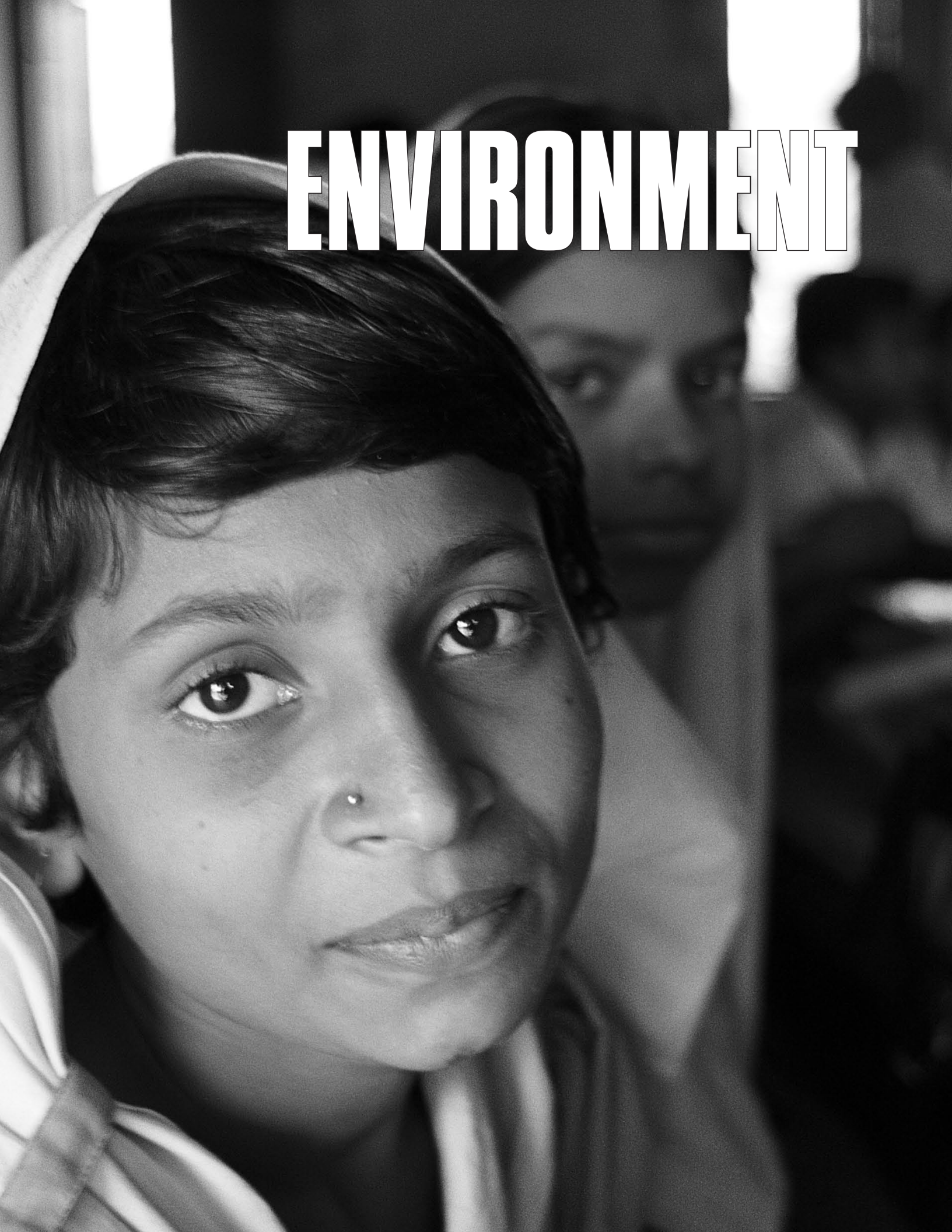

ENVIRONMENT

3

Global climate change presents a significant challenge to achieving the Millennium Development Goals (MDGs). The expected extreme changes in weather—such as shifts in the intensity and pattern of rainfall and variations in temperature—may lower agricultural productivity and damage infrastructure, leading to slower economic growth, threatening food security, and increasing poverty. Projected floods and droughts could cause many people to lose their livelihoods, be displaced, or migrate, while rising temperatures could increase the incidence of vector-borne diseases and lead to heat-related deaths and water scarcity.

The poorest countries and regions face the greatest danger. Africa—with the most rainfed agricultural land of any continent, half its population without access to improved water sources, and about 70 percent without access to improved sanitation facilities—is particularly vulnerable to climate change.

International action on greenhouse gas emissions and developing countries

Economic growth—necessary for reducing poverty, improving people's lives, and achieving the MDGs—entails significant energy use. Generating this energy will affect greenhouse gas emissions. There is now consensus that greenhouse gas emissions need to peak by 2015 to curb emissions to about 50 percent of their 1990 levels by 2050, to keep global warming below 2°C, and to avoid more dangerous and catastrophic climate change (United Nations 2009b; World Bank 2009k). To meet this target and achieve the MDGs, sustainable energy systems need to be part of long-term economic planning for developed and developing countries.

The 2009 United Nations Climate Change Conference in Copenhagen did not reach a binding agreement on targets and timetables for reducing greenhouse gas emissions. The Copenhagen Accord recognized the critical importance of keeping global warming below 2°C and affirmed that the first priority of developing countries is to eradicate poverty and promote socioeconomic development—but that a low-emission development strategy is indispensable to sustainable development. On the principle of "differentiated responsibilities and respective capabilities," the accord urged developed countries to help developing countries in their mitigation efforts and their adaptation to the adverse effects of climate change (United Nations 2009c).

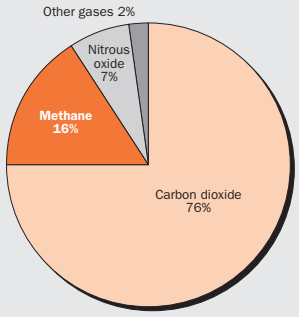
Greenhouse gas emissions have been rising at increasing rates

Carbon dioxide is the most common of the Kyoto Protocol greenhouse gases, which also include methane, nitrous oxide, and other artificial gases. It constitutes more than 75 percent of greenhouse gas emissions (figure 3a). About 80 percent of carbon dioxide is generated by the energy sector.

Carbon dioxide emissions, on the rise since the beginning of the industrial revolution 150 years ago, began to surge in the second half of the 20th century (figure 3b), reaching more than 30 petagrams (billion metric tons) a year in 2006 (see table 3.8).

Carbon dioxide is the most common greenhouse gas **3a**

Global greenhouse gas emissions (share of total carbon dioxide equivalent), 2005



Source: International Energy Agency.

High-income Organisation for Economic Co-operation and Development (OECD) countries, which have produced more than 55 percent of total cumulative emissions since the beginning of industrialization, stabilized their emissions growth at about 0.9 percent a year between 1990 and 2006.

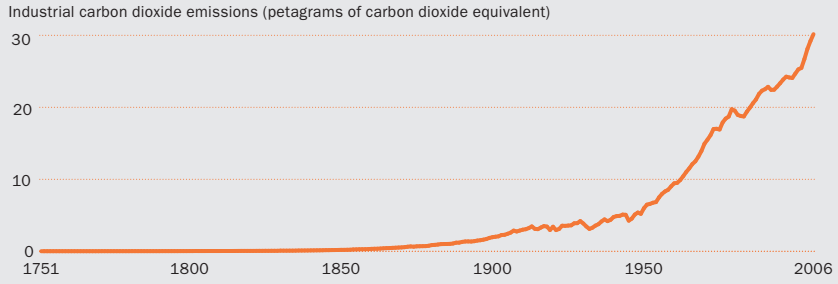
Carbon dioxide emissions per capita from developing economies were less than a fourth those of developed economies in 2006, but their total emissions rate grew about twice as fast during 1990–2006 (table 3c). Over the same period carbon dioxide emissions grew 5.1 percent a year in China and 4.8 percent a year in India. China became the largest emitter of carbon dioxide in 2006 (see tables 3.8 and 3.9). During 1990–2006 developing economies' carbon energy intensity—the ratio of carbon dioxide emissions per unit of energy used—remained unchanged. But their carbon income intensity—the carbon dioxide emitted for each unit of gross domestic product—decreased 2 percent a year, indicating greater economic productivity and energy efficiency.

The world's top five carbon dioxide emitters—China, the United States, the Russian Federation, India, and Japan (figure 3d)—all decreased their carbon income intensity in 1990–2006. Only China and India increased their carbon energy intensity, because of a higher share of fossil fuel in their energy consumption. Energy use has been increasing in China and India, both as a share of the global total and per capita. Among the five economies with the highest energy consumption, India uses fossil fuels the least—but its dependence on fossil fuels is growing the most, at about 1.3 percent annually during 1990–2007 (table 3e).

World energy consumption has increased about 2 percent a year since 1970 but decreased in 2009 because of the economic crisis. According to the International Energy Agency (IEA), energy demand could increase 40 percent by 2030 under business as usual conditions. Fossil fuels would remain the main energy source, accounting for 77 percent of increased demand during 2007–30 (IEA 2009). The IEA estimates that using fossil fuels at this rate will increase carbon dioxide emissions to about 40 petagrams a year by 2030, resulting in a long-term atmospheric concentration of 1,000 parts per million. This increase will be environmentally, socially, and economically unsustainable.

In Copenhagen the IEA proposed an emission reduction scenario to limit the concentration

Carbon dioxide emissions have surged since the 1950s **3b**



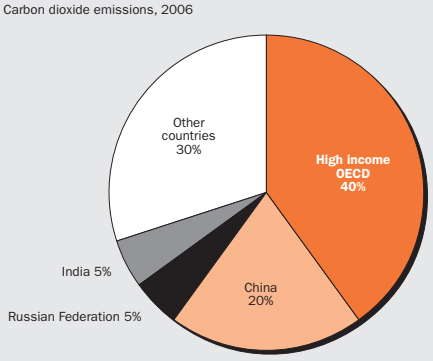
Source: Carbon Dioxide Information Analysis Center and World Development Indicators data files.

Carbon dioxide emissions are growing, 1990–2006 (percent) **3c**

Country or group	Carbon dioxide: Average annual growth	Carbon dioxide: Per capita growth	Carbon intensity (average annual growth): Energy	Carbon intensity (average annual growth): Income
China	5.1	4.1	0.8	–4.3
United States	1.2	0.1	–0.1	–1.9
Russian Federation	–2.4	–2.2	–0.9	–2.8
India	4.8	3.1	1.3	–1.2
Japan	0.6	0.3	–0.5	–0.5
Developing economies[a]	2.1	0.6	0.0	–2.0
High-income OECD	0.9	0.2	–0.4	–1.7

a. Emissions from oil-producing economies constitute 8 percent (excluding the Russian Federation).
Source: World Development Indicators data files; International Energy Agency; Carbon Dioxide Information Analysis Center.

A few rapidly developing and high-income countries produce 70 percent of carbon dioxide emissions **3d**



Source: Carbon Dioxide Information Analysis Center and World Bank.

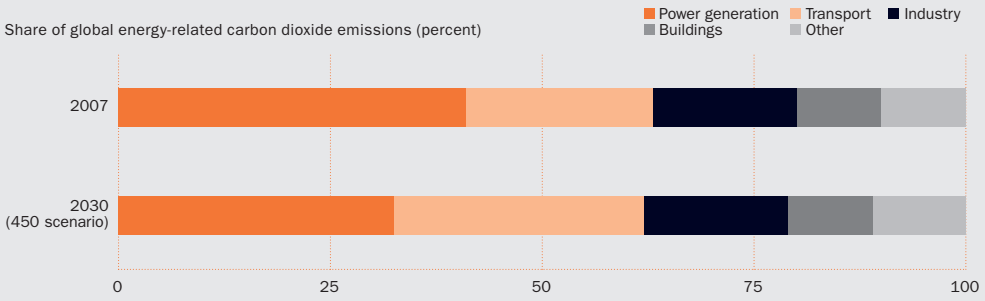
of greenhouse gases in the atmosphere to 450 parts per million of carbon dioxide equivalent, which would reduce energy-related carbon dioxide emissions from 28.8 petagrams in 2007 to 26.4 petagrams in 2030. Under this scenario carbon dioxide emissions from the power sector are projected to be reduced the most (figure 3f). High-income OECD countries are projected to reduce their power generation emissions from 484 grams of carbon dioxide per kilowatt hour of energy produced to 145, a 70 percent reduction. According to this scenario, high-income OECD economies should also reduce their carbon energy intensity by about 38 percent, and other economies by less than half that (table 3g).

Trends in fossil fuel use and energy intensity (percent) **3e**

	Energy use		Fossil fuel		Energy intensity of GDP	Net imports[a]
Country or group	Share of world energy use, 2007	Average annual growth, 1990–2007	Share of total, 2007	Average annual growth, 1990–2007	Average annual growth, 1990–2007	Share of energy use, 2007
China	16.8	4.5	86.9	0.8	–4.9	7.2
United States	20.1	1.2	85.6	0.0	–1.8	28.8
Russian Federation	5.8	–1.3	89.3	–0.3	–2.1	–83.1
India	5.1	3.5	70.0	1.3	–2.6	24.2
Japan	4.4	0.9	83.2	–0.1	–0.2	82.4
Developing economies	52.1	2.2	79.8	0.2	–2.1	–20.1
High-income OECD	43.9	1.3	81.6	–0.1	–1.3	31.9

a. A negative value indicates that the economy is a net energy exporter.
Source: World Development Indicators data files and International Energy Agency.

Emission reductions by 2030 **3f**



Note: Based on International Energy Agency 450 scenario.
Source: IEA 2009.

Future energy use under the IEA-450 scenario (percentage change, 2007–30) **3g**

	Energy use		Carbon dioxide emissions		Carbon dioxide intensity		Power intensity
Group	Total	Per capita	Total	Per capita	Income	Energy	
World	17.6	–5.6	–8.3	–26.4	–55.0	–22.1	–53.1
European Union	–3.8	–5.7	–41.0	–42.2	–58.2	–38.7	–72.9
OECD[a]	–5.2	–13.3	–41.2	–46.3	–60.7	–38.0	–70.0
Other major economies[b]	36.3	21.1	14.4	1.7	–62.1	–16.0	–48.3
Other economies	55.9	14.3	28.0	–6.2	–51.5	–17.9	–49.9

a. OECD economies and European Union.
b. Other major economies are those in the Middle East and North Africa and Brazil, China, and South Africa.
Source: IEA 2009.

People affected by natural disasters and projected changes in rainfall and agricultural production (percent) **3h**

Country	Average share of population affected by droughts, floods, and storms, 1971–2008	Projected change in precipitation outcome, 2000–50		Projected change in agricultural outcome, 2000–50	
		Total	Intensity	Output	Yield
Bangladesh	9.1	1.4	5.4	–21.7	8.9
China	5.2	4.5	5.4	–7.2	8.4
Ethiopia	6.6	2.4	5.0	–31.3	0.5
India	7.2	1.9	2.7	–38.1	–12.2
Malawi	12.3	–0.1	2.4	–31.3	–3.0
Mozambique	13.8	–2.7	1.4	–21.7	–10.7
Niger	13.2	5.6	2.5	–34.1	–1.7
Senegal	11.3	–1.9	3.1	–51.9	–19.3
Swaziland	18.3	..	..	..	..
Zimbabwe	10.7	–3.7	4.8	–37.9	–10.6

Source: World Bank 2009k.

Climate change will affect food and water security

During the last century rising atmospheric concentrations of carbon dioxide led to a 0.74°C increase in average global temperature. Even if greenhouse gas emissions stop growing, global warming is expected to continue because changes in temperature lag behind changes in concentrations, which lag behind changes in emissions (World Bank 2009k). According to the Intergovernmental Panel on Climate Change, during the coming decades global warming will cause droughts, floods, changes in rainfall patterns, severe freshwater shortages, and shifts in crop growing seasons—especially in developing countries (FAO 2008a). The agriculture and water sectors will be affected most by climate change, and adaptive measures are needed to mitigate expected adverse outcomes; otherwise, areas such as Southern Africa will suffer severe drops in agricultural yields by 2030 (World Bank 2009a) (table 3h). Developing countries already suffering from hunger and water supply problems, especially those in Southeast Asia and Sub-Saharan Africa, will be hardest hit without aid for adaptation.

Demand for water will increase, making better water management crucial

Properly using and managing water resources are important components of sustainable development—and essential for achieving the MDGs (World Bank and IMF 2008b; FAO 2010; Bates and others 2008) (table 3i). Some 1 billion people lack access to safe water, and more than 2.5 billion need access to improved sanitation facilities. The world's population is growing by about 80 million people a year, demanding an additional 64 billion cubic meters of freshwater a year (UNESCO 2009). And about 90 percent of population growth by 2050 is projected to occur in developing countries, where many people still lack access to safe water and improved sanitation. By 2025, 1.8 billion people will be living in countries or regions with absolute water scarcity, and two-thirds of the world's population could be living under conditions of water stress (FAO 2007, 2010).

The effects of climate change on freshwater availability will depend on temperature increases, droughts, floods, regional variation in precipitation, and rising sea levels (UNESCO 2009; Bates and others 2008; Kundzewicz and Mata 2007; FAO 2008b). Precipitation is the most important source of freshwater; 80 percent of the world's cultivated land and about 60 percent of crops depend on rainwater (UNESCO 2009). Climate change models predict more precipitation in high latitudes and the tropics but less precipitation in subtropical regions such as the northern Sahara (UNESCO 2009; Kundzewicz and Mata 2007; IPCC 2007). In addition, non-climate-related water stresses—such as industrial water pollution, extensive irrigation, construction of dams, and draining of wetlands—have already raised concerns about future freshwater shortages (Bates and others 2008).

Potential contributions of the water sector to attaining the Millennium Development Goals 3i

Goal	Relation to water
1 Eradicate extreme poverty and hunger	Water is a factor in many production activities (agriculture, animal husbandry, cottage industries).
3 Promote gender equity and empower women	More gender-sensitive water management programs can reduce time wasted and health burdens through improved water service, leading to more time for income earning and more-balanced gender roles.
4 Reduce child mortality	Improved access to more and better quality drinking water and improved sanitation can reduce the main factors contributing to illness and death among young children.
6 Combat HIV/AIDS, malaria, and other diseases	Improved access to water and sanitation supports HIV/AIDS-affected households and may improve the impact of health care programs. Better water management reduces mosquito habitats and the risk of malaria transmission.
7 Ensure environmental sustainability	Improved water management reduces water consumption and allows recycling of nutrients and organics. Action could ensure improved water supply and sanitation services for poor communities, and reduced wastewater discharge and improved environmental health in slum areas.

Source: Bates and others 2008.

In response to higher freshwater demand and geographic changes in water supply caused by climate change and other factors, countries must improve water storage, use water more efficiently, reuse freshwater (especially in agriculture), and use technology to anticipate regional, local, and seasonal variation in water availability and water use (UNESCO 2009; Bates and others 2008; Faurèsa, Hoogeveena, and Bruinsmab 2004; FAO 2009a).

Sustainable agriculture can help developing countries adapt to climate change

Sustainable agriculture is essential for development—and for achieving the MDG to eradicate poverty and hunger (World Bank and IFPRI 2006). Today's challenges for sustainable agricultural development are to respond to increasing demand for food, adjust to rapid climate changes caused by global warming, and reduce agricultural greenhouse gas emissions (FAO 2008a).

Adaptation strategies for agriculture will require balancing many environmental variables and socioeconomic factors—and their interactions. Countries may integrate climate change adaptation and MDG efforts into their sustainable development policies. Research and development in sustainable agriculture could significantly affect agricultural resource conservation, promoting synergy among human needs.

The agriculture sector also causes greenhouse gas emissions—primarily nitrous oxide and methane. Climate change mitigation in agriculture will require more efficient use of fertilizer, soil conservation, and better production management. Inefficient use of fertilizers has undesirable environmental impacts, such as increased nitrogen loss into the atmosphere. Under current fertilization practices, crop plant uptake of nitrogen as a nutrient is about 50 percent, with losses and emissions to the atmosphere through runoff and leaching from soil erosion (Takle and Hofstrand 2008; FAO 2001). Use of fossil fuels in agricultural production causes 7 percent of agricultural emissions, primarily from combustion of gasoline and diesel fuel (Takle and Hofstrand 2008). Capturing and using methane from livestock production as an energy source can reduce emissions and improve profitability by reducing the need to buy fossil fuel energy (Takle and Hofstrand 2008).

3.1 Rural population and land use

	Rural population			Land area	Land use							
	% of total		average annual % growth	thousand sq. km	% of land area						Arable land hectares per 100 people	
	Forest area		Permanent cropland		Arable land							
	1990	2008	1990–2008	2008	1990	2007	1990	2007	1990	2007	1990–92	2005–07
Afghanistan	..	..	..	652.2	2.0	1.2	0.2	0.2	12.1	13.1	..	..
Albania	64	53	–1.2	27.4	28.8	29.3	4.6	4.4	21.1	21.1	18.8	18.2
Algeria	48	35	–0.1	2,381.7	0.8	1.0	0.2	0.4	3.0	3.1	24.5	22.4
Angola	63	43	0.8	1,246.7	48.9	47.2	0.4	0.2	2.3	2.6	20.6	19.3
Argentina	13	8	–1.6	2,736.7	12.9	12.0	0.4	0.4	9.6	11.9	75.1	80.5
Armenia	33	36	–0.2	28.2	*12.0*	9.7	*2.1*	1.9	*15.0*	14.4	14.4[a]	13.4
Australia	15	11	–0.2	7,682.3	21.9	21.3	0.0	0.0	6.2	5.8	248.9	227.5
Austria	34	33	0.2	82.5	45.8	47.0	1.0	0.8	17.3	16.8	17.3	16.7
Azerbaijan	46	48	1.3	82.6	*11.2*	11.3	*3.7*	2.7	*20.5*	22.4	22.6[a]	21.8
Bangladesh	80	73	1.3	130.2	6.8	6.7	2.3	3.7	70.2	61.2	5.6	5.1
Belarus	34	27	–1.7	202.9	*36.8*	39.0	*0.9*	0.6	*30.0*	27.3	58.6[a]	56.9
Belgium	4	3	–1.3	30.3	22.3[b]	22.0	0.5[b]	0.8	0.6[b]	27.7	8.2	8.0
Benin	66	59	2.7	110.6	30.0	20.1	0.9	2.4	14.6	24.4	35.7	33.4
Bolivia	44	34	0.7	1,083.3	58.0	53.7	0.1	0.2	1.9	3.3	35.7	38.9
Bosnia and Herzegovina	61	53	–1.5	51.2	*43.1*	42.7	*2.9*	1.9	*16.6*	20.0	26.8[a]	27.1
Botswana	58	40	–0.1	566.7	24.2	20.7	0.0	0.0	0.7	0.4	15.2	13.0
Brazil	25	14	–1.7	8,459.4	61.5	55.7	0.8	0.8	6.0	7.0	33.2	31.6
Bulgaria	34	29	–1.6	108.6	30.1	34.3	2.7	1.8	34.9	28.4	43.4	40.5
Burkina Faso	86	80	2.7	273.6	26.1	24.7	0.2	0.2	12.9	19.0	36.5	35.3
Burundi	94	90	1.7	25.7	11.3	5.2	14.0	13.6	36.2	38.7	14.7	13.0
Cambodia	87	78	1.7	176.5	73.3	56.7	0.6	0.9	20.9	21.5	28.5	26.7
Cameroon	59	43	0.7	472.7	51.9	44.0	2.6	2.5	12.6	12.6	36.7	32.7
Canada	23	20	0.0	9,093.5	34.1	34.1	0.7	0.8	5.0	5.0	147.4	138.3
Central African Republic	63	61	2.0	623.0	37.2	36.4	0.1	0.1	3.1	3.1	50.6	46.0
Chad	79	73	2.8	1,259.2	10.4	9.3	0.0	0.0	2.6	3.4	41.0	41.3
Chile	17	12	–0.7	743.8	20.5	21.8	0.3	0.6	3.8	1.7	11.0	8.3
China	73	57	–0.5	9,327.5	16.8	22.0	0.8	1.3	13.3	15.1	10.4	10.5
Hong Kong SAR, China	1	0	..	1.0	..	..	..	..	..	..	..	..
Colombia	32	26	0.5	1,109.5	55.4	54.6	1.5	1.4	3.0	1.8	6.2	4.5
Congo, Dem. Rep.	72	66	2.6	2,267.1	62.0	58.7	0.5	0.4	2.9	3.0	12.8	11.0
Congo, Rep.	46	39	1.2	341.5	66.5	65.7	0.1	0.1	1.4	1.4	15.8	14.2
Costa Rica	49	37	0.5	51.1	50.2	46.9	4.9	5.9	5.1	3.9	5.1	4.6
Côte d'Ivoire	60	51	1.8	318.0	32.1	32.8	11.0	13.2	7.6	8.8	15.8	14.2
Croatia	46	43	–0.8	53.9	*37.9*	39.6	*2.0*	1.5	*21.7*	15.8	25.2[a]	19.4
Cuba	27	24	–0.2	109.8	18.7	25.7	4.1	3.8	30.9	32.5	32.5	32.4
Czech Republic	25	27	0.4	77.3	*34.1*	34.3	*3.1*	3.1	*41.1*	39.2	30.1	29.6
Denmark	15	13	–0.4	42.4	10.5	11.9	0.2	0.2	60.4	54.3	42.6	42.8
Dominican Republic	45	31	–0.4	48.3	28.5	28.5	9.3	10.3	18.6	17.0	9.1	8.5
Ecuador	45	34	0.0	276.8	49.9	37.8	4.8	4.4	5.8	4.3	12.0	9.4
Egypt, Arab Rep.	57	57	2.0	995.5	0.0	0.1	0.4	0.5	2.3	3.0	4.0	3.8
El Salvador	51	39	–0.6	20.7	18.1	13.9	12.5	11.4	26.5	32.9	11.2	11.6
Eritrea	84	79	2.1	101.0	*15.9*	15.3	*0.0*	0.0	*4.9*	6.3	14.8	13.8
Estonia	29	31	–0.6	42.4	51.4	54.3	*0.3*	0.2	*26.3*	14.1	52.1[a]	43.3
Ethiopia	87	83	2.6	1,000.0	*14.7*	12.7	*0.5*	1.0	*10.0*	14.0	15.2	17.5
Finland	39	37	0.1	304.1	72.9	74.0	0.0	0.0	7.4	7.4	42.2	42.7
France	26	23	–0.2	547.7	26.5	28.5	2.2	2.0	32.9	33.7	31.1	30.1
Gabon	31	15	–1.5	257.7	85.1	84.4	0.6	0.7	1.1	1.3	25.8	23.3
Gambia, The	62	44	1.5	10.0	44.2	47.5	0.5	0.6	18.2	34.8	22.4	21.7
Georgia	45	47	–1.0	69.5	*39.7*	39.7	*4.8*	1.6	*11.4*	6.7	17.0[a]	10.5
Germany	27	26	0.1	348.8	30.8	31.8	1.3	0.6	34.3	34.1	14.3	14.4
Ghana	64	50	1.1	227.5	32.7	23.2	6.6	10.5	11.9	18.0	20.3	18.2
Greece	41	39	0.3	128.9	25.6	29.6	8.3	8.8	22.5	19.8	24.9	23.1
Guatemala	59	51	1.6	107.2	44.3	35.7	4.5	8.8	12.1	14.7	12.2	11.5
Guinea	72	66	2.1	245.7	30.1	27.1	2.0	2.7	3.3	9.0	16.8	21.9
Guinea-Bissau	72	70	2.3	28.1	78.8	73.0	4.2	8.9	10.7	10.7	22.5	19.9
Haiti	72	53	0.2	27.6	4.2	3.8	11.6	10.9	28.3	32.7	10.2	9.4
Honduras	60	52	1.5	111.9	66.0	38.7	3.2	3.2	13.1	9.5	16.8	15.2

3.1 Rural population and land use

	Rural population			Land area	Land use							
	% of total		average annual % growth	thousand sq. km	Forest area		% of land area: Permanent cropland		Arable land		Arable land hectares per 100 people	
	1990	2008	1990–2008	2008	1990	2007	1990	2007	1990	2007	1990–92	2005–07
Hungary	34	33	–0.5	89.6	20.0	22.4	2.6	2.2	56.2	51.2	45.2	45.6
India	75	71	1.3	2,973.2	21.5	22.8	2.2	3.6	54.8	53.4	15.6	14.3
Indonesia	69	49	–0.6	1,811.6	64.3	46.8	6.5	8.6	11.2	12.1	9.7	9.9
Iran, Islamic Rep.	44	32	–0.3	1,628.6	6.8	6.8	0.8	1.0	9.3	10.4	24.0	23.8
Iraq	30	..	..	437.4	1.8	1.9	0.7	0.6	13.3	11.9	20.3	..
Ireland	43	39	0.7	68.9	6.4	10.1	0.0	0.0	15.1	15.4	29.7	26.6
Israel	10	8	1.7	21.6	7.1	8.0	4.1	3.2	15.9	14.2	5.3	4.4
Italy	33	32	0.1	294.1	28.5	34.6	10.1	8.6	30.6	24.4	14.7	12.6
Jamaica	51	47	0.2	10.8	31.9	31.2	9.2	10.2	11.0	16.1	6.7	6.5
Japan	37	34	–0.3	364.5	68.4	68.2	1.3	0.9	13.1	11.9	3.5	3.4
Jordan	28	22	2.0	88.2	0.9	0.9	0.8	0.9	2.0	1.6	3.9	3.1
Kazakhstan	44	42	–0.4	2,699.7	*1.3*	1.2	*0.1*	0.0	*13.0*	8.4	148.7[a]	148.1
Kenya	82	78	2.6	569.1	6.5	6.1	0.8	0.9	8.8	9.1	15.6	14.3
Korea, Dem. Rep.	42	37	0.3	120.4	68.1	49.3	1.5	1.7	19.0	23.3	11.4	11.8
Korea, Rep.	26	19	–1.2	96.9	64.5	64.5	1.6	1.9	19.8	16.5	3.6	3.4
Kosovo	..	..	..	10.9[c]	..	41.3[c]	..	..	..	27.6[c]	..	16.8[c]
Kuwait	2	2	0.3	17.8	0.2	0.3	0.1	0.2	0.2	0.8	0.6	0.6
Kyrgyz Republic	62	64	1.1	191.8	*4.4*	4.6	*0.4*	0.4	6.9	6.7	27.2[a]	24.7
Lao PDR	85	69	1.0	230.8	75.0	69.3	0.3	0.4	3.5	5.1	16.4	18.5
Latvia	31	32	–0.7	62.3	*45.1*	47.6	*0.4*	0.2	*27.2*	19.1	41.0[a]	50.8
Lebanon	17	13	0.5	10.2	11.8	13.6	11.9	14.0	17.9	14.1	3.3	3.5
Lesotho	86	75	0.6	30.4	0.2	0.3	0.1	0.1	10.4	9.9	16.7	15.4
Liberia	55	40	1.4	96.3	42.1	31.5	1.6	2.2	3.6	4.0	12.9	11.0
Libya	24	23	1.6	1,759.5	0.1	0.1	0.2	0.2	1.0	1.0	33.3	29.0
Lithuania	32	33	–0.4	62.7	*31.3*	34.0	*0.7*	0.5	*46.0*	29.3	58.8[a]	55.2
Macedonia, FYR	42	33	–1.0	25.4	*35.6*	35.6	*2.2*	1.4	*23.8*	16.9	26.8[a]	21.8
Madagascar	76	71	2.5	581.5	23.5	21.9	1.0	1.0	4.7	5.1	18.7	16.3
Malawi	88	81	2.0	94.1	41.4	35.5	1.4	1.3	23.9	31.9	23.1	21.4
Malaysia	50	30	–0.7	328.6	68.1	62.7	16.0	17.6	5.2	5.5	7.6	6.9
Mali	77	68	1.4	1,220.2	11.5	10.1	0.1	0.1	1.7	4.0	43.1	39.1
Mauritania	60	59	2.5	1,030.7	0.4	0.2	0.0	0.0	0.4	0.4	16.7	15.5
Mauritius	56	58	1.2	2.0	19.2	18.0	3.0	2.0	49.3	44.3	8.2	7.3
Mexico	29	23	0.1	1,944.0	35.5	32.8	1.0	1.2	12.5	12.6	25.4	23.7
Moldova	53	58	–0.5	32.9	*9.7*	10.0	*14.2*	9.2	*52.8*	55.3	45.7[a]	49.3
Mongolia	43	43	1.0	1,553.6	7.4	6.5	0.0	0.0	0.9	0.5	42.4	32.5
Morocco	52	44	0.5	446.3	9.6	9.8	1.6	2.0	19.5	18.1	29.7	26.5
Mozambique	79	63	1.6	786.4	25.4	24.4	0.3	0.4	4.4	5.7	21.9	21.2
Myanmar	75	67	0.5	653.5	60.0	47.9	0.8	1.7	14.6	16.2	21.1	21.2
Namibia	72	63	1.5	823.3	10.6	9.1	0.0	0.0	0.8	1.0	43.8	39.6
Nepal	91	83	1.7	143.4	33.7	24.6	0.5	0.8	16.0	16.4	9.4	8.5
Netherlands	31	18	–2.5	33.8	10.2	10.9	0.9	1.0	26.0	31.4	5.7	6.2
New Zealand	15	13	0.5	267.7	28.8	31.2	0.2	0.2	9.9	3.2	33.2	22.1
Nicaragua	48	43	1.2	120.0	54.5	41.5	1.6	2.0	10.8	16.3	37.6	36.0
Niger	85	84	3.4	1,266.7	1.5	1.0	0.0	0.0	8.7	11.6	122.6	106.2
Nigeria	65	52	1.2	910.8	18.9	11.3	2.8	3.3	32.4	40.1	24.0	24.8
Norway	28	23	–0.6	304.3	30.0	31.0	0.0	0.0	2.8	2.8	19.5	18.4
Oman	34	28	1.3	309.5	0.0	0.0	0.1	0.1	0.1	0.2	1.6	2.3
Pakistan	69	64	1.9	770.9	3.3	2.4	0.6	1.0	26.6	27.9	15.2	13.4
Panama	46	27	–1.1	74.3	58.9	57.7	2.1	2.0	6.7	7.4	18.2	16.7
Papua New Guinea	85	88	2.7	452.9	69.6	64.4	1.2	1.3	0.4	0.6	3.8	3.9
Paraguay	51	40	0.7	397.3	53.3	45.6	0.2	0.3	5.3	10.8	56.9	68.7
Peru	31	29	1.1	1,280.0	54.8	53.6	0.3	0.7	2.7	2.9	13.9	13.0
Philippines	51	35	0.0	298.2	35.5	23.0	14.8	16.4	18.4	17.1	6.3	5.8
Poland	39	39	0.0	304.3	29.2	30.4	1.1	1.3	47.3	41.1	35.3	32.3
Portugal	52	41	–1.0	91.5	33.9	42.2	8.5	6.4	25.6	11.8	15.4	11.0
Puerto Rico	28	2	–15.0	8.9	45.5	46.0	5.6	4.2	7.3	7.0	1.7	1.6
Qatar	8	4	2.4	11.6	..	..	0.1	0.3	0.9	1.6	2.8	1.8

3.1 Rural population and land use

	Rural population			Land area	Land use							
	% of total		average annual % growth	thousand sq. km	% of land area						Arable land hectares per 100 people	
	1990	2008	1990–2008	2008	Forest area 1990	Forest area 2007	Permanent cropland 1990	Permanent cropland 2007	Arable land 1990	Arable land 2007	1990–92	2005–07
Romania	47	46	–0.5	229.9	27.8	27.7	2.6	2.0	41.2	37.2	42.4	40.9
Russian Federation	27	27	–0.1	16,377.7	*49.3*	49.4	*0.1*	0.1	0.0	7.4	84.9[a]	85.3
Rwanda	95	82	0.9	24.7	12.9	21.7	12.4	11.1	35.7	48.6	12.1	12.7
Saudi Arabia	23	18	0.7	2,000.0[d]	1.4	1.4	0.0	0.1	1.7	1.7	17.0	14.6
Senegal	61	58	2.4	192.5	48.6	44.6	0.2	0.3	16.1	15.5	30.4	26.3
Serbia	50	48	–0.4	88.4	..	23.6	..	3.4	..	37.3	..	44.7
Sierra Leone	67	62	1.3	71.6	42.5	37.9	0.8	1.1	6.8	12.6	11.6	16.4
Singapore	0	0	..	0.7	3.4	3.3	1.5	0.3	1.5	0.9	0.0	0.0
Slovak Republic	44	43	0.1	48.1	*40.0*	40.2	*0.5*	0.5	*32.5*	28.6	27.1	25.6
Slovenia	50	51	0.3	20.1	*59.5*	63.3	*1.8*	1.3	9.9	8.8	8.6[a]	8.9
Somalia	70	64	1.1	627.3	13.2	11.1	0.0	0.0	1.6	1.6	14.4	13.7
South Africa	48	39	0.7	1,214.5	7.6	7.6	0.7	0.8	11.1	11.9	33.0	30.7
Spain	25	23	0.5	499.0	27.0	37.1	9.7	9.7	30.7	25.5	32.2	29.0
Sri Lanka	83	85	1.0	64.6	36.4	29.0	15.5	14.7	13.9	15.0	4.9	5.0
Sudan	73	57	0.9	2,376.0	32.1	27.9	0.0	0.1	5.4	8.1	45.9	48.9
Swaziland	77	75	1.5	17.2	27.4	32.0	0.7	0.8	10.5	10.3	16.3	15.6
Sweden	17	16	–0.1	410.3	66.7	67.1	0.0	0.0	6.9	6.4	30.2	29.3
Switzerland	27	27	0.7	40.0	28.9	30.7	0.5	0.6	9.8	10.2	5.7	5.4
Syrian Arab Republic	51	46	2.1	183.6	2.0	2.6	4.0	5.2	26.6	25.8	27.1	24.0
Tajikistan	68	74	1.8	140.0	*2.9*	2.9	*0.9*	0.7	*6.1*	5.1	12.5[a]	11.2
Tanzania	81	75	2.4	885.8	46.8	38.9	1.1	1.4	10.2	10.2	25.5	23.3
Thailand	71	67	0.6	510.9	31.2	28.2	6.1	7.3	34.2	29.8	24.7	22.9
Timor-Leste	79	73	1.7	14.9	65.0	52.2	3.9	4.6	7.4	11.4	16.3	16.5
Togo	70	58	1.7	54.4	12.6	6.4	1.7	3.1	38.6	45.2	46.5	40.2
Trinidad and Tobago	92	87	0.2	5.1	45.8	43.9	6.8	4.3	7.0	4.9	2.4	1.9
Tunisia	42	34	0.0	155.4	4.1	7.0	12.5	14.0	18.7	17.7	29.0	27.2
Turkey	41	31	0.1	769.6	12.6	13.3	3.9	3.8	32.0	28.5	35.4	31.8
Turkmenistan	55	51	1.4	469.9	*8.8*	8.8	*0.1*	0.1	2.9	3.9	37.8[a]	37.9
Uganda	89	87	3.1	197.1	25.0	17.5	9.4	11.2	25.4	27.9	20.2	18.3
Ukraine	33	32	–0.8	579.3	*16.1*	16.6	*1.9*	1.6	*57.6*	56.0	66.9[a]	69.3
United Arab Emirates	21	22	5.2	83.6	2.9	3.7	0.2	2.6	0.4	0.8	2.0	1.6
United Kingdom	11	10	–0.3	241.9	10.8	11.8	0.3	0.2	27.4	25.2	9.8	9.8
United States	25	18	–0.6	9,161.9	32.6	33.1	0.2	0.3	20.3	18.6	61.6	57.4
Uruguay	11	8	–1.6	175.0	5.2	8.8	0.3	0.2	7.2	7.7	40.8	40.1
Uzbekistan	60	63	1.9	425.4	*7.2*	7.8	*0.9*	0.8	*10.5*	10.1	18.0[a]	16.4
Venezuela, RB	16	7	–2.8	882.1	59.0	53.4	0.9	0.8	3.2	3.0	10.4	9.8
Vietnam	80	72	0.9	310.1	28.8	43.3	3.2	9.9	16.4	20.5	8.2	7.6
West Bank and Gaza	32	28	3.1	6.0	..	1.5	..	18.9	..	18.1	3.4	2.9
Yemen, Rep.	79	69	2.7	528.0	1.0	1.0	0.2	0.5	2.9	2.6	7.9	6.2
Zambia	61	65	2.9	743.4	66.1	55.9	0.0	0.0	7.1	7.1	49.1	43.8
Zimbabwe	71	63	0.3	386.9	57.5	43.7	0.3	0.3	7.5	8.3	25.9	25.9
World	**57 w**	**50 w**	**0.6 w**	**129,611.3 s**	**31.4 w**	**30.3 w**	**0.9 w**	**1.1 w**	**9.1 w**	**10.9 w**	**22.8 w**	**21.7 w**
Low income	77	71	1.8	18,731.9	27.9	24.7	0.7	1.0	6.8	8.7	18.1	17.3
Middle income	61	52	0.4	77,325.4	33.5	32.3	1.1	1.3	8.6	11.6	20.4	19.6
Lower middle income	69	59	0.5	31,182.2	25.7	24.8	1.7	2.3	14.8	17.0	15.0	14.5
Upper middle income	32	25	–0.3	46,143.3	38.7	37.3	0.6	0.7	4.3	7.9	40.9	39.0
Low & middle income	64	55	0.7	96,057.3	32.4	30.8	1.0	1.2	8.2	11.0	20.0	19.2
East Asia & Pacific	71	56	–0.3	15,853.6	28.9	28.5	2.2	3.0	12.1	13.3	11.0	10.9
Europe & Central Asia	37	36	0.0	23,054.0	38.2	38.4	0.4	0.4	2.7	10.8	58.5	57.1
Latin America & Carib.	29	21	–0.3	20,147.6	48.8	44.9	0.9	1.0	6.6	7.4	27.5	26.7
Middle East & N. Africa	48	43	1.3	8,643.6	2.3	2.5	0.8	1.0	5.9	6.0	17.9	16.4
South Asia	75	71	1.4	4,773.1	16.5	16.7	1.8	2.8	42.6	41.9	14.5	13.3
Sub-Saharan Africa	72	64	1.9	23,585.4	29.2	26.1	0.8	1.0	6.3	8.3	25.9	25.0
High income	27	22	–0.3	33,554.0	28.6	28.9	0.7	0.7	11.5	10.7	37.2	35.0
Euro area	29	27	–0.1	2,509.8	33.6	37.7	4.6	4.2	26.7	24.8	20.6	19.4

a. Data are not available for all three years. b. Includes Luxembourg. c. Data are from national sources. d. Provisional estimate.

Rural population and land use 3.1

About the data

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

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

Satellite images show land use that differs from that of ground-based measures in area under cultivation and type of land use. Moreover, land use data in some countries (India is an example) are based on reporting systems designed for collecting tax revenue. With land taxes no longer a major source of government revenue, the quality and coverage of land use data have declined. Data on forest area may be particularly unreliable because of irregular surveys and differences in definitions (see *About the data* for table 3.4). FAO's *Global Forest Resources Assessment 2005* is an important background document for the data. Conducted during 2003–05, it covers 229 countries and is the most comprehensive assessment of forests, forestry, and the benefits of forest resources in both scope and number of countries and people involved. It examines status and trends for about 40 variables on the extent, condition, uses, and values of forests and other wooded land.

