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	1997[a]	1980	1997[a]	1997[a]	1997[a]	1997[a]	1997[a]	1997[a]	1997[a]	1997[a]	1997[a]
Albania	..	5,844	..	0.24	22.9	1.5	6.2	62.0	0.4	4.7	0.7	1.5
Algeria	60,290	102,969	0.19	0.25	44.6	..	3.8	40.8	0.4	8.0	2.5	..
Angola	..	1,472	..	0.20	7.6	3.0	9.1	65.9	0.3	5.5	4.4	4.1
Argentina	244,711	186,844	0.18	0.21	6.3	12.6	8.1	59.4	0.2	7.4	1.5	4.6
Armenia	..	12,858	..	0.23	..	..	0.0	66.5	..	33.5	..	..
Australia	204,333	173,269	0.18	0.19	12.4	22.8	6.7	43.5	0.2	5.3	2.8	6.3
Austria	108,416	78,040	0.16	0.14	13.1	19.5	9.1	36.1	0.3	6.7	4.3	10.9
Azerbaijan	..	45,025	..	0.17	11.6	2.5	12.0	49.0	0.2	18.1	1.0	5.6
Bangladesh	66,713	186,852	0.16	0.16	2.8	6.8	3.5	34.2	0.1	50.9	0.6	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	10,251	0.22	0.23	4.7	13.8	6.5	61.8	0.3	9.0	2.6	1.2
Bosnia and Herzegovina	..	8,903	..	0.18	20.5	13.1	6.6	33.3	0.2	17.6	5.8	2.8
Botswana	1,307	4,386	0.24	0.18	0.0	11.5	2.8	67.5	0.0	12.5	2.1	3.7
Brazil	866,790	690,876	0.16	0.19	19.0	12.6	9.3	41.6	0.2	10.9	1.6	4.8
Bulgaria	152,125	88,729	0.13	0.15	14.6	8.6	11.0	38.8	0.3	15.2	2.1	9.3
Burkina Faso	2,385	..	0.29	..	..	..	..	..	..	..	..	..
Burundi	769	1,644	0.22	0.24	0.0	8.3	4.7	67.8	0.1	16.7	1.6	0.8
Cambodia	..	12,078	..	0.16	0.0	3.4	3.3	59.2	0.6	24.7	5.8	3.1
Cameroon	14,569	12,796	0.29	0.24	3.0	5.7	20.8	63.4	0.0	2.9	3.8	0.3
Canada	330,241	295,525	0.18	0.17	9.6	29.8	9.1	34.0	0.1	5.8	3.9	7.6
Central African Republic	861	..	..	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	44,371	77,111	0.21	0.23	7.2	11.8	8.6	59.6	0.1	7.2	2.6	2.9
China	3,377,105	7,396,000	0.14	0.14	20.6	11.9	14.2	28.9	0.4	14.1	1.0	8.9
Hong Kong, China	102,002	51,577	0.11	0.15	1.4	37.2	3.9	20.5	0.1	29.0	0.2	7.6
Colombia	96,055	111,139	0.19	0.20	3.6	15.2	10.6	51.3	0.2	14.8	0.9	3.3
Congo, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Congo, Rep.	1,039	..	0.21	..	..	..	..	..	..	..	..	..
Costa Rica	..	32,301	..	0.22	1.2	10.2	6.6	62.3	0.1	15.8	1.5	2.3
Côte d'Ivoire	15,414	..	0.23	..	..	..	..	..	..	..	..	..
Croatia	..	50,014	..	0.16	4.7	14.2	8.9	45.8	0.2	16.2	3.6	6.4
Cuba	120,703	172,973	0.24	0.25	5.0	4.6	2.3	78.4	0.3	6.1	0.7	2.7
Czech Republic	..	162,615	..	0.14	24.6	9.2	6.8	32.7	0.4	12.3	2.4	11.7
Denmark	65,465	91,815	0.17	0.18	2.1	28.9	7.7	46.6	0.2	3.5	2.9	8.3
Dominican Republic	54,935	..	0.38	..	..	..	..	..	..	..	..	..
