use change were the two largest sources of greenhouse gas emissions in 2000 **3f**



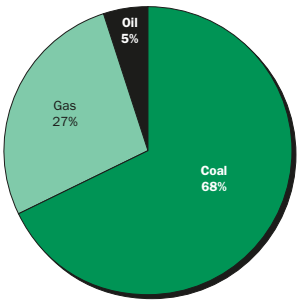
Source: WRI 2006.

Fossil fuels accounted for three-quarters of the fuel used in the power sector in 2002 **3g**



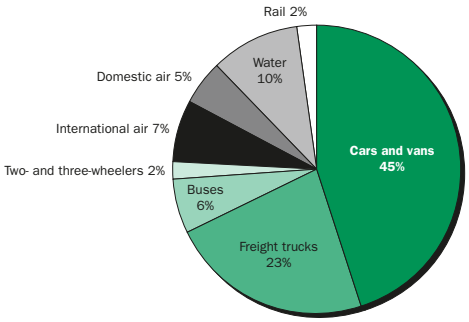
Source: WRI 2006.

Coal was responsible for the majority of emissions from the power sector in 2002 **3h**



Source: WRI 2006.

Road transport accounted for more than three-quarters of total transport carbon dioxide emissions in 2000 **3i**



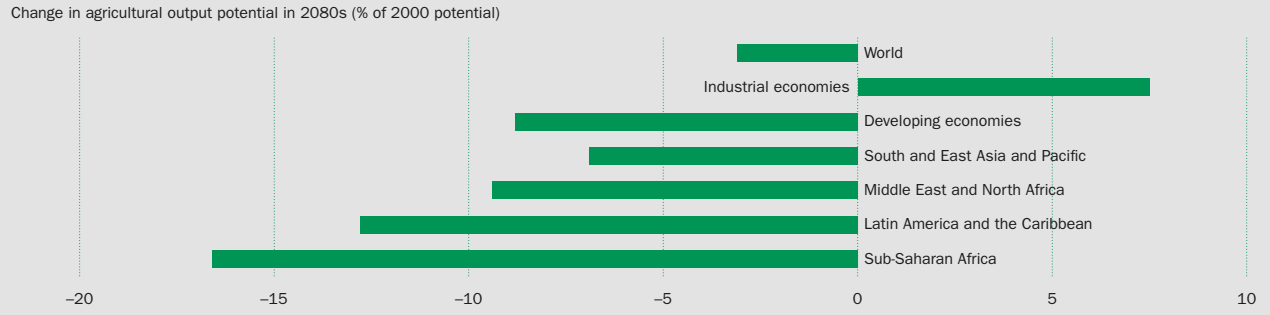
Source: WRI 2006.

Climate change and vulnerable people and regions

Climate change will have different effects on different regions (depending on geography) and different income groups (depending on livelihoods and adaptive capacity). The effects will also vary by the extent of adaptation, exposure to temperature change, and socioeconomic conditions. Potential impacts could include:

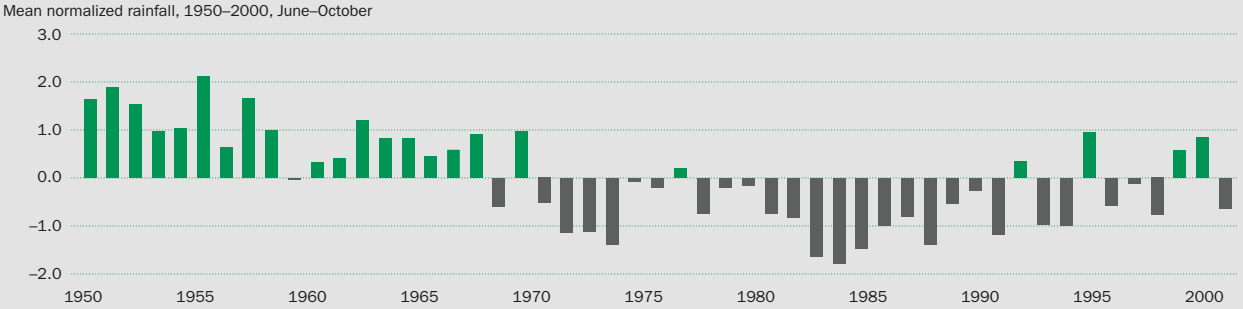
- *Lower agricultural productivity.* Climate change has the potential to drastically affect food production (figure 3j). In parts of Sub-Saharan Africa and South and East Asia losses in agricultural productivity are linked to drought and rainfall variation. Drought has already become more frequent in Sub-Saharan Africa (figure 3k). Because a large share of the world's poor people depend directly on agriculture, drought and other negative effects of climate change put poverty reduction efforts at risk. But global warming could potentially benefit agriculture in some temperate areas—mostly in developed countries.
- *Greater water scarcity.* The rise in global temperature is accelerating (figure 3l). If it exceeds the 2° C threshold (as some scenarios project), the distribution of the world's water resources will change drastically. While water's availability could increase in the moist tropics and in high latitudes, it will decline in the midlatitudes and in semiarid low altitudes, increasing droughts and water shortages. Accelerated glacial melt in the Himalayas will compound severe ecological problems in northern China, India, and Pakistan, increasing floods but reducing water flow to major river systems vital for irrigation. In Latin America accelerated melting of tropical glaciers will threaten water supplies for urban populations, agriculture, and hydroelectricity, especially in the Andean region. Water shortages could contribute to regional conflicts.
- *Heightened health risks.* Climate change will affect human health. Globally, 220–400 million more people could be at increased risk of malaria, particularly in Sub-Saharan Africa, where exposure to malaria is projected to increase 16–28 percent (UNDP 2007b; IPCC 2007b). Climate change could also increase the incidence of malnutrition, diarrhea, and infectious diseases—and change the distribution of disease vectors, adding to the burden on health services.

Climate change would hurt developing countries' agricultural output **3j**



Source: Cline 2007.

Less rain is falling in the Sahel, with dire consequences **3k**



Note: The averages are standardized for the period 1950–2000 so that the mean of the series is zero and the standard deviation is one.
Source: World Bank 2002e.

- *More exposure to climate disasters.* Climate-related disasters, mainly floods and droughts, have already increased. On average 262 million people a year were affected between 2000 and 2004, more than twice the number in the 1980s (figure 3m), and most of them (98 percent) live in developing countries (figure 3n). Temperature increases greater than 2° C would accelerate the rise in sea level, causing widespread displacement of people in countries such as Bangladesh, Egypt, and Vietnam and the inundation of several small-island economies. Rising sea levels and more intense tropical storm activity could raise the number of people experiencing coastal flooding by 180–230 million (Dasgupta and others 2007; Anthoff and others 2006; UNDP 2007b).
- *Harm to ecosystems.* Coral reef systems, already in decline, would suffer extensive bleaching, transforming marine ecologies, with large losses of biodiversity and ecosystem services. This would adversely affect hundreds of millions of people dependent on fish for their livelihoods and nutrition (UNDP 2007b).

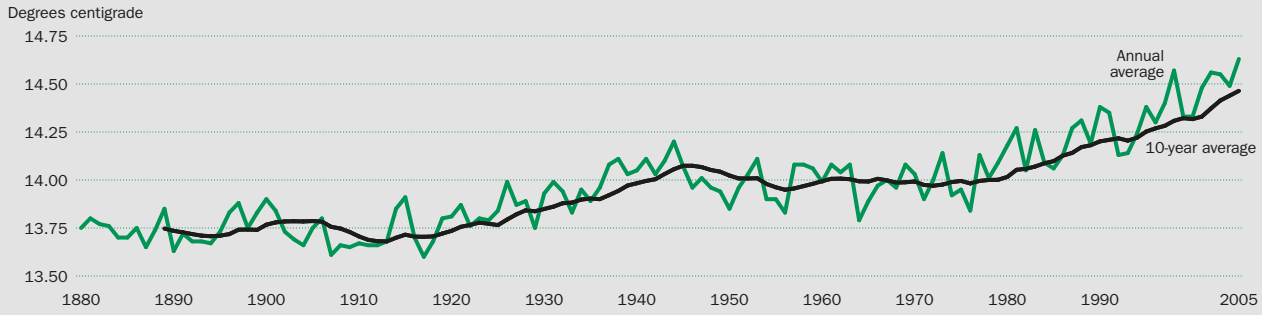
The negative impacts will not occur everywhere (IPCC 2007a). These impacts depend on two main factors: exposure to the effects of climate change and capacity to adapt to them.

Exposure is partly determined by environmental factors. People, flora, and fauna in areas prone to flooding or facing water scarcity have far greater exposure. The level of exposure also depends on the population density or the infrastructure in environmentally sensitive areas. Adaptive capacity is the ability to deal with climate change, such as by building levies to combat flooding or irrigation systems to deal with drought. It is closely associated with a society's wealth, education, institutional strength, and access to technology (Burton, Diringer, and Smith 2006; IPCC 2007e).

High exposure and low adaptive capacity occur mostly in developing countries, making them highly vulnerable to climate change.

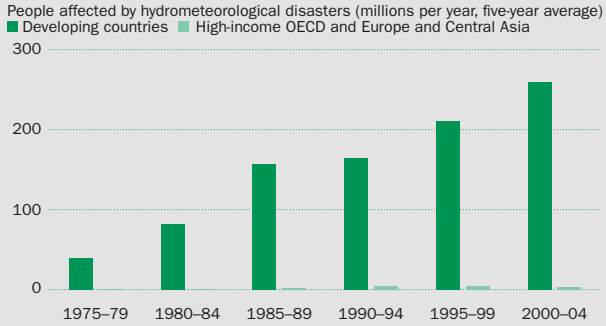
Poverty and political instability make the negative impacts of climate change more severe and weaken the ability to adapt.

The rise in global mean surface temperature is accelerating **3l**



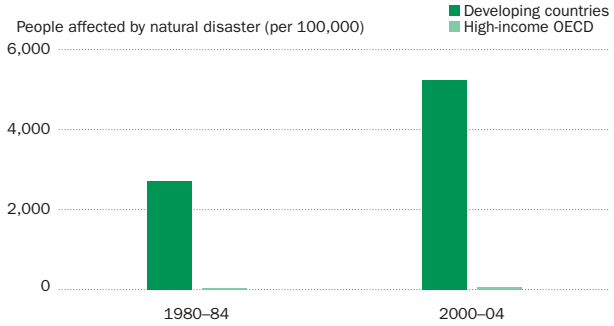
Source: Goddard Institute for Space Science Studies Analysis.

Climate disasters are affecting more and more people, mostly in developing countries **3m**



Source: UNDP 2007b, based on OFDA and CRED 2007.

Developing countries are exposed to higher risk of natural disaster **3n**



Source: UNDP 2007b, based on OFDA and CRED 2007.

The enormous costs of inaction

The impacts of climate change are costly—so is mitigating the causes of the climate change or adapting to the unavoidable outcomes of change. There is substantial economic and social justification for mitigating global greenhouse gases emissions over the coming decades (IPCC 2007d), offsetting the projected growth of global emissions or even reducing emissions below current levels. The costs of mitigation depend on the level at which emissions stabilize.

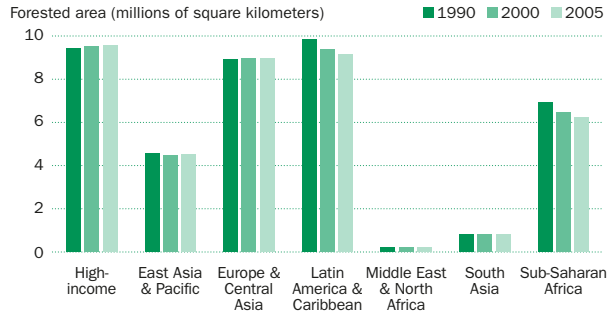
But the cost of inaction is significantly higher. The range of estimates is wide, depending on underlying assumptions, on which consensus is lacking. For example, the Stern Review (Stern 2006) estimates that without action the overall costs of climate change will be equivalent to losing at least 5 percent of global GDP each year, now and forever. They would be much higher under a wider range of risks and impacts.

Some steps to reduce carbon dioxide are economically and socially desirable, regardless of their mitigating impact. Conserving energy and promoting new technologies and energy alternatives (such as capturing and storing carbon and shifting to renewable and cleaner sources of energy) would reduce pollution while economizing on exhaustible resources. Preventing deforestation is important because forests protect biodiversity and provide livelihood for millions of poor people (figure 3o). But taking a low carbon path by shifting to alternative energy may be difficult for many developing countries that need to grow but can afford to use only fossil fuels—particularly coal, the "dirtiest" of energy sources.

With some 1.6 billion people lacking electricity (figure 3p; IEA 2006b), cheap and abundant coal is the fuel of choice in much of the world, powering economic booms in most developing economies, notably China and India, that have lifted millions of people out of poverty. Low-income countries use coal to generate 47 percent of their electricity. Coal generates 78 percent of China's electricity and 69 percent of India's (figure 3q). Worldwide, coal demand is projected to rise about 60 percent by 2030, to 6.9 billion metric tons a year, most of it going to electrical plants. So, greater coal efficiency can reduce carbon dioxide emissions (figure 3r).

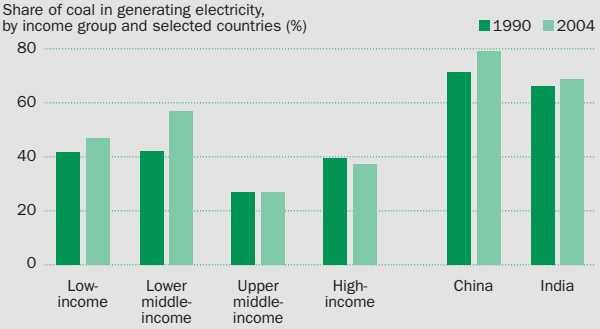
Burning coal does more than add to global warming—it is also linked to other environmental and health issues,

Forested areas are shrinking in Latin America and Sub-Saharan Africa—recovering in East Asia **3o**



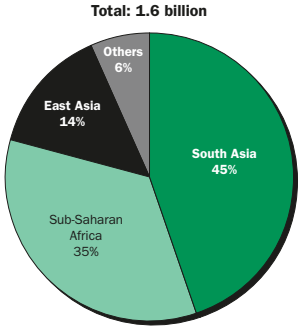
Source: Table 3.4.

China and India generate more than two-thirds of their electricity from coal **3q**



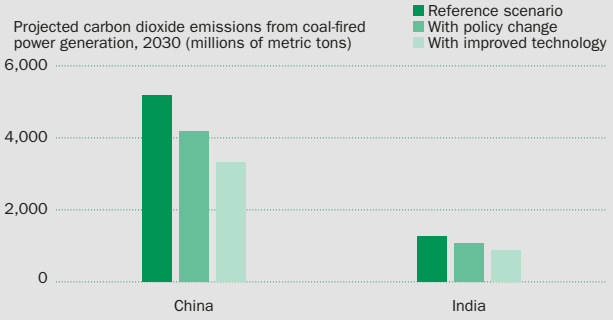
Source: Table 3.10.

The vast majority of people without access to electricity in 2004 lived in developing countries **3p**



Source: IEA 2006b.

Greater coal efficiency can reduce carbon dioxide emissions **3r**



Source: Watson 2007; UNDP 2007b.

including acid rain and asthma. Air pollution prematurely kills more than 2 million people a year. In China the health costs attributable to air pollution are estimated at $68 billion a year, nearly 4 percent of its economic output (World Bank 2007c). And acid rain has contaminated one-third of the country, destroying some $4 billion worth of crops every year. Chinese authorities have closed some polluting factories and by 2010 will retire 50 gigawatts of inefficient power plants (about 8 percent of the power grid; Pew Center on Global Climate Change 2007). The authorities have also mandated that solar, wind, hydroelectric, and other forms of renewable energy provide 10 percent of the nation's power by 2010—and ordered key industries to reduce energy consumption by 20 percent.

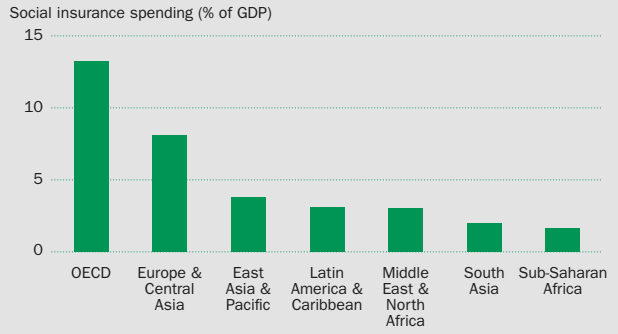
There is considerable agreement and much evidence that, even with current mitigation policies, global greenhouse gas emissions will continue to grow over the coming decades (IPCC 2007d). So, countries need to adapt to the unavoidable effects of climate change that are already affecting the well-being of their people, particularly those who are poor, the unintended victims of industrialized economies' past energy consumption.

With poor adaptive capacity, inadequate social protection, and gaps in climate information, developing countries will find it difficult to respond (figures 3s and 3t). Because climate change crosses national borders, a coordinated program of funding and new technologies is required. But the funding needed for adaptation is enormous, and the amount available for climate adaptation in developing countries is still insufficient. In June 2007 pledges totaled less than $220 million, with even smaller amounts allocated and disbursed (figure 3u). The Netherlands has already spent $2.2 billion for flood protection, and Austria has a $1.3 billion project to deal with water scarcity and extreme weather (WRI 2007).

There is still a window of opportunity to act before the economic and human costs become insurmountable (Stern 2006; IPCC 2007c). But action requires measuring and monitoring the state of the environment and human well-being and how they are changing. There are still information gaps, and many of the available data are not up to date. The impacts of carbon dioxide emissions are not well quantified, especially in developing countries. The impacts of extreme climate events are poorly tracked. Local impacts are not widely researched. Few projections on aquatic resources are available. Research on adaptation is still not comprehensive across a range of climate and socioeconomic futures. There is much to be learned about the impacts on biofuel and industrial crops.

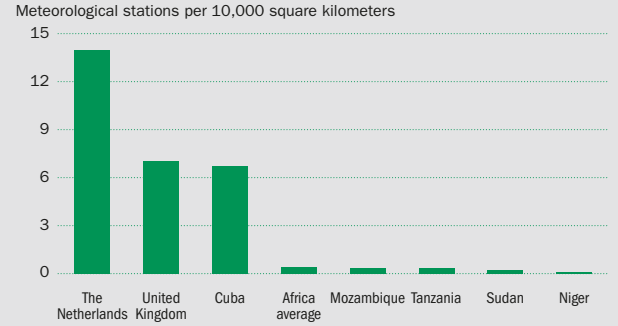
Numbers tell the story. But we still lack many of the numbers to tell the whole story.

Social insurance spending is lower in developing countries, where people are exposed to higher risk of climate change impact 3s



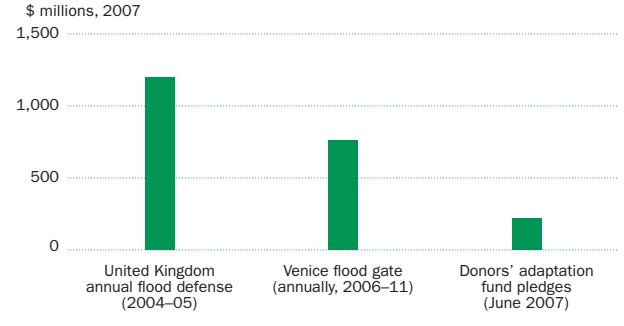
Source: World Bank 2005d.

The climate information gap makes adaptation more difficult 3t



Source: UNDP 2007b; WMO 2007; UN 2007.

Adaptation is expensive, and funding for developing countries is inadequate 3u



Source: UNDP 2007b; Abott 2004; DEFRA 2007; GEF 2007.

3.1 Rural population and land use

	Rural population			Land area	Land use							
	% of total		average annual % growth	thousand sq. km	% of land area						Arable land hectares per 100 people	
	1990	2006	1990–2006	2006	Forest area 1990	Forest area 2005	Permanent cropland 1990	Permanent cropland 2005	Arable land 1990	Arable land 2005	1990–92	2003–05
Afghanistan	..	..	..	652.1	2.0	1.3	0.2	0.2	12.1	12.1	..	..
Albania	63.6	53.9	–1.3	27.4	28.8	29.0	4.6	4.5	21.1	21.1	18.7	18.4
Algeria	47.9	36.1	0.0	2,381.7	0.8	1.0	0.2	0.4	3.0	3.1	24.5	23.1
Angola	62.9	46.0	0.9	1,246.7	48.9	47.4	0.4	0.2	2.3	2.6	21.2	21.1
Argentina	13.0	9.7	–0.7	2,736.7	12.9	12.1	0.4	0.4	9.6	10.4	75.2	74.0
Armenia	32.5	36.0	–0.4	28.2	12.3	10.0	2.7	2.1	17.7	17.6	16.1[c]	16.4
Australia	14.6	11.6	–0.2	7,682.3	21.9	21.3	0.0	0.0	6.2	6.4	248.9	240.6
Austria	34.2	33.9	0.4	82.5	45.8	46.8	1.0	0.8	17.3	16.8	17.3	17.0
Azerbaijan	46.3	48.4	1.3	82.7	11.3	11.3	3.7	2.7	20.5	22.3	22.6	22.2
Bangladesh	80.2	74.5	1.5	130.2	6.8	6.7	2.3	3.5	70.2	61.1	5.7	5.3
Belarus	33.6	27.3	–1.6	207.5	35.6	38.0	0.9	0.6	29.3	26.3	58.4[c]	56.2
Belgium	3.6	2.8	–1.3	30.2	22.4	22.1	..	0.8	..	27.9	8.2	8.1
Benin	65.5	59.5	2.7	110.6	30.0	21.3	0.9	2.4	14.6	24.9	33.0	33.0
Bolivia	44.4	35.3	0.7	1,084.4	57.9	54.2	0.1	0.2	1.9	2.8	34.9	33.9
Bosnia and Herzegovina	60.8	53.7	–1.4	51.2	43.2	42.7	2.9	1.9	16.6	19.5	26.1[c]	25.9
Botswana	58.1	41.8	–0.1	566.7	24.2	21.1	0.0	0.0	0.7	0.7	21.5	20.8
Brazil	25.2	15.3	–1.6	8,459.4	61.5	56.5	0.8	0.9	6.0	7.0	33.1	32.0
Bulgaria	33.6	29.7	–1.5	108.6	30.1	33.4	2.7	1.9	34.9	29.2	43.4	42.0
Burkina Faso	86.2	81.3	2.6	273.6	26.1	24.8	0.2	0.2	12.9	17.7	35.9	35.9
Burundi	93.7	89.7	2.0	25.7	11.3	5.9	14.0	14.2	36.2	37.8	14.2	13.0
Cambodia	87.4	79.7	1.8	176.5	73.3	59.2	0.6	0.9	20.9	21.0	28.4	27.0
Cameroon	59.3	44.5	0.7	465.4	52.7	45.6	2.6	2.6	12.8	12.8	36.7	34.2
Canada	23.4	19.8	0.0	9,093.5	34.1	34.1	0.7	0.7	5.0	5.0	147.4	142.8
Central African Republic	63.2	61.8	2.0	623.0	37.2	36.5	0.1	0.1	3.1	3.1	49.1	46.8
Chad	79.2	74.2	3.0	1,259.2	10.4	9.5	0.0	0.0	2.6	3.3	40.7	40.1
Chile	16.7	12.1	–0.6	748.8	20.4	21.5	0.3	0.5	3.7	2.6	12.7	12.2
China	72.6	58.7	–0.4	9,360.8[a]	16.8	21.2	0.8	1.4	13.3	15.4	11.1	11.0
Hong Kong, China	0.5	0.0	..	1.0	..	..	..	..	..	..	..	..
Colombia	31.3	27.0	0.7	1,109.5	55.4	54.7	1.5	1.5	3.0	1.8	5.9	4.9
Congo, Dem. Rep.	72.2	67.3	2.5	2,267.1	62.0	58.9	0.5	0.5	2.9	3.0	12.9	11.8
Congo, Rep.	45.7	39.4	1.7	341.5	66.5	65.8	0.1	0.1	1.4	1.4	15.0	14.0
Costa Rica	49.3	37.8	0.6	51.1	50.2	46.8	4.9	6.5	5.1	4.4	5.6	5.3
Côte d'Ivoire	60.3	54.6	1.8	318.0	32.1	32.7	11.0	11.3	7.6	11.0	18.2	18.8
Croatia	46.0	43.2	–0.8	55.9	37.8	38.2	2.0	2.1	21.7	19.8	32.7[c]	27.6
Cuba	26.6	24.6	–0.1	109.8	18.7	24.7	7.4	6.1	27.6	33.4	32.8	32.7
Czech Republic	24.8	26.5	0.4	77.3	34.0	34.3	..	3.1	..	39.4	30.1	29.9
Denmark	15.2	14.3	0.0	42.4	10.5	11.8	0.2	0.2	60.4	52.7	42.6	41.8
Dominican Republic	44.8	32.5	–0.3	48.4	28.4	28.4	9.3	10.3	18.6	16.9	9.2	8.8
Ecuador	44.9	36.7	0.3	276.8	49.9	39.2	4.8	4.4	5.8	4.9	12.0	10.1
Egypt, Arab Rep.	56.5	57.0	1.9	995.5	0.0	0.1	0.4	0.5	2.3	3.0	4.2	4.1
El Salvador	50.8	39.9	0.2	20.7	18.1	14.4	12.5	12.1	26.5	31.9	10.4	10.0
Eritrea	84.2	80.2	2.2	101.0	16.0	15.4	..	0.0	..	6.3	14.6	14.0
Estonia	28.9	30.9	–0.6	42.4	51.0	53.9	0.3	0.3	26.3	13.9	52.1[c]	40.9
Ethiopia	87.4	83.7	2.3	1,000.0	13.7	13.0	0.6	0.8	9.8	13.1	15.1	16.7
Finland	38.6	38.8	0.4	304.6	72.9	73.9	0.0	0.0	7.4	7.3	42.2	42.5
France	25.9	23.1	–0.2	550.1	26.4	28.3	2.2	2.1	32.7	33.6	31.1	30.5
Gabon	30.9	15.9	–1.9	257.7	85.1	84.5	0.6	0.7	1.1	1.3	27.0	25.6
Gambia, The	61.7	45.3	1.5	10.0	44.2	47.1	0.5	0.5	18.2	35.0	21.3	21.9
Georgia	44.8	47.7	–0.9	69.5	39.7	39.7	4.8	3.8	11.4	11.5	17.1[c]	17.8
Germany	26.6	24.7	–0.2	348.8	30.8	31.8	1.3	0.6	34.3	34.1	14.3	14.4
Ghana	63.5	51.5	1.1	227.5	32.7	24.2	6.6	9.7	11.9	18.4	19.7	19.0
Greece	41.2	40.9	0.5	128.9	25.6	29.1	8.3	8.8	22.5	20.4	24.9	24.1
Guatemala	58.9	52.3	1.6	108.4	43.8	36.3	4.5	5.6	12.0	13.3	12.2	11.6
Guinea	72.0	66.5	2.1	245.7	30.1	27.4	2.0	2.7	3.0	4.9	12.1	13.2
Guinea-Bissau	71.9	70.3	2.9	28.1	78.8	73.7	4.2	8.9	10.7	10.7	21.2	19.4
Haiti	70.5	60.5	0.8	27.6	4.2	3.8	11.6	11.6	28.3	28.3	8.9	8.5

Rural population and land use

3.1

	Rural population			Land area	Land use							
	% of total		average annual % growth	thousand sq. km	Forest area		% of land area Permanent cropland		Arable land		Arable land hectares per 100 people	
	1990	2006	1990–2006	2006	1990	2005	1990	2005	1990	2005	1990–92	2003–05
Honduras	59.7	53.0	1.5	111.9	66.0	41.5	3.2	3.2	13.1	9.5	16.9	15.9
Hungary	34.2	33.3	–0.4	89.6	20.0	22.1	2.6	2.3	56.2	51.3	45.2	45.5
India	74.5	71.0	1.4	2,973.2	21.5	22.8	2.2	3.4	54.8	53.7	15.5	14.8
Indonesia	69.4	50.8	–0.6	1,811.6	64.3	48.8	6.5	7.5	11.2	12.7	10.3	10.6
Iran, Islamic Rep.	43.7	32.6	–0.3	1,628.6	6.8	6.8	0.8	1.0	9.3	10.2	24.0	24.0
Iraq	30.3	..	..	437.4	1.8	1.9	0.7	0.6	12.1	13.1	22.0	..
Ireland	43.1	39.2	0.6	68.9	6.4	9.7	0.0	0.0	15.1	17.6	29.7	29.5
Israel	9.6	8.4	1.7	21.6	7.1	7.9	4.1	3.5	15.9	14.6	5.3	4.8
Italy	33.3	32.2	0.0	294.1	28.5	33.9	10.1	8.6	30.6	26.3	14.7	13.6
Jamaica	50.6	46.6	0.2	10.8	31.9	31.3	9.2	10.2	11.0	16.1	6.7	6.6
Japan	36.9	34.0	–0.3	364.5	68.4	68.2	1.3	0.9	13.1	12.0	3.5	3.4
Jordan	27.8	17.4	0.6	88.2	0.9	0.9	0.8	1.0	2.0	2.1	3.9	3.6
Kazakhstan	43.7	42.4	–0.6	2,699.7	1.3	1.2	*0.1*	0.1	*13.0*	8.3	148.7	149.3
Kenya	81.8	79.0	2.6	569.1	6.5	6.2	0.8	0.8	8.8	9.2	15.7	15.1
Korea, Dem. Rep.	41.6	38.0	0.5	120.4	68.1	51.4	1.5	1.7	19.0	23.3	11.4	11.7
Korea, Rep.	26.2	19.0	–1.3	98.7	64.5	63.5	1.6	2.0	19.8	16.4	3.6	3.4
Kuwait	2.0	1.7	0.2	17.8	0.2	0.3	0.1	0.2	0.2	0.8	0.6[c]	0.6
Kyrgyz Republic	62.2	64.0	1.2	191.8	4.4	4.5	*0.4*	0.4	6.9	6.7	27.2[c]	25.9
Lao PDR	84.6	79.0	1.7	230.8	75.0	69.9	0.3	0.4	3.5	4.3	17.0	17.8
Latvia	30.7	32.1	–0.7	62.3	44.7	47.2	*0.4*	0.2	*27.2*	17.5	41.0[c]	44.1
Lebanon	16.9	13.3	0.4	10.2	11.8	13.3	11.9	13.9	17.9	18.2	4.7	4.7
Lesotho	82.8	81.0	1.2	30.4	0.2	0.3	0.1	0.1	10.4	10.9	17.3	16.8
Liberia	54.7	41.2	1.5	96.3	42.1	32.7	2.2	2.3	4.2	4.0	12.0	11.4
Libya	21.4	14.9	–0.2	1,759.5	0.1	0.1	0.2	0.2	1.0	1.0	33.3	30.6
Lithuania	32.4	33.4	–0.3	62.7	31.0	33.5	*0.7*	0.6	*46.0*	30.4	58.8[c]	49.0
Macedonia, FYR	42.2	30.4	–1.6	25.4	35.6	35.6	*2.2*	1.8	*23.8*	22.3	27.9[c]	27.9
Madagascar	76.4	72.9	2.6	581.5	23.5	22.1	1.0	1.0	4.7	5.1	17.6	16.3
Malawi	88.4	82.3	1.8	94.1	41.4	36.2	1.2	1.5	19.3	27.6	18.4	19.8
Malaysia	50.2	31.8	–0.6	328.6	68.1	63.6	16.0	17.6	5.2	5.5	7.6	7.1
Mali	76.7	68.9	2.1	1,220.2	11.5	10.3	0.0	0.0	1.7	3.9	45.3	42.6
Mauritania	60.3	59.4	2.7	1,030.7	0.4	0.3	0.0	0.0	0.4	0.5	18.5	17.1
Mauritius	56.1	57.5	1.2	2.0	19.2	18.2	3.0	3.0	49.3	49.3	8.3	8.1
Mexico	27.5	23.7	0.5	1,944.0	35.5	33.0	1.0	1.3	12.5	12.9	25.4	24.6
Moldova	53.2	53.0	–0.9	32.9	9.7	10.0	*14.2*	9.1	*52.8*	56.2	45.1[c]	47.1
Mongolia	43.0	43.1	1.3	1,566.5	7.3	6.5	0.0	0.0	0.9	0.7	49.1	46.7
Morocco	51.6	40.7	0.0	446.3	9.6	9.8	1.6	2.1	19.5	19.0	29.7	28.4
Mozambique	78.9	64.7	1.5	786.4	25.4	24.5	0.3	0.3	4.4	5.6	21.6	21.8
Myanmar	75.1	68.7	0.6	657.6	59.6	49.0	0.8	1.4	14.5	15.3	21.4	21.1
Namibia	72.3	64.3	1.6	823.3	10.6	9.3	0.0	0.0	0.8	1.0	42.7	40.9
Nepal	91.1	83.7	1.8	143.0	33.7	25.4	0.5	0.9	16.0	16.5	9.4	8.9
Netherlands	31.3	19.3	–2.5	33.9	10.2	10.8	0.9	1.0	25.9	26.8	5.7	5.6
New Zealand	15.3	13.7	0.5	267.7	28.8	31.0	5.1	7.1	9.9	5.6	38.5	36.7
Nicaragua	46.9	40.6	0.9	121.4	53.9	42.7	1.6	1.9	10.7	15.9	37.1	35.7
Niger	84.6	83.0	3.4	1,266.7	1.5	1.0	0.0	0.0	8.7	11.4	125.7	113.1
Nigeria	65.0	51.0	1.2	910.8	18.9	12.2	2.8	3.3	32.4	35.1	22.6	22.6
Norway	28.0	22.5	–0.8	304.3	30.0	30.8	..	..	2.8	2.8	19.6	19.0
Oman	34.6	28.5	0.8	309.5	0.0	0.0	0.1	0.1	0.1	0.2	1.6	2.2
Pakistan	69.4	64.7	2.0	770.9	3.3	2.5	0.6	1.0	26.6	27.6	15.2	14.1
Panama	46.1	28.4	–1.1	74.4	58.8	57.7	2.1	2.0	6.7	7.4	18.1	17.3
Papua New Guinea	86.9	86.5	2.5	452.9	69.6	65.0	1.3	1.4	0.4	0.5	3.8	3.9
Paraguay	51.3	40.9	0.8	397.3	53.3	46.5	0.2	0.2	5.3	10.6	61.2	70.2
Peru	31.1	27.2	0.6	1,280.0	54.8	53.7	0.3	0.5	2.7	2.9	14.2	13.7
Philippines	51.2	36.6	0.0	298.2	35.5	24.0	14.8	16.8	18.4	19.1	7.3	6.9
Poland	38.7	37.8	–0.2	306.3	29.2	30.0	1.1	1.2	47.3	39.6	35.3	32.6
Portugal	52.1	41.8	–1.0	91.5	33.9	41.3	8.5	7.1	25.6	13.8	15.4	13.3
Puerto Rico	27.8	2.2	–15.3	8.9	45.5	46.0	5.6	4.7	7.3	8.0	1.7	1.8

3.1 Rural population and land use

	Rural population			Land area	Land use							
	% of total		average annual % growth	thousand sq. km	Forest area		% of land area Permanent cropland		Arable land		Arable land hectares per 100 people	
	1990	2006	1990–2006	2006	1990	2005	1990	2005	1990	2005	1990–92	2003–05
Romania	45.7	46.1	–0.4	230.0	27.8	27.7	2.6	2.3	41.2	40.4	42.4	43.2
Russian Federation	26.6	27.1	–0.1	16,381.4	49.4	49.4	*0.1*	0.1	*8.1*	7.4	84.9[c]	84.9
Rwanda	94.6	79.8	0.6	24.7	12.9	19.5	12.4	11.1	35.7	48.6	11.8	13.2
Saudi Arabia	23.4	18.8	0.9	2,000.0[b]	1.4	1.4	0.0	0.1	1.7	1.8	17.0	15.7
Senegal	61.0	58.1	2.4	192.5	48.6	45.0	0.1	0.2	12.1	13.2	22.9	21.8
Serbia[d]	49.1	47.6	..	102.0	25.1	26.4	*3.5*	3.1	*36.5*	34.4	41.9[c]	42.4
Sierra Leone	69.9	58.6	1.0	71.6	42.5	38.5	0.8	1.1	6.8	8.4	10.8	11.0
Singapore	0.0	0.0	..	0.7	3.0	2.9	1.5	0.3	1.5	0.9	0.0	0.0
Slovak Republic	43.5	43.7	0.2	48.1	40.0	40.1	..	0.5	..	28.9	27.1	26.0
Slovenia	49.6	48.8	–0.1	20.1	59.0	62.8	*1.8*	1.3	*9.9*	8.7	8.6[c]	8.7
Somalia	70.3	64.3	0.9	627.3	13.2	11.4	0.0	0.0	1.6	2.2	15.1	16.5
South Africa	48.0	40.2	0.8	1,214.5	7.6	7.6	0.7	0.8	11.1	12.1	33.0	31.8
Spain	24.6	23.2	0.4	499.2	27.0	35.9	9.7	9.9	30.7	27.4	32.2	32.0
Sri Lanka	82.8	84.9	1.1	64.6	36.4	29.9	15.9	15.5	13.5	14.2	4.7	4.7
Sudan	73.4	58.3	0.9	2,376.0	32.1	28.4	0.0	0.1	5.4	8.2	48.1	51.2
Swaziland	77.1	75.6	2.3	17.2	27.4	31.5	0.7	0.8	10.5	10.3	16.7	15.9
Sweden	16.9	15.7	–0.1	410.3	66.7	67.1	0.0	0.0	6.9	6.6	30.3	29.8
Switzerland	31.6	24.4	–0.9	40.0	28.9	30.5	0.5	0.6	9.8	10.3	5.7	5.5
Syrian Arab Republic	51.1	49.2	2.4	183.8	2.0	2.5	4.0	4.7	26.6	26.5	27.1	25.9
Tajikistan	68.5	75.4	2.0	140.0	2.9	2.9	*0.9*	0.9	*6.1*	6.6	14.9[c]	14.4
Tanzania	81.1	75.4	2.3	885.8	46.8	39.8	1.1	1.3	10.2	10.4	25.9	24.5
Thailand	70.6	67.4	0.7	510.9	31.2	28.4	6.1	7.0	34.2	27.8	25.9	22.7
Timor-Leste	79.2	73.1	1.5	14.9	65.0	53.7	3.9	4.6	7.4	8.2	15.2	13.2
Togo	69.9	59.2	2.0	54.4	12.6	7.1	1.7	2.6	38.6	45.8	45.1	41.2
Trinidad and Tobago	91.5	87.5	0.2	5.1	45.8	44.1	9.0	9.2	14.4	14.6	5.7	5.7
Tunisia	40.4	34.3	0.3	155.4	4.1	6.8	12.5	13.9	18.7	17.6	29.0	27.9
Turkey	40.8	32.2	0.2	769.6	12.6	13.2	3.9	3.6	32.0	31.0	34.8	33.2
Turkmenistan	54.9	53.4	1.6	469.9	8.8	8.8	*0.1*	0.1	*2.9*	4.9	40.5[c]	46.9
Uganda	88.9	87.3	3.1	197.1	25.0	18.4	9.4	11.2	25.4	27.4	20.0	18.9
Ukraine	33.2	32.0	–0.9	579.4	16.0	16.5	*1.9*	1.6	*57.6*	56.0	66.9[c]	68.4
United Arab Emirates	20.9	23.3	6.1	83.6	2.9	3.7	0.2	2.3	0.4	0.8	2.0	1.6
United Kingdom	11.3	10.2	–0.3	241.9	10.8	11.8	0.3	0.2	27.4	23.7	9.7	9.6
United States	24.7	18.9	–0.5	9,161.9	32.6	33.1	0.2	0.3	20.3	19.0	61.6	59.6
Uruguay	11.0	7.9	–1.7	175.0	5.2	8.6	0.3	0.2	7.2	7.8	41.5	41.5
Uzbekistan	59.9	63.3	2.0	425.4	7.2	7.7	*0.9*	0.8	*10.5*	11.0	18.0[c]	18.2
Venezuela, RB	16.0	6.3	–3.9	882.1	59.0	54.1	0.9	0.9	3.2	3.0	10.5	10.1
Vietnam	79.7	73.1	1.0	310.1	28.8	41.7	3.2	7.6	16.4	21.3	8.2	8.0
West Bank and Gaza	32.1	28.3	3.3	6.0	1.5	1.5	19.1	19.1	18.4	17.8	3.4	3.0
Yemen, Rep.	79.1	72.3	3.0	528.0	1.0	1.0	0.2	0.3	2.9	2.9	8.1	7.4
Zambia	60.6	64.9	2.7	743.4	66.1	57.1	0.0	0.0	7.1	7.1	49.3	46.7
Zimbabwe	71.0	63.6	0.8	386.9	57.5	45.3	0.3	0.3	7.5	8.3	25.2	24.7
World	**57.0 w**	**50.9 w**	**0.6 w**	**129,644.6 w**	**31.5 w**	**30.5 w**	**1.1 w**	**1.1 w**	**10.9 w**	**11.0 w**	**23.0 w**	**22.3 w**
Low income	74.6	69.6	1.6	28,147.5	26.2	23.9	1.0	1.3	13.2	14.1	17.4	16.9
Middle income	55.8	45.5	–0.2	68,468.3	34.8	33.8	1.4	1.2	9.1	9.7	22.4	21.8
Lower middle income	64.9	52.7	–0.2	27,976.6	27.0	26.5	1.6	1.9	9.4	11.4	14.5	14.2
Upper middle income	30.6	25.0	–0.3	40,491.7	40.2	38.8	1.1	0.7	*8.9*	8.5	44.6	43.2
Low & middle income	63.3	56.1	0.7	96,615.8	32.2	30.9	1.2	1.2	10.6	11.0	20.3	19.7
East Asia & Pacific	71.2	57.6	–0.2	15,871.1	28.8	28.4	2.2	2.9	12.1	13.5	11.6	11.4
Europe & Central Asia	37.0	36.2	0.0	23,247.6	38.2	38.3	*0.4*	0.4	*12.3*	11.1	57.7	57.0
Latin America & Carib.	29.0	22.3	–0.1	20,156.5	48.8	45.4	0.9	1.0	6.5	7.2	27.5	26.7
Middle East & N. Africa	48.0	42.5	1.2	8,953.2	2.2	2.4	0.8	0.9	5.6	5.9	18.1	17.5
South Asia	75.1	71.2	1.5	4,781.3	16.5	16.8	1.8	2.6	42.6	41.9	14.5	13.8
Sub-Saharan Africa	72.0	64.2	1.9	23,606.1	29.2	26.5	0.8	0.9	6.7	8.0	25.5	25.0
High income	26.4	22.4	–0.3	33,028.8	29.1	29.5	0.7	0.7	11.4	11.0	37.3	36.4
Euro area	29.0	26.5	–0.2	2,464.9	33.4	37.2	4.7	4.4	27.1	25.4	20.4	20.1

a. Includes Taiwan, China; Macao, China; and Hong Kong, China. b. Provisional estimate. c. Data for all three years are not available. d. Includes Montenegro.

Rural population and land use 3.1

About the data

With 3 billion people, including 70 percent of the world's poor people, living in rural areas, adequate indicators to monitor progress in rural areas are essential. However, few indicators are disaggregated between rural and urban areas (for some that are, see tables 2.7, 3.5, and 3.11). The table shows indicators of rural population and land use. Rural population is approximated as the midyear nonurban population. While a practical means of identifying the rural population, it is not precise (see box 3.1a for further discussion).

The data in the table show that land use patterns are changing. They also indicate major differences in resource endowments and uses among countries. True comparability of the data is limited, however, by variations in definitions, statistical methods, and quality of data. Countries use different definitions of rural and urban population and land use. The Food and Agriculture Organization of the United Nations (FAO), the primary compiler of the data, occasionally adjusts its definitions of land use categories and revises earlier data. Because the data reflect changes in reporting procedures as well as actual changes in land use, apparent trends should be interpreted cautiously.

Satellite images show land use that differs from that of ground-based measures in area under cultivation and type of land use. Moreover, land use data in some countries (India is an example) are based on reporting systems designed for collecting tax revenue. With land taxes no longer a major source of government revenue, the quality and coverage of land use data have declined. Data on forest area may be particularly unreliable because of irregular surveys and differences in definitions (see *About the data* for table 3.4). FAO's *Global Forest Resources Assessment 2005* aims to address this limitation. The FAO has been coordinating global forest resources assessments every 5–10 years since 1946. *Global Forest Resources Assessment 2005,* conducted during 2003–05, covers 229 countries and territories at three points: 1990, 2000, and 2005. The most comprehensive assessment of forests, forestry, and the benefits of forest resources in both scope and number of countries and people involved, it examines status and trends for about 40 variables on the extent, condition, uses, and values of forests and other wooded land.

What is rural? Urban? 3.1a

The rural population identified in table 3.1 is approximated as the difference between total population and urban population, calculated using the urban share reported by the United Nations Population Division. There is no universal standard for distinguishing rural from urban areas, and any urban-rural dichotomy is an oversimplification (see *About the data* for table 3.11). The two distinct images—isolated farm, thriving metropolis—represent poles on a continuum. Life changes along a variety of dimensions, moving from the most remote forest outpost through fields and pastures, past tiny hamlets, through small towns with weekly farm markets, into intensively cultivated areas near large towns and small cities, eventually reaching the center of a megacity. Along the way access to infrastructure, social services, and nonfarm employment increase, and with them population density and income. Because rurality has many dimensions, for policy purposes the rural-urban dichotomy presented in tables 3.1 and 3.11 is inadequate.

A recent World Bank Policy Research Paper proposes an operational definition of rurality based on population density and distance to large cities (Chomitz, Buys, and Thomas 2005). The report argues that these criteria are important gradients along which economic behavior and appropriate development interventions vary substantially. Where population densities are low, markets of all kinds are thin, and the unit cost of delivering most social services and many types of infrastructure is high. Where large urban areas are distant, farm-gate or factory-gate prices of outputs will be low and input prices will be high, and it will be difficult to recruit skilled people to public service or private enterprises. Thus, low population density and remoteness together define a set of rural areas that face special development challenges.

Using these criteria and the Gridded Population of the World (CIESIN 2005), the authors' estimates of the rural population for Latin America and the Caribbean differ substantially from those in table 3.1. Their estimates range from 13 percent of the population, based on a population density of less than 20 people per square kilometer, to 64 percent, based on a population density of more than 500 people per square kilometer. Taking remoteness into account, the estimated rural population would be 13–52 percent. The estimate for Latin America and the Caribbean in table 3.1 is 22 percent.

Definitions

• **Rural population** is calculated as the difference between the total population and the urban population (see *Definitions* for tables 2.1 and 3.11). • **Land area** is a country's total area, excluding area under inland water bodies and national claims to the continental shelf and to exclusive economic zones. In most cases definitions of inland water bodies includes major rivers and lakes. (See table 1.1 for the total surface area of countries.) • **Land use** can be broken into several categories, three of which are presented in the table (not shown are land used as permanent pasture and land under urban developments). • **Forest area** is land under natural or planted stands of trees, whether productive or not. • **Permanent cropland** is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee, and rubber. Land under flowering shrubs, fruit trees, nut trees, and vines is included, but land under trees grown for wood or timber is not. • **Arable land** is land defined by the FAO as under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded.