What is rural? Urban? 3.1a

The rural population identified in table 3.1 is approximated as the difference between total population and urban population, calculated using the urban share reported by the United Nations Population Division. There is no universal standard for distinguishing rural from urban areas, and any urban-rural dichotomy is an oversimplification (see *About the data* for table 3.11). The two distinct images—isolated farm, thriving metropolis—represent poles on a continuum. Life changes along a variety of dimensions, moving from the most remote forest outpost through fields and pastures, past tiny hamlets, through small towns with weekly farm markets, into intensively cultivated areas near large towns and small cities, eventually reaching the center of a megacity. Along the way access to infrastructure, social services, and nonfarm employment increase, and with them population density and income. Because rurality has many dimensions, for policy purposes the rural-urban dichotomy presented in tables 3.1, 3.5, and 3.11 is inadequate.

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

Using these criteria and the Gridded Population of the World (CIESIN 2005), the authors' estimates of the rural population for Latin America and the Caribbean differ substantially from those in table 3.1. Their estimates range from 13 percent of the population, based on a population density of less than 20 people per square kilometer, to 64 percent, based on a population density of more than 500 people per square kilometer. Taking remoteness into account, the estimated rural population would be 13–52 percent. The estimate for Latin America and the Caribbean in table 3.1 is 21 percent.

Definitions

• **Rural population** is calculated as the difference between the total population and the urban population (see *Definitions* for tables 2.1 and 3.11). • **Land area** is a country's total area, excluding area under inland water bodies and national claims to the continental shelf and to exclusive economic zones. In most cases the definition of inland water bodies includes major rivers and lakes. (See table 1.1 for the total surface area of countries.) Variations from year to year may be due to updated or revised data rather than to change in area. • **Land use** can be broken into several categories, three of which are presented in the table (not shown are land used as permanent pasture and land under urban developments). • **Forest area** is land under natural or planted stands of trees of at least 5 meters in height in situ, whether productive or not, and excludes tree stands in agricultural production systems (for example, in fruit plantations and agroforestry systems) and trees in urban parks and gardens. • **Permanent cropland** is land cultivated with crops that occupy the land for long periods and need not be replanted after each harvest, such as cocoa, coffee, and rubber. Land under flowering shrubs, fruit trees, nut trees, and vines is included, but land under trees grown for wood or timber is not. • **Arable land** is land defined by the FAO as under temporary crops (double-cropped areas are counted once), temporary meadows for mowing or pasture, land under market or kitchen gardens, and land temporarily fallow. Land abandoned as a result of shifting cultivation is excluded.

Data sources

Data on urban population shares used to estimate rural population are from the United Nations Population Division's *World Urbanization Prospects: The 2007 Revision,* and data on total population 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.

3.2 Agricultural inputs

	Agricultural land[a]			Average annual precipitation	Land under cereal production		Fertilizer consumption		Agricultural employment		Agricultural machinery	
	% of land area		% irrigated	millimeters	thousand hectares		% of fertilizer production	kilograms per hectare of arable land	% of total employment		Tractors per 100 sq. km of arable land	
	1990–92	2005–07	2005–07	2008	1990–92	2006–08	2005–07	2005–07	1990–92	2005–07	1990–92	2005–07
Afghanistan	58	59	5.8	327	2,283.3	2,913.0	171.2	3.7	..	..	0.1	0.6
Albania	41	40	..	1,485	242.6	136.4	..	81.9	..	58.3	177.3	143.0
Algeria	16	17	2.0	89	3,104.9	2,831.5	86.1	12.7	..	..	128.5	136.9
Angola	46	46	..	1,010	892.6	1,487.5	..	2.9	5.1	..	30.5	27.3
Argentina	47	48	1.1	591	8,509.6	9,584.1	231.8	43.0	0.4	1.0	98.8	80.1
Armenia	41[b]	56	..	562	162.8[b]	178.4	523.6	27.5	..	46.2	345.5[b]	353.1
Australia	60	57	0.6	534	12,813.8	19,153.0	231.5	46.3	5.5	3.5	67.4	67.0
Austria	42	39	1.1	1,110	903.2	813.6	80.3	173.0	7.5	5.6	2,367.1	2,392.0
Azerbaijan	53[b]	58	30.0	447	627.0[b]	795.1	..	11.2	32.5[b]	39.0	194.8[b]	83.7
Bangladesh	73	70	55.7	2,666	10,985.4	11,616.4	149.1	185.6	66.4	48.1	2.4	3.2
Belarus	46[b]	44	1.3	618	2,603.0[b]	2,368.2	17.8	172.2	..	..	206.9[b]	94.3
Belgium	44.1[c]	46	1.6	847	354.3[c]	333.2	..	..	2.8	1.9	..	1,128.0
Benin	21	32	..	1,039	659.9	902.6	..	2.9	..	..	1.0	0.7
Bolivia	33	34	..	1,146	642.4	926.6	..	4.8	1.7	..	24.9	16.5
Bosnia and Herzegovina	43[b]	42	..	1,028	304.1[b]	308.0	..	44.9	..	..	235.3[b]	283.0
Botswana	46	46	0.0	416	140.1	81.7	..	..	..	29.9	142.9	117.4
Brazil	29	31	..	1,782	19,632.5	19,592.8	293.6	156.8	25.6	19.9	144.0	131.9
Bulgaria	56	48	1.3	608	2,179.3	1,598.5	71.4	97.0	19.7	8.2	127.8	132.2
Burkina Faso	35	40	..	748	2,724.5	3,529.1	..	8.5	..	..	2.9	16.9
Burundi	83	89	..	1,274	218.8	221.7	..	1.8	..	..	1.8	1.7
Cambodia	25	31	..	1,904	1,800.8	2,702.1	..	2.5	..	..	3.2	11.0
Cameroon	19	19	..	1,604	816.1	1,106.6	..	8.1	..	..	0.8	0.8
Canada	7	7	..	537	20,864.4	16,235.7	24.3	69.7	4.2	2.6	162.0	162.4
Central African Republic	8	8	..	1,343	104.0	204.7	..	..	..	..	0.2	0.2
Chad	38	39	..	322	1,241.9	2,541.1	..	..	..	..	0.5	0.4
Chile	21	21	6.1	1,522	741.6	542.3	101.6	428.2	18.8	12.8	143.7	396.6
China	57	59	..	..	93,430.3	86,057.9	103.4	327.9	53.5	..	64.4	124.3
Hong Kong, China	..	..	..	..	..	..	..	..	0.8	0.2	..	..
Colombia	41	38	..	2,612	1,598.1	997.6	827.6	344.1	1.4	20.1	97.8	106.3
Congo, Dem. Rep.	10	10	..	1,543	1,867.6	1,976.1	..	0.2	..	..	3.6	3.6
Congo, Rep.	31	31	..	1,646	9.1	27.4	..	0.5	..	..	14.7	14.1
Costa Rica	54	54	..	2,926	83.1	62.8	..	799.9	25.2	14.1	259.4	350.0
Côte d'Ivoire	60	63	..	1,348	1,434.0	808.6	..	25.7	..	..	19.7	33.4
Croatia	43[b]	22	0.6	1,113	592.7[b]	559.7	58.9	238.9	..	14.8	35.2[b]	2,203.3
Cuba	62	60	..	1,335	235.0	277.4	449.4	26.6	25.1	19.6	221.1	205.4
Czech Republic	..	55	1.5	677	..	1,561.9	137.6	146.4	..	3.8	..	281.0
Denmark	65	63	8.5	703	1,581.3	1,484.3	228.7	129.9	5.4	3.0	624.9	481.0
Dominican Republic	53	52	..	1,410	134.2	170.5	..	..	19.5	14.7	25.5	22.8
Ecuador	29	27	9.7	2,087	861.0	810.0	..	579.5	7.0	8.3	54.1	118.6
Egypt, Arab Rep.	3	4	..	51	2,410.2	2,956.4	86.2	570.5	36.2	31.1	250.7	333.1
El Salvador	69	76	1.9	1,724	452.6	361.9	..	84.9	23.1	19.5	60.3	48.6
Eritrea	..	75	..	384	345.6	419.2	..	2.3	..	..	..	7.3
Estonia	32[b]	19	..	626	453.6[b]	293.9	227.5	118.1	19.5[b]	5.0	455.3[b]	573.2
Ethiopia	..	34	0.4	848	..	8,589.5	..	8.3	..	44.4	..	2.2
Finland	8	8	2.8	536	1,050.5	1,158.6	88.0	138.2	8.8	4.6	899.9	779.8
France	56	54	5.8	867	9,211.6	9,260.9	219.8	205.2	5.6	3.6	784.1	624.7
Gabon	20	20	..	1,831	14.4	20.2	..	5.9	..	..	28.5	29.0
Gambia, The	63	81	..	836	89.5	212.7	..	4.9	..	..	1.9	2.6
Georgia	46[b]	36	4.0	1,026	248.5[b]	195.1	19.5	37.1	..	54.3	295.6[b]	468.4
Germany	50	49	..	700	6,673.0	6,770.8	54.2	212.8	3.9	2.2	1,253.3	673.0
Ghana	56	65	..	1,187	1,077.6	1,409.4	..	9.5	62.0	..	14.7	8.9
Greece	71	64	15.8	652	1,455.2	1,196.0	236.4	141.1	22.7	12.0	773.6	1,008.1
Guatemala	40	41	..	1,996	768.2	854.2	..	119.6	13.3	33.2	32.6	28.9
Guinea	49	55	..	1,651	774.2	1,822.9	..	1.6	..	..	43.4	27.0
Guinea-Bissau	53	58	..	1,577	112.4	142.6	..	..	..	..	0.6	0.7
Haiti	58	61	..	1,440	406.5	445.5	..	..	65.6	..	2.4	1.7
Honduras	30	28	..	1,976	502.3	409.3	..	117.8	42.1	39.2	31.1	49.6

Agricultural inputs 3.2

	Agricultural land[a]			Average annual precipitation	Land under cereal production		Fertilizer consumption		Agricultural employment		Agricultural machinery	
	% of land area		% irrigated	millimeters	thousand hectares		% of fertilizer production	kilograms per hectare of arable land	% of total employment		Tractors per 100 sq. km of arable land	
	1990–92	2005–07	2005–07	2008	1990–92	2006–08	2005–07	2005–07	1990–92	2005–07	1990–92	2005–07
Hungary	71	65	2.2	589	2,803.5	2,899.4	215.4	118.0	15.2	4.9	157.8	264.2
India	61	61	30.4	1,083	100,759.8	99,791.3	133.0	121.3	..	..	65.4	186.9
Indonesia	24	27	15.4	2,702	13,861.2	15,740.9	117.3	158.8	54.9	42.4	2.7	2.3
Iran, Islamic Rep.	39	29	15.1	228	9,611.9	7,534.3	179.5	92.7	..	23.9	135.9	178.4
Iraq	23	22	..	216	3,506.1	3,334.8	132.7	22.0	..	..	64.9	139.3
Ireland	70	62	..	1,118	298.0	291.0	285.3	525.2	14.1	5.6	1,666.7	1,548.4
Israel	27	23	31.2	435	107.8	90.4	18.9	1,443.9	3.7	1.8	763.0	796.4
Italy	55	49	18.0	832	4,346.9	3,933.6	365.3	173.2	8.4	4.2	1,619.3	2,539.4
Jamaica	44	47	..	2,051	2.6	1.5	..	54.3	27.3	18.2	158.0	128.4
Japan	16	13	35.7	1,668	2,438.6	2,002.4	145.4	347.2	6.8	4.3	..	..
Jordan	12	11	7.6	111	111.9	56.4	10.7	911.4	..	..	351.9	323.9
Kazakhstan	82[b]	77	..	250	22,152.4[b]	14,857.6	119.0	5.9	..	..	62.0[b]	18.8
Kenya	47	47	0.1	630	1,765.9	2,149.1	..	35.0	..	..	20.0	26.2
Korea, Dem. Rep.	21	25	..	1,054	1,569.0	1,268.7	..	..	..	..	297.1	229.3
Korea, Rep.	22	19	52.7	1,274	1,367.8	1,030.5	150.8	453.6	16.7	7.7	274.6	1,458.2
Kosovo	..	52	..	..	..	..			..	..	..	..
Kuwait	8	9	..	121	0.4	1.4	4.4	1,022.2	..	..	215.0	70.0
Kyrgyz Republic	53[b]	56	9.4	533	578.0[b]	586.3	..	20.5	35.5[b]	37.4	189.4[b]	178.6
Lao PDR	7	9	..	1,834	625.3	951.8	..	..	..	..	11.4	9.8
Latvia	41[b]	29	..	641	696.7[b]	526.4	..	59.5	..	11.0	363.7[b]	498.3
Lebanon	59	66	19.9	661	41.5	70.4	31.8	273.5	..	..	187.6	576.6
Lesotho	77	76	..	788	177.6	222.9	..	..	..	..	57.1	64.6
Liberia	26	27	..	2,391	135.0	160.0	..	..	..	..	9.4	8.5
Libya	9	9	..	56	355.0	342.9	25.0	53.5	..	..	187.2	227.1
Lithuania	54[b]	44	..	656	1,134.0[b]	996.1	26.6	172.2	..	12.3	256.0[b]	650.6
Macedonia, FYR	51[b]	46	2.7	619	235.2[b]	179.2	..	50.2	..	19.3	730.2[b]	1,208.9
Madagascar	63	70	2.2	1,513	1,321.0	1,580.1	..	2.9	..	82.0	4.6	1.9
Malawi	45	53	..	1,181	1,442.6	1,701.1	..	36.4	..	..	6.1	4.8
Malaysia	23	24	..	2,875	699.3	683.2	229.6	821.3	24.4	14.7	..	..
Mali	26	32	..	282	2,392.7	3,424.1	..	0.0	..	..	10.5	2.3
Mauritania	38	39	..	92	132.9	235.0	..	..	..	..	8.2	8.2
Mauritius	56	51	20.4	2,041	0.5	0.1	507.5	278.7	15.5	9.6	36.2	60.0
Mexico	54	55	3.5	752	10,075.0	10,233.1	702.5	64.0	24.7	14.2	126.7	98.8
Moldova	78[b]	76	9.7	450	675.6[b]	923.1	..	12.9	38.5[b]	35.7	310.1[b]	208.5
Mongolia	81	75	..	241	620.0	134.0	..	6.0	..	38.8	73.2	46.1
Morocco	68	67	5.2	346	5,373.9	5,253.5	29.0	49.1	3.8	44.4	46.0	53.5
Mozambique	61	62	..	1,032	1,508.6	2,037.6	..	4.3	..	..	14.3	14.5
Myanmar	16	18	23.8	2,091	5,282.9	8,860.7	1,444.8	6.4	69.4	..	11.5	6.8
Namibia	47	47	..	285	206.4	289.1	..	2.6	48.2	..	30.3	24.7
Nepal	29	29	27.7	1,500	2,957.2	3,360.7	..	23.4	81.2	..	26.4	123.0
Netherlands	59	57	..	778	185.0	222.2	49.4	892.4	4.2	3.1	2,056.1	1,433.6
New Zealand	60	46	3.0	1,732	153.5	122.4	309.1	1,054.7	10.7	7.1	323.1	829.8
Nicaragua	34	44	..	2,391	299.3	458.9	..	29.9	38.7	29.0	20.3	20.1
Niger	27	34	..	151	7,010.6	9,313.6	..	0.4	..	..	0.1	0.1
Nigeria	79	85	..	1,150	16,416.7	19,152.0	974.8	5.0	..	..	4.9	6.7
Norway	3	3	4.2	1,414	361.4	336.8	28.0	237.0	5.9	3.2	1,731.8	1,544.2
Oman	3	6	..	125	2.4	4.8	3.6	285.7	..	..	42.0	35.2
Pakistan	34	35	64.9	494	11,776.8	13,145.5	132.6	160.8	48.9	43.3	133.3	207.8
Panama	29	30	..	2,692	182.4	149.0	..	39.9	26.2	15.4	103.3	147.8
Papua New Guinea	2	2	..	3,142	1.9	3.2	..	139.3	..	..	59.4	50.0
Paraguay	43	51	..	1,130	454.7	969.4	..	63.2	..	29.5	72.4	40.0
Peru	17	17	..	1,738	682.5	1,170.9	75,752.0	91.2	1.0	10.8	35.9	36.0
Philippines	37	38	..	2,348	6,957.4	6,924.3	265.1	150.6	45.3	36.6	72.1	124.4
Poland	62	53	0.5	600	8,522.7	8,444.3	102.8	170.8	25.2	16.0	820.7	1,211.8
Portugal	43	39	12.2	854	780.1	348.2	175.1	199.3	15.6	11.7	569.5	1,522.1
Puerto Rico	48	22	8.0	2,054	0.5	0.3	..	..	3.5	1.5	478.2	504.1
Qatar	64	61	..	74	5,842.3	5,006.4			30.6	30.7	146.1	197.1

3.2 Agricultural inputs

	Agricultural land[a]			Average annual precipitation	Land under cereal production		Fertilizer consumption		Agricultural employment		Agricultural machinery	
	% of land area		% irrigated	millimeters	thousand hectares		% of fertilizer production	kilograms per hectare of arable land	% of total employment		Tractors per 100 sq. km of arable land	
	1990–92	2005–07	2005–07	2008	1990–92	2006–08	2005–07	2005–07	1990–92	2005–07	1990–92	2005–07
Romania	14	13	2.1	637	59,541.3	41,825.3	42.6	42.2	14.5	9.7	97.8	36.3
Russian Federation	76[b]	77	2.1	460	258.2[b]	328.0	12.1	12.4	..[b]	..	1.0[b]	0.5
Rwanda	5	6	..	1,212	1.2	2.0	..	2.6	..	3.0	75.9	41.3
Saudi Arabia	..	..	..	59	1,061.8	596.7	22.5	99.0	..	4.4	20.3	28.8
Senegal	46	45	0.7	686	1,153.8	1,230.8	78.3	9.0	..	33.7	1.7	3.0
Serbia	..	57	0.5	..	..	1,886.8	332.9	38.8	..	..	..	19.8
Sierra Leone	38	44	..	2,526	451.7	1,037.2	..	..	..	..	3.3	1.1
Singapore	2	1	..	2,497	..	..	..	13,528.1	0.3	1.2	636.7	1,083.3
Slovak Republic	..	40	2.7	824	..	772.2	50.9	84.3	..	4.4	..	158.6
Slovenia	28[b]	25	0.5	1,162	112.5[b]	101.5	38,791.4	354.9	..	9.5	..	..
Somalia	70	70	..	282	531.4	536.0	..	..	..	..	15.5	12.0
South Africa	80	82	..	495	5,735.9	3,408.5	170.2	48.7	..	8.3	101.1	43.3
Spain	61	58	12.1	636	7,588.5	6,381.8	117.0	155.5	10.5	4.9	494.2	782.0
Sri Lanka	36	37	..	1,712	834.3	955.1	2,497.4	289.5	44.3	31.3	175.0	213.2
Sudan	52	58	1.1	416	6,266.9	11,122.4	..	3.4	..	..	7.8	31.3
Swaziland	76	78	..	788	69.1	48.5	..	..	..	..	251.4	86.0
Sweden	8	8	..	624	1,184.3	1,009.4	316.9	100.3	3.3	2.1	604.4	596.7
Switzerland	47	39	..	1,537	207.3	159.8	..	214.0	4.2	3.8	2,870.2	2,624.7
Syrian Arab Republic	74	76	10.1	252	3,811.9	3,108.4	149.0	77.9	28.2	..	136.7	229.0
Tajikistan	32[b]	33	..	691	266.5[b]	403.3	369.3	22.0	45.8[b]	..	415.4[b]	299.0
Tanzania	38	39	..	1,071	3,003.3	5,013.0	..	6.0	..	74.6	8.2	23.1
Thailand	42	39	..	1,622	10,593.6	11,520.2	1,148.7	123.3	61.1	42.1	38.8	529.6
Timor-Leste	22	26	..	..	83.7	101.7	..	..	..	..	8.0	5.2
Togo	59	67	..	1,168	610.2	797.5	..	..	..	..	0.5	0.3
Trinidad and Tobago	16	11	12.7	2,200	6.4	2.0	3.5	406.8	11.8	4.3	..	..
Tunisia	58	63	3.6	207	1,524.7	1,311.0	9.1	39.3	..	..	88.3	142.5
Turkey	52	52	12.8	593	13,759.9	12,183.5	218.9	102.5	46.5	27.7	286.7	447.0
Turkmenistan	69[b]	69	..	161	331.3[b]	1,000.5	..	..	..	..	464.7[b]	268.8
Uganda	61	65	..	1,180	1,097.6	1,724.7	..	1.5	..	..	9.2	8.7
Ukraine	72[b]	71	5.3	565	12,542.3[b]	14,012.9	28.3	21.8	20.0[b]	17.9	153.3[b]	106.2
United Arab Emirates	4	7	..	78	1.4	0.0	14.4	615.8	..	4.9	49.8	56.0
United Kingdom	75	72	..	1,220	3,548.5	3,006.3	126.3	289.3	2.2	1.3	761.2	744.2
United States	47	45	..	715	64,547.3	58,581.6	134.1	149.9	2.9	1.5	235.8	258.9
Uruguay	85	84	1.2	1,265	509.4	711.4	1,040.8	133.4	1.5	8.9	259.5	274.4
Uzbekistan	65[b]	63	..	206	1,225.3[b]	1,562.9	..	..	..	..	402.3[b]	390.8
Venezuela, RB	25	24	..	1,875	798.7	1,138.7	61.7	167.1	12.6	8.9	176.1	184.9
Vietnam	21	32	..	1,821	6,726.1	8,390.6	441.2	374.3	..	..	60.4	256.6
West Bank and Gaza	..	62	4.3	402	..	32.8	..	..	..	15.4	..	694.2
Yemen, Rep.	45	45	2.8	167	738.2	879.7	..	10.0	52.6	..	40.4	48.4
Zambia	31	34	..	1,020	813.4	896.0	..	16.3	49.8	..	11.3	11.4
Zimbabwe	34	40	..	657	1,430.8	2,139.5	161.6	35.5	..	..	61.4	74.3
World	**38 w**	**38 w**	**1.8 w**		**707,271.9 s**	**697,843.7 s**	**99.5 w**	**117.7 w**	**.. w**	**.. w**	**189.6 w**	**198.7 w**
Low income	36	38	1.5		73,977.3	100,232.3	256.2	35.0	..	..	33.5	33.7
Middle income	38	38	2.3		483,693.9	456,809.5	101.5	120.2	..	..	131.7	152.1
Lower middle income	49	50	3.6		310,393.3	314,214.7	109.1	155.1	..	..	72.3	140.7
Upper middle income	30	30	1.0		173,300.6	142,594.7	83.1	70.5	20.9	15.7	252.6	175.2
Low & middle income	37	38	2.2		557,671.3	557,041.8	104.2	108.5	..	..	117.0	133.1
East Asia & Pacific	48	50	0.9		142,265.1	143,348.3	114.0	271.0	53.5	..	55.1	137.7
Europe & Central Asia	28	28	2.0		136,657.9	109,979.2	35.2	37.7	23.4	17.6	187.1	175.3
Latin America & Carib.	34	36	0.5		47,722.2	50,046.2	298.3	111.9	18.7	16.4	121.7	109.0
Middle East & N. Africa	24	23	5.9		30,590.3	27,701.1	58.0	89.9	..	..	114.2	161.4
South Asia	55	55	16.1		129,690.1	131,869.1	135.4	122.8	..	..	67.1	173.2
Sub-Saharan Africa	43	44	0.2		70,745.7	94,098.0	343.8	10.8	..	..	17.7	14.9
High income	38	38	0.8		149,600.7	140,801.9	90.8	143.8	5.6	3.2	360.2	380.7
Euro area	50	47	4.2		33,854.7	31,664.6	107.3	200.8	6.9	4.2	989.0	1,013.0

a. Includes permanent pastures, arable land, and land under permanent crops. b. Data are not available for all three years. c. Includes Luxembourg.

Agricultural inputs 3.2

About the data

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

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

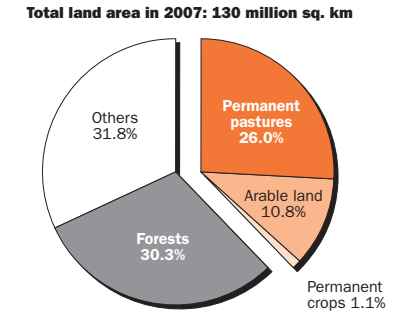
The agriculture sector is the most water-intensive sector, and water delivery in agriculture is increasingly important. The table shows irrigated agricultural land as share of total agricultural land area and data on average precipitation to illustrate how countries obtain water for agricultural use.

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

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. Fertilizer consumption as a share of production shows the agriculture sector's vulnerability to import and energy price fluctuation. The FAO recently revised the time series for fertilizer consumption and irrigation for 2002 onward, but recent data are not available for all countries. FAO collects fertilizer statistics for production, imports, exports, and consumption through the new FAO fertilizer resources questionnaire. In the previous release, the data were based on total consumption of fertilizers, but the data in the recent release are based on the nutrients in fertilizers. Some countries compile fertilizer data on a calendar year basis, while others do so on a crop year basis (July–June). Previous editions of *World Development Indicators* reported data on a crop year basis, but this edition uses the calendar year, as adopted by the FAO. Caution should thus be used when comparing data over time.

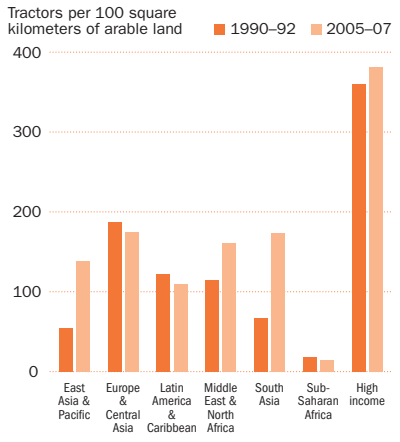
To smooth annual fluctuations in agricultural activity, all the indicators in the table (except average annual precipitation) have been averaged over three years.

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



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

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



Source: Table 3.2.

Definitions

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

Data sources

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

3.3 Agricultural output and productivity

	Crop production index		Food production index		Livestock production index		Cereal yield		Agricultural productivity	
	1999–2001 = 100		1999–2001 = 100		1999–2001 = 100		kilograms per hectare		Agriculture value added per worker 2000 $	
	1990–92	2005–07	1990–92	2005–07	1990–92	2005–07	1990–92	2006–08	1990–92	2005–07
Afghanistan	148.0	124.0	119.7	94.3	100.0	71.0	1,153	1,603	..	..
Albania	81.0	112.3	69.7	112.0	62.0	110.3	2,372	3,717	837	1,663
Algeria	99.7	144.3	95.7	126.3	94.7	107.0	915	1,384	1,823	2,239
Angola	76.7	147.3	82.3	126.0	96.3	83.3	378	490	176	222
Argentina	74.3	120.0	81.7	113.3	99.0	102.0	2,652	3,991	6,919	11,191
Armenia	95.0[a]	180.3	101.0[a]	164.3	106.0[a]	131.7	1,843[a]	1,992	1,607[a]	4,508
Australia	66.7	73.3	104.0	77.3	155.0	84.3	1,739	1,292	20,676	30,830
Austria	96.3	99.3	93.3	91.7	95.7	91.0	5,400	6,128	12,060	21,440
Azerbaijan	147.0[a]	137.7	112.0[a]	132.0	103.0[a]	128.0	2,113[a]	2,669	1,067[a]	1,222
Bangladesh	90.7	103.0	88.7	104.3	87.3	114.3	2,567	3,896	255	387
Belarus	107.0[a]	146.3	132.0[a]	138.0	142.0[a]	129.0	2,741[a]	3,000	2,042[a]	4,266
Belgium	77.6[b]	103.0	87.8[b]	62.3	93.8[b]	50.7	6,122.0[b]	8,223	..	38,337
Benin	76.7	88.3	83.3	94.0	118.3	98.7	880	1,247	429	661
Bolivia	78.0	107.7	86.3	101.7	93.3	101.7	1,373	1,933	703	732
Bosnia and Herzegovina	101.0[a]	113.3	113.0[a]	119.0	114.0[a]	139.3	3,553[a]	3,977	..	10,352
Botswana	117.7	103.0	137.3	103.7	141.3	103.7	312	487	766	452
Brazil	87.3	122.0	79.7	118.0	74.3	113.3	1,916	3,531	1,611	3,315
Bulgaria	137.7	89.3	125.3	82.0	133.7	68.0	3,633	3,252	2,686	8,015
Burkina Faso	95.7	115.3	94.7	103.7	88.0	103.3	783	1,118	126	182
Burundi	128.7	86.7	128.3	86.0	153.0	74.7	1,370	1,307	117	70
Cambodia	82.7	145.3	82.7	139.0	82.3	104.0	1,356	2,672	..	376
Cameroon	89.0	98.3	93.0	98.7	106.0	90.0	1,166	1,343	409	703
Canada	95.3	101.0	91.0	103.0	83.7	104.7	2,559	3,133	28,541	46,138
Central African Republic	92.7	89.7	86.7	98.3	84.3	101.3	883	1,115	322	409
Chad	92.0	92.3	97.0	95.0	113.3	90.3	636	775	209	246
Chile	89.3	111.7	84.0	110.0	77.3	109.0	3,949	5,960	3,618	6,103
China	75.7	116.0	66.3	117.7	54.7	116.3	4,307	5,388	269	459
Hong Kong SAR, China	..	..	..	..	..	..	..	..	..	..
Colombia	106.3	92.7	93.3	95.3	94.0	101.3	2,492	4,046	3,342	3,001
Congo, Dem. Rep.	160.3	82.7	156.3	82.7	130.0	80.3	794	772	209	162
Congo, Rep.	102.0	98.3	100.7	103.7	96.7	128.3	688	776	..	..
Costa Rica	89.7	98.3	90.3	103.7	99.0	101.3	3,188	3,433	3,158	5,132
Côte d'Ivoire	92.7	95.3	95.3	101.0	117.3	100.0	863	1,713	652	875
Croatia	78.0[a]	84.0	98.0[a]	92.3	124.0[a]	113.0	3,975[a]	5,535	5,553[a]	14,823
Cuba	117.0	83.7	116.0	84.3	135.0	83.7	2,092	2,787	..	..
Czech Republic	..	94.3	..	96.0	..	89.7	..	4,679	..	5,871
Denmark	106.0	94.7	100.3	100.0	91.7	102.0	5,448	5,825	15,190	43,201
Dominican Republic	137.3	108.3	120.3	122.3	92.7	133.3	4,078	4,292	2,055	3,829
Ecuador	92.3	96.0	83.3	103.3	75.0	105.7	1,724	2,995	1,801	1,872
Egypt, Arab Rep.	81.3	104.7	79.3	105.3	77.0	104.7	5,738	7,537	1,826	2,758
El Salvador	120.7	88.7	106.3	100.0	92.3	113.7	1,871	2,957	1,774	2,404
Eritrea	..	83.7	..	81.3	..	78.7	..	456	..	118
Estonia	108.0[a]	113.3	162.0[a]	122.7	173.0[a]	108.7	1,304[a]	2,679	..	4,550
Ethiopia	..	115.7	..	116.0	..	113.3	..	1,489	..	187
Finland	100.0	107.0	106.7	101.7	109.7	100.0	3,246	3,497	19,011	35,653
France	97.0	90.0	100.7	91.7	100.7	92.7	6,370	6,880	22,254	47,418
Gabon	108.7	91.0	111.0	91.0	108.0	91.0	1,712	1,656	1,246	1,741
Gambia, The	77.3	68.3	83.0	69.3	136.0	87.3	1,114	935	262	269
Georgia	108.0[a]	87.3	93.0[a]	95.0	71.0[a]	96.0	1,998[a]	1,954	2,359[a]	1,871
Germany	86.0	90.3	101.0	94.0	110.0	99.7	5,578	6,596	13,863	26,745
Ghana	72.3	111.3	75.0	110.3	114.3	93.7	1,084	1,330	352	378
Greece	91.3	85.7	99.7	89.3	111.7	95.7	3,589	4,069	7,669	8,656
Guatemala	95.7	109.3	93.0	112.0	94.3	91.3	1,882	1,582	2,304	2,719
Guinea	98.7	107.3	99.0	107.7	78.3	121.0	1,423	1,501	156	208
Guinea-Bissau	92.3	95.0	95.0	95.0	105.3	95.0	1,529	1,464	236	315
Haiti	127.7	88.0	117.7	92.7	82.0	102.0	997	885	..	..
Honduras	113.7	128.0	107.0	125.3	84.7	117.0	1,371	1,662	1,227	1,858

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 $	
	1990–92	2005–07	1990–92	2005–07	1990–92	2005–07	1990–92	2006–08	1990–92	2005–07
Hungary	111.7	108.3	115.3	101.7	124.7	86.7	4,551	5,226	4,289	8,136
India	95.0	100.3	91.0	101.7	83.3	112.3	1,947	2,574	359	460
Indonesia	93.7	120.3	95.3	121.3	99.3	132.3	3,826	4,508	519	657
Iran, Islamic Rep.	85.7	117.3	83.3	118.7	77.7	119.7	1,523	2,574	2,042	2,931
Iraq	120.3	96.7	117.7	92.7	117.0	93.0	872	1,377	..	..
Ireland	99.3	80.0	102.0	84.7	101.0	85.7	6,653	7,417	..	14,217
Israel	127.0	100.7	108.0	93.3	94.7	93.7	3,132	2,741	..	..
Italy	98.7	94.3	98.0	94.0	96.3	95.0	4,340	5,282	11,714	26,784
Jamaica	91.0	88.0	82.0	92.7	70.7	104.0	1,298	1,227	2,366	2,400
Japan	115.0	93.3	110.7	96.7	109.0	98.7	5,713	5,977	20,350	39,368
Jordan	139.0	127.3	122.7	118.3	97.3	98.7	1,167	891	2,348	2,232
Kazakhstan	149.0[a]	121.7	149.0[a]	121.0	163.0[a]	124.7	1,338[a]	1,169	1,776[a]	1,730
Kenya	108.3	101.0	111.3	108.7	114.3	117.0	1,645	1,621	379	367
Korea, Dem. Rep.	140.7	106.0	129.0	109.7	131.7	128.7	5,073	3,607	..	..
Korea, Rep.	94.7	90.7	85.7	92.3	73.3	98.0	5,885	6,525	5,804	14,501
Kosovo	..	..	..	..	..	..	..	..	..	..
Kuwait	35.7	96.0	27.7	101.3	29.0	99.3	3,112	2,623	..	..
Kyrgyz Republic	76.0[a]	93.7	81.0[a]	96.7	118.0[a]	97.3	2,772[a]	2,481	684[a]	1,017
Lao PDR	77.0	117.7	73.0	115.7	74.3	109.3	2,355	3,612	382	495
Latvia	117.0[a]	139.3	203.0[a]	128.7	249.0[a]	114.3	1,641[a]	2,767	1,896[a]	3,260
Lebanon	136.3	88.0	124.3	96.7	80.3	115.0	2,001	2,351	..	30,573
Lesotho	77.3	68.0	91.3	78.3	110.3	87.0	703	569	259	193
Liberia	90.0	90.3	116.3	95.7	132.0	99.0	951	1,421	..	..
Libya	94.3	91.0	93.0	90.3	92.7	89.0	706	619	..	..
Lithuania	75.0[a]	99.3	149.0[a]	125.3	175.0[a]	125.0	1,938[a]	2,762	..	4,636
Macedonia, FYR	112.0[a]	101.0	116.0	105.7	119.0	118.0	2,652	3,135	2,413	4,395
Madagascar	122.3	103.7	121.0	100.7	130.7	89.7	1,935	2,418	210	182
Malawi	66.3	98.3	56.3	99.3	97.3	107.0	871	1,837	86	126
Malaysia	92.7	116.7	88.0	114.7	100.3	114.3	2,827	3,422	398	583
Mali	93.0	101.3	103.3	113.0	114.7	109.0	840	1,133	405	515
Mauritania	80.3	85.3	111.3	95.3	116.3	96.3	802	760	671	414
Mauritius	122.0	90.0	111.3	98.3	77.0	129.7	4,117	8,381	3,747	5,222
Mexico	94.0	105.7	89.0	110.0	83.3	110.0	2,520	3,341	2,274	3,022
Moldova	127.0[a]	102.7	146.0[a]	116.3	183.0[a]	116.7	2,928[a]	2,236	1,349[a]	1,278
Mongolia	270.0	115.0	110.0	72.7	104.3	70.7	967	1,141	1,150	1,511
Morocco	115.0	129.7	107.3	121.7	93.3	101.3	1,094	1,057	1,788	2,306
Mozambique	81.0	105.7	87.0	92.3	112.3	104.3	330	787	117	173
Myanmar	68.7	133.3	71.0	139.7	66.0	180.3	2,739	3,670	..	..
Namibia	90.3	117.0	133.3	93.0	141.7	86.3	388	434	1,307	1,917
Nepal	92.3	104.3	93.7	103.0	99.3	102.0	1,831	2,286	245	241
Netherlands	98.3	93.7	110.3	89.7	110.3	89.0	7,142	7,813	24,752	39,910
New Zealand	87.3	100.0	86.7	110.3	89.7	109.7	5,257	7,439	19,150	26,105
Nicaragua	91.7	112.3	76.0	119.3	68.7	125.0	1,543	1,866	..	2,334
Niger	96.7	116.3	90.0	112.3	81.3	106.0	323	460	242	..
Nigeria	86.7	108.0	86.7	106.3	90.3	99.0	1,135	1,502	..	..
Norway	125.0	99.0	108.7	94.3	103.0	91.7	3,744	3,690	19,077	39,206
Oman	78.0	87.7	74.7	104.0	81.7	139.3	2,206	3,265	1,012	..
Pakistan	99.7	102.7	87.3	106.0	83.3	108.7	1,818	2,656	765	888
Panama	130.7	100.3	107.0	97.0	82.7	95.0	1,862	2,195	2,341	4,011
Papua New Guinea	99.0	91.0	100.7	95.7	102.0	100.3	2,504	3,700	555	639
Paraguay	105.0	126.0	96.3	116.0	113.7	91.7	1,905	3,092	1,648	2,136
Peru	57.0	120.3	63.3	121.3	77.7	121.0	2,463	3,657	879	1,390
Philippines	103.7	109.7	95.3	108.0	74.7	105.3	2,070	3,278	905	1,148
Poland	109.3	88.0	110.0	104.0	115.0	106.0	2,958	3,022	1,605	2,901
Portugal	109.0	89.7	103.0	94.3	87.3	96.7	1,939	3,418	4,642	6,387
Puerto Rico	176.7	98.7	136.3	89.0	127.0	86.7	1,100	1,882	..	..
Qatar	83.3	73.0	98.0	51.7	109.7	34.3	2,941	3,585	..	..

3.3 Agricultural output and productivity

	Crop production index		Food production index		Livestock production index		Cereal yield		Agricultural productivity	
	1999–2001 = 100		1999–2001 = 100		1999–2001 = 100		kilograms per hectare		Agriculture value added per worker 2000 $	
	1990–92	2005–07	1990–92	2005–07	1990–92	2005–07	1990–92	2006–08	1990–92	2005–07
Romania	87.3	97.3	94.7	104.3	116.3	112.7	2,777	2,664	2,129	6,179
Russian Federation	125.0[a]	134.7	130.0[a]	122.3	149.0[a]	111.0	1,743[a]	2,092	1,917[a]	2,914
Rwanda	129.0	102.3	125.0	103.3	93.3	105.3	1,088	1,110	193	226
Saudi Arabia	149.7	112.0	130.7	99.3	84.0	95.0	4,212	5,099	8,476	17,365
Senegal	90.0	67.3	92.3	72.7	110.3	96.7	803	892	251	224
Serbia	101.0[a,c]	123.0[a,c]	113.0[a,c]	109.0[a,c]	107.0[a,c]	97.0[a,c]	2,926[a,c]	4,087	..	1,890[a,c]
Sierra Leone	136.7	148.7	131.0	146.0	117.0	107.7	1,223	1,016	..	..
Singapore	204.3	343.7	467.3	122.0	526.0	100.7	..	..	22,695	50,828
Slovak Republic	..	99.0	..	93.7	..	79.3	..	4,244	..	4,995
Slovenia	84.0[a]	102.7	78.0[a]	100.7	78.0[a]	100.0	3,279[a]	5,310	13,217[a]	50,960
Somalia	110.3	87.0	90.7	87.0	88.0	87.0	622	408	..	..
South Africa	95.3	92.7	101.3	104.0	114.3	116.3	1,602	3,244	2,149	3,077
Spain	90.7	90.7	89.3	90.3	81.3	95.0	2,310	3,493	9,583	17,894
Sri Lanka	93.0	104.0	96.0	106.0	101.7	114.7	2,950	3,700	697	823
Sudan	83.3	100.3	78.0	107.3	77.0	113.7	596	600	526	844
Swaziland	126.3	101.0	128.7	106.7	152.3	110.7	1,299	845	993	1,108
Sweden	104.7	91.7	100.0	96.7	97.3	93.3	4,272	4,781	22,319	39,578
Switzerland	117.3	92.3	110.0	98.0	110.0	99.3	6,102	6,361	19,369	22,653
Syrian Arab Republic	92.0	103.0	94.0	107.3	95.0	116.7	947	1,749	2,778	4,479
Tajikistan	138.0[a]	141.7	151.0[a]	147.7	214.0[a]	168.0	1,020[a]	2,246	370[a]	517
Tanzania	118.0	122.3	111.0	109.7	100.3	92.3	1,276	1,209	261	324
Thailand	89.7	110.0	92.0	109.0	94.7	103.0	2,186	3,007	480	653
Timor-Leste	103.7	81.0	113.3	86.7	109.0	102.0	1,694	1,184	..	..
Togo	93.7	85.7	95.3	98.0	112.7	98.7	791	1,130	345	394
Trinidad and Tobago	122.7	65.0	93.0	106.3	77.0	140.3	3,159	2,656	1,818	1,317
Tunisia	119.7	118.3	103.7	109.3	68.7	95.0	1,401	1,278	2,975	3,424
Turkey	102.3	100.0	104.0	99.3	107.0	94.3	2,192	2,548	2,204	3,229
Turkmenistan	114.0[a]	119.0	69.0[a]	122.3	75.0[a]	118.3	2,210[a]	3,079	1,321[a]	..
Uganda	103.3	85.0	105.3	87.3	109.3	93.3	1,487	1,528	175	191
Ukraine	124.0[a]	133.3	139.0[a]	119.0	161.0[a]	108.3	2,834[a]	2,707	1,232[a]	2,010
United Arab Emirates	35.0	38.7	39.7	41.7	94.7	90.3	2,042	2,200	10,414	29,465
United Kingdom	105.7	91.7	109.3	93.0	108.3	95.0	6,321	7,110	21,817	28,065
United States	97.0	99.7	92.7	99.7	91.3	98.0	4,875	6,578	20,353	45,015
Uruguay	73.7	137.7	80.3	124.0	88.0	116.7	2,445	4,185	6,278	9,370
Uzbekistan	124.0[a]	124.7	107.0[a]	121.7	113.0[a]	112.3	1,777[a]	4,287	1,427[a]	2,231
Venezuela, RB	95.7	96.0	89.7	95.7	89.7	93.7	2,561	3,533	4,584	7,386
Vietnam	69.7	116.0	71.3	114.3	60.0	113.3	3,097	4,883	229	335
West Bank and Gaza	..	91.0	..	92.7	..	91.3	..	1,863	..	..
Yemen, Rep.	102.7	97.7	99.0	102.7	93.3	110.7	906	963	412	..
Zambia	95.3	116.3	105.3	103.7	106.3	96.0	1,251	1,803	189	232
Zimbabwe	81.0	56.3	90.7	81.0	105.0	94.7	1,125	592	271	239
World	**82.0 w**	**114.7 w**	**78.8 w**	**114.3 w**	**83.7 w**	**112.2 w**	**2,847 w**	**3,397 w**	**801 w**	**959 w**
Low income	77.3	122.8	76.0	123.2	82.5	122.9	1,710	2,190	249	307
Middle income	79.5	119.3	73.2	119.7	77.5	119.0	2,537	3,122	501	741
Lower middle income	76.0	119.3	69.6	120.3	64.9	121.2	2,672	3,324	383	570
Upper middle income	89.8	119.5	82.7	118.4	99.8	114.9	1,961	2,676	2,154	3,286
Low & middle income	79.3	119.7	73.4	120.1	77.9	119.2	2,419	2,954	465	663
East Asia & Pacific	71.6	122.6	65.0	124.0	53.9	122.2	3,816	4,767	307	491
Europe & Central Asia	114.2	115.8	116.7	113.9	150.7	109.0	1,935	2,335	2,009	2,842
Latin America & Carib.	77.2	124.0	73.5	121.7	73.0	117.9	2,234	3,487	2,213	3,273
Middle East & N. Africa	79.1	123.7	76.6	123.1	71.3	120.6	1,544	2,308	1,846	2,823
South Asia	80.0	112.1	75.8	114.0	69.9	122.8	1,977	2,678	372	480
Sub-Saharan Africa	74.9	118.0	76.4	119.5	82.6	120.1	987	1,205	305	318
High income	90.3	99.9	91.4	100.4	93.1	101.0	4,260	5,147	14,601	27,557
Euro area	91.8	95.1	96.0	94.8	97.8	96.0	4,631	5,597	12,696	22,921

a. Data are not available for all three years. b. Includes Luxembourg. c. Includes Montenegro.

