3.1 Land use and deforestation

	Land area	Rural population density	Land use						Forest area	Annual deforestation	
			Cropland		Permanent pasture		Other land				
	thousand sq. km	people per sq. km	% of land area		% of land area		% of land area		thousand sq. km	sq. km	average % change
	1995	1995	1980	1995	1980	1994	1980	1994	1995	1990–95	1990–95
Albania	27	354	26	26	15	*15*	59	59	10	0	0.0
Algeria	2,382	165	3	3	15	*13*	82	83	19	234	1.2
Angola	1,247	248	3	3	43	*43*	54	54	222	2,370	1.0
Argentina	2,737	17	10	10	52	*52*	38	38	339	894	0.3
Armenia	28	198	..	25	..	*24*	..	54	3	–84	–2.7
Australia	7,682	6	6	6	57	*54*	37	40	409	–170	0.0
Austria	83	202	20	18	25	*24*	56	57	39	0	0.0
Azerbaijan	87	208	..	23	..	*25*	..	52	10	0	0.0
Bangladesh	130	1,157	70	67	5	*5*	25	29	10	88	0.8
Belarus	207	49	..	30	..	*14*	..	56	74	–688	–1.0
Belgium[a]	33	39	24	23	23	*21*	53	55	7	0	0.0
Benin	111	236	16	17	4	*4*	80	79	46	596	1.2
Bolivia	1,084	137	2	2	25	*24*	73	73	483	5,814	1.2
Bosnia and Herzegovina	51	516	..	13	..	*24*	..	61	27	0	0.0
Botswana	567	168	1	1	45	*45*	54	54	139	708	0.5
Brazil	8,457	65	6	8	20	*22*	74	71	5,511	25,544	0.5
Bulgaria	111	67	38	38	18	*16*	44	46	32	–6	0.0
Burkina Faso	274	255	10	13	22	*22*	68	66	43	320	0.7
Burundi	26	623	46	43	39	*42*	15	14	3	14	0.4
Cambodia	177	209	12	22	3	*8*	85	70	98	1,638	1.6
Cameroon	465	123	15	15	4	*4*	81	81	196	1,292	0.6
Canada	9,221	15	5	5	3	*3*	92	92	2,446	–1,764	–0.1
Central African Republic	623	103	3	3	5	*5*	92	92	299	1,282	0.4
Chad	1,259	154	3	3	36	*36*	62	62	110	942	0.8
Chile	749	57	6	6	17	*17*	77	77	79	292	0.4
China	9,326	913	11	10	36	*43*	53	47	1,333	866	0.1
Hong Kong, China	1	5,130	7	7	1	*1*	92	92	..	..	..
Colombia	1,039	419	5	6	39	*39*	56	55	530	2,622	0.5
Congo, Dem. Rep.	2,267	429	3	3	7	*7*	90	90	..	..	..
Congo, Rep.	342	755	0	0	29	*29*	70	70	195	416	0.2
Costa Rica	51	600	10	10	39	*46*	51	44	12	414	3.0
Côte d'Ivoire	318	272	10	13	41	*41*	49	46	55	308	0.6
Croatia	56	189	..	22	..	*20*	..	59	18	0	0.0
Cuba	110	71	30	41	24	*20*	46	39	18	236	1.2
Czech Republic	77	114	..	44	..	*12*	..	45	26	–2	0.0
Denmark	42	33	63	55	6	*7*	31	37	4	0	0.0
Dominican Republic	48	221	29	39	43	*43*	27	19	16	264	1.6
Ecuador	277	299	9	11	15	*18*	77	71	111	1,890	1.6
Egypt, Arab Rep.	995	1,144	2	3	..	..	..	..	0	0	0.0
El Salvador	21	572	35	37	29	*28*	36	35	1	38	3.3
Eritrea	101	673	..	5	..	*69*	..	26	3	0	0.0
Estonia	42	36	..	27	..	*7*	..	66	20	–196	–1.0
Ethiopia	1,000	421	..	12	..	*20*	..	69	136	624	0.5
Finland	305	74	..	..	1	*0*	..	..	200	166	0.1
France	550	80	34	35	23	*19*	42	45	150	–1,608	–1.1
Gabon	258	169	2	2	18	*18*	80	80	179	910	0.5
Gambia, The	10	452	..	..	19	*20*	..	..	1	8	0.9
Georgia	70	290	..	16	..	*27*	..	57	30	0	0.0
Germany	349	93	36	35	17	*15*	47	50	107	0	0.0
Ghana	228	391	16	20	37	*37*	47	43	90	1,172	1.3
Greece	129	178	30	27	41	*41*	29	32	65	–1,408	–2.3
Guatemala	108	479	16	18	12	*24*	72	58	38	824	2.1
Guinea	246	667	3	4	44	*44*	54	53	64	748	1.1
Guinea-Bissau	28	279	10	12	38	*38*	51	50	23	104	0.4
Haiti	28	873	32	33	18	*18*	49	49	0	8	3.4
Honduras	112	196	16	18	13	*14*	71	68	41	1,022	2.3

3.1

	Land area	Rural population density	Land use						Forest area	Annual deforestation	
			Cropland		Permanent pasture		Other land				
	thousand sq. km	people per sq. km	% of land area		% of land area		% of land area		thousand sq. km	sq. km	average % change
	1995	1995	1980	1995	1980	1994	1980	1994	1995	1990–95	1990–95
Hungary	92	75	58	54	14	*12*	28	34	17	–88	–0.5
India	2,973	410	57	57	4	*4*	39	39	650	–72	0.0
Indonesia	1,812	732	14	17	7	*7*	79	77	1,098	10,844	1.0
Iran, Islamic Rep.	1,622	148	8	11	27	*27*	64	61	15	284	1.7
Iraq	437	96	12	13	9	*9*	78	78	1	0	0.0
Ireland	69	115	16	19	67	*45*	17	36	6	–140	–2.7
Israel	21	147	20	21	6	*7*	74	72	1	0	0.0
Italy	294	236	42	37	17	*16*	40	47	65	–58	–0.1
Jamaica	11	660	22	22	24	*24*	54	56	2	158	7.2
Japan	377	692	13	12	2	*2*	85	87	251	132	0.1
Jordan	89	375	4	5	9	*9*	87	87	0	12	2.5
Kazakhstan	2,671	21	..	12	..	*70*	..	17	105	–1,928	–1.9
Kenya	569	476	8	8	37	*37*	55	55	13	34	0.3
Korea, Dem. Rep.	120	504	16	17	0	*0*	84	83	62	0	0.0
Korea, Rep.	99	471	22	20	1	*1*	77	78	76	130	0.2
Kuwait	18	927	0	0	8	*8*	92	92	0	0	0.0
[illegible]	[illegible]	336	..	7	..	*47*	..	46	7	0	0.0
Lao PDR	231	417	3	4	3	*3*	94	93	..	..	..
Latvia	62	40	..	28	..	*13*	..	59	29	–250	–0.9
Lebanon	10	236	30	30	1	*1*	69	69	1	52	7.8
Lesotho	30	470	..	..	66	*66*	..	..	0	0	0.0
Libya	1,760	41	1	1	7	*8*	91	91	4	0	0.0
Lithuania	65	35	..	46	..	*8*	..	46	20	–112	–0.6
Macedonia, FYR	25	130	..	26	..	*25*	..	49	10	2	0.0
Madagascar	582	379	5	5	41	*41*	54	53	151	1,300	0.8
Malawi	94	505	14	18	20	*20*	66	62	33	546	1.6
Malaysia	329	512	15	23	1	*1*	85	76	155	4,002	2.4
Mali	1,220	208	2	3	25	*25*	74	73	116	1,138	1.0
Mauritania	1,025	541	0	0	38	*38*	62	62	6	0	0.0
Mauritius	2	668	53	52	3	*3*	44	44	0	0	0.0
Mexico	1,909	95	13	14	39	*42*	48	45	554	5,080	0.9
Moldova	33	118	..	66	..	*11*	..	22	4	0	0.0
Mongolia	1,567	73	1	1	79	*75*	20	24	94	0	0.0
Morocco	446	148	18	21	47	*47*	35	32	38	118	0.3
Mozambique	784	391	4	4	56	*56*	40	40	169	1,162	0.7
Myanmar	658	351	15	15	1	*1*	84	84	272	3,874	1.4
Namibia	823	121	1	1	46	*46*	53	53	124	420	0.3
Nepal	143	659	16	21	13	*12*	71	69	48	548	1.1
Netherlands	34	193	24	27	35	*31*	41	42	3	0	0.0
New Zealand	268	32	13	12	53	*51*	34	38	79	–434	–0.6
Nicaragua	121	67	11	23	40	*40*	49	39	56	1,508	2.5
Niger	1,267	148	..	..	8	*8*	..	..	26	0	0.0
Nigeria	911	222	33	36	44	*44*	23	20	138	1,214	0.9
Norway	307	118	3	3	0	*0*	97	97	81	–180	–0.2
Oman	212	3,256	0	0	5	*5*	95	95	0	0	0.0
Pakistan	771	405	26	28	6	*6*	67	66	17	550	2.9
Panama	74	234	7	9	17	*20*	75	71	28	636	2.1
Papua New Guinea	453	6,023	1	1	0	*0*	99	99	369	1,332	0.4
Paraguay	397	105	4	6	40	*55*	56	40	115	3,266	2.6
Peru	1,280	182	3	3	21	*21*	76	76	676	2,168	0.3
Philippines	298	586	29	32	3	*4*	67	64	68	2,624	3.5
Poland	304	99	49	48	13	*13*	38	39	87	–120	–0.1
Portugal	92	278	34	33	9	*10*	57	57	29	–240	–0.9
Puerto Rico	9	3,022	11	9	38	*26*	51	65	3	24	0.9
Romania	230	107	46	43	19	*21*	35	36	62	12	0.0
Russian Federation	16,889	27	..	8	..	*5*	..	87	7,635	0	0.0

3.1

	Land area	Rural population density	Land use						Forest area	Annual deforestation	
	thousand sq. km	people per sq. km	Cropland % of land area		Permanent pasture % of land area		Other land % of land area		thousand sq. km	sq. km	average % change
	1995	1995	1980	1995	1980	1994	1980	1994	1995	1990–95	1990–95
Rwanda	25	710	41	47	28	*28*	30	25	3	4	0.2
Saudi Arabia	2,150	88	1	2	40	*56*	60	42	2	18	0.8
Senegal	193	208	12	12	30	*30*	58	58	74	496	0.7
Sierra Leone	72	619	7	8	31	*31*	62	62	13	426	3.0
Singapore	1	0	13	2	..	..	..	..	0	0	0.0
Slovak Republic	48	148	..	33	..	*17*	..	49	20	-24	-0.1
Slovenia	20	414	..	14	..	*25*	..	61	11	0	0.0
South Africa	1,221	125	11	13	67	*67*	22	21	85	150	0.2
Spain	499	60	41	40	22	*21*	37	38	84	0	0.0
Sri Lanka	65	1,549	29	29	7	*7*	64	64	18	202	1.1
Sudan	2,376	142	5	5	41	*46*	54	48	416	3,526	0.8
Sweden	412	54	7	7	2	*1*	91	92	244	24	0.0
Switzerland	40	688	10	11	41	*29*	49	60	11	0	0.0
Syrian Arab Republic	184	134	31	32	46	*45*	23	22	2	52	2.2
Tajikistan	141	483	..	6	..	*25*	..	69	4	0	0.0
Tanzania	884	728	3	4	40	*40*	57	56	325	3,226	1.0
Thailand	511	278	36	40	1	*2*	63	58	116	3,294	2.6
Togo	54	138	43	45	4	*4*	53	52	12	186	1.4
Trinidad and Tobago	5	486	23	24	2	*2*	75	74	2	26	1.5
Tunisia	155	120	30	31	22	*20*	48	49	6	30	0.5
Turkey	770	77	37	35	13	*16*	50	48	89	0	0.0
Turkmenistan	470	177	..	3	..	*64*	..	33	38	0	0.0
Uganda	200	331	28	34	9	*9*	63	57	61	592	0.9
Ukraine	579	46	..	59	..	*13*	..	28	92	-54	-0.1
United Arab Emirates	84	1,172	0	1	2	*3*	97	96	1	0	0.0
United Kingdom	242	107	29	25	47	*46*	24	29	24	-128	-0.5
United States	9,159	34	21	21	26	*26*	53	53	2,125	-5,886	-0.3
Uruguay	175	25	8	7	78	*77*	14	15	8	4	0.0
Uzbekistan	414	327	..	11	..	*50*	..	39	91	-2,260	-2.7
Venezuela	882	115	4	4	20	*21*	76	75	440	5,034	1.1
Vietnam	325	1,082	20	21	1	*1*	79	78	91	1,352	1.4
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	528	702	3	3	30	*30*	67	67	0	0	0.0
Yugoslavia, FR (Serb./Mont.)	102	123	..	40	..	*21*	..	39	18	0	0.0
Zambia	743	97	7	7	40	*40*	53	53	314	2,644	0.8
Zimbabwe	387	244	7	8	44	*44*	49	48	87	500	0.6
World	**130,129 s**	**559 w**	**11 w**	**11 w**	**27 w**	**26 w**	**61 w**	**62 w**	**32,712 s**	**101,724 s**	**0.3 w**
Low income	39,294	634	12	13	31	32	56	54	6,227	38,690	0.6
Excl. China & India	26,994	515	8	9	32	32	59	59	4,243	37,896	0.9
Middle income	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Lower middle income	39,310	462	10	11	21	18	68	71	12,884	37,888	0.3
Upper middle income	20,574	170	7	9	30	32	63	59	7,100	36,710	0.5
Low & middle income	99,178	583	10	11	28	27	61	62	26,211	113,288	0.4
East Asia & Pacific	15,869	841	11	12	30	34	59	54	3,756	29,826	0.8
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Latin America & Carib.	20,064	230	7	8	28	29	65	63	9,064	57,766	0.6
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
High income	30,951	215	..	..	25	24	..	..	6,501	-11,564	-0.2

a. Includes Luxembourg.

3.1

About the data

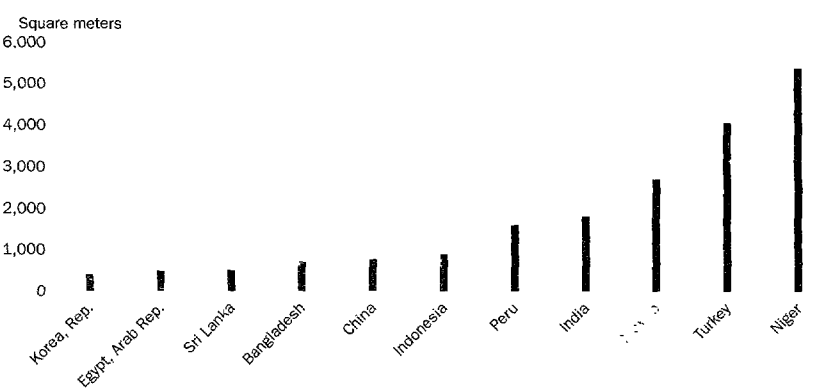
The data in the table show that land use patterns are changing. They also indicate major differences in resource endowments and uses among countries. True comparability is limited, however, by variations in definitions, statistical methods, and the quality of data collection. For example, countries use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

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

Estimates of forest area are from the FAO's *State of the World's Forests 1997*, which provides information on forest cover as of 1995 and a revised estimate of forest cover in 1990. Forest cover data for developing countries are based on country assessments that were prepared at different times and that, for reporting purposes, had to be adapted to the standard reference years of 1990 and 1995. This adjustment was made with a deforestation model that was designed to correlate forest cover change over time with ancillary variables, including population change and density, initial forest cover, and ecological zone of the forest area under consideration. Although the same model was used to estimate forest cover for the 1990 forest assessment, the inputs to *State of the World's Forests 1997* had more recent and accurate information on boundaries of ecological zones and, in some countries, new national forest cover assessments. Specifically, for the calculation of the forest cover area for 1995 and recalculation of the 1990 estimates, new forest inventory information was used for Bolivia, Brazil, Cambodia, Côte d'Ivoire, Guinea-Bissau, Mexico, Papua New Guinea, the Philippines, and Sierra Leone. The new information on global totals raised estimates of forest cover. For industrial countries, the United Nations Economic Commission for Europe and the FAO use a detailed questionnaire to survey the forest cover in each country.

Figure 3.1a

Arable land per capita in selected countries, 1995



Note: Does not include land under cultivation for permanent crops.

Source: Table 3.2.

Growing populations and changing consumption patterns are putting increased pressure on land and other natural resources, reducing some countries' potential for self-sufficiency. The threshold for food self-sufficiency is estimated at 600–700 square meters per person. On average, all regions have arable land per capita in excess of this threshold, but some countries fall below.

Definitions

• **Land area** is a country's total area, excluding area under inland water bodies. In most cases the definition of inland water bodies includes major rivers and lakes. • **Rural population density** is the rural population divided by the arable land area. Rural population is the difference between total and urban population (see definitions in tables 2.1 and 3.10). • **Land use** is broken into three categories. **Cropland** includes land under temporary and permanent crops, temporary meadows, market and kitchen gardens, and land temporarily fallow. Permanent crops are those that do not need to be replanted after each harvest, excluding trees grown for wood or timber. **Permanent pasture** is land used for five or more years for forage crops, either cultivated or growing wild. **Other land** includes forest and woodland as well as logged-over areas to be forested in the near future. Also included are uncultivated land, grassland not used for pasture, wetlands, wastelands, and built-up areas—residential, recreational, and industrial lands and areas covered by roads and other fabricated infrastructure. • **Forest area** is land under natural or planted stands of trees, whether productive or not (see *About the data*). • **Annual deforestation** refers to the permanent conversion of natural forest area to other uses, including shifting cultivation, permanent agriculture, ranching, settlements, and infrastructure development. Deforested areas do not include areas logged but intended for regeneration or areas degraded by fuelwood gathering, acid precipitation, or forest fires. Negative numbers indicate an increase in forest area.

Data sources

Data on land area and land use are from the FAO's electronic files and are published in its *Production Yearbook*. The FAO gathers these data from national agencies through annual questionnaires and by analyzing the results of national agricultural censuses. Forestry data are from the FAO's *State of the World's Forests 1997*.

3.2 Agricultural inputs

	Arable land		Irrigated land		Area under cereal production		Agricultural land per worker		Fertilizer consumption		Pesticide consumption	
	hectares per capita		% of cropland		thousand hectares		hectares		Hundreds of grams per hectare of arable land		Grams per hectare of arable land	
	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1992–94	1979–81	1994–96	1984–86	1994–96
Albania	0.22	0.18	53.0	48.4	367	246	1.61	1.29	1,556	267	..	391
Algeria	0.37	0.27	3.4	6.9	2,968	2,488	23.6	20.0	277	145	..	*836*
Angola	0.41	0.28	2.2	2.1	705	915	21.4	16.5	49	33	.	..
Argentina	0.89	0.72	5.8	6.3	11,099	9,342	123.0	113.7	46	208	..	1,139
Armenia	..	0.15	..	44.7	..	179	..	4.5	..	129	..	..
Australia	2.97	2.65	3.5	4.9	15,986	14,626	1119.0	1074.4	269	358	..	..
Austria	0.20	0.18	0.2	0.3	1,062	820	11.1	13.6	2,615	1,736	..	..
Azerbaijan	..	0.21	..	50.0	..	613	..	4.3	..	244	.	..
Bangladesh	0.10	0.07	17.1	37.3	10,823	10,713	0.3	0.3	458	1,316	..	..
Belarus	..	0.59	..	1.9	..	2,528	..	9.4	..	849	.	..
Belgium[a]	..	..	0.1	0.1	426	336	12.5	13.6	5,323	4,190	*11,052*	..
Benin	0.39	0.26	0.3	0.5	525	681	2.0	1.6	12	146	*61*	..
Bolivia	0.35	0.29	6.6	3.7	559	698	27.2	22.4	23	32	..	..
Bosnia and Herzegovina	..	0.13	..	0.3	..	296	..	11.8	..	0	..	..
Botswana	0.44	0.27	0.5	0.3	153	197	103.0	102.4	33	26	..	..
Brazil	0.32	0.32	3.3	4.9	20,612	19,799	12.6	17.4	915	894	..	811
Bulgaria	0.43	0.48	28.3	19.0	2,110	2,057	6.8	11.8	2,334	468	..	..
Burkina Faso	0.40	0.33	0.4	0.7	2,026	2,998	2.4	1.9	26	69	.	1
Burundi	0.24	0.15	0.7	1.3	203	197	1.0	0.8	10	33	*160*	123
Cambodia	0.30	0.39	4.9	4.5	1,241	1,832	1.1	1.5	45	26	..	..
Cameroon	0.68	0.46	0.2	0.3	1,021	881	3.3	2.6	56	50	*737*	*253*
Canada	1.86	1.54	1.3	1.6	19,561	19,113	92.2	173.9	415	519	..	*643*
Central African Republic	0.81	0.60	..	..	194	136	4.8	4.2	5	6	.	*12*
Chad	0.70	0.51	0.2	0.4	907	1,514	24.3	20.3	6	22	*51*	..
Chile	0.36	0.28	29.6	29.9	820	602	21.6	18.2	321	1,000	..	2,701
China	0.10	0.08	45.1	51.8	..	..	1.1	1.0	1,493	3,539	..	..
Hong Kong, China	0.00	0.00	43.5	28.6	0	0	0.3	0.3	..	..	.	9,750
Colombia	0.13	0.07	7.7	16.6	1,361	1,346	12.7	12.9	812	2,383	*4,351*	..
Congo, Dem. Rep.	0.26	0.17	0.1	0.1	..	..	2.6	1.9	11	15		..
Congo, Rep.	0.08	0.06	0.7	0.6	19	29	24.7	21.6	28	134	*76*	..
Costa Rica	0.12	0.09	12.1	23.8	136	61	9.2	9.6	2,650	4,407	..	18,726
Côte d'Ivoire	0.24	0.21	1.4	1.7	1,008	1,589	7.5	6.2	261	224	.	..
Croatia	..	0.23	..	0.2	..	623	..	7.3	..	1,700	..	*3,060*
Cuba	0.27	0.34	23.0	20.2	224	166	6.7	7.7	2,030	532	.	..
Czech Republic	..	0.30	..	0.7	..	1,606	..	7.1	..	1,073	..	1,154
Denmark	0.52	0.45	14.5	20.1	1,818	1,480	15.6	19.1	2,453	1,883	*95*	1,923
Dominican Republic	0.19	0.17	11.7	13.7	149	137	5.2	5.6	572	727	.	..
Ecuador	0.20	0.14	19.4	8.1	419	1,013	6.5	6.6	471	895	..	1,672
Egypt, Arab Rep.	0.06	0.05	100.0	100.0	2,007	2,659	0.3	0.4	2,864	3,493	*14,494*	..
El Salvador	0.12	0.10	14.8	15.8	422	443	2.0	2.0	1,330	1,386	..	..
Eritrea	..	0.12	..	5.4	..	301	..	6.1	..	..	..	..
Estonia	..	0.76	..	..	..	303	..	12.6	..	370	..	138
Ethiopia	..	0.20	..	1.7	4,890	..	..	1.5	..	139	..	*21*
Finland	0.54	0.50	..	..	1,190	999	9.5	13.7	1,868	1,421	*779*	450
France	0.32	0.32	4.6	8.0	9,804	8,429	16.5	25.6	3,260	2,628	..	..
Gabon	0.42	0.29	0.9	0.8	6	15	21.1	22.3	20	13	.	..
Gambia, The	0.26	0.16	..	..	54	90	1.3	0.9	132	49	..	29
Georgia	..	0.15	..	42.0	..	295	..	4.3	..	394	..	..
Germany	0.15	0.14	3.7	3.9	7,692	6,528	7.3	12.6	4,249	2,421	..	..
Ghana	0.18	0.17	0.2	0.1	902	1,243	3.8	2.9	104	43	..	16
Greece	0.30	0.23	24.2	38.0	1,600	1,326	7.9	9.6	1,927	2,239	*2,540*	..
Guatemala	0.18	0.13	5.0	6.5	716	644	2.4	2.5	726	1,355	..	..
Guinea	0.13	0.10	12.8	10.9	708	673	5.4	4.1	19	16	..	147
Guinea-Bissau	0.32	0.28	6.0	5.0	142	135	3.9	3.4	24	20	.	..
Haiti	0.10	0.08	7.9	9.6	416	421	0.8	0.7	62	88	..	19
Honduras	0.43	0.29	4.1	3.6	421	482	4.7	5.1	163	340	..	..

	Arable land		Irrigated land		Area under cereal production		Agricultural land per worker		Fertilizer consumption		Pesticide consumption	
	hectares per capita		% of cropland		thousand hectares		hectares		Hundreds of grams per hectare of arable land		Grams per hectare of arable land	
	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1992–94	1979–81	1994–96	1984–86	1994–96
Hungary	0.47	0.47	3.6	4.2	2,878	2,820	7.1	9.2	2,906	683	*6,271*	3,294
India	0.24	0.18	22.8	29.5	104,350	99,891	0.9	0.8	342	826	..	..
Indonesia	0.12	0.09	16.2	15.2	11,825	14,682	1.1	0.9	645	1,439	..	..
Iran, Islamic Rep.	0.36	0.28	35.5	39.3	8,062	9,284	10.7	8.7	430	598	..	..
Iraq	0.40	0.27	32.1	61.3	2,159	3,202	9.4	14.7	172	650	..	..
Ireland	0.33	0.37	..	..	425	276	24.7	25.0	5,373	5,647	..	..
Israel	0.08	0.06	49.3	44.6	129	106	6.1	7.6	2,384	2,963	..	..
Italy	0.17	0.14	19.3	24.7	5,082	4,196	6.3	8.6	2,295	2,297	*19,876*	..
Jamaica	0.08	0.07	13.6	14.3	4	3	1.7	1.6	923	1,601	..	..
Japan	0.04	0.03	62.6	61.8	2,724	2,378	0.9	1.3	4,687	4,267	..	..
Jordan	0.14	0.08	11.0	18.2	158	79	12.1	7.5	404	503	*2,362*	..
Kazakhstan	..	2.00	..	7.0	..	18,839	..	128.7	..	36	..	..
Kenya	0.23	0.15	0.9	1.5	1,692	1,796	3.9	2.7	160	267	..	..
Korea, Dem. Rep.	0.09	0.08	58.9	73.0	1,625	1,447	0.6	0.5	4,688	4,421	..	..
Korea, Rep.	0.05	0.04	59.6	66.5	1,689	1,183	0.4	0.7	3,920	5,337	..	..
Kuwait	0.00	0.00	..	..	0	0	14.3	15.3	4,500	2,000	..	..
Kyrgyz Republic	..	0.25	..	77.6	..	590	..	17.6	..	270	..	..
Lao PDR	0.21	0.19	15.4	18.4	751	580	1.1	1.0	40	46	..	..
Latvia	..	0.68	..	..	..	447	..	12.1	..	550	..	190
Lebanon	0.07	0.05	28.1	28.7	34	39	3.0	6.5	1,653	1,837	..	..
Lesotho	0.22	0.16	..	..	203	123	9.8	7.5	150	188	..	..
Libya	0.58	0.36	10.7	21.7	538	464	64.1	138.7	357	475	..	..
Lithuania	..	0.79	..	..	..	1,070	..	10.1	..	283	..	..
Macedonia, FYR	..	0.31	..	9.9	..	235	..	7.2	..	814	..	..
Madagascar	0.29	0.20	21.5	35.0	1,309	1,330	7.3	5.3	31	38	..	29
Malawi	0.21	0.17	1.3	1.6	1,155	1,336	1.2	0.9	235	183	..	..
Malaysia	0.07	0.09	6.7	4.5	729	707	2.4	4.2	4,273	6,735	..	..
Mali	0.31	0.33	2.9	2.6	1,346	2,866	10.1	7.6	60	83	..	..
Mauritania	0.12	0.09	25.1	23.6	125	292	..	..	59	195	..	..
Mauritius	0.10	0.09	15.0	17.0	0	0	1.2	1.8	2,547	3,037	..	..
Mexico	0.35	0.27	20.3	23.5	9,547	10,424	12.2	12.0	570	562	..	..
Moldova	..	0.41	..	14.1	..	708	..	3.8	..	651	..	..
Mongolia	0.71	0.54	3.0	6.1	559	359	404.4	350.0	83	9	*28*	..
Morocco	0.39	0.33	15.0	13.5	4,414	5,374	7.3	7.4	269	344	..	..
Mozambique	0.24	0.17	2.1	3.4	1,077	1,640	8.3	6.9	109	27	..	..
Myanmar	0.28	0.21	10.4	14.3	5,133	6,645	0.8	0.6	111	130	*9*	..
Namibia	0.64	0.51	0.6	0.8	195	329	152.8	136.1	..	..	..	..
Nepal	0.16	0.13	22.5	31.0	2,251	3,122	0.6	0.5	98	328	..	*21*
Netherlands	0.06	0.06	58.5	61.5	225	194	6.4	6.4	8,620	5,849	..	..
New Zealand	0.80	0.44	5.2	9.1	193	153	120.8	98.9	1,965	4,212	..	2,370
Nicaragua	0.41	0.55	6.0	3.3	266	357	16.5	21.0	392	141	..	353
Niger	0.63	0.53	..	..	3,872	6,789	5.0	3.9	10	17	..	..
Nigeria	0.39	0.28	0.7	0.7	6,048	17,990	4.4	4.4	59	82	..	..
Norway	0.20	0.22	..	..	311	340	5.9	8.6	3,146	2,187	..	*941*
Oman	0.01	0.01	92.7	98.4	2	3	6.3	4.6	840	6,875	*15,133*	24,125
Pakistan	0.24	0.16	72.7	79.8	10,693	12,254	1.4	1.2	525	1,085	..	330
Panama	0.22	0.19	5.0	4.8	166	168	9.4	8.9	692	700	..	..
Papua New Guinea	0.01	0.01	..	..	2	2	0.4	0.3	3,827	2,383	*17,833*	2,635
Paraguay	0.52	0.46	3.4	3.0	304	545	33.7	38.4	44	105	..	..
Peru	0.19	0.16	33.0	41.2	732	816	13.9	11.3	381	445	..	..
Philippines	0.11	0.08	14.0	16.7	6,790	6,621	1.0	0.9	639	1,091	..	..
Poland	0.41	0.37	0.7	0.7	7,875	8,575	3.5	3.7	2,393	1,031	*995*	500
Portugal	0.25	0.23	20.1	20.9	1,099	679	3.3	5.3	1,113	1,112	..	..
Puerto Rico	0.02	0.01	39.0	51.3	1	0	8.2	8.1	..	..	..	..
Romania	0.44	0.41	21.9	31.3	6,340	6,177	4.0	6.6	1,448	508	..	..
Russian Federation	..	0.88	..	4.0	..	52,901	..	21.9	..	123	..	..

