ENVIRONMENT

03

Development and economic growth have improved the quality of life for many people, but the gains have been uneven and economic growth has often had negative environmental consequences, with profound impact on poor people. Using the environment wisely is crucial for reducing poverty. Many poor people depend on the environment for their livelihoods. Because poor people control far fewer natural and produced resources, environmental degradation affects them disproportionately. The indicators in this section measure environmental resources and the goods and services produced from them—helping to establish the link between growth and environmental change and pointing the way toward sustainable development.

Environmental changes and their impact

Income derived from the environment is a major source of livelihood for many people, particularly for the rural population—a majority of the people who live on less than $1 a day. Despite rapid urbanization in most regions, almost half the world's population still lives in rural areas. In South Asia more than 70 percent of people live in rural areas, and in Sub-Saharan Africa more than 60 percent do. An estimated 75 percent of poor people live in rural areas. The sustainability and proper management of natural resources are crucial for maintaining rural livelihoods and safety nets in difficult times. Without proper management of natural resources and environmentally sustainable development, it would be difficult to reverse environmental losses—one of the main Millennium Development Goals.

At the same time, the environment is a source of vulnerability. Increasing use of fossil energy—mainly by industrial economies—and the resulting climate change add to poor people's vulnerability. The adverse impact of environmental change will be most striking in developing countries—and particularly among the poor—because of their high dependence on natural resources, their limited capacity to adapt to a changing climate, and their limited resources to remedy the impact of such changes or to implement mitigating policies.

Low-income families and regions are more vulnerable not only to human-induced environmental hazards but also to natural disasters and environmental risks such as the impact of global climate changes. Water scarcity is already a major problem for the world's poor, and changes in rainfall and temperature associated with climate change will likely make this scarcity worse. Crop yields are expected to decline in most tropical and subtropical regions as rainfall and temperature patterns change with a changing climate (IPCC 2001b, p. 84). The Food and Agriculture Organization estimates that land suitable for rainfed agriculture may shrink by 11 percent in developing countries by 2080 due to climate change (FAO 2005, p. 2). There is also some evidence that disease vectors such as malaria-bearing mosquitoes will spread more widely (IPCC 2001a, p. 455). Global warming may bring an increase in severe weather events like cyclones and torrential rains. The inadequate construction and exposed locations of poor people's dwellings often make poor people the most likely victims of such disasters. Hence mitigating the consequences of environmental changes that affect their livelihoods must be an integral part of poverty reduction efforts.

The following discussion highlights selected issues related to the indicators in the tables in this section, issues with profound impact on the livelihoods of the populace, particularly poor people:

- Agriculture and land use.
- Water quality and availability.
- Shrinking forests.
- Mix of energy use.

Natural resources—a major source of livelihoods

In many developing countries agriculture is still a major source of employment and income. While globally 44 percent of the active workforce is engaged in agriculture, the importance of this sector as a source of employment varies by region and income. About 60 percent of the active workforce is employed in agriculture, fisheries, and livestock in the Sub-Saharan Africa and Asia and Pacific regions, but only 19 percent in Latin America, where the urban population share is as high as in high-income Europe. In high-income countries only 7 percent of the workforce is engaged in these activities.

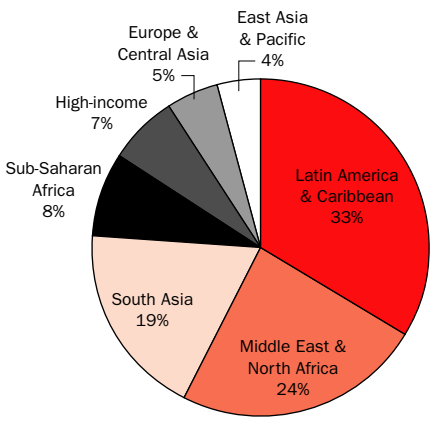
These variations are even more profound across countries: 2 percent in the United Kingdom and United States, 59 percent in India, 67 percent in China, and 93 percent in Nepal.

Population growth in developing countries will put further pressure on agriculture as rising demand for food requires more land and more forests to be turned to agricultural use. Greater numbers of poor people will be forced to live and work on marginal and fragile lands. In 2002 almost 1.4 billion people were living on fragile lands—more than three-fourths in Africa and Asia (figure 3a). This has an important impact on food production and food security in these regions—particularly in Sub-Saharan Africa, where food production barely keeps up with population growth.

3a

More than three-fourths of the 1.4 billion people living on fragile lands are in Asia and Africa

Rural population living on fragile lands as a share of world total



Source: World Bank 2003.

Climate change makes the situation even worse, and the region appears to be the most vulnerable to the consequences of global warming. In the past 30 years Africa has experienced at least one major drought each decade. Changes in rainfall—there are already indications of significant changes in the last decades—could also have serious consequences for parts of Africa that depend on hydroelectricity.

Climate variability and associated floods and droughts increase the risk of crop failure, reducing food security and increasing the incidence of malnutrition and disease. In Ethiopia, for example, the 1984 drought affected 8.7 million people: 1 million people died and millions more suffered from malnutrition and famine (UNEP 2002, p. 218). Nearly 1.5 million livestock also died (FAO 2000). The 1991–92 drought in southern Africa reduced the cereal harvest by more than half and exposed more than 17 million people to the risk of starvation. More than 100,000 people died in the Sahelian drought of the 1970s and 1980s (UNEP 2002, p. 219). Crop failure and livestock losses increase the dependence on imports and foreign aid, reducing economic performance and the ability to cope with future environmental disasters.

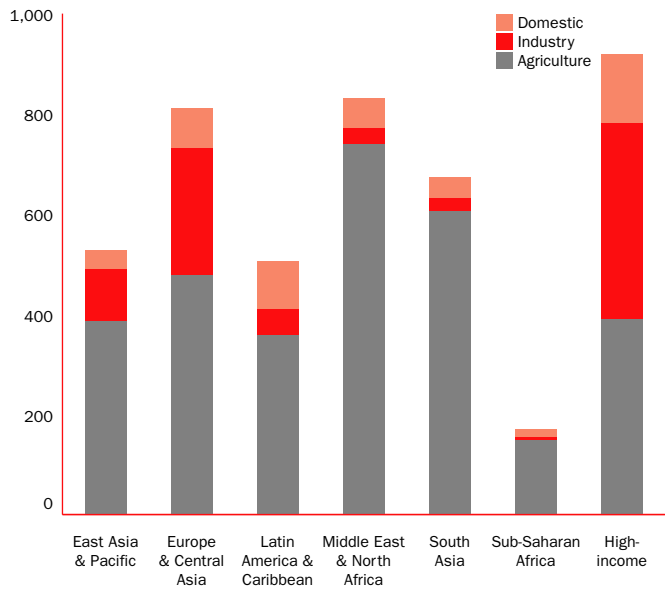
Water is life, but water is getting dirtier and scarcer

Water scarcity is a major reason for the low levels of food production in most parts of Africa. Average per capita renewable water resources in Africa are below the world average, and the distribution of surface water and ground water is uneven (figure 3b). By 2020 an estimated two-thirds of the world's

3b

Water withdrawal is skewed toward agriculture in every developing region

Annual water withdrawal per capita, 2002 (cubic meters)



Source: Tables 2.1 and 3.5.

people will be living in water-stressed countries (CSD 1997 as cited in UNEP 2002, p. 150). By then, water use is expected to have increased 40 percent, and 17 percent more water will be required for food production to meet the needs of growing populations (World Water Council 2000; UNEP 2002, p. 151).

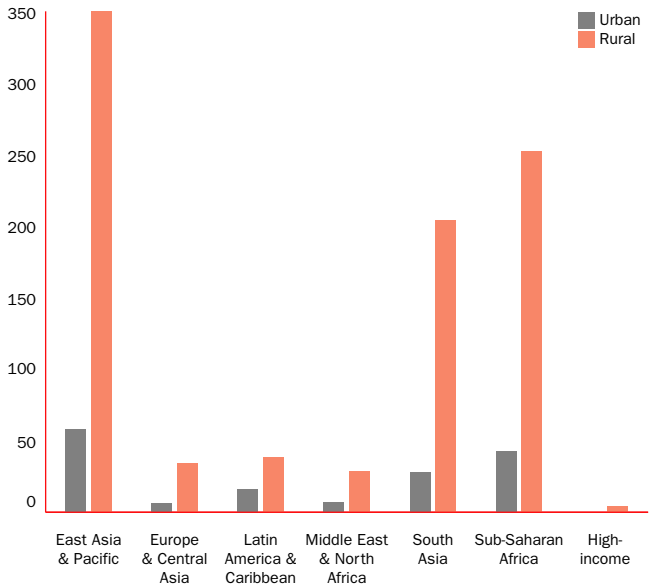
Population growth, expansion of irrigated agriculture, and industrial development are all behind the growing demand for water. Globally, agriculture accounts for 70 percent of freshwater withdrawal. Most is used for irrigation, which provides about 40 percent of world food production (CSD 1997 as cited in UNEP 2002). In Africa agriculture uses more than 85 percent of total water withdrawal, and population growth and demand for food are continuing to put more pressure on water availability. Without efficient and comprehensive water resources management that considers all aspects of water use, the projected water scarcity will have an even more profound impact.

Water quality can often be as severe a problem as water availability, but it receives less attention, particularly in developing regions. For many of the world's poorest populations, one of the greatest environmental threats to health remains the use of untreated water. While the share of people with access to an improved water source increased from 75 percent in 1990 to 82 percent in 2002, 1.1 billion people still lack access to safe drinking water (figure 3c) and 2.8 billion lack access to improved sanitation (table 3.10). Most of them are in Africa and Asia. Lack of access to safe water and sanitation results in hundreds of millions of cases of water-related diseases and more than 5 million deaths every year (UNEP 2002, p. 153).

3c

Many more people lack access to an improved water source in rural than in urban areas

Population without access to improved water, 2002 (millions)



Source: WHO and World Bank database.

Forests are still shrinking—but the rate of net loss is slowing

In developing regions population growth, increasing demand for food, particularly meat and dairy products, and declining growth in agricultural productivity are maintaining the pressure for deforestation. Total forest area in 2005 was just under 4 billion hectares, covering 30 percent of total land area, for an average of 0.62 hectare per capita. But forest area is unevenly distributed. For example, 64 countries with a combined population of 2 billion have less than 0.1 hectare of forest per capita. The 10 most forest-rich countries account for two-thirds of total forest area, while 7 countries or territories have no forest at all, and an additional 57 have forest on less than 10 percent of their land area.

Deforestation, mainly for conversion to agricultural land, continues—about 13 million hectares a year. At the same time, forest planting, landscape restoration, and natural expansion of forests have reduced the net loss of forest area. The net change in forest area during 2000–05 is estimated at a loss of 7.3 million hectares a year (an area about the size of Panama or Sierra Leone), an improvement from 8.9 million hectares a year during 1990–2000. Africa and Latin America continued to have the largest net loss of forests, while forest area in Europe continued to expand, although at a slower rate. Asia, which had a net loss in the 1990s, reported a net gain of forests in 2000–05, due primarily to large-scale reforestation reported by China.

Forests contribute directly and indirectly to the livelihoods of many people. Recognizing that, countries in most regions understand the need for more efficient forest management (box 3d). This effort has been very slow in developing regions, however, particularly in Asia and Sub-Saharan Africa.

Energy—the mix affects the impact

Economic growth and energy use move together. Energy, especially electricity, is important in raising people's standard of living. High-income countries use more than five times as much energy per capita as developing countries do, and with only 15 percent of the world's population they use more than half of its energy. Despite high and increasing energy costs, and the Kyoto Protocol, which calls for reduction in carbon dioxide emissions, fossil fuels are still the main source of energy—and their use has been rising faster than that of any other source of energy (figure 3e).

How energy is generated largely determines the resulting environmental damages. Generating energy from fossil fuels produces emissions of carbon dioxide, the main greenhouse gas contributing to global warming and climate change. Human-induced carbon dioxide emissions result primarily from fossil fuel combustion and cement manufacturing, with high-income countries contributing half

(figure 3f). Burning coal releases twice as much carbon dioxide as burning an equivalent amount of natural gas. Sub-Saharan Africa uses coal as its main source of electricity generation (more than two-thirds). So do East Asia and the Pacific and South Asia. Even though the low-income countries contribute less than 8 percent of global carbon dioxide emissions, they are affected by the consequences of climate change. Furthermore, there are local impacts from the type of energy use as well.

Most low-income countries depend on biomass energy for cooking and heating, a health hazard to billions of people. More than 3 million deaths a year are caused by air pollution, mostly due to particulate pollution. Many of these deaths are among children in developing countries, who die of acute respiratory infections due to indoor air pollution resulting from burning fuelwood, crop residues, or animal dung for cooking and heating. Sub-Saharan Africa has the highest death rate from respiratory disease followed by North Africa and Asia (figure 3g).

In South Africa children living in homes with wood stoves are almost five times more likely than others to develop respiratory infections severe enough to require hospitalization. In

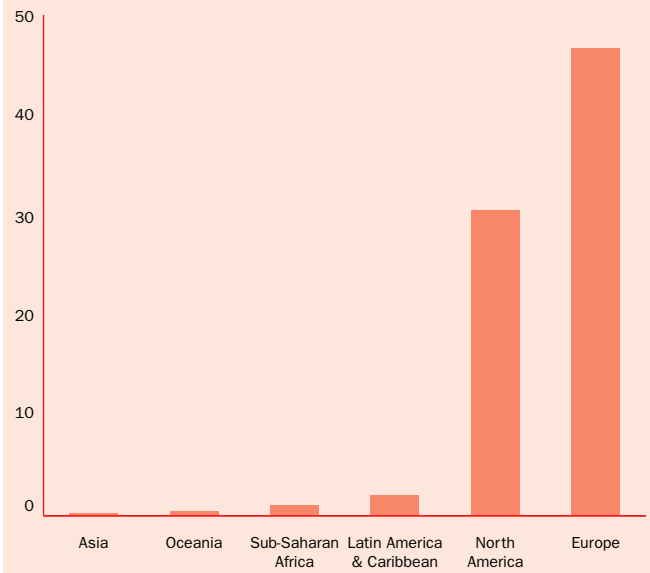
3d

Sustainable management of forests is spreading

Regulatory pressure, social activism, and consumer preferences have encouraged producers and marketers to provide a range of sustainably produced forest products, including timber, coffee, and fruit. Some products are certified as having been produced in an environmentally and socially responsible manner. About 2 percent of forests worldwide are now certified as managed for sustainable yield and for providing wildlife habitat, watershed protection, biodiversity, and other ecological services. While the market share for certified products is small, it is growing rapidly, although developed country regions are far ahead of developing regions in product certification (see figure).

Developing regions lag far behind developed regions in certifying forest area

Certified forest area, 2000 (millions of hectares)

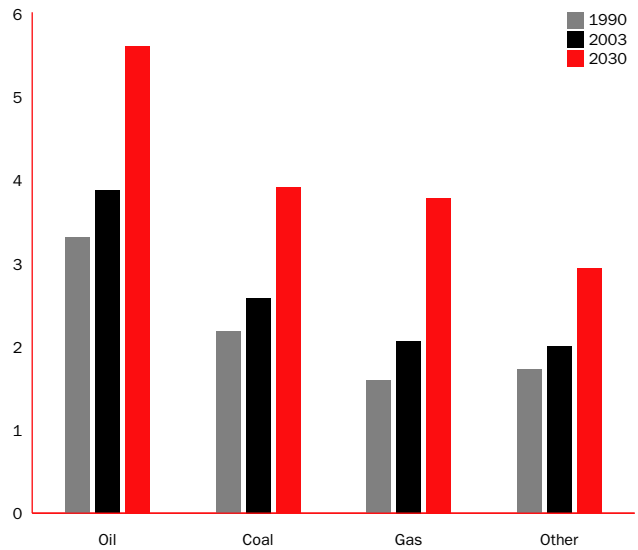


Source: FAO 2001.

3e

Use of fossil fuels continues to rise faster than that of other sources of energy

Energy use, 1990, 2003, and 2030 (billions of metric tons of oil equivalent)

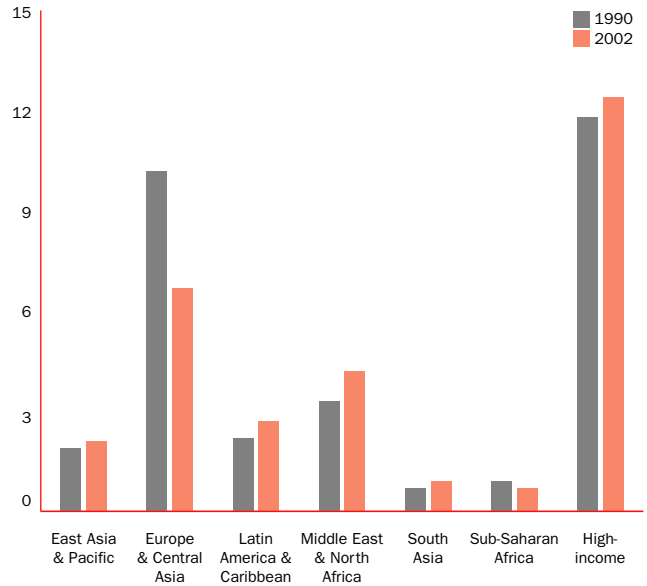


Source: International Energy Agency.

3f

High-income countries are the leading source of carbon dioxide emissions

Carbon dioxide emissions per capita, 1990 and 2002 (metric tons)



Source: Table 3.8.

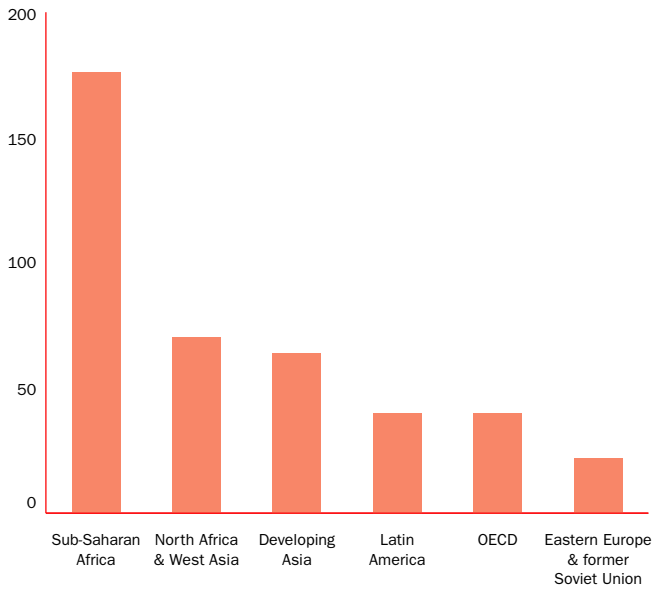
Tanzania children under age 5 who die of acute respiratory infection are three times more likely to have been sleeping in a room with an open cookstove than are healthy children. In The Gambia children carried on their mothers' backs as they cook over smoky stoves contract pneumonia at a rate 2.5 times higher than unexposed children (WRI 2005). Efforts to reduce indoor air pollution focus on improved cookstoves (box 3h).

The use of cleaner energy sources is another path toward sustainable energy use. Use of renewable energy is growing, but it is still a very small share of the total (figure 3i). About 4.5 percent of global energy production comes from modern renewable energy sources, up from 3.2 percent in 1971. Hydropower is the largest renewable energy source, but large-scale hydropower can have major adverse environmental and social impacts. Modern biomass and geothermal energy are the other major renewable sources and have substantial growth potential. Wind and solar energy, while growing rapidly, provide only about 0.02 percent each of the global energy supply.

3g

Sub-Sarahan Africa has the highest death rate from respiratory disease

Deaths per 100,000 people, 2002



Source: World Health Organization.

3h

More efficient use of traditional biomass is improving the lives of women

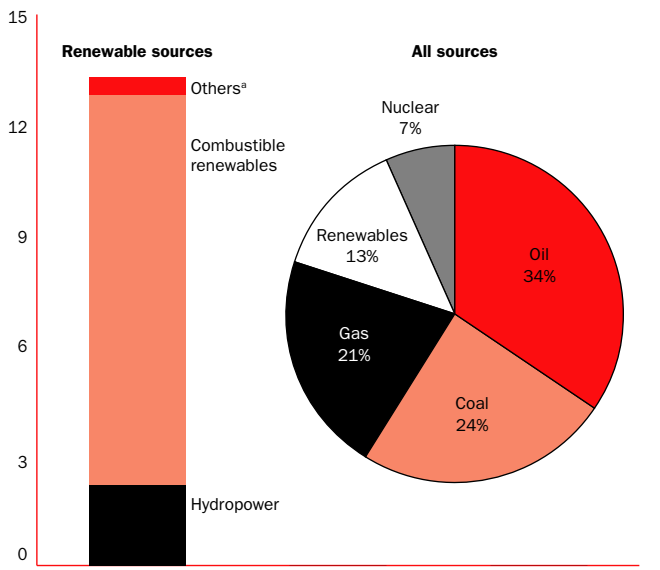
For most poor households in rural Africa and Asia improved biomass cookstoves are the most feasible option for reducing death and disease from traditional biomass cooking. They also conserve biomass resources and reduce the time and energy needed for collecting fuel and cooking, thus freeing women's time for other productive activities. The Upesi stove developed in Kenya, for example, with a clay liner in a mud and stone hearth, uses 40 percent less fuel than the traditional three-stone stove and emits 60 percent less smoke. For higher income rural households, expanding the distribution networks for canisters of liquefied petroleum gas can improve the welfare of women and children.

Source: United Nations 2002.

3i

Use of renewable sources of energy is growing, but is still small

Sources of energy, 2003 (%)



a. Includes wind, solar, and geothermal sources.

Source: International Energy Agency.

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 capita	
	1990	2004	1990–2004	2004	1990	2005	1990	2003	1990	2003	1989–91	2001–03
Afghanistan	82	..	..	652	2.0	1.3	0.2	0.2	12.1	12.1	0.54	0.31
Albania	64	56	–1.4	27	28.8	29.0	4.6	4.4	21.1	21.1	0.18	0.19
Algeria	49	41	0.5	2,382	0.8	1.0	0.2	0.3	3.0	3.2	0.28	0.24
Angola	74	64	1.7	1,247	48.9	47.4	0.4	0.2	2.3	2.7	0.28	0.21
Argentina	13	10	–1.0	2,737	12.9	12.1	0.4	0.4	9.7	10.2	0.81	0.74
Armenia	33	36	–0.6	28	12.3	10.0	2.7	2.1	17.7	17.7	..	0.16
Australia	15	8	–3.5	7,682	21.9	21.3	0.0	0.0	6.2	6.2	2.76	2.49
Austria	34	34	0.4	82	45.8	46.8	1.0	0.9	17.3	16.9	0.19	0.17
Azerbaijan	46	50	1.6	83	11.3	11.3	3.5	2.7	18.1	21.6	..	0.22
Bangladesh	80	75	1.6	130	6.8	6.7	2.3	3.4	70.2	61.3	0.09	0.06
Belarus	34	29	–1.5	207	35.6	38.1	0.9	0.6	29.3	26.8	..	0.57
Belgium	4	3	–1.6	33	20.6	20.3	0.5[a]	0.6	23.3[a]	26.6	..	..
Benin	66	55	2.0	111	30.0	21.3	1.0	2.4	14.6	24.0	0.31	0.33
Bolivia	44	36	0.7	1,084	57.9	54.2	0.1	0.2	1.9	2.8	0.31	0.35
Bosnia and Herzegovina	61	55	–1.4	51	..	42.7	*2.9*	1.9	*16.6*	19.6	..	0.26
Botswana	58	48	0.2	567	24.2	21.1	0.0	0.0	0.7	0.7	0.29	0.21
Brazil	25	16	–1.6	8,459	61.5	56.5	0.8	0.9	6.0	7.0	0.34	0.33
Bulgaria	34	30	–1.7	111	30.1	32.8	2.7	1.9	34.9	30.0	0.44	0.43
Burkina Faso	86	82	2.5	274	26.2	24.8	0.2	0.2	12.9	17.7	0.41	0.39
Burundi	94	90	1.5	26	11.3	5.9	14.0	14.2	36.2	38.6	0.16	0.14
Cambodia	87	81	1.9	177	73.3	59.2	0.6	0.6	20.9	21.0	0.38	0.28
Cameroon	60	48	0.7	465	52.7	45.7	2.6	2.6	12.8	12.8	0.51	0.39
Canada	23	19	–0.4	9,094	34.1	34.1	0.7	0.7	5.0	5.0	1.64	1.46
Central African Republic	63	57	1.3	623	37.3	36.5	0.1	0.2	3.1	3.1	0.64	0.50
Chad	79	75	2.8	1,259	10.4	9.5	0.0	0.0	2.6	2.9	0.54	0.41
Chile	17	13	–0.5	749	20.4	21.5	0.3	0.4	3.7	2.7	0.22	0.13
China[b]	73	60	–0.4	9,327	16.9	21.2	0.8	1.3	13.3	15.3	0.11	0.11
Hong Kong, China	0	0	..	..	..	..	..	..	..	..	..	..
Colombia	31	23	–0.4	1,039	59.2	58.5	1.6	1.5	3.2	2.2	0.09	0.05
Congo, Dem. Rep.	72	68	2.4	2,267	62.0	58.9	0.5	0.5	2.9	3.0	0.18	0.13
Congo, Rep.	52	46	2.4	342	66.6	65.8	0.1	0.2	1.4	1.5	0.20	0.13
Costa Rica	46	39	1.1	51	50.2	46.8	4.9	5.9	5.1	4.4	0.08	0.05
Côte d'Ivoire	60	55	1.8	318	32.1	32.7	11.0	11.3	7.6	10.4	0.19	0.19
Croatia	46	41	–1.4	56	..	38.2	*2.0*	2.2	*21.7*	26.1	..	0.33
Cuba	26	24	–0.2	110	18.7	24.7	7.4	6.6	27.6	27.9	0.29	0.28
Czech Republic	25	26	0.1	77	..	34.3	..	3.1	..	39.6	..	0.30
Denmark	15	15	0.1	42	10.5	11.8	0.2	0.2	60.4	53.4	0.50	0.42
Dominican Republic	45	40	0.8	48	28.4	28.4	9.3	10.3	21.7	22.7	0.15	0.13
Ecuador	45	38	0.5	277	49.9	39.2	4.8	4.9	5.8	5.9	0.16	0.13
Egypt, Arab Rep.	57	58	2.1	995	0.0	0.1	0.4	0.5	2.3	2.9	0.04	0.04
El Salvador	51	40	0.3	21	18.1	14.4	12.6	12.1	26.5	31.9	0.11	0.10
Eritrea	84	80	2.0	101	..	15.4	..	0.0	..	5.6	..	0.15
Estonia	29	30	–0.7	42	51.0	53.9	0.3	0.4	26.3	12.9	..	0.45
Ethiopia	87	84	2.0	1,000	..	13.0	..	0.7	..	11.1	..	0.16
Finland	39	39	0.4	305	72.9	73.9	0.0	0.0	7.5	7.3	0.46	0.42
France	26	24	–0.3	550	26.4	28.3	2.2	2.0	32.7	33.5	0.32	0.31
Gabon	32	16	–2.6	258	85.1	84.5	0.6	0.7	1.1	1.3	0.31	0.25
Gambia, The	75	74	3.1	10	44.2	47.1	0.5	0.5	18.2	31.5	0.20	0.23
Georgia	45	48	–0.8	69	39.7	39.7	4.8	3.8	11.4	11.5	..	0.17
Germany	15	12	–1.4	349	30.8	31.7	1.3	0.6	34.3	33.9	0.15	0.14
Ghana	64	54	1.3	228	32.7	24.3	6.6	9.7	11.9	18.4	0.17	0.20
Greece	41	39	0.2	129	25.6	29.1	8.3	8.8	22.5	20.9	0.28	0.25
Guatemala	59	53	1.6	108	43.8	36.3	4.5	5.6	12.0	13.3	0.15	0.12
Guinea	75	64	1.7	246	30.2	27.4	2.0	2.7	3.0	4.5	0.12	0.12
Guinea-Bissau	76	65	1.9	28	78.8	73.7	4.2	8.9	10.7	10.7	0.30	0.21
Haiti	71	62	0.5	28	4.2	3.8	11.6	11.6	28.3	28.3	0.11	0.10

Rural population and land use

3.1

	Rural population			Land area	Land use							
	% of total		average annual % growth	thousand sq. km	% of land area						Arable land hectares per capita	
	Forest area				Permanent cropland		Arable land					
	1990	2004	1990–2004	2004	1990	2005	1990	2003	1990	2003	1989–91	2001–03
Honduras	60	54	1.9	112	66.0	41.5	3.2	3.2	13.1	9.6	0.30	0.16
Hungary	38	34	–0.9	92	19.5	21.5	2.5	2.1	54.7	50.1	0.49	0.45
India	74	71	1.4	2,973	21.5	22.8	2.2	3.1	54.8	54.0	0.19	0.15
Indonesia	69	53	–0.5	1,812	64.4	48.9	6.5	7.4	11.2	11.6	0.11	0.10
Iran, Islamic Rep.	44	33	–0.6	1,636	6.8	6.8	0.8	1.3	9.3	9.9	0.29	0.23
Iraq	30	..	..	437	1.8	1.9	0.7	0.6	12.1	13.2	0.29	0.22
Ireland	43	40	0.5	69	6.4	9.7	0.0	0.0	15.1	17.2	0.30	0.29
Israel	10	8	1.6	22	7.1	7.9	4.1	4.0	15.8	15.8	0.07	0.05
Italy	33	33	–0.1	294	28.5	33.9	10.1	9.3	30.6	27.1	0.16	0.14
Jamaica	49	48	0.6	11	31.9	31.3	9.2	10.2	11.0	16.1	0.05	0.07
Japan	37	34	–0.3	365	68.4	68.2	1.3	0.9	13.1	12.1	0.04	0.03
Jordan	28	21	1.8	88	0.9	0.9	1.0	1.2	3.3	3.3	0.09	0.05
Kazakhstan	43	44	–0.4	2,700	1.3	1.2	0.1	0.1	13.0	8.4	..	1.51
Kenya	75	60	0.9	569	6.5	6.2	0.9	1.0	7.4	8.2	0.18	0.14
Korea, Dem. Rep.	42	39	0.4	120	68.1	51.4	1.5	1.7	19.0	22.4	0.12	0.12
Korea, Rep.	26	19	–1.3	99	64.5	63.5	1.6	2.0	19.8	16.7	0.05	0.03
Kuwait	5	4	–1.3	18	0.2	0.3	0.1	0.2	0.2	0.8	0.00	0.01
Kyrgyz Republic	62	66	1.4	192	4.4	4.5	0.3	0.3	7.0	6.8	..	0.26
Lao PDR	85	79	1.9	231	75.0	69.9	0.3	0.4	3.5	4.1	0.19	0.17
Latvia	30	34	–0.1	62	44.7	47.4	0.4	0.5	27.2	29.4	..	0.78
Lebanon	17	12	–0.4	10	11.8	13.3	11.9	14.0	17.9	16.6	0.07	0.05
Lesotho	83	82	0.8	30	0.2	0.3	0.1	0.1	10.4	10.9	0.20	0.18
Liberia	58	53	2.3	96	42.1	32.8	2.2	2.3	4.2	4.0	0.19	0.12
Libya	20	13	–0.8	1,760	0.1	0.1	0.2	0.2	1.0	1.0	0.42	0.33
Lithuania	32	33	–0.3	63	31.0	33.5	0.9	0.9	47.8	46.7	..	0.84
Macedonia, FYR	42	40	0.1	25	..	35.6	*2.2*	1.8	*23.8*	22.3	..	0.28
Madagascar	76	73	2.6	582	23.5	22.1	1.0	1.0	4.7	5.1	0.23	0.17
Malawi	88	83	1.6	94	41.4	36.2	1.2	1.5	19.3	26.0	0.19	0.19
Malaysia	50	36	–0.1	329	68.1	63.6	16.0	17.6	5.2	5.5	0.10	0.08
Mali	76	67	1.9	1,220	11.5	10.3	0.0	0.0	1.7	3.8	0.23	0.38
Mauritania	56	37	–0.2	1,025	0.4	0.3	0.0	0.0	0.4	0.5	0.20	0.17
Mauritius	60	56	0.7	2	19.2	18.2	3.0	3.0	49.3	49.3	0.09	0.08
Mexico	28	24	0.7	1,909	36.2	33.7	1.0	1.3	12.6	13.0	0.29	0.25
Moldova	53	54	–0.2	33	9.7	10.0	14.2	9.1	52.8	56.1	..	0.43
Mongolia	43	43	1.3	1,567	7.3	6.5	0.0	0.0	0.9	0.8	0.65	0.49
Morocco	52	42	0.1	446	9.6	9.8	1.7	2.0	19.5	19.0	0.36	0.30
Mozambique	79	63	1.1	784	25.5	24.6	0.3	0.3	4.4	5.6	0.26	0.22
Myanmar	75	70	1.0	658	59.6	49.0	0.8	1.4	14.6	15.4	0.23	0.20
Namibia	73	67	1.9	823	10.6	9.3	0.0	0.0	0.8	1.0	0.47	0.42
Nepal	91	85	1.8	143	33.7	25.4	0.5	0.9	16.0	16.5	0.12	0.09
Netherlands	40	34	–0.6	34	10.2	10.8	0.9	0.9	25.9	26.9	0.06	0.06
New Zealand	15	14	0.6	268	28.8	31.0	5.1	7.0	9.4	5.6	0.73	0.38
Nicaragua	47	42	1.4	121	53.9	42.7	1.6	1.9	10.7	15.9	0.33	0.37
Niger	84	77	2.7	1,267	1.5	1.0	0.0	0.0	8.7	11.4	1.28	1.15
Nigeria	65	53	1.0	911	18.9	12.2	2.8	3.2	32.4	33.5	0.33	0.24
Norway	28	20	–1.7	306	29.8	30.7	..	..	2.8	2.9	0.21	0.19
Oman	38	22	–1.6	310	0.0	0.0	0.2	0.1	0.1	0.1	0.02	0.02
Pakistan	69	66	2.0	771	3.3	2.5	0.6	0.9	26.6	25.2	0.19	0.14
Panama	46	43	1.4	74	58.8	57.7	2.1	2.0	6.7	7.4	0.21	0.18
Papua New Guinea	87	87	2.4	453	69.6	65.0	1.3	1.4	0.4	0.5	0.05	0.04
Paraguay	51	42	1.1	397	53.3	46.5	0.2	0.2	5.3	7.7	0.50	0.53
Peru	31	26	0.4	1,280	54.8	53.7	0.3	0.5	2.7	2.9	0.16	0.14
Philippines	51	38	0.0	298	35.5	24.0	14.8	16.8	18.4	19.1	0.09	0.07
Poland	39	38	–0.2	306	29.2	30.0	1.1	1.0	47.3	41.1	0.38	0.35
Portugal	53	45	–0.8	92	33.9	41.3	8.5	7.9	25.6	17.4	0.24	0.16
Puerto Rico	28	3	–15.0	9	45.6	46.0	5.6	5.6	7.3	3.7	0.02	0.01

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 % of land area		Arable land % of land area		Arable land hectares per capita	
	1990	2004	1990–2004	2004	1990	2005	1990	2003	1990	2003	1989–91	2001–03
Romania	47	45	–0.7	230	27.8	27.7	2.6	2.0	41.2	40.9	0.41	0.43
Russian Federation	27	27	–0.2	16,381	49.4	49.4	0.1	0.1	8.1	7.5	..	0.85
Rwanda	95	80	0.4	25	12.9	19.5	12.4	10.9	35.7	48.6	0.12	0.13
Saudi Arabia	22	12	–1.6	2,150	1.3	1.3	0.0	0.1	1.6	1.7	0.21	0.16
Senegal	60	50	1.2	193	48.6	45.1	0.1	0.2	12.1	12.8	0.29	0.23
Serbia and Montenegro	49	48	–2.0	102	..	26.4	*3.5*	3.2	*36.5*	33.2	..	0.42
Sierra Leone	70	60	0.9	72	42.5	38.5	0.8	1.1	6.8	8.0	0.12	0.11
Singapore	0	0	..	1	3.0	3.0	1.5	1.5	1.5	1.5	0.00	0.00
Slovak Republic	44	42	–0.1	48	..	..	..	..	..	..	..	..
Slovenia	49	49	0.0	20	..	62.8	*1.8*	1.4	*9.9*	8.6	..	0.09
Somalia	71	65	0.6	627	13.2	11.4	0.0	0.0	1.6	1.7	0.15	0.14
South Africa	51	43	0.5	1,214	7.6	7.6	0.7	0.8	11.1	12.2	0.38	0.33
Spain	25	23	0.3	499	27.0	35.9	9.7	10.0	30.7	27.5	0.40	0.33
Sri Lanka	79	79	1.0	65	36.4	29.9	15.9	15.5	13.5	14.2	0.05	0.05
Sudan	73	60	0.8	2,376	32.2	28.4	0.1	0.2	5.5	7.2	0.50	0.48
Swaziland	77	76	2.6	17	27.4	31.5	0.7	0.8	10.5	10.4	0.24	0.16
Sweden	17	17	0.2	410	66.7	67.1	0.0	0.0	6.9	6.5	0.33	0.30
Switzerland	32	32	0.9	40	28.9	30.5	0.5	0.6	9.8	10.2	0.06	0.06
Syrian Arab Republic	51	50	2.5	184	2.0	2.5	4.0	4.5	26.6	25.0	0.38	0.26
Tajikistan	68	75	2.1	140	2.9	2.9	0.9	0.9	6.1	6.6	..	0.15
Tanzania	78	64	1.1	884	46.9	39.9	1.0	1.2	4.0	4.5	0.13	0.11
Thailand	71	68	0.8	511	31.3	28.4	6.1	7.0	34.2	27.7	0.32	0.24
Togo	72	64	2.2	54	12.6	7.1	1.7	2.2	38.6	46.2	0.53	0.44
Trinidad and Tobago	31	24	–1.3	5	45.8	44.1	9.0	9.2	14.4	14.6	0.06	0.06
Tunisia	42	36	0.3	155	4.1	6.8	12.5	13.8	18.7	18.0	0.36	0.28
Turkey	41	33	0.3	770	12.6	13.2	3.9	3.5	32.0	30.4	0.44	0.34
Turkmenistan	55	54	1.8	470	8.8	8.8	0.1	0.1	2.9	4.7	..	0.42
Uganda	89	88	3.1	197	25.0	18.4	9.4	10.9	25.4	26.4	0.28	0.20
Ukraine	33	33	–0.8	579	16.0	16.5	1.9	1.6	57.6	56.1	..	0.67
United Arab Emirates	17	15	5.2	84	2.9	3.7	0.2	2.3	0.4	0.8	0.02	0.02
United Kingdom	11	11	0.0	242	10.8	11.8	0.3	0.2	27.4	23.4	0.12	0.10
United States	25	20	–0.5	9,159	32.6	33.1	0.2	0.2	20.3	18.9	0.74	0.60
Uruguay	11	7	–2.3	175	5.2	8.6	0.3	0.2	7.2	7.8	0.41	0.40
Uzbekistan	60	63	2.2	425	7.2	7.8	0.9	0.8	10.5	11.1	..	0.18
Venezuela, RB	16	12	0.0	882	59.0	54.1	0.9	0.9	3.2	3.0	0.14	0.10
Vietnam	80	74	1.0	325	28.8	39.7	3.2	7.1	16.4	20.5	0.08	0.08
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	79	74	3.3	528	1.0	1.0	0.2	0.3	2.9	2.9	0.12	0.08
Zambia	61	64	2.6	743	66.1	57.1	0.0	0.0	7.1	7.1	0.63	0.47
Zimbabwe	71	65	0.8	387	57.5	45.3	0.3	0.3	7.5	8.3	0.27	0.25
World	**57 w**	**51 w**	**0.6 w**	**129,663 s**	**31.6 w**	**30.5 w**	**0.9 w**	**1.1 w**	**10.8 w**	**10.8 w**	**0.24 w**	**0.23 w**
Low income	74	69	1.6	29,192	27.8	24.8	1.0	1.2	12.9	13.5	0.21	0.17
Middle income	56	47	–0.2	67,543	34.5	33.6	1.0	1.2	9.6	9.7	0.18	0.22
Lower middle income	62	51	–0.2	38,470	32.1	30.7	1.3	1.6	10.0	10.5	0.15	0.17
Upper middle income	31	28	0.1	28,983	37.7	37.3	0.6	0.6	9.0	8.7	0.37	0.45
Low & middle income	63	57	0.7	96,645	32.5	30.9	1.0	1.2	10.5	10.8	0.20	0.20
East Asia & Pacific	71	59	–0.2	15,885	28.8	28.4	2.2	2.8	12.1	13.3	0.12	0.12
Europe & Central Asia	37	36	0.0	23,371	38.2	38.3	0.4	0.4	12.3	11.4	..	0.57
Latin America & Carib.	29	23	–0.1	20,057	49.0	45.6	0.9	1.0	6.6	7.1	0.30	0.27
Middle East & N. Africa	48	44	1.3	8,955	2.2	2.4	0.7	0.9	5.6	5.8	0.23	0.18
South Asia	75	72	1.6	4,781	16.5	16.8	1.8	2.4	42.6	41.7	0.18	0.14
Sub-Saharan Africa	72	64	1.6	23,596	30.0	26.5	0.8	0.9	6.3	7.5	0.31	0.25
High income	25	22	–0.4	33,018	28.9	29.3	0.7	0.7	11.4	10.8	0.43	0.37
Europe EMU	26	24	–0.3	2,435	33.2	37.0	4.7	4.5	27.1	25.8	0.23	0.21

a. Includes Luxembourg. b. Includes Taiwan, China.