Agricultural output and productivity 3.3

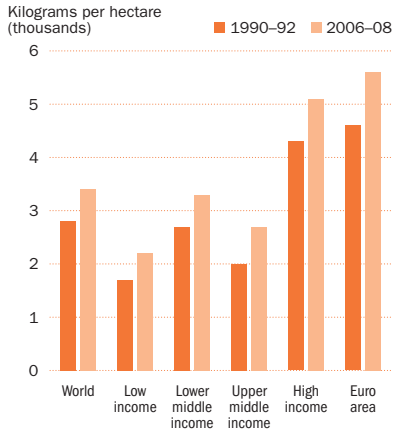
About the data

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

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

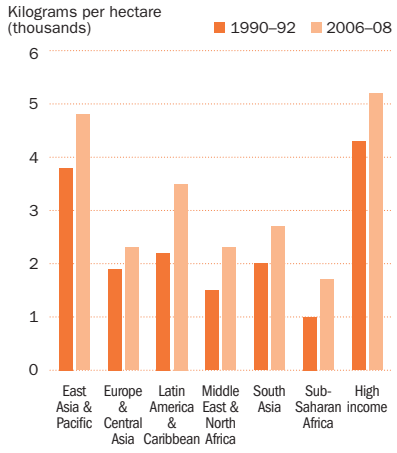
Data on cereal yield may be affected by a variety of reporting and timing differences. Millet and sorghum, which are grown as feed for livestock and poultry in Europe and North America, are used as food in Africa, Asia, and countries of the former Soviet Union. So some cereal crops are excluded from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

Cereal yield in low-income economies is less than 40 percent of the yield in high-income countries **3.3a**



Source: Table 3.3.

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



Source: Table 3.3.

Definitions

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

Data sources

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

3.4 Deforestation and biodiversity

	Forest area		Average annual deforestation[a]		Threatened species				GEF benefits index for biodiversity	Nationally protected areas			
										Terrestrial		Marine	
	thousand sq. km		%		Mammals	Birds	Fish	Higher plants[b]	0–100 (no biodiversity to maximum biodiversity)	% of surface area	Number of areas	% of surface area	Number of areas
	1990	2007	1990–2000	2000–07	2008	2008	2008	2008	2008	2008	2008	2008	2008
Afghanistan	13	8	2.5	3.2	11	13	3	2	..	0.2	7	0.0	0
Albania	8	8	0.3	–0.6	3	6	33	0	0.2	8.0	80	1.1	7
Algeria	18	23	–1.8	–1.2	14	11	23	3	2.9	5.0	23	0.3	6
Angola	610	589	0.2	0.2	14	18	22	26	8.3	8.3	15	0.2	4
Argentina	353	327	0.4	0.4	35	49	31	44	17.7	6.5	307	0.6	36
Armenia	*3*	3	1.0	1.5	9	12	4	1	0.2	8.2	10	0.0	0
Australia	1,679	1,633	0.2	0.1	57	49	84	55	87.7	0.1	5,485	70.6	384
Austria	38	39	–0.2	–0.1	4	9	9	4	0.3	28.0	1,087	0.0	0
Azerbaijan	9	9	0.0	0.0	7	15	9	0	0.8	7.3	42	0.0	0
Bangladesh	9	9	0.0	0.3	34	28	12	12	1.4	2.2	20	0.5	7
Belarus	*75*	79	–0.5	–0.1	4	4	1	0	0.0	6.5	440	0.0	0
Belgium	..	7	..	0.0	3	2	9	1	0.0	3.2	502	0.1	2
Benin	33	22	2.1	2.6	10	4	15	14	0.2	23.2	49	0.0	0
Bolivia	628	582	0.4	0.5	19	29	0	71	12.5	21.2	53	0.0	0
Bosnia and Herzegovina	*22*	22	0.1	0.0	4	6	27	1	0.4	0.8	32	0.0	0
Botswana	137	117	0.9	1.0	6	7	2	0	1.4	30.1	60	0.0	0
Brazil	5,200	4,715	0.5	0.6	82	122	64	382	100.0	29.6	1,444	4.8	58
Bulgaria	33	37	–0.1	–1.4	7	12	17	0	0.8	10.1	905	0.0	1
Burkina Faso	72	67	0.3	0.4	8	5	0	2	0.3	14.4	72	0.0	0
Burundi	3	1	3.7	5.5	9	8	18	2	0.3	5.6	15	0.0	0
Cambodia	129	100	1.1	2.0	37	25	18	31	3.5	24.0	30	0.4	2
Cameroon	245	208	0.9	1.0	41	15	43	355	12.5	10.1	39	0.1	2
Canada	3,101	3,101	0.0	0.0	12	16	26	2	21.5	8.2	5,122	1.1	563
Central African Republic	232	227	0.1	0.1	7	5	0	15	1.5	18.2	32	0.0	0
Chad	131	118	0.6	0.7	12	7	0	2	2.2	9.0	9	0.0	0
Chile	153	162	–0.4	–0.4	21	32	18	40	15.3	18.8	102	0.3	9
China	1,571	2,054	–1.2	–2.1	74	85	70	446	66.6	15.1	1,981	0.3	36
Hong Kong SAR, China	..	..	..	..	2	16	13	6	..	44.1	98	0.0	22
Colombia	614	606	0.1	0.1	52	86	31	223	51.5	26.2	263	84.2	15
Congo, Dem. Rep.	1,405	1,330	0.4	0.2	29	31	25	65	19.9	12.2	66	1.8	1
Congo, Rep.	227	224	0.1	0.1	11	3	15	35	3.6	10.3	14	0.0	0
Costa Rica	26	24	0.8	–0.1	8	17	19	111	9.7	31.0	165	9.8	35
Côte d'Ivoire	102	104	–0.1	–0.1	24	14	19	105	3.4	21.1	240	0.0	3
Croatia	*21*	21	–0.1	–0.1	7	11	46	1	0.6	7.5	177	4.4	19
Cuba	21	28	–1.7	–2.1	14	17	28	163	12.5	18.8	71	12.6	42
Czech Republic	26	27	0.0	–0.1	2	6	5	4	0.1	15.8	1,765	0.0	0
Denmark	4	5	–0.9	–0.6	2	2	13	3	0.2	5.7	3,847	2.7	52
Dominican Republic	14	14	0.0	0.0	6	14	15	30	6.0	28.5	59	0.0	15
Ecuador	138	105	1.5	1.8	43	69	15	1,839	29.3	25.4	104	12.4	3
Egypt, Arab Rep.	0[c]	1	–3.0	–2.5	17	10	24	2	2.9	7.7	26	9.9	8
El Salvador	4	3	1.5	1.7	5	3	7	26	0.9	1.3	77	0.0	1
Eritrea	*16*	15	0.2	0.2	9	9	14	3	0.8	4.3	3	0.0	0
Estonia	*22*	23	–0.3	–0.4	1	3	4	0	0.1	46.8	9,617	2.5	3
Ethiopia	*147*	127	0.7	1.1	31	22	2	22	8.4	17.5	42	0.0	0
Finland	222	225	–0.1	0.0	1	4	5	1	0.2	9.3	6,046	3.4	15
France	145	156	–0.5	–0.3	9	6	31	8	5.3	15.4	1,541	3.2	64
Gabon	219	218	0.0	0.0	13	5	21	108	3.0	16.5	22	4.9	5
Gambia, The	4	5	–0.4	–0.4	9	5	16	4	0.1	2.0	6	1.5	6
Georgia	*28*	28	0.0	0.0	10	10	12	0	0.6	3.9	33	0.0	2
Germany	107	111	–0.3	0.0	6	6	20	12	0.6	56.2	14,388	26.7	21
Ghana	74	53	2.0	2.0	17	8	17	117	1.9	16.6	302	0.0	0
Greece	33	38	–0.9	–0.8	10	11	62	11	2.8	3.4	111	2.4	12
Guatemala	47	38	1.2	1.3	16	11	16	83	8.0	32.7	163	4.7	7
Guinea	74	67	0.7	0.5	22	12	19	22	2.3	6.6	102	0.0	0
Guinea-Bissau	22	21	0.4	0.5	11	2	18	4	0.6	18.2	9	54.4	4
Haiti	1	1	0.6	0.8	5	13	15	29	5.2	0.3	8	0.0	0
Honduras	74	43	3.0	3.2	6	7	19	110	7.2	21.0	77	2.8	22

3.4 Deforestation and biodiversity

	Forest area		Average annual deforestation[a]		Threatened species				GEF benefits index for biodiversity	Nationally protected areas			
										Terrestrial		Marine	
	thousand sq. km		%		Mammals	Birds	Fish	Higher plants[b]	0–100 (no biodiversity to maximum biodiversity)	% of surface area	Number of areas	% of surface area	Number of areas
	1990	2007	1990–2000	2000–07	2008	2008	2008	2008	2008	2008	2008	2008	2008
Hungary	18	20	–0.6	–0.7	2	9	9	1	0.2	5.6	136	0.0	0
India	639	678	–0.6	0.0	96	76	40	246	39.9	4.8	556	1.5	117
Indonesia	1,166	848	1.7	2.0	183	115	111	386	81.0	15.7	469	1.8	139
Iran, Islamic Rep.	111	111	0.0	0.0	16	20	21	1	7.3	7.0	145	3.5	12
Iraq	8	8	–0.2	–0.1	13	18	6	0	1.6	0.0	8	0.0	0
Ireland	4	7	–3.3	–1.9	5	1	16	1	0.6	1.1	85	0.1	12
Israel	2	2	–0.6	–0.8	15	13	31	0	0.8	34.5	222	0.5	13
Italy	84	102	–1.2	–1.1	7	8	33	19	3.8	7.1	456	3.1	58
Jamaica	3	3	0.1	0.1	5	10	15	209	4.4	20.9	71	3.6	12
Japan	250	249	0.0	0.0	27	40	40	12	36.0	14.1	216	5.2	135
Jordan	1	1	0.0	0.0	13	8	14	0	0.4	10.5	12	21.6	1
Kazakhstan	*34*	33	0.1	0.2	16	21	13	16	5.1	2.8	77	0.0	0
Kenya	37	35	0.3	0.3	27	27	71	103	8.8	12.3	284	5.8	11
Korea, Dem. Rep.	82	59	1.8	2.0	9	20	8	3	0.7	2.6	31	0.0	0
Korea, Rep.	64	63	0.1	0.1	9	30	14	0	1.7	4.3	32	3.2	6
Kosovo	..	5[d]	..	..	0	0	..	0	..	..			
Kuwait	0[c]	0[c]	–3.4	–2.4	6	8	10	0	0.1	0.8	5	1.8	5
Kyrgyz Republic	*8*	9	–0.2	–0.3	6	12	3	14	1.1	3.1	29	0.0	0
Lao PDR	173	160	0.5	0.5	46	23	6	21	5.0	15.9	25	0.0	0
Latvia	*28*	30	–0.3	–0.4	1	4	6	0	0.0	16.4	540	0.0	1
Lebanon	1	1	–0.8	–0.8	10	6	15	0	0.2	0.4	11	0.0	1
Lesotho	0[c]	0[c]	–3.4	–2.6	2	5	1	1	0.3	0.2	1	0.0	0
Liberia	41	30	1.6	1.8	20	11	19	46	2.6	15.0	16	0.0	1
Libya	2	2	0.0	0.0	12	4	14	1	1.6	0.1	8	1.0	4
Lithuania	*20*	21	–0.3	–0.8	3	4	6	0	0.0	6.0	250	7.9	3
Macedonia, FYR	9	9	0.0	0.0	5	10	14	0	0.2	0.0	61	0.0	0
Madagascar	137	128	0.5	0.3	62	35	75	281	29.2	3.1	53	0.1	8
Malawi	39	33	0.9	1.0	6	12	101	14	3.5	15.5	96	0.0	0
Malaysia	224	206	0.4	0.7	70	42	49	686	13.9	20.3	684	4.6	147
Mali	141	124	0.7	0.8	11	6	1	6	1.5	2.1	10	0.0	0
Mauritania	4	2	2.7	3.5	14	8	23	0	1.3	0.9	3	31.3	3
Mauritius	0[c]	0[c]	0.3	0.5	6	11	11	88	3.3	5.5	23	0.3	18
Mexico	690	637	0.5	0.4	100	54	114	261	68.7	8.0	182	14.0	38
Moldova	*3*	3	–0.2	–0.2	4	9	9	0	0.0	1.4	63	0.0	0
Mongolia	115	101	0.7	0.8	11	21	1	0	4.2	13.9	51	0.0	0
Morocco	43	44	–0.1	–0.2	18	10	31	2	3.5	1.2	31	1.6	11
Mozambique	200	192	0.3	0.3	11	21	45	46	7.2	15.7	46	4.0	3
Myanmar	392	313	1.3	1.4	45	41	17	38	10.0	6.7	49	0.5	6
Namibia	88	75	0.9	1.0	11	21	21	24	5.2	15.0	31	0.2	4
Nepal	48	35	2.1	1.4	32	32	0	7	2.1	16.6	19	0.0	0
Netherlands	3	4	–0.4	–0.3	4	2	11	0	0.2	19.8	1,948	3.1	6
New Zealand	77	83	–0.6	–0.2	8	69	14	21	20.2	29.5	3,878	7.1	87
Nicaragua	65	50	1.6	1.5	5	9	21	39	3.3	16.9	74	10.3	5
Niger	19	12	3.7	1.0	11	5	2	2	0.9	6.6	6	0.0	0
Nigeria	172	103	2.7	3.5	27	12	21	171	6.0	16.0	972	0.0	0
Norway	91	94	–0.2	–0.2	7	2	14	2	1.3	5.2	1,795	0.5	17
Oman	0[c]	0[c]	0.0	0.0	9	9	20	6	3.7	9.4	6	1.2	3
Pakistan	25	18	1.8	2.2	23	27	22	2	4.9	9.0	151	1.1	5
Panama	44	43	0.2	0.1	14	17	19	194	10.9	28.1	53	8.6	21
Papua New Guinea	315	292	0.5	0.5	41	36	38	142	25.4	9.7	67	0.5	24
Paraguay	212	181	0.9	0.9	8	27	0	10	2.8	6.0	33	0.0	0
Peru	702	686	0.1	0.1	53	93	10	275	33.4	13.8	61	2.9	2
Philippines	106	68	2.8	2.1	39	67	60	216	32.3	17.2	204	0.7	212
Poland	89	92	–0.2	–0.3	5	6	6	4	0.5	24.3	1,605	2.5	3
Portugal	31	39	–1.5	–1.1	11	8	38	16	5.5	6.6	59	1.1	27
Puerto Rico	4	4	–0.1	0.0	3	8	13	53	4.0	6.8	50	11.5	19
Qatar	..	..			2	4	7	0	0.1	0.0	0	..	..

3.4 Deforestation and biodiversity

	Forest area		Average annual deforestation[a]		Threatened species				GEF benefits index for biodiversity	Nationally protected areas			
										Terrestrial		Marine	
	thousand sq. km		%		Mammals	Birds	Fish	Higher plants[b]	0–100 (no biodiversity to maximum biodiversity)	% of surface area	Number of areas	% of surface area	Number of areas
	1990	2007	1990–2000	2000–07	2008	2008	2008	2008	2008	2008	2008	2008	2008
Romania	64	64	0.0	0.0	7	12	16	1	0.7	10.7	923	37.9	10
Russian Federation	*8,090*	8,086	0.0	0.0	33	51	32	7	34.1	9.0	11,181	6.3	27
Rwanda	3	5	–0.8	–6.5	19	10	9	3	0.9	7.6	5	0.0	0
Saudi Arabia	27	27	0.0	0.0	9	14	16	3	3.2	38.4	30	1.1	3
Senegal	93	86	0.5	0.5	15	8	28	7	1.0	25.0	109	13.0	11
Serbia	..	21	..	..	6	11	8	1	0.2	2.7	68	0.0	0
Sierra Leone	30	27	0.7	0.7	16	10	16	47	1.3	4.1	39	0.0	0
Singapore	0[c]	0[c]	0.0	0.0	12	14	22	54	0.1	5.2	7	0.8	3
Slovak Republic	*19*	19	0.0	–0.1	3	7	7	2	0.1	19.6	1,126	0.0	0
Slovenia	*12*	13	–0.4	–0.4	4	4	24	0	0.2	6.6	30	0.4	3
Somalia	83	70	1.0	1.1	14	12	26	17	6.1	0.6	7	0.2	2
South Africa	92	92	0.0	0.0	23	35	65	74	20.7	6.0	931	6.2	30
Spain	135	185	–2.0	–1.7	16	15	52	49	6.8	9.5	468	5.3	47
Sri Lanka	24	19	1.2	1.5	30	13	31	280	7.9	20.6	234	1.0	14
Sudan	764	664	0.8	0.9	14	13	13	17	5.1	4.6	20	0.0	1
Swaziland	5	6	–0.9	–0.9	4	7	3	11	0.1	3.1	7	0.0	0
Sweden	274	275	0.0	0.0	1	3	12	3	0.3	10.4	4,622	4.9	477
Switzerland	12	12	–0.4	–0.4	2	2	11	3	0.2	28.6	2,146	0.0	0
Syrian Arab Republic	4	5	–1.5	–1.3	16	13	27	0	0.9	0.7	9	1.3	4
Tajikistan	*4*	4	0.0	0.0	8	9	8	14	0.7	13.7	15	0.0	0
Tanzania	414	344	1.0	1.1	34	40	138	240	14.8	38.8	537	12.5	17
Thailand	160	144	0.7	0.4	57	44	50	86	8.0	20.4	206	3.9	19
Timor-Leste	10	8	1.2	1.4	4	5	5	0	0.6	14.6	6	0.0	0
Togo	7	3	3.4	4.7	10	2	16	10	0.3	11.1	90	0.2	1
Trinidad and Tobago	2	2	0.3	0.2	2	2	19	1	2.2	35.0	64	0.3	13
Tunisia	6	11	–4.1	–1.9	14	8	20	0	0.5	1.5	36	0.2	4
Turkey	97	102	–0.4	–0.2	17	15	60	3	6.2	1.9	236	2.8	13
Turkmenistan	*41*	41	0.0	0.0	9	15	12	3	1.8	2.6	18	0.0	0
Uganda	49	35	1.9	2.3	21	18	54	38	2.8	26.1	732	0.0	0
Ukraine	*93*	96	–0.2	–0.1	11	12	20	1	0.5	3.4	5,197	4.3	15
United Arab Emirates	2	3	–2.4	–0.1	7	8	9	0	0.2	0.3	10	0.1	3
United Kingdom	26	29	–0.7	–0.4	5	2	34	14	3.5	22.3	778	4.6	149
United States	2,986	3,034	–0.1	–0.1	37	74	164	244	94.2	27.1	6,770	67.6	787
Uruguay	9	15	–4.5	–1.3	10	24	28	1	1.2	0.4	20	0.1	4
Uzbekistan	*31*	33	–0.4	–0.5	11	15	8	15	1.1	1.9	13	0.0	0
Venezuela, RB	520	471	0.6	0.6	32	26	29	69	25.3	71.3	231	10.9	19
Vietnam	94	134	–2.3	–1.9	54	39	33	147	12.1	5.6	116	1.4	36
West Bank and Gaza	..	0[c]	..	0.0	3	7	1	0	..	0.0	0	0.0	0
Yemen, Rep.	5	5	0.0	0.0	9	13	18	159	3.2	0.3	3	2.7	1
Zambia	491	416	0.9	1.0	8	12	10	8	3.8	41.1	625	0.0	0
Zimbabwe	222	169	1.5	1.7	8	11	3	17	1.9	15.8	240	0.0	0
World	**40,678 s**	**39,280 s**	**0.2 w**	**0.2 w**	**1,141**	**1,222**	**1,275**	**8,457**		**14.4 w**	**112,355 s**	**1.7 w**	**4,949 s**
Low income	5,221	4,635	0.7	0.7						11.9	3,970	0.2	121
Middle income	25,888	24,955	0.2	0.2						12.9	33,010	0.9	1,484
Lower middle income	8,016	7,725	0.3	0.1						11.2	11,729	1.3	791
Upper middle income	17,872	17,230	0.2	0.2						14.0	21,281	0.6	693
Low & middle income	31,109	29,591	0.3	0.3						12.7	36,980	0.8	1,605
East Asia & Pacific	4,580	4,525	0.3	–0.2						14.7	4,044	1.8	754
Europe & Central Asia	8,812	8,837	0.0	0.0						7.8	21,825	0.4	84
Latin America & Carib.	9,834	9,052	0.5	0.5						22.8	3,801	1.6	422
Middle East & N. Africa	200	212	–0.4	–0.3						3.8	313	0.1	53
South Asia	789	799	–0.2	0.1						5.5	996	0.1	143
Sub-Saharan Africa	6,894	6,165	0.7	0.6						12.4	6,001	0.1	149
High income	9,569	9,689	–0.1	–0.1						19.1	75,375	4.3	3,344
Euro area	843	947	–0.7	–0.6						17.1	28,025	1.0	277

a. Negative values indicate an increase in forest area. b. Flowering plants only. c. Less than 0.5. d. Data are from national sources.

Deforestation and biodiversity 3.4

About the data

Biological diversity is defined in terms of variability in genes, species, and ecosystems. A 2008 comprehensive assessment of world species shows that at least 1,141 of 5,487 known mammals are threatened with extinction. As threats to biodiversity mount, the international community is increasingly focusing on conserving diversity. Deforestation is a major cause of loss of biodiversity, and habitat conservation is vital for stemming this loss. Conservation efforts have focused on protecting areas of high biodiversity.

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

The number of threatened species is also an important measure of the immediate need for conservation in an area. Global analyses of the status of threatened species have been carried out for few groups of organisms. Only for mammals, birds, and amphibians has the status of virtually all known species been assessed. Threatened species are defined using the World Conservation Union's (IUCN) classification: *endangered* (in danger of extinction and unlikely to survive if causal factors continue operating) and *vulnerable* (likely to move into the endangered category in the near future if causal factors continue operating).

Unlike mammals, birds, and fish, it is difficult to accurately count plants. The number of plant species is highly debated. The *2008 IUCN Red List of Threatened Species*, the result of more than 20 years' work by botanists worldwide, is the most comprehensive list of threatened species on a global scale. Only 5 percent of plant species have been evaluated, and 70 percent of these are threatened with extinction. Plant species data may not be comparable across countries because of differences in taxonomic concepts and coverage and so should be used with caution. However, the data identify countries that are major sources of global biodiversity and that show national commitments to habitat protection.

The Global Environment Facility's (GEF) benefits index for biodiversity is a comprehensive indicator of national biodiversity status and is used to guide its biodiversity priorities. The indicator incorporates information on individual species range maps available from the IUCN for virtually all mammals (5,487), amphibians (5,915), and endangered birds (1,098); country data from the World Resources Institute for reptiles and vascular plants; country data from FishBase for 31,190 fish species; and the ecological characteristics of 867 world terrestrial ecoregions from WWF International. For each country the biodiversity indicator incorporates the best available and comparable information in four relevant dimensions: represented species, threatened species, represented ecoregions, and threatened ecoregions. To combine these dimensions into one measure, the indicator uses dimensional weights that reflect the consensus of conservation scientists at the GEF, IUCN, WWF International, and other nongovernmental organizations.

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

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

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

Definitions

• **Forest area** is land under natural or planted stands of trees, whether productive or not. • **Average annual deforestation** is the permanent conversion of natural forest area to other uses, including agriculture, ranching, settlements, and infrastructure. It does not include areas logged but intended for regeneration or areas degraded by fuelwood gathering, acid precipitation, or forest fires. • **Threatened species** are species classified by the IUCN as endangered, vulnerable, rare, indeterminate, out of danger, or insufficiently known. Mammals exclude whales and porpoises. Birds are listed for the country where their breeding or wintering ranges are located. Fish are cold-blooded aquatic vertebrates of the superclass *Pisces*. Higher plants are native vascular plant species. • **GEF benefits index for biodiversity** is a composite index of relative biodiversity potential based on the species in each country and their threat status and diversity of habitat types. The index is normalized from 0 (no biodiversity potential) to 100 (maximum biodiversity potential). • **Nationally protected areas** are totally or partially protected areas of at least 1,000 hectares that are designated as scientific reserves with limited public access, national parks, natural monuments, nature reserves or wildlife sanctuaries, and protected landscapes. Terrestrial protected areas exclude marine areas, unclassified areas, littoral (intertidal) areas, and sites protected under local or provincial law. Marine protected areas are areas of intertidal or subtidal terrain—and overlying water and associated flora and fauna and historical and cultural features—that have been reserved to protect part of or the entire enclosed environment.

Data sources

Data on forest area are from the FAO's electronic files. The FAO gathers these data from national agencies through annual questionnaires and country official publications and websites and by analyzing national agricultural censuses. Data on species are from the electronic files of the United Nations Environment Programme (UNEP) and WCMC, the *2008 IUCN Red List of Threatened Species,* and Froese and Pauly's (2008) FishBase database. The GEF benefits index for biodiversity is from Pandey and others' "Biodiversity Conservation Indicators: New Tools for Priority Setting at the Global Environment Facility" (2006a). Data on protected areas are from the UNEP and WCMC, as compiled by the World Resources Institute, based on data from national authorities and national legislation and international agreements.

3.5 Freshwater

	Internal renewable freshwater resources[a]		Annual freshwater withdrawals					Water productivity	Access to an improved water source	
	Flows billion cu. m 2007	Per capita cu. m 2007	billion cu. m 2007	% of internal resources 2007	% for agriculture 2007	% for industry 2007	% for domestic 2007	GDP/water use 2000 $ per cu. m 2007	% of urban population 2006	% of rural population 2006
Afghanistan	55	..	23.3	42.3	98	0	2	..	..	..
Albania	27	8,588	1.7	6.4	62	11	27	36.2	97	97
Algeria	11	332	6.1	54.0	65	13	22	9.0	87	81
Angola	148	8,431	0.4	0.2	60	17	23	26.1	62	39
Argentina	276	6,989	29.2	10.6	74	9	17	9.7	98	80
Armenia	9	2,952	3.0	32.5	66	4	30	0.6	99	96
Australia	492	23,348	23.9	4.9	75	10	15	16.9	100	100
Austria	55	6,626	2.1	3.8	1	64	35	91.9	100	100
Azerbaijan	8	946	12.2	150.5	76	19	4	0.8	95	59
Bangladesh	105	666	79.4	75.6	96	1	3	0.6	85	78
Belarus	37	3,834	2.8	7.5	30	47	23	4.6	100	99
Belgium	12	1,129	..	..	..	..	..	..	100	..
Benin	10	1,227	0.1	1.3	45	23	32	18.2	78	57
Bolivia	304	31,868	1.4	0.5	81	7	13	5.8	96	69
Bosnia and Herzegovina	36	9,395	..	..	..	..	..	..	100	98
Botswana	2	1,268	0.2	8.1	41	18	41	31.8	100	90
Brazil	5,418	28,498	59.3	1.1	62	18	20	10.9	97	58
Bulgaria	21	2,742	10.5	50.0	19	78	3	1.2	100	97
Burkina Faso	13	849	0.8	6.4	86	1	13	3.3	97	66
Burundi	10	1,283	0.3	2.9	77	6	17	2.5	84	70
Cambodia	121	8,417	4.1	3.4	98	0	1	0.9	80	61
Cameroon	273	14,630	1.0	0.4	74	8	18	10.2	88	47
Canada	2,850	86,426	46.0	1.6	12	69	20	15.8	100	99
Central African Republic	141	33,119	0.0	0.0	4	16	80	38.4	90	51
Chad	15	1,412	0.2	1.5	83	0	17	6.0	71	40
Chile	884	53,137	12.6	1.4	64	25	11	6.0	98	72
China	2,812	2,134	630.3	22.4	68	26	7	1.9	98	81
Hong Kong SAR, China	..	..	..	..	..	..	..	..	..	..
Colombia	2,112	47,611	10.7	0.5	46	4	50	8.8	99	77
Congo, Dem. Rep.	900	14,395	0.4	0.0	31	17	53	12.0	82	29
Congo, Rep.	222	62,516	0.0	0.0	9	22	70	76.0	95	35
Costa Rica	112[b]	25,209[b]	2.7	2.4	53	17	29	6.0	99	96
Côte d'Ivoire	77	3,819	0.9	1.2	65	12	24	11.2	98	66
Croatia	38	8,493	..	..	..	..	..	..	100	98
Cuba	38	3,402	8.2	21.5	69	12	19	..	95	78
Czech Republic	13	1,272	2.6	19.6	2	57	41	22.0	100	100
Denmark	6	1,099	1.3	21.2	43	25	32	126.0	100	100
Dominican Republic	21	2,139	3.4	16.1	66	2	32	7.1	97	91
Ecuador	432	32,379	17.0	3.9	82	5	12	0.9	98	91
Egypt, Arab Rep.	2	22	68.3	3,794.4	86	6	8	1.5	99	98
El Salvador	18	2,907	1.3	7.2	59	16	25	10.3	94	68
Eritrea	3[b]	586[b]	0.6	20.8	95	0	5	1.2	74	57
Estonia	13	9,475	0.2	1.2	5	38	57	35.6	100	99
Ethiopia	122[b]	1,551[b]	5.6	4.6	94	0	6	1.6	96	31
Finland	107	20,232	2.5	2.3	3	84	14	49.2	100	100
France	179	2,882	40.0	22.4	10	74	16	33.2	100	100
Gabon	164	115,340	0.1	0.1	42	8	50	42.2	95	47
Gambia, The	3	1,857	0.0	1.0	65	12	23	13.8	91	81
Georgia	58	13,339	1.6	2.8	65	13	22	2.7	100	97
Germany	107	1,301	47.1	44.0	20	68	12	40.4	100	100
Ghana	30	1,325	1.0	3.2	66	10	24	5.1	90	71
Greece	58	5,182	7.8	13.4	80	3	16	16.2	100	99
Guatemala	109	8,177	2.0	1.8	80	13	6	9.6	99	94
Guinea	226	23,505	1.5	0.7	90	2	8	2.1	91	59
Guinea-Bissau	16	10,383	0.2	1.1	82	5	13	1.2	82	47
Haiti	13	1,338	1.0	7.6	94	1	5	3.7	70	51
Honduras	96	13,372	0.9	0.9	80	12	8	8.3	95	74

3.5 Freshwater

	Internal renewable freshwater resources[a]		Annual freshwater withdrawals					Water productivity	Access to an improved water source	
	Flows billion cu. m 2007	Per capita cu. m 2007	billion cu. m 2007	% of internal resources 2007	% for agriculture 2007	% for industry 2007	% for domestic 2007	GDP/water use 2000 $ per cu. m 2007	% of urban population 2006	% of rural population 2006
Hungary	6	597	7.6	127.3	32	59	9	6.3	100	100
India	1,261	1,121	645.8	51.2	86	5	8	0.7	96	86
Indonesia	2,838	12,578	82.8	2.9	91	1	8	2.0	89	71
Iran, Islamic Rep.	129	1,809	93.3	72.6	92	1	7	1.4	99	84
Iraq	35	..	66.0	187.5	79	15	7	0.4	..	..
Ireland	49	11,246	1.1	2.3	0	77	23	85.3	100	..
Israel	1	104	2.0	260.5	58	6	36	67.6	100	100
Italy	183	3,074	44.4	24.3	45	37	18	24.7	100	..
Jamaica	9	3,514	0.4	4.4	49	17	34	22.0	97	88
Japan	430	3,365	88.4	20.6	62	18	20	52.8	100	100
Jordan	1	119	0.9	138.0	65	4	31	12.2	99	91
Kazakhstan	75	4,871	35.0	46.4	82	17	2	0.5	99	91
Kenya	21	548	2.7	13.2	79	4	17	5.0	85	49
Korea, Dem. Rep.	67	2,824	9.0	13.5	55	25	20	..	100	100
Korea, Rep.	65	1,338	18.6	28.7	48	16	36	28.7	97	71
Kosovo	..	..	..	..	..	..	..	..	..	..
Kuwait	..	..	0.9	..	54	2	44	42.9	..	..
Kyrgyz Republic	46	8,873	10.1	21.7	94	3	3	0.1	99	83
Lao PDR	190	31,256	3.0	1.6	90	6	4	0.6	86	53
Latvia	17	7,355	0.3	1.8	13	33	53	26.1	100	96
Lebanon	5	1,153	1.3	27.3	60	11	29	15.9	100	100
Lesotho	5	2,574	0.1	1.0	20	40	40	15.7	93	74
Liberia	200[b]	55,138[b]	0.1	0.1	55	18	27	5.1	72	52
Libya	1	97	4.3	721.0	83	3	14	7.8	72	68
Lithuania	16	4,610	0.3	1.7	7	15	78	42.3	..	..
Macedonia, FYR	5	2,647	..	..	..	..	..	..	100	99
Madagascar	337	18,114	15.0	4.4	96	2	3	0.3	76	36
Malawi	16[b]	1,118[b]	1.0	6.3	80	5	15	1.7	96	72
Malaysia	580	21,841	9.0	1.6	62	21	17	10.4	100	96
Mali	60	4,835	6.5	10.9	90	1	9	0.4	86	48
Mauritania	0[c]	127	1.7	425.0	88	3	9	0.6	70	54
Mauritius	3	2,182	0.7	26.4	68	3	30	6.9	100	100
Mexico	409	3,885	78.2	19.1	77	5	17	7.4	98	85
Moldova	1	273	2.3	231.0	33	58	10	0.6	96	85
Mongolia	35	13,326	0.4	1.3	52	27	20	2.5	90	48
Morocco	29	940	12.6	43.4	87	3	10	2.9	100	58
Mozambique	100	4,586	0.6	0.6	87	2	11	6.7	71	26
Myanmar	881	17,924	33.2	3.8	98	1	1	..	80	80
Namibia	6	2,949	0.3	4.9	71	5	24	13.0	99	90
Nepal	198	7,007	10.2	5.1	96	1	3	0.5	94	88
Netherlands	11	671	7.9	72.2	34	60	6	48.5	100	100
New Zealand	327	77,336	2.1	0.6	42	9	48	24.1	100	..
Nicaragua	190	33,912	1.3	0.7	83	2	15	3.0	90	63
Niger	4	248	2.2	62.3	95	0	4	0.8	91	32
Nigeria	221	1,496	8.0	3.6	69	10	21	5.7	65	30
Norway	382	81,119	2.2	0.6	11	67	23	76.8	100	100
Oman	1	514	1.3	94.4	88	1	10	16.6	85	73
Pakistan	55[b]	338[b]	169.4	308.0	96	2	2	0.4	95	87
Panama	147	44,094	0.8	0.6	28	5	67	14.2	96	81
Papua New Guinea	801	124,716	0.1	0.0	1	42	56	49.6	88	32
Paraguay	94	15,343	0.5	0.5	71	8	20	14.4	94	52
Peru	1,616	56,685	20.1	1.2	82	10	8	2.6	92	63
Philippines	479	5,399	28.5	6.0	74	9	17	2.7	96	88
Poland	54	1,406	16.2	30.2	8	79	13	10.6	100	..
Portugal	38	3,582	11.3	29.6	78	12	10	10.0	99	100
Puerto Rico	7	1,802	..	..	..	..	..	..	..	..
Qatar	0.1	45	0.4	870.6	59	2	39	58.7	100	100

3.5 Freshwater

	Internal renewable freshwater resources[a]		Annual freshwater withdrawals					Water productivity	Access to an improved water source	
	Flows billion cu. m 2007	Per capita cu. m 2007	billion cu. m 2007	% of internal resources 2007	% for agriculture 2007	% for industry 2007	% for domestic 2007	GDP/water use 2000 $ per cu. m 2007	% of urban population 2006	% of rural population 2006
Romania	42	1,963	*23.2*	54.8	*57*	*34*	*9*	*1.6*	99	76
Russian Federation	4,313	30,350	*76.7*	1.8	*18*	*63*	*19*	*3.4*	100	88
Rwanda	10[b]	1,005[b]	*0.2*	1.6	*68*	*8*	*24*	*11.6*	82	61
Saudi Arabia	2	99	*23.7*	986.1	*88*	*3*	*9*	*9.9*	97	..
Senegal	26[b]	2,169[b]	*2.2*	*8.6*	*93*	*3*	*4*	*2.2*	93	65
Serbia	44[d]	*5,419*[d]	..	..	..	..	..	..	99[e]	..
Sierra Leone	160[b]	29,518[b]	*0.4*	0.2	*92*	*3*	*5*	*1.7*	83	32
Singapore	1	131	..	..	..	..	..	..	100	..
Slovak Republic	13	2,334	..	..	..	..	..	..	100	100
Slovenia	19	9,251	..	..	..	..	..	..	..	..
Somalia	6	687	*3.3*	55.0	*99*	*0*	*0*	..	63	10
South Africa	45	936	*12.5*	27.9	*63*	*6*	*31*	*10.6*	100	82
Spain	111	2,478	*35.6*	32.0	*68*	*19*	*13*	*16.3*	100	100
Sri Lanka	50	2,499	*12.6*	25.2	*95*	*2*	*2*	*1.3*	98	79
Sudan	30	742	*37.3*	124.4	*97*	*1*	*3*	*0.3*	78	64
Swaziland	3	2,293	*1.0*	39.5	*97*	*1*	*2*	*1.4*	87	51
Sweden	171	18,692	*3.0*	1.7	*9*	*54*	*37*	*83.0*	100	100
Switzerland	40	5,350	*2.6*	6.4	*2*	*74*	*24*	*97.2*	100	100
Syrian Arab Republic	7	349	*16.7*	*238.4*	*88*	*4*	*9*	*1.3*	95	83
Tajikistan	66	9,855	*12.0*	18.0	*92*	*5*	*4*	*0.1*	93	58
Tanzania	84	2,035	*5.2*	6.2	*89*	*0*	*10*	*2.0*	81	46
Thailand	210	3,135	*87.1*	41.5	*95*	*2*	*2*	*1.4*	99	97
Togo	12	1,825	*0.2*	*1.5*	*45*	*2*	*53*	*8.2*	86	40
Trinidad and Tobago	4	2,891	*0.3*	8.1	*6*	*26*	*68*	*26.3*	97	93
Tunisia	4	410	*2.6*	62.9	*82*	*4*	*14*	*7.4*	99	84
Turkey	227	3,109	*40.1*	17.7	*74*	*11*	*15*	*7.0*	98	95
Turkmenistan	1	273	*24.7*	1,812.5	*98*	*1*	*2*	*0.1*	..	..
Uganda	39	1,273	..	..	..	..	..	..	90	60
Ukraine	53	1,142	*37.5*	70.7	*52*	*35*	*12*	*0.8*	97	97
United Arab Emirates	0	34	4.0	2,665.3	83	2	15	24.5	100	100
United Kingdom	145	2,377	*9.5*	6.6	*3*	*75*	*22*	*152.1*	100	100
United States	2,800	9,293	*479.3*	17.1	*41*	*46*	*13*	*20.4*	100	94
Uruguay	59	17,750	*3.2*	5.3	*96*	*1*	*3*	*7.2*	100	100
Uzbekistan	16	608	*58.3*	357.0	*93*	*2*	*5*	*0.2*	98	82
Venezuela, RB	722	26,287	*8.4*	1.2	*47*	*7*	*46*	*14.0*	..	..
Vietnam	367	4,304	*71.4*	19.5	*68*	*24*	*8*	*0.4*	98	90
West Bank and Gaza	..	..	..	..	..	..	..	..	90	88
Yemen, Rep.	2	94	*3.4*	161.9	*90*	*2*	*8*	*2.8*	68	65
Zambia	80	6,513	*1.7*	2.2	*76*	*7*	*17*	*1.9*	90	41
Zimbabwe	12	985	*4.2*	*34.3*	*79*	*7*	*14*	*1.6*	98	72
World	**43,464 s**	**6,616 w**	**3,765.3 w**	**9.0 w**	**70 w**	**20 w**	**10 w**	**8.3 w**	**96 w**	**77 w**
Low income	4,784	5,004	357.3	7.9	88	6	5	1.2	86	60
Middle income	29,126	6,350	2,518.2	8.8	77	14	9	2.9	95	81
Lower middle income	11,525	3,154	2,039.5	18.1	81	12	7	1.7	94	81
Upper middle income	17,601	18,876	478.7	2.7	58	25	17	15.9	98	82
Low & middle income	33,910	6,118	2,875.5	8.7	78	13	8	2.9	94	76
East Asia & Pacific	9,454	4,938	959.0	10.2	74	20	7	1.9	96	81
Europe & Central Asia	5,129	11,867	356.5	7.2	60	30	10	1.0	99	88
Latin America & Carib.	13,425	24,004	264.9	2.0	71	10	19	7.8	97	73
Middle East & N. Africa	225	715	253.2	122.3	86	6	8	14.4	95	81
South Asia	1,819	1,194	941.1	51.7	90	4	6	0.7	94	84
Sub-Saharan Africa	3,858	4,829	100.8	3.2	87	3	10	1.2	81	46
High income	9,554	9,305	..	10.4	43	42	15	27.9	100	98
Euro area	942	2,905	200.0	22.3	38	48	15	29.8	100	100

a. Excludes river flows from other countries because of data unreliability. b. Food and Agriculture Organization estimates. c. Less than 0.5. d. Includes Montenegro. e. Includes Kosovo and Metohija.

About the data

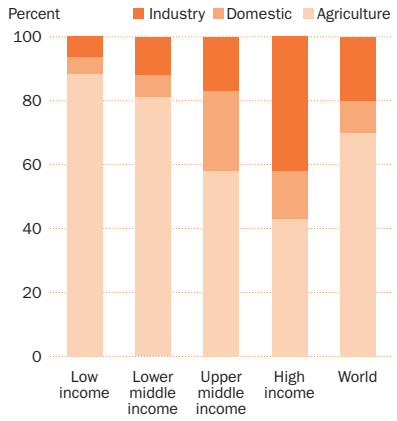
The data on freshwater resources are based on estimates of runoff into rivers and recharge of groundwater. These estimates are based on different sources and refer to different years, so cross-country comparisons should be made with caution. Because the data are collected intermittently, they may hide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

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

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

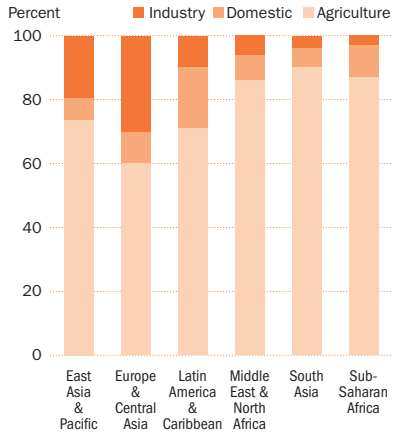
The data on access to an improved water source measure the percentage of the population with ready access to water for domestic purposes. The data are based on surveys and estimates provided by governments to the Joint Monitoring Programme of the World Health Organization (WHO) and the United Nations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

Agriculture is still the largest user of water, accounting for some 70 percent of global withdrawals in 2007 . . . 3.5a



Source: Table 3.5.