Data sources

Data on urban population shares used to estimate rural population come from the United Nations Population Division's *World Urbanization Prospects: The 2005 Revision.* The total population figures are World Bank estimates. Data on land area and land use are from the FAO's electronic files. The FAO gathers these data from national agencies through annual questionnaires and by analyzing the results of national agricultural censuses. Data on forest area are from the FAO's *Global Forest Resources Assessment 2005.*

3.2 Agricultural inputs

	Agricultural land[a]		Irrigated land		Land under cereal production		Fertilizer consumption		Agricultural employment		Agricultural machinery	
	% of land area		% of cropland		thousand hectares		hundred grams per hectare of arable land		% of total employment		Tractors per 100 sq. km of arable land	
	1990–92	2003–05	1990–92[b]	2003–05[b,c]	1990–92	2004–06	1990–92[b]	2003–05[b]	1990–92	2003–05	1990–92	2001–03
Afghanistan	58.3	58.3	33.9	*33.8*	2,283	2,702	59	..	..	..	1	1
Albania	41.1	40.9	55.6	*49.5*	243	145	903	924	..	58.3	177	141
Algeria	16.3	17.1	6.4	*6.9*	3,105	2,675	144	137	..	21.1	128	129
Angola	46.1	46.2	2.3	*2.3*	893	1,441	29	29	..	..	35	33
Argentina	46.6	47.2	5.6	*4.7*[d]	8,510	9,309	73	480	0.4	1.2	103	107
Armenia	44.7[d]	49.3	49.9[d]	*51.2*	163[d]	171	502[d]	232	..	46.5	293	289
Australia	60.5	57.5	4.2	*4.9*	12,814	19,004	275	469	5.5	3.8	67	65
Austria	42.5	40.0	0.3	*2.5*[d,e]	903	798	1,995	2,309	7.5	5.4	2,367	2,380
Azerbaijan	53.4[d]	57.5	68.0[d]	*69.1*	627	791	440[d]	134	32.5	39.6	195[d]	164
Bangladesh	73.5	69.2	33.8	*54.3*	10,985	11,312	1,136	2,094	66.4	51.7	6	7
Belarus	45.3[d]	42.7	2.1[d]	*2.0*	2,578[d]	2,186	2,293[d]	1,886	21.7	..	207[d]	111
Belgium	..	46.0	..	*4.6*	..	320	..	..	2.8	1.9	..	1,146
Benin	20.6	31.9	0.6	*0.4*	660	937	78	3	..	..	1	1
Bolivia	32.9	34.6	5.5	*4.1*	633	846	42	62	1.7	..	25	20
Bosnia and Herzegovina	43.0[d]	42.1	0.2[d]	*0.3*	305[d]	318	..	453	..	..	235[d]	289
Botswana	45.9	45.8	0.2	*0.3*	140	75	22	..	..	21.2	143	159
Brazil	28.9	31.2	4.6	*4.4*	19,633	19,368	656	1,539	25.6	20.9	142	137
Bulgaria	55.7	48.5	29.6	*16.5*	2,174	1,701	1,194	1,541	19.7	9.6	128	95
Burkina Faso	34.9	39.8	0.6	*0.5*	2,725	3,249	60	75	..	..	3	4
Burundi	82.9	90.9	1.2	*1.6*	219	209	34	16	..	..	2	2
Cambodia	25.5	29.6	6.6	*7.0*	1,801	2,431	19	50[c]	..	..	3	7
Cameroon	19.7	19.7	0.3	*0.4*	816	1,107	34	94	60.6	..	1	1
Canada	7.5	7.4	1.4	*1.5*	20,864	16,772	476	581	4.2	2.7	162	160
Central African Republic	8.0	8.4	0.0	*0.1*	104	177	5	..	..	..	0	0
Chad	38.4	38.9	0.5	*0.8*	1,242	2,264	25	..	..	..	1	0
Chile	21.0	20.4	57.1	*81.1*	742	663	1,215	2,910	18.8	13.4	144	272
China	57.0	59.5	36.9	*35.5*	93,430	81,957	2,321	3,214	53.5	..	64	65
Hong Kong, China	..	..	..	..	..	..	..	..	0.8	0.3	..	..
Colombia	40.5	38.2	14.3	*23.3*	1,598	1,210	1,822	2,940	1.4	21.3	98	91
Congo, Dem. Rep.	10.1	10.1	0.1	*0.1*	1,868	1,964	8	..	..	..	4	4
Congo, Rep.	30.8	30.9	0.3	*0.4*	9	12	35	..	..	..	15	14
Costa Rica	55.7	56.5	15.2	*20.4*	83	62	4,522	8,528	25.2	15.0	259	311
Côte d'Ivoire	59.8	63.4	1.1	*1.1*	1,434	842	151	203	..	..	15	12
Croatia	43.0[d]	50.8	0.2[d]	*0.4*	593[d]	598	1,514[d]	1,337	..	16.8	35[d]	25
Cuba	61.5	60.0	22.6	*19.5*	235	286	1,288	156	25.1	21.5	250	209
Czech Republic	..	55.2	..	*0.7*	..	1,589	..	1,404	10.1	4.3	..	305
Denmark	65.4	62.0	16.9	9.7	1,581	1,499	2,249	1,159	5.4	3.0	625	540
Dominican Republic	71.6	70.7	16.5	*20.9*	134	156	1,003	..	19.5	14.4	25	23
Ecuador	28.6	26.9	27.9	28.3	861	881	508	1,731	7.0	8.9	67	106
Egypt, Arab Rep.	2.7	3.5	100.0	*100.0*	2,410	2,918	3,977	6,707	36.2	29.9	251	309
El Salvador	71.1	82.2	4.9	*4.9*	453	335	1,336	904	17.9	18.7	60	52
Eritrea	..	75.1	..	*3.6*	..	371	..	13	..	..	..	8
Estonia	32.4[d]	19.1	0.5[d]	*0.6*	454	274	1,011[d]	4,846	19.5	5.8	419[d]	889
Ethiopia	51.0	33.0	1.4	*2.6*	4,586	9,126	..	32	..	44.1	4	3
Finland	7.9	7.4	2.8	2.9	1,050	1,154	1,647	1,286	8.8	4.9	1,040	882
France	55.3	53.9	11.0	*13.3*	9,212	9,226	2,918	2,162	..	4.0	784	685
Gabon	20.0	20.0	1.1	*1.4*	14	20	25	38	..	..	50	46
Gambia, The	63.2	80.7	0.9	*0.6*	90	200	44	..	..	..	2	1
Georgia	46.5[d]	43.3	39.9[d]	*44.1*	249	314	906[d]	319	..	54.4	296[d]	254
Germany	49.8	48.8	4.0	*4.0*	6,673	6,829	2,616	2,208	4.0	2.4	1,253	801
Ghana	55.7	64.8	0.7	*0.5*	1,078	1,377	38	63	62.0	..	15	9
Greece	71.3	65.2	31.1	*37.4*	1,455	1,156	2,289	1,691	22.7	13.4	774	939
Guatemala	39.5	42.9	6.8	*6.4*	768	790	1,072	1,285	..	..	33	30
Guinea	48.9	51.0	7.0	*5.6*	774	1,398	16	27	..	..	5	5
Guinea-Bissau	53.2	58.0	4.1	*4.6*	112	139	15	..	..	..	1	1
Haiti	57.9	57.7	8.0	*8.4*	406	444	35	..	..	..	2	2

3.2 Agricultural inputs

	Agricultural land[a]		Irrigated land		Land under cereal production		Fertilizer consumption		Agricultural employment		Agricultural machinery	
	% of land area		% of cropland		thousand hectares		hundred grams per hectare of arable land		% of total employment		Tractors per 100 sq. km of arable land	
	1990–92	2003–05	1990–92[b]	2003–05[b,c]	1990–92	2004–06	1990–92[b]	2003–05[b]	1990–92	2003–05	1990–92	2001–03
Honduras	29.8	26.2	3.8	*5.6*	502	354	203	545	42.1	37.2	31	49
Hungary	70.7	65.4	4.1	2.5	2,803	2,939	796	1,197	11.3	5.3	158	247
India	60.9	60.6	28.3	*32.7*	100,760	97,347	758	1,140	68.1	..	65	141
Indonesia	23.5	26.3	14.5	*12.7*	13,861	15,151	1,330	1,449	54.9	44.5	18	41
Iran, Islamic Rep.	38.5	36.1	39.9	47.2	9,612	9,056	750	571	25.6	24.9	136	158
Iraq	21.9	22.9	63.0	*58.6*	3,506	3,509	347	..	..	17.0	72	80
Ireland	70.2	62.4	..	..	298	287	6,591	4,529	14.1	6.3	1,667	1,324
Israel	26.7	24.4	44.4	*40.9*	108	88	2,836	20,008	3.7	2.0	763	714
Italy	55.4	50.7	22.9	25.8[d]	4,347	4,025	2,195	1,817	8.4	4.6	1,619	2,031
Jamaica	44.0	47.4	11.0	*8.8*	3	1	1,737	432	27.3	19.0	242	177
Japan	15.5	12.9	54.3	35.8	2,439	2,015	3,779	3,924	6.8	4.5	4,297	4,588
Jordan	12.0	11.5	25.0	27.5	112	57	969	7,295	..	3.6	352	308
Kazakhstan	82.0[d]	76.9	9.8[d]	*15.7*	22,152[d]	14,517	136[d]	68	..	33.7	62[d]	22
Kenya	47.3	47.4	1.1	*1.7*	1,766	2,103	209	442	19.0	..	20	25
Korea, Dem. Rep.	21.0	24.9	58.2	*50.9*	1,569	1,282	3,522	..	..	..	297	241
Korea, Rep.	21.9	19.2	47.1	*47.1*	1,368	1,072	4,932	4,379	16.7	8.3	275	1,239
Kuwait	7.9	8.6	60.0	*77.0*	0	1	2,000[d]	15,602[c,e]	..	0.0	215	69
Kyrgyz Republic	52.6[d]	56.2	72.6[d]	73.1	579[d]	611	242[d]	152	35.5	43.4	189[d]	167
Lao PDR	7.2	8.5	16.2	*17.2*	630	770	31	..	..	..	11	12
Latvia	40.8[d]	26.5	1.1[d]	*2.1*	699[d]	475	995[d]	876	..	13.0	364[d]	580
Lebanon	31.1	38.1	28.1	*32.3*	41	64	1,639	1,619	..	..	188	465
Lesotho	76.7	76.9	0.6	*0.9*	178	182	167	..	..	..	57	61
Liberia	27.1	27.0	0.5	*0.5*	135	..	8	..	..	..	8	9
Libya	8.8	8.8	21.8	*21.9*	355	356	458	506	..	..	187	219
Lithuania	54.1[d]	42.5	0.5[d]	*0.4*	1,134[d]	933	541[d]	1,470	18.8	15.9	256[d]	641
Macedonia, FYR	51.4[d]	48.8	12.1[d]	*9.0*	235[d]	192	..	200	..	19.4	730[d]	954
Madagascar	62.5	70.2	30.7	*30.6*	1,321	1,486	34	32	..	78.0	11	12
Malawi	40.2	48.3	1.2	*2.3*	1,443	1,491	351	236	..	..	8	6
Malaysia	22.7	24.0	4.8	*4.8*	699	692	5,264	8,536	23.9	14.6	161	241
Mali	26.3	32.4	3.7	*5.0*	2,393	3,206	91	..	..	41.5	11	6
Mauritania	38.5	38.6	11.8	*9.8*	133	203	132	..	..	..	8	8
Mauritius	55.7	55.7	16.0	*20.1*	1	0	2,732	2,301	14.7	10.0	36	37
Mexico	53.8	55.3	22.0	*22.8*	10,075	9,941	686	733	24.7	15.9	128	129
Moldova	77.9[d]	76.7	14.2[d]	*11.5*	676[d]	969	776[d]	122	..	41.4	310[d]	221
Mongolia	79.9	83.3	5.8	*7.0*	620	153	111	38	..	40.6	73	42
Morocco	68.2	68.1	13.2	*15.5*	5,374	5,584	353	570	..	45.0	46	58
Mozambique	60.7	61.8	2.8	*2.7*	1,509	2,046	12	51	..	..	16	14
Myanmar	15.8	17.1	10.1	*17.9*	5,283	7,670	79	11	69.4	..	12	10
Namibia	47.0	47.2	0.7	*1.0*	215	290	..	22	48.2	..	47	39
Nepal	29.0	29.5	43.0	47.0	2,957	3,352	340	124	81.9	..	23	24
Netherlands	58.9	56.8	61.0	*60.0*	185	215	6,298	5,839	4.3	2.9	2,056	1,645
New Zealand	65.0	64.5	7.6	*11.4*[d]	153	114	1,911	6,741	10.7	7.6	324	507
Nicaragua	33.5	43.5	4.0	*2.8*	299	484	270	317	38.7	29.0	20	15
Niger	27.0	30.4	0.5	*0.5*	7,011	7,666	1	4	..	..	0	0
Nigeria	79.4	80.4	0.7	*0.8*	16,417	18,399	142	64	..	..	8	10
Norway	3.3	3.4	..	..	361	324	2,362	1,886	5.9	3.5	1,723	1,486
Oman	3.5	5.1	71.6	*88.4*	4	5	2,441	3,424	..	..	42	50
Pakistan	33.7	35.2	78.5	84.2	11,777	12,714	962	1,621[c,e]	48.9	42.7	133	149
Panama	28.7	30.0	4.8	*6.2*	182	188	666	421	25.8	16.4	103	148
Papua New Guinea	2.0	2.3	..	..	2	3	622	1,806	..	..	59	53
Paraguay	56.0	60.7	2.9	*1.8*	455	791	92	581	1.7	31.5	72	46
Peru	17.1	16.6	29.9	*27.9*	683	1,110	246	854	1.0	0.7	36	36
Philippines	37.4	40.9	15.7	*14.5*	6,957	6,632	935	1,579	45.3	37.1	20	20
Poland	61.6	52.8	0.7	*0.6*[d,e]	8,523	8,362	895	1,297	25.2	17.9	821	1,034
Portugal	42.8	41.2	20.5	23.8[d]	780	403	1,123	1,884	15.6	12.1	569	1,100
Puerto Rico	47.5	25.1	36.8	*15.7*[d]	0	0	..	..	3.5	2.1	478	449

3.2 Agricultural inputs

	Agricultural land[a]		Irrigated land		Land under cereal production		Fertilizer consumption		Agricultural employment		Agricultural machinery	
	% of land area		% of cropland		thousand hectares		hundred grams per hectare of arable land		% of total employment		Tractors per 100 sq. km of arable land	
	1990–92	2003–05	1990–92[b]	2003–05[b,c]	1990–92	2004–06	1990–92[b]	2003–05[b]	1990–92	2003–05	1990–92	2001–03
Romania	64.4	63.8	31.0	3.2	5,842	5,663	788	429	30.6	33.1	146	179
Russian Federation	13.5[d]	13.2	4.2[d]	3.6	59,541[d]	40,742	417	137	..	10.4	98[d]	52
Rwanda	75.6	78.6	0.3	*0.7*	258	336	20	..	..	..	1	1
Saudi Arabia	..	..	44.2	*42.7*	1,062	666	1,446	1,060	..	..	20	28
Senegal	41.9	42.6	3.3	*4.6*	1,154	1,133	65	221	..	..	2	3
Serbia	..	..	..	..	..	1,856[d]	..	..	..	..	..	..
Sierra Leone	38.3	40.0	5.2	*5.0*	452	576	23	..	..	..	3	2
Singapore	2.2	1.2	..	..	..	..	54,333	160,533	0.3	0.2	637	794
Slovak Republic	..	42.3	..	3.8	1[d]	782	..	965	..	5.2	..	159
Slovenia	28.0[d]	25.0	0.8[d]	1.2	112[d]	97	3,168	3,835	..	8.9	..	..
Somalia	70.2	70.7	19.2	*16.9*	531	704	26[d]	..	..	..	21	15
South Africa	80.2	82.0	8.3	*9.5*	5,736	3,875	549	521	..	10.3	101	46
Spain	60.8	58.3	16.9	*20.6*	7,588	6,485	1,186	1,472	10.7	5.5	494	712
Sri Lanka	36.2	36.5	28.0	*34.4*	834	879	2,016	2,873	44.3	33.9	71	113
Sudan	51.9	57.2	14.1	*10.9*	6,267	7,883	51	36	..	..	8	7
Swaziland	75.8	80.9	24.1	*26.0*	69	54	688	..	..	..	251	222
Sweden	8.2	7.8	4.1	*4.3*	1,184	1,040	1,112	1,051	3.3	2.1	604	615
Switzerland	46.9	38.1	6.0	*5.8*	207	164	4,032	2,100	4.2	4.0	2,870	2,649
Syrian Arab Republic	73.7	75.6	14.3	*24.0*	3,812	3,214	621	857	28.2	27.0	137	224
Tajikistan	32.1[d]	30.4	72.9[d]	*68.2*	266[d]	392	1,488[d]	..	57.9	..	415[d]	233
Tanzania	38.4	38.8	1.4	*1.8*	3,003	3,519	53	70	84.2	..	7	8
Thailand	41.9	36.3	21.0	*26.6*	10,594	11,252	598	1,411	61.7	43.3	39	144
Timor-Leste	21.9	22.9	..	..	84	115	..	..	..	..	10	9
Togo	58.7	66.7	0.3	*0.3*	610	729	56	61	..	..	0	0
Trinidad and Tobago	25.7	25.9	3.3	*3.3*	6	2	1,111	6,764	11.8	4.9	354	360
Tunisia	58.4	63.0	7.3	7.2	1,525	1,457	330	461	..	..	88	126
Turkey	51.8	53.3	14.8	19.7	13,760	13,929	757	836	46.5	32.5	287	410
Turkmenistan	68.6[d]	70.2	106.1[d]	*89.2*	331[d]	1,013	1,296[d]	..	..	..	465[d]	256
Uganda	61.0	63.9	0.1	*0.1*	1,098	1,611	1	15	91.5	69.1	9	9
Ukraine	72.4[d]	71.4	7.6[d]	*6.8*	12,542[d]	14,144	807[d]	157	20.0	19.8	153[d]	124
United Arab Emirates	3.7	6.7	106.7	*29.2*	1	0	4,810	5,531	..	..	50	55
United Kingdom	75.0	70.2	2.5	*3.0*	3,549	2,970	3,323	3,020	2.2	1.3	762	878
United States	46.6	45.3	11.3	*12.5*	64,547	56,333	1,015	1,153	2.9	1.6	245	270
Uruguay	84.7	85.4	10.2	*14.3*	509	557	610	1,257	1.5	4.6	259	241
Uzbekistan	65.2[d]	65.6	87.3[d]	*87.4*	1,225[d]	1,632	1,632	..	..	..	402[d]	373
Venezuela, RB	24.7	24.6	13.9	*16.9*	799	1,119	1,388	1,747	12.6	10.7	176	189
Vietnam	21.0	30.8	44.6	*33.9*	6,730	8,393	1,299	3,309	73.8	58.8	60	247
West Bank and Gaza	62.5	61.8	..	6.9	31	33	..	..	..	15.8	441	710
Yemen, Rep.	33.4	33.6	24.3	*31.4*	738	710	127	25	52.6	..	40	43
Zambia	31.4	34.4	0.7	*2.8*	813	647	131	..	..	..	11	11
Zimbabwe	34.1	39.9	3.6	*5.2*	1,431	1,606	508	316	..	..	61	75
World	**38.6 w**	**37.5 w**	**17.4 w**	**18.1 w**	**632,022 s**	**677,485 s**	**958 w**	**1,145 w**	**42.5 w**	**.. w**	**189 w**	**191 w**
Low income	43.3	45.0	21.5	24.0	209,966	229,649	522	..	66.5	..	46	82
Middle income	37.3	35.3	19.4	18.2	279,067	312,815	1,096	1,289	45.9	..	125	123
Lower middle income	40.5	42.4	27.1	26.3	170,383	175,242	1,502	1,949	49.5	..	75	90
Upper middle income	34.5	30.5	8.5	9.0	108,684	137,573	644	694	..	17.1	187	153
Low & middle income	39.3	38.2	20.2	20.4	489,033	542,464	851	1,104	51.9	..	91	108
East Asia & Pacific	48.3	50.7	..	..	142,273	136,511	..	..	54.3	..	56	72
Europe & Central Asia	47.8	28.4	10.5	10.9	67,977	114,139	782	371	..	20.0	175	171
Latin America & Carib.	34.4	35.7	11.3	12.5	47,713	49,115	586	1,091	17.4	16.5	123	122
Middle East & N. Africa	22.8	22.9	29.6	33.8	30,625	29,638	643	928	..	..	116	143
South Asia	54.7	54.7	33.9	39.2	129,690	128,361	767	1,220	66.1	..	67	129
Sub-Saharan Africa	42.5	43.8	3.3	3.5	70,755	84,700	130	..	..	..	17	13
High income	36.9	35.5	10.9	..	142,990	135,021	1,206	1,260	5.8	3.4	415	434
Euro area	49.9	47.4	14.9	16.8	32,589	31,089	2,303	2,027	7.3	4.5	986	1,003

a. Includes permanent pastures, arable land, and land under permanent crops. b. Time series have been revised but are available only from 2001 onward; data for earlier years are from the Food and Agriculture Organization's previous release of time series data. c. The averages in italics are for years other than those specified. d. Data for all three years are not available. e. The average is not for consecutive years.

Agricultural inputs 3.2

About the data

Agriculture is still a major sector in many economies, and agricultural activities provide developing countries with food and revenue. But agricultural activities also can degrade natural resources. Poor farming practices can cause soil erosion and loss of soil fertility. Efforts to increase productivity through the use of chemical fertilizers, pesticides, and intensive irrigation have environmental costs and health impacts. Excessive use of chemical fertilizers can alter the chemistry of soil. Pesticide poisoning is common in developing countries. And salinization of irrigated land diminishes soil fertility. Thus inappropriate use of inputs for agricultural production has far-reaching effects.

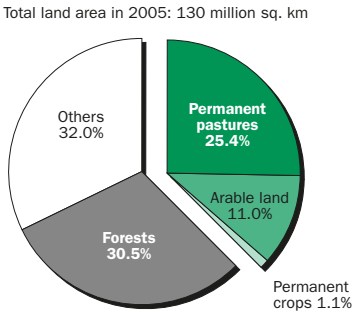
The table provides indicators of major inputs to agricultural production: land, fertilizer, labor, and machinery. There is no single correct mix of inputs: appropriate levels and application rates vary by country and over time and depend on the type of crops, the climate and soils, and the production process used.

The data shown here and in table 3.3 are collected by the Food and Agriculture Organization of the United Nations (FAO) through annual questionnaires. The FAO tries to impose standard definitions and reporting methods, but complete consistency across countries and over time is not possible. For example, despite standard definitions, data on agricultural land in different climates may not be comparable. For example, permanent pastures are quite different in nature and intensity in African countries and dry Middle Eastern countries. Data on agricultural employment, in particular, should be used with caution. In many countries much agricultural employment is informal and unrecorded, including substantial work performed by women and children.

Fertilizer consumption measures the quantity of plant nutrients. Consumption is calculated as production plus imports minus exports. Because some chemical compounds used for fertilizers have other industrial applications, the consumption data may overstate the quantity available for crops. The FAO recently revised the time series for fertilizer consumption and irrigation but only for 2001 onward. The data for earlier years are from the FAO's previous releases and are not necessarily comparable with later data. Caution should thus be exercised when comparing data over time.

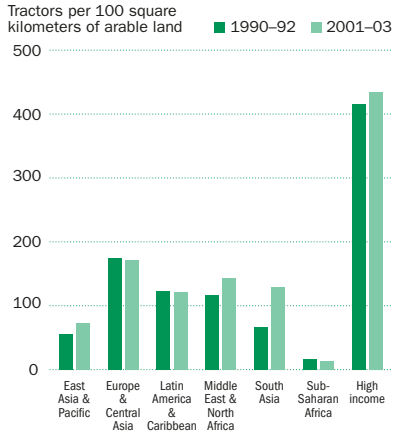
To smooth annual fluctuations in agricultural activity, the indicators in the table have been averaged over three years.

Nearly 40 percent of land globally is devoted to agriculture **3.2a**



Note: Agricultural land includes permanent pastures, arable land, and land under permanent crops.
Source: Tables 3.1 and 3.2.

Developing regions lag in agricultural machinery, which reduces their agricultural productivity **3.2b**



Source: Table 3.2.

Definitions

• **Agricultural land** is the share of land area that is permanent pastures, arable, or under permanent crops. Permanent pasture is land used for five or more years for forage, including natural and cultivated crops. Arable land includes land defined by the FAO as land under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or for pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded. Land under permanent crops is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee, and rubber. Land under flowering shrubs, fruit trees, nut trees, and vines is included, but land under trees grown for wood or timber is not. • **Irrigated land** refers to areas purposely provided with water, including land irrigated by controlled flooding. • **Cropland** is arable land and permanent cropland (see table 3.1). • **Land under cereal production** refers to harvested areas, although some countries report only sown or cultivated area. • **Fertilizer consumption** is the quantity of plant nutrients used per unit of arable land. Fertilizer products cover nitrogen, potash, and phosphate fertilizers (including ground rock phosphate). Traditional nutrients—animal and plant manures—are not included. The time reference for fertilizer consumption is the crop year (July through June). • **Agricultural employment** is employment in agriculture, forestry, hunting, and fishing (see table 2.3). • **Agricultural machinery** refers to wheel and crawler tractors (excluding garden tractors) in use in agriculture at the end of the calendar year specified or during the first quarter of the following year.

Data sources

Data on agricultural inputs are from electronic files that the FAO makes available to the World Bank.

3.3 Agricultural output and productivity

	Crop production index		Food production index		Livestock production index		Cereal yield		Agricultural productivity	
	1999–2001 = 100		1999–2001 = 100		1999–2001 = 100		kilograms per hectare		Agriculture value added per worker 2000 $	
	1990–92	2002–04	1990–92	2004–06[a]	1990–92	2002–04	1990–92	2004–06	1990–92	2003–05
Afghanistan	..	..	..	..	..	..	1,153	1,571	..	..
Albania	86.2	100.6	74.2	105.1	66.6	108.9	2,372	3,492	778	1,449
Algeria	85.4	122.9	81.7	116.8	80.7	103.3	915	1,449	1,911	2,225
Angola	60.5	119.4	65.0	112.9	75.6	100.0	378	522	165	174
Argentina	67.2	106.4	73.6	102.0	89.2	92.0	2,652	3,857	6,767	10,072
Armenia	106.5	119.2	112.9	140.6	118.9	123.2	1,843[b]	2,036	1,476	3,692
Australia	59.7	81.6	69.2	91.9	83.3	96.9	1,739	1,560	22,523	34,880
Austria	93.4	99.1	89.8	102.2	92.5	99.6	5,400	6,128	12,048	22,203
Azerbaijan	137.4	122.7	104.8	121.1	98.2	113.6	2,112[b]	2,594	1,084	1,143
Bangladesh	75.4	104.7	73.8	104.6	73.8	103.2	2,567	3,648	254	338
Belarus	107.3	124.7	136.1[b]	116.0	146.5	99.7	2,739[b]	2,801	1,977[b]	3,153
Belgium	77.6	106.0	91.3	101.0	94.3	99.7	..	8,680	21,479	41,631
Benin	57.7	125.4	62.7	137.4	89.1	109.2	880	1,136	326	519
Bolivia	63.6	116.4	70.0	110.3	77.2	107.9	1,385	1,865	670	773
Bosnia and Herzegovina	107.2	101.1	120.3[b]	98.0	122.7[b]	86.6	3,548[b]	4,326	..	8,270
Botswana	96.2	111.5	114.8	104.3	118.8	103.4	312	363	536	390
Brazil	77.2	119.6	70.4	124.3	65.5	116.8	1,916	3,076	1,506	3,126
Bulgaria	149.2	110.9	137.5	107.7	147.1	96.2	3,639	3,679	2,500	7,159
Burkina Faso	67.0	126.6	68.7	115.2	70.7	108.1	783	1,065	110	173
Burundi	112.4	107.0	112.1	104.4	135.1	100.2	1,370	1,328	108	70
Cambodia	65.2	105.8	65.1	105.4	65.7	103.5	1,356	2,356	..	306
Cameroon	71.2	103.0	73.9	104.7	84.1	103.1	1,166	1,459	389	652
Canada	87.9	93.8	84.1	101.6	78.3	103.6	2,559	3,114	28,243	43,055
Central African Republic	74.4	97.7	69.9	108.2	68.1	113.5	884	1,033	287	381
Chad	69.0	110.9	72.5	112.2	84.5	105.4	636	727	173	215
Chile	78.2	110.5	74.0	112.8	68.0	107.0	3,949	5,822	3,600	5,308
China	69.6	110.6	60.1	117.8	49.4	116.1	4,307	5,237	254	401
Hong Kong, China	..	..	..	..	..	..	..	..	..	..
Colombia	98.4	107.4	83.9	109.7	80.6	107.1	2,492	3,725	3,405	2,847
Congo, Dem. Rep.	124.7	97.2	121.4	97.5	100.8	99.2	794	776	184	149
Congo, Rep.	80.2	105.1	79.0	108.8	76.0	114.5	688	794	..	..
Costa Rica	71.4	99.6	72.2	99.4	79.9	101.4	3,188	3,135	3,143	4,499
Côte d'Ivoire	73.0	96.2	72.9	101.2	74.9	110.9	869	1,708	598	795
Croatia	79.9	97.2	99.0	96.7	126.6[b]	108.2	3,975[b]	5,233	4,921[b]	9,987
Cuba	112.1	112.6	111.5	109.6	130.0	92.7	2,092	2,755	..	..
Czech Republic	..	94.8	..	104.6	..	95.8	..	4,785	..	5,423
Denmark	103.5	97.7	97.6	101.4	89.0	102.8	5,448	5,976	15,190	40,780
Dominican Republic	119.1	110.0	104.0	102.6	79.5	103.7	4,078	4,262	2,268	4,586
Ecuador	80.1	95.9	72.4	107.2	65.1	115.3	1,724	2,779	1,686	1,676
Egypt, Arab Rep.	69.2	104.2	67.5	110.9	65.4	115.3	5,738	7,536	1,528	2,072
El Salvador	102.2	90.6	86.4	104.8	74.5	108.5	1,871	2,639	1,633	1,638
Eritrea	..	67.7	..	86.3[b]	..	97.1	..	343	..	61
Estonia	121.4	89.9	181.3[b]	102.1	193.3	101.7	1,304[b]	2,412	2,747	3,235
Ethiopia	..	106.7	..	112.1	..	117.7	1,234	1,374	135	145
Finland	97.5	102.4	104.0	103.6	106.5	104.3	3,246	3,309	18,822	31,214
France	94.0	98.8	97.4	101.6	97.3	100.4	6,370	7,099	22,234	44,017
Gabon	87.2	101.9	89.1	101.7	86.5	100.5	1,712	1,574	1,176	1,592
Gambia, The	55.8	65.2	60.2	69.0	98.8	102.6	1,114	1,145	224	233
Georgia	120.6	91.9	102.7	100.8	78.9	110.3	1,998[b]	1,858	2,443[b]	1,790
Germany	83.7	95.1	98.0	102.9	107.5	101.0	5,578	6,855	13,724	26,549
Ghana	59.1	117.0	61.1	121.0	89.8	108.7	1,084	1,380	293	320
Greece	86.9	90.4	93.7	95.3	101.5	98.2	3,589	3,951	7,668	9,011
Guatemala	77.6	102.6	75.4	104.4	76.6	100.6	1,882	1,542	2,120	2,547
Guinea	73.7	107.5	72.9	113.8	60.5	111.8	1,423	1,599	142	190
Guinea-Bissau	71.1	104.9	73.1	109.7	81.2	106.6	1,529	1,460	205	238
Haiti	108.5	98.8	99.8	100.6	69.8	111.6	997	882	..	..

3.3 Agricultural output and productivity

	Crop production index		Food production index		Livestock production index		Cereal yield		Agricultural productivity	
	1999–2001 = 100		1999–2001 = 100		1999–2001 = 100		kilograms per hectare		Agriculture value added per worker 2000 $	
	1990–92	2002–04	1990–92	2004–06[a]	1990–92	2002–04	1990–92	2004–06	1990–92	2003–05
Honduras	92.9	118.9	86.5	111.0	69.3	105.8	1,371	1,471	977	1,197
Hungary	114.0	99.7	117.0	111.9	125.5	101.9	4,551	5,403	4,105	6,987
India	79.6	100.0	75.9	104.7	69.4	110.5	1,947	2,428	324	392
Indonesia	82.8	112.7	83.8	117.4	85.8	127.3	3,826	4,354	484	583
Iran, Islamic Rep.	73.8	118.1	72.2	115.4	68.8	103.3	1,523	2,462	1,954	2,542
Iraq	..	..	..	..	..	..	872	1,014	..	1,756
Ireland	92.7	100.3	95.3	98.4	94.3	96.1	6,653	7,473	..	17,879
Israel	97.8	103.3	82.8	108.2	72.4	113.1	3,132	3,096	..	..
Italy	97.3	92.6	97.0	98.1	95.1	99.4	4,340	5,368	11,542	23,967
Jamaica	84.9	96.7	85.7	99.4	87.2	102.8	1,298	1,099	2,016	1,889
Japan	112.9	95.0	108.4	97.7	106.8	100.2	5,713	5,983	20,445	35,517
Jordan	100.1	136.6	85.4	118.2	71.2	94.1	1,168	1,267	1,892	1,360
Kazakhstan	163.8	108.4	163.0[b]	103.1	178.5	111.6	1,338[b]	975	1,795[b]	1,557
Kenya	86.9	103.2	85.7	104.3	83.9	110.4	1,645	1,709	335	333
Korea, Dem. Rep.	126.2	108.4	119.6	109.7	145.1	114.2	5,073	3,787	..	..
Korea, Rep.	88.2	91.3	79.8	92.1	68.1	100.4	5,885	6,400	5,679	11,286
Kuwait	33.6	110.6	26.4	125.9	27.9	115.7	3,112	2,440	..	13,521[b]
Kyrgyz Republic	68.5	102.9	74.0[b]	97.9	106.9	98.4	2,771[b]	2,696	675[b]	979
Lao PDR	62.2	115.3	59.1	116.8[b]	60.6	107.5	2,341	3,804	360	458
Latvia	128.7	119.4	222.3[b]	117.4	273.8	101.1	1,641[b]	2,499	1,790[b]	2,704
Lebanon	109.7	94.1	100.4	100.8	65.6	120.4	2,001	2,708	..	30,099
Lesotho	67.5	100.8	87.8	106.0[b]	115.0	100.0	716	589	422	418
Liberia	62.3	97.7	80.5	97.3	90.4	107.8	951	..	..	..
Libya	79.2	96.9	77.1	104.3	75.9	101.0	706	619	..	..
Lithuania	80.2	113.1	159.9[b]	112.2	187.0	107.8	1,938[b]	2,708	..	4,703
Macedonia, FYR	107.4	93.3	107.8	108.5	105.1[b]	103.3	2,652[b]	3,345	2,256[b]	3,487
Madagascar	93.6	103.5	90.4	107.6	93.3	97.1	1,935	2,440	186	174
Malawi	57.5	84.3	49.6	95.6	85.4	101.8	871	1,099	72	116
Malaysia	74.4	114.0	70.5	120.0	81.3	115.1	2,827	3,317	3,803	5,126
Mali	73.8	107.4	78.6	109.6[b]	81.3	112.9	840	1,008	208	241
Mauritania	63.2	97.2	84.2	108.8[b]	87.4	109.3	802	771	574	356
Mauritius	110.7	101.6	101.1	105.9	71.1	116.8	4,117	7,269	3,942	5,011
Mexico	82.8	103.8	77.7	107.8	71.4	107.8	2,520	3,083	2,256	2,792
Moldova	136.6	112.2	153.3[b]	115.7	198.7	103.2	2,928[b]	2,721	1,286[b]	816
Mongolia	246.9	107.3	98.3	93.6	93.9	95.9	967	791	870	907
Morocco	101.1	133.4	94.3	132.1	81.3	102.0	1,095	1,307	1,430	1,775
Mozambique	64.7	106.1	70.5	104.0	94.8	100.9	330	938	109	153
Myanmar	61.5	114.7	62.3	115.4	65.0	115.1	2,739	3,424	..	..
Namibia	71.9	111.4	99.5	114.0	104.1	109.3	381	403	820	1,103
Nepal	73.5	111.2	75.2	110.5	80.1	107.3	1,831	2,304	192	209
Netherlands	93.7	97.9	105.5	95.1	105.3	92.6	7,145	8,287	24,914	42,198
New Zealand	78.9	101.9	77.8	116.4	80.7	112.1	5,257	6,876	19,869	25,978
Nicaragua	76.6	115.3	64.0	123.1	57.5	119.9	1,529	1,808	..	2,071
Niger	71.4	119.5	75.4	118.4	82.0	104.7	323	463	152	157[b]
Nigeria	68.9	103.4	69.1	106.2	76.9	106.6	1,135	1,420	562	950
Norway	120.7	103.4	104.1	99.5	98.2	97.3	3,744	4,085	19,500	37,776
Oman	62.8	87.3	60.2	92.1[b]	65.7	94.0	2,411	2,621	1,005	1,302
Pakistan	80.6	102.5	70.6	110.6	67.6	109.1	1,818	2,533	594	696
Panama	110.9	104.2	94.8	103.7	76.3	101.1	1,862	1,845	2,363	3,914
Papua New Guinea	78.5	101.6	79.9	107.7[b]	80.8	110.1	2,504	3,848	390	490[b]
Paraguay	85.8	120.7	77.4	115.0	87.3	98.2	1,905	2,283	1,596	2,052
Peru	52.6	108.1	57.1	110.2	68.3	114.1	2,463	3,433	930	1,498
Philippines	84.2	109.6	77.9	115.5	62.1	120.7	2,070	3,074	905	1,075
Poland	109.1	91.6	110.0	106.7	114.8	105.0	2,958	3,123	1,502[b]	2,182
Portugal	103.1	98.6	98.7	98.9	85.7	98.2	1,939	2,744	4,612	5,980
Puerto Rico	167.7	114.6	127.6	98.2	118.4	94.1	1,100	2,119	..	..

3.3 Agricultural output and productivity

	Crop production index		Food production index		Livestock production index		Cereal yield		Agricultural productivity	
	1999–2001 = 100		1999–2001 = 100		1999–2001 = 100		kilograms per hectare		Agriculture value added per worker 2000 $	
	1990–92	2002–04	1990–92	2004–06[a]	1990–92	2002–04	1990–92	2004–06	1990–92	2003–05
Romania	92.2	112.2	97.7	123.2	114.5	107.6	2,777	3,478	2,196	4,646
Russian Federation	125.8	116.0	132.6[b]	111.4	152.1	103.2	1,743[b]	1,879	1,825[b]	2,518
Rwanda	111.4	117.6	107.3	113.2	77.7	107.3	1,088	1,087	191	214
Saudi Arabia	120.7	114.8	105.2	118.6	67.8	104.9	4,212	4,545	7,875	15,780
Senegal	73.0	68.3	71.9	81.6	74.8	98.2	803	1,018	225	215
Serbia[c]	97.6	110.0	109.2	114.2	103.8	94.9	2,926	4,910	..	1,679
Sierra Leone	128.1	113.5	118.9	113.5	86.1	105.2	1,223	1,971	..	..
Singapore	157.1	100.0	352.1	70.2[b]	396.3	74.2	..	..	22,695	40,323
Slovak Republic	..	..	..	..	..	..	1,031[b]	4,383	..	5,026
Slovenia	93.1	110.2	77.2[b]	108.5	73.6	103.6	3,270[b]	5,668	11,531[b]	..
Somalia	..	..	..	..	..	..	622	558	..	..
South Africa	79.6	102.4	84.2	105.9	94.6	108.2	1,602	3,076	1,786	2,484
Spain	87.9	106.1	87.1	105.9	79.5	107.2	2,310	3,008	9,511	19,030
Sri Lanka	86.2	98.8	88.9	95.6	94.6	109.9	2,950	3,550	679	700
Sudan	68.9	110.8	66.7	107.8	67.6	106.3	596	663	418	666
Swaziland	106.6	100.1	108.9	105.9	130.3	111.9	1,299	1,030	1,225	1,243
Sweden	102.2	102.1	97.9	99.4	95.7	97.7	4,272	4,711	21,463	33,023
Switzerland	112.4	95.3	104.9	99.6	104.8	101.9	6,102	6,393	22,344	23,418
Syrian Arab Republic	73.6	117.1	75.1	121.7	75.0	115.6	947	1,711	2,344	3,261
Tajikistan	123.6	132.9	138.1	145.8	192.6	139.2	1,037[b]	2,211	397[b]	465
Tanzania	92.7	103.6	88.7	105.6	82.9	109.4	1,276	1,477	238	295
Thailand	82.0	106.1	84.1	104.7	86.8	105.5	2,186	2,976	497	621
Timor-Leste	93.5	107.2	102.2	112.9	101.6	117.9	1,694	1,322	..	281
Togo	73.4	110.3	74.1	104.2	87.9	106.7	791	1,155	312	347
Trinidad and Tobago	116.3	91.9	88.7	117.5	73.5	142.6	3,159	3,341	1,666	1,989
Tunisia	104.6	104.2	91.2	101.6	60.3	99.9	1,401	1,360	2,422	2,719
Turkey	88.0	104.0	89.5	103.9	92.2	101.6	2,192	2,514	1,890	1,891
Turkmenistan	111.4	116.5	57.1[b]	131.0	64.0	121.7	2,210[b]	3,057	1,222[b]	..
Uganda	78.0	106.6	79.5	109.2	82.3	112.9	1,487	1,508	184	229
Ukraine	130.6	114.0	146.0[b]	115.4	170.0	108.1	2,834[b]	2,636	1,195[b]	1,702
United Arab Emirates	23.4	56.0	26.5	63.7[b]	57.5	116.9	2,042	7,333	10,454	25,841
United Kingdom	104.9	100.3	107.2	98.0	105.6	98.5	6,321	7,169	22,659	26,933
United States	88.4	101.5	84.8	107.5	83.4	102.6	4,875	6,538	20,793	41,797
Uruguay	70.4	112.7	76.7	115.5	84.2	98.3	2,445	4,203	5,714	7,973
Uzbekistan	107.8	109.0	91.3[b]	105.2	99.7	104.7	1,777	3,839	1,272[b]	1,800
Venezuela, RB	79.5	96.0	73.9	98.3	73.5	100.4	2,561	3,401	4,483	6,292
Vietnam	60.1	116.6	63.1	124.4	57.9	124.9	3,096	4,717	214	305
West Bank and Gaza	..	..	..	..	..	..	1,105	2,037	..	..
Yemen, Rep.	75.0	100.1	71.5	110.5	66.3	115.5	906	798	271	328[b]
Zambia	80.7	102.4	84.3	108.0	80.1	99.2	1,251	1,822	159	206
Zimbabwe	69.2	69.3	77.3	86.4	90.1	100.1	1,123	663	240	222
World	**82.5 w**	**105.7 w**	**82.0 w**	***106.2* w**	**83.4 w**	**107.0 w**	**2,866 w**	**3,306 w**	**742 w**	**914 w**
Low income	78.5	103.5	76.1	*105.2*	73.5	109.6	1,752	2,105	303	376
Middle income	80.9	110.2	79.8	*110.5*	81.2	111.0	2,986	3,354	531	763
Lower middle income	77.5	111.7	72.8	*112.5*	67.9	114.1	3,424	3,956	388	561
Upper middle income	93.1	104.9	101.8	*104.2*	115.8	102.7	2,318	2,602	2,163	2,999
Low & middle income	80.1	108.1	78.7	*108.9*	79.3	110.6	2,451	2,827	438	591
East Asia & Pacific	71.8	110.8	64.5	*112.4*	52.4	116.6	3,816	4,518	303	445
Europe & Central Asia	113.2	107.1	127.1	*106.1*	149.3	104.1	2,652	2,359	1,903	2,195
Latin America & Carib.	78.2	111.5	74.4	*110.4*	72.9	108.9	2,234	3,194	2,151	3,057
Middle East & N. Africa	78.8	113.7	75.7	*112.5*	70.4	107.7	1,632	2,360	1,576	2,198
South Asia	79.9	101.0	75.5	*103.5*	69.1	109.8	1,992	2,513	335	406
Sub-Saharan Africa	75.9	103.9	77.6	*105.1*	84.5	107.1	984	1,120	277	335
High income	89.9	98.2	89.7	99.9	90.1	101.2	4,254	5,160	15,072	26,940
Euro area	91.5	97.8	94.6	98.8	97.9	99.7	4,632	5,664	12,701	23,097

a. Aggregates are for 2002–04. b. Data for all three years are not available. c. Includes Montenegro.

Agricultural output and productivity 3.3

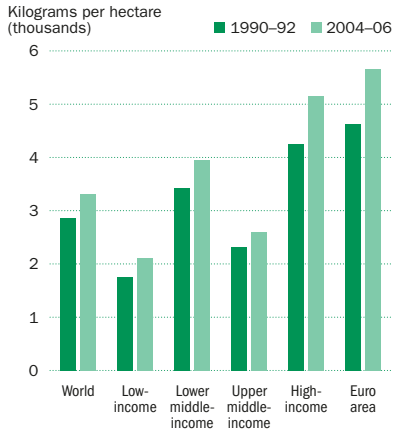
About the data

The agricultural production indexes in the table are prepared by the Food and Agriculture Organization of the United Nations (FAO). The FAO obtains data from official and semiofficial reports of crop yields, area under production, and livestock numbers. If data are unavailable, the FAO makes estimates. The indexes are calculated using the Laspeyres formula: production quantities of each commodity are weighted by average international commodity prices in the base period and summed for each year. Because the FAO's indexes are based on the concept of agriculture as a single enterprise, estimates of the amounts retained for seed and feed are subtracted from the production data to avoid double counting. The resulting aggregate represents production available for any use except as seed and feed. The FAO's indexes may differ from those from other sources because of differences in coverage, weights, concepts, time periods, calculation methods, and use of international prices.

To facilitate cross-country comparisons, the FAO uses international commodity prices to value production. These prices, expressed in international dollars (equivalent in purchasing power to the U.S. dollar), are derived using a Geary-Khamis formula applied to agricultural outputs (see Inter-Secretariat Working Group on National Accounts 1993, sections 16.93–96). This method assigns a single price to each commodity so that, for example, one metric ton of wheat has the same price regardless of where it was produced. The use of international prices eliminates fluctuations in the value of output due to transitory movements of nominal exchange rates unrelated to the purchasing power of the domestic currency.

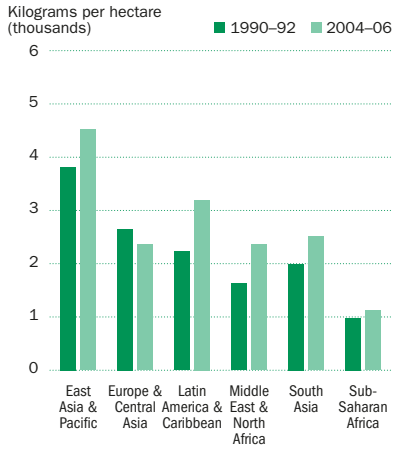
Data on cereal yield may be affected by a variety of reporting and timing differences. Millet and sorghum, which are grown as feed for livestock and poultry in Europe and North America, are used as food in Africa, Asia, and countries of the former Soviet Union. So some cereal crops are excluded from the data for some countries and included elsewhere, depending on their use. To smooth annual fluctuations in agricultural activity, the indicators in the table have been averaged over three years.

Cereal yield in low-income countries was only 40 percent of the yield in high-income countries **3.3a**



Source: Table 3.3.

Sub-Saharan Africa had the lowest yield, while East Asia and Pacific is closing the gap with high-income countries **3.3b**



Source: Table 3.3.

Definitions

• **Crop production index** is agricultural production for each period relative to the base period 1999–2001. It includes all crops except fodder crops. The regional and income group aggregates for the FAO's production indexes are calculated from the underlying values in international dollars, normalized to the base period 1999–2001. • **Food production index** covers food crops that are considered edible and that contain nutrients. Coffee and tea are excluded because, although edible, they have no nutritive value. • **Livestock production index** includes meat and milk from all sources, dairy products such as cheese, and eggs, honey, raw silk, wool, and hides and skins. • **Cereal yield,** measured in kilograms per hectare of harvested land, includes wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, and mixed grains. Production data on cereals refer to crops harvested for dry grain only. Cereal crops harvested for hay or harvested green for food, feed, or silage, and those used for grazing, are excluded. The FAO allocates production data to the calendar year in which the bulk of the harvest took place. But most of a crop harvested near the end of a year will be used in the following year. • **Agricultural productivity** is the ratio of agricultural value added, measured in 2000 U.S. dollars, to the number of workers in agriculture. Agricultural productivity is measured by value added per unit of input. (For further discussion of the calculation of value added in national accounts, see *About the data* for tables 4.1 and 4.2.) Agricultural value added includes that from forestry and fishing. Thus interpretations of land productivity should be made with caution.

Data sources

Data on agricultural production indexes, cereal yield, and agricultural employment are from electronic files that the FAO makes available to the World Bank. The files may contain more recent information than published versions. Data on agricultural value added are from the World Bank's national accounts files.