Rural population and land use 3.1

About the data

Indicators of rural development are sparse, as few indicators are disaggregated between rural and urban areas (for some that are, see tables 2.7 and 3.10). This table shows indicators of rural population and land use. Rural population is approximated as the midyear nonurban population.

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 the quality of data collection. Countries use different definitions of rural population and land use, for example. The Food and Agriculture Organization (FAO), the primary compiler of these data, occasionally adjusts its definitions of land use categories and sometimes revises earlier data. Because the data reflect changes in reporting procedures as well as actual changes in land use, apparent trends should be interpreted with caution.

Satellite images show land use that differs from that given by ground-based measures in both area under cultivation and type of land use. Moreover, land use data in countries such as India are based on reporting systems that were designed for the collection of tax revenue. Because taxes on land are no longer a major source of government revenue, the quality and coverage of land use data (except for cropland) have declined. Data on forest area may be particularly unreliable because of differences in definitions and irregular surveys (see *About the data* for table 3.4).

Definitions

• **Rural population** is calculated as the difference between the total population and the urban population (see *Definitions* for tables 2.1 and 3.10). • **Land area** is a country's total area, excluding area under inland water bodies, national claims to the continental shelf, and exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes. (See table 1.1 for the total surface area of countries.) • **Land use** is broken into three categories. • **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. This category includes land under flowering shrubs, fruit trees, nut trees, and vines, but excludes land under trees grown for wood or timber. • **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.

3.1a

Ten countries with the largest forest area, 2005

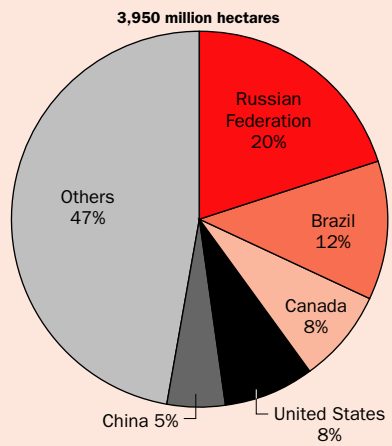
Country	Million hectares
Russian Federation	809
Brazil	478
Canada	310
United States	303
China	197
Australia	164
Congo, Dem. Rep.	134
Indonesia	88
Peru	69
India	68

Source: Food and Agricultural Organization's Global Forest Resources Assessment.

3.1b

Five countries had more than half the world's forest in 2005

Forest area as share of world total



Source: Food and Agricultural Organization's Global Forest Resources Assessment.

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.

3.2 Agricultural inputs

	Agricultural land		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	
	1989–91	2001–03	1989–91	2001–03	1989–91	2003–05	1989–91	2000–02	1989–91	2001–03	1989–91	2001–03
Afghanistan	58.3	58.3	33.8	33.8	..	..	63	19	..	..	1	1
Albania	40.9	41.4	58.9	49.6	295	144	1,378	420	..	..	195	141
Algeria	16.2	16.8	5.8	6.9	2,807	2,784	157	130	..	21.1	125	129
Angola	46.1	46.1	2.3	2.3	883	1,372	46	2	..	..	35	33
Argentina	46.6	47.0	5.7	5.4	8,557	9,633	61	295	0.3	1.0	103	108
Armenia	..	49.5	..	51.1	168	194	..	157	20.5	..	..	288
Australia	60.5	58.2	4.0	5.1	12,823	18,360	272	465	5.4	4.4	67	64
Austria	42.7	41.2	0.3	0.3	940	783	2,001	1,533	7.7	5.7	2,378	2,368
Azerbaijan	..	56.8	..	72.5	627	794	..	63	31.4	40.1	..	169
Bangladesh	76.5	69.5	30.5	54.3	11,083	11,624	1,049	1,738	65.7	..	6	7
Belarus	..	43.1	..	2.3	2,578	2,066	..	1,325	21.6	..	..	111
Belgium	44.0[a]	46.3	2.3[a]	4.5	367[a]	314	4,969[a]	3,322[a]	2.7	1.7	1,530[a]	1,202[a]
Benin	20.4	30.4	0.6	0.4	658	948	54	154	..	..	1	1
Bolivia	32.8	34.2	5.4	4.1	620	748	37	37	1.7	..	25	20
Bosnia and Herzegovina	..	41.7	..	0.3	..	340	..	356	..	..	..	289
Botswana	45.9	45.8	0.3	0.3	203	137	22	122	..	12.3	135	159
Brazil	28.6	31.2	4.6	4.4	20,101	19,772	653	1,201	23.0	20.2	142	137
Bulgaria	55.7	48.7	30.1	16.5	2,152	1,760	1,698	500	18.9	18.0	135	95
Burkina Faso	35.0	39.2	0.5	0.5	2,743	3,249	59	30	..	..	2	4
Burundi	82.8	90.8	1.2	1.6	218	211	32	33	..	..	2	2
Cambodia	30.1	30.1	6.3	7.1	1,860	2,247	9	0	..	70.2	3	7
Cameroon	19.7	19.7	0.3	0.4	755	863	38	75	60.6	..	1	1
Canada	7.5	7.4	1.4	1.5	21,446	17,276	470	549	4.3	2.8	165	160
Central African Republic	8.0	8.3	0.0	0.1	110	187	5	3	..	..	0	0
Chad	38.4	38.6	0.5	0.8	1,170	1,887	20	49	..	..	1	0
Chile	21.3	20.4	51.8	82.4	778	687	1,082	2,386	19.3	13.6	129	272
China	57.0	59.5	36.0	35.4	93,047	79,896	2,222	2,578	55.8	44.7	67	65
Hong Kong, China	..	..	..	..	..	..	..	..	0.9	0.2	..	..
Colombia	43.4	44.2	13.1	22.6	1,655	1,195	1,770	2,605	1.3	21.6	98	89
Congo, Dem. Rep.	10.1	10.1	0.1	0.1	1,840	2,049	11	7	..	..	4	4
Congo, Rep.	30.8	30.9	0.2	0.4	15	11	24	67	..	..	14	14
Costa Rica	55.6	56.1	15.1	20.6	89	58	4,256	6,455	25.9	15.5	248	311
Côte d'Ivoire	59.4	62.4	1.1	1.1	1,401	1,638	152	256	..	..	15	12
Croatia	..	56.2	..	0.4	..	701	..	1,303	..	15.8	..	25
Cuba	61.5	60.6	23.2	22.5	233	326	1,771	476	24.9	25.5	256	249
Czech Republic	..	55.3	..	0.7	..	1,557	..	1,186	11.4	4.7	..	305
Denmark	65.5	62.9	16.9	19.6	1,564	1,493	2,436	1,393	5.6	3.2	639	540
Dominican Republic	74.0	76.4	15.1	17.2	135	150	859	848	20.3	15.4	22	17
Ecuador	28.3	29.2	27.9	29.0	828	844	465	1,531	7.1	8.5	65	91
Egypt, Arab Rep.	2.6	3.4	100.0	100.0	2,280	2,846	4,181	4,478	37.6	28.0	250	309
El Salvador	70.1	82.2	4.9	5.0	428	330	1,392	1,054	9.3	19.9	62	52
Eritrea	..	74.6	..	3.7	..	371	..	119	..	..	..	8
Estonia	..	19.0	..	0.6	454	267	..	432	20.5	6.7	..	889
Ethiopia	..	31.3	..	2.6	..	7,233	..	145	..	..	..	3
Finland	7.9	7.3	2.8	2.9	1,144	1,168	1,904	1,353	8.9	5.3	1,059	882
France	55.6	53.9	10.3	13.3	9,244	9,158	3,217	2,221	6.4	..	799	685
Gabon	20.0	20.0	1.0	1.4	14	20	33	9	..	..	50	46
Gambia, The	63.8	77.9	0.7	0.6	92	182	64	26	..	..	2	1
Georgia	..	43.2	..	44.1	249	332	..	412	..	53.8	..	254
Germany	50.8	48.7	4.0	4.0	6,864	6,983	3,070	2,245	4.1	2.5	1,314	801
Ghana	55.4	64.4	0.7	0.5	1,066	1,376	36	60	..	..	15	9
Greece	71.4	65.6	30.3	37.4	1,473	1,278	2,307	1,580	23.8	15.9	752	939
Guatemala	39.5	42.7	6.6	6.4	726	666	999	1,427	49.9	38.7	32	30
Guinea	48.7	50.4	7.2	5.6	603	778	18	32	..	..	5	5
Guinea-Bissau	53.2	57.9	4.1	4.6	106	134	22	80	..	..	1	1
Haiti	58.0	57.7	7.6	8.4	408	458	32	181	..	..	3	2

Agricultural inputs 3.2

	Agricultural land		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	
	1989–91	2001–03	1989–91	2001–03	1989–91	2003–05	1989–91	2000–02	1989–91	2001–03	1989–91	2001–03
Honduras	29.9	26.2	3.8	5.6	475	391	191	1,193	44.1	35.1	31	49
Hungary	70.1	63.7	3.8	4.8	2,827	2,934	1,459	992	..	6.0	126	246
India	60.9	60.8	27.6	32.7	102,279	97,569	739	1,044	68.7	..	61	141
Indonesia	24.1	24.9	14.2	13.3	13,442	15,140	1,227	1,321	55.7	44.8	15	45
Iran, Islamic Rep.	37.3	37.5	41.1	44.1	9,503	9,013	760	921	26.0	..	136	168
Iraq	21.9	22.9	57.3	58.6	..	..	350	968	..	..	72	80
Ireland	76.2	63.6	..	..	306	292	6,609	5,308	14.6	6.8	1,624	1,360
Israel	26.6	26.2	47.0	45.4	111	84	2,877	2,598	4.1	1.9	795	718
Italy	56.4	52.2	21.9	24.9	4,481	4,124	2,135	1,819	8.9	5.1	1,593	2,031
Jamaica	44.0	47.4	11.3	8.8	2	1	2,079	1,258	..	19.9	252	177
Japan	15.6	14.2	54.3	54.7	2,469	2,001	3,865	3,066	7.2	4.7	4,306	4,588
Jordan	13.3	12.9	16.5	18.8	101	53	663	977	..	..	213	212
Kazakhstan	..	76.9	..	15.8	22,152	13,794	..	23	22.5	35.4	..	22
Kenya	45.7	46.5	1.2	1.8	1,776	2,101	258	320	19.0	..	24	28
Korea, Dem. Rep.	20.9	24.2	57.5	50.9	1,604	1,296	3,577	1,018	..	..	299	241
Korea, Rep.	22.1	19.5	46.8	47.2	1,427	1,093	4,888	4,317	17.4	9.4	215	1,239
Kuwait	7.9	8.6	60.0	77.0	1	2	417	711	..	..	222	69
Kyrgyz Republic	..	56.0	..	78.3	578	568	..	213	33.8	48.4	..	171
Lao PDR	7.2	8.1	15.7	17.6	643	819	18	95	..	..	11	12
Latvia	40.8	39.9	1.1	1.1	699	451	995	300	17.6	14.8	..	305
Lebanon	31.0	32.2	28.2	33.2	41	61	1,510	2,838	..	..	175	488
Lesotho	76.3	76.9	0.6	0.9	199	247	161	309	..	..	59	61
Liberia	27.1	27.0	0.4	0.5	179	120	25	0	..	..	8	9
Libya	8.8	8.8	20.2	21.9	418	341	445	349	..	..	179	219
Lithuania	..	55.6	..	0.2	1,134	880	..	579	..	17.7	..	349
Macedonia, FYR	..	48.8	..	9.0	..	195	..	502	..	23.0	..	954
Madagascar	47.0	47.4	30.1	30.6	1,308	1,423	32	31	..	78.0	11	12
Malawi	40.1	45.8	1.0	2.3	1,415	1,694	317	400	..	..	8	6
Malaysia	22.0	24.0	5.0	4.8	696	699	5,386	6,548	27.4	14.8	153	241
Mali	26.3	28.4	3.7	5.0	2,340	3,275	78	89	..	..	10	6
Mauritania	38.7	38.8	12.2	9.8	156	121	95	40	..	..	8	8
Mauritius	55.7	55.7	16.0	20.1	1	0	2,867	3,035	15.8	10.0	36	37
Mexico	54.2	56.2	21.6	23.2	10,014	10,946	716	727	24.2	17.0	124	131
Moldova	..	77.1	..	14.0	676	882	..	86	..	47.9	..	223
Mongolia	80.3	83.3	5.7	7.0	647	185	116	31	33.8	45.0	79	42
Morocco	67.8	68.0	13.5	15.5	5,545	5,578	369	440	..	44.2	45	58
Mozambique	60.8	61.8	2.8	2.7	1,561	2,112	10	53	..	..	17	14
Myanmar	15.8	16.8	10.2	17.9	5,154	6,827	84	146	67.5	..	13	10
Namibia	47.0	47.2	0.6	1.0	214	244	0	4	48.2	..	46	39
Nepal	29.0	29.5	41.6	47.1	3,013	3,333	320	333	82.8	..	22	24
Netherlands	59.0	57.2	61.0	59.9	192	222	6,506	4,286	4.6	3.0	2,074	1,641
New Zealand	65.3	64.3	7.3	8.5	161	121	1,525	5,704	10.6	8.7	301	507
Nicaragua	52.0	57.5	4.0	2.8	305	502	281	177	38.7	37.0	20	15
Niger	25.9	30.4	0.6	0.5	6,232	7,138	2	3	..	..	0	0
Nigeria	79.2	78.8	0.7	0.8	15,596	21,508	135	66	..	..	8	10
Norway	3.2	3.4	..	..	357	326	2,388	2,100	6.3	3.9	1,741	1,498
Oman	3.5	3.5	72.6	88.4	2	2	2,185	2,491	..	..	41	50
Pakistan	33.7	34.4	76.8	83.9	11,794	12,507	921	1,377	49.9	45.3	127	154
Panama	28.5	30.0	4.8	6.2	179	208	656	545	28.2	17.7	103	148
Papua New Guinea	2.0	2.3	..	..	2	3	671	556	..	..	60	53
Paraguay	58.6	62.5	3.0	2.2	447	782	92	319	1.7	32.2	72	55
Peru	16.3	16.6	30.5	27.9	802	1,118	320	759	1.1	0.8	37	36
Philippines	37.3	40.9	15.7	14.5	7,113	6,562	955	1,313	45.2	37.4	19	20
Poland	61.7	56.1	0.7	0.7	8,541	8,276	1,383	1,140	25.3	18.9	815	1,025
Portugal	43.3	41.5	20.2	27.5	832	465	1,152	1,234	18.1	12.6	563	1,029
Puerto Rico	49.0	25.5	34.5	48.2	1	0	..	..	3.7	2.0	..	..

3.2 Agricultural inputs

	Agricultural land		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	
	1989–91	2001–03	1989–91	2001–03	1989–91	2003–05	1989–91	2000–02	1989–91	2001–03	1989–91	2001–03
Romania	64.4	64.4	31.1	31.1	5,927	5,655	1,077	355	28.9	38.1	147	178
Russian Federation	..	13.2	..	3.7	59,541	39,476	..	121	14.1	10.5	..	52
Rwanda	75.8	74.8	0.3	0.7	250	330	20	48	90.1	..	1	1
Saudi Arabia	56.7	80.9	45.6	42.7	1,009	646	1,461	1,067	..	5.4	19	28
Senegal	41.9	42.4	3.6	4.6	1,211	1,165	58	140	..	..	2	3
Serbia and Montenegro	..	54.8	..	0.8	..	2,047	..	732	..	..	..	1,023
Sierra Leone	38.3	39.1	5.2	5.0	462	253	24	5	..	..	6	2
Singapore	3.0	3.0	..	..	..	..	54,333	25,920	0.4	0.3	620	650
Slovak Republic	..	..	..	..	..	..	..	..	..	6.0	..	..
Slovenia	..	25.2	..	1.5	..	99	..	4,239	..	9.3	..	6,314
Somalia	70.2	70.3	19.2	18.7	..	..	18	5	..	..	21	16
South Africa	79.7	82.0	8.4	9.5	6,192	4,469	573	558	..	10.7	108	46
Spain	61.1	60.2	16.8	20.3	7,756	6,570	1,282	1,605	11.5	6.0	481	689
Sri Lanka	36.2	36.4	27.5	34.4	810	873	2,127	2,862	44.6	34.7	75	113
Sudan	51.9	56.4	13.7	11.0	5,376	9,365	48	40	..	..	7	7
Swaziland	74.3	80.9	22.9	26.0	80	64	697	371	..	..	233	222
Sweden	8.3	7.7	4.0	4.3	1,235	1,099	1,148	1,010	3.4	2.1	604	616
Switzerland	50.5	38.1	6.1	5.8	210	164	4,297	2,272	4.3	4.1	2,874	2,644
Syrian Arab Republic	73.5	74.8	12.9	24.1	3,969	3,194	581	718	..	30.3	129	225
Tajikistan	..	30.4	..	68.2	266	391	..	175	63.4	..	..	233
Tanzania	53.7	54.4	3.3	3.5	2,990	3,243	378	31	84.2	82.1	19	19
Thailand	41.9	38.4	20.6	26.6	10,991	11,152	537	1,039	63.2	45.7	33	144
Togo	58.4	66.7	0.3	0.3	625	767	57	74	..	..	0	0
Trinidad and Tobago	25.5	25.9	3.3	3.3	6	2	833	631	12.6	7.4	355	360
Tunisia	56.9	62.3	6.7	8.0	1,375	1,377	328	372	..	..	86	126
Turkey	51.8	51.0	14.5	19.5	13,679	13,809	736	768	47.4	35.5	278	410
Turkmenistan	..	69.7	..	89.1	331	948	..	543	42.4	..	..	256
Uganda	60.6	62.7	0.1	0.1	1,078	1,532	1	14	80.1	69.1	9	9
Ukraine	..	71.4	..	6.8	12,542	13,089	..	154	..	19.5	..	124
United Arab Emirates	3.3	6.8	128.1	29.2	1	0	4,247	5,149	..	..	55	55
United Kingdom	75.3	70.1	2.4	3.0	3,677	3,039	3,553	3,141	2.2	1.3	762	877
United States	46.6	44.7	11.1	12.7	63,775	57,028	1,006	1,101	2.9	2.5	248	273
Uruguay	84.7	85.5	9.6	14.3	508	567	586	849	..	4.3	262	241
Uzbekistan	..	64.2	..	87.4	1,225	1,753	..	1,614	40.6	..	..	373
Venezuela, RB	24.8	24.5	13.1	16.9	819	1,040	1,579	1,132	13.1	10.0	169	189
Vietnam	20.7	29.3	44.8	33.8	6,549	8,378	1,183	3,172	74.7	61.9	51	245
West Bank and Gaza	..	..	..	..	..	..	..	..	..	14.2	..	..
Yemen, Rep.	33.4	33.5	22.4	31.4	781	638	134	95	..	..	40	43
Zambia	47.4	47.5	0.6	2.9	929	861	128	84	..	..	11	11
Zimbabwe	52.1	53.1	3.5	5.2	1,606	1,610	562	443	..	..	60	75
World	**38.4 w**	**38.4 w**	**16.8 w**	**18.0 w**	**690,883 s**	**669,691 s**	**992 w**	**986 w**	**41.7 w**	**.. w**	**187 w**	**194 w**
Low income	43.4	44.6	21.8	23.8	205,135	230,127	529	663	65.9	..	47	83
Middle income	36.2	35.6	17.9	17.7	341,823	305,289	1,124	1,057	46.8	35.8	123	130
Lower middle income	40.6	43.1	22.7	23.1	226,040	208,050	1,324	1,431	50.5	40.3	90	105
Upper middle income	30.8	25.7	9.04	8.6	115,782	97,239	788	471	20.8	14.2	187	171
Low & middle income	38.4	38.3	19.3	20.0	546,957	535,416	887	910	50.6	..	93	112
East Asia & Pacific	48.4	50.6	..	..	141,839	133,283	1,767	2,148	56.0	45.1	56	73
Europe & Central Asia	38.5	28.6	11.6	11.1	137,259	113,303	1,098	345	23.8	20.2	231	184
Latin America & Carib.	34.6	36.1	11.1	11.4	48,262	50,630	602	895	17.9	17.2	121	123
Middle East & N. Africa	22.5	23.0	28.9	32.9	26,822	25,887	651	841	..	..	113	144
South Asia	54.8	54.7	33.0	39.0	129,072	125,982	745	1,066	66.6	..	62	130
Sub-Saharan Africa	42.9	44.0	3.6	3.6	63,703	86,332	142	123	..	..	20	13
High income	38.3	38.5	10.5	11.9	143,926	134,275	1,248	1,208	6.0	3.9	420	436
Europe EMU	50.6	48.4	14.4	16.9	33,599	31,385	2,524	2,040	8.7	4.8	997	980

a. Includes Luxembourg.

Agricultural inputs 3.2

About the data

Agricultural activities provide developing countries with food and revenue, but they 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.

This table provides indicators of major inputs to agricultural production: land, fertilizer, labor, and agricultural machinery. There is no single correct mix of inputs: appropriate levels and application rates vary by country and over time, depending 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 (FAO) through annual questionnaires. The FAO tries to impose standard definitions and reporting methods, but exact consistency across countries and over time is not possible. 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.

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

3.2a

Irrigated lands have increased in all income groups and most regions, putting further pressure on water resources

Note: Data are not available for East Asia and Pacific.
Source: Table 3.2.

Definitions

• **Agricultural land** refers to the share of land area that is arable, under permanent crops, and under permanent pastures. 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. This category includes land under flowering shrubs, fruit trees, nut trees, and vines, but excludes land under trees grown for wood or timber. Permanent pasture is land used for five or more years for forage, including natural and cultivated crops.• **Irrigated land** refers to areas purposely provided with water, including land irrigated by controlled flooding. • **Cropland** refers to 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 nitrogenous, 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** refers to employment in agriculture, forestry, hunting, and fishing (see table 2.3 for more detail). • **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 and that may contain more recent information than those published in the FAO's *Production Yearbook*.

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 $	
	1992–94	2002–04	1992–94	2002–04	1992–94	2002–04	1993–95	2003–05	1992–94	2002–04
Afghanistan	..	..	..	..	..	..	..	..	..	..
Albania	85.1	100.6	81.1	105.9	78.7	108.9	2,662	3,491	916	1,469
Algeria	85.3	122.9	84.5	113.2	85.4	103.3	774	1,468	1,743	1,983
Angola	67.9	119.4	71.3	113.0	79.4	100.0	323	547	99	168
Argentina	68.8	106.4	76.0	101.4	92.5	92.0	2,821	3,771	7,335	9,311
Armenia	106.2	119.2	103.5	121.8	96.9	123.2	1,646	2,122	1,464	2,717
Australia	60.2	81.6	73.0	91.7	85.4	96.9	1,706	1,960	20,693	27,058
Austria	89.5	99.1	90.9	99.0	96.3	99.6	5,338	5,738	12,882	21,083
Azerbaijan	115.6	122.7	90.8	118.6	88.1	113.6	1,586	2,633	922	1,061
Bangladesh	74.8	104.7	74.0	104.6	80.2	103.2	2,572	3,533	251	309
Belarus	115.1	124.7	127.7	107.2	135.3	99.7	2,377	2,850	1,964	2,612
Belgium	87.8[a]	106.0	98.4[a]	101.3	98.7[a]	99.7	6,726[a]	8,710	..	..
Benin	66.0	125.4	67.9	126.3	92.5	109.2	988	1,147	391	599
Bolivia	68.2	116.4	72.6	111.6	77.5	107.9	1,513	1,857	678	749
Bosnia and Herzegovina	97.6	101.1	108.7	96.0	109.4	86.6	3,569	3,393	2,951	5,709
Botswana	95.8	111.5	111.9	104.8	115.4	103.4	325	514	532	409
Brazil	82.1	119.6	76.9	118.0	73.4	116.8	2,384	3,149	1,839	3,111
Bulgaria	116.1	110.9	113.7	101.7	117.7	96.2	2,794	3,157	2,153	6,639
Burkina Faso	76.6	126.6	79.1	116.2	75.6	108.1	858	959	157	166
Burundi	108.0	107.0	108.1	106.3	137.2	100.2	1,329	1,336	115	103
Cambodia	64.1	105.8	66.1	106.3	75.8	103.5	1,520	2,062	276	289
Cameroon	76.2	103.0	78.8	104.2	85.7	103.1	1,034	1,720	720	1,177
Canada	89.1	93.8	84.1	94.8	80.4	103.6	2,647	2,962	29,378	38,509
Central African Republic	76.7	97.7	74.6	106.9	73.7	113.5	902	1,046	292	415
Chad	68.8	110.9	73.9	110.2	84.1	105.4	611	711	189	199
Chile	85.7	110.5	81.5	108.6	76.0	107.0	4,403	5,621	4,235	3,222
China	75.0	110.6	68.5	113.2	61.2	116.1	4,581	5,057	273	373
Hong Kong, China	..	..	..	..	..	..	..	..	..	..
Colombia	97.5	107.4	85.7	106.8	82.2	107.1	2,552	3,567	3,207	2,751
Congo, Dem. Rep.	127.8	97.2	124.8	97.5	103.2	99.2	778	767	227	197
Congo, Rep.	83.2	105.1	82.2	107.0	79.6	114.5	770	806	295	337
Costa Rica	77.1	99.6	77.6	101.0	82.8	101.4	3,671	4,001	3,364	4,285
Côte d'Ivoire	73.4	96.2	75.2	100.0	78.1	110.9	946	1,266	608	757
Croatia	83.8	97.2	96.7	98.9	116.4	108.2	4,255	4,179	5,189	9,237
Cuba	82.0	112.6	83.2	108.1	98.9	92.7	1,697	3,076	..	..
Czech Republic	97.1	94.8	111.6	96.6	114.9	95.8	4,099	4,816	3,531	4,543
Denmark	94.4	97.7	96.8	100.6	93.9	102.8	5,833	6,080	22,271	37,443
Dominican Republic	114.7	110.0	104.8	106.1	86.1	103.7	3,739	4,177	2,482	4,169
Ecuador	90.7	95.9	80.4	106.5	70.9	115.3	1,983	2,485	1,027	1,478
Egypt, Arab Rep.	74.3	104.2	72.5	107.7	71.0	115.3	5,920	7,528	1,575	2,007
El Salvador	102.7	90.6	87.9	102.9	77.7	108.5	1,883	2,462	1,639	1,607
Eritrea	91.9	67.7	83.5	83.2	76.4	97.1	487	296	91	56
Estonia	115.3	89.9	161.6	100.4	166.6	101.7	1,815	2,274	2,693	3,199
Ethiopia	69.7	106.7	71.5	110.6	78.8	117.7	1,106	1,261	123	118
Finland	91.9	102.4	99.2	103.3	101.3	104.3	3,534	3,284	17,815	31,339
France	92.2	98.8	96.0	99.5	97.4	100.4	6,504	6,876	24,724	40,521
Gabon	86.7	101.9	88.6	101.6	88.5	100.5	1,848	1,641	1,535	1,747
Gambia, The	55.5	65.2	59.7	68.7	102.1	102.6	1,129	1,155	204	204
Georgia	119.4	91.9	98.6	100.9	74.5	110.3	1,978	2,152	2,127	1,442
Germany	83.8	95.1	91.8	97.5	96.8	101.0	5,882	6,497	13,908	23,616
Ghana	69.1	117.0	70.2	116.9	90.9	108.7	1,341	1,437	301	341
Greece	93.9	90.4	97.0	92.2	101.0	98.2	3,717	3,699	8,315	9,303
Guatemala	79.8	102.6	78.7	105.5	80.2	100.6	1,873	1,747	2,178	2,275
Guinea	80.5	107.5	80.0	110.7	68.5	111.8	1,178	1,476	175	229
Guinea-Bissau	73.1	104.9	75.9	105.1	86.1	106.6	1,410	1,149	211	224
Haiti	101.9	98.8	95.7	101.9	76.7	111.6	930	824	682	427

Agricultural output and productivity

3.3

	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 $	
	1992–94	2002–04	1992–94	2002–04	1992–94	2002–04	1993–95	2003–05	1992–94	2002–04
Honduras	96.6	118.9	90.6	111.9	77.5	105.8	1,393	1,095	992	1,163
Hungary	89.1	99.7	93.6	100.9	101.9	101.9	3,706	4,718	2,825	3,986
India	84.5	100.0	80.8	102.5	74.5	110.5	2,104	2,391	362	391
Indonesia	88.0	112.7	90.3	113.1	99.4	127.3	3,875	4,278	498	564
Iran, Islamic Rep.	83.0	118.1	82.1	113.3	77.6	103.3	1,782	2,411	2,042	2,438
Iraq	..	..	..	..	..	..	..	..	..	2,271
Ireland	89.8	100.3	95.1	96.4	94.8	96.1	6,183	7,390	..	..
Israel	91.5	103.3	81.8	106.5	79.5	113.1	2,678	3,725	..	..
Italy	98.8	92.6	98.4	94.3	95.3	99.4	4,732	5,057	13,672	21,553
Jamaica	102.2	96.7	94.9	97.9	81.9	102.8	1,447	1,162	2,162	1,916
Japan	108.8	95.0	106.9	97.4	107.0	100.2	5,627	5,807	19,958	26,557
Jordan	106.8	136.6	97.1	124.1	92.8	94.1	1,363	1,354	1,810	1,192
Kazakhstan	121.7	108.4	140.6	106.4	178.3	111.6	803	994	1,585	1,420
Kenya	88.8	103.2	86.4	106.4	82.5	110.4	1,711	1,409	301	317
Korea, Dem. Rep.	124.4	108.4	118.5	109.1	113.7	114.2	4,455	3,408	..	..
Korea, Rep.	89.1	91.3	84.2	92.8	80.3	100.4	5,780	6,233	6,257	9,996
Kuwait	39.1	110.6	35.6	122.0	39.2	115.7	5,998	1,975	..	13,898
Kyrgyz Republic	60.0	102.9	71.0	101.0	101.4	98.4	1,968	2,984	625	942
Lao PDR	63.4	115.3	63.4	115.9	72.1	107.5	2,447	3,180	376	461
Latvia	127.4	119.4	186.1	111.0	219.0	101.1	1,778	2,225	1,566	2,415
Lebanon	116.9	94.1	107.4	100.4	68.1	120.4	2,264	2,377	15,726	25,189
Lesotho	74.1	100.8	94.6	100.4	125.8	100.0	855	906	447	495
Liberia	56.9	97.7	72.9	96.2	89.9	107.8	1,106	889	..	..
Libya	81.9	96.9	79.4	101.6	76.7	101.0	683	626	..	..
Lithuania	88.8	113.1	136.5	111.0	154.3	107.8	1,907	3,183	..	4,280
Macedonia, FYR	90.9	93.3	94.8	96.2	105.8	103.3	2,571	3,053	2,105	3,034
Madagascar	95.4	103.5	93.4	101.8	95.2	97.1	1,939	2,321	183	174
Malawi	57.7	84.3	49.3	87.1	85.2	101.8	1,233	1,150	73	131
Malaysia	78.1	114.0	78.6	113.7	98.8	115.1	3,051	3,293	3,918	4,690
Mali	75.6	107.4	81.8	105.8	85.2	112.9	797	872	205	229
Mauritania	84.4	97.2	81.8	107.6	80.9	109.3	763	1,075	283	282
Mauritius	107.3	101.6	100.4	104.9	82.4	116.8	3,942	3,436	4,034	4,996
Mexico	83.4	103.8	81.6	105.5	78.3	107.8	2,559	2,872	2,295	2,727
Moldova	147.6	112.2	151.4	112.6	170.3	103.2	3,001	2,572	902	732
Mongolia	173.0	107.3	83.3	96.4	81.4	95.9	780	808	697	661
Morocco	95.2	133.4	91.1	122.6	80.7	102.0	864	1,282	1,275	1,582
Mozambique	60.5	106.1	65.5	103.0	91.5	100.9	579	921	98	142
Myanmar	71.7	114.7	71.9	115.2	68.2	115.1	2,895	3,420	..	..
Namibia	68.6	111.4	104.8	109.8	112.0	109.3	299	441	845	1,097
Nepal	75.2	111.2	77.2	109.4	82.4	107.3	1,841	2,284	191	208
Netherlands	98.3	97.9	107.4	94.8	106.4	92.6	7,644	8,036	27,857	39,358
New Zealand	86.4	101.9	84.3	112.1	85.8	112.1	5,457	7,360	20,319	27,660
Nicaragua	73.7	115.3	69.7	119.4	65.3	119.9	1,731	1,778	1,221	1,916
Niger	73.4	119.5	77.9	116.3	85.9	104.7	311	394	165	172
Nigeria	79.4	103.4	79.6	103.7	82.8	106.6	1,165	1,057	610	863
Norway	113.4	103.4	101.3	98.6	98.1	97.3	3,768	4,121	23,252	32,779
Oman	69.2	87.3	67.0	89.9	75.3	94.0	2,185	2,332	1,000	1,128
Pakistan	80.3	102.5	77.3	106.0	75.6	109.1	1,946	2,438	603	688
Panama	110.2	104.2	96.7	101.8	80.2	101.1	1,863	1,958	2,450	3,570
Papua New Guinea	83.8	101.6	84.5	105.9	85.3	110.1	2,865	3,539	451	482
Paraguay	81.3	120.7	80.1	110.3	92.5	98.2	2,074	2,245	2,165	2,453
Peru	57.4	108.1	61.3	110.7	70.0	114.1	2,745	3,399	1,169	1,764
Philippines	87.3	109.6	81.5	112.2	67.4	120.7	2,263	2,946	907	1,001
Poland	101.3	91.6	99.2	103.6	99.4	105.0	2,781	3,191	1,026	1,408
Portugal	88.1	98.6	90.4	99.1	88.9	98.2	2,142	2,683	4,414	5,735
Puerto Rico	160.5	114.6	121.6	97.8	113.2	94.1	1,548	1,731	..	..