. . . and approaching 90 percent in some developing regions in 2007 3.5b



Source: Table 3.5.

Definitions

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

Data sources

Data on freshwater resources and withdrawals are from the Food and Agriculture Organization of the United Nations AQUASTAT data. The GDP estimates used to calculate water productivity are from the World Bank national accounts database. Data on access to water are from WHO and UNICEF's *Progress on Drinking Water and Sanitation* (2008).

3.6 Water pollution

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	thousand kilograms per day		kilograms per day per worker		% of total							
	1990	2006[a]	1990	2006[a]	Primary metals 2006[a]	Paper and pulp 2006[a]	Chemicals 2006[a]	Food and beverages 2006[a]	Stone, ceramics, and glass 2006[a]	Textiles 2006[a]	Wood 2006[a]	Other 2006[a]
Afghanistan	5.9	0.2	0.16	0.21	..	19.7	27.9	14.1	11.7	23.3	..	3.1
Albania	2.4	3.6	0.25	0.25	0.0	0.0	0.0	39.8	0.0	60.2	0.0	0.0
Algeria	107.0	..	0.25	..	..	..	..	..	..	..	..	..
Angola	4.5	..	0.19	..	..	..	..	..	..	..	..	..
Argentina	181.4	155.5	0.21	0.23	3.8	8.4	15.8	30.5	3.5	14.3	2.1	21.6
Armenia	37.9	7.1	0.11	0.28	..	..	..	77.6	..	22.4	..	..
Australia	186.1	111.7	0.18	0.18	12.4	22.8	6.7	43.5	0.2	5.3	2.8	6.3
Austria	90.5	84.8	0.15	0.14	5.7	7.1	9.2	12.5	5.9	4.5	5.9	49.0
Azerbaijan	41.3	18.8	0.15	0.18	9.7	2.5	18.7	19.0	6.5	13.6	1.4	28.5
Bangladesh	250.8	303.0	0.15	0.14	0.7	2.3	3.0	7.6	2.6	79.3	0.5	4.2
Belarus	..	..	..	..	..	..	..	..	..	..	..	..
Belgium	107.8	97.9	0.17	0.17	6.4	7.8	17.3	15.7	5.5	6.9	2.2	38.3
Benin	..	..	..	..	..	..	..	..	..	..	..	..
Bolivia	11.3	11.5	0.24	0.25	0.9	9.8	13.1	35.4	7.7	18.4	5.3	9.5
Bosnia and Herzegovina	50.7	..	0.14	..	..	..	..	..	..	..	..	..
Botswana	2.5	5.0	0.30	0.28	0.0	2.4	0.0	56.7	0.6	3.4	0.0	36.9
Brazil	780.4	..	0.19	..	..	..	..	..	..	..	..	..
Bulgaria	124.3	101.2	0.17	0.17	3.8	4.3	7.6	18.0	4.6	28.0	3.0	30.6
Burkina Faso	..	..	..	..	..	..	..	..	..	..	..	..
Burundi	1.6	..	0.24	..	..	..	..	..	..	..	..	..
Cambodia	3.6	..	0.21	..	..	..	..	..	..	..	..	..
Cameroon	14.0	10.0	0.28	0.19	0.4	5.2	36.1	48.8	0.0	3.8	5.0	0.8
Canada	300.9	310.3	0.17	0.16	4.4	9.1	10.6	13.9	2.8	7.9	6.7	44.6
Central African Republic	1.0	..	0.18	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	..	92.5	..	0.25	7.6	6.3	13.7	35.1	3.6	9.1	6.9	17.7
China	7,038.1	6,088.7	0.14	0.14	20.4	10.9	14.8	28.1	0.5	15.5	0.9	8.8
Hong Kong SAR, China	86.1	34.3	0.12	0.20	1.2	43.5	3.9	30.5	0.1	16.2	0.2	4.6
Colombia	..	87.0	..	0.20	2.3	8.9	17.3	21.3	5.3	24.1	0.9	19.9
Congo, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Congo, Rep.	2.5	..	0.32	..	..	..	..	..	..	..	..	..
Costa Rica	27.2	31.2	0.20	0.22	1.6	10.0	8.2	65.7	0.1	10.2	1.3	2.9
Côte d'Ivoire	7.9	..	0.22	..	..	..	..	..	..	..	..	..
Croatia	48.5	41.8	0.17	0.17	3.2	7.2	9.5	18.0	5.9	15.3	4.8	36.0
Cuba	173.0	..	0.25	..	..	..	..	..	..	..	..	..
Czech Republic	176.8	146.5	0.15	0.13	5.4	4.8	10.9	10.9	6.4	7.4	4.4	49.8
Denmark	84.5	60.5	0.18	0.16	1.4	11.3	12.4	16.2	4.4	2.2	4.0	48.1
Dominican Republic	88.6	88.6	0.18	0.18	0.1	1.3	2.3	18.6	1.4	73.1	0.1	3.1
Ecuador	28.6	44.7	0.24	0.28	1.8	7.8	12.8	46.4	4.4	12.3	2.2	12.3
Egypt, Arab Rep.	206.5	206.5	0.19	0.19	5.8	4.0	13.9	20.0	8.2	31.1	0.6	16.4
El Salvador	5.5	..	0.22	..	..	..	..	..	..	..	..	..
Eritrea	2.4	2.8	0.19	0.20	0.2	4.1	9.5	30.0	13.2	25.1	0.0	17.8
Estonia	21.7	16.4	0.15	0.15	0.4	7.3	8.4	15.1	5.1	8.8	17.0	37.9
Ethiopia	18.5	26.8	0.23	0.23	1.8	6.8	10.6	30.7	8.5	28.8	1.5	11.3
Finland	72.5	61.6	0.19	0.16	4.8	15.6	8.6	8.8	4.0	2.8	6.7	48.7
France	326.5	578.2	0.11	0.16	3.3	7.4	15.0	16.2	3.8	5.1	2.3	46.9
Gabon	2.0	..	0.25	..	..	..	..	..	..	..	..	..
Gambia, The	0.8	..	0.34	..	..	..	..	..	..	..	..	..
Georgia	..	..	..	..	..	..	..	..	..	..	..	..
Germany	1,020.9	954.2	0.14	0.14	3.8	7.2	12.0	11.8	3.4	2.5	2.0	57.4
Ghana	..	15.4	..	0.17	3.1	2.8	15.0	19.2	4.2	10.0	34.3	11.4
Greece	50.9	58.6	0.19	0.20	4.4	9.0	10.3	23.1	6.7	15.3	2.7	28.6
Guatemala	21.6	..	0.23	..	..	..	..	..	..	..	..	..
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	0.1	0.0	0.01	0.01	0.0	2.0	0.0	0.0	0.0	0.0	0.0	98.0
Honduras	17.8	..	0.23	..	..	..	..	..	..	..	..	..

Water pollution 3.6

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	thousand kilograms per day		kilograms per day per worker		% of total							
	1990	2006[a]	1990	2006[a]	Primary metals 2006[a]	Paper and pulp 2006[a]	Chemicals 2006[a]	Food and beverages 2006[a]	Stone, ceramics, and glass 2006[a]	Textiles 2006[a]	Wood 2006[a]	Other 2006[a]
Hungary	122.1	115.1	0.18	0.15	2.7	6.4	10.5	15.8	3.8	10.5	3.4	46.9
India	1,410.6	1,519.8	0.20	0.20	12.2	7.6	9.2	53.7	0.3	12.7	0.3	3.9
Indonesia	721.8	764.0	0.18	0.18	1.3	4.0	13.0	21.5	3.9	29.0	7.4	19.8
Iran, Islamic Rep.	131.6	160.8	0.16	0.15	7.1	2.8	12.8	16.1	13.8	11.2	0.7	35.5
Iraq	7.7	7.7	0.27	0.27	13.1	25.6	29.9	16.9	5.4	9.1	..	..
Ireland	36.1	34.1	0.19	0.18	1.3	10.1	17.2	21.6	5.8	1.9	3.5	38.6
Israel	43.9	42.8	0.18	0.18	2.2	8.5	15.0	19.7	0.0	9.1	1.5	43.9
Italy	378.3	475.8	0.13	0.12	3.5	5.2	10.5	9.0	5.5	14.2	2.9	49.2
Jamaica	18.7	..	0.29	..	..	..	..	..	..	..	..	..
Japan	1,451.4	1,122.7	0.14	0.15	3.2	7.1	11.2	15.1	3.6	5.3	2.0	52.6
Jordan	15.0	27.2	0.18	0.18	2.5	6.1	14.7	21.6	11.6	16.8	2.6	24.2
Kazakhstan	1.3	1.7	0.40	0.41	0.0	50.0	0.0	47.6	0.0	0.0	0.0	2.4
Kenya	42.6	56.1	0.23	0.24	..	11.5	5.4	66.8	0.1	12.8	1.7	1.8
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Korea, Rep.	366.9	319.6	0.12	0.11	4.2	5.4	12.1	6.3	3.0	9.3	0.9	58.9
Kosovo	..	..	..	..	..	..	..	..	..	..	..	..
Kuwait	9.1	11.9	0.16	0.17	2.1	16.6	11.1	50.2	0.4	11.6	2.8	5.2
Kyrgyz Republic	28.9	11.8	0.14	0.20	8.6	6.0	8.4	24.8	14.9	11.8	1.8	23.7
Lao PDR	0.5	0.5	0.44	0.44	0.0	26.3	0.0	73.7	0.0	0.0	0.0	0.0
Latvia	39.8	29.3	0.12	0.18	2.6	6.8	5.6	21.9	3.7	12.6	19.7	27.2
Lebanon	14.7	14.7	0.19	0.19	0.5	7.5	6.0	25.5	12.9	16.7	4.5	26.3
Lesotho	..	15.3	..	0.13	0.9	0.5	1.2	3.6	1.2	90.7	..	1.9
Liberia	0.6	..	0.30	..	..	..	..	..	..	..	..	..
Libya	..	..	..	..	..	..	..	..	..	..	..	..
Lithuania	54.0	42.6	0.15	0.17	0.8	5.2	7.6	20.0	4.4	19.3	11.5	31.2
Macedonia, FYR	32.4	..	0.18	..	..	..	..	..	..	..	..	..
Madagascar	..	92.8	..	0.14	0.3	1.6	12.4	7.6	2.8	58.9	6.3	10.0
Malawi	37.2	32.7	0.40	0.39	..	1.4	3.7	82.1	0.6	7.5	1.1	3.6
Malaysia	..	208.4	..	0.13	2.9	5.2	16.2	9.5	3.9	6.8	7.9	47.5
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	0.3	0.4	0.05	0.06	0.0	13.7	0.0	0.0	..	0.0	0.0	86.3
Mexico	370.8	..	0.19	..	..	..	..	..	..	..	..	..
Moldova	29.2	21.1	0.44	0.45	0.0	3.3	0.0	95.7	0.0	0.0	..	1.0
Mongolia	10.2	..	0.18	..	..	..	..	..	..	..	..	..
Morocco	..	80.4	..	0.16	1.0	2.8	8.7	17.6	9.4	42.0	1.9	16.6
Mozambique	20.4	10.2	0.27	0.31	1.1	7.1	2.7	81.2	0.1	5.8	1.4	0.7
Myanmar	7.7	6.2	0.17	0.18	56.5	4.6	13.2	14.9	0.4	2.9	1.7	5.8
Namibia	7.4	..	0.35	..	..	..	..	..	..	..	..	..
Nepal	26.4	26.8	0.14	0.16	1.6	3.9	7.2	19.2	29.9	29.4	2.0	6.8
Netherlands	142.3	122.1	0.20	0.18	1.2	13.8	14.8	18.4	4.1	2.6	2.5	42.5
New Zealand	46.7	62.5	0.24	0.23	2.1	12.7	8.6	30.6	3.2	6.1	7.8	28.9
Nicaragua	10.5	..	0.27	..	..	..	..	..	..	..	..	..
Niger	..	0.4	..	0.32	..	17.0	4.4	76.9	0.3	..	0.8	0.6
Nigeria	70.8	..	0.22	..	..	..	..	..	..	..	..	..
Norway	51.8	50.5	0.20	0.20	5.1	14.3	7.5	20.9	4.0	2.1	5.6	40.5
Oman	3.8	6.6	0.15	0.17	4.3	5.1	16.3	21.6	23.7	5.2	2.1	21.6
Pakistan	104.1	..	0.18	..	..	..	..	..	..	..	..	..
Panama	10.3	13.7	0.30	0.32	0.9	11.7	7.0	55.7	4.0	4.8	1.7	14.2
Papua New Guinea	5.7	..	0.25	..	..	..	..	..	..	..	..	..
Paraguay	15.3	10.8	0.20	0.28	3.1	9.3	16.7	42.6	5.9	11.0	4.5	6.9
Peru	56.1	..	0.20	..	..	..	..	..	..	..	..	..
Philippines	118.4	97.9	0.26	0.23	5.8	6.3	13.2	33.1	6.2	3.1	0.0	32.4
Poland	446.7	364.5	0.16	0.16	3.1	5.2	11.1	18.8	5.4	11.0	4.8	40.6
Portugal	140.6	105.0	0.14	0.15	1.7	7.2	6.6	15.1	5.0	19.1	6.8	38.5
Puerto Rico	19.0	9.2	0.15	0.18	1.9	14.9	21.9	34.4	0.2	15.5	1.4	9.7
Qatar	..	3.7	..	0.12	5.6	1.3	17.2	10.7	29.7	2.2	20.4	12.8

3.6 Water pollution

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	thousand kilograms per day		kilograms per day per worker		% of total							
	1990	2006[a]	1990	2006[a]	Primary metals 2006[a]	Paper and pulp 2006[a]	Chemicals 2006[a]	Food and beverages 2006[a]	Stone, ceramics, and glass 2006[a]	Textiles 2006[a]	Wood 2006[a]	Other 2006[a]
Romania	411.2	228.1	0.12	0.15	4.6	3.4	6.7	13.4	3.9	27.4	5.1	35.4
Russian Federation	*1,521.4*	1,388.1	*0.16*	0.17	9.0	5.0	11.9	17.8	8.0	6.6	4.2	37.7
Rwanda	*7.1*	*7.1*	*0.44*	*0.44*	..	..	*0.0*	*97.0*	*0.0*	*0.0*	*0.0*	*3.0*
Saudi Arabia	..	6.8	..	0.39	0.0	96.9	0.0	0.5	0.0	0.0	0.0	2.6
Senegal	*6.1*	*6.6*	*0.30*	*0.29*	*4.9*	*6.3*	*23.8*	*44.6*	*3.9*	*10.5*	*0.8*	*5.3*
Serbia	..	..	..	..	..	..	..	..	..	..	..	..
Sierra Leone	*4.2*	..	*0.32*	..	..	..	..	..	..	..	..	..
Singapore	*32.3*	35.3	*0.09*	0.09	0.0	5.8	11.4	5.3	1.4	2.4	0.4	73.3
Slovak Republic	*72.8*	*51.4*	*0.13*	*0.14*	*7.6*	*4.8*	*8.8*	*10.7*	*5.9*	*11.5*	*3.9*	*46.8*
Slovenia	*28.1*	28.2	*0.13*	0.13	4.5	6.4	11.9	8.1	3.5	11.4	4.9	49.3
Somalia	*6.2*	..	*0.38*	..	..	..	..	..	..	..	..	..
South Africa	*260.5*	191.6	*0.17*	0.16	5.8	7.0	11.4	14.7	5.2	11.9	4.3	39.6
Spain	*348.0*	*379.7*	*0.16*	*0.15*	*3.1*	*7.9*	*10.8*	*15.2*	*7.9*	*9.0*	*3.7*	*42.4*
Sri Lanka	..	266.1	..	0.19	2.6	4.3	9.0	22.4	6.3	43.6	2.5	9.3
Sudan	..	*38.6*	..	*0.29*	*0.6*	*1.9*	*7.0*	*57.5*	*14.2*	*8.0*	*1.7*	*9.1*
Swaziland	*146.0*	..	*0.16*	..	..	..	..	..	..	..	..	..
Sweden	116.8	*97.6*	0.15	*0.14*	*5.4*	*12.2*	*9.9*	*8.7*	*2.5*	*1.4*	*5.4*	*54.4*
Switzerland	..	..	..	..	..	..	..	..	..	..	..	..
Syrian Arab Republic	*6.6*	*4.5*	*0.45*	*0.45*	*0.0*	*6.2*	*0.0*	*93.8*	*0.0*	*0.0*	*0.0*	*0.0*
Tajikistan	29.1	*16.1*	0.17	*0.23*	*21.9*	*1.4*	*5.1*	*20.2*	*7.6*	*37.5*	*0.4*	*5.9*
Tanzania	*31.1*	*35.2*	*0.24*	*0.25*	*1.5*	*9.4*	*2.7*	*69.3*	*0.1*	*14.0*	*1.5*	*1.4*
Thailand	*369.4*	*333.8*	*0.15*	*0.16*	*1.8*	*4.1*	*13.2*	*16.5*	*3.4*	*22.5*	*2.4*	*36.1*
Timor-Leste	..	..	..	..	..	..	..	..	..	..	..	..
Togo	..	..	..	..	..	..	..	..	..	..	..	..
Trinidad and Tobago	*7.0*	*7.6*	*0.23*	*0.29*	*0.0*	*18.1*	*21.4*	*39.1*	*0.4*	*7.6*	*8.5*	*4.9*
Tunisia	*44.6*	*55.8*	*0.18*	*0.14*	*2.5*	*6.1*	*5.5*	*35.8*	*0.4*	*43.3*	*1.9*	*4.6*
Turkey	*174.9*	*177.7*	*0.18*	*0.16*	*5.2*	*3.0*	*9.8*	*15.2*	*6.2*	*35.7*	*1.0*	*24.0*
Turkmenistan	..	..	..	..	..	..	..	..	..	..	..	..
Uganda	*3.3*	*17.5*	*0.29*	*0.26*	..	*4.6*	*7.9*	*44.5*	*0.0*	*14.4*	*16.8*	*11.7*
Ukraine	..	537.4	..	0.20	14.5	4.1	10.3	20.7	6.5	6.1	2.1	35.8
United Arab Emirates	*5.6*	..	*0.14*	..	..	..	..	..	..	..	..	..
United Kingdom	*599.9*	*521.7*	*0.16*	*0.17*	*2.7*	*12.5*	*13.5*	*14.9*	*3.6*	*4.3*	*2.5*	*46.1*
United States	*2,307.0*	*1,889.4*	*0.14*	*0.14*	*3.4*	*8.3*	*13.1*	*12.0*	*3.7*	*4.7*	*4.1*	*50.6*
Uruguay	*38.7*	*15.8*	*0.23*	*0.28*	*1.2*	*3.7*	*6.6*	*79.2*	*0.1*	*7.4*	*0.6*	*1.2*
Uzbekistan	..	..	..	..	..	..	..	..	..	..	..	..
Venezuela, RB	*96.5*	..	*0.21*	..	..	..	..	..	..	..	..	..
Vietnam	*141.0*	500.5	*0.16*	0.15	1.4	3.5	6.8	13.3	6.7	40.3	3.3	24.7
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	*1.5*	1.6	*0.43*	0.41	..	67.4	0.0	32.6	0.0	0.0	0.0	0.0
Zambia	*15.9*	..	*0.23*	..	..	..	..	..	..	..	..	..
Zimbabwe	*29.3*	*29.3*	*0.20*	*0.20*	*8.0*	*4.7*	*11.0*	*21.5*	*6.3*	*25.2*	*1.7*	*21.5*

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

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

The data in the table come from an international study of industrial emissions that may have been the first to include data from developing countries (Hettige, Mani, and Wheeler 1998). These data were updated through 2006 by the World Bank's Development Research Group. Unlike estimates from earlier studies based on engineering or economic models, these estimates are based on actual measurements of plant-level water pollution. The focus is on organic water pollution caused by organic waste, measured in terms of biochemical oxygen demand (BOD), because the data for this indicator are the most plentiful and reliable for cross-country comparisons of emissions. BOD measures the strength of an organic waste by the amount of oxygen consumed in breaking it down. A sewage overload in natural waters exhausts the water's dissolved oxygen content. Wastewater treatment, by contrast, reduces BOD.

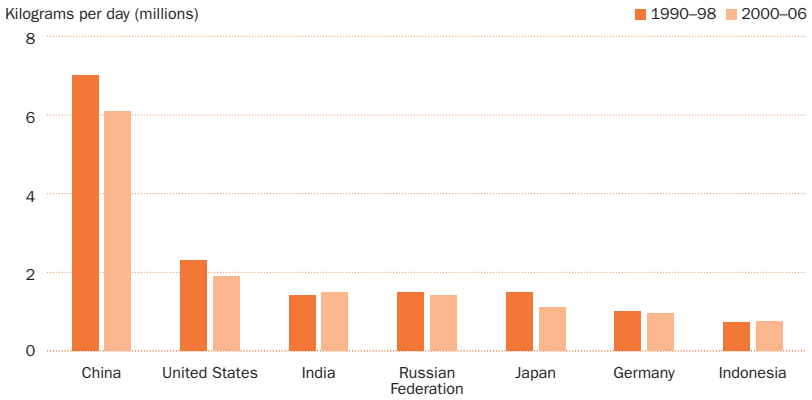
Data on water pollution are more readily available than are other emissions data because most industrial pollution control programs start by regulating emissions of organic water pollutants. Such data are fairly reliable because sampling techniques for measuring water pollution are more widely understood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

Hettige, Mani, and Wheeler (1998) used plant- and sector-level information on emissions and employment from 13 national environmental protection agencies and sector-level information on output and employment from the United Nations Industrial Development Organization (UNIDO). Their econometric analysis found that the ratio of BOD to employment in each industrial sector is about the same across countries. This finding allowed the authors to estimate BOD loads across countries and over time. The estimated BOD intensities per unit of employment were multiplied by sectoral employment numbers from UNIDO's industry database for 1980–98. These estimates of sectoral emissions were then used to calculate kilograms of emissions of organic water pollutants per day for each country and year. The data in the table were derived by updating these estimates through 2006.

Definitions

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

Emissions of organic water pollutants declined in most economies from 1990 to 2006, even in some of the top emitters **3.6a**



Note: Data are for the most recent year available during the period specified.

Source: Table 3.6.

Data sources

Data on water pollutants are from Hettige, Mani, and Wheeler, "Industrial Pollution in Economic Development: Kuznets Revisited" (1998). The data were updated through 2006 by the World Bank's Development Research Group using the same methodology as the initial study. Data on industrial sectoral employment are from UNIDO's industry database.

3.7 Energy production and use

	Energy production		Energy use									Alternative and nuclear energy production	
	Total million metric tons of oil equivalent		Total million metric tons of oil equivalent		average annual % growth	Per capita kilograms of oil equivalent		% of total Fossil fuel		% of total Combustible renewables and waste		% of total energy use	
	1990	2007	1990	2007	1990–2007	1990	2007	1990	2007	1990	2007	1990	2007
Afghanistan	..	..	..	..	..	..	..	..	..	..	..	..	..
Albania	2.4	1.1	2.7	2.2	2.0	809	694	76.5	67.8	13.6	9.9	9.2	11.1
Algeria	100.1	164.3	22.2	36.9	2.7	878	1,089	99.9	99.7	0.1	0.2	0.1	0.1
Angola	28.7	95.0	5.9	10.6	3.4	552	606	25.5	34.0	73.5	63.4	1.1	2.6
Argentina	48.4	81.9	46.1	73.1	2.1	1,418	1,850	88.7	89.5	3.7	3.5	7.5	6.2
Armenia	0.1	0.8	7.7	2.8	–3.7	2,171	926	97.2	70.7	0.1	0.0	1.7	29.0
Australia	157.5	289.2	86.2	124.1	2.3	5,053	5,888	93.9	94.4	4.6	4.3	1.5	1.3
Austria	8.1	10.9	24.8	33.2	2.0	3,214	3,997	79.2	72.6	10.0	15.4	11.0	10.3
Azerbaijan	21.3	52.1	25.8	11.9	–3.2	3,609	1,388	..	98.4	0.0	0.0	0.2	1.7
Bangladesh	10.8	21.3	12.7	25.8	4.5	110	163	45.5	66.2	53.9	33.3	0.6	0.5
Belarus	3.3	4.0	42.3	28.0	–1.9	4,155	2,891	95.4	91.5	0.5	5.2	0.0	0.0
Belgium	13.1	14.4	48.2	57.0	1.1	4,840	5,366	76.0	73.1	1.6	3.6	23.1	22.2
Benin	1.8	1.8	1.7	2.9	3.1	346	343	4.8	36.8	94.2	61.5	0.0	0.0
Bolivia	4.9	15.1	2.8	5.4	3.4	416	571	69.1	81.8	27.2	14.5	3.6	3.7
Bosnia and Herzegovina	4.6	3.9	7.0	5.6	2.2	1,627	1,483	93.9	91.5	2.3	3.3	3.8	6.1
Botswana	0.9	1.1	1.3	2.0	2.6	933	1,068	66.1	69.4	33.4	23.1	0.1	0.0
Brazil	103.7	215.6	139.5	235.6	3.1	933	1,239	51.1	52.6	34.1	30.7	13.2	15.1
Bulgaria	9.6	10.0	28.6	20.2	–1.3	3,277	2,641	84.3	77.8	0.6	3.7	13.9	20.4
Burkina Faso	..	..	..	..	..	..	..	..	..	..	..	..	..
Burundi	..	..	..	..	..	..	..	..	..	..	..	..	..
Cambodia	..	3.6	..	5.1	*3.5*	..	358	..	29.1	..	70.5	..	0.1
Cameroon	11.0	10.2	5.0	7.3	2.3	407	391	18.7	27.4	76.7	68.1	4.6	4.5
Canada	273.8	413.2	208.7	269.4	1.6	7,509	8,169	74.5	75.6	4.0	4.3	21.5	20.9
Central African Republic	..	..	..	..	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..	..
Chile	7.4	8.5	13.8	30.8	5.0	1,048	1,851	75.1	77.7	19.4	15.4	5.5	6.5
China	886.3	1,814.0	863.1	1,955.8	4.5	760	1,484	75.5	86.9	23.2	9.9	1.3	3.2
Hong Kong SAR, China	0.0	0.0	8.8	13.7	2.4	1,539	1,985	99.4	95.3	0.6	0.4	0.0	0.0
Colombia	48.2	87.6	24.2	29.5	0.5	730	655	67.4	71.5	22.8	15.5	9.8	13.2
Congo, Dem. Rep.	12.0	18.4	11.8	18.1	2.5	319	289	11.2	4.2	84.7	92.7	4.1	3.9
Congo, Rep.	8.7	12.5	0.8	1.3	2.8	326	357	35.0	38.7	59.5	55.9	5.3	2.3
Costa Rica	1.0	2.5	2.0	4.8	5.1	643	1,070	47.2	47.1	37.4	17.7	14.7	35.0
Côte d'Ivoire	3.4	11.2	4.3	10.0	5.0	343	496	23.3	22.7	73.5	76.4	2.6	1.6
Croatia	5.1	4.1	9.0	9.3	1.4	1,884	2,099	86.5	86.7	3.5	3.5	3.6	4.0
Cuba	6.6	5.2	16.5	9.9	–1.7	1,558	884	64.3	86.8	35.6	13.1	0.1	0.1
Czech Republic	40.1	33.7	48.8	45.8	0.2	4,705	4,428	93.2	83.0	0.0	4.6	6.9	15.4
Denmark	10.1	27.0	17.3	19.6	0.2	3,374	3,598	89.6	82.3	6.6	14.8	0.3	3.3
Dominican Republic	1.0	1.5	4.1	7.9	4.0	556	804	74.8	80.5	24.4	18.0	0.7	1.5
Ecuador	16.5	28.9	6.0	11.8	3.9	583	885	79.1	86.6	13.8	6.2	7.2	6.6
Egypt, Arab Rep.	54.9	82.3	31.8	67.2	4.7	551	840	94.0	95.8	3.3	2.2	2.7	2.1
El Salvador	1.7	2.8	2.5	4.9	3.8	463	800	31.4	41.9	48.2	30.7	20.3	27.4
Eritrea	*0.7*	0.5	*0.9*	0.7	*-2.2*	*276*	151	*19.3*	26.5	*80.7*	73.5	*0.0*	0.0
Estonia	5.1	4.4	9.6	5.6	–2.2	6,099	4,198	99.8	91.3	2.0	10.5	0.0	0.2
Ethiopia	14.1	20.9	14.9	22.8	2.6	308	290	5.5	8.5	93.9	90.2	0.6	1.3
Finland	12.1	15.9	28.4	36.5	1.8	5,692	6,895	55.5	50.0	16.1	20.1	20.9	20.1
France	112.5	135.5	224.5	263.7	1.1	3,957	4,258	58.0	51.2	5.2	5.1	38.6	45.6
Gabon	14.6	12.0	1.2	1.8	2.3	1,275	1,300	32.0	39.6	62.9	56.6	5.2	3.7
Gambia, The	..	..	..	..	..	..	..	..	..	..	..	..	..
Georgia	1.8	1.1	12.1	3.3	–7.3	2,217	767	88.6	70.7	3.8	11.8	5.4	18.0
Germany	186.2	137.0	351.4	331.3	–0.1	4,424	4,027	86.8	80.8	1.4	6.8	11.8	12.8
Ghana	4.4	6.5	5.3	9.5	3.4	353	415	18.2	31.8	73.7	64.7	9.3	3.4
Greece	9.2	12.1	21.4	32.2	2.6	2,110	2,875	94.6	93.4	4.2	3.7	1.0	1.7
Guatemala	3.4	5.3	4.4	8.3	4.0	498	620	28.1	46.0	68.5	50.4	3.4	3.8
Guinea	..	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	1.3	2.0	1.6	2.8	3.6	219	286	19.7	27.8	77.8	71.7	2.5	0.5
Honduras	1.7	2.1	2.4	4.7	3.6	486	661	30.0	55.3	62.9	40.7	8.2	4.0

Energy production and use 3.7

	Energy production		Energy use									Alternative and nuclear energy production	
	Total million metric tons of oil equivalent		Total million metric tons of oil equivalent		average annual % growth	Per capita kilograms of oil equivalent		% of total				% of total energy use	
								Fossil fuel		Combustible renewables and waste			
	1990	2007	1990	2007	1990–2007	1990	2007	1990	2007	1990	2007	1990	2007
Hungary	14.6	10.2	28.7	26.7	0.0	2,762	2,658	81.5	79.0	2.3	5.0	12.8	14.8
India	291.1	450.9	318.2	594.9	3.5	375	529	55.6	70.0	41.9	27.2	2.4	2.7
Indonesia	170.0	331.1	102.5	190.6	3.5	575	845	54.6	68.8	43.9	27.5	1.5	3.7
Iran, Islamic Rep.	179.8	323.1	68.3	184.9	5.7	1,256	2,604	98.2	98.7	1.0	0.5	0.8	0.8
Iraq	104.9	104.8	18.1	33.1	3.9	1,000	..	98.6	99.4	0.1	0.1	1.2	0.1
Ireland	3.5	1.4	10.0	15.1	2.9	2,843	3,457	84.8	90.9	1.1	1.6	0.6	1.5
Israel	0.4	2.7	11.6	22.0	3.6	2,486	3,059	97.2	97.4	0.0	0.0	3.1	3.4
Italy	25.3	26.4	146.7	178.2	1.4	2,586	3,001	93.4	90.5	0.6	2.6	3.9	4.6
Jamaica	0.5	0.5	2.8	5.0	2.8	1,167	1,852	82.6	89.9	17.1	9.8	0.3	0.4
Japan	75.1	90.5	438.1	513.5	0.9	3,546	4,019	84.5	83.2	1.1	1.4	14.4	15.3
Jordan	0.2	0.3	3.3	7.2	4.4	1,028	1,259	98.2	98.4	0.1	0.1	1.8	1.5
Kazakhstan	90.5	136.0	72.7	66.5	–1.5	4,450	4,292	96.9	98.9	0.2	0.1	0.9	1.1
Kenya	9.0	14.7	11.2	18.3	3.0	479	485	19.5	19.6	75.9	74.0	4.4	6.4
Korea, Dem. Rep.	28.9	19.7	33.2	18.4	–2.3	1,649	774	93.1	88.1	2.9	5.7	4.0	6.2
Korea, Rep.	22.6	42.5	93.1	222.2	5.0	2,171	4,586	83.8	81.9	0.8	1.2	15.4	16.9
Kosovo	..	..	..	..	..	..	..	..	..	..	..	..	..
Kuwait	50.4	146.6	7.8	25.2	7.5	3,681	9,463	99.9	100.0	0.1	0.0	0.0	0.0
Kyrgyz Republic	2.5	1.4	7.6	2.9	–4.3	1,713	556	93.6	65.7	0.1	0.1	11.3	41.2
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	1.1	1.8	7.8	4.7	–2.6	2,913	2,052	81.6	64.2	8.5	25.1	5.0	5.1
Lebanon	0.1	0.2	2.2	4.0	3.8	755	959	93.5	92.7	4.6	3.5	1.9	1.7
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..	..
Liberia	..	..	..	..	..	..	..	..	..	..	..	..	..
Libya	73.2	101.6	11.3	17.8	2.3	2,596	2,889	98.9	99.1	1.1	0.9	0.0	0.0
Lithuania	4.9	3.8	16.1	9.3	–2.4	4,357	2,740	75.8	61.9	1.8	8.3	28.2	28.7
Macedonia, FYR	1.3	1.5	2.5	3.0	0.8	1,298	1,482	98.0	85.0	0.0	4.8	1.7	3.2
Madagascar	..	..	..	..	..	..	..	..	..	..	..	..	..
Malawi	..	..	..	..	..	..	..	..	..	..	..	..	..
Malaysia	50.3	94.4	22.7	72.6	6.2	1,252	2,733	89.1	95.5	9.4	4.0	1.5	0.8
Mali	..	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	..	..	..	..	..	..	..	..	..	..	..	..	..
Mexico	193.4	251.1	121.2	184.3	2.3	1,456	1,750	88.1	89.3	6.1	4.5	5.9	6.3
Moldova	0.1	0.1	9.9	3.3	–5.6	2,261	910	99.6	90.0	0.4	2.3	0.2	0.1
Mongolia	2.7	3.6	3.4	3.1	–1.3	1,541	1,182	97.0	96.1	2.5	3.3	0.0	0.0
Morocco	0.8	0.7	6.9	14.4	4.0	287	465	93.8	93.8	4.6	3.1	1.5	1.0
Mozambique	5.6	11.0	5.9	9.2	2.8	437	418	5.5	8.0	93.9	80.3	0.4	15.1
Myanmar	10.7	23.9	10.7	15.6	2.4	261	319	14.4	31.7	84.7	66.3	1.0	1.9
Namibia	0.2	0.3	0.7	1.6	5.1	446	745	62.0	68.0	16.0	12.3	17.5	8.7
Nepal	5.5	8.5	5.8	9.6	3.1	303	338	5.1	10.7	93.7	86.7	1.3	2.5
Netherlands	60.5	61.5	65.7	80.4	1.0	4,392	4,909	96.0	92.9	1.4	3.5	1.4	1.8
New Zealand	12.0	14.0	13.3	16.8	1.3	3,859	3,966	64.2	67.4	4.1	6.6	31.7	25.9
Nicaragua	1.5	2.1	2.1	3.5	3.2	506	621	28.3	40.6	53.9	52.4	17.5	6.8
Niger	..	..	..	..	..	..	..	..	..	..	..	..	..
Nigeria	150.5	231.7	70.6	106.7	2.4	725	722	19.3	19.3	80.2	80.2	0.5	0.5
Norway	119.1	213.9	21.0	26.9	1.7	4,951	5,704	51.9	54.8	4.9	5.1	49.6	43.2
Oman	38.3	59.3	4.2	15.5	7.0	2,304	5,678	100.0	100.0	0.0	0.0	0.0	0.0
Pakistan	34.2	63.6	42.9	83.3	3.7	397	512	52.7	62.1	43.8	33.9	3.6	3.9
Panama	0.6	0.7	1.5	2.8	3.5	618	845	58.4	75.7	28.3	13.5	12.7	11.2
Papua New Guinea	..	..	..	..	..	..	..	..	..	..	..	..	..
Paraguay	4.6	7.1	3.1	4.2	1.5	723	686	21.3	29.4	72.5	53.0	76.0	109.9
Peru	10.6	12.2	9.7	14.1	2.2	447	494	63.3	69.8	27.5	18.2	9.2	12.0
Philippines	15.7	22.4	27.5	40.0	2.3	440	451	45.8	57.0	35.2	19.2	19.0	23.8
Poland	103.9	72.6	103.1	97.1	–0.6	2,705	2,547	97.8	94.8	2.2	5.4	0.1	0.3
Portugal	3.4	4.6	16.7	25.1	2.9	1,691	2,363	80.4	79.1	14.8	12.6	4.8	5.7
Puerto Rico	..	..	..	..	..	..	..	..	..	..	..	..	..
Qatar	26.6	103.0	6.9	22.2	6.4	14,732	19,504	99.9	100.0	0.1	0.0	0.0	0.0

3.7 Energy production and use

	Energy production		Energy use									Alternative and nuclear energy production	
	Total million metric tons of oil equivalent		Total million metric tons of oil equivalent		average annual % growth	Per capita kilograms of oil equivalent		% of total Fossil fuel		% of total Combustible renewables and waste		% of total energy use	
	1990	2007	1990	2007	1990–2007	1990	2007	1990	2007	1990	2007	1990	2007
Romania	40.8	27.6	62.3	38.9	–2.1	2,683	1,806	96.1	82.8	1.0	8.9	1.6	8.7
Russian Federation	1,280.3	1,230.6	870.0	672.1	–1.3	5,867	4,730	93.3	89.3	1.4	1.0	5.2	8.6
Rwanda	..	..	..	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	370.8	551.3	59.3	150.3	4.8	3,618	6,223	100.0	100.0	0.0	0.0	0.0	0.0
Senegal	1.0	1.3	1.7	2.7	3.5	224	225	43.2	53.1	56.8	45.9	0.0	0.7
Serbia	13.4	9.8	19.3	15.8	..	2,550	2,141	90.6	89.2	6.0	5.1	4.2	5.7
Serbia	*25.2*	..	*43.8*	..	..	*4,182*	..	*90.6*	..	*2.1*	..	*7.4*	..
Sierra Leone	..	..	..	..	..	..	..	..	..	..	..	..	..
Singapore	0.0	0.0	11.5	26.8	3.8	3,760	5,831	100.0	100.0	0.0	0.0	0.0	0.0
Slovak Republic	5.3	6.0	21.3	17.8	–0.2	4,037	3,307	81.6	70.8	0.8	3.5	15.5	24.9
Slovenia	3.1	3.5	5.7	7.3	2.0	2,835	3,632	71.1	69.2	4.7	6.5	25.8	24.1
Somalia	..	..	..	..	..	..	..	..	..	..	..	..	..
South Africa	114.5	159.6	90.9	134.3	2.2	2,581	2,807	86.1	87.7	11.5	10.2	2.5	2.3
Spain	34.6	30.3	90.1	144.0	3.2	2,320	3,208	77.4	83.2	4.5	3.7	18.1	13.3
Sri Lanka	4.2	5.1	5.5	9.3	3.5	322	464	24.1	45.5	71.0	50.8	4.9	3.7
Sudan	8.8	34.6	10.6	14.7	2.6	392	363	17.5	26.3	81.8	72.8	0.8	0.9
Swaziland	..	..	..	..	..	..	..	..	..	..	..	..	..
Sweden	29.7	33.6	47.2	50.4	0.5	5,514	5,512	37.3	32.9	11.7	19.6	50.9	46.2
Switzerland	9.7	12.6	23.8	25.7	0.6	3,545	3,406	59.9	51.6	3.8	8.2	37.0	40.9
Syrian Arab Republic	22.3	24.4	11.4	19.6	2.9	895	958	97.9	98.4	0.0	0.0	2.1	1.5
Tajikistan	2.0	1.6	5.6	3.9	–1.9	1,051	580	72.7	62.0	0.0	0.0	25.5	37.7
Tanzania	9.1	16.9	9.7	18.3	4.1	382	443	6.9	10.3	91.7	88.6	1.4	1.2
Thailand	26.5	59.4	42.0	104.0	5.2	742	1,553	63.9	81.2	34.9	17.8	1.0	0.7
Timor-Leste	..	..	..	..	..	..	..	..	..	..	..	..	..
Togo	1.1	2.1	1.3	2.5	4.5	322	390	15.0	12.8	82.8	85.1	0.6	0.3
Trinidad and Tobago	12.6	37.0	6.0	15.3	6.1	4,899	11,506	99.2	99.9	0.8	0.1	0.0	0.0
Tunisia	5.7	7.9	4.9	8.8	3.7	607	864	87.0	86.3	12.9	13.6	0.1	0.1
Turkey	25.8	27.3	52.8	100.0	3.6	941	1,370	81.8	90.5	13.7	5.1	4.6	4.6
Turkmenistan	74.9	66.1	19.6	18.1	1.2	5,352	3,631	100.0	100.0	0.0	0.0	0.3	0.0
Uganda	..	..	..	..	..	..	..	..	..	..	..	..	..
Ukraine	135.8	81.6	251.8	137.3	–3.2	4,851	2,953	91.8	81.7	0.1	0.6	8.2	18.2
United Arab Emirates	110.2	178.4	19.9	51.6	5.2	10,645	11,833	100.0	100.0	0.0	0.0	0.0	0.0
United Kingdom	208.0	176.2	207.2	211.3	0.2	3,619	3,464	90.7	89.6	0.3	1.9	8.5	8.2
United States	1,649.4	1,665.2	1,913.2	2,339.9	1.2	7,664	7,766	86.4	85.6	3.3	3.5	10.3	10.8
Uruguay	1.1	1.2	2.3	3.2	1.3	725	953	58.7	62.3	24.3	16.4	26.8	21.9
Uzbekistan	38.6	60.1	46.4	48.7	0.6	2,261	1,812	99.2	98.9	0.0	0.0	1.2	1.1
Venezuela, RB	148.9	183.8	43.6	63.7	1.6	2,206	2,319	91.5	87.8	1.2	0.8	7.3	11.2
Vietnam	24.7	73.9	24.3	55.8	5.1	367	655	20.4	51.4	77.7	44.0	1.9	4.6
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	9.4	16.5	2.5	7.2	6.2	204	324	97.0	98.9	3.1	1.1	0.0	0.0
Zambia	4.9	6.8	5.4	7.4	1.8	683	604	15.6	10.7	74.3	78.3	12.7	11.3
Zimbabwe	8.6	8.7	9.3	9.4	–0.2	889	759	44.8	27.9	50.9	65.0	4.0	4.7
World	**8,823.2 t**	**11,926.4 t**	**8,555.5 t**	**11,664.3 t**	**1.8 w**	**1,666 w**	**1,819 w**	**81.0 w**	**81.3 w**	**10.2 w**	**9.6 w**	**8.8 w**	**9.0 w**
Low income	249.0	407.6	277.3	378.3	2.1	449	423	50.6	46.7	46.2	49.3	3.4	4.1
Middle income	4,811.7	6,906.3	3,884.6	5,715.4	2.2	1,054	1,242	79.5	81.6	16.4	13.2	4.1	5.1
Lower middle income	2,296.4	3,981.5	2,013.2	3,713.4	3.5	696	1,013	71.4	80.0	25.9	16.3	2.8	3.8
Upper middle income	2,515.6	2,926.8	1,871.9	2,004.7	0.5	2,354	2,130	88.1	84.7	6.2	7.3	5.4	7.4
Low & middle income	5,055.3	7,298.0	4,145.7	6,074.4	2.2	980	1,127	77.9	79.8	18.1	15.1	4.0	5.0
East Asia & Pacific	1,225.4	2,460.3	1,138.8	2,475.5	4.4	715	1,295	71.5	83.8	26.6	12.8	1.8	3.4
Europe & Central Asia	1,861.3	1,796.8	1,675.5	1,297.3	–1.3	3,885	2,948	93.2	89.2	1.6	2.1	5.1	8.1
Latin America & Carib.	608.4	919.8	453.0	711.2	2.5	1,042	1,273	71.2	72.8	19.7	16.3	9.2	10.8
Middle East & N. Africa	558.6	836.8	185.5	406.5	4.5	819	1,276	97.2	97.9	1.7	1.1	1.1	0.9
South Asia	348.7	554.1	388.3	728.9	3.6	347	484	53.7	67.9	43.7	29.3	2.5	2.8
Sub-Saharan Africa	475.6	779.9	310.8	474.1	2.5	676	662	41.3	41.8	56.5	55.8	2.2	2.5
High income	3,785.4	4,654.1	4,433.0	5,625.0	1.5	4,733	5,321	83.9	82.9	2.8	3.7	13.1	13.3
Euro area	477.1	459.9	1,060.4	1,229.2	1.1	3,516	3,789	79.8	75.7	3.2	5.6	16.7	18.2

Energy production and use 3.7

About the data

In developing economies 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 economies, but high-income economies still use almost five times as much energy on a per capita basis.