3.2

	Arable land		Irrigated land		Area under cereal production		Agricultural land per worker		Fertilizer consumption		Pesticide consumption	
	hectares per capita		% of cropland		thousand hectares		hectares		Hundreds of grams per hectare of arable land		Grams per hectare of arable land	
	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1992–94	1979–81	1994–96	1984–86	1994–96
Rwanda	0.15	0.13	0.4	0.3	239	108	0.7	0.7	3	0	..	..
Saudi Arabia	0.20	0.20	28.9	38.7	388	906	69.8	137.7	228	929	..	..
Senegal	0.42	0.28	2.6	3.1	1,216	1,235	3.9	3.0	104	78	..	214
Sierra Leone	0.14	0.11	4.1	5.4	434	348	3.1	2.7	58	62	..	..
Singapore	0.00	0.00	..	..	..	..	0.5	0.2	22,333	50,010	..	..
Slovak Republic	..	0.28	..	18.6	..	868	..	..	..	675	..	3,469
Slovenia	..	0.12	..	0.7	..	110	..	18.2	..	3,538	..	6,248
South Africa	0.46	0.40	8.4	8.1	6,645	6,389	50.3	51.0	874	506	..	57
Spain	0.42	0.39	14.8	17.8	7,391	6,612	12.2	18.7	1,012	1,211	..	..
Sri Lanka	0.06	0.05	28.4	29.2	864	903	0.8	0.7	1,757	2,270	..	..
Sudan	0.66	0.49	14.5	15.0	4,407	8,637	22.1	19.1	51	43	..	90
Sweden	0.36	0.31	..	..	1,505	1,130	14.4	17.4	1,654	1,147	..	..
Switzerland	0.06	0.06	6.2	5.8	172	206	10.7	8.0	4,623	3,547	..	4,632
Syrian Arab Republic	0.60	0.37	9.6	18.1	2,642	3,509	14.6	11.5	250	672	..	..
Tajikistan	..	0.14	..	83.5	..	260	..	5.5	..	854	..	..
Tanzania	0.12	0.11	4.1	4.9	2,835	3,168	4.6	3.2	143	98	..	..
Thailand	0.35	0.29	16.4	23.5	10,625	10,584	1.1	1.0	177	816	*1.492*	..
Togo	0.76	0.51	0.3	0.3	416	694	3.2	2.6	13	59	..	97
Trinidad and Tobago	0.06	0.06	17.8	18.0	4	5	2.8	2.6	1.064	867	*28.486*	..
Tunisia	0.51	0.32	4.9	7.4	1,416	1,091	9.3	10.5	212	296	..	..
Turkey	0.57	0.40	9.6	15.3	13,499	13,958	3.4	2.9	529	650	*1.591*	..
Turkmenistan	..	0.31	..	87.8	..	442	..	58.6	..	914	.	..
Uganda	0.32	0.27	0.1	0.1	752	1,319	1.3	1.1	1	5	..	15
Ukraine	..	0.64	..	7.5	..	12,225	..	8.5	..	310	..	..
United Arab Emirates	0.01	0.02	237.7	86.8	0	1	8.7	3.8	2,250	9,508	..	..
United Kingdom	0.12	0.10	2.0	1.8	3,930	3,193	26.2	28.2	3.185	3,790	..	..
United States	0.83	0.71	10.8	11.4	72,630	62,929	111.0	118.2	1,092	1,061	*1.983*	..
Uruguay	0.48	0.40	5.4	10.7	614	591	78.5	76.0	564	765	..	..
Uzbekistan	..	0.18	..	88.9	..	1,538	..	8.8	.	1,155	..	..
Venezuela	0.19	0.13	3.6	5.2	814	815	28.1	24.0	711	986	..	..
Vietnam	0.11	0.08	24.1	29.6	5,964	7,430	0.4	0.3	302	2,488	..	..
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	0.16	0.10	19.9	31.3	865	724	9.9	7.2	93	85	..	..
Yugoslavia, FR (Serb./Mont.)	..	0.35	..	1.6	..	..	..	..	..	225	..	..
Zambia	0.89	0.59	0.4	0.9	..	..	19.1	14.7	145	104	..	171
Zimbabwe	0.36	0.27	3.1	4.5	1,633	1,942	8.4	6.0	609	615	*911*	578
World	**0.27 w**	**0.24 w**	**16.6 w**	**17.6 w**	**492,369 s**	**597,529 s**	**3.9 w**	**3.8 w**	**864 w**	**935 w**	**..**	**.. w**
Low income	0.19	0.15	24.5	28.3	190,761	214,825	1.9	1.7	530	1,142	..	..
Excl. China & India	0.28	0.21	14.7	17.1	86,411	114,934	4.5	3.6	168	328	..	..
Middle income	0.29	0.34	13.4	12.9	145,335	245,730	8.0	9.7	783	548	..	..
Lower middle income	0.24	0.34	17.9	14.5	83,573	181,878	4.4	6.8	670	455	..	..
Upper middle income	0.38	0.33	8.1	9.4	61,762	63,852	18.6	22.3	912	776	..	..
Low & middle income	0.22	0.21	19.8	19.9	336,096	460,555	2.9	3.0	628	826	..	..
East Asia & Pacific	0.12	0.09	..	..	45,260	50,899	1.3	1.1	1,119	2,588	.	..
[illegible]		[illegible]		[illegible]	[illegible]	[illegible]		[illegible]		[illegible]		[illegible]
Latin America & Carib.	0.33	0.28	9.8	11.1	49,979	49,080	15.8	17.0	586	672	..	..
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Sub-Saharan Africa	0.36	0.26	3.7	4.0	50,003	70,926	7.9	6.0	160	132	..	..
High income	0.46	0.41	..	..	156,273	136,974	36.2	51.5	1,321	1,231	.	..

a. Includes Luxembourg.

About the data

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

This table provides indicators of major inputs to agricultural production: land, labor, fertilizers, and pesticides. There is no single correct mix of inputs: appropriate levels and application rates vary by country and over time, depending on the type of crops, the climate and soils, and the production process used. Most of the data shown here and in table 3.3 are collected by the Food and Agriculture Organization (FAO) through annual questionnaires. The FAO tries to impose standard definitions and reporting methods, but exact consistency across countries and over time is not possible.

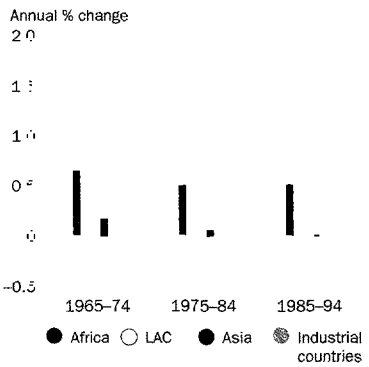
The calculation of agricultural land per worker is based on estimates by the International Labour Organization of the number of persons employed in agriculture (see table 2.5). Data on agricultural employment should be used with caution. In many countries much agricultural employment is informal and unrecorded, including substantial work performed by women and children.

Fertilizer consumption measures the quantity of plant nutrients in the form of nitrogen, potassium, and phosphorous compounds available for direct application. Consumption is calculated as production plus imports minus exports. Traditional nutrients—animal and plant manures—are not included. Because some chemical compounds used for fertilizers have other industrial applications, the consumption data may overstate the quantity available for crops.

Data on pesticides refer to major groups of pesticides, herbicides, seed treatments, and plant growth regulators used in or sold to the agricultural sector. They are usually shown in terms of active ingredients, but some countries report weights including fillers. Country coverage and time series are incomplete because of the limited information provided by countries to the FAO. The FAO is currently revising its pesticides database.

Figure 3.2a

Arable land is no longer expanding

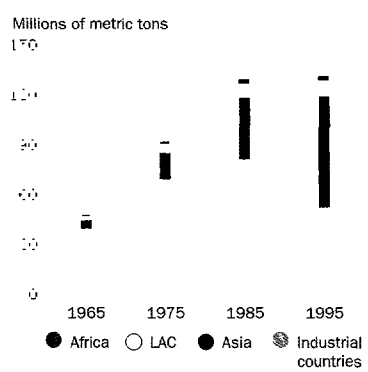


Source: FAO.

Over the past ten years growth in arable land area—which historically has been the main source of agricultural growth—fell to near zero on a global basis. A small increase in arable land in developing countries was offset by a decrease in industrial countries. Arable land area is still expanding in Africa and to some extent in Latin America, but in Asia the land frontier has been reached. With increasing demand for diversified crop and livestock products, the area under traditional food staples (mainly cereals) has begun to decline in Asia. The world is now almost entirely dependent on increased yields to expand agricultural supply.

Figure 3.2b

The distribution of fertilizer consumption has changed



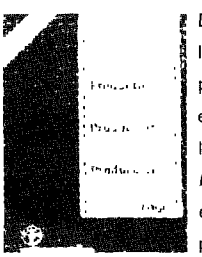
Source: FAO.

Fertilizer consumption grew rapidly after World War II but has leveled off in recent years. Fertilizer use has declined sharply in industrial countries because of concerns about its environmental effects. But consumption has expanded rapidly in developing countries—especially in Asia, which now accounts for more than half of world fertilizer consumption, up from less than 10 percent in 1965. Still, growth in fertilizer use is slowing in many countries, because higher fertilizer doses offer low marginal returns. Fertilizer use is lowest in Sub-Saharan Africa (at 13 kilograms of nutrients per hectare of arable land, compared with 85 in South Asia), and over the past 10 years its use has stagnated.

Definitions

• **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 not included. • **Irrigated land** refers to areas purposely provided with water, including land irrigated by controlled flooding. Cropland refers to arable land and land used for permanent crops (see table 3.1) • **Land under cereal production** refers to harvested areas, although some countries report only sown or cultivated areas. • **Agricultural land per worker** is the ratio of land used as cropland and permanent pasture (see table 3.1) to the number of workers in agriculture (see table 2.5), expressed in hectares. • **Fertilizer consumption** measures the quantity of plant nutrients used per unit of arable land. Fertilizer products cover nitrogenous, potash, and phosphate fertilizers (including ground rock phosphate). The crop year (July through June) is the time reference for fertilizer consumption. • **Pesticide consumption** refers to use or sale to the agricultural sector of substances that reduce or eliminate unwanted plants or animals, especially insects. They include major groups of pesticides such as insecticides, mineral oils, herbicides, plant growth regulators, bacteria and seed treatments, and other active ingredients.

Data sources



Data on arable land, irrigated land, and land under cereal production are from the FAO's electronic files and are published in its *Production Yearbook.* Data on agricultural employment, fertilizers, and pesticides 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			
									Agriculture value added per worker		Agriculture value added per hectare of agricultural land	
	1989–91 = 100		1989–91 = 100		1989–91 = 100		kilograms per hectare		1987 $		1987 $	
	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1992–94
Albania	..	..	..	..	..	..	2,500	2,537	908	1,161	565	752
Algeria	80	116	71	115	52	110	656	953	2,713	3,612	109	180
Angola	102	143	92	126	88	102	526	405	..	149	..	9
Argentina	84	125	95	116	107	104	2,183	2,811	6,248	7,028	51	62
Armenia	..	108	..	78	..	62	..	1,431	..	1,275	..	261
Australia	80	123	92	118	91	108	1,321	1,740	17,222	22,256	16	21
Austria	93	95	92	101	95	105	4,131	5,384	10,695	15,659	956	1,088
Azerbaijan	..	56	..	55	..	64	..	1,599	..	..	..	..
Bangladesh	80	100	79	103	81	125	1,938	2,602	187	226	587	863
Belarus	..	99	..	68	..	63	..	2,161	..	3,023	..	380
Belgium[a]	85	122	88	114	89	113	4,861	7,369	..	..	..	..
Benin	54	147	63	126	69	108	698	1,008	374	563	188	321
Bolivia	71	128	71	120	76	111	1,183	1,561	1,135	..	42	..
Bosnia and Herzegovina	..	..	..	..	..	..	..	2,957	..	..	..	..
Botswana	90	95	88	102	88	103	203	300	392	483	4	5
Brazil	75	113	70	117	68	120	1,496	2,383	1,217	2,384	93	119
Bulgaria	108	69	105	68	96	57	3,853	2,615	4,446	6,240	650	513
Burkina Faso	59	121	63	121	60	117	575	808	155	182	64	93
Burundi	80	93	80	94	88	96	1,081	1,298	218	177	212	270
Cambodia	55	115	51	116	32	121	1,025	1,638	..	131	..	86
Cameroon	91	113	83	114	61	108	849	1,313	861	827	252	313
Canada	78	115	80	111	88	111	2,173	2,702	12,317	30,202	131	154
Central African Republic	103	111	80	111	49	110	529	790	456	516	96	119
Chad	67	117	91	117	120	109	587	639	148	198	6	10
Chile	71	120	72	125	76	131	2,124	4,409	1,729	3,042	79	150
China	67	125	61	144	45	181	..	..	113	193	106	184
Hong Kong, China	134	77	97	52	189	41	1,712	..	..	..	..	..
Colombia	84	102	76	109	73	114	2,452	2,623	1,579	2,172	123	165
Congo, Dem. Rep.	72	105	72	106	77	105	..	..	218	219	83	113
Congo, Rep.	82	111	80	112	80	115	825	936	544	629	21	28
Costa Rica	71	122	73	123	77	115	2,498	3,426	2,544	3,790	280	373
Côte d'Ivoire	74	110	71	118	75	119	867	1,111	1,527	1,354	195	212
Croatia	..	77	..	57	..	45	..	4,340	..	..	..	..
Cuba	87	57	90	62	91	66	2,458	1,877	..	..	..	..
Czech Republic	..	84	..	82	..	79	..	4,167	..	..	..	..
Denmark	65	89	83	102	95	112	4,040	5,934	18,790	38,131	1,166	1,684
Dominican Republic	96	91	85	104	69	123	3,004	4,034	1,325	1,587	251	262
Ecuador	78	135	77	131	73	128	1,633	2,066	1,267	1,790	194	259
Egypt, Arab Rep.	76	117	68	118	68	116	4,053	6,082	757	1,331	2,691	2,990
El Salvador	120	107	91	107	89	113	1,702	1,887	1,417	1,300	733	674
Eritrea	..	128	..	106	..	91	..	699	..	..	..	..
Estonia	..	67	..	56	..	46	..	1,756	..	6,266	..	526
Ethiopia	92	..	90	..	89	..	1,186	..	..	181	..	116
Finland	75	93	93	92	107	92	2,511	3,478	20,171	31,457	2,100	2,072
France	88	101	94	101	98	104	4,700	6,698	13,699	30,035	838	1,113
Gabon	78	111	80	107	87	105	1,718	1,779	1,412	1,516	67	74
Gambia, The	79	81	83	84	93	107	1,284	1,106	215	167	162	199
Georgia	..	65	..	71	..	75	..	1,881	..	..	..	..
Germany	90	100	91	89	98	84	4,166	6,049	..	..	..	..
Ghana	72	152	73	143	80	104	807	1,399	813	684	215	227
Greece	87	108	91	102	99	97	3,090	3,590	5,595	7,726	685	766
Guatemala	90	104	70	111	77	114	1,578	1,915	..	1,240	..	503
Guinea	90	125	97	126	116	124	958	1,219	..	225	..	54
Guinea-Bissau	66	111	69	111	78	111	711	1,389	186	292	54	78
Haiti	103	85	106	91	112	112	1,009	929	..	..	..	..
Honduras	90	107	88	104	81	112	1,170	1,436	959	1,490	200	268

	Crop production index		Food production index		Livestock production index		Cereal yield		Agricultural productivity			
									Agriculture value added per worker		Agriculture value added per hectare of agricultural land	
	1989–91 = 100		1989–91 = 100		1989–91 = 100		kilograms per hectare		1987 $		1987 $	
	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1992–94
Hungary	93	77	91	73	94	68	4,519	3,910	..	4,679	..	485
India	71	114	68	115	63	119	1,324	2,136	304	404	338	520
Indonesia	67	116	64	119	50	138	2,837	3,895	422	481	376	519
Iran, Islamic Rep.	58	134	61	135	68	130	1,108	1,826	4,415	6,157	404	696
Iraq	74	105	78	93	82	57	832	717	..	..	..	..
Ireland	94	106	83	105	83	106	4,733	6,687	..	..	..	..
Israel	98	103	86	108	79	114	1,840	1,424	..	..	..	..
Italy	106	100	101	102	93	104	3,548	4,716	10,516	17,876	1,650	1,964
Jamaica	99	130	86	116	74	100	1,667	1,374	711	1,045	433	591
Japan	108	96	94	98	85	98	5,252	6,119	9,832	16,712	11,279	12,445
Jordan	59	142	61	148	51	162	521	1,209	3,129	2,769	224	461
Kazakhstan	..	59	..	70	..	73	..	650	..	..	..	..
Kenya	75	109	68	101	60	97	1,364	1,822	268	240	68	90
Korea, Dem. Rep.	..	..	..	..	..	..	3,405	3,472	..	..	..	..
Korea, Rep.	88	102	78	115	53	143	4,986	5,813	1,950	5,302	5,229	6,961
Kuwait	41	106	99	129	109	134	3,124	4,937	4,564	..	288	224
Kyrgyz Republic	..	87	..	81	..	78	..	1,923	..	69	..	4
Lao PDR	73	111	71	115	64	127	1,402	2,561	..	..	..	..
Latvia	..	77	..	57	..	47	..	1,854	..	3,870	..	349
Lebanon	52	112	58	117	88	128	1,307	1,969	..	..	..	..
Lesotho	95	117	89	109	88	113	977	1,560	291	194	35	24
Libya	78	89	82	95	69	89	430	679	..	..	..	..
Lithuania	..	72	..	65	..	57	..	2,024	..	..	..	..
Macedonia, FYR	..	94	..	96	..	101	..	2,719	..	..	..	..
Madagascar	83	101	82	104	90	104	1,664	2,010	190	178	26	34
Malawi	84	107	91	102	79	98	1,161	1,194	162	156	145	153
Malaysia	75	106	55	122	41	141	2,828	3,052	2,235	4,052	941	942
Mali	59	120	80	114	95	113	804	809	251	259	24	33
Mauritania	60	137	86	100	89	95	384	750	..	..	5	7
Mauritius	92	96	89	104	66	135	2,536	4,339	1,764	3,762	1,607	1,902
Mexico	88	107	85	117	85	124	2,152	2,506	1,372	1,518	109	123
Moldova	..	71	..	63	..	49	..	2,711	..	..	..	..
Mongolia	45	37	88	80	93	85	573	734	..	..	..	..
Morocco	55	100	56	101	60	98	811	1,236	565	919	78	111
Mozambique	109	109	99	106	83	96	603	647	..	92	..	12
Myanmar	89	142	88	139	86	117	2,521	3,015	..	..	..	..
Namibia	81	99	108	107	116	108	377	264	1,295	1,458	8	9
Nepal	63	109	65	109	75	109	1,615	1,819	173	198	271	406
Netherlands	80	110	87	104	89	102	5,696	7,752	23,131	41,245	3,489	5,932
New Zealand	75	126	91	117	95	111	4,089	5,356	10,693	13,373	86	132
Nicaragua	123	110	118	120	140	116	1,475	1,687	3,268	3,697	212	155
Niger	94	123	101	120	110	114	440	338	292	256	57	63
Nigeria	52	134	58	132	82	125	1,269	1,172	479	684	111	150
Norway	91	95	92	99	95	102	3,634	3,807	19,593	34,809	3,172	3,403
Oman	60	110	63	88	62	96	982	2,180	1,041	..	155	328
Pakistan	66	111	66	125	60	131	1,608	1,943	323	466	227	382
Panama	97	96	86	102	71	113	1,524	2,078	1,954	2,320	208	246
Papua New Guinea	86	106	86	106	85	105	2,087	1,698	671	752	1,756	2,186
Paraguay	58	99	61	113	62	113	1,511	2,137	1,698	2,204	49	54
Peru	81	125	78	123	78	119	1,944	2,915	..	..	..	..
Philippines	88	109	86	116	74	138	1,611	2,283	777	780	782	835
Poland	85	86	88	83	98	79	2,345	2,854	..	1,359	..	366
Portugal	85	90	72	97	72	106	1,102	2,310	..	..	..	715
Puerto Rico	131	72	100	86	90	91	8,925	5,733	6,379	..	817	..
Romania	114	96	111	97	110	96	2,854	2,812	..	3,007	..	393
Russian Federation	..	77	..	71	..	67	..	1,313	..	..	..	..

3.3

	Crop production index		Food production index		Livestock production index		Cereal yield		Agricultural productivity			
									Agriculture value added per worker		Agriculture value added per hectare of agricultural land	
	1989–91 = 100		1989–91 = 100		1989–91 = 100		kilograms per hectare		1987 $		1987 $	
	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1994–96	1979–81	1992–94
Rwanda	89	68	90	72	81	86	1,134	1,491	306	206	445	378
Saudi Arabia	27	105	31	95	33	111	820	4,143	1,641	..	23	..
Senegal	78	97	75	106	64	131	690	824	328	375	92	118
Sierra Leone	80	94	85	95	84	107	1,249	1,192	365	344	117	123
Singapore	595	57	154	42	174	40	..	.	8,791	20,215	18,956	72,942
Slovak Republic	..	89	..	76	..	67	..	4,298	..	..	..	497
Slovenia	..	112	..	96	..	97	..	5,026	..	..	..	..
South Africa	97	101	93	98	90	92	2,117	1,918	2,361	2,870	45	49
Spain	83	90	82	95	84	107	1,986	2,478	..	8,699	.	496
Sri Lanka	99	105	98	108	93	133	2,462	2,568	489	561	592	801
Sudan	122	129	104	125	91	119	659	527	889	..	42	..
Sweden	92	86	100	96	104	102	3,595	4,399	18,485	28,590	1,263	1,577
Switzerland	95	94	96	97	99	97	4,883	6,362	..	..	..	..
Syrian Arab Republic	101	147	94	134	73	103	1,156	1,660	3,426	..	212	..
Tajikistan	..	61	..	70	.	64	..	1,109	.	.	.	.
Tanzania	82	94	77	98	69	109	1,063	1,310	..	..	.	..
Thailand	80	111	80	108	65	116	1,911	2,434	375	554	338	488
Togo	70	116	77	117	52	119	729	762	404	461	119	189
Trinidad and Tobago	120	102	102	105	84	99	3,167	3,649	4,822	3,586	1,801	1,245
Tunisia	69	93	68	99	64	123	828	1,164	1,384	2,286	142	232
Turkey	77	106	76	105	81	102	1,869	2,019	1,208	1,168	354	404
Turkmenistan	..	87	..	121	..	119	..	2,570	.	..	..	..
Uganda	68	110	71	107	85	113	1,555	1,552	..	592	..	515
Ukraine	..	69	..	70	..	64	..	2,410	..	..	..	..
United Arab Emirates	39	192	47	169	42	137	5,608	7,528	8,928	..	970	2,076
United Kingdom	79	100	92	101	98	101	4,792	6,909	..	.	..	..
United States	99	114	95	113	89	112	4,151	5,136	17,719	..	156	261
Uruguay	86	129	87	123	86	117	1,644	3,016	5,379	6,535	65	80
Uzbekistan	..	86	..	108	..	110	..	1,762	..	1,228	.	150
Venezuela	77	108	78	120	82	122	1,904	2,719	3,103	3,270	110	139
Vietnam	67	127	64	127	54	130	2,049	3,504	.	801	.	2,640
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	82	109	75	113	69	118	1,038	1,046	..	..		..
Yugoslavia, FR (Serb./Mont.)	..	83	..	94	..	104	..	..	..	..	..	..
Zambia	66	93	74	97	86	102	..	..	116	100	6	7
Zimbabwe	78	100	82	92	85	94	1,359	1,163	294	266	34	41
World	**80 w**	**113 w**	**80 w**	**116 w**	**81 w**	**118 w**	**2,230 w**	**2,561 w**	**.. w**	**.. w**	**..w**	**236 w**
Low income	70	121	67	130	58	153	1,349	1,846	209	293	128	206
Excl. China & India	75	116	76	118	75	118	1,380	1,595	..	393	79	135
Middle income	80	109	79	110	82	108	1,997	2,120	..	..	..	202
Lower middle income	79	110	77	111	77	110	1,957	1,919	..	..	..	320
Upper middle income	82	107	81	109	85	107	2,050	2,694	..	.	..	114
Low & middle income	74	116	72	122	70	131	1,629	1,993	..	459	..	206
East Asia & Pacific	70	124	65	139	50	174	2,216	3,067	..	..	.	..
Europe & Central Asia	..	..	..	..	..	..	..	1,774	..	..	.	..
Latin America & Carib.	82	112	80	115	82	116	1,840	2,494	1,586	2,292	90	116
Middle East & N. Africa	69	119	67	118	65	113	1,173	1,926	1,918	.	185	..
South Asia	73	113	70	115	64	122	1,410	2,136	290	383	337	519
Sub-Saharan Africa	77	115	79	113	84	106	1,100	1,041	458	392	53	68
High income	93	107	92	106	92	106	3,522	4,470	..	..	..	..

a. Includes Luxembourg.

About the data

The agricultural production indexes in the table are prepared by the Food and Agriculture Organization (FAO). The FAO obtains data from official and semi-official reports of crop yields, area under production, and livestock numbers. If data are not available, the FAO makes estimates. The indexes are calculated using the Laspeyres formula: production quantities of each commodity are weighted by average international commodity prices in the base period and summed for each year. Because the FAO's indexes are based on the concept of agriculture as a single enterprise, estimates of the amounts retained for seed and feed are subtracted from the production data to avoid double counting. The resulting aggregate represents production available for any use except as seed and feed. The FAO's indexes may differ from other sources because of differences in coverage, weights, concepts, time periods, calculation methods, and use of international prices.

To ease cross-country comparisons, the FAO uses international commodity prices to value production. These prices, expressed in international dollars (equivalent in purchasing power to the U.S. dollar), are derived using a Geary-Khamis formula for agriculture (see Inter-Secretariat Working Group on National Accounts 1993, sections 16–93). 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. Unlike the International Comparison Programme (ICP), the FAO calculates international prices only for agricultural products. Substantial differences may arise between the implicit exchange rate derived by the ICP and that of the FAO. For further discussion of the FAO's methods see FAO (1986). (See tables 4.10 and 4.11 for a discussion of the ICP.)

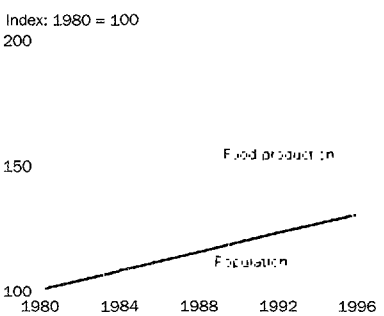
Data on cereal yields may be affected by a variety of reporting and timing differences. The FAO allocates production data to the calendar year in which the bulk of the harvest took place. But most of a crop harvested near the end of a year will be used in the following year. In general, cereal crops harvested for hay or harvested green for food, feed, or silage and those used for grazing are excluded. But millet and sorghum, which are grown as feed for livestock and poultry in Europe and North America, are used as food in Africa, Asia, and countries of the former Soviet Union.

Agricultural productivity is measured by value added per unit of input. (See tables 4.1 and 4.2 for further discussion on the calculation of value added in national accounts.) Agricultural value added includes that from forestry and fishing. Thus interpretations of land productivity should be made with caution.

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

Figure 3.3a

Food production has outpaced population growth



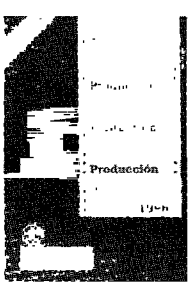
Source: Tables 2.1 and 3.3.

Food production has increased by more than 50 percent since 1980, outstripping population growth of about 30 percent in the same period. Growth in food consumption has not been evenly distributed, however, and the gain in production may have reduced crop diversity and natural habitats—and increased chemical contamination (see also tables 3.2 and 3.4).

Definitions

• **Crop production index** shows agricultural production for each year relative to the base period 1989–91. It includes all crops except fodder crops. 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 1989–91. Data in this table are three-year averages. However, missing observations have not been estimated or imputed. • **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 as kilograms per hectare of harvested land, includes wheat, rice, maize, barley, oats, rye, millet, sorghum, buckwheat, and mixed grains. Production data on cereals refer to crops harvested for dry grain only. Cereal crops harvested for hay or harvested green for food, feed, or silage and those used for grazing are excluded. • **Agricultural productivity** refers to value added per agricultural worker and valued added per hectare of agricultural land (measured as the sum of arable land, permanent cropland, and permanent pasture) measured in constant 1987 U.S. dollars.

Data sources



Agricultural production indexes are prepared by the FAO and published annually in its *Production Yearbook.* The FAO makes these data and data on cereal yields and agricultural employment available to the World Bank in electronic files that may contain more recent information than the published versions.