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 $	
	1992–94	2002–04	1992–94	2002–04	1992–94	2002–04	1993–95	2003–05	1992–94	2002–04
Romania	94.6	112.2	101.1	110.7	112.7	107.6	2,760	3,255	2,312	3,519
Russian Federation	113.9	116.0	122.0	110.2	142.8	103.2	1,439	1,839	1,746	2,297
Rwanda	86.5	117.6	85.0	117.2	74.3	107.3	1,208	989	183	229
Saudi Arabia	126.0	114.8	100.6	116.0	70.4	104.9	4,264	4,430	8,905	14,284
Senegal	72.3	68.3	74.1	74.9	83.9	98.2	820	1,013	236	235
Serbia and Montenegro	99.8	110.0	106.1	106.0	101.7	94.9	3,385	4,056	..	1,446
Sierra Leone	123.0	113.5	114.7	112.3	88.6	105.2	1,181	1,223	..	..
Singapore	116.1	100.0	240.4	69.3	235.0	74.2	..	..	28,729	32,267
Slovak Republic	..	..	..	..	..	..	..	..	..	..
Slovenia	101.1	110.2	86.4	105.8	83.1	103.6	4,433	5,247	12,494	32,311
Somalia	..	..	..	..	..	..	..	..	..	..
South Africa	80.9	102.4	85.2	105.7	93.8	108.2	2,052	2,907	1,764	2,414
Spain	81.6	106.1	83.6	105.3	81.0	107.2	2,267	3,040	12,611	19,132
Sri Lanka	89.4	98.8	94.4	100.0	107.5	109.9	2,993	3,428	713	743
Sudan	80.8	110.8	77.6	107.6	75.4	106.3	479	481	364	688
Swaziland	94.5	100.1	106.1	105.3	140.4	111.9	1,607	1,114	1,040	1,161
Sweden	94.0	102.1	96.3	100.0	97.2	97.7	4,336	4,835	21,654	31,716
Switzerland	112.2	95.3	104.3	100.1	103.3	101.9	6,220	6,150	21,565	22,190
Syrian Arab Republic	83.9	117.1	81.0	122.2	69.6	115.6	1,558	1,786	2,356	2,977
Tajikistan	119.0	132.9	128.5	132.6	176.0	139.2	994	2,252	367	401
Tanzania	87.9	103.6	87.0	105.0	87.7	109.4	1,292	1,469	242	287
Thailand	85.6	106.1	88.6	106.0	98.9	105.5	2,383	2,725	481	599
Togo	81.4	110.3	81.6	104.2	83.6	106.7	816	1,040	360	409
Trinidad and Tobago	116.8	91.9	91.7	122.1	76.1	142.6	3,533	2,722	1,748	2,368
Tunisia	91.5	104.2	84.9	103.0	66.7	99.9	1,069	1,539	2,365	2,415
Turkey	88.1	104.0	90.2	103.2	94.6	101.6	2,068	2,399	1,772	1,793
Turkmenistan	115.6	116.5	68.4	125.2	71.4	121.7	2,215	3,011	1,179	..
Uganda	81.4	106.6	82.5	107.7	86.1	112.9	1,536	1,667	192	231
Ukraine	127.5	114.0	134.8	108.1	155.5	108.1	2,881	2,436	1,235	1,442
United Arab Emirates	31.8	56.0	34.1	62.2	65.5	116.9	1,485	3,119	11,659	34,739
United Kingdom	102.3	100.3	106.3	98.9	106.1	98.5	6,618	7,097	23,089	26,897
United States	92.2	101.5	88.7	102.7	87.1	102.6	4,836	6,444	22,868	36,863
Uruguay	78.7	112.7	82.2	104.3	88.3	98.3	2,880	4,279	6,213	7,102
Uzbekistan	105.1	109.0	92.6	107.9	103.1	104.7	1,730	3,461	1,263	1,567
Venezuela, RB	79.9	96.0	77.3	98.9	79.2	100.4	2,949	3,329	4,781	5,899
Vietnam	67.0	116.6	70.1	118.3	64.7	124.9	3,463	4,651	225	294
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	83.0	100.1	79.1	107.4	73.7	115.5	1,102	772	383	511
Zambia	88.8	102.4	92.5	104.1	87.3	99.2	1,684	1,584	160	206
Zimbabwe	72.0	69.3	75.2	85.7	86.4	100.1	1,154	676	238	242
World	**85.0 w**	**105.7 w**	**84.8 w**	**106.2 w**	**85.7 w**	**107.0 w**	**2,789 w**	**3,254 w**	**770 w**	**864 w**
Low income	82.4	103.5	80.6	105.2	77.8	109.6	1,820	2,083	336	378
Middle income	83.4	110.2	82.6	110.5	83.4	111.0	2,815	3,318	576	719
Lower middle income	81.4	111.7	78.0	112.5	74.2	114.1	3,217	3,644	456	588
Upper middle income	90.8	104.9	97.3	104.3	107.5	102.7	2,028	2,619	2,227	2,650
Low & middle income	83.1	108.1	82.0	109.0	82.0	110.6	2,420	2,787	477	568
East Asia & Pacific	77.0	110.8	72.1	112.4	63.8	116.6	4,031	4,466	..	..
Europe & Central Asia	105.9	107.1	114.7	106.1	128.8	104.1	1,902	2,331	1,602	1,914
Latin America & Carib.	80.7	111.5	79.1	110.4	78.7	108.9	2,493	3,159	2,234	2,812
Middle East & N. Africa	84.1	113.7	80.9	112.5	74.8	107.7	1,877	2,439	1,589	1,975
South Asia	83.8	101.0	80.3	103.5	75.0	109.8	2,128	2,505	364	401
Sub-Saharan Africa	80.3	103.9	81.7	105.1	85.9	107.1	1,034	1,087	294	341
High income	91.0	98.2	91.1	99.9	91.7	101.2	4,297	5,115	..	..
Europe EMU	90.6	97.8	93.3	98.8	96.2	99.7	4,855	5,427	14,186	21,695

a. Includes Luxembourg.

Agricultural output and productivity 3.3

About the data

The agricultural production indexes in the table are prepared by the Food and Agriculture Organization (FAO). The FAO obtains data from official and semiofficial reports of crop yields, area under production, and livestock numbers. If data are not available, 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 other sources because of differences in coverage, weights, concepts, time periods, calculation methods, and use of international prices.

To ease 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. 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. Cereal crops harvested for hay or harvested green for food, feed, or silage, and those used for grazing, are generally excluded. But 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.

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

Definitions

• **Crop production index** shows 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. The data in this table are three-year averages. • **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. • **Agricultural productivity** refers to the ratio of agricultural value added, measured in constant 2000 U.S. dollars, to the number of workers in agriculture.

3.3a The 10 countries with the highest cereal yield in 2003–05—and the 10 with the lowest

Country	Kilograms per hectare	Country	Kilograms per hectare
Belgium	8,710	Eritrea	296
Netherlands	8,036	Niger	394
Egypt, Arab Rep.	7,528	Namibia	441
Ireland	7,390	Sudan	481
New Zealand	7,360	Botswana	514
United Kingdom	7,097	Angola	547
France	6,876	Libya	626
Germany	6,497	Zimbabwe	676
United States	6,444	Chad	711
Korea, Rep.	6,233	Congo, Dem. Rep.	767

Source: Table 3.3.

Data sources

The agricultural production indexes are prepared by the FAO and published annually in its *Production Yearbook*. The FAO makes these data and the data on cereal yield and agricultural employment available to the World Bank in electronic files that may contain more recent information than the published versions. For sources of data on agricultural value added, see *Data sources* for table 4.2.

3.4 Deforestation and biodiversity

	Average annual deforestation[a]		Mammals		Birds		Higher plants[b]		GEF benefits index for biodiversity	Nationally protected areas		Marine protected areas	
	thousand sq. km 1990–2005	% 1990–2005	Total known species 2004	Threatened species 2004	Total known species 2004	Threatened species 2004	Total known species 2004	Threatened species 2004	2005	thousand sq. km 2004[c]	% of total land area 2004[c]	thousand sq. km 2004[c]	% of surface area 2004[c]
Afghanistan	295	2.3	144	12	434	17	4,000	1	24.1	2.0	0.3	..	..
Albania	–3	0.0	73	1	303	9	3,031	0	1.3	1.0	3.8	0.3	1.0
Algeria	–325	–1.8	100	12	372	11	3,164	2	19.9	119.1	5.0	0.9	0.0
Angola	1,248	0.2	296	11	930	20	5,185	26	63.4	82.3	6.6	29.1	2.3
Argentina	1,494	0.4	375	32	1,038	55	9,372	42	122.9	180.6	6.6	7.8	0.3
Armenia	42	1.2	78	9	302	12	3,553	1	1.7	2.1	7.6	..	..
Australia	2,817	0.2	376	63	851	60	15,638	56	635.5	1,029.4	13.4	680.8	8.8
Austria	–57	–0.2	101	5	412	8	3,100	3	2.3	27.3	33.1	..	..
Azerbaijan	0	0.0	82	11	364	11	4,300	0	5.7	5.3	6.4	1.2	1.4
Bangladesh	7	0.1	131	22	604	23	5,000	12	10.5	1.0	0.8	0.3	0.2
Belarus	–345	–0.5	71	6	226	4	2,100	0	0.1	13.1	6.3	..	..
Belgium[d]	7	0.1	92	9	427	10	1,550	0	0.1	..	..	0.0	0.0
Benin	647	2.0	159	6	485	2	2,500	14	1.6	12.6	11.4	..	..
Bolivia	2,703	0.4	361	26	1,414	30	17,367	70	91.9	145.3	13.4	..	..
Bosnia and Herzegovina	17	0.1	78	8	312	8	..	1	2.5	0.3	0.5	..	..
Botswana	1,183	0.9	169	6	570	9	2,151	0	9.9	104.9	18.5	..	..
Brazil	28,219	0.5	578	74	1,712	120	56,215	381	663.7	566.6	6.7	47.5	0.6
Bulgaria	–199	–0.6	106	12	379	11	3,572	0	6.1	5.0	4.5	0.0	0.0
Burkina Faso	240	0.3	129	6	452	2	1,100	2	1.9	31.5	11.5	..	..
Burundi	91	3.2	116	7	597	9	2,500	2	3.3	1.5	5.7	..	..
Cambodia	1,666	1.3	127	23	521	24	..	31	25.8	32.7	18.5	1.9	1.1
Cameroon	2,200	0.9	322	42	936	18	8,260	334	88.4	20.9	4.5	3.9	0.8
Canada	0	0.0	211	16	472	19	3,270	1	147.3	1,023.5	11.3	362.7	3.6
Central African Republic	299	0.1	187	11	663	3	3,602	15	11.0	54.2	8.7	..	..
Chad	793	0.6	104	12	531	5	1,600	2	14.1	114.6	9.1	..	..
Chile	–572	–0.4	159	22	445	32	5,284	40	107.3	141.5	18.9	114.5	15.1
China	–26,766	–1.7	502	80	1,221	82	32,200	443	430.4	727.5	7.8	16.0	0.2
Hong Kong, China	..	..	57	1	306	20	..	6	..	..	..	0.3	26.5
Colombia	474	0.1	467	39	1,821	86	51,220	222	380.0	106.0	10.2	8.1	0.7
Congo, Dem. Rep.	4,614	0.3	430	29	1,148	30	11,007	65	113.0	113.4	5.0	..	..
Congo, Rep.	170	0.1	166	14	597	4	6,000	35	22.8	22.2	6.5	..	..
Costa Rica	115	0.5	232	13	838	18	12,119	110	73.6	11.7	23.0	4.8	9.4
Côte d'Ivoire	–122	–0.1	229	23	702	11	3,660	105	25.7	19.1	6.0	0.3	0.1
Croatia	–13	–0.1	96	7	365	9	4,288	0	3.6	4.2	7.5	2.5	4.4
Cuba	–437	–2.1	65	11	358	18	6,522	163	89.8	75.9	69.1	31.7	28.6
Czech Republic	–12	–0.1	88	6	386	9	1,900	4	0.9	12.4	16.1	..	..
Denmark	–37	–0.8	81	4	427	10	1,450	3	1.1	14.4	34.0	5.1	11.8
Dominican Republic	0	0.0	36	5	224	16	5,657	30	45.0	25.1	51.9	8.6	17.6
Ecuador	1,976	1.4	341	34	1,515	69	19,362	1	199.4	50.7	18.3	141.0	49.7
Egypt, Arab Rep.	–15	–3.5	118	6	481	17	2,076	2	21.5	96.6	9.7	76.7	7.7
El Salvador	51	1.4	137	2	434	3	2,911	25	5.5	0.1	0.4	0.1	0.4
Eritrea	45	0.3	70	9	537	7	..	3	6.0	4.3	4.3	..	..
Estonia	–81	–0.4	67	4	267	3	1,630	0	0.3	5.0	11.8	..	..
Ethiopia	1,409	0.9	288	35	839	20	6,603	22	56.7	169.0	16.9	..	..
Finland	–204	–0.1	80	3	421	10	1,102	1	1.2	28.3	9.3	1.1	0.3
France	–677	–0.5	148	16	517	15	4,630	2	26.1	73.2	13.3	0.5	0.1
Gabon	101	0.1	166	11	632	5	6,651	107	22.8	1.8	0.7	1.0	0.4
Gambia, The	–19	–0.4	133	3	535	2	974	4	0.7	0.2	2.3	0.2	2.0
Georgia	0	0.0	98	11	268	8	4,350	0	4.6	1.6	2.3	0.0	0.1
Germany	–223	–0.2	126	9	487	14	2,682	12	4.4	113.8	32.6	9.1	2.6
Ghana	1,287	1.7	249	15	729	8	3,725	117	13.0	12.7	5.6	..	..
Greece	–302	–0.9	118	11	412	14	4,992	2	20.0	4.6	3.6	2.5	1.9
Guatemala	540	1.1	193	7	684	10	8,681	85	58.9	21.7	20.0	0.1	0.1
Guinea	456	0.6	215	18	640	10	3,000	22	17.0	1.7	0.7	..	..
Guinea-Bissau	96	0.4	101	5	459	1	1,000	4	4.6	..	..	..	..
Haiti	7	0.6	41	4	271	15	5,242	28	38.4	0.1	0.4	..	..

Deforestation and biodiversity 3.4

	Average annual deforestation[a]		Mammals		Birds		Higher plants[b]		GEF benefits index for biodiversity	Nationally protected areas		Marine protected areas	
	thousand sq. km 1990–2005	% 1990–2005	Total known species 2004	Threatened species 2004	Total known species 2004	Threatened species 2004	Total known species 2004	Threatened species 2004	2005	thousand sq. km 2004[c]	% of total land area 2004[c]	thousand sq. km 2004[c]	% of surface area 2004[c]
Honduras	1,825	2.5	201	10	699	6	5,680	111	52.7	7.2	6.4	1.9	1.7
Hungary	–117	–0.7	88	7	367	9	2,214	1	1.2	6.5	7.0	..	..
India	–2,508	–0.4	422	85	1,180	79	18,664	246	291.3	154.6	5.2	16.1	0.5
Indonesia	18,715	1.6	667	146	1,604	121	29,375	383	597.0	373.2	20.6	130.1	6.8
Iran, Islamic Rep.	0	0.0	158	21	498	18	8,000	1	52.2	78.5	4.8	6.2	0.4
Iraq	–12	–0.2	102	9	396	18	..	0	11.2	0.0	0.0	..	..
Ireland	–152	–3.5	63	4	408	8	950	1	5.0	1.2	1.7	0.0	0.0
Israel	–11	–0.7	115	13	534	18	2,317	0	5.7	3.3	15.0	0.1	0.6
Italy	–1,064	–1.3	132	12	478	15	5,599	3	28.9	23.2	7.9	1.5	0.5
Jamaica	4	0.1	35	5	298	12	3,308	208	32.8	..	..	8.2	74.5
Japan	55	0.0	171	37	592	53	5,565	12	274.6	24.8	6.8	10.6	2.8
Jordan	0	0.0	93	7	397	14	2,100	0	2.3	3.0	3.4	0.0	0.1
Kazakhstan	57	0.2	145	15	497	23	6,000	1	36.1	72.9	2.7	0.5	0.0
Kenya	124	0.3	407	33	1,103	28	6,506	103	65.9	45.5	8.0	3.1	0.5
Korea, Dem. Rep.	1,343	1.6	105	12	369	22	2,898	3	4.7	3.1	2.6	..	..
Korea, Rep.	71	0.1	89	12	423	34	2,898	0	12.2	6.8	6.9	3.5	3.5
Kuwait	–2	–6.7	23	1	358	12	234	0	0.9	0.3	1.5	0.3	1.5
Kyrgyz Republic	–22	–0.3	58	6	207	4	4,500	1	7.8	28.9	15.0	..	..
Lao PDR	781	0.5	215	30	704	21	8,286	19	35.7	6.9	3.0	..	..
Latvia	–111	–0.4	68	4	325	8	1,153	0	0.3	8.3	13.4	0.2	0.2
Lebanon	–10	–0.8	70	5	377	10	3,000	0	1.2	0.1	0.5	0.0	0.1
Lesotho	–2	–4.0	59	3	311	7	1,591	1	2.0	0.1	0.2	..	..
Liberia	603	1.5	183	20	576	11	2,200	46	19.5	1.6	1.7	0.6	0.5
Libya	0	0.0	87	5	326	7	1,825	1	11.5	1.8	0.1	0.5	0.0
Lithuania	–103	–0.5	71	5	227	4	1,796	0	0.2	6.7	10.7	0.5	0.8
Macedonia, FYR	0	0.0	89	9	291	9	3,500	0	1.5	1.8	7.1	..	..
Madagascar	569	0.4	165	49	262	34	9,505	276	208.7	25.0	4.3	0.2	0.0
Malawi	329	0.9	207	7	658	13	3,765	14	26.1	10.5	11.2	..	..
Malaysia	991	0.4	337	50	746	40	15,500	683	98.5	18.7	5.7	5.0	1.5
Mali	1,000	0.7	134	12	624	5	1,741	6	10.3	45.2	3.7	..	..
Mauritania	99	2.4	94	7	521	5	1,100	0	9.5	17.4	1.7	15.0	1.5
Mauritius	1	0.3	14	3	137	13	750	87	27.9	..	..	0.1	4.4
Mexico	3,185	0.5	544	72	1,026	57	26,071	261	503.1	194.7	10.2	82.1	4.2
Moldova	–7	–0.2	50	4	203	8	1,752	0	0.1	0.5	1.4	..	..
Mongolia	827	0.7	140	13	387	22	2,823	0	29.5	180.2	11.5	..	..
Morocco	–50	–0.1	129	12	430	13	3,675	2	26.5	3.1	0.7	0.5	0.1
Mozambique	500	0.3	228	12	685	23	5,692	46	54.4	65.9	8.4	22.5	2.8
Myanmar	4,665	1.2	288	39	1,047	41	7,000	38	70.5	2.0	0.3	0.2	0.0
Namibia	734	0.8	192	10	619	18	3,174	24	39.1	112.0	13.6	74.0	9.0
Nepal	787	1.6	203	29	..	31	6,973	7	14.9	12.7	8.9	..	..
Netherlands	–13	–0.4	95	9	444	11	1,221	0	0.6	4.8	14.2	0.8	1.9
New Zealand	–393	–0.5	73	8	351	74	2,382	21	147.8	79.3	29.6	22.7	8.4
Nicaragua	899	1.4	181	6	632	8	7,590	39	23.7	21.6	17.8	1.3	1.0
Niger	453	2.3	123	10	493	2	1,460	2	6.0	97.5	7.7	..	..
Nigeria	4,097	2.4	290	25	899	9	4,715	170	43.6	30.1	3.3	..	..
Norway	–171	–0.2	83	9	442	6	1,715	2	10.7	20.9	6.8	1.3	0.4
Oman	0	0.0	74	12	483	14	1,204	6	29.3	43.3	14.0	29.6	9.6
Pakistan	417	1.7	195	17	625	30	4,950	2	33.6	37.8	4.9	2.2	0.3
Panama	55	0.1	241	17	904	20	9,915	195	78.0	16.2	21.7	10.0	13.3
Papua New Guinea	1,391	0.4	260	58	720	33	11,544	142	183.7	10.4	2.3	3.5	0.8
Paraguay	1,788	0.9	168	11	696	27	7,851	10	22.2	13.9	3.5	..	..
Peru	943	0.1	441	46	1,781	94	17,144	274	241.0	78.1	6.1	3.4	0.3
Philippines	2,275	2.2	222	50	590	70	8,931	212	224.0	17.0	5.7	16.6	5.5
Poland	–207	–0.2	110	12	424	12	2,450	4	3.8	37.8	12.3	0.7	0.2
Portugal	–456	–1.5	105	15	501	15	5,050	15	25.1	6.0	6.6	2.0	2.2
Puerto Rico	–3	–0.1	38	2	310	12	2,493	52	25.1	..	..	1.7	19.1

3.4 Deforestation and biodiversity

	Average annual deforestation[a]		Mammals		Birds		Higher plants[b]		GEF benefits index for biodiversity	Nationally protected areas		Marine protected areas	
	thousand sq. km 1990–2005	% 1990–2005	Total known species 2004	Threatened species 2004	Total known species 2004	Threatened species 2004	Total known species 2004	Threatened species 2004	2005	thousand sq. km 2004[c]	% of total land area 2004[c]	thousand sq. km 2004[c]	% of surface area 2004[c]
Romania	1	0.0	101	15	365	13	3,400	1	..	10.8	4.7	6.1	2.6
Russian Federation	107	0.0	296	43	645	47	11,400	7	246.4	1,317.3	8.0	301.8	1.8
Rwanda	–108	–3.4	206	13	665	9	2,288	3	7.0	1.5	6.2	..	..
Saudi Arabia	0	0.0	94	9	433	17	2,028	3	22.8	823.3	38.3	5.2	0.2
Senegal	450	0.5	191	11	612	5	2,086	7	8.5	22.3	11.6	0.9	0.4
Serbia and Montenegro	–90	–0.4	96	10	381	10	4,082	1	..	..	..	0.1	0.1
Sierra Leone	193	0.6	197	12	626	10	2,090	47	10.1	1.5	2.1	..	..
Singapore	0	0.0	73	3	400	10	2,282	54	1.0	0.0	4.5	0.0	0.2
Slovak Republic	–5	0.0	87	7	332	11	3,124	2	0.8	..	..	..	..
Slovenia	–51	–0.4	87	7	350	7	3,200	0	1.1	1.2	6.0	0.0	0.0
Somalia	767	0.9	182	15	642	13	3,028	17	44.2	5.0	0.8	3.3	0.5
South Africa	0	0.0	320	29	829	36	23,420	75	156.1	67.2	5.5	3.4	0.3
Spain	–2,957	–2.2	132	20	515	20	5,050	14	44.0	42.5	8.5	1.8	0.4
Sri Lanka	278	1.2	123	21	381	16	3,314	280	43.9	8.7	13.5	2.3	3.5
Sudan	5,890	0.8	302	16	952	10	3,137	17	36.4	123.6	5.2	0.3	0.0
Swaziland	–46	–1.0	124	6	490	6	2,715	11	0.9	..	..	..	..
Sweden	–107	0.0	85	5	457	9	1,750	3	2.2	37.5	9.1	4.3	1.0
Switzerland	–44	–0.4	93	4	382	8	3,030	2	1.7	11.9	29.7	..	..
Syrian Arab Republic	–59	–1.6	82	3	350	11	3,000	0	6.2	..	..	..	..
Tajikistan	–1	0.0	76	7	351	9	5,000	2	4.9	5.9	4.2	..	..
Tanzania	4,123	1.0	375	34	1,056	37	10,008	239	100.4	263.3	29.8	2.3	0.2
Thailand	963	0.6	300	36	971	42	11,625	84	53.0	71.0	13.9	5.8	1.1
Togo	199	2.9	175	7	565	2	3,085	10	2.5	4.3	7.9	..	..
Trinidad and Tobago	6	0.3	116	1	435	2	2,259	1	16.0	0.3	6.0	0.1	1.3
Tunisia	–275	–4.3	78	10	360	9	2,196	0	3.5	0.5	0.3	0.2	0.1
Turkey	–330	–0.3	145	15	436	14	8,650	3	39.6	12.3	1.6	4.5	0.6
Turkmenistan	0	0.0	103	12	318	13	..	0	13.0	19.7	4.2	..	..
Uganda	865	1.8	360	29	1,015	15	4,900	38	22.1	48.5	24.6	..	..
Ukraine	–201	–0.2	120	14	325	13	5,100	1	2.8	22.6	3.9	3.1	0.5
United Arab Emirates	–45	–1.8	30	5	268	11	..	0	1.4	0.0	0.0	..	..
United Kingdom	–156	–0.6	103	10	557	10	1,623	13	14.2	50.3	20.8	22.5	9.2
United States	–2,961	–0.1	468	40	888	71	19,473	240	599.1	2,372.2	25.9	909.5	9.5
Uruguay	–401	–4.4	118	6	414	24	2,278	1	9.5	0.5	0.3	0.1	0.0
Uzbekistan	–167	–0.6	91	7	343	16	4,800	1	7.9	8.3	2.0	..	..
Venezuela, RB	2,875	0.6	353	26	1,392	25	21,073	67	178.2	562.8	63.8	21.3	2.3
Vietnam	–2,379	–2.5	279	41	837	41	10,500	145	77.4	12.0	3.7	0.7	0.2
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	0	0.0	74	6	385	14	1,650	159	22.3	..	..	..	..
Zambia	4,448	0.9	255	11	770	12	4,747	8	33.4	237.1	31.9	..	..
Zimbabwe	3,129	1.4	222	8	661	10	4,440	17	13.7	46.8	12.1	..	..
World	**83,484 s**	**0.1 w**	**..**	**..**	**..**	**..**	**..**	**..**	**..**	**13,740.8 s**	**10.7 w**	**4,348.9 s**	**3.0 w**
Low income	48,343	0.5	..	..	..	..	..	..	..	2,203.2	7.7	79.0	..
Middle income	42,278	0.1	..	..	..	..	..	..	..	5,703.8	8.5	1,228.0	1.9
Lower middle income	33,970	0.2	..	..	..	..	..	..	..	2,947.4	7.7	633.5	1.7
Upper middle income	8,308	0.1	..	..	..	..	..	..	..	2,756.4	..	594.5	2.1
Low & middle income	90,621	0.2	..	..	..	..	..	..	..	7,907.0	8.3	1,307.0	1.6
East Asia & Pacific	4,939	–0.2	..	..	..	..	..	..	..	1,454.8	..	192.1	1.3
Europe & Central Asia	–1,789	0.0	..	..	..	..	..	..	..	1,610.2	6.9	321.6	1.4
Latin America & Carib.	45,753	0.4	..	..	..	..	..	..	..	2,228.7	11.1	495.8	2.7
Middle East & N. Africa	–747	–0.5	..	..	..	..	..	..	..	345.9	4.2	114.7	1.5
South Asia	–831	–0.2	..	..	..	..	..	..	..	228.6	4.8	20.9	0.5
Sub-Saharan Africa	43,296	0.6	..	..	..	..	..	..	..	2,038.8	8.7	162.0	..
High income	–7,137	–0.1	..	..	..	..	..	..	..	5,833.9	..	3,041.9	6.1
Europe EMU	–6,101	–0.8	..	..	..	..	..	..	..	324.9	13.5	19.5	0.8

a. Negative numbers 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.

Deforestation and biodiversity 3.4

About the data

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

The estimates of forest area are from the Food and Agriculture Organization's (FAO) Global Forest Resources Assessment, which provides information on forest cover in 2005 and estimates of forest cover in 1990 and 2000. The current survey is the latest global forest assessment and uses a uniform global definition of forest. No breakdown of forest cover between natural forest and plantation is shown in the table because of space limitations. (This breakdown is provided by the FAO only for developing countries.) For this reason the deforestation data in the table may underestimate the rate at which natural forest is disappearing in some countries.

Measures of species richness are among the most straightforward ways to indicate the importance of an area for biodiversity. The number of threatened species is also an important measure of the immediate need for conservation efforts in a geographic 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 according to the World Conservation Union's (IUCN) classification categories: 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).

While the number of birds and mammals is fairly well known, it is difficult to make an accurate count of plants. The number of plant species is highly debated. The IUCN's *2004 IUCN Red List of Threatened Plants* provides the most comprehensive list of threatened species on a global scale, the result of more than 20 years' work by botanists from around the world. Only 5 percent of plant species have been evaluated, and 70 percent of these are threatened with extinction. Plant species data should be interpreted with caution since they are not necessarily comparable across countries because of differences in taxonomic concepts and coverage. However, they do identify countries that are major sources of global biodiversity and that show national commitments to habitat protection.

Setting priorities for conserving biodiversity requires a broader set of information than species richness. With the support of the World Bank's Development Research Group and in close collaboration with scientific nongovernmental organizations, the Global Environment Facility (GEF) developed the GEF benefits index for biodiversity, a comprehensive indicator of national biodiversity status, to guide its biodiversity priorities. This indicator incorporates information on individual species range maps available from the IUCN for virtually all mammals (4,612), amphibians (5,327), and endangered birds (1,098); country-level data from the World Resources Institute (WRI) for reptiles and vascular plants; country-level data from FishBase for 27,669 fish species; and the ecological characteristics of 867 terrestial ecoregions of the world from World Wildlife Federation (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 in the GEF, IUCN, WWF International, and other nongovernmental organizations. Each unit of the index represents 0.01 percent of the total global biodiversity value,

The table shows information on protected areas, numbers of certain species, and numbers of those species under threat. The World Conservation Monitoring Centre (WCMC) compiles these data from a variety of sources. Because of differences in definitions and reporting practices, cross-country comparability is limited. Compounding these problems, available data cover different periods.

Nationally protected areas are areas of at least 1,000 hectares that fall into one of five management categories defined by the WCMC:

- 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 necessarily mean that protection is in force. For small countries that may only have protected areas smaller than 1,000 hectares, this size limit in the definition will result in an underestimate of the extent and number of protected areas.

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

Definitions

• **Average annual deforestation** refers to the permanent conversion of natural forest area to other uses, including shifting cultivation, permanent agriculture, ranching, settlements, and infrastructure development. Deforested areas do not include areas logged but intended for regeneration or areas degraded by fuelwood gathering, acid precipitation, or forest fires. Negative numbers indicate an increase in forest area. • **Mammals** exclude whales and porpoises. • **Birds** are listed for countries included within their breeding or wintering ranges. • **Higher plants** refer to 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 for each country based on the species represented in each country, their threat status, and the diversity of habitat types in each country. • **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, and litoral (intertidal) areas are not included. The data also do not include sites protected under local or provincial law. Total land area is used to calculate the percentage of total area protected (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—which have been reserved by law or other effective means to protect part or all of the enclosed environment.

Data sources

Data on deforestation are from the FAO's Global Forest Resources Assessment 2005. Data on species are from the WCMC's electronic files and the IUCN's *2002 IUCN Red List of Threatened Animals* and *1997 IUCN Red List of Threatened Plants*. 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.