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

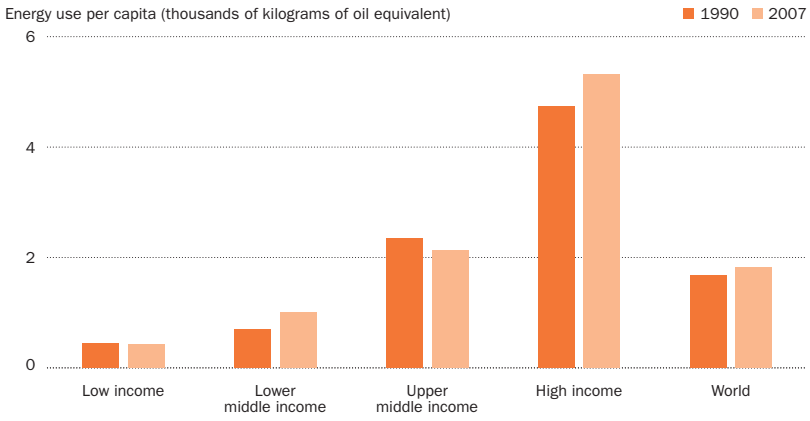
Total energy use refers to the use of primary energy before transformation to other end-use fuels (such as electricity and refined petroleum products). It includes energy from combustible renewables and waste—solid biomass and animal products, gas and liquid from biomass, and industrial and municipal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

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

Definitions

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

A person in a high-income economy uses more than 12 times as much energy on average as a person in a low-income economy **3.7a**



Source: Table 3.7.

Data sources

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

3.8 Energy dependency and efficiency and carbon dioxide emissions

	Net energy imports[a]		GDP per unit of energy use		Carbon dioxide emissions							
	% of energy use		2005 PPP $ per kilogram of oil equivalent		Total million metric tons		Carbon intensity kilograms per kilogram of oil equivalent energy use		Per capita metric tons		kilograms per 2005 PPP $ of GDP	
	1990	2007	1990	2007	1990	2006	1990	2006	1990	2006	1990	2006
Afghanistan	..	..	..	..	2.7	0.7	..	..	0.2	0.0	..	0.0
Albania	8	51	4.5	9.2	7.5	4.3	2.8	2.0	2.3	1.4	0.6	0.2
Algeria	–351	–346	7.1	6.7	78.8	132.6	3.6	3.8	3.1	4.0	0.5	0.6
Angola	–387	–793	5.8	8.1	4.4	10.6	0.8	1.1	0.4	0.6	0.1	0.1
Argentina	–5	–12	5.3	6.8	112.5	173.4	2.4	2.5	3.5	4.4	0.5	0.4
Armenia	98	71	1.4	5.7	*3.7*	4.4	*0.9*	1.7	*1.1*	1.4	*0.7*	0.3
Australia	–83	–133	4.8	6.0	292.9	371.7	3.4	3.0	17.2	18.0	0.7	0.5
Austria	67	67	8.0	8.9	60.7	71.8	2.4	2.1	7.9	8.7	0.3	0.3
Azerbaijan	17	–337	1.3	5.3	*44.1*	35.0	*2.7*	2.6	*6.0*	4.1	*1.7*	0.7
Bangladesh	16	17	6.2	7.2	15.5	41.6	1.2	1.7	0.1	0.3	0.2	0.2
Belarus	92	86	1.5	3.6	*98.5*	68.8	*2.6*	2.4	9.6	7.1	*1.7*	0.7
Belgium	73	75	5.2	6.2	107.5	107.1	2.2	1.8	10.8	10.2	0.4	0.3
Benin	–7	39	3.2	3.9	0.7	3.1	0.4	1.1	0.1	0.4	0.1	0.3
Bolivia	–77	–177	7.0	6.6	5.5	11.4	2.0	2.4	0.8	1.2	0.3	0.3
Bosnia and Herzegovina	34	30	..	4.5	*4.7*	27.4	*1.1*	5.1	*1.2*	7.3	..	1.2
Botswana	28	45	7.5	11.6	2.2	4.8	1.7	2.4	1.6	2.6	0.2	0.2
Brazil	26	8	7.7	7.4	208.7	352.3	1.5	1.6	1.4	1.9	0.2	0.2
Bulgaria	66	51	2.2	3.8	76.6	48.0	2.7	2.4	8.8	6.2	1.2	0.7
Burkina Faso	..	..	..	..	0.6	0.8	..	..	0.1	0.1	0.1	0.1
Burundi	..	..	..	..	0.3	0.2	..	..	0.1	0.0	0.1	0.1
Cambodia	..	29	..	4.8	0.5	4.1	..	0.8	0.0	0.3	..	0.2
Cameroon	–120	–39	5.1	5.1	1.7	3.6	0.3	0.5	0.1	0.2	0.1	0.1
Canada	–31	–53	3.6	4.4	449.7	544.3	2.2	2.0	16.2	16.7	0.6	0.5
Central African Republic	..	..	..	..	0.2	0.2	..	..	0.1	0.1	0.1	0.1
Chad	..	..	..	..	0.1	0.4	..	..	0.0	0.0	0.0	0.0
Chile	46	73	6.3	7.1	35.5	60.1	2.6	2.0	2.7	3.6	0.4	0.3
China	–3	7	1.4	3.4	2,412.9	6,099.1	2.8	3.3	2.1	4.7	1.9	1.0
Hong Kong SAR, China	100	100	15.4	20.1	27.6	39.0	3.1	2.9	4.8	5.7	0.2	0.2
Colombia	–99	–202	8.2	12.3	57.3	63.4	2.4	2.1	1.7	1.5	0.3	0.2
Congo, Dem. Rep.	–2	–2	1.9	1.0	4.1	2.2	0.3	0.1	0.1	0.0	0.2	0.1
Congo, Rep.	–997	–891	10.7	9.9	1.2	1.5	1.5	1.2	0.5	0.4	0.1	0.1
Costa Rica	48	47	9.7	9.6	3.0	7.8	1.5	1.8	1.0	1.8	0.2	0.2
Côte d'Ivoire	22	–13	5.5	3.1	5.8	6.9	1.3	0.7	0.5	0.3	0.2	0.2
Croatia	43	57	6.6	7.5	*16.9*	23.7	*2.5*	2.6	*3.8*	5.3	*0.4*	0.4
Cuba	60	48	..	..	33.3	29.6	2.0	3.0	3.1	2.6	..	..
Czech Republic	18	26	3.5	5.2	*131.0*	114.8	*3.0*	2.5	*12.7*	11.2	*0.9*	0.5
Denmark	42	–38	7.5	9.6	50.4	53.9	2.9	2.7	9.8	9.9	0.4	0.3
Dominican Republic	75	80	6.7	9.0	9.6	20.3	2.3	2.6	1.3	2.1	0.3	0.3
Ecuador	–175	–145	9.4	7.9	16.8	31.3	2.8	2.9	1.6	2.4	0.3	0.3
Egypt, Arab Rep.	–72	–22	5.8	5.7	75.9	166.7	2.4	2.6	1.3	2.1	0.4	0.5
El Salvador	31	42	8.0	7.7	2.6	6.5	1.1	1.4	0.5	1.1	0.1	0.2
Eritrea	*19*	26	*1.9*	4.0	..	0.6	..	0.8	..	0.1	..	0.2
Estonia	47	22	1.7	4.7	*25.0*	17.5	*4.0*	3.5	*16.3*	13.0	*2.2*	0.7
Ethiopia	5	9	1.8	2.6	3.0	6.0	0.2	0.3	0.1	0.1	0.1	0.1
Finland	57	56	4.1	4.8	51.0	66.6	1.8	1.8	10.2	12.7	0.4	0.4
France	50	49	6.3	7.4	397.8	382.9	1.8	1.4	7.0	6.2	0.3	0.2
Gabon	–1,139	–549	11.8	10.3	6.1	2.1	5.2	1.2	6.6	1.5	0.4	0.1
Gambia, The	..	..	..	..	0.2	0.3	..	..	0.2	0.2	0.2	0.2
Georgia	85	68	2.4	5.8	*15.3*	5.5	*1.8*	1.8	*2.9*	1.3	*1.2*	0.3
Germany	47	59	5.8	8.2	*962.7*	804.5	*2.8*	2.4	*12.0*	9.8	*0.4*	0.3
Ghana	17	32	2.5	3.1	3.9	9.2	0.7	1.0	0.3	0.4	0.3	0.3
Greece	57	62	8.3	9.4	72.7	96.3	3.4	3.2	7.2	8.6	0.4	0.3
Guatemala	24	36	6.7	7.0	5.1	11.8	1.1	1.4	0.6	0.9	0.2	0.2
Guinea	..	..	..	..	1.1	1.4	..	..	0.2	0.1	0.2	0.2
Guinea-Bissau	..	..	..	..	0.3	0.3	..	..	0.2	0.2	0.4	0.4
Haiti	20	28	*6.4*	3.6	1.0	1.8	0.6	0.7	0.1	0.2	*0.1*	0.2
Honduras	29	55	5.5	5.4	2.6	7.2	1.1	1.8	0.5	1.0	0.2	0.3

Energy dependency and efficiency and carbon dioxide emissions

	Net energy imports[a]		GDP per unit of energy use		Carbon dioxide emissions							
	% of energy use		2005 PPP $ per kilogram of oil equivalent		Total million metric tons		Carbon intensity kilograms per kilogram of oil equivalent energy use		Per capita metric tons		kilograms per 2005 PPP $ of GDP	
	1990	2007	1990	2007	1990	2006	1990	2006	1990	2006	1990	2006
Hungary	49	62	4.5	6.7	61.9	57.6	2.2	2.1	6.0	5.7	0.5	0.3
India	9	24	3.2	4.9	690.1	1,509.3	2.2	2.7	0.8	1.4	0.7	0.6
Indonesia	–66	–74	3.6	4.1	150.3	333.2	1.5	1.8	0.8	1.5	0.4	0.4
Iran, Islamic Rep.	–163	–75	5.0	4.0	227.0	466.6	3.3	2.7	4.2	6.7	0.7	0.7
Iraq	–480	–217	..	..	52.5	92.5	2.9	2.7	2.8	3.2	..	..
Ireland	65	91	6.2	11.9	30.9	43.8	3.1	3.0	8.8	10.3	0.5	0.3
Israel	96	88	7.2	8.2	33.5	70.4	2.9	3.3	7.2	10.0	0.4	0.4
Italy	83	85	9.2	9.6	424.7	473.8	2.9	2.6	7.5	8.0	0.3	0.3
Jamaica	83	90	5.1	3.9	8.0	12.1	2.9	2.8	3.3	4.6	0.6	0.6
Japan	83	82	7.3	7.9	1,171.4	1,292.5	2.7	2.5	9.5	10.1	0.4	0.3
Jordan	95	96	3.2	3.8	10.4	20.7	3.2	3.0	3.3	3.7	1.0	0.8
Kazakhstan	–24	–105	1.6	2.4	*261.1*	193.4	*3.3*	3.0	*15.9*	12.6	*2.7*	1.3
Kenya	20	20	3.0	3.0	5.8	12.1	0.5	0.7	0.2	0.3	0.2	0.2
Korea, Dem. Rep.	13	–7	..	..	244.6	84.7	7.4	3.9	12.1	3.6	..	..
Korea, Rep.	76	81	5.2	5.5	241.5	474.9	2.6	2.2	5.6	9.8	0.5	0.4
Kosovo	..	..	..	..	..	..	..	..	..	..	..	..
Kuwait	–544	–482	*2.8*	4.8	40.7	86.5	5.2	3.5	19.2	33.3	*0.6*	0.7
Kyrgyz Republic	67	51	1.5	3.4	*11.0*	5.6	*2.2*	2.0	*2.4*	1.1	*1.3*	0.6
Lao PDR	..	..	..	..	0.2	1.4	..	..	0.1	0.2	0.1	0.1
Latvia	86	61	3.2	7.4	*13.3*	7.5	*2.2*	1.6	*5.1*	3.3	*0.9*	0.2
Lebanon	94	95	7.5	10.5	9.1	15.3	4.0	3.3	3.1	3.7	0.5	0.4
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..
Liberia	..	..	..	..	0.5	0.8	..	..	0.2	0.2	0.5	0.7
Libya	–546	–470	..	5.1	40.3	55.5	3.6	3.1	9.2	9.2	..	0.6
Lithuania	69	59	2.7	5.8	*22.1*	14.2	*2.0*	1.7	*6.0*	4.2	*0.7*	0.3
Macedonia, FYR	49	50	6.0	5.3	*10.8*	10.9	*4.0*	3.7	*5.6*	5.3	*0.8*	0.7
Madagascar	..	..	..	..	1.0	2.8	..	..	0.1	0.2	0.1	0.2
Malawi	..	..	..	..	0.6	1.0	..	..	0.1	0.1	0.1	0.1
Malaysia	–122	–30	5.3	4.7	56.5	187.7	2.5	2.8	3.1	7.2	0.5	0.6
Mali	..	..	..	..	0.4	0.6	..	..	0.0	0.0	0.1	0.0
Mauritania	..	..	..	..	2.7	1.7	..	..	1.3	0.5	0.9	0.3
Mauritius	..	..	..	..	1.5	3.8	..	..	1.4	3.1	0.2	0.3
Mexico	–60	–36	6.9	7.6	384.4	435.8	3.2	2.5	4.6	4.2	0.5	0.3
Moldova	99	97	1.7	2.7	*21.0*	7.8	*3.1*	2.3	*4.8*	2.1	*2.1*	0.9
Mongolia	20	–15	1.4	2.6	10.0	9.4	2.9	3.3	4.5	3.7	2.0	1.3
Morocco	89	95	9.7	8.3	23.5	45.3	3.4	3.4	0.9	1.5	0.4	0.4
Mozambique	5	–20	0.9	1.8	1.0	2.0	0.2	0.2	0.1	0.1	0.2	0.1
Myanmar	0	–53	..	..	4.3	10.0	0.4	0.6	0.1	0.2	..	..
Namibia	67	79	*9.4*	7.9	0.0	2.8	*0.0*	1.9	0.0	1.4	0.0	0.2
Nepal	5	11	2.3	2.9	0.6	3.2	0.1	0.3	0.0	0.1	0.0	0.1
Netherlands	8	24	6.0	7.6	167.3	168.4	2.5	2.2	11.2	10.3	0.4	0.3
New Zealand	10	16	4.8	6.4	22.7	30.5	1.7	1.8	6.6	7.3	0.4	0.3
Nicaragua	29	41	3.7	3.9	2.6	4.3	1.3	1.3	0.6	0.8	0.3	0.3
Niger	..	..	..	..	1.1	0.9	..	..	0.1	0.1	0.2	0.1
Nigeria	–113	–117	2.0	2.6	45.3	97.2	0.6	0.9	0.5	0.7	0.3	0.4
Norway	–467	–696	6.5	8.6	31.3	40.2	1.5	1.4	7.4	8.6	0.2	0.2
Oman	–802	–283	6.4	3.8	10.3	41.3	2.4	2.8	5.6	15.5	0.4	0.8
Pakistan	20	24	4.2	4.6	68.5	142.6	1.6	1.8	0.6	0.9	0.4	0.4
Panama	59	75	9.8	12.7	3.1	6.4	2.1	2.2	1.3	2.0	0.2	0.2
Papua New Guinea	..	..	..	..	2.1	4.6	..	..	0.5	0.7	0.3	0.4
Paraguay	–49	–70	5.5	6.1	2.3	4.0	0.7	1.0	0.5	0.7	0.1	0.2
Peru	–9	13	10.0	14.7	21.1	38.6	2.2	2.9	1.0	1.4	0.2	0.2
Philippines	43	44	5.4	7.1	44.5	68.3	1.6	1.7	0.7	0.8	0.3	0.3
Poland	–1	25	3.0	6.1	347.6	318.0	3.4	3.3	9.1	8.3	1.1	0.6
Portugal	80	82	9.4	9.0	44.3	60.0	2.6	2.4	4.5	5.7	0.3	0.3
Puerto Rico	..	..	..	..	..	..	..	..	..	..	..	..
Qatar	–286	–364	..	*3.4*	11.8	46.2	1.7	2.5	25.2	46.1	..	0.7

3.8 Energy dependency and efficiency and carbon dioxide emissions

	Net energy imports[a]		GDP per unit of energy use		Carbon dioxide emissions							
	% of energy use		2005 PPP $ per kilogram of oil equivalent		Total million metric tons		Carbon intensity kilograms per kilogram of oil equivalent energy use		Per capita metric tons		kilograms per 2005 PPP $ of GDP	
	1990	2007	1990	2007	1990	2006	1990	2006	1990	2006	1990	2006
Romania	34	29	2.7	5.6	158.7	98.4	2.5	2.5	6.8	4.6	0.9	0.5
Russian Federation	–47	–83	2.2	2.9	*2,073.5*	1,563.5	*2.7*	2.3	*13.9*	11.0	*1.4*	0.9
Rwanda	..	..	..	..	0.7	0.8	..	..	0.1	0.1	0.1	0.1
Saudi Arabia	–526	–267	5.3	3.5	214.9	381.3	3.6	2.6	13.2	16.1	0.7	0.8
Senegal	43	53	6.3	7.3	3.2	4.3	1.9	1.5	0.4	0.4	0.3	0.2
Serbia	31	38	4.8	4.4	..	..	..	..	..	..	..	..
Sierra Leone	..	..	..	..	0.4	1.0	..	..	0.1	0.2	0.1	0.3
Singapore	100	100	6.3	8.1	46.9	56.2	4.1	2.1	15.4	12.8	0.6	0.3
Slovak Republic	75	67	3.1	5.9	*44.3*	37.4	*2.4*	2.0	*8.4*	6.9	*0.8*	0.4
Slovenia	46	53	5.8	7.2	*12.3*	15.2	*2.4*	2.1	6.2	7.6	*0.4*	0.3
Somalia	..	..	..	..	0.0	0.2	..	..	0.0	0.0	..	..
South Africa	–26	–19	3.0	3.3	333.3	414.3	3.7	3.2	9.5	8.7	1.2	1.0
Spain	62	79	8.5	8.9	229.0	352.0	2.5	2.5	5.9	8.0	0.3	0.3
Sri Lanka	24	45	6.3	8.6	3.8	11.9	0.7	1.3	0.2	0.6	0.1	0.2
Sudan	17	–136	2.5	5.2	5.6	10.8	0.5	0.7	0.2	0.3	0.2	0.2
Swaziland	..	..	..	..	0.4	1.0	..	..	0.5	0.9	0.1	0.2
Sweden	37	33	4.5	6.2	51.2	50.8	1.1	1.0	6.0	5.6	0.2	0.2
Switzerland	59	51	9.4	11.0	42.9	41.8	1.8	1.5	6.4	5.6	0.2	0.2
Syrian Arab Republic	–96	–24	3.3	4.2	37.4	68.4	3.3	3.7	2.9	3.5	1.0	0.9
Tajikistan	64	59	2.9	2.9	*21.3*	6.4	*4.4*	1.7	*3.9*	1.0	*2.0*	0.6
Tanzania	7	8	2.3	2.5	2.4	5.4	0.2	0.3	0.1	0.1	0.1	0.1
Thailand	37	43	5.3	4.7	95.8	272.3	2.3	2.7	1.7	4.1	0.4	0.6
Timor-Leste	..	..	..	..	..	0.2	..	..	..	0.2	..	0.3
Togo	17	15	2.7	2.0	0.8	1.2	0.6	0.5	0.2	0.2	0.2	0.3
Trinidad and Tobago	–111	–142	2.1	2.0	16.9	33.6	2.8	2.4	13.9	25.4	1.4	1.2
Tunisia	–16	11	6.6	8.2	13.3	23.1	2.7	2.7	1.6	2.3	0.4	0.3
Turkey	51	73	8.3	8.7	146.5	269.3	2.8	2.9	2.6	3.7	0.3	0.3
Turkmenistan	–281	–266	0.7	1.6	*28.0*	44.1	*2.5*	2.7	*7.2*	9.0	*2.3*	1.7
Uganda	..	..	..	..	0.8	2.7	..	..	0.0	0.1	0.1	0.1
Ukraine	46	41	1.7	2.2	*611.0*	318.9	*2.8*	2.3	*11.7*	6.8	*1.8*	1.1
United Arab Emirates	–454	–245	4.8	4.5	54.8	139.5	2.8	3.1	29.3	32.9	0.6	0.6
United Kingdom	0	17	6.6	9.9	573.3	568.1	2.8	2.6	10.0	9.4	0.4	0.3
United States	14	29	4.2	5.5	4,861.1	5,748.1	2.5	2.5	19.5	19.3	0.6	0.5
Uruguay	49	62	10.1	11.4	4.0	6.9	1.8	2.2	1.3	2.1	0.2	0.2
Uzbekistan	17	–23	0.9	1.3	*113.9*	115.6	*2.5*	2.4	*5.3*	4.4	*3.1*	2.1
Venezuela, RB	–242	–188	4.3	4.9	122.1	171.5	2.8	2.8	6.2	6.3	0.6	0.6
Vietnam	–2	–33	2.5	3.7	21.4	106.1	0.9	2.0	0.3	1.3	0.4	0.6
West Bank and Gaza	..	..	..	..	..	3.0	..	..	..	0.8	..	..
Yemen, Rep.	–273	–129	8.7	6.8	..	21.2	..	3.1	..	1.0	..	0.4
Zambia	9	8	1.8	2.0	2.4	2.5	0.5	0.3	0.3	0.2	0.2	0.2
Zimbabwe	8	8	0.3	*0.2*	16.6	11.1	1.8	1.2	1.6	0.9	6.0	*5.0*
World	**–3[b] w**	**–2[b] w**	**4.2 w**	**5.4 w**	**22,511.6[c] t**	**30,154.7[c] t**	**2.5[c] w**	**2.5[c] w**	**4.3[c] w**	**4.4[c] w**	**0.6[c] w**	**0.5[c] w**
Low income	10	–8	2.2	3.2	508.5	478.2	1.9	1.5	0.6	0.5	0.2	0.4
Middle income	–24	–21	3.0	4.4	9,936.6	14,821.4	*2.6*	2.7	1.8	3.3	0.7	0.6
Lower middle income	–14	–7	2.5	3.9	4,849.7	9,976.8	2.4	2.8	1.4	2.8	0.9	0.8
Upper middle income	–34	–46	3.6	5.2	5,086.1	4,837.2	*2.8*	2.5	3.8	5.2	*0.5*	0.5
Low & middle income	–22	–20	3.0	4.3	10,445.0	15,299.3	*2.5*	2.7	1.6	2.8	0.7	0.6
East Asia & Pacific	–8	1	2.0	3.6	3,046.8	7,188.2	2.7	3.1	1.9	3.8	1.3	0.9
Europe & Central Asia	–11	–39	2.3	3.7	4,566.0	3,195.3	*3.2*	2.5	*9.4*	7.3	*1.3*	0.7
Latin America & Carib.	–34	–29	6.9	7.5	1,044.8	1,462.3	2.3	2.2	2.4	2.6	0.3	0.3
Middle East & N. Africa	–201	–106	5.6	5.0	565.9	1,111.4	3.1	2.9	2.5	3.5	0.5	0.6
South Asia	10	24	3.5	5.0	781.5	1,710.4	2.0	2.5	0.7	1.1	0.6	0.5
Sub-Saharan Africa	–54	–64	2.6	3.2	466.4	640.8	1.7	1.5	0.9	0.8	0.6	0.5
High income	15	18	5.3	6.5	11,332.7	13,377.9	2.5	2.4	12.1	12.7	0.5	0.4
Euro area	55	63	6.7	8.2	2,602.0	2,701.4	2.5	2.2	7.5	8.4	0.3	0.3

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

Energy dependency and efficiency and carbon dioxide emissions 3.8

About the data

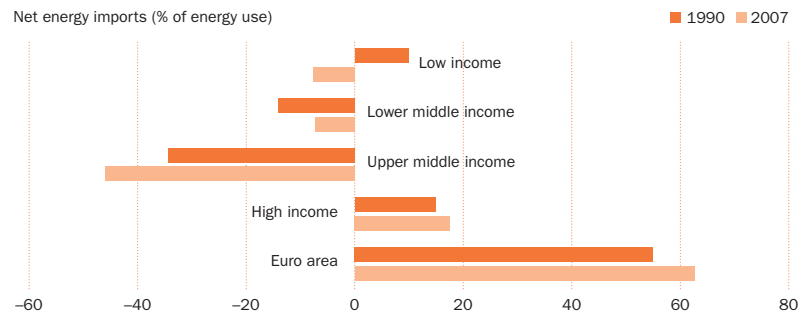
Because commercial energy is widely traded, its production and use need to be distinguished. Net energy imports show the extent to which an economy's use exceeds its production. High-income economies are net energy importers; middle-income economies are their main suppliers.

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

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

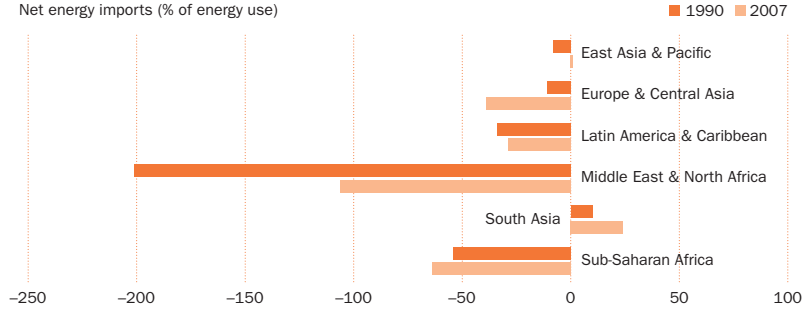
The U.S. Department of Energy's Carbon Dioxide Information Analysis Center (CDIAC) calculates annual anthropogenic emissions from data on fossil fuel consumption (from the United Nations Statistics Division's World Energy Data Set) and world cement manufacturing (from the U.S. Bureau of Mines's Cement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

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



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

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



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

Definitions

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

Data sources

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

3.9 Trends in greenhouse gas emissions

	Carbon dioxide emissions		Methane emissions				Nitrous oxide emissions				Other greenhouse gas emissions	
	average annual % growth[a] 1990–2006	% change[b] 1990–2006	Total thousand metric tons of carbon dioxide equivalent 2005	% change[b] 1990–2005	% of total From energy processes 2005	% of total Agricultural 2005	Total thousand metric tons of carbon dioxide equivalent 2005	% change[b] 1990–2005	% of total From energy processes 2005	% of total Agricultural 2005	Total thousand metric tons of carbon dioxide equivalent 2005	% change[b] 1990–2005
Afghanistan	–8.6	–74.0	..	..	..	..	..	..	..	..	..	..
Albania	2.3	–42.6	2,300	0.0	16.1	73.9	970	–21.1	5.2	82.5	60	..
Algeria	3.7	68.2	53,720	33.0	83.0	8.3	4,640	28.5	10.1	61.4	490	48.5
Angola	5.8	138.9	44,680	–9.6	14.3	28.4	68,590	4.9	0.2	21.7	20	..
Argentina	2.2	54.1	101,180	–8.7	18.4	71.0	35,890	5.8	1.8	89.8	790	–65.7
Armenia	0.6	5.2	2,960	10.9	50.7	36.8	570	–21.9	1.8	82.5	340	..
Australia	1.3	26.9	119,560	8.3	28.6	58.3	57,910	–0.7	5.3	84.5	6,510	33.4
Austria	1.1	18.3	8,210	–14.2	18.9	50.4	3,640	–19.8	14.3	63.2	2,330	45.6
Azerbaijan	–2.4	–29.7	36,600	111.3	82.0	13.6	2,460	–1.6	6.5	82.5	90	–50.0
Bangladesh	6.6	168.0	93,200	6.6	10.8	69.9	21,260	40.4	6.5	83.0	0	..
Belarus	–3	–38.1	11,110	–33.2	4.4	73.4	11,370	–26.4	3.3	74.4	460	..
Belgium	–0.1	–0.4	11,760	–18.0	8.6	48.5	5,940	–28.0	10.3	49.0	2,110	603.3
Benin	8.3	334.9	3,940	–17.4	12.7	49.5	4,320	–15.6	2.8	40.0	0	..
Bolivia	2.8	107.2	30,400	30.9	25.7	34.1	25,400	17.1	0.5	19.5	0	..
Bosnia and Herzegovina	14.7	292.5	2,550	–53.6	42.7	45.5	1,100	–42.7	27.3	61.8	570	–8.1
Botswana	4.1	119.8	4,460	–22.8	7.8	84.8	2,930	–43.0	1.4	96.6	0	..
Brazil	3.5	68.8	482,860	57.4	6.1	62.2	255,970	36.3	1.5	54.7	11,810	40.4
Bulgaria	–2.5	–37.3	7,160	–33.5	14.9	28.8	3,770	–56.7	6.9	53.8	380	..
Burkina Faso	1.9	34.4	..	..	..	..	..	..	..	..	..	..
Burundi	–4.6	–34.9	..	..	..	..	..	..	..	..	..	..
Cambodia	16.7	803.2	20,350	35.1	5.6	75.6	6,010	63.3	3.3	62.4	0	..
Cameroon	3.4	109.7	18,460	38.0	38.9	42.5	11,470	–10.4	2.1	59.5	420	–54.8
Canada	1.5	21.0	72,860	27.5	39.0	35.9	33,380	–12.5	16.3	64.4	21,940	69.7
Central African Republic	1	25.9	..	..	..	..	..	..	..	..	..	..
Chad	10.3	169.9	..	..	..	..	..	..	..	..	..	..
Chile	3.7	69.4	17,800	49.7	23.8	40.2	7,650	61.1	6.4	77.8	10	–50.0
China	5.1	152.8	1,287,860	32.6	44.1	40.2	414,800	43.3	8.7	82.0	137,120	1,085.1
Hong Kong SAR, China	2.3	41.1	2,610	97.7	28.7	0.0	200	25.0	95.0	0.0	120	–68.4
Colombia	–0.4	10.6	57,720	13.1	19.3	68.5	22,710	2.8	2.2	80.4	80	100.0
Congo, Dem. Rep.	–4.7	–45.9	56,230	–41.5	9.9	23.2	108,260	–20.9	1.1	15.7	0	..
Congo, Rep.	–1.4	23.1	5,460	–11.8	30.6	32.6	5,890	–8.7	0.7	31.2	0	..
Costa Rica	5.4	165.8	2,570	–31.3	9.3	67.3	1,250	–28.2	3.2	90.4	60	..
Côte d'Ivoire	1.9	18.7	10,420	–6.0	12.4	18.3	14,010	6.9	1.5	15.3	0	..
Croatia	1.7	–5.4	3,750	–61.0	55.7	34.4	2,550	–26.5	5.1	56.9	60	–93.3
Cuba	–1.3	–11.1	9,470	–23.1	11.4	62.3	6,010	–30.6	3.0	82.5	130	..
Czech Republic	–1.5	–29.4	9,250	–39.8	37.2	41.7	8,370	–4.1	41.0	38.8	1,130	..
Denmark	–1.1	7.0	11,990	–7.5	9.9	43.1	5,780	–21.3	5.9	79.8	1,420	468.0
Dominican Republic	5.1	112.7	5,940	2.4	5.6	65.3	1,980	3.7	8.1	86.9	0	..
Ecuador	3.3	86.1	17,120	31.8	31.3	57.8	4,280	44.6	4.0	89.7	60	..
Egypt, Arab Rep.	5.4	119.6	46,160	69.9	49.8	32.2	17,650	59.0	5.0	85.0	3,180	54.4
El Salvador	5	146.8	3,150	18.4	12.7	52.7	1,230	1.7	8.9	82.9	80	..
Eritrea	8.9	..	2,390	26.5	7.9	75.3	1,160	16.0	4.3	92.2	0	..
Estonia	–2.6	–37.9	1,990	–37.8	38.7	32.2	810	–51.8	19.8	69.1	30	..
Ethiopia	4.5	99.0	52,320	32.9	14.5	72.4	29,160	19.0	5.5	91.5	10	..
Finland	1.3	30.8	8,660	–2.3	6.5	23.3	5,050	–16.9	12.7	58.8	830	730.0
France	–0.3	–3.8	79,540	6.3	41.3	46.4	45,560	–30.7	4.8	71.0	15,540	57.1
Gabon	–7	–66.2	8,210	1.4	90.4	1.1	660	40.4	7.6	16.7	10	..
Gambia, The	4	75.0	..	..	..	..	..	..	..	..	..	..
Georgia	–7.4	–68.1	4,130	–14.0	31.7	54.2	1,970	–25.7	2.5	57.9	10	..
Germany	–1.1	–16.4	57,030	–46.0	26.8	51.9	52,590	–23.1	7.5	56.0	30,930	6.8
Ghana	4.8	135.1	8,520	22.6	19.1	41.7	5,060	–6.1	7.9	68.2	20	–96.7
Greece	2.3	32.5	5,770	–2.0	31.5	63.1	4,810	–21.7	10.6	71.9	1,840	–21.0
Guatemala	6	131.4	8,280	75.1	12.2	48.9	7,000	182.3	3.9	42.7	480	..
Guinea	1.6	28.8	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	0.1	10.2	..	..	..	..	..	..	..	..	..	..
Haiti	6.6	82.3	3,860	39.4	8.8	58.3	1,380	62.4	6.5	86.2	0	..
Honduras	7.4	177.5	5,180	31.5	6.9	78.6	2,620	21.3	4.2	92.4	0	..

Trends in greenhouse gas emissions

3.9

	Carbon dioxide emissions		Methane emissions				Nitrous oxide emissions				Other greenhouse gas emissions	
	average annual % growth[a] 1990–2006	% change[b] 1990–2006	Total thousand metric tons of carbon dioxide equivalent 2005	% change[b] 1990–2005	% of total From energy processes 2005	% of total Agricultural 2005	Total thousand metric tons of carbon dioxide equivalent 2005	% change[b] 1990–2005	% of total From energy processes 2005	% of total Agricultural 2005	Total thousand metric tons of carbon dioxide equivalent 2005	% change[b] 1990–2005
Hungary	–0.4	–6.9	7,510	–20.0	26.6	34.8	6,640	–29.8	4.4	62.5	1,550	121.4
India	4.8	118.7	589,630	10.5	16.8	63.8	196,110	30.1	12.3	77.1	8,430	–11.8
Indonesia	3.9	121.7	208,910	18.7	25.5	46.4	165,370	48.6	1.8	53.1	1,030	–40.5
Iran, Islamic Rep.	4.5	105.6	114,180	32.3	70.6	18.3	23,230	41.9	6.5	85.3	2,570	–2.7
Iraq	3.2	76.2	15,910	–45.8	58.3	18.6	2,540	–23.7	13.0	84.6	90	–64.0
Ireland	2.6	41.7	13,540	12.8	12.0	86.9	7,150	–9.3	2.7	94.7	1,150	3,733.3
Israel	4.4	110.1	3,510	84.7	18.2	31.3	1,410	43.9	20.6	66.7	1,980	90.4
Italy	0.7	11.5	40,190	–13.9	13.4	40.4	25,810	–1.5	9.1	47.5	13,580	213.6
Jamaica	2.1	52.6	1,230	12.8	6.5	53.7	440	10.0	11.4	79.5	50	..
Japan	0.6	10.3	39,300	–32.9	4.5	77.5	22,790	–24.0	28.8	36.0	52,740	105.6
Jordan	4.3	99.2	1,770	110.7	23.7	22.0	530	43.2	13.2	69.8	110	..
Kazakhstan	–3.1	–34.4	46,120	–28.5	65.4	25.8	15,950	–45.4	10.9	68.8	340	..
Kenya	4.8	108.7	20,100	19.5	8.6	72.1	10,200	15.4	5.5	90.2	0	..
Korea, Dem. Rep.	–9.6	–65.4	17,090	–14.8	55.9	25.0	2,730	–63.8	16.5	69.2	2,790	..
Korea, Rep.	4.2	96.7	146,330	296.3	3.8	8.5	10,960	41.8	24.5	43.8	10,220	66.2
Kosovo	..	..	..	..	..	..	..	..	..	..	..	..
Kuwait	9.6	112.5	14,350	119.1	93.4	1.0	390	129.4	59.0	28.2	940	261.5
Kyrgyz Republic	–4.8	–55.3	3,590	–37.9	6.7	72.4	1,460	–57.3	11.6	74.0	20	..
Lao PDR	14.5	507.8	..	..	..	..	..	..	..	..	..	..
Latvia	–5	–50.4	2,760	–45.8	49.3	31.2	1,180	–57.2	11.9	82.2	890	..
Lebanon	3.7	68.5	990	45.6	9.1	26.3	550	77.4	14.5	70.9	0	..
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..
Liberia	5.2	62.1	..	..	..	..	..	..	..	..	..	..
Libya	2	37.7	14,630	–34.8	86.5	5.7	920	–6.1	17.4	71.7	280	0.0
Lithuania	–3.7	–43.2	5,330	–34.3	29.6	34.9	2,360	–44.1	5.1	88.6	660	..
Macedonia, FYR	–0.4	–31.8	1,350	–36.9	29.6	48.1	530	–32.9	17.0	71.7	120	..
Madagascar	7.7	187.4	..	..	..	..	..	..	..	..	..	..
Malawi	4	71.3	..	..	..	..	..	..	..	..	..	..
Malaysia	6.7	232.0	46,130	65.0	69.1	12.5	18,570	8.3	4.2	52.8	1,000	66.7
Mali	2	34.8	..	..	..	..	..	..	..	..	..	..
Mauritania	–5.5	–37.5	..	..	..	..	..	..	..	..	..	..
Mauritius	6.3	163.2	..	..	..	..	..	..	..	..	..	..
Mexico	0.6	13.4	127,490	25.8	40.0	42.5	41,030	12.8	6.8	76.5	4,560	53.0
Moldova	–7.3	–66.9	3,330	–14.4	44.4	29.7	780	–51.6	5.1	74.4	10	..
Mongolia	–1.2	–6.0	5,990	–25.0	1.3	93.2	3,410	–28.4	2.1	95.3	0	..
Morocco	3.9	92.5	10,490	15.4	7.3	52.1	5,460	10.8	3.1	86.4	0	..
Mozambique	5	103.7	12,570	17.5	21.0	45.2	10,020	–5.1	3.2	66.9	290	..
Myanmar	5.6	134.5	77,410	–7.0	12.9	68.8	64,000	–15.9	1.3	19.6	0	..
Namibia	47.2	38,647.9	5,070	47.4	0.4	94.7	3,620	48.4	0.6	98.9	0	..
Nepal	8.5	411.0	22,370	9.8	6.8	82.0	4,310	24.9	12.8	78.2	0	..
Netherlands	0	0.7	21,070	–30.5	22.9	43.8	13,840	–10.3	4.8	41.6	3,740	–41.1
New Zealand	2.1	34.1	27,570	3.6	3.4	90.4	12,700	24.0	3.0	95.8	970	3.2
Nicaragua	4.7	63.9	6,010	26.5	6.3	74.9	3,150	7.1	3.2	94.6	0	..
Niger	–1.2	–11.2	..	..	..	..	..	..	..	..	..	..
Nigeria	6.1	114.4	129,790	11.7	68.8	19.9	20,550	11.4	9.9	78.0	670	179.2
Norway	3.3	28.4	16,580	55.4	75.3	12.8	4,370	–0.5	5.0	42.3	5,200	–39.4
Oman	8.5	299.8	17,850	195.0	94.1	3.0	540	92.9	27.8	70.4	180	..
Pakistan	4.5	108.1	138,400	50.5	24.2	63.0	25,710	46.5	12.6	76.5	820	–18.8
Panama	4.3	105.0	3,230	16.6	4.3	78.9	1,100	12.2	4.5	90.9	0	..
Papua New Guinea	5.9	115.7	..	..	..	..	..	..	..	..	..	..
Paraguay	3.2	76.2	15,320	2.1	3.5	84.5	9,210	–6.9	1.6	68.9	0	..
Peru	3.6	82.6	17,010	22.8	13.2	62.0	8,000	27.6	2.8	76.6	330	..
Philippines	3.4	53.5	51,340	28.8	8.4	64.4	11,660	37.8	9.0	81.0	370	131.3
Poland	–1	–8.5	60,660	–41.6	56.8	25.3	27,770	5.5	10.6	62.5	2,450	362.3
Portugal	2.4	35.2	7,720	22.3	19.8	55.8	5,160	24.6	8.3	50.4	780	609.1
Puerto Rico	..	..	..	..	..	..	..	..	..	..	..	..
Qatar	4.7	292.3	15,700	387.6	96.4	0.4	200	122.2	75.0	25.0	0	..