3.4 Biodiversity and protected areas

	Nationally protected areas		Mammals		Birds		Higher plants[a]	
	thousand sq. km 1994[b]	% of total land area 1994[b]	Species 1994[b]	Threatened species 1994[b]	Species 1994[b]	Threatened species 1994[b]	Species 1994[b]	Threatened species 1994[b]
Albania	0.3	1.2	68	3	306	5	2,965	50
Algeria	119.2	5.0	92	11	375	7	3,100	145
Angola	26.4	2.1	276	16	909	13	5,000	25
Argentina	43.7	1.6	320	20	976	40	9,000	170
Armenia	2.1	7.6	..	1	..	5	..	..
Australia	940.8	12.2	252	43	751	51	15,000	1,597
Austria	20.8	24.2	83	3	414	3	2,950	22
Azerbaijan	1.9	2.2	..	3	..	6	..	1
Bangladesh	1.0	0.7	109	16	684	28	5,000	24
Belarus	2.7	1.2	..	5	..	4	..	..
Belgium	0.8	..	58	2	429	3	1,400	3
Benin	7.8	7.0	188	7	423	1	2,000	3
Bolivia	92.3	8.5	316	21	1,274	27	16,500	49
Bosnia and Herzegovina	0.3	0.5	..	..	..	2	..	..
Botswana	106.6	18.8	164	8	550	5	..	4
Brazil	321.9	3.8	394	45	1,635	103	55,000	463
Bulgaria	3.7	3.3	81	1	374	11	3,505	94
Burkina Faso	26.6	9.7	147	6	453	1	1,100	..
Burundi	0.9	3.5	107	6	596	5	2,500	1
Cambodia	30.0	17.0	123	19	429	16	..	7
Cameroon	20.5	4.4	297	21	874	14	8,000	74
Canada	823.6	9.0	193	6	578	5	2,920	649
Central African Republic	61.1	9.8	209	9	662	2	3,600	..
Chad	114.9	9.1	134	13	532	3	1,600	12
Chile	137.3	18.3	91	11	448	15	5,125	292
China	580.8	6.2	499	94	1,186	183	30,000	1,009
Hong Kong, China	..	..	..	..	..	..	..	..
Colombia	93.8	9.0	359	24	1,695	62	50,000	376
Congo, Dem. Rep.	99.2	4.4	415	23	1,096	26	11,000	7
Congo, Rep.	11.8	3.4	200	13	569	3	4,350	3
Costa Rica	6.5	12.5	205	8	850	10	11,000	456
Côte d'Ivoire	19.9	6.3	230	16	694	11	3,517	66
Croatia	3.9	6.9	..	..	..	4	..	..
Cuba	11.5	8.1	31	10	342	13	6,004	811
Czech Republic	10.7	13.8	..	3	..	5	..	..
Denmark	13.9	32.7	43	1	439	2	1,200	6
Dominican Republic	10.5	21.7	20	3	254	10	5,000	73
Ecuador	111.1	40.1	302	20	1,559	50	18,250	375
Egypt, Arab Rep.	7.9	0.8	98	7	439	10	2,066	84
El Salvador	0.1	0.2	135	2	420	..	2,500	35
Eritrea	..	..	112	3	537	3	..	..
Estonia	4.1	10.4	65	5	330	2	1,630	2
Ethiopia	60.2	6.0	255	21	813	17	6,500	153
Finland	27.4	9.0	60	3	425	4	1,040	11
France	56.0	10.2	93	5	506	5	4,500	117
Gabon	10.5	4.1	190	12	629	4	6,500	78
Gambia, The	0.2	2.3	108	3	504	1	966	..
Georgia	1.9	2.7	..	3	..	5	..	1
Germany	91.9	26.3	..	..	..	..	..	..
Ghana	11.0	4.9	222	12	725	7	3,600	32
Greece	2.2	1.7	95	5	398	9	4,900	539
Guatemala	13.3	7.7	250	5	669	4	8,000	315
Guinea	1.6	0.7	190	13	552	11	3,000	35
Guinea-Bissau	..	..	108	5	319	1	1,000	..
Haiti	0.1	0.4	3	3	220	10	4,685	28
Honduras	8.6	7.7	173	5	684	4	5,000	55

Why does biodiversity matter?

It is said that species are going extinct at 50–100 times the natural rate. Why should we be concerned? Biodiversity conservation, and the protection of ecosystems where biodiversity is greatest, are sometimes dismissed as being an elitist concern for a few charismatic species. In fact, biodiversity and the ecosystems that contain it generate a wide range of benefits to human society. Diverse ecosystems often contain a variety of economically useful products that can be harvested or used as inputs for production. They also provide economically valuable services, such as:

- Improving water quality and quantity for agriculture, industry, and human consumption
- Reducing sedimentation in reservoirs and waterways.
- Minimizing floods, landslides, coastal erosion, and droughts
- Providing recreational opportunities.
- Filtering excess nutrients.
- Providing essential habitats for species containing genetic material that can be used to develop useful products such as pharmaceuticals and improved crops. Moreover, many people value species and ecosystems for aesthetic, moral, or spiritual reasons, even if they do not use them.

Although all these benefits are real, many of them do not enter markets. This is one of the reasons biodiversity tends to be undervalued. With normal market transactions, buyers know what they are getting for their money—a kilogram of rice, a pair of shoes, a movie ticket. With biodiversity, however, there is much less certainty about the value, and even the quantity, of what is being "bought."

Habitat destruction—the main cause of biodiversity loss

Although there are cases where hunting has caused species to go extinct (for example, the passenger pigeon in the United States in the 20th century), the main cause of biodiversity loss is usually habitat destruction, driven by activities such as logging, conversion to agriculture, infrastructure development, or human settlement. Agriculture has played a major role in this process because crop and livestock production affect the largest portion of the earth's surface and are the world's biggest users of land and freshwater. In many countries the conversion of land to agriculture is closely related to logging because many logged areas are later cultivated, and roads built for logging facilitate new settlement.

Habitat conversion can lead directly to the extinction of species. Even if species survive the conversion of

	Nationally protected areas		Mammals		Birds		Higher plants[a]	
	thousand sq. km 1994[b]	% of total land area 1994[b]	Species 1994[b]	Threatened species 1994[b]	Species 1994[b]	Threatened species 1994[b]	Species 1994[b]	Threatened species 1994[b]
Hungary	5.7	6.2	72	2	363	7	2,148	24
India	143.4	4.8	316	40	1,219	71	15,000	1,256
Indonesia	185.6	10.2	436	57	1,531	104	27,500	281
Iran, Islamic Rep.	83.0	5.1	140	9	502	12	..	1
Iraq	..	..	81	4	381	11	..	2
Ireland	0.5	0.7	25	..	417	1	892	9
Israel	3.1	14.9	92	7	500	8	..	38
Italy	22.8	7.7	90	4	490	6	5,463	273
Jamaica	0.0	0.2	24	2	262	7	2,746	371
Japan	27.6	7.3	132	17	583	31	4,700	704
Jordan	2.9	3.3	71	8	361	4	2,200	10
Kazakhstan	9.9	0.3	..	9	..	14	..	..
Kenya	35.0	6.2	359	16	1,068	22	6,000	158
Korea, Dem. Rep.	0.6	0.5	..	7	390	16	2,898	7
Korea, Rep.	6.9	7.0	49	6	372	19	2,898	69
Kuwait	0.3	1.5	21	2	321	3	234	..
Kyrgyz Republic	2.9	1.5	..	4	..	5	..	1
Lao PDR	*24.4*	10.6	172	25	651	23	..	5
Latvia	7.8	12.5	83	4	325	5	1,153	..
Lebanon	0.0	0.4	54	5	329	5	..	4
Lesotho	0.1	0.2	33	2	281	3	1,576	7
Libya	1.7	0.1	76	8	323	2	1,800	57
Lithuania	6.3	9.8	68	4	305	4	1,200	..
Macedonia, FYR	2.2	8.5	..	..	..	..	..	..
Madagascar	11.2	1.9	105	33	253	28	9,000	189
Malawi	10.6	11.3	195	6	645	9	3,600	61
Malaysia	14.8	4.5	286	20	736	31	15,000	510
Mali	40.1	3.3	137	12	622	5	1,741	14
Mauritania	17.5	1.7	61	10	541	3	1,100	3
Mauritius	0.0	2.0	4	3	81	9	700	222
Mexico	98.5	5.1	450	24	1,026	34	25,000	1,048
Moldova	0.1	0.2	68	1	270	6	..	1
Mongolia	61.7	3.9	134	8	390	11	2,272	1
Morocco	3.7	0.8	105	7	416	11	3,600	195
Mozambique	0.0	0.0	179	9	678	13	5,500	92
Myanmar	1.7	0.3	251	20	999	43	7,000	29
Namibia	102.2	12.4	154	12	609	6	3,128	23
Nepal	11.1	8.1	167	23	824	23	6,500	21
Netherlands	4.3	11.5	55	2	456	3	1,170	1
New Zealand	60.7	22.9	10	3	287	45	2,160	236
Nicaragua	9.0	7.4	200	6	750	3	7,000	78
Niger	84.2	6.6	131	10	482	2	1,170	..
Nigeria	29.7	3.3	274	22	862	8	4,614	9
Norway	55.4	18.0	54	3	453	3	1,650	20
Oman	9.9	17.6	56	5	430	5	1,018	4
Pakistan	37.2	4.8	151	10	671	22	4,929	12
Panama	13.3	17.8	218	11	929	9	9,000	561
Papua New Guinea	0.8	0.2	214	33	708	31	10,000	95
Paraguay	15.0	3.7	305	8	600	22	7,500	12
Peru	41.8	3.3	344	29	1,678	60	17,121	377
Philippines	6.1	2.0	153	22	556	86	8,000	371
Poland	30.7	10.1	79	4	421	5	2,300	27
Portugal	5.8	6.3	63	6	441	7	2,500	240
Puerto Rico	..	..	..	..	..	..	..	..
Romania	10.7	4.7	84	3	368	11	3,175	122
Russian Federation	705.4	3.9	..	17	..	35	..	127

part of their habitat, their long-term survival may be threatened by fragmentation and disturbance of the rest of the ecosystem. As habitats become smaller, the number of species they can support per unit area falls, and the populations of wide-ranging or more aggressive species (often introduced species) may expand at the expense of species with more specialized habitat requirements. In Hawaii, for example, the natural ecosystem has been under continuous attack by introduced plant and animal species. Some birds unique to Hawaii build their nests on the ground and are now threatened by pigs and mongoose, both introduced species. Species are also threatened by agricultural chemicals and by changes in water sources caused by human use.

Protected areas are on the rise

Protection of endangered ecosystems is one way to ensure that biodiversity and its many benefits are preserved for current and future generations. Since the first national park (Yellowstone National Park in the United States) was created 125 years ago, the number of established protected areas and the total area protected have grown dramatically (figure 3.4a). Recent growth of protected areas has been especially rapid in low- and middle-income countries. Almost 7 percent of the world's land area is now protected, still short of the 10–15 percent recommended by some experts.

The real question, however, is not just how many hectares of land are protected, but which land is protected and how effective the protection is. The extent of physical area covered does not necessarily mean that the most vulnerable species, genes, or ecosystems are protected. For this reason the selection and establishment of protected areas must be based on a partnership between experts on biodiversity, other potential users, and government. Experience has also demonstrated the need to work with surrounding communities rather than rely on a strict enforcement approach.

Knowledge of national biological resources and the extent to which they are endangered varies greatly. In most countries more is known about the number of birds and mammals (and the number endangered) than about the number of higher plants. Plant species, however, are often a more important source of potentially usable biological material than birds or mammals. Many poor or very poor countries are among those with the largest number of plant species (the so-called megadiversity countries). For example, Brazil and Colombia are estimated to have more than 50,000 species of higher plants apiece, and China, Indonesia, and Mexico each have more

	Nationally protected areas		Mammals		Birds		Higher plants[a]	
	thousand sq. km 1994[b]	% of total land area 1994[b]	Species 1994[b]	Threatened species 1994[b]	Species 1994[b]	Threatened species 1994[b]	Species 1994[b]	Threatened species 1994[b]
Rwanda	3.3	13.3	151	14	666	6	2,288	..
Saudi Arabia	62.0	2.9	77	6	413	10	1,729	6
Senegal	21.8	11.3	155	9	610	5	2,062	32
Sierra Leone	0.8	1.1	147	12	622	12	2,090	12
Singapore	0.0	4.9	45	3	295	6	2,000	14
Slovak Republic	10.2	21.1	..	3	..	4	..	..
Slovenia	1.1	5.4	69	3	361	3	..	11
South Africa	69.7	5.7	247	25	790	16	23,000	953
Spain	42.5	8.5	82	7	506	10	..	896
Sri Lanka	8.0	12.3	88	4	428	11	3,000	436
Sudan	93.8	3.9	267	16	937	9	3,132	8
Sweden	29.8	7.3	60	3	463	4	4,916	19
Switzerland	7.3	18.5	75	2	400	3	1,650	9
Syrian Arab Republic	..	..	..	4	..	6	..	10
Tajikistan	0.9	0.6	..	6	..	9	..	..
Tanzania	139.4	15.7	322	16	1,005	30	10,000	406
Thailand	70.2	13.7	265	22	915	44	11,000	382
Togo	6.5	11.9	196	8	558	1	2,000	..
Trinidad and Tobago	0.2	3.1	100	1	433	2	1,982	16
Tunisia	0.4	0.3	78	5	356	6	2,150	24
Turkey	10.7	1.1	116	4	418	13	8,472	1,827
Turkmenistan	11.1	2.4	..	8	..	9	..	1
Uganda	19.1	9.6	338	15	992	10	5,000	6
Ukraine	4.9	0.9	..	4	..	10	2,927	16
United Arab Emirates	..	..	25	2	360	4	..	..
United Kingdom	51.1	21.2	50	1	219	2	1,550	28
United States	1,302.1	11.4	428	22	768	46	16,302	1,845
Uruguay	0.3	0.2	81	4	365	9	2,184	11
Uzbekistan	2.4	0.6	..	7	..	11	..	5
Venezuela	263.2	29.8	305	12	1,296	22	20,000	107
Vietnam	13.3	4.1	213	25	761	45	..	350
West Bank and Gaza	..	..	..	..	..	..	..	..
Yemen, Rep.	..	..	66	4	366	12	..	149
Yugoslavia FR (Serb./Mont.)	3.5	3.4	..	..	..	..	..	..
Zambia	63.6	8.6	229	7	736	10	4,600	9
Zimbabwe	30.7	7.9	270	9	648	7	4,200	94
World	**8,603.2 s**	**6.7 w**						
Low income	1,999.0	5.2						
Excl. China & India	1,274.8	4.9						
Middle income	2,994.1	5.1						
Lower middle income	2,160.8	5.6						
Upper middle income	833.3	4.1						
Low & middle income	4,993.2	5.1						
East Asia & Pacific	966.3	6.2						
Europe & Central Asia	857.8	3.6						
Latin America & Carib.	1,303.4	6.5						
Middle East & N. Africa	1,360.5	3.0						
South Asia	212.4	4.4						
Sub-Saharan Africa	1,332.0	5.5						
High income	3,610.1	11.9						

a. Flowering plants only. b. Data may refer to earlier years. They are the most recent reported by the World Conservation Monitoring Center in 1994.

than 25,000 species. Many high-income countries have fewer than 5,000 species of higher plants. Therein lies a paradox: species diversity and the potential benefits of unexplored genetic material are concentrated in precisely those countries that can least afford to protect ecosystems and where protected areas and biodiversity tend to be under the greatest threat.

Conserving biodiversity while reaping its economic benefits

Habitat conservation provides only a partial answer to the challenge of conserving biodiversity. To also reap the benefits of biodiversity, complementarities must be sought between biodiversity protection and economic activities. Such complementarities are particularly important for agriculture, which depends on many services provided by the environment, such as crop pollination and genes for developing improved crop varieties and livestock breeds. Exploiting biodiversity could substantially boost agricultural production. At the same time, damage to biodiversity often hurts agriculture. Reconciling biodiversity conservation with increased production to meet the needs of growing human populations will be a major challenge.

Some countries have been quite successful in linking economic benefits and biodiversity conservation. Costa Rica, for example, has a rich mix of biodiversity packed into a small country. It now advertises itself as "the Natural Country" and has developed a major ecotourism industry focused on activities associated with protected areas. Foreign exchange earnings from tourism now rival those of traditional exports like coffee and bananas. In addition, tourism revenues help generate political support for continued management of Costa Rica's extensive protected area system, which covers almost 13 percent of the country.

Political and popular support are essential if conservation of protected areas and the biodiversity they contain are to be sustained over the long term. Information—on the value of biodiversity and on the direct economic benefits flowing from protected areas and their wise management—is probably the best way to build this consensus.

About the data

Habitat conservation is vital for stemming the decline in biodiversity. Conservation efforts traditionally have focused on protected areas, which have grown substantially in recent decades. Measures of species richness are one of the most straightforward ways to indicate how important an area is for biodiversity. The number of small plants and animals is usually estimated by sampling of plots. It is also important to know which aspects are under most immediate threat. This, however, requires a large amount of data and time-consuming analysis. For this reason, global analyses of threatened species status have been carried out for only a few groups of organisms. Birds are the only species for which the status of all members has been assessed. Mammals approach birds in this respect, but an estimated 45 percent of mammal species remain to be assessed.

The table shows information on protected areas, numbers of certain species, and numbers of those species under threat. The World Conservation Monitoring Centre (WCMC)—a joint venture of the United Nations Environment Programme (UNEP), World Wide Fund for Nature (WWF), and World Conservation Union (IUCN)—compiles these data from a variety of sources. Because of differences in definitions and reporting practices, cross-country comparability is limited. Compounding these problems, available data cover different periods.

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

- Scientific reserves and strict nature reserves with limited public access.
- National parks of national or international significance (not materially affected by human activity).
- Natural monuments and natural landscapes with unique aspects.
- Managed nature reserves and wildlife sanctuaries.
- Protected landscapes and seascapes (which may include cultural landscapes).

The first three categories, referred to as "totally protected," are areas maintained in a natural state and closed to extractive uses. The last two categories, referred to as "partially protected," are areas that may be managed for specific uses, such as recreation or tourism, or that provide optimal conditions for certain species or communities of wildlife. Some natural resource extraction is allowed within these areas. Designating land as a protected area does not necessarily mean, however, that protection is in force. For small countries that may only have protected areas smaller than 1,000 hectares, this limit will result in an underestimate of the extent and number of protected areas.

Threatened species are defined according to the IUCN's classification categories: endangered (in danger of extinction and survival unlikely if causal factors continue operating), vulnerable (likely to move into the endangered category in the near future if causal factors continue operating), rare (not endangered or vulnerable, but at risk), indeterminate (known to be endangered, vulnerable, or rare but not enough information is available to say which), out of danger (formerly included in one of the above categories but now considered relatively secure because appropriate conservation measures are in effect), and insufficiently known (suspected but not definitely known to belong to one of the above categories).

Figures on species are not necessarily comparable across countries because taxonomic concepts and coverage vary. And while the number of mammals and birds is fairly well known, it is difficult to make an accurate account of plants. Although the data in the table should be interpreted with caution, especially for numbers of threatened species (where our knowledge is very incomplete), they do identify countries that are major sources of global biodiversity and show national commitments to habitat protection. Until a practical indicator of the effectiveness of protection is available, these data are the best available on the distribution and potential protection of global biodiversity resources.

Definitions

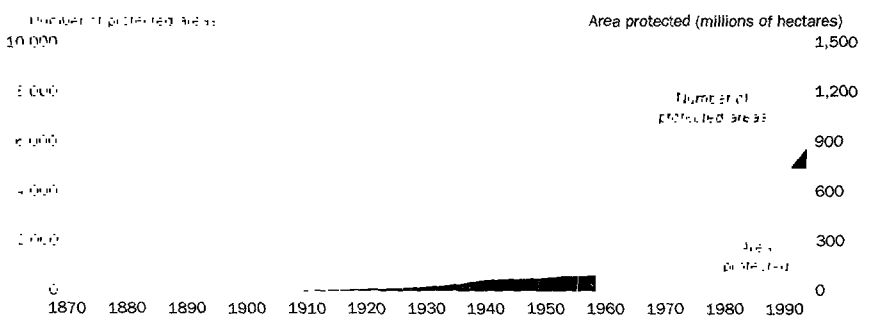
- **Nationally protected areas** are totally or partially protected areas of at least 1,000 hectares that are designed as national parks, natural monuments, nature reserves or wildlife sanctuaries, protected landscapes and seascapes, or scientific reserves with limited public access. The data do not include sites protected under local or provincial law. Total land area is used to calculate the percentage of total area protected (see table 3.1). • **Mammals** exclude whales and porpoises. • **Birds** are listed for countries included within their breeding or wintering ranges. • **Higher plants** refer to native vascular plant species. • ***Threatened species*** *are the number of* species classified by the IUCN as endangered, vulnerable, rare, indeterminate, out of danger, or insufficiently known.

Data sources

Data on protected areas are from the WCMC's Protected Areas Data Unit. Data on species are from the WCMC's *Biodiversity Data Sourcebook*, the WCMC's *Global Biodiversity: Status of the Earth's Living Resources*, and the IUCN's 1996 *Red List of Threatened Animals*.

Figure 3.4a

Worldwide, the number and coverage of protected areas have increased dramatically



Source: [illegible] and IUCN.

3.5 Freshwater

	Freshwater resources	Annual freshwater withdrawals					Access to safe water			
							Urban		Rural	
	cubic meters per capita	billion cu. m[a]	% of total resources[a]	% for agriculture[b]	% for industry[b]	% for domestic[b]	% of population		% of population	
	1996						1980	1995	1980	1995
Albania	13,542	0.2[c]	0.4	76	18	6	..	..	..	..
Algeria	483	4.5	32.4	60[d]	15[d]	25[d]	*100*	..	*70*	..
Angola	16,577	0.5	0.3	76[d]	10[d]	14[d]	..	*69*	..	*15*
Argentina	19,705	27.6[c]	4.0	73	18	9	..	*73*	..	*17*
Armenia	2,411	3.8	41.8	72[d]	15[d]	13[d]	..	..	..	..
Australia	18,731	14.6[c]	4.3	33	2	65	..	..	..	..
Austria	6,986	2.4	4.2	9[d]	58[d]	33[d]	..	..	..	..
Azerbaijan	1,068	15.8	195.1	74[d]	22[d]	4[d]	..	..	..	..
Bangladesh	11,153	22.5	1.7	96	1	3	*24*	42	*40*	80
Belarus	3,612	3.0	8.1	19	49	32	..	..	..	..
Belgium	827	9.0	107.5	4	85	11	..	..	..	..
Benin	1,829	0.2	1.5	67[d]	10[d]	23[d]	..	*41*	..	*53*
Bolivia	39,536	1.2	0.4	85	5	10	..	75	..	*27*
Bosnia and Herzegovina	..	..	..	..	..	..	..	..	..	..
Botswana	1,959	0.1	3.8	48[d]	20[d]	32[d]	..	*100*	..	*53*
Brazil	32,163	36.5	0.7	59	19	22	..	*85*	..	*31*
Bulgaria	2,154	13.9	77.2	22	76	3	..	..	..	..
Burkina Faso	1,640	0.4	2.2	81[d]	0[d]	19[d]	..	..	..	..
Burundi	561	0.1	2.8	64[d]	0[d]	36[d]	..	..	..	..
Cambodia	8,574	0.5	0.6	94	1	5	..	*20*	..	*12*
Cameroon	19,596	0.4	0.1	35[d]	19[d]	46[d]	..	*71*	..	*24*
Canada	95,097	45.1	1.6	12	70	18	..	..	..	..
Central African Republic	42,166	0.1	0.0	74[d]	5[d]	21[d]	..	18	*5*	18
Chad	2,269	0.2	1.2	82[d]	2[d]	16[d]	*27*	*48*	*30*	*17*
Chile	32,458	16.8[c]	3.6	89	5	6	..	..	..	..
China	2,304	460.0	16.4	87	7	6	..	*93*	..	*89*
Hong Kong, China	..	..	..	..	..	..	..	..	..	..
Colombia	28,571	5.3	0.5	43	16	41	..	*88*	..	*48*
Congo, Dem. Rep.	20,670	0.4	0.0	23[d]	16[d]	61[d]	..	..	..	..
Congo, Rep.	345,619	0.0	0.0	11[d]	27[d]	62[d]	..	..	..	..
Costa Rica	27,600	1.4[c]	1.4	89	7	4	..	..	..	..
Côte d'Ivoire	5,346	0.7	0.9	67[d]	11[d]	22[d]	*30*	*59*	*10*	*81*
Croatia	12,870	..	..	..	..	..	..	98	..	80
Cuba	3,131	8.1[c]	23.5	89	2	9	..	*96*	..	*85*
Czech Republic	5,642	2.7	4.7	2[d]	57[d]	41[d]	..	..	..	..
Denmark	2,090	1.2	10.9	43	27	30	..	*100*	..	*100*
Dominican Republic	2,511	3.0	14.9	89	6	5	..	*74*	..	*67*
Ecuador	26,842	5.6	1.8	90	3	7	..	*82*	..	*55*
Egypt, Arab Rep.	47	55.1	1,967.9	86[d]	8[d]	6[d]	*93*	*82*	*61*	*50*
El Salvador	3,270	1.0[c]	5.3	89	4	7	..	*78*	..	*37*
Eritrea	757	..	..	..	..	..	..	..	..	..
Estonia	8,663	3.3	26.0	3[d]	92[d]	5[d]	..	..	..	..
Ethiopia	1,889	2.2	2.0	86[d]	3[d]	11[d]	..	*90*	..	*20*
Finland	21,463	2.2	2.0	3	85	12	..	*100*	..	*100*
France	3,084	37.7	21.0	15	69	16	..	100	..	100
Gabon	145,778	0.1	0.0	6[d]	22[d]	72[d]	*75*	*80*	*34*	*30*
Gambia, The	2,616	0.0	0.7	91[c]	2[c]	7[a]	*100*	..	*27*	..
Georgia	10,737	4.0	6.9	42[d]	37[d]	21[c]	..	..	..	..
Germany	1,172	46.3	48.2	20[d]	70[d]	11[d]	..	..	..	..
Ghana	1,729	0.3[c]	1.0	52[d]	13[d]	35[d]	..	*70*	..	*49*
Greece	4,310	5.0	11.2	63	29	8	..	..	..	..
Guatemala	10,615	0.7[c]	0.6	74	17	9	..	91	..	43
Guinea	33,436	0.7	0.3	87[d]	3[d]	10[d]	..	*61*	*20*	*62*
Guinea-Bissau	14,628	0.0	0.1	36[d]	4[d]	60[d]	..	18	..	27
Haiti	1,499	0.0	0.4	68	8	24	..	*37*	..	*23*
Honduras	9,084	1.5	2.7	91	5	4	..	*81*	..	*53*

3.5

	Freshwater resources	Annual freshwater withdrawals					Access to safe water			
							Urban		Rural	
	cubic meters per capita	billion cu. m[a]	% of total resources[a]	% for agriculture[b]	% for industry[b]	% for domestic[b]	% of population		% of population	
	1996						1980	1995	1980	1995
Hungary	589	6.8	113.5	36	55	9	..	..	..	..
India	1,957	380.0[c]	20.5	93	4	3	*72*	*85*	..	*79*
Indonesia	12,839	16.6	0.7	76	11	13	..	*78*	..	*54*
Iran, Islamic Rep.	2,051	70.0[c]	54.6	92[d]	2[d]	6[d]	*70*	..	*33*	..
Iraq	1,647	42.8[c]	121.6	92[d]	5[d]	3[d]	*92*	..	*22*	..
Ireland	12,962	0.8[c]	1.7	10	74	16	..	..	..	..
Israel	299	1.9	108.8	79[d]	5[d]	16[d]	..	..	..	..
Italy	2,778	56.2	35.3	59	27	14	..	..	..	..
Jamaica	3,259	0.3[c]	3.9	86	7	7	..	*92*	..	*48*
Japan	4,350	90.8	16.6	50	33	17	..	..	..	..
Jordan	158	0.5[c]	66.2	75[d]	3[d]	22[d]	*100*	..	*65*	..
Kazakhstan	4,579	37.9	50.3	79[d]	17[d]	4[d]	..	..	..	..
Kenya	738	2.1	10.1	76[d]	4[d]	20[d]	..	*67*	..	*49*
Korea, Dem. Rep.	2,984	14.2	21.1	73	16	11	..	*100*	..	*100*
Korea, Rep.	1,451	27.6	41.8	46	35	19	..	..	..	..
Kuwait	0	0.5	..	60[d]	2[d]	38[d]	*100*	..	*100*	..
Kyrgyz Republic	10,315	11.0	23.4	95[d]	3[d]	2[d]	..	..	..	..
Lao PDR	9,840	1.0	2.1	82	10	8	..	*40*	..	*39*
Latvia	6,707	0.7	4.2	14[d]	44[d]	42[d]	..	..	..	..
Lebanon	1,030	1.3[c]	30.7	68[d]	4[d]	28[d]	*95*	..	*85*	..
Lesotho	2,571	0.1	1.0	56[d]	22[d]	22[d]	*37*	*14*	*14*	*64*
Libya	116	4.6	766.7	87[d]	2[d]	11[d]	..	..	..	..
Lithuania	4,206	4.4	28.2	3	90	7	..	..	..	..
Macedonia, FYR	..	..	..	..	..	..	..	..	..	..
Madagascar	24,590	16.3	4.8	99[d]	0[d]	1[d]	..	*83*	..	*10*
Malawi	1,747	0.9	5.1	86[d]	3[d]	10[d]	*60*	*52*	*53*	*44*
Malaysia	22,174	9.4[c]	2.1	47	30	23	..	100	..	74
Mali	6,001	1.4	2.3	97[d]	1[d]	2[d]	*58*	*36*	*20*	*38*
Mauritania	171	1.6[c]	407.5	92[d]	2[d]	6[d]	..	..	..	..
Mauritius	1,940	0.4[c]	16.4	77[d]	7[d]	16[d]	*100*	*95*	*98*	*100*
Mexico	3,836	77.6[c]	21.7	86	8	6	..	*91*	..	*62*
Moldova	231	3.7	370.0	23	70	7	..	..	..	..
Mongolia	9,776	0.6	2.2	62	27	11	..	..	..	..
Morocco	1,110	10.9	36.2	92[d]	3[d]	5[d]	*63*	*98*	*2*	*14*
Mozambique	5,547	0.6	0.6	89	2[d]	9[d]	*82*	*17*	*2*	*40*
Myanmar	23,582	4.0	0.4	90	3	7	..	*36*	..	*39*
Namibia	3,913	0.3	4.0	68[d]	3[d]	29[d]	..	..	..	..
Nepal	7,714	2.7	1.6	95	1	4	*75*	64	*6*	49
Netherlands	644	7.8	78.1	34	61	5	..	100	..	100
New Zealand	89,959	2.0	0.6	44	10	46	..	..	..	..
Nicaragua	38,862	0.9[c]	0.5	54	21	25	..	*81*	..	*27*
Niger	375	0.5	14.3	82[d]	2[d]	16[d]	..	*46*	*40*	*55*
Nigeria	1,929	3.6	1.6	54[d]	15[c]	31[d]	..	*63*	..	*26*
Norway	87,651	2.0	0.5	8	72	20	..	..	..	..
Oman	456	1.2	123.2	93[d]	2[d]	5[d]	*70*	..	*10*	..
Pakistan	1,858	155.6[c]	62.7	96[d]	2[d]	2[d]	*77*	*77*	*22*	*52*
Panama	53,852	1.3	0.9	77	11	12	..	..	..	..
Papua New Guinea	181,993	0.1	0.0	49	22	29	..	*84*	..	*17*
Paraguay	18,971	0.4	0.5	78	7	15	..	..	..	*17*
Peru	1,647	6.1	15.3	72	9	19	..	*74*	..	*24*
Philippines	4,492	29.5[c]	9.1	61	21	18	..	..	..	..
Poland	1,279	12.3	24.9	11	76	13	..	..	..	..
Portugal	3,827	7.3	19.2	48	37	15	..	..	..	..
Puerto Rico	..	..	..	..	..	..	..	..	..	..
Romania	1,637	26.0	70.3	59	33	8	..	..	..	..
Russian Federation	29,191	117.0	2.7	23[d]	60[d]	17[d]	..	..	..	..