3.4 Deforestation and biodiversity

	Forest area		Average annual deforestation[a]		Animal species		Higher plants[b]		GEF benefits index for biodiversity	Nationally protected areas		Marine protected areas	
	thousand sq. km		%		Total known species	Threatened species	Total known species	Threatened species	0–100 (no biodiversity to maximum biodiversity)	thousand sq. km	% of total land area	thousand sq. km	% of surface area
	1990	2005	1990–2000	2000–05	2004	2007	2004	2007	2005	2004[c]	2004[c]	2004	2004
Afghanistan	13	9	2.5	3.1	578	33	4,000	2	3.6	2.2	0.3	..	..
Albania	8	8	0.3	–0.6	376	45	3,031	0	0.2	0.7	2.7	0.3	1.0
Algeria	18	23	–1.8	–1.2	472	71	3,164	3	3.0	118.6	5.0	0.9	0.0
Angola	610	591	0.2	0.2	1,226	62	5,185	26	9.6	125.5	10.1	29.1	2.3
Argentina	353	330	0.4	0.4	1,413	152	9,372	42	18.5	174.5	6.4	7.8	0.3
Armenia	3	3	1.3	1.5	380	35	3,553	1	0.3	3.0	10.6	..	..
Australia	1,679	1,637	0.2	0.1	1,227	568	15,638	55	95.8	745.3	9.7	680.8	8.8
Austria	38	39	–0.2	–0.1	513	62	3,100	4	0.3	23.5	28.5	..	..
Azerbaijan	9	9	0.0	0.0	446	38	4,300	0	0.9	4.0	4.8	1.2	1.4
Bangladesh	9	9	0.0	0.3	735	89	5,000	12	1.6	0.7	0.5	0.3	0.2
Belarus	74	79	–0.6	–0.1	297	17	2,100	..	0.0	13.2	6.3	..	..
Belgium[d]	7	7	0.1	0.0	519	29	1,550	1	0.0	1.0	3.5	0.0	0.0
Benin	33	24	2.1	2.5	644	34	2,500	14	0.2	26.4	23.9	..	..
Bolivia	628	587	0.4	0.5	1,775	80	17,367	71	13.8	211.0	19.5	..	..
Bosnia and Herzegovina	22	22	0.1	0.0	390	55	..	1	0.4	0.3	0.5	..	..
Botswana	137	119	0.9	1.0	739	18	2,151	0	1.5	174.9	30.9	..	..
Brazil	5,200	4,777	0.5	0.6	2,290	343	56,215	382	100.0	1,532.6	18.1	47.4	0.6
Bulgaria	33	36	–0.1	–1.4	485	47	3,572	0	0.9	11.2	10.3	0.0	0.0
Burkina Faso	72	68	0.3	0.3	581	13	1,100	2	0.3	42.1	15.4	..	..
Burundi	3	2	3.7	5.2	713	48	2,500	2	0.5	1.5	5.7	..	..
Cambodia	129	104	1.1	2.0	648	82	..	31	3.9	41.5	23.5	1.9	1.1
Cameroon	245	212	0.9	1.0	1,258	157	8,260	355	13.3	37.4	8.0	3.9	0.8
Canada	3,101	3,101	0.0	0.0	683	77	3,270	1	22.2	628.7	6.9	362.7	3.6
Central African Republic	232	228	0.1	0.1	850	17	3,602	15	1.7	103.3	16.6	..	..
Chad	131	119	0.6	0.7	635	21	1,600	2	2.1	119.8	9.5	..	..
Chile	153	161	–0.4	–0.4	604	95	5,284	39	16.2	26.9	3.6	114.5	15.1
China	1,571	1,973	–1.2	–2.2	1,801	351	32,200	446	64.8	1,100.7	11.8	16.0	0.2
Hong Kong, China	..	..	..	..	363	37	..	6	..	0.3	24.7	0.3	..
Colombia	614	607	0.1	0.1	2,288	382	51,220	222	57.3	825.3	74.4	8.1	0.7
Congo, Dem. Rep.	1,405	1,336	0.4	0.2	1,578	126	11,007	65	17.0	194.4	8.6	..	..
Congo, Rep.	227	225	0.1	0.1	763	37	6,000	35	3.4	61.3	18.0	..	..
Costa Rica	26	24	0.8	–0.1	1,070	131	12,119	111	11.1	12.1	23.6	4.8	9.4
Côte d'Ivoire	102	104	–0.1	–0.1	931	73	3,660	105	3.9	54.5	17.1	0.3	0.1
Croatia	21	21	–0.1	–0.1	461	78	4,288	1	0.5	3.6	6.5	2.5	4.4
Cuba	21	27	–1.7	–2.2	423	115	6,522	163	13.5	1.5	1.4	31.7	28.6
Czech Republic	26	26	0.0	–0.1	474	39	1,900	4	0.1	14.4	18.7	..	..
Denmark	4	5	–0.9	–0.6	508	28	1,450	3	0.2	10.9	25.7	5.1	11.8
Dominican Republic	14	14	0.0	0.0	260	81	5,657	30	6.8	11.9	24.6	8.6	17.6
Ecuador	138	109	1.5	1.7	1,856	340	19,362	1,838	30.0	67.2	24.3	141.0	49.7
Egypt, Arab Rep.	0	1	–3.0	–2.6	599	59	2,076	2	3.2	56.0	5.6	76.7	7.7
El Salvador	4	3	1.5	1.7	571	29	2,911	26	0.8	0.4	1.9	0.1	0.4
Eritrea	16	16	0.3	0.3	607	38	..	3	0.9	5.0	5.0	..	..
Estonia	22	23	–0.4	–0.4	334	14	1,630	0	0.0	8.9	21.1	..	..
Ethiopia	151	130	1.0	1.1	1,127	86	6,603	22	8.5	186.2	18.6	..	..
Finland	222	225	–0.1	0.0	501	19	1,102	1	0.2	29.5	9.7	1.1	0.3
France	145	156	–0.5	–0.3	665	117	4,630	7	3.9	16.2	3.0	0.5	0.1
Gabon	219	218	0.0	0.0	798	43	6,651	108	3.4	8.8	3.4	1.0	0.4
Gambia, The	4	5	–0.4	–0.4	668	31	974	4	0.1	0.3	3.5	0.2	1.9
Georgia	28	28	0.0	0.0	366	46	4,350	0	0.7	3.0	4.3	0.0	0.1
Germany	107	111	–0.3	0.0	613	59	2,682	12	0.7	111.5	32.0	9.1	2.6
Ghana	74	55	2.0	2.0	978	56	3,725	117	2.0	36.9	16.2	..	..
Greece	33	38	–0.9	–0.8	530	95	4,992	11	3.0	4.3	3.3	2.5	1.9
Guatemala	47	39	1.2	1.3	877	133	8,681	84	8.9	25.4	23.4	0.1	0.1
Guinea	74	67	0.7	0.5	855	61	3,000	22	2.6	15.6	6.4	..	..
Guinea-Bissau	22	21	0.4	0.5	560	29	1,000	4	0.7	0.0	0.0	..	..
Haiti	1	1	0.6	0.7	312	91	5,242	29	5.8	0.1	0.3	..	..

3.4 Deforestation and biodiversity

	Forest area		Average annual deforestation[a]		Animal species		Higher plants[b]		GEF benefits index for biodiversity	Nationally protected areas		Marine protected areas	
	thousand sq. km		%		Total known species	Threatened species	Total known species	Threatened species	0–100 (no biodiversity to maximum biodiversity)	thousand sq. km	% of total land area	thousand sq. km	% of surface area
	1990	2005	1990–2000	2000–05	2004	2007	2004	2007	2005	2004[c]	2004[c]	2004	2004
Honduras	74	46	3.0	3.1	900	102	5,680	110	7.9	23.4	21.0	1.9	1.7
Hungary	18	20	–0.6	–0.7	455	55	2,214	1	0.2	8.3	9.3	..	..
India	639	677	–0.6	0.0	1,602	313	18,664	247	43.9	156.3	5.3	16.1	0.5
Indonesia	1,166	885	1.7	2.0	2,271	464	29,375	386	90.0	259.9	14.3	130.1	6.8
Iran, Islamic Rep.	111	111	0.0	0.0	656	75	8,000	1	7.9	105.5	6.5	6.2	0.4
Iraq	8	8	–0.2	–0.1	498	40	..	0	1.7	0.0	0.0	..	..
Ireland	4	7	–3.3	–1.9	471	15	950	1	0.7	0.8	1.1	0.0	0.0
Israel	2	2	–0.6	–0.8	649	79	2,317	0	0.9	4.6	21.3	0.1	0.6
Italy	84	100	–1.2	–1.1	610	119	5,599	19	4.4	32.4	11.0	1.5	0.5
Jamaica	3	3	0.1	0.1	333	61	3,308	209	4.9	1.8	16.2	8.2	74.5
Japan	250	249	0.0	0.0	763	190	5,565	12	41.4	52.2	14.3	10.6	2.8
Jordan	1	1	0.0	0.0	490	43	2,100	0	0.3	9.7	11.0	0.0	0.0
Kazakhstan	34	33	0.2	0.2	642	55	6,000	16	5.4	77.4	2.9	0.5	0.0
Kenya	37	35	0.3	0.3	1,510	172	6,506	103	9.9	71.9	12.6	3.1	0.5
Korea, Dem. Rep.	82	62	1.8	1.9	474	44	2,898	3	0.7	3.2	2.6	..	..
Korea, Rep.	64	63	0.1	0.1	512	54	2,898	0	1.8	3.5	3.6	3.5	3.5
Kuwait	0	0	–5.2	–3.7	381	23	234	..	0.1	0.0	0.0	0.3	1.5
Kyrgyz Republic	8	9	–0.3	–0.3	265	22	4,500	14	1.2	7.2	3.7	..	..
Lao PDR	173	161	0.5	0.5	919	77	8,286	21	5.4	37.4	16.2	..	..
Latvia	28	29	–0.4	–0.4	393	23	1,153	0	0.0	9.7	15.6	0.2	0.2
Lebanon	1	1	–0.8	–0.8	447	38	3,000	0	0.2	0.1	0.7	0.0	0.0
Lesotho	0	0	–3.4	–2.7	370	11	1,591	1	0.3	0.1	0.2	..	..
Liberia	41	32	1.6	1.8	759	60	2,200	46	2.9	15.2	15.8	0.6	0.5
Libya	2	2	0.0	0.0	413	31	1,825	1	1.7	1.2	0.1	0.5	0.0
Lithuania	19	21	–0.4	–0.8	298	20	1,796	..	0.0	5.9	9.5	0.5	0.8
Macedonia, FYR	9	9	0.0	0.0	380	34	3,500	0	0.2	2.0	7.9	..	..
Madagascar	137	128	0.5	0.3	427	262	9,505	280	31.4	18.3	3.1	0.2	0.0
Malawi	39	34	0.9	0.9	865	141	3,765	14	3.9	19.4	20.6	..	..
Malaysia	224	209	0.4	0.7	1,083	225	15,500	686	14.8	100.8	30.7	5.0	1.5
Mali	141	126	0.7	0.8	758	21	1,741	6	1.6	46.7	3.8	..	..
Mauritania	4	3	2.7	3.4	615	44	1,100	..	1.4	2.5	0.2	15.0	1.5
Mauritius	0	0	0.3	0.5	151	65	750	88	4.2	0.1	3.3	0.1	4.4
Mexico	690	642	0.5	0.4	1,570	579	26,071	261	75.8	99.0	5.1	82.1	4.2
Moldova	3	3	–0.2	–0.2	253	28	1,752	0	0.0	0.5	1.4	..	..
Mongolia	115	103	0.7	0.8	527	38	2,823	0	4.4	217.9	13.9	..	..
Morocco	43	44	–0.1	–0.2	559	76	3,675	2	4.0	4.7	1.1	0.5	0.1
Mozambique	200	193	0.3	0.3	913	93	5,692	46	8.2	45.3	5.8	22.5	2.8
Myanmar	392	322	1.3	1.4	1,335	118	7,000	38	10.6	35.3	5.4	0.2	0.0
Namibia	88	77	0.9	0.9	811	55	3,174	24	5.9	46.0	5.6	74.0	9.0
Nepal	48	36	2.1	1.4	477	72	6,973	7	2.2	26.6	18.6	..	..
Netherlands	3	4	–0.4	–0.3	539	26	1,221	0	0.1	9.5	28.0	0.8	1.9
New Zealand	77	83	–0.6	–0.2	424	124	2,382	21	22.3	64.7	24.2	22.7	8.4
Nicaragua	65	52	1.6	1.3	813	59	7,590	39	3.6	28.1	23.1	1.3	1.0
Niger	19	13	3.7	1.0	616	20	1,460	2	0.9	96.9	7.7	..	..
Nigeria	172	111	2.7	3.3	1,189	79	4,715	171	6.6	55.0	6.0	..	..
Norway	91	94	–0.2	–0.2	525	32	1,715	2	1.6	19.7	6.5	1.3	0.4
Oman	0	0	0.0	0.0	557	50	1,204	6	4.4	0.2	0.1	29.6	9.6
Pakistan	25	19	1.8	2.1	820	78	4,950	2	5.1	73.1	9.5	2.2	0.3
Panama	44	43	0.2	0.1	1,145	121	9,915	194	11.7	13.1	17.6	10.0	13.3
Papua New Guinea	315	294	0.5	0.5	980	158	11,544	142	27.7	7.3	1.6	3.5	0.8
Paraguay	212	185	0.9	0.9	864	39	7,851	10	3.3	16.6	4.2	..	..
Peru	702	687	0.1	0.1	2,222	238	17,144	274	36.3	216.1	16.9	3.4	0.3
Philippines	106	72	2.8	2.1	812	253	8,931	213	33.7	24.3	8.2	16.6	5.5
Poland	89	92	–0.2	–0.3	534	38	2,450	4	0.6	70.3	23.1	0.7	0.2
Portugal	31	38	–1.5	–1.1	606	147	5,050	16	3.8	4.7	5.1	2.0	2.2
Puerto Rico	4	4	–0.1	0.0	348	47	2,493	53	3.8	*0.3*	3.5	*1.7*	19.1

3.4 Deforestation and biodiversity

	Forest area		Average annual deforestation[a]		Animal species		Higher plants[b]		GEF benefits index for biodiversity	Nationally protected areas		Marine protected areas	
	thousand sq. km		%		Total known species	Threatened species	Total known species	Threatened species	0–100 (no biodiversity to maximum biodiversity)	thousand sq. km	% of total land area	thousand sq. km	% of surface area
	1990	2005	1990–2000	2000–05	2004	2007	2004	2007	2005	2004[c]	2004[c]	2004	2004
Romania	64	64	0.0	0.0	466	64	3,400	1	..	5.8	2.5	6.1	2.6
Russian Federation	8,090	8,088	0.0	0.0	941	153	11,400	7	37.1	1,287.0	7.9	301.8	1.8
Rwanda	3	5	–0.8	–6.9	871	49	2,288	3	1.1	1.9	7.9	..	..
Saudi Arabia	27	27	0.0	0.0	527	45	2,028	3	3.4	819.1	41.0	5.2	0.2
Senegal	93	87	0.5	0.5	803	55	2,086	7	1.3	21.6	11.2	0.9	0.4
Serbia[e]	26	27	–0.3	–0.3	477	91	4,082	1	..	3.8	3.7	0.1	0.1
Sierra Leone	30	28	0.7	0.7	823	48	2,090	47	1.5	3.2	4.5	..	..
Singapore	0	0	0.0	0.0	473	44	2,282	54	0.1	0.0	4.2	0.0	0.1
Slovak Republic	19	19	0.0	–0.1	419	44	3,124	2	0.1	11.0	22.8	..	..
Slovenia	12	13	–0.4	–0.4	437	80	3,200	..	0.2	2.9	14.5	0.0	0.0
Somalia	83	71	1.0	1.0	824	55	3,028	17	6.7	1.9	0.3	3.3	0.5
South Africa	92	92	0.0	0.0	1,149	323	23,420	73	23.5	74.0	6.1	3.4	0.3
Spain	135	179	–2.0	–1.7	647	170	5,050	49	6.6	46.2	9.3	1.8	0.4
Sri Lanka	24	19	1.2	1.5	504	177	3,314	280	6.6	17.7	27.3	2.3	3.5
Sudan	764	675	0.8	0.8	1,254	47	3,137	17	5.5	123.0	5.2	0.3	0.0
Swaziland	5	5	–0.9	–0.9	614	16	2,715	11	0.1	0.6	3.5	..	..
Sweden	274	275	0.0	0.0	542	30	1,750	3	0.3	44.8	10.9	4.3	1.0
Switzerland	12	12	–0.4	–0.4	475	44	3,030	3	0.2	11.9	29.6	..	..
Syrian Arab Republic	4	5	–1.5	–1.3	432	59	3,000	0	0.9	2.7	1.5	..	..
Tajikistan	4	4	0.0	0.0	427	27	5,000	14	0.7	26.0	18.6	..	..
Tanzania	414	353	1.0	1.1	1,431	299	10,008	240	15.1	374.3	42.3	2.3	0.2
Thailand	160	145	0.7	0.4	1,271	157	11,625	86	8.0	80.3	15.7	5.8	1.1
Timor-Leste	10	8	1.2	1.3	..	..	..	..	..	1.9	12.6	..	..
Togo	7	4	3.4	4.5	740	33	3,085	10	0.4	6.5	11.9	..	..
Trinidad and Tobago	2	2	0.3	0.2	551	38	2,259	1	2.4	0.2	4.7	0.1	1.3
Tunisia	6	11	–4.1	–1.9	438	52	2,196	0	0.5	2.3	1.5	0.2	0.1
Turkey	97	102	–0.4	–0.2	581	121	8,650	3	6.0	20.3	2.6	4.5	0.6
Turkmenistan	41	41	0.0	0.0	421	44	..	3	2.0	19.8	4.2	..	..
Uganda	49	36	1.9	2.2	1,375	131	4,900	38	3.3	64.3	32.6	..	..
Ukraine	93	96	–0.3	–0.1	445	58	5,100	1	0.4	19.4	3.3	3.1	0.5
United Arab Emirates	2	3	–2.4	–0.1	298	27	..	..	0.2	0.2	0.2	..	..
United Kingdom	26	28	–0.7	–0.4	660	38	1,623	13	2.1	60.5	25.0	22.5	9.2
United States	2,986	3,031	–0.1	–0.1	1,356	937	19,473	242	90.3	1,490.1	16.3	909.5	9.4
Uruguay	9	15	–4.5	–1.3	532	66	2,278	1	1.4	0.7	0.4	0.1	0.0
Uzbekistan	30	33	–0.5	–0.5	434	33	4,800	15	1.2	20.5	4.8	..	..
Venezuela, RB	520	477	0.6	0.6	1,745	166	21,073	68	26.8	644.4	73.1	21.3	2.3
Vietnam	94	129	–2.3	–2.0	1,116	152	10,500	146	11.7	13.6	4.4	0.7	0.2
West Bank and Gaza	0	0	0.0	0.0	..	..	..	..	..	..	..	..	..
Yemen, Rep.	5	5	0.0	0.0	459	47	1,650	159	3.4	0.0	0.0	..	..
Zambia	491	425	0.9	1.0	1,025	38	4,747	8	5.0	312.3	42.0	..	..
Zimbabwe	222	175	1.5	1.7	883	35	4,440	17	2.1	57.5	14.9	..	..
World	**40,679 s**	**39,426 s**	**0.2 w**	**0.2 w**						**15,050.8 s**	**11.6 w**	**4,348.9 s**	**3.8 w**
Low income	7,392	6,714	0.6	0.7						2,794.9	9.9	73.8	..
Middle income	23,770	23,086	0.2	0.1						7,975.0	11.7	1,233.1	1.9
Lower middle income	7,550	7,413	0.2	–0.1						3,585.7	12.8	632.6	1.7
Upper middle income	16,220	15,673	0.2	0.3						4,389.3	10.9	600.6	2.1
Low & middle income	31,161	29,799	0.3	0.3						10,769.9	11.2	1,307.0	1.6
East Asia & Pacific	4,581	4,507	0.3	–0.2						1,926.6	12.1	192.1	1.3
Europe & Central Asia	8,845	8,869	0.0	0.0						1,630.1	7.0	321.6	1.4
Latin America & Carib.	9,834	9,147	0.5	0.5						3,966.0	19.7	495.7	2.7
Middle East & N. Africa	200	211	–0.4	–0.3						301.1	3.4	114.7	1.5
South Asia	789	801	–0.2	0.1						288.6	6.0	20.9	0.5
Sub-Saharan Africa	6,913	6,263	0.7	0.6						2,657.5	11.3	162.0	..
High income	9,492	9,600	–0.1	–0.1						4,277.1	13.0	3,042.0	8.8
Euro area	822	915	–0.8	–0.6						283.9	11.5	19.5	0.8

a. Negative values indicate an increase in forest area. b. Flowering plants only. c. Data may refer to earlier years. They are the most recent reported by the World Conservation Monitoring Centre in 2004. d. Includes Luxembourg. e. Includes Montenegro.

Deforestation and biodiversity 3.4

About the data

Biological diversity is defined in terms of variability in genes, species, and ecosystems. As threats to biodiversity mount, the international community is increasingly focusing on conserving diversity. Deforestation is a major cause of loss of biodiversity, and habitat conservation is vital for stemming this loss. Conservation efforts have focused on protecting areas of high biodiversity.

The Food and Agriculture Organization's (FAO) *Global Forest Resources Assessment 2005* provides detailed information on forest cover in 2005 and adjusted estimates of forest cover in 1990 and 2000. The current survey uses a uniform definition of forest. Because of space limitations, the table does not break down forest cover between natural forest and plantation, a breakdown the FAO provides for developing countries. Thus the deforestation data in the table may underestimate the rate at which natural forest is disappearing in some countries.

Measures of species richness are a straightforward way to indicate an area's importance for biodiversity. The number of threatened species is also an important measure of the immediate need for conservation in an area. Global analyses of the status of threatened species have been carried out for few groups of organisms. Only for mammals, birds, and amphibians has the status of virtually all known species been assessed. Threatened species are defined using the World Conservation Union's (IUCN) classification: *endangered* (in danger of extinction and unlikely to survive if causal factors continue operating); *vulnerable* (likely to move into the endangered category in the near future if causal factors continue operating); *rare* (not endangered or vulnerable but at risk); *indeterminate* (known to be endangered, vulnerable, or rare but not enough information is available to say which); *out of danger* (formerly included in one of the above categories but now considered relatively secure because appropriate conservation measures are in effect); and *insufficiently known* (suspected but not definitely known to belong to one of the above categories).

Unlike birds and mammals, it is difficult to accurately count plants. The number of plant species is highly debated. The IUCN's *2007 IUCN Red List of Threatened Species*, the result of more than 20 years' work by botanists worldwide, is the most comprehensive list of threatened species on a global scale. Only 5 percent of plant species have been evaluated, and 70 percent are threatened with extinction. Plant species data may not be comparable across countries because of differences in taxonomic concepts and coverage and so should be interpreted with caution. However, the data identify countries that are major sources of global biodiversity and that show national commitments to habitat protection.

More than information about species richness is needed to set priorities for conserving biodiversity. The Global Environment Facility's (GEF) benefits index for biodiversity is a comprehensive indicator of national biodiversity status and is used to guide its biodiversity priorities. The indicator incorporates information on individual species range maps available from the IUCN for virtually all mammals (4,863), amphibians (5,915), and endangered birds (1,098); country data from the World Resources Institute for reptiles and vascular plants; country data from FishBase for 31,190 fish species; and the ecological characteristics of 867 world terrestrial ecoregions from WWF International. For each country the biodiversity indicator incorporates the best available and comparable information in four relevant dimensions: represented species, threatened species, represented ecoregions, and threatened ecoregions. To combine these dimensions into one measure, the indicator uses dimensional weights that reflect the consensus of conservation scientists at the GEF, IUCN, WWF International, and other nongovernmental organizations.

The World Conservation Monitoring Centre (WCMC) compiles data on protected areas, numbers of certain species, and numbers of those species under threat from various sources. Because of differences in definitions, reporting practices, and reporting periods, cross-country comparability is limited.

Nationally protected areas are defined using the six IUCN management categories for areas of at least 1,000 hectares: *scientific reserves* and strict nature reserves with limited public access; *national parks* of national or international significance and not materially affected by human activity; *natural monuments* and natural landscapes with unique aspects; *managed nature reserves* and wildlife sanctuaries; *protected landscapes* (which may include cultural landscapes); and *areas managed mainly for the sustainable use* of natural systems to ensure long-term protection and maintenance of biological diversity. Designating land as a protected area does not mean that protection is in force. And for small countries that only have protected areas smaller than 1,000 hectares, the size limit in the definition leads to an underestimate of protected areas.

Due to variations in consistency and methods of collection, data quality is highly variable across countries. Some countries update their information more frequently than others, some have more accurate data on extent of coverage, and many underreport the number or extent of protected areas.

Definitions

• **Forest area** is land under natural or planted stands of trees, whether productive or not. • **Average annual deforestation** is the permanent conversion of natural forest area to other uses, including agriculture, ranching, settlements, and infrastructure. Deforested areas do not include areas logged but intended for regeneration or areas degraded by fuelwood gathering, acid precipitation, or forest fires. • **Animal species** are mammals (excluding whales and porpoises) and birds (included within a country's breeding or wintering ranges). • **Higher plants** are native vascular plant species. • **Threatened species** are the number of species classified by the IUCN as endangered, vulnerable, rare, indeterminate, out of danger, or insufficiently known. • **GEF benefits index for biodiversity** is a composite index of relative biodiversity potential based on the species represented in each country and their threat status and diversity of habitat types. The index has been normalized from 0 (no biodiversity potential) to 100 (maximum biodiversity potential). • **Nationally protected areas** are totally or partially protected areas of at least 1,000 hectares that are designated as scientific reserves with limited public access, national parks, natural monuments, nature reserves or wildlife sanctuaries, and protected landscapes. Marine areas, unclassified areas, littoral (intertidal) areas, and sites protected under local or provincial law are excluded. Total area protected is a percentage of total land area (see table 3.1). • **Marine protected areas** are areas of intertidal or subtidal terrain—and overlying water and associated flora and fauna and historical and cultural features—that have been reserved to protect part or all of the enclosed environment.

Data sources

Data on forest area and deforestation are from the FAO's *Global Forest Resources Assessment 2005*. Data on species are from the electronic files of the United Nations Environmental Program and WCMC and *2007 IUCN Red List of Threatened Species*. The GEF benefits index for biodiversity is from Kiran Dev Pandey, Piet Buys, Ken Chomitz, and David Wheeler's, "Biodiversity Conservation Indicators: New Tools for Priority Setting at the Global Environment Facility" (2006). Data on protected areas are from the United Nations Environment Programme and WCMC, as compiled by the World Resources Institute.

3.5 Freshwater

	Renewable internal freshwater resources[a]		Annual freshwater withdrawals					Water productivity	Access to an improved water source	
	Flows billion cu. m 2005	Per capita cu. m 2005	billion cu. m 1987–2002[b]	% of internal resources 1987–2002[b]	% for agriculture 1987–2002[b]	% for industry 1987–2002[b]	% for domestic 1987–2002[b]	GDP/water use 2000 $ per cu. m 2002	% of urban population 2004	% of rural population 2004
Afghanistan	55	..	23.3	42.3	98	0	2	..	..	..
Albania	27	8,530	1.7	6.4	62	11	27	2.4	99	94
Algeria	11	341	6.1	54.2	65	13	22	9.7	88	80
Angola	148	9,195	0.4	0.2	60	17	23	30.8	75	40
Argentina	276	7,123	29.2	10.6	74	9	17	8.3	98	80
Armenia	9	3,016	3.0	32.4	66	4	30	0.8	99	80
Australia	492	24,118	23.9	4.9	75	10	15	17.9	100	100
Austria	55	6,680	2.1	3.8	1	64	35	93.4	100	100
Azerbaijan	8	965	17.3	213.0	68	28	5	0.4	95	59
Bangladesh	105	685	79.4	75.6	96	1	3	0.7	82	72
Belarus	37	3,805	2.8	7.5	30	47	23	5.0	100	100
Belgium	12	1,145	..	..	..	..	..	..	100	..
Benin	10	1,213	0.1	1.3	45	23	32	19.0	78	57
Bolivia	304	33,054	1.4	0.5	81	7	13	6.1	95	68
Bosnia and Herzegovina	36	9,067	..	..	..	..	..	..	99	96
Botswana	2	1,307	0.2	8.1	41	18	41	35.4	100	90
Brazil	5,418	29,000	59.3	1.1	62	18	20	11.3	96	57
Bulgaria	21	2,713	10.5	50.0	19	78	3	1.3	100	97
Burkina Faso	13	897	0.8	6.4	86	1	13	3.6	94	54
Burundi	10	1,285	0.3	2.9	77	6	17	2.6	92	77
Cambodia	121	8,642	4.1	3.4	98	0	1	1.0	64	35
Cameroon	273	15,341	1.0	0.4	74	8	18	11.1	86	44
Canada	2,850	88,203	46.0	1.6	12	69	20	16.5	100	99
Central African Republic	141	33,640	0.0	0.0	4	16	80	38.3	93	61
Chad	15	1,478	0.2	1.5	83	0	17	7.3	41	43
Chile	884	54,249	12.6	1.4	64	25	11	6.4	100	58
China	2,812	2,156	630.3	22.4	68	26	7	2.2	93	67
Hong Kong, China	..	..	..	..	..	..	..	..	..	..
Colombia	2,112	46,990	10.7	0.5	46	4	50	8.1	99	71
Congo, Dem. Rep.	900	15,322	0.4	0.0	31	17	53	12.1	82	29
Congo, Rep.	222	61,498	0.0	0.0	9	22	70	76.1	84	27
Costa Rica	112	25,975	2.7	2.4	53	17	29	6.2	100	92
Côte d'Ivoire	77	4,132	0.9	1.2	65	12	24	11.0	97	74
Croatia	38	8,485	..	..	..	..	..	..	100	100
Cuba	38	3,384	8.2	21.5	69	12	19	..	95	78
Czech Republic	13	1,290	2.6	19.5	2	57	41	23.0	100	100
Denmark	6	1,108	1.3	21.2	43	25	32	127.5	100	100
Dominican Republic	21	2,218	3.4	16.1	66	2	32	6.3	97	91
Ecuador	432	33,076	17.0	3.9	82	5	12	1.0	97	89
Egypt, Arab Rep.	2	25	68.3	3,794.4	86	6	8	1.6	99	97
El Salvador	18	2,669	1.3	7.2	59	16	25	10.7	94	70
Eritrea	3	619	0.3	10.7	97	0	3	2.3	74	57
Estonia	13	9,435	0.2	1.2	5	38	57	41.4	100	99
Ethiopia	122	1,623	5.6	4.6	94	0	6	1.6	81	11
Finland	107	20,396	2.5	2.3	3	84	14	51.3	100	100
France	179	2,932	40.0	22.4	10	74	16	34.2	100	100
Gabon	164	127,064	0.1	0.1	42	8	50	43.0	95	47
Gambia, The	3	1,855	0.0	1.0	65	12	23	14.1	95	77
Georgia	58	12,988	3.6	6.2	59	21	20	0.9	96	67
Germany	107	1,297	47.1	44.0	20	68	12	40.9	100	100
Ghana	30	1,345	1.0	3.2	66	10	24	5.5	88	64
Greece	58	5,223	7.8	13.4	80	3	16	20.1	..	..
Guatemala	109	8,592	2.0	1.8	80	13	6	10.0	99	92
Guinea	226	25,104	1.5	0.7	90	2	8	2.2	78	35
Guinea-Bissau	16	10,019	0.2	1.1	82	5	13	1.1	79	49
Haiti	13	1,398	1.0	7.6	94	1	5	3.8	52	56

3.5 Freshwater

	Renewable internal freshwater resources[a]		Annual freshwater withdrawals					Water productivity	Access to an improved water source	
	Flows billion cu. m 2005	Per capita cu. m 2005	billion cu. m 1987–2002[b]	% of internal resources 1987–2002[b]	% for agriculture 1987–2002[b]	% for industry 1987–2002[b]	% for domestic 1987–2002[b]	GDP/water use 2000 $ per cu. m 2002	% of urban population 2004	% of rural population 2004
Honduras	96	14,033	0.9	0.9	80	12	8	7.3	95	81
Hungary	6	595	7.6	127.3	32	59	9	6.8	100	98
India	1,261	1,152	645.8	51.2	86	5	8	0.8	95	83
Indonesia	2,838	12,867	82.8	2.9	91	1	8	2.2	87	69
Iran, Islamic Rep.	129	1,860	72.9	56.7	91	2	7	1.5	99	84
Iraq	35	..	42.7	121.3	92	5	3	0.5	..	..
Ireland	49	11,781	1.1	2.3	0	77	23	95.7	100	..
Israel	1	116	2.1	256.3	62	7	31	58.1	100	100
Italy	183	3,114	44.4	24.3	45	37	18	25.3	100	..
Jamaica	9	3,541	0.4	4.4	49	17	34	20.2	98	88
Japan	430	3,365	88.4	20.6	62	18	20	53.0	100	100
Jordan	1	129	1.0	144.3	75	4	21	9.3	99	91
Kazakhstan	75	4,978	35.0	46.4	82	17	2	0.7	97	73
Kenya	21	581	1.6	7.6	64	6	30	8.4	83	46
Korea, Dem. Rep.	67	2,837	9.0	13.5	55	25	20	..	100	100
Korea, Rep.	65	1,344	18.6	28.6	48	16	36	30.6	97	71
Kuwait	..	..	0.4	..	52	2	45	90.8	..	..
Kyrgyz Republic	47	9,041	10.1	21.7	94	3	3	0.1	98	66
Lao PDR	190	33,616	3.0	1.6	90	6	4	0.6	79	43
Latvia	17	7,259	0.3	1.8	13	33	53	30.0	100	96
Lebanon	5	1,197	1.4	28.8	67	1	33	13.2	100	100
Lesotho	5	2,625	0.1	1.0	20	40	40	17.9	92	76
Liberia	200	58,109	0.1	0.1	55	18	27	5.4	72	52
Libya	1	101	4.3	711.3	83	3	14	8.7	72	68
Lithuania	16	4,569	0.3	1.7	7	15	78	48.2	..	..
Macedonia, FYR	5	2,655	..	..	..	..	..	..	..	..
Madagascar	337	18,077	15.0	4.4	96	2	3	0.2	77	35
Malawi	16	1,217	1.0	6.3	80	5	15	1.6	98	68
Malaysia	580	22,609	9.0	1.6	62	21	17	10.5	100	96
Mali	60	5,167	6.5	10.9	90	1	9	0.4	78	36
Mauritania	0	135	1.7	425.0	88	3	9	0.7	59	44
Mauritius	3	2,252	0.6	21.8	..	..	..	7.9	100	100
Mexico	409	3,967	78.2	19.1	77	5	17	7.5	100	87
Moldova	1	258	2.3	231.0	33	58	10	0.6	97	88
Mongolia	35	13,626	0.4	1.3	52	27	20	2.7	87	30
Morocco	29	962	12.6	43.4	87	3	10	3.3	99	56
Mozambique	100	4,885	0.6	0.6	87	2	11	8.2	72	26
Myanmar	881	18,358	33.2	3.8	98	1	1	..	80	77
Namibia	6	3,070	0.3	4.8	71	5	24	12.4	98	81
Nepal	198	7,315	10.2	5.1	96	1	3	0.6	96	89
Netherlands	11	674	7.9	72.2	34	60	6	49.5	100	100
New Zealand	327	79,102	2.1	0.6	42	9	48	27.0	100	..
Nicaragua	190	34,727	1.3	0.7	83	2	15	3.1	90	63
Niger	4	264	2.2	62.3	95	0	4	0.9	80	36
Nigeria	221	1,563	8.0	3.6	69	10	21	6.0	67	31
Norway	382	82,625	2.2	0.6	11	67	23	79.6	100	100
Oman	1	399	1.4	136.0	90	2	7	16.1	85	73
Pakistan	52	336	169.4	323.3	96	2	2	0.5	96	89
Panama	147	45,613	0.8	0.6	28	5	67	14.6	99	79
Papua New Guinea	801	131,967	..	..	..	..	..	..	88	32
Paraguay	94	15,936	0.5	0.5	71	8	20	14.7	99	68
Peru	1,616	59,250	20.1	1.2	82	10	8	2.8	89	65
Philippines	479	5,664	28.5	6.0	74	9	17	2.8	87	82
Poland	54	1,404	16.2	30.2	8	79	13	10.9	100	..
Portugal	38	3,602	11.3	29.6	78	12	10	10.3	..	..
Puerto Rico	7	1,815	..	..	..	..	..	..	..	..

3.5 Freshwater

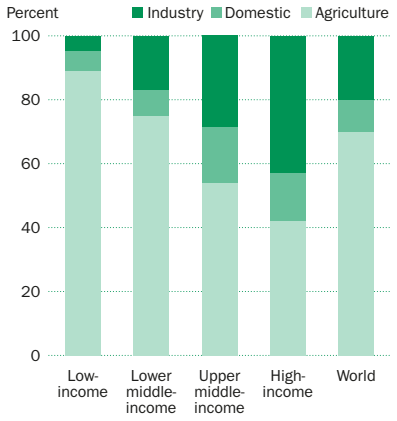
	Renewable internal freshwater resources[a]		Annual freshwater withdrawals					Water productivity	Access to an improved water source	
	Flows billion cu. m 2005	Per capita cu. m 2005	billion cu. m 1987–2002[b]	% of internal resources 1987–2002[b]	% for agriculture 1987–2002[b]	% for industry 1987–2002[b]	% for domestic 1987–2002[b]	GDP/water use 2000 $ per cu. m 2002	% of urban population 2004	% of rural population 2004
Romania	42	1,955	23.2	54.8	57	34	9	1.8	91	16
Russian Federation	4,313	30,127	76.7	1.8	18	63	19	3.7	100	88
Rwanda	10	1,029	0.2	1.6	68	8	24	14.1	92	69
Saudi Arabia	2	104	17.3	721.7	89	1	10	11.0	97	63
Senegal	26	2,192	2.2	8.6	93	3	4	2.2	92	60
Serbia[c]	44	5,456	..	..	..	..	..	..	99	86
Sierra Leone	160	28,641	0.4	0.2	92	3	5	2.5	75	46
Singapore	1	138	..	..	..	..	..	..	100	..
Slovak Republic	13	2,339	..	..	..	..	..	..	100	99
Slovenia	19	9,348	..	..	..	..	..	..	..	..
Somalia	6	732	3.3	54.8	100	0	0	..	32	27
South Africa	45	955	12.5	27.9	63	6	31	11.3	99	73
Spain	111	2,562	35.6	32.0	68	19	13	17.3	100	100
Sri Lanka	50	2,542	12.6	25.2	95	2	2	1.3	98	74
Sudan	30	813	37.3	124.4	97	1	3	0.4	78	64
Swaziland	3	2,299	1.0	40.1	97	1	2	1.4	87	54
Sweden	171	18,949	3.0	1.7	9	54	37	84.3	100	100
Switzerland	40	5,432	2.6	6.4	2	74	24	97.0	100	100
Syrian Arab Republic	7	370	20.0	285.0	95	2	3	1.1	98	87
Tajikistan	66	10,122	12.0	18.0	92	5	4	0.1	92	48
Tanzania	84	2,183	5.2	6.2	89	0	10	2.0	85	49
Thailand	210	3,333	87.1	41.5	95	2	2	1.5	98	100
Timor-Leste	..	..	..	..	..	..	..	..	..	..
Togo	12	1,843	0.2	1.5	45	2	53	8.2	80	36
Trinidad and Tobago	4	2,871	0.3	8.2	6	26	68	29.6	92	88
Tunisia	4	419	2.6	62.9	82	4	14	7.9	99	82
Turkey	227	3,150	37.5	16.5	74	11	15	5.3	98	93
Turkmenistan	1	290	24.7	1,760.7	98	1	2	..	93	54
Uganda	39	1,347	0.3	0.8	40	17	43	22.1	87	56
Ukraine	53	1,127	37.5	70.7	52	35	12	1.0	99	91
United Arab Emirates	0	49	2.3	1,150.0	68	9	23	34.0	100	100
United Kingdom	145	2,408	9.5	6.6	3	75	22	157.9	100	100
United States	2,800	9,443	479.3	17.1	41	46	13	20.9	100	100
Uruguay	59	17,848	3.2	5.3	96	1	3	5.6	100	100
Uzbekistan	16	623	58.3	357.9	93	2	5	0.3	95	75
Venezuela, RB	723	27,185	8.4	1.2	47	7	46	13.2	85	70
Vietnam	367	4,410	71.4	19.5	68	24	8	0.5	99	80
West Bank and Gaza	..	..	..	..	..	..	..	..	94	88
Yemen, Rep.	4	194	6.6	161.7	95	1	4	1.5	71	65
Zambia	80	6,987	1.7	2.2	76	7	17	2.0	90	40
Zimbabwe	12	938	4.2	34.2	79	7	14	1.6	98	72
World	**43,507 s**	**6,778 w**	**3,807.4 s**	**9.1 w**	**70 w**	**20 w**	**10 w**	**8.6 w**	**94 w**	**72 w**
Low income	7,404	3,077	1,240.7	18.9	89	5	6	0.8	88	69
Middle income	26,662	8,754	1,667.0	6.3	71	19	10	3.3	95	72
Lower middle income	18,455	5,769	1,337.3	7.3	75	17	8	2.1	93	71
Upper middle income	8,207	17,199	329.6	4.0	54	29	18	6.7	98	78
Low & middle income	34,066	6,268	2,907.6	8.8	78	13	8	2.3	93	70
East Asia & Pacific	9,454	5,022	958.8	11.1	74	20	7	2.1	92	70
Europe & Central Asia	5,255	11,473	383.2	7.5	59	31	10	2.5	99	80
Latin America & Carib.	13,429	24,471	265.3	2.0	71	10	19	7.8	96	73
Middle East & N. Africa	228	757	239.8	105.0	89	4	7	2.0	96	81
South Asia	1,816	1,230	941.1	51.8	90	4	6	0.7	94	81
Sub-Saharan Africa	3,884	5,093	119.3	3.1	87	3	10	3.1	80	42
High income	9,441	9,579	899.7	10.2	42	42	15	28.3	100	98
Euro area	929	2,951	199.7	22.3	38	48	15	30.7	100	100

a. Excludes river flows from other countries because of data unreliability. b. Data are for the most recent year available (see *Primary data documentation*). c. Includes Montenegro.

About the data

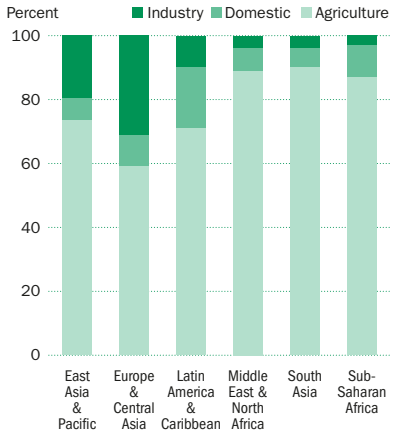
The data on freshwater resources are based on estimates of runoff into rivers and recharge of groundwater. These estimates are based on different sources and refer to different years, so cross-country comparisons should be made with caution. Because the data are collected intermittently, they may hide significant variations in total renewable water resources from year to year. The data also fail to distinguish between seasonal and geographic variations in water availability within countries. Data for small countries and countries in arid and semiarid zones are less reliable than those for larger countries and countries with greater rainfall.

Agriculture is still the largest user of water, accounting for some 70 percent of global withdrawals **3.5a**



Source: Table 3.5.

The share of withdrawals for agriculture approaches 90 percent in some developing regions **3.5b**



Source: Table 3.5.

Caution should also be exercised in comparing data on annual freshwater withdrawals, which are subject to variations in collection and estimation methods. In addition, inflows and outflows are estimated at different times and at different levels of quality and precision, requiring caution in interpreting the data, particularly for water-short countries, notably in the Middle East and North Africa.

Water productivity is an indication only of the efficiency by which each country uses its water resources. Given the different economic structure of each country, these indicators should be used carefully, taking into account the countries' sectoral activities and natural resource endowments.

The data on access to an improved water source measure the percentage of the population with ready access to water for domestic purposes. The data are based on surveys and estimates provided by governments to the Joint Monitoring Programme of the World Health Organization (WHO) and the United Nations Children's Fund (UNICEF). The coverage rates are based on information from service users on actual household use rather than on information from service providers, which may include nonfunctioning systems. Access to drinking water from an improved source does not ensure that the water is safe or adequate, as these characteristics are not tested at the time of survey. While information on access to an improved water source is widely used, it is extremely subjective, and such terms as *safe, improved, adequate,* and *reasonable* may have different meaning in different countries despite official WHO definitions (see *Definitions*). Even in high-income countries treated water may not always be safe to drink. Access to an improved water source is equated with connection to a supply system; it does not take into account variations in the quality and cost (broadly defined) of the service.

Definitions

• **Renewable internal freshwater resources flows** are internal renewable resources (internal river flows and groundwater from rainfall) in the country. • **Renewable internal freshwater resources per capita** are calculated using the World Bank's population estimates (see table 2.1). • **Annual freshwater withdrawals** are total water withdrawals, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source. Withdrawals can exceed 100 percent of total renewable resources where extraction from nonrenewable aquifers or desalination plants is considerable or where water reuse is significant. Withdrawals for agriculture and industry are total withdrawals for irrigation and livestock production and for direct industrial use (including for cooling thermoelectric plants). Withdrawals for domestic uses include drinking water, municipal use or supply, and use for public services, commercial establishments, and homes. • **Water productivity** is calculated as GDP in constant prices divided by annual total water withdrawal. • **Access to an improved water source** is the percentage of the population with reasonable access to an adequate amount of water from an improved source, such as piped water into a dwelling, plot, or yard; public tap or standpipe; tubewell or borehole; protected dug well or spring; and rainwater collection. Unimproved sources include unprotected dug wells or springs, carts with small tank or drum, bottled water, and tanker trucks. Reasonable access is defined as the availability of at least 20 liters a person a day from a source within 1 kilometer of the dwelling.

Data sources

Data on freshwater resources and withdrawals are compiled by the World Resources Institute from various sources and published in *World Resources 2005* (produced in collaboration with the United Nations Environment Programme, United Nations Development Programme, and World Bank). These data are supplemented by the Food and Agriculture Organization's AQUASTAT data. The GDP estimates used to calculate water productivity are from the World Bank national accounts database. Data on access to water are from WHO and UNICEF's *Meeting the MDG Drinking Water and Sanitation Target* (www.unicef.org/wes/mdgreport).