3.5 Freshwater

	Renewable internal freshwater resources[a]		Annual freshwater withdrawals[b]					Water productivity		
	Flows billion cu. m 2004	Per capita cu. m 2004	billion cu. m 1987–2002	% of internal resources 1987–2002	% for agriculture 1987–2002	% for industry 1987–2002	% for domestic 1987–2002	GDP/water use 2000 $ per cu. m Total 1987–2004	Agriculture 1987–2004	Industry 1987–2004
Afghanistan	55	..	23.3	42.3	98	0	2	..	..	..
Albania	27	8,645	1.7	6.4	62	11	27	2.4	1.0	3.7
Algeria	11	348	6.1	54.0	65	13	22	9.4	1.3	38.4
Angola	148	9,555	0.4	0.2	60	17	23	30.8	3.3	130.7
Argentina	276	7,193	29.2	10.6	74	10	17	8.3	0.6	21.6
Armenia	9	2,998	3.0	32.5	66	4	30	0.8	0.3	6.1
Australia	492	24,464	23.9	4.9	75	10	15	17.4	*0.6*	*41.2*
Austria	55	6,729	2.1	3.8	1	64	35	93.6	183.0	40.8
Azerbaijan	8	977	17.3	212.6	68	28	5	0.4	0.1	0.6
Bangladesh	105	754	79.4	75.6	96	1	3	0.6	0.2	25.3
Belarus	37	3,786	2.8	7.5	30	47	23	5.0	1.9	3.7
Belgium	12	1,152	..	..	..	..	..	..	..	..
Benin	10	1,260	0.1	1.3	45	23	32	19.3	15.4	12.1
Bolivia	304	33,692	1.4	0.5	81	7	13	6.1	1.0	22.5
Bosnia and Herzegovina	36	9,080	..	..	..	..	..	..	..	..
Botswana	2	1,357	0.2	8.1	41	18	41	29.9	1.8	77.0
Brazil	5,418	29,460	59.3	1.1	62	18	20	10.5	1.0	12.6
Bulgaria	21	2,706	10.5	50.0	19	78	3	1.3	0.8	0.4
Burkina Faso	13	975	0.8	6.4	86	1	13	3.6	1.3	76.7
Burundi	10	1,382	0.3	2.9	77	6	17	2.5	1.5	9.5
Cambodia	121	8,738	4.1	3.4	98	1	2	1.0	0.3	52.1
Cameroon	273	17,022	1.0	0.4	74	8	18	9.8	5.8	24.8
Canada	2,850	89,134	46.0	1.6	12	69	20	16.4	*2.5*	*7.1*
Central African Republic	141	35,374	0.0	0.0	4	16	80	38.4	517.4	46.8
Chad	15	1,588	0.2	1.5	83	0	17	7.3	*2.9*	..
Chile	884	54,826	12.6	1.4	64	25	11	6.4	0.4	9.1
China	2,812	2,170	630.3	22.4	68	26	7	2.2	0.4	4.0
Hong Kong, China	..	..	..	..	..	..	..	..	..	..
Colombia	2,112	47,022	10.7	0.5	46	4	50	8.1	2.0	56.0
Congo, Dem. Rep.	900	16,114	0.4	0.0	31	17	53	12.1	*23.9*	*15.4*
Congo, Rep.	222	57,173	0.1	0.0	9	22	70	76.0	47.0	233.6
Costa Rica	112	26,428	2.7	2.4	53	17	30	6.2	0.9	9.9
Côte d'Ivoire	77	4,299	0.9	1.2	65	12	24	11.0	3.9	19.2
Croatia	38	8,487	..	..	..	..	..	..	..	..
Cuba	38	3,390	8.2	21.5	69	12	19	..	..	..
Czech Republic	13	1,287	2.6	19.6	2	57	41	22.5	32.1	13.6
Denmark	6	1,110	1.3	21.2	43	25	32	126.8	6.8	112.4
Dominican Republic	21	2,395	3.4	16.1	66	2	32	6.3	1.1	113.3
Ecuador	432	33,129	17.0	3.9	82	5	13	1.0	0.1	6.5
Egypt, Arab Rep.	2	25	68.3	3,794.4	86	6	8	1.6	0.3	8.2
El Salvador	18	2,625	1.3	7.2	59	16	25	10.7	1.6	21.1
Eritrea	3	662	0.3	10.7	97	0	3	2.3	0.3	..
Estonia	13	9,423	0.2	1.2	5	38	57	39.5	31.3	26.5
Ethiopia	122	1,744	5.6	4.6	94	0	6	1.3	0.6	29.2
Finland	107	20,466	2.5	2.3	3	84	14	50.0	60.5	17.6
France	179	2,956	40.0	22.4	10	75	16	34.3	8.8	9.4
Gabon	164	120,382	0.1	0.1	42	8	50	42.1	7.0	274.9
Gambia, The	3	2,030	0.0	1.0	65	12	23	14.1	5.2	15.7
Georgia	58	12,866	3.6	6.2	59	21	20	0.9	0.3	1.0
Germany	107	1,297	47.1	44.0	20	68	12	40.9	2.3	15.9
Ghana	30	1,399	1.0	3.2	66	10	24	5.5	3.0	14.8
Greece	58	5,246	7.8	13.4	80	3	16	15.6	1.1	97.2
Guatemala	109	8,882	2.0	1.8	80	13	7	10.0	2.8	14.5
Guinea	226	24,561	1.5	0.7	90	2	8	2.2	0.6	39.5
Guinea-Bissau	16	10,392	0.2	1.1	82	5	13	1.1	0.8	3.9
Haiti	13	1,548	1.0	7.6	94	1	5	*3.7*	*1.0*	*56.7*

Freshwater 3.5

	Renewable internal freshwater resources[a]		Annual freshwater withdrawals[b]					Water productivity		
	Flows billion cu. m 2004	Per capita cu. m 2004	billion cu. m 1987–2002	% of internal resources 1987–2002	% for agriculture 1987–2002	% for industry 1987–2002	% for domestic 1987–2002	GDP/water use 2000 $ per cu. m Total 1987–2004	Agriculture 1987–2004	Industry 1987–2004
Honduras	96	13,610	0.9	0.9	80	12	8	7.3	*1.3*	*16.8*
Hungary	6	594	7.6	127.3	32	59	9	6.6	0.8	3.1
India	1,261	1,167	645.8	51.2	87	6	8	0.8	0.2	3.5
Indonesia	2,838	13,043	82.8	2.9	91	1	8	2.2	0.4	145.0
Iran, Islamic Rep.	129	1,918	72.9	56.7	91	2	7	1.6	0.2	26.2
Iraq	35	..	42.7	121.3	92	5	3	0.5	*0.0*	*10.0*
Ireland	49	12,045	1.1	2.3	0	77	23	94.5	..	..
Israel	1	110	2.1	273.3	62	7	31	55.5	..	..
Italy	183	3,170	44.4	24.3	45	37	18	24.7	1.3	17.2
Jamaica	9	3,556	0.4	4.4	49	17	34	20.1	2.5	34.2
Japan	430	3,366	88.4	20.6	63	18	20	53.6	*1.2*	*91.9*
Jordan	1	125	1.0	148.5	75	4	21	9.3	0.3	58.0
Kazakhstan	75	5,030	35.0	46.4	82	17	2	0.7	0.1	1.5
Kenya	21	619	1.6	7.6	64	6	30	8.4	3.8	20.0
Korea, Dem. Rep.	67	2,993	9.0	13.5	55	25	20	..	..	..
Korea, Rep.	65	1,349	18.6	28.7	48	16	36	30.6	2.4	66.7
Kuwait	0	0	0.4	..	52	2	46	84.0	*0.8*	*2,070.0*
Kyrgyz Republic	46	9,121	10.1	21.7	94	3	3	0.1	0.1	1.2
Lao PDR	190	32,878	3.0	1.6	90	6	4	0.6	0.4	2.8
Latvia	17	7,238	0.3	1.8	13	33	53	29.6	8.6	19.0
Lebanon	5	1,356	1.4	28.8	67	1	33	12.9	1.1	368.3
Lesotho	5	2,909	0.1	1.0	20	40	40	18.4	13.9	17.8
Liberia	200	61,717	0.1	0.1	55	18	27	5.4	..	..
Libya	1	105	4.3	711.3	83	3	14	8.7	..	..
Lithuania	16	4,529	0.3	1.7	7	15	78	47.9	41.4	91.3
Macedonia, FYR	5	2,659	..	..	..	..	..	..	..	..
Madagascar	337	18,606	15.0	4.4	96	2	3	0.2	0.1	1.9
Malawi	16	1,280	1.0	6.3	80	5	15	1.7	0.7	5.0
Malaysia	580	23,298	9.0	1.6	62	21	17	10.5	1.5	24.2
Mali	60	4,572	6.6	10.9	90	1	9	0.4	0.2	11.8
Mauritania	0	134	1.7	425.0	88	3	9	0.7	0.1	7.9
Mauritius	3	2,229	0.6	22.2	..	..	30	8.1	..	..
Mexico	409	3,940	78.2	19.1	77	6	17	7.5	0.4	33.2
Moldova	1	237	2.3	231.0	33	58	10	0.6	0.5	0.2
Mongolia	35	13,839	0.4	1.3	52	27	21	2.3	0.9	2.1
Morocco	29	972	12.6	43.4	87	3	10	2.9	0.6	31.9
Mozambique	100	5,164	0.6	0.6	87	2	11	7.3	2.0	120.3
Myanmar	881	17,611	33.2	3.8	98	1	1	..	..	..
Namibia	6	3,066	0.3	4.9	71	5	24	12.4	1.6	69.7
Nepal	198	7,454	10.2	5.1	97	1	3	0.6	0.2	19.0
Netherlands	11	676	7.9	72.2	34	60	6	47.6	3.3	18.5
New Zealand	327	80,522	2.1	0.6	42	10	48	26.7	*5.2*	*66.0*
Nicaragua	190	35,293	1.3	0.7	83	2	15	3.1	0.7	34.4
Niger	4	259	2.2	62.3	95	1	4	0.9	*0.4*	*33.7*
Nigeria	221	1,717	8.0	3.6	69	10	21	5.5	2.3	20.7
Norway	382	83,205	2.2	0.6	11	67	23	79.2	14.5	43.6
Oman	1	389	1.4	138.1	90	2	7	16.0	0.3	388.6
Pakistan	52	345	169.4	323.3	96	2	2	0.5	0.1	4.7
Panama	147	46,426	0.8	0.6	28	5	67	14.6	3.8	46.7
Papua New Guinea	801	138,775	0.1	0.0	..	..	..	..	..	..
Paraguay	94	15,622	0.5	0.5	71	8	20	15.8	4.9	46.5
Peru	1,616	58,631	20.1	1.2	82	10	8	2.8	0.3	7.7
Philippines	479	5,869	28.5	6.0	74	9	17	2.8	0.6	9.2
Poland	54	1,404	16.2	30.2	8	79	13	10.5	4.2	3.7
Portugal	38	3,618	11.3	29.6	78	12	10	9.7	0.4	20.2
Puerto Rico	7	1,823	..	..	..	..	..	..	..	..

3.5 Freshwater

	Renewable internal freshwater resources[a]		Annual freshwater withdrawals[b]					Water productivity		
	Flows billion cu. m 2004	Per capita cu. m 2004	billion cu. m 1987–2002	% of internal resources 1987–2002	% for agriculture 1987–2002	% for industry 1987–2002	% for domestic 1987–2002	GDP/water use 2000 $ per cu. m Total 1987–2004	Agriculture 1987–2004	Industry 1987–2004
Romania	42	1,951	23.2	54.8	57	34	9	1.8	0.4	1.7
Russian Federation	4,313	29,981	76.7	1.8	18	64	19	3.7	1.3	2.0
Rwanda	10	1,070	0.2	1.6	68	8	24	14.1	9.1	35.9
Saudi Arabia	2	100	17.3	721.7	89	1	10	11.0	0.6	482.0
Senegal	26	2,266	2.2	8.6	93	3	4	2.1	0.3	17.8
Serbia and Montenegro	44	5,401	..	..	..	..	..	..	..	..
Sierra Leone	160	29,982	0.4	0.2	92	3	5	1.9	..	..
Singapore	1	142	..	..	..	..	..	..	..	..
Slovak Republic	13	2,341	..	..	..	..	..	..	..	..
Slovenia	19	9,349	..	..	..	..	..	..	..	..
Somalia	6	753	3.3	54.8	100	0	0	..	..	..
South Africa	45	984	12.5	27.9	63	6	31	11.3	0.5	53.0
Spain	111	2,605	35.6	32.0	68	19	13	17.3	0.9	24.9
Sri Lanka	50	2,575	12.6	25.2	95	3	2	1.3	0.2	12.7
Sudan	30	845	37.3	124.4	97	1	3	0.4	*0.1*	*11.2*
Swaziland	3	2,357	1.0	39.5	97	1	2	1.4	0.1	37.6
Sweden	171	19,017	3.0	1.7	9	54	37	83.4	16.7	39.4
Switzerland	40	5,467	2.6	6.4	2	74	24	97.1	*67.5*	*36.5*
Syrian Arab Republic	7	377	20.0	285.0	95	2	3	1.0	0.3	13.9
Tajikistan	66	10,311	12.0	18.0	92	5	4	0.1	*0.0*	*0.8*
Tanzania	84	2,232	5.2	6.2	89	1	10	2.0	0.9	61.7
Thailand	210	3,297	87.1	41.5	95	3	3	1.5	0.1	26.2
Togo	12	1,920	0.2	1.5	45	2	53	8.2	6.5	63.8
Trinidad and Tobago	4	2,951	0.3	8.1	7	26	68	28.1	6.4	55.5
Tunisia	4	422	2.6	62.9	82	4	14	7.9	1.0	55.2
Turkey	227	3,165	37.5	16.5	74	11	15	5.3	1.0	10.4
Turkmenistan	1	285	24.7	1,812.5	98	1	2	..	..	..
Uganda	39	1,402	0.3	0.8	40	17	43	22.4	18.3	25.2
Ukraine	53	1,119	37.5	70.7	53	35	12	1.0	0.3	0.9
United Arab Emirates	0	35	2.3	1,533.3	68	9	23	34.5	1.5	197.8
United Kingdom	145	2,422	9.5	6.6	3	75	22	157.0	49.0	49.2
United States	2,800	9,535	479.3	17.1	41	46	13	20.9	*0.5*	*9.6*
Uruguay	59	17,154	3.2	5.3	96	1	3	5.6	0.4	115.2
Uzbekistan	16	623	58.3	357.0	93	2	5	0.3	0.1	2.5
Venezuela, RB	722	27,652	8.4	1.2	47	7	46	13.2	1.2	83.8
Vietnam	367	4,461	71.4	19.5	68	24	8	0.5	0.2	0.8
West Bank and Gaza	0	13	..	..	..	..	..	..	..	..
Yemen, Rep.	4	202	6.6	161.7	95	1	4	1.5	0.2	116.0
Zambia	80	6,987	1.7	2.2	76	8	17	2.0	0.5	6.7
Zimbabwe	12	948	4.2	34.3	79	7	14	1.6	0.3	4.3
World	**43,507 s**	**6,872 w**	**3,807.4 s**	**9.0 w**	**70 w**	**20 w**	**10 w**	**8.6 w**	**1.0 w**	**18.7 w**
Low income	8,095	3,456	1,245.4	15.5	88	5	6	0.8	0.3	7.0
Middle income	25,971	8,611	1,662.3	6.4	71	19	10	3.3	0.6	19.0
Lower middle income	17,807	7,295	1,355.8	7.7	75	17	8	2.5	0.4	17.9
Upper middle income	8,164	14,190	306.4	3.8	53	28	19	7.2	1.4	23.7
Low & middle income	34,066	6,358	2,907.7	8.6	78	13	8	2.3	0.5	14.0
East Asia & Pacific	9,454	5,062	958.9	10.2	74	20	7	2.1	0.5	19.2
Europe & Central Asia	5,255	11,123	383.2	7.5	59	31	10	2.7	1.0	2.9
Latin America & Carib.	13,429	24,619	265.3	2.0	71	10	19	7.6	0.7	26.3
Middle East & N. Africa	228	761	239.8	105.0	89	4	7	2.0	0.3	24.7
South Asia	1,816	1,255	941.1	51.8	90	4	6	0.7	0.2	5.9
Sub-Saharan Africa	3,884	5,353	119.3	3.1	87	3	10	3.1	1.0	*21.8*
High income	9,441	9,703	899.7	10.4	43	43	15	28.2	*2.7*	*33.6*
Europe EMU	910	2,942	199.7	22.3	38	48	15	30.3	5.7	20.3

a. River flows from other countries are not included because of data unreliability. b. Data are for the most recent year available for 1987–2004 (see *Primary data documentation*).

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 one year to the next. 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.

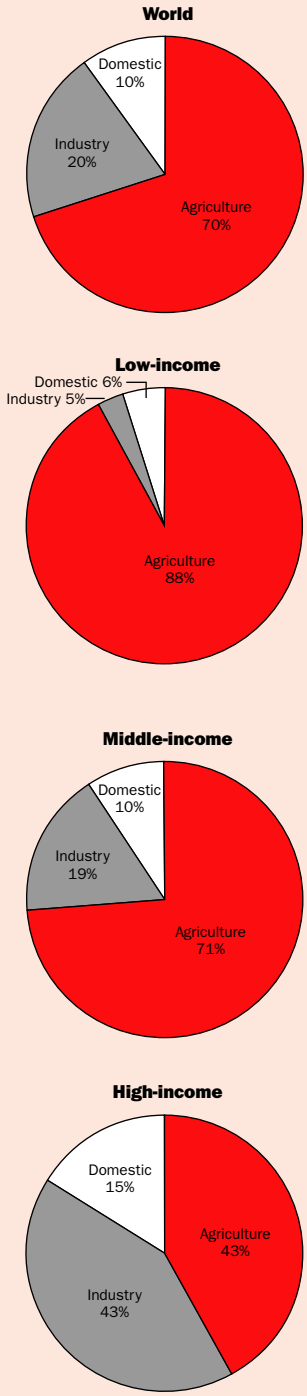
Caution is also needed in comparing data on annual freshwater withdrawals, which are subject to variations in collection and estimation methods. In addition, inflows and outflows are estimated at different times and at different levels of quality and precision, requiring caution in interpreting the data,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

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 with proper caution, taking into account the countries' sectoral activities and natural resource endowments.

3.5a

Agriculture uses 70 percent of freshwater globally

Share of annual freshwater withdrawals, most recent year available



Note: Components may not sum to 100 percent because of rounding.

Source: Table 3.5.

Definitions

• **Renewable internal freshwater resources flows** refer to 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** refer to 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 internal renewable resources because river flows from other countries are not included, because extraction from nonrenewable aquifers or desalination plants is considerable, or because there is significant water reuse. Withdrawals for agriculture and industry are total withdrawals for irrigation and livestock production and for direct industrial use (including withdrawals 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. Sectoral water productivity is calculated as annual value added in agriculture or industry divided by water withdrawal in each sector.

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.

3.6 Water pollution

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	kilograms per day		kilograms per day per worker		% of total							
	1990	2003[a]	1990	2003[a]	Primary metals 2003[a]	Paper and pulp 2003[a]	Chemicals 2003[a]	Food and beverages 2003[a]	Stone, ceramics, and glass 2003[a]	Textiles 2003[a]	Wood 2003[a]	Other 2003[a]
Afghanistan	*5,864*	*236*	*0.16*	*0.21*	..	*37.7*	*17.5*	*31.1*	*0.4*	*13.2*	..	..
Albania	34,785	..	0.14	..	..	..	..	..	..	..	..	..
Algeria	106,977	..	0.25	..	..	..	..	..	..	..	..	..
Angola	*4,544*	..	*0.19*	..	..	..	..	..	..	..	..	..
Argentina	186,686	*149,455*	0.20	*0.23*	*4.9*	*7.2*	*4.2*	*71.1*	*0.0*	*6.6*	*1.5*	*4.3*
Armenia	37,900	*7,104*	0.11	*0.28*	..	..	*0.0*	*77.6*	..	*22.4*	..	..
Australia	186,110	*111,658*	0.18	*0.18*	..	..	*5.6*	*77.1*	*0.2*	*5.1*	*5.3*	6.5
Austria	94,121	*93,463*	0.15	*0.14*	*14.6*	*17.8*	*10.9*	*35.6*	*0.4*	*4.5*	*5.3*	*10.8*
Azerbaijan	53,251	*17,511*	0.15	*0.17*	*17.6*	*5.5*	*15.2*	*41.6*	*0.3*	*12.3*	*1.1*	*6.2*
Bangladesh	171,087	..	0.17	..	..	..	..	..	..	..	..	..
Belarus	..	..	..	..	..	..	..	..	..	..	..	..
Belgium	117,978	*102,460*	0.16	*0.17*	*13.7*	*18.0*	*12.0*	*40.4*	*0.2*	*6.0*	*2.0*	*7.5*
Benin	..	..	..	..	..	..	..	..	..	..	..	..
Bolivia	8,404	*12,759*	0.24	*0.25*	*0.9*	*20.5*	*6.6*	*61.4*	*0.3*	*7.1*	*2.4*	*0.5*
Bosnia and Herzegovina	50,741	..	0.14	..	..	..	..	..	..	..	..	..
Botswana	4,509	*5,204*	0.19	*0.18*	*2.0*	*7.2*	*5.1*	*55.7*	*0.3*	*25.8*	*1.5*	*2.2*
Brazil	780,395	..	0.19	..	..	..	..	..	..	..	..	..
Bulgaria	149,381	*97,137*	0.11	*0.17*	*8.5*	*9.9*	*7.0*	*45.1*	*0.2*	*21.7*	*2.1*	*5.3*
Burkina Faso	..	*2,598*	..	*0.22*	*3.5*	*1.1*	*5.4*	*73.8*	*0.1*	*4.1*	*10.1*	*1.7*
Burundi	1,570	..	0.24	..	..	..	..	..	..	..	..	..
Cambodia	11,823	..	0.14	..	..	..	..	..	..	..	..	..
Cameroon	13,989	*10,714*	0.28	*0.20*	*3.1*	*6.3*	*28.3*	*52.7*	*0.0*	*3.6*	*5.6*	*0.2*
Canada	321,471	*313,431*	0.17	*0.16*	*9.7*	*22.8*	*8.3*	*38.5*	*0.1*	*6.1*	*5.2*	*9.1*
Central African Republic	998	..	0.18	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	66,783	*72,850*	0.22	*0.24*	*6.9*	*11.3*	*8.9*	*62.7*	*0.1*	*5.0*	*2.6*	*2.3*
China	7,038,131	*6,088,663*	0.14	*0.14*	*20.4*	*10.9*	*14.8*	*28.1*	*0.5*	*15.5*	*0.9*	*8.8*
Hong Kong, China	86,124	*38,698*	0.12	*0.21*	*1.4*	*41.6*	*3.4*	*34.5*	-	*14.4*	*0.2*	*4.3*
Colombia	93,253	*93,879*	0.19	*0.21*	*3.1*	*16.2*	*9.7*	*53.2*	*0.2*	*14.2*	*1.0*	*2.2*
Congo, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Congo, Rep.	*2,456*	..	*0.32*	..	..	..	..	..	..	..	..	..
Costa Rica	27,249	*31,236*	0.20	*0.22*	*1.6*	*10.0*	*8.2*	*65.7*	*0.1*	*10.2*	*1.3*	*2.7*
Côte d'Ivoire	*7,874*	..	*0.22*	..	..	..	..	..	..	..	..	..
Croatia	80,034	*42,734*	0.15	*0.17*	*6.7*	*15.3*	*7.6*	*47.5*	*0.2*	*12.8*	*3.6*	*6.1*
Cuba	*172,973*	..	*0.25*	..	..	..	..	..	..	..	..	..
Czech Republic	205,102	*158,462*	0.13	*0.14*	*15.6*	*7.0*	*7.9*	*43.6*	*0.3*	*10.4*	*3.9*	*11.2*
Denmark	91,871	*83,591*	0.18	*0.17*	*4.4*	*29.1*	*7.9*	*44.2*	*0.2*	*2.2*	*3.5*	*8.3*
Dominican Republic	*47,900*	..	*0.36*	..	..	..	..	..	..	..	..	..
Ecuador	25,567	*41,171*	0.23	*0.28*	*2.2*	*10.1*	*5.6*	*73.7*	*0.1*	*5.6*	*1.4*	*1.0*
Egypt, Arab Rep.	211,531	*186,059*	0.20	*0.20*	*10.8*	*8.2*	*9.0*	*50.7*	*0.3*	*17.7*	*0.6*	*2.5*
El Salvador	*7,663*	*22,760*	*0.22*	*0.18*	*2.1*	*10.2*	*8.1*	*43.5*	*0.1*	*34.1*	*0.5*	*1.2*
Eritrea	..	..	..	..	..	..	..	..	..	..	..	..
Estonia	..	..	..	..	..	..	..	..	..	..	..	..
Ethiopia	18,593	*22,085*	0.23	*0.23*	*2.3*	*11.0*	*5.5*	*61.0*	*0.3*	*17.3*	*2.0*	*0.4*
Finland	79,514	*68,819*	0.18	*0.16*	*9.0*	*39.6*	*6.6*	*27.7*	*0.2*	*2.6*	*4.0*	*10.1*
France	653,455	*281,747*	0.15	*0.10*	*14.7*	*31.0*	*23.0*	..	*0.3*	*9.0*	*2.8*	19.1
Gabon	*2,018*	..	*0.25*	..	..	..	..	..	..	..	..	..
Gambia, The	*832*	..	*0.34*	..	..	..	..	..	..	..	..	..
Georgia	..	..	..	..	..	..	..	..	..	..	..	..
Germany	*835,019*	*1,020,145*	*0.12*	*0.14*	*9.0*	*20.9*	*11.3*	*38.7*	*0.2*	*2.8*	*2.5*	*14.5*
Ghana	*13,667*	..	*0.17*	..	..	..	..	..	..	..	..	..
Greece	63,479	*57,178*	0.18	*0.20*	*6.3*	*11.8*	*9.1*	*54.0*	*0.2*	*13.2*	*1.5*	*3.7*
Guatemala	*16,070*	*19,253*	*0.27*	*0.28*	*4.9*	*7.2*	*6.1*	*72.8*	*0.1*	*6.9*	*0.8*	*0.9*
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	*5,427*	..	*0.20*	..	..	..	..	..	..	..	..	..

Water pollution 3.6

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	kilograms per day		kilograms per day per worker		% of total							
	1990	2003[a]	1990	2003[a]	Primary metals 2003[a]	Paper and pulp 2003[a]	Chemicals 2003[a]	Food and beverages 2003[a]	Stone, ceramics, and glass 2003[a]	Textiles 2003[a]	Wood 2003[a]	Other 2003[a]
Honduras	17,824	..	0.23	..	..	..	..	..	..	..	..	..
Hungary	178,002	*155,386*	0.16	*0.16*	*7.9*	*11.9*	*8.4*	*47.1*	*0.2*	*13.8*	*2.3*	*8.2*
India	1,410,617	*1,515,683*	0.20	*0.20*	*12.4*	*7.2*	*9.4*	*53.9*	*0.2*	*12.7*	*0.4*	*3.6*
Indonesia	495,594	*720,326*	0.19	*0.18*	*2.6*	*8.1*	*9.3*	*51.5*		*21.0*	*5.1*	*2.2*
Iran, Islamic Rep.	102,689	*141,982*	0.16	*0.16*	*17.2*	*7.1*	*10.8*	*43.8*	*0.6*	*12.5*	*0.8*	*7.0*
Iraq	*20,352*	..	*0.16*	..	..	..	..	..	..	..	..	..
Ireland	34,610	*49,144*	0.18	*0.15*	*1.3*	*14.2*	*11.4*	*56.4*	*0.2*	*3.1*	*1.6*	*11.7*
Israel	46,359	*51,740*	0.16	*0.16*	*3.4*	*21.5*	*10.6*	*45.6*	*0.1*	*6.6*	*1.5*	*10.5*
Italy	358,084	*504,492*	0.13	*0.12*	*9.4*	*16.8*	*10.8*	*29.9*	*0.3*	*15.9*	*3.7*	*13.1*
Jamaica	18,736	..	0.29	..	..	..	..	..	..	..	..	..
Japan	1,556,648	*1,279,287*	0.14	*0.15*	*7.0*	*21.9*	*9.0*	*43.2*	*0.2*	*5.0*	*1.6*	*12.0*
Jordan	8,325	*18,516*	0.19	*0.19*	*4.8*	*17.2*	*12.0*	*52.6*	*0.5*	*9.7*	*0.5*	*2.5*
Kazakhstan	..	..	..	..	..	..	..	..	..	..	..	..
Kenya	42,588	*54,246*	0.23	*0.25*	..	*11.8*	*5.7*	*69.0*	*0.1*	*9.9*	*1.8*	1.5
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Korea, Rep.	369,193	*309,517*	0.12	*0.12*	*11.4*	*18.2*	*12.9*	*26.0*	*0.2*	*14.4*	*1.4*	*15.4*
Kuwait	9,052	*11,897*	0.16	*0.17*	*2.1*	*16.6*	*11.1*	*50.2*	*0.4*	*11.6*	*2.8*	*5.0*
Kyrgyz Republic	30,885	*20,801*	0.12	*0.21*	*8.5*	*5.9*	*3.3*	*65.6*	*0.3*	*11.6*	*1.0*	*3.6*
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	39,887	*29,166*	0.12	*0.19*	*4.1*	*14.6*	*3.2*	*55.4*	*0.1*	*9.8*	*9.4*	*3.2*
Lebanon	..	*14,899*	..	*0.19*	*0.9*	*15.6*	*4.0*	*60.7*	*0.5*	*10.2*	*4.6*	*3.3*
Lesotho	2,958	*3,123*	0.16	*0.16*	*1.2*	*4.0*	*0.7*	*39.7*	*0.1*	*51.3*	*0.6*	*2.2*
Liberia	*615*	..	*0.30*	..	..	..	..	..	..	..	..	..
Libya	..	..	..	..	..	..	..	..	..	..	..	..
Lithuania	*53,818*	*37,477*	*0.13*	*0.18*	*1.0*	*10.3*	*5.1*	*54.8*	*0.2*	*18.3*	*6.1*	*4.0*
Macedonia, FYR	32,419	..	0.18	..	..	..	..	..	..	..	..	..
Madagascar	*11,043*	..	*0.27*	..	..	..	..	..	..	..	..	..
Malawi	10,024	*11,805*	0.29	*0.29*	-	*16.0*	*3.7*	*70.0*	-	*7.8*	*1.7*	*0.5*
Malaysia	104,728	*170,662*	0.13	*0.12*	*7.9*	*14.4*	*15.1*	*34.4*	*0.2*	*8.0*	*7.1*	*12.8*
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	17,813	*17,700*	0.16	*0.15*	*0.9*	*6.6*	*2.6*	*32.8*	*0.1*	*55.4*	*0.6*	*0.9*
Mexico	174,266	*296,093*	0.18	*0.20*	*7.8*	*12.5*	*10.4*	*55.6*	*0.2*	*7.5*	*0.9*	*4.9*
Moldova	55,887	*21,409*	0.15	*0.45*	..	*2.0*	..	*98.0*	..	..	..	..
Mongolia	10,160	..	0.18	..	..	..	..	..	..	..	..	..
Morocco	41,710	*69,060*	0.14	*0.16*	*2.2*	*8.6*	*6.4*	*42.1*	*0.3*	*36.3*	*1.2*	*2.7*
Mozambique	20,414	*10,230*	0.27	*0.31*	*1.1*	*7.1*	*2.7*	*81.2*	*0.1*	*5.8*	*1.4*	*0.3*
Myanmar	7,663	*6,159*	0.17	*0.18*	*56.5*	*4.6*	*13.2*	*14.9*	*0.4*	*2.9*	*1.7*	*5.6*
Namibia	*7,350*	..	*0.35*	..	..	..	..	..	..	..	..	..
Nepal	20,894	*26,908*	0.13	*0.16*	*3.5*	*9.7*	*5.9*	*55.1*	*1.4*	*21.7*	*1.7*	*0.8*
Netherlands	136,686	*124,182*	0.18	*0.18*	*7.3*	*26.7*	*11.3*	*43.0*	*0.2*	*2.3*	*1.2*	*7.8*
New Zealand	50,243	*46,099*	0.22	*0.22*	*3.2*	*21.7*	*5.2*	*57.3*	*0.1*	*4.6*	*3.6*	*4.1*
Nicaragua	*10,465*	..	*0.27*	..	..	..	..	..	..	..	..	..
Niger	..	..	..	..	..	..	..	..	..	..	..	..
Nigeria	*52,350*	..	*0.23*	..	..	..	..	..	..	..	..	..
Norway	54,996	*51,693*	0.20	*0.19*	*9.0*	*31.3*	*4.7*	*42.8*	*0.1*	*1.4*	*3.1*	*7.4*
Oman	360	5,739	0.11	0.17	7.3	13.4	10.2	54.0	0.9	8.4	2.4	3.2
Pakistan	104,095	..	0.18	..	..	..	..	..	..	..	..	..
Panama	9,700	*11,692*	0.26	*0.32*	*1.5*	*13.2*	*4.6*	*76.6*	*0.2*	*3.2*	*0.4*	..
Papua New Guinea	*5,729*	..	*0.25*	..	..	..	..	..	..	..	..	..
Paraguay	*3,250*	..	*0.28*	..	..	..	..	..	..	..	..	..
Peru	56,144	..	0.20	..	..	..	..	..	..	..	..	..
Philippines	228,301	..	0.21	..	..	..	..	..	..	..	..	..
Poland	428,894	*416,934*	0.14	*0.16*	*12.8*	*11.4*	*6.3*	*45.4*	*0.4*	*12.7*	*3.4*	*7.4*
Portugal	147,873	*133,570*	0.15	*0.14*	*3.9*	*15.8*	*4.9*	*36.2*	*0.4*	*26.5*	*5.5*	*6.7*
Puerto Rico	19,026	*15,367*	0.15	*0.14*	*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							
	kilograms per day		kilograms per day per worker		% of total							
	1990	2003[a]	1990	2003[a]	Primary metals 2003[a]	Paper and pulp 2003[a]	Chemicals 2003[a]	Food and beverages 2003[a]	Stone, ceramics, and glass 2003[a]	Textiles 2003[a]	Wood 2003[a]	Other 2003[a]
Romania	413,864	*38,395*	0.12	*0.07*	..	*17.6*	..	*5.1*	..	*28.7*	*12.5*	36.0
Russian Federation	*1,911,348*	*1,518,704*	*0.13*	*0.16*	*18.1*	*7.7*	*8.6*	*48.0*	*0.4*	*5.9*	*2.5*	*8.6*
Rwanda	*1,624*	..	*0.25*	..	..	..	..	..	..	..	..	..
Saudi Arabia	*18,476*	..	*0.15*	..	..	..	..	..	..	..	..	..
Senegal	10,309	*6,603*	0.32	*0.30*	*5.8*	*8.4*	*10.7*	*70.1*	*0.1*	*4.2*	*0.4*	-
Serbia and Montenegro	*137,795*	*98,696*	*0.15*	*0.16*	*9.9*	*11.8*	*8.2*	*47.4*	*0.3*	*12.7*	*2.2*	*7.3*
Sierra Leone	*4,170*	..	*0.32*	..	..	..	..	..	..	..	..	..
Singapore	32,364	*33,644*	0.09	*0.09*	*1.3*	*25.9*	*16.2*	*22.8*	*0.1*	*4.1*	*1.8*	*27.7*
Slovak Republic	*77,174*	*45,011*	*0.13*	*0.14*	*4.2*	*15.0*	*8.4*	*44.2*	*0.4*	*15.0*	*1.7*	*11.0*
Slovenia	55,640	*38,390*	0.16	*0.16*	*33.7*	*14.7*	*8.3*	*23.7*	*0.2*	*10.8*	*2.0*	*6.4*
Somalia	*6,177*	..	*0.38*	..	..	..	..	..	..	..	..	..
South Africa	261,618	*221,256*	0.17	*0.18*	*15.1*	*18.0*	*10.5*	*36.0*	*0.1*	*10.9*	*3.9*	*5.3*
Spain	320,262	*374,589*	0.17	*0.15*	*6.7*	*19.8*	*8.9*	*42.5*	*0.3*	*9.3*	*4.0*	*8.3*
Sri Lanka	53,024	*88,943*	0.19	*0.18*	*0.5*	*7.0*	*6.4*	*52.3*	*0.2*	*31.2*	*1.1*	*1.1*
Sudan	..	..	..	..	..	..	..	..	..	..	..	..
Swaziland	6,586	..	0.33	..	..	..	..	..	..	..	..	..
Sweden	109,582	*103,913*	0.15	*0.14*	*11.3*	*35.0*	*7.8*	*26.6*	*0.1*	*1.3*	*3.0*	*14.8*
Switzerland	146,038	..	0.16	..	..	..	..	..	..	..	..	..
Syrian Arab Republic	21,702	*15,115*	0.22	*0.20*	*4.1*	*1.5*	*3.9*	*69.8*	*0.9*	*19.4*	*0.2*	-
Tajikistan	..	..	..	..	..	..	..	..	..	..	..	..
Tanzania	31,125	*35,155*	0.24	*0.25*	*1.5*	*9.4*	*2.7*	*69.3*	*0.1*	*14.0*	*1.5*	*1.3*
Thailand	291,552	..	0.17	..	..	..	..	..	..	..	..	..
Togo	..	..	..	..	..	..	..	..	..	..	..	..
Trinidad and Tobago	9,951	*7,945*	0.26	*0.23*	*6.5*	*18.8*	*11.9*	*55.3*	*0.2*	*3.8*	*2.0*	*1.3*
Tunisia	*44,551*	*54,191*	*0.18*	*0.14*	*2.8*	*6.5*	*6.7*	*35.6*	*0.4*	*41.9*	*1.9*	*4.1*
Turkey	177,264	*188,199*	0.18	*0.16*	*11.5*	*7.3*	*7.7*	*42.6*	*0.3*	*24.4*	*1.4*	*4.6*
Turkmenistan	..	..	..	..	..	..	..	..	..	..	..	..
Uganda	*16,728*	..	*0.30*	..	..	..	..	..	..	..	..	..
Ukraine	692,373	*445,758*	0.14	*0.18*	*28.1*	*4.2*	*7.0*	*46.8*	*0.4*	*5.4*	*1.1*	*6.8*
United Arab Emirates	*5,638*	..	*0.14*	..	..	..	..	..	..	..	..	..
United Kingdom	739,562	*615,410*	0.15	*0.15*	*6.7*	*28.5*	*11.4*	*33.8*	*0.2*	*5.5*	*2.5*	*11.3*
United States	2,565,226	*1,897,480*	0.15	*0.13*	*9.8*	*10.9*	*13.8*	*40.3*	*0.2*	*6.3*	*4.1*	*14.5*
Uruguay	38,661	*16,362*	0.23	*0.28*	*1.2*	*7.2*	*6.7*	*75.9*	*0.1*	*8.2*	*0.6*	..
Uzbekistan	..	..	..	..	..	..	..	..	..	..	..	..
Venezuela, RB	96,495	*94,175*	0.21	*0.21*	*13.7*	*10.4*	*10.2*	*53.1*	*0.3*	*7.5*	*1.5*	*3.1*
Vietnam	..	..	..	..	..	..	..	..	..	..	..	..
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	6,873	*13,082*	0.27	*0.22*	-	*5.1*	*7.6*	*76.0*	*0.5*	*7.6*	*1.3*	*1.7*
Zambia	15,880	..	0.23	..	..	..	..	..	..	..	..	..
Zimbabwe	37,149	..	0.20	..	..	..	..	..	..	..	..	..