3.9 Trends in greenhouse gas emissions

	Carbon dioxide emissions		Methane emissions				Nitrous oxide emissions				Other greenhouse gas emissions	
	average annual % growth[a] 1990–2006	% change[b] 1990–2006	Total thousand metric tons of carbon dioxide equivalent 2005	% change[b] 1990–2005	% of total From energy processes 2005	% of total Agricultural 2005	Total thousand metric tons of carbon dioxide equivalent 2005	% change[b] 1990–2005	% of total From energy processes 2005	% of total Agricultural 2005	Total thousand metric tons of carbon dioxide equivalent 2005	% change[b] 1990–2005
Romania	–3.1	–38.0	23,270	–36.9	40.0	37.6	10,860	–44.3	5.7	58.7	740	–63.2
Russian Federation	–2.4	–33.2	557,200	–17.1	79.1	9.2	68,900	–48.6	10.4	48.4	58,600	130.4
Rwanda	1.2	16.7	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	2.3	77.4	47,790	66.9	83.9	4.0	4,680	14.7	26.7	63.9	2,190	–10.6
Senegal	2.8	33.9	6,900	38.8	6.8	70.6	3,870	37.2	3.1	93.0	0	..
Serbia[c]	0.3	–20.6	6,720	–47.7	..	59.2	4,700	–48.2	..	81.5	840	147.1
Sierra Leone	5.4	155.6	..	..	..	..	..	..	..	..	..	..
Singapore	0.4	19.8	2,190	138.0	58.9	1.4	960	500.0	15.6	3.1	2,540	408.0
Slovak Republic	–1.8	–32.0	3,800	–39.2	15.8	40.3	3,140	–36.2	13.4	39.8	390	457.1
Slovenia	0.7	–16.9	3,380	0.3	28.4	33.1	1,010	–17.2	9.9	80.2	470	–39.0
Somalia	*31*	841.0	..	..	..	..	..	..	..	..	..	..
South Africa	1.2	24.3	61,610	23.8	43.7	32.5	20,530	10.6	10.8	69.5	2,170	45.6
Spain	3	53.7	37,510	16.5	9.1	55.1	23,170	4.3	8.4	71.3	9,080	47.6
Sri Lanka	7.9	214.8	10,220	–11.5	5.4	65.2	1,830	10.2	13.1	72.7	0	..
Sudan	6.2	94.5	65,270	55.2	4.0	88.1	46,880	36.4	1.3	97.5	0	..
Swaziland	10.9	138.8	..	..	..	..	..	..	..	..	..	..
Sweden	–0.3	–0.7	11,150	1.5	8.6	28.5	5,050	–13.2	13.5	69.7	2,080	136.4
Switzerland	–0.2	–2.7	4,780	–16.0	17.4	67.2	2,000	–14.2	10.0	71.5	2,110	97.2
Syrian Arab Republic	3.6	82.8	12,530	–10.4	54.1	27.9	5,010	35.4	4.2	84.0	0	..
Tajikistan	–8.2	–73.4	3,920	–5.3	13.3	68.1	1,350	–0.7	1.5	88.1	380	–86.5
Tanzania	4.4	126.4	30,240	19.1	7.4	67.0	23,420	5.7	2.6	72.2	0	..
Thailand	5.9	184.4	80,540	6.8	14.1	68.2	20,210	13.2	17.4	71.4	1,100	–23.1
Timor-Leste	..	..	..	..	..	..	..	..	..	..	..	..
Togo	3.9	57.8	2,660	2.3	16.9	43.2	1,980	–17.2	5.1	58.1	0	..
Trinidad and Tobago	3.6	98.1	9,940	30.3	84.9	0.7	210	23.5	23.8	66.7	0	..
Tunisia	3.3	74.3	8,000	107.3	54.8	26.0	2,150	16.8	5.6	71.6	0	..
Turkey	3.5	83.8	49,970	26.9	17.5	43.2	29,790	11.7	9.0	71.6	5,070	96.5
Turkmenistan	2.7	39.3	27,950	–4.7	75.2	21.6	4,280	98.1	3.0	78.0	70	..
Uganda	7.8	230.9	..	..	..	..	..	..	..	..	..	..
Ukraine	–4.8	–53.7	66,990	–42.4	60.2	24.5	24,160	–51.3	4.4	47.9	690	213.6
United Arab Emirates	6.6	154.6	23,250	57.9	93.1	2.6	1,080	151.2	43.5	47.2	1,080	27.1
United Kingdom	–0.3	–0.9	42,290	–43.2	34.6	59.4	27,750	–44.0	8.5	65.1	10,400	96.6
United States	1.2	18.2	610,910	–3.4	32.6	31.2	257,060	–2.4	24.9	59.1	238,510	158.7
Uruguay	2	71.9	19,570	24.0	1.5	94.4	6,750	13.4	0.6	98.4	60	..
Uzbekistan	0.1	–10.1	39,530	25.3	57.2	33.8	9,630	6.9	3.4	87.4	610	..
Venezuela, RB	2.4	40.5	61,170	5.8	47.4	40.1	16,760	25.6	4.7	66.9	2,470	–24.0
Vietnam	11.8	395.8	83,660	39.9	23.3	63.4	21,660	96.6	6.3	87.3	0	..
West Bank and Gaza	*24.1*	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	4.5	–806.8	6,650	73.6	16.7	55.0	2,710	39.0	4.1	86.3	0	..
Zambia	–0.7	1.0	18,600	–30.0	3.2	61.6	30,500	–22.9	0.7	58.9	0	..
Zimbabwe	–3.2	–33.5	9,500	–5.4	10.9	73.7	5,490	–14.5	3.6	93.8	0	..
World	**1.7 w**	**34.0 w**	**7,138,440 s**	**9.9 w**	**35.4 w**	**42.5 w**	**2,827,550 s**	**4.8 w**	**8.2 w**	**63.9 w**	**715,400 s**	**123.7 w**
Low income	–1.4	–6.0	595,600	2.6	17.0	60.0	369,940	–7.3	3.0	49.5	4,120	20.8
Middle income	2.2	49.2	4,962,640	12.9	38.7	42.8	1,786,860	15.7	6.2	67.7	256,890	206.4
Lower middle income	4.1	105.7	3,085,730	20.5	36.1	45.9	1,151,140	28.2	7.0	70.1	157,820	393.5
Upper middle income	–0.3	–4.9	1,876,910	2.2	42.8	37.7	635,720	–1.8	4.8	63.3	99,070	91.0
Low & middle income	2.1	46.5	5,558,240	11.7	36.4	44.7	2,156,800	11.0	5.7	64.6	261,010	199.2
East Asia & Pacific	4.5	135.9	1,879,280	27.2	37.7	44.7	728,420	33.1	6.5	68.9	..	..
Europe & Central Asia	–2.2	–30.0	966,150	–19.6	67.4	18.5	225,390	–35.3	8.5	60.9	77,050	117.8
Latin America & Carib.	2	40.0	996,560	30.3	16.5	59.3	459,810	24.8	2.4	62.4	20,970	23.4
Middle East & N. Africa	4.2	96.4	285,030	19.8	64.4	20.8	65,390	34.9	6.3	82.7	6,720	20.9
South Asia	4.8	118.9	853,820	14.7	16.9	64.8	249,220	32.2	11.8	77.5	9,250	–12.5
Sub-Saharan Africa	2	37.4	577,400	4.7	29.0	44.9	428,570	–3.2	2.6	51.1	..	..
High income	1.1	18.0	1,580,200	4.3	32.1	35.1	670,750	–11.0	16.2	61.7	454,390	95.4
Euro area	0.2	3.8	300,030	–16.1	23.8	49.3	197,530	–18.3	7.4	60.7	83,170	36.4

a. Calculated using the least squares method, which accounts for ups and downs of all data points in the period (see *Statistical methods*). b. Calculated as the change in emission since 1990, which is the baseline for Kyoto Protocol requirements. c. Includes Kosovo and Montenegro.

Trends in greenhouse gas emissions 3.9

About the data

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

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

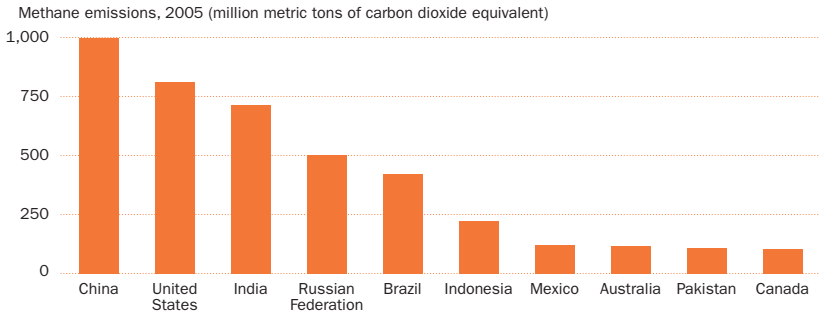
Methane emissions result largely from agricultural activities, industrial production landfills and wastewater treatment, and other sources such as tropical forest and other vegetation fires. The emissions are usually expressed in carbon dioxide equivalents using the global warming potential, which allows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

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

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

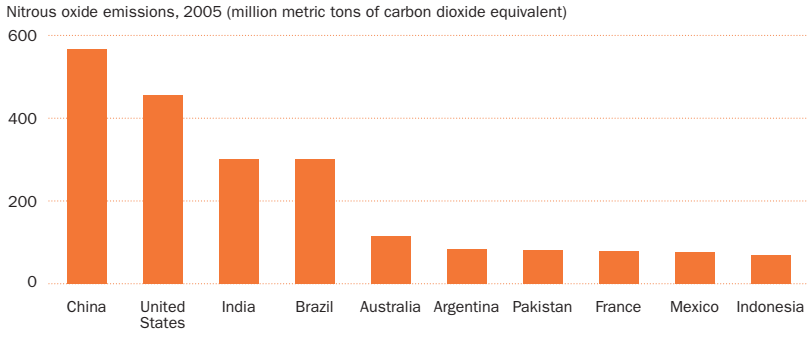
For a discussion of carbon dioxide sources and the methodology behind emissions calculation, see *About the data* for table 3.8.

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



Source: Table 3.9.

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



Source: Table 3.9.

Definitions

• **Carbon dioxide emissions** are emissions from the burning of fossil fuels and the manufacture of cement and include carbon dioxide produced during consumption of solid, liquid, and gas fuels and gas flaring. • **Methane emissions** are emissions from human activities such as agriculture and from industrial methane production. • **Methane emissions from energy processes** are emissions from the production, handling, transmission, and combustion of fossil fuels and biofuels. • **Agricultural methane emissions** are emissions from animals, animal waste, rice production, agricultural waste burning (nonenergy, on-site), and savannah burning. • **Nitrous oxide emissions** are emissions from agricultural biomass burning, industrial activities, and livestock management. • **Nitrous oxide emissions from energy processes** are emissions produced by the combustion of fossil fuels and biofuels. • **Agricultural nitrous oxide emissions** are emissions produced through fertilizer use (synthetic and animal manure), animal waste management, agricultural waste burning (nonenergy, on-site), and savannah burning. • **Other greenhouse gas emissions** are byproduct emissions of hydrofluorocarbons (byproduct emissions of fluoroform from chlorodifluoromethane manufacture and use of hydrofluorocarbons), perfluoro carbons (byproduct emissions of tetrafluoromethane and hexafluoroethane from primary aluminum production and use of perfluoro carbons, in particular for semiconductor manufacturing), and sulfur hexafluoride (various sources, the largest being the use and manufacture of gas insulated switchgear used in electricity distribution networks).

Data sources

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

3.10 Sources of electricity

	Electricity production		Sources of electricity[a]									
			% of total									
	billion kilowatt hours		Coal		Gas		Oil		Hydropower		Nuclear power	
	1990	2007	1990	2007	1990	2007	1990	2007	1990	2007	1990	2007
Afghanistan	..	..	..	..	..	..	..	..	..	..	..	..
Albania	3.2	2.9	0.0	0.0	0.0	0.0	10.9	2.5	89.1	97.5	0.0	0.0
Algeria	16.1	37.2	0.0	0.0	93.7	97.3	5.4	2.1	0.8	0.6	0.0	0.0
Angola	0.8	3.8	0.0	0.0	0.0	0.0	13.8	15.5	86.2	84.5	0.0	0.0
Argentina	50.7	115.1	1.3	2.2	39.2	54.3	9.8	9.4	35.2	26.5	14.3	6.3
Armenia	10.4	5.9	0.0	0.0	16.4	25.2	68.6	0.0	15.0	31.4	0.0	43.3
Australia	154.3	254.6	77.1	76.3	10.6	15.4	2.7	0.9	9.2	5.7	0.0	0.0
Austria	49.3	60.9	14.2	12.5	15.7	16.2	3.8	2.1	63.9	59.1	0.0	0.0
Azerbaijan	23.2	24.2	0.0	0.0	0.0	74.5	97.0	15.7	3.0	9.8	0.0	0.0
Bangladesh	7.7	24.4	0.0	0.0	84.3	87.6	4.3	6.7	11.4	5.7	0.0	0.0
Belarus	39.5	31.8	0.0	0.0	58.1	99.0	41.8	0.5	0.1	0.1	0.0	0.0
Belgium	70.3	87.5	28.2	9.5	7.7	29.0	1.9	0.9	0.4	0.4	60.8	55.1
Benin	0.0	0.1	0.0	0.0	0.0	0.0	100.0	99.2	0.0	0.8	0.0	0.0
Bolivia	2.1	5.7	0.0	0.0	37.6	42.3	5.3	14.3	55.3	40.4	0.0	0.0
Bosnia and Herzegovina	14.6	11.8	71.8	64.8	0.0	0.0	7.3	1.3	20.9	33.8	0.0	0.0
Botswana	0.9	1.1	88.1	99.5	0.0	0.0	11.9	0.5	0.0	0.0	0.0	0.0
Brazil	222.8	445.1	2.1	2.3	0.0	3.5	2.2	3.1	92.8	84.0	1.0	2.8
Bulgaria	42.1	42.9	50.3	52.3	7.6	5.4	2.9	1.3	4.5	6.7	34.8	34.1
Burkina Faso	..	..	..	..	..	..	..	..	..	..	..	..
Burundi	..	..	..	..	..	..	..	..	..	..	..	..
Cambodia	..	1.3	..	0.0	..	0.0	..	95.9	..	3.7	..	0.0
Cameroon	2.7	5.8	0.0	0.0	0.0	7.6	1.5	25.5	98.5	66.9	0.0	0.0
Canada	482.0	639.7	17.1	18.1	2.0	6.4	3.4	1.5	61.6	57.6	15.1	14.6
Central African Republic	..	..	..	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	18.4	58.5	38.3	22.7	2.1	7.9	9.2	24.6	48.5	39.5	0.0	0.0
China	621.2	3,279.2	71.3	81.0	0.4	0.9	7.9	1.0	20.4	14.8	0.0	1.9
Hong Kong SAR, China	28.9	39.0	98.3	73.3	0.0	26.5	1.7	0.2	0.0	0.0	0.0	0.0
Colombia	36.4	55.3	10.1	6.3	12.4	11.9	1.0	0.3	75.6	80.4	0.0	0.0
Congo, Dem. Rep.	5.7	8.3	0.0	0.0	0.0	0.0	0.4	0.3	99.6	99.7	0.0	0.0
Congo, Rep.	0.5	0.4	0.0	0.0	0.0	17.7	0.6	0.0	99.4	82.3	0.0	0.0
Costa Rica	3.5	9.1	0.0	0.0	0.0	0.0	2.5	8.0	97.5	74.8	0.0	0.0
Côte d'Ivoire	2.0	5.6	0.0	0.0	0.0	65.7	33.3	0.3	66.7	31.9	0.0	0.0
Croatia	9.2	12.1	6.8	20.1	20.2	25.4	31.6	19.2	41.3	35.1	0.0	0.0
Cuba	15.0	17.6	0.0	0.0	0.2	0.0	91.4	97.4	0.8	0.7	0.0	0.0
Czech Republic	62.3	87.8	76.4	62.5	0.6	3.6	0.9	0.1	1.9	2.4	20.2	29.8
Denmark	26.0	39.2	90.7	50.8	2.7	17.7	3.4	3.3	0.1	0.1	0.0	0.0
Dominican Republic	3.7	14.8	1.2	13.2	0.0	11.5	88.6	65.6	9.4	9.4	0.0	0.0
Ecuador	6.3	17.3	0.0	0.0	0.0	6.8	21.5	41.0	78.5	52.1	0.0	0.0
Egypt, Arab Rep.	42.3	125.1	0.0	0.0	39.6	68.4	36.9	18.6	23.5	12.4	0.0	0.0
El Salvador	2.2	5.8	0.0	0.0	0.0	0.0	6.9	45.7	73.5	30.0	0.0	0.0
Eritrea	*0.1*	0.3	*0.0*	0.0	*0.0*	0.0	*100.0*	99.3	*0.0*	0.0	*0.0*	0.0
Estonia	17.4	12.2	85.8	93.5	5.9	4.8	8.3	0.3	0.0	0.2	0.0	0.0
Ethiopia	1.2	3.5	0.0	0.0	0.0	0.0	11.6	3.8	88.4	96.2	0.0	0.0
Finland	54.4	81.2	18.5	17.9	8.6	13.0	3.1	0.6	20.0	17.4	35.3	28.8
France	417.2	564.4	8.5	5.0	0.7	3.9	2.1	1.1	12.9	10.3	75.3	77.9
Gabon	1.0	1.8	0.0	0.0	16.4	16.0	11.2	40.2	72.1	43.4	0.0	0.0
Gambia, The	..	..	..	..	..	..	..	..	..	..	..	..
Georgia	13.7	8.3	0.0	0.0	15.6	17.9	29.2	0.3	55.2	81.8	0.0	0.0
Germany	547.7	629.5	58.7	49.3	7.4	11.6	1.9	1.8	3.2	3.3	27.8	22.3
Ghana	5.7	7.0	0.0	0.0	0.0	0.0	0.0	46.6	100.0	53.4	0.0	0.0
Greece	34.8	62.7	72.4	55.3	0.3	22.0	22.3	15.4	5.1	4.1	0.0	0.0
Guatemala	2.3	8.8	0.0	12.8	0.0	0.0	9.0	30.1	76.0	41.5	0.0	0.0
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	0.6	0.5	0.0	0.0	0.0	0.0	20.6	67.2	76.5	32.8	0.0	0.0
Honduras	2.3	6.3	0.0	0.0	0.0	0.0	1.7	62.3	98.3	35.1	0.0	0.0

Sources of electricity 3.10

	Electricity production		Sources of electricity[a]									
	billion kilowatt hours		% of total									
			Coal		Gas		Oil		Hydropower		Nuclear power	
	1990	2007	1990	2007	1990	2007	1990	2007	1990	2007	1990	2007
Hungary	28.4	40.0	30.5	18.7	15.7	38.1	4.8	1.3	0.6	0.5	48.3	36.7
India	289.4	803.4	66.2	68.4	3.4	8.3	3.5	4.1	24.8	15.4	2.1	2.1
Indonesia	33.3	142.2	31.5	44.9	2.3	15.7	42.7	26.5	20.2	7.9	0.0	0.0
Iran, Islamic Rep.	59.1	204.0	0.0	0.0	52.5	78.6	37.3	12.5	10.3	8.8	0.0	0.0
Iraq	24.0	33.2	0.0	0.0	0.0	0.0	89.2	98.5	10.8	1.5	0.0	0.0
Ireland	14.2	27.9	41.6	19.7	27.7	55.5	10.0	7.1	4.9	2.4	0.0	0.0
Israel	20.9	53.8	50.1	69.5	0.0	19.7	49.9	10.8	0.0	0.0	0.0	0.0
Italy	213.1	308.2	16.8	16.1	18.6	56.0	48.2	11.5	14.8	10.6	0.0	0.0
Jamaica	2.5	7.8	0.0	0.0	0.0	0.0	92.4	95.9	3.6	2.1	0.0	0.0
Japan	835.5	1,123.5	14.0	27.7	20.0	25.8	18.5	9.8	10.7	6.6	24.2	23.5
Jordan	3.6	13.0	0.0	0.0	11.9	76.4	87.8	23.0	0.3	0.5	0.0	0.0
Kazakhstan	87.4	76.6	71.1	70.3	10.5	10.7	10.0	8.3	8.4	10.7	0.0	0.0
Kenya	3.2	6.8	0.0	0.0	0.0	0.0	7.1	28.8	76.6	51.4	0.0	0.0
Korea, Dem. Rep.	27.7	21.5	40.1	34.8	0.0	0.0	3.6	3.5	56.3	61.7	0.0	0.0
Korea, Rep.	105.4	425.9	16.8	40.1	9.1	19.3	17.9	5.9	6.0	0.9	50.2	33.6
Kosovo	..	..	..	..	..	..	..	..	..	..	..	..
Kuwait	18.5	48.8	0.0	0.0	45.7	27.7	54.3	72.3	0.0	0.0	0.0	0.0
Kyrgyz Republic	15.7	16.2	13.1	3.3	23.5	10.8	0.0	0.0	63.5	85.9	0.0	0.0
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	6.6	4.8	0.0	0.0	26.1	40.3	5.4	0.4	67.6	57.3	0.0	0.0
Lebanon	1.5	9.6	0.0	0.0	0.0	0.0	66.7	93.9	33.3	6.1	0.0	0.0
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..
Liberia	..	..	..	..	..	..	..	..	..	..	..	..
Libya	10.2	25.7	0.0	0.0	0.0	44.9	100.0	55.1	0.0	0.0	0.0	0.0
Lithuania	28.4	13.5	0.0	0.0	23.8	17.9	14.6	2.1	1.5	3.1	60.0	73.0
Macedonia, FYR	5.8	6.7	89.7	77.9	0.0	0.0	1.8	7.1	8.5	15.0	0.0	0.0
Madagascar	..	..	..	..	..	..	..	..	..	..	..	..
Malawi	..	..	..	..	..	..	..	..	..	..	..	..
Malaysia	23.0	101.3	12.3	29.5	22.0	62.0	48.4	2.0	17.3	6.4	0.0	0.0
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	..	..	..	..	..	..	..	..	..	..	..	..
Mexico	124.1	257.5	6.3	12.3	11.6	48.8	56.7	20.3	18.9	10.6	2.4	4.0
Moldova	16.2	3.8	30.8	0.0	42.3	98.2	25.4	0.0	1.6	0.9	0.0	0.0
Mongolia	3.5	3.8	92.4	96.1	0.0	0.0	7.6	3.9	0.0	0.0	0.0	0.0
Morocco	9.6	22.9	23.0	57.1	0.0	13.6	64.4	22.3	12.7	5.8	0.0	0.0
Mozambique	0.5	16.1	13.9	0.0	0.0	0.1	23.6	0.0	62.6	99.9	0.0	0.0
Myanmar	2.5	6.5	1.6	0.0	39.3	41.6	10.9	4.5	48.1	53.9	0.0	0.0
Namibia	1.4	1.7	1.5	7.1	0.0	0.0	3.3	0.5	95.2	92.3	0.0	0.0
Nepal	0.9	2.8	0.0	0.0	0.0	0.0	0.1	0.4	99.9	99.6	0.0	0.0
Netherlands	71.9	103.2	38.3	27.6	50.9	57.2	4.3	2.1	0.1	0.1	4.9	4.1
New Zealand	32.3	43.8	1.9	7.1	17.6	27.3	0.0	0.0	72.3	53.6	0.0	0.0
Nicaragua	1.4	3.2	0.0	0.0	0.0	0.0	39.8	71.1	28.8	9.5	0.0	0.0
Niger	..	..	..	..	..	..	..	..	..	..	..	..
Nigeria	13.5	23.0	0.1	0.0	53.7	67.2	13.7	4.9	32.6	27.9	0.0	0.0
Norway	121.6	136.4	0.1	0.1	0.0	0.5	0.0	0.0	99.6	98.2	0.0	0.0
Oman	4.5	14.4	0.0	0.0	81.6	82.0	18.4	18.0	0.0	0.0	0.0	0.0
Pakistan	37.7	95.7	0.1	0.1	33.6	34.4	20.6	32.2	44.9	30.0	0.8	3.2
Panama	2.7	6.5	0.0	0.0	0.0	0.0	14.7	43.1	83.2	56.6	0.0	0.0
Papua New Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Paraguay	27.2	53.7	0.0	0.0	0.0	0.0	0.0	0.0	99.9	100.0	0.0	0.0
Peru	13.8	29.9	0.0	2.8	1.7	24.3	21.5	6.0	75.8	65.3	0.0	0.0
Philippines	27.4	59.6	7.0	28.2	0.0	32.6	45.3	7.5	22.1	14.4	0.0	0.0
Poland	134.4	158.8	97.5	93.0	0.1	1.9	1.2	1.5	1.1	1.5	0.0	0.0
Portugal	28.4	46.9	32.1	26.4	0.0	28.0	33.1	10.4	32.3	21.5	0.0	0.0
Puerto Rico	..	..	..	..	..	..	..	..	..	..	..	..
Qatar	4.8	16.1	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0	0.0	0.0

3.10 Sources of electricity

	Electricity production		Sources of electricity[a]									
	billion kilowatt hours		% of total									
	Coal		Gas		Oil		Hydropower		Nuclear power			
	1990	2007	1990	2007	1990	2007	1990	2007	1990	2007	1990	2007
Romania	64.3	61.7	28.8	41.0	35.1	18.7	18.4	1.8	17.7	25.9	0.0	12.5
Russian Federation	1,082.2	1,013.4	14.3	16.7	47.3	48.0	11.9	1.7	15.3	17.5	10.9	15.8
Rwanda	..	..	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	69.2	189.1	0.0	0.0	48.1	44.8	51.9	55.2	0.0	0.0	0.0	0.0
Senegal	0.9	2.0	0.0	0.0	2.3	2.0	93.0	83.1	0.0	10.8	0.0	0.0
Serbia	40.9[b]	36.5	69.1[b]	70.2	3.2[b]	1.1	4.6[b]	1.3	23.1[b]	27.5	0.0[b]	0.0
Sierra Leone	..	..	..	..	..	..	..	..	..	..	..	..
Singapore	15.7	41.1	0.0	0.0	0.0	78.7	100.0	21.3	0.0	0.0	0.0	0.0
Slovak Republic	25.5	27.9	31.9	18.7	7.1	5.8	6.4	2.5	7.4	16.0	47.2	55.0
Slovenia	12.4	15.0	31.3	36.5	0.0	3.0	7.9	0.2	23.7	21.7	37.1	37.9
Somalia	..	..	..	..	..	..	..	..	..	..	..	..
South Africa	165.4	260.5	94.3	94.7	0.0	0.0	0.0	0.4	0.6	0.4	5.1	4.3
Spain	151.2	300.2	40.1	24.8	1.0	30.8	5.7	6.2	16.8	9.2	35.9	18.4
Sri Lanka	3.2	9.9	0.0	0.0	0.0	0.0	0.2	59.9	99.8	39.9	0.0	0.0
Sudan	1.5	4.5	0.0	0.0	0.0	0.0	36.8	68.0	63.2	32.0	0.0	0.0
Swaziland	..	..	..	..	..	..	..	..	..	..	..	..
Sweden	146.0	148.8	1.1	0.9	0.3	0.6	0.9	0.7	49.7	44.5	46.7	45.0
Switzerland	55.0	66.5	0.1	0.0	0.6	1.1	0.7	0.3	54.2	53.0	43.0	42.0
Syrian Arab Republic	11.6	38.6	0.0	0.0	20.5	31.2	56.0	59.7	23.5	9.1	0.0	0.0
Tajikistan	18.1	17.5	0.0	0.0	9.1	2.2	0.0	0.0	90.9	97.8	0.0	0.0
Tanzania	1.6	4.2	0.0	2.7	0.0	36.2	4.9	0.9	95.1	60.1	0.0	0.0
Thailand	44.2	143.4	25.0	21.4	40.2	67.3	23.5	2.7	11.3	5.7	0.0	0.0
Timor-Leste	..	..	..	..	..	..	..	..	..	..	..	..
Togo	0.2	0.2	0.0	0.0	0.0	0.0	39.9	48.0	60.1	46.9	0.0	0.0
Trinidad and Tobago	3.6	7.7	0.0	0.0	99.0	99.6	0.1	0.2	0.0	0.0	0.0	0.0
Tunisia	5.8	14.7	0.0	0.0	63.7	83.1	35.5	16.2	0.8	0.3	0.0	0.0
Turkey	57.5	191.6	35.1	27.9	17.7	49.6	6.9	3.4	40.2	18.7	0.0	0.0
Turkmenistan	14.6	14.9	0.0	0.0	95.2	100.0	0.0	0.0	4.8	0.0	0.0	0.0
Uganda	..	..	..	..	..	..	..	..	..	..	..	..
Ukraine	298.6	196.1	38.2	34.2	16.7	13.0	16.1	0.4	3.5	5.2	25.5	47.2
United Arab Emirates	17.1	76.1	0.0	0.0	96.3	98.1	3.7	1.9	0.0	0.0	0.0	0.0
United Kingdom	317.8	392.3	65.0	35.3	1.6	41.9	10.9	1.2	1.6	1.3	20.7	16.1
United States	3,202.8	4,322.9	53.1	49.0	11.9	21.2	4.1	1.8	8.5	5.8	19.1	19.4
Uruguay	7.4	9.4	0.0	0.0	0.0	0.0	5.1	13.0	94.2	85.6	0.0	0.0
Uzbekistan	56.3	49.0	7.4	5.0	76.4	70.6	4.4	11.3	11.8	13.1	0.0	0.0
Venezuela, RB	59.3	114.9	0.0	0.0	26.2	16.3	11.5	11.4	62.3	72.3	0.0	0.0
Vietnam	8.7	69.5	23.1	21.4	0.1	32.1	15.0	3.5	61.8	43.0	0.0	0.0
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	1.7	6.0	0.0	0.0	0.0	0.0	100.0	100.0	0.0	0.0	0.0	0.0
Zambia	8.0	9.9	0.5	0.2	0.0	0.0	0.3	0.4	99.2	99.4	0.0	0.0
Zimbabwe	9.4	9.2	53.3	43.0	0.0	0.0	0.0	0.3	46.7	56.8	0.0	0.0
World	**11,847.9 t**	**19,818.9 t**	**37.3 w**	**41.5 w**	**14.6 w**	**20.8 w**	**10.3 w**	**5.3 w**	**18.0 w**	**15.5 w**	**17.0 w**	**13.7 w**
Low income	210.5	336.8	11.6	8.7	26.5	25.1	4.2	7.7	41.2	41.9	0.0	0.0
Middle income	4,066.0	8,665.5	34.9	49.1	20.8	18.9	14.5	5.8	22.5	19.8	6.2	4.7
Lower middle income	1,672.0	5,425.0	46.8	62.7	10.8	11.8	16.3	5.4	19.9	15.2	4.9	3.3
Upper middle income	2,393.6	3,244.0	26.5	26.3	27.8	30.7	13.2	6.4	24.3	27.5	7.1	7.2
Low & middle income	4,271.6	9,008.7	33.8	47.5	21.1	19.1	14.0	5.9	23.4	20.6	5.9	4.6
East Asia & Pacific	796.3	3,851.0	61.0	73.3	3.4	6.7	12.6	2.3	21.4	14.7	0.0	1.6
Europe & Central Asia	2,076.4	1,991.2	27.8	29.2	34.3	37.4	12.9	2.3	13.8	16.2	10.9	14.4
Latin America & Carib.	606.2	1,245.6	3.9	5.2	9.2	19.8	18.9	13.3	63.5	55.8	2.1	2.4
Middle East & N. Africa	187.9	536.9	1.2	2.4	36.9	61.6	48.3	27.0	12.4	7.4	0.0	0.0
South Asia	341.7	944.1	56.1	58.2	8.5	12.8	5.3	7.6	27.4	17.0	1.9	2.1
Sub-Saharan Africa	260.2	432.3	62.2	58.3	2.8	5.0	1.9	3.7	15.9	16.9	3.2	2.6
High income	7,595.3	10,858.4	39.2	36.2	10.9	22.2	8.3	4.7	14.9	11.1	23.2	21.3
Euro area	1,694.1	2,326.1	33.7	25.2	8.6	22.0	9.6	4.3	11.1	9.1	35.6	31.5

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

Sources of electricity

About the data

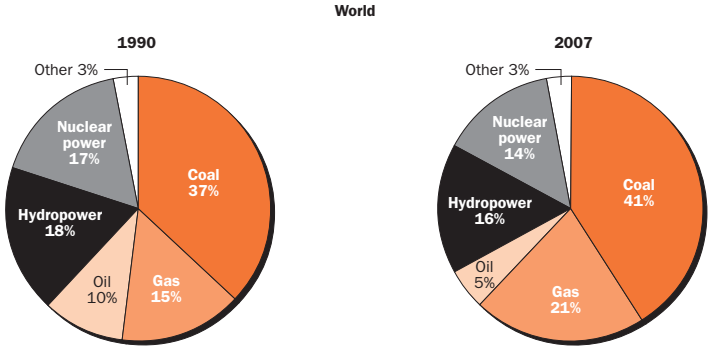
Use of energy is important in improving people's standard of living. But electricity generation also can damage the environment. Whether such damage occurs depends largely on how electricity is generated. For example, burning coal releases twice as much carbon dioxide—a major contributor to global warming—as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

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

Definitions

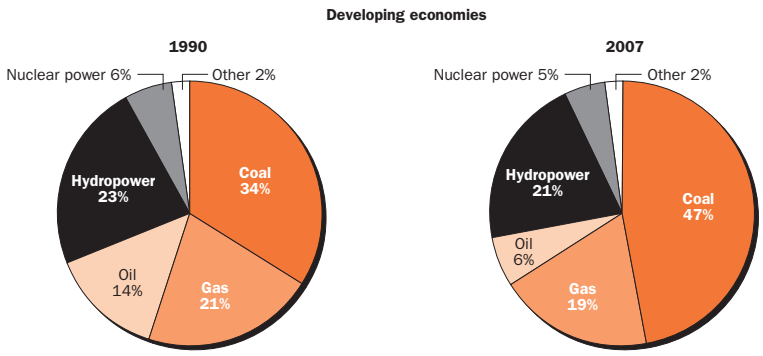
• **Electricity production** is measured at the terminals of all alternator sets in a station. In addition to hydropower, coal, oil, gas, and nuclear power generation, it covers generation by geothermal, solar, wind, and tide and wave energy as well as that from combustible renewables and waste. Production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

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



Source: Table 3.10.

. . . with developing economies relying more on coal **3.10b**



Source: Table 3.10.

Data sources

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

3.11 Urbanization

	Urban population					Population in urban agglomerations of more than 1 million		Population in largest city		Access to improved sanitation facilities			
	millions		% of total population		average annual % growth	% of total population		% of urban population		% of urban population		% of rural population	
	1990	2008	1990	2008	1990–2008	1990	2007	1990	2007	1990	2006	1990	2006
Afghanistan	..	..	..	..	..	..	..	..	..	..	..	..	..
Albania	1.2	1.5	36	47	1.1	..	..	..	..	97	98	..	97
Algeria	13.2	22.4	52	65	3.0	8	10	14	15	99	98	77	87
Angola	4.0	10.2	37	57	5.3	15	23	40	41	55	79	9	16
Argentina	28.3	36.7	87	92	1.4	39	39	37	35	86	92	45	83
Armenia	2.4	2.0	68	64	–1.1	33	36	49	56	94	96	..	81
Australia	14.6	19.0	85	89	1.5	60	61	25	23	100	100	100	100
Austria	5.1	5.6	66	67	0.5	27	28	41	41	100	100	100	100
Azerbaijan	3.8	4.5	54	52	0.9	24	22	45	43	..	90	..	70
Bangladesh	22.9	43.4	20	27	3.6	8	12	29	32	56	48	18	32
Belarus	6.7	7.1	66	73	0.3	16	19	24	26	..	91	..	97
Belgium	9.6	10.4	96	97	0.5	10	17	10	17	..	..	..	..
Benin	1.7	3.6	35	41	4.3	..	..	..	..	32	59	2	11
Bolivia	3.7	6.4	56	66	3.0	25	32	29	26	47	54	15	22
Bosnia and Herzegovina	1.7	1.8	39	47	0.3	..	..	..	..	99	99	..	92
Botswana	0.6	1.1	42	60	3.9	..	..	..	..	60	60	22	30
Brazil	111.9	164.3	75	86	2.1	34	39	13	12	82	84	37	37
Bulgaria	5.8	5.4	66	71	–0.4	14	16	21	22	100	100	96	96
Burkina Faso	1.2	3.0	14	20	5.0	..	8	49	41	23	41	2	6
Burundi	0.4	0.8	6	10	4.7	..	..	..	..	41	44	44	41
Cambodia	1.2	3.1	13	22	5.2	6	10	49	49	..	62	2	19
Cameroon	5.0	10.8	41	57	4.3	14	19	19	18	47	58	34	42
Canada	21.3	26.8	77	80	1.3	40	44	18	20	100	100	99	99
Central African Republic	1.1	1.7	37	39	2.4	..	..	..	..	21	40	5	25
Chad	1.3	2.9	21	27	4.6	..	..	38	35	19	23	1	4
Chile	11.0	14.9	83	88	1.7	35	34	42	39	91	97	48	74
China	311.0	570.9	27	43	3.4	13	18	3	3	61	74	43	59
Hong Kong SAR, China	5.7	7.0	100	100	1.1	100	100	100	100	..	..	..	..
Colombia	22.7	33.5	68	75	2.2	32	35	22	23	81	85	39	58
Congo, Dem. Rep.	10.3	21.8	28	34	4.2	15	17	35	37	53	42	1	25
Congo, Rep.	1.3	2.2	54	61	2.8	29	38	53	63	..	19	..	21
Costa Rica	1.6	2.9	51	63	3.4	24	29	47	46	96	96	92	95
Côte d'Ivoire	5.0	10.0	40	49	3.9	17	19	42	39	39	38	8	12
Croatia	2.6	2.5	54	57	–0.1	..	..	..	..	99	99	98	98
Cuba	7.8	8.5	73	76	0.5	20	19	27	26	99	99	95	95
Czech Republic	7.8	7.7	75	74	–0.1	12	11	16	16	100	100	98	98
Denmark	4.4	4.8	85	87	0.5	26	20	31	23	100	100	100	100
Dominican Republic	4.1	6.9	55	69	2.9	21	22	37	32	77	81	57	74
Ecuador	5.7	8.8	55	66	2.5	26	32	28	29	88	91	50	72
Egypt, Arab Rep.	25.1	34.8	44	43	1.8	21	20	36	35	68	85	37	52
El Salvador	2.6	3.7	49	61	1.9	18	23	37	39	88	90	59	80
Eritrea	0.5	1.0	16	21	4.0	..	..	..	..	20	14	0	3
Estonia	1.1	0.9	71	69	–1.0	..	..	..	..	96	96	94	94
Ethiopia	6.1	13.7	13	17	4.5	4	4	29	22	19	27	2	8
Finland	3.1	3.4	61	63	0.5	17	21	28	34	100	100	100	100
France	42.0	48.2	74	77	0.8	23	22	22	21	..	..	..	..
Gabon	0.6	1.2	69	85	3.6	..	..	..	..	..	37	..	30
Gambia, The	0.3	0.9	38	56	5.6	..	..	..	..	..	50	..	55
Georgia	3.0	2.3	55	53	–1.6	22	25	41	48	96	94	91	92
Germany	58.1	60.5	73	74	0.2	8	9	6	6	100	100	100	100
Ghana	5.4	11.7	36	50	4.2	13	16	22	19	11	15	3	6
Greece	6.0	6.9	59	61	0.8	30	29	51	48	100	99	93	97
Guatemala	3.7	6.6	41	49	3.3	..	8	22	16	87	90	58	79
Guinea	1.7	3.4	28	34	3.8	15	16	52	46	19	33	10	12
Guinea-Bissau	0.3	0.5	28	30	2.7	..	..	..	..	..	48	..	26
Haiti	2.0	4.6	29	47	4.6	16	21	56	45	49	29	20	12
Honduras	2.0	3.5	40	48	3.2	..	..	29	29	68	78	29	55

3.11 Urbanization

	Urban population					Population in urban agglomerations of more than 1 million		Population in largest city		Access to improved sanitation facilities			
	millions		% of total population		average annual % growth	% of total population		% of urban population		% of urban population		% of rural population	
	1990	2008	1990	2008	1990–2008	1990	2007	1990	2007	1990	2006	1990	2006
Hungary	6.8	6.8	66	68	0.0	19	17	29	25	100	100	100	100
India	216.6	336.7	26	30	2.5	10	11	6	6	44	52	4	18
Indonesia	54.3	117.0	31	51	4.3	9	9	14	8	73	67	42	37
Iran, Islamic Rep.	30.6	49.3	56	68	2.6	23	23	21	16	86	..	78	..
Iraq	13.2	..	70	..	..	26	..	31	..	75	..	..	..
Ireland	2.0	2.7	57	61	1.7	26	25	46	40	..	..	..	..
Israel	4.2	6.7	90	92	2.6	43	60	48	49	100	100	..	..
Italy	37.8	40.7	67	68	0.4	19	17	9	8	..	..	..	..
Jamaica	1.2	1.4	49	53	1.1	..	..	..	..	82	82	83	84
Japan	78.0	84.9	63	66	0.5	46	48	42	42	100	100	100	100
Jordan	2.3	4.6	72	78	3.9	27	18	37	*30*	..	88	..	71
Kazakhstan	9.2	9.1	56	58	–0.1	7	8	12	14	97	97	96	98
Kenya	4.3	8.4	18	22	3.7	6	8	32	37	18	19	44	48
Korea, Dem. Rep.	11.8	14.9	58	63	1.3	15	19	21	22	..	..	..	..
Korea, Rep.	31.6	39.6	74	81	1.2	51	48	33	25	..	..	..	..
Kosovo	..	..	..	..	..	..	..	..	..	..	..	..	..
Kuwait	2.1	2.7	98	98	1.4	65	72	67	74	..	..	..	..
Kyrgyz Republic	1.7	1.9	38	36	0.8	..	..	38	*43*	..	94	..	93
Lao PDR	0.6	1.9	15	31	6.0	..	..	..	..	..	87	..	38
Latvia	1.9	1.5	69	68	–1.0	..	..	..	..	..	82	..	71
Lebanon	2.5	3.6	83	87	2.2	43	44	52	51	100	100	..	..
Lesotho	0.2	0.5	14	25	4.7	..	..	..	..	..	43	30	34
Liberia	1.0	2.3	45	60	4.7	..	29	54	48	59	49	24	7
Libya	3.3	4.9	76	78	2.2	48	55	45	46	97	97	96	96
Lithuania	2.5	2.2	68	67	–0.6	..	..	..	..	..	..	..	..
Macedonia, FYR	1.1	1.4	58	67	1.2	..	..	..	..	..	92	..	81
Madagascar	2.7	5.6	24	30	4.2	8	9	36	31	15	18	6	10
Malawi	1.1	2.8	12	19	5.2	..	..	..	..	50	51	46	62
Malaysia	9.0	19.0	50	70	4.1	6	5	12	8	95	95	..	93
Mali	2.0	4.1	23	32	3.9	9	12	37	38	53	59	30	39
Mauritania	0.8	1.3	40	41	2.9	..	..	..	..	33	44	11	10
Mauritius	0.5	0.5	44	42	0.8	..	..	..	..	95	95	94	94
Mexico	59.4	82.1	71	77	1.8	32	34	26	23	74	91	8	48
Moldova	2.0	1.5	47	42	–1.7	..	..	..	..	..	85	..	73
Mongolia	1.3	1.5	57	57	1.0	..	..	45	*60*	..	64	..	31
Morocco	12.0	17.7	48	56	2.2	16	19	22	18	80	85	25	54
Mozambique	2.9	8.2	21	37	5.9	6	7	27	18	..	53	12	19
Myanmar	10.2	16.1	25	33	2.6	7	8	28	26	47	85	15	81
Namibia	0.4	0.8	28	37	3.8	..	..	..	..	73	66	8	18
Nepal	1.7	5.0	9	17	6.0	..	..	23	*19*	36	45	6	24
Netherlands	10.3	13.5	69	82	1.5	14	12	10	8	100	100	100	100
New Zealand	2.9	3.7	85	87	1.3	25	30	30	34	..	..	88	..
Nicaragua	2.2	3.2	52	57	2.2	18	*21*	34	*38*	59	57	23	34
Niger	1.2	2.4	15	17	3.8	..	..	35	*40*	16	27	1	3
Nigeria	34.4	73.1	35	48	4.2	11	14	14	13	33	35	22	25
Norway	3.1	3.7	72	77	1.1	..	..	22	*22*	..	..	..	..
Oman	1.2	2.0	66	72	2.7	..	..	..	..	97	97	61	..
Pakistan	33.0	60.1	31	36	3.3	16	18	22	21	76	90	14	40
Panama	1.3	2.5	54	73	3.6	35	38	65	53	..	78	..	63
Papua New Guinea	0.6	0.8	15	13	1.6	..	..	..	..	67	67	41	41
Paraguay	2.1	3.8	49	60	3.3	22	30	45	51	88	89	34	42
Peru	15.0	20.6	69	71	1.8	27	28	39	39	73	85	15	36
Philippines	30.5	58.7	49	65	3.6	14	14	26	19	71	81	46	72
Poland	23.4	23.4	61	61	0.0	4	4	7	7	..	..	..	..
Portugal	4.7	6.3	48	59	1.6	37	39	54	45	97	99	88	98
Puerto Rico	2.6	3.9	72	98	2.3	44	67	60	69	..	..	..	..
Qatar	0.4	1.2	92	96	5.8	..	..	..	..	100	100	100	100

3.11 Urbanization

	Urban population					Population in urban agglomerations of more than 1 million		Population in largest city		Access to improved sanitation facilities			
	millions		% of total population		average annual % growth	% of total population		% of urban population		% of urban population		% of rural population	
	1990	2008	1990	2008	1990–2008	1990	2007	1990	2007	1990	2006	1990	2006
Romania	12.3	11.7	53	54	–0.3	8	9	14	17	88	88	52	54
Russian Federation	108.8	103.4	73	73	–0.3	18	18	8	10	93	93	70	70
Rwanda	0.4	1.8	5	18	8.5	..	..	57	49	31	34	29	20
Saudi Arabia	12.5	20.3	77	82	2.7	30	40	19	22	100	100	..	..
Senegal	2.9	5.2	39	42	3.1	18	22	47	52	52	54	9	9
Serbia	3.8	3.8	50	52	0.0	..	11	..	21	..	96[a]	..	88[a]
Sierra Leone	1.3	2.1	33	38	2.5	..	..	40	43	..	20	..	5
Singapore	3.0	4.8	100	100	2.6	99	100	99	100	100	100	..	..
Slovak Republic	3.0	3.1	57	57	0.1	..	..	..	..	100	100	99	99
Slovenia	1.0	1.0	50	49	–0.1	..	..	..	..	..	..	..	..
Somalia	2.0	3.3	30	37	2.8	14	13	48	35	..	51	..	7
South Africa	18.3	29.6	52	61	2.7	25	33	10	12	64	66	45	49
Spain	29.3	35.1	75	77	1.0	22	24	15	16	100	100	100	100
Sri Lanka	2.9	3.0	17	15	0.2	..	..	..	..	85	89	68	86
Sudan	7.2	18.0	27	43	5.1	9	12	33	28	53	50	26	24
Swaziland	0.2	0.3	23	25	2.1	..	..	..	..	..	64	..	46
Sweden	7.1	7.8	83	85	0.5	17	14	21	16	100	100	100	100
Switzerland	4.9	5.6	73	73	0.7	14	15	19	20	100	100	100	100
Syrian Arab Republic	6.2	11.2	49	54	3.2	26	31	25	25	94	96	69	88
Tajikistan	1.7	1.8	32	26	0.4	..	..	..	..	..	95	..	91
Tanzania	4.8	10.8	19	26	4.5	5	7	27	28	29	31	36	34
Thailand	16.7	22.5	29	33	1.7	10	10	35	30	92	95	72	96
Timor-Leste	0.2	0.3	21	27	3.7	..	..	..	..	..	64	..	32
Togo	1.2	2.7	30	42	4.6	16	23	53	56	25	24	8	3
Trinidad and Tobago	0.1	0.2	9	13	3.0	..	..	..	..	93	92	93	92
Tunisia	4.7	6.9	58	67	2.1	..	..	..	..	95	96	44	64
Turkey	33.2	50.8	59	69	2.4	22	27	20	20	96	96	69	72
Turkmenistan	1.7	2.5	45	49	2.2	..	..	..	..	..	..	..	..
Uganda	2.0	4.1	11	13	4.1	4	5	38	36	27	29	29	34
Ukraine	34.7	31.4	67	68	–0.5	12	11	7	9	98	97	93	83
United Arab Emirates	1.5	3.5	79	78	4.8	25	31	32	40	98	98	95	95
United Kingdom	50.8	55.2	89	90	0.5	26	26	15	16	..	..	..	..
United States	188.0	248.4	75	82	1.5	41	43	9	8	100	100	99	99
Uruguay	2.8	3.1	89	92	0.6	41	45	46	49	100	100	99	99
Uzbekistan	8.2	10.1	40	37	1.1	10	8	25	22	97	97	91	95
Venezuela, RB	16.6	26.1	84	93	2.5	34	32	17	12	90	..	47	..
Vietnam	13.4	24.0	20	28	3.2	13	13	30	22	62	88	21	56
West Bank and Gaza	1.3	2.8	68	72	4.1	..	..	..	..	..	84	..	69
Yemen, Rep.	2.6	7.0	21	31	5.6	5	9	25	30	79	88	14	30
Zambia	3.1	4.5	39	35	2.0	10	11	24	31	49	55	38	51
Zimbabwe	3.0	4.7	29	37	2.4	10	13	35	34	65	63	35	37
World	**2,257.4 s**	**3,330.6 s**	**43 w**	**50 w**	**2.2 w**	**18 w**	**20 w**	**17 w**	**16 w**	**76 w**	**78 w**	**34 w**	**44 w**
Low income	148.4	280.4	23	29	3.5	9	11	31	31	48	52	19	33
Middle income	1,435.2	2,238.0	39	48	2.5	15	18	14	12	71	75	32	43
Lower middle income	891.8	1,528.3	31	41	3.0	..	..	11	10	62	69	30	41
Upper middle income	543.4	709.7	68	75	1.5	24	27	18	18	86	89	52	63
Low & middle income	1,583.6	2,518.4	37	45	2.6	14	17	16	14	69	73	30	41
East Asia & Pacific	461.3	851.6	29	44	3.4	..	..	9	7	65	75	42	59
Europe & Central Asia	271.1	281.4	63	64	0.2	15	16	13	14	95	94	77	79
Latin America & Carib.	308.2	445.0	71	79	2.0	32	34	24	22	81	86	35	51
Middle East & N. Africa	117.5	186.4	52	57	2.6	20	20	27	24	83	89	50	59
South Asia	280.7	455.6	25	29	2.7	10	12	10	11	49	57	8	23
Sub-Saharan Africa	144.9	298.4	28	36	4.0	..	13	26	25	41	42	20	24
High income	673.7	812.1	73	78	1.0	..	..	20	19	100	100	99	99
Euro area	213.0	238.7	71	73	0.6	18	18	15	15	..	..	..	..

a. Includes Kosovo.