3.6 Water pollution

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	thousand kilograms per day		kilograms per day per worker		% of total							
	Primary metals	Paper and pulp	Chemicals	Food and beverages	Stone, ceramics, and glass	Textiles	Wood	Other				
	1990	2004[a]	1990	2004[a]	2004[a]	2004[a]	2004[a]	2004[a]	2004[a]	2004[a]	2004[a]	2004[a]
Afghanistan	*5.9*	*0.2*	*0.16*	*0.21*	..	*37.7*	*17.5*	*31.1*	*0.4*	*13.2*	..	..
Albania	34.8	2.0	0.14	0.20	0.0	0.0	0.0	25.0	0.0	75.0	0.0	0.0
Algeria	107.0	..	0.25	..	..	..	..	..	..	..	..	..
Angola	*4.5*	..	*0.19*	..	..	..	..	..	..	..	..	..
Argentina	186.7	*164.3*	0.20	*0.23*	*5.6*	*14.6*	*8.6*	*58.9*	*0.1*	*7.6*	*1.1*	*3.5*
Armenia	37.9	*7.1*	0.11	*0.28*	..	..	..	*77.6*	..	*22.4*	..	..
Australia	186.1	*111.7*	0.18	*0.18*	*12.4*	*22.8*	*6.7*	*43.5*	*0.2*	*5.3*	*2.8*	*6.3*
Austria	94.1	*36.9*	0.15	*0.08*	*14.6*	*21.0*	*7.8*	*34.9*	*0.3*	*3.3*	*6.1*	*12.1*
Azerbaijan	53.3	16.1	0.15	0.17	9.9	2.4	21.0	15.0	5.9	14.3	1.0	30.4
Bangladesh	171.1	..	0.17	..	..	..	..	..	..	..	..	..
Belarus	..	..	..	..	..	..	..	..	..	..	..	..
Belgium	118.0	*102.3*	0.16	*0.17*	*13.6*	*18.4*	*11.2*	*40.3*	*0.2*	*5.9*	*2.2*	*8.2*
Benin	..	..	..	..	..	..	..	..	..	..	..	..
Bolivia	8.4	*11.5*	0.24	*0.25*	*1.2*	*15.1*	*6.8*	*64.9*	*0.2*	*8.7*	*2.3*	*0.7*
Bosnia and Herzegovina	50.7	..	0.14	..	..	..	..	..	..	..	..	..
Botswana	4.5	3.3	0.19	0.34	0.0	3.4	0.0	69.5	0.0	5.6	0.0	21.4
Brazil	780.4	..	0.19	..	..	..	..	..	..	..	..	..
Bulgaria	149.4	*101.9*	0.11	*0.17*	*7.9*	*9.5*	*6.6*	*46.1*	*0.2*	*22.2*	*2.3*	*5.2*
Burkina Faso	..	..	..	..	..	..	..	..	..	..	..	..
Burundi	1.6	..	0.24	..	..	..	..	..	..	..	..	..
Cambodia	11.8	..	0.14	..	..	..	..	..	..	..	..	..
Cameroon	14.0	*10.0*	0.28	*0.19*	*0.4*	*5.2*	*36.1*	*48.8*	*0.0*	*3.8*	*5.0*	*0.8*
Canada	321.5	*312.5*	0.17	*0.16*	*9.6*	*22.1*	*8.6*	*39.5*	*0.1*	*5.8*	*5.4*	*8.9*
Central African Republic	1.0	..	0.18	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	66.8	*72.9*	0.22	*0.24*	*6.9*	*11.3*	*8.9*	*62.7*	*0.1*	*5.0*	*2.6*	*2.5*
China	7,038.1	*6,088.7*	0.14	*0.14*	*20.4*	*10.9*	*14.8*	*28.1*	*0.5*	*15.5*	*0.9*	*8.8*
Hong Kong, China	86.1	*34.3*	0.12	*0.20*	*1.2*	*43.5*	*3.9*	*30.5*	*0.1*	*16.2*	*0.2*	*4.6*
Colombia	93.3	*93.9*	0.19	*0.21*	*3.1*	*16.2*	*9.7*	*53.2*	*0.2*	*14.2*	*1.0*	*2.4*
Congo, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Congo, Rep.	*2.5*	..	*0.32*	..	..	..	..	..	..	..	..	..
Costa Rica	27.2	*31.2*	0.20	*0.22*	*1.6*	*10.0*	*8.2*	*65.7*	*0.1*	*10.2*	*1.3*	*2.9*
Côte d'Ivoire	*7.9*	..	*0.22*	..	..	..	..	..	..	..	..	..
Croatia	80.0	*42.9*	0.15	*0.17*	*6.1*	*15.9*	*7.5*	*48.4*	*0.2*	*12.0*	*3.6*	*6.3*
Cuba	*173.0*	..	*0.25*	..	..	..	..	..	..	..	..	..
Czech Republic	205.1	..	0.13	..	..	..	..	..	..	..	..	..
Denmark	91.9	..	0.18	..	..	..	..	..	..	..	..	..
Dominican Republic	*47.9*	..	*0.36*	..	..	..	..	..	..	..	..	..
Ecuador	25.6	41.5	0.23	0.28	1.9	7.5	12.6	45.4	4.6	12.9	2.6	12.5
Egypt, Arab Rep.	211.5	*186.1*	0.20	*0.20*	*10.8*	*8.2*	*9.0*	*50.7*	*0.3*	*17.7*	*0.6*	*2.8*
El Salvador	*5.5*	..	*0.22*	..	..	..	..	..	..	..	..	..
Eritrea	..	..	..	..	..	..	..	..	..	..	..	..
Estonia	..	..	..	..	..	..	..	..	..	..	..	..
Ethiopia	18.6	*22.1*	0.23	*0.23*	*2.3*	*11.0*	*5.5*	*61.0*	*0.3*	*17.3*	*2.0*	*0.7*
Finland	79.5	*67.4*	0.18	*0.16*	*8.7*	*40.1*	*7.6*	*26.6*	*0.2*	*2.4*	*3.9*	*10.6*
France	653.5	*564.6*	0.15	*0.15*	*7.2*	*13.8*	*12.9*	*49.5*	*0.2*	*2.9*	*2.3*	*11.1*
Gabon	*2.0*	..	*0.25*	..	..	..	..	..	..	..	..	..
Gambia, The	*0.8*	..	*0.34*	..	..	..	..	..	..	..	..	..
Georgia	..	..	..	..	..	..	..	..	..	..	..	..
Germany	*835.0*	*966.7*	*0.12*	*0.14*	*9.3*	*20.4*	*11.8*	*38.7*	*0.2*	*2.3*	*2.1*	*15.1*
Ghana	*16.5*	..	*0.20*	..	..	..	..	..	..	..	..	..
Greece	63.5	..	0.18	..	..	..	..	..	..	..	..	..
Guatemala	*21.6*	..	*0.23*	..	..	..	..	..	..	..	..	..
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	*5.4*	..	*0.20*	..	..	..	..	..	..	..	..	..

3.6 Water pollution

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	thousand kilograms per day		kilograms per day per worker		% of total							
	1990	2004[a]	1990	2004[a]	Primary metals 2004[a]	Paper and pulp 2004[a]	Chemicals 2004[a]	Food and beverages 2004[a]	Stone, ceramics, and glass 2004[a]	Textiles 2004[a]	Wood 2004[a]	Other 2004[a]
Honduras	17.8	..	0.23	..	..	..	..	..	..	..	..	..
Hungary	178.0	*60.7*	0.16	*0.10*	*6.4*	*11.8*	*7.6*	*49.1*	*0.2*	*12.8*	*2.4*	*9.8*
India	1,410.6	*1,519.8*	0.20	*0.20*	*12.2*	*7.6*	*9.2*	*53.7*	*0.3*	*12.7*	*0.3*	*3.9*
Indonesia	495.6	*733.0*	0.19	*0.18*	*2.5*	*8.2*	*9.2*	*53.7*	*0.1*	*19.4*	*4.5*	*2.4*
Iran, Islamic Rep.	102.7	*164.8*	0.16	*0.15*	*15.6*	*8.0*	*10.7*	*46.7*	*0.7*	*9.5*	*0.9*	*8.1*
Iraq	*26.7*	..	*0.19*	..	..	..	..	..	..	..	..	..
Ireland	34.6	*11.6*	0.18	*0.21*	..	*58.5*	*10.4*	*22.9*	*0.7*	..	*7.5*	..
Israel	46.4	*54.0*	0.16	*0.16*	*3.6*	*22.3*	*10.5*	*45.5*	*0.1*	*6.0*	*1.9*	*10.1*
Italy	358.1	*488.9*	0.13	*0.12*	*9.4*	*16.6*	*10.7*	*30.8*	*0.3*	*15.0*	*3.9*	*13.3*
Jamaica	18.7	..	0.29	..	..	..	..	..	..	..	..	..
Japan	1,556.6	*1,184.7*	0.14	*0.15*	*7.1*	*19.0*	*9.4*	*45.7*	*0.2*	*4.8*	*1.6*	*12.3*
Jordan	8.3	25.3	0.19	0.18	2.7	6.5	15.5	21.8	11.6	16.9	2.4	22.7
Kazakhstan	..	..	..	..	..	..	..	..	..	..	..	..
Kenya	42.6	*56.1*	0.23	*0.24*	..	*11.5*	*5.4*	*66.8*	*0.1*	*12.8*	*1.7*	*1.8*
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Korea, Rep.	369.2	*315.2*	0.12	*0.12*	*11.4*	*18.9*	*13.0*	*25.8*	*0.2*	*13.6*	*1.5*	*15.7*
Kuwait	9.1	*11.9*	0.16	*0.17*	*2.1*	*16.6*	*11.1*	*50.2*	*0.4*	*11.6*	*2.8*	*5.2*
Kyrgyz Republic	30.9	*19.1*	0.12	*0.21*	*7.3*	*7.8*	*3.5*	*65.4*	*0.4*	*11.0*	*0.9*	*3.7*
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	39.9	*29.2*	0.12	*0.19*	*4.1*	*15.4*	*3.6*	*53.8*	*0.1*	*9.6*	*9.7*	*3.7*
Lebanon	..	..	..	..	..	..	..	..	..	..	..	..
Lesotho	3.0	..	0.16	..	..	..	..	..	..	..	..	..
Liberia	*0.6*	..	*0.30*	..	..	..	..	..	..	..	..	..
Libya	..	..	..	..	..	..	..	..	..	..	..	..
Lithuania	*53.8*	43.9	*0.13*	0.17	0.8	4.8	6.8	20.5	3.8	22.9	11.2	29.2
Macedonia, FYR	32.4	..	0.18	..	..	..	..	..	..	..	..	..
Madagascar	*11.0*	67.2	*0.27*	0.14	0.3	1.7	12.4	7.6	2.8	58.9	6.3	10.0
Malawi	10.0	..	0.29	..	..	..	..	..	..	..	..	..
Malaysia	104.7	*183.8*	0.13	*0.12*	*7.8*	*14.9*	*15.5*	*33.7*	*0.2*	*8.3*	*6.8*	*12.8*
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	17.8	*17.7*	0.16	*0.15*	*0.9*	*6.6*	*2.6*	*32.8*	*0.1*	*55.4*	*0.6*	*1.1*
Mexico	174.3	*296.1*	0.18	*0.20*	*7.8*	*12.5*	*10.4*	*55.6*	*0.2*	*7.5*	*0.9*	*5.1*
Moldova	55.9	*21.6*	0.15	*0.45*	..	*2.2*	..	*97.7*	..	..	..	*0.1*
Mongolia	10.2	..	0.18	..	..	..	..	..	..	..	..	..
Morocco	41.7	91.0	0.14	0.18	1.2	3.0	8.5	21.8	6.0	43.2	1.8	14.5
Mozambique	20.4	*10.2*	0.27	*0.31*	*1.1*	*7.1*	*2.7*	*81.2*	*0.1*	*5.8*	*1.4*	*0.7*
Myanmar	7.7	6.2	0.17	*0.18*	*56.5*	*4.6*	*13.2*	*14.9*	*0.4*	*2.9*	*1.7*	*5.8*
Namibia	*7.4*	..	*0.35*	..	..	..	..	..	..	..	..	..
Nepal	20.9	*26.9*	0.13	*0.16*	*3.5*	*9.7*	*5.9*	*55.1*	*1.4*	*21.7*	*1.7*	*1.0*
Netherlands	136.7	..	0.18	..	..	..	..	..	..	..	..	..
New Zealand	50.2	*46.1*	0.22	*0.22*	*3.2*	*21.7*	*5.2*	*57.3*	*0.1*	*4.6*	*3.6*	*4.2*
Nicaragua	*10.5*	..	*0.27*	..	..	..	..	..	..	..	..	..
Niger	..	*0.4*	..	*0.32*	..	*17.0*	*4.4*	*76.9*	*0.3*	..	*0.8*	*0.6*
Nigeria	*70.8*	..	*0.22*	..	..	..	..	..	..	..	..	..
Norway	55.0	*51.7*	0.20	*0.20*	*9.0*	*31.3*	*4.7*	*42.8*	*0.1*	*1.4*	*3.1*	*7.5*
Oman	0.4	*5.8*	0.11	*0.17*	*7.3*	*13.3*	*10.1*	*54.3*	*0.9*	*8.3*	*2.4*	*3.4*
Pakistan	104.1	..	0.18	..	..	..	..	..	..	..	..	..
Panama	9.7	*11.7*	0.26	*0.32*	*1.5*	*13.2*	*4.6*	*76.6*	*0.2*	*3.2*	*0.4*	*0.4*
Papua New Guinea	*5.7*	..	*0.25*	..	..	..	..	..	..	..	..	..
Paraguay	*3.3*	..	*0.28*	..	..	..	..	..	..	..	..	..
Peru	56.1	..	0.20	..	..	..	..	..	..	..	..	..
Philippines	228.3	..	0.21	..	..	..	..	..	..	..	..	..
Poland	428.9	*329.4*	0.14	*0.17*	*7.5*	*11.7*	*7.6*	*52.2*	*0.2*	*9.1*	*4.3*	*7.3*
Portugal	147.9	*127.5*	0.15	*0.15*	*3.1*	*16.4*	*4.9*	*37.8*	*0.4*	*26.1*	*5.3*	*6.0*
Puerto Rico	19.0	*9.2*	0.15	*0.18*	*1.9*	*14.9*	*21.9*	*34.4*	*0.2*	*15.5*	*1.4*	*9.7*

3.6 Water pollution

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	thousand kilograms per day		kilograms per day per worker		% of total							
	1990	2004[a]	1990	2004[a]	Primary metals 2004[a]	Paper and pulp 2004[a]	Chemicals 2004[a]	Food and beverages 2004[a]	Stone, ceramics, and glass 2004[a]	Textiles 2004[a]	Wood 2004[a]	Other 2004[a]
Romania	413.9	241.5	0.12	0.14	4.8	3.0	6.6	12.2	4.2	30.9	5.4	32.9
Russian Federation	*1,911.3*	1,470.8	*0.13*	0.18	9.9	4.4	11.5	18.5	8.0	7.7	4.6	35.4
Rwanda	*1.6*	..	*0.25*	..	..	..	..	..	..	..	..	..
Saudi Arabia	*18.5*	..	*0.15*	..	..	..	..	..	..	..	..	..
Senegal	10.3	*6.6*	0.32	*0.30*	*5.8*	*8.4*	*10.7*	*70.1*	*0.1*	*4.2*	*0.4*	*0.3*
Serbia	..	..	..	..	..	..	..	..	..	..	..	..
Sierra Leone	*4.2*	..	*0.32*	..	..	..	..	..	..	..	..	..
Singapore	32.4	*34.3*	0.09	*0.10*	*1.4*	*24.6*	*16.0*	*25.4*	*0.1*	*3.9*	*1.6*	*26.9*
Slovak Republic	*77.2*	*43.3*	*0.13*	*0.14*	*2.9*	*16.9*	*8.4*	*43.7*	*0.3*	*12.2*	*4.0*	*11.6*
Slovenia	55.6	*38.4*	0.16	*0.16*	*33.7*	*14.7*	*8.3*	*23.7*	*0.2*	*10.8*	*2.0*	*6.7*
Somalia	*6.2*	..	*0.38*	..	..	..	..	..	..	..	..	..
South Africa	261.6	181.7	0.17	0.17	6.8	7.4	10.4	16.7	5.0	7.1	4.7	41.9
Spain	320.3	*352.9*	0.17	*0.15*	*7.5*	*20.6*	*9.5*	*39.6*	*0.4*	*8.6*	*4.3*	*9.6*
Sri Lanka	53.0	*78.4*	0.19	*0.18*	*0.5*	*7.2*	*6.6*	*51.5*	*0.2*	*31.6*	*1.1*	*1.2*
Sudan	..	*38.6*	..	*0.29*	*0.7*	*2.5*	*3.1*	*88.6*	*0.4*	*3.2*	*0.6*	*1.1*
Swaziland	6.6	..	0.33	..	..	..	..	..	..	..	..	..
Sweden	109.6	*103.9*	0.15	*0.14*	*11.3*	*35.0*	*7.8*	*26.6*	*0.1*	*1.3*	*3.0*	*14.9*
Switzerland	146.0	..	0.16	..	..	..	..	..	..	..	..	..
Syrian Arab Republic	21.7	..	0.22	..	..	..	..	..	..	..	..	..
Tajikistan	..	..	..	..	..	..	..	..	..	..	..	..
Tanzania	31.1	*35.2*	0.24	*0.25*	*1.5*	*9.4*	*2.7*	*69.3*	*0.1*	*14.0*	*1.5*	*1.4*
Thailand	291.6	..	0.17	..	..	..	..	..	..	..	..	..
Timor-Leste	..	..	..	..	..	..	..	..	..	..	..	..
Togo	..	..	..	..	..	..	..	..	..	..	..	..
Trinidad and Tobago	10.0	*7.9*	0.26	*0.23*	*6.5*	*18.8*	*11.9*	*55.3*	*0.2*	*3.8*	*2.0*	*1.5*
Tunisia	*44.6*	*55.8*	*0.18*	*0.14*	*2.5*	*6.1*	*5.5*	*35.8*	*0.4*	*43.3*	*1.9*	*4.6*
Turkey	177.3	*172.2*	0.18	*0.16*	*11.4*	*4.8*	*8.0*	*43.7*	*0.3*	*26.4*	*0.4*	*5.0*
Turkmenistan	..	..	..	..	..	..	..	..	..	..	..	..
Uganda	*16.7*	..	*0.30*	..	..	..	..	..	..	..	..	..
Ukraine	692.4	525.1	0.14	0.19	14.3	4.1	9.7	18.9	6.4	7.0	2.3	37.2
United Arab Emirates	*5.6*	..	*0.14*	..	..	..	..	..	..	..	..	..
United Kingdom	739.6	*331.0*	0.15	*0.12*	*9.0*	*48.0*	*17.5*	*0.6*	*0.3*	*5.2*	*4.0*	*15.4*
United States	2,565.2	*1,805.9*	0.15	*0.13*	*9.6*	*10.6*	*14.0*	*42.1*	*0.2*	*5.4*	*4.2*	*13.9*
Uruguay	38.7	*15.8*	0.23	*0.28*	*1.2*	*3.7*	*6.6*	*79.2*	*0.1*	*7.4*	*0.6*	*1.2*
Uzbekistan	..	..	..	..	..	..	..	..	..	..	..	..
Venezuela, RB	96.5	..	0.21	..	..	..	..	..	..	..	..	..
Vietnam	..	..	..	..	..	..	..	..	..	..	..	..
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	6.9	*15.4*	0.27	*0.23*	..	*7.7*	*6.8*	*74.6*	*0.4*	*7.6*	*0.9*	*2.0*
Zambia	15.9	..	0.23	..	..	..	..	..	..	..	..	..
Zimbabwe	37.1	..	0.20	..	..	..	..	..	..	..	..	..

a. Data are derived using the United Nations Industrial Development Organization's (UNIDO) industry database four-digit International Standard Industrial Classification (ISIC). Data in italics are for the most recent year available and are derived using UNIDO's industry database at the three-digit ISIC.

About the data

Emissions of organic pollutants from industrial activities are a major cause of degradation of water quality. Water quality and pollution levels are generally measured as concentration or load—the rate of occurrence of a substance in an aqueous solution. Polluting substances include organic matter, metals, minerals, sediment, bacteria, and toxic chemicals. The table focuses on organic water pollution resulting from industrial activities. Because water pollution tends to be sensitive to local conditions, the national-level data in the table may not reflect the quality of water in specific locations.

The data in the table come from an international study of industrial emissions that may be the first to include data from developing countries (Hettige, Mani, and Wheeler 1998). These data were updated through 2004 by the World Bank's Development Research Group. Unlike estimates from earlier studies based on engineering or economic models, these estimates are based on actual measurements of plant-level water pollution. The focus is on organic water pollution caused by organic waste, measured in terms of biochemical oxygen demand (BOD), because the data for this indicator are the most plentiful and reliable for cross-country comparisons of emissions. BOD measures the strength of an organic waste by the amount of oxygen consumed in breaking it down. A sewage overload in natural waters exhausts the water's dissolved oxygen content. Wastewater treatment, by contrast, reduces BOD.

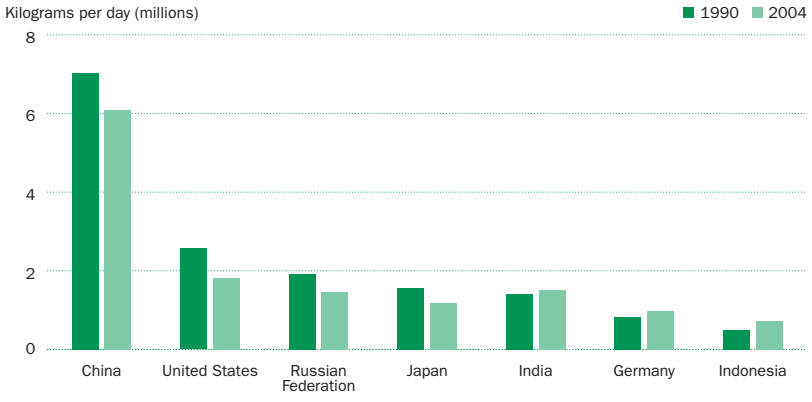
Data on water pollution are more readily available than are other emissions data because most industrial pollution control programs start by regulating emissions of organic water pollutants. Such data are fairly reliable because sampling techniques for measuring water pollution are more widely understood and much less expensive than those for air pollution.

Hettige, Mani, and Wheeler (1998) used plant- and sector-level information on emissions and employment from 13 national environmental protection agencies and sector-level information on output and employment from the United Nations Industrial Development Organization (UNIDO). Their econometric analysis found that the ratio of BOD to employment in each industrial sector is about the same across countries. This finding allowed the authors to estimate BOD loads across countries and over time. The estimated BOD intensities per unit of employment were multiplied by sectoral employment numbers from UNIDO's industry database for 1980–98. These estimates of sectoral emissions were then used to calculate kilograms of emissions of organic water pollutants per day for each country and year. The data in the table were derived by updating these estimates through 2004.

Definitions

• **Emissions of organic water pollutants** are measured as biochemical oxygen demand, or the amount of oxygen that bacteria in water will consume in breaking down waste, a standard water treatment test for the presence of organic pollutants. Emissions per worker are total emissions divided by the number of industrial workers. • **Industry shares of emissions of organic water pollutants** are emissions from manufacturing activities as defined by two-digit divisions of the International Standard Industrial Classification (ISIC) revision 3.

Emissions of organic water pollutants declined in most countries from 1990 to 2004, even in some of the top emitters 3.6a



Source: Table 3.6.

Data sources

Data on water pollutants come from the 1998 study by Hemamala Hettige, Muthukumara Mani, and David Wheeler, "Industrial Pollution in Economic Development: Kuznets Revisited" (available at www.worldbank.org/nipr). The data were updated through 2004 by the World Bank's Development Research Group using the same methodology as the initial study. Data on industrial sectoral employment are from UNIDO's industry database.

3.7 Energy production and use

	Total energy production		Energy use									
	million metric tons of oil equivalent		Total million metric tons of oil equivalent		Per capita kilograms of oil equivalent		% of total Fossil fuel		Combustible renewables and waste		Clean energy	
	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005
Afghanistan	..	..	..	..	..	..	..	..	..	..	..	..
Albania	2.4	1.2	2.7	2.4	809	762	76.5	69.8	13.6	9.6	9.2	19.2
Algeria	104.4	175.1	23.9	34.8	944	1,058	99.8	99.6	0.1	0.2	0.1	0.1
Angola	28.7	70.7	6.3	9.9	597	615	30.2	34.7	68.8	63.8	1.0	1.5
Argentina	48.5	81.0	46.1	63.7	1,415	1,644	88.6	88.5	3.7	3.5	7.5	7.4
Armenia	0.1	0.9	7.9	2.6	2,240	848	97.3	66.4	0.1	0.0	1.7	33.6
Australia	157.5	271.0	87.5	122.0	5,130	5,978	94.0	94.5	4.5	4.3	1.4	1.1
Austria	8.1	9.8	25.1	34.4	3,251	4,174	79.4	78.1	9.8	11.6	10.8	9.1
Azerbaijan	21.3	27.3	26.0	13.8	3,637	1,649	98.8	97.3	0.0	0.0	0.2	1.9
Bangladesh	10.8	19.3	12.8	24.2	113	158	45.9	65.2	53.5	34.3	0.6	0.5
Belarus	3.3	3.8	42.2	26.6	4,139	2,720	97.6	93.9	0.5	4.8	0.0	0.0
Belgium	13.1	13.9	49.2	56.7	4,932	5,407	75.8	74.1	1.5	2.8	22.7	21.9
Benin	1.8	1.7	1.7	2.6	324	304	5.8	33.3	93.2	64.7	0.0	0.0
Bolivia	4.9	13.9	2.8	5.3	416	578	69.1	81.9	27.2	14.0	3.6	4.1
Bosnia and Herzegovina	4.6	3.3	7.0	5.0	1,633	1,268	93.9	86.6	2.3	3.7	3.7	9.4
Botswana	0.9	1.1	1.3	1.9	930	1,032	66.3	68.0	33.1	24.1	0.0	0.0
Brazil	98.1	187.8	134.0	209.5	896	1,122	53.5	56.7	31.1	26.5	13.7	15.1
Bulgaria	9.6	10.6	28.8	20.1	3,306	2,592	84.5	70.0	0.6	3.7	13.8	26.3
Burkina Faso	..	..	..	..	..	..	..	..	..	..	..	..
Burundi	..	..	..	..	..	..	..	..	..	..	..	..
Cambodia	..	..	..	..	..	..	..	..	..	..	..	..
Cameroon	12.1	11.9	5.0	7.0	411	392	19.5	16.6	75.9	78.6	4.5	4.8
Canada	273.7	401.3	209.4	272.0	7,535	8,417	74.7	75.1	3.9	4.6	21.4	20.3
Central African Republic	..	..	..	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	7.6	9.1	14.1	29.6	1,067	1,815	74.8	76.9	19.0	15.5	6.2	7.0
China	886.3	1,640.9	863.2	1,717.2	760	1,316	75.5	84.2	23.2	13.0	1.3	2.8
Hong Kong, China	0.0	0.0	10.7	18.1	1,869	2,653	99.5	96.6	0.5	0.3	0.0	0.0
Colombia	48.2	79.5	24.7	28.6	710	636	68.1	73.6	22.3	14.4	9.6	12.0
Congo, Dem. Rep.	12.0	17.4	11.9	17.0	314	289	11.9	3.8	84.0	92.5	4.1	3.7
Congo, Rep.	9.0	13.7	1.1	1.2	436	332	26.4	38.2	69.4	56.3	4.0	2.6
Costa Rica	1.0	1.8	2.0	3.8	658	883	48.3	51.9	36.6	7.0	14.4	40.6
Côte d'Ivoire	3.4	8.2	4.4	7.8	345	422	24.8	40.1	72.1	58.3	2.6	1.6
Croatia	5.1	3.8	9.1	8.9	1,897	2,000	86.6	84.9	3.4	4.0	3.6	6.1
Cuba	6.6	5.5	16.8	10.2	1,587	906	65.1	79.6	34.9	20.3	0.0	0.1
Czech Republic	40.1	32.9	49.0	45.2	4,728	4,417	93.1	81.3	0.0	3.9	6.9	14.8
Denmark	10.0	31.3	17.9	19.6	3,482	3,621	89.9	83.2	6.4	13.2	0.0	0.0
Dominican Republic	1.0	1.5	4.1	7.4	567	777	75.1	79.2	24.2	18.6	0.7	2.2
Ecuador	16.5	28.6	6.1	10.4	597	799	79.5	87.9	13.5	5.1	7.0	5.7
Egypt, Arab Rep.	54.9	76.0	31.9	61.3	578	841	94.0	95.9	3.3	2.3	2.7	1.8
El Salvador	1.7	2.5	2.5	4.6	496	694	32.0	44.4	48.2	32.4	19.8	22.6
Eritrea	..	..	..	..	..	..	..	..	..	..	..	..
Estonia	5.0	3.7	9.6	5.1	6,107	3,786	98.0	87.9	2.0	12.1	0.0	0.0
Ethiopia	14.2	19.9	15.2	21.6	296	288	6.6	8.2	92.8	90.6	0.6	1.1
Finland	12.1	16.6	29.2	35.0	5,851	6,664	60.9	55.0	15.6	19.6	20.4	20.7
France	112.4	136.9	227.8	276.0	4,015	4,534	56.9	51.4	5.1	4.3	38.0	44.3
Gabon	14.6	12.1	1.2	1.7	1,354	1,333	35.3	37.2	59.8	58.7	4.9	4.1
Gambia, The	..	..	..	..	..	..	..	..	..	..	..	..
Georgia	1.8	1.3	12.3	3.2	2,259	718	88.8	59.3	3.7	20.1	5.3	17.0
Germany	186.2	134.5	356.2	344.7	4,485	4,180	87.0	82.9	1.3	3.5	11.6	12.9
Ghana	4.4	6.4	5.3	8.9	343	397	17.7	28.7	73.1	66.0	9.2	5.1
Greece	9.2	10.3	22.2	31.0	2,183	2,790	94.7	93.6	4.0	3.3	0.7	1.4
Guatemala	3.4	5.4	4.5	8.0	503	628	28.8	43.3	67.8	53.2	3.4	3.5
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	1.3	1.9	1.6	2.5	223	269	20.9	23.2	76.5	75.9	2.5	0.9

3.7 Energy production and use

	Total energy production		Energy use									
	million metric tons of oil equivalent		Total million metric tons of oil equivalent		Per capita kilograms of oil equivalent		% of total					
							Fossil fuel		Combustible renewables and waste		Clean energy	
	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005
Honduras	1.7	1.8	2.4	3.9	494	566	29.9	53.9	62.0	42.0	8.1	4.0
Hungary	14.3	10.3	28.6	27.8	2,753	2,752	82.4	80.6	1.3	4.0	12.9	13.4
India	291.1	419.0	319.9	537.3	377	491	55.8	68.0	41.7	29.4	2.4	2.4
Indonesia	170.3	263.4	103.2	179.5	579	814	54.9	67.8	43.6	28.5	1.5	3.7
Iran, Islamic Rep.	179.7	303.8	68.8	162.5	1,264	2,352	98.2	98.6	1.0	0.5	0.8	0.9
Iraq	104.9	96.0	19.1	30.8	1,029	..	98.7	99.4	0.1	0.1	1.2	0.1
Ireland	3.5	1.7	10.4	15.3	2,957	3,676	98.4	96.3	1.0	1.6	0.6	0.4
Israel	0.4	2.1	12.1	19.5	2,599	2,816	97.3	97.0	0.0	0.0	0.0	0.0
Italy	25.3	27.6	148.0	185.2	2,609	3,160	93.5	91.2	0.6	2.3	3.8	4.1
Jamaica	0.5	0.5	2.9	3.8	1,231	1,445	83.5	87.4	16.2	12.2	0.3	0.3
Japan	75.2	99.8	444.5	530.5	3,598	4,152	84.7	81.9	1.1	1.2	13.9	16.8
Jordan	0.2	0.3	3.5	7.1	1,103	1,311	98.3	98.1	0.1	0.0	0.0	0.1
Kazakhstan	90.5	121.7	73.7	52.4	4,506	3,462	97.0	98.6	0.2	0.1	0.9	1.3
Kenya	10.3	13.9	12.5	17.2	532	484	17.6	19.5	78.4	74.6	4.0	5.9
Korea, Dem. Rep.	28.7	20.2	32.9	21.2	1,632	898	93.0	89.8	2.9	4.9	4.1	5.3
Korea, Rep.	22.6	42.9	93.4	213.8	2,178	4,426	83.9	80.9	0.8	1.0	15.3	18.0
Kuwait	50.4	146.3	8.5	28.1	3,984	11,100	99.9	100.0	0.1	0.0	0.0	0.0
Kyrgyz Republic	2.5	1.4	7.6	2.8	1,723	544	88.6	56.1	0.1	0.1	11.3	43.8
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	1.2	2.3	7.8	4.7	2,916	2,050	82.2	59.8	8.5	30.2	5.0	6.1
Lebanon	0.1	0.2	2.3	5.6	776	1,391	93.6	95.3	4.5	2.3	1.9	1.6
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..
Liberia	..	..	..	..	..	..	..	..	..	..	..	..
Libya	73.2	95.0	11.5	19.0	2,645	3,218	98.9	99.2	1.1	0.8	0.0	0.0
Lithuania	4.9	3.9	16.2	8.6	4,377	2,515	70.2	59.3	1.8	8.3	28.0	32.4
Macedonia, FYR	1.5	1.5	2.7	2.7	1,421	1,346	98.2	84.2	0.0	5.6	1.5	5.1
Madagascar	..	..	..	..	..	..	..	..	..	..	..	..
Malawi	..	..	..	..	..	..	..	..	..	..	..	..
Malaysia	50.3	93.9	23.3	61.3	1,288	2,389	89.4	94.6	9.1	4.5	1.5	0.8
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	..	..	..	..	..	..	..	..	..	..	..	..
Mexico	194.8	259.2	124.3	176.5	1,494	1,712	88.3	88.8	5.9	4.7	5.8	6.5
Moldova	0.1	0.1	10.0	3.6	2,277	917	99.4	90.1	0.4	2.1	0.2	0.1
Mongolia	..	..	..	..	..	..	..	..	..	..	..	..
Morocco	0.8	1.0	6.7	13.8	278	458	93.6	95.2	4.7	3.3	1.6	0.9
Mozambique	6.8	11.7	7.2	10.2	532	497	5.1	3.4	94.4	85.4	0.3	11.2
Myanmar	10.7	22.1	10.7	14.7	266	307	14.6	28.6	84.4	69.6	1.0	1.8
Namibia	0.0	0.3	0.0	1.4	0	683	62.0	66.9	16.0	13.5	17.5	10.4
Nepal	5.5	8.2	5.8	9.2	304	338	5.3	11.1	93.4	86.6	1.3	2.3
Netherlands	60.5	61.9	66.8	81.8	4,464	5,015	96.0	93.3	1.4	3.2	1.4	1.3
New Zealand	12.0	12.2	13.8	16.9	3,990	4,090	65.3	71.1	4.0	5.1	30.7	23.4
Nicaragua	1.5	2.0	2.1	3.3	512	611	29.2	41.3	53.2	50.5	17.3	8.1
Niger	..	..	..	..	..	..	..	..	..	..	..	..
Nigeria	150.5	231.8	70.9	103.8	751	734	19.7	21.3	79.8	78.0	0.5	0.7
Norway	120.3	233.7	21.5	32.1	5,072	6,948	46.8	59.5	4.8	4.1	48.4	36.4
Oman	38.3	59.6	4.6	14.0	2,475	5,570	100.0	100.0	0.0	0.0	0.0	0.0
Pakistan	34.4	61.3	43.4	76.3	402	490	53.3	60.2	43.2	35.5	3.5	4.3
Panama	0.6	0.7	1.5	2.6	618	804	58.4	71.6	28.3	16.1	12.8	12.3
Papua New Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Paraguay	4.6	6.6	3.1	4.0	731	674	21.6	29.2	72.3	54.8	..	..
Peru	10.6	10.8	10.0	13.8	457	506	64.1	70.7	26.9	16.4	9.0	12.4
Philippines	13.7	24.2	26.2	44.7	427	528	50.8	54.9	29.2	24.4	20.0	20.7
Poland	99.4	78.6	99.9	93.0	2,620	2,436	97.7	94.7	2.2	5.1	0.1	0.2
Portugal	3.4	3.6	17.7	27.2	1,793	2,575	81.5	84.7	14.0	10.8	4.5	1.7
Puerto Rico	..	..	..	..	..	..	..	..	..	..	..	..

3.7 Energy production and use

	Total energy production		Energy use									
	million metric tons of oil equivalent		Total million metric tons of oil equivalent		Per capita kilograms of oil equivalent		% of total Fossil fuel		% of total Combustible renewables and waste		% of total Clean energy	
	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005
Romania	40.8	27.9	62.4	38.3	2,689	1,772	96.2	83.0	1.0	8.5	1.6	8.5
Russian Federation	1,280.3	1,184.9	878.3	646.7	5,923	4,517	93.4	90.5	1.4	1.1	5.2	8.4
Rwanda	..	..	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	370.8	576.7	61.3	140.3	3,744	6,068	100.0	100.0	0.0	0.0	0.0	0.0
Senegal	1.4	1.3	2.2	3.0	283	258	39.4	58.8	60.6	39.2	0.0	0.8
Serbia[a]	13.2	*11.5*	21.5	*16.2*	2,044	*2,004*	..	..	1.8	*4.9*	..	..
Sierra Leone	..	..	..	..	..	..	..	..	..	..	..	..
Singapore	0.0	0.0	13.4	30.1	4,384	6,933	100.0	100.0	0.0	0.0	0.0	0.0
Slovak Republic	5.3	6.6	21.3	18.8	4,035	3,496	81.6	70.6	0.8	2.4	15.5	27.0
Slovenia	2.9	3.4	5.6	7.3	2,801	3,657	69.1	68.3	4.8	6.7	26.1	25.0
Somalia	..	..	..	..	..	..	..	..	..	..	..	..
South Africa	114.5	158.6	91.2	127.6	2,592	2,722	86.1	87.0	11.4	10.5	2.5	2.5
Spain	34.6	30.3	91.1	145.2	2,345	3,346	77.6	83.8	4.5	3.5	17.9	11.5
Sri Lanka	4.2	5.3	5.5	9.4	324	477	24.1	43.9	71.0	52.9	4.9	3.2
Sudan	8.8	31.1	10.6	18.4	410	499	17.5	19.9	81.7	79.5	0.8	0.6
Swaziland	..	..	..	..	..	..	..	..	..	..	..	..
Sweden	29.8	34.8	47.6	52.2	5,557	5,782	37.9	34.6	11.6	17.2	50.5	48.2
Switzerland	9.7	10.9	25.0	27.2	3,723	3,651	61.1	57.9	3.7	7.1	35.2	32.9
Syrian Arab Republic	22.3	29.1	11.7	17.9	918	948	98.0	98.3	0.0	0.0	2.0	1.7
Tajikistan	2.0	1.5	5.6	3.5	1,055	528	72.8	57.9	0.0	0.0	25.4	41.5
Tanzania	9.1	19.1	9.8	20.4	385	530	7.6	7.1	91.0	92.1	1.4	0.7
Thailand	26.5	54.0	43.9	100.0	808	1,588	65.5	82.7	33.4	16.5	1.0	0.5
Timor-Leste	..	..	..	..	..	..	..	..	..	..	..	..
Togo	1.2	1.6	1.4	2.0	365	320	15.5	18.1	82.6	79.4	0.6	0.3
Trinidad and Tobago	12.6	31.4	6.0	12.7	4,934	9,599	99.2	99.8	0.8	0.2	0.0	0.0
Tunisia	6.1	6.7	5.5	8.5	679	843	81.2	86.5	18.7	13.3	0.1	0.1
Turkey	25.8	23.6	53.0	85.2	943	1,182	81.8	88.2	13.6	6.3	4.6	5.2
Turkmenistan	74.9	61.1	19.6	16.3	5,353	3,381	99.7	100.0	0.0	0.0	0.3	0.0
Uganda	..	..	..	..	..	..	..	..	..	..	..	..
Ukraine	133.7	81.0	251.7	143.2	4,851	3,041	91.7	82.9	0.1	0.2	8.2	16.9
United Arab Emirates	109.4	167.9	22.5	46.9	12,716	11,436	100.0	100.0	0.0	0.0	0.0	0.0
United Kingdom	208.0	204.3	212.2	233.9	3,686	3,884	90.9	88.6	0.3	1.7	8.3	9.3
United States	1,650.3	1,630.7	1,927.5	2,340.3	7,721	7,893	86.5	86.2	3.2	3.2	10.2	10.4
Uruguay	1.1	1.0	2.3	2.9	725	875	58.7	62.5	24.3	15.4	26.8	19.9
Uzbekistan	38.6	56.6	46.4	47.0	2,262	1,798	98.8	98.9	0.0	0.0	1.2	1.1
Venezuela, RB	148.9	204.7	43.9	60.9	2,224	2,293	91.5	88.5	1.2	0.9	7.2	10.6
Vietnam	24.7	69.5	24.3	51.3	367	617	20.4	49.7	77.7	46.7	1.9	3.6
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	9.4	20.4	2.6	6.7	208	319	97.0	98.8	3.0	1.1	0.0	0.0
Zambia	4.9	6.5	5.5	7.1	673	621	14.1	10.6	73.4	78.7	12.5	10.7
Zimbabwe	8.6	8.9	9.4	9.7	895	741	45.3	30.3	50.4	61.9	4.0	5.2
World	**8,804.7 t**	**11,441.1 t**	**8,610.9 t**	**11,209.7 t**	**1,682 w**	**1,796 w**	**81.3 w**	**81.1 w**	**10.0 w**	**9.7 w**	**8.7 w**	**9.1 w**
Low income	739.4	1,147.0	723.3	1,110.7	426	486	49.1	55.5	48.3	41.7	2.6	2.8
Middle income	4,367.6	5,790.6	3,495.9	4,544.6	1,346	1,486	83.9	84.1	11.7	10.3	4.4	5.6
Lower middle income	1,982.3	3,133.1	1,701.7	2,747.8	894	1,216	78.6	83.3	18.4	12.8	3.0	3.9
Upper middle income	2,385.3	2,657.5	1,794.2	1,796.9	2,586	2,248	88.7	85.4	5.3	6.5	5.8	8.0
Low & middle income	5,106.5	6,929.5	4,213.0	5,639.6	993	1,071	78.2	78.8	17.7	16.2	4.1	5.0
East Asia & Pacific	1,222.6	2,209.1	1,138.3	2,210.7	717	1,182	71.7	81.4	26.5	15.5	1.8	3.1
Europe & Central Asia	1,879.2	1,729.1	1,734.7	1,287.5	3,878	2,826	93.2	89.1	1.5	2.2	5.3	8.7
Latin America & Carib.	604.3	908.0	452.9	656.9	1,039	1,198	72.4	74.3	18.4	14.8	9.2	10.8
Middle East & N. Africa	601.9	874.1	194.4	386.8	861	1,270	97.1	98.0	1.8	1.1	1.0	0.8
South Asia	348.8	517.3	390.7	661.9	350	453	54.0	65.9	43.5	31.5	2.5	2.6
Sub-Saharan Africa	481.8	748.0	317.4	462.6	685	681	41.2	41.3	56.6	56.3	2.2	2.4
High income	3,723.0	4,545.8	4,426.7	5,609.3	4,841	5,498	84.2	83.4	2.8	3.2	13.0	13.2
Euro area	471.3	450.5	1,052.7	1,244.4	3,562	3,961	80.2	77.5	3.2	4.3	16.4	17.5

a. Includes Montenegro.

Energy production and use 3.7

About the data

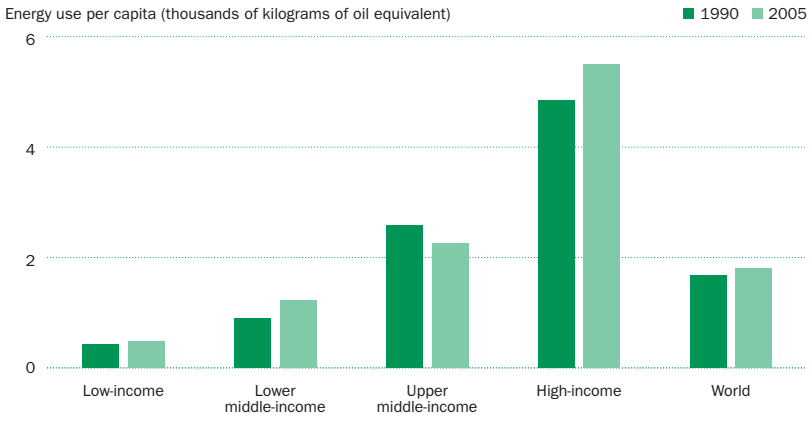
In developing countries growth in energy use is closely related to growth in the modern sectors—industry, motorized transport, and urban areas—but energy use also reflects climatic, geographic, and economic factors (such as the relative price of energy). Energy use has been growing rapidly in low- and middle-income countries, but high-income countries still use more than five times as much energy on a per capita basis.

Energy data are compiled by the International Energy Agency (IEA). IEA data for countries that are not members of the Organisation for Economic Co-operation and Development (OECD) are based on national energy data adjusted to conform to annual questionnaires completed by OECD member governments.

Total energy use refers to the use of primary energy before transformation to other end-use fuels (such as electricity and refined petroleum products). It includes energy from combustible renewables and waste—solid biomass and animal products, gas and liquid from biomass, and industrial and municipal waste. Biomass is any plant matter used directly as fuel or converted into fuel, heat, or electricity. (The data series published in *World Development Indicators 1998* and earlier editions did not include energy from combustible renewables and waste.) Data for combustible renewables and waste are often based on small surveys or other incomplete information and thus give only a broad impression of developments and are not strictly comparable across countries. The IEA reports include country notes that explain some of these differences (see *Data sources*). All forms of energy—primary energy and primary electricity—are converted into oil equivalents. A notional thermal efficiency of 33 percent is assumed to convert nuclear electricity into oil equivalents and 100 percent efficiency to convert hydroelectric power.

The IEA makes these estimates in consultation with national statistical offices, oil companies, electric utilities, and national energy experts. The IEA occasionally revises its time series to reflect political changes, and energy statistics undergo continual changes in coverage or methodology as more detailed energy accounts become available. Breaks in series are therefore unavoidable.

A person in a high-income economy uses an average of more than 11 times as much energy as a person in a low-income economy **3.7a**



Source: Table 3.7.

Definitions

• **Total energy production** refers to forms of primary energy—petroleum (crude oil, natural gas liquids, and oil from nonconventional sources), natural gas, solid fuels (coal, lignite, and other derived fuels), and combustible renewables and waste—and primary electricity, all converted into oil equivalents (see *About the data*). • **Energy use** refers to the use of primary energy before transformation to other end-use fuels, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transport (see *About the data*). • **Fossil fuel** comprises coal, oil, petroleum, and natural gas products. • **Combustible renewables and waste** comprise solid biomass, liquid biomass, biogas, industrial waste, and municipal waste. • **Clean energy** is noncarbohydrate energy that does not produce carbon dioxide when generated. It includes hydropower and nuclear, geothermal, and solar power, among others.