Note: Industry shares may not sum to 100 percent because data may be for different years.
a. Data refer to any year from 1993 to 2003.

Water pollution 3.6

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 in terms of 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. This 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 2003 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 the most 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 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.

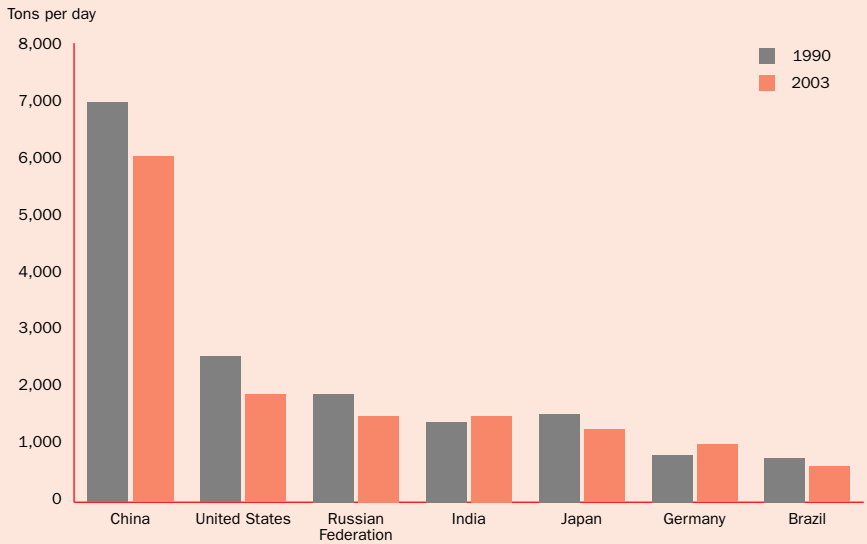
Hettige, Mani, and Wheeler (1998) used plant- and sector-level information on emissions and employment from 13 national environmental protection agencies and sector-level information on output and employment from the United Nations Industrial Development Organization (UNIDO). Their econometric analysis 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. The estimates of sectoral emissions were then totaled to get daily emissions of organic water pollutants in kilograms per day for each country and year. The data in the table were derived by updating these estimates through 2003.

Definitions

• **Emissions of organic water pollutants** are measured in terms of biochemical oxygen demand, which refers to the amount of oxygen that bacteria in water will consume in breaking down waste. This is 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** refer to emissions from manufacturing activities as defined by two-digit divisions of the International Standard Industrial Classification (ISIC) revision 2: primary metals (ISIC division 37); paper and pulp (34); chemicals (35); food and beverages (31); stone, ceramics, and glass (36); textiles (32); wood (33); and other (38 and 39).

3.6a

Emission of organic water pollutants declined in most countries from 1990 to 2003



Source: Table 3.6.

Data sources

Data on water pollution come from a 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 2003 by the World Bank's Development Research Group using the same methodology as the initial study. Sectoral employment numbers are from UNIDO's industry database.

3.7 Energy production and use

	Total energy production		Energy use								Net energy imports[a]	
	thousand metric tons of oil equivalent		Total thousand metric tons of oil equivalent		Combustible renewables and waste % of total		average annual % growth	Per capita kilograms of oil equivalent		average annual % growth	% of energy use	
	1990	2003	1990	2003	1990	2003	1990–2003	1990	2003	1990–2003	1990	2003
Afghanistan	..	..	..	..	..	..	..	..	..	..	..	..
Albania	2,449	899	2,662	2,084	13.6	6.8	–1.9	809	674	–1.4	8	57
Algeria	104,439	163,271	23,858	32,998	0.1	0.2	2.5	943	1,036	0.7	–338	–395
Angola	28,652	50,730	6,280	9,115	68.8	66.4	2.9	596	606	0.1	–356	–457
Argentina	48,456	84,318	46,110	59,851	3.7	5.3	2.0	1,415	1,575	0.8	–5	–41
Armenia	*263*	692	*4,298*	2,004	*0.0*	0.1	..	*1,246*	660	..	*94*	65
Australia	157,712	253,534	87,536	112,645	4.5	4.4	1.9	5,130	5,668	0.8	–80	–125
Austria	8,104	10,025	25,026	33,183	9.9	11.1	2.2	3,246	4,086	1.8	68	70
Azerbaijan	*18,150*	19,826	*16,675*	12,290	*0.0*	0.0	..	*2,259*	1,493	..	*–9*	–61
Bangladesh	10,758	17,532	12,826	21,682	53.5	36.9	4.0	123	159	1.9	16	19
Belarus	*4,103*	3,497	*39,703*	25,797	*1.5*	4.2	..	*3,886*	2,613	..	*90*	86
Belgium	12,481	13,381	49,109	59,157	1.4	2.0	1.4	4,927	5,701	1.1	75	77
Benin	1,774	1,584	1,678	2,310	93.2	68.6	2.5	324	292	–0.8	–6	31
Bolivia	4,923	7,728	2,774	4,451	27.2	16.2	3.6	416	504	1.5	–77	–74
Bosnia and Herzegovina	*3,642*	3,109	*4,474*	4,453	*3.6*	4.2	..	*1,130*	1,137	..	*19*	30
Botswana	..	..	..	..	..	..	..	..	..	..	..	..
Brazil	97,554	171,139	133,469	193,245	30.8	25.9	2.9	893	1,065	1.4	27	11
Bulgaria	9,613	10,062	28,820	19,510	0.6	3.6	–3.0	3,306	2,494	–2.2	67	48
Burkina Faso	..	..	..	..	..	..	..	..	..	..	..	..
Burundi	..	..	..	..	..	..	..	..	..	..	..	..
Cambodia	..	..	..	..	..	..	..	..	..	..	..	..
Cameroon	12,090	12,135	5,032	6,754	75.9	78.8	2.3	432	429	–0.1	–140	–80
Canada	273,695	385,291	209,104	260,641	3.9	4.5	1.7	7,524	8,240	0.7	–31	–48
Central African Republic	..	..	..	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	7,638	8,336	14,064	26,268	19.0	15.4	4.8	1,067	1,647	3.3	46	68
China	902,689	1,380,786	879,923	1,409,377	22.8	15.5	3.6	775	1,094	2.7	–3	2
Hong Kong, China	43	48	10,662	16,515	0.5	0.3	3.4	1,869	2,428	2.0	100	100
Colombia	48,479	74,363	25,048	28,371	23.2	17.4	1.0	716	642	–0.9	–94	–162
Congo, Dem. Rep.	12,019	16,547	11,903	15,884	84.0	93.5	2.2	315	293	–0.6	–1	–4
Congo, Rep.	9,005	12,112	1,056	1,028	69.4	62.1	–0.2	425	273	–3.4	–753	–1,078
Costa Rica	1,032	1,626	2,025	3,675	36.6	8.2	4.6	658	880	2.2	49	56
Côte d'Ivoire	3,382	6,690	4,408	6,577	72.1	65.7	3.1	348	374	0.5	23	–2
Croatia	*4,346*	3,745	*6,714*	8,779	*3.8*	4.3	..	*1,502*	1,976	..	*35*	57
Cuba	6,271	6,661	16,535	11,216	33.7	22.3	–3.0	1,569	1,000	–3.5	62	41
Czech Republic	38,474	33,002	47,379	44,117	*1.2*	2.7	–0.6	4,572	4,324	–0.4	19	25
Denmark	9,996	28,498	17,847	20,755	6.4	10.7	1.2	3,472	3,853	0.8	44	–37
Dominican Republic	1,031	1,546	4,139	7,971	24.2	18.1	5.0	584	923	3.5	75	81
Ecuador	16,474	23,617	6,128	9,105	13.5	7.1	3.1	597	708	1.3	–169	–159
Egypt, Arab Rep.	54,869	60,998	31,895	52,356	3.3	2.6	3.8	573	735	1.9	–72	–17
El Salvador	1,722	2,390	2,535	4,487	48.2	32.1	4.4	496	675	2.4	32	47
Eritrea	..	..	..	..	..	..	..	..	..	..	..	..
Estonia	*4,118*	3,661	*6,271*	4,915	*2.9*	10.6	..	*4,091*	3,631	..	*34*	26
Ethiopia	14,158	18,903	15,151	20,509	92.9	91.2	2.3	296	299	0.1	7	8
Finland	12,081	15,976	29,171	37,554	15.6	19.5	1.9	5,851	7,204	1.6	59	57
France	111,445	136,003	227,282	271,287	4.9	4.4	1.4	4,006	4,519	0.9	51	50
Gabon	14,630	12,418	1,243	1,685	59.8	58.8	2.3	1,298	1,256	–0.3	–1,077	–637
Gambia, The	..	..	..	..	..	..	..	..	..	..	..	..
Georgia	*1,470*	1,376	*8,757*	2,727	*7.7*	23.7	..	*1,642*	597	..	*83*	50
Germany	186,159	134,520	356,221	347,118	1.4	2.8	–0.2	4,485	4,205	–0.5	48	61
Ghana	4,392	5,991	5,337	8,493	73.1	66.6	3.6	345	400	1.2	18	29
Greece	9,200	9,915	22,181	29,887	4.0	3.3	2.3	2,183	2,709	1.7	59	67
Guatemala	3,390	5,469	4,478	7,293	67.9	53.3	3.8	504	608	1.5	24	25
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	1,253	1,673	1,585	2,237	76.5	73.8	2.7	231	270	1.2	21	25

Energy production and use 3.7

	Total energy production		Energy use								Net energy imports[a]	
	thousand metric tons of oil equivalent		Total thousand metric tons of oil equivalent		Combustible renewables and waste % of total		average annual % growth	Per capita kilograms of oil equivalent		average annual % growth	% of energy use	
	1990	2003	1990	2003	1990	2003	1990–2003	1990	2003	1990–2003	1990	2003
Honduras	1,694	1,659	2,416	3,597	62.0	40.9	3.1	496	522	0.4	30	54
Hungary	14,325	10,411	28,553	26,341	1.3	3.1	–0.6	2,755	2,600	–0.4	50	60
India	334,056	453,147	365,377	553,390	48.1	38.2	3.2	430	520	1.5	9	18
Indonesia	162,556	249,955	96,085	161,553	38.8	26.8	4.0	539	753	2.6	–69	–55
Iran, Islamic Rep.	179,738	265,400	68,775	136,443	1.0	0.6	5.3	1,264	2,055	3.7	–161	–95
Iraq	104,933	68,448	19,060	25,750	0.1	0.1	2.3	1,029	..	..	–451	–166
Ireland	3,467	1,896	10,424	15,092	1.0	1.1	2.9	2,973	3,777	1.8	67	87
Israel	433	751	12,112	20,638	0.0	0.0	4.1	2,599	3,086	1.3	96	96
Italy	25,312	27,660	148,031	181,026	0.6	1.7	1.6	2,610	3,140	1.4	83	85
Jamaica	485	468	2,943	4,059	16.2	11.3	2.5	1,231	1,543	1.7	84	88
Japan	75,745	84,643	445,336	517,103	1.3	1.3	1.2	3,605	4,053	0.9	83	84
Jordan	162	285	3,498	5,450	0.1	0.1	3.4	1,103	1,027	–0.6	95	95
Kazakhstan	*89,007*	105,522	*79,661*	49,829	*0.1*	0.2	..	*4,846*	3,342	..	*–12*	–112
Kenya	10,272	13,492	12,479	16,170	78.4	77.5	2.0	533	494	–0.6	18	17
Korea, Dem. Rep.	28,725	18,760	32,874	19,944	2.9	5.1	–3.8	1,670	896	–4.8	13	6
Korea, Rep.	21,908	36,920	92,650	205,300	*0.3*	0.4	6.1	2,161	4,291	5.3	76	82
Kuwait	50,401	120,722	8,110	22,924	0.1	..	8.0	3,816	9,566	7.1	–521	–427
Kyrgyz Republic	*1,818*	1,366	*5,066*	2,661	*0.1*	0.2	..	*1,114*	528	..	*64*	49
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	*794*	1,977	*4,258*	4,375	13.2	28.9	..	*1,618*	1,881	..	81	55
Lebanon	143	251	2,309	5,956	4.5	2.1	7.3	842	1,700	5.4	94	96
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..
Liberia	..	..	..	..	..	..	..	..	..	..	..	..
Libya	73,173	77,498	11,541	17,963	1.1	0.8	3.4	2,663	3,191	1.4	–534	–331
Lithuania	*4,298*	5,216	*11,017*	8,930	*2.6*	7.6	..	*2,978*	2,585	..	*61*	42
Macedonia, FYR	..	..	..	..	..	..	..	..	..	..	..	..
Madagascar	..	..	..	..	..	..	..	..	..	..	..	..
Malawi	..	..	..	..	..	..	..	..	..	..	..	..
Malaysia	48,753	83,843	22,637	56,655	9.4	4.6	7.1	1,269	2,318	4.6	–115	–48
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	..	..	..	..	..	..	..	..	..	..	..	..
Mexico	194,783	242,511	124,341	159,935	5.9	5.1	1.9	1,494	1,564	0.4	–57	–52
Moldova	*58*	61	*6,884*	3,267	*0.5*	1.8	..	*1,575*	772	..	*99*	98
Mongolia	..	..	..	..	..	..	..	..	..	..	..	..
Morocco	773	637	6,725	10,891	4.7	4.1	3.7	281	378	2.3	89	94
Mozambique	6,846	7,990	7,203	8,198	94.4	86.1	1.0	536	430	–1.7	5	3
Myanmar	10,651	18,345	10,683	13,673	84.4	73.5	1.9	262	276	0.4	0	–34
Namibia	*218*	308	*652*	1,262	*16.0*	14.5	..	*449*	635	..	*67*	76
Nepal	5,501	7,795	5,806	8,751	93.4	86.8	3.2	304	336	0.8	5	11
Netherlands	60,447	58,465	66,623	80,829	1.3	2.4	1.5	4,456	4,982	0.9	9	28
New Zealand	12,019	13,171	13,769	17,372	4.0	4.8	1.8	3,993	4,333	0.6	13	24
Nicaragua	1,495	1,805	2,118	3,099	53.3	49.9	2.9	535	588	0.7	29	42
Niger	..	..	..	..	..	..	..	..	..	..	..	..
Nigeria	150,453	214,580	70,905	97,789	79.8	79.4	2.5	783	777	–0.1	–112	–119
Norway	120,304	233,205	21,492	23,347	4.8	6.6	0.6	5,067	5,100	0.1	–460	–899
Oman	38,313	59,824	4,562	12,492	..	..	7.8	2,475	4,975	5.4	–740	–379
Pakistan	34,360	55,494	43,424	69,309	43.2	37.3	3.6	402	467	1.2	21	20
Panama	612	689	1,490	2,607	28.3	17.1	4.3	618	836	2.3	59	74
Papua New Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Paraguay	4,578	6,623	3,083	3,989	72.3	54.4	2.0	731	679	–0.6	–48	–66
Peru	10,596	9,444	9,952	12,003	26.9	18.7	1.4	457	442	–0.3	–6	21
Philippines	13,701	22,503	26,159	42,124	29.2	24.5	3.7	428	525	1.6	48	47
Poland	99,228	79,969	99,847	93,666	2.2	5.6	–0.5	2,619	2,452	–0.5	1	15
Portugal	3,393	4,340	17,746	25,778	14.0	11.0	2.9	1,793	2,469	2.5	81	83
Puerto Rico	..	..	..	..	..	..	..	..	..	..	..	..

3.7 Energy production and use

	Total energy production		Energy use								Net energy imports[a]	
	thousand metric tons of oil equivalent		Total thousand metric tons of oil equivalent		Combustible renewables and waste % of total		average annual % growth	Per capita kilograms of oil equivalent		average annual % growth	% of energy use	
	1990	2003	1990	2003	1990	2003	1990–2003	1990	2003	1990–2003	1990	2003
Romania	40,834	28,927	62,403	39,009	1.0	7.5	–3.6	2,689	1,794	–3.1	35	26
Russian Federation	*1,118,707*	1,106,924	*774,823*	639,717	*1.6*	1.0	..	*5,211*	4,424	..	*–44*	–73
Rwanda	..	..	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	376,342	533,664	64,976	130,783	0.0	0.0	5.4	3,967	5,607	2.7	–479	–308
Senegal	1,362	1,744	2,238	3,193	60.6	53.0	2.7	281	287	0.2	39	45
Serbia and Montenegro	*11,835*	11,474	*15,002*	16,235	*5.0*	4.9	..	*1,435*	1,991	..	*21*	29
Sierra Leone	..	..	..	..	..	..	..	..	..	..	..	..
Singapore	..	140	13,357	22,427	..	..	4.0	4,384	5,359	1.5	..	99
Slovak Republic	5,281	6,401	21,434	18,521	0.8	1.9	–1.1	4,057	3,443	–1.3	75	65
Slovenia	*2,765*	3,285	*5,008*	7,021	1.9	6.7	..	*2,508*	3,518	..	57	53
Somalia	..	..	..	..	..	..	..	..	..	..	..	..
South Africa	114,534	154,480	91,229	118,566	11.4	11.1	2.0	2,592	2,587	0.0	–26	–30
Spain	34,513	32,995	91,073	136,102	4.5	3.5	3.1	2,345	3,240	2.5	62	76
Sri Lanka	4,191	4,294	5,516	8,110	71.0	49.5	3.0	324	421	2.0	24	47
Sudan	8,775	26,974	10,642	16,615	81.7	80.6	3.4	408	477	1.2	18	–62
Swaziland	..	..	..	..	..	..	..	..	..	..	..	..
Sweden	29,754	31,664	47,566	51,532	11.6	17.1	0.6	5,557	5,754	0.3	37	39
Switzerland	9,830	11,999	25,105	27,075	4.1	6.2	0.6	3,740	3,689	–0.1	61	56
Syrian Arab Republic	22,319	33,989	11,677	17,882	0.0	0.0	3.3	909	986	0.6	–91	–90
Tajikistan	*1,553*	1,450	*9,087*	3,187	..	..	..	*1,647*	501	..	*83*	55
Tanzania	9,063	16,027	9,808	17,154	91.0	92.0	4.3	374	465	1.7	8	7
Thailand	26,496	48,255	43,860	88,762	33.4	16.5	5.4	803	1,406	4.3	40	46
Togo	1,203	1,873	1,447	2,598	82.6	71.3	4.5	365	445	1.5	17	28
Trinidad and Tobago	12,612	28,842	6,037	11,096	0.8	0.2	4.7	4,968	8,553	4.2	–109	–160
Tunisia	6,127	6,452	5,536	8,240	18.7	12.7	3.1	679	837	1.6	–11	22
Turkey	25,857	23,635	53,005	78,954	13.6	7.3	3.1	944	1,117	1.3	51	70
Turkmenistan	*48,822*	58,551	*11,314*	17,203	..	..	..	*2,912*	3,662	..	*–332*	–240
Uganda	..	..	..	..	..	..	..	..	..	..	..	..
Ukraine	*110,170*	75,537	*218,376*	132,555	*0.1*	0.2	..	*4,187*	2,772	..	*50*	43
United Arab Emirates	109,446	159,162	19,618	39,226	*0.2*	0.0	5.3	11,065	9,707	–1.0	–458	–306
United Kingdom	207,007	246,083	212,176	231,954	0.3	1.2	0.7	3,686	3,893	0.4	2	–6
United States	1,650,464	1,631,383	1,927,628	2,280,791	3.2	3.0	1.3	7,722	7,843	0.1	14	28
Uruguay	1,149	1,161	2,251	2,519	24.3	17.0	0.9	725	738	0.1	49	54
Uzbekistan	*40,461*	55,735	*44,994*	52,254	..	..	..	*2,092*	2,023	..	*10*	–7
Venezuela, RB	148,854	179,622	43,918	54,227	1.2	1.0	1.6	2,224	2,112	–0.4	–239	–231
Vietnam	24,711	54,528	24,324	44,260	77.7	53.0	4.6	367	544	3.0	–2	–23
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	9,384	21,895	2,543	5,697	3.0	1.4	6.2	210	289	2.5	–269	–284
Zambia	4,923	6,352	5,470	6,688	73.4	80.8	1.6	653	592	–0.8	10	5
Zimbabwe	8,550	8,532	9,384	9,668	50.4	60.5	0.2	888	752	–1.3	9	12
World	**8,804,865 t**	**10,672,009 t**	**8,615,951 t**	**10,543,712 t**	**10.8 w**	**10.4 w**	**1.6 w**	**1,685 w**	**1,734 w**	**0.2 w**	**–2 w**	**–1 w**
Low income	816,190	1,148,130	793,735	1,107,697	54.8	48.9	2.6	464	501	0.6	–3	–4
Middle income	4,378,339	5,234,462	3,499,414	4,114,859	11.6	10.8	1.3	1,349	1,373	0.1	–25	–27
Lower middle income	2,198,061	3,004,295	1,987,670	2,639,085	17.4	14.6	2.2	953	1,090	1.0	–11	–14
Upper middle income	2,181,284	2,230,191	1,511,828	1,474,925	3.8	3.9	–0.2	2,980	2,574	–1.1	–44	–51
Low & middle income	5,190,966	6,370,660	4,284,003	5,204,041	18.9	18.2	1.5	1,008	1,014	0.0	–21	–22
East Asia & Pacific	1,229,840	1,894,782	1,147,328	1,853,770	25.6	17.7	3.7	722	1,007	2.6	–7	–2
Europe & Central Asia	1,890,157	1,659,437	1,736,190	1,318,474	1.9	2.4	–2.1	3,726	2,794	–2.2	–9	–26
Latin America & Carib.	617,444	865,000	459,196	617,665	18.1	15.0	2.3	1,050	1,148	0.7	–34	–40
Middle East & N. Africa	601,905	768,565	194,412	336,326	1.8	1.3	4.2	861	1,144	2.2	–210	–129
South Asia	392,146	542,802	436,601	666,820	48.7	38.8	3.3	394	474	1.4	10	19
Sub-Saharan Africa	489,789	693,529	321,812	435,623	56.7	57.4	2.3	693	681	–0.1	–52	–59
High income	3,654,490	4,351,438	4,363,308	5,377,597	2.9	3.0	1.6	4,842	5,410	0.9	16	19
Europe EMU	466,633	445,236	1,046,458	1,221,275	3.1	3.9	1.2	3,568	3,964	0.8	55	64

a. A negative value indicates that a country is a net exporter.

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 defined as 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. Thus the data give only a broad impression of developments and are not strictly comparable between countries. The IEA reports (see *Data sources*) include country notes that explain some of these differences. All forms of energy—primary energy and primary electricity—are converted into oil equivalents. To convert nuclear electricity into oil equivalents, a notional thermal efficiency of 33 percent is assumed; for hydroelectric power 100 percent efficiency is assumed.

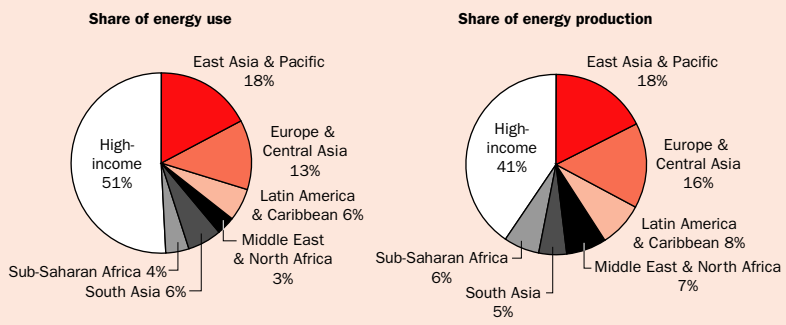
The IEA makes these estimates in consultation with national statistical offices, oil companies, electricity utilities, and national energy experts. The IEA occasionally revises its time series to reflect political changes. Since 1990, for example, it has constructed energy statistics for countries of the former Soviet Union. In addition, energy statistics for other countries have undergone continuous changes in coverage or methodology as more detailed energy accounts have become available in recent years. Breaks in series are therefore unavoidable.

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 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*). • **Combustible renewables and waste** comprise solid biomass, liquid biomass, biogas, industrial waste, and municipal waste, measured as a percentage of total energy use. • **Net energy imports** are estimated as energy use less production, both measured in oil equivalents.

3.7a

In 2003 high-income economies, with 15 percent of world population, used 52 percent of world energy—and produced 41 percent



Source: Table 3.7.

Data sources

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

3.8 Energy efficiency and emissions

	GDP per unit of energy use		Carbon dioxide emissions						Methane emissions		Nitrous oxide emissions	
	2000 PPP $ per kilogram of oil equivalent		Total million metric tons		Per capita metric tons		kilograms per 2000 PPP $ of GDP		million metric tons of carbon dioxide equivalent	% change	thousand metric tons of carbon dioxide equivalent	% change
	1990	2003	1990	2002	1990	2002	1990	2002	2000	1990–2000	2000	1990–2000
Afghanistan	..	..	2.6	0.6	0.2	..	..	..	13.2	53.5	7,482	33.8
Albania	3.8	6.4	7.3	2.6	2.2	0.8	0.7	0.2	0.5	–37.5	52	–5.5
Algeria	5.7	5.6	77.0	92.0	3.0	2.9	0.6	0.5	28.5	40.4	9,196	14.2
Angola	3.7	3.1	4.7	7.7	0.4	0.5	0.2	0.3	15.8	16.2	6,135	20.0
Argentina	6.4	7.2	109.7	133.1	3.4	3.5	0.4	0.3	86.7	7.4	63,384	12.0
Armenia	*1.6*	5.2	*3.7*	2.9	*1.1*	1.0	*0.5*	0.3	2.8	–20.0	291	–41.1
Australia	4.0	4.8	272.2	355.8	16.0	18.1	0.8	0.7	113.2	0.5	26,974	33.7
Austria	7.1	7.2	57.7	63.6	7.5	7.9	0.3	0.3	9.7	–16.4	2,802	9.8
Azerbaijan	..	2.3	*47.1*	28.0	*6.4*	3.4	..	1.1	11.9	–23.7	782	–42.2
Bangladesh	9.8	10.4	15.4	34.5	0.2	0.3	0.1	0.2	47.6	8.9	44,800	37.0
Belarus	*1.2*	2.2	*94.6*	59.9	*9.3*	6.0	*2.0*	1.1	21.6	–10.7	8,318	–34.3
Belgium	4.7	4.9	100.6	91.5	10.1	8.9	0.4	0.3	11.7	–4.1	13,282	0.9
Benin	2.6	3.5	0.7	1.9	0.1	0.3	0.2	0.3	3.3	22.2	2,704	27.4
Bolivia	5.1	4.9	5.5	10.1	0.8	1.2	0.4	0.5	21.3	11.5	5,824	–0.9
Bosnia and Herzegovina	..	5.3	*4.7*	18.6	*1.2*	4.7	..	0.8	1.4	–30.0	556	–51.1
Botswana	..	..	2.2	4.1	1.5	2.3	0.3	0.3	7.0	12.9	4,842	9.8
Brazil	7.3	6.9	202.6	313.2	1.4	1.8	0.2	0.2	297.2	9.1	207,696	10.9
Bulgaria	2.1	2.8	75.3	41.9	8.6	5.3	1.2	0.8	10.0	–63.0	18,483	–22.4
Burkina Faso	..	..	1.0	1.1	0.1	0.1	0.1	0.1	8.8	20.6	11,733	23.1
Burundi	..	..	0.2	0.3	0.0	0.0	0.0	0.1	1.8	20.0	1,212	9.1
Cambodia	..	..	0.5	0.6	0.1	0.0	..	0.0	68.0	10.4	105	36.4
Cameroon	4.7	4.6	1.6	3.5	0.1	0.2	0.1	0.1	11.8	12.4	9,821	18.5
Canada	3.0	3.4	415.8	516.3	15.0	16.5	0.7	0.6	123.4	57.6	57,464	9.2
Central African Republic	..	..	0.2	0.3	0.1	0.1	0.1	0.1	6.6	15.8	5,055	18.1
Chad	..	..	0.1	0.1	0.0	0.0	0.0	0.0	9.6	15.7	8,699	21.6
Chile	5.5	5.9	35.3	57.2	2.7	3.6	0.5	0.4	14.5	15.1	7,474	35.6
China	2.1	4.5	2,398.9	3,507.4	2.1	2.7	1.3	0.6	802.9	18.1	644,725	23.8
Hong Kong, China	10.6	10.9	26.2	35.4	4.6	5.2	0.2	0.2	..	..	..	..
Colombia	8.4	10.1	56.8	57.3	1.6	1.3	0.3	0.2	55.5	11.7	41,220	48.0
Congo, Dem. Rep.	5.0	2.1	4.0	1.8	0.1	0.0	0.1	0.1	32.9	5.8	17,186	–0.3
Congo, Rep.	2.3	3.3	1.2	2.3	0.5	0.6	0.5	0.7	3.2	18.5	1,031	25.7
Costa Rica	9.7	9.9	2.9	5.8	1.0	1.4	0.2	0.2	3.6	–2.7	3,555	–9.9
Côte d'Ivoire	5.2	3.8	5.4	6.4	0.4	0.4	0.2	0.3	6.5	20.4	2,892	17.7
Croatia	*5.0*	5.6	*16.8*	21.1	*3.8*	4.8	*0.5*	0.5	3.8	–5.0	3,363	–12.1
Cuba	..	..	32.1	23.6	3.0	2.1	..	..	9.1	–8.1	9,288	–33.3
Czech Republic	*3.1*	3.9	*135.4*	114.4	*13.1*	11.2	*1.0*	0.7	10.8	–34.9	8,186	–48.1
Denmark	6.9	7.5	49.8	47.5	9.7	8.9	0.4	0.3	6.0	–3.2	9,331	–15.3
Dominican Republic	7.1	7.4	9.6	21.5	1.4	2.5	0.3	0.4	5.9	11.3	4,287	3.6
Ecuador	5.9	4.9	16.6	24.8	1.6	2.0	0.5	0.6	16.2	18.3	2,878	–2.7
Egypt, Arab Rep.	5.1	5.2	75.4	143.5	1.4	2.1	0.5	0.6	34.3	40.6	15,965	39.4
El Salvador	7.3	6.9	2.6	6.2	0.5	1.0	0.1	0.2	3.2	18.5	2,208	6.7
Eritrea	..	..	..	0.7	..	0.2	..	0.2	0.0	..	..	..
Estonia	*1.6*	3.4	*24.9*	15.9	*16.2*	11.7	*2.4*	1.0	2.4	–44.2	444	–57.8
Ethiopia	2.1	2.1	3.0	6.2	0.1	0.1	0.1	0.1	47.5	20.3	12,170	65.9
Finland	3.8	3.7	51.2	62.6	10.3	12.0	0.5	0.5	4.3	–33.9	7,302	–14.9
France	5.5	5.9	362.4	367.7	6.4	6.2	0.3	0.2	59.3	–11.0	72,265	–16.5
Gabon	4.8	4.9	6.0	3.5	6.3	2.6	1.0	0.4	3.8	22.6	1,847	–0.4
Gambia, The	..	..	0.2	0.3	0.2	0.2	0.1	0.1	0.7	16.7	506	3.1
Georgia	*1.2*	4.1	*15.1*	3.3	*2.8*	0.7	*1.4*	0.3	4.4	–18.5	1,129	–44.4
Germany	4.7	6.1	980.6	850.0	12.3	10.3	0.6	0.4	62.7	–44.2	60,468	–32.1
Ghana	4.6	5.0	3.8	7.5	0.2	0.4	0.2	0.2	7.1	34.0	7,431	63.8
Greece	6.7	7.3	72.2	94.0	7.1	8.5	0.5	0.5	10.9	23.9	11,198	2.4
Guatemala	6.7	6.5	5.1	10.3	0.6	0.9	0.2	0.2	6.2	5.1	5,165	8.1
Guinea	..	..	1.0	1.3	0.2	0.2	0.1	0.1	5.7	18.8	2,409	29.4
Guinea-Bissau	..	..	0.2	0.3	0.2	0.2	0.2	0.3	0.9	0.0	776	24.4
Haiti	10.4	6.4	1.0	1.8	0.1	0.2	0.1	0.1	3.4	17.2	2,632	6.7

Energy efficiency and emissions

3.8

	GDP per unit of energy use		Carbon dioxide emissions						Methane emissions		Nitrous oxide emissions	
	2000 PPP $ per kilogram of oil equivalent		Total million metric tons		Per capita metric tons		kilograms per 2000 PPP $ of GDP		million metric tons of carbon dioxide equivalent	% change	thousand metric tons of carbon dioxide equivalent	% change
	1990	2003	1990	2002	1990	2002	1990	2002	2000	1990–2000	2000	1990–2000
Honduras	5.0	4.9	2.6	5.9	0.5	0.9	0.2	0.4	4.9	–2.0	3,540	–0.4
Hungary	4.2	5.6	60.1	56.6	5.8	5.6	0.5	0.4	11.3	–24.7	12,896	136.1
India	4.0	5.3	677.9	1,218.9	0.8	1.2	0.5	0.5	445.3	16.3	398,980	26.4
Indonesia	4.2	4.3	165.7	306.0	0.9	1.4	0.4	0.5	169.2	13.7	38,747	10.1
Iran, Islamic Rep.	3.6	3.2	218.3	359.6	4.0	5.5	0.9	0.9	96.9	67.4	43,768	14.9
Iraq	..	..	48.5	79.3	2.6	..	..	..	14.4	6.7	6,461	1.4
Ireland	5.2	9.3	30.6	43.1	8.7	11.0	0.6	0.3	12.9	–0.8	9,787	5.9
Israel	7.0	7.1	33.1	69.5	7.1	10.6	0.4	0.5	11.4	32.6	1,672	20.1
Italy	8.4	8.2	389.6	432.3	6.9	7.5	0.3	0.3	37.0	–7.0	43,522	5.7
Jamaica	3.0	2.5	8.0	10.8	3.3	4.1	0.9	1.1	1.3	8.3	1,251	2.8
Japan	6.5	6.5	1,070.7	1,201.6	8.7	9.4	0.4	0.4	21.8	–17.1	36,982	–6.3
Jordan	3.5	4.0	10.2	16.7	3.2	3.2	0.8	0.8	7.9	9.7	232	91.7
Kazakhstan	*1.0*	1.9	*252.7*	147.7	*15.4*	9.9	*3.2*	1.8	27.3	–44.9	7,830	–65.0
Kenya	2.2	2.1	5.8	7.2	0.3	0.2	0.2	0.2	21.5	10.8	22,588	3.5
Korea, Dem. Rep.	..	..	244.6	143.0	12.4	6.5	..	..	33.5	3.4	6,535	–39.9
Korea, Rep.	4.5	4.2	241.2	445.5	5.6	9.4	0.6	0.5	25.0	–1.6	16,094	47.7
Kuwait	*1.2*	1.8	45.2	59.8	21.3	25.6	*1.5*	1.6	9.9	65.0	159	140.9
Kyrgyz Republic	*1.7*	3.2	*11.0*	5.0	*2.4*	1.0	*1.3*	0.6	2.2	–24.1	82	12.3
Lao PDR	..	..	0.2	1.3	0.1	0.2	0.1	0.1	6.2	8.8	52	26.8
Latvia	*3.5*	5.3	*12.7*	6.3	*4.8*	2.7	*0.9*	0.3	2.6	–39.5	1,245	–66.0
Lebanon	2.7	3.0	9.1	16.4	3.3	4.7	1.4	1.0	1.3	85.7	1,149	54.6
Lesotho	..	..	..	..	..	..	..	..	1.2	20.0	1,519	4.5
Liberia	..	..	0.5	0.5	0.2	0.1	..	..	1.2	–7.7	840	8.8
Libya	..	..	37.8	50.3	8.7	9.1	..	..	9.6	9.1	2,534	–11.4
Lithuania	*2.9*	4.3	*21.4*	12.6	*5.8*	3.6	*0.7*	0.4	5.9	–42.2	3,516	167.6
Macedonia, FYR	..	..	*10.6*	10.2	*5.5*	5.1	*0.9*	0.9	1.3	0.0	1,063	15.0
Madagascar	..	..	0.9	2.3	0.1	0.1	0.1	0.2	18.9	14.6	11,600	11.7
Malawi	..	..	0.6	0.8	0.1	0.1	0.1	0.1	3.6	16.1	2,277	13.2
Malaysia	4.4	3.9	55.3	151.4	3.1	6.3	0.6	0.7	30.4	42.7	13,304	14.7
Mali	..	..	0.4	0.6	0.1	0.0	0.1	0.1	12.0	9.1	13,764	24.2
Mauritania	..	..	2.6	3.1	1.3	1.1	0.9	0.7	4.4	12.8	6,427	13.1
Mauritius	..	..	1.5	3.1	1.4	2.6	0.2	0.3	0.3	50.0	856	17.4
Mexico	5.1	5.6	375.2	383.1	4.5	3.8	0.6	0.4	111.7	–0.5	10,027	10.6
Moldova	*1.4*	1.9	*20.9*	6.7	*4.8*	1.6	*2.2*	1.1	2.6	–40.9	1,576	–59.5
Mongolia	..	..	10.0	8.3	4.7	3.4	3.1	2.1	8.2	17.1	12,072	37.2
Morocco	11.9	10.2	23.5	43.6	1.0	1.5	0.3	0.4	10.0	9.9	15,673	5.6
Mozambique	1.3	2.5	1.0	1.5	0.1	0.1	0.1	0.1	11.1	18.1	3,234	9.8
Myanmar	..	..	4.3	7.6	0.1	0.2	..	..	61.1	23.9	12,470	32.2
Namibia	*12.3*	9.9	0.0	2.2	0.0	1.1	0.0	0.2	4.5	4.7	4,170	–1.5
Nepal	3.4	4.0	0.6	3.8	0.0	0.2	0.0	0.1	16.4	15.5	11,301	15.5
Netherlands	5.2	5.8	139.6	150.6	9.3	9.3	0.4	0.3	21.6	–22.9	17,242	3.0
New Zealand	4.1	4.8	23.6	33.9	6.9	8.6	0.4	0.4	36.2	–5.0	12,411	5.4
Nicaragua	5.3	5.5	2.7	3.9	0.7	0.8	0.2	0.2	5.3	12.8	4,048	7.8
Niger	..	..	1.1	1.2	0.1	0.1	0.2	0.1	6.5	25.0	4,999	28.2
Nigeria	1.1	1.3	45.3	52.0	0.5	0.4	0.6	0.5	72.5	41.9	41,556	18.7
Norway	5.1	6.8	46.9	63.1	11.1	13.9	0.4	0.4	7.1	6.0	5,123	0.1
Oman	4.3	2.8	11.2	30.1	6.1	12.1	0.6	0.9	3.7	85.0	1,033	19.3
Pakistan	3.9	4.2	68.0	108.5	0.6	0.8	0.4	0.4	94.7	25.1	84,591	34.0
Panama	7.4	7.6	3.1	6.2	1.3	2.0	0.3	0.4	3.3	10.0	2,694	7.0
Papua New Guinea	..	..	2.4	2.5	0.6	0.5	0.3	0.2	3.9	39.3	2,349	18.0
Paraguay	6.5	6.4	2.3	4.1	0.5	0.7	0.1	0.2	12.3	5.1	10,157	1.8
Peru	8.4	11.3	21.7	25.5	1.0	1.0	0.3	0.2	19.6	15.3	21,919	80.2
Philippines	9.1	7.8	43.9	73.7	0.7	0.9	0.2	0.2	34.2	6.9	20,795	33.4
Poland	3.0	4.6	347.6	295.9	9.1	7.7	1.2	0.7	47.2	–21.7	23,921	–22.3
Portugal	7.9	7.2	42.3	62.2	4.3	6.0	0.3	0.3	14.3	2.9	8,073	3.4
Puerto Rico	..	..	11.8	13.6	3.3	3.5	0.2	*0.1*	..	..	..	..