3.5

	Freshwater resources	Annual freshwater withdrawals					Access to safe water			
							Urban		Rural	
	cubic meters per capita	billion cu. m[a]	% of total resources[a]	% for agriculture[b]	% for industry[b]	% for domestic[b]	% of population		% of population	
	1996						1980	1995	1980	1995
Rwanda	937	0.8	12.2	94[d]	2[c]	5[d]	..	..	..	..
Saudi Arabia	124	17.0[c]	709.2	90[d]	1[d]	9[d]	*92*	..	*87*	..
Senegal	3,093	1.4	5.2	92[d]	3[d]	5[d]	..	*82*	..	*28*
Sierra Leone	34,557	0.4	0.2	89[d]	4[d]	7[d]	*50*	*58*	*3*	*21*
Singapore	197	0.2[c]	31.7	4	51	45	*100*	100	..	..
Slovak Republic	5,765	1.8	5.8	..	..	..	..	..	..	..
Slovenia	..	..	..	..	..	..	..	..	..	..
South Africa	1,190	13.3	29.7	72[d]	11[c]	17[d]	..	..	..	..
Spain	2,809	30.8	27.9	62	26	12	..	..	..	..
Sri Lanka	2,361	6.3[c]	14.6	96	2	2	..	..	..	..
Sudan	1,283	17.8	50.9	94[c]	1[d]	4[d]	*49*	*66*	*45*	*45*
Sweden	19,903	2.9	1.7	9	55	36	..	..	..	..
Switzerland	6,008	1.2	2.8	4	73	23	..	*100*	..	*100*
Syrian Arab Republic	483	14.4	205.9	94[d]	2[d]	4[d]	*77*	*92*	*65*	*78*
Tajikistan	11,186	12.6	19.0	88[d]	7[d]	5[d]	..	..	..	..
Tanzania	2,623	1.2	1.5	89[d]	2[d]	9[d]	*88*	*65*	*40*	*45*
Thailand	1,833	31.9	29.0	90	6	4	..	*89*	..	*72*
Togo	2,719	0.1	0.8	25[c]	13[d]	62[d]	..	..	..	..
Trinidad and Tobago	3,932	0.2[c]	2.9	35	38	27	..	*83*	..	*80*
Tunisia	385	3.1	87.2	89[d]	3[c]	9[d]	*96*	..	*29*	..
Turkey	3,126	31.6	16.1	72[d]	11[d]	16[d]	..	98	*62*	85
Turkmenistan	217	22.8	2,280.0	91	8	1	..	..	..	..
Uganda	1,976	0.2	0.5	60	8	32	..	*47*	..	*32*
Ukraine	1,047	34.7	65.3	30	54	16	..	..	..	..
United Arab Emirates	59	2.1	1,406.7	92[d]	1[d]	7[d]	*100*	*98*	*100*	*98*
United Kingdom	1,208	11.8	16.6	3	77	20	..	*100*	..	*100*
United States	9,270	467.3	19.0	42[d]	45[c]	13[d]	..	..	..	..
Uruguay	18,420	0.7[c]	1.1	91	3	6	..	..	..	..
Uzbekistan	702	82.2	504.3	84[d]	12[d]	4[d]	..	..	..	..
Venezuela	38,367	4.1[c]	0.5	46	11	43	..	80	..	75
Vietnam	4,990	28.9	7.7	78	9	13	..	*53*	..	*32*
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	260	2.9	71.5	92[d]	1[d]	7[d]	..	*88*	..	*17*
Yugoslavia, FR (Serb./Mont.)	..	..	..	..	..	..	..	..	..	..
Zambia	8,703	1.7	2.1	77[d]	7[d]	16[d]	..	*64*	..	*27*
Zimbabwe	1,254	1.2	8.7	79[d]	7[d]	14[d]	..	*99*	..	*65*
World	**7,342 w**	..	..	**68 w**	**22 w**	**10 w**	**.. w**	**.. w**	**.. w**	**.. w**
Low income	4,089	..	..	90	5	4	..	..	..	..
Excl. China & India	8,295	..	..	92	4	4	..	..	..	..
Middle income	12,719	..	..	66	23	11	..	..	..	..
Lower middle income	11,154	..	..	66	24	10	..	..	..	..
Upper middle income	16,447	..	..	68	17	14	..	..	..	..
Low & middle income	6,961	..	..	80	13	7	..	..	..	..
East Asia & Pacific	5,072	..	..	84	8	7	..	*89*	..	*82*
Europe & Central Asia	11,411	..	..	52	37	11	..	..	..	..
Latin America & Carib.	22,011	..	..	77	11	12	..	..	..	..
Middle East & N. Africa	854	..	..	84	8	8	*84*	..	*45*	..
South Asia	3,017	..	..	95	3	2	*70*	*83*	..	*74*
Sub-Saharan Africa	7,821	..	..	85	4	10	..	..	..	..
High income	9,378	..	..	40	45	15	..	..	..	..

a. Data refer to any year from 1980 to 1996 unless otherwise noted. b. Unless otherwise noted, sectoral withdrawal shares are estimated for 1987. Data may not sum to 100 percent because of rounding. c. Data refer to estimates for years before 1980 (see *Primary data documentation*). d. Data refer to years other than 1987 (see *Primary data documentation*)

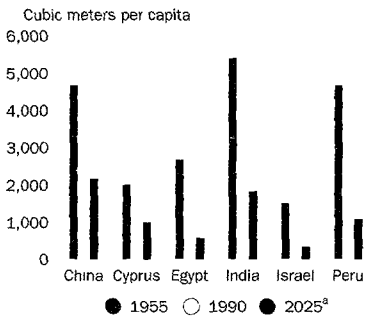
About the data

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 of data on freshwater resources should be made with caution. Because they are collected intermittently, the data may hide significant variations in total renewable water resources from one year to the next. The data also fail to distinguish between seasonal and geographic variations in water availability within countries. Data for small countries and countries in arid and semiarid zones are less reliable than those for larger countries and countries with higher rainfall. Finally, caution is needed in comparing data on annual freshwater withdrawal, which are subject to variations in collection and estimation methods.

While information on access to safe water is widely used, it is extremely subjective, and such terms as "adequate amount" and "safe" may have very different meanings in different countries despite official World Health Organization definitions (see *Definitions* for table 2.14). Even in industrial countries treated water may not always be safe to drink. While access to safe water is equated with connection to a public supply system, this does not take account of variations in the quality and cost (broadly defined) of the service once connected. Thus cross-country comparisons must be made cautiously. Changes over time within countries may result from changes in definitions or measurements.

Figure 3.5a

Annual renewable freshwater resources are coming under increasing strain



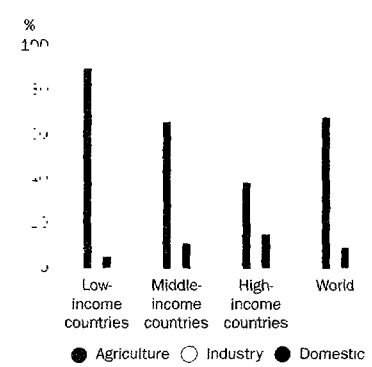
a. Projected.

Source: Serageldin 1995.

Global per capita water supplies are a third lower than they were 25 years ago. The reason? The world's population has increased by some 2 billion people since then. By 2025 further increases are expected to boost demand for water by more than 650 percent, leaving many countries subject to periodic water stress (defined as annual per capita availability of less than 1,700 cubic meters). Today 25 countries have renewable water resources of less than 1,000 cubic meters per capita, and another 27 have less than 2,000. By 2025, 52 countries inhabited by some 3 billion people are expected to suffer from periodic water stress or chronic water scarcity.

Figure 3.5b

Agriculture drinks up a lot of the world's freshwater



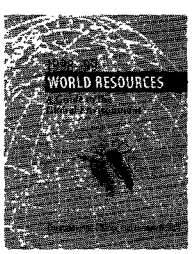
Source: Table 3.5.

Agriculture uses two-thirds of the world's freshwater. Although irrigated agriculture has accounted for much of the dramatic increase in world food supplies over the past 20 years, constraints on water supplies will limit its capacity to do so in the future. In low-income countries, where an enormous share of water goes to agriculture, efforts must be made to increase efficiency.

Definitions

• **Freshwater resources** refer to internal renewable resources, which include flows of rivers and groundwater from rainfall in the country but not river flows from other countries. Freshwater resources per capita are calculated using the World Bank's population estimates (see table 2.1). • **Annual freshwater withdrawals** refer to total water withdrawal, not counting evaporation losses from storage basins. Withdrawals also include water from desalination plants in countries where they are a significant source of water withdrawals. Withdrawal data are for single years between 1980 and 1996 unless otherwise indicated. Withdrawals can exceed 100 percent of renewable supplies when extraction from nonrenewable aquifers or desalination plants is considerable, when river flows from other countries are used substantially, or if there is significant water reuse. Withdrawals for agriculture and industry are total withdrawals for irrigation and livestock production and for direct industrial use (including withdrawals for cooling thermoelectric plants). Withdrawals for domestic uses include drinking water, municipal use or supply, and use for public services, commercial establishments, and homes. For most countries sectoral withdrawal data are estimated for 1987–95. • **Access to safe water** refers to the percentage of people with reasonable access to an adequate amount of safe drinking water in a dwelling or within a convenient distance of their dwelling (see *About the data*).

Data sources



Data are compiled by the World Resources Institute from various sources and published in its *World Resources 1998–99*. The Département Hydrogéologie in Orléans, France, compiles data on water resources and withdrawals from published documents, including national, United Nations, and professional literature. The Institute of Geography at the National Academy of Sciences in Moscow also compiles global water data on the basis of published work and, where necessary, estimates water resources and consumption from models that use other data, such as area under irrigation, livestock populations, and precipitation.

3.6 Water pollution

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	kilograms per day		kilograms per day per worker		Primary metals %	Paper and pulp %	Chemicals %	Food and beverages %	Stone, ceramics, and glass %	Textiles %	Wood %	Other %
	1980	1993	1980	1993	1993	1993	1993	1993	1993	1993	1993	1993
Albania	..	2,431	..	0.06	..	91.8	..	..	7.5	..	..	0.7
Algeria	60,290	..	0.19	..	..	..	..	..	..	..	..	..
Angola	..	..	..	..	..	..	..	..	.	..	..	..
Argentina	244,711	179,432	0.18	0.20	7.7	11.8	7.7	57.4	0.3	8.6	1.5	5.1
Armenia	..	34,982	..	0.11	6.4	3.9	5.7	35.1	0.5	31.4	1.4	15.5
Australia	204,333	173,490	0.18	0.19	12.4	22.7	6.8	43.4	0.2	5.3	2.8	6.4
Austria	108,416	86,692	0.16	0.15	14.6	19.9	9.4	34.3	0.3	6.9	3.9	10.7
Azerbaijan	..	..	..	..	..	..	..	..	..	..	..	..
Bangladesh	66,713	171,087	0.16	0.17	2.9	7.2	4.1	36.9	0 1	47.1	0.7	1.1
Belarus	..	..	..	..	..	..	..	..	..	..	..	..
Belgium	136,452	113,460	0.16	0.16	14.4	17.7	11.6	36.8	0.2	8.8	2.0	8.4
Benin	1,646	..	0.28	..	..	..	..	..	..	..	.	..
Bolivia	9,343	5,724	0.22	0.24	5.8	11.8	7.3	62.6	0.3	8.6	2.7	0.9
Bosnia and Herzegovina	..	..	..	..	..	..	..	..	..	..	..	..
Botswana	1,106	2,598	0.31	0.25	..	..	..	99.6	..	..	..	0.4
Brazil	866,790	855,432	0.16	0.17	10.4	13.5	9.1	45.8	0.3	11.5	3.0	6.4
Bulgaria	151,016	111,310	0.14	0.14	11.5	6.2	16.2	42.1	0.3	14.8	2.0	6.9
Burkina Faso	2,347	..	0.29	..	..	..	..	..	..	..	..	..
Burundi	756	1,617	0.23	0.26	..	8.4	4.8	68.9	0.1	17.0	..	0.8
Cambodia	..	11,881	..	0.17	..	3.5	3.3	60.1	0.6	25.1	5.9	1.5
Cameroon	14,280	13,029	0.29	0.30	3.8	5.9	1.6	79.4	0.0	5.1	3.6	0.5
Canada	330,241	300.071	0.18	0.18	10.1	30.1	8.7	34.5	0.1	5.9	3.3	7.3
Central African Republic	760	749	0.31	0.19	..	8.2	6.5	66.6	..	..	18.1	0.6
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	44,371	82,825	0.21	0.24	6.6	10.1	6.4	65.0	0.1	7.4	1.9	2.5
China	3,358,203	5,339,072	0.14	0.15	22.0	10.0	14.0	33.3	0.4	11.5	0.4	8.3
Hong Kong, China	102,002	86.140	0.11	0.13	1.1	28.5	7.0	14.8	0.0	39.9	0.5	8.3
Colombia	96.055	97.024	0.19	0.19	4.0	13.2	11.3	52.1	0.3	14.6	1.0	3.5
Congo, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Congo, Rep.	848	..	0.37	..	..	..	..	..	..	..	.	..
Costa Rica	..	27,624	..	0.20	0.4	10.1	8.6	58.6	0.1	18.6	1.6	2.0
Côte d'Ivoire	13,898	..	0.24	..	..	..	..	..	..	..	.	..
Croatia	..	55,440	..	0.16	9.3	13.8	8.9	43.1	0.3	14.2	3.7	6.8
Cuba	114,708	..	0.28	..	..	..	..	..	..	..	..	..
Czech Republic	..	171.227	..	0.13	24.5	9.9	6.7	31.3	0.4	12.5	2.3	12.4
Denmark	65,465	87,244	0.17	0.18	2.3	28.0	7.3	47.7	0.1	3.7	2.7	8.1
Dominican Republic	54,935	..	0.38	..	..	..	..	..	..	..	..	..
Ecuador	25,297	28,053	0.23	0.22	2.8	11.9	10.6	62.1	0.2	8.4	1.7	2.4
Egypt, Arab Rep.	169,146	198,373	0.19	0.19	11.7	7.1	9.1	50.5	0.3	17.5	0 5	3.5
El Salvador	9,390	7,663	0.24	0.22	7.5	12.0	9.9	49.6	0.1	19.4	0.5	1.1
Eritrea	..	..	..	..	..	..	..	..	..	..	..	..
Estonia	..	..	..	..	..	..	..	..	..	..	.	..
Ethiopia	..	18,593	..	0.23	2.1	9.5	2.4	59.0	0.1	24.9	1.5	0.4
Finland	92,275	68,255	0.17	0.19	7.8	41.3	6.5	31.1	0.2	3.3	3.3	6.6
France	716,285	609.940	0.14	0.15	11.9	20.7	11.0	37.0	0.2	6.7	1.8	10.8
Gabon	2,661	..	0.15	..	..	..	..	.	..	..	..	..
Gambia, The	549	..	0.30	..	..	..	..	..	..	..	..	..
Georgia	..	..	..	..	..	..	..	..	..	..	..	..
Germany	..	1,046,176	..	0.12	15.6	15.3	15.1	27.9	0.2	6.4	2.0	17.6
Ghana	15,868	..	0.20	..	..	..	..	..	..	..	..	..
Greece	65,304	59,701	0.17	0.19	6.0	12.1	8.0	51.8	0.3	16.6	1.5	3.8
Guatemala	20,856	22,606	0.25	0.24	2.1	8.7	8.7	67.3	0.2	10.5	1.4	1.1
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	.	..
Haiti	4,734	..	0.19	..	..	..	..	..	..	..	..	..
Honduras	12,395	27,565	0.23	0.22	0.7	7.3	6.7	69.8	0.1	5.5	8.6	1.2

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	kilograms per day		kilograms per day per worker		Primary metals %	Paper and pulp %	Chemicals %	Food and beverages %	Stone, ceramics, and glass %	Textiles %	Wood %	Other %
	1980	1993	1980	1993	1993	1993	1993	1993	1993	1993	1993	1993
Hungary	201,888	151,311	0.15	0.18	9.9	7.6	8.1	54.9	0.2	10.8	1.8	6.8
India	1,457,474	1,441,293	0.21	0.20	15.6	8.1	7.3	50.9	0.2	12.9	0.3	4.8
Indonesia	214,010	537,142	0.22	0.19	..	7.8	10.4	58.9	0.2	15.4	4.8	2.6
Iran, Islamic Rep.	72,334	101,763	0.15	0.16	21.7	7.8	7.9	38.2	0.6	17.6	0.8	5.5
Iraq	31,805	17,882	0.18	0.15	..	15.4	16.6	43.2	0.8	18.3	0.4	5.2
Ireland	43,544	33,417	0.19	0.17	1.6	17.3	9.6	54.5	0.2	7.5	1.5	7.7
Israel	39,113	50,030	0.15	0.16	4.1	19.3	8.4	44.3	0.2	12.3	2.1	9.3
Italy	442,712	353,906	0.13	0.13	17.0	16.1	10.5	25.8	0.3	16.1	2.1	12.1
Jamaica	11,123	17,752	0.25	0.27	0.7	7.3	4.6	75.4	0.1	10.0	1.1	0.8
Japan	1,456,016	1,548,021	0.14	0.14	9.9	22.0	8.8	36.5	0.2	7.9	1.9	12.8
Jordan	4,146	11,166	0.17	0.17	4.1	15.3	15.9	49.8	0.7	7.6	3.4	3.3
Kazakhstan	..	..	..	..	..	..	..	..	..	..	..	..
Kenya	26,150	44,065	0.19	0.23	..	11.5	5.6	68.6	0.1	9.1	1.9	3.2
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Korea, Rep.	281,900	358,610	0.14	0.13	12.8	15.4	11.2	25.8	0.3	20.8	1.5	12.2
Kuwait	6,921	9,052	0.16	0.16	2.5	16.1	11.4	47.9	0.4	12.4	3.7	5.5
Kyrgyz Republic	..	25,426	..	0.19	14.2	3.0	1.1	53.5	0.5	26.1	1.5	..
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	..	42,866	..	0.15	2.4	7.9	5.3	57.2	0.3	14.5	3.8	8.5
Lebanon	13,137	..	0.24	..	..	..	..	..	..	..	..	..
Lesotho	190	87	0.11	0.09	..	69.5	27.6	..	2.0	..	..	0.9
Libya	3,532	..	0.21	..	..	..	..	..	..	..	..	..
Lithuania	..	..	..	..	..	..	..	..	..	..	..	..
Macedonia, FYR	..	29,054	..	0.17	16.6	8.4	6.0	37.7	0.1	24.5	2.0	4.7
Madagascar	9,196	..	0.23	..	..	..	..	..	..	..	..	..
Malawi	12,224	..	0.32	..	..	..	..	..	..	..	..	..
Malaysia	77,215	136,055	0.15	0.12	6.8	14.3	15.2	31.8	0.2	11.1	7.6	13.1
Mali	1,774	..	0.30	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	8,949	18,229	0.21	0.15	1.5	4.2	2.3	35.4	0.1	54.6	0.9	1.0
Mexico	130,993	167,335	0.22	0.18	11.0	9.8	12.6	51.9	0.3	7.6	0.5	6.4
Moldova	..	54,263	..	0.17	2.1	3.2	1.5	69.0	0.3	15.0	1.7	7.1
Mongolia	2,376	..	0.15	..	..	..	..	..	..	..	..	..
Morocco	26,598	33,752	0.15	0.14	..	..	..	36.3	..	57.5	..	6.2
Mozambique	..	0	..	0.00	..	..	..	..	..	..	..	..
Myanmar	..	..	..	..	..	..	..	..	..	..	..	..
Namibia	..	..	..	..	..	..	..	..	..	..	..	..
Nepal	18,692	28,860	0.25	0.14	1.9	5.5	3.4	46.5	1.6	39.0	1.5	0.7
Netherlands	165,416	136,071	0.18	0.18	..	28.1	12.2	46.4	0.0	2.1	1.5	9.7
New Zealand	59,012	45,849	0.21	0.22	4.6	20.4	5.3	56.5	0.1	6.4	2.5	4.3
Nicaragua	9,647	..	0.28	..	..	..	..	..	..	..	..	..
Niger	372	..	0.19	..	..	..	..	..	..	..	..	..
Nigeria	72,082	..	0.17	..	..	..	..	..	..	..	..	..
Norway	67,897	47,494	0.19	0.20	11.5	33.1	5.5	38.3	0.1	1.8	2.4	7.3
Oman	..	..	..	0.00	..	..	..	..	..	..	..	..
Pakistan	75,125	..	0.17	..	..	..	..	..	..	..	..	..
Panama	8,207	10,821	0.26	0.28	1.1	8.2	5.5	76.4	0.2	6.7	1.2	0.7
Papua New Guinea	4,222	..	0.22	..	..	..	..	..	..	..	..	..
Paraguay	..	3,250	..	0.28	2.3	9.9	6.0	73.6	0.3	6.7	0.3	0.9
Peru	50,367	..	0.18	..	..	..	..	..	..	..	..	..
Philippines	182,052	181,714	0.19	0.19	4.1	8.1	6.9	52.9	0.1	21.4	3.7	2.7
Poland	580,869	365,580	0.14	0.16	13.4	6.6	7.7	48.4	0.3	12.5	2.4	8.7
Portugal	105,441	77,451	0.16	0.16	6.0	8.7	0.4	44.7	0.4	31.4	3.8	4.6
Puerto Rico	23,224	23,466	0.15	0.15	..	10.2	15.2	46.8	0.2	19.6	0.8	7.3
Romania	352,368	146,154	0.12	0.08	..	16.1	2.9	1.8	..	41.4	11.3	26.6
Russian Federation	..	..	..	..	..	..	..	..	..	..	..	..

3.6

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	kilograms per day		kilograms per day per worker		Primary metals %	Paper and pulp %	Chemicals %	Food and beverages %	Stone, ceramics, and glass %	Textiles %	Wood %	Other %
	1980	1993	1980	1993	1993	1993	1993	1993	1993	1993	1993	1993
Rwanda	..	..	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	*18,181*	..	*0.12*	*0.00*	..	..	..	..	..	..	..	..
Senegal	9,865	..	0.31	..	..	..	..	..	..	..	..	..
Sierra Leone	..	..	..	..	..	..	..	..	..	..	..	..
Singapore	28,120	32,410	0.10	0.09	2.7	26.0	10.8	19.9	0.1	10.9	1.8	27.7
Slovak Republic	..	..	..	..	..	..	..	..	..	..	..	..
Slovenia	..	*39,846*	..	*0.15*	*17.7*	*17.1*	*8.4*	*25.3*	..	*17.6*	*4.1*	*9.8*
South Africa	237,599	251,142	0.17	0.17	12.7	16.7	9.5	41.3	0.2	11.0	2.7	5.9
Spain	376,253	*318,506*	0.16	*0.17*	*10.7*	*15.4*	*9.3*	*45.6*	*0.3*	*8.7*	*2.8*	*7.2*
Sri Lanka	30,086	*51,328*	0.18	*0.19*	*1.4*	*8.0*	*6.4*	*52.0*	*0.2*	*29.9*	*0.7*	*1.2*
Sudan	..	..	..	..	..	..	..	..	..	..	..	..
Sweden	130,439	102,341	0.15	0.16	11.6	36.4	7.4	27.9	0.1	1.5	3.1	11.9
Switzerland	..	38,161	..	0.15	..	76.9	..	..	..	8.0	..	15.1
Syrian Arab Republic	36,262	*23,754*	0.19	*0.19*	*2.8*	*1.4*	*7.4*	*65.6*	*0.5*	*16.0*	*5.4*	*0.9*
Tajikistan	..	..	..	..	..	..	..	..	..	..	..	..
Tanzania	20,648	..	0.21	..	..	..	..	..	..	..	..	..
Thailand	*214,426*	*256,930*	*0.22*	*0.16*	*6.3*	*7.6*	*6.8*	*46.4*	*0.3*	*26.4*	*1.9*	*4.3*
Togo	963	..	0.27	..	..	..	..	..	..	..	..	..
Trinidad and Tobago	6,737	*7,384*	0.19	*0.25*	..	*13.9*	*6.1*	*70.1*	*0.2*	*6.2*	*1.3*	*2.2*
Tunisia	20,294	*25,610*	0.16	*0.19*	*5.6*	*5.6*	*5.1*	*62.7*	*0.8*	*17.4*	*0.7*	*2.1*
Turkey	160,173	168,548	0.20	0.19	15.8	8.0	7.0	46.6	0.3	17.0	0.7	4.5
Turkmenistan	..	..	..	..	..	..	..	..	..	..	..	..
Uganda	..	..	..	..	..	..	..	..	..	..	..	..
Ukraine	..	*666,233*	..	*0.14*	*18.3*	*3.7*	*7.3*	*46.9*	*0.5*	*10.1*	*2.0*	*11.3*
United Arab Emirates	*4,524*	..	*0.15*	..	..	..	..	..	..	..	..	..
United Kingdom	964,510	*680,865*	0.15	*0.16*	*8.9*	*24.7*	*10.1*	*37.1*	*0.2*	*7.2*	*1.7*	*10.0*
United States	2,742,993	2,477,830	0.14	0.15	8.3	32.7	9.5	28.2	0.1	7.8	2.4	10.8
Uruguay	34,270	37,825	0.21	0.23	1.4	11.1	5.4	65.1	0.2	13.9	1.0	1.9
Uzbekistan	..	..	..	..	..	..	..	..	..	..	..	..
Venezuela	84,797	103,961	0.20	0.21	14.3	13.2	10.4	48.2	0.2	8.7	1.4	3.5
Vietnam	..	..	..	..	..	..	..	..	..	..	..	..
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Yugoslavia, FR (Serb./Mont.)	..	..	..	..	..	..	..	..	..	..	..	..
Zambia	13,605	*13,453*	0.23	*0.23*	*3.5*	*9.4*	*7.5*	*63.4*	*0.2*	*12.4*	*1.6*	*2.1*
Zimbabwe	32,681	35,535	0.20	0.21	13.5	12.5	4.7	48.7	0.1	15.8	1.9	2.8
World	**18,745,247 s**	..	..	..	..	..	..	..	..	..	..	..
Low income	5,286,072	..	..	..	..	..	..	..	..	..	..	..
Excl. China & India	470,396	..	..	..	..	..	..	..	..	..	..	..
Middle income	4,461,968	..	..	..	..	..	..	..	..	..	..	..
Lower middle income	1,992,457	..	..	..	..	..	..	..	..	..	..	..
Upper middle income	2,469,512	..	..	..	..	..	..	..	..	..	..	..
Low & middle income	9,748,041	..	..	..	..	..	..	..	..	..	..	..
East Asia & Pacific	3,843,665	..	..	..	..	..	..	..	..	..	..	..
Europe & Central Asia	1,450,659	..	..	..	..	..	..	..	..	..	..	..
Latin America & Carib.	1,879,176	..	..	..	..	..	..	..	..	..	..	..
Middle East & N. Africa	437,544	..	..	..	..	..	..	..	..	..	..	..
South Asia	1,635,990	..	..	..	..	..	..	..	..	..	..	..
Sub-Saharan Africa	502,005	..	..	..	..	..	..	..	..	..	..	..
High income	8,997,206	..	..	..	..	..	..	..	..	..	..	..

Note: Industry shares of emissions may not sum to 100 percent because of rounding.

About the data

Emissions of organic pollutants from industrial activities are a major source of water quality degradation. Water quality standards and pollution levels are generally measured in terms of concentration or load—the rate of occurrence of a substance in an aqueous solution. These substances include organic matter, metals, minerals, sediment, bacteria, and toxic chemicals. Because water pollution tends to be sensitive to local conditions, it is not meaningful to show national data for most pollutants. This table, however, focuses on organic water pollution resulting from industrial activities in a number of countries.

The data in the table come from an international study of industrial emissions that may be the first to include data from developing countries (Hettige, Mani, and Wheeler 1998). Unlike the estimates from engineering or economic models used in previous studies, these estimates are based on actual measurements of plant-level water pollution. The focus is on organic water pollution—measured by biochemical oxygen demand, or BOD—because it provides the most plentiful and reliable source of comparable cross-country emissions data. BOD measures the strength of an organic waste in terms of the amount of oxygen consumed in breaking it down. A sewage overload in natural waters exhausts the water's dissolved oxygen content. Wastewater treatment, by contrast, reduces BOD.

Data on water pollution are more readily available than other emissions data because most industrial pollution control programs start by regulating organic water emissions. 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.

In their study 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 1975–93. The sectoral emissions estimates were then totaled to get daily BOD emissions in kilograms per day for each country and year.

Definitions

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

Data sources

The indicators are from a 1998 study by Hemamala Hettige, Muthukumara Mani, and David Wheeler, "Industrial Pollution in Economic Development: Kuznets Revisited" (available as "New Ideas in Pollution Regulation" on the World Bank website at http://www.worldbank.org/NIPR). Sectoral employment numbers are from UNIDO's industry database.