Data sources

Data on energy production and use are from IEA electronic files and are published in IEA's annual publications, *Energy Statistics and Balances of Non-OECD Countries, Energy Statistics of OECD Countries,* and *Energy Balances of OECD Countries.*

3.8 Energy dependency and efficiency and carbon dioxide emissions

	Net energy imports[a]		Energy use	GDP per unit of energy use		Carbon dioxide emissions							
	% of energy use		average annual % growth	2005 PPP $ per kilogram of oil equivalent		Total million metric tons		From solid fuel consumption % of total		Per capita metric tons		kilograms per 2005 PPP $ of GDP	
	1990	2005	1990–2005	1990	2005	1990	2004	1990	2004	1990	2004	1990	2004
Afghanistan	..	..	..	..	..	2.6	0.7	10.7	13.2	..	..	..	0.0
Albania	8	51	2.0	4.3	7.2	7.3	3.7	38.2	3.0	2.2	1.2	0.6	0.2
Algeria	–338	–404	2.4	5.6	5.7	77.0	193.8	3.9	1.0	3.0	6.0	0.6	1.0
Angola	–356	–614	3.1	5.4	6.1	4.6	7.9	0.0	0.0	0.4	0.5	0.1	0.2
Argentina	–5	–27	1.9	5.3	6.6	109.7	141.7	2.8	1.2	3.4	3.7	0.5	0.4
Armenia	98	66	–5.8	1.3	4.9	4.2	3.6	*10.2*	0.0	1.2	1.2	0.4	0.3
Australia	–80	–122	2.2	4.8	5.7	278.4	326.5	52.4	50.3	16.3	16.2	0.7	0.5
Austria	68	71	2.0	8.1	8.2	57.6	69.8	28.3	21.0	7.5	8.5	0.3	0.3
Azerbaijan	18	–97	–4.0	1.3	2.8	53.7	31.3	*0.1*	0.0	7.5	3.8	1.5	1.0
Bangladesh	16	20	4.5	6.1	6.8	15.4	37.1	6.9	3.6	0.1	0.2	0.2	0.2
Belarus	92	86	–2.8	1.6	3.1	107.8	64.8	*8.3*	3.4	10.6	6.6	1.6	0.9
Belgium	73	75	1.2	5.1	5.9	100.6	100.6	40.8	22.9	10.1	9.7	0.4	0.3
Benin	–6	35	2.8	3.2	4.0	0.7	2.4	0.0	0.0	0.1	0.3	0.1	0.2
Bolivia	–77	–161	4.0	7.3	6.4	5.5	7.0	0.0	0.0	0.8	0.8	0.3	0.2
Bosnia and Herzegovina	35	33	0.9	..	4.7	6.9	15.6	*52.1*	70.7	1.6	4.0	..	0.7
Botswana	28	45	2.7	7.3	11.6	2.2	4.3	100.0	57.3	1.6	2.4	0.2	0.2
Brazil	27	10	3.2	8.1	7.6	209.5	331.5	20.4	18.2	1.4	1.8	0.2	0.2
Bulgaria	67	47	–1.8	2.3	3.6	75.3	42.5	46.8	63.8	8.6	5.5	1.1	0.6
Burkina Faso	..	..	..	..	..	1.0	1.1	0.0	0.0	0.1	0.1	0.2	0.1
Burundi	..	..	..	..	..	0.2	0.2	7.5	3.3	0.0	0.0	0.1	0.1
Cambodia	..	..	..	..	..	0.5	0.5	0.0	0.0	0.0	0.0	..	0.0
Cameroon	–140	–71	2.4	5.1	5.1	1.6	3.8	0.2	0.0	0.1	0.2	0.1	0.1
Canada	–31	–48	1.7	3.6	4.2	415.7	638.8	22.0	15.6	15.0	20.0	0.6	0.6
Central African Republic	..	..	..	..	..	0.2	0.3	0.0	0.0	0.1	0.1	0.1	0.1
Chad	..	..	..	..	..	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.0
Chile	46	69	5.2	6.2	6.7	35.6	62.4	30.3	23.6	2.7	3.9	0.4	0.3
China	–3	4	3.9	1.5	3.1	2,398.2	5,005.7	80.5	71.9	2.1	3.9	1.9	1.0
Hong Kong, China	100	100	3.2	12.0	13.5	26.2	37.4	69.2	53.2	4.6	5.5	0.2	0.2
Colombia	–95	–178	0.4	7.0	9.2	58.0	53.6	23.9	13.7	1.7	1.2	0.3	0.2
Congo, Dem. Rep.	–1	–2	2.4	1.9	0.9	4.0	2.1	19.3	45.1	0.1	0.0	0.2	0.1
Congo, Rep.	–753	–1,041	0.1	7.8	9.8	1.2	3.5	0.0	0.0	0.5	1.0	0.1	0.3
Costa Rica	49	52	4.6	9.1	9.9	2.9	6.4	0.0	2.3	0.9	1.5	0.2	0.2
Côte d'Ivoire	23	–5	3.6	5.4	3.8	5.4	5.2	0.0	0.0	0.4	0.3	0.2	0.2
Croatia	43	57	1.2	6.0	6.6	24.6	23.5	*10.0*	13.2	5.1	5.3	0.5	0.4
Cuba	61	46	–1.5	..	..	32.0	25.8	1.2	0.1	3.0	2.3	..	..
Czech Republic	18	27	–0.1	3.4	4.6	161.7	116.9	*77.6*	66.7	15.6	11.5	1.0	0.6
Denmark	44	–60	0.3	7.4	9.3	49.7	52.9	47.2	37.1	9.7	9.8	0.4	0.3
Dominican Republic	75	79	4.6	5.6	6.7	9.6	19.6	0.3	10.5	1.3	2.1	0.4	0.4
Ecuador	–169	–174	3.6	9.2	8.4	16.7	29.2	0.0	0.0	1.6	2.3	0.3	0.4
Egypt, Arab Rep.	–72	–24	4.6	5.7	5.4	75.4	158.1	4.5	2.1	1.4	2.2	0.4	0.5
El Salvador	32	45	3.9	8.2	7.8	2.6	6.2	0.0	0.0	0.5	0.9	0.1	0.2
Eritrea	..	..	..	..	..	..	0.8	..	0.0	..	0.2	..	0.2
Estonia	47	27	–3.1	1.7	4.3	28.3	18.9	*76.9*	75.1	18.1	14.0	1.8	0.9
Ethiopia	7	8	2.6	1.7	2.0	3.0	8.0	0.0	0.0	0.1	0.1	0.1	0.2
Finland	59	53	1.8	4.0	4.6	51.2	65.7	39.6	44.9	10.3	12.6	0.4	0.4
France	51	50	1.2	6.2	6.7	363.7	373.4	21.7	15.1	6.4	6.2	0.3	0.2
Gabon	–1,077	–604	2.1	11.2	10.4	6.0	1.4	0.0	0.0	6.5	1.1	0.4	0.1
Gambia, The	..	..	..	..	..	0.2	0.3	0.0	0.0	0.2	0.2	0.2	0.2
Georgia	85	60	–9.2	2.4	4.9	17.3	3.9	*6.4*	0.7	3.2	0.9	0.6	0.3
Germany	48	61	0.0	5.5	7.3	980.3	808.0	*48.6*	41.4	12.3	9.8	0.5	0.3
Ghana	18	29	3.6	2.5	2.9	3.8	7.2	0.2	0.0	0.2	0.3	0.3	0.3
Greece	59	67	2.5	9.4	10.5	72.4	96.6	43.8	39.8	7.1	8.7	0.3	0.3
Guatemala	24	32	4.2	8.2	7.8	5.1	12.2	0.0	10.0	0.6	1.0	0.1	0.2
Guinea	..	..	..	..	..	1.0	1.3	0.0	0.0	0.2	0.2	0.2	0.1
Guinea-Bissau	..	..	..	..	..	0.2	0.3	0.0	0.0	0.2	0.2	0.3	0.4
Haiti	21	23	3.3	8.1	4.4	1.0	1.8	3.3	0.0	0.1	0.2	0.1	0.2

Energy dependency and efficiency and carbon dioxide emissions

	Net energy imports[a]		Energy use	GDP per unit of energy use		Carbon dioxide emissions							
	% of energy use		average annual % growth	2005 PPP $ per kilogram of oil equivalent		Total million metric tons		From solid fuel consumption % of total		Per capita metric tons		kilograms per 2005 PPP $ of GDP	
	1990	2005	1990–2005	1990	2005	1990	2004	1990	2004	1990	2004	1990	2004
Honduras	30	54	3.0	5.7	5.8	2.6	7.6	0.0	6.1	0.5	1.1	0.2	0.4
Hungary	50	63	0.0	4.5	6.2	60.1	57.1	31.2	22.3	5.8	5.7	0.5	0.3
India	9	22	3.5	3.2	4.5	681.5	1,341.8	69.9	69.6	0.8	1.2	0.7	0.6
Indonesia	–65	–47	3.6	3.6	3.9	213.8	377.9	3.7	10.0	1.2	1.7	0.6	0.6
Iran, Islamic Rep.	–161	–87	5.5	5.0	4.0	218.2	433.2	2.1	1.0	4.0	6.4	0.6	0.7
Iraq	–451	–212	3.3	..	..	48.5	81.6	0.0	0.0	2.6	..	..	..
Ireland	67	89	3.3	5.9	10.3	30.6	42.3	43.0	22.6	8.7	10.4	0.5	0.3
Israel	96	89	3.6	6.8	8.0	33.1	71.2	29.7	48.5	7.1	10.5	0.4	0.5
Italy	83	85	1.6	9.1	8.8	389.6	449.5	13.1	14.5	6.9	7.7	0.3	0.3
Jamaica	84	87	2.3	4.9	5.0	8.0	10.6	1.7	1.7	3.3	4.0	0.6	0.6
Japan	83	81	1.2	7.2	7.3	1,070.4	1,256.8	28.5	38.0	8.7	9.8	0.3	0.3
Jordan	95	96	4.0	3.0	3.3	10.2	16.5	0.0	0.0	3.2	3.1	1.0	0.8
Kazakhstan	–23	–132	–3.8	1.6	2.5	288.1	200.1	*56.9*	54.4	17.6	13.3	2.5	1.7
Kenya	18	19	2.2	2.7	2.8	5.8	10.6	6.9	2.7	0.2	0.3	0.2	0.2
Korea, Dem. Rep.	13	5	–2.8	..	..	244.6	79.0	91.2	92.1	12.1	3.4	..	..
Korea, Rep.	76	80	5.6	4.9	4.8	241.1	465.2	38.7	43.8	5.6	9.7	0.5	0.5
Kuwait	–495	–420	8.3	*3.0*	3.9	43.4	99.3	0.0	0.0	20.4	40.4	*0.6*	1.0
Kyrgyz Republic	67	48	–5.6	1.5	3.2	12.6	5.7	*31.4*	37.1	2.8	1.1	1.1	0.6
Lao PDR	..	..	..	..	..	0.2	1.3	1.6	60.2	0.1	0.2	0.1	0.1
Latvia	85	51	–3.0	3.5	6.4	14.5	7.1	*10.6*	2.7	5.4	3.1	0.5	0.3
Lebanon	94	96	5.4	6.7	6.9	9.1	16.2	0.0	3.3	3.1	4.1	0.6	0.4
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..	..
Liberia	..	..	..	..	..	0.5	0.5	0.0	0.0	0.2	0.1	0.4	0.5
Libya	–534	–399	2.8	..	3.4	37.8	59.9	0.0	0.0	8.7	10.3	..	1.0
Lithuania	70	54	–3.1	2.9	5.6	24.3	13.3	*8.5*	5.9	6.6	3.9	0.5	0.3
Macedonia, FYR	46	47	–0.4	5.7	5.5	15.5	10.4	*67.7*	77.6	8.1	5.1	1.0	0.7
Madagascar	..	..	..	..	..	0.9	2.7	3.5	0.9	0.1	0.2	0.1	0.2
Malawi	..	..	..	..	..	0.6	1.0	7.9	14.4	0.1	0.1	0.1	0.1
Malaysia	–116	–53	6.0	5.2	4.9	55.3	177.4	9.8	19.8	3.1	7.0	0.5	0.6
Mali	..	..	..	..	..	0.4	0.6	0.0	0.0	0.1	0.1	0.1	0.1
Mauritania	..	..	..	..	..	2.6	2.6	0.6	0.7	1.4	0.9	0.9	0.5
Mauritius	..	..	..	..	..	1.5	3.2	13.5	24.0	1.4	2.6	0.2	0.3
Mexico	–57	–47	2.0	6.1	6.6	413.1	437.6	2.2	4.5	5.0	4.3	0.5	0.4
Moldova	99	98	–6.7	1.7	2.4	23.8	7.7	*19.2*	4.1	5.4	2.0	1.4	1.0
Mongolia	..	..	..	..	..	10.0	8.5	73.2	79.5	4.7	3.4	2.0	1.4
Morocco	89	93	4.2	9.9	7.8	23.5	41.1	19.9	35.3	1.0	1.4	0.4	0.4
Mozambique	5	–15	2.8	0.8	1.4	1.0	2.2	15.4	2.9	0.1	0.1	0.2	0.2
Myanmar	0	–50	2.0	1.3	2.7	4.3	9.8	6.4	3.9	0.1	0.2	0.3	0.3
Namibia	67	76	5.1	*8.1*	6.7	0.0	2.5	0.0	0.4	0.0	1.2	0.0	0.3
Nepal	5	11	3.2	2.3	2.8	0.6	3.0	5.2	26.3	0.0	0.1	0.0	0.1
Netherlands	9	24	1.2	5.8	6.9	141.0	141.9	28.7	22.2	9.4	8.7	0.4	0.3
New Zealand	13	28	1.6	4.7	6.0	22.6	31.5	14.6	14.5	6.6	7.7	0.3	0.3
Nicaragua	29	41	3.1	4.2	4.3	2.6	4.0	0.0	0.0	0.6	0.7	0.3	0.3
Niger	..	..	..	..	..	1.0	1.2	43.7	39.0	0.1	0.1	0.2	0.2
Nigeria	–112	–123	2.3	1.7	2.1	45.3	113.9	0.3	0.0	0.5	0.8	0.4	0.6
Norway	–459	–627	2.0	6.4	6.8	33.2	87.5	9.9	4.0	7.8	19.1	0.2	0.4
Oman	–740	–327	7.0	5.7	3.7	10.3	30.9	0.0	0.0	5.6	12.5	0.4	0.6
Pakistan	21	20	3.7	4.2	4.5	68.0	125.6	12.5	13.5	0.6	0.8	0.4	0.4
Panama	59	72	3.8	9.1	10.5	3.1	5.7	2.9	0.1	1.3	1.8	0.2	0.2
Papua New Guinea	..	..	..	..	..	2.4	2.4	0.2	0.1	0.6	0.4	0.4	0.2
Paraguay	–48	–66	1.7	5.4	5.7	2.3	4.2	0.0	0.0	0.5	0.7	0.1	0.2
Peru	–6	22	2.1	9.8	12.7	21.0	31.5	2.6	9.0	1.0	1.2	0.2	0.2
Philippines	48	46	4.0	5.7	5.6	43.9	80.4	13.0	28.7	0.7	1.0	0.3	0.3
Poland	1	15	–0.8	3.1	5.6	347.5	307.0	82.9	71.0	9.1	8.0	1.1	0.6
Portugal	81	87	3.2	8.6	7.7	42.3	58.9	26.0	22.0	4.3	5.6	0.3	0.3
Puerto Rico	..	..	..	..	..	11.8	*2.1*	..	..	3.3	*0.5*	..	..

3.8 Energy dependency and efficiency and carbon dioxide emissions

	Net energy imports[a]		Energy use	GDP per unit of energy use		Carbon dioxide emissions							
	% of energy use		average annual % growth	2005 PPP $ per kilogram of oil equivalent		Total million metric tons		From solid fuel consumption % of total		Per capita metric tons		kilograms per 2005 PPP $ of GDP	
	1990	2005	1990–2005	1990	2005	1990	2004	1990	2004	1990	2004	1990	2004
Romania	35	27	–2.6	2.9	5.3	155.0	90.3	30.9	35.1	6.7	4.2	0.9	0.5
Russian Federation	–46	–83	–1.8	2.1	2.6	2,261.7	1,523.6	24.9	22.2	15.3	10.6	1.2	1.0
Rwanda	..	..	..	..	..	0.5	0.6	0.0	0.0	0.1	0.1	0.1	0.1
Saudi Arabia	–505	–311	4.7	5.1	3.5	254.7	308.1	0.0	0.0	15.6	13.7	0.8	0.7
Senegal	39	58	2.4	4.8	6.0	3.1	5.0	0.0	0.0	0.4	0.4	0.3	0.3
Serbia[b]	38	29	–0.5	..	..	130.4	53.3	54.7	68.7	12.4	6.6	..	..
Sierra Leone	..	..	..	..	..	0.3	1.0	0.0	0.0	0.1	0.2	0.1	0.3
Singapore	100	100	3.6	5.3	6.0	45.1	52.2	0.2	0.0	14.8	12.3	0.6	0.3
Slovak Republic	75	65	–0.2	3.1	4.5	51.4	36.3	49.0	43.4	9.7	6.7	0.8	0.4
Slovenia	48	53	2.3	5.7	6.2	18.0	16.2	42.9	41.3	9.0	8.1	0.6	0.4
Somalia	..	..	..	..	..	0.0	..	0.0	..	0.0	..	..	..
South Africa	–26	–24	2.1	3.0	3.1	331.7	436.6	79.9	82.2	9.4	9.4	1.2	1.2
Spain	62	79	3.4	8.4	8.1	212.1	330.2	35.6	25.2	5.5	7.7	0.3	0.3
Sri Lanka	24	44	3.8	6.0	7.2	3.8	11.5	0.1	2.2	0.2	0.6	0.1	0.2
Sudan	18	–69	3.8	2.5	3.4	5.4	10.4	0.0	0.0	0.2	0.3	0.2	0.2
Swaziland	..	..	..	..	..	0.4	1.0	100.0	100.0	0.6	0.9	0.1	0.2
Sweden	37	33	0.6	4.5	5.5	49.4	53.0	21.3	20.9	5.8	5.9	0.2	0.2
Switzerland	61	60	0.7	8.9	9.6	42.7	40.4	3.3	1.3	6.4	5.5	0.2	0.2
Syrian Arab Republic	–91	–63	2.9	3.2	4.2	35.9	68.4	0.0	0.0	2.8	3.7	1.0	0.9
Tajikistan	64	56	–3.3	2.9	2.8	23.4	5.0	3.5	5.7	4.4	0.8	1.4	0.6
Tanzania	8	6	4.9	2.0	1.8	2.3	4.3	0.5	4.0	0.1	0.1	0.1	0.1
Thailand	40	46	5.2	5.1	4.4	95.7	267.8	14.2	21.6	1.8	4.3	0.4	0.6
Timor-Leste	..	..	..	..	..	..	0.2	..	0.0	..	0.2	..	0.1
Togo	17	20	2.3	2.3	2.3	0.8	2.3	0.0	0.0	0.2	0.4	0.2	0.5
Trinidad and Tobago	–109	–147	5.7	1.6	1.6	16.9	32.5	0.0	0.0	13.8	24.7	1.7	1.7
Tunisia	–11	21	3.3	5.8	7.6	13.3	22.9	2.0	0.0	1.6	2.3	0.4	0.4
Turkey	51	72	3.4	6.0	6.6	146.1	225.9	42.1	38.6	2.6	3.2	0.5	0.4
Turkmenistan	–281	–274	0.8	..	..	32.0	41.7	2.5	0.0	8.7	8.7	..	..
Uganda	..	..	..	..	..	0.8	1.8	0.0	0.0	0.0	0.1	0.1	0.1
Ukraine	47	43	–3.7	1.7	1.8	684.0	329.7	45.9	38.0	13.2	6.9	1.6	1.3
United Arab Emirates	–385	–258	4.8	2.7	2.9	54.7	149.1	0.0	0.0	30.8	37.8	0.9	1.2
United Kingdom	2	13	0.6	6.2	8.1	579.2	586.7	41.5	25.8	10.1	9.8	0.4	0.3
United States	14	30	1.4	4.1	5.3	4,816.9	6,044.0	37.1	35.7	19.3	20.6	0.6	0.5
Uruguay	49	65	1.1	9.7	10.6	3.9	5.5	0.1	0.1	1.3	1.7	0.2	0.2
Uzbekistan	17	–20	0.7	0.9	1.1	129.2	137.8	6.0	2.0	6.3	5.3	3.1	2.8
Venezuela, RB	–239	–236	1.6	4.3	4.3	117.3	172.5	1.0	0.0	5.9	6.6	0.6	0.7
Vietnam	–2	–36	5.2	2.5	3.5	21.4	98.6	51.5	40.1	0.3	1.2	0.4	0.6
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	–266	–203	6.3	8.6	6.9	9.6	21.1	0.0	0.0	0.8	1.0	0.4	0.5
Zambia	10	9	1.7	1.8	1.9	2.4	2.3	34.0	14.9	0.3	0.2	0.2	0.2
Zimbabwe	9	9	–0.1	0.3	0.2	16.6	10.5	87.5	80.8	1.6	0.8	6.0	4.3
World	**–2[c] w**	**–2[c] w**	**1.7 w**	**4.1 w**	**5.0 w**	**22,695.9[d] t**	**28,974.3[d] t**	**38.5[d] w**	**35.9[d] w**	**4.3[d] w**	**4.5[d] w**	**0.6[d] w**	**0.5[d] w**
Low income	–2	–3	2.9	2.8	3.8	1,337.9	2,082.9	63.1	58.5	0.8	0.9	0.6	0.5
Middle income	–25	–27	1.6	3.0	4.0	9,187.1	11,936.3	42.2	46.0	3.6	4.0	0.9	0.7
Lower middle income	–17	–14	2.9	2.5	3.6	4,388.4	7,508.5	55.1	55.5	2.3	3.4	1.1	0.8
Upper middle income	–33	–48	0.1	3.4	4.6	4,798.7	4,427.8	33.1	31.1	6.9	5.6	0.8	0.6
Low & middle income	–21	–23	1.8	2.9	4.0	10,525.0	14,019.1	44.6	47.7	2.4	2.6	0.8	0.7
East Asia & Pacific	–7	0	3.9	2.0	3.3	3,091.4	6,111.6	71.6	63.6	1.9	3.3	1.3	0.9
Europe & Central Asia	–8	–34	–1.8	2.3	3.3	4,566.4	3,187.7	35.5	31.9	10.3	7.1	1.2	0.8
Latin America & Carib.	–33	–38	2.4	6.7	7.0	1,066.0	1,381.8	7.9	8.3	2.4	2.5	0.4	0.3
Middle East & N. Africa	–210	–126	4.4	5.4	4.7	569.0	1,143.9	3.9	3.0	2.5	3.9	0.6	0.7
South Asia	11	22	3.5	3.4	4.6	772.2	1,520.8	63.0	62.8	0.7	1.0	0.6	0.5
Sub-Saharan Africa	–52	–62	2.4	2.5	2.7	460.0	673.2	88.4	79.2	0.9	0.9	0.6	0.6
High income	16	19	1.6	5.2	6.0	10,929.8	13,382.1	34.7	32.7	11.9	13.2	0.5	0.4
Euro area	55	64	1.2	6.6	7.5	2,469.2	2,564.5	33.8	27.5	8.4	8.2	0.4	0.3

a. Negative values indicate that a country is a net exporter. b. Includes Montenegro. c. Deviation from zero is due to statistical errors and changes in stock. d. Includes emissions not allocated to specific countries.

Energy dependency and efficiency and carbon dioxide emissions 3.8

About the data

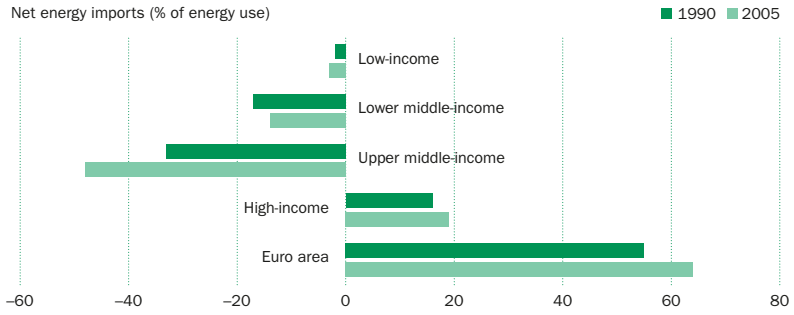
Because commercial energy is widely traded, its production and use need to be distinguished. Net energy imports show the extent to which an economy's use exceeds its production. High-income countries are net energy importers; middle-income countries are their main suppliers.

The ratio of gross domestic product (GDP) to energy use indicates energy efficiency. To produce comparable and consistent estimates of real GDP across countries relative to physical inputs to GDP—that is, units of energy use—GDP is converted to 2005 constant international dollars using purchasing power parity (PPP) rates. Differences in this ratio over time and across countries reflect structural changes in the economy, changes in sectoral energy efficiency, and differences in fuel mixes.

Carbon dioxide emissions, largely byproducts of energy production and use (see table 3.7), account for the largest share of greenhouse gases, which are associated with global warming. Anthropogenic carbon dioxide emissions result primarily from fossil fuel combustion and cement manufacturing. In combustion different fossil fuels release different amounts of carbon dioxide for the same level of energy use: oil releases about 50 percent more carbon dioxide than natural gas, and coal releases about twice as much. Cement manufacturing releases about half a metric ton of carbon dioxide for each metric ton of cement produced.

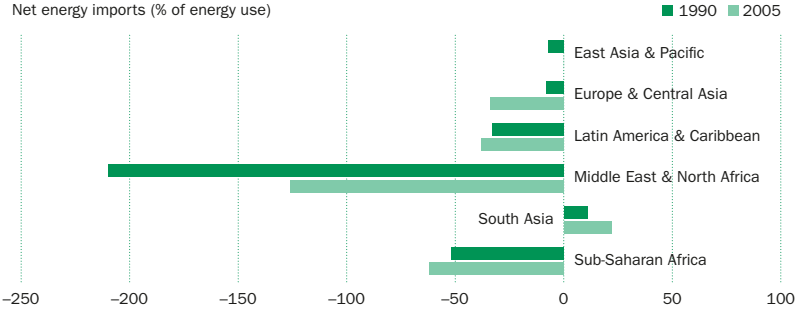
The U.S. Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC) calculates annual anthropogenic emissions from data on fossil fuel consumption (from the United Nations Statistics Division's World Energy Data Set) and world cement manufacturing (from the U.S. Bureau of Mines's Cement Manufacturing Data Set). Carbon dioxide emissions are often calculated and reported as elemental carbon. For the table these values were converted to actual carbon dioxide mass by multiplying them by 3.664 (the ratio of the mass of carbon to that of carbon dioxide). Although estimates of global carbon dioxide emissions are probably accurate within 10 percent (as calculated from global average fuel chemistry and use), country estimates may have larger error bounds. Trends estimated from a consistent time series tend to be more accurate than individual values. Each year the CDIAC recalculates the entire time series since 1949, incorporating recent findings and corrections to its database. Estimates exclude fuels supplied to ships and aircraft in international transport because of the difficulty of apportioning these fuels among the benefiting countries.

High-income economies depend on imported energy . . . **3.8a**



Note: Negative values indicate that the income group is a net energy exporter.
Source: Table 3.8.

. . . mostly from middle-income countries in the Middle East and North Africa and Latin America and the Caribbean **3.8b**



Note: Negative values indicate that the region is a net energy exporter.
Source: Table 3.8.

Definitions

• **Net energy imports** are estimated as energy use less production, both measured in oil equivalents. • **Energy use** refers to the use of primary energy before transformation to other end-use fuel, which is equal to indigenous production plus imports and stock changes minus exports and fuel supplied to ships and aircraft engaged in international transport (see *About the data* for table 3.7). • **GDP per unit of energy use** is the ratio of gross domestic product (GDP) per kilogram of oil equivalent of energy use, with GDP converted to 2005 constant international dollars using purchasing power parity (PPP) rates. An international dollar has the same purchasing power over GDP that a U.S. dollar has in the United States. • **Carbon dioxide emissions** are emissions from the burning of fossil fuels and the manufacture of cement and include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. • **Carbon dioxide emissions from solid fuel consumption** refer mainly to emissions from use of coal as an energy source.

Data sources

Data on energy use are from the electronic files of the International Energy Agency. Data on carbon dioxide emissions are from the CDIAC, Environmental Sciences Division, Oak Ridge National Laboratory, in Tennessee, United States.

3.9 Trends in greenhouse gas emissions

	Carbon dioxide emissions		Methane emissions				Nitrous oxide emissions				Other greenhouse gas emissions	
	average annual % growth		Total thousand metric tons of carbon dioxide equivalent		Industrial % of total	Agricultural % of total	Total thousand metric tons of carbon dioxide equivalent		Industrial % of total	Agricultural % of total	thousand metric tons of carbon dioxide equivalent	
	1970–90	1990–2004	1990	2005	2005	2005	1990	2005	2005	2005	1990	2005
Afghanistan	3.2	–11.0	..	..	..	..	..	..	..	..	..	..
Albania	3.5	–2.0	2,230	2,170	11.5	70.0	2,340	1,390	0.0	97.1	0	50
Algeria	7.3	8.8	18,570	24,310	66.3	15.3	8,780	10,330	7.2	89.1	230	110
Angola	1.5	4.1	13,630	37,020	11.6	39.1	5,110	28,350	0.0	35.9	0	0
Argentina	1.3	1.4	82,110	94,340	13.0	63.9	65,060	83,410	0.2	97.7	1,880	930
Armenia	2.6	–0.5	3,090	2,300	25.2	50.9	910	450	0.0	93.3	0	10
Australia	3.1	1.2	104,050	116,840	24.6	61.5	106,090	114,500	1.3	94.9	2,620	4,580
Austria	–0.1	1.4	8,210	7,210	14.6	50.1	5,740	4,620	9.1	85.3	1,210	3,310
Azerbaijan	2.6	–4.5	14,510	11,550	45.2	45.4	4,060	4,040	0.0	93.6	180	50
Bangladesh	7.8	6.9	81,620	92,530	11.6	69.2	22,420	37,100	0.0	91.9	0	0
Belarus	2.6	–3.8	19,230	16,620	43.0	38.8	15,270	10,360	32.3	65.6	0	440
Belgium	–1.9	–0.4	10,230	7,610	17.0	59.7	11,250	9,650	12.0	65.4	130	9,380
Benin	4.3	7.9	2,730	4,840	8.9	47.5	2,120	4,660	0.0	68.0	0	0
Bolivia	1.9	2.6	15,550	27,120	2.8	34.5	14,310	28,300	0.0	43.3	0	0
Bosnia and Herzegovina	3.4	12.5	2,000	2,850	51.9	32.6	1,140	1,020	0.0	82.4	460	850
Botswana	21.1	4.3	130	4,480	17.9	71.9	0	2,460	0.0	96.3	0	0
Brazil	3.9	3.6	285,650	421,820	3.0	67.1	227,790	300,300	3.2	74.4	5,290	7,760
Bulgaria	1.7	–3.4	9,560	6,140	31.9	32.7	13,250	5,880	29.9	64.5	0	650
Burkina Faso	8.7	1.3	..	..	..	..	..	..	..	..	..	..
Burundi	7.4	1.2	..	..	..	..	..	..	..	..	..	..
Cambodia	7.2	1.1	..	14,890	5.4	71.5	..	3,820	0.0	74.1	0	0
Cameroon	9.3	5.0	10,500	15,110	17.9	56.0	8,290	14,540	0.0	85.0	810	890
Canada	0.7	3.6	83,000	103,830	46.6	22.2	50,700	51,390	4.5	86.7	12,810	11,010
Central African Republic	1.9	2.0	..	..	..	..	..	..	..	..	..	..
Chad	–0.5	2.7	..	..	..	..	..	..	..	..	..	..
Chile	0.2	4.8	14,190	19,560	12.1	29.9	8,170	12,590	6.9	88.7	0	10
China	5.7	4.0	895,350	995,760	34.2	50.0	455,150	566,680	3.0	92.7	8,640	119,720
Hong Kong, China	6.9	2.5	1,180	1,090	40.4	0.9	210	200	0.0	5.0	0	330
Colombia	3.7	–0.8	49,180	61,690	15.7	55.1	21,140	24,530	0.9	78.0	190	330
Congo, Dem. Rep.	1.5	–6.1	2,670	5,750	49.6	11.8	820	2,250	0.0	15.6	0	0
Congo, Rep.	2.9	8.8	27,720	50,320	7.7	26.3	19,390	38,680	0.0	23.2	0	0
Costa Rica	2.8	5.0	3,720	2,450	1.6	58.0	3,440	2,850	0.0	98.9	0	0
Côte d'Ivoire	5.3	0.5	5,410	15,320	11.2	20.6	2,460	12,350	0.0	25.0	0	0
Croatia	3.4	1.8	3,950	3,690	44.2	29.8	3,390	3,590	22.3	63.8	670	720
Cuba	3.0	–1.8	9,890	9,490	6.4	62.4	13,650	8,330	8.0	87.4	0	110
Czech Republic	0.6	–2.0	22,250	14,930	58.7	17.2	10,740	6,570	16.4	75.0	20	3,530
Denmark	–0.5	–1.0	5,650	4,920	16.3	67.7	10,000	7,380	7.7	78.6	260	1,460
Dominican Republic	4.6	6.1	5,280	5,960	4.0	62.1	4,140	2,850	0.0	96.1	0	0
Ecuador	8.8	2.8	12,170	12,890	16.3	57.4	8,840	8,500	0.0	97.6	0	0
Egypt, Arab Rep.	7.3	5.6	23,250	32,960	31.2	44.2	16,980	27,810	11.5	85.6	2,250	1,820
El Salvador	1.7	5.8	2,740	3,200	12.5	48.1	2,050	2,250	0.0	95.1	0	0
Eritrea	..	12.3	2,090	2,410	7.5	77.6	1,340	2,350	0.0	99.1	0	0
Estonia	2.6	–3.3	2,610	1,230	43.1	35.0	1,630	610	0.0	83.6	0	60
Ethiopia	3.5	8.1	39,110	47,740	10.0	77.2	50,730	63,130	0.0	98.6	0	0
Finland	0.7	1.5	7,400	5,470	10.2	30.3	..	..	27.0	59.5	220	1,030
France	–1.6	0.1	56,710	43,520	10.7	71.1	88,450	78,090	12.1	77.3	10,740	27,010
Gabon	4.5	–9.0	3,120	2,040	79.9	4.4	1,850	420	0.0	57.1	0	0
Gambia, The	7.0	3.3	..	..	..	..	..	..	..	..	..	..
Georgia	2.6	–10.2	5,790	4,330	29.6	51.7	3,390	3,390	17.4	49.3	0	10
Germany	–0.2	–1.0	109,870	58,100	45.7	39.2	77,470	69,470	13.3	74.2	11,230	41,980
Ghana	1.7	5.3	5,310	8,630	10.7	49.6	4,540	10,520	0.0	88.6	190	170
Greece	4.8	2.5	6,390	7,410	9.7	39.1	13,060	13,090	3.3	91.3	790	1,620
Guatemala	2.6	6.7	5,920	8,990	11.3	42.7	4,780	7,980	0.0	70.8	0	0
Guinea	1.4	2.1	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	5.4	2.0	..	..	..	..	..	..	..	..	..	..
Haiti	5.3	7.0	2,870	3,740	6.4	61.2	2,470	4,290	0.0	98.4	0	0

Trends in greenhouse gas emissions

	Carbon dioxide emissions		Methane emissions				Nitrous oxide emissions				Other greenhouse gas emissions	
	average annual % growth		Total thousand metric tons of carbon dioxide equivalent		Industrial % of total	Agricultural % of total	Total thousand metric tons of carbon dioxide equivalent		Industrial % of total	Agricultural % of total	thousand metric tons of carbon dioxide equivalent	
	1970–90	1990–2004	1990	2005	2005	2005	1990	2005	2005	2005	1990	2005
Honduras	3.0	7.7	5,020	5,380	5.8	71.9	3,550	3,860	0.0	97.9	0	0
Hungary	0.1	–0.4	14,220	11,050	52.6	18.3	11,950	8,760	20.7	76.0	760	1,540
India	6.6	4.8	625,420	712,330	14.7	64.8	225,250	300,680	0.5	93.0	8,010	9,510
Indonesia	8.0	3.8	180,250	224,330	36.2	41.2	60,220	69,910	0.3	72.6	1,380	900
Iran, Islamic Rep.	2.6	5.0	54,730	95,060	64.7	21.8	48,620	66,140	0.9	97.6	2,130	1,560
Iraq	3.5	3.7	11,120	10,980	48.7	14.7	6,570	3,990	0.0	93.0	390	470
Ireland	2.0	2.8	11,560	3,660	24.3	32.0	12,840	12,320	0.2	92.6	110	2,050
Israel	3.2	5.6	1,010	1,170	9.4	36.8	1,900	1,820	0.0	83.5	840	1,140
Italy	1.0	1.0	42,310	36,670	19.1	37.7	35,560	37,200	23.7	70.5	4,770	27,710
Jamaica	–1.0	2.3	1,220	1,160	3.4	47.4	1,220	1,020	0.0	96.1	0	0
Japan	1.0	1.1	57,690	53,480	30.0	13.4	31,970	23,590	8.4	49.3	26,560	70,570
Jordan	11.3	3.5	1,080	1,610	13.0	24.2	1,160	1,240	0.0	93.5	0	10
Kazakhstan	2.6	–3.8	55,300	28,270	49.1	37.9	23,600	5,530	0.0	90.2	0	0
Kenya	1.6	4.9	19,410	20,310	18.0	65.0	21,830	19,060	0.0	96.4	0	0
Korea, Dem. Rep.	5.1	–11.2	9,800	10,650	29.0	36.4	9,190	23,160	0.0	97.5	300	860
Korea, Rep.	7.8	4.4	27,430	31,280	18.5	31.1	9,480	22,020	56.6	36.1	5,400	8,700
Kuwait	2.7	12.2	6,800	11,200	93.9	1.5	250	540	0.0	81.5	250	390
Kyrgyz Republic	2.6	–6.3	4,680	3,520	10.5	72.2	4,240	3,260	0.0	98.8	0	60
Lao PDR	–4.2	15.8	..	..	..	..	..	..	..	..	..	..
Latvia	2.6	–6.1	4,320	2,290	40.6	29.3	2,690	1,390	0.0	88.5	0	110
Lebanon	2.4	4.5	730	980	12.2	18.4	740	1,020	0.0	93.1	0	0
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..
Liberia	–5.4	3.2	..	..	..	..	..	..	..	..	..	..
Libya	4.4	4.0	8,750	8,540	77.6	8.9	2,860	2,050	0.0	91.7	100	290
Lithuania	2.6	–4.7	7,740	3,650	44.1	38.1	4,160	2,860	0.0	90.2	0	150
Macedonia, FYR	3.4	–0.8	..	..	..	..	..	..	..	..	..	..
Madagascar	–0.2	8.6	..	..	..	..	..	..	..	..	..	..
Malawi	0.6	4.4	..	..	..	..	..	..	..	..	..	..
Malaysia	6.4	6.9	21,300	25,510	57.2	22.3	11,600	9,920	3.9	64.3	960	530
Mali	2.9	2.2	..	..	..	..	..	..	..	..	..	..
Mauritania	9.6	–1.1	..	..	..	..	..	..	..	..	..	..
Mauritius	3.4	6.3	..	..	..	..	..	..	..	..	..	..
Mexico	7.1	0.3	95,840	120,100	22.2	39.6	70,240	75,500	1.2	90.1	1,930	3,160
Moldova	2.6	–9.1	4,780	2,590	43.6	30.9	3,270	970	0.0	94.8	0	360
Mongolia	7.4	–2.1	7,380	4,840	2.9	83.9	10,000	22,850	0.0	99.6	0	0
Morocco	5.9	3.7	9,070	13,240	2.6	41.6	14,380	15,510	0.0	75.2	0	0
Mozambique	–6.8	4.2	9,430	11,680	16.9	64.3	2,950	9,930	0.0	99.7	0	0
Myanmar	1.2	6.2	40,170	60,840	6.8	70.0	14,390	25,900	0.0	66.8	0	10
Namibia	..	57.6	4,320	4,260	4.7	89.9	4,240	4,620	0.0	99.1	0	0
Nepal	6.9	10.3	33,810	36,040	10.4	80.5	5,700	7,100	0.0	88.5	0	0
Netherlands	–0.4	0.2	19,320	15,180	23.6	49.2	19,320	16,800	33.8	51.5	5,950	5,300
New Zealand	1.9	3.1	27,370	27,490	10.4	82.3	33,920	27,960	0.1	99.4	400	820
Nicaragua	1.4	4.7	4,690	6,350	4.7	80.2	3,750	3,210	0.0	96.9	0	0
Niger	9.4	1.1	..	..	..	..	..	..	..	..	..	..
Nigeria	2.7	6.8	59,690	78,290	45.5	33.7	28,050	39,030	0.0	87.1	120	80
Norway	2.4	7.4	7,620	12,080	61.8	14.3	5,290	4,680	37.8	53.0	4,980	1,770
Oman	11.2	8.6	2,020	4,260	76.1	12.9	870	1,140	0.0	96.5	0	0
Pakistan	6.6	4.0	82,830	110,300	14.1	66.3	55,400	80,040	0.8	96.4	700	620
Panama	0.3	4.9	2,970	3,040	4.3	72.4	2,520	2,070	0.0	95.7	0	0
Papua New Guinea	4.7	0.0	..	..	..	..	..	..	..	..	..	..
Paraguay	6.4	4.3	11,690	17,750	1.7	70.9	9,980	12,870	0.0	81.8	0	0
Peru	0.9	2.7	17,260	21,510	6.4	48.1	14,300	18,720	0.0	89.4	0	80
Philippines	1.6	4.6	38,830	44,860	8.0	66.7	17,990	18,940	0.1	95.6	100	350
Poland	1.6	–1.2	90,010	60,060	67.0	18.4	31,570	26,110	22.3	72.5	460	1,270
Portugal	5.0	2.8	7,450	7,140	8.0	52.9	6,920	7,000	9.9	80.7	130	1,050
Puerto Rico	0.7	–4.1	..	..	..	..	..	..	..	..	..	..

3.9 Trends in greenhouse gas emissions

	Carbon dioxide emissions		Methane emissions				Nitrous oxide emissions				Other greenhouse gas emissions	
	average annual % growth		Total thousand metric tons of carbon dioxide equivalent		Industrial % of total	Agricultural % of total	Total thousand metric tons of carbon dioxide equivalent		Industrial % of total	Agricultural % of total	thousand metric tons of carbon dioxide equivalent	
	1970–90	1990–2004	1990	2005	2005	2005	1990	2005	2005	2005	1990	2005
Romania	2.4	–3.7	42,300	23,260	52.4	30.1	24,700	11,790	25.9	69.6	1,500	2,220
Russian Federation	2.6	–2.7	631,450	501,380	77.3	7.9	129,210	42,650	8.0	76.2	19,380	56,600
Rwanda	14.2	1.6	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	8.9	–1.1	39,710	63,500	91.8	1.9	8,230	7,720	0.0	92.1	2,260	1,530
Senegal	4.4	2.4	5,550	6,340	4.7	75.9	6,220	10,250	0.0	99.0	0	10
Serbia[a]	3.4	–3.1	12,860	6,720	16.4	59.2	9,070	4,700	11.1	81.5	340	840
Sierra Leone	–0.7	5.0	..	..	..	..	..	..	..	..	..	..
Singapore	3.6	1.0	740	1,260	27.0	4.8	180	7,970	95.7	0.8	400	1,300
Slovak Republic	0.6	–1.8	7,450	5,290	54.3	19.5	4,650	2,760	32.2	58.0	10	710
Slovenia	3.4	1.5	1,740	1,630	20.9	47.9	1,070	1,100	0.0	88.2	580	210
Somalia	2.5	..	..	..	..	..	..	..	..	..	..	..
South Africa	4.6	1.8	52,260	59,200	54.3	23.8	26,460	29,250	7.3	82.7	1,450	2,600
Spain	2.2	3.3	31,640	38,010	11.3	44.1	35,290	48,520	3.5	85.7	4,440	15,050
Sri Lanka	1.0	8.5	10,280	10,280	12.3	61.8	2,410	3,130	0.0	89.1	0	0
Sudan	–1.3	5.9	39,760	67,310	21.5	73.3	39,400	59,750	0.0	96.2	0	0
Swaziland	1.0	11.5	..	..	..	..	..	..	..	..	..	..
Sweden	–2.9	0.1	7,670	6,460	6.5	41.5	6,330	6,070	8.4	76.8	990	1,620
Switzerland	–0.1	–0.2	4,790	4,150	8.7	68.0	3,170	2,840	8.1	78.2	760	3,310
Syrian Arab Republic	9.7	2.6	5,810	7,960	33.8	34.7	7,860	9,430	2.8	94.9	0	0
Tajikistan	2.6	–11.1	3,690	3,270	10.1	68.5	3,110	1,590	0.0	99.4	80	120
Tanzania	0.0	3.4	26,860	39,460	20.3	63.5	23,300	31,690	0.0	84.3	0	0
Thailand	7.6	6.3	68,930	78,840	9.4	76.1	21,330	27,990	0.7	87.9	1,580	940
Timor-Leste	..	..	..	..	..	..	..	..	..	..	..	..
Togo	4.7	8.3	1,790	2,840	14.8	48.6	1,990	5,470	0.0	88.8	0	0
Trinidad and Tobago	4.5	4.7	2,510	3,820	78.0	1.0	340	360	0.0	91.7	0	0
Tunisia	7.0	3.3	3,740	4,390	32.1	34.2	4,260	7,230	4.1	94.2	0	30
Turkey	5.8	3.5	27,050	23,140	15.3	59.5	44,270	47,950	9.0	88.0	2,840	1,480
Turkmenistan	2.6	3.0	33,230	23,060	81.8	15.2	4,150	3,200	20.0	78.8	0	250
Uganda	–3.5	7.1	..	..	..	..	..	..	..	..	..	..
Ukraine	2.6	–5.6	146,380	75,640	68.9	15.7	69,380	23,270	41.6	54.2	60	1,390
United Arab Emirates	4.6	9.3	19,110	34,250	96.8	1.7	930	2,730	0.0	90.5	220	480
United Kingdom	–0.6	–0.2	67,750	39,400	35.7	50.7	68,470	65,480	37.1	52.2	5,880	14,030
United States	0.3	1.9	857,660	810,280	56.4	18.4	412,740	456,210	5.5	74.7	91,230	108,420
Uruguay	–2.7	1.1	14,110	17,700	0.6	90.3	15,170	15,630	0.0	99.6	0	20
Uzbekistan	2.6	0.9	41,610	51,480	70.1	23.2	14,330	14,660	0.3	98.3	0	760
Venezuela, RB	3.7	1.8	41,520	65,730	42.0	33.6	21,700	26,460	0.1	77.8	1,330	2,300
Vietnam	–0.3	11.9	52,990	75,080	17.8	66.8	13,920	37,470	0.0	94.9	0	10
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	10.0	5.1	4,620	9,040	44.5	27.7	5,110	7,080	0.0	98.9	0	10
Zambia	–2.5	–1.6	9,820	16,770	5.7	68.6	4,800	11,410	3.7	65.1	0	0
Zimbabwe	3.3	–3.1	10,850	10,400	24.8	60.4	8,970	10,160	0.0	97.1	0	20
World	**1.8 w**	**1.6 w**	**6,174,140 s**	**6,607,490 s**	**34.8 w**	**43.1 w**	**3,323,000 s**	**3,787,800 s**	**82.6 w**	**47.9 w**	**265,210 s**	**601,890 s**
Low income	4.9	2.8	1,231,970	1,526,640	18.1	62.6	585,050	861,010	91.5	63.3	9,400	12,240
Middle income	3.6	1.4	3,270,800	3,491,860	36.1	41.9	1,660,270	1,809,370	82.8	48.4	56,960	213,780
Lower middle income	4.6	3.1	1,749,030	1,973,890	32.8	46.1	908,360	1,085,030	84.0	46.1	18,400	130,730
Upper middle income	2.9	–0.6	1,521,770	1,517,970	40.4	36.5	751,910	724,340	81.1	51.8	38,560	83,050
Low & middle income	3.8	1.6	4,502,770	5,018,500	30.6	48.2	2,245,320	2,670,380	85.6	53.2	66,360	226,020
East Asia & Pacific	5.7	3.6	..	..	30.5	51.9	..	..	90.0	52.3	..	..
Europe & Central Asia	2.5	–2.6	1,174,570	867,600	68.8	16.2	419,030	226,870	77.2	30.6	26,400	69,800
Latin America & Carib.	4.1	1.7	683,590	929,970	10.7	57.9	518,270	645,520	80.8	59.0	10,620	14,700
Middle East & N. Africa	4.7	5.3	143,490	213,330	52.5	25.7	118,190	152,970	92.0	28.7	5,100	4,300
South Asia	6.6	4.8	833,960	961,480	14.1	66.0	311,180	428,050	93.4	65.7	8,710	10,130
Sub-Saharan Africa	3.9	2.6	..	..	24.4	49.4	..	..	78.5	54.4	..	..
High income	0.6	1.5	1,671,370	1,588,990	47.8	27.1	1,077,680	1,117,420	75.3	35.3	198,850	375,870
Euro area	0.0	0.4	313,430	232,220	22.2	47.6	313,640	303,960	76.4	49.3	40,300	135,750

a. Includes Montenegro.

Trends in greenhouse gas emissions 3.9

About the data

Greenhouse gases—which include carbon dioxide, methane, nitrous oxide, hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride—contribute to climate change.

Carbon dioxide emissions, largely a by-product of energy production and use (see table 3.7), account for the largest share of greenhouse gases. Anthropogenic carbon dioxide emissions result primarily from fossil fuel combustion and cement manufacturing. Burning oil releases more carbon dioxide than burning natural gas, and burning coal releases even more for the same level of energy use. Cement manufacturing releases about half a metric ton of carbon dioxide for each metric ton of cement produced.

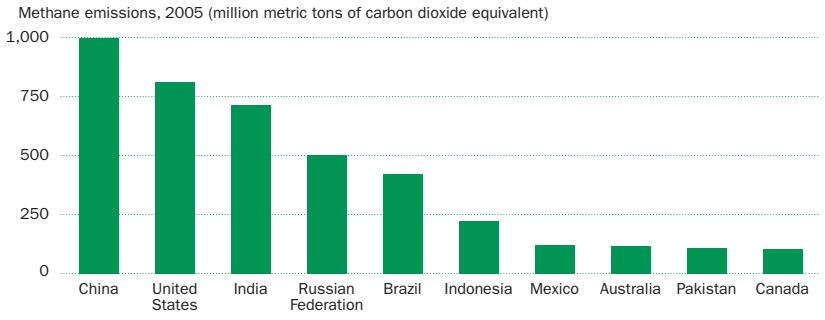
Methane emissions result largely from agricultural activities, industrial production landfills and wastewater treatment, and other sources such as tropical forest and other vegetation fires. The emissions are usually expressed in carbon dioxide equivalents using the global warming potential, which allows the effective contributions of different gases to be compared. A kilogram of methane is 21 times as effective at trapping heat in the earth's atmosphere as a kilogram of carbon dioxide within 100 years.

Nitrous oxide emissions are mainly from fossil fuel combustion, fertilizers, rainforest fires, and animal waste. Nitrous oxide is a powerful greenhouse gas, with an estimated atmospheric lifetime of 114 years, compared with 12 years for methane. The per kilogram global warming potential of nitrous oxide is nearly 310 times that of carbon dioxide within 100 years.