3.8 Energy efficiency and emissions

	GDP per unit of energy use		Carbon dioxide emissions						Methane emissions		Nitrous oxide emissions	
	2000 PPP $ per kilogram of oil equivalent		Total million metric tons		Per capita metric tons		kilograms per 2000 PPP $ of GDP		million metric tons of carbon dioxide equivalent	% change	thousand metric tons of carbon dioxide equivalent	% change
	1990	2003	1990	2002	1990	2002	1990	2002	2000	1990–2000	2000	1990–2000
Romania	2.5	4.0	155.1	86.6	6.7	4.0	1.0	0.6	36.1	–16.6	7,160	–66.1
Russian Federation	*1.6*	1.9	*1,984.0*	1,430.6	*13.3*	9.9	*1.6*	1.3	298.7	–46.0	51,508	–37.1
Rwanda	..	..	0.5	0.6	0.1	0.1	0.1	0.1	2.2	–15.4	1,170	–14.2
Saudi Arabia	2.9	2.2	179.9	340.0	11.0	15.0	0.9	1.3	54.4	56.8	8,666	15.2
Senegal	5.0	5.2	3.1	4.2	0.4	0.4	0.3	0.3	8.4	25.4	6,598	38.1
Serbia and Montenegro	..	..	..	..	..	..	..	..	9.5	–26.4	6,089	–34.7
Sierra Leone	..	..	0.3	0.6	0.1	0.1	0.1	0.3	2.6	8.3	941	30.2
Singapore	3.3	4.5	45.1	57.3	14.8	13.7	1.0	0.6	1.2	71.4	897	460.6
Slovak Republic	2.7	3.7	*43.1*	36.8	*8.1*	6.8	*0.9*	0.6	4.2	–31.2	3,172	–48.9
Slovenia	*4.9*	5.2	*12.3*	15.3	*6.2*	7.7	*0.5*	0.4	2.5	–7.4	1,978	22.6
Somalia	..	..	0.0	..	0.0	..	..	..	..	..	..	..
South Africa	3.8	3.9	285.5	344.8	8.1	7.6	0.8	0.8	37.4	6.6	25,752	1.4
Spain	7.4	7.0	211.8	304.1	5.5	7.4	0.3	0.3	39.6	22.6	30,094	15.2
Sri Lanka	7.3	8.8	3.8	10.3	0.2	0.5	0.1	0.2	13.3	29.1	2,884	19.8
Sudan	2.7	3.7	5.4	8.8	0.2	0.3	0.2	0.2	46.6	17.1	47,090	19.5
Swaziland	..	..	0.4	1.0	0.6	0.9	0.1	0.2	1.1	10.0	1,216	11.9
Sweden	4.0	4.6	49.5	51.8	5.8	5.8	0.3	0.2	7.1	–10.1	7,096	–3.6
Switzerland	8.2	8.1	42.7	40.8	6.4	5.6	0.2	0.2	5.0	–10.7	3,720	2.6
Syrian Arab Republic	2.9	3.4	35.8	49.0	2.8	2.8	1.1	0.8	9.7	67.2	9,359	19.7
Tajikistan	*0.9*	2.1	*20.6*	4.7	*3.7*	0.8	*2.6*	0.8	1.4	7.7	54	14.9
Tanzania	1.4	1.3	2.3	3.6	0.1	0.1	0.2	0.2	31.7	17.8	27,110	16.3
Thailand	5.7	5.0	95.7	231.6	1.8	3.7	0.4	0.6	75.9	4.3	13,083	6.9
Togo	4.3	3.2	0.8	1.7	0.2	0.3	0.1	0.2	2.1	16.7	2,294	15.1
Trinidad and Tobago	1.4	1.2	16.9	41.2	13.9	31.8	2.0	3.4	3.1	24.0	287	–15.8
Tunisia	6.7	8.1	13.3	22.0	1.6	2.3	0.4	0.4	4.8	29.7	5,176	14.4
Turkey	5.8	6.0	143.8	207.7	2.6	3.0	0.5	0.5	97.4	21.1	40,615	–11.7
Turkmenistan	*1.6*	*1.3*	*28.0*	42.1	*7.2*	9.1	*1.5*	*2.1*	27.1	17.3	573	–13.8
Uganda	..	..	0.8	1.7	0.1	0.1	0.1	0.1	12.4	25.3	12,891	26.9
Ukraine	*1.7*	1.9	*600.0*	306.3	*11.5*	6.4	*1.6*	1.3	153.5	–22.4	19,874	–42.8
United Arab Emirates	2.2	2.3	60.7	94.0	34.2	25.0	1.4	1.2	35.2	70.9	136	32.0
United Kingdom	5.9	7.1	569.3	542.7	9.9	9.2	0.5	0.3	51.1	–33.3	43,775	–35.4
United States	3.7	4.5	4,817.5	5,834.5	19.3	20.2	0.7	0.6	613.4	–4.8	429,959	8.2
Uruguay	9.9	10.5	3.9	4.1	1.3	1.2	0.2	0.2	18.3	19.6	673	29.7
Uzbekistan	*0.7*	0.8	*113.4*	122.1	*5.3*	4.8	*3.4*	3.0	46.2	15.2	13,478	19.1
Venezuela, RB	2.6	2.3	117.3	108.0	5.9	4.3	1.0	0.8	95.1	24.3	6,870	–5.4
Vietnam	3.3	4.4	21.4	66.2	0.3	0.8	0.3	0.4	68.1	15.0	12,873	52.2
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	3.0	2.8	9.6	13.0	0.8	0.7	1.2	0.8	8.7	89.1	5,591	9.5
Zambia	1.5	1.4	2.4	2.0	0.3	0.2	0.3	0.2	11.2	14.3	5,502	12.8
Zimbabwe	3.1	2.6	16.7	12.4	1.6	1.0	0.6	0.4	11.0	1.9	8,576	–5.0
World	**3.9 w**	**4.7 w**	**21,254.1 t**	**24,355.2 t**	**4.0 w**	**3.9 w**	**0.6 w**	**0.5 t**	**5,835.0 t**	**–5.5 w**	**3,454,338 t**	**3.0 w**
Low income	3.5	4.2	1,368.2	1,898.2	0.8	0.8	0.4	0.4	1,367.4	18.3	928,766	26.5
Middle income	3.0	4.2	9,255.9	9,795.3	3.5	3.3	0.9	0.6	3,007.8	8.3	1,528,288	9.7
Lower middle income	3.1	4.6	5,086.8	6,250.2	2.5	2.6	0.8	0.6	2,092.1	15.0	1,231,441	16.3
Upper middle income	2.8	3.5	4,176.7	3,547.9	8.1	6.2	1.0	0.7	916.0	–0.9	297,173	0.8
Low & middle income	3.1	4.2	10,622.4	11,693.5	2.4	2.2	0.8	0.6	4,375.1	9.7	2,456,507	12.1
East Asia & Pacific	2.6	4.6	3,047.9	4,506.5	1.9	2.5	1.0	0.6	1,365.1	17.3	779,925	21.9
Europe & Central Asia	2.1	2.7	4,827.8	3,118.8	10.2	6.7	1.3	1.0	844.1	–20.3	236,256	–19.4
Latin America & Carib.	6.0	6.2	1,038.5	1,264.8	2.4	2.4	0.4	0.3	800.5	7.7	419,712	13.8
Middle East & N. Africa	4.6	4.2	576.5	926.3	2.6	3.2	0.7	0.7	233.0	42.2	118,262	19.0
South Asia	4.2	5.3	768.6	1,378.1	0.7	1.0	0.4	0.4	631.7	17.2	550,313	27.9
Sub-Saharan Africa	2.8	2.8	418.3	511.2	0.8	0.7	0.5	0.4	501.5	15.3	353,802	11.8
High income	4.7	5.2	10,654.1	12,685.3	11.8	12.8	0.5	0.5	1,432.7	–9.0	960,933	0.9
Europe EMU	5.8	6.4	2,448.7	2,531.1	8.4	8.3	0.4	0.3	284.5	–17.6	276,251	–10.8

Energy efficiency and emissions 3.8

About the data

The ratio of GDP to energy use provides a measure of 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 2000 constant international dollars using purchasing power parity (PPP) rates. Differences in this ratio over time and across countries reflect in part structural changes in the economy, changes in the energy efficiency of particular sectors, and differences in fuel mixes.

Because commercial energy is widely traded, it is necessary to distinguish between its production and its use. Net energy imports show the extent to which an economy's use exceeds its domestic production. High-income countries are net energy importers; middle-income countries have been their main suppliers.

Carbon dioxide emissions, largely a by-product 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. Burning oil releases about 50 percent more carbon dioxide than burning natural gas, and burning coal releases about twice as much. Cement manufacturing releases about half a metric ton of carbon dioxide for each metric ton of cement produced.

Methane emissions, largely the result of agricultural activities and industrial production of methane, are expressed in carbon dioxide equivalents using the global warming potential, which allows the different gases to be compared on the basis of their effective contributions. A kilogram of methane is 23 times as effective at trapping heat in the earth's atmosphere as a kilogram of carbon dioxide within a time horizon of 100 years. The global warming potential of a kilogram of nitrous oxide is nearly 300 times that of a kilogram of carbon dioxide within the same time horizon.

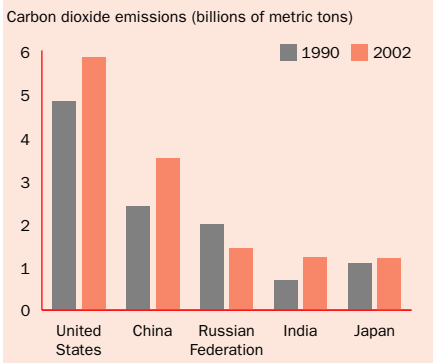
The Carbon Dioxide Information Analysis Center (CDIAC), sponsored by the U.S. Department of Energy, calculates annual anthropogenic emissions of carbon dioxide. These calculations are based on data on fossil fuel consumption (from the World Energy Data Set maintained by the United Nations Statistics Division) and data on world cement manufacturing (from the Cement Manufacturing Data Set maintained by the U.S. Bureau of Mines). Emissions of carbon dioxide are often calculated and reported in terms of their content of elemental carbon. For this table these values were converted to the actual mass of carbon dioxide by multiplying the carbon mass by 3.664 (the ratio of the mass of carbon to that of carbon dioxide). Although the estimates of global carbon dioxide emissions are probably within 10 percent of actual emissions (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 from 1950 to the present, incorporating its most recent findings and the latest corrections to its database. Estimates do not include fuels supplied to ships and aircraft engaged in international transport because of the difficulty of apportioning these fuels among the countries benefiting from that transport.

Definitions

• **GDP per unit of energy use** is the PPP GDP per kilogram of oil equivalent of energy use. PPP GDP is gross domestic product converted to 2000 constant international dollars using purchasing power parity rates. An international dollar has the same purchasing power over GDP as a U.S. dollar has in the United States. • **Carbon dioxide emissions** are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. • **Methane emissions** are those stemming from human activities such as agriculture and from industrial methane production. • **Nitrous oxide emissions** are those stemming from agriculture, biomass burning, industrial activities, and livestock management.

3.8a

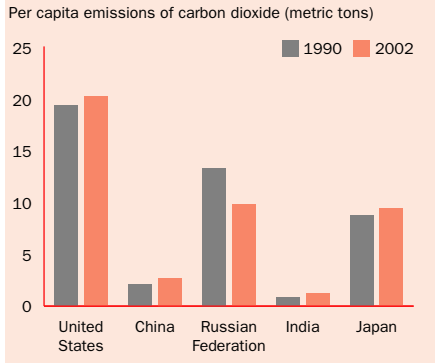
The five largest producers of carbon dioxide . . .



Source: Table 3.8.

3.8b

. . . differ significantly in per capita emissions



Source: Table 3.8.

Data sources

The underlying data on energy use are from electronic files of the International Energy Agency. Data on carbon dioxide emissions are from the CDIAC, Environmental Sciences Division, Oak Ridge National Laboratory, in the U.S. state of Tennessee. Data on methane and nitrous oxide emissions are compiled by the World Resources Institute.

3.9 Sources of electricity

	Electricity production		Sources of electricity[a]									
	billion kilowatt hours		% of total									
			Hydropower		Coal		Oil		Gas		Nuclear power	
	1990	2003	1990	2003	1990	2003	1990	2003	1990	2003	1990	2003
Afghanistan	..	..	..	..	..	..	..	..	..	..	..	..
Albania	3.2	5.2	89.1	98.8	..	..	10.9	1.2	..	..	..	..
Algeria	16.1	29.6	0.8	0.9	..	..	5.4	2.3	93.7	96.8	..	..
Angola	0.8	2.0	86.2	62.2	..	..	13.8	37.8	..	..	..	..
Argentina	51.0	92.1	35.6	36.8	1.3	1.0	9.7	1.1	39.0	51.7	14.3	8.2
Armenia	*10.0*	5.5	*33.8*	36.0	..	..	*43.3*	..	*22.9*	27.6	..	36.3
Australia	154.3	227.9	9.2	7.0	77.1	77.2	2.7	1.0	10.6	13.8	..	..
Austria	49.3	61.2	63.9	59.4	14.2	15.4	3.8	2.9	15.7	18.3	..	..
Azerbaijan	*21.8*	21.3	*8.9*	11.6	..	..	*91.1*	35.7	*0.5*	52.7	..	..
Bangladesh	7.7	19.7	11.4	5.7	..	..	4.3	6.7	84.3	87.5	..	..
Belarus	*41.6*	26.6	*0.0*	0.1	..	0.0	*52.1*	4.4	*47.9*	95.5	..	..
Belgium	70.3	83.6	0.4	0.3	28.2	13.9	1.9	1.2	7.7	25.9	60.8	56.7
Benin	0.0	0.1		2.6	..	..	100.0	97.4	..	..	..	..
Bolivia	2.1	4.3	55.3	60.3	..	..	5.3	19.1	37.6	18.5	..	..
Bosnia and Herzegovina	*6.5*	11.2	*52.2*	48.0	*47.8*	50.9	..	1.1	..	..	..	..
Botswana	..	..	..	..	..	..	..	..	..	..	..	..
Brazil	222.8	364.9	92.8	83.8	2.1	2.4	2.5	3.0	0.0	3.6	1.0	3.7
Bulgaria	42.1	42.3	4.5	7.0	50.3	46.1	2.9	1.9	7.6	4.2	34.8	40.9
Burkina Faso	..	..	..	..	..	..	..	..	..	..	..	..
Burundi	..	..	..	..	..	..	..	..	..	..	..	..
Cambodia	..	..	..	..	..	..	..	..	..	..	..	..
Cameroon	2.7	3.7	98.5	95.8	..	..	1.5	4.2	..	..	..	..
Canada	481.9	586.9	61.6	57.5	17.1	19.3	3.4	3.0	2.0	5.8	15.1	12.8
Central African Republic	..	..	..	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	18.4	48.8	55.1	46.3	34.4	13.5	7.6	1.3	1.3	35.4	..	..
China	621.2	1,907.4	20.4	14.9	71.2	79.4	7.9	3.0	0.5	0.3	*0.2*	2.3
Hong Kong, China	28.9	35.5	..	..	98.3	77.7	1.7	0.5	..	21.8	..	..
Colombia	36.2	47.1	76.0	76.8	9.8	8.1	1.0	0.3	12.4	13.6	..	..
Congo, Dem. Rep.	5.6	6.3	99.6	99.7	..	..	0.4	0.3	..	..	..	..
Congo, Rep.	0.5	0.3	99.4	99.7	..	..	0.6	0.3	..	..	..	..
Costa Rica	3.5	7.6	97.5	78.3	..	..	2.5	1.8	..	..	..	..
Côte d'Ivoire	2.0	5.1	66.7	36.0	..	..	33.3	0.1	..	63.9	..	..
Croatia	*8.9*	12.6	*48.8*	38.7	*5.0*	19.1	*35.8*	25.0	*15.4*	17.2	..	..
Cuba	15.0	15.9	0.6	0.6	..	..	91.5	94.3	0.2	0.0	..	..
Czech Republic	62.6	82.8	2.3	1.7	71.8	62.3	4.8	0.4	1.0	3.7	20.1	31.2
Denmark	26.0	46.3	0.1	0.0	90.3	54.7	3.7	5.1	2.7	21.2	..	..
Dominican Republic	3.7	13.5	9.4	8.9	1.2	21.1	88.6	69.5	..	0.1	..	..
Ecuador	6.3	11.5	78.5	62.2	..	..	21.5	29.7	..	8.1	..	..
Egypt, Arab Rep.	42.3	91.9	23.5	14.1	..	..	36.9	5.7	39.6	79.9	..	..
El Salvador	2.2	4.1	73.5	35.8	..	..	6.9	40.0	..	..	..	..
Eritrea	..	..	..	..	..	..	..	..	..	..	..	..
Estonia	*13.1*	10.2	*0.0*	0.1	*90.0*	92.2	*4.5*	0.4	*5.5*	6.9	..	..
Ethiopia	1.2	2.3	88.4	99.3	..	..	11.6	0.7	..	..	..	..
Finland	54.4	84.2	20.0	11.4	33.0	31.8	3.1	1.1	8.6	16.6	35.3	27.0
France	417.8	561.7	12.9	10.5	8.5	5.3	2.1	1.5	0.7	3.1	75.2	78.5
Gabon	1.0	1.5	72.1	59.8	..	..	11.2	22.8	16.4	16.9	..	..
Gambia, The	..	..	..	..	..	..	..	..	..	..	..	..
Georgia	*12.4*	7.1	*58.3*	91.7	..	..	*5.0*	0.4	*36.6*	7.9	..	..
Germany	547.7	594.3	3.2	3.2	58.8	52.9	1.9	0.8	7.4	9.8	27.8	27.8
Ghana	5.7	5.9	100.0	65.8	..	..	*0.3*	34.2	..	..	..	..
Greece	34.8	57.9	5.1	8.2	72.4	60.7	22.3	15.1	0.3	13.8	..	..
Guatemala	2.3	6.6	76.0	37.8	..	14.5	9.0	34.8	..	..	..	..
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	0.6	0.5	76.5	47.7	..	..	20.6	52.3	..	..	..	..

Sources of electricity 3.9

	Electricity production		Sources of electricity[a]									
	billion kilowatt hours		% of total									
	Hydropower		Coal		Oil		Gas		Nuclear power			
	1990	2003	1990	2003	1990	2003	1990	2003	1990	2003	1990	2003
Honduras	2.3	4.5	98.3	48.0	..	..	1.7	51.7	..	..	..	..
Hungary	28.4	34.1	0.6	0.5	30.5	27.1	4.8	4.8	15.7	34.8	48.3	32.3
India	289.4	633.3	24.8	11.9	65.3	68.3	4.3	4.6	3.4	11.5	2.1	2.8
Indonesia	33.3	112.9	20.2	8.0	31.5	41.1	42.7	24.9	2.3	20.3	..	..
Iran, Islamic Rep.	59.1	152.6	10.3	7.3	..	..	37.3	16.0	52.5	76.7	..	..
Iraq	24.0	28.3	10.8	1.5	..	..	89.2	98.5	..	..	..	..
Ireland	14.2	24.9	4.9	2.4	57.4	33.1	10.0	9.9	27.7	52.5	..	..
Israel	20.9	47.0	0.0	0.1	50.1	77.0	49.9	22.9	..	0.1	..	..
Italy	213.1	283.4	14.8	11.9	16.8	15.6	48.2	26.8	18.6	41.4	*0.1*	..
Jamaica	2.5	7.1	3.6	1.6	..	..	92.4	96.9	..	..	..	..
Japan	834.5	1,037.7	10.7	9.1	14.4	28.2	29.6	13.2	19.5	24.3	24.2	23.1
Jordan	3.6	8.5	0.3	0.5	..	..	87.8	90.7	11.9	8.8	..	..
Kazakhstan	*91.6*	63.8	*8.3*	13.5	*72.3*	69.9	*8.8*	6.0	*10.6*	10.6	..	..
Kenya	3.0	4.9	81.6	67.0	..	..	7.6	16.8	..	..	..	..
Korea, Dem. Rep.	27.7	21.0	56.3	55.7	40.1	39.4	3.6	4.9	..	..	..	..
Korea, Rep.	105.4	344.9	6.0	1.4	16.8	38.9	17.9	9.2	9.1	12.3	50.2	37.6
Kuwait	18.5	39.8	..	..	..	..	54.3	80.0	45.7	20.0	..	..
Kyrgyz Republic	*13.2*	14.0	*77.4*	92.7	*9.1*	3.6	..	..	*13.6*	3.6	..	..
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	*4.2*	4.0	*65.8*	57.0	*2.0*	0.6	*7.9*	2.1	*26.3*	38.5	..	..
Lebanon	1.5	10.5	33.3	12.9	..	..	66.7	87.1	..	..	..	..
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..
Liberia	..	..	..	..	..	..	..	..	..	..	..	..
Libya	10.2	18.9	..	..	..	..	100.0	79.6	..	20.4	..	..
Lithuania	*20.7*	18.8	*2.5*	1.7	..	..	*12.4*	1.7	*6.7*	13.4	*78.2*	82.2
Macedonia, FYR	..	..	..	..	..	..	..	..	..	..	..	..
Madagascar	..	..	..	..	..	..	..	..	..	..	..	..
Malawi	..	..	..	..	..	..	..	..	..	..	..	..
Malaysia	23.0	78.4	17.3	7.3	12.3	14.4	50.0	4.3	20.4	74.0	..	..
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	..	..	..	..	..	..	..	..	..	..	..	..
Mexico	122.7	218.7	19.1	9.1	6.3	14.3	57.3	32.4	10.6	35.4	2.4	4.8
Moldova	*12.5*	3.4	*2.3*	1.9	*34.4*	5.4	*26.4*	0.5	*36.9*	92.2	..	..
Mongolia	..	..	..	..	..	..	..	..	..	..	..	..
Morocco	9.6	18.1	12.7	8.0	23.0	67.7	64.4	23.2	..	..	..	..
Mozambique	0.5	10.6	62.6	99.7	13.9	..	23.6	0.3	*0.2*	0.1	..	..
Myanmar	2.5	6.2	48.1	36.2	1.6	..	10.9	6.8	39.3	57.0	..	..
Namibia	*1.4*	1.5	*95.2*	96.9	*1.5*	0.4	*3.3*	2.7	..	..	..	..
Nepal	0.9	2.3	99.9	99.8	..	..	0.1	0.2	..	..	..	..
Netherlands	71.9	96.8	0.1	0.1	38.2	28.4	4.3	3.0	50.9	58.8	4.9	4.2
New Zealand	32.3	41.1	72.3	57.5	1.5	8.1	0.0	0.0	17.6	24.4	..	..
Nicaragua	1.4	2.7	28.8	11.0	..	..	39.8	75.2	..	..	..	..
Niger	..	..	..	..	..	..	..	..	..	..	..	..
Nigeria	13.5	20.2	32.6	38.8	0.1	..	13.7	22.7	53.7	38.5	..	..
Norway	121.6	106.7	99.6	98.9	0.2	0.1	0.0	0.0	*0.0*	0.3	..	..
Oman	4.5	10.7	..	..	..	..	18.4	18.0	81.6	82.0	..	..
Pakistan	37.7	80.8	44.9	33.3	0.1	0.2	20.6	15.7	33.6	48.5	0.8	2.2
Panama	2.7	5.6	83.2	50.6	..	..	14.7	49.0	..	..	..	..
Papua New Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Paraguay	27.2	51.8	99.9	100.0	..	..	0.0	..	..	..	..	..
Peru	13.8	22.9	75.8	80.8	..	3.3	21.5	9.7	1.7	5.2	..	..
Philippines	25.2	52.9	24.0	14.9	7.7	27.5	46.7	14.2	..	24.9	..	..
Poland	134.4	150.0	1.1	1.1	97.5	95.1	1.2	1.6	0.1	1.6	..	..
Portugal	28.4	46.5	32.3	33.8	32.1	31.2	33.1	13.2	..	16.6	..	..
Puerto Rico	..	..	..	..	..	..	..	..	..	..	..	..

3.9 Sources of electricity

	Electricity production		Sources of electricity[a]									
	billion kilowatt hours		% of total									
	Hydropower		Coal		Oil		Gas		Nuclear power			
	1990	2003	1990	2003	1990	2003	1990	2003	1990	2003	1990	2003
Romania	64.3	55.1	17.7	24.0	28.8	42.9	18.4	6.6	35.1	17.6	..	8.9
Russian Federation	*1,116.7*	914.3	*17.0*	17.0	*15.3*	18.8	*9.9*	3.0	*45.7*	44.5	*11.9*	16.4
Rwanda	..	..	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	69.2	153.0	..	..	..	..	56.5	53.6	43.5	46.4	..	..
Senegal	0.9	2.1	..	15.7	..	..	98.0	74.6	2.0	1.6	..	..
Serbia and Montenegro	*36.5*	35.4	*31.1*	27.9	*65.6*	69.9	*1.7*	0.8	*1.6*	1.5	..	..
Sierra Leone	..	..	..	..	..	..	..	..	..	..	..	..
Singapore	15.7	35.3	..	..	..	..	100.0	34.6	*0.0*	60.8	..	..
Slovak Republic	23.4	31.0	8.0	11.2	32.2	20.6	3.4	2.3	4.9	7.7	51.4	57.7
Slovenia	*12.1*	14.0	*28.2*	22.5	*36.2*	36.4	*2.5*	0.4	*0.2*	2.6	*32.9*	37.1
Somalia	..	..	..	..	..	..	..	..	..	..	..	..
South Africa	165.4	229.1	0.6	0.8	94.3	93.5	*0.0*	..	..	0.0	5.1	5.5
Spain	151.2	257.9	16.8	15.9	40.1	29.5	5.7	9.3	1.0	15.3	35.9	24.0
Sri Lanka	3.2	7.6	99.8	43.5	..	..	0.2	56.5	..	..	..	..
Sudan	1.5	3.4	63.2	34.7	..	..	36.8	65.3	..	..	..	..
Swaziland	..	..	..	..	..	..	..	..	..	..	..	..
Sweden	146.0	135.6	49.7	39.3	1.2	3.1	0.8	2.9	0.3	0.4	46.7	49.7
Switzerland	54.7	64.9	54.5	53.6	0.1	..	0.5	0.1	0.6	1.4	43.2	42.3
Syrian Arab Republic	11.6	29.5	23.5	9.5	..	..	56.0	41.7	20.5	48.9	..	..
Tajikistan	*18.6*	16.5	*94.7*	97.7	..	..	..	..	*5.3*	2.3	..	..
Tanzania	1.6	2.7	95.1	93.0	..	2.7	4.9	4.3	..	..	..	..
Thailand	44.2	117.0	11.3	6.2	25.0	15.8	23.5	2.7	40.2	73.0	..	..
Togo	0.2	0.3	60.1	82.8	..	..	39.9	17.2	..	..	..	..
Trinidad and Tobago	3.6	6.4	..	..	..	..	0.1	0.1	99.0	99.7	..	..
Tunisia	5.8	12.4	0.8	1.3	..	..	35.5	8.7	63.7	89.7	..	..
Turkey	57.5	140.6	40.2	25.1	35.1	22.9	6.9	6.5	17.7	45.2	..	..
Turkmenistan	*14.6*	10.8	*0.0*	0.0	..	..	..	..	*100.0*	100.0	..	..
Uganda	..	..	..	..	..	..	..	..	..	..	..	..
Ukraine	*279.6*	180.2	*3.2*	5.1	*18.1*	18.3	*9.1*	0.5	*40.4*	30.9	*29.2*	45.2
United Arab Emirates	17.1	49.5			..	..	4.0	0.6	96.0	99.4	..	..
United Kingdom	317.8	395.9	1.6	0.8	65.0	35.4	10.9	1.8	1.6	37.5	20.7	22.4
United States	3,202.8	4,054.4	8.5	6.9	53.1	51.4	4.1	3.4	11.9	16.5	19.1	19.4
Uruguay	7.4	8.6	94.2	99.4	..	..	5.1	0.2	..	0.0	..	..
Uzbekistan	*56.4*	49.4	*12.3*	12.8	*4.9*	2.9	*6.9*	11.4	*75.9*	72.9	..	..
Venezuela, RB	59.3	91.8	62.3	66.0	..	..	11.5	16.4	26.2	17.6	..	..
Vietnam	8.7	40.9	61.8	46.4	23.1	17.7	15.0	6.5	0.1	29.4	..	..
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	1.7	4.1	..	..	..	..	100.0	100.0	..	..	..	..
Zambia	8.0	9.6	99.2	99.5	0.5	0.2	0.3	0.4	..	..	..	..
Zimbabwe	9.4	8.8	46.7	60.9	53.3	38.9	..	0.2	..	..	..	..
World	**11,697.4**	**16,618.4**	**18.1**	**15.8**	**38.0**	**40.1**	**11.2**	**6.8**	**13.9**	**19.4**	**17.2**	**15.9**
Low income	535.1	981.1	34.4	23.8	40.9	46.3	7.3	7.2	14.5	20.0	1.2	2.0
Middle income	3,753.1	5,818.3	21.5	20.8	35.2	42.4	15.0	7.3	19.8	21.5	7.6	7.1
Lower middle income	1,817.8	3,591.1	27.4	23.3	37.4	49.4	16.8	7.2	14.0	14.4	5.1	4.5
Upper middle income	1,935.3	2,227.2	16.1	16.6	33.2	31.0	13.4	7.4	25.3	32.9	10.0	11.3
Low & middle income	4,288.2	6,799.4	23.1	21.2	35.9	42.9	14.0	7.3	19.1	21.3	6.8	6.4
East Asia & Pacific	785.8	2,336.8	21.7	14.8	61.3	69.4	12.7	4.4	3.5	8.6	*0.2*	1.9
Europe & Central Asia	2,143.0	1,946.4	12.9	15.7	31.9	29.8	12.6	3.6	29.2	34.0	12.3	16.8
Latin America & Carib.	607.0	1,037.0	63.7	56.4	3.8	5.4	19.0	14.2	9.5	18.1	2.1	3.0
Middle East & N. Africa	190.0	415.3	12.2	7.4	1.2	3.0	48.2	27.4	38.4	62.2	..	..
South Asia	338.8	743.7	27.6	14.7	55.8	58.2	6.1	6.4	8.6	17.4	1.9	2.6
Sub-Saharan Africa	223.5	320.3	18.5	20.1	72.1	68.0	2.2	4.0	3.3	3.5	3.8	4.0
High income	7,409.2	9,818.9	15.2	12.1	39.2	38.2	9.6	6.5	10.8	18.1	23.2	22.4
Europe EMU	1,653.6	2,155.1	11.0	10.2	34.4	27.7	9.5	6.4	8.7	17.0	35.5	34.4

a. Shares may not sum to 100 percent because some sources of generated electricity are not shown.

Sources of electricity 3.9

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

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.

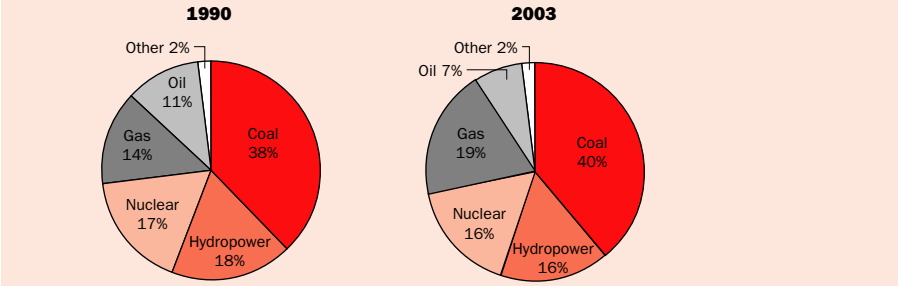
The IEA makes these estimates in consultation with national statistical offices, oil companies, electricity utilities, and national energy experts. The IEA occasionally revises its time series to reflect political changes. Since 1990, for example, it has constructed energy statistics for countries of the former Soviet Union. In addition, energy statistics for other countries have undergone continuous changes in coverage or methodology as more detailed energy accounts have become available in recent years. 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 electricity plants designed to produce electricity only, as well as that of combined heat and power plants. • **Sources of electricity** refer to the inputs used to generate electricity: hydropower, coal, oil, gas, and nuclear power. • **Hydropower** refers to electricity produced by hydroelectric power plants. • **Oil** refers to crude oil and petroleum products. • **Gas** refers to natural gas but not to natural gas liquids. • **Nuclear power** refers to electricity produced by nuclear power plants.

3.9a

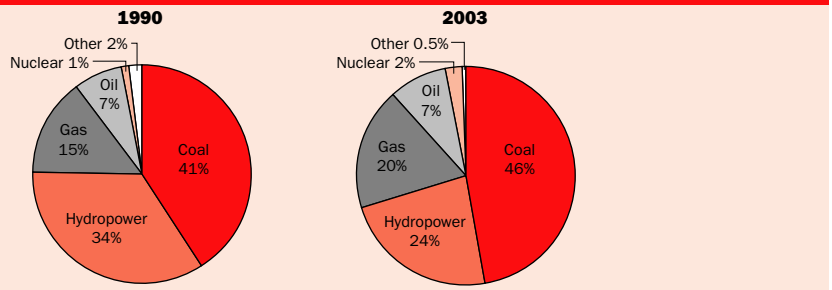
Electricity sources have shifted since 1990 . . .