3.7 Energy production and use

	Commercial energy production		Commercial energy use			Commercial energy use per capita			Net energy imports	
	thousand metric tons of oil equivalent		thousand metric tons of oil equivalent		average annual % growth	kg of oil equivalent		average annual % growth	% of commercial energy use	
	1980	1995	1980	1995	1980–95	1980	1995	1980–95	1980	1995
Albania	3,053	940	2,674	1,020	-6.4	1,001	314	-7.7	-14	8
Algeria	66,730	109,257	12,078	24,346	4.2	647	866	1.4	-452	-349
Angola	7,700	26,189	937	959	0.5	133	89	-2.3	-722	-2,631
Argentina	36,661	66,055	39,716	53,016	1.9	1,413	1,525	0.5	8	-25
Armenia	1,263	244	1,070	1,671	-1.8	346	444	-3.1	-18	85
Australia	86,096	186,625	70,372	94,200	2.2	4,790	5,215	0.7	-22	-98
Austria	7,654	8,481	23,449	26,383	1.3	3,105	3,279	0.9	67	68
Azerbaijan	14,821	14,719	15,001	13,033	-3.9	2,433	1,735	-5.1	1	-13
Bangladesh	1,113	5,962	2,809	8,061	7.4	32	67	5.1	60	26
Belarus	2,566	2,793	2,385	23,808	10.3	247	2,305	9.7	-8	88
Belgium	7,986	11,628	46,100	52,378	1.6	4,682	5,167	1.3	83	78
Benin	..	232	149	107	-3.3	43	20	-6.2	100	-117
Bolivia	3,553	4,478	1,599	2,939	3.2	299	396	1.0	-122	-52
Bosnia and Herzegovina	..	470	..	1,595	..	..	364	..	..	71
Botswana	260	250	384	555	2.5	426	383	-0.8	32	55
Brazil	25,777	73,172	73,041	122,928	4.2	602	772	2.3	65	40
Bulgaria	7,541	9,810	28,476	22,878	-2.5	3,213	2,724	-2.1	74	57
Burkina Faso	0	0	144	162	1.1	21	16	-1.5	100	100
Burundi	1	5	58	144	6.4	14	23	3.5	98	97
Cambodia	13	22	393	517	2.1	60	52	-1.0	97	96
Cameroon	2,855	5,380	774	1,556	3.3	89	117	0.4	-269	-246
Canada	207,359	350,629	192,942	233,328	1.6	7,845	7,879	0.3	-7	-50
Central African Republic	17	24	59	94	2.6	26	29	0.2	71	74
Chad	0	0	93	101	0.6	21	16	-1.8	100	100
Chile	3,871	4,361	7,732	15,131	5.4	694	1,065	3.6	50	71
China	428,693	866,556	413,176	850,521	5.1	421	707	3.7	-4	-2
Hong Kong, China	0	0	5,628	13,615	6.2	1,117	2,212	5.0	100	100
Colombia	13,047	54,361	13,962	24,120	3.5	501	655	1.6	7	-125
Congo, Dem. Rep.	1,478	1,948	1,487	2,058	2.2	55	47	-1.1	1	5
Congo, Rep.	3,387	9,031	262	367	2.6	157	139	-0.5	-1,193	-2,361
Costa Rica	181	380	949	1,971	6.0	415	584	3.3	81	81
Côte d'Ivoire	192	435	1,435	1,362	1.2	175	97	-2.4	87	68
Croatia	..	3,917	..	6,852	..	..	1,435	..	..	43
Cuba	293	1,223	9,645	10,437	0.1	992	949	-0.9	97	88
Czech Republic	40,002	30,448	45,766	39,013	-1.2	4,473	3,776	-1.2	13	22
Denmark	896	15,497	19,734	20,481	0.7	3,852	3,918	0.6	95	24
Dominican Republic	50	171	2,211	3,801	4.3	388	486	2.1	98	96
Ecuador	10,774	20,967	4,209	6,343	2.6	529	553	0.1	-156	-231
Egypt, Arab Rep.	33,374	59,287	15,176	34,678	5.4	371	596	2.9	-120	-71
El Salvador	407	703	1,004	2,322	5.7	221	410	4.2	59	70
Eritrea	..	..	..	..	..	..	..	..	..	..
Estonia	..	3,117	..	5,126	..	..	3,454	..	..	39
Ethiopia	55	158	624	1,178	4.9	17	21	2.0	91	87
Finland	6,912	12,911	25,022	28,670	1.5	5,235	5,613	1.1	72	55
France	46,829	126,866	190,109	241,322	2.1	3,528	4,150	1.6	75	47
Gabon	9,090	18,703	831	644	-4.3	1,203	587	-7.2	-994	-2,804
Gambia, The	0	0	53	61	0.9	83	55	-2.9	100	100
Georgia	4,706	478	4,474	1,850	-3.3	882	342	-3.7	-5	74
Germany	184,238	142,712	358,995	339,287	-0.2	4,585	4,156	-0.5	49	58
Ghana	554	526	1,303	1,564	2.7	121	92	-0.5	57	66
Greece	3,696	9,053	15,960	23,698	3.2	1,655	2,266	2.7	77	62
Guatemala	230	589	1,443	2,191	3.6	209	206	0.6	84	73
Guinea	38	58	356	422	1.3	80	64	-1.4	89	86
Guinea-Bissau	0	0	31	40	2.1	38	37	0.3	100	100
Haiti	19	32	241	357	0.1	45	50	-1.8	92	91
Honduras	67	235	636	1,401	5.1	174	236	1.9	89	83

	Commercial energy production		Commercial energy use			Commercial energy use per capita			Net energy imports	
	thousand metric tons of oil equivalent		thousand metric tons of oil equivalent		average annual % growth	kg of oil equivalent		average annual % growth	% of commercial energy use	
	1980	1995	1980	1995	1980–95	1980	1995	1980–95	1980	1995
Hungary	14,442	13,295	28,556	25,103	–1.0	2,667	2,454	–0.7	49	47
India	73,760	196,941	93,897	241,291	6.5	137	260	4.4	21	18
Indonesia	94,717	169,325	25,904	85,785	8.9	175	442	7.0	*–266*	–97
Iran, Islamic Rep.	83,430	216,406	38,347	84,069	6.3	980	1,374	3.2	*–118*	–157
Iraq	136,616	31,100	12,003	25,061	4.1	923	1,206	0.8	*–1,038*	–24
Ireland	1,894	3,601	8,484	11,461	2.2	2,495	3,196	2.0	78	69
Israel	151	562	8,607	16,650	5.0	2,219	3,003	2.6	98	97
Italy	19,644	28,645	138,629	161,360	1.4	2,456	2,821	1.3	86	82
Jamaica	10	10	2,164	3,003	2.7	1,015	1,191	1.6	100	100
Japan	43,247	99,468	346,567	497,231	2.8	2,968	3,964	2.3	88	80
Jordan	0	192	1,713	4,323	5.2	785	1,031	0.7	100	96
Kazakhstan	76,799	64,354	76,799	55,432	–3.1	*5,153*	3,337	–3.8	*0*	–16
Kenya	91	518	1,991	2,907	3.5	120	109	0.3	95	82
Korea, Dem. Rep.	28,275	21,538	30,932	24,600	–1.2	1,751	1,113	–2.6	9	12
Korea, Rep.	9,644	20,570	41,426	145,099	9.6	1,087	3,225	8.4	77	86
Kuwait	94,084	111,227	9,561	14,494	0.3	6,953	9,381	0.2	*–884*	–667
Kyrgyz Republic	2,190	1,377	1,938	2,315	5.0	*534*	513	3.4	*–13*	41
Lao PDR	236	220	107	184	2.6	33	40	0.1	*–121*	–20
Latvia	261	322	566	3,702	22.9	*222*	1,471	22.9	*54*	91
Lebanon	73	69	2,376	4,486	3.2	791	1,120	1.2	97	98
Lesotho	0	0	..	..	..	..	..	..	..	..
Libya	96,537	77,825	7,048	15,781	4.5	2,316	3,129	1.1	*–1,270*	–393
Lithuania	186	3,316	11,353	8,510	*–3.2*	*3,326*	2,291	–3.8	*98*	61
Macedonia, FYR	..	1,621	..	2,572	..	..	1,308	..	..	37
Madagascar	38	84	391	484	1.6	45	36	–1.2	90	83
Malawi	99	154	334	374	1.6	54	38	–1.6	70	59
Malaysia	15,049	62,385	9,522	33,252	9.8	692	1,655	7.0	*–58*	–88
Mali	21	42	164	207	1.7	25	21	–0.9	87	80
Mauritania	0	0	214	231	0.5	138	102	–2.0	100	100
Mauritius	21	34	339	435	2.6	351	388	1.7	94	92
Mexico	149,365	201,957	98,904	133,371	2.2	1,486	1,456	0.0	*–51*	–51
Moldova	35	24	..	4,177	..	..	963	..	..	99
Mongolia	1,195	2,190	1,943	2,576	1.8	1,168	1,045	–0.9	38	15
Morocco	617	440	4,518	8,253	4.4	233	311	2.2	86	95
Mozambique	1,293	160	1,123	662	–1.6	93	38	–3.5	*–15*	76
Myanmar	1,940	2,167	1,858	2,234	0.2	55	50	–1.7	*–4*	3
Namibia	0	0	..	..	..	..	..	..	..	..
Nepal	15	97	174	700	9.3	12	33	6.5	91	86
Netherlands	71,830	65,705	65,000	73,292	1.4	4,594	4,741	0.8	*–11*	10
New Zealand	5,592	12,436	9,190	15,409	3.9	2,952	4,290	3.1	39	19
Nicaragua	44	302	696	1,159	3.4	248	265	0.3	94	74
Niger	14	56	210	330	2.0	38	37	–1.2	93	83
Nigeria	105,512	104,475	9,879	18,393	3.4	139	165	0.4	*–968*	–468
Norway	55,743	182,428	18,819	23,715	1.8	4,600	5,439	1.4	*–196*	–669
Oman	14,756	45,403	1,010	4,013	9.2	917	1,880	4.6	*–1,361*	–1,031
Pakistan	6,970	18,612	11,451	31,536	7.0	139	243	3.8	39	41
Panama	83	202	1,419	1,783	1.6	725	678	–0.4	94	89
Papua New Guinea	80	2,500	705	1,000	2.4	228	232	0.2	*89*	–150
Paraguay	58	3,578	544	1,487	7.1	173	308	4.1	*89*	–141
Peru	11,188	8,388	8,233	10,035	0.6	476	421	–1.5	*–36*	16
Philippines	2,789	6,006	13,357	21,542	3.6	276	307	0.9	79	72
Poland	120.774	94,666	124,557	94,472	–2.0	3,501	2,448	–2.5	*3*	0
Portugal	1,481	1,870	10,291	19,245	4.6	1,054	1,939	4.6	86	90
Puerto Rico	35	42	8,042	7,444	0.9	2,508	1,993	–0.1	100	99
Romania	51,631	30,008	63,751	44,026	–2.9	2,872	1,941	–3.1	19	32
Russian Federation	749.289	928,870	764,349	604,461	–3.0	*5,499*	4,079	–3.4	*2*	–54

3.7

	Commercial energy production		Commercial energy use			Commercial energy use per capita			Net energy imports	
	thousand metric tons of oil equivalent		thousand metric tons of oil equivalent		average annual % growth	kg of oil equivalent		average annual % growth	% of commercial energy use	
	1980	1995	1980	1995	1980–95	1980	1995	1980–95	1980	1995
Rwanda	29	46	190	211	-0.7	37	33	-2.6	85	78
Saudi Arabia	533,071	469,820	35,355	82,742	5.2	3,772	4,360	0.3	*-1,408*	-468
Senegal	0	46	875	866	-0.3	158	104	-3.0	100	95
Sierra Leone	0	0	310	326	0.5	96	72	-1.7	100	100
Singapore	0	0	6,049	21,389	10.0	2,651	7,162	8.1	100	100
Slovak Republic	3,251	4,846	20,646	17,447	-1.3	4,142	3,272	-1.7	84	72
Slovenia	1,623	2,578	4,269	5,583	0.7	*2,245*	2,806	0.4	*62*	54
South Africa	66,740	116,160	59,051	88,882	1.8	2,175	2,405	-0.2	*-13*	-31
Spain	15,781	31,422	68,583	103,491	3.2	1,834	2,639	2.9	77	70
Sri Lanka	127	383	1,411	2,469	2.7	96	136	1.3	91	84
Sudan	58	81	1,140	1,745	3.3	61	65	0.9	95	95
Sweden	16,133	31,549	40,984	50,658	1.3	4,932	5,736	0.9	61	38
Switzerland	7,030	10,961	20,814	25,142	1.7	3,294	3,571	0.9	66	56
Syrian Arab Republic	9,495	34,287	5,343	14,121	5.9	614	1,001	2.5	*-78*	-143
Tajikistan	1,986	1,325	1,650	3,283	8.9	*416*	563	6.1	*-20*	60
Tanzania	86	135	1,023	947	0.8	55	32	-2.3	92	86
Thailand	535	19,430	12,093	52,125	11.1	259	878	9.4	96	63
Togo	1	0	195	185	0.9	75	45	-2.1	99	100
Trinidad and Tobago	13,127	12,991	3,860	6,925	4.0	3,567	5,381	2.8	*-240*	-88
Tunisia	6,149	4,579	3,083	5,314	4.0	483	591	1.7	*-99*	14
Turkey	17,190	26,079	31,314	62,187	4.9	704	1,009	2.6	45	58
Turkmenistan	8,034	32,589	7,948	13,737	..	*2,778*	3,047	-9.8	*-1*	-137
Uganda	153	185	320	430	2.8	25	22	0.0	52	57
Ukraine	109,708	80,700	97,893	161,586	2.1	*1,956*	3,136	1.9	*-12*	50
United Arab Emirates	93,915	138,821	8,576	28,454	7.5	8,222	11,567	1.6	*-995*	-388
United Kingdom	197,738	254,967	201,168	221,911	1.0	3,571	3,786	0.7	*2*	-15
United States	1,546,307	1,655,644	1,801,406	2,078,265	1.3	7,928	7,905	0.3	14	20
Uruguay	233	477	2,206	2,035	0.7	757	639	0.1	89	77
Uzbekistan	4,615	49,135	4,821	46,543	11.6	*302*	2,043	8.9	*4*	-6
Venezuela	132,919	187,498	35,011	47,140	1.7	2,354	2,158	-0.9	*-280*	-298
Vietnam	2,728	13,808	4,024	7,694	4.1	75	104	1.8	*32*	-79
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	..	17,394	1,364	2,933	5.3	160	192	1.2	..	-493
Yugoslavia, FR (Serb./Mont.)	..	11,295	..	11,865	..	..	1,125	..	..	5
Zambia	1,146	898	1,685	1,302	-2.1	294	145	-5.0	32	31
Zimbabwe	2,024	3,567	2,797	4,673	4.4	399	424	1.3	28	24
World	**6,273,572 t**	**8,385,643 t**	**6,325,980 t**	**8,244,516 t**	**3.2 t**	**1,456 w**	**1,474 w**	**1.1 w**	**0 w**	**0 w**
Low income	666,864	1,301,090	587,166	1,227,330	5.5	252	393	3.3	-14	-6
Excl. China & India	164,411	237,593	80,093	135,518	5.8	118	132	2.8	-105	-75
Middle income	2,821,534	3,509,935	1,935,029	2,342,066	5.8	1,604	1,488	2.6	-46	-50
Lower middle income	1,671,934	2,203,208	1,359,924	1,579,612	9.0	1,598	1,426	5.1	-23	-39
Upper middle income	1,149,600	1,306,727	575,105	762,454	1.9	1,618	1,633	0.0	-100	-71
Low & middle income	3,488,398	4,811,025	2,522,195	3,569,396	5.6	706	751	3.1	-38	-35
East Asia & Pacific	576,250	1,166,252	514,939	1,082,697	5.3	391	657	3.7	-12	-8
Europe & Central Asia	1,235,966	1,413,336	1,340,658	1,284,686	8.8	3,333	2,690	-2.7	8	-10
Latin America & Carib.	402,279	642,539	319,888	463,321	2.7	893	969	0.7	-26	-39
Middle East & N. Africa	985,969	1,073,532	142,738	315,726	5.2	822	1,178	2.2	-591	-240
South Asia	84,738	225,491	110,649	286,730	6.6	123	231	4.3	23	21
Sub-Saharan Africa	203,196	289,875	93,323	136,236	2.0	248	238	-0.8	-118	-113
High income	2,785,174	3,574,618	3,803,785	4,675,120	1.7	4,611	5,123	1.1	27	24

About the data

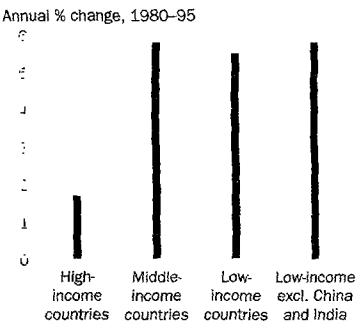
In developing countries growth in commercial energy use is closely related to growth in the modern sectors—industry, motorized transport, and urban areas. This connection is less robust in more developed countries. Thus commercial energy use per capita reflects the size of the modern sector as well as climatic, geographic, and economic factors (such as the relative price of energy). Because commercial energy is widely traded, it is necessary to distinguish between its production and use. Net energy imports show the extent to which an economy's use exceeds its domestic production.

Energy data are compiled by the International Energy Agency (IEA) and the United Nations Statistical Division (UNSD). IEA data for non-OECD countries is based on national energy data that have been adjusted to conform with annual questionnaires completed by OECD member governments. UNSD data are primarily from responses to questionnaires sent to national governments, supplemented by official national statistical publications and by data from intergovernmental organizations. When official data are not available, the UNSD prepares estimates based on the professional and commercial literature. The variety of sources affects the cross-country comparability of data.

Commercial energy use refers to domestic primary energy use before transformation to other end-use fuels (such as electricity and refined petroleum products). The use of firewood, dried animal manure, and other traditional fuels is not included. All forms of commercial energy—primary energy and primary electricity—are converted into oil equivalents. To convert nuclear electricity into oil equivalents, a notional thermal efficiency of 33 percent is assumed; for hydroelectric power, 100 percent efficiency is assumed.

Figure 3.7a

Since 1980 low- and middle-income countries have seen rapid growth in commercial energy use

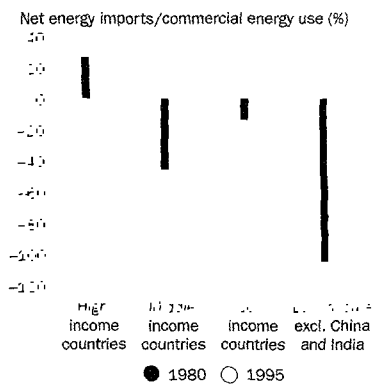


Source: Table 3.7.

Although high-income countries use nearly four times as much commercial energy as low-income countries, since 1980 growth in energy use has been greatest in rapidly industrializing middle-income economies. At its current pace, energy use in low- and middle-income countries will double every 13 years. Slower growth in high-income countries reflects the generally lower economic growth in these economies as well as their greater energy efficiency.

Figure 3.7b

Low-income countries are exporting less energy



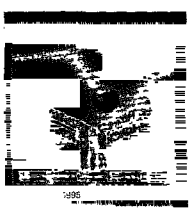
Source: Table 3.7.

High-income countries depend on imports for roughly a quarter of their energy use, a ratio that was remarkably constant from 1980 to 1995. Middle-income countries have been the main net exporters of energy, with net exports equal to roughly half of domestic use. This ratio was also nearly constant from 1980 to 1995. Low-income countries, however, have seen a substantial drop in net energy exports, particularly when China and India are excluded.

Definitions

• **Commercial energy production** refers to commercial forms of primary energy—petroleum (crude oil, natural gas liquids, and oil from nonconventional sources), natural gas, and solid fuels (coal, lignite, and other derived fuels)—and primary electricity, all converted into oil equivalents (see *About the data*). • **Commercial energy use** refers to apparent consumption, which is equal to indigenous production plus imports and stock changes, minus exports and fuels supplied to ships and aircraft engaged in international transportation (see *About the data*). • **Net energy imports** are calculated as energy use less production, both measured in oil equivalents. A minus sign indicates that the country is a net exporter.

Data sources



Data on commercial energy production and use are primarily from the IEA's electronic files that are also published in its annual publications, *Energy Statistics and Balances of Non-OECD Countries*, *Energy Statistics of OECD Countries*, and *Energy Balances of OECD Countries*, and the United Nations *Energy Statistics Yearbook*.

3.8 Energy efficiency and emissions

	GDP per unit of energy use		Traditional fuel use		Carbon dioxide emissions					
	1987 $ per kg oil equivalent		% of total energy use		Total million metric tons		Per capita metric tons		kg per 1987 $ of GDP	
	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995
Albania	0.7	1.8	12.3	8.6	4.8	1.8	1.8	0.6	2.6	1.0
Algeria	4.1	2.7	2.7	2.0	66.2	91.3	3.5	3.2	1.3	1.4
Angola	..	7.7	47.1	59.5	5.3	4.6	0.8	0.4	..	0.6
Argentina	2.8	2.5	6.5	4.0	107.5	129.5	3.8	3.7	1.0	1.0
Armenia	2.1	0.6	..	..	..	3.6	..	1.0	.	3.4
Australia	2.4	2.8	2.1	3.8	202.8	289.8	13.8	16.0	1.2	1.1
Austria	4.6	5.5	1.4	2.8	52.2	59.3	6.9	7.4	0.5	0.4
Azerbaijan	..	0.2	..	..	..	42.6	..	5.7	..	14.6
Bangladesh	4.5	3.0	67.8	49.9	7.6	20.9	0.1	0.2	0.6	0.9
Belarus	..	0.7	..	0.8	..	59.3	..	5.7	..	3.4
Belgium	2.8	3.2	0.2	0.9	127.2	103.8	12.9	10.2	1.0	0.6
Benin	7.9	18.4	84.9	92.5	0.5	0.6	0.1	0.1	0.4	0.3
Bolivia	2.9	2.0	19.8	12.8	4.5	10.5	0.8	1.4	1.0	1.8
Bosnia and Herzegovina	..	..	..	9.9	..	1.8	..	0.4	..	..
Botswana	2.3	5.1	35.7	..	1.0	2.2	1.1	1.5	1.1	0.8
Brazil	3.4	2.7	41.2	27.5	183.4	249.2	1.5	1.6	0.7	0.8
Bulgaria	0.7	1.0	0.7	0.8	75.3	56.7	8.5	6.7	3.6	2.5
Burkina Faso	11.2	16.4	91.4	93.3	0.4	1.0	0.1	0.1	0.3	0.4
Burundi	13.9	7.7	92.7	88.8	0.1	0.2	0.0	0.0	0.1	0.2
Cambodia	..	2.6	71.2	75.3	0.3	0.5	0.0	0.0	..	0.4
Cameroon	9.7	6.1	69.4	77.3	3.9	4.1	0.4	0.3	0.5	0.4
Canada	1.7	2.0	0.6	0.6	420.9	435.7	17.1	14.7	1.3	0.9
Central African Republic	18.2	13.6	90.8	89.0	0.1	0.2	0.0	0.1	0.1	0.2
Chad	6.2	10.7	87.4	90.2	0.2	0.1	0.0	0.0	0.4	0.1
Chile	2.3	2.4	14.5	13.3	27.9	44.1	2.5	3.1	1.6	1.2
China	0.3	0.7	8.0	5.6	1,476.8	3,192.5	1.5	2.7	10.9	5.5
Hong Kong, China	5.3	5.4	0.9	0.3	16.4	31.0	3.3	5.0	0.5	0.4
Colombia	2.1	2.1	21.4	21.1	39.8	67.5	1.4	1.8	1.4	1.3
Congo, Dem. Rep.	4.4	2.3	79.5	83.9	3.5	2.1	0.1	0.0	0.5	0.4
Congo, Rep.	5.7	6.6	55.9	61.0	0.4	1.3	0.2	0.5	0.3	0.5
Costa Rica	4.2	3.3	40.4	12.7	2.5	5.2	1.1	1.6	0.6	0.8
Côte d'Ivoire	6.7	8.4	53.5	67.2	4.7	10.4	0.6	0.7	0.5	0.9
Croatia	..	..	..	3.0	..	17.0	..	3.6	..	..
Cuba	..	..	28.1	19.7	30.7	29.1	3.2	2.6	..	..
Czech Republic	..	0.8	..	0.5	..	112.0	..	10.8	..	3.4
Denmark	4.4	5.7	0.3	3.3	62.9	54.9	12.3	10.5	0.7	0.5
Dominican Republic	2.1	1.9	28.3	12.1	6.4	11.8	1.1	1.5	1.4	1.6
Ecuador	2.3	2.2	26.5	14.8	13.4	22.6	1.7	2.0	1.4	1.6
Egypt, Arab Rep.	1.8	1.6	5.0	3.3	45.2	91.7	1.1	1.6	1.6	1.6
El Salvador	4.4	2.5	50.3	42.9	2.1	5.2	0.5	0.9	0.5	0.9
Eritrea	..	..	..	..	..	..	..	..	..	..
Estonia	..	0.8	..	2.3	..	16.4	..	11.1	..	4.3
Ethiopia	..	7.4	92.4	90.1	1.8	3.5	0.0	0.1	..	0.4
Finland	2.9	3.3	3.8	5.1	54.9	51.0	11.5	10.0	0.8	0.5
France	4.1	4.3	1.3	1.0	482.7	340.1	9.0	5.8	0.6	0.3
Gabon	5.1	7.9	33.6	51.8	4.8	3.5	6.9	3.2	1.1	0.7
Gambia, The	3.2	4.4	79.7	81.2	0.2	0.2	0.2	0.2	0.9	0.8
Georgia	..	..	..	1.3	..	7.7	..	1.4	..	..
Germany	..	..	..	0.7	..	835.1	..	10.2	..	..
Ghana	3.6	4.6	68.2	79.0	2.4	4.0	0.2	0.2	0.5	0.6
Greece	2.8	2.2	2.8	1.5	51.7	76.3	5.4	7.3	1.2	1.5
Guatemala	5.0	4.4	53.1	59.9	4.5	7.2	0.6	0.7	0.6	0.7
Guinea	..	6.7	68.4	69.9	0.9	1.1	0.2	0.2	..	0.4
Guinea-Bissau	3.9	5.8	76.1	70.5	0.1	0.2	0.2	0.2	1.1	1.0
Haiti	6.8	3.3	82.4	80.3	0.8	0.6	0.1	0.1	0.5	0.5
Honduras	5.6	3.8	61.2	49.3	2.1	3.9	0.6	0.7	0.6	0.7

3.8

	GDP per unit of energy use		Traditional fuel use		Carbon dioxide emissions					
	1987 $ per kg oil equivalent		% of total energy use		Total million metric tons		Per capita metric tons		kg per 1987 $ of GDP	
	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995
Hungary	0.8	1.0	2.1	1.8	82.5	55.9	7.7	5.5	3.7	2.3
India	1.9	1.7	34.7	23.3	347.3	908.7	0.5	1.0	1.9	2.2
Indonesia	2.0	1.6	51.6	29.9	94.6	296.1	0.6	1.5	1.8	2.1
Iran, Islamic Rep.	3.0	2.2	1.6	0.8	116.1	263.8	3.0	4.3	1.0	1.4
Iraq	7.2	..	0.2	0.1	44.0	99.0	3.4	4.8	0.5	..
Ireland	3.1	4.1	0.1	0.2	25.2	32.2	7.4	9.0	0.9	0.7
Israel	3.4	3.5	..	..	21.1	46.3	5.4	8.4	0.7	0.8
Italy	4.8	5.5	0.7	1.9	371.9	410.0	6.6	7.2	0.6	0.5
Jamaica	1.3	1.2	6.2	8.0	8.4	9.1	4.0	3.6	3.1	2.4
Japan	5.5	6.1	0.1	0.5	907.4	1,126.8	7.8	9.0	0.5	0.4
Jordan	2.7	1.9	..	..	4.7	13.3	2.2	3.2	1.0	1.7
Kazakhstan	..	0.3	..	0.1	..	221.5	..	13.3	..	13.8
Kenya	3.1	3.4	75.4	76.1	6.2	6.7	0.4	0.3	1.0	0.7
Korea, Dem. Rep.	..	..	2.7	3.9	124.9	257.0	7.1	11.6	..	..
Korea, Rep.	1.8	1.8	5.7	0.7	125.2	373.6	3.3	8.3	1.7	1.5
Kuwait	2.7	2.0	..	..	24.7	48.7	18.0	31.5	1.0	1.7
Kyrgyz Republic	..	0.5	..	..	..	5.5	..	1.2	..	4.9
Lao PDR	..	9.6	86.6	85.1	0.2	0.3	0.1	0.1	..	0.2
Latvia	12.1	1.3	..	18.0	..	9.3	..	3.7	..	1.9
Lebanon	0.0	1.3	4.3	2.6	6.2	13.3	2.1	3.3	..	2.4
Lesotho	..	..	..	..	..	..	..	..	..	..
Libya	5.7	..	1.7	0.8	26.9	39.4	8.8	7.8	0.7	..
Lithuania	..	0.8	..	5.6	..	14.8	..	4.0	..	2.1
Macedonia, FYR	..	..	..	6.9	..	..	..	..	..	..
Madagascar	6.9	5.8	77.1	83.8	1.6	1.1	0.2	0.1	0.6	0.4
Malawi	3.1	3.8	89.1	86.8	0.7	0.7	0.1	0.1	0.7	0.5
Malaysia	2.4	1.9	14.4	6.6	28.0	106.6	2.0	5.3	1.2	1.7
Mali	10.8	12.1	85.2	87.4	0.4	0.5	0.1	0.0	0.2	0.2
Mauritania	3.8	5.0	0.7	..	0.6	3.1	0.4	1.3	0.8	2.7
Mauritius	3.7	6.6	44.1	41.6	0.6	1.5	0.6	1.3	0.5	0.5
Mexico	1.3	1.3	4.4	4.4	255.0	357.8	3.8	3.9	2.0	2.1
Moldova	..	..	..	0.5	..	10.8	..	2.5	..	..
Mongolia	..	..	14.0	3.6	6.8	8.5	4.1	3.4	..	..
Morocco	3.4	2.8	5.4	4.7	15.9	29.3	0.8	1.1	1.1	1.3
Mozambique	1.2	3.4	72.6	86.0	3.2	1.0	0.3	0.1	2.3	0.4
Myanmar	..	..	66.5	69.4	4.8	7.0	0.1	0.2	..	..
Namibia	..	..	..	..	..	..	..	..	..	..
Nepal	12.6	6.4	94.8	88.9	0.5	1.5	0.0	0.1	0.2	0.3
Netherlands	3.0	3.7	0.0	0.5	152.6	135.9	10.8	8.8	0.8	0.5
New Zealand	3.4	2.8	0.2	..	17.6	27.4	5.6	7.6	0.6	0.6
Nicaragua	5.5	3.1	50.4	45.8	2.0	2.7	0.7	0.6	0.5	0.7
Niger	12.1	7.5	78.0	79.6	0.6	1.1	0.1	0.1	0.2	0.5
Nigeria	2.6	1.9	63.7	56.6	68.1	90.7	1.0	0.8	2.6	2.7
Norway	3.9	4.7	0.8	1.1	30.4	33.5	32.1	16.6	1.2	0.7
Oman	3.9	3.1	..	..	5.9	11.4	5.3	5.3	1.5	0.9
Pakistan	1.9	1.6	27.2	20.2	31.6	85.4	0.4	0.7	1.5	1.7
Panama	3.3	3.9	26.4	19.4	3.5	6.9	1.8	2.6	0.7	1.0
Papua New Guinea	3.9	4.6	64.1	58.9	1.8	2.5	0.6	0.6	0.7	0.5
Paraguay	6.0	3.4	66.1	51.5	1.5	3.8	0.5	0.8	0.4	0.7
Peru	2.5	2.4	18.7	22.9	23.5	30.6	1.4	1.3	1.2	1.3
Philippines	2.5	2.0	35.8	30.5	36.5	61.2	0.8	0.9	1.1	1.4
Poland	0.5	0.7	0.4	1.1	456.2	338.0	12.8	8.8	7.6	5.1
Portugal	3.5	2.7	1.1	0.7	27.1	51.9	2.8	5.2	0.7	1.0
Puerto Rico	2.4	4.2	..	..	14.0	15.5	4.4	4.2	0.7	0.4
Romania	0.5	0.7	1.5	21.5	191.8	121.1	8.6	5.3	5.7	3.9
Russian Federation	0.5	0.5	..	1.1	..	1,818.0	..	12.3	..	6.1