Other greenhouse gases covered under the Kyoto Protocol are hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride. Although emissions of these artificial gases are small, they are more powerful greenhouse gases than carbon dioxide, with much higher atmospheric lifetime and high global warming potential.

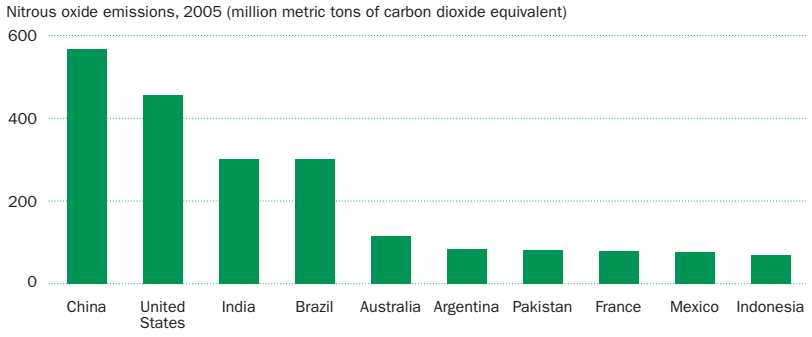
The Carbon Dioxide Information Analysis Center (CDIAC), sponsored by the U.S. Department of Energy, calculates annual anthropogenic emissions of carbon dioxide from fossil fuel consumption data (from the United Nations Statistics Division's World Energy Data Set) and data on world cement manufacturing data (from the U.S. Bureau of Mines's Cement Manufacturing Data Set). Carbon dioxide emissions are often calculated and reported as elemental carbon. For the table these values were converted to actual carbon dioxide mass by multiplying by 3.664 (the ratio of the mass of carbon to that of carbon dioxide). Although estimates of global carbon dioxide emissions are probably accurate within 10 percent, country estimates may have larger error bounds. Trends estimated from a consistent time series tend to be more accurate than individual values. Each year the CDIAC recalculates the entire time series, incorporating recent findings and corrections to the database. Estimates exclude fuels supplied to ships and aircraft in international transport because of the difficulty of apportioning these fuels among benefiting countries.

The 10 largest contributors to methane emissions account for about 62 percent of emissions 3.9a



Source: Table 3.9.

The 10 largest contributors to nitrous oxide emissions account for about 56 percent of emissions 3.9b



Source: Table 3.9.

Definitions

• **Carbon dioxide emissions** are emissions from the burning of fossil fuels and the manufacture of cement and include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. • **Methane emissions** are emissions from human activities such as agriculture and from industrial methane production. • **Industrial methane emissions** are emissions from the handling, transmission, and combustion of fossil fuels and biofuels. • **Agricultural methane emissions** are emissions from animals, animal waste, rice production, agricultural waste burning (nonenergy, on-site), and savannah burning. • **Nitrous oxide emissions** are emissions from agricultural biomass burning, industrial activities, and livestock management. • **Industrial nitrous oxide emissions** are emissions produced during the manufacturing of adipic acid and nitric acid. • **Agricultural nitrous oxide emissions** are emissions produced through fertilizer use (synthetic and animal manure), animal waste management, agricultural waste burning (nonenergy, on-site), and savannah burning. • **Other greenhouse gas emissions** are by-product emissions of hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride.

Data sources

Data on carbon dioxide emissions are from the CDIAC, Environmental Sciences Division, Oak Ridge National Laboratory, Tennessee, United States. Data on methane, nitrous oxide, and other greenhouse gases emissions are compiled by the International Energy Agency.

3.10 Sources of electricity

	Electricity production		Sources of electricity[a]									
			% of total									
	billion kilowatt hours		Coal		Gas		Oil		Hydropower		Nuclear power	
	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005
Afghanistan	..	..	..	..	..	..	..	..	..	..	..	..
Albania	3.2	5.4	0.0	0.0	0.0	0.0	10.9	1.3	89.1	98.7	0.0	0.0
Algeria	16.1	33.9	0.0	0.0	93.7	96.2	5.4	2.2	0.8	1.6	0.0	0.0
Angola	0.8	2.7	0.0	0.0	0.0	0.0	13.8	34.2	86.2	65.8	0.0	0.0
Argentina	51.0	105.8	1.3	2.1	39.0	52.3	9.7	5.4	35.6	32.4	14.3	6.5
Armenia	10.4	6.3	0.0	0.0	16.4	28.9	68.6	0.0	15.0	28.1	0.0	43.0
Australia	154.3	250.9	77.1	80.1	10.6	11.7	2.7	0.8	9.2	6.3	0.0	0.0
Austria	49.3	63.0	14.2	13.5	15.7	20.7	3.8	2.6	63.9	57.0	0.0	0.0
Azerbaijan	23.2	21.2	0.0	0.0	0.0	58.1	97.0	27.7	3.0	14.2	0.0	0.0
Bangladesh	7.7	22.6	0.0	0.0	84.3	87.6	4.3	6.7	11.4	5.7	0.0	0.0
Belarus	29.5	31.0	0.0	0.0	44.0	91.4	55.9	8.4	0.1	0.1	0.0	0.0
Belgium	70.3	85.7	28.2	12.2	7.7	26.7	1.9	2.0	0.4	0.3	60.8	55.5
Benin	0.0	0.1	0.0	0.0	0.0	0.0	100.0	99.1	0.0	0.9	0.0	0.0
Bolivia	2.1	5.2	0.0	0.0	37.6	32.3	5.3	16.7	55.3	47.8	0.0	0.0
Bosnia and Herzegovina	14.6	12.7	71.8	56.0	0.0	0.0	7.3	1.1	20.9	42.9	0.0	0.0
Botswana	0.9	1.0	88.1	99.4	0.0	0.0	11.9	0.6	0.0	0.0	0.0	0.0
Brazil	222.8	403.0	2.0	2.5	0.0	4.7	2.2	2.9	92.8	83.7	1.0	2.4
Bulgaria	42.1	44.0	50.3	42.4	7.6	3.9	2.9	1.4	4.5	9.9	34.8	42.4
Burkina Faso	..	..	..	..	..	..	..	..	..	..	..	..
Burundi	..	..	..	..	..	..	..	..	..	..	..	..
Cambodia	..	0.9	..	..	..	..	..	41.0	..	1.9	..	..
Cameroon	2.7	4.1	0.0	0.0	0.0	0.0	1.5	5.6	98.5	94.4	0.0	0.0
Canada	481.9	628.1	17.1	16.9	2.0	5.8	3.4	3.1	61.6	57.9	15.1	14.7
Central African Republic	..	..	..	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	18.4	49.9	34.3	16.7	1.3	29.9	7.6	3.4	55.3	48.1	0.0	0.0
China	621.2	2,497.4	71.3	79.0	0.4	0.5	7.9	2.4	20.4	15.9	0.0	2.1
Hong Kong, China	28.9	38.5	98.3	62.6	0.0	36.8	1.7	0.6	0.0	0.0	0.0	0.0
Colombia	36.4	51.6	10.1	8.2	12.4	13.3	1.0	0.2	75.6	77.2	0.0	0.0
Congo, Dem. Rep.	5.7	7.4	0.0	0.0	0.0	0.0	0.4	0.3	99.6	99.7	0.0	0.0
Congo, Rep.	0.5	0.4	0.0	0.0	0.0	0.0	0.6	0.3	99.4	99.7	0.0	0.0
Costa Rica	3.5	8.3	0.0	0.0	0.0	0.0	2.5	3.3	97.5	79.6	0.0	0.0
Côte d'Ivoire	2.0	5.6	0.0	0.0	0.0	74.1	33.3	0.1	66.7	25.8	0.0	0.0
Croatia	9.2	12.4	6.8	18.8	20.2	14.7	31.6	15.0	41.3	51.3	0.0	0.0
Cuba	15.0	15.3	0.0	0.0	0.2	0.0	91.5	97.5	0.6	0.6	0.0	0.0
Czech Republic	62.3	81.9	76.4	60.8	0.6	4.8	0.9	0.4	1.9	2.9	20.2	30.2
Denmark	26.0	36.3	90.7	42.6	2.7	24.3	3.4	3.8	0.1	0.1	0.0	0.0
Dominican Republic	3.7	12.9	1.2	10.0	0.0	0.3	88.6	74.6	9.4	14.7	0.0	0.0
Ecuador	6.3	13.4	0.0	0.0	0.0	7.7	21.5	41.0	78.5	51.4	0.0	0.0
Egypt, Arab Rep.	42.3	108.7	0.0	0.0	39.6	74.3	36.9	13.6	23.5	11.6	0.0	0.0
El Salvador	2.2	4.8	0.0	0.0	0.0	0.0	6.9	42.6	73.5	35.0	0.0	0.0
Eritrea	..	..	..	..	..	..	..	..	..	..	..	..
Estonia	17.2	10.2	86.8	91.2	4.8	7.4	8.4	0.3	0.0	0.2	0.0	0.0
Ethiopia	1.2	2.9	0.0	0.0	0.0	0.0	11.6	0.7	88.4	99.3	0.0	0.0
Finland	54.4	70.6	33.0	16.5	8.6	15.9	3.1	0.7	20.0	19.5	35.3	33.0
France	417.2	570.6	8.5	5.4	0.7	4.0	2.1	1.3	12.9	9.1	75.3	79.1
Gabon	1.0	1.6	0.0	0.0	16.4	15.9	11.2	31.7	72.1	51.9	0.0	0.0
Gambia, The	..	..	..	..	..	..	..	..	..	..	..	..
Georgia	13.7	7.3	0.0	0.0	15.6	13.3	29.2	0.9	55.2	85.8	0.0	0.0
Germany	547.7	613.2	58.7	49.8	7.4	11.3	1.9	1.7	3.2	3.2	27.8	26.6
Ghana	5.7	6.8	0.0	0.0	0.0	0.0	0.0	21.5	100.0	78.5	0.0	0.0
Greece	34.8	59.4	72.4	59.8	0.3	13.7	22.3	15.5	5.1	8.4	0.0	0.0
Guatemala	2.3	7.6	0.0	13.9	0.0	0.0	9.0	31.4	76.0	42.8	0.0	0.0
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	0.6	0.6	0.0	0.0	0.0	0.0	20.6	52.3	76.5	47.7	0.0	0.0

3.10 Sources of electricity

	Electricity production		Sources of electricity[a]									
			% of total									
	billion kilowatt hours		Coal		Gas		Oil		Hydropower		Nuclear power	
	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005
Honduras	2.3	5.6	0.0	0.0	0.0	0.0	1.7	66.4	98.3	32.3	0.0	0.0
Hungary	28.4	35.8	30.5	20.0	15.7	34.6	4.8	1.3	0.6	0.6	48.3	38.7
India	289.4	699.0	66.2	68.7	3.4	8.9	3.5	4.5	24.8	14.3	2.1	2.5
Indonesia	33.3	127.4	31.5	40.7	2.3	13.8	42.7	31.9	20.2	8.4	0.0	0.0
Iran, Islamic Rep.	59.1	180.4	0.0	0.0	52.5	73.0	37.3	18.0	10.3	8.9	0.0	0.0
Iraq	24.0	34.0	0.0	0.0	0.0	0.0	89.2	98.5	10.8	1.5	0.0	0.0
Ireland	14.2	25.6	57.4	34.5	27.7	45.2	10.0	13.0	4.9	2.5	0.0	0.0
Israel	20.9	49.8	50.1	71.1	0.0	11.4	49.9	17.5	0.0	0.1	0.0	0.0
Italy	213.1	294.4	16.8	16.8	18.6	50.7	48.2	16.0	14.8	11.4	0.0	0.0
Jamaica	2.5	7.4	0.0	0.0	0.0	0.0	92.4	96.6	3.6	2.0	0.0	0.0
Japan	836.7	1,094.2	14.0	28.3	19.9	21.1	18.2	9.5	10.7	7.1	24.2	27.9
Jordan	3.6	9.7	0.0	0.0	11.9	57.3	87.8	42.1	0.3	0.6	0.0	0.0
Kazakhstan	87.4	67.9	71.1	70.3	10.5	10.7	10.0	7.4	8.4	11.6	0.0	0.0
Kenya	3.0	6.0	0.0	0.0	0.0	0.0	7.6	29.5	81.6	50.4	0.0	0.0
Korea, Dem. Rep.	27.7	22.9	40.1	39.0	0.0	0.0	3.6	3.6	56.3	57.3	0.0	0.0
Korea, Rep.	105.4	387.9	16.8	38.4	9.1	16.0	17.9	6.3	6.0	0.9	50.2	37.8
Kuwait	18.5	43.7	0.0	0.0	45.7	17.9	54.3	82.1	0.0	0.0	0.0	0.0
Kyrgyz Republic	15.7	16.4	13.1	3.6	23.5	9.5	0.0	0.0	63.5	86.9	0.0	0.0
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	6.6	4.9	0.9	0.0	26.1	30.3	5.4	0.1	67.6	67.8	0.0	0.0
Lebanon	1.5	10.1	0.0	0.0	0.0	0.0	66.7	89.7	33.3	10.3	0.0	0.0
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..
Liberia	..	..	..	..	..	..	..	..	..	..	..	..
Libya	10.2	22.5	0.0	0.0	0.0	28.2	100.0	71.8	0.0	0.0	0.0	0.0
Lithuania	28.4	14.4	0.0	0.0	23.8	20.9	14.6	2.8	1.5	3.1	60.0	71.7
Macedonia, FYR	5.8	6.9	89.7	78.3	0.0	0.0	1.8	0.2	8.5	21.5	0.0	0.0
Madagascar	..	..	..	..	..	..	..	..	..	..	..	..
Malawi	..	..	..	..	..	..	..	..	..	..	..	..
Malaysia	23.0	87.3	12.3	26.5	22.0	64.0	48.4	2.9	17.3	6.6	0.0	0.0
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	..	..	..	..	..	..	..	..	..	..	..	..
Mexico	124.1	234.9	6.3	14.0	11.6	36.1	56.7	29.3	18.9	11.8	2.4	4.6
Moldova	15.5	3.9	32.3	0.0	39.5	98.1	26.6	0.2	1.7	1.6	0.0	0.0
Mongolia	..	..	..	..	..	..	..	..	..	..	..	..
Morocco	9.6	22.6	23.0	69.2	0.0	0.0	64.4	23.6	12.7	6.3	0.0	0.0
Mozambique	0.5	13.3	13.9	0.0	0.0	0.1	23.6	0.1	62.6	99.8	0.0	0.0
Myanmar	2.5	6.0	1.6	0.0	39.3	39.8	10.9	10.3	48.1	49.8	0.0	0.0
Namibia	0.0	1.7	1.5	0.4	0.0	0.0	3.3	2.6	95.2	97.0	0.0	0.0
Nepal	0.9	2.4	0.0	0.0	0.0	0.0	0.1	0.2	99.9	99.8	0.0	0.0
Netherlands	71.9	100.2	38.3	26.9	50.9	57.7	4.3	2.3	0.1	0.1	4.9	4.0
New Zealand	32.3	43.0	1.9	13.5	17.6	22.0	0.0	0.0	72.3	54.6	0.0	0.0
Nicaragua	1.4	2.9	0.0	0.0	0.0	0.0	39.8	69.8	28.8	15.1	0.0	0.0
Niger	..	..	..	..	..	..	..	..	..	..	..	..
Nigeria	13.5	23.5	0.1	0.0	53.7	53.6	13.7	12.7	32.6	33.8	0.0	0.0
Norway	121.6	137.3	0.1	0.1	0.0	0.3	0.0	0.0	99.6	98.9	0.0	0.0
Oman	4.5	12.6	0.0	0.0	81.6	82.0	18.4	18.0	0.0	0.0	0.0	0.0
Pakistan	37.7	93.8	0.1	0.1	33.6	44.0	20.6	20.3	44.9	32.9	0.8	2.6
Panama	2.7	5.8	0.0	0.0	0.0	0.0	14.7	35.7	83.2	63.9	0.0	0.0
Papua New Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Paraguay	27.2	51.2	0.0	0.0	0.0	0.0	0.0	0.0	99.9	100.0	0.0	0.0
Peru	13.8	25.5	0.0	3.2	1.7	9.7	21.5	8.2	75.8	78.3	0.0	0.0
Philippines	25.2	56.5	7.7	27.0	0.0	29.8	46.7	10.9	24.0	14.8	0.0	0.0
Poland	134.4	155.4	97.5	93.4	0.1	2.3	1.2	1.5	1.1	1.4	0.0	0.0
Portugal	28.4	46.2	32.1	33.0	0.0	29.5	33.1	19.0	32.3	10.2	0.0	0.0
Puerto Rico	..	..	..	..	..	..	..	..	..	..	..	..

3.10 Sources of electricity

	Electricity production		Sources of electricity[a]									
	billion kilowatt hours		% of total									
	Coal		Gas		Oil		Hydropower		Nuclear power			
	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005	1990	2005
Romania	64.3	59.4	28.8	37.3	35.1	16.2	18.4	3.2	17.7	34.0	0.0	9.3
Russian Federation	1,082.2	951.2	14.5	17.4	47.3	46.2	11.9	2.2	15.3	18.2	10.9	15.7
Rwanda	..	..	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	69.2	176.1	0.0	0.0	48.1	49.1	51.9	50.9	0.0	0.0	0.0	0.0
Senegal	0.9	2.5	0.0	0.0	2.4	2.4	97.6	79.4	0.0	10.5	0.0	0.0
Serbia[b]	43.2	*35.4*	79.8	69.9	1.6	*1.5*	1.2	*0.8*	22.3	*27.9*	0.0	0.0
Sierra Leone	..	..	..	..	..	..	..	..	..	..	..	..
Singapore	15.7	38.2	0.0	0.0	0.0	74.4	100.0	25.6	0.0	0.0	0.0	0.0
Slovak Republic	25.5	31.4	31.9	19.1	7.1	7.0	6.4	2.4	7.4	14.8	47.2	56.5
Slovenia	12.0	15.1	31.9	34.9	0.0	2.2	4.8	0.3	24.7	22.9	38.7	38.9
Somalia	..	..	..	..	..	..	..	..	..	..	..	..
South Africa	165.4	242.9	94.3	94.1	0.0	0.0	0.0	0.0	0.6	0.9	5.1	4.6
Spain	151.2	290.6	40.1	27.8	1.0	27.2	5.7	8.4	16.8	6.7	35.9	19.8
Sri Lanka	3.2	8.8	0.0	0.0	0.0	0.0	0.2	60.6	99.8	39.4	0.0	0.0
Sudan	1.5	4.1	0.0	0.0	0.0	0.0	36.8	70.0	63.2	30.0	0.0	0.0
Swaziland	..	..	..	..	..	..	..	..	..	..	..	..
Sweden	146.0	158.4	1.1	1.2	0.3	0.4	0.9	0.9	49.7	46.0	46.7	45.7
Switzerland	55.0	57.8	0.1	0.0	0.6	1.5	0.7	0.3	54.2	54.1	43.0	40.4
Syrian Arab Republic	11.6	34.9	0.0	0.0	20.5	37.1	56.0	53.0	23.5	9.9	0.0	0.0
Tajikistan	18.1	17.1	0.0	0.0	9.1	2.3	0.0	0.0	90.9	97.7	0.0	0.0
Tanzania	1.6	3.0	0.0	3.3	0.0	0.0	4.9	38.2	95.1	58.6	0.0	0.0
Thailand	44.2	132.2	25.0	15.1	40.2	71.4	23.5	6.6	11.3	4.4	0.0	0.0
Timor-Leste	..	..	..	..	..	..	..	..	..	..	..	..
Togo	0.2	0.2	0.0	0.0	0.0	0.0	39.9	60.4	60.1	39.6	0.0	0.0
Trinidad and Tobago	3.6	7.1	0.0	0.0	99.0	99.5	0.1	0.2	0.0	0.0	0.0	0.0
Tunisia	5.8	13.7	0.0	0.0	63.7	90.4	35.5	8.2	0.8	1.1	0.0	0.0
Turkey	57.5	162.0	35.1	26.7	17.7	45.3	6.9	3.4	40.2	24.4	0.0	0.0
Turkmenistan	14.6	12.8	0.0	0.0	95.2	100.0	0.0	0.0	4.8	0.0	0.0	0.0
Uganda	..	..	..	..	..	..	..	..	..	..	..	..
Ukraine	298.6	185.9	38.2	26.7	16.8	18.7	16.1	0.3	3.5	6.7	25.5	47.7
United Arab Emirates	17.1	60.7	0.0	0.0	96.3	97.9	3.7	2.1	0.0	0.0	0.0	0.0
United Kingdom	317.8	397.6	65.0	34.3	1.6	38.5	10.9	1.4	1.6	1.2	20.7	20.5
United States	3,202.8	4,268.4	53.1	50.5	11.9	18.3	4.1	3.3	8.5	6.4	19.1	19.0
Uruguay	7.4	7.7	0.0	0.0	0.0	0.0	5.1	12.5	94.2	87.0	0.0	0.0
Uzbekistan	56.3	47.7	7.4	4.7	76.4	68.8	4.4	13.6	11.8	12.8	0.0	0.0
Venezuela, RB	59.3	101.5	0.0	0.0	26.2	15.6	11.5	10.5	62.3	73.9	0.0	0.0
Vietnam	8.7	53.5	23.1	16.7	0.1	38.5	15.0	4.6	61.8	40.1	0.0	0.0
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	1.7	4.7	0.0	0.0	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0
Zambia	8.0	8.9	0.5	0.2	0.0	0.0	0.3	0.4	99.2	99.4	0.0	0.0
Zimbabwe	9.4	10.3	53.3	43.0	0.0	0.0	0.0	0.2	46.7	56.8	0.0	0.0
World	**11,735.9 s**	**18,155.6 s**	**37.5 w**	**40.3 w**	**14.6 w**	**19.8 w**	**10.4 w**	**6.2 w**	**18.1 w**	**16.0 w**	**17.2 w**	**15.2 w**
Low income	520.1	1,082.4	41.5	46.7	16.5	18.3	5.7	7.4	35.0	24.8	1.2	1.8
Middle income	3,709.5	6,599.4	32.7	44.1	22.0	20.3	15.4	7.1	22.0	21.5	7.4	6.0
Lower middle income	1,447.7	3,765.8	41.9	56.9	12.6	13.9	20.2	7.8	19.3	16.8	5.3	3.8
Upper middle income	2,261.8	2,833.5	26.8	27.0	28.0	28.9	12.3	6.1	23.7	27.8	8.7	9.0
Low & middle income	4,229.7	7,681.8	33.8	44.4	21.3	20.0	14.2	7.1	23.6	22.0	6.6	5.5
East Asia & Pacific	785.8	2,984.2	61.4	70.4	3.5	7.4	12.6	4.1	21.7	15.6	0.0	1.8
Europe & Central Asia	2,085.5	1,913.2	27.3	27.3	34.0	35.8	13.1	2.9	13.6	17.5	12.1	16.0
Latin America & Carib.	605.1	1,120.8	3.8	5.4	9.2	18.0	18.9	13.6	63.9	57.6	2.1	2.5
Middle East & N. Africa	190.0	487.9	1.2	3.2	38.4	60.0	48.2	29.3	12.2	7.4	0.0	0.0
South Asia	338.9	826.7	56.6	58.1	8.6	14.9	5.4	6.9	27.6	16.7	1.9	2.4
Sub-Saharan Africa	224.4	349.0	72.1	67.1	3.3	4.9	2.2	4.1	18.4	20.1	3.8	3.2
High income	7,506.2	10,473.9	39.5	37.3	10.8	19.6	8.2	5.6	15.1	11.5	23.1	22.4
Euro area	1,665.0	2,238.0	34.4	26.3	8.6	20.7	9.5	5.2	11.1	8.4	35.5	33.6

a. Shares may not sum to 100 percent because some sources of generated electricity (such as wind, solar, and geothermal) are not shown. b. Includes Montenegro.

Sources of electricity

About the data

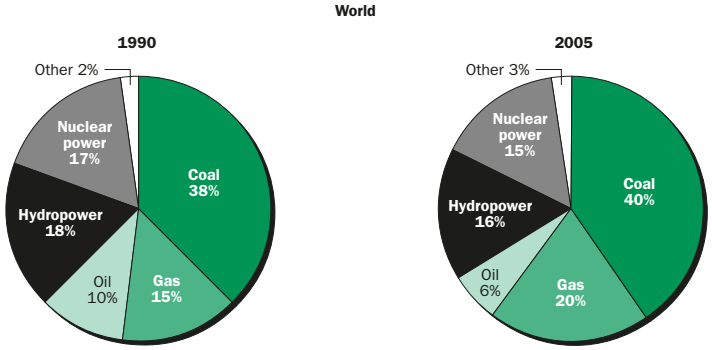
Use of energy is important in improving people's standard of living. But electricity generation also can damage the environment. Whether such damage occurs depends largely on how electricity is generated. For example, burning coal releases twice as much carbon dioxide—a major contributor to global warming—as does burning an equivalent amount of natural gas (see *About the data* for table 3.8). Nuclear energy does not generate carbon dioxide emissions, but it produces other dangerous waste products. The table provides information on electricity production by source.

The International Energy Agency (IEA) compiles data on energy inputs used to generate electricity. IEA data for countries that are not members of the Organisation for Economic Co-operation and Development (OECD) are based on national energy data adjusted to conform to annual questionnaires completed by OECD member governments. In addition, estimates are sometimes made to complete major aggregates from which key data are missing, and adjustments are made to compensate for differences in definitions. The IEA makes these estimates in consultation with national statistical offices, oil companies, electric utilities, and national energy experts. It occasionally revises its time series to reflect political changes. Since 1990, for example, the IEA has constructed energy statistics for countries of the former Soviet Union. In addition, energy statistics for other countries have undergone continuous changes in coverage or methodology in recent years as more detailed energy accounts have become available. Breaks in series are therefore unavoidable.

Definitions

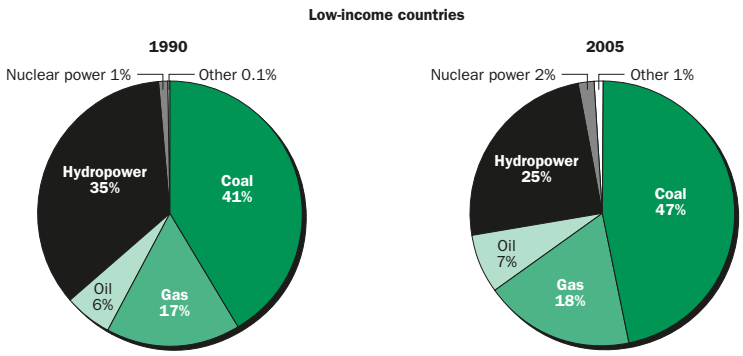
• **Electricity production** is measured at the terminals of all alternator sets in a station. In addition to hydropower, coal, oil, gas, and nuclear power generation, it covers generation by geothermal, solar, wind, and tide and wave energy as well as that from combustible renewables and waste. Production includes the output of electric plants designed to produce electricity only, as well as that of combined heat and power plants. • **Sources of electricity** are the inputs used to generate electricity: coal, gas, oil, hydropower, and nuclear power. • **Coal** is all coal and brown coal, both primary (including hard coal and lignite-brown coal) and derived fuels (including patent fuel, coke oven coke, gas coke, coke oven gas, and blast furnace gas). Peat is also included in this category. • **Gas** is natural gas but not natural gas liquids. • **Oil** is crude oil and petroleum products. • **Hydropower** is electricity produced by hydroelectric power plants. • **Nuclear power** is electricity produced by nuclear power plants.

Sources of electricity generation have shifted since 1990 . . . **3.10a**



Source: Table 3.10.

. . . with low-income countries relying more on coal **3.10b**



Source: Table 3.10.

Data sources

Data on electricity production are from the IEA's electronic files and its annual publications *Energy Statistics and Balances of Non-OECD Countries, Energy Statistics of OECD Countries,* and *Energy Balances of OECD Countries.*

3.11 Urbanization

	Urban population					Population in urban agglomerations of more than 1 million		Population in largest city		Access to improved sanitation facilities			
	millions		% of total population		average annual % growth	% of total population		% of urban population		% of urban population		% of rural population	
	1990	2006	1990	2006	1990–2006	1990	2005	1990	2005	1990	2004	1990	2004
Afghanistan	..	..	..	..	..	..	..	..	..	..	..	..	..
Albania	1.2	1.5	36	46	1.3	..	..	..	..	99	99	..	84
Algeria	13.2	21.3	52	64	3.0	8	10	14	15	99	99	77	82
Angola	3.9	8.9	37	54	5.2	15	17	40	32	61	56	18	16
Argentina	28.3	35.3	87	90	1.4	39	39	37	36	86	92	45	83
Armenia	2.4	1.9	68	64	–1.4	33	37	49	57	96	96	..	61
Australia	14.6	18.3	85	88	1.4	60	60	25	24	100	100	100	100
Austria	5.1	5.5	66	66	0.5	27	27	41	42	100	100	100	100
Azerbaijan	3.8	4.4	54	52	0.8	24	22	45	43	..	73	..	36
Bangladesh	22.4	39.8	20	26	3.6	8	12	29	32	55	51	12	35
Belarus	6.8	7.1	66	73	0.3	16	18	24	25	..	93	..	61
Belgium	9.6	10.2	96	97	0.4	10	10	10	10	..	..	..	..
Benin	1.8	3.5	35	41	4.3	..	..	..	..	32	59	2	11
Bolivia	3.7	6.0	56	65	3.1	25	31	29	26	49	60	14	22
Bosnia and Herzegovina	1.7	1.8	39	46	0.5	..	..	..	..	99	99	..	92
Botswana	0.6	1.1	42	58	4.0	..	..	..	..	61	57	21	25
Brazil	111.8	160.3	75	85	2.2	34	37	13	12	82	83	37	37
Bulgaria	5.8	5.4	66	70	–0.4	14	14	21	20	100	100	96	96
Burkina Faso	1.2	2.7	14	19	4.9	..	..	49	36	32	42	3	6
Burundi	0.4	0.8	6	10	5.3	..	..	..	..	42	47	44	35
Cambodia	1.2	2.9	13	20	5.4	6	10	49	50	..	53	..	8
Cameroon	5.0	10.1	41	55	4.4	14	18	19	18	59	58	40	43
Canada	21.3	26.2	77	80	1.3	40	44	18	21	100	100	99	99
Central African Republic	1.1	1.6	37	38	2.4	..	..	..	..	34	47	17	12
Chad	1.3	2.7	21	26	4.7	..	..	38	35	28	24	2	4
Chile	11.0	14.4	83	88	1.7	35	35	42	40	91	95	52	62
China	311.0	541.8	27	41	3.5	13	18	3	3	64	69	7	28
Hong Kong, China	5.7	6.9	100	100	1.2	100	100	100	100	..	..	..	..
Colombia	24.0	33.3	69	73	2.0	30	36	20	24	95	96	52	54
Congo, Dem. Rep.	10.5	19.8	28	33	3.9	15	16	35	32	53	42	1	25
Congo, Rep.	1.3	2.2	54	61	3.3	29	32	53	54	..	28	..	25
Costa Rica	1.6	2.7	51	62	3.5	24	28	47	46	..	89	97	97
Côte d'Ivoire	5.1	8.6	40	45	3.3	16	19	41	43	37	46	10	29
Croatia	2.6	2.5	54	57	–0.1	..	..	..	..	100	100	100	100
Cuba	7.8	8.5	73	75	0.5	20	19	27	26	99	99	95	95
Czech Republic	7.8	7.5	75	74	–0.2	12	11	16	16	99	99	97	97
Denmark	4.4	4.7	85	86	0.4	26	20	31	23	..	..	..	..
Dominican Republic	4.0	6.5	55	68	3.0	21	21	38	32	60	81	43	73
Ecuador	5.7	8.4	55	63	2.4	26	30	28	29	77	94	45	82
Egypt, Arab Rep.	24.0	31.9	44	43	1.8	22	20	38	36	70	86	42	58
El Salvador	2.5	4.1	49	60	3.0	19	23	39	38	70	77	33	39
Eritrea	0.5	0.9	16	20	3.9	..	..	..	..	44	32	0	3
Estonia	1.1	0.9	71	69	–1.2	..	..	..	..	97	97	96	96
Ethiopia	6.4	12.6	13	16	4.2	3	4	28	24	13	44	2	7
Finland	3.1	3.2	61	61	0.3	17	21	28	34	100	100	100	100
France	42.0	47.1	74	77	0.7	23	22	22	21	..	..	..	..
Gabon	0.6	1.1	69	84	3.5	..	..	..	..	..	37	..	30
Gambia, The	0.4	0.9	38	55	5.7	..	..	..	..	..	72	..	46
Georgia	3.0	2.3	55	52	–1.6	22	23	41	45	99	96	94	91
Germany	58.3	62.0	73	75	0.4	8	8	6	5	100	100	100	100
Ghana	5.7	11.2	37	49	4.2	12	16	21	18	23	27	10	11
Greece	6.0	6.6	59	59	0.6	30	29	51	49	..	..	..	..
Guatemala	3.7	6.2	41	48	3.3	..	..	22	16	73	90	47	82
Guinea	1.7	3.1	28	33	3.7	15	16	53	48	27	31	10	11
Guinea-Bissau	0.3	0.5	28	30	3.4	..	..	..	..	..	57	..	23
Haiti	2.1	3.7	30	39	3.6	16	23	54	59	25	57	23	14

3.11 Urbanization

	Urban population					Population in urban agglomerations of more than 1 million		Population in largest city		Access to improved sanitation facilities			
	millions		% of total population		average annual % growth	% of total population		% of urban population		% of urban population		% of rural population	
	1990	2006	1990	2006	1990–2006	1990	2005	1990	2005	1990	2004	1990	2004
Honduras	2.0	3.3	40	47	3.2	..	..	29	29	77	87	31	54
Hungary	6.8	6.7	66	67	–0.1	19	17	29	25	100	100	..	85
India	216.6	321.6	26	29	2.5	10	12	6	6	45	59	3	22
Indonesia	54.5	109.8	31	49	4.4	9	12	14	12	65	73	37	40
Iran, Islamic Rep.	30.6	47.3	56	67	2.7	23	23	21	16	86	..	78	..
Iraq	12.9	..	70	..	..	26	..	32	..	95	..	48	..
Ireland	2.0	2.6	57	61	1.6	26	25	46	41	..	..	..	..
Israel	4.2	6.5	90	92	2.7	43	44	48	47	100	100	..	..
Italy	37.8	39.9	67	68	0.3	19	17	9	8	..	..	..	..
Jamaica	1.2	1.4	49	53	1.2	..	..	..	..	86	91	64	69
Japan	78.0	84.3	63	66	0.5	46	48	42	42	100	100	100	100
Jordan	2.3	4.6	72	83	4.3	27	24	37	29	97	94	82	87
Kazakhstan	9.2	8.8	56	58	–0.3	7	8	12	13	87	87	52	52
Kenya	4.3	7.7	18	21	3.7	6	8	32	38	48	46	37	41
Korea, Dem. Rep.	11.8	14.7	58	62	1.4	15	19	21	23	..	58	..	60
Korea, Rep.	31.6	39.2	74	81	1.3	51	51	33	25	..	..	..	..
Kuwait	2.1	2.6	98	98	1.3	65	71	67	73	..	..	..	..
Kyrgyz Republic	1.7	1.9	38	36	0.7	..	..	38	43	75	75	51	51
Lao PDR	0.6	1.2	15	21	4.1	..	..	..	..	..	67	..	20
Latvia	1.9	1.6	69	68	–1.1	..	..	..	..	..	82	..	71
Lebanon	2.5	3.5	83	87	2.2	43	44	52	51	100	100	..	87
Lesotho	0.3	0.4	17	19	2.0	..	..	..	..	61	61	32	32
Liberia	1.0	2.1	45	59	4.9	..	..	55	47	59	49	24	7
Libya	3.4	5.1	79	85	2.5	48	54	44	42	97	97	96	96
Lithuania	2.5	2.3	68	67	–0.6	..	..	..	..	..	..	..	..
Macedonia, FYR	1.1	1.4	58	70	1.6	..	..	..	..	..	..	..	..
Madagascar	2.8	5.2	24	27	3.8	8	9	33	32	27	48	10	26
Malawi	1.1	2.4	12	18	4.9	..	..	..	..	64	62	45	61
Malaysia	9.0	17.8	50	68	4.3	6	5	12	8	95	95	..	93
Mali	1.8	3.7	23	31	4.6	10	12	42	39	50	59	32	39
Mauritania	0.8	1.2	40	41	2.9	..	..	..	..	42	49	22	8
Mauritius	0.5	0.5	44	42	0.9	..	..	..	..	95	95	..	94
Mexico	60.3	79.5	73	76	1.7	32	35	25	25	75	91	13	41
Moldova	2.1	1.8	47	47	–0.8	..	..	..	..	..	86	..	52
Mongolia	1.2	1.5	57	57	1.3	..	..	48	60	..	75	..	37
Morocco	11.7	18.1	48	59	2.7	16	16	23	18	87	88	27	52
Mozambique	2.9	7.4	21	35	5.9	6	6	27	19	49	53	12	19
Myanmar	10.0	15.1	25	31	2.6	7	9	29	28	48	88	16	72
Namibia	0.4	0.7	28	36	3.9	..	..	..	..	70	50	8	13
Nepal	1.7	4.5	9	16	6.1	..	..	23	19	48	62	7	30
Netherlands	10.3	13.2	69	81	1.6	14	14	10	9	100	100	100	100
New Zealand	2.9	3.6	85	86	1.3	25	28	30	32	..	..	88	..
Nicaragua	2.2	3.3	53	59	2.5	18	21	33	36	64	56	24	34
Niger	1.2	2.3	15	17	4.1	..	..	36	38	35	43	2	4
Nigeria	33.1	70.9	35	49	4.8	11	13	14	16	51	53	33	36
Norway	3.1	3.6	72	78	1.0	..	..	22	22	..	..	..	..
Oman	1.2	1.8	65	72	2.6	..	..	..	..	97	97	61	..
Pakistan	33.0	56.2	31	35	3.3	16	18	22	21	82	92	17	41
Panama	1.3	2.4	54	72	3.7	35	38	65	53	89	89	51	51
Papua New Guinea	0.5	0.8	13	14	2.7	..	..	..	..	67	67	41	41
Paraguay	2.1	3.6	49	59	3.4	22	31	45	54	72	94	45	61
Peru	15.0	20.1	69	73	1.8	27	26	39	36	69	74	15	32
Philippines	29.9	54.7	49	63	3.8	14	14	27	20	66	80	48	59
Poland	23.4	23.7	61	62	0.1	4	4	7	7	..	..	..	..
Portugal	4.7	6.2	48	58	1.6	37	39	54	45	..	..	..	..
Puerto Rico	2.6	3.8	72	98	2.6	44	67	60	68	..	..	..	..

3.11 Urbanization

	Urban population					Population in urban agglomerations of more than 1 million		Population in largest city		Access to improved sanitation facilities			
	millions		% of total population		average annual % growth	% of total population		% of urban population		% of urban population		% of rural population	
	1990	2006	1990	2006	1990–2006	1990	2005	1990	2005	1990	2004	1990	2004
Romania	12.6	11.6	54	54	–0.5	8	9	14	17	..	89	..	..
Russian Federation	108.8	103.9	73	73	–0.3	18	19	8	10	93	93	70	70
Rwanda	0.4	1.9	5	20	9.9	..	..	56	44	49	56	36	38
Saudi Arabia	12.5	19.2	77	81	2.7	30	36	19	22	100	100	..	..
Senegal	3.1	5.1	39	42	3.1	18	18	45	44	53	79	19	34
Serbia[a]	5.4	*4.2*	51	52	..	11	14	22	26	97	97	77	77
Sierra Leone	1.2	2.4	30	41	4.1	..	..	43	35	..	53	..	30
Singapore	3.0	4.5	100	100	2.4	99	100	99	100	100	100	..	..
Slovak Republic	3.0	3.0	57	56	0.1	..	..	..	..	100	100	98	98
Slovenia	1.0	1.0	50	51	0.1	..	..	..	..	..	..	..	..
Somalia	2.0	3.0	30	36	2.6	14	16	47	46	..	48	..	14
South Africa	18.3	28.3	52	60	2.7	25	30	10	12	85	79	53	46
Spain	29.3	33.9	75	77	0.9	22	24	15	17	100	100	100	100
Sri Lanka	2.9	3.0	17	15	0.2	..	..	..	..	89	98	64	89
Sudan	6.9	15.7	27	42	5.1	9	12	34	30	53	50	26	24
Swaziland	0.2	0.3	23	24	2.8	..	..	..	..	..	59	..	44
Sweden	7.1	7.7	83	84	0.5	17	19	21	22	100	100	100	100
Switzerland	4.6	5.7	68	76	1.3	14	15	20	20	100	100	100	100
Syrian Arab Republic	6.2	9.9	49	51	2.9	26	25	25	26	97	99	50	81
Tajikistan	1.7	1.6	32	25	–0.1	..	..	..	..	..	70	..	45
Tanzania	4.8	9.7	19	25	4.4	5	7	27	29	52	53	45	43
Thailand	16.0	20.7	29	33	1.6	11	10	37	32	95	98	74	99
Timor-Leste	0.2	0.3	21	27	3.6	..	..	..	..	..	66	..	33
Togo	1.2	2.6	30	41	4.9	16	21	52	53	71	71	24	15
Trinidad and Tobago	0.1	0.2	9	13	2.9	..	..	..	..	100	100	100	100
Tunisia	4.9	6.7	60	66	2.0	..	..	..	..	95	96	47	65
Turkey	33.2	49.4	59	68	2.5	22	26	20	20	96	96	70	72
Turkmenistan	1.7	2.3	45	47	2.0	..	..	..	..	..	77	..	50
Uganda	2.0	3.8	11	13	4.1	4	5	38	36	54	54	41	41
Ukraine	34.7	31.8	67	68	–0.5	12	13	7	8	98	98	..	93
United Arab Emirates	1.4	3.3	79	77	5.3	27	32	34	42	98	98	95	95
United Kingdom	51.1	54.4	89	90	0.4	26	26	15	16	..	..	..	..
United States	188.0	242.8	75	81	1.6	41	43	9	8	100	100	100	100
Uruguay	2.8	3.1	89	92	0.6	41	38	46	42	100	100	99	99
Uzbekistan	8.2	9.8	40	37	1.1	10	8	25	23	69	78	39	61
Venezuela, RB	16.6	25.3	84	94	2.6	34	37	17	12	..	71	..	48
Vietnam	13.4	22.6	20	27	3.3	13	13	30	23	58	92	30	50
West Bank and Gaza	1.3	2.7	68	72	4.4	..	..	..	..	..	78	..	61
Yemen, Rep.	2.6	6.0	21	28	5.3	5	9	25	31	82	86	19	28
Zambia	3.2	4.1	39	35	1.6	9	11	24	31	63	59	31	52
Zimbabwe	3.0	4.8	29	36	2.9	10	12	34	32	69	63	42	47
World	**2,250.7 s**	**3,197.7 s**	**43 w**	**49 w**	**2.2 w**	**18 w**	**20 w**	**17 w**	**16 w**	**77 w**	**79 w**	**23 w**	**38 w**
Low income	444.5	735.8	25	30	3.1	10	12	17	18	50	60	12	28
Middle income	1,146.2	1,679.3	44	55	2.4	..	..	15	14	78	81	24	41
Lower middle income	666.2	1,077.3	35	47	3.0	14	18	14	12	73	76	20	39
Upper middle income	480.0	602.1	69	75	1.4	..	..	17	17	87	89	53	60
Low & middle income	1,590.7	2,415.1	37	44	2.6	14	17	16	15	70	74	18	34
East Asia & Pacific	459.9	804.8	29	42	3.5	..	..	9	8	65	72	15	36
Europe & Central Asia	279.7	288.6	63	64	0.2	15	17	13	15	94	93	..	70
Latin America & Carib.	310.3	432.2	71	78	2.1	32	34	24	22	81	86	35	49
Middle East & N. Africa	117.2	178.6	52	57	2.6	20	20	27	25	87	92	52	58
South Asia	279.1	431.4	25	29	2.7	10	12	10	11	50	63	6	27
Sub-Saharan Africa	144.5	279.6	28	36	4.1	..	..	26	25	52	53	24	28
High income	660.0	782.6	74	78	1.1	..	..	20	19	100	100	..	..
Euro area	210.2	232.7	71	73	0.6	18	18	15	15	..	..	..	..

a. Includes Montenegro.

About the data

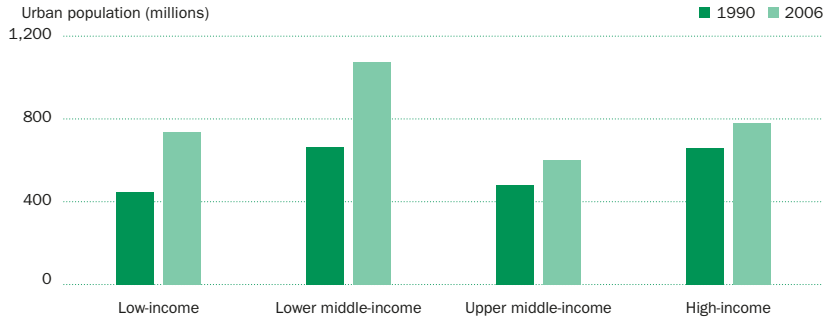
There is no consistent and universally accepted standard for distinguishing urban from rural areas, in part because of the wide variety of situations across countries. Most countries use an urban classification related to the size or characteristics of settlements. Some define urban areas based on the presence of certain infrastructure and services. And other countries designate urban areas based on administrative arrangements.

The population of a city or metropolitan area depends on the boundaries chosen. For example, in 1990 Beijing, China, contained 2.3 million people in 87 square kilometers of "inner city" and 5.4 million in 158 square kilometers of "core city." The population of "inner city and inner suburban districts" was 6.3 million and that of "inner city, inner and outer suburban districts, and inner and outer counties" was 10.8 million. (Most countries use the last definition.) For further discussion of urban-rural issues see box 3.1a in *About the data* for table 3.1.

Estimates of the world's urban population would change significantly if China, India, and a few other populous nations were to change their definition of urban centers. According to China's State Statistical Bureau, by the end of 1996 urban residents accounted for about 43 percent of China's population, more than double the 20 percent considered urban in 1994. In addition to the continuous migration of people from rural to urban areas, one of the main reasons for this shift was the rapid growth in the hundreds of towns reclassified as cities in recent years. Because the estimates in the table are based on national definitions of what constitutes a city or metropolitan area, cross-country comparisons should be made with caution. To estimate urban populations, UN ratios of urban to total population were applied to the World Bank's estimates of total population (see table 2.1).

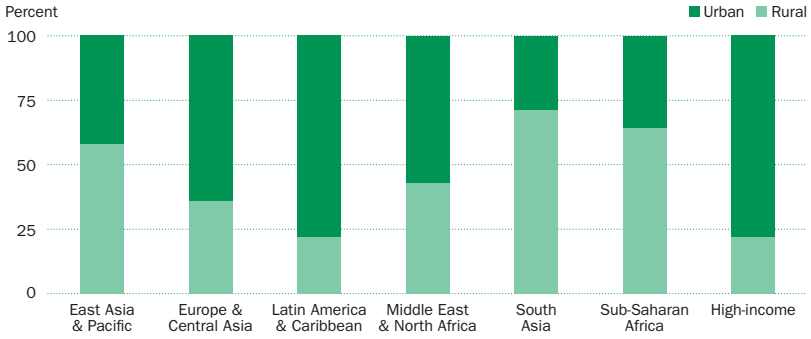
The table shows access to improved sanitation facilities for both urban and rural populations to allow comparison of access. Definitions of access and urban areas vary, however, so comparisons between countries can be misleading.

Developing economies had the largest increase in urban population between 1990 and 2006 **3.11a**



Source: Table 3.11.

Latin America and the Caribbean had the same share of urban population as high-income economies in 2006 **3.11b**



Source: Table 3.11.

Definitions

• **Urban population** is the midyear population of areas defined as urban in each country and reported to the United Nations (see *About the data*). • **Population in urban agglomerations of more than 1 million** is the percentage of a country's population living in metropolitan areas that in 2005 had a population of more than 1 million. • **Population in largest city** is the percentage of a country's urban population living in that country's largest metropolitan area. • **Access to improved sanitation facilities** is the percentage of the urban or rural population with access to at least adequate excreta disposal facilities (private or shared but not public) that can effectively prevent human, animal, and insect contact with excreta. Improved facilities range from simple but protected pit latrines to flush toilets with a sewerage connection. To be effective, facilities must be correctly constructed and properly maintained.