About the data

There is no consistent and universally accepted standard for distinguishing urban from rural areas, in part because of the wide variety of situations across countries (see *About the data* for table 3.1). Most countries use an urban classification related to the size or characteristics of settlements. Some define urban areas based on the presence of certain infrastructure and services. And other countries designate urban areas based on administrative arrangements.

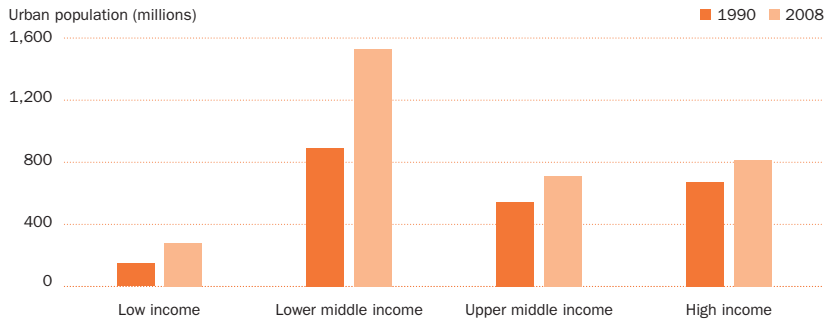
The population of a city or metropolitan area depends on the boundaries chosen. For example, in 1990 Beijing, China, contained 2.3 million people in 87 square kilometers of "inner city" and 5.4 million in 158 square kilometers of "core city." The population of "inner city and inner suburban districts"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

Estimates of the world's urban population would change significantly if China, India, and a few other populous nations were to change their definition of urban centers. According to China's State Statistical Bureau, by the end of 1996 urban residents accounted for about 43 percent of China's population, more than double the 20 percent considered urban in 1994. In addition to the continuous migration of people from rural to urban areas, one of the main reasons for this shift was the rapid growth in the hundreds of towns reclassified as cities in recent years.

Because the estimates in the table are based on national definitions of what constitutes a city or metropolitan area, cross-country comparisons should be made with caution. To estimate urban populations, UN ratios of urban to total population were applied to the World Bank's estimates of total population (see table 2.1).

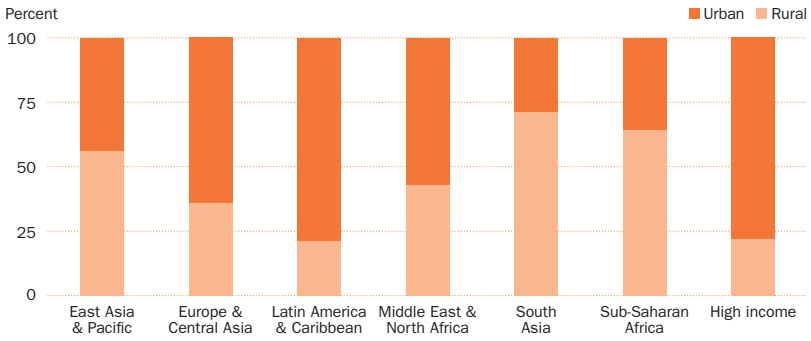
The table shows access to improved sanitation facilities for both urban and rural populations to allow comparison of access. Definitions of access and urban areas vary, however, so comparisons between countries can be misleading.

Urban population nearly doubled in low- and lower middle-income economies between 1990 and 2008 3.11a



Source: Table 3.11.

Latin America and the Caribbean had the same share of urban population as high-income economies in 2008 3.11b



Source: Tables 3.1 and 3.11.

Definitions

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

Data sources

Data on urban population and the population in urban agglomerations and in the largest city are from the United Nations Population Division's *World Urbanization Prospects: The 2007 Revision.* Data on total population are World Bank estimates. Data on access to sanitation are from the World Health Organization and United Nations Children's Fund's *Progress on Drinking Water and Sanitation* (2008).

3.12 Urban housing conditions

	Census year	Household size		Overcrowding		Durable dwelling units		Home ownership		Multiunit dwellings		Vacancy rate	
		number of people		Households living in overcrowded dwellings[a] % of total		Buildings with durable structure % of total		Privately owned dwellings % of total		% of total		Unoccupied dwellings % of total	
		National	Urban	National	Urban	National	Urban	National	Urban	National	Urban	National	Urban
Afghanistan		..	..	..	..	..	..	..	..	..	..	..	..
Albania	2001	4.2	3.9	..	..	..	..	65[b]	30[b]	..	..	12	13
Algeria	1998	4.9	..	..	..	..	..	67	..	..	..	19	..
Angola		..	..	..	..	..	..	..	..	..	..	..	..
Argentina	2001	3.6	..	19	..	97	..	..	..	4	..	16[b]	..
Armenia	2001	4.1	4.0	4	6	93	93	95	90	1	1	..	..
Australia	2001	3.8	..	1	..	..	..	..	..	..	..	..	..
Austria	2001	2.4	..	2	..	..	..	48	..	..	..	..	..
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	2005	5.0	4.9	35	32	79	88	58	57	27	32	..	..
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 SAR, China		..	..	..	..	..	..	..	..	..	..	..	..
Colombia	1993	4.8	..	27[b]	..	83[b]	..	68[b]	..	13	..	10[b]	..
Congo Dem Rep	1984	5.4	..	55	..	..	..	..	..	..	..	..	..
Congo Rep	1984	10.5	..	..	..	..	..	76	..	..	..	..	..
Costa Rica	2000	4.0	..	22	..	88	..	72	..	2	3	9	6
Côte D'Ivoire	1998	5.4	..	..	..	..	..	..	..	..	..	..	..
Croatia	2001	3.0	..	..	..	..	..	..	..	..	..	12	..
Cuba	1981	4.2	4.2	..	..	..	..	..	..	15	21	0	0
Czech Republic	2001	2.4	..	..	..	..	..	52	..	49	..	12	..
Denmark	2001	2.2	..	..	..	..	..	..	..	..	..	..	..
Dominican Republic	2002	3.9	..	..	..	97	..	..	..	8	..	11	..
Ecuador	2001	3.5	3.7	30	..	81	88	68[b]	58[b]	9	14	12	7
Egypt	1996	4.7	..	..	..	..	..	..	..	75	..	..	..
El Salvador	1992	..	..	63	..	67	83	70	68	3	6	11	11
Eritrea		..	..	..	..	..	..	..	..	..	..	..	..
Estonia	2000	2.4	2.3	3	..	..	..	..	..	72	..	13	..
Ethiopia	1994	4.8	4.7	..	..	..	23	..	54	..	..	..	..
Finland	2000	2.2	..	..	..	..	..	64	..	44	..	..	..
France	1999	2.5	..	..	..	..	..	55	..	..	..	7	..
Gabon	2003	5.2	..	..	..	..	..	..	..	..	..	..	..
Gambia	1993	8.9	..	..	..	18	..	68	..	..	..	..	..
Georgia	2002	3.5	3.5	..	..	..	..	..	..	..	..	..	..
Germany	2001	2.3	..	..	..	..	..	43	..	..	..	7	..
Ghana	2000	5.1	5.1	..	..	45	..	57	..	53	..	5	..
Greece	2001	3.0	..	1	..	..	..	..	..	..	..	..	..
Guatemala	2002	4.4	4.7	..	..	67	80	81	74	2	4	13	11
Guinea	1996	6.7	..	63	..	..	..	76	..	..	..	..	..
Guinea-Bissau		..	..	..	..	..	..	..	..	..	..	..	..
Haiti	1982	4.2	..	26	..	..	..	92	68	..	..	9	19
Honduras	2001	4.4	..	..	..	69	85	..	..	..	..	14	..

Urban housing conditions

	Census year	Household size		Overcrowding		Durable dwelling units		Home ownership		Multiunit dwellings		Vacancy rate	
		number of people		Households living in overcrowded dwellings[a] % of total		Buildings with durable structure % of total		Privately owned dwellings % of total		% of total		Unoccupied dwellings % of total	
		National	Urban	National	Urban	National	Urban	National	Urban	National	Urban	National	Urban
Hungary	2001	2.6	..	2	..	..	..	..	..	..	..	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	2004	5.3	5.1	35	34	..	..	64	60	72	80	..	..
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	..	..	..	..	..	..	..	..	..	..	..
Kosovo		..	..	..	..	..	..	..	..	..	..	..	..
Kuwait	1995	6.4	..	..	..	..	..	..	..	9[b]	..	11	..
Kyrgyz Republic	1999	4.4	3.6	..	..	..	..	..	..	..	..	..	..
Laos	1995	6.1	6.1	..	..	49	77	96	86	..	..	..	..
Latvia	2000	3.0	2.6	4	..	88	..	58	..	74	..	0	..
Lebanon		..	..	..	..	..	..	..	..	..	..	..	..
Lesotho	2001	5.0	..	10[b]	..	..	..	84	..	0	..	..	..
Liberia	1974	4.8	..	31	..	20	..	1	..	..	..	..	..
Libya		6.4	..	..	..	..	..	..	..	..	..	7	..
Lithuania	2001	2.6	..	7	..	..	..	..	..	..	..	..	..
Macedonia, FYR	2002	3.6	3.6[b]	8[b]	..	95[b]	95[b]	48[b]	..	..	..	7[b]	3[b]
Madagascar	1993	4.9	4.8	64	57	..	..	81	59	..	..	..	..
Malawi	1998	4.4	4.4	30	..	48	84	86	47	..	..	..	..
Malaysia	2000	4.5	4.4	..	..	..	..	..	..	10[b]	16[b]	..	..
Mali	1998	5.6	..	..	..	..	..	..	..	..	..	..	..
Mauritania	1988	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	2000	3.9	3.8	6	7	91	94	87	81	..	..	7	6
Mexico	2005	4.0	3.9	24	20	..	..	..	..	..	..	3	2
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	2000	4.9	..	..	..	..	..	71	..	12			
Poland	1988	3.2	..	..	..	..	..	..	..	..	..	1	..
Portugal	2001	2.8	..	..	..	..	..	76	..	86	..	..	..
Puerto Rico	1990	3.3	..	..	..	..	..	72	..	..	..	11	..
Qatar		..	..	..	..	..	..	..	..	..	..	..	..

3.12 Urban housing conditions

	Census year	Household size		Overcrowding		Durable dwelling units		Home ownership		Multiunit dwellings		Vacancy rate	
		number of people		Households living in overcrowded dwellings[a] % of total		Buildings with durable structure % of total		Privately owned dwellings % of total		% of total		Unoccupied dwellings % of total	
		National	Urban	National	Urban	National	Urban	National	Urban	National	Urban	National	Urban
Romania	2002	2.9	2.8	20	20	..	..	84	72	..	..	..	..
Russia	2002	2.8	2.7	7	5	..	..	..	..	73	86	..	..
Rwanda	2002	4.4	3.7	43	36	13	31	79	41	36	60	..	..
Saudi Arabia	2004	5.5	..	..	..	92[b]	..	43	..	..	..	..	..
Senegal		..	..	..	..	..	..	..	..	..	..	..	..
Serbia	2001	2.9	2.2	..	..	..	..	..	..	..	..	..	..
Sierra Leone	1985	6.8	..	..	..	34	..	68	..	..	..	..	..
Singapore	2000	4.4	..	..	..	..	..	..	..	..	..	..	..
Slovak Republic		..	..	..	..	..	..	..	..	..	..	..	..
Slovenia	2002	2.8	2.7	14	17	..	..	91	87	33	56	..	..
Somalia	1975	..	..	..	..	..	..	..	..	..	..	..	..
South Africa	2007	3.0	2.8	16	15	..	..	43	40	..	..	..	..
Spain	2001	2.9	..	1	..	..	..	82	..	..	..	..	..
Sri Lanka	2001	3.8	..	..	..	93[b]	92[b]	70[b]	58[b]	1	14[b]	13	1[b]
Sudan	1993	5.8	6.0	..	..	..	..	86[b]	58[b]	0[b]	1[b]	..	..
Swaziland	1997	5.4	3.7	..	..	..	..	..	..	..	..	..	..
Sweden	1990	2.0	..	..	..	..	..	..	..	54	..	1	..
Switzerland	1990	2.4	2.1	..	..	..	..	31	24	28	32	11	7
Syrian Arab Republic	1981	6.3	6.0	..	..	..	..	..	..	..	..	..	..
Tajikistan	2000	..	..	..	..	..	..	..	..	..	..	..	..
Tanzania	2002	4.9	4.5[b]	33[b]	7[b]	..	..	82[b]	43[b]	..	..	..	..
Thailand	2000	3.8	..	..	..	93	93	81	62	3	..	3	..
Timor-Leste		..	..	..	..	..	..	..	..	..	..	..	..
Togo		..	..	..	..	..	..	..	..	..	..	..	..
Trinidad and Tobago	2000	3.7	..	9[b]	..	98[b]	..	74[b]	..	17[b]	..	..	..
Tunisia	1994	8.0	..	..	..	99	..	71	89[b]	6	10[b]	15	12[b]
Turkey	1990	5.0	..	..	..	..	..	70	..	..	..	..	..
Turkmenistan		..	..	..	..	..	..	..	..	..	..	..	..
Uganda	2002	4.7	3.9	..	..	19	61	76	28	37	71	..	..
Ukraine	2003	..	..	..	..	..	..	..	..	..	..	..	..
United Arab Emirates		..	..	..	..	..	..	..	..	..	..	..	..
United Kingdom	2001	..	2.4	..	..	..	..	..	69	..	19	..	..
United States	2005	2.5	..	0	..	..	..	74	..	26	..	..	..
Uruguay	1996	3.3	3.4[b]	22[b]	..	..	..	57[b]	57[b]	..	..	13[b]	13[b]
Uzbekistan		..	..	..	..	..	..	..	..	..	..	..	..
Venezuela. RB	2001	4.4	..	..	..	..	..	78	..	14	..	16	..
Vietnam	1999	4.6	4.5	..	..	77	89	95	86	..	..	..	..
West Bank and Gaza	1997	7.1	..	..	..	..	..	78	..	45	..	..	..
Yemen	1994	6.7	6.8	54[b]	6[b]	..	..	88[b]	68[b]	3[b]	11[b]	..	..
Zambia	2000	5.3	5.9	..	..	..	..	94	30	..	..	..	..
Zimbabwe	1992	4.8	4.2	..	..	..	..	94	30	6	..	..	..

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

Urban housing conditions

About the data

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

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

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

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

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

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

Definitions

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

Data sources

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

3.13 Traffic and congestion

	Motor vehicles		Passenger cars	Road density	Road sector energy consumption				Fuel price		Particulate matter concentration	
	per 1,000 people	per kilometer of road	per 1,000 people	km. of road per 100 sq. km. of land area	% of total consumption	kilograms of oil equivalent Per capita	Diesel fuel	Gasoline fuel	$ per liter Super grade gasoline	Diesel	Urban-population-weighted PM10 micrograms per cubic meter	
	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	1990	2006
Afghanistan	23	9	15	6	..	..	..	..	1.05	0.96	78	41
Albania	102	15	75	63	29	198	151	42	1.36	1.31	92	44
Algeria	91	27	58	5	16	170	91	61	0.34	0.20	115	71
Angola	40	..	8	..	11	68	41	24	0.53	0.39	142	66
Argentina	314	..	..	8	19	343	172	102	0.78	0.58	105	73
Armenia	105	42	96	25	6	58	0	55	1.08	1.11	453	59
Australia	653	17	545	11	19	1,103	315	664	0.74	0.94	23	15
Austria	556	43	511	128	23	933	646	233	1.37	1.43	38	33
Azerbaijan	61	10	57	68	10	134	30	92	0.74	0.56	226	60
Bangladesh	2	..	1	166	5	8	5	2	1.17	0.70	231	135
Belarus	282	..	240	46	5	147	86	50	1.33	1.06	23	6
Belgium	539	37	471	499	14	762	599	131	1.50	1.34	30	22
Benin	21	..	17	17	22	77	27	46	1.03	1.03	75	46
Bolivia	68	7	18	6	26	149	67	53	0.68	0.53	120	94
Bosnia and Herzegovina	170	..	152	43	15	230	143	80	1.13	1.18	36	19
Botswana	113	7	56	4	26	283	96	172	0.88	1.02	95	67
Brazil	198	18	158	20	23	281	143	72	1.26	1.03	40	23
Bulgaria	295	63	257	37	12	315	175	78	1.28	1.37	111	57
Burkina Faso	11	..	7	34	..	..	..	..	1.38	1.33	151	84
Burundi	6	..	2	48	..	..	..	..	1.39	1.23	56	29
Cambodia	..	..	..	22	8	27	15	11	0.94	0.89	86	46
Cameroon	..	..	11	11	9	37	14	20	1.14	1.04	116	62
Canada	597	14	372	14	16	1,341	328	914	0.76	0.90	25	17
Central African Republic	0	..	0	..	..	..	..	..	1.44	1.44	62	44
Chad	6	2	..	3	..	..	..	..	1.30	1.32	217	109
Chile	164	..	103	..	18	338	187	134	0.95	0.95	88	48
China	32	12	22	36	5	72	29	40	0.99	1.01	114	73
Hong Kong SAR, China	72	247	54	184	11	209	152	48	1.95	1.16	..	..
Colombia	66	16	38	15	24	159	79	65	1.04	0.73	39	22
Congo, Dem. Rep.	5	..	..	..	1	3	0	3	1.23	1.21	73	47
Congo, Rep.	26	..	15	5	23	80	51	26	0.81	0.57	135	64
Costa Rica	152	18	118	72	30	322	160	145	1.24	1.10	45	36
Côte d'Ivoire	..	..	7	25	4	18	11	6	1.33	1.20	94	36
Croatia	377	58	336	51	21	445	260	160	1.27	1.37	44	30
Cuba	38	..	21	..	3	26	19	5	1.67	1.51	44	17
Czech Republic	470	38	414	163	13	576	344	203	1.37	1.45	67	21
Denmark	466	35	370	168	22	799	446	326	1.54	1.54	30	19
Dominican Republic	123	..	62	..	20	161	57	96	1.04	0.94	44	20
Ecuador	63	19	38	15	33	288	134	139	0.51	0.27	38	25
Egypt, Arab Rep.	..	..	29	9	16	138	80	48	0.49	0.20	223	119
El Salvador	84	..	41	..	19	151	76	67	0.78	0.81	46	33
Eritrea	11	..	6	..	5	8	8	1	2.53	1.07	118	56
Estonia	444	10	390	128	13	559	302	240	1.18	1.30	45	13
Ethiopia	3	4	1	3	5	15	12	2	0.92	0.89	112	68
Finland	559	37	483	23	11	782	417	340	1.57	1.39	23	18
France	600	39	498	172	16	691	501	147	1.52	1.45	18	13
Gabon	..	..	..	3	9	117	87	25	1.14	0.90	10	8
Gambia, The	7	3	5	33	..	..	..	..	0.79	0.75	144	86
Georgia	116	16	95	29	20	150	48	93	1.09	1.16	208	47
Germany	623	80	566	181	15	623	304	250	1.56	1.56	27	19
Ghana	33	9	21	25	13	52	23	27	0.90	0.90	39	34
Greece	112	47	429	89	21	597	198	367	1.23	1.41	67	36
Guatemala	117	..	..	..	24	150	76	66	0.86	0.82	63	62
Guinea	..	..	..	10	..	..	..	..	1.02	1.02	108	70
Guinea-Bissau	33	1	27	12	..	..	..	..	0.00	0.00	119	72
Haiti	..	..	..	..	9	25	0	23	1.16	0.89	70	37
Honduras	97	..	69	..	22	149	85	57	0.80	0.80	45	43

3.13 Traffic and congestion

	Motor vehicles		Passenger cars	Road density	Road sector energy consumption				Fuel price		Particulate matter concentration	
	per 1,000 people	per kilometer of road	per 1,000 people	km. of road per 100 sq. km. of land area	% of total consumption	kilograms of oil equivalent Per capita	Diesel fuel	Gasoline fuel	$ per liter Super grade gasoline	Diesel	Urban-population-weighted PM10 micrograms per cubic meter	
	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	1990	2006
Hungary	384	20	300	210	16	423	252	152	1.27	1.38	36	19
India	*12*	*3*	*8*	1,001	6	33	21	9	1.09	0.70	112	65
Indonesia	76	*62*	42	*20*	12	99	32	62	0.60	0.46	137	83
Iran, Islamic Rep.	16	..	13	*10*	19	497	214	242	0.53[a]	0.03	86	51
Iraq	..	..	..	..	30	332	186	131	*0.03*	*0.01*	146	115
Ireland	537	*20*	437	*132*	31	1,064	610	417	1.56	1.64	25	16
Israel	305	122	251	81	16	504	163	314	*1.47*	*1.27*	71	31
Italy	677	*81*	601	*162*	22	659	415	199	1.57	1.63	42	27
Jamaica	*188*	*24*	*138*	201	11	198	0	185	0.74	0.84	59	43
Japan	595	64	325	316	14	572	195	340	1.74	1.54	43	30
Jordan	137	101	94	9	23	295	125	162	0.61	0.61	110	45
Kazakhstan	170	28	141	3	5	234	22	200	0.83	0.72	43	19
Kenya	21	*10*	15	*11*	6	29	16	11	1.20	1.14	67	36
Korea, Dem. Rep.	..	..	..	*21*	2	17	9	7	0.76	0.95	165	68
Korea, Rep.	338	161	248	103	13	573	297	151	*1.65*	*1.33*	51	35
Kosovo	..	..	..	..	..	..	..	..	..	..	..	..
Kuwait	502	*181*	282	*32*	13	1,232	302	860	0.24	0.20	75	97
Kyrgyz Republic	59	9	44	..	9	51	0	49	0.80	0.88	75	22
Lao PDR	21	*10*	2	*13*	..	..	..	..	0.92	0.76	91	49
Latvia	459	15	398	108	25	511	305	178	1.12	1.23	38	16
Lebanon	..	..	..	67	26	252	2	234	0.76	0.76	43	36
Lesotho	..	..	..	..	..	..	..	..	0.79	0.93	86	41
Liberia	3	..	2	..	..	..	..	..	0.74	1.03	61	40
Libya	291	..	225	..	19	536	313	198	0.14	0.12	106	88
Lithuania	479	0	470	124	18	485	267	123	1.13	1.22	53	19
Macedonia, FYR	136	20	122	54	13	190	106	56	1.15	1.12	46	21
Madagascar	..	..	..	..	..	..	..	..	1.55	1.43	78	34
Malawi	9	..	4	*16*	..	..	..	..	1.78	1.67	75	33
Malaysia	*272*	*72*	*225*	*28*	18	505	180	306	0.53	0.53	37	23
Mali	9	..	7	*1*	..	..	..	..	1.30	1.10	274	152
Mauritania	..	..	..	*1*	..	..	..	..	1.49	1.06	147	86
Mauritius	150	93	115	99	..	..	..	..	*0.74*	*0.56*	23	18
Mexico	244	71	167	18	26	455	119	299	0.74	0.54	69	36
Moldova	120	36	89	38	9	78	50	22	1.20	1.04	97	36
Mongolia	61	*2*	42	*3*	13	150	7	133	1.38	1.42	198	110
Morocco	71	38	53	13	23	105	88	13	1.29	0.83	34	21
Mozambique	10	..	7	..	5	20	14	5	1.71	1.37	111	28
Myanmar	7	..	6	*4*	8	26	17	8	0.43	0.52	107	58
Namibia	109	*4*	52	*5*	37	278	78	173	0.78	0.88	74	47
Nepal	5	..	3	*12*	3	10	7	2	1.13	0.82	67	34
Netherlands	503	*62*	441	*372*	14	711	394	255	1.68	1.45	46	34
New Zealand	729	33	615	35	27	1,062	450	558	1.09	0.85	16	14
Nicaragua	48	*13*	18	*14*	15	92	53	36	0.87	0.82	48	28
Niger	*5*	*4*	*4*	1	..	..	..	..	0.99	0.97	220	132
Nigeria	31	..	31	*21*	7	50	5	41	0.59	1.13	175	45
Norway	572	29	458	29	14	773	449	293	1.63	1.63	24	15
Oman	225	12	174	16	10	582	53	492	0.31	0.38	148	108
Pakistan	11	*8*	9	*34*	13	66	45	9	0.84	0.77	224	120
Panama	188	..	131	..	16	136	0	127	0.67	0.68	58	35
Papua New Guinea	9	..	6	..	..	..	..	..	0.94	0.90	34	21
Paraguay	82	..	39	..	27	185	147	29	1.17	0.96	106	77
Peru	52	*16*	33	*6*	25	124	87	26	1.42	0.99	98	54
Philippines	32	*14*	11	*67*	20	90	56	29	0.91	0.81	55	23
Poland	451	66	383	83	14	365	197	106	1.43	1.40	59	37
Portugal	*507*	*67*	*471*	*90*	24	578	398	150	1.61	1.47	51	23
Puerto Rico	642	..	614	*289*	..	..	..	..	*0.65*	*0.78*	27	21
Qatar	724	..	*335*	*68*	9	2	1	1	*0.22*	*0.19*	57	51

3.13 Traffic and congestion

	Motor vehicles		Passenger cars	Road density	Road sector energy consumption				Fuel price		Particulate matter concentration	
	per 1,000 people	per kilometer of road	per 1,000 people	km. of road per 100 sq. km. of land area	% of total consumption	kilograms of oil equivalent Per capita	Diesel fuel	Gasoline fuel	$ per liter Super grade gasoline	Diesel	Urban-population-weighted PM10 micrograms per cubic meter	
	2007	2007	2007	2007	2007	2007	2007	2007	2008	2008	1990	2006
Romania	*180*	*20*	*156*	..	10	188	111	67	1.11	1.22	36	14
Russian Federation	245	*35*	206	*5*	6	291	69	202	0.89	0.86	41	18
Rwanda	4	..	2	*57*	..	..	..	..	1.37	1.37	49	26
Saudi Arabia	..	*20*	*415*	*10*	20	1,230	553	615	0.16	0.09	161	113
Senegal	20	..	15	*7*	19	42	35	6	1.35	1.26	97	95
Serbia	*244*	*46*	*204*	*44*	..	..	..	..	1.11	1.29	33[b]	15[b]
Sierra Leone	5	*2*	3	*16*	..	..	..	..	0.91	0.91	92	50
Singapore	149	207	113	472	9	527	325	179	1.07	0.90	106	41
Slovak Republic	282	*35*	272	*89*	11	354	214	114	1.57	1.68	41	15
Slovenia	547	29	505	191	23	838	502	305	1.18	1.26	*40*	30
Somalia	..	..	..	..	..	..	..	..	1.12	1.15	78	31
South Africa	159	..	108	..	11	303	119	172	0.87	0.95	34	21
Spain	601	*35*	485	*132*	23	749	573	149	1.23	1.28	42	32
Sri Lanka	58	*11*	18	*148*	21	96	65	25	1.43	0.75	94	82
Sudan	28	..	20	..	14	51	33	16	0.65	0.45	296	165
Swaziland	89	*25*	46	*21*	..	..	..	..	0.86	0.93	56	33
Sweden	523	11	465	95	15	807	354	394	1.38	1.52	15	12
Switzerland	569	60	524	173	22	746	259	457	1.30	1.52	37	26
Syrian Arab Republic	52	26	22	21	21	198	115	74	0.85	0.53	159	75
Tajikistan	38	..	29	..	39	224	0	214	1.03	1.00	103	50
Tanzania	12	..	2	*8*	5	24	18	6	1.11	1.30	57	25
Thailand	..	..	*54*	*35*	17	269	172	78	0.87	0.64	88	71
Timor-Leste	..	..	..	..	..	..	..	..	1.22	1.35	..	..
Togo	2	..	2	..	9	34	15	17	0.89	0.88	57	35
Trinidad and Tobago	351	..	..	..	5	546	203	314	0.36	*0.24*	142	101
Tunisia	103	*49*	73	*12*	17	151	101	41	0.96	0.84	74	30
Turkey	131	*20*	88	*55*	14	193	125	33	1.87	1.63	68	40
Turkmenistan	106	..	81	..	5	179	0	170	0.22	0.20	177	55
Uganda	7	..	3	*17*	..	..	..	..	1.30	1.22	28	12
Ukraine	140	39	128	28	6	173	52	112	0.88	0.96	72	21
United Arab Emirates	313	..	293	*5*	16	1,867	958	819	0.37	0.52	266	127
United Kingdom	527	76	463	172	19	662	345	288	1.44	1.65	25	15
United States	*814*[c]	*31*	*461*[c,d]	*68*	23	1,785	422	1,218	0.56	0.78	30	21
Uruguay	*176*	..	*151*	*102*	26	250	164	71	1.18	1.17	237	175
Uzbekistan	..	..	..	..	3	58	9	43	1.35	0.75	85	55
Venezuela, RB	147	..	107	..	24	553	81	416	0.02	0.01	22	11
Vietnam	13	7	13	49	13	86	48	35	0.80	0.77	123	55
West Bank and Gaza	16	*18*	16	..	..	..	..	..	1.34	1.25	..	..
Yemen, Rep.	35	..	..	*14*	26	83	15	59	0.30	0.17	..	..
Zambia	18	..	11	..	4	25	11	14	1.70	1.61	96	40
Zimbabwe	106	..	91	*25*	4	29	17	11	1.30	1.05	35	27
World	**183 w**	**.. w**	**132 w**	**.. w**	**14 w**	**262 w**	**103 w**	**138 w**	**1.11 m**	**1.03 m**	**80 w**	**50 w**
Low income	12	..	8	..	7	31	15	15	1.13	1.03	120	65
Middle income	85	..	61	*89*	10	125	55	59	0.91	0.90	96	57
Lower middle income	*18*	*10*	*14*	240	8	81	39	37	0.87	0.82	121	69
Upper middle income	206	..	155	..	14	296	118	142	1.11	1.01	55	32
Low & middle income	70	..	51	..	10	112	49	52	1.03	0.95	98	58
East Asia & Pacific	36	12	23	36	7	87	38	45	0.92	0.85	112	69
Europe & Central Asia	219	*30*	182	*9*	8	232	88	121	1.13	1.12	63	27
Latin America & Carib.	175	..	119	*18*	23	292	117	133	0.87	0.83	59	35
Middle East & N. Africa	..	..	*32*	..	20	250	125	107	0.61	0.53	125	73
South Asia	*12*	*3*	*8*	1,001	7	34	22	8	1.09	0.76	134	78
Sub-Saharan Africa	30	..	24	..	8	56	23	31	1.14	1.06	114	53
High income	621	*41*	434	*76*	19	1,019	372	568	1.28	1.37	37	26
Euro area	588	*66*	*418*[e]	*123*	18	686	432	207	1.54	1.44	33	23

a. $1.12 for consumption below 120 liters a month. b. Includes Montenegro. c. Data are from the U.S. Federal Highway Administration. d. Excludes personal passenger vans, passenger minivans, and utility-type vehicles, which are all treated as trucks. e. Data are from the European Commission and the European Road Federation.

Traffic and congestion

About the data

Traffic congestion in urban areas constrains economic productivity, damages people's health, and degrades the quality of life. In recent years ownership of passenger cars has increased, and the expansion of economic activity has led to more goods and services being transported by road over greater distances (see table 5.10). These developments have increased demand for roads and vehicles, adding to urban congestion, air pollution, health hazards, and traffic accidents and injuries. Congestion, the most visible cost of expanding vehicle ownership, is reflected in the indicators in the table. Other relevant indicators—such as average vehicle speed and the economic cost of traffic congestion—are not included because data are incomplete or difficult to compare.

The data in the table—except those on fuel prices and particulate matter—are compiled by the International Road Federation (IRF) through questionnaires sent to national organizations. Primary sources are national road associations. If they lack data or do not respond, other agencies are contacted, including road directorates, ministries of transport or public works, and central statistical offices. As a result, data quality is uneven. Coverage of each indicator may differ across countries because of different definitions. The IRF is taking steps to improve the quality of the data in its *World Road Statistics 2009*. Because this effort covers only 2002–07, time series data may not be comparable. Another reason is coverage. For example, the 2005 estimate for U.S. passenger cars from the U.S. Federal Highway Administration excludes personal passenger vans, passenger minivans, and utility-type vehicles. Road density is a rough indicator of accessibility and does not capture road width, type, or condition. Thus comparisons over time and across countries require caution.

Road sector energy consumption includes energy from petroleum products, natural gas, renewable and combustible waste, and electricity. Biodiesel and biogasoline, forms of renewable energy, are biodegradable and emit less sulfur and carbon monoxide than petroleum-derived fuels. They can be produced from vegetable oils, such as soybean, corn, palm, peanut, or sunflower oil, and can be used directly only in a modified internal combustion engine.

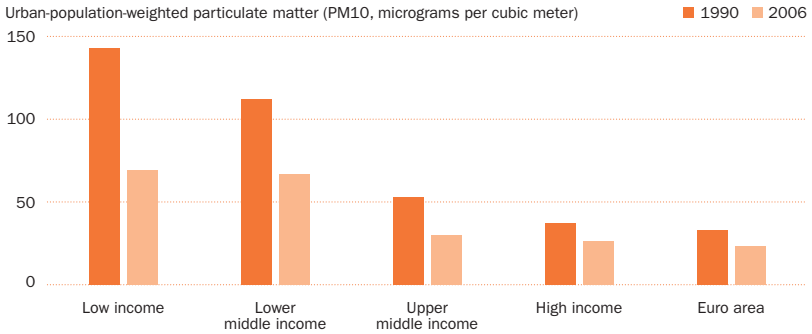
Data on fuel prices are compiled by the German Agency for Technical Cooperation (GTZ), from its global network and other sources, including the Allgemeiner Deutscher Automobile Club (for Europe) and the Latin American Energy Organization (for Latin America). Local prices are converted to U.S. dollars using the exchange rate in the *Financial Times* international monetary table on the survey date. When multiple exchange rates exist, the market, parallel, or black market rate is used. Prices were compiled in mid-November 2008, when crude oil prices had dropped to $48 a barrel Brent (from a high of $148 in July).

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

Definitions

• **Motor vehicles** include cars, buses, and freight vehicles but not two-wheelers. Population figures are midyear population in the year for which data are available. Roads refer to motorways (a road designed and built for motor traffic that separates the traffic flowing in opposite directions), highways, main or national roads, and secondary or regional roads. • **Passenger cars** are road motor vehicles, other than two-wheelers, intended for the carriage of passengers and designed to seat no more than nine people (including the driver). • **Road density** is the ratio of the length of the country's total road network to the country's land area. It includes all roads in the country—motorways, highways, main or national roads, secondary or regional roads, and other urban and rural roads. • **Road sector energy consumption** is the total energy used in the road sector from all sources, including energy from petroleum products, natural gas, combustible and renewable waste, and electricity (see table 3.7). • **Gasoline** is light hydrocarbon oil use in internal combustion engines such as motor vehicles, excluding aircraft. • **Diesel** is heavy oils used as a fuel for internal combustion in diesel engines and heating installations. • **Fuel price** is the pump price of super grade gasoline (usually 95 octane) and diesel fuel, converted from the local currency to U.S. dollars (see *About the data*). • **Particulate matter concentration** is fine suspended particulates of less than 10 microns in diameter (PM10) that are capable of penetrating deep into the respiratory tract and causing severe health damage. Data are urban-population-weighted PM10 levels in residential areas of cities with more than 100,000 residents. The estimates represent the average annual exposure level of the average urban resident to outdoor particulate matter.

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



Source: Table 3.13.

Data sources

Data on vehicles and road density are from the IRF's electronic files and its annual *World Road Statistics,* except where noted. Data on road sector energy consumption are from the IRF and the International Energy Agency. Data on fuel prices are from the GTZ's electronic files. Data on particulate matter concentrations are from Pandey and others' "Ambient Particulate Matter Concentrations in Residential and Pollution Hotspot Areas of World Cities: New Estimates Based on the Global Model of Ambient Particulates (GMAPS)" (2006b).

3.14 Air pollution

	City	City population	Particulate matter concentration	Sulfur dioxide	Nitrogen dioxide
		thousands	Urban-population-weighted PM10 micrograms per cubic meter	micrograms per cubic meter	micrograms per cubic meter
		2007	2006	2001[a]	2001[a]
Argentina	Córdoba	1,452	55	..	97
Australia	Melbourne	3,728	12	..	30
	Perth	1,532	12	5	19
	Sydney	4,327	19	28	81
Austria	Vienna	2,315	39	14	42
Belgium	Brussels	1,743	25	20	48
Brazil	Rio de Janeiro	11,748	29	129	..
	São Paulo	18,845	34	43	83
Bulgaria	Sofia	1,185	63	39	122
Canada	Montréal	3,678	17	10	42
	Toronto	5,213	20	17	43
	Vancouver	2,146	12	14	37
Chile	Santiago	5,720	54	29	81
China	Anshan	1,639	83	115	88
	Beijing	11,106	90	90	122
	Changchun	3,183	75	21	64
	Chengdu	4,123	87	77	74
	Chongqing	6,461	124	340	70
	Dalian	3,167	50	61	100
	Guangzhou	8,829	64	57	136
	Guiyang	3,662	71	424	53
	Harbin	3,621	77	23	30
	Jinan	2,798	95	132	45
	Kunming	2,931	71	19	33
	Lanzhou	2,561	92	102	104
	Liupanshui	1,221	60	102	..
	Nanchang	2,350	79	69	29
	Pingxiang	*905*	67	75	..
	Quingdao	*2,817*	62	190	64
	Shanghai	14,987	74	53	73
	Shenyang	4,787	102	99	73
	Taiyuan	*2,794*	89	211	55
	Tianjin	7,180	126	82	50
	Wulumqi	*2,025*	57	60	70
	Wuhan	7,243	80	40	43
	Zhengzhou	2,636	98	63	95
	Zibo	3,061	75	198	43
Colombia	Bogotá	7,772	30	..	..
Croatia	Zagreb	*908*	32	31	..
Cuba	Havana	2,174	20	1	5
Czech Republic	Prague	1,162	21	14	33
Denmark	Copenhagen	1,085	19	7	54
Ecuador	Guayaquil	2,514	23	15	..
	Quito	1,701	30	22	..
Egypt, Arab Rep.	Cairo	11,893	149	69	..
Finland	Helsinki	1,115	19	4	35
France	Paris	9,904	11	14	57
Germany	Berlin	3,406	21	18	26
	Frankfurt	668	18	11	45
	Munich	1,275	19	8	53
Ghana	Accra	2,121	33	..	..
Greece	Athens	3,242	38	34	64
Hungary	Budapest	1,679	20	39	51
Iceland	Reykjavik	*164*	18	5	42
India	Ahmadabad	5,375	76	30	21
	Bengaluru	6,787	41	..	..