3.8

	GDP per unit of energy use		Traditional fuel use		Carbon dioxide emissions					
	1987 $ per kg oil equivalent		% of total energy use		Total million metric tons		Per capita metric tons		kg per 1987 $ of GDP	
	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995
Rwanda	9.2	6.3	84.8	85.7	0.3	0.5	0.1	0.1	0.2	0.4
Saudi Arabia	2.7	1.2	..	..	130.7	254.3	14.0	13.4	1.4	2.6
Senegal	4.2	6.1	48.6	55.9	2.8	3.1	0.5	0.4	0.8	0.6
Sierra Leone	2.7	2.2	63.5	69.4	0.6	0.4	0.2	0.1	0.7	0.6
Singapore	2.3	2.0	0.0	0.0	30.1	63.7	13.2	21.3	2.2	1.5
Slovak Republic	..	0.9	..	0.5	..	38.0	..	7.1	..	2.3
Slovenia	..	..	..	0.8	..	11.7	..	5.9	..	..
South Africa	1.3	1.0	4.5	3.9	211.3	305.8	7.8	8.3	2.8	3.4
Spain	3.6	3.5	0.5	0.6	200.0	231.6	5.3	5.9	0.8	0.6
Sri Lanka	3.4	3.8	54.3	48.4	3.4	5.9	0.2	0.3	0.7	0.6
Sudan	12.9	*12.1*	76.4	76.4	3.3	3.5	0.2	0.1	0.2	*0.2*
Sweden	3.4	3.4	3.9	2.5	71.4	44.6	8.6	5.0	0.5	0.3
Switzerland	7.3	7.5	1.1	2.1	40.9	38.9	6.5	5.5	0.3	0.2
Syrian Arab Republic	1.9	1.3	0.1	0.0	19.3	46.0	2.2	3.3	1.9	2.6
Tajikistan	..	0.5	..	..	..	3.7	..	0.6	..	2.5
Tanzania	..	..	83.7	89.6	1.9	2.4	0.1	0.1	..	..
Thailand	2.8	2.1	48.3	32.7	40.1	175.0	0.9	2.9	1.2	1.6
Togo	6.4	7.1	38.3	73.1	0.6	0.7	0.2	0.2	0.5	0.6
Trinidad and Tobago	1.5	0.7	1.8	1.0	16.7	17.1	15.4	13.3	3.0	3.5
Tunisia	2.4	2.4	15.4	12.9	9.4	15.3	1.5	1.7	1.3	1.2
Turkey	1.9	1.8	18.0	3.1	76.3	165.9	1.7	2.7	1.3	1.5
Turkmenistan	..	..	..	..	..	28.3	..	6.3	..	..
Uganda	..	24.8	87.2	89.2	0.6	1.0	0.1	0.1	..	0.1
Ukraine	..	0.2	..	0.4	..	438.2	..	8.5	..	..
United Arab Emirates	3.6	..	..	..	36.3	68.3	34.8	27.8	1.2	..
United Kingdom	2.8	3.5	0.0	1.1	585.1	542.1	10.4	9.3	1.0	0.7
United States	2.1	2.6	1.2	4.2	4,515.3	5,468.6	19.9	20.8	1.2	1.0
Uruguay	3.4	4.4	20.4	26.7	5.8	5.4	2.0	1.7	0.8	0.6
Uzbekistan	..	0.3	..	..	..	98.9	..	4.3	..	7.3
Venezuela	1.3	1.2	1.0	1.2	89.6	180.2	6.0	8.3	2.0	3.1
Vietnam	..	7.8	53.5	49.1	16.8	31.7	0.3	0.4	..	0.5
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	..	..	..	..	1.2	..	0.1	..	..	..
Yugoslavia, FR (Serb./Mont.)	..	..	..	..	..	33.0	..	3.1	..	..
Zambia	1.3	1.7	54.6	71.2	3.5	2.4	0.6	0.3	1.6	1.1
Zimbabwe	1.6	1.4	33.6	27.4	9.6	9.7	1.4	0.9	2.2	1.5
World	**2.2 w**	**2.4 w**	**7.1 w**	**6.8 w**	**13,585.7 t**	**22,700.2 t**	**3.4 w**	**4.1 w**	**1.1 w**	**1.2 w**
Low income	0.9	1.1	25.4	19.0	2,037.8	4,503.7	0.9	1.4	4.2	3.4
Excl. China & India	3.4	2.7	64.0	56.1	213.7	402.5	0.3	0.4	1.1	1.2
Middle income	1.2	1.1	14.0	7.7	2,775.7	7,073.8	2.9	4.5	1.7	2.6
Lower middle income	1.0	1.0	16.8	7.5	1,209.0	4,942.5	2.0	4.5	..	3.2
Upper middle income	1.7	1.5	11.7	8.2	1,566.7	2,131.3	4.6	4.6	1.8	1.9
Low & middle income	1.1	1.1	18.8	12.0	4,813.5	11,577.5	1.5	2.5	2.3	2.9
East Asia & Pacific	..	0.9	15.8	11.6	1,832.7	4,140.0	1.4	2.5	6.0	3.9
Europe & Central Asia	..	0.6	3.5	2.1	887.9	3,733.7	..	7.9	..	5.1
Latin America & Carib.	2.2	2.0	20.3	15.6	850.5	1,219.8	2.4	2.6	1.2	1.4
Middle East & N. Africa	3.3	1.8	2.0	1.2	499.5	982.9	2.9	3.9	1.1	1.7
South Asia	2.0	1.7	37.5	25.6	392.4	1,024.1	0.4	0.8	1.8	2.1
Sub-Saharan Africa	2.1	1.9	46.6	47.4	350.5	477.1	0.9	0.8	1.8	1.9
High income	2.9	3.4	1.1	2.5	8,772.1	11,122.7	12.0	12.5	0.9	0.7

About the data

The ratio of real GDP to energy use provides a measure of energy efficiency. Differences in this ratio over time and across countries are influenced by structural changes in the economy, changes in the energy efficiency of particular sectors of the economy, and differences in fuel mixes.

For traditional fuels, fuelwood and charcoal consumption estimates are calculated by the Food and Agriculture Organization (FAO) based on population data and country-specific per capita consumption figures. Estimates of bagasse consumption are based on sugar production data.

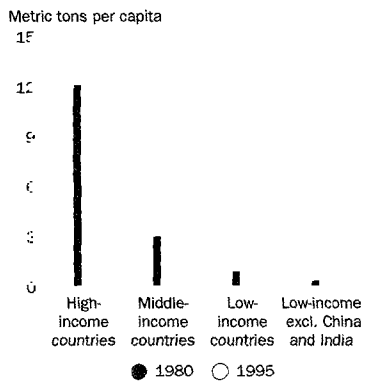
Carbon dioxide (CO_2) emissions, largely a byproduct of energy production and use (see table 3.7), are the largest source of greenhouse gases, which are associated with global warming. Anthropogenic CO_2 emissions result primarily from fossil fuel combustion and cement manufacturing. Combustion of different fossil fuels releases different amounts of CO_2 for the same level of energy production. Burning oil releases about 50 percent more CO_2 than burning natural gas, and burning coal releases about twice as much. During cement manufacturing about 0.5 metric ton of CO_2 is released for each ton of cement produced.

The Carbon Dioxide Information Analysis Center (CDIAC), sponsored by the U.S. Department of Energy, calculates annual anthropogenic emissions of CO_2. These calculations are derived from data on fossil fuel consumption, based on the World Energy Data Set maintained by the United Nations Statistical Division, and from data on world cement manufacturing, based on the Cement Manufacturing Data Set maintained by the U.S. Bureau of Mines.

Although the estimates of global CO_2 emissions are probably within 10 percent of actual emissions (as calculated from global average fuel chemistry and use), country estimates may have larger error bounds. Trends estimated from a consistent time series tend to be more accurate than individual values. Each year the CDIAC recalculates the entire time series from 1950 to the present, incorporating its most recent findings and the latest corrections to its database. Estimates do not include fuels supplied to ships and aircraft engaged in international transportation because of the difficulty of apportioning these fuels among the countries benefiting from that transport.

Figure 3.8a

Carbon dioxide emissions are increasing everywhere

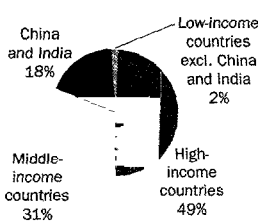


Source: Table 3.8.

The main sources of carbon dioxide, the principal greenhouse gas, are the burning of fossil fuels and the manufacturing of cement. Decoupling economic growth and carbon dioxide emissions in both industrial and developing countries will be essential to preventing global warming. On average, high-income economies emitted 5 times as much carbon dioxide per capita as low- and middle-income countries in 1995, and 32 times as much per capita as low-income countries excluding China and India. Although per capita emissions declined slightly in high-income countries in the early 1990s, since 1980 emissions have grown in every income group—especially middle-income countries.

Figure 3.8b

In 1995 high-income countries emitted the most carbon dioxide



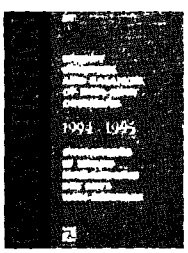
Source: Table 3.8.

Carbon dioxide emissions per capita are highest in high-income countries, but large populations in low- and middle-income countries meant that they produced more than half of the world's carbon dioxide emissions in 1995. Middle-income countries, China, and India accounted for most of the developing world's emissions; the remaining low-income countries contributed a mere 2 percent.

Definitions

- **GDP per unit of energy use** is the U.S. dollar estimate of real GDP (at 1987 prices) per kilogram of oil equivalent of commercial energy use (see table 3.7).
- **Traditional fuel use** includes estimates of the consumption of fuelwood, charcoal, bagasse, and animal and vegetable wastes. Total energy use comprises commercial energy use (see table 3.7) and traditional fuel use. • **Carbon dioxide emissions** are those stemming from the burning of fossil fuels and the manufacture of cement. They include carbon dioxide produced during consumption of solid fuels, liquid fuels, gas fuels, and gas flaring.

Data sources



Underlying data on commercial energy production and use are from International Energy Agency (IEA) and United Nations sources. Data on CO_2 emissions are based on several sources as reported by the World Resources Institute. The main source is the Carbon Dioxide Information Analysis Center, Environmental Sciences Division, Oak Ridge National Laboratory, in the state of Tennessee in the United States. Traditional fuel data are from the World Resources Institute's *World Resources*, the United Nations *Energy Statistics Yearbook*, and FAO electronic files.

3.9 Sources of electricity

	Electricity production		Sources of electricity									
			Hydropower		Coal		Oil		Gas		Nuclear power	
	billion kwh		%		%		%		%		%	
	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995
Albania	3.7	4.4	79.4	95.2	0.0	0.0	20.6	4.8	0.0	0.0	..	..
Algeria	7.1	19.7	3.6	1.0	..	..	12.2	3.3	84.1	95.7	..	..
Angola	0.7	1.0	88.1	93.8	..	..	11.9	6.3	..	..	..	..
Argentina	39.7	64.6	38.1	41.3	2.5	2.5	31.9	4.8	21.0	40.0	5.9	10.9
Armenia	13.0	5.6	12.0	34.5	..	..	54.8	39.3	0.0	20.8	33.2	5.5
Australia	95.2	173.4	13.6	9.2	73.3	77.0	5.4	1.7	7.3	10.3	..	..
Austria	41.6	55.1	69.1	67.3	7.0	10.6	14.0	3.1	9.2	15.5	..	..
Azerbaijan	15.0	17.0	7.3	9.1	..	..	92.7	90.9	0.0	0.0	..	..
Bangladesh	2.4	10.9	24.8	3.4	..	..	26.6	16.3	48.6	80.3	..	..
Belarus	34.1	24.9	0.1	0.1	0.0	0.0	99.9	28.5	0.0	71.5	..	..
Belgium	53.1	73.6	0.5	0.5	29.4	26.2	34.7	1.8	11.2	13.8	23.6	56.2
Benin	0.0	0.0	..	..	..	..	100.0	100.0	..	..	..	..
Bolivia	1.6	3.0	68.8	53.2	..	..	10.3	7.6	18.4	36.7	..	..
Bosnia and Herzegovina	..	2.2	..	64.5	..	35.5	..	0.0	..	..	..	..
Botswana	..	..	..	..	..	..	..	..	..	..	..	..
Brazil	139.4	275.4	92.5	92.2	2.0	1.5	3.8	2.7	0.0	0.2	0.0	0.9
Bulgaria	34.8	40.7	10.7	3.1	49.2	43.1	22.5	3.6	0.0	7.9	17.7	42.4
Burkina Faso	..	..	..	..	..	..	..	..	..	..	..	..
Burundi	..	..	..	..	..	..	..	..	..	..	..	..
Cambodia	..	..	..	..	..	..	..	..	..	..	..	..
Cameroon	1.5	2.7	93.9	96.9	..	..	6.1	3.1	..	..	..	..
Canada	373.3	551.4	67.3	60.5	16.0	15.1	3.7	1.9	2.5	3.9	10.2	17.7
Central African Republic	..	..	..	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	11.8	28.0	62.5	65.7	13.8	24.7	21.5	8.2	1.2	0.9	..	..
China	300.6	1,007.7	19.4	18.9	59.3	73.4	21.1	6.1	0.2	0.2	0.0	1.3
Hong Kong, China	12.6	27.9	..	..	0.0	97.7	100.0	2.3	..	..	..	..
Colombia	20.6	45.4	70.1	70.4	9.7	11.4	2.1	1.0	17.6	16.7	..	..
Congo, Dem. Rep.	4.4	6.2	95.5	96.2	..	..	4.5	3.8	..	..	..	..
Congo, Rep.	0.2	0.4	64.1	98.6	..	..	34.0	0.7	1.9	0.7	..	..
Costa Rica	2.2	5.1	94.7	86.1	..	..	5.3	13.7	..	..	..	..
Côte d'Ivoire	1.7	2.3	77.6	42.1	..	..	22.4	57.9	..	..	..	..
Croatia	..	8.9	..	59.4	..	2.7	..	27.7	..	10.1	..	..
Cuba	9.9	11.2	1.0	0.8	..	..	99.0	90.9	0.0	0.1	..	..
Czech Republic	52.7	60.6	4.6	3.3	84.8	74.0	9.6	1.0	1.1	0.8	0.0	20.2
Denmark	26.8	36.8	0.1	0.1	81.8	75.2	18.0	9.4	0.0	9.7	..	..
Dominican Republic	3.3	6.5	17.7	30.6	0.0	4.5	82.3	64.4	..	..	..	..
Ecuador	3.4	8.9	25.9	62.0	..	..	74.1	38.0	..	..	..	..
Egypt, Arab Rep.	18.9	54.8	51.8	19.7	..	..	27.7	37.3	20.5	43.0	..	..
El Salvador	1.6	3.4	68.3	42.2	..	..	8.6	36.3	..	..	..	..
Eritrea	..	..	..	..	..	..	..	..	..	..	..	..
Estonia	18.9	8.7	0.0	0.0	0.0	96.5	100.0	1.2	0.0	2.2	..	..
Ethiopia	0.7	1.3	70.2	86.8	..	..	27.6	7.9	..	..	..	..
Finland	40.7	63.9	25.1	20.2	42.6	26.7	10.8	2.3	4.2	10.4	17.2	30.1
France	256.9	489.3	26.9	14.6	27.2	5.4	18.9	1.6	2.7	0.8	23.8	77.1
Gabon	0.5	0.9	49.1	77.1	..	..	50.9	11.8	0.0	11.1	..	..
Gambia, The	..	..	..	..	..	..	..	..	..	..	..	..
Georgia	14.7	6.8	43.8	69.3	..	..	56.2	2.8	0.0	27.9	..	..
Germany	466.3	532.6	4.1	3.7	62.9	55.8	5.7	1.7	14.2	8.1	11.9	28.9
Ghana	5.3	6.2	99.4	99.3	..	..	0.6	0.7	..	..	..	..
Greece	22.7	41.2	15.0	8.6	44.8	69.6	40.1	21.5	0.0	0.2	..	..
Guatemala	1.7	3.2	16.7	67.2	..	..	83.3	26.1	..	..	..	..
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	0.3	0.5	70.1	75.4	..	..	29.9	20.6	..	..	..	..
Honduras	0.9	2.7	84.0	99.6	..	..	16.0	0.4	..	..	..	..

	Electricity production		Sources of electricity									
	billion kwh		Hydropower %		Coal %		Oil %		Gas %		Nuclear power %	
	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995
Hungary	23.9	34.0	0.5	0.5	46.9	29.5	24.6	16.3	28.0	11.9	0.0	41.2
India	119.3	414.6	39.0	20.1	49.9	69.4	7.7	2.9	0.8	5.9	2.5	1.7
Indonesia	8.4	61.2	16.0	14.2	0.0	23.5	84.0	26.8	0.0	32.0	..	..
Iran, Islamic Rep.	22.4	85.4	25.1	8.5	..	..	50.1	35.8	24.8	55.7	..	..
Iraq	11.4	29.0	6.1	2.0	..	..	93.9	98.0	..	..	..	..
Ireland	10.6	17.6	7.9	4.0	16.4	51.3	60.4	15.2	15.2	29.3	..	..
Israel	12.5	30.3	0.0	0.2	0.0	62.1	100.0	37.7	0.0	0.0	..	..
Italy	183.5	237.4	24.7	15.9	9.9	11.6	57.0	50.9	5.0	19.8	1.2	0.0
Jamaica	1.5	5.8	8.3	2.1	..	..	87.9	93.2	..	..	..	..
Japan	572.5	980.9	15.4	8.4	9.6	17.8	46.2	22.9	14.2	19.5	14.4	29.7
Jordan	1.1	5.6	0.0	0.3	..	..	100.0	86.4	0.0	13.3	..	..
Kazakhstan	..	66.7	..	12.5	..	72.0	..	7.3	..	8.2	..	0.0
Kenya	1.5	3.7	71.1	83.3	..	..	28.9	8.9	..	..	..	..
Korea, Dem. Rep.	35.0	36.0	64.3	63.9	35.7	36.1	..	..	..	..	..	..
Korea, Rep.	37.2	184.7	5.3	3.0	6.7	26.4	78.7	22.8	0.0	11.5	9.3	36.3
Kuwait	9.4	23.7	..	..	..	..	37.2	21.7	62.8	78.3	..	..
Libya	3.2	12.3	0.1	0.0	0.0	0.0	46.9	3.9	0.0	0.0	..	..
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	4.7	4.0	64.9	73.8	0.0	2.5	35.1	10.5	0.0	13.2	..	..
Lebanon	2.8	5.3	30.9	13.8	..	..	69.1	86.2	..	..	..	..
Lesotho	..	..	..	..	..	..	..	..	..	..	..	..
Libya	4.8	18.0	..	..	..	..	100.0	100.0	..	..	..	..
Lithuania	11.7	13.5	4.0	2.8	..	..	96.0	8.3	0.0	1.5	0.0	87.4
Macedonia, FYR	..	6.1	..	13.1	..	86.3	..	0.6	..	..	..	..
Madagascar	..	..	..	..	..	..	..	..	..	..	..	..
Malawi	..	..	..	..	..	..	..	..	..	..	..	..
Malaysia	10.0	45.5	13.9	13.7	0.0	8.6	84.7	39.5	1.3	38.3	..	..
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	..	..	..	..	..	..	..	..	..	..	..	..
Mexico	67.0	152.5	25.2	18.0	0.0	9.4	57.9	51.4	15.5	11.9	0.0	5.5
Moldova	15.4	8.4	2.6	3.3	0.0	38.3	97.4	11.1	0.0	47.2	..	..
Mongolia	..	..	..	..	..	..	..	..	..	..	..	..
Morocco	5.2	12.0	28.9	5.0	19.5	46.3	51.6	48.7	..	..	..	..
Mozambique	14.0	0.6	96.8	8.9	0.0	13.0	3.2	63.6	0.0	14.6	..	..
Myanmar	1.5	3.8	53.5	40.4	2.0	0.1	31.3	14.3	13.2	45.2	..	..
Namibia	..	..	..	..	..	..	..	..	..	..	..	..
Nepal	0.2	1.2	82.3	96.9	..	..	17.7	3.1	..	..	..	..
Netherlands	64.8	81.1	0.0	0.1	13.7	35.6	38.4	4.8	39.8	51.8	6.5	5.0
New Zealand	22.3	36.2	85.0	76.1	1.9	2.0	0.1	0.1	7.7	13.6	..	..
Nicaragua	1.1	1.8	47.8	22.8	..	..	52.2	57.4	..	..	..	..
Niger	..	..	..	..	..	..	..	..	..	..	..	..
Nigeria	7.1	14.5	39.0	38.0	0.4	0.0	45.1	24.1	15.5	38.0	..	..
Norway	83.8	122.0	99.8	99.4	0.0	0.2	0.1	0.0	0.0	0.2	..	..
Oman	0.8	6.5	..	..	..	..	0.0	19.3	100.0	80.7	..	..
Pakistan	15.0	53.6	58.2	42.7	0.2	0.1	1.1	29.4	40.5	26.9	0.0	1.0
Panama	2.0	3.5	49.4	66.9	..	..	48.4	31.1	..	..	..	..
Papua New Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Paraguay	0.8	41.6	88.6	99.9	..	..	2.5	0.0	..	..	..	..
Peru	10.0	16.0	69.8	85.9	..	..	27.3	11.9	1.7	1.4	..	..
Philippines	18.0	29.7	19.6	10.9	1.0	6.8	67.9	62.8	..	..	..	..
Poland	121.9	136.7	2.7	1.4	89.4	97.3	7.8	1.1	0.1	0.2	..	..
Portugal	15.2	33.2	52.7	25.2	2.3	40.6	42.9	31.1	..	..	..	..
Puerto Rico	..	..	..	..	..	..	..	..	..	..	..	..
Romania	67.5	59.3	18.7	28.2	31.4	35.1	9.6	9.8	38.2	26.9	..	..
Russian Federation	804.9	859.0	16.1	20.5	0.0	18.3	77.2	9.2	0.0	40.1	6.7	11.6

3.9

	Electricity production		Sources of electricity									
			Hydropower		Coal		Oil		Gas		Nuclear power	
	billion kwh		%		%		%		%		%	
	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995	1980	1995
Rwanda	..	..	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	20.5	93.9	..	..	..	..	58.5	55.3	41.5	44.7	..	..
Senegal	0.6	0.9	..	..	..	..	100.0	100.0	..	..	..	..
Sierra Leone	..	..	..	..	..	..	..	..	..	..	..	..
Singapore	7.0	22.1	..	..	..	..	100.0	82.8	0.0	17.2	.	..
Slovak Republic	20.0	25.6	11.3	19.1	37.9	22.6	17.9	4.7	10.2	9.0	22.7	44.6
Slovenia	8.0	12.6	42.3	25.6	51.6	34.3	3.9	2.3	2.2	0.0	0.0	37.8
South Africa	99.0	186.8	1.0	0.3	99.0	93.5	..	..	..	..	0.0	6.0
Spain	109.2	165.6	27.1	14.0	30.0	40.5	35.2	8.8	2.7	2.3	4.7	33.5
Sri Lanka	1.7	4.8	88.7	92.7	..	..	11.3	7.3	..	..	..	..
Sudan	1.1	1.3	61.7	71.0	..	..	27.7	10.2	..	..	..	..
Sweden	96.3	147.0	61.1	45.6	0.2	2.2	10.4	2.4	0.0	0.5	27.5	47.6
Switzerland	48.2	62.3	68.1	56.5	0.1	0.0	1.0	0.6	0.6	1.3	29.8	40.0
Syrian Arab Republic	4.0	15.3	64.7	45.4	..	..	31.9	32.1	3.4	22.5	..	..
Tajikistan	13.6	14.8	93.4	98.8	..	..	6.6	1.2	..	..	..	..
Tanzania	1.0	1.8	100.0	85.9	..	..	0.0	14.1	..	..	..	..
Thailand	14.4	80.1	8.8	8.4	9.8	18.5	81.4	30.5	0.0	42.3	..	..
Togo	..	..	..	..	..	..	..	..	..	..	.	..
Trinidad and Tobago	2.0	4.3	..	..	..	..	2.3	0.0	96.0	99.2	..	..
Tunisia	2.9	7.3	0.8	0.5	..	..	68.3	65.5	30.9	34.0	..	..
Turkey	23.1	86.2	49.0	41.2	25.8	32.5	25.2	6.7	0.0	19.2	..	..
Turkmenistan	6.7	9.8	0.1	0.0	..	..	100.0	0.0	0.0	100.0	..	..
Uganda	..	..	..	..	..	..	..	..	..	..	.	..
Ukraine	236.0	194.0	5.7	5.2	0.0	32.9	88.3	4.3	0.0	21.3	6.0	36.3
United Arab Emirates	6.3	19.1	..	..	..	..	44.8	18.8	55.2	81.2	..	..
United Kingdom	284.1	332.9	1.4	1.6	73.2	43.0	11.7	10.7	0.7	17.5	13.0	26.7
United States	2,427.3	3,558.4	11.5	8.8	51.2	51.5	10.8	2.5	15.3	14.9	11.0	20.1
Uruguay	3.4	6.3	67.9	87.8	..	..	30.7	11.0	..	..	..	..
Uzbekistan	33.9	47.2	14.6	15.0	0.0	6.5	85.4	2.4	0.0	76.1	..	..
Venezuela	36.9	73.5	39.6	70.0	..	..	14.5	5.4	45.9	24.5	..	..
Vietnam	3.6	14.4	41.8	77.9	39.9	7.4	18.3	8.2	0.0	6.5	..	..
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	0.5	2.4	..	..	..	..	100.0	100.0	..	..	..	..
Yugoslavia, FR (Serb./Mont.)	..	37.2	..	30.2	..	63.7	..	2.4	..	3.7	..	..
Zambia	9.5	7.8	98.8	99.7	0.7	0.3	0.5	0.0	..	..	..	..
Zimbabwe	4.3	7.3	87.6	32.3	11.8	67.7	0.6	0 0	..	..	..	..
World	**8226.9 s**	**13180.7 s**	**20.8 w**	**18.9 w**	**33.1 w**	**37.5 w**	**28.3 w**	**9.9 w**	**8.8 w**	**14.7 w**	**8.7 w**	**17.7 w**
Low income	566.8	1636.7	32.8	23.8	42.4	63.5	21.8	7.6	1.8	3.9	1.3	1.3
Excl. China & India	146.9	214.4	55.1	53.8	1.4	5.1	34.6	23.2	5.8	17.0	2.9	0.4
Middle income	2229.2	3304.9	21.2	26.1	15.3	25.3	54.8	15.4	4.7	24.2	3.6	8.2
Lower middle income	1601.7	2137.3	18.0	23.7	3.8	20.2	69.4	14.7	3.9	31.4	4.6	9.3
Upper middle income	627.5	1167.6	29.4	30.6	44.6	34.6	17.6	16.6	6.6	10.8	1.1	6.1
Low & middle income	2796.0	4941.6	23.6	25.4	20.8	37.9	48.1	12.8	4.1	17.4	3.2	5.9
East Asia & Pacific	391.6	1278.3	23.1	19.6	49.5	61.7	26.6	11.0	0.3	5.9	0.0	1.0
Europe & Central Asia	1648.0	1808.9	13.7	18.1	13.4	32.0	65.7	8.2	2.1	28.1	5.0	13.4
Latin America & Carib.	360.8	763.5	59.9	64.7	2.0	4.2	24.6	16.6	11.6	10.0	0.6	2.4
Middle East & N. Africa	104.0	360.0	20.5	7.6	1.0	1.5	52.2	49.6	26.4	41.3	.	..
South Asia	138.5	485.1	41.5	23.1	43.0	59.3	7.4	6.2	5.9	9.8	2.2	1.5
Sub-Saharan Africa	153.1	245.8	30.6	16.6	64.4	73.1	4.2	3.0	0.7	2.3	0.0	4.6
High income	5430.9	8239.1	19.4	15.0	39.4	37.3	18.1	8 1	11.2	13.0	11.5	24.8

About the data

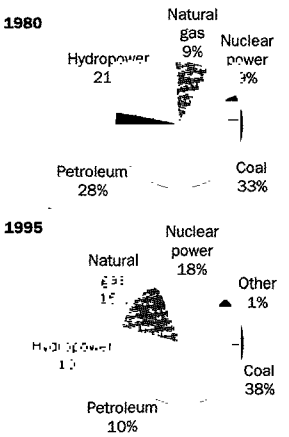
Use of energy in general, and access to electricity in particular, are major factors in improving people's standard of living. Electricity generation, however, has the potential to damage the environment. Whether such damage occurs largely depends on how electricity is generated. For example, burning coal as an energy input emits twice as much carbon dioxide—a major contributor to global warming—as does burning an equivalent amount of natural gas (see table 3.8). Nuclear energy does not generate any carbon dioxide emissions, but it is not as safe as solar energy. The table shows how "clean" generated electricity is.

The International Energy Agency (IEA) compiles data on energy inputs used to generate electricity. IEA data for non-OECD countries are based on national energy data that have been adjusted to conform with annual questionnaires completed by OECD member governments. In addition, estimates are sometimes made to complete major aggregates from which key data are missing, and adjustments are made to compensate for differences in definitions. The IEA makes these estimates in consultation with national statistical offices, oil companies, electricity utilities, and national energy experts.

The IEA occasionally revises its time series to reflect political changes. For example, since 1990 estimates of energy balances have been constructed for countries of the former Soviet Union. Energy statistics for some countries undergo continuous changes in coverage or methodology. For example, in recent years more detailed energy accounts have become available for some countries. Thus breaks in series are unavoidable.