Data sources

Data on urban population and the population in urban agglomerations and in the largest city are from the United Nations Population Division's *World Urbanization Prospects: The 2005 Revision.* Data on total population are World Bank estimates. Data on access to sanitation are from the World Health Organization and United Nations Children's Fund's *Meeting the MDG Drinking Water and Sanitation Target.*

3.12 Urban housing conditions

	Census year	Household size		Overcrowding		Durable dwelling units		Home ownership		Multiunit dwellings		Vacancy rate	
		number of people		Households living in overcrowded dwellings[a] % of total		Buildings with durable structure % of total		Privately owned dwellings % of total		% of total		Unoccupied dwellings % of total	
		National	Urban	National	Urban	National	Urban	National	Urban	National	Urban	National	Urban
Afghanistan		..	..	..	..	..	..	..	..	..	..	..	..
Albania	2001	4.2	3.9	..	..	..	..	65[b]	30[b]	..	..	12	13
Algeria	1998	4.9	..	..	..	..	..	67	..	..	..	19	..
Angola		..	..	..	..	..	..	..	..	..	..	..	..
Argentina	2001	3.6	..	19	..	97	..	..	..	4	..	16[b]	..
Armenia	2001	4.1	4.0	4	6	93	93	95	90	1	1	..	..
Australia	2001	3.8	..	1	..	..	..	..	..	..	..	..	..
Austria	1991	2.6	..	2	..	..	..	..	..	50	..	13	..
Azerbaijan	1999	4.7	4.4	..	..	..	..	74	62	4	5	..	..
Bangladesh	2001	4.8	4.8	..	..	21[b]	42[b]	88[b]	61[b]	..	..	..	..
Belarus	1999	..	..	..	..	..	..	..	..	..	..	..	..
Belgium	2001	2.6	..	0[b]	..	..	..	67	..	32[b]	..	..	..
Benin	1992	5.9	..	..	..	26	..	59	..	..	..	..	..
Bolivia	2001	4.2	4.3	40	..	43	58	70	59	3[b]	5[b]	6	4
Bosnia and Herzegovina		..	..	..	..	..	..	..	..	..	..	..	..
Botswana	2001	4.2	3.9	27	47	88	90[b]	61	47	1	..	..	..
Brazil	2000	3.8	3.7	..	..	..	..	74	75	..	..	..	..
Bulgaria	2001	2.7	2.7	..	..	79	89	98	98	..	..	23	17
Burkina Faso	1996	6.2	5.8	30	53	..	..	..	..	..	..	..	..
Burundi	1990	4.7	..	..	..	..	..	..	..	..	..	..	..
Cambodia	1998	5.2	..	..	..	..	..	..	..	..	..	..	..
Cameroon	1987	5.2	5.1	67	77	77	..	73	48	27	42	..	..
Canada	2001	2.6	..	..	..	..	..	64	..	32	..	8	..
Central African Republic	2003	5.2	5.8	32	36[b]	78	92	85	74	..	..	..	..
Chad	1993	5.1	5.1	..	..	..	..	..	..	..	..	..	..
Chile	2002	3.4	3.5	..	..	91	92	66	65	13	15	11	10
China	2000	3.4	3.2	..	..	82	..	88	74	..	..	1	..
Hong Kong, China		..	..	..	..	..	..	..	..	..	..	..	..
Colombia	1993	4.8	..	27[b]	..	83[b]	..	68[b]	..	13	..	10[b]	..
Congo Dem Rep	1984	5.4	..	55	..	..	..	..	..	..	..	..	..
Congo Rep	1984	10.5	..	..	..	..	..	76	..	..	..	..	..
Costa Rica	2000	4.0	..	22	..	88	..	72	..	2	3	9	6
Côte d'Ivoire	1998	5.4	..	..	..	..	..	..	..	..	..	..	..
Croatia	2001	3.0	..	..	..	..	..	..	..	..	..	12	..
Cuba	1981	4.2	4.2	..	..	..	..	..	..	15	21	0	0
Czech Republic	2001	2.4	..	..	..	..	..	52	..	49	..	12	..
Denmark	2001	2.2	..	..	..	..	..	..	..	..	..	..	..
Dominican Republic	2002	3.9	..	..	..	97	..	..	..	8	..	11	..
Ecuador	2001	3.5	3.7	30	..	81	88	68[b]	58[b]	9	14	12	7
Egypt	1996	4.7	..	..	..	..	..	..	..	75	..	..	..
El Salvador	1992	..	..	63	..	67	83	70	68	3	6	11	11
Eritrea		..	..	..	..	..	..	..	..	..	..	..	..
Estonia	2000	2.4	2.3	3	..	..	..	..	..	72	..	13	..
Ethiopia	1994	4.8	4.7	..	..	..	23	..	54	..	..	..	..
Finland	2000	2.2	..	..	..	..	..	64	..	44	..	..	..
France	1999	2.5	..	..	..	..	..	55	..	..	..	7	..
Gabon	2003	5.2	..	..	..	..	..	..	..	..	..	..	..
Gambia	1993	8.9	..	..	..	18	..	68	..	..	..	..	..
Georgia	2002	3.5	3.5	..	..	..	..	..	..	..	..	..	..
Germany	2001	2.3	..	..	..	..	..	43	..	..	..	7	..
Ghana	2000	5.1	5.1	..	..	45	..	57	..	53	..	5	..
Greece	2001	3.0	..	1	..	..	..	..	..	..	..	..	..
Guatemala	2002	4.4	4.7	..	..	67	80	81	74	2	4	13	11
Guinea		..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau		..	..	..	..	..	..	..	..	..	..	..	..
Haiti	1982	4.2	..	26	..	..	..	92	68	..	..	9	19

Urban housing conditions

	Census year	Household size		Overcrowding		Durable dwelling units		Home ownership		Multiunit dwellings		Vacancy rate	
		number of people		Households living in overcrowded dwellings[a] % of total		Buildings with durable structure % of total		Privately owned dwellings % of total		% of total		Unoccupied dwellings % of total	
		National	Urban	National	Urban	National	Urban	National	Urban	National	Urban	National	Urban
Honduras	2001	4.4	..	..	..	69	85	..	..	..	..	14	..
Hungary	1990	2.7	..	..	..	..	..	..	..	..	..	4	..
India	2001	5.3	5.3	77	71	83	81	87	67	..	..	6	9
Indonesia	2000	4.0	..	..	..	..	..	..	..	..	..	..	..
Iran, Islamic Rep.	1996	4.8	4.6	33[b]	26[b]	72	76	73	67	..	..	..	..
Iraq	1997	7.7	7.2	..	..	88	96	70	66	4	5	13	15
Ireland	2002	3.0	..	..	..	..	..	..	..	8[b]	..	..	..
Israel	1995	3.5	..	..	..	..	..	..	..	..	..	..	..
Italy	2001	2.8	..	..	..	..	..	..	..	..	..	21	..
Jamaica	2001	3.5	..	..	..	98[b]	..	58[b]	..	2[b]	..	..	..
Japan	2000	2.7	..	..	..	..	..	61	..	37	..	..	..
Jordan	1994	6.2	6.0	1	..	97	97	69	64	57	67	..	..
Kazakhstan		..	..	..	..	..	..	..	..	..	..	..	..
Kenya	1999	4.6	3.4	..	..	35	72	72	25	..	..	39	17
Korea, Dem Rep	2000	3.8	..	23	..	..	..	50	..	15	..	..	..
Korea, Rep.	1993	4.4	..	..	..	..	..	..	..	..	..	..	..
Kuwait	1995	6.4	..	..	..	..	..	..	..	9[b]	..	11	..
Kyrgyz Republic	1999	4.4	3.6	..	..	..	..	..	..	..	..	..	..
Laos	1995	6.1	6.1	..	..	49	77	96	86	..	..	..	..
Latvia	2000	3.0	2.6	4	..	88	..	58	..	74	..	0	..
Lebanon		..	..	..	..	..	..	..	..	..	..	..	..
Lesotho	2001	5.0	..	10[b]	..	..	..	84	..	0	..	..	..
Liberia	1974	4.8	..	31	..	20	..	1	..	..	..	..	..
Libya		6.4	..	..	..	..	..	..	..	..	..	7	..
Lithuania	2001	2.6	..	7	..	..	..	..	..	..	..	..	..
Macedonia, FYR	2002	3.6	3.6[b]	8[b]	..	95[b]	95[b]	48[b]	..	..	..	7[b]	3[b]
Madagascar	1993	4.9	4.8	64	57	..	..	81	59	..	..	..	..
Malawi	1998	4.4	4.4	30	..	48	84	86	47	..	..	..	..
Malaysia	2000	4.5	4.4	..	..	..	..	..	..	10[b]	16[b]	..	..
Mali	1998	5.6	..	..	..	..	..	..	..	..	..	..	..
Mauritania	1988	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	2000	3.9	3.8	6	7	91	94	87	81	..	..	7	6
Mexico	2000	4.4	..	27[b]	..	87	..	78	..	6	..	..	..
Moldova	2003	..	..	..	..	..	..	..	..	..	..	..	..
Mongolia	2000	4.4	4.5	..	..	..	..	..	..	48	56	..	..
Morocco	1982	5.9	5.3	..	..	..	..	..	..	..	..	..	..
Mozambique	1997	4.4	4.9	37	28	7	20	92	83	1	1	0	..
Myanmar		..	..	..	..	..	..	..	..	..	..	..	..
Namibia	2001	5.3	..	..	..	..	..	..	..	..	..	..	..
Nepal	2001	5.4	4.9	..	..	..	..	88	..	..	..	0	..
Netherlands		..	..	..	..	..	..	..	..	..	..	..	..
New Zealand	2001	2.8	..	1[b]	..	..	..	65	..	17	..	10	..
Nicaragua	1995	5.3	..	..	..	79	87	84	86	0	0	8	..
Niger	2001	6.4	6.0	..	..	..	..	77	40	..	..	..	..
Nigeria	1991	5.0	4.7	..	..	..	..	..	..	..	..	..	..
Norway	1980	2.7	..	1	..	..	..	67	..	38	..	..	..
Oman	2003	7.1	..	..	..	..	..	..	..	..	..	..	..
Pakistan	1998	6.8	6.8	..	..	58	86	81	..	..	..	..	..
Panama	2000	4.1	..	28[b]	..	88	98[b]	80	66[b]	10[b]	10[b]	14	..
Papua New Guinea	1990	4.5[b]	6.5	..	..	..	..	..	44	..	8	..	..
Paraguay	2002	4.6	4.5	38[b]	..[b]	95[b]	98[b]	79	75	1[b]	2[b]	6[b]	6[b]
Peru	1993	..	..	..	..	49	64	..	..	..	..	7	3
Philippines	1990	5.3	5.3	..	..	62	..	83	76	6	11	4	4
Poland	1988	3.2	..	..	..	..	..	..	..	..	..	1	..
Portugal	2001	2.8	..	..	..	..	..	76	..	86	..	..	..
Puerto Rico	1990	3.3	..	..	..	..	..	72	..	..	..	11	..

3.12 Urban housing conditions

	Census year	Household size		Overcrowding		Durable dwelling units		Home ownership		Multiunit dwellings		Vacancy rate	
		number of people		Households living in overcrowded dwellings[a] % of total		Buildings with durable structure % of total		Privately owned dwellings % of total		% of total		Unoccupied dwellings % of total	
		National	Urban	National	Urban	National	Urban	National	Urban	National	Urban	National	Urban
Romania	1992	3.1	3.1	..	..	58	..	87	77	39	71	6	4
Russia	2002	2.8	2.7	7	5	..	..	..	..	73	86	..	..
Rwanda	1991	4.7	..	..	..	79	78	92	73	19	25	..	..
Saudi Arabia	2004	5.5	..	..	..	92[b]	..	43	..	..	..	..	..
Senegal		..	..	..	..	..	..	..	..	..	..	..	..
Serbia	2001	2.9	2.2	..	..	..	..	..	..	..	..	..	..
Sierra Leone	1985	6.8	..	..	..	34	..	68	..	..	..	..	..
Singapore	2000	4.4	..	..	..	..	..	..	..	..	..	..	..
Slovak Republic		..	..	..	..	..	..	..	..	..	..	..	..
Slovenia	1991	3.1	..	..	..	..	..	69	..	37	..	9	..
Somalia	1975	..	..	..	..	..	..	..	..	..	..	..	..
South Africa	2001	4.0	..	..	..	..	..	..	..	7	..	..	..
Spain	1991	3.3	..	0	..	..	..	78	..	..	..	..	..
Sri Lanka	2001	3.8	..	..	..	93[b]	92[b]	70[b]	58[b]	1	14[b]	13	1[b]
Sudan	1993	5.8	6.0	..	..	..	..	86[b]	58[b]	0[b]	1[b]	..	..
Swaziland	1997	5.4	3.7	..	..	..	..	..	..	..	..	..	..
Sweden	1990	2.0	..	..	..	..	..	..	..	54	..	1	..
Switzerland	1990	2.4	2.1	..	..	..	..	31	24	28	32	11	7
Syrian Arab Republic	1981	6.3	6.0	..	..	..	..	..	..	..	..	..	..
Tajikistan	2000	..	..	..	..	..	..	..	..	..	..	..	..
Tanzania	2002	4.9	4.5[b]	33[b]	7[b]	..	..	82[b]	43[b]	..	..	..	..
Thailand	2000	3.8	..	..	..	93	93	81	62	3	..	3	..
Timor-Leste		..	..	..	..	..	..	..	..	..	..	..	..
Togo		..	..	..	..	..	..	..	..	..	..	..	..
Trinidad and Tobago	2000	3.7	..	9[b]	..	98[b]	..	74[b]	..	17[b]	..	..	..
Tunisia	1994	8.0	..	..	..	99	..	71	89[b]	6	10[b]	15	12[b]
Turkey	1990	5.0	..	..	..	..	..	70	..	..	..	..	..
Turkmenistan		..	..	..	..	..	..	..	..	..	..	..	..
Uganda	1991	4.9	4.0[b]	..	..	21[b]	..	80[b]	24[b]	0[b]	2[b]	..	..
Ukraine	2003	..	..	..	..	..	..	..	..	..	..	..	..
United Arab Emirates		..	..	..	..	..	..	..	..	..	..	..	..
United Kingdom	2001	..	2.4	..	..	..	..	..	69	..	19	..	..
United States	2000	2.7	..	..	..	..	..	66	..	..	..	9	7
Uruguay	1996	3.3	3.4[b]	22[b]	..	..	..	57[b]	57[b]	..	..	13[b]	13[b]
Uzbekistan		..	..	..	..	..	..	..	..	..	..	..	..
Venezuela. RB	2001	4.4	..	..	..	..	..	78	..	14	..	16	..
Vietnam	1999	4.6	4.5	..	..	77	89	95	86	..	..	..	..
West Bank and Gaza	1997	7.1	..	..	..	..	..	78	..	45	..	..	..
Yemen	1994	6.7	6.8	54[b]	6[b]	..	..	88[b]	68[b]	3[b]	11[b]	..	..
Zambia	2000	5.3	5.9	..	..	..	..	94	30	..	..	..	..
Zimbabwe	1992	4.8	4.2	..	..	..	..	94	30	6	..	..	..

a. More than two people per room. b. Data are from a previous census.

Urban housing conditions

About the data

Urbanization can yield important social benefits, improving access to public services and the job market. It also leads to significant demands for services. Inadequate living quarters and demand for housing and shelter are major concerns for policymakers.

The unmet demand for affordable housing, along with urban poverty, has led to the emergence of slums in many poor countries. Improving the shelter situation requires a better understanding of the mechanisms governing housing markets and the processes governing housing availability. That requires good data and adequate policy-oriented analysis so that housing policy can be formulated in a global comparative perspective and drawn from lessons learned in other countries. Housing policies and outcomes affect such broad socioeconomic conditions as the infant mortality rate, performance in school, household saving, productivity levels, capital formation, and government budget deficits. A good understanding of housing conditions thus requires an extensive set of indicators within a reasonable framework.

There is a strong demand for quantitative indicators that can measure housing conditions on a regular basis to monitor progress. However, data deficiencies and lack of rigorous quantitative analysis hamper informed decisionmaking on desirable policies to improve housing conditions. The data in the table are from housing and population censuses, collected using similar definitions. The table will incorporate household survey data in future editions. The table focuses attention on urban areas, where housing conditions are typically most severe. Not all the compiled indicators are presented in the table because of space limitations.

Selected housing indicators for smaller economies **3.12a**

	Census year	Household size	Overcrowding	Durable dwelling units	Home ownership	Multiunit dwellings	Vacancy rate
		number of people	Households living in overcrowded dwellings[a] % of total	Buildings with durable structure % of total	Privately owned dwellings % of total	% of total	Unoccupied dwellings % of total
Antigua and Barbuda	2001	3.0	..	99[b]	65[b]	3[b]	22
Bahamas	1990	3.8	12	99	55	13	14
Bahrain	2001	5.9	..	94[b]	51	28	6
Barbados	1990	3.5	3	100	76	9	9
Belize	2000	4.6	..	93	63	4	..
Cape Verde	1990	5.1	28	78	72	2	..
Cayman Islands	1999	3.1	..	100	53	38	19
Equatorial Guinea	1993	7.5	14	56[b]	75	14	..
Fiji	1996	5.4	..	60	65	7	..
Guam	2000	4.0	2[b]	93	48	29	19
Isle of Man	2001	2.4	0	..	68	16	..
Maldives	2000	6.6	..	93	..	1	15
Marshall Islands	1999	7.8	..	95	72	12	8
Netherlands Antilles	2001	2.9	24[b]	99	60	16	12
New Caledonia	1989	4.1	..	77	53	9	13
Northern Mariana Islands	1995	4.9	9[b]	99	33	27	17
Palau	2000	5.7	8	76	79	11	3
Seychelles	1997	4.2	15[b]	97	78	..	0
Solomon Islands	1999	6.3	51	23	85	1	..
St. Vincent & Grenadines	1991	3.9	..	98	71	7	..
Turks and Caicos	1990	3.3	4	96	66	11	..
Virgin Islands (UK)	1991	3.0	2	99	40	46	..
Western Samoa	1991	7.3	..	42	90	47	30

a. More than two people per room. b. Data are from a previous census.
Source: National population and housing censuses.

Definitions

• **Census year** is the year in which the underlying data were collected. • **Household size** is the average number of people within a household, calculated by dividing total population by the number of households in the country and in urban areas. • **Overcrowding** refers to the number of households living in dwellings with two or more people per room as a percentage of total households in the country and in urban areas. • **Durable dwelling units** are the number of housing units in structures made of durable building materials (concrete, stone, cement, brick, asbestos, zinc, and stucco) expected to maintain their stability for 20 years or longer under local conditions with normal maintenance and repair, taking into account location and environmental hazards such as floods, mudslides, and earthquakes, as a percentage of total dwellings. • **Home ownership** refers to the number of privately owned dwellings as a percentage of total dwellings. When the number of private dwellings is not available from the census data, the share of households that own their housing unit is used. Privately owned and owner-occupied units are included, depending on the definition used in the census data. State- and community-owned units and rented, squatted, and rent-free units are excluded. • **Multiunit dwellings** are the number of multiunit dwellings, such as apartments, flats, condominiums, barracks, boardinghouses, orphanages, retirement houses, hostels, hotels, and collective dwellings, as a percentage of total dwellings. • **Vacancy rate** is the percentage of completed dwelling units that are currently unoccupied. It includes all vacant units, whether on the market or not (such as second homes).

Data sources

Data on urban housing conditions are from national population and housing censuses.

3.13 Traffic and congestion

	Motor vehicles				Passenger cars		Road density	Fuel prices		Particulate matter concentration	
	per 1,000 people		per kilometer of road		per 1,000 people		km. of road per 100 sq. km. of land area	$ per liter		Urban-population-weighted PM10 micrograms per cubic meter	
	1990	2005	1990	2005	1990	2005	2005	Gasoline 2006	Diesel 2006	1990	2005
Afghanistan	..	..	*3*	*9*	..	..	*5*	0.68	0.65	79	44
Albania	11	*85*	*3*	*15*	2	*61*	*66*	1.44	1.29	92	50
Algeria	*55*	91	*15*	27	*26*	58	*5*	0.32	0.19	115	71
Angola	19	..	*3*	..	..	*8*	*4*	0.50	0.36	142	80
Argentina	181	..	27	..	134	*146*	*8*	0.62	0.48	105	76
Armenia	5	..	2	..	1	..	27	0.96	0.77	456	68
Australia	530	671	11	17	450	542	*11*	0.93	0.94	22	15
Austria	421	*599*	30	*36*	387	*503*	*162*	1.32	1.26	38	34
Azerbaijan	52	61	7	10	36	57	*72*	0.46	0.41	169	59
Bangladesh	1	*1*	0	*1*	0	*0*	*184*	0.79	0.45	231	140
Belarus	61	..	13	*21*	59	181	46	0.79	0.55	23	7
Belgium	423	*529*	30	*37*	385	*468*	*498*	1.63	1.34	31	23
Benin	3	..	2	..	2	*13*	*17*	0.81	0.81	75	41
Bolivia	41	*49*	6	*7*	..	*15*	*6*	0.54	0.47	120	97
Bosnia and Herzegovina	114	..	24	..	101	..	43	1.34	1.24	36	19
Botswana	18	113	3	8	10	47	*4*	0.78	0.74	95	68
Brazil	88	*170*	8	*18*	*84*	*136*	*21*	1.26	0.84	40	26
Bulgaria	163	*360*	39	*63*	146	*314*	*40*	1.05	1.08	111	60
Burkina Faso	4	*7*	3	*7*	2	*5*	*34*	1.15	1.12	149	94
Burundi	..	..	*3*	..	..	*1*	*48*	1.20	1.22	56	30
Cambodia	..	*36*	0	*37*	..	*25*	*22*	1.01	0.78	116	62
Cameroon	10	*11*	3	*3*	6	*11*	*11*	1.14	1.07	116	65
Canada	..	*582*	20	*13*	468	*561*	*15*	0.84	0.78	25	19
Central African Republic	1	..	0	..	1	*1*	*4*	1.37	1.27	61	49
Chad	2	..	0	..	1	..	*3*	1.31	1.20	215	123
Chile	81	*135*	13	*26*	52	*88*	*11*	1.09	0.86	88	53
China	5	24	4	16	1	15	21	0.69	0.61	114	75
Hong Kong, China	66	*72*	253	*254*	42	*53*	188	1.69	1.06	..	..
Colombia	*39*	59	*13*	16	*21*	35	15	0.98	0.57	39	23
Congo, Dem. Rep.	..	..	9	..	*17*	..	*7*	0.94	1.00	73	50
Congo, Rep.	18	..	3	..	..	*8*	*5*	0.96	0.67	132	91
Costa Rica	87	*198*	7	*24*	55	*146*	*69*	0.98	0.67	45	37
Côte d'Ivoire	24	..	6	..	..	*7*	*25*	1.20	1.06	94	48
Croatia	..	349	*34*	55	*185*	312	51	1.34	1.22	50	31
Cuba	*37*	..	*16*	..	*18*	..	*55*	1.10	0.91	44	17
Czech Republic	246	*394*	46	*31*	228	*363*	*165*	1.30	1.29	68	22
Denmark	368	437	27	33	320	354	170	1.58	1.45	30	19
Dominican Republic	75	115	48	..	21	78	*26*	1.03	0.75	44	23
Ecuador	35	*55*	8	*17*	31	*32*	*16*	0.47	0.39	38	26
Egypt, Arab Rep.	29	..	33	..	21	*27*	9	0.30	0.12	222	128
El Salvador	33	..	14	..	17	*24*	*48*	0.82	0.80	46	35
Eritrea	1	..	1	..	1	..	*4*	1.90	0.81	121	61
Estonia	211	477	22	11	154	367	135	1.23	1.22	45	14
Ethiopia	1	*2*	2	*4*	1	*1*	4	0.93	0.62	112	74
Finland	441	531	29	35	386	460	26	1.55	1.26	24	18
France	494	596	32	38	405	494	173	1.48	1.33	18	14
Gabon	32	..	4	..	19	..	*4*	0.64	0.39	10	7
Gambia, The	..	*7*	..	*3*	..	*5*	*37*	1.08	1.01	142	95
Georgia	..	*71*	..	*16*	..	*56*	*29*	0.86	0.89	208	51
Germany	405	585	53	208	386	550	..	1.55	1.38	27	19
Ghana	*8*	*21*	*4*	9	*5*	*5*	25	0.86	0.84	39	34
Greece	248	497	22	47	171	388	91	1.16	1.19	64	36
Guatemala	*21*	*68*	*16*	*53*	*11*	*53*	*13*	0.78	0.64	63	62
Guinea	4	*14*	1	*4*	2	*8*	*18*	0.79	0.82	107	77
Guinea-Bissau	..	..	..	..	..	..	*12*	*0.00*	*0.00*	118	80
Haiti	*8*	..	*14*	..	*5*	..	*15*	*0.88*	*0.60*	70	39

3.13 Traffic and congestion

	Motor vehicles				Passenger cars		Road density	Fuel prices		Particulate matter concentration	
	per 1,000 people		per kilometer of road		per 1,000 people		km. of road per 100 sq. km. of land area	$ per liter		Urban-population-weighted PM10 micrograms per cubic meter	
								Gasoline	Diesel		
	1990	2005	1990	2005	1990	2005	2005	2006	2006	1990	2005
Honduras	22	*67*	10	*31*	*5*	*52*	*12*	0.89	0.73	45	46
Hungary	212	*316*	21	*20*	188	*274*	*178*	1.30	1.31	36	18
India	4	*12*	2	*3*	2	*8*	*114*	1.01	0.75	112	68
Indonesia	16	*109*	10	*62*	7	..	*21*	0.57	0.44	138	96
Iran, Islamic Rep.	34	..	14	..	..	*24*	*11*	0.09	0.03	86	55
Iraq	14	..	6	..	1	..	*10*	*0.03*	*0.01*	146	126
Ireland	270	*447*	10	*20*	227	*382*	*140*	1.34	1.35	26	17
Israel	210	293	*74*	115	174	239	81	1.47	1.27	71	31
Italy	529	667	99	81	476	595	*165*	1.56	1.49	42	28
Jamaica	*52*	..	*7*	..	*43*	*135*	199	0.82	0.75	58	38
Japan	469	*586*	52	*63*	283	*441*	*323*	1.09	0.90	43	31
Jordan	60	115	26	83	*44*	78	9	0.86	0.45	110	52
Kazakhstan	76	116	8	*17*	50	93	3	0.70	0.45	43	19
Kenya	12	*18*	5	*10*	..	*9*	*11*	1.12	0.98	66	38
Korea, Dem. Rep.	..	..	..	..	..	..	*26*	0.71	0.79	181	73
Korea, Rep.	79	319	60	151	48	230	104	1.65	1.33	51	37
Kuwait	..	*422*	..	*181*	..	*349*	*32*	0.22	0.21	82	101
Kyrgyz Republic	..	*39*	..	*10*	..	39	*10*	0.64	0.54	76	24
Lao PDR	9	*57*	3	*10*	6	..	*14*	0.86	0.73	73	47
Latvia	135	377	6	12	106	323	112	1.20	1.15	38	15
Lebanon	321	..	183	..	300	*403*	68	0.74	0.62	43	40
Lesotho	11	..	4	..	3	..	*20*	0.89	0.88	85	42
Liberia	14	..	4	..	..	*6*	*11*	0.79	0.85	60	45
Libya	*165*	257	*10*	..	96	232	*5*	0.13	0.13	106	94
Lithuania	160	467	12	20	133	426	127	1.08	1.09	53	19
Macedonia, FYR	132	*163*	30	*25*	121	*150*	*52*	1.23	1.09	46	20
Madagascar	6	..	2	..	4	..	*9*	1.15	1.00	77	35
Malawi	4	..	4	..	2	..	*16*	1.17	1.12	75	34
Malaysia	124	*272*	26	*72*	101	*225*	*30*	0.53	0.40	37	25
Mali	3	..	2	..	2	..	*2*	1.22	1.04	271	171
Mauritania	10	..	3	..	7	..	*1*	0.97	0.84	145	104
Mauritius	59	*130*	35	*79*	44	*96*	99	*0.74*	*0.56*	23	17
Mexico	119	208	41	90	82	137	18	0.74	0.52	69	40
Moldova	53	94	17	31	48	70	39	*0.45*	*0.31*	98	38
Mongolia	21	*43*	1	*2*	6	*28*	*3*	0.88	0.87	65	64
Morocco	37	*59*	15	*29*	28	*46*	13	1.22	0.87	32	22
Mozambique	4	..	2	..	3	..	*4*	1.15	1.06	110	28
Myanmar	*2*	5	*3*	..	*1*	4	*4*	0.66	0.75	116	63
Namibia	71	*85*	1	*4*	39	*42*	*5*	0.87	0.87	74	42
Nepal	..	..	..	..	..	*3*	*12*	0.94	0.73	67	36
Netherlands	405	*486*	58	*62*	368	*429*	*372*	1.70	1.32	46	35
New Zealand	524	720	19	32	436	607	35	0.98	0.70	16	15
Nicaragua	19	*46*	5	*13*	10	*18*	*15*	0.67	0.58	49	30
Niger	6	5	..	4	5	4	1	1.14	1.11	217	149
Nigeria	*30*	..	*21*	..	*12*	*17*	*21*	0.51	0.66	176	62
Norway	458	546	22	27	380	439	31	1.80	1.66	24	20
Oman	130	..	9	..	83	*156*	*11*	0.31	0.39	148	132
Pakistan	6	*14*	4	*8*	4	*10*	*34*	1.01	0.64	212	120
Panama	75	*103*	18	*27*	60	*73*	*16*	0.70	0.60	58	35
Papua New Guinea	*27*	..	*6*	..	..	*5*	*4*	*0.94*	*0.64*	34	24
Paraguay	*27*	*85*	*4*	*15*	*16*	*50*	*7*	0.97	0.77	106	84
Peru	..	*47*	*43*	*16*	..	*30*	*6*	1.22	0.86	98	61
Philippines	10	34	4	14	7	9	*67*	0.76	0.67	55	26
Poland	168	386	18	35	138	323	*138*	1.30	1.30	59	37
Portugal	222	*507*	34	67	162	*471*	*86*	1.56	1.10	52	28
Puerto Rico	*295*	..	*79*	..	*242*	..	*289*	0.65	0.78	27	21

3.13 Traffic and congestion

	Motor vehicles				Passenger cars		Road density	Fuel prices		Particulate matter concentration	
	per 1,000 people		per kilometer of road		per 1,000 people		km. of road per 100 sq. km. of land area	$ per liter		Urban-population-weighted PM10 micrograms per cubic meter	
	1990	2005	1990	2005	1990	2005	2005	Gasoline 2006	Diesel 2006	1990	2005
Romania	72	*185*	11	*20*	56	*149*	*86*	1.26	1.24	36	14
Russian Federation	*87*	*174*	*14*	*48*	*65*	*161*	*3*	0.77	0.66	41	19
Rwanda	2	*3*	1	..	1	*1*	*57*	1.11	1.08	49	28
Saudi Arabia	165	..	19	..	98	*415*	*8*	0.16	0.07	161	120
Senegal	11	*14*	6	*9*	8	*10*	*7*	1.31	1.09	95	95
Serbia[a]	137	*199*	31	*102*	133	*181*	*44*	1.48	1.31	30	14
Sierra Leone	..	*4*	..	*2*	..	*2*	*16*	0.98	0.98	91	57
Singapore	130	137	142	183	89	101	469	0.92	0.63	106	40
Slovak Republic	194	*256*	57	*32*	163	*222*	*89*	1.35	1.43	41	16
Slovenia	306	523	42	27	289	471	191	1.23	1.21	*40*	31
Somalia	2	..	1	..	1	..	*4*	0.74	0.67	78	32
South Africa	139	143	26	*16*	97	98	*30*	0.85	0.84	34	22
Spain	360	*550*	43	*35*	309	*445*	*133*	1.15	1.10	42	34
Sri Lanka	21	*42*	4	*9*	7	*13*	*151*	0.88	0.55	95	94
Sudan	9	..	22	..	8	..	*1*	0.72	0.49	326	173
Swaziland	66	*84*	18	*25*	35	*40*	*21*	0.80	0.85	60	31
Sweden	464	513	29	11	426	460	104	1.46	1.44	15	12
Switzerland	491	563	46	59	449	520	178	1.27	1.36	37	25
Syrian Arab Republic	26	*36*	10	*7*	10	*12*	*52*	0.60	0.13	159	79
Tajikistan	3	..	1	..	0	*19*	*20*	0.80	0.74	104	52
Tanzania	5	..	2	..	1	*1*	*9*	1.04	0.99	57	24
Thailand	46	..	36	..	14	*54*	*11*	0.70	0.65	88	77
Timor-Leste	..	..	..	..	..	..	..	..	..	..	..
Togo	24	..	11	..	..	*10*	*14*	1.03	1.01	56	36
Trinidad and Tobago	*117*	..	*19*	..	*98*	..	*162*	0.43	0.24	142	107
Tunisia	48	*95*	19	*49*	23	*83*	*12*	0.83	0.57	71	32
Turkey	50	117	8	20	34	80	55	1.88	1.62	75	43
Turkmenistan	..	..	..	..	..	..	*5*	0.02	0.01	177	56
Uganda	2	*5*	..	*4*	1	*2*	*36*	1.17	1.01	27	12
Ukraine	63	128	20	36	63	118	29	0.81	0.87	72	23
United Arab Emirates	121	..	52	..	97	*228*	*5*	0.37	0.53	264	135
United Kingdom	400	517	64	80	341	457	160	1.63	1.73	25	16
United States	756[b]	814[b]	30	31	536[b]	461[b,c]	71	0.63	0.69	30	22
Uruguay	138	176	45	..	122	151	*44*	1.23	0.94	237	161
Uzbekistan	..	..	..	..	..	..	*19*	0.85	0.54	84	61
Venezuela, RB	*93*	..	*25*	..	*73*	*94*	*11*	0.03	0.02	22	11
Vietnam	..	*8*	..	..	..	..	*72*	0.67	0.53	124	61
West Bank and Gaza	..	36	..	26	..	29	83	1.29	0.98	..	..
Yemen, Rep.	34	..	8	..	14	*19*	14	0.30	0.28	*141*	82
Zambia	14	..	3	..	8	..	*12*	1.31	1.22	95	44
Zimbabwe	*32*	..	*4*	..	*29*	*45*	*25*	*0.61*	*0.65*	35	27
World	**117 w**	***148* w**	**..**	**..**	**91 w**	***118* w**	***23* w**	**0.97 m**	**0.84 m**	**80 w**	**53 w**
Low income	5	9	..	..	3	*8*	*21*	0.98	0.84	130	74
Middle income	36	*66*	..	..	22	*50*	*13*	0.86	0.74	85	56
Lower middle income	14	31	..	..	8	21	*16*	0.85	0.70	107	69
Upper middle income	111	*174*	..	..	*87*	*140*	*12*	0.92	0.79	54	33
Low & middle income	24	*39*	..	..	15	*39*	*15*	0.89	0.79	98	61
East Asia & Pacific	9	24	..	..	4	14	*22*	*0.53*	*0.40*	112	73
Europe & Central Asia	*93*	*167*	..	..	*75*	*152*	*9*	1.14	1.09	62	29
Latin America & Carib.	100	*155*	..	..	*71*	*115*	*18*	0.82	0.67	59	37
Middle East & N. Africa	37	..	..	..	25	*34*	*7*	0.46	0.34	124	77
South Asia	4	*12*	..	..	2	*8*	*110*	0.91	0.65	132	81
Sub-Saharan Africa	21	..	..	..	14	..	*7*	1.03	0.98	115	60
High income	496	600	..	..	388	467	*55*	1.33	1.24	37	27
Euro area	428	604	..	..	379	418[d]	*139*	1.52	1.29	33	24

a. Includes Montenegro. b. Data are from the U.S. Federal Highway Administration. c. Excludes personal passenger vans, passenger minivans, and utility-type vehicles, which are all treated as trucks. d. Data are from the European Commission and the European Road Federation.

Traffic and congestion

About the data

Traffic congestion in urban areas constrains economic productivity, damages people's health, and degrades the quality of life. The particulate air pollution emitted by motor vehicles—the dust and soot in exhaust—is far more damaging to human health than once believed. (For information on particulate matter and other air pollutants, see table 3.14.)

In recent years ownership of passenger cars has increased, and the expansion of economic activity has led to the transport by road of more goods and services over greater distances (see table 5.9). These developments have increased demand for roads and vehicles, adding to urban congestion, air pollution, health hazards, and traffic accidents and injuries. Congestion, the most visible cost of expanding vehicle ownership, is reflected in the indicators in the table. Other relevant indicators—such as average vehicle speed in major cities and the cost of traffic congestion, which takes a heavy toll on economic productivity—are not included because data are incomplete or difficult to compare.

The data in the table—except those on fuel prices and particulate matter—are compiled by the International Road Federation (IRF) through questionnaires sent to national organizations. The IRF uses a hierarchy of sources to gather as much information as possible. Primary sources are national road associations. Where an association lacks data or does not respond, other agencies are contacted, including road directorates, ministries of transport or public works, and central statistical offices. As a result, data are of uneven quality. The coverage of each indicator may differ across countries because of different definitions. Comparability is also limited when time series data are reported. The IRF is taking steps to improve the quality of the data in its 2006 *World Road Statistics*. Because this effort covers data for 1999–2005 only, data in the table for 1990 and 2005 may not be comparable. Another reason is coverage. For example, for the United States the 2005 estimate for passenger cars from the U.S. Federal Highway Administration excludes personal passenger vans, passenger minivans, and utility-type vehicles, which are all treated as trucks. Moreover, the data do not cover vehicle quality or age. Road density is a rough indicator of accessibility and does not capture the width, type, or condition of roads. Thus comparisons over time and across countries should be made with caution.

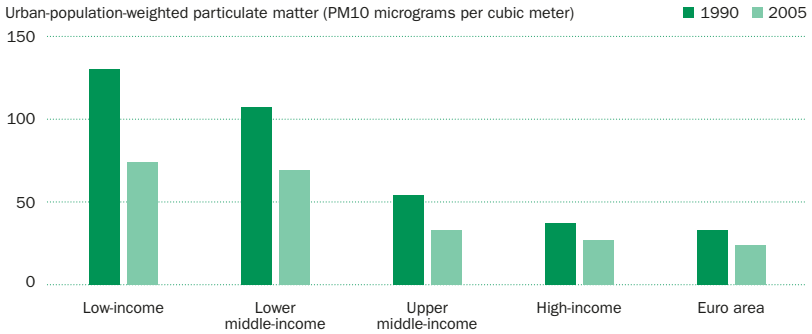
Data on fuel prices are compiled by the German Agency for Technical Cooperation (GTZ), from its global network of regional offices and representatives, and other sources, including the Allgemeiner Deutscher Automobile Club (for Europe) and a project of the Latin American Energy Organization for Latin America. Local prices are converted to U.S. dollars using the exchange rate in the *Financial Times* international monetary table on the survey date. When multiple exchange rates exist, the market, parallel, or black market rate is used.

Considerable uncertainty surrounds estimates of particulate matter concentrations, and caution should be used in interpreting them. They allow for cross-country comparisons of the relative risk of particulate matter pollution facing urban residents. Major sources of urban outdoor particulate matter pollution are traffic and industrial emissions, but nonanthropogenic sources such as dust storms may also be a substantial contributor for some cities. Country technology and pollution controls are important determinants of particulate matter. Data on particulate matter for selected cities are in table 3.14. Estimates of economic damages from death and illness due to particulate matter pollution are in table 3.16.

Definitions

• **Motor vehicles** include cars, buses, and freight vehicles but not two-wheelers. Population figures refer to the midyear population in the year for which data are available. Roads refer to motorways, highways, main or national roads, and secondary or regional roads. A motorway is a road designed and built for motor traffic that separates the traffic flowing in opposite directions. • **Passenger cars** are road motor vehicles, other than two-wheelers, intended for the carriage of passengers and designed to seat no more than nine people (including the driver). • **Road density** is the ratio of the length of the country's total road network to the country's land area. The road network includes all roads in the country—motorways, highways, main or national roads, secondary or regional roads, and other urban and rural roads. • **Fuel prices** are the pump prices of the most widely sold grade of gasoline and of diesel fuel. Prices are converted from the local currency to U.S. dollars (see *About the data*). • **Particulate matter concentration** is fine suspended particulates of less than 10 microns in diameter (PM10) that are capable of penetrating deep into the respiratory tract and causing significant health damage. Data are urban-population-weighted PM10 levels in residential areas of cities with more than 100,000 residents. The estimates represent the average annual exposure level of the average urban resident to outdoor particulate matter.

Particulate matter concentration has fallen in all income groups, and the higher the income, the lower the concentration 3.13a



Source: Table 3.13.

Data sources

Data on vehicles and road density are from the IRF's electronic files and its annual *World Road Statistics,* except where footnoted. Data on fuel prices are from the GTZ's electronic files. Data on particulate matter concentrations are from Kiran Dev Pandey, David Wheeler, Bart Ostro, Uwe Deichmann, Kirk Hamilton, and Katie Bolt's "Ambient Particulate Matter Concentrations in Residential and Pollution Hotspot Areas of World Cities: New Estimates Based on the Global Model of Ambient Particulates (GMAPS)" (2006).

3.14 Air pollution

	City	City population	Particulate matter concentration	Sulfur dioxide	Nitrogen dioxide
		thousands	Urban-population-weighted PM10 micrograms per cubic meter	micrograms per cubic meter	micrograms per cubic meter
		2005	2004	2001[a]	2001[a]
Argentina	Córdoba	1,423	58	..	97
Australia	Melbourne	3,626	12	..	30
	Perth	1,474	12	5	19
	Sydney	4,331	20	28	81
Austria	Vienna	2,260	41	14	42
Belgium	Brussels	1,012	28	20	48
Brazil	Rio de Janeiro	11,469	35	129	..
	São Paulo	18,333	40	43	83
Bulgaria	Sofia	1,093	61	39	122
Canada	Montréal	3,640	19	10	42
	Toronto	5,312	22	17	43
	Vancouver	2,188	13	14	37
Chile	Santiago	5,683	61	29	81
China	Anshan	1,611	82	115	88
	Beijing	10,717	89	90	122
	Changchun	3,046	74	21	64
	Chengdu	4,065	86	77	74
	Chongqing	6,363	123	340	70
	Dalian	3,073	50	61	100
	Guangzhou	8,425	63	57	136
	Guiyang	3,447	70	424	53
	Harbin	3,695	77	23	30
	Jinan	2,743	94	132	45
	Kunming	2,837	70	19	33
	Lanzhou	2,411	91	102	104
	Liupanshui	1,149	59	102	..
	Nanchang	2,188	78	69	29
	Pingxiang	905	67	75	..
	Quingdao	2,817	68	190	64
	Shanghai	14,503	73	53	73
	Shenyang	4,720	101	99	73
	Taiyuan	2,794	88	211	55
	Tianjin	7,040	125	82	50
	Wulumqi	2,025	57	60	70
	Wuhan	7,093	79	40	43
	Zhengzhou	2,590	97	63	95
	Zibo	2,982	74	198	43
Colombia	Bogotá	7,747	31	..	..
Croatia	Zagreb	908[b]	33	31	..
Cuba	Havana	2,189	21	1	5
Czech Republic	Prague	1,171	23	14	33
Denmark	Copenhagen	1,088	21	7	54
Ecuador	Guayaquil	2,387	23	15	..
	Quito	1,514	30	22	..
Egypt, Arab Rep.	Cairo	11,128	169	69	..
Finland	Helsinki	1,091	21	4	35
France	Paris	9,820	11	14	57
Germany	Berlin	3,389	22	18	26
	Frankfurt	668[b]	19	11	45
	Munich	1,263	20	8	53
Ghana	Accra	1,981	33	..	..
Greece	Athens	3,230	43	34	64
Hungary	Budapest	1,693	19	39	51
Iceland	Reykjavik	164[b]	18	5	42
India	Ahmadabad	5,120	83	30	21
	Bengaluru	6,462	45	..	..

About the data

Indoor and outdoor air pollution place a major burden on world health. More than half the world's people rely on dung, wood, crop waste, or coal to meet basic energy needs. Cooking and heating with these fuels on open fires or stoves without chimneys lead to indoor air pollution, which is responsible for 1.6 million deaths a year—one every 20 seconds. In many urban areas air pollution exposure is the main environmental threat to health. Long-term exposure to high levels of soot and small particles contributes to a range of health effects, including respiratory diseases, lung cancer, and heart disease. Particulate pollution, alone or with sulfur dioxide, creates an enormous burden of ill health.

Sulfur dioxide and nitrogen dioxide emissions lead to deposition of acid rain and other acidic compounds over long distances, which can lead to the leaching of trace minerals and nutrients critical to trees and plants. Sulfur dioxide emissions can damage human health, particularly that of the young and old. Nitrogen dioxide is emitted by bacteria, motor vehicles, industrial activities, nitrogen fertilizers, fuel and biomass combustion, and aerobic decomposition of organic matter in soils and oceans.

Where coal is the primary fuel for power plants without effective dust controls, steel mills, industrial boilers, and domestic heating, high levels of urban air pollution are common—especially particulates and sulfur dioxide. Elsewhere the worst emissions are from petroleum product combustion.

Sulfur dioxide and nitrogen dioxide concentration data are based on average observed concentrations at urban monitoring sites, which not all cities have.

The data on particulate matter are estimated average annual concentrations in residential areas away from air pollution "hotspots," such as industrial districts and transport corridors. The data are from the World Bank's Development Research Group and Environment Department estimates of annual ambient concentrations of particulate matter in cities with populations exceeding 100,000 (Pandey and others 2006b). A country's technology and pollution controls are important determinants of particulate matter concentrations.

Pollutant concentrations are sensitive to local conditions, and even monitoring sites in the same city may register different levels. Thus these data should be considered only a general indication of air quality, and comparisons should be made with caution. Current World Health Organization (WHO) air quality guidelines are annual mean concentrations of 20 micrograms per cubic meter for particulate matter less than 10 microns in diameter and 40 micrograms for nitrogen dioxide and daily mean concentrations of 20 micrograms per cubic meter for sulfur dioxide.

Air pollution 3.14

	City	City population	Particulate matter concentration	Sulfur dioxide	Nitrogen dioxide
		thousands	Urban-population-weighted PM10 micrograms per cubic meter	micrograms per cubic meter	micrograms per cubic meter
		2005	2004	2001[a]	2001[a]
India	Chennai	6,916	37	15	17
	Delhi	15,048	150	24	41
	Hyderabad	6,115	41	12	17
	Kanpur	3,018	109	15	14
	Kolkata	14,277	128	49	34
	Lucknow	2,566	109	26	25
	Mumbai	18,196	63	33	39
	Nagpur	2,350	56	6	13
	Pune	4,409	47	..	..
Indonesia	Jakarta	13,215	104	..	..
Iran, Islamic Rep.	Tehran	7,314	58	209	..
Ireland	Dublin	1,037	19	20	..
Italy	Milan	2,953	30	31	248
	Rome	3,348	29	..	..
	Turin	1,660	44	..	..
Japan	Osaka-Kobe	11,268	35	19	63
	Tokyo	35,197	40	18	68
	Yokohama	3,366[b]	31	100	13
Kenya	Nairobi	2,773	43	..	..
Korea, Rep.	Pusan	3,554	*44*	60	51
	Seoul	9,645	41	44	60
	Taegu	2,511	*50*	81	62
Malaysia	Kuala Lumpur	1,405	29	24	..
Mexico	Mexico City	19,411	51	74	130
Netherlands	Amsterdam	1,147	34	10	58
New Zealand	Auckland	1,148	14	3	20
Norway	Oslo	802	14	8	43
Philippines	Manila	10,686	39	33	..
Poland	Katowice	2,914[b]	39	83	79
	Lódz	776	39	21	43
	Warsaw	1,680	43	16	32
Portugal	Lisbon	2,761	23	8	52
Romania	Bucharest	1,934	18	10	71
Russian Federation	Moscow	10,654	21	109	..
	Omsk	1,132	22	20	34
Singapore	Singapore	4,326	44	20	30
Slovak Republic	Bratislava	456[b]	15	21	27
South Africa	Cape Town	3,083	16	21	72
	Durban	2,631	32	31	..
	Johannesburg	3,254	33	19	31
Spain	Barcelona	4,795	35	11	43
	Madrid	5,608	30	24	66
Sweden	Stockholm	1,708	11	3	20
Switzerland	Zurich	1,144	23	11	39
Thailand	Bangkok	6,593	79	11	23
Turkey	Ankara	3,573	46	55	46
	Istanbul	9,712	55	120	..
Ukraine	Kiev	2,672	35	14	51
United Kingdom	Birmingham	2,280	25	9	45
	London	8,505	21	25	77
	Manchester	2,228	15	26	49
United States	Chicago	8,814	25	14	57
	Los Angeles	12,298	34	9	74
	New York-Newark	18,718	21	26	79
Venezuela, RB	Caracas	2,913	10	33	57

a. Data are for the most recent year available. b. Data are for 2000.