About the data

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

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

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

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

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

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

Air pollution 3.14

	City	City population	Particulate matter concentration	Sulfur dioxide	Nitrogen dioxide
		thousands	Urban-population-weighted PM10 micrograms per cubic meter	micrograms per cubic meter	micrograms per cubic meter
		2007	2006	2001[a]	2001[a]
India	Chennai	7,163	34	15	17
	Delhi	15,926	136	24	41
	Hyderabad	6,376	37	12	17
	Kanpur	3,162	99	15	14
	Kolkata	14,787	116	49	34
	Lucknow	2,695	99	26	25
	Mumbai	18,978	57	33	39
	Nagpur	2,454	50	6	13
	Pune	4,672	42	..	..
Indonesia	Jakarta	9,125	84	..	..
Iran, Islamic Rep.	Tehran	7,873	50	209	..
Ireland	Dublin	1,059	16	20	..
Italy	Milan	2,945	30	31	248
	Rome	3,339	29	..	..
	Turin	1,652	43	..	..
Japan	Osaka-Kobe	11,294	33	19	63
	Tokyo	35,676	38	18	68
	Yokohama	*3,366*	29	100	13
Kenya	Nairobi	3,010	40	..	..
Korea, Rep.	Pusan	3,480	35	60	51
	Seoul	9,796	37	44	60
	Taegu	2,460	40	81	62
Malaysia	Kuala Lumpur	1,448	23	24	..
Mexico	Mexico City	19,028	48	74	130
Netherlands	Amsterdam	1,031	34	10	58
New Zealand	Auckland	1,245	13	3	20
Norway	Oslo	*802*	18	8	43
Philippines	Manila	11,100	28	33	..
Poland	Katowice	*2,914*	39	83	79
	Lódz	*776*	38	21	43
	Warsaw	1,707	42	16	32
Portugal	Lisbon	2,812	21	8	52
Romania	Bucharest	1,942	16	10	71
Russian Federation	Moscow	10,452	19	109	..
	Omsk	1,135	19	20	34
Singapore	Singapore	4,436	41	20	30
Slovak Republic	Bratislava	*456*	15	21	27
South Africa	Cape Town	3,215	13	21	72
	Durban	2,729	25	31	..
	Johannesburg	3,435	26	19	31
Spain	Barcelona	4,920	33	11	43
	Madrid	5,567	29	24	66
Sweden	Stockholm	1,264	11	3	20
Switzerland	Zurich	1,108	24	11	39
Thailand	Bangkok	6,704	76	11	23
Turkey	Ankara	3,716	39	55	46
	Istanbul	10,061	46	120	..
Ukraine	Kiev	2,709	26	14	51
United Kingdom	Birmingham	2,285	14	9	45
	London	8,567	19	25	77
	Manchester	2,230	15	26	49
United States	Chicago	8,990	23	14	57
	Los Angeles	12,500	32	9	74
	New York-Newark	19,040	20	26	79
Venezuela, RB	Caracas	2,985	16	33	57

a. Data are for the most recent year available.

Definitions

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

Data sources

Data on city population are from the United Nations Population Division. Data on particulate matter concentrations are from Pandey and others' "Ambient Particulate Matter Concentration in Residential and Pollution Hotspot Areas of World Cities: New Estimates Based on the Global Model of Ambient Particulates (GMAPS)" (2006b). Data on sulfur dioxide and nitrogen dioxide concentrations are from the WHO's Healthy Cities Air Management Information System and the World Resources Institute.

3.15 Government commitment

	Environmental strategies or action plans	Biodiversity assessments, strategies, or action plans	Participation in treaties[a]								
			Climate change[b]	Ozone layer	CFC control	Law of the Sea[c]	Biological diversity[b]	Kyoto Protocol	CITES	CCD	Stockholm Convention
			1992	1985	1987	1982	1992	1997	1973	1994	2001
Afghanistan			2002	2004[d]	2004[d]		2002		1985[d]	1995[d]	
Albania	1993		1995	1999[d]	1999[d]	2003[d]	1994[d]	2005[d]	2003[d]	2000[d]	2004
Algeria	2001		1994	1992[d]	1992[d]	1996	1995	2005[d]	1983[d]	1996	2006
Angola			2000	2000[d]	2000[d]	1994	1998	2007		1997	2006
Argentina	1992		1994	1990	1990	1995	1994	2001	1981	1997	2005
Armenia			1994	1999[d]	1999[d]	2002[d]	1993[e]	2008[e]		1997	2003
Australia	1992	1994	1994	1987[d]	1989	1994	1993		1976	2000	2004
Austria			1994	1987	1989	1995	1994	2002	1982[d]	1997[d]	2002
Azerbaijan	1998		1995	1996[d]	1996[d]		2000[f]	2000[d]	1998[d]	1998[d]	2004[d]
Bangladesh	1991	1990	1994	1990[d]	1990[d]	2001	1994	2001[d]	1981	1996	2007
Belarus			2000	1986[e]	1988[e]	2006[d]	1993	2007[e]	1995[d]	2001[d]	2004[d]
Belgium			1996	1988	1988	1998	1996	2002	1983	1997[d]	2006
Benin	1993		1994	1993[d]	1993[d]	1997	1994	2002[d]	1984[d]	1996	2004
Bolivia	1994	1988	1995	1994[d]	1994[d]	1995	1994	1999	1979	1996	2003
Bosnia and Herzegovina			2000	1992[g]	1992[g]	1994[g]	2002[d]	2007	2002	2002[d]	
Botswana	1990	1991	1994	1991[d]	1991[d]	1994	1995	2003[d]	1977[d]	1996	2002[d]
Brazil		1988	1994	1990[d]	1990[d]	1994	1994	2002	1975	1997	2004
Bulgaria		1994	1995	1990[d]	1990[d]	1996	1996	2002	1991[d]	2001[d]	2004
Burkina Faso	1993		1994	1989	1989	2005	1993	2005[d]	1989[d]	1996	2004
Burundi	1994	1989	1997	1997[d]	1997[d]		1997	2001[d]	1988[d]	1997	2005
Cambodia	1999		1996	2001[d]	2001[d]		1995[d]	2002[d]	1997	1997	2006
Cameroon		1989	1995	1989[d]	1989[d]	1994	1994	2002[d]	1981[d]	1997	
Canada	1990	1994	1994	1986	1988	2003	1992	2002	1975	1995	2001
Central African Republic			1995	1993[d]	1993[d]		1995	2008	1980[d]	1996	
Chad	1990		1994	1989[d]	1994		1994		1989[d]	1996	2004
Chile		1993	1995	1990	1990	1997	1994	2002	1975	1997	2005
China	1994	1994	1994	1989[d]	1991[d]	1996	1993	2002[f]	1981[d]	1997	2004
Hong Kong SAR, China											
Colombia	1998	1988	1995	1990[d]	1993[d]		1994	2001[d]	1981	1999	
Congo, Dem. Rep.		1990	1995	1994[d]	1994[d]	1995	1996	2005[d]	1976[d]	1997	2005[d]
Congo, Rep.		1990	1997	1994[d]	1994[d]	2008	1994	2007	1983[d]	1999	2007
Costa Rica	1990	1992	1994	1991[d]	1991[d]	1994	1994	2002	1975	1998	2007
Côte d'Ivoire	1994	1991	1995	1993[d]	1993[d]	1994	1994	2007	1994[d]	1997	2004
Croatia	2001	2000	1996	1991[e]	1991[e]	1994[g]	1996		2000[d]	2000[e]	2007
Cuba			1994	1992[d]	1992[d]	1994	1994	2002	1990[d]	1997	2007
Czech Republic	1994		1994	1993[e]	1993[e]	1996	1993[f]	2007[e]	993[g]	2000[d]	2002
Denmark	1994		1994	1988	1988	2004	1993	2002	1977	1995[d]	2003
Dominican Republic		1995	1999	1993[d]	1993[d]		1996	2002[d]	1986[d]	1997[d]	2007
Ecuador	1993	1995	1994	1990[d]	1990[d]		1993	2000	1975	1995	2004
Egypt, Arab Rep.	1992	1988	1995	1988	1988	1994	1994	2005[d]	1978	1995	2003
El Salvador	1994	1988	1996	1992	1992		1994	1998	1987[d]	1997[d]	
Eritrea	1995		1995	2005[d]	2005[d]		1996[d]	2005[d]	1994[d]	1996	2005[d]
Estonia	1998		1994	1996[d]	1996[d]	2005[d]	1994	2002	1992[d]		
Ethiopia	1994	1991	1994	1994[d]	1994[d]		1994	2005[d]	1989[d]	1997	2003
Finland	1995		1994	1986	1988	1996	1994[e]	2002	1976[d]	1995[e]	2002[e]
France	1990		1994	1987[f]	1988[f]	1996	1994	2002[f]	978	1997	2004[f]
Gabon		1990	1998	1994[d]	1994[d]	1998	1997		1989[d]	1996[d]	2007
Gambia, The	1992	1989	1994	1990[d]	1990[d]	1994	1994	2001[d]	1977[d]	1996	2006
Georgia	1998		1994	1996[d]	1996[d]	1996[d]	1994[d]	1999[d]	1996[d]	1999	2006
Germany			1994	1988	1988	1994[d]	1993	2002	1976	1996	2002
Ghana	1992	1988	1995	1989[d]	1989	1994	1994	2003[d]	1975	1996	2003
Greece			1994	1988	1988	1995	1994	2002	1992[d]	1997	2006
Guatemala	1994	1988	1996	1987[d]	1989[d]	1997	1995	1999	1979	1998[d]	
Guinea	1994	1988	1994	1992[d]	1992[d]	1994	1993	2000[d]	1981[d]	1997	
Guinea-Bissau	1993	1991	1996	2002[d]	2002[d]	1994	1995		1990[d]	1995	2008
Haiti	1999		1996	2000[d]	2000[d]	1996	1996	2005[d]		1996	
Honduras	1993		1996	1993[d]	1993[d]	1994	1995	2000	1985[d]	1997	2005

Government commitment 3.15

	Environmental strategies or action plans	Biodiversity assessments, strategies, or action plans	Participation in treaties[a]								
			Climate change[b]	Ozone layer	CFC control	Law of the Sea[c]	Biological diversity[b]	Kyoto Protocol	CITES	CCD	Stockholm Convention
			1992	1985	1987	1982	1992	1997	1973	1994	2001
Hungary	1995		1994	1988[d]	1989[d]	2002	1994	2002[d]	1985[d]	1999[d]	2008
India	1993	1994	1994	1991[d]	1992[d]	1995	1994	2008[e]	1976	1996	2006
Indonesia	1993	1993	1994	1992[d]	1992	1994	1994	2004	1978[d]	1998	
Iran, Islamic Rep.			1996	1990[d]	1990[d]		1996	2005[d]	1976	1997	2006
Iraq						1994					
Ireland			1994	1988[d]	1988	1996	1996	2002	2002	1997	
Israel			1996	1992[d]	1992		1995	2004	1979	1996	
Italy			1994	1988	1988	1995	1994	2002	1979	1997	
Jamaica	1994		1995	1993[d]	1993[d]	1994	1995	1999[d]	1997[d]	1997[d]	2007
Japan			1994	1988[d]	1988	1996	1993[e]	2002[e]	1980	1998[e]	2002[d]
Jordan	1991		1994	1989[d]	1989[d]	1995[d]	1993	2003[d]	1978[d]	1996	2004
Kazakhstan			1995	1998[d]	1998[d]		1994		2000[d]	1997	
Kenya	1994	1992	1994	1988[d]	1988	1994	1994	2005[d]	1978	1997	2004
Korea, Dem. Rep.			1995	1995[d]	1995[d]		1994[f]	2005[d]		2003[d]	2002[d]
Korea, Rep.			1994	1992	1992	1996	1994	2002	1993[d]	1999	2007
Kosovo											
Kuwait			1995	1992[d]	1992[d]	1994	2002	2005[d]	2002	1997	2006
Kyrgyz Republic	1995		2000	2000[d]	2000[d]		1996[f]	2003[d]		1997[d]	2006
Lao PDR	1995		1995	1998[d]	1998[d]	1998	1996[f]	2003[d]	2004[d]	1996[e]	2006
Latvia			1995	1995[d]	1995[d]	2004[d]	1995	2002	1997[d]	2002[d]	2004
Lebanon			1995	1993[d]	1993[d]	1995	1994	2006		1996	2003
Lesotho	1989		1995	1994[d]	1994[d]	2007	1995	2000[d]	2003	1995	2002
Liberia			2003	1996[d]	1996[d]	2008	2000	2002[d]	2005[d]	1998[d]	2002[d]
Libya			1999	1990[d]	1990[d]		2001	2006	2003[d]	1996	2005[d]
Lithuania			1995	1995[d]	1995[d]	2003[d]	1996	2003	2001[d]	2003[d]	2006
Macedonia, FYR			1998	1994[g]	1994[g]	1994[g]	1997[d]	2004[d]	2000[d]	2002[d]	2004
Madagascar	1988	1991	1999	1996[d]	1996[d]	2001	1996	2003[d]	1975	1997	
Malawi	1994		1994	1991[d]	1991[d]		1994	2001[d]	1982[d]	1996	
Malaysia	1991	1988	1994	1989[d]	1989[d]	1996	1994	2002	1977[d]	1997	
Mali		1989	1995	1994[d]	1994[d]	1994	1995	2002	1994[d]	1995	2003
Mauritania	1988		1994	1994[d]	1994[d]	1996	1996	2005[d]	1998[d]	1996	2005
Mauritius	1990		1994	1992[d]	1992[d]	1994	1992	2001[d]	1975	1996	2004
Mexico		1988	1994	1987	1988	1994	1993	2000	1991[d]	1995	2003
Moldova	2002		1995	1996[d]	1996[d]	2007	1995	2008[e]	2001[d]	1999[d]	2004
Mongolia	1995		1994	1996[d]	1996[d]	1996	1993	1999[d]	1996[d]	1996	2004
Morocco		1988	1996	1995	1995	2007	1995	2002[d]	1975	1996	2004
Mozambique	1994		1995	1994[d]	1994[d]	1997	1995	2005[d]	1981[d]	1997	2005
Myanmar		1989	1995	1993[d]	1993[d]	1996	1995	2003[d]	1997[d]	1997[d]	2004[d]
Namibia	1992		1995	1993[d]	1993[d]	1994	1997	2003[d]	1990[d]	1997	2005[d]
Nepal	1993		1994	1994[d]	1994[d]	1998	1993	2005[d]	1975[d]	1996	2007
Netherlands	1994		1994	1988[d]	1988[e]	1996	1994[e]	2002[d]	1984	1995[e]	2002[e]
New Zealand	1994		1994	1987	1988	1996	1993	2002	1989[d]	2000[d]	2004
Nicaragua	1994		1996	1993[d]	1993[d]	2000	1995	1999	1977[d]	1998	
Niger		1991	1995	1992[d]	1992[d]		1995	2004	1975	1996	2006
Nigeria	1990	1992	1994	1988[d]	1988[d]	1994	1994	2004[d]	1974	1997	2004
Norway		1994	1994	1986	1988	1996	1993	2008[e]	1976	1996	2002
Oman			1995	1999[d]	1999[d]	1994	1995	2005[d]		1996[d]	2005
Pakistan	1994	1991	1994	1992[d]	1992[d]	1997	1994	2005[d]	1976[d]	1997	
Panama	1990		1995	1989[d]	1989	1996	1995	1999	1978	1996	2003
Papua New Guinea	1992	1993	1994	1992[d]	1992[d]	1997	1993	2002	1975[d]	2000[d]	2003
Paraguay			1994	1992[d]	1992[d]	1994	1994	1999	1976	1997	2004
Peru		1988	1994	1989	1993[d]		1993	2002	1975	1995	2005
Philippines	1989	1989	1994	1991[d]	1991	1994	1993	2003	1981	2000	2004
Poland	1993	1991	1994	1990[d]	1990[d]	1998	1996	2002	1989	2001[d]	2008
Portugal	1995		1994	1988[d]	1988	1997	1993	2002[f]	1980	1996	2004[e]
Puerto Rico											
Qatar											

3.15 Government commitment

	Environmental strategies or action plans	Biodiversity assessments, strategies, or action plans	Participation in treaties[a]								
			Climate change[b]	Ozone layer	CFC control	Law of the Sea[c]	Biological diversity[b]	Kyoto Protocol	CITES	CCD	Stockholm Convention
			1992	1985	1987	1982	1992	1997	1973	1994	2001
Romania	1995		1994	1993[d]	1993[d]	1996	1994	2001	1994[d]	1998[d]	2004
Russian Federation	1999	1994	1995	1986[e]	1988[e]	1997	1995	2008[e]	1992	2003[d]	
Rwanda	1991		1998	2001[d]	2001[d]		1996	2004[d]	1980[d]	1998	2002[d]
Saudi Arabia			1995	1993[d]	1993[d]	1996	2001[f]	2005[d]	1996[d]	1997[d]	
Senegal	1984	1991	1995	1993[d]	1993	1994	1994	2001[d]	1977[d]	1995	2003
Serbia			2001[h]	2001[g,h]	2001[g,h]	2001[g,h]	2002[h]	2007	2002[h]		2002[h]
Sierra Leone	1994		1995	2001[d]	2001[d]	1994	1994[f]	2006[d]	1994[d]	1997	2003[d]
Singapore	1993	1995	1997	1989[d]	1989[d]	1994	1995	2006[d]	1986[d]	1999[d]	2005
Slovak Republic			1994	1993[g]	1993[g]	1996	1994[f]	2002	1993	2002[d]	2002
Slovenia	1994		1996	1992[g]	1992[g]	1995[g]	1996	2002	2000[d]	2001[d]	2004
Somalia				2001[d]	2001[d]	1994			1985[d]	2002[d]	
South Africa	1993		1997	1990[d]	1990[d]	1997	1995	2002[d]	1975	1997	2002
Spain			1994	1988[d]	1988	1997	1995	2002	1986[d]	1996	2004
Sri Lanka	1994	1991	1994	1989[d]	1989[d]	1994	1994	2002[d]	1979[d]	1998[d]	
Sudan			1994	1993[d]	1993[d]	1994	1995	2004[d]	1982	1995	2006
Swaziland			1997	1992[d]	1992[d]		1994		1997[d]	1996	2006
Sweden			1994	1986	1988	1996	1993	2002	1974	1995	2002
Switzerland			1994	1987	1988		1994	2006[d]	1974	1996	2003
Syrian Arab Republic	1999		1996	1989[d]	1989[d]		1996	2006[d]	2003[d]	1997	2005
Tajikistan			1998	1996[d]	1998[d]		1997[f]			1997[d]	2007
Tanzania	1994	1988	1996	1993[d]	1993[d]	1994	1996	2002[d]	1979	1997	2004
Thailand			1995	1989[d]	1989		2004	2002	1983	2001[d]	2005
Togo	1991		1995	1991[d]	1991	1994	1995[e]	2004[d]	1978	1995[e]	2004
Trinidad and Tobago			1994	1989[d]	1989[d]	1994	1996	1999	1984[d]	2000[d]	2002[d]
Tunisia	1994	1988	1994	1989[d]	1989[d]	1994	1993	2003[d]	1974	1995	2004
Turkey	1998		2004	1991[d]	1991[d]		1997		1996[d]	1998	
Turkmenistan			1995	1993[d]	1993[d]		1996[f]	2008[e]		1996	
Uganda	1994	1988	1994	1988[d]	1988	1994	1993	2002[d]	1991[d]	1997	2004[d]
Ukraine	1999		1997	1986[e]	1988[e]	1999	1995	2004	1999[d]	2002[d]	
United Arab Emirates			1996	1989[d]	1989[d]		2000	2005[d]	1990[d]	1998[d]	2002
United Kingdom	1995	1994	1994	1987	1988	1997[d]	1994	2002	1976	1996	2005
United States	1995	1995	1994	1986	1988				1974	2000	
Uruguay			1994	1989[d]	1991[d]	1994	1993	2001	1975	1999[d]	2004
Uzbekistan			1994	1993[d]	1993[d]		1995[f]	2007[e]	1997[d]	1995	
Venezuela			1995	1988[d]	1989		1994		1977	1998[d]	2005
Vietnam		1993	1995	1994[d]	1994[d]	2006[d]	1994	2008[e]	1994[d]	1998[d]	2002
West Bank and Gaza											
Yemen, Rep.	1996	1992	1996	1996[d]	1996[d]	1994	1996	2004[d]	1997[d]	1997[d]	2004
Zambia	1994		1994	1990[d]	1990[d]	1994	1993	2006[d]	1980[d]	1996	2006
Zimbabwe	1987		1994	1992[d]	1992[d]	1994	1994		1981[d]	1997	

a. Ratification of the treaty. b. Year the treaty entered into force in the country. c. Convention became effective November 16, 1994. d. Accession. e. Acceptance. f. Approval. g. Succession. h. Signed by Serbia and Montenegro as a unified country before Montenegro declared its independence.

Government commitment

About the data

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

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

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

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

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

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

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

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

Definitions

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

Data sources

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

3.16 Toward a broader measure of savings

	Gross savings	Consumption of fixed capital	Net national savings	Education expenditure	Energy depletion	Mineral depletion	Net forest depletion	Carbon dioxide damage	Particulate emission damage	Adjusted net savings
	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008
Afghanistan	..	7.0	–7.0	..	0.0	0.0	3.4	0.1	0.2	..
Albania	18.0	10.1	7.9	2.8	1.7	0.0	0.0	0.3	0.2	8.5
Algeria	58.8	10.9	47.9	4.5	29.9	0.2	0.1	0.6	0.2	21.4
Angola	24.1	12.9	11.2	2.3	54.6	0.0	0.0	0.2	1.3	–42.6
Argentina	25.5	11.8	13.8	4.5	8.6	0.4	0.0	0.5	1.1	7.7
Armenia	28.1	10.0	18.1	2.2	0.0	0.8	0.0	0.3	1.2	18.1
Australia	32.9	14.7	18.1	5.1	4.1	3.8	0.0	0.3	0.0	15.0
Austria	27.2	14.3	12.9	5.3	0.2	0.0	0.0	0.1	0.1	17.6[a]
Azerbaijan	63.0	12.3	50.7	2.0	51.4	0.0	0.0	1.2	0.3	–0.1
Bangladesh	33.9	6.8	27.1	2.0	4.0	0.0	0.6	0.4	0.4	23.7
Belarus	28.4	11.2	17.2	4.9	1.3	0.0	0.0	1.1	0.0	19.8
Belgium	..	13.9	..	5.8	0.0	0.0	0.0	0.2	0.1	..
Benin	..	8.1	..	3.3	0.0	0.0	1.0	0.3	0.3	..
Bolivia	29.9	9.5	20.4	4.7	27.6	0.8	0.0	0.5	0.9	–4.7
Bosnia and Herzegovina	41.0	10.4	30.6	..	2.0	0.0	..	1.2	0.1	..
Botswana	46.3	11.5	34.8	6.6	0.5	3.2	0.0	0.3	0.2	37.2[b]
Brazil	17.5	11.8	5.8	4.8	2.7	2.3	0.0	0.2	0.1	5.2
Bulgaria	14.1	11.6	2.5	4.1	1.1	0.8	0.0	0.9	0.9	2.9
Burkina Faso	..	7.5	..	3.3	0.0	0.0	1.2	0.1	0.6	..
Burundi	..	5.6	..	5.1	0.0	0.6	10.9	0.1	0.1	..
Cambodia	..	8.3	..	1.7	0.0	0.0	0.2	0.4	0.3	..
Cameroon	..	8.8	..	2.6	7.8	0.0	0.0	0.1	0.4	..
Canada	23.4	14.0	9.4	4.8	5.5	0.6	0.0	0.3	0.1	7.6
Central African Republic	1.8	7.4	–5.6	1.3	0.0	0.0	0.0	0.1	0.2	–4.6
Chad	3.7	10.0	–6.4	1.2	43.7	0.0	0.0	0.0	1.0	–49.9
Chile	24.2	12.9	11.4	3.6	0.3	14.3	0.0	0.3	0.4	–0.4
China	53.9	10.1	43.8	1.8	6.7	1.7	0.0	1.3	0.8	35.1
Hong Kong SAR, China	29.7	13.4	16.3	3.0	0.0	0.0	0.0	0.2	..	19.1[c]
Colombia	20.2	11.4	8.8	3.6	10.0	0.6	0.0	0.2	0.1	1.5
Congo, Dem. Rep.	9.4	6.7	2.7	0.9	3.1	2.3	0.0	0.2	0.6	–2.5
Congo, Rep.	26.7	14.1	12.6	2.3	71.2	0.0	0.0	0.2	0.6	–57.1
Costa Rica	15.9	11.5	4.5	5.0	0.0	0.0	0.1	0.2	0.1	9.1
Côte d'Ivoire	12.7	9.0	3.8	4.7	6.2	0.0	0.0	0.2	0.3	1.7
Croatia	21.8	12.9	8.9	4.3	1.3	0.0	0.2	0.3	0.2	11.3
Cuba	..	..	..	13.2	..	..	..	..	0.1	..
Czech Republic	24.2	13.8	10.4	4.4	0.7	0.0	0.0	0.5	0.0	13.4
Denmark	23.6	14.2	9.4	7.4	3.0	0.0	0.0	0.1	0.0	13.7
Dominican Republic	9.0	11.1	–2.1	3.5	0.0	1.3	0.0	0.4	0.0	–0.3
Ecuador	31.8	10.8	21.0	1.4	21.1	0.4	0.0	0.5	0.1	0.4
Egypt, Arab Rep.	23.5	9.3	14.2	4.4	14.5	0.5	0.2	0.9	0.5	2.1
El Salvador	7.9	10.5	–2.6	3.3	0.0	0.0	0.4	0.2	0.1	–0.1
Eritrea	..	6.9	..	1.9	0.0	0.0	0.8	0.3	0.3	..
Estonia	20.1	13.5	6.6	4.6	1.5	0.0	0.0	0.7	0.0	9.0
Ethiopia	17.3	6.7	10.6	3.7	0.0	0.3	4.7	0.2	0.2	8.9
Finland	24.8	14.1	10.7	5.6	0.0	0.1	0.0	0.2	0.0	16.0[a]
France	18.7	13.9	4.9	5.1	0.0	0.0	0.0	0.1	0.0	9.8
Gabon	48.8	13.9	34.9	3.1	34.3	0.0	0.0	0.1	0.0	3.6
Gambia, The	11.1	7.9	3.2	2.0	0.0	0.0	0.6	0.4	0.4	3.9
Georgia	8.3	10.1	–1.8	2.8	0.2	0.0	0.0	0.3	0.7	–0.3
Germany	..	13.8	..	4.3	0.3	0.0	0.0	0.2	0.0	..
Ghana	7.3	8.8	–1.5	4.7	0.0	6.5	2.8	0.5	0.1	–6.5
Greece	7.4	13.9	–6.5	2.8	0.3	0.1	0.0	0.2	0.3	–4.8
Guatemala	14.4	10.1	4.3	2.9	0.8	0.0	0.7	0.3	0.1	5.3
Guinea	2.9	7.7	–4.8	2.0	0.0	5.2	2.6	0.3	0.5	–11.3
Guinea-Bissau	22.4	6.7	15.7	2.3	0.0	0.0	0.0	0.5	0.8	16.6
Haiti	..	..	..	1.5	..	..	..	..	0.4	..
Honduras	21.2	9.5	11.7	3.5	0.0	1.4	0.0	0.5	0.2	13.1

Toward a broader measure of savings

	Gross savings	Consumption of fixed capital	Net national savings	Education expenditure	Energy depletion	Mineral depletion	Net forest depletion	Carbon dioxide damage	Particulate emission damage	Adjusted net savings
	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI	% of GNI
	2008	2008	2008	2008	2008	2008	2008	2008	2008	2008
Hungary	15.9	15.1	0.8	5.3	0.8	0.0	0.0	0.3	0.0	5.0
India	38.2	8.5	29.7	3.2	4.9	1.4	0.8	1.2	0.5	24.2
Indonesia	22.2	10.7	11.6	1.1	12.6	1.4	0.0	0.6	0.5	–2.4
Iran, Islamic Rep.	..	..	..	4.2	..	..	..	..	0.4	..
Iraq	..	..	..	..	..	..	..	..	2.7	..
Ireland	19.7	17.1	2.5	5.2	0.0	0.0	0.0	0.1	0.0	7.5[a]
Israel	19.8	13.5	6.3	5.9	0.2	0.3	0.0	0.3	0.1	11.3
Italy	18.5	14.0	4.5	4.5	0.2	0.0	0.0	0.2	0.1	8.5
Jamaica	..	11.4	..	5.3	0.0	1.3	0.0	0.6	0.2	..
Japan	25.9	13.3	12.6	3.2	0.0	0.0	0.0	0.2	0.3	15.3[a]
Jordan	13.7	9.8	3.8	5.6	0.2	4.5	0.0	0.8	0.2	3.6
Kazakhstan	46.2	13.5	32.8	4.4	31.3	1.8	0.0	1.4	0.1	2.5
Kenya	13.1	8.0	5.0	6.6	0.0	0.1	1.0	0.3	0.1	10.2
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	0.8	..
Korea, Rep.	30.5	12.6	17.9	3.9	0.0	0.0	0.0	0.4	0.3	21.1
Kosovo	..	..	..	..	..	..	..	..	..	
Kuwait	58.7	13.3	45.3	3.0	38.0	0.0	0.0	0.4	0.3	9.7
Kyrgyz Republic	14.9	8.5	6.4	5.8	0.7	0.0	0.0	1.0	0.2	10.4
Lao PDR	25.2	8.6	16.6	1.2	0.0	0.0	0.0	0.2	0.5	17.1
Latvia	22.3	12.6	9.6	5.6	0.0	0.0	0.2	0.2	0.0	14.8
Lebanon	10.2	11.3	–1.1	1.8	0.0	0.0	0.0	0.5	0.1	0.1
Lesotho	17.8	6.4	11.4	9.4	0.0	0.0	1.3	0.0	0.1	19.4
Liberia	–2.7	7.8	–10.5	..	0.0	0.0	7.7	0.9	0.3	..
Libya	66.8	12.3	54.5	..	38.8	0.0	0.0	0.5	1.0	..
Lithuania	15.2	12.7	2.5	4.6	0.1	0.0	0.1	0.3	0.1	6.6
Macedonia, FYR	16.1	10.8	5.3	4.9	0.0	0.0	0.1	1.0	0.1	9.0
Madagascar	14.7	7.4	7.2	2.6	0.0	0.0	2.5	0.3	0.1	7.0
Malawi	29.3	6.5	22.8	3.5	0.0	0.0	0.9	0.2	0.1	25.1
Malaysia	..	11.9	..	4.0	13.1	0.1	0.0	0.7	0.0	..
Mali	..	8.1	..	3.6	0.0	0.0	0.0	0.1	1.1	..
Mauritania	..	..	..	2.8	..	..	..	..	0.5	..
Mauritius	16.5	11.1	5.4	3.4	0.0	0.0	0.0	0.3	0.0	8.5
Mexico	25.3	12.0	13.3	4.8	8.2	0.3	0.0	0.3	0.3	9.0
Moldova	20.8	8.3	12.5	6.5	0.0	0.0	0.1	1.0	0.5	17.3
Mongolia	26.5	9.7	16.8	4.6	5.9	9.2	0.0	1.7	1.6	3.0
Morocco	31.4	10.1	21.3	5.2	0.0	6.1	0.0	0.4	0.1	19.8
Mozambique	7.4	7.9	–0.5	3.8	7.0	0.0	0.5	0.2	0.1	–4.6
Myanmar	..	..	..	0.8	..	..	..	..	0.4	..
Namibia	17.1	12.1	5.0	7.3	0.0	2.1	0.0	0.3	0.0	9.9
Nepal	37.5	7.1	30.4	3.4	0.0	0.0	3.1	0.2	0.0	30.5
Netherlands	10.3	13.9	–3.6	4.8	2.0	0.0	0.0	0.2	0.2	–1.2
New Zealand	..	14.5	..	6.6	2.3	0.2	0.0	0.2	0.0	..
Nicaragua	..	8.9	..	3.0	0.0	0.6	0.0	0.6	0.0	..
Niger	..	2.6	..	2.6	0.0	0.0	2.3	0.2	1.1	..
Nigeria	..	1.2	..	0.9	23.8	0.0	0.2	0.5	0.5	..
Norway	41.2	15.0	26.2	6.0	15.9	0.0	0.0	0.1	0.0	16.2
Oman	..	..	..	3.9	..	..	0.0	..	0.0	..
Pakistan	19.3	8.2	11.1	2.1	4.9	0.0	0.7	0.7	0.8	6.1
Panama	25.9	11.1	14.8	4.4	0.0	0.0	0.0	0.3	0.1	18.8
Papua New Guinea	30.8	9.4	21.4	6.3	0.0	24.1	0.0	0.5	0.0	3.1
Paraguay	16.1	9.9	6.2	3.9	0.0	0.0	0.0	0.2	0.8	9.0
Peru	24.1	11.4	12.7	2.5	1.4	6.2	0.0	0.3	0.3	7.0
Philippines	30.3	8.4	21.9	2.2	0.5	0.8	0.1	0.3	0.1	22.3
Poland	19.1	12.7	6.4	5.4	1.5	0.3	0.1	0.5	0.2	9.2
Portugal	12.6	13.6	–1.0	5.3	0.0	0.1	0.0	0.2	0.0	4.1
Puerto Rico	..	..	..	..	..	..	..	..	..	..
Qatar	..	..	..	..	..	..	..	..	0.1	..

3.16 Toward a broader measure of savings

	Gross savings	Consumption of fixed capital	Net national savings	Education expenditure	Energy depletion	Mineral depletion	Net forest depletion	Carbon dioxide damage	Particulate emission damage	Adjusted net savings
	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008	% of GNI 2008
Romania	25.0	11.7	13.3	3.4	2.4	0.1	0.0	0.4	0.0	13.7
Russian Federation	32.8	12.4	20.4	3.5	20.5	1.0	0.0	0.9	0.1	1.5
Rwanda	25.4	6.7	18.7	4.6	0.0	0.0	3.0	0.2	0.1	20.1
Saudi Arabia	48.3	12.5	35.9	7.2	43.5	0.0	0.0	0.6	0.7	–1.8
Senegal	18.0	8.6	9.4	4.5	0.0	0.9	0.0	0.3	0.5	12.2
Serbia	..	..	..	..	..	..	..	..	..	..
Sierra Leone	5.5	7.0	–1.6	3.9	0.0	0.5	1.5	0.4	0.8	–1.0
Singapore	47.0	14.1	32.9	2.7	0.0	0.0	0.0	0.3	0.6	34.7
Slovak Republic	–70.9	13.1	–83.9	3.7	0.1	0.0	0.4	0.4	0.0	–81.1
Slovenia	27.0	13.6	13.4	5.3	0.1	0.0	0.2	0.2	0.1	18.1
Somalia	..	..	..	..	..	..	..	..	0.5	..
South Africa	16.1	13.9	2.2	5.1	6.4	2.6	0.5	1.3	0.1	–3.4
Spain	20.6	14.0	6.6	3.9	0.0	0.0	0.0	0.2	0.2	10.1
Sri Lanka	18.4	9.7	8.8	2.6	0.0	0.0	0.4	0.3	0.2	10.4
Sudan	15.9	9.9	6.0	0.9	19.1	0.1	0.0	0.2	0.5	–13.1
Swaziland	10.7	9.6	1.1	6.4	0.0	0.0	0.0	0.3	0.0	7.1
Sweden	27.1	12.5	14.6	6.4	0.0	0.4	0.0	0.1	0.0	20.5
Switzerland	..	13.3	..	4.7	0.0	0.0	0.0	0.1	0.1	..
Syrian Arab Republic	12.6	10.1	2.6	2.6	17.6	1.1	0.0	1.1	0.7	–15.2
Tajikistan	25.5	8.2	17.3	3.2	0.4	0.0	0.0	1.1	0.3	18.8
Tanzania	..	7.6	..	2.4	0.7	5.0	0.0	0.2	0.1	..
Thailand	30.7	10.9	19.8	4.8	5.3	0.0	0.2	0.8	0.2	18.0
Timor-Leste	..	1.2	..	0.9	0.0	0.0	..	0.1	..	..
Togo	..	7.3	..	3.7	0.0	5.2	2.5	0.4	0.1	..
Trinidad and Tobago	41.8	13.1	28.7	4.0	50.5	0.0	0.0	1.2	0.2	–19.2
Tunisia	22.6	11.1	11.5	6.7	5.8	4.7	0.1	0.5	0.1	7.0
Turkey	17.7	11.8	5.9	3.7	0.3	0.1	0.0	0.3	0.6	8.3
Turkmenistan	32.1	10.9	21.2	..	133.3	0.0	..	3.1	0.6	..
Uganda	12.6	7.4	5.2	3.3	0.0	0.0	5.1	0.1	0.0	3.3
Ukraine	20.2	10.5	9.7	5.9	5.3	0.0	0.0	1.6	0.2	8.5
United Arab Emirates	..	..	..	..	..	..	..	..	0.6	..
United Kingdom	14.8	13.7	1.2	5.1	2.1	0.0	0.0	0.2	0.0	3.9
United States	12.6	14.0	–1.4	4.8	1.9	0.1	0.0	0.3	0.1	0.9
Uruguay	18.2	11.9	6.3	2.6	0.0	0.0	0.4	0.2	1.1	7.2
Uzbekistan	40.5	8.5	32.0	9.4	51.1	0.0	0.0	4.0	0.4	–14.1
Venezuela, RB	34.6	11.9	22.7	3.5	18.6	0.6	0.0	0.5	0.0	6.5
Vietnam	30.4	8.8	21.6	2.8	12.9	0.3	0.2	1.0	0.3	9.7
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	..	9.4	..	..	22.3	0.0	0.0	0.7	..	..
Zambia	21.4	9.5	11.9	1.3	0.1	13.4	0.0	0.2	0.3	–0.7
Zimbabwe	..	..	..	6.9	..	..	..	..	0.1	..
World	**20.9 w**	**13.0 w**	**7.9 w**	**4.2 w**	**3.9 w**	**0.5 w**	**0.0 w**	**0.4 w**	**0.2 w**	**7.2 w**
Low income	25.3	7.9	17.4	3.4	7.8	1.0	1.0	0.7	0.3	10.1
Middle income	31.6	10.9	20.7	3.3	8.8	1.3	0.1	0.8	0.4	12.6
Lower middle income	41.1	9.6	31.4	2.3	8.1	1.4	0.2	1.1	0.6	22.4
Upper middle income	23.8	12.1	11.8	4.2	9.4	1.3	0.0	0.5	0.2	4.6
Low & middle income	31.4	10.8	20.6	3.3	8.7	1.3	0.1	0.8	0.4	12.5
East Asia & Pacific	47.3	10.1	37.1	2.0	7.2	1.5	0.0	1.1	0.7	28.6
Europe & Central Asia	24.8	12.1	12.7	4.1	12.1	0.6	0.0	0.8	0.2	3.2
Latin America & Carib.	22.4	11.8	10.6	4.4	6.3	1.8	0.0	0.3	0.3	6.3
Middle East & N. Africa	..	10.5	..	4.4	18.6	1.5	0.1	0.7	0.4	
South Asia	35.0	8.4	26.6	3.0	4.6	1.1	0.8	1.0	0.5	21.6
Sub-Saharan Africa	16.5	9.0	7.6	3.3	14.2	1.3	0.6	0.6	0.4	–6.2
High income	18.5	13.8	4.7	4.6	2.0	0.2	0.0	0.2	0.1	6.7
Euro area	..	14.0	..	4.6	0.3	0.0	0.0	0.2	0.1	

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

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 check on the extent to which today's rents from a number of natural resources and changes in human capital are balanced by net savings, or 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. However, because of the wide variability in the effectiveness of public education expenditures, these figures cannot be construed as the value of investments in human capital. A current expenditure of $1 on education does not necessarily yield $1 of human capital. The calculation should also consider private education expenditure, but data are not available for a large number of countries.

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

Estimates of resource depletion are based on the "change in real wealth" method described in Hamilton and Ruta (2008), which estimates depletion as the ratio between the total value of the resource and the remaining reserve lifetime. The total value of the resource is the present value of current and future rents from resource extractions. An economic rent represents an excess return to a given factor of production. 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 (to reflect the social opportunity cost of resource extraction) 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 to arrive at total rent. To estimate the value of the resource, rents are assumed to be constant over the life of the resource (the El Serafy approach), and the present value of the rent flow is calculated using a 4 percent social discount rate. For details on the estimation of natural wealth see World Bank (2006).

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

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

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

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

Definitions

• **Gross savings** are the difference between gross national income and public and private consumption, plus net current transfers. • **Consumption of fixed capital** is the replacement value of capital used up in production. • **Net national savings** are gross savings minus consumption of fixed capital. • **Education expenditure** is public current operating expenditures in education, including wages and salaries and excluding capital investments in buildings and equipment. • **Energy depletion** is the ratio of the value of the stock of energy resources to the remaining reserve lifetime (capped at 25 years). It covers coal, crude oil, and natural gas. • **Mineral depletion** is the ratio of the value of the stock of mineral resources to the remaining reserve lifetime (capped at 25 years). It covers tin, gold, lead, zinc, iron, copper, nickel, silver, bauxite, and phosphate. • **Net forest depletion** is unit resource rents times the excess of roundwood harvest over natural growth. • **Carbon dioxide damage** is estimated at $20 per ton of carbon (the unit damage in 1995 U.S. dollars) times tons of carbon emitted. • **Particulate emission damage** is the willingness to pay to avoid illness and death attributable to particulate emissions.• **Adjusted net savings** are net savings plus education expenditure minus energy depletion, mineral depletion, net forest depletion, and carbon dioxide and particulate emissions damage.

Data sources

Data on gross savings are from World Bank national accounts data files (see table 4.8). Data on consumption of fixed capital are from the United Nations Statistics Division's *National Accounts Statistics: Main Aggregates and Detailed Tables, 1997,* extrapolated to 2008. 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 by World Bank staff. Data on energy, mineral, and forest depletion are estimates based on sources and methods in Kunte and others' "Estimating National Wealth: Methodology and Results" (1998). Data on carbon dioxide damage are from Fankhauser's *Valuing Climate Change: The Economics of the Greenhouse* (1995). Data on particulate emission damage are from Pandey and others' "The Human Costs of Air Pollution: New Estimates for Developing Countries" (2006). The conceptual underpinnings of the savings measure appear in Hamilton and Clemens' "Genuine Savings Rates in Developing Countries" (1999).