Source: Table 3.9.

3.9b

. . . with a more profound shift in low-income countries



Source: Table 3.9.

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*.

3.10 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	2004	1990	2004	1990–2004	1990	2005	1990	2005	1990	2002	1990	2002
Afghanistan	2.7	..	18	..	..	11	..	59	..	..	..	5	..
Albania	1.2	1.4	36	44	1.1	..	..	..	..	99	99	..	81
Algeria	13.0	19.2	51	59	2.8	8	10	15	17	99	99	76	82
Angola	2.8	5.6	26	36	5.1	15	18	58	48	62	56	19	16
Argentina	28.3	34.7	87	90	1.4	41	42	39	38	87	..	47	..
Armenia	2.4	1.9	67	64	–1.4	33	35	49	55	96	96	..	61
Australia	14.5	18.6	85	92	1.8	60	61	25	23	100	100	100	100
Austria	5.1	5.4	66	66	0.4	27	27	41	41	100	100	100	100
Azerbaijan	3.8	4.2	54	50	0.5	24	22	45	44	..	73	..	36
Bangladesh	20.6	34.3	20	25	3.7	9	13	32	35	71	75	11	39
Belarus	6.7	7.0	66	71	0.3	16	17	24	24	..	..	..	..
Belgium	9.6	10.1	96	97	0.4	..	..	10	10	..	..	..	..
Benin	1.8	3.7	34	45	5.2	..	..	..	..	31	58	1	12
Bolivia	3.7	5.8	56	64	3.1	25	31	29	26	49	58	13	23
Bosnia and Herzegovina	1.7	1.8	39	45	0.3	..	..	..	..	99	99	..	88
Botswana	0.6	0.9	42	52	3.0	..	..	..	..	61	57	21	25
Brazil	111.6	153.8	75	84	2.3	33	36	13	12	82	83	37	35
Bulgaria	5.8	5.4	66	70	–0.4	14	13	21	19	100	100	100	100
Burkina Faso	1.2	2.3	14	18	5.0	..	..	51	35	47	45	8	5
Burundi	0.4	0.7	6	10	5.3	..	..	..	..	42	47	44	35
Cambodia	1.2	2.6	13	19	5.5	6	8	..	..	..	53	..	8
Cameroon	4.7	8.4	40	52	4.1	16	23	21	23	43	63	7	33
Canada	21.3	25.8	77	81	1.4	34	37	18	19	100	100	99	99
Central African Republic	1.1	1.7	37	43	3.1	..	..	..	..	32	47	18	12
Chad	1.3	2.4	21	25	4.5	..	..	..	..	27	30	1	0
Chile	11.0	14.1	83	87	1.8	35	35	42	39	91	96	52	64
China	311.0	513.0	27	40	3.6	14	15	4	2	64	69	7	29
Hong Kong, China	5.7	6.9	100	100	1.4	100	100	100	100	..	..	..	..
Colombia	24.0	34.5	69	77	2.6	28	34	21	22	95	96	52	54
Congo, Dem. Rep.	10.6	18.0	28	32	3.8	9	10	32	30	56	43	3	23
Congo, Rep.	1.2	2.1	48	54	4.0	..	..	59	53	..	14	2	2
Costa Rica	1.6	2.6	54	61	3.3	..	..	45	43	..	89	97	97
Côte d'Ivoire	5.0	8.1	40	45	3.4	17	19	42	42	52	61	16	23
Croatia	2.6	2.6	54	59	0.2	..	..	..	..	..	..	..	..
Cuba	7.8	8.5	74	76	0.7	20	19	27	26	99	99	95	95
Czech Republic	7.8	7.6	75	74	–0.2	12	11	16	15	..	..	..	..
Denmark	4.4	4.6	85	85	0.4	26	20	31	24	..	..	..	..
Dominican Republic	3.9	5.2	55	60	2.1	21	22	39	36	60	67	33	43
Ecuador	5.7	8.1	55	62	2.6	26	29	28	29	73	80	36	59
Egypt, Arab Rep.	24.2	30.7	43	42	1.7	22	20	37	36	70	84	42	56
El Salvador	2.5	4.0	49	60	3.4	19	21	39	36	70	78	33	40
Eritrea	0.5	0.9	16	20	4.2	..	..	..	..	46	34	0	3
Estonia	1.1	0.9	71	70	–1.2	..	..	..	..	..	93	..	..
Ethiopia	6.5	11.1	13	16	3.8	3	4	28	25	14	19	2	4
Finland	3.1	3.2	61	61	0.3	17	21	28	35	100	100	100	100
France	42.0	46.2	74	76	0.7	23	23	22	21	..	..	..	..
Gabon	0.7	1.2	68	84	4.1	..	..	..	..	..	37	..	30
Gambia, The	0.2	0.4	25	26	3.6	..	..	..	..	..	72	..	46
Georgia	3.0	2.3	55	52	–1.8	22	23	41	45	96	96	..	69
Germany	67.8	72.9	85	88	0.5	40	42	9	9	..	..	..	..
Ghana	5.6	9.9	36	46	4.0	8	9	21	19	54	74	37	46
Greece	6.0	6.8	59	61	0.9	30	29	51	48	..	..	..	..
Guatemala	3.7	5.7	41	47	3.2	..	..	22	17	71	72	35	52
Guinea	1.6	3.3	25	36	5.2	14	16	56	43	27	25	13	6
Guinea-Bissau	0.2	0.5	24	35	5.7	..	..	..	..	..	57	..	23
Haiti	2.0	3.2	29	38	3.3	17	25	56	63	27	52	11	23

3.10 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	2004	1990	2004	1990–2004	1990	2005	1990	2005	1990	2002	1990	2002
Honduras	2.0	3.2	40	46	3.6	..	..	36	32	77	89	31	52
Hungary	6.4	6.6	62	66	0.2	19	17	31	25	100	100	..	85
India	217.0	308.0	26	29	2.5	9	11	6	6	43	58	1	18
Indonesia	54.5	101.6	31	47	4.4	9	11	14	12	66	71	38	38
Iran, Islamic Rep.	30.6	45.1	56	67	2.8	22	22	21	16	86	86	78	78
Iraq	12.9	..	70	..	..	29	..	32	..	95	..	48	..
Ireland	2.0	2.4	57	60	1.5	..	..	46	41	..	..	..	..
Israel	4.2	6.2	90	92	2.8	48	58	43	48	100	100	..	..
Italy	37.8	38.8	67	67	0.2	23	20	12	10	..	..	..	..
Jamaica	1.2	1.4	51	52	0.8	..	..	..	..	85	90	64	68
Japan	77.9	83.8	63	66	0.5	42	44	42	42	100	100	100	100
Jordan	2.3	4.3	72	79	4.5	27	23	37	29	97	94	..	85
Kazakhstan	9.3	8.4	57	56	–0.8	7	7	12	13	87	87	52	52
Kenya	5.8	13.6	25	40	6.1	6	8	24	20	49	56	40	43
Korea, Dem. Rep.	11.5	13.8	58	61	1.3	16	20	22	24	..	58	..	60
Korea, Rep.	31.7	38.7	74	81	1.4	49	46	33	25	..	..	..	..
Kuwait	2.0	2.4	95	96	1.1	48	..	51	..	..	..	..	..
Kyrgyz Republic	1.7	1.7	38	34	0.2	..	..	38	48	..	75	..	51
Lao PDR	0.6	1.2	15	21	4.7	..	..	..	..	..	61	..	14
Latvia	1.9	1.5	70	66	–1.5	..	..	48	47	..	..	..	..
Lebanon	2.3	3.1	83	88	2.2	42	52	51	60	100	100	..	87
Lesotho	0.3	0.3	17	18	1.2	..	..	..	..	61	61	32	32
Liberia	0.9	1.5	42	47	3.8	..	..	..	..	59	49	24	7
Libya	3.5	5.0	80	87	2.6	35	36	43	41	97	97	96	96
Lithuania	2.5	2.3	68	67	–0.6	..	..	..	..	..	..	..	..
Macedonia, FYR	1.1	1.2	58	60	0.7	..	..	..	..	..	..	..	..
Madagascar	2.8	4.9	24	27	3.8	8	10	33	36	25	49	8	27
Malawi	1.1	2.1	12	17	4.6	..	..	..	..	52	66	34	42
Malaysia	8.9	16.0	50	64	4.2	6	5	13	8	94	..	98	98
Mali	2.1	4.3	24	33	5.1	8	10	35	30	50	59	32	38
Mauritania	0.9	1.9	44	63	5.3	..	..	..	..	31	64	26	9
Mauritius	0.4	0.5	41	44	1.6	..	..	..	..	100	100	99	99
Mexico	60.3	78.6	72	76	1.9	32	34	25	24	84	90	20	39
Moldova	2.0	1.9	47	46	–0.3	..	..	..	..	..	86	..	52
Mongolia	1.2	1.4	57	57	1.3	..	..	48	58	..	75	..	37
Morocco	11.6	17.3	48	58	2.9	21	25	23	21	87	83	28	31
Mozambique	2.8	7.1	21	37	6.6	6	7	27	18	..	51	14	14
Myanmar	10.1	15.0	25	30	2.8	7	8	29	26	39	96	15	63
Namibia	0.4	0.7	27	33	4.1	..	..	..	..	68	66	8	14
Nepal	1.7	4.1	9	15	6.2	..	..	..	..	62	68	7	20
Netherlands	9.0	10.8	60	66	1.3	14	14	12	11	100	100	100	100
New Zealand	2.9	3.5	85	86	1.3	25	28	30	33	..	..	88	..
Nicaragua	2.1	3.1	53	58	2.8	19	21	35	36	64	78	27	51
Niger	1.4	3.1	16	23	5.8	..	..	33	31	35	43	2	4
Nigeria	31.7	61.1	35	47	4.7	11	13	15	18	50	48	33	30
Norway	3.1	3.7	72	80	1.3	..	..	22	22	..	..	..	..
Oman	1.1	2.0	62	78	3.9	..	..	..	..	97	97	61	61
Pakistan	33.0	52.4	31	34	3.3	16	18	22	22	81	92	19	35
Panama	1.3	1.8	54	57	2.4	..	..	65	51	..	89	..	51
Papua New Guinea	0.5	0.8	13	13	2.5	..	..	..	..	67	67	41	41
Paraguay	2.1	3.5	49	58	3.8	22	28	45	49	71	94	46	58
Peru	15.0	20.5	69	74	2.2	27	29	39	39	68	72	15	33
Philippines	29.8	50.4	49	62	3.8	14	14	27	21	63	81	46	61
Poland	23.2	23.7	61	62	0.2	14	13	15	12	..	..	..	..
Portugal	4.6	5.8	47	55	1.6	30	31	40	34	..	..	..	..
Puerto Rico	2.6	3.8	72	97	2.8	44	60	60	62	..	..	..	..

3.10 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	2004	1990	2004	1990–2004	1990	2005	1990	2005	1990	2002	1990	2002
Romania	12.4	11.9	53	55	–0.3	9	8	17	15	..	86	..	10
Russian Federation	108.8	105.4	73	73	–0.2	18	20	8	10	93	93	70	70
Rwanda	0.4	1.8	5	20	11.1	..	..	..	..	49	56	36	38
Saudi Arabia	12.8	21.1	78	88	3.6	30	44	18	25	100	100	..	..
Senegal	3.2	5.7	40	50	4.2	18	20	46	39	52	70	23	34
Serbia and Montenegro	5.4	4.3	51	52	–1.6	11	14	21	26	97	97	77	77
Sierra Leone	1.2	2.1	30	40	3.9	..	..	47	45	..	53	..	30
Singapore	3.0	4.2	100	100	2.4	99	100	99	100	100	100	..	..
Slovak Republic	3.0	3.1	56	58	0.3	..	..	..	..	100	100	100	100
Slovenia	1.0	1.0	51	51	0.0	..	..	..	..	..	..	..	..
Somalia	2.0	2.8	29	35	2.6	11	15	39	43	..	47	..	14
South Africa	17.2	26.1	49	57	3.0	23	30	11	13	85	86	42	44
Spain	29.3	32.7	75	77	0.8	23	22	16	15	..	..	..	..
Sri Lanka	3.6	4.1	21	21	0.9	..	..	..	..	89	98	64	89
Sudan	6.9	14.2	27	40	5.1	9	12	34	30	53	50	26	24
Swaziland	0.2	0.3	23	24	2.9	..	..	..	..	..	78	..	44
Sweden	7.1	7.5	83	83	0.4	17	19	21	23	100	100	100	100
Switzerland	4.6	5.0	68	68	0.6	..	..	18	20	100	100	100	100
Syrian Arab Republic	6.3	9.3	49	50	2.8	26	25	25	26	97	97	56	56
Tajikistan	1.7	1.6	32	25	–0.4	..	..	..	..	..	71	..	47
Tanzania	5.7	13.7	22	36	6.3	5	7	23	19	51	54	45	41
Thailand	16.1	20.5	29	32	1.7	11	10	37	32	95	97	74	100
Togo	1.1	2.1	29	36	4.6	..	..	..	..	71	71	24	15
Trinidad and Tobago	0.8	1.0	69	76	1.2	..	..	..	..	100	100	100	100
Tunisia	4.7	6.4	58	64	2.1	19	21	33	32	95	90	47	62
Turkey	33.2	47.9	59	67	2.6	22	25	20	20	96	94	67	62
Turkmenistan	1.7	2.2	45	46	2.0	..	..	..	..	..	77	..	50
Uganda	2.0	3.4	11	12	3.9	4	5	38	38	54	53	41	39
Ukraine	34.6	31.9	67	67	–0.6	14	15	7	8	100	100	97	97
United Arab Emirates	1.5	3.7	83	85	6.6	..	..	32	26	100	100	100	100
United Kingdom	51.1	53.4	89	89	0.3	24	22	15	14	..	..	..	..
United States	188.0	236.2	75	80	1.6	40	42	9	8	100	100	100	100
Uruguay	2.8	3.2	89	93	1.0	41	39	46	42	95	95	..	85
Uzbekistan	8.2	9.6	40	37	1.1	10	8	25	22	73	73	48	48
Venezuela, RB	16.6	23.0	84	88	2.3	31	34	17	14	..	71	..	48
Vietnam	13.4	21.6	20	26	3.4	13	13	30	23	46	84	16	26
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	2.6	5.3	21	26	5.1	6	8	26	29	59	76	11	14
Zambia	3.3	4.2	39	36	1.6	12	12	30	34	64	68	26	32
Zimbabwe	3.1	4.6	29	35	2.9	10	12	34	33	69	69	40	51
World	**2,259.9 s**	**3,091.5 s**	**43 w**	**49 w**	**2.2 w**	**.. w**	**.. w**	**17 w**	**16 w**	**76 w**	**79 w**	**22 w**	**35 w**
Low income	454.7	717.1	26	31	3.3	10	12	17	17	49	61	10	24
Middle income	1,146.2	1,604.3	44	53	2.4	..	..	16	14	79	81	25	41
Lower middle income	797.7	1,187.9	38	49	2.8	16	17	14	12	75	78	22	39
Upper middle income	348.5	416.4	69	72	1.3	..	..	20	20	91	91	58	61
Low & middle income	1,600.9	2,321.4	37	43	2.7	..	..	16	15	71	74	18	32
East Asia & Pacific	459.5	759.0	29	41	3.6	..	..	10	7	65	72	15	35
Europe & Central Asia	293.2	300.4	63	64	0.2	16	18	14	15	94	93	72	63
Latin America & Carib.	310.9	420.8	71	77	2.2	31	34	24	22	83	84	35	44
Middle East & N. Africa	115.5	167.2	52	56	2.6	21	21	28	25	86	89	51	56
South Asia	278.6	409.9	25	28	2.8	10	12	10	11	50	64	5	23
Sub-Saharan Africa	143.2	264.3	28	36	4.4	..	..	26	25	53	55	24	26
High income	659.0	770.1	75	78	1.1	..	..	20	19	..	..	..	..
Europe EMU	216.5	235.5	74	76	0.6	28	27	17	16	..	..	..	..

About the data

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. (For most countries the last definition is used.)

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, while in 1994 only 20 percent of the population was considered urban. 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 urban population with access to improved sanitation facilities is defined as people with access to at least adequate excreta disposal facilities that can effectively prevent human, animal, and insect contact with excreta. The rural population with access is included to allow comparison of rural and urban access. This definition and the definition of urban areas vary, however, so comparisons between countries can be misleading.

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 2000 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** refers to 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.

3.10a

The urban population in developing countries has increased substantially since 1990

Source: Table 3.10.

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*. The total population figures are World Bank estimates. Data on access to sanitation in urban and rural areas are from the World Health Organization.

3.11 Urban housing conditions

	Census year	Household size: number of people National	Household size: number of people Urban	Overcrowding: People living in overcrowded dwellings[a] % of total National	Overcrowding: People living in overcrowded dwellings[a] % of total Urban	Durable dwelling units: Buildings with durable structure % of total National	Durable dwelling units: Buildings with durable structure % of total Urban	Home ownership: Privately owned dwellings % of total National	Home ownership: Privately owned dwellings % of total Urban	Multiunit dwellings: % of total National	Multiunit dwellings: % of total Urban	Vacancy rate: Unoccupied dwellings % of total National	Vacancy rate: Unoccupied dwellings % of total 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, Arab Rep.	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, The	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

3.11

	Census year	Household size: number of people National	Household size: number of people Urban	Overcrowding: People living in overcrowded dwellings[a] % of total National	Overcrowding: People living in overcrowded dwellings[a] % of total Urban	Durable dwelling units: Buildings with durable structure % of total National	Durable dwelling units: Buildings with durable structure % of total Urban	Home ownership: Privately owned dwellings % of total National	Home ownership: Privately owned dwellings % of total Urban	Multiunit dwellings: % of total National	Multiunit dwellings: % of total Urban	Vacancy rate: Unoccupied dwellings % of total National	Vacancy rate: Unoccupied dwellings % of total 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	..	..	..	..	..	..	..	..	..	..
Lao PDR	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	..

3.11 Urban housing conditions

	Census year	Household size: number of people National	Household size: number of people Urban	Overcrowding: People living in overcrowded dwellings[a] % of total National	Overcrowding: People living in overcrowded dwellings[a] % of total Urban	Durable dwelling units: Buildings with durable structure % of total National	Durable dwelling units: Buildings with durable structure % of total Urban	Home ownership: Privately owned dwellings % of total National	Home ownership: Privately owned dwellings % of total Urban	Multiunit dwellings: % of total National	Multiunit dwellings: % of total Urban	Vacancy rate: Unoccupied dwellings % of total National	Vacancy rate: Unoccupied dwellings % of total Urban
Romania	1992	3.1	3.1	..	..	58	..	87	77	39	71	6	4
Russian Federation	2002	2.8	2.7	7	5	..	..	..	..	73	86	..	..
Rwanda	1991	4.7	..	..	..	79	78	92	73	19	25	..	..
Saudi Arabia	1992	6.1	..	..	..	92	..	42	..	..	..	..	..
Senegal	..	..	..	..	..	..	..	..	..	..	..	..	..
Serbia and Montenegro	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	..
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, Rep.	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 previous census.

Urban housing conditions 3.11

About the data

Urbanization can yield important social benefits, improving access to public services and the job market. At the same time 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 the 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. Additional indicators for more countries will be available in the online version of *World Development Indicators* and on the companion CD-ROM.

3.11a Selected housing indicators for smaller economies

		Household size	Overcrowding	Durable dwelling units	Home ownership	Multiunit dwellings	Vacancy rate
	Census year	number of people	People 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, The	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 (U.K.)	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 previous census.
Source: National population and housing censuses.

Definitions

• **Household size** refers to the average number of people within a household. It is 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 the total number of households in the country and in urban areas. • **Durable dwelling units** refer to 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 or the number of households that own housing units as a percentage of total households. This category includes privately owned and owner-occupied units, depending on the definition used in the census data. State- and community-owned units, rented, squatted, and rent-free units are not included. • **Multiunit dwellings** refer to the number of multiunit dwellings, such as apartments, flats, condominiums, barracks, boarding houses, orphanages, retirement houses, hostels, hotels, and collective dwellings, as a percentage of total occupied dwellings. • **Vacancy rate** refers to 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.

3.12 Traffic and congestion

	Motor vehicles				Passenger cars		Two-wheelers		Road traffic		Particulate matter concentrations	
	per 1,000 people		per kilometer of road		per 1,000 people		per 1,000 people		million vehicle kilometers		Urban-population-weighted PM10 micrograms per cubic meter	
	1990	2003[a]	1990	2003[a]	1990	2003[a]	1990	2003[a]	1990	2003[a]	1990	2002
Afghanistan	*3*	..	*3*	..	*2*	..	..	..	..	..	34	27
Albania	11	*70*	*3*	*12*	2	*47*	3	*1*	..	..	93	58
Algeria	*55*	..	*15*	..	*26*	..	..	..	..	..	123	65
Angola	19	..	*3*	..	14	..	..	..	..	..	142	113
Argentina	181	*181*	27	*37*	134	*140*	1	..	43,119	*27,458*	105	78
Armenia	5	..	2	..	1	..	*2*	..	..	316	..	84
Australia	530	..	11	..	450	..	18	*18*	*138,501*	..	22	18
Austria	421	545	30	33	387	501	71	73	..	49,800	39	37
Azerbaijan	52	57	7	17	36	45	*5*	1	..	5,263	..	64
Bangladesh	1	*1*	0	*1*	0	*0*	1	*1*	..	..	229	157
Belarus	61	168	13	18	59	168	*45*	51	*10,026*	*5,650*	7	9
Belgium	423	527	30	37	385	470	14	31	*150,750*	*156,633*	31	28
Benin	3	..	2	..	2	..	34	..	..	..	75	51
Bolivia	41	*10*	6	*1*	25	*3*	9	*0*	1,139	..	119	92
Bosnia and Herzegovina	114	..	24	..	101	..	..	..	..	..	41	22
Botswana	18	92	3	6	10	38	*1*	1	..	..	40	25
Brazil	88	*170*	8	*17*	*84*	*137*	..	*28*	..	..	41	35
Bulgaria	163	335	39	26	146	295	55	*28*	..	*285*	109	69
Burkina Faso	4	..	3	..	2	..	*9*	..	..	..	140	97
Burundi	..	..	..	..	..	..	..	..	..	..	168	99
Cambodia	..	*30*	0	*31*	..	*25*	9	*127*	*314*	*7,210*	83	51
Cameroon	10	..	3	..	6	..	..	..	..	..	118	86
Canada	605	577	20	34	468	561	12	*11*	..	..	25	21
Central African Republic	1	..	0	..	1	..	0	..	1,494	..	29	24
Chad	2	..	0	..	1	..	0	..	..	..	103	73
Chile	81	136	13	*26*	52	89	2	2	..	..	85	56
China	5	15	4	11	1	10	3	46	..	*659,390*	113[b]	80[b]
Hong Kong, China	66	*79*	253	*287*	42	*59*	4	*5*	8,192	*10,781*	..	38
Colombia	*39*	*51*	*13*	*19*	*21*	*43*	8	*12*	50,945	*41,587*	37	24
Congo, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	70	57
Congo, Rep.	18	..	3	..	12	..	..	..	..	..	126	74
Costa Rica	87	185	7	21	55	103	14	29	..	..	50	40
Côte d'Ivoire	24	..	6	..	15	..	..	..	..	..	94	38
Croatia	..	324	..	50	..	291	..	22	..	18,104	52	35
Cuba	*37*	..	*16*	..	*18*	..	*19*	..	..	..	43	25
Czech Republic	246	*391*	46	*31*	228	*358*	113	*75*	*37,350*	..	70	25
Denmark	368	*424*	27	*32*	320	*360*	9	*15*	36,304	*46,520*	29	22
Dominican Republic	75	..	48	..	21	..	..	..	..	..	44	36
Ecuador	35	53	8	16	31	47	*2*	2	10,306	19,604	37	28
Egypt, Arab Rep.	29	..	33	..	21	..	6	..	..	..	227	136
El Salvador	33	..	14	..	17	..	0	..	2,002	..	46	40
Eritrea	1	..	1	..	1	..	..	..	..	..	178	109
Estonia	211	386	22	9	154	321	66	6	*5,455*	*6,843*	18	17
Ethiopia	1	2	2	4	1	1	0	0	..	*1,495*	175	88
Finland	441	450	29	30	386	433	12	47	39,750	49,790	24	22
France	494	596	32	40	405	495	*55*	..	422,000	548,900	18	15
Gabon	32	..	4	..	19	..	..	..	..	..	21	13
Gambia, The	13	8	5	3	6	6	..	..	..	..	189	138
Georgia	107	63	27	16	89	50	5	0	4,620	..	204	46
Germany	405	578	53	206	386	545	18	45	446,000	639,100	28	22
Ghana	*8*	..	*4*	..	*5*	..	..	..	..	*15,320*	39	42
Greece	248	*435*	22	*34*	171	*331*	120	*229*	..	*79,377*	70	48
Guatemala	*21*	*57*	*16*	*45*	*11*	*52*	*10*	*12*	*3,243*	*4,547*	64	76
Guinea	4	..	1	..	2	..	..	..	..	..	87	63
Guinea-Bissau	7	..	2	..	4	..	..	..	..	..	114	84
Haiti	*8*	..	*14*	..	*5*	..	..	..	..	..	69	47

3.12 Traffic and congestion

	Motor vehicles				Passenger cars		Two-wheelers		Road traffic		Particulate matter concentrations	
	per 1,000 people		per kilometer of road		per 1,000 people		per 1,000 people		million vehicle kilometers		Urban-population-weighted PM10 micrograms per cubic meter	
	1990	2003[a]	1990	2003[a]	1990	2003[a]	1990	2003[a]	1990	2003[a]	1990	2002
Honduras	22	*61*	10	*28*	*5*	*52*	..	*14*	*3,288*	..	44	46
Hungary	212	313	21	*19*	188	274	16	10	22,898	*23,260*	35	22
India	4	*9*	2	*3*	2	*6*	15	*35*	..	..	109	84
Indonesia	16	..	10	..	7	..	34	*59*	..	..	137	114
Iran, Islamic Rep.	34	..	14	..	25	..	*36*	..	..	..	85	68
Iraq	14	..	6	..	1	..	..	..	..	..	150	167
Ireland	270	447	10	11	227	382	6	9	24,205	*33,915*	25	20
Israel	210	284	74	110	174	231	8	11	18,212	38,273	70	53
Italy	529	*610*	99	*73*	476	*545*	*45*	*125*	344,726	*65,983*	43	33
Jamaica	*52*	..	*7*	..	*43*	..	..	..	..	..	57	43
Japan	469	582	52	*63*	283	433	146	105	628,581	*790,829*	42	33
Jordan	60	99	26	71	*44*	67	*0*	0	*1,098*	*526,677*	124	69
Kazakhstan	76	96	8	6	50	77	..	5	18,248	*4,087*	12	27
Kenya	12	*11*	5	*5*	10	*8*	1	*1*	5,170	..	66	38
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	203	88
Korea, Rep.	79	304	60	150	48	215	32	36	30,464	..	83	43
Kuwait	*474*	332	*165*	..	*368*	326	..	..	..	..	77	129
Kyrgyz Republic	44	*38*	10	*10*	44	*38*	*16*	*2*	5,220	*1,992*	..	36
Lao PDR	9	..	3	..	6	..	*18*	..	..	..	35	25
Latvia	135	329	6	11	106	280	76	10	3,932	..	30	17
Lebanon	321	..	183	..	300	..	13	..	..	..	41	43
Lesotho	11	..	4	..	3	..	..	..	*445*	..	176	94
Liberia	14	..	4	..	7	..	..	..	..	..	57	39
Libya	*165*	..	*10*	..	*96*	..	*0*	..	..	..	109	121
Lithuania	160	397	12	17	133	364	52	6	..	*2,709*	28	22
Macedonia, FYR	132	..	30	..	121	..	1	..	3,102	..	36	29
Madagascar	6	..	2	..	4	..	..	..	41,500	..	101	51
Malawi	4	..	4	..	2	..	..	..	..	..	169	88
Malaysia	124	254	26	*75*	101	222	167	249	..	..	36	28
Mali	3	..	2	..	2	..	..	..	..	..	144	102
Mauritania	10	..	3	..	7	..	..	..	..	..	55	42
Mauritius	59	119	35	72	44	88	54	103	..	*78*	85	47
Mexico	119	201	41	59	82	133	3	*4*	55,095	..	70	43
Moldova	53	78	17	26	48	60	45	3	*891*	*678*	..	41
Mongolia	21	*41*	1	*2*	6	*26*	22	*10*	340	*2,321*	22	16
Morocco	37	*45*	15	*23*	28	*45*	1	*1*	..	*14,242*	33	27
Mozambique	4	..	2	..	3	..	..	..	1,889	..	108	44
Myanmar	*2*	..	*3*	..	*1*	..	..	..	..	..	130	75
Namibia	71	*82*	1	*4*	39	*42*	1	*2*	1,896	..	74	50
Nepal	..	..	..	..	..	..	..	..	..	..	67	43
Netherlands	405	*427*	58	*58*	368	*383*	44	*25*	90,150	*109,955*	47	40
New Zealand	524	*730*	19	*31*	436	*613*	24	*21*	..	..	16	16
Nicaragua	19	39	5	11	10	16	3	8	108	*412*	49	32
Niger	6	..	4	..	5	..	..	..	178	..	112	86
Nigeria	*30*	..	*21*	..	*12*	..	*5*	..	..	..	172	95
Norway	458	527	22	26	380	424	48	64	*28,136*	35,047	26	18
Oman	130	..	9	..	83	..	3	..	..	..	163	124
Pakistan	6	*8*	4	*5*	4	*7*	8	*11*	*25,317*	*205,385*	226	165
Panama	75	*107*	18	*27*	60	*76*	2	..	..	..	58	58
Papua New Guinea	*27*	..	*6*	..	*7*	..	..	..	..	..	12	11
Paraguay	*27*	*88*	*4*	*15*	*16*	*52*	..	..	..	..	109	103
Peru	*128*	46	*43*	16	*62*	30	..	9	..	*23,360*	98	68
Philippines	10	*34*	4	*13*	7	*9*	6	*18*	*6,189*	*9,548*	55	34
Poland	168	354	18	*33*	138	294	36	22	59,608	*138,100*	59	39
Portugal	222	*463*	34	*278*	162	*429*	5	*56*	28,623	*47,943*	53	31
Puerto Rico	*295*	..	*79*	..	*242*	..	..	..	..	*741,445*	70	62

3.12 Traffic and congestion

	Motor vehicles				Passenger cars		Two-wheelers		Road traffic		Particulate matter concentrations	
	per 1,000 people		per kilometer of road		per 1,000 people		per 1,000 people		million vehicle kilometers		Urban-population-weighted PM10 micrograms per cubic meter	
	1990	2003[a]	1990	2003[a]	1990	2003[a]	1990	2003[a]	1990	2003[a]	1990	2002
Romania	72	*168*	11	*19*	56	*144*	13	*12*	23,907	*35,675*	36	20
Russian Federation	*87*	*174*	*14*	*48*	*65*	*140*	..	*43*	..	*56,455*	13	25
Rwanda	2	..	1	..	1	..	..	..	..	..	162	100
Saudi Arabia	165	..	19	..	98	..	0	..	*94,141*	..	105	91
Senegal	11	*14*	6	*9*	8	*11*	0	*0*	..	*4,013*	99	93
Serbia and Montenegro	137	..	31	..	133	..	*3*	..	..	..	26	17
Sierra Leone	10	*4*	4	*2*	7	*2*	2	*0*	*996*	..	101	69
Singapore	130	135	142	111	89	100	40	32	..	16,133	107	48
Slovak Republic	194	286	57	36	163	252	61	9	*8,127*	*10,992*	40	20
Slovenia	306	490	42	25	289	446	8	21	5,620	10,261	..	33
Somalia	2	..	1	..	1	..	..	..	..	..	81	35
South Africa	139	*144*	26	*24*	97	*92*	8	*4*	..	..	34	24
Spain	360	558	43	34	309	455	79	37	100,981	*224,370*	42	40
Sri Lanka	21	*34*	4	..	7	*13*	24	*49*	3,468	*15,630*	97	93
Sudan	9	..	22	..	8	..	..	..	..	..	291	219
Swaziland	66	83	18	*24*	35	40	3	3	..	..	117	71
Sweden	464	504	29	11	426	455	11	24	61,040	*58,992*	15	14
Switzerland	491	553	46	57	449	511	114	103	48,660	59,052	37	27
Syrian Arab Republic	26	36	10	7	10	12	..	6	..	..	151	89
Tajikistan	3	..	1	..	0	..	..	..	..	*1,092*	..	57
Tanzania	5	..	2	..	1	..	..	..	..	..	57	38
Thailand	46	..	36	..	14	..	86	..	45,769	..	87	77
Togo	24	..	11	..	16	..	8	..	..	..	50	45
Trinidad and Tobago	*117*	..	*19*	..	*98*	..	..	..	..	..	124	22
Tunisia	48	*88*	19	*43*	23	*60*	..	*1*	..	*19,231*	71	46
Turkey	50	90	8	101	34	66	10	15	27,041	52,344	76	56
Turkmenistan	..	..	..	..	..	..	..	..	..	..	..	73
Uganda	2	*5*	..	*4*	1	*2*	0	*3*	..	..	60	33
Ukraine	63	137	20	39	63	114	*59*	28	59,500	*13,755*	45	29
United Arab Emirates	121	..	52	..	97	..	..	..	..	..	233	109
United Kingdom	400	442	64	42	341	439	14	19	399,000	484,722	25	17
United States	758	*808*	30	*36*	573	*482*	17	*17*	2,527,441	*4,208,594*	30	24
Uruguay	138	..	45	..	122	..	74	..	..	..	235	154
Uzbekistan	..	..	..	..	..	..	..	..	..	..	95	81
Venezuela, RB	*93*	..	*25*	..	*73*	..	..	..	*563*	..	22	12
Vietnam	..	..	..	..	..	..	45	..	..	..	127	66
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	34	..	8	..	14	..	..	..	8,681	..	..	82
Zambia	14	..	3	..	8	..	..	..	..	..	133	71
Zimbabwe	*32*	*50*	*4*	*7*	*29*	*44*	*33*	*4*	..	..	60	43
World	**118 w**	***141* w**	**..**	**..**	**91 w**	***100* w**	**..**	**..**	**..**	**..**	**77 w**	**60 w**
Low income	5	*8*	..	..	3	*6*	..	..	..	..	129	89
Middle income	37	*69*	..	..	24	*51*	..	..	..	..	79	62
Lower middle income	22	*39*	..	..	10	*29*	..	..	..	..	92	70
Upper middle income	*121*	*187*	..	..	*91*	*143*	..	..	..	..	50	40
Low & middle income	25	*47*	..	..	16	*35*	..	..	..	..	93	70
East Asia & Pacific	9	20	..	..	4	14	..	..	..	..	112	80
Europe & Central Asia	*97*	*170*	..	..	*79*	*142*	..	..	..	..	39	35
Latin America & Carib.	100	*153*	..	..	*72*	*108*	..	..	..	..	60	43
Middle East & N. Africa	36	..	..	..	24	..	..	..	..	..	126	89
South Asia	4	*10*	..	..	2	*6*	..	..	..	..	131	99
Sub-Saharan Africa	21	..	..	..	15	..	..	..	..	..	114	73
High income	499	*623*	..	..	390	*433*	..	..	..	..	37	29
Europe EMU	429	570	..	..	379	502	..	..	..	..	33	27

a. Data are for 2003 or most recent year available. b. Includes data for Hong Kong, China; Macao, China; and Taiwan, China.

Traffic and congestion

About the data

Traffic congestion in urban areas constrains economic productivity, damages people's health, and degrades the quality of their lives. The particulate air pollution emitted by motor vehicles—the dust and soot in exhaust—is proving to be far more damaging to human health than was once believed. (For information on particulate matter and other air pollutants, see table 3.13.)

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 5.8). These developments have increased demand for roads and vehicles, adding to urban congestion, air pollution, health hazards, 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 or 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—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. The primary sources are national road associations. Where such 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, the compiled data are of uneven quality. The coverage of each indicator may differ across countries because of differences in definitions. Comparability also is limited when time-series data are reported. Moreover, the data do not capture the quality or age of vehicles or the condition or width of roads. Thus comparisons over time and between countries should be made with caution.

Estimates of particulate matter concentrations weighted by urban population represent the average annual exposure level of the average urban resident to outdoor particulate matter under 10 microns (PM10). Data for countries and aggregates for regions and income groups are urban-population-weighted PM10 levels in residential areas of cities with more than 100,000 residents; they are available at www.worldbank.org/research. Data for selected cities are in table 3.13.