Figure 3.9a

Sources of global electricity generation are shifting



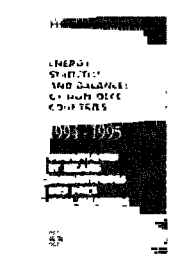
Source: Table 3.9.

Electricity generation has increased more than 60 percent since 1980—twice as much as population growth (see tables 2.1 and 3.9). Because fossil fuels are the main sources of generated electricity, this increase has been associated with various environmental impacts, including increased carbon dioxide emissions and depleted nonrenewable natural resources. As these figures show, since 1980 there has been a move toward "cleaner" sources of energy. Still, sources with the least environmental impact, such as solar energy, account for a small fraction of generated electricity.

Definitions

- **Electricity production** is measured at the terminals of all alternator sets in a station. In addition to electricity generated by hydropower, coal, oil, gas, and nuclear power, it covers that generated by geothermal, solar, wind, and tide and wave energy, as well as that from combustible renewables and waste. Production includes the output of electricity plants that are designed to produce electricity only as well as that of combined heat and power plants.
- **Sources of electricity** refer to the inputs used to generate electricity: hydropower, coal, oil, gas, and nuclear power. *Hydropower* refers to electricity produced by hydroelectric power plants, *oil* refers to crude oil and petroleum products, *gas* refers to natural gas but excludes natural gas liquids, and *nuclear* refers to electricity produced by nuclear power plants. Shares may not sum to 100 percent because other sources of generated electricity (such as geothermal, solar, and wind) are not shown.

Data sources



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

3.10 Urbanization

	Urban population				Population in urban agglomerations of more than one million			Population in the largest city		Access to sanitation in urban areas	
	millions		% of total population		% of total population			% of urban population		% of urban population	
	1980	1996	1980	1996	1980	1996	2015	1980	1995	1980	1995
Albania	0.9	1.2	34	38	..	..	..	..	..	..	..
Algeria	8.1	16.2	43	56	11	13	16	25	24	*95*	..
Angola	1.5	3.5	21	32	13	20	30	63	62	..	34
Argentina	23.3	31.1	83	88	35	41	36	43	39	..	100
Armenia	2.0	2.6	66	69	34	34	41	51	50	..	..
Australia	12.6	15.5	86	85	47	57	59	26	23	..	..
Austria	4.9	5.2	65	64	27	26	27	42	40	..	100
Azerbaijan	3.3	4.2	53	56	26	25	29	48	44	..	..
Bangladesh	9.8	23.0	11	19	5	10	15	33	39	*20*	*77*
Belarus	5.4	7.4	57	72	14	17	20	24	24	..	..
Belgium	9.4	9.9	95	97	12	11	11	13	11	..	100
Benin	0.9	2.2	27	39	..	..	..	..	..	..	54
Bolivia	2.4	4.7	46	61	14	*17*	19	30	28	..	64
Bosnia and Herzegovina	1.5	..	36	42	..	..	..	..	..	..	..
Botswana	0.1	0.9	15	63	..	..	..	..	..	..	91
Brazil	80.3	127.3	66	79	27	33	34	16	13	..	55
Bulgaria	5.4	5.7	61	69	12	14	20	20	21	..	100
Burkina Faso	0.6	1.8	9	16	..	..	..	44	50	..	42
Burundi	0.2	0.5	4	8	..	..	..	..	..	..	..
Cambodia	0.8	2.2	12	21	..	..	..	..	..	..	..
Cameroon	2.7	6.2	31	46	6	19	14	19	22	..	73
Canada	18.6	23.0	76	77	29	35	35	16	19	..	..
Central African Republic	0.8	1.3	35	40	..	..	..	..	..	..	..
Chad	0.8	1.5	19	23	..	..	..	40	58	..	73
Chile	9.0	12.1	81	84	33	34	36	41	41	..	100
China	192.3	377.0	20	31	8	11	14	6	4	..	58
Hong Kong, China	4.6	6.0	92	95	91	93	86	100	99	..	..
Colombia	17.8	27.4	64	73	22	34	30	20	23	..	76
Congo, Dem. Rep.	7.8	13.1	29	29	..	10	..	28	34	*8*	..
Congo, Rep.	0.7	1.6	41	59	..	39	..	67	65	*17*	*11*
Costa Rica	1.0	1.7	43	50	..	..	..	61	55	..	..
Côte d'Ivoire	2.9	6.3	35	44	15	20	31	44	46	*13*	*59*
Croatia	2.3	2.7	50	56	..	..	..	28	37	..	72
Cuba	6.6	8.4	68	76	20	20	22	29	27	..	71
Czech Republic	6.5	6.8	64	66	12	12	13	18	18	..	..
Denmark	4.3	4.5	84	85	27	25	25	32	30	..	100
Dominican Republic	2.9	5.0	51	63	25	58	36	50	65	..	76
Ecuador	3.7	7.0	47	60	14	28	31	30	27	..	87
Egypt, Arab Rep.	17.9	26.6	44	45	23	25	25	38	37	*95*	*20*
El Salvador	1.9	2.6	42	45	..	22	..	40	48	..	78
Eritrea	..	0.6	..	17	..	..	..	..	..	..	..
Estonia	1.0	1.1	70	73	..	..	..	..	..	..	..
Ethiopia	4.0	9.2	11	16	3	4	6	30	28	..	..
Finland	2.9	3.3	60	64	..	21	..	22	33	*100*	*100*
France	39.5	43.7	73	75	21	21	20	23	22	..	100
Gabon	0.2	0.6	34	51	..	..	..	..	..	..	79
Gambia, The	0.1	0.3	20	30	..	..	..	..	..	..	83
Georgia	2.6	3.2	52	59	22	25	31	42	43	..	..
Germany	64.7	71.0	83	87	38	41	42	10	9	..	100
Ghana	3.4	6.4	31	36	9	10	14	30	27	..	50
Greece	5.6	6.2	58	59	31	30	37	54	50	..	100
Guatemala	2.6	4.3	37	39	..	21	..	29	53	..	78
Guinea	0.9	2.0	19	30	12	24	35	65	81	*54*	..
Guinea-Bissau	0.1	0.2	17	22	..	..	..	..	..	*21*	*32*
Haiti	1.3	2.4	24	32	13	21	27	55	64	..	42
Honduras	1.3	2.7	35	44	..	..	..	32	38	..	89

	Urban population				Population in urban agglomerations of more than one million			Population in the largest city		Access to sanitation in urban areas	
	millions		% of total population		% of total population			% of urban population		% of urban population	
	1980	1996	1980	1996	1980	1996	2015	1980	1995	1980	1995
Hungary	6.1	6.6	57	65	19	20	21	34	31	..	100
India	158.8	256.3	23	27	6	10	12	5	6	*25*	*70*
Indonesia	32.9	71.6	22	36	7	9	16	18	13	..	73
Iran, Islamic Rep.	19.4	37.2	50	60	13	22	24	26	19	*90*	..
Iraq	8.5	16.0	66	75	26	29	21	39	28	*30*	*95*
Ireland	1.9	2.1	55	58	..	..	..	48	44	..	100
Israel	3.4	5.2	89	91	37	35	31	41	39	..	..
Italy	37.6	38.3	67	67	26	20	21	14	11	..	100
Jamaica	1.0	1.4	47	54	..	..	..	..	..	..	89
Japan	89.0	98.4	76	78	34	38	39	25	28	..	..
Jordan	1.3	3.1	60	72	29	29	34	49	39	*91*	..
Kazakhstan	8.0	9.9	54	60	6	8	10	12	13	..	..
Kenya	2.7	8.1	16	30	5	7	14	32	24	..	69
Korea, Dem. Rep.	10.1	13.8	57	62	10	11	13	18	18	..	100
Korea, Rep.	21.7	37.5	57	82	37	52	54	2	2	..	..
Kuwait	1.2	1.5	90	97	60	70	67	67	73	*100*	*100*
Kyrgyz Republic	1.4	1.8	38	39	..	..	..	..	..	*78*	*87*
Lao PDR	0.4	1.0	13	21	..	..	..	..	..	..	30
Latvia	1.7	1.8	68	73	..	..	..	49	50	..	..
Lebanon	2.2	3.6	74	88	..	46	..	55	52	*94*	..
Lesotho	0.2	0.5	13	25	..	..	..	..	..	*22*	*1*
Libya	2.1	4.4	69	86	38	34	77	38	39	..	..
Lithuania	2.1	2.7	61	73	..	..	..	..	..	..	..
Macedonia, FYR	1.0	1.2	54	60	..	..	..	..	..	..	..
Madagascar	1.6	3.7	18	27	..	..	..	30	25	..	12
Malawi	0.6	1.4	9	14	..	..	..	..	..	..	70
Malaysia	5.8	11.2	42	54	7	6	7	16	11	..	100
Mali	1.2	2.7	19	27	..	..	..	40	35	*90*	*58*
Mauritania	0.4	1.2	27	53	..	..	..	..	..	..	..
Mauritius	0.4	0.5	42	41	..	..	..	..	..	*100*	..
Mexico	44.1	68.6	66	74	27	27	25	31	25	..	81
Moldova	1.6	2.3	40	52	..	..	..	..	..	..	96
Mongolia	0.9	1.5	52	61	..	..	..	..	..	..	..
Morocco	8.0	14.2	41	53	11	17	22	26	23	*85*	*69*
Mozambique	1.6	6.3	13	35	6	13	20	47	38	*51*	*53*
Myanmar	8.1	12.0	24	26	7	9	13	27	33	..	42
Namibia	0.2	0.6	23	37	..	..	..	..	..	..	77
Nepal	0.9	2.3	7	11	..	..	..	..	..	*5*	*51*
Netherlands	12.5	13.8	88	89	7	14	14	8	8	..	100
New Zealand	2.6	3.1	83	86	..	..	..	30	31	..	..
Nicaragua	1.5	2.8	53	63	23	26	33	42	41	..	34
Niger	0.7	1.7	13	19	..	..	..	..	..	*20*	*71*
Nigeria	19.1	46.3	27	40	6	11	15	23	23	..	61
Norway	2.9	3.2	71	73	..	..	..	..	..	*100*	*100*
Oman	0.3	1.7	32	77	..	..	..	..	..	*60*	*98*
Pakistan	23.2	46.5	28	35	11	18	23	22	22	*48*	*53*
Panama	1.0	1.5	50	56	..	..	..	62	66	..	..
Papua New Guinea	0.4	0.7	13	16	..	..	..	..	..	..	82
Paraguay	1.3	2.6	42	53	..	23	..	51	43	..	..
Peru	11.2	17.3	65	71	26	28	33	39	39	..	62
Philippines	18.1	39.5	38	55	12	15	15	33	24	..	..
Poland	20.7	24.7	58	64	18	*18*	19	16	14	..	100
Portugal	2.9	3.6	29	36	13	19	24	46	53	..	100
Puerto Rico	2.1	2.8	67	74	34	35	30	51	48	..	..
Romania	10.9	12.7	49	56	9	9	10	18	17	..	85
Russian Federation	97.0	112.7	70	76	16	19	20	8	8	..	..

	Urban population				Population in urban agglomerations of more than one million			Population in the largest city		Access to sanitation in urban areas	
	millions		% of total population		% of total population			% of urban population		% of urban population	
	1980	1996	1980	1996	1980	1996	2015	1980	1995	1980	1995
Rwanda	0.2	0.4	5	6	..	..	..	..	..	..	..
Saudi Arabia	6.2	16.2	66	83	19	22	22	16	17	..	..
Senegal	2.0	3.8	36	44	18	21	31	47	47	..	83
Sierra Leone	0.8	1.6	24	34	..	..	..	..	..	*30*	*17*
Singapore	2.3	3.0	100	100	100	100	100	100	100	..	97
Slovak Republic	2.6	3.2	52	59	..	..	..	..	..	..	..
Slovenia	0.9	1.0	48	52	..	..	..	..	..	..	95
South Africa	13.1	18.6	48	50	12	34	24	12	12	..	79
Spain	27.2	30.1	73	77	20	18	18	16	14	..	100
Sri Lanka	3.2	4.1	22	22	..	..	..	..	..	..	..
Sudan	3.7	8.8	20	32	6	9	14	31	27	*70*	*79*
Sweden	6.9	7.4	83	83	17	18	19	20	21	..	100
Switzerland	3.6	4.3	57	61	..	..	..	20	21	..	100
Syrian Arab Republic	4.1	7.6	47	53	28	28	36	34	28	*58*	*100*
Tajikistan	1.4	1.9	34	32	..	..	..	..	..	..	83
Tanzania	2.7	7.6	15	25	5	6	9	30	24	*93*	*97*
Thailand	7.9	12.2	17	20	10	11	16	59	55	..	..
Togo	0.6	1.3	23	31	..	..	..	..	..	..	56
Trinidad and Tobago	0.7	0.9	63	72	..	..	..	..	..	..	60
Tunisia	3.3	5.7	52	63	17	19	26	35	31	*64*	..
Turkey	19.5	44.2	44	70	17	25	25	23	19	..	99
Turkmenistan	1.3	2.1	47	45	..	..	..	..	..	..	70
Uganda	1.1	2.5	9	13	..	..	..	42	40	..	75
Ukraine	30.9	35.8	62	71	14	16	18	7	8	..	70
United Arab Emirates	0.7	2.1	72	84	..	..	..	31	39	..	..
United Kingdom	50.0	52.5	89	89	25	23	23	15	15	..	..
United States	167.5	202.5	74	76	36	39	39	9	8	..	..
Uruguay	2.5	2.9	85	91	42	42	41	49	46	..	..
Uzbekistan	6.5	9.6	41	41	11	10	12	28	24	..	46
Venezuela	11.8	19.2	79	86	16	28	28	22	16	..	64
Vietnam	10.3	14.7	19	19	5	6	9	27	25	..	43
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	1.7	5.4	20	34	..	..	..	..	..	..	70
Yugoslavia, FR (Serb./Mont.)	4.5	6.1	46	57	11	11	15	24	20	..	100
Zambia	2.3	4.0	40	43	9	15	23	23	34	..	40
Zimbabwe	1.6	3.7	22	33	..	13	..	39	40	..	98
World	**1,743.2 s**	**2,619.0 s**	**40 w**	**46 w**	**15 w**	**18 w**	**20 w**	**18 w**	**17 w**	**.. w**	**.. w**
Low income	501.1	940.6	21	29	7	11	14	12	13	..	..
Excl. China & India	150.0	307.3	21	29	8	12	16	30	31	..	..
Middle income	638.7	977.6	52	61	17	21	23	22	21	..	..
Lower middle income	408.3	632.1	47	56	14	18	20	22	21	..	..
Upper middle income	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Low & middle income	1,139.7	1,918.2	32	40	11	14	17	18	17	..	..
East Asia & Pacific	288.4	558.0	21	33	8	11	14	13	9	..	62
Europe & Central Asia	249.4	317.3	58	66	15	18	19	15	15	..	..
Latin America & Carib.	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		
Middle East & N. Africa	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
South Asia	198.4	337.3	22	27	6	11	14	9	11	*27*	*68*
Sub-Saharan Africa	87.2	189.0	23	32	..	13	..	28	30	..	..
High income	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]		

About the data

The population of a city or metropolitan area depends on the boundaries chosen. For example, in 1990 Beijing, China, contained 2.3 million people in 87 square kilometers of "inner city" and 5.4 million people 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 counties" was 10.8 million. (This table uses the last definition.)

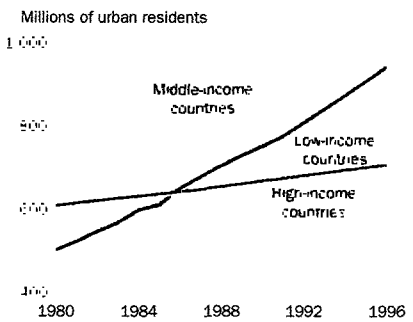
Estimates of the world's urban population would change significantly if China, India, and a few other populous nations were to change their definition of urban centers. In fact, according to China's State Statistical Bureau, by the end of 1996 urban residents accounted for about 43 percent of the country's population, when in 1994 only 20 percent of the population was considered urban. Besides 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, the United Nations ratio of urban to total population was applied to the World Bank's estimates of total population (see table 2.1). The resulting urban population estimates are also used to calculate the population in the largest city as a percentage of the urban population.

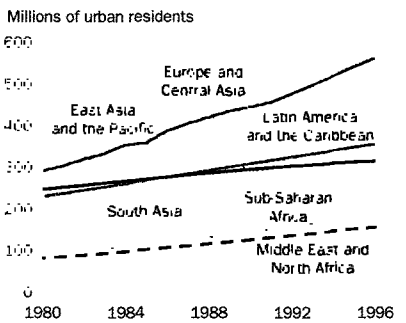
Urban areas with access to sanitation services are defined as urban populations served by connections to public sewers or household systems such as pit privies, pour-flush latrines, septic tanks, communal toilets, and similar facilities. These definitions and definitions of urban areas vary, however, so comparisons between countries can be misleading (see table 2.14).

Figure 3.10a

Urban populations in developing countries are ballooning



East Asia has had the sharpest increase in urban population



Source: Table 3.10.

Almost all low- and middle-income countries have experienced rapid urban growth in recent years. In 1960 less than 22 percent of the developing world's population lived in cities; by 1996 that share had increased to 40 percent. By 2015 it is expected to exceed 50 percent. If that happens, the number of urban residents would reach 4 billion, a more than 50 percent increase over today's total. Worldwide, almost three-quarters of the 2.6 billion people living in urban areas in 1996 were in developing countries.

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 one million** is the percentage of a country's population living in metropolitan areas that in 1990 had a population of more than one million people. • **Population in the largest city** is the percentage of a country's urban population living in that country's largest metropolitan area. • **Access to sanitation in urban areas** is the percentage of the urban population served by connections to public sewers or household systems such as pit privies, pour-flush latrines, septic tanks, communal toilets, and other such facilities.

Data sources

Data on urban population, population in urban agglomerations, and population in the largest city come from the United Nations *World Urbanization Prospects: The 1996 Revision.* Total population figures are World Bank estimates. Data on access to sanitation in urban areas are from the World Health Organization.

3.11 Traffic and congestion

	Motor vehicles				Passenger cars		Two-wheelers		Road traffic		Traffic accidents	
	per 1,000 people		per kilometer of road		per 1,000 people		per 1,000 people		million vehicle kilometers		people injured or killed per 1,000 vehicles	
	1980	1996	1980	1996	1980	1996	1980	1996	1980	1996	1980	1996
Albania	..	31	..	6	..	20	..	2	..	..	..	5
Algeria	..	53	..	14	*30*	25	*1*	..	..	..	..	*44*
Angola	..	21	..	3	..	19	..	..	..	..	..	..
Argentina	155	154	20	25	..	127	..	1	..	56,590	..	..
Armenia	..	2	..	1	..	0	..	2	..	..	..	..
Australia	502	604	..	12	401	485	24	16	204	..	5	..
Austria	330	495	23	31	297	458	76	70	35,430	..	27	14
Azerbaijan	..	48	..	7	..	36	..	1	..	*2,207*	..	9
Bangladesh	..	1	..	*1*	..	0	..	1	..	..	..	*30*
Belarus	..	101	..	20	..	101	..	*49*	..	*5,493*	..	*10*
Belgium	349	469	28	*33*	..	424	..	21	45,779	*59,884*	25	14
Benin	..	8	..	7	..	7	..	44	..	..	..	74
Bolivia	19	48	3	7	..	29	..	9	795	1,730	41	..
Bosnia and Herzegovina	..	24	..	5	..	22	..	..	..	..	..	25
Botswana	27	45	3	4	9	15	1	..	..	..	50	*94*
Brazil	85	79	7	6	75	*84*	3	..	..	..	3	*4*
Bulgaria	..	234	..	53	92	204	..	62	665	*19*	..	4
Burkina Faso	..	5	..	5	..	4	..	10	..	..	..	..
Burundi	..	6	..	3	..	..	..	..	..	..	..	..
Cambodia	..	6	..	2	..	5	..	39	..	1,236	..	29
Cameroon	8	12	4	*4*	..	7	..	..	..	..	112	*46*
Canada	548	559	..	16	417	440	19	11	205,515	..	..	*13*
Central African Republic	8	0	1	0	..	0	..	0	..	1,250	..	..
Chad	..	4	..	1	..	2	..	1	..	..	..	*22*
Chile	61	110	8	20	45	71	4	2	7,540	..	38	*33*
China	2	8	2	7	..	3	..	8	2,032	*165,000*	12	*22*
Hong Kong, China	54	78	234	276	41	55	5	5	4,407	10,514	77	39
Colombia	..	38	..	13	12	20	17	..	2,480	..	..	..
Congo, Dem. Rep.	..	31	..	9	..	17	..	..	..	..	..	..
Congo, Rep.	..	20	..	4	..	14	..	..	..	*103*	..	*21*
Costa Rica	..	123	..	12	*20*	81	..	15	..	*4,244*	..	26
Côte d'Ivoire	24	32	..	9	..	20	..	..	..	..	..	..
Croatia	..	196	..	34	..	175	..	..	..	..	..	18
Cuba	..	5	..	2	..	2	..	..	..	..	..	..
Czech Republic	..	349	..	65	..	325	..	107	..	*37,350*	..	11
Denmark	322	390	24	28	271	331	..	10	26,300	41,500	10	*5*
Dominican Republic	36	47	11	30	20	28	12	9	..	..	18	..
Ecuador	..	46	..	12	*28*	41	..	3	..	*14,190*	..	*18*
Egypt, Arab Rep.	..	30	..	28	8	23	..	7	..	*6,222*	..	*16*
El Salvador	..	77	..	44	*16*	29	..	7	..	3,646	..	17
Eritrea	..	2	..	1	..	2	..	..	..	..	..	..
Estonia	..	329	..	32	..	277	..	3	..	..	..	0
Ethiopia	2	1	1	3	1	1	0	0	2	..	38	..
Finland	288	431	18	28	256	379	36	32	26,750	10,120	7	4
France	402	524	27	34	355	437	97	*52*	298,000	467,300	16	6
Gabon	..	36	..	5	..	22	..	..	..	..	..	*30*
Gambia, The	..	15	..	7	*11*	8	*1*	*1*	..	..	..	..
Georgia	..	87	..	23	..	79	..	5	..	*165*	..	*5*
Germany	399	528	51	68	297	500	38	30	..	563,200	..	12
Ghana	..	8	..	4	..	5	..	..	..	..	..	..
Greece	134	312	35	28	91	223	12	184	..	*510*	23	10
Guatemala	..	18	..	15	..	9	..	..	..	..	..	..
Guinea	..	5	..	1	..	2	..	..	..	..	..	*147*
Guinea-Bissau	..	12	..	3	..	7	..	..	..	..	..	..
Haiti	..	7	..	13	..	4	..	..	..	..	..	..
Honduras	..	33	..	13	..	*4*	..	..	..	..	..	..

	Motor vehicles				Passenger cars		Two-wheelers		Road traffic		Traffic accidents	
	per 1,000 people		per kilometer of road		per 1,000 people		per 1,000 people		million vehicle kilometers		people injured or killed per 1,000 vehicles	
	1980	1996	1980	1996	1980	1996	1980	1996	1980	1996	1980	1996
Hungary	108	273	13	17	95	239	..	15	..	..	22	5
India	2	7	1	3	..	4	..	24	..	..	..	*65*
Indonesia	8	22	8	11	..	11	..	48	..	..	59	..
Iran, Islamic Rep.	..	38	..	15	..	29	..	..	..	..	..	*15*
Iraq	..	14	..	6	..	1	..	..	..	..	..	*32*
Ireland	236	307	9	12	216	272	8	6	14,917	28,390	11	*10*
Israel	123	263	114	98	107	208	..	12	10,442	31,060	38	32
Italy	334	674	65	122	303	571	114	*44*	226,569	453,160	12	*7*
Jamaica	..	50	..	7	..	41	..	..	..	..	..	..
Japan	323	552	34	60	203	374	102	120	389,052	689,800	16	*14*
Jordan	56	68	25	44	41	50	2	0	623	2,154	63	54
Kazakhstan	..	80	..	10	..	61	..	..	..	8,617	..	15
Kenya	8	13	3	6	7	10	1	1	..	6,200	74	*75*
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Korea, Rep.	14	195	11	106	7	151	6	54	8,728	56,940	212	42
Kuwait	390	404	..	156	..	338	..	*10*	12,189	..	7	..
Kyrgyz Republic	..	32	..	8	..	32	..	1	..	*2,562*	..	*26*
Lao PDR	..	4	..	1	..	3	..	49	..	..	..	..
Latvia	..	189	..	*7*	..	153	..	8	..	..	..	5
Lebanon	..	320	..	205	..	298	..	13	..	..	..	..
Lesotho	10	19	3	8	3	6	0	0	..	*445*	85	*77*
Libya	..	138	..	9	..	87	..	..	..	..	..	..
Lithuania	..	238	..	14	..	212	..	5	..	*198*	..	7
Macedonia, FYR	..	142	..	35	..	139	..	..	..	4,247	..	*11*
Madagascar	..	6	3	2	..	5	..	..	1	..	..	*11*
Malawi	5	6	3	2	2	3	2	1	..	..	..	..
Malaysia	..	152	..	33	52	131	101	164	..	..	..	*17*
Mali	..	4	..	3	..	3	..	..	..	*3*	..	*22*
Mauritania	..	13	..	4	..	8	..	..	..	..	..	..
Mauritius	44	88	23	54	27	63	27	85	46	..	..	..
Mexico	..	140	..	52	61	92	..	3	..	..	..	*4*
Moldova	..	54	..	19	..	39	..	25	..	*910*	..	*15*
Mongolia	..	26	..	2	..	12	..	10	..	..	..	20
Morocco	..	50	..	22	..	40	..	1	18	..	..	44
Mozambique	..	1	..	0	..	0	..	..	..	..	..	..
Myanmar	..	2	..	2	..	1	..	..	..	..	..	..
Namibia	..	83	..	2	..	40	..	1	..	*2,149*	..	5
Nepal	..	..	..	..	..	..	..	*1*	..	..	..	..
Netherlands	343	400	..	49	322	363	61	27	70,825	108,100	12	*2*
New Zealand	492	562	17	22	420	461	43	13	16,545	..	11	*9*
Nicaragua	..	30	..	8	*9*	16	..	5	..	150	..	*29*
Niger	6	6	..	5	5	4	..	..	..	240	63	..
Nigeria	4	12	3	7	3	7	4	3	..	..	123	..
Norway	342	470	17	22	302	379	36	46	..	*25,386*	8	6
Oman	..	134	..	9	..	97	..	2	..	..	..	23
Pakistan	2	7	5	4	2	5	3	12	..	31,950	71	*28*
Panama	..	99	..	24	..	76	..	3	..	..	..	*33*
Papua New Guinea	..	26	..	6	..	7	..	..	..	..	..	..
Paraguay	..	24	..	4	..	14	..	..	..	..	..	..
Peru	..	121	..	40	..	58	..	..	..	..	..	..
Philippines	..	13	..	*5*	*6*	9	*4*	11	..	*193*	..	..
Poland	86	248	10	26	67	209	..	43	44,597	118,530	..	8
Portugal	145	370	26	*50*	..	277	..	79	283	84,590	31	19
Puerto Rico	..	285	..	74	..	232	..	..	..	..	..	..
Romania	..	124	..	18	..	107	..	15	..	33,531	..	4
Russian Federation	..	158	..	24	..	92	..	..	..	..	..	*9*

3.11

	Motor vehicles				Passenger cars		Two-wheelers		Road traffic		Traffic accidents	
	per 1,000 people		per kilometer of road		per 1,000 people		per 1,000 people		million vehicle kilometers		people injured or killed per 1,000 vehicles	
	1980	1996	1980	1996	1980	1996	1980	1996	1980	1996	1980	1996
Rwanda	2	4	2	2	1	2	1	0	..	..	..	..
Saudi Arabia	163	149	26	18	67	90	..	0	..	*94,141*	..	*13*
Senegal	19	14	8	8	..	10	..	0	..	..	56	*86*
Sierra Leone	..	6	..	2	..	4	..	2	..	*29*	..	..
Singapore	..	167	..	168	*71*	120	*55*	44	..	..	..	*14*
Slovak Republic	..	217	..	32	..	198	..	38	..	*651*	..	11
Slovenia	..	387	..	52	..	365	..	4	..	8,037	..	11
South Africa	133	134	18	*16*	86	106	7	7	52,939	..	25	*26*
Spain	239	455	120	52	202	376	33	33	70,489	134,541	13	7
Sri Lanka	..	14	..	3	*8*	6	*6*	28	..	8,950	..	*75*
Sudan	..	12	..	28	..	10	..	..	..	..	..	..
Sweden	370	450	24	29	347	414	2	13	35,000	65,440	7	*6*
Switzerland	383	501	38	50	356	462	128	101	..	50,650	14	8
Syrian Arab Republic	..	28	..	10	..	10	..	..	..	..	..	*24*
Tajikistan	..	1	..	1	..	0	..	..	..	..	..	..
Tanzania	3	5	1	2	2	1	1	1	..	..	..	*104*
Thailand	13	106	13	97	9	28	19	171	16,824	99,900	29	*13*
Togo	..	27	1	15	..	19	..	14	..	*386*	..	..
Trinidad and Tobago	..	113	..	18	..	94	..	..	..	..	..	..
Tunisia	38	64	10	25	20	29	2	1	..	..	45	..
Turkey	23	70	4	11	..	55	..	14	14,785	41,015	26	25
Turkmenistan	..	..	..	..	..	..	..	..	..	..	..	..
Uganda	1	4	1	..	1	2	0	2	479	..	..	*130*
Ukraine	..	92	..	27	..	93	..	59	..	60,168	..	5
United Arab Emirates	..	99	..	52	..	79	..	..	..	..	..	..
United Kingdom	303	399	50	63	268	359	24	10	245,900	436,470	19	*14*
United States	..	767	25	32	536	521	30	14	2,418,620	2,577,600	..	17
Uruguay	..	166	..	63	..	151	..	100	..	..	..	4
Uzbekistan	..	..	..	..	..	..	..	..	..	..	..	..
Venezuela	112	88	27	23	92	68	41	..	56,900	..	32	..
Vietnam	..	..	..	..	..	..	..	45	..	..	..	..
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	..	34	..	8	8	15	3	..	1,251	11,476	..	15
Yugoslavia, FR (Serb./Mont.)	118	163	23	35	..	150	..	..	..	..	59	12
Zambia	..	26	..	6	..	17	..	..	..	..	..	..
Zimbabwe	..	32	..	19	..	29	..	32	..	..	..	54
World	**72 w**	**121 w**	**..**	**..**	**..**	**91 w**	**.. w**	**25 w**	**..**	**..**	**..**	***14 w***
Low income	2	8	..	..	..	4	..	13	..	..	..	..
Excl. China & India	..	10	..	..	..	6	..	..	..	..	..	..
Middle income	..	91	..	..	..	65	..	..	..	..	..	*12*
Lower middle income	..	70	..	..	..	46	..	..	..	..	..	*13*
Upper middle income	101	139	..	..	70	111	..	..	..	..	..	*12*
Low & middle income	14	36	..	..	..	23	..	19	..	..	..	*14*
East Asia & Pacific	3	15	..	..	..	7	..	22	..	..	..	*18*
Europe & Central Asia	..	142	..	..	..	109	..	..	..	..	..	*10*
Latin America & Carib.	..	92	..	..	62	*72*	..	..	..	..	..	..
Middle East & N. Africa	..	53	..	..	..	35	..	..	..	..	..	*21*
South Asia	2	6	..	..	..	4	..	20	..	..	..	*61*
Sub-Saharan Africa	..	20	..	..	..	14	..	..	..	..	..	*36*
High income	321	559	..	..	338	427	..	52	..	..	..	*14*

About the data

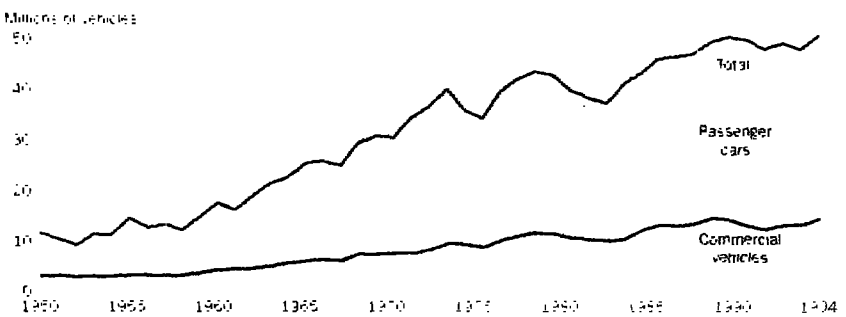
Traffic congestion in urban areas constrains economic productivity, damages people's health, and worsens their quality of life. In recent years ownership of passenger cars has increased, and the expansion of economic activity has contributed to the transport by road of more goods and services over greater distances. These developments have increased demand for roads and vehicles, adding to urban congestion, air pollution, health hazards, traffic accidents, and injuries.