Ecuador	25,297	28,969	0.23	0.25	2.4	13.2	7.5	66.1	0.2	7.2	1.7	1.6
Egypt, Arab Rep.	169,146	216,060	0.19	0.19	12.4	5.3	9.5	50.1	0.3	18.2	0.6	3.7
El Salvador	9,390	16,385	0.24	0.18	1.0	10.6	8.6	46.5	0.1	30.9	0.5	1.7
Eritrea	16,754	22,175	..	..	1.4	8.9	4.4	58.5	0.1	24.8	1.4	0.5
Estonia	..	..	..	..	..	..	..	..	..	..	..	..
Ethiopia	..	19,390	0.22	0.22	2.0	11.3	3.4	56.6	0.2	24.2	1.7	0.6
Finland	92,275	64,253	0.17	0.18	9.1	39.8	7.0	30.0	0.1	2.6	3.5	7.9
France	729,776	585,382	0.14	0.15	11.6	21.2	10.8	37.7	0.2	6.1	1.8	10.8
Gabon	2,661	1,886	0.15	0.26	0.0	6.0	4.9	79.7	0.1	1.2	6.9	1.2
Gambia, The	549	832	0.30	0.34	0.0	15.3	1.9	77.8	0.1	2.6	1.9	0.4
Georgia	..	..	..	..	..	..	..	..	..	..	..	..
Germany	..	811,315	..	0.12	12.7	16.8	15.5	30.6	0.3	4.8	2.2	17.2
Ghana	15,868	14,449	0.20	0.17	9.8	16.9	10.5	39.5	0.2	9.1	12.4	1.7
Greece	65,304	58,229	0.17	0.19	6.1	12.1	8.6	53.3	0.3	14.7	1.5	3.5
Guatemala	20,856	19,052	0.25	0.28	5.3	8.0	6.2	71.4	0.1	6.9	1.1	1.0
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	4,734	..	0.19	..	..	..	..	..	..	..	..	..
Honduras	13,067	34,036	0.23	0.20	1.1	7.8	3.9	55.5	0.1	26.8	4.0	0.8

Water pollution | 3.6

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	kilograms per day		kilograms per day per worker		Primary metals %	Paper and pulp %	Chemicals %	Food and beverages %	Stone, ceramics, and glass %	Textiles %	Wood %	Other %
	1980	1997[a]	1980	1997[a]	1997[a]	1997[a]	1997[a]	1997[a]	1997[a]	1997[a]	1997[a]	1997[a]
Hungary	201,888	139,453	0.15	0.18	10.7	10.2	8.3	50.3	0.2	11.6	1.8	6.9
India	1,422,564	1,664,150	0.21	0.19	15.5	7.5	8.2	51.5	0.2	11.6	0.3	5.2
Indonesia	214,010	727,496	0.22	0.17	2.4	8.9	8.6	50.2	0.2	21.7	5.3	2.8
Iran, Islamic Rep.	72,334	101,900	0.15	0.17	20.6	8.0	8.0	39.7	0.5	17.3	0.7	5.4
Iraq	32,986	19,617	0.19	0.16	8.8	14.1	15.1	39.4	0.7	16.7	0.3	4.8
Ireland	43,544	33,994	0.19	0.16	1.8	17.2	10.6	52.2	0.2	6.8	1.8	9.4
Israel	39,113	54,251	0.15	0.16	3.7	19.7	9.4	43.9	0.2	12.1	1.8	9.3
Italy	442,712	359,578	0.13	0.13	12.1	16.0	11.8	28.7	0.3	16.1	2.5	12.6
Jamaica	11,123	17,507	0.25	0.29	6.9	7.2	3.8	70.8	0.1	9.8	1.3	..