Significant uncertainties exist around these estimates, and caution should be used in interpreting them. But they do allow for cross-country comparisons of the relative risk of particulate matter pollution that urban residents face. Major sources of urban outdoor particulate matter pollution are emissions from traffic and industrial sources, but nonanthropogenic sources such as dust storms may also be a significant contributor for some cities. Estimates of economic damages from death and illness due to particulate matter pollution are shown in table 3.15.

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 specially designed and built for motor traffic that separates the traffic flowing in opposite directions. • **Passenger cars** refer to 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). • **Two-wheelers** refer to mopeds and motorcycles. • **Road traffic** is the number of vehicles multiplied by the average distances they travel. • **Particulate matter concentrations** refer to fine suspended particulates less than 10 microns in diameter that are capable of penetrating deep into the respiratory tract and causing significant health damage. The state of a country's technology and pollution controls is an important determinant of particulate matter concentrations.

3.12a

The 15 countries with the fewest passenger cars per 1,000 people in 2003—and the 15 with the most

Country	Number of cars	Country	Number of cars
Bangladesh	0.5	New Zealand	613
Ethiopia	1	Canada	561
Sierra Leone	2	Germany	545
Uganda	2	Italy	545
Bolivia	3	Switzerland	511
Gambia, The	6	Austria	501
India	6	France	495
Pakistan	7	United States	482
Kenya	8	Belgium	470
Afghanistan	9	Spain	455
Philippines	9	Sweden	455
China	10	Slovenia	446
Senegal	11	United Kingdom	439
Syrian Arab Republic	12	Finland	433
Sri Lanka	13	Japan	433

Source: Table 3.12.

Data sources

Data on vehicles and traffic are from the IRF's electronic files and its annual *World Road Statistics*. 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).

3.13 Air pollution

	City	City population thousands 2005	Particulate matter micrograms per cubic meter 2002	Sulfur dioxide micrograms per cubic meter 1995–2001[a]	Nitrogen dioxide micrograms per cubic meter 1995–2001[a]
Argentina	Cordoba City	1,592	58	..	97
Australia	Melbourne	3,663	13	..	30
	Perth	1,484	13	5	19
	Sydney	4,388	22	28	81
Austria	Vienna	2,190	44	14	42
Belgium	Brussels	1,027	30	20	48
Brazil	Rio de Janeiro	11,469	42	129	..
	Sao Paulo	18,333	49	43	83
Bulgaria	Sofia	1,045	76	39	122
Canada	Montreal	3,511	20	10	42
	Toronto	5,060	24	17	43
	Vancouver	2,125	14	14	37
Chile	Santiago	5,623	62	29	81
China	Anshan	1,459	92	115	88
	Beijing	10,849	99	90	122
	Changchun	3,092	82	21	64
	Chengdu	3,478	95	77	74
	Chongquing	4,975	137	340	70
	Dalian	2,709	55	61	100
	Guangzhu	976	70	57	136
	Guiyang	2,467	78	424	53
	Harbin	2,898	85	23	30
	Jinan	2,654	104	132	45
	Kunming	1,748	78	19	33
	Lanzhou	1,788	101	102	104
	Liupanshui	2,118	65	102	..
	Nanchang	1,742	87	69	29
	Pinxiang	1,562	74	75	..
	Quingdao	2,431	68	190	64
	Shanghai	12,665	81	53	73
	Shenyang	4,916	112	99	73
	Taiyuan	2,516	98	211	55
	Tianjin	9,346	139	82	50
	Urumqi	1,467[b]	57	60	70
	Wuhan	6,003	88	40	43
	Zhengzhou	2,250	108	63	95
	Zibo	2,775	82	198	43
Colombia	Bogota	5,442[b]	32	..	..
Croatia	Zagreb	908[b]	37	31	..
Cuba	Havana	2,192	28	1	5
Czech Republic	Prague	1,164	25	14	33
Denmark	Copenhagen	1,091	23	7	54
Ecuador	Guayaquil	2,387	25	15	..
	Quito	1,514	33	22	..
Egypt, Arab Rep.	Cairo	11,146	159	69	..
Finland	Helsinki	1,103	23	4	35
France	Paris	9,854	12	14	57
Germany	Berlin	3,328	25	18	26
	Frankfurt	668[b]	22	11	45
	Munich	2,318	22	8	53
Ghana	Accra	1,970	40	..	..
Greece	Athens	3,238	51	34	64
Hungary	Budapest	1,670	23	39	51
Iceland	Reykjavik	164[b]	20	5	42
India	Ahmedabad	5,171	98	30	21
	Bangalore	6,532	53	..	..

About the data

In many towns and cities exposure to air pollution is the main environmental threat to human health. Long-term exposure to high levels of soot and small particles in the air contributes to a wide range of health effects, including respiratory diseases, lung cancer, and heart disease. Particulate pollution, on its own or in combination with sulfur dioxide, leads to an enormous burden of ill health.

Emissions of sulfur dioxide and nitrogen oxides lead to the deposition of acid rain and other acidic compounds over long distances. Acid deposition changes the chemical balance of soils and can lead to the leaching of trace minerals and nutrients critical to trees and plants.

Where coal is the primary fuel for power plants, steel mills, industrial boilers, and domestic heating, the result is usually high levels of urban air pollution—especially particulates and sometimes sulfur dioxide—and, if the sulfur content of the coal is high, widespread acid deposition. Where coal is not an important primary fuel or is used in plants with effective dust control, the worst emissions of air pollutants stem from the combustion of petroleum products.

The data on sulfur dioxide and nitrogen dioxide concentrations are based on reports from urban monitoring sites. Annual means (measured in micrograms per cubic meter) are average concentrations observed at these sites. Coverage is not comprehensive because not all cities have monitoring systems.

The data on concentrations of particulate matter are estimates, for selected cities, of average annual concentrations in residential areas away from air pollution "hotspots," such as industrial districts and transport corridors. The data have been extracted from a complete set of estimates developed by the World Bank's Development Research Group and Environment Department in a study of annual ambient concentrations of particulate matter in world cities with populations exceeding 100,000 (Pandey and others 2006).

Pollutant concentrations are sensitive to local conditions, and even in the same city different monitoring sites may register different concentrations. Thus these data should be considered only a general indication of air quality in each city, and cross-country comparisons should be made with caution. The current World Health Organization (WHO) air quality guidelines for annual mean concentrations are 50 micrograms per cubic meter for sulfur dioxide and 40 micrograms for nitrogen dioxide. The WHO has set no guidelines for particulate matter concentrations below which there are no appreciable health effects.

3.13 Air pollution

	City	City population thousands 2005	Particulate matter micrograms per cubic meter 2002	Sulfur dioxide micrograms per cubic meter 1995–2001[a]	Nitrogen dioxide micrograms per cubic meter 1995–2001[a]
India	Calcutta	14,299	145	49	34
	Chennai	6,915	44	15	17
	Delhi	15,334	177	24	41
	Hyderabad	6,145	48	12	17
	Kanpur	3,040	128	15	14
	Lucknow	2,589	129	26	25
	Mumbai	18,336	74	33	39
	Nagpur	2,359	65	6	13
	Pune	4,485	55	..	..
Indonesia	Jakarta	13,194	115	..	..
Iran, Islamic Rep.	Tehran	7,352	68	209	..
Ireland	Dublin	1,033	21	20	..
Italy	Milan	4,007	36	31	248
	Rome	2,628	35	..	..
	Torino	969[b]	53	..	..
Japan	Osaka	2,626[b]	37	19	63
	Tokyo	35,327	42	18	68
	Yokohama	3,366	32	100	13
Kenya	Nairobi	2,818	42	..	..
Korea, Rep	Pusan	3,527	44	60	51
	Seoul	9,592	46	44	60
	Taegu	2,510	50	81	62
Malaysia	Kuala Lumpur	1,392	28	24	..
Mexico	Mexico City	19,013	55	74	130
Netherlands	Amsterdam	1,157	40	10	58
New Zealand	Auckland	1,152	15	3	20
Norway	Oslo	808	19	8	43
Philippines	Manila	10,432[b]	42	33	..
Poland	Lodz	943	39	21	43
	Warsaw	2,204	43	16	32
Portugal	Lisbon	1,977	28	8	52
Romania	Bucharest	1,764	22	10	71
Russian Federation	Moscow	10,672	25	109	..
	Omsk	1,132	27	20	34
Singapore	Singapore	4,372	48	20	30
Slovak Republic	Bratislava	456[b]	19	21	27
South Africa	Capetown	3,103	15	21	72
	Durban	2,643	29	31	..
	Johannesburg	3,288	30	19	31
Spain	Barcelona	4,424	43	11	43
	Madrid	5,145	37	24	66
Sweden	Stockholm	1,729	13	3	20
Switzerland	Zurich	984	26	11	39
Thailand	Bangkok	6,604	83	11	23
Turkey	Ankara	3,593	54	55	46
	Istanbul	9,760	64	120	..
Ukraine	Kiev	2,623	38	14	51
United Kingdom	Birmingham	2,215	26	9	45
	London	7,615	23	25	77
	Manchester	2,193	17	26	49
United States	Chicago	8,711	26	14	57
	Los Angeles	12,146	36	9	74
	New York	18,498	22	26	79
Venezuela, RB	Caracas	3,276	17	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** refers to fine suspended particulates less than 10 microns in diameter that are capable of penetrating deep into the respiratory tract and causing significant health damage. The state of a country's technology and pollution controls is an important determinant of particulate matter concentrations. • **Sulfur dioxide** is an air pollutant produced when fossil fuels containing sulfur are burned. It contributes to acid rain and can damage human health, particularly that of the young and the elderly. • **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. Nitrogen dioxide is emitted by bacteria, motor vehicles, industrial activities, nitrogenous fertilizers, combustion of fuels and biomass, and aerobic decomposition of organic matter in soils and oceans.

Data sources

Data on city population are from the United Nations Population Division. Data on particulate matter concentrations are from a recent World Bank study by Kiran D. Pandey, David Wheeler, Bart Ostro, Uwe Deichman, Kirk Hamilton, and Kathrine Bolt, "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, which relies on various national sources as well as, among others, the Organisation for Economic Co-operation and Development's *OECD Environmental Data Compendium 1999*, the U.S. Environmental Protection Agency's *National Air Quality and Emissions Trends Report 1995*, the Aerometric Information Retrieval System Executive International database, and the United Nations Centre for Human Settlements' Urban Indicators database.

3.14 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
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	..
Angola	..	..	2000	2000[f]	2000[f]	1994	1998	..	..	1997	..
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	..	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	..
Belarus	..	..	2000	1986[d]	1988[d]	..	1993	..	1995[f]	2001[f]	2004[f]
Belgium	..	..	1996	1988	1988	1998	1996	2002	1983	1997[f]	..
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]	..	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	..
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	..	1983[f]	1999	..
Costa Rica	1990	1992	1994	1991[f]	1991[f]	1994	1994	2002	1975	1998	..
Côte d'Ivoire	1994	1991	1995	1993[f]	1993[f]	1994	1994	..	1994[f]	1997	2004
Croatia	2001	2000	1996	1991[d]	1991[d]	1994[g]	1996	..	2000[f]	2000[d]	..
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]	1993[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]	..
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]	1978	1997	2004[e]
Gabon	..	1990	1998	1994[f]	1994[f]	1998	1997	..	1989[f]	1996[f]	..
Gambia, The	1992	1989	1994	1990[f]	1990[f]	1994	1994	2001[f]	1977[f]	1996	..
Georgia	1998	..	1994	1996[f]	1996[f]	1996[f]	1994[f]	1999[f]	1996[f]	1999	..
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	..
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	..	1990[f]	1995	..
Haiti	1999	..	1996	2000[f]	2000[f]	1996	1996	2005[f]	..	1996	..

3.14 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
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	..
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	..
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]	..
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	..
Kuwait	..	..	1995	1992[f]	1992[f]	1994	2002	2005[f]	2002	1997	..
Kyrgyz Republic	1995	..	2000	2000[f]	2000[f]	..	1996[e]	2003[f]	..	1997[f]	..
Lao PDR	1995	..	1995	1998[f]	1998[f]	1998	1996[e]	2003[f]	2004[f]	1996[d]	..
Latvia	..	..	1995	1995[f]	1995[f]	2004[f]	1995	2002	1997[f]	2002[f]	2004
Lebanon	..	..	1995	1993[f]	1993[f]	1995	1994	..	..	1996	2003
Lesotho	1989	..	1995	1994[f]	1994[f]	..	1995	2000[f]	2003	1995	2002
Liberia	..	..	2003	1996[f]	1996[f]	..	2000	2002[f]	1981[f]	1998[f]	2002[f]
Libya	..	..	1999	1990[f]	1990[f]	..	2001	..	2003[f]	1996	2005[f]
Lithuania	..	..	1995	1995[f]	1995[f]	2003[f]	1996	2003	2001[f]	2003[f]	..
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]	..	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	..
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	..
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	..	..	..	..	..	..	..	..	..	..	..

3.14 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
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 and Montenegro	..	..	2001	2001[g]	2001[g]	2001[g]	2002	..	2002	..	2002
Sierra Leone	1994	..	1995	2001[f]	2001[f]	1994	1994[e]	..	1994[f]	1997	2003[f]
Singapore	1993	1995	1997	1989[f]	1989[f]	1994	1995	..	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	..
Swaziland	..	..	1997	1992[f]	1992[f]	..	1994	..	1997[f]	1996	..
Sweden	..	..	1994	1986	1988	1996	1993	2002	1974	1995	2002
Switzerland	..	..	1994	1987	1988	..	1994	2003	1974	1996	2003
Syrian Arab Republic	1999	..	1996	1989[f]	1989[f]	..	1996	..	2003[f]	1997	2005
Tajikistan	..	..	1998	1996[f]	1998[f]	..	1997[e]	..	..	1997[f]	..
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
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, RB	..	..	1995	1988[f]	1989	..	1994	..	1977	1998[f]	2005
Vietnam	..	1993	1995	1994[f]	1994[f]	1994	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	..	1980[f]	1996	..
Zimbabwe	1987	..	1994	1992[f]	1992[f]	1994	1994	..	1981[f]	1997	..

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

Government commitment 3.14

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 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 chlorofluorocarbons) 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 Rio the World Summit on Sustainable Development in Johannesburg recognized that many of the proposed actions have 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 (UNDP), and the 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 is chair of the GEF.

Definitions

• **Environmental strategies and action plans** provide a comprehensive, cross-sectoral analysis of conservation and resource management issues to help integrate environmental concerns with the development process. They include national conservation strategies, national environmental action plans, national environmental management strategies, and national sustainable development strategies. The year shown for a country refers to the year in which a strategy or action plan was adopted. • **Biodiversity assessments, strategies, and 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 New York in 1992). • **Ozone layer** refers to the Vienna Convention for the Protection of the Ozone Layer (signed in 1985). • **CFC control** refers to the Montreal Protocol for Chlorofluorocarbon Control (formally, the Protocol on Substances That Deplete the Ozone Layer, signed in 1987). • **Law of the Sea** refers to the United Nations Convention on the Law of the Sea (signed in Montego Bay, Jamaica, in 1982). • **Biological diversity** refers to the Convention on Biological Diversity (signed at the Earth Summit in Rio de Janeiro 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, held in Kyoto, Japan, in December 1997. • **CITES** refers to the Convention on International Trade in Endangered Species of Wild Fauna and Flora, an agreement between governments to ensure that the survival of wild animals and plants is not threatened by uncontrolled exploitation. • **CCD** refers to the United Nations Convention to Combat Desertification, an international convention dedicated to addressing the problems of land degradation in the world's drylands. Adopted in Paris on June 17, 1994, it entered into force on December 26, 1996. • **Stockholm Convention** is an international legally binding instrument designed to protect human health and the environment from persistent organic pollutants. It was adopted on May 22, 2001, and entered into force May 17, 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.

3.15 Toward a broader measure of savings

	Gross savings	Consumption of fixed capital	Net 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
	2004	2004	2004	2004	2004	2004	2004	2004	2004	2004
Afghanistan	..	7.7	..	..	0.0	..	1.3	0.1	0.1	..
Albania	17.1	10.8	6.3	2.8	1.2	0.0	0.0	0.2	0.3	7.4
Algeria	47.6	11.6	36.0	4.5	35.2	0.0	0.1	0.8	0.7	3.6
Angola	18.4	11.5	6.9	3.1	45.0	0.0	0.0	0.3	1.1	–36.3
Argentina	22.2	12.4	9.8	4.3	8.2	0.3	0.0	0.6	2.3	2.7
Armenia	13.7	9.8	3.9	3.0	0.0	0.7	0.0	0.9	3.0	2.4
Australia	19.5	15.0	4.5	4.8	1.5	1.3	0.0	0.4	0.1	6.0
Austria	24.3	14.4	9.9	5.6	0.1	0.0	0.0	0.1	0.5	14.7
Azerbaijan	26.3	10.8	15.5	3.3	54.6	0.0	0.0	3.4	0.7	–40.0
Bangladesh	29.0	8.2	20.8	1.9	2.4	0.0	0.7	0.4	0.5	18.7
Belarus	23.6	11.0	12.6	5.4	2.1	0.0	0.0	2.1	..	13.8[a]
Belgium	23.2	15.6	7.5	3.0	0.0	0.0	0.0	0.2	0.3	10.1
Benin	12.5	9.0	3.5	2.4	0.1	0.0	0.0	0.3	0.5	5.1
Bolivia	18.2	10.3	7.9	6.3	15.4	1.0	0.0	0.7	1.0	–3.9
Bosnia and Herzegovina	3.9	10.6	–6.7	..	0.1	0.0	..	1.6	0.2	..
Botswana	40.0	12.5	27.5	5.6	0.0	2.0	0.0	0.4	..	30.8[a]
Brazil	24.0	11.8	12.1	4.1	3.7	1.1	0.0	0.4	0.4	10.7
Bulgaria	16.3	11.6	4.7	3.5	0.2	0.7	0.0	1.4	2.4	3.5
Burkina Faso	..	8.6	..	2.4	0.0	0.0	1.2	0.2	0.5	..
Burundi	15.5	6.8	8.7	3.7	0.0	0.0	14.6	0.3	0.3	–2.9
Cambodia	19.6	8.9	10.8	1.8	0.0	0.0	0.8	0.1	0.1	11.6
Cameroon	15.4	10.0	5.5	3.5	10.8	0.0	0.0	0.2	0.9	–3.0
Canada	20.7[b]	14.7	6.0	5.2	5.1	0.3	0.0	0.4	0.3	5.2
Central African Republic	14.1	8.3	5.8	1.6	0.0	0.0	0.0	0.1	0.1	7.2
Chad	10.0	13.7	–3.8	1.4	79.1	0.0	0.0	0.0	0.7	–82.2
Chile	22.7	12.5	10.2	3.9	0.2	10.8	0.0	0.5	1.2	1.5
China	42.3	10.4	31.9	2.0	3.0	0.2	0.0	1.4	1.5	27.8
Hong Kong, China	31.7	13.8	17.9	3.7	0.0	0.0	0.0	0.2	..	21.5[a]
Colombia	17.6	11.4	6.2	5.0	7.2	0.8	0.0	0.4	0.1	2.6
Congo, Dem. Rep.	7.6	7.3	0.3	0.9	2.8	0.9	0.0	0.3	0.6	–3.3
Congo, Rep.	36.0	13.3	22.7	3.8	54.1	0.0	0.0	0.2	..	–27.8[a]
Costa Rica	17.8	6.1	11.7	4.2	0.0	0.0	0.3	0.2	0.5	14.9
Côte d'Ivoire	15.5	10.2	5.4	4.6	2.9	0.0	0.6	0.3	0.3	5.7
Croatia	24.6	12.9	11.8	4.1	1.0	0.0	0.2	0.5	0.3	13.8
Cuba	..	..	..	8.1	..	..	..	..	0.2	..
Czech Republic	23.6	13.7	9.9	4.2	0.1	0.0	0.0	0.8	0.1	13.0
Denmark	22.7	15.4	7.3	8.1	1.3	0.0	0.0	0.1	0.1	13.9
Dominican Republic	29.3	11.8	17.5	2.2	0.0	2.2	0.0	0.9	0.3	16.3
Ecuador	28.4	11.6	16.8	1.4	19.0	0.1	0.0	0.6	0.2	–1.6
Egypt, Arab Rep.	21.1	10.0	11.1	4.4	10.6	0.1	0.3	1.2	1.7	1.6
El Salvador	9.4	11.3	–2.0	2.8	0.0	0.0	0.6	0.3	0.3	–0.2
Eritrea	–8.9	8.0	–16.9	1.6	0.0	0.0	1.2	0.5	0.6	–17.6
Estonia	19.9	13.5	6.4	5.1	0.6	0.0	1.0	1.2	0.1	8.6
Ethiopia	13.5	6.9	6.6	3.0	0.0	0.0	11.9	0.5	0.3	–3.2
Finland	23.7	16.2	7.5	5.9	0.0	0.0	0.0	0.2	0.1	13.1
France	19.0	12.6	6.4	5.2	0.1	0.0	0.0	0.1	0.0	11.2
Gabon	34.6	14.0	20.6	3.3	25.5	0.0	0.0	0.4	..	–2.0
Gambia, The	19.1	8.6	10.5	2.6	0.0	0.0	0.6	0.5	1.1	10.8
Georgia	18.0	9.9	8.1	4.3	0.6	0.0	0.0	0.7	1.1	10.0
Germany	20.7	14.9	5.7	4.5	0.1	0.0	0.0	0.2	0.1	9.7
Ghana	28.1	8.7	19.3	2.8	0.1	0.2	2.3	0.5	0.3	18.8
Greece	17.7	8.7	9.0	3.1	0.0	0.0	0.0	0.3	1.0	10.8
Guatemala	13.4	11.1	2.4	1.6	1.2	0.0	0.9	0.3	0.4	1.2
Guinea	8.0	8.8	–0.8	2.0	0.0	1.9	1.8	0.2	0.8	–3.5
Guinea-Bissau	8.8	7.9	0.9	..	0.0	0.0	0.0	0.6	1.0	..
Haiti	20.1	8.5	11.6	1.5	0.0	0.0	1.0	0.3	0.3	11.5

Toward a broader measure of savings

	Gross savings	Consumption of fixed capital	Net 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
	2004	2004	2004	2004	2004	2004	2004	2004	2004	2004
Honduras	..	10.3	..	3.5	0.0	0.2	0.0	0.6	0.3	..
Hungary	15.4	13.8	1.7	5.2	0.5	0.0	0.0	0.4	0.3	5.7
India	23.0	9.3	13.7	4.0	2.5	0.4	0.7	1.3	0.8	12.0
Indonesia	24.6	10.4	14.2	1.1	9.4	1.6	0.0	0.7	0.9	2.6
Iran, Islamic Rep.	39.7	11.0	28.7	4.4	36.0	0.2	0.0	1.7	0.9	–5.6
Iraq	..	..	..	..	..	..	..	..	2.7	..
Ireland	29.9[b]	11.0	18.9	4.8	0.0	0.0	0.0	0.2	0.1	23.3
Israel	10.0[b]	14.0	–4.0	7.3	0.0	0.0	0.0	0.4	1.2	1.6
Italy	19.5	13.9	5.6	4.5	0.1	0.0	0.0	0.2	0.3	9.5
Jamaica	26.6	12.1	14.5	5.0	0.0	1.3	0.0	0.9	0.3	17.0
Japan	26.3	14.4	12.0	3.1	0.0	0.0	0.0	0.2	0.6	14.4
Jordan	21.0	10.7	10.3	5.6	0.3	0.1	0.0	1.0	0.9	13.5
Kazakhstan	27.0	12.0	15.0	4.4	39.9	1.6	0.0	3.0	0.5	–25.5
Kenya	13.7	9.0	4.7	6.6	0.0	0.0	0.2	0.4	0.2	10.5
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	2.0	..
Korea, Rep.	34.3	13.3	20.9	3.8	0.0	0.0	0.0	0.5	1.3	22.9
Kuwait	47.2[b]	12.6	34.7	5.0	46.8	0.0	0.0	0.7	2.7	–10.5
Kyrgyz Republic	9.8	9.1	0.7	4.4	1.0	0.0	0.0	1.6	0.2	2.2
Lao PDR	10.7	9.1	1.7	1.3	0.0	0.0	0.0	0.4	0.1	2.5
Latvia	..	..	..	..	..	..	..	..	..	..
Lebanon	2.4	12.9	–10.5	2.6	0.0	0.0	0.0	0.6	0.9	–9.3
Lesotho	..	..	..	..	..	..	..	..	..	..
Liberia	35.8	9.2	26.7	..	0.0	0.0	6.3	0.5	0.2	..
Libya	..	12.6	..	..	60.7	0.0	0.0	1.2	..	..
Lithuania	15.3	12.8	2.6	5.7	0.5	0.0	0.3	0.5	0.4	6.6
Macedonia, FYR	15.2	11.2	3.9	4.9	0.0	0.0	0.2	1.4	0.3	6.9
Madagascar	17.6	8.1	9.5	2.1	0.0	0.0	0.0	0.4	0.3	10.8
Malawi	–7.9	7.5	–15.4	5.0	0.0	0.0	2.1	0.3	0.3	–13.1
Malaysia	37.3	12.6	24.6	5.1	14.1	0.0	0.0	0.9	0.1	14.5
Mali	11.3	8.9	2.3	2.7	0.0	0.0	0.0	0.1	0.6	4.4
Mauritania	–6.3	8.5	–14.9	3.2	0.0	10.9	0.7	1.5	0.6	–25.3
Mauritius	23.8	12.0	11.8	3.3	0.0	0.0	0.0	0.4	..	14.8[a]
Mexico	21.1	12.6	8.6	5.3	7.4	0.1	0.0	0.4	0.6	5.3
Moldova	18.8	8.2	10.6	6.9	0.0	0.0	0.0	1.8	0.7	14.9
Mongolia	40.8	9.3	31.6	8.1	0.9	8.4	0.0	3.8	0.0	26.6
Morocco	28.0	10.7	17.3	6.1	0.0	0.3	0.0	0.6	0.3	22.3
Mozambique	6.6	8.8	–2.2	1.8	0.0	0.0	0.0	0.2	0.4	–1.0
Myanmar	..	..	..	0.8	..	..	..	..	0.6	..
Namibia	39.2	11.1	28.1	7.3	0.0	0.6	0.0	0.3	0.2	34.3
Nepal	26.9	8.1	18.8	2.6	0.0	0.0	2.8	0.4	0.1	18.2
Netherlands	23.6	16.0	7.6	4.9	1.0	0.0	0.0	0.2	0.7	10.6
New Zealand	22.6[b]	14.8	7.8	7.1	0.8	0.1	0.0	0.3	0.0	13.7
Nicaragua	10.8	10.1	0.7	2.9	0.0	0.0	1.0	0.6	0.1	1.8
Niger	8.0	7.9	0.1	2.3	0.0	0.0	3.0	0.3	0.5	–1.4
Nigeria	32.6	10.9	21.7	0.9	49.1	0.0	0.1	0.6	1.0	–28.2
Norway	32.5	13.7	18.9	7.0	10.9	0.0	0.0	0.1	0.1	14.8
Oman	29.4[b]	13.4	16.0	4.2	58.8	0.0	0.0	0.8	1.1	–40.6
Pakistan	23.6	8.2	15.4	2.3	5.3	0.0	0.5	0.8	1.4	9.7
Panama	13.8	12.8	1.1	4.4	0.0	0.0	0.0	0.4	0.5	4.6
Papua New Guinea	..	10.4	..	..	10.7	25.1	0.0	0.5	..	..
Paraguay	22.9	10.1	12.8	4.2	0.0	0.0	0.0	0.4	0.7	16.0
Peru	19.2	11.7	7.6	2.9	1.5	2.1	0.0	0.3	1.0	5.6
Philippines	34.1	9.2	24.8	2.8	0.3	0.4	0.2	0.6	0.3	25.9
Poland	18.9	12.6	6.3	5.3	0.5	0.3	0.1	0.9	0.7	9.1
Portugal	15.6	18.2	–2.6	5.7	0.0	0.0	0.0	0.2	0.5	2.3
Puerto Rico	..	..	..	..	..	..	..	..	..	..

3.15 Toward a broader measure of savings

	Gross savings	Consumption of fixed capital	Net 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
	2004	2004	2004	2004	2004	2004	2004	2004	2004	2004
Romania	18.2	11.7	6.5	3.2	3.3	0.0	0.0	0.9	0.2	5.3
Russian Federation	32.1	7.1	25.0	3.5	29.7	0.6	0.0	2.0	0.6	–4.4
Rwanda	17.7	7.9	9.8	3.5	0.0	0.0	3.7	0.2	0.2	9.1
Saudi Arabia	46.6[b]	13.0	33.6	7.2	50.1	0.0	0.0	0.9	1.0	–11.1
Senegal	17.2	9.6	7.5	3.4	0.0	0.0	0.2	0.4	1.4	8.9
Serbia and Montenegro	4.6	11.4	–6.8	..	0.9	0.0	..	0.3	0.1	..
Sierra Leone	11.4	7.9	3.4	1.0	0.0	0.0	4.3	0.4	0.6	–1.0
Singapore	46.6[b]	15.0	31.7	2.7	0.0	0.0	0.0	0.4	0.9	33.0
Slovak Republic	23.4	21.8	1.6	4.2	0.1	0.0	0.4	0.7	0.1	4.6
Slovenia	25.9	13.6	12.3	5.6	0.0	0.0	0.2	0.3	0.2	17.2
Somalia	..	..	..	..	..	..	..	..	0.2	..
South Africa	14.7	12.1	2.6	5.3	0.0	0.6	0.3	1.2	0.3	5.6
Spain	23.4	14.5	8.9	4.1	0.0	0.0	0.0	0.2	0.6	12.2
Sri Lanka	19.4	10.3	9.1	2.6	0.0	0.0	0.4	0.4	0.5	10.4
Sudan	15.8	9.9	5.9	0.9	15.1	0.0	0.0	0.3	0.8	–9.4
Swaziland	16.8	11.0	5.8	5.5	0.0	0.0	0.0	0.3	0.2	10.8
Sweden	23.6	12.1	11.6	8.0	0.0	0.1	0.0	0.1	0.0	19.4
Switzerland	..	13.9	..	5.0	0.0	0.0	0.0	0.1	0.3	..
Syrian Arab Republic	20.7	10.5	10.1	2.6	38.6	0.1	0.0	1.5	1.0	–28.4
Tajikistan	5.7	8.7	–3.0	2.8	0.4	0.0	0.0	2.0	0.2	–2.8
Tanzania	8.5	8.2	0.3	2.4	0.0	0.1	0.0	0.2	0.3	2.0
Thailand	31.8	11.3	20.5	4.9	2.4	0.0	0.2	1.0	0.6	21.2
Togo	8.6	8.6	0.0	2.6	0.0	0.1	3.0	0.6	0.3	–1.3
Trinidad and Tobago	28.5	12.3	16.2	4.0	46.2	0.0	0.0	2.3	0.0	–28.3
Tunisia	23.5	11.8	11.7	5.9	4.2	0.2	0.1	0.6	0.4	12.1
Turkey	20.0	11.8	8.2	3.5	0.2	0.0	0.0	0.5	1.4	9.4
Turkmenistan	33.6[b]	10.4	23.3	..	..	0.0	..	4.0	0.6	..
Uganda	9.9	8.2	1.7	1.9	0.0	0.0	6.4	0.2	0.0	–2.9
Ukraine	29.9	10.4	19.6	4.4	5.7	0.0	0.0	4.5	0.9	12.8
United Arab Emirates	39.2[b]	14.1	25.2	..	29.2	0.0	..	0.7	2.5	..
United Kingdom	14.5	10.3	4.1	5.3	1.1	0.0	0.0	0.2	0.1	8.1
United States	13.4	12.2	1.2	4.8	1.3	0.0	0.0	0.3	0.4	4.0
Uruguay	12.0	12.2	–0.2	2.6	0.0	0.0	0.3	0.3	2.7	–0.8
Uzbekistan	30.2	8.9	21.3	9.4	59.3	0.0	0.0	7.6	0.7	–37.0
Venezuela, RB	35.2	12.2	23.0	4.4	34.7	0.4	0.0	0.9	0.0	–8.6
Vietnam	32.7	9.2	23.6	2.8	9.5	0.0	0.6	1.1	0.5	14.6
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	12.9	10.0	2.9	..	44.2	0.0	0.0	0.7	0.5	..
Zambia	13.3	9.4	3.9	2.5	0.0	3.7	0.0	0.3	1.0	1.4
Zimbabwe	3.2	8.6	–5.5	6.9	0.6	1.3	0.0	1.6	0.4	–2.5
World	**20.8 w**	**12.7 w**	**8.1 w**	**4.4 w**	**2.8 w**	**0.1 w**	**0.0 w**	**0.4 w**	**0.5 w**	**8.7 w**
Low income	22.7	9.2	13.5	3.4	6.7	0.4	0.7	1.1	0.8	7.3
Middle income	28.3	11.1	17.2	3.6	8.4	0.5	0.0	1.0	0.9	9.8
Lower middle income	32.1	10.8	21.3	2.9	6.5	0.5	0.0	1.1	1.0	15.1
Upper middle income	23.1	11.5	11.6	4.5	11.2	0.6	0.0	0.9	0.7	2.6
Low & middle income	27.5	10.8	16.6	3.5	8.2	0.5	0.1	1.0	0.9	9.4
East Asia & Pacific	39.1	10.5	28.6	2.3	4.1	0.4	0.0	1.2	1.2	23.9
Europe & Central Asia	23.4	10.7	12.7	4.1	12.0	0.3	0.0	1.4	0.7	2.3
Latin America & Carib.	22.7	12.1	10.6	4.4	7.2	1.1	0.0	0.5	0.6	5.6
Middle East & N. Africa	30.0	11.2	18.8	4.5	27.3	0.1	0.1	1.2	0.9	–6.2
South Asia	23.6	9.1	14.4	3.6	2.7	0.3	0.7	1.2	0.8	12.4
Sub-Saharan Africa	17.1	10.9	6.2	3.9	9.8	0.4	0.6	0.7	0.5	–2.0
High income	19.4	13.2	6.2	4.6	1.4	0.0	0.0	0.3	0.4	8.7
Europe EMU	20.8	14.2	6.6	4.6	0.1	0.0	0.0	0.2	0.3	10.6

a. Adjusted net savings do not include particulate emission damage. b. World Bank staff estimate.

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. The adjustment made to savings goes in the right direction. 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. The reader should bear in mind that 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 from 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 depletion estimates that are possible, 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. Researchers should keep this in mind when using the depletion estimates. In general, the data on energy and mineral depletion should not be considered a substitute for energy and mineral gross domestic product.

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 be exploited economically at present. 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 mortality and morbidity from cardiopulmonary disease and lung cancer in adults and acute respiratory infections in children that is attributable to particulate emissions.

For a detailed methodological note, 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** represents the replacement value of capital used up in the process of production. • **Net savings** are gross savings minus the value of consumption of fixed capital. • **Education expenditure** refers to public current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment. • **Energy depletion** is the product of unit resource rents and the physical quantities of energy extracted. It covers coal, crude oil, and natural gas. • **Mineral depletion** is the product of unit resource rents and the physical quantities of minerals extracted. It refers to tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate. • **Net forest depletion** is the product of unit resource rents and the excess of roundwood harvest over natural growth. • **Carbon dioxide damage** is estimated to be $20 per ton of carbon (the unit damage in 1995 U.S. dollars) times the number of tons of carbon emitted. • **Particulate emission damage** is the willingness to pay to avoid mortality and morbidity attributable to particulate emissions. • **Adjusted net savings** are net savings plus education expenditure and minus energy depletion, mineral depletion, net forest depletion, and carbon dioxide and particulate emissions damage.

Data sources

Gross savings are derived from the World Bank's national accounts data files, described in the *Economy* section. Consumption of fixed capital is from the United Nations Statistics Division's *National Accounts Statistics: Main Aggregates and Detailed Tables, 1997,* extrapolated to 2004. 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. Missing data are estimated. The wide range of data sources and estimation methods used to arrive at resource depletion estimates are described in a World Bank working paper, "Estimating National Wealth" (Kunte and others 1998). The unit damage figure for carbon dioxide emissions is from Fankhauser (1995). The estimates of damage from particulate emissions are from Pandey and others (2006). The conceptual underpinnings of the savings measure appear in Hamilton and Clemens (1999).