Congestion, the most visible cost of expanding vehicle ownership, is reflected in the indicators in the table. Other relevant indicators, such as average vehicle speed in major cities or cost of traffic congestion, exact a heavy toll on economic productivity but are not included because data are incomplete or difficult to compare. Motor vehicles also emit particulate air pollution—the dust and soot from their exhaust—which is proving to be far more damaging to human health than was once believed. (See table 3.12 for information on suspended particulates and other air pollutants.)

The data in the table are compiled by the International Road Federation (IRF) through questionnaires sent to national organizations. The IRF uses a hierarchy of sources to gather as much information as possible. The primary sources are national road associations. In the absence of such an association, or in cases of nonresponse, other agencies are contacted, including road directorates, ministries of transport or public works, and central statistical offices. As a result the compiled data are of uneven quality. In addition, the coverage of each indicator may differ across countries because of differences in definitions. Moreover, comparability is limited when time-series data are reported. The data do not capture the quality or age of vehicles or the condition or width of roads. Thus comparisons over time and between countries should be made with caution.

Figure 3.11a

Global production of motor vehicles continues to rise



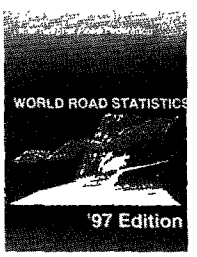
Source: Table 3.11

In recent decades, along with household income, ownership of passenger cars has increased substantially. In 1946 about 46 million vehicles were registered worldwide. By 1994 that number exceeded 600 million. Growth in the number of private vehicles has substantially exceeded that of total vehicles, leading to relatively less use of public and mass transportation and thus to more pollution. The total number of vehicles (excluding motorized two- and three-wheel vehicles) is expected to reach 820 million by 2010.

Definitions

• **Motor vehicles per 1,000 people** include cars, buses, and freight vehicles but do not include two-wheelers. Population refers to midyear population in the year for which data are available. • **Motor vehicles per kilometer of road** include cars, buses, and freight vehicles but do not include two-wheelers. • **Passenger cars** refer to individual four-wheel transport. • **Two-wheelers** refer to mopeds and motorcycles. • **Road traffic** is the number of vehicles multiplied by the average distances they travel. • ***Traffic accidents*** refer to accident-related injuries reported to the authorities and to deaths resulting from accidents that occur within 30 days of the accident.

Data sources



The data in the table are from the IRF's annual *World Road Statistics.*

3.12 Air pollution

Country	City	City population	Total suspended particulates	Sulfur dioxide	Nitrogen dioxide
		thousands 1995	micrograms per cu. m 1995[a]	micrograms per cu. m 1995[a]	micrograms per cu. m 1995[a]
Argentina	Córdoba City	1,294	97	..	97
Australia	Sydney	3,590	54	28	..
	Melbourne	3,094	35	0	30
	Perth	1,220	45	5	19
Austria	Vienna	2,060	47	14	42
Belgium	Brussels	1,122	78	20	48
Brazil	São Paulo	16,533	86	43	83
	Rio de Janeiro	10,181	139	129	..
Bulgaria	Sofia	1,188	195	39	122
Canada	Toronto	4,319	36	17	43
	Montreal	3,320	34	10	42
	Vancouver	1,823	29	14	37
Chile	Santiago	4,891	..	29	81
China	Shanghai	13,584	246	53	73
	Beijing	11,299	377	90	122
	Tianjin	9,415	306	82	50
Colombia	Bogotá	6,079	120	..	..
Croatia	Zagreb	981	71	31	..
Cuba	Havana	2,241	..	1	5
Czech Republic	Prague	1,225	59	32	23
Denmark	Copenhagen	1,326	61	7	54
Ecuador	Guayaquil	1,831	127	15	..
	Quito	1,298	175	31	..
Egypt, Arab Rep.	Cairo	9,690	..	69	..
Finland	Helsinki	1,059	40	4	35
France	Paris	9,523	14	14	57
Germany	Frankfurt	3,606	36	11	45
	Berlin	3,317	50	18	26
	Munich	2,238	45	8	53
Ghana	Accra	1,673	137	..	..
Greece	Athens	3,093	178	34	64
Hungary	Budapest	2,017	63	39	51
Iceland	Reykjavik	100	24	5	42
India	Bombay	15,138	240	33	39
	Calcutta	11,923	375	49	34
	Delhi	9,948	415	24	41
Indonesia	Jakarta	8,621	271	..	..
Iran, Islamic Rep.	Tehran	6,836	248	209	..
Ireland	Dublin	911	..	20	..
Italy	Milan	4,251	77	31	248
	Rome	2,931	73	..	..
	Torino	1,294	151	..	..
Japan	Tokyo	26,959	49	18	68
	Osaka	10,609	43	19	63
	Yokohama	3,178	..	100	13
Kenya	Nairobi	1,810	69	..	..
Korea, Rep.	Seoul	11,609	84	44	60
	Pusan	4,082	94	60	51
	Taegu	2,432	72	81	62
Malaysia	Kuala Lumpur	1,238	85	24	..
Mexico	Mexico City	16,562	279	74	130
Netherlands	Amsterdam	1,108	40	10	58
New Zealand	Auckland	945	26	3	20
Norway	Oslo	477	15	8	43
Philippines	Manila	9,286	200	33	..
Poland	Katowice	3,552	..	83	79
	Warsaw	2,219	..	16	32

About the data

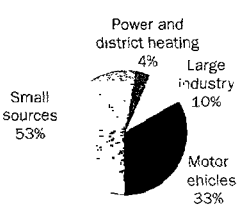
In many towns and cities exposure to air pollution is the main environmental threat to human health. Winter smog—made up of soot, dust, and sulfur dioxide—has long been associated with temporary spikes in the number of deaths. But long-term exposure to high levels of soot and small particles in the air contributes to a wide range of chronic respiratory diseases and exacerbates heart disease and other conditions. The burden of ill health caused by particulate pollution, either on its own or in combination with sulfur dioxide, is enormous, causing at least 500,000 premature deaths and 4–5 million new cases of chronic bronchitis each year (World Bank 1992).

Summer smog is formed from small particles and ground-level ozone produced by the action of the sun on nitrogen oxides and volatile organic compounds. Exposure to ozone makes it difficult for people to breathe, causing particular problems for asthmatics. And many plants and trees are susceptible to damage from ozone exposure, which reduces yields or kills them off.

Emissions of sulfur dioxide and nitrogen oxides lead to the deposition of acid rain and other acidic compounds over long distances—often more than 1,000 kilometers from their source. Such deposition changes the chemical balance of soils and can lead to the leaching of trace minerals and nutrients critical to trees and plants. The links between forest damage and acid deposition are complex. Direct exposure to high levels of sulfur dioxide or acid deposition can cause defoliation and dieback.

Figure 3.12a

Most environmental costs of fossil fuel use result from small sources



Note: Data are an average for five cities: Krakow, Poland; Manila, Philippines; Mumbai, India; Santiago, Chile; and Shanghai, China.

Source: Lovei 1997.

Fuel combustion accounts for most air pollution emissions. Although the composition of pollution sources and contribution of different fuels vary by city, motor vehicles and small, dispersed sources—refuse incinerators, small industrial, commercial, and household boilers and stoves—usually do the most damage to air quality.

Country	City	City population	Total suspended particulates	Sulfur dioxide	Nitrogen dioxide
		thousands	micrograms per cu. m	micrograms per cu. m	micrograms per cu. m
		1995	1995[a]	1995[a]	1995[a]
	Lodz	1,063	..	21	43
Portugal	Lisbon	1,863	61	8	52
Romania	Bucharest	2,100	82	10	71
Russian Federation	Moscow	9,269	100	109	..
	Omsk	1,199	100	9	30
Singapore	Singapore	2,848	..	20	30
Slovak Republic	Bratislava	651	62	21	27
South Africa	Capetown	2,671	..	21	72
	Johannesburg	1,849	..	19	31
	Durban	1,149	..	31	..
Spain	Madrid	4,072	42	11	25
	Barcelona	2,819	117	11	43
Sweden	Stockholm	1,545	9	5	29
Switzerland	Zurich	897	31	11	39
Thailand	Bangkok	6,547	223	11	23
Turkey	Istanbul	7,911	..	120	..
	Ankara	2,826	57	55	46
	Izmir	2,031	..	..	..
Ukraine	Kiev	2,809	100	14	51
United Kingdom	London	7,640	..	25	77
	Manchester	2,434	..	26	49
	Birmingham	2,271	..	9	45
United States	New York	16,332	..	26	79
	Los Angeles	12,410	..	9	74
	Chicago	6,844	..	14	57
Venezuela	Caracas	3,007	53	33	57

a. Data are most recent available for 1990–95. Most are for 1995.

Where coal is the primary fuel for power plants, steel mills, industrial boilers, and domestic heating, the result is usually high levels of urban air pollution—especially particulates and sometimes sulfur dioxide—and widespread acid deposition if the sulfur content of the coal is high. Countries such as China, India, Poland, and Turkey fit this pattern today, as many high-income countries once did. Where coal is not an important primary fuel or is used by plants with effective dust controls, the worst air pollutant emissions are caused by the combustion of petroleum products—diesel oil, heating oil, and heavy fuel oil. Industrial plants and motor vehicles—especially those with two-stroke engines, which do not fully process their fuel—are usually the worst offenders.

Data on air pollution are based on reports from urban monitoring sites. Annual means (measured in micrograms per cubic meter) are average concentrations observed at these sites. Coverage is not comprehensive because, due to lack of resources or different priorities, not all cities have monitoring systems. For example, data are reported for just 3 cities in Africa but for more than 87 cities in China. Pollutant concentrations are sensitive to local conditions, and even in the same city different monitoring sites may register different concentrations. Thus these data should be considered only a general indication of air quality in each city, and cross-country comparisons should be made with caution. World Health Organization (WHO) annual mean guidelines for air quality standards are 90 micrograms per cubic meter for total suspended particulates, 50 micrograms per cubic meter for sulfur dioxide, and 50 micrograms per cubic meter for nitrogen dioxide.

Definitions

• **City population** is the number of residents of the city as defined by national authorities and reported to the United Nations. • **Total suspended particulates** refer to smoke, soot, dust, and liquid droplets from combustion that are in the air. Particulate levels indicate the quality of the air people are breathing and the state of a country's technology and pollution controls. • **Sulfur dioxide** (SO_2) is an air pollutant produced when fossil fuels containing sulfur are burned. It contributes to acid rain and can damage human health, particularly that of the young and the elderly. • **Nitrogen dioxide** (NO_2) 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. NO_2 is emitted by bacteria, nitrogenous fertilizers, aerobic decomposition of organic matter in oceans and soils, combustion of fuels and biomass, and motor vehicles and industrial activities.

Data sources

The data in the table are from WHO's Healthy Cities Air Management Information System and the World Resources Institute, which relies on various national sources as well as, among others, the United Nations Environment Programme (UNEP) and WHO's *Urban Air Pollution in Megacities of the World*, the OECD's *Compendiums of Environmental Data*, the U.S. Environmental Protection Agency's *National Air Quality and Emissions Trends Report 1995* and AIRS Executive International database, the *China Environmental Yearbook 1996*, and the *Korea Statistical Yearbook 1995*.

3.13 Government commitment

	Environmental strategy or action plan	Country environmental profile	Biodiversity assessment, strategy, or action plan	Frequency of reporting on trade in endangered species	Participation in treaties[a]			
				% of years reported[b]	Climate change	Ozone layer	CFC control	Law of the Sea[c]
Albania	1993	..	..	..	1995	..	..	..
Algeria	..	..	..	50	1994	1993	1993	1996
Angola	..	..	..	..	..	..	..	1994
Argentina	1992	..	..	82	1994	1990	1990	1996
Armenia	..	..	..	..	1994	..	..	..
Australia	1992	..	1994	88	1994	1988	1989	1995
Austria	..	..	..	100	1994	1988	1989	1995
Azerbaijan	..	..	..	..	1995	..	1996	..
Bangladesh	1991	1989	1990	80	1994	1990	1990	..
Belarus	..	..	..	..	..	1988	1989	..
Belgium	..	..	..	100	1996	1989	1989	..
Benin	1993	..	..	0	1994	1993	1993	..
Bolivia	1994	1986	1988	62	1995	1995	1995	1995
Bosnia and Herzegovina	..	..	..	..	..	1992	..	1994
Botswana	1990	1986	1991	86	1994	1992	1992	1994
Brazil	..	..	1988	41	1994	1990	1990	1994
Bulgaria	..	..	1994	0	1995	1991	1991	1996
Burkina Faso	1993	1994	..	0	1994	1989	1989	..
Burundi	1994	1981	1989	0	..	..	..	..
Cambodia	1997	1994	..	..	1996	..	..	..
Cameroon	..	1989	1989	92	1995	1989	1989	1994
Canada	1990	..	1994	100	1994	1988	1989	..
Central African Republic	..	..	..	50	1995	..	1993	..
Chad	1990	1982	..	0	1994	1989	1994	..
Chile	..	1987	1993	65	1995	..	1990	..
China	1994	..	1994	100	1994	1989	1991	1996
Hong Kong, China	..	..	..	..	..	..	..	..
Colombia	..	1990	1988	64	1995	1990	1994	..
Congo, Dem. Rep.	..	1986	1990	69	1995	1995	..	1994
Congo, Rep.	..	..	1990	100	1997	1995	1995	..
Costa Rica	1990	1987	1992	76	1994	1991	1991	1994
Côte d'Ivoire	1994	..	1991	..	1995	1993	1993	1994
Croatia	..	..	..	..	1996	1992	1991	1994
Cuba	..	..	..	50	1994	1992	1992	1994
Czech Republic	1991	..	..	100	1994	1993	1993	1996
Denmark	1994	..	..	100	1994	1988	1989	..
Dominican Republic	..	1984	1995	80	..	1993	1993	..
Ecuador	1993	1987	1995	76	1994	1990	1990	..
Egypt, Arab Rep.	1992	1992	1988	0	1995	1988	1989	1994
El Salvador	1994	1985	1988	20	1996	1993	1992	..
Eritrea	1995	..	..	..	1995	..	..	..
Estonia	..	..	..	..	1994	1997	1997	..
Ethiopia	1994	..	1991	75	1994	1995	1995	..
Finland	1995	..	..	75	1994	1988	1989	1996
France	1990	..	..	100	1994	1988	1989	1996
Gabon	..	..	1990	67	..	1994	1994	..
Gambia, The	1992	1981	1989	20	1994	1990	1990	1994
Georgia	..	..	..	..	1994	1996	1996	1996
Germany	..	..	..	100	1994	1988	1989	1994
Ghana	1992	1985	1988	81	1995	1989	1989	1994
Greece	..	..	..	..	1994	1989	1989	1995
Guatemala	1994	1984	1988	83	1996	1988	1990	..
Guinea	1994	1983	1988	45	1994	1992	1992	1994
Guinea-Bissau	1993	..	1991	0	1996	..	..	1994
Haiti	..	1985	..	..	1996	..	..	1996
Honduras	1993	1989	..	29	1996	1994	1994	1994

Status of national environmental action plans

Completed

Albania	Grenada	Nepal
Azerbaijan	Guinea	Nicaragua
Bangladesh	Guinea-Bissau	Nigeria
Belarus	Guyana	Pakistan
Benin	Honduras	Papua New
Bhutan	Hungary	Guinea
Botswana	India	Bulgaria
Indonesia	Philippines	Poland
Burkina Faso	Kenya	Romania
Burundi	Lao PDR	Rwanda
Cambodia	Latvia	São Tomé and
Cape Verde	Lebanon	Principe
China	Lesotho	Senegal
Comoros	Lithuania	Seychelles
Congo, Rep.	Macedonia, FYR	Sierra Leone
Costa Rica	Madagascar	Sri Lanka
Côte d'Ivoire	Maldives	St. Kitts and
El Salvador	Mexico	Nevis
Estonia	Moldova	Uganda
Ethiopia	Mongolia	Ukraine
Gambia, The	Mozambique	Zambia
Ghana		

Being prepared

Armenia	Haiti	St. Lucia
Djibouti	Kazakhstan	St. Vincent &
Dominican Rep.	Korea, Rep.	Grenadines
Ecuador	Malaysia	Togo
Equatorial Guinea	Mali	Uzbekistan
Gabon	Niger	Vietnam
Georgia	Paraguay	Zimbabwe

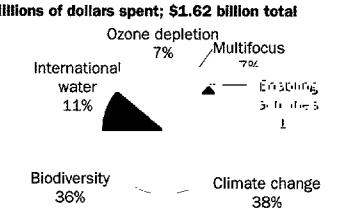
Source: World Resources Institute, International Institute for Environment and Development, and IUCN 1996; World Bank.

	Environmental strategy or action plan	Country environmental profile	Biodiversity assessment, strategy, or action plan	Frequency of reporting on trade in endangered species	Participation in treaties[a]			
				% of years reported[b]	Climate change	Ozone layer	CFC control	Law of the Sea[c]
Hungary	1995	..	..	57	1994	1988	1989	
India	1993	1989	1994	100	1994	1991	1992	1995
Indonesia	1992	1994	1993	92	1994	1992	1992	1994
Iran, Islamic Rep.	..	..	..	31	1996	1991	1991	
Iraq	..	..	..					1994
Ireland	..	..	..		1994	1988	1989	
Israel	..	..	..	25	1994	1992	1992	
Italy	..	..	..	86	1994	1988	1989	1995
Jamaica	1994	1987	..		1995		1993	1994
Japan	..	..	..	92	1994	1988	1989	1996
Jordan	1991	1979	..	31	1994	1989	1989	1995
Kazakhstan	..	..	..		1995			
Kenya	1994	1989	1992	54	1994	1989	1989	1994
Korea, Dem. Rep.	..	..	..		1995	1995	1995	
Korea, Rep.	..	..	..		1994	1992	1992	1996
Kuwait	..	..	..		1995	1993	1993	1994
Kyrgyz Republic	..	..	..					
Lao PDR	1995	..	..		1995			
Latvia	..	..	..		1995	1995	1995	
Lebanon	..	..	..		1995	1993	1993	1995
Lesotho	1989	1982	..		1995	1994	1994	
Libya	..	..	..			1990	1990	
Lithuania	..	..	..		1995	1995	1995	
Macedonia, FYR	..	..	..			1994	1994	1994
Madagascar	1988	..	1991	82	1996	1997	1997	
Malawi	1994	1982	..	70	1994	1991	1991	
Malaysia	1991	1979	1988	86	1994	1989	1989	1997
Mali	..	1991	1989		1995	1995	1995	1994
Mauritania	1988	1984	..		1994	1994	1994	1996
Mauritius	1990	..	..	88	1994	1992	1992	1994
Mexico	..	..	1988	100	1994	1988	1989	1994
Moldova	..	..	..		1995	1997	1997	
Mongolia	1995	..	..		1994	1996	1996	
Morocco	..	1980	1988	44	1996	1996	1996	
Mozambique	1994	..	..	73	1995	1994	1994	
Myanmar	..	1982	1989		1995	1994	1994	1996
Namibia	1992	..	..	0	1995	1993	1993	1994
Nepal	1993	1983	..	76	1994	1994	1994	
Netherlands	1994	..	..	100	1994	1988	1989	1996
New Zealand	1994	..	..	67	1994	1988	1989	1996
Nicaragua	1994	1981	..	80	1996	1993	1993	
Niger	..	1985	1991	41	1995		1993	
Nigeria	1990	..	1992	18	1994	1989	1989	1994
Norway	..	..	1994	100	1994	1988	1989	1996
Oman	..	1981	..		1995			1994
Pakistan	1994	1994	1991	94	1994	1993	1993	
Panama	1990	1980	..	86	1995	1989		1996
Papua New Guinea	1992	1994	1993	75	1994	1993	1993	
Paraguay	..	1985	..	60	1994	1993	1993	1994
Peru	..	1988	1988	59	1994	1989	1993	
Philippines	1989	1992	1989	82	1994	1991	1991	1994
Poland	1993	..	1991	0	1994	1990	1990	
Portugal	1995	..	..	55	1994	1989	1989	
Puerto Rico	..	..	..					
Romania	..	..	..		1994	1993	1993	1997
Russian Federation	..	..	1994		1995	1988	1989	

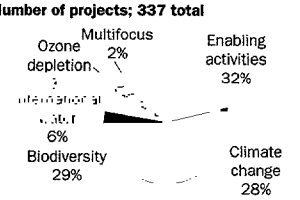
Figure 3.13a

Projects financed by the Global Environment Facility, February 1995–June 1997

Millions of dollars spent; $1.62 billion total



Number of projects; 337 total



Source: GEF.

Through its implementing agencies—the United Nations Development Programme, United Nations Environment Programme, and World Bank—the Global Environment Facility provides funding to developing and transition economies for projects and activities targeting global benefits in one or more of four focus areas: biodiversity, climate change, international waters, and ozone depletion. Activities involving desertification and deforestation, as they relate to the focus areas, are also eligible for funding. Enabling activities lay the foundations for designing and implementing measures to achieve the overall goals in the focus areas. Between February 1995 and June 1997 the facility provided $1.62 billion for a total of 337 projects.

3.13

	Environmental strategy or action plan	Country environmental profile	Biodiversity assessment, strategy, or action plan	Frequency of reporting on trade in endangered species	Participation in treaties[a]			
				% of years reported[b]	Climate change	Ozone layer	CFC control	Law of the Sea[c]
Rwanda	1991	1987	..	27				
Saudi Arabia	..	..	..		1995	1993	1993	
Senegal	1984	1990	1991	80	1995	1993	1993	1994
Sierra Leone	1994	..	..		1995			1995
Singapore	1993	1988	1995	100		1989	1989	1994
Slovak Republic	..	..	..		1994	1993	1993	1996
Slovenia	..	..	..		1996		1992	1994
South Africa	1993	..	..	94		1990	1990	1994
Spain	..	..	..	100	1994	1988	1989	
Sri Lanka	1994	1983	1991	54	1994	1990	1990	1994
Sudan	..	1989	..	44	1994		1993	1994
Sweden	..	..	..	94	1994	1988	1989	1996
Switzerland	..	..	..	100	1994	1988	1989	
Syrian Arab Republic	..	1981	..		1996	1990	1990	
Tajikistan	..	..	..					
Tanzania	1994	1989	1988	75		1993	1993	1994
Thailand	..	1992	..	56	1995	1989	1989	
Togo	1991	..	..	69	1995	1991	1991	1994
Trinidad and Tobago	..	..	..	67	1994	1989	1989	1994
Tunisia	1994	1980	1988	100	1994	1989	1989	1994
Turkey	..	1982	..			1991	1991	
Turkmenistan	..	..	..		1995	1994	1994	
Uganda	1994	1982	1988	0	1994	1988	1989	1994
Ukraine	..	..	..			1988	1989	
United Arab Emirates	..	..	..	0	1996	1990	1990	
United Kingdom	1995	..	1994	100		1988	1989	
United States	1995	..	1995	88	1994	1988	1989	
Uruguay	..	..	..	59	1994	1989	1991	1994
Uzbekistan	..	..	..		1994	1993	1993	
Venezuela	..	..	..	79	1995	1988	1989	
Vietnam	..	..	1993		1995	1994	1994	1994
West Bank and Gaza	..	..	..					
Yemen, Rep.	..	1990	1992		1996	1996	1996	1994
Yugoslavia, FR (Serb./Mont.)	..	..	..					
Zambia	1994	1988	..	45	1994	1990	1990	1994
Zimbabwe	1987	1982	..	83	1994	1993	1993	1994

a. The year the treaty entered into force in that country. b. Includes all trade reported by members of the Convention on International Trade in Endangered Species of Wild Flora and Fauna (CITES) as of May 1993. c. Convention became effective November 16, 1994.

The Kyoto Protocol on climate change

The Kyoto Protocol was adopted at the third conference of the parties to the United Nations Framework Convention on Climate Change, held in Kyoto, Japan in December 1997.

When the protocol enters into force, it will impose binding emission limitations in industrial and transition economies known as "annex 1" countries. These countries agreed to ensure that their greenhouse gas emissions do not exceed their assigned amounts, with a view to reducing overall emissions of such gases by at least 5.2 percent over 1990 levels by 2008–12.

The protocol will:

- Allow quantification of emissions to take into account carbon sinks (such as forests).
- Provide for possible carbon emissions trading among annex 1 countries.
- Allow for joint project implementation activities among annex 1 countries.
- Create a "clean development mechanism" that enables annex 1 countries to undertake joint implementation projects in developing countries.
- Commit all countries to cooperate in the development and transfer of climate-friendly technologies, commit industrial countries to help developing countries create a private sector–enabling environment, and commit annex 1 countries to eliminating relevant market distortions.
- Enter into force after ratification by 55 countries that account for at least 55 percent of [illegible] emissions by annex 1 countries. (The United States accounts for 38 percent of CO_2 emissions by annex 1 countries.)

About the data

Unlike most other tables in this book, this table presents qualitative rather than quantitative indicators. 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, others dealing with the integration of environmental, economic, and social concerns. Among such initiatives are conservation strategies and environmental action plans. Some countries have also prepared country environmental profiles and biological diversity 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 a country's current and future needs, institutional capabilities, prevailing technical conditions, and the status of natural resources.

National environmental action plans (NEAPs), 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 (table 3.13a). The NEAP is 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.

Country environmental profiles identify how national economic and other activities can stay within the constraints imposed by the need to conserve natural resources. Some profiles consider issues of equity, justice, and fairness. 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 on biodiversity conservation, the United Nations Environment Programme (UNEP) coordinates global biodiversity assessment.

To address global issues, many governments have also signed international treaties and agreements, launched in the wake of the 1972 United Nations Conference on Human Environment in Stockholm and the 1992 United Nations Conference on Environment and Development in Rio de Janeiro:

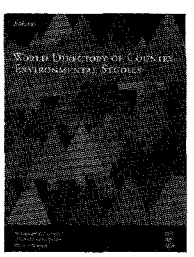
- The Convention on Climate Change aims to stabilize atmospheric concentrations of greenhouse gases at levels that will prevent human activities from interfering dangerously with the global climate.
- The Vienna Convention for the Protection of the Ozone Layer aims to protect human health and the environment by promoting research on the effects of changes in the ozone layer and on alternative substances (such as substitutes for chlorofluorocarbons) and technologies, monitoring the ozone layer, and taking measures to control the activities that produce adverse effects.
- The Montreal Protocol for CFC 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 International Trade in Endangered Species of Wild Flora and Fauna (CITES) prohibits commercial trade in endangered species and requires signatories to closely monitor trade in species that may become depleted by trade.

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 Global Environmental Trust Fund and is chair of the GEF.

Definitions

- **Environmental strategies and action plans** provide a comprehensive, cross-sectoral analysis of conservation and resource management issues to help integrate environmental concerns with the development process. They include national conservation strategies, national environmental action plans, national environmental management strategies, and national sustainable development strategies. The years shown refer to the year in which a strategy or action plan was adopted. • **Country environmental profiles** identify how national economic and other activities can stay within the constraints imposed by the need to conserve natural resources. The years shown refer to the year in which a profile was completed. • **Biodiversity assessments, strategies, or action plans** covers biodiversity assessments, country strategies or action plans, and biodiversity profiles (see *About the data*). • **Frequency of reporting on trade in endangered species** refers to the percentage of years for which a country has submitted an annual report to the CITES Secretariat since it became a party to the Convention on International Trade in Endangered Species. • **Participation in treaties** covers four international treaties (see *About the data*). • **Climate change** refers to the Convention on Climate Change (signed in New York in 1992). • **Ozone layer** refers to the Vienna Convention for the Protection of the Ozone Layer (1985). • **CFC control** refers to the Montreal Protocol for CFC Control (formally, the Protocol on Substances that Deplete the Ozone Layer, signed in 1987). • **Law of the Sea** refers to the United Nations Convention on the Law of the Sea (signed in Montego Bay, Jamaica, in 1982). The years shown refer to the year in which a treaty entered into force in a country.

Data sources



Data are from the World Resources Institute, UNEP, and UNDP's *World Resources 1994–95;* the World Resources Institute, International Institute for Environment and Development, and IUCN's 1996 *World Directory of Country Environmental Studies;* and the World Bank Environment Department's 1996 *National Environmental Strategies: Learning from Experience.*