Japan	1,456,016	1,468,545	0.14	0.14	8.6	21.9	8.9	38.9	0.2	6.8	1.9	12.8
Jordan	4,146	15,225	0.17	0.18	3.9	15.6	14.4	50.6	0.6	8.3	3.4	3.2
Kazakhstan	..	..	..	..	..	..	..	..	..	..	..	..
Kenya	26,834	48,354	0.19	0.24	4.1	11.7	5.6	65.2	0.1	8.7	1.9	2.7
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Korea, Rep.	281,900	340,035	0.14	0.12	11.8	17.5	11.7	26.3	0.3	16.6	1.6	14.3
Kuwait	6,921	8,761	0.16	0.15	3.1	4.4	13.8	50.9	0.5	17.0	3.9	6.4
Kyrgyz Republic	..	20,700	..	0.16	13.7	0.2	0.9	54.8	0.4	21.0	1.0	8.0
Lao PDR	..	..	..	..	..	..	..	..	..	..	..	..
Latvia	..	27,357	..	0.18	2.8	11.8	4.5	58.2	0.1	11.0	5.9	5.7
Lebanon	14,586	..	0.20	..	..	..	..	..	..	..	..	..
Lesotho	993	2,550	0.24	0.16	0.8	2.2	0.9	41.0	0.1	54.8	0.2	0.1
Libya	3,532	..	0.21	..	..	..	..	..	..	..	..	..
Lithuania	..	48,621	..	0.15	1.3	8.4	3.9	55.4	0.4	19.2	4.2	7.4
Macedonia, FYR	..	23,490	..	0.18	11.7	9.6	6.2	45.0	0.1	20.9	1.7	4.9
Madagascar	9,131	..	0.23	..	..	..	..	..	..	..	..	..
Malawi	12,224	9,055	0.32	0.26	0.0	12.6	5.1	67.7	0.1	11.6	1.7	1.1
Malaysia	77,215	166,960	0.15	0.11	7.3	13.1	15.2	32.0	0.3	8.5	8.5	14.9
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	9,224	17,424	0.21	0.16	1.2	5.2	2.2	38.4	0.1	51.1	0.8	1.1
Mexico	130,993	142,921	0.22	0.19	9.9	9.4	13.2	54.5	0.2	6.6	0.4	5.8
Moldova	..	34,234	..	0.29	0.2	4.0	1.4	81.7	0.2	10.8	1.3	0.5
Mongolia	9,254	7,939	0.19	0.18	1.8	4.3	0.9	64.2	0.3	24.6	4.9	..
Morocco	26,598	84,601	0.15	0.18	0.8	7.7	7.3	54.1	0.3	26.4	0.9	2.5
Mozambique	..	9,217	..	0.25	3.1	7.9	4.1	71.1	0.1	8.2	4.4	1.2
Myanmar	..	4,479	..	0.09	11.4	6.8	29.6	18.5	1.5	3.9	27.1	1.2
Namibia	..	7,350	..	0.35	0.0	5.0	1.6	90.4	0.1	1.2	0.9	0.8
Nepal	18,692	26,550	0.25	0.14	1.5	8.1	3.9	43.3	1.2	39.3	1.7	1.0
Netherlands	165,416	126,892	0.18	0.18	7.6	26.0	11.7	42.7	0.2	2.4	1.2	8.2
New Zealand	59,012	47,321	0.21	0.22	5.0	19.9	5.2	56.6	0.1	6.3	3.0	3.9
Nicaragua	9,647	..	0.28	..	..	..	..	..	..	..	..	..
Niger	372	..	0.19	..	..	..	..	..	..	..	..	..