Definitions

• **City population** is the number of residents of the city or metropolitan area as defined by national authorities and reported to the United Nations. • **Particulate matter concentration** is fine suspended particulates of less than 10 microns in diameter (PM10) that are capable of penetrating deep into the respiratory tract and causing significant health damage. Data are urban-population-weighted PM10 levels in residential areas of cities with more than 100,000 residents. The estimates represent the average annual exposure level of the average urban resident to outdoor particulate matter. • **Sulfur dioxide** is an air pollutant produced when fossil fuels containing sulfur are burned. • **Nitrogen dioxide** is a poisonous, pungent gas formed when nitric oxide combines with hydrocarbons and sunlight, producing a photochemical reaction. These conditions occur in both natural and anthropogenic activities.

Data sources

Data on city population are from the United Nations Population Division. Data on particulate matter concentrations are from Kiran D. Pandey, David Wheeler, Bart Ostro, Uwe Deichman, Kirk Hamilton, and Kathrine Bolt's "Ambient Particulate Matter Concentration in Residential and Pollution Hotspot Areas of World Cities: New Estimates Based on the Global Model of Ambient Particulates (GMAPS)" (2006). Data on sulfur dioxide and nitrogen dioxide concentrations are from the WHO's Healthy Cities Air Management Information System and the World Resources Institute.

3.15 Government commitment

	Environmental strategies or action plans	Biodiversity assessments, strategies, or action plans	Participation in treaties[a]								
			Climate change[b]	Ozone layer	CFC control	Law of the Sea[c]	Biological diversity[b]	Kyoto Protocol	CITES	CCD	Stockholm Convention
			1992	1985	1987	1982	1992	1997	1973	1994	2004
Afghanistan			2002	2004[f]	2004[f]		2002		1985[f]	1995[f]	
Albania	1993		1995	1999[f]	1999[f]	2003[f]	1994[f]	2005[f]	2003[f]	2000[f]	2004
Algeria	2001		1994	1992[f]	1992[f]	1996	1995	2005[f]	1983[f]	1996	2006
Angola			2000	2000[f]	2000[f]	1994	1998	2007		1997	2006
Argentina	1992		1994	1990	1990	1995	1994	2001	1981	1997	2005
Armenia			1994	1999[f]	1999[f]	2002[f]	1993[d]	2003[f]		1997	2003
Australia	1992	1994	1994	1987[f]	1989	1994	1993	2007[d]	1976	2000	2004
Austria			1994	1987	1989	1995	1994	2002	1982[f]	1997[f]	2002
Azerbaijan	1998		1995	1996[f]	1996[f]		2000[e]	2000[f]	1998[f]	1998[f]	2004[f]
Bangladesh	1991	1990	1994	1990[f]	1990[f]	2001	1994	2001[f]	1981	1996	2007
Belarus			2000	1986[d]	1988[d]	2006[f]	1993	2005[d]	1995[f]	2001[f]	2004[f]
Belgium			1996	1988	1988	1998	1996	2002	1983	1997[f]	2006
Benin	1993		1994	1993[f]	1993[f]	1997	1994	2002[f]	1984[f]	1996	2004
Bolivia	1994	1988	1995	1994[f]	1994[f]	1995	1994	1999	1979	1996	2003
Bosnia and Herzegovina			2000	1992[g]	1992[g]	1994[g]	2002[f]	2007	2002	2002[f]	
Botswana	1990	1991	1994	1991[f]	1991[f]	1994	1995	2003[f]	1977[f]	1996	2002[f]
Brazil		1988	1994	1990[f]	1990[f]	1994	1994	2002	1975	1997	2004
Bulgaria		1994	1995	1990[f]	1990[f]	1996	1996	2002	1991[f]	2001[f]	2004
Burkina Faso	1993		1994	1989	1989	2005	1993	2005[f]	1989[f]	1996	2004
Burundi	1994	1989	1997	1997[f]	1997[f]		1997	2001[f]	1988[f]	1997	2005
Cambodia	1999		1996	2001[f]	2001[f]		1995[f]	2002[f]	1997	1997	2006
Cameroon		1989	1995	1989[f]	1989[f]	1994	1994	2002[f]	1981[f]	1997	
Canada	1990	1994	1994	1986	1988	2003	1992	2002	1975	1995	2001
Central African Republic			1995	1993[f]	1993[f]		1995		1980[f]	1996	
Chad	1990		1994	1989[f]	1994		1994		1989[f]	1996	2004
Chile		1993	1995	1990	1990	1997	1994	2002	1975	1997	2005
China	1994	1994	1994	1989[f]	1991[f]	1996	1993	2002[e]	1981[f]	1997	2004
Hong Kong, China											
Colombia	1998	1988	1995	1990[f]	1993[f]		1994	2001[f]	1981	1999	
Congo, Dem. Rep.		1990	1995	1994[f]	1994[f]	1995	1996	2005[f]	1976[f]	1997	2005[f]
Congo, Rep.		1990	1997	1994[f]	1994[f]		1994	2007	1983[f]	1999	2007
Costa Rica	1990	1992	1994	1991[f]	1991[f]	1994	1994	2002	1975	1998	2007
Côte d'Ivoire	1994	1991	1995	1993[f]	1993[f]	1994	1994	2007	1994[f]	1997	2004
Croatia	2001	2000	1996	1991[d]	1991[d]	1994[g]	1996	2007[d]	2000[f]	2000[d]	2007
Cuba			1994	1992[f]	1992[f]	1994	1994	2002	1990[f]	1997	
Czech Republic	1994		1994	1993[d]	1993[d]	1996	1993[e]	2001[e]	993[g]	2000[f]	2002
Denmark	1994		1994	1988	1988	2004	1993	2002	1977	1995[f]	2003
Dominican Republic		1995	1999	1993[f]	1993[f]		1996	2002[f]	1986[f]	1997[f]	2007
Ecuador	1993	1995	1994	1990[f]	1990[f]		1993	2000	1975	1995	2004
Egypt, Arab Rep.	1992	1988	1995	1988	1988	1994	1994	2005[f]	1978	1995	2003
El Salvador	1994	1988	1996	1992	1992		1994	1998	1987[f]	1997[f]	
Eritrea	1995		1995	2005[f]	2005[f]		1996[f]	2005[f]	1994[f]	1996	2005[f]
Estonia	1998		1994	1996[f]	1996[f]	2005[f]	1994	2002	1992[f]		
Ethiopia	1994	1991	1994	1994[f]	1994[f]		1994	2005[f]	1989[f]	1997	2003
Finland	1995		1994	1986	1988	1996	1994[d]	2002	1976[f]	1995[d]	2002[d]
France	1990		1994	1987[e]	1988[e]	1996	1994	2002[e]	978	1997	2004[e]
Gabon		1990	1998	1994[f]	1994[f]	1998	1997	2006[d]	1989[f]	1996[f]	2007
Gambia, The	1992	1989	1994	1990[f]	1990[f]	1994	1994	2001[f]	1977[f]	1996	2006
Georgia	1998		1994	1996[f]	1996[f]	1996[f]	1994[f]	1999[f]	1996[f]	1999	2006
Germany			1994	1988	1988	1994[f]	1993	2002	1976	1996	2002
Ghana	1992	1988	1995	1989[f]	1989	1994	1994	2003[f]	1975	1996	2003
Greece			1994	1988	1988	1995	1994	2002	1992[f]	1997	2006
Guatemala	1994	1988	1996	1987[f]	1989[f]	1997	1995	1999	1979	1998[f]	
Guinea	1994	1988	1994	1992[f]	1992[f]	1994	1993	2000[f]	1981[f]	1997	
Guinea-Bissau	1993	1991	1996	2002[f]	2002[f]	1994	1995	2005[d]	1990[f]	1995	
Haiti	1999		1996	2000[f]	2000[f]	1996	1996	2005[f]		1996	

3.15 Government commitment

	Environmental strategies or action plans	Biodiversity assessments, strategies, or action plans	Participation in treaties[a]								
			Climate change[b]	Ozone layer	CFC control	Law of the Sea[c]	Biological diversity[b]	Kyoto Protocol	CITES	CCD	Stockholm Convention
			1992	1985	1987	1982	1992	1997	1973	1994	2004
Honduras	1993		1996	1993[f]	1993[f]	1994	1995	2000	1985[f]	1997	2005
Hungary	1995		1994	1988[f]	1989[f]	2002	1994	2002[f]	1985[f]	1999[f]	
India	1993	1994	1994	1991[f]	1992[f]	1995	1994	2002[f]	1976	1996	2006
Indonesia	1993	1993	1994	1992[f]	1992	1994	1994	2004	1978[f]	1998	
Iran, Islamic Rep.			1996	1990[f]	1990[f]		1996	2005[f]	1976	1997	2006
Iraq						1994					
Ireland			1994	1988[f]	1988	1996	1996	2002	2002	1997	
Israel			1996	1992[f]	1992		1995	2004	1979	1996	
Italy			1994	1988	1988	1995	1994	2002	1979	1997	
Jamaica	1994		1995	1993[f]	1993[f]	1994	1995	1999[f]	1997[f]	1997[f]	2007
Japan			1994	1988[f]	1988	1996	1993[d]	2002[d]	1980	1998[d]	2002[f]
Jordan	1991		1994	1989[f]	1989[f]	1995[f]	1993	2003[f]	1978[f]	1996	2004
Kazakhstan			1995	1998[f]	1998[f]		1994		2000[f]	1997	
Kenya	1994	1992	1994	1988[f]	1988	1994	1994	2005[f]	1978	1997	2004
Korea, Dem. Rep.			1995	1995[f]	1995[f]		1994[e]	2005[f]		2003[f]	2002[f]
Korea, Rep.			1994	1992	1992	1996	1994	2002	1993[f]	1999	2007
Kuwait			1995	1992[f]	1992[f]	1994	2002	2005[f]	2002	1997	2006
Kyrgyz Republic	1995		2000	2000[f]	2000[f]		1996[e]	2003[f]		1997[f]	2006
Lao PDR	1995		1995	1998[f]	1998[f]	1998	1996[e]	2003[f]	2004[f]	1996[d]	2006
Latvia			1995	1995[f]	1995[f]	2004[f]	1995	2002	1997[f]	2002[f]	2004
Lebanon			1995	1993[f]	1993[f]	1995	1994	2006		1996	2003
Lesotho	1989		1995	1994[f]	1994[f]		1995	2000[f]	2003	1995	2002
Liberia			2003	1996[f]	1996[f]		2000	2002[f]	2005[f]	1998[f]	2002[f]
Libya			1999	1990[f]	1990[f]		2001	2006	2003[f]	1996	2005[f]
Lithuania			1995	1995[f]	1995[f]	2003[f]	1996	2003	2001[f]	2003[f]	2006
Macedonia, FYR			1998	1994[g]	1994[g]	1994[g]	1997[f]	2004[f]	2000[f]	2002[f]	2004
Madagascar	1988	1991	1999	1996[f]	1996[f]	2001	1996	2003[f]	1975	1997	
Malawi	1994		1994	1991[f]	1991[f]		1994	2001[f]	1982[f]	1996	
Malaysia	1991	1988	1994	1989[f]	1989[f]	1996	1994	2002	1977[f]	1997	
Mali		1989	1995	1994[f]	1994[f]	1994	1995	2002	1994[f]	1995	2003
Mauritania	1988		1994	1994[f]	1994[f]	1996	1996	2005[f]	1998[f]	1996	2005
Mauritius	1990		1994	1992[f]	1992[f]	1994	1992	2001[f]	1975	1996	2004
Mexico		1988	1994	1987	1988	1994	1993	2000	1991[f]	1995	2003
Moldova	2002		1995	1996[f]	1996[f]	2007	1995	2003[f]	2001[f]	1999[f]	2004
Mongolia	1995		1994	1996[f]	1996[f]	1996	1993	1999[f]	1996[f]	1996	2004
Morocco		1988	1996	1995	1995		1995	2002[f]	1975	1996	2004
Mozambique	1994		1995	1994[f]	1994[f]	1997	1995	2005[f]	1981[f]	1997	2005
Myanmar		1989	1995	1993[f]	1993[f]	1996	1995	2003[f]	1997[f]	1997[f]	2004[f]
Namibia	1992		1995	1993[f]	1993[f]	1994	1997	2003[f]	1990[f]	1997	2005[f]
Nepal	1993		1994	1994[f]	1994[f]	1998	1993	2005[f]	1975[f]	1996	2007
Netherlands	1994		1994	1988[f]	1988[d]	1996	1994[d]	2002[f]	1984	1995[d]	2002[d]
New Zealand	1994		1994	1987	1988	1996	1993	2002	1989[f]	2000[f]	2004
Nicaragua	1994		1996	1993[f]	1993[f]	2000	1995	1999	1977[f]	1998	
Niger		1991	1995	1992[f]	1992[f]		1995	2004	1975	1996	2006
Nigeria	1990	1992	1994	1988[f]	1988[f]	1994	1994	2004[f]	1974	1997	2004
Norway		1994	1994	1986	1988	1996	1993	2002	1976	1996	2002
Oman			1995	1999[f]	1999[f]	1994	1995	2005[f]		1996[f]	2005
Pakistan	1994	1991	1994	1992[f]	1992[f]	1997	1994	2005[f]	1976[f]	1997	
Panama	1990		1995	1989[f]	1989	1996	1995	1999	1978	1996	2003
Papua New Guinea	1992	1993	1994	1992[f]	1992[f]	1997	1993	2002	1975[f]	2000[f]	2003
Paraguay			1994	1992[f]	1992[f]	1994	1994	1999	1976	1997	2004
Peru		1988	1994	1989	1993[f]		1993	2002	1975	1995	2005
Philippines	1989	1989	1994	1991[f]	1991	1994	1993	2003	1981	2000	2004
Poland	1993	1991	1994	1990[f]	1990[f]	1998	1996	2002	1989	2001[f]	
Portugal	1995		1994	1988[f]	1988	1997	1993	2002[e]	1980	1996	2004[d]
Puerto Rico											

3.15 Government commitment

	Environmental strategies or action plans	Biodiversity assessments, strategies, or action plans	Participation in treaties[a]								
			Climate change[b]	Ozone layer	CFC control	Law of the Sea[c]	Biological diversity[b]	Kyoto Protocol	CITES	CCD	Stockholm Convention
			1992	1985	1987	1982	1992	1997	1973	1994	2004
Romania	1995		1994	1993[f]	1993[f]	1996	1994	2001	1994[f]	1998[f]	2004
Russian Federation	1999	1994	1995	1986[d]	1988[d]	1997	1995	2004	1992	2003[f]	
Rwanda	1991		1998	2001[f]	2001[f]		1996	2004[f]	1980[f]	1998	2002[f]
Saudi Arabia			1995	1993[f]	1993[f]	1996	2001[e]	2005[f]	1996[f]	1997[f]	
Senegal	1984	1991	1995	1993[f]	1993	1994	1994	2001[f]	1977[f]	1995	2003
Serbia			2001	2001[g]	2001[g]	2001[g]	2002		2002		2002
Sierra Leone	1994		1995	2001[f]	2001[f]	1994	1994[e]	2006[f]	1994[f]	1997	2003[f]
Singapore	1993	1995	1997	1989[f]	1989[f]	1994	1995	2006[f]	1986[f]	1999[f]	2005
Slovak Republic			1994	1993[g]	1993[g]	1996	1994[e]	2002	1993	2001[f]	2002
Slovenia	1994		1996	1992[g]	1992[g]	1995[g]	1996	2002	2000[f]	2001[f]	2004
Somalia				2001[f]	2001[f]	1994			1985[f]	2002[f]	
South Africa	1993		1997	1990[f]	1990[f]	1997	1995	2002[f]	1975	1997	2002
Spain			1994	1988[f]	1988	1997	1995	2002	1986[f]	1996	2004
Sri Lanka	1994	1991	1994	1989[f]	1989[f]	1994	1994	2002[f]	1979[f]	1998[f]	
Sudan			1994	1993[f]	1993[f]	1994	1995	2004[f]	1982	1995	2006
Swaziland			1997	1992[f]	1992[f]		1994		1997[f]	1996	2006
Sweden			1994	1986	1988	1996	1993	2002	1974	1995	2002
Switzerland			1994	1987	1988		1994	2006[f]	1974	1996	2003
Syrian Arab Republic	1999		1996	1989[f]	1989[f]		1996	2006[f]	2003[f]	1997	2005
Tajikistan			1998	1996[f]	1998[f]		1997[e]			1997[f]	2007
Tanzania	1994	1988	1996	1993[f]	1993[f]	1994	1996	2002[f]	1979	1997	2004
Thailand			1995	1989[f]	1989		2004	2002	1983	2001[f]	2005
Timor-Leste											
Togo	1991		1995	1991[f]	1991	1994	1995[d]	2004[f]	1978	1995[d]	2004
Trinidad and Tobago			1994	1989[f]	1989[f]	1994	1996	1999	1984[f]	2000[f]	2002[f]
Tunisia	1994	1988	1994	1989[f]	1989[f]	1994	1993	2003[f]	1974	1995	2004
Turkey	1998		2004	1991[f]	1991[f]		1997		1996[f]	1998	
Turkmenistan			1995	1993[f]	1993[f]		1996[e]	1999		1996	
Uganda	1994	1988	1994	1988[f]	1988	1994	1993	2002[f]	1991[f]	1997	2004[f]
Ukraine	1999		1997	1986[d]	1988[d]	1999	1995	2004	1999[f]	2002[f]	
United Arab Emirates			1996	1989[f]	1989[f]		2000	2005[f]	1990[f]	1998[f]	2002
United Kingdom	1995	1994	1994	1987	1988	1997[f]	1994	2002	1976	1996	2005
United States	1995	1995	1994	1986	1988				1974	2000	
Uruguay			1994	1989[f]	1991[f]	1994	1993	2001	1975	1999[f]	2004
Uzbekistan			1994	1993[f]	1993[f]		1995[e]	1999	1997[f]	1995	
Venezuela			1995	1988[f]	1989		1994		1977	1998[f]	2005
Vietnam		1993	1995	1994[f]	1994[f]	2006[f]	1994	2002	1994[f]	1998[f]	2002
West Bank and Gaza											
Yemen, Rep.	1996	1992	1996	1996[f]	1996[f]	1994	1996	2004[f]	1997[f]	1997[f]	2004
Zambia	1994		1994	1990[f]	1990[f]	1994	1993	2006[f]	1980[f]	1996	2006
Zimbabwe	1987		1994	1992[f]	1992[f]	1994	1994		1981[f]	1997	

a. Ratification of the treaty. b. Year the treaty entered into force in the country. c. Convention became effective November 16, 1994. d. Acceptance. e. Approval. f. Accession. g. Succession.

Government commitment

About the data

National environmental strategies and participation in international treaties on environmental issues provide some evidence of government commitment to sound environmental management. But the signing of these treaties does not always imply ratification, nor does it guarantee that governments will comply with treaty obligations.

In many countries efforts to halt environmental degradation have failed, primarily because governments have neglected to make this issue a priority, a reflection of competing claims on scarce resources. To address this problem, many countries are preparing national environmental strategies—some focusing narrowly on environmental issues, and others integrating environmental, economic, and social concerns. Among such initiatives are conservation strategies and environmental action plans. Some countries have also prepared country environmental profiles and biodiversity strategies and profiles.

National conservation strategies—promoted by the World Conservation Union (IUCN)—provide a comprehensive, cross-sectoral analysis of conservation and resource management issues to help integrate environmental concerns with the development process. Such strategies discuss current and future needs, institutional capabilities, prevailing technical conditions, and the status of natural resources in a country.

National environmental action plans, supported by the World Bank and other development agencies, describe a country's main environmental concerns, identify the principal causes of environmental problems, and formulate policies and actions to deal with them. These plans are a continuing process in which governments develop comprehensive environmental policies, recommend specific actions, and outline the investment strategies, legislation, and institutional arrangements required to implement them.

Biodiversity profiles—prepared by the World Conservation Monitoring Centre and the IUCN—provide basic background on species diversity, protected areas, major ecosystems and habitat types, and legislative and administrative support. In an effort to establish a scientific baseline for measuring progress in biodiversity conservation, the United Nations Environment Programme (UNEP) coordinates global biodiversity assessments.

To address global issues, many governments have also signed international treaties and agreements launched in the wake of the 1972 United Nations Conference on the Human Environment in Stockholm and the 1992 United Nations Conference on Environment and Development (the Earth Summit) in Rio de Janeiro, which produced Agenda 21—an array of actions to address environmental challenges:

- The Framework Convention on Climate Change aims to stabilize atmospheric concentrations of greenhouse gases at levels that will prevent human activities from interfering dangerously with the global climate.
- The Vienna Convention for the Protection of the Ozone Layer aims to protect human health and the environment by promoting research on the effects of changes in the ozone layer and on alternative substances (such as substitutes for chlorofluorocarbon) and technologies, monitoring the ozone layer, and taking measures to control the activities that produce adverse effects.
- The Montreal Protocol for Chlorofluorocarbon Control requires that countries help protect the earth from excessive ultraviolet radiation by cutting chlorofluorocarbon consumption by 20 percent over their 1986 level by 1994 and by 50 percent over their 1986 level by 1999, with allowances for increases in consumption by developing countries.
- The United Nations Convention on the Law of the Sea, which became effective in November 1994, establishes a comprehensive legal regime for seas and oceans, establishes rules for environmental standards and enforcement provisions, and develops international rules and national legislation to prevent and control marine pollution.
- The Convention on Biological Diversity promotes conservation of biodiversity through scientific and technological cooperation among countries, access to financial and genetic resources, and transfer of ecologically sound technologies.

But 10 years after the Earth Summit in Rio de Janeiro the World Summit on Sustainable Development in Johannesburg recognized that many of the proposed actions had yet to materialize. To help developing countries comply with their obligations under these agreements, the Global Environment Facility (GEF) was created to focus on global improvement in biodiversity, climate change, international waters, and ozone layer depletion. The UNEP, United Nations Development Programme, and World Bank manage the GEF according to the policies of its governing body of country representatives. The World Bank is responsible for the GEF Trust Fund and chairs the GEF.

Definitions

• **Environmental strategies or action plans** provide a comprehensive analysis of conservation and resource management issues that integrate environmental concerns with development. They include national conservation strategies, environmental action plans, environmental management strategies, and sustainable development strategies. The date is the year a country adopted a strategy or action plan. • **Biodiversity assessments, strategies, or action plans** include biodiversity profiles (see *About the data*). • **Participation in treaties** covers nine international treaties (see *About the data*). • **Climate change** refers to the Framework Convention on Climate Change (signed in 1992). • **Ozone layer** refers to the Vienna Convention for the Protection of the Ozone Layer (signed in 1985). • **CFC control** refers to the Protocol on Substances That Deplete the Ozone Layer (the Montreal Protocol for Chlorofluorocarbon Control) (signed in 1987). • **Law of the Sea** refers to the United Nations Convention on the Law of the Sea (signed in 1982). • **Biological diversity** refers to the Convention on Biological Diversity (signed at the Earth Summit in 1992). • **Kyoto Protocol** refers to the protocol on climate change adopted at the third conference of the parties to the United Nations Framework Convention on Climate Change in December 1997. • **CITES** is the Convention on International Trade in Endangered Species of Wild Fauna and Flora, an agreement among governments to ensure that the survival of wild animals and plants is not threatened by uncontrolled exploitation. Adopted in 1973, it entered into force in 1975. • **CCD** is the United Nations Convention to Combat Desertification, an international convention addressing the problems of land degradation in the world's drylands. Adopted in 1994, it entered into force in 1996. • **Stockholm Convention** is an international legally binding instrument to protect human health and the environment from persistent organic pollutants. Adopted in 2001, it entered into force in 2004.

Data sources

Data on environmental strategies and participation in international environmental treaties are from the Secretariat of the United Nations Framework Convention on Climate Change, the Ozone Secretariat of the UNEP, the World Resources Institute, the UNEP, the Center for International Earth Science Information Network, and the United Nations Treaty Series.

3.16 Toward a broader measure of savings

	Gross savings	Consumption of fixed capital	Net national savings	Education expenditure	Energy depletion	Mineral depletion	Net forest depletion	Carbon dioxide damage	Particulate emission damage	Adjusted net savings
	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI
	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006
Afghanistan	..	7.7	..	..	0.0	..	0.9	0.1	0.9	..
Albania	16.7	10.5	6.1	2.8	2.0	0.0	0.0	0.2	0.2	6.5
Algeria	..	11.8	..	4.5	58.1	0.1	0.1	1.3	0.3	..
Angola	42.2	12.2	30.0	3.0	68.8	0.0	0.0	0.2	1.6	–37.6
Argentina	27.1	12.0	15.1	4.0	12.8	1.0	0.0	0.5	1.6	3.2
Armenia	29.3	10.2	19.2	3.0	0.0	2.2	0.0	0.6	1.8	17.6
Australia	21.9[a]	15.1	6.8	4.7	3.6	5.1	0.0	0.4	0.1	2.4
Austria	25.8	14.2	11.6	5.3	0.3	0.0	0.0	0.2	0.3	16.1
Azerbaijan	57.0	12.1	44.9	2.8	83.8	0.0	0.0	2.4	1.1	–39.7
Bangladesh	31.6	8.1	23.6	1.9	5.6	0.0	0.7	0.4	0.5	18.3
Belarus	26.4	11.2	15.2	5.7	2.1	0.0	0.0	1.6	..	17.2[b]
Belgium	23.9	15.4	8.5	5.9	0.0	0.0	0.0	0.2	0.2	14.1
Benin	..	8.5	..	3.6	0.0	0.0	0.9	0.3	0.4	..
Bolivia	26.9	9.8	17.1	6.3	40.6	4.9	0.0	0.7	1.4	–24.2
Bosnia and Herzegovina	6.0	10.4	–4.4	..	0.3	0.0	..	1.3	0.1	..
Botswana	55.8	12.5	43.3	8.6	0.3	7.0	0.0	0.3	..	44.2[b,c]
Brazil	17.8	12.0	5.8	4.3	3.7	2.3	0.0	0.2	0.3	3.5
Bulgaria	15.5	11.9	3.6	4.2	0.9	2.0	0.0	1.2	1.6	2.1
Burkina Faso	..	8.1	..	4.5	0.0	0.0	0.9	0.1	1.4	..
Burundi	2.0	6.4	–4.4	5.1	0.0	0.8	10.5	0.2	0.1	–10.9
Cambodia	18.1	8.7	9.5	1.8	0.0	0.0	0.3	0.1	0.4	10.5
Cameroon	17.5	9.4	8.1	1.6	14.9	0.1	0.0	0.2	0.8	–6.2
Canada	23.7[a]	14.6	9.1	5.2	7.4	1.1	0.0	0.3	0.1	5.4
Central African Republic	..	7.8	..	1.6	0.0	0.0	0.0	0.1	0.4	..
Chad	29.5	10.9	18.6	1.3	65.4	0.0	0.0	0.0	1.1	–46.6
Chile	27.6	14.2	13.4	3.7	0.6	27.5	0.0	0.4	0.6	–12.1
China	53.8	10.2	43.6	1.8	5.8	0.7	0.0	1.3	1.5	36.1
Hong Kong, China	31.9	13.9	18.1	3.4	0.0	0.0	0.0	0.2	..	21.3[b]
Colombia	20.9	11.4	9.5	5.0	9.7	1.7	0.0	0.3	0.1	2.5
Congo, Dem. Rep.	9.3	6.8	2.5	0.9	4.8	4.2	0.0	0.2	0.6	–6.3
Congo, Rep.	..	..	..	2.6	..	..	..	..	1.0	..
Costa Rica	19.4	6.2	13.2	4.0	0.0	0.0	0.2	0.2	0.3	16.5
Côte d'Ivoire	15.1	9.6	5.6	4.7	12.5	0.0	0.0	0.3	0.4	–3.0
Croatia	24.7	12.9	11.8	4.5	2.1	0.0	0.2	0.4	0.5	13.0
Cuba	..	..	..	7.1	..	..	..	..	0.1	..
Czech Republic	25.4	13.7	11.7	4.2	0.3	0.0	0.1	0.7	0.1	14.7
Denmark	25.0	15.0	10.0	8.1	3.4	0.0	0.0	0.1	0.1	14.4
Dominican Republic	20.7	11.6	9.1	1.9	0.0	3.4	0.0	0.6	0.1	6.9
Ecuador	28.1	11.4	16.7	1.4	28.8	0.4	0.0	0.5	0.1	–11.8
Egypt, Arab Rep.	22.1	9.8	12.3	4.4	24.4	0.2	0.2	1.1	1.0	–10.2
El Salvador	11.9	11.0	0.9	2.8	0.0	0.0	0.5	0.3	0.3	2.7
Eritrea	8.7	7.2	1.5	4.0	0.0	0.0	1.1	0.4	0.4	3.5
Estonia	25.7	12.9	12.8	5.1	37.6	0.0	0.0	1.1	0.0	–20.9
Ethiopia	9.4	6.9	2.5	4.0	0.0	0.6	6.8	0.5	0.3	–1.7
Finland	26.5	15.8	10.8	6.0	0.0	0.2	0.0	0.2	0.1	16.3
France	18.8	12.5	6.3	5.3	0.0	0.0	0.0	0.1	0.0	11.4
Gabon	52.4	15.3	37.1	3.3	60.8	0.0	0.0	0.2	..	–20.6[b]
Gambia, The	10.3	7.8	2.5	2.0	0.0	0.0	0.6	0.5	0.8	2.7
Georgia	7.7	10.4	–2.7	2.8	0.4	0.0	0.0	0.5	1.4	–2.2
Germany	22.9	14.7	8.2	4.5	0.3	0.0	0.0	0.2	0.1	12.1
Ghana	27.4	8.5	18.9	4.7	0.0	7.7	1.6	0.5	0.1	13.8
Greece	16.4	6.9	9.5	3.4	0.2	0.2	0.0	0.3	0.7	11.6
Guatemala	14.5	10.8	3.7	1.6	1.1	0.0	0.7	0.2	0.4	2.9
Guinea	8.6	7.9	0.7	2.0	0.0	9.5	2.1	0.3	0.4	–9.7
Guinea-Bissau	23.5	7.1	16.4	2.3	0.0	0.0	0.0	0.7	1.0	17.0
Haiti	..	9.6	..	1.5	0.0	0.0	0.8	0.3	0.4	..

Toward a broader measure of savings

	Gross savings	Consumption of fixed capital	Net national savings	Education expenditure	Energy depletion	Mineral depletion	Net forest depletion	Carbon dioxide damage	Particulate emission damage	Adjusted net savings
	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI
	2006	2006	2006	2006	2006	2006	2006	2006	2006	2006
Honduras	32.3	10.0	22.3	3.5	0.0	2.4	0.0	0.5	0.4	22.5
Hungary	20.3	13.6	6.6	5.5	1.3	0.0	0.0	0.4	0.1	10.3
India	33.7	9.0	24.7	3.9	4.3	1.2	0.5	1.3	0.7	20.6
Indonesia	27.6	10.4	17.2	0.9	11.4	3.1	0.0	0.7	1.2	1.7
Iran, Islamic Rep.	40.7	11.0	29.7	4.4	54.2	0.5	0.0	1.3	0.8	–22.7
Iraq	..	..	..	..	..	..	..	..	..	..
Ireland	37.7[a]	10.7	27.0	5.3	3.4	0.4	0.0	0.2	0.0	28.2
Israel	..	16.7	..	6.7	0.3	0.0	0.0	0.4	0.4	..
Italy	19.3	13.4	5.9	4.5	0.3	0.0	0.0	0.2	0.2	9.7
Jamaica	..	7.6	..	4.5	0.0	3.5	0.0	0.8	0.2	..
Japan	27.3[a]	13.9	13.4	3.1	0.0	0.0	0.0	0.2	0.5	15.8
Jordan	13.8	10.2	3.6	5.6	0.4	0.0	0.0	1.0	0.7	7.1
Kazakhstan	34.5	13.1	21.3	4.4	52.4	4.2	0.0	2.1	0.3	–33.2
Kenya	10.1	9.6	0.5	6.3	0.0	0.1	1.0	0.4	0.1	5.2
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	..	..
Korea, Rep.	30.5	13.3	17.1	4.0	0.1	0.0	0.0	0.4	0.6	20.0
Kuwait	..	..	..	4.2	..	..	0.0	..	1.4	..
Kyrgyz Republic	4.5	8.5	–4.0	4.4	1.1	0.0	0.0	1.3	0.3	–2.3
Lao PDR	21.8	9.7	12.1	1.1	0.0	0.0	0.0	0.4	0.8	12.1
Latvia	17.5	18.2	–0.7	5.6	0.0	0.0	0.7	0.3	0.0	3.8
Lebanon	–4.5	11.9	–16.4	2.5	0.0	0.0	0.0	0.6	0.9	–15.4
Lesotho	21.8	7.1	14.7	9.3	0.0	0.0	1.4	0.0	0.2	22.4
Liberia	..	8.7	..	..	0.0	0.1	6.0	0.6	0.5	..
Libya	..	12.2	..	..	81.3	0.0	0.0	0.8	..	..
Lithuania	14.5	13.0	1.5	5.1	0.3	0.0	0.1	0.4	0.2	5.6
Macedonia, FYR	22.1	10.8	11.3	4.9	0.0	0.0	0.2	1.4	0.1	14.5
Madagascar	16.3	7.6	8.7	2.7	0.0	0.0	0.0	0.3	0.2	10.9
Malawi	15.7	7.3	8.4	4.9	0.0	0.0	0.6	0.2	0.2	12.2
Malaysia	32.7	12.1	20.6	5.8	22.1	0.0	0.0	0.8	0.1	3.3
Mali	13.8	8.8	5.0	3.6	0.0	0.0	0.0	0.1	1.6	7.0
Mauritania	27.5	8.7	18.8	2.4	0.0	24.2	0.4	0.8	2.8	–7.0
Mauritius	18.9	11.5	7.4	3.8	0.0	0.0	0.0	0.4	..	10.8[b]
Mexico	22.2	12.4	9.8	5.3	10.6	0.6	0.0	0.4	0.4	3.1
Moldova	20.3	8.1	12.2	3.6	0.1	0.0	0.0	1.7	0.7	13.3
Mongolia	45.3	7.9	37.3	5.1	2.8	26.4	0.0	2.5	1.1	9.7
Morocco	35.0	10.5	24.5	6.5	0.2	0.8	0.0	0.5	0.1	29.4
Mozambique	3.5	8.5	–5.1	3.7	11.5	0.0	0.5	0.2	0.2	–13.8
Myanmar	..	..	..	0.8	..	..	..	..	0.6	..
Namibia	42.7	11.0	31.6	7.3	0.0	5.2	0.0	0.3	0.1	33.4
Nepal	28.0	7.6	20.4	2.6	0.0	0.0	2.1	0.3	0.1	20.5
Netherlands	28.7	14.5	14.2	5.2	2.5	0.0	0.0	0.2	0.6	16.0
New Zealand	21.2[a]	13.7	7.5	7.0	1.5	0.3	0.0	0.3	0.0	12.4
Nicaragua	13.6	9.5	4.1	3.0	0.0	1.1	0.0	0.6	0.1	5.3
Niger	..	7.4	..	2.3	0.0	0.0	2.6	0.3	0.9	..
Nigeria	38.8	10.2	28.5	0.9	57.7	0.0	0.2	0.4	0.7	–29.6
Norway	38.8[a]	13.3	25.4	7.0	23.0	0.0	0.0	0.1	0.1	9.2
Oman	..	..	..	3.7	..	..	0.0	..	1.4	..
Pakistan	23.1	8.4	14.7	1.8	7.2	0.0	0.4	0.8	1.5	6.8
Panama	18.6	12.3	6.3	4.4	0.0	0.0	0.0	0.3	0.2	10.2
Papua New Guinea	..	10.2	..	..	23.8	48.5	0.0	0.4	0.0	..
Paraguay	7.3	9.9	–2.6	4.1	0.0	0.0	0.0	0.3	0.7	0.5
Peru	25.1	12.0	13.1	2.5	3.2	14.8	0.0	0.3	0.7	–3.4
Philippines	30.5	8.4	22.1	2.4	0.7	1.2	0.1	0.5	0.3	21.7
Poland	18.8	12.8	6.0	5.4	1.3	1.1	0.0	0.8	0.4	7.8
Portugal	12.7	17.4	–4.7	5.7	0.0	0.2	0.0	0.2	0.4	0.1
Puerto Rico	..	..	..	..	..	..	..	..	..	..

3.16 Toward a broader measure of savings

	Gross savings	Consumption of fixed capital	Net national savings	Education expenditure	Energy depletion	Mineral depletion	Net forest depletion	Carbon dioxide damage	Particulate emission damage	Adjusted net savings
	% of GNI 2006	% of GNI 2006	% of GNI 2006	% of GNI 2006	% of GNI 2006	% of GNI 2006	% of GNI 2006	% of GNI 2006	% of GNI 2006	% of GNI 2006
Romania	13.0	12.0	0.9	3.3	4.5	0.2	0.0	0.7	0.0	–1.2
Russian Federation	30.7	7.0	23.7	3.5	37.5	1.9	0.0	1.4	0.3	–13.8
Rwanda	13.9	7.4	6.4	3.5	0.0	0.0	2.3	0.2	0.1	7.3
Saudi Arabia	..	..	..	7.2	..	..	0.0	..	1.4	..
Senegal	18.8	9.0	9.8	4.6	0.0	0.1	0.0	0.4	1.1	12.6
Serbia[d]	9.0	..	..	..	2.2	0.1	..	1.5	..	..
Sierra Leone	9.7	7.5	2.2	4.5	0.0	0.0	1.7	0.5	1.1	3.5[c]
Singapore	47.8[a]	15.0	32.8	2.5	0.0	0.0	0.0	0.4	0.8	34.0
Slovak Republic	21.2	21.9	–0.8	4.1	0.1	0.0	0.4	0.6	0.0	2.2
Slovenia	26.3	13.5	12.8	5.6	5.1	0.0	0.2	0.3	0.2	12.5
Somalia	..	..	..	..	..	..	..	..	..	..
South Africa	14.2	11.9	2.3	5.3	3.5	3.1	0.1	1.1	0.1	–0.3
Spain	22.4	14.5	7.9	3.9	0.0	0.0	0.0	0.2	0.4	11.2
Sri Lanka	24.9	9.7	15.1	2.6	0.0	0.0	0.3	0.3	0.4	16.7
Sudan	15.5	10.0	5.4	0.9	21.6	0.2	0.0	0.2	0.4	–16.2
Swaziland	18.6	10.4	8.2	6.2	0.0	0.0	0.0	0.3	0.1	14.1
Sweden	24.8	12.1	12.7	7.3	0.0	0.5	0.0	0.1	0.0	19.4
Switzerland	..	13.5	..	5.1	0.0	0.0	0.0	0.1	0.2	..
Syrian Arab Republic	17.6	10.3	7.3	2.6	31.7	0.0	0.0	1.2	0.9	–24.0
Tajikistan	12.2	8.3	3.9	3.2	0.6	0.0	0.0	1.6	0.4	4.5
Tanzania	11.4	7.8	3.6	2.4	0.3	4.7	0.0	0.2	0.1	0.6
Thailand	32.1	11.2	20.9	4.7	5.8	0.0	0.2	1.0	0.4	18.1
Timor-Leste	104.5	3.3	101.3	..	..	..	..	..	..	..
Togo	..	7.8	..	2.5	0.0	0.3	2.8	0.6	0.2	..
Trinidad and Tobago	..	12.1	..	4.0	71.7	0.0	0.0	1.6	0.2	..
Tunisia	26.9	11.4	15.5	6.7	7.4	0.4	0.1	0.6	0.3	13.4
Turkey	16.6	11.7	4.9	3.5	0.4	0.1	0.0	0.5	1.2	6.2
Turkmenistan	..	11.0	..	..	..	0.0	..	2.9	1.0	..
Uganda	14.7	7.7	7.0	4.0	0.0	0.0	4.5	0.2	..	6.3[b]
Ukraine	23.2	10.6	12.6	4.4	9.7	0.0	0.0	2.8	0.5	4.1
United Arab Emirates	..	..	..	..	..	..	..	..	..	..
United Kingdom	14.2	10.2	4.0	5.3	2.2	0.0	0.0	0.2	0.0	6.9
United States	14.1[a]	12.2	1.9	4.8	1.8	0.1	0.0	0.3	0.3	4.1
Uruguay	14.3	12.1	2.3	2.6	0.0	0.0	0.2	0.2	1.9	2.6
Uzbekistan	36.0	8.7	27.4	9.4	..	0.0	0.0	6.3	0.9	..
Venezuela, RB	39.8	12.0	27.8	4.4	39.8	1.1	0.0	0.7	0.0	–9.5
Vietnam	37.7	9.0	28.7	2.8	17.9	0.1	0.4	1.1	0.6	11.6
West Bank and Gaza	10.0	9.1	1.0	..	0.0	0.0	..	..	..	..
Yemen, Rep.	..	9.8	..	..	42.8	0.0	0.0	0.7	0.9	..
Zambia	25.3	10.1	15.3	2.2	0.1	31.0	0.0	0.2	0.7	–14.4
Zimbabwe	..	..	..	6.9	..	..	..	..	0.1	..
World	**21.8 w**	**12.4 w**	**9.3 w**	**4.4 w**	**4.1 w**	**0.5 w**	**0.0 w**	**0.4 w**	**0.4 w**	**8.3 w**
Low income	30.5	9.0	21.5	3.4	9.4	1.3	0.6	1.0	0.7	11.9
Middle income	30.5	10.9	19.6	3.5	12.8	1.6	0.0	0.9	0.8	7.0
Lower middle income	41.4	10.4	31.0	2.5	11.1	1.1	0.0	1.2	1.1	18.9
Upper middle income	22.3	11.4	10.9	4.4	14.4	2.0	0.0	0.7	0.4	–2.2
Low & middle income	30.5	10.7	19.8	3.5	12.3	1.5	0.1	0.9	0.8	7.6
East Asia & Pacific	47.2	10.3	36.9	2.1	7.1	0.9	0.0	1.2	1.3	28.5
Europe & Central Asia	22.6	10.3	12.3	4.1	18.4	1.1	0.0	1.1	0.5	–4.9
Latin America & Carib.	22.4	12.1	10.4	4.4	9.1	3.0	0.0	0.4	0.4	1.8
Middle East & N. Africa	..	10.9	..	4.6	40.0	0.3	0.1	1.1	0.6	..
South Asia	32.1	8.9	23.2	3.5	4.5	0.9	0.5	1.1	0.8	18.8
Sub-Saharan Africa	19.4	10.7	8.7	3.8	18.7	2.3	0.4	0.6	0.4	–10.0
High income	19.9	13.0	6.9	4.7	1.5	0.2	0.0	0.3	0.3	9.3
Euro area	21.8	13.8	8.0	4.8	0.4	0.0	0.0	0.2	0.2	12.0

a. World Bank staff estimates. b. Excludes particulate emissions damage. c. Likely to be overestimated because mineral depletion excludes diamonds. d. Includes Montenegro.

Toward a broader measure of savings

About the data

Adjusted net savings measure the change in value of a specified set of assets, excluding capital gains. If a country's net savings are positive and the accounting includes a sufficiently broad range of assets, economic theory suggests that the present value of social welfare is increasing. Conversely, persistently negative adjusted net savings indicate that an economy is on an unsustainable path.

The table provides a test to check the extent to which today's rents from a number of natural resources and changes in human capital are balanced by net savings, that is, this generation's bequest to future generations.

Adjusted net savings are derived from standard national accounting measures of gross savings by making four adjustments. First, estimates of capital consumption of produced assets are deducted to obtain net savings. Second, current public expenditures on education are added to net savings (in standard national accounting these expenditures are treated as consumption). Third, estimates of the depletion of a variety of natural resources are deducted to reflect the decline in asset values associated with their extraction and harvest. And fourth, deductions are made for damages from carbon dioxide and particulate emissions.

The exercise treats public education expenditures as an addition to savings effort. However, because of the wide variability in the effectiveness of government education expenditures, these figures cannot be construed as the value of investments in human capital. Current expenditure of $1 on education does not necessarily yield $1 of human capital. The calculation should also consider private education expenditure, but data are not available for a large number of countries.

While extensive, the accounting of natural resource depletion and pollution costs still has some gaps. Key estimates missing on the resource side include the value of fossil water extracted from aquifers, net depletion of fish stocks, and depletion and degradation of soils. Important pollutants affecting human health and economic assets are excluded because no internationally comparable data are widely available on damage from ground-level ozone or sulfur oxides.

Estimates of resource depletion are based on the calculation of unit resource rents. An economic rent represents an excess return to a given factor of production—in this case the returns from resource extraction or harvest are higher than the normal rate of return on capital. Natural resources give rise to rents because they are not produced; in contrast, for produced goods and services competitive forces will expand supply until economic profits are driven to zero. For each type of resource and each country, unit resource rents are derived by taking the difference between world prices and the average unit extraction or harvest costs (including a "normal" return on capital). Unit rents are then multiplied by the physical quantity extracted or harvested in order to arrive at a depletion figure. This figure is one of a range of possible depletion estimates, depending on the assumptions made about future quantities, prices, and costs, and there is reason to believe that it is at the high end of the range. World prices are used in order to reflect the social opportunity cost of depleting minerals and energy.

A positive net depletion figure for forest resources implies that the harvest rate exceeds the rate of natural growth; this is not the same as deforestation, which represents a change in land use (see *Definitions* for table 3.4). In principle, there should be an addition to savings in countries where growth exceeds harvest, but empirical estimates suggest that most of this net growth is in forested areas that cannot currently be exploited economically. Because the depletion estimates reflect only timber values, they ignore all the external and nontimber benefits associated with standing forests.

Pollution damage from emissions of carbon dioxide is calculated as the marginal social cost per unit multiplied by the increase in the stock of carbon dioxide. The unit damage figure represents the present value of global damage to economic assets and to human welfare over the time the unit of pollution remains in the atmosphere.

Pollution damage from particulate emissions is estimated by valuing the human health effects from exposure to particulate matter pollution in urban areas. The estimates are calculated as willingness to pay to avoid illness and death from cardiopulmonary disease and lung cancer in adults and acute respiratory infections in children that is attributable to particulate emissions.

For a detailed note on methodology, see www.worldbank.org/data.

Definitions

• **Gross savings** are the difference between gross national income and public and private consumption, plus net current transfers. • **Consumption of fixed capital** is the replacement value of capital used up in production. • **Net national savings** are gross savings minus consumption of fixed capital. • **Education expenditure** is public current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment. • **Energy depletion** is unit resource rents times the physical quantities of extracted coal, crude oil, and natural gas. • **Mineral depletion** is unit resource rents times the physical quantities of extracted tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate. • **Net forest depletion** is unit resource rents times the excess of roundwood harvest over natural growth. • **Carbon dioxide damage** is estimated at $20 per ton of carbon (in 1995 U.S. dollars) times tons of carbon emitted. • **Particulate emission damage** is the willingness to pay to avoid illness and death attributable to particulate emissions.• **Adjusted net savings** are net savings plus education expenditure minus energy depletion, mineral depletion, net forest depletion, and carbon dioxide and particulate emissions damage.

Data sources

Data on gross savings are from World Bank national accounts data files, described in the *Economy* section. Data on consumption of fixed capital are from the United Nations Statistics Division's *National Accounts Statistics: Main Aggregates and Detailed Tables, 1997,* extrapolated to 2006. Data on education expenditure are from the United Nations Statistics Division's *Statistical Yearbook 1997* and from the United Nations Educational, Scientific, and Cultural Organization Institute for Statistics' online database. The data sources and methods used to estimate resource depletion are described in Kunte and others' "Estimating National Wealth" (1998). The unit damage figure for carbon dioxide emissions is from Frankhauser's "Fractales, tissues urbains et reseaux de transport" (1994). The estimates of particulate emissions damage are from Pandey and others' "The Human Costs of Air Pollution: New Estimates for Developing Countries" (2006). The conceptual underpinnings of the savings measure appear in Hamilton and Clemens' "Genuine Savings Rates in Developing Countries" (1999).