Nigeria	72,082	57,224	0.17	0.23	12.1	9.3	10.4	57.0	0.2	7.3	2.2	1.6
Norway	67,897	49,494	0.19	0.20	10.1	31.0	5.2	42.4	0.1	1.6	2.6	6.9
Oman	..	236	..	0.15	2.5	6.0	13.6	55.2	0.5	10.9	4.2	7.0
Pakistan	75,125	114,726	0.17	0.18	14.1	5.8	7.3	39.5	0.2	30.1	0.3	2.7
Panama	8,121	11,396	0.26	0.28	1.0	10.5	4.8	74.3	0.1	7.4	1.2	0.7
Papua New Guinea	4,365	5,729	0.22	0.25	0.6	7.3	1.7	80.1	0.1	1.1	6.2	2.9
Paraguay	..	3,250	..	0.28	2.3	9.9	6.0	73.6	0.3	6.7	0.3	0.9
Peru	50,367	51,828	0.18	0.21	9.6	12.0	8.4	53.0	0.2	12.3	1.6	2.9
Philippines	182,052	178,239	0.19	0.18	5.2	9.8	7.3	54.5	0.2	16.4	2.0	4.6
Poland	580,869	385,331	0.14	0.16	15.5	4.9	6.7	48.7	0.3	13.4	2.0	8.5
Portugal	105,441	137,362	0.15	0.14	3.5	14.2	5.1	38.9	0.4	26.7	4.8	6.5
Puerto Rico	24,034	18,202	0.16	0.14	0.9	9.7	16.9	41.4	0.1	21.9	1.1	8.0
Romania	343,145	333,168	0.12	0.14	17.1	6.7	9.0	34.3	0.3	18.5	4.8	9.4
Russian Federation	..	1,615,346	..	0.15	18.2	6.8	9.2	44.7	0.4	8.0	2.6	10.0

	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	**1997**[a]	**1980**	**1997**[a]	**1997**[a]	**1997**[a]	**1997**[a]	**1997**[a]	**1997**[a]	**1997**[a]	**1997**[a]	**1997**[a]
Rwanda	..	..	..	..	..	..	..	..	..	..	..	..
Saudi Arabia	18,181	24,436	0.12	0.14	4.4	15.9	21.1	45.1	1.0	3.8	2.0	6.8
Senegal	9,865	10,223	0.31	0.33	0.0	7.4	7.4	81.6	0.0	3.0	0.1	0.6
Sierra Leone	1,612	4,170	0.24	0.32	..	9.6	3.0	82.3	0.1	2.0	2.2	0.8
Singapore	28,558	34,267	0.10	0.09	2.4	27.9	14.2	18.7	0.1	6.2	1.5	29.0
Slovak Republic	..	64,293	..	0.14	15.5	13.8	9.6	34.9	0.3	14.0	1.6	10.3
Slovenia	..	40,148	..	0.16	29.2	16.8	8.3	24.2	0.2	13.2	2.2	5.9
South Africa	237,599	241,756	0.17	0.17	11.6	16.4	9.7	41.8	0.2	10.8	3.3	6.2
Spain	376,253	335,240	0.16	0.16	7.3	17.7	8.8	46.3	0.3	8.6	3.4	7.6
Sri Lanka	30,086	55,665	0.18	0.17	1.2	8.9	7.2	42.2	0.2	38.3	0.7	1.3
Sudan	..	..	..	..	..	..	..	..	..	..	..	..
Sweden	130,439	91,981	0.15	0.16	10.9	37.0	7.6	27.8	0.1	1.6	3.3	11.7
Switzerland	..	123,752	..	0.17	24.9	23.6	10.4	25.0	0.2	3.2	4.2	8.7
Syrian Arab Republic	36,262	21,421	0.19	0.22	2.9	1.5	8.4	68.3	0.4	17.2	0.3	1.1
Tajikistan	..	..	..	..	..	..	..	..	..	..	..	..
Tanzania	21,084	32,508	0.21	0.26	4.7	10.8	5.0	65.2	0.1	11.8	1.4	1.2
Thailand	213,271	355,819	0.22	0.16	6.1	5.3	5.3	42.2	0.2	35.4	1.5	3.9
Togo	963	..	0.27	..	10.4	38.7	5.8	41.8	0.2	2.1	0.8	..
Trinidad and Tobago	7,835	11,787	0.18	0.28	4.4	10.9	6.7	72.6	0.1	2.9	1.3	1.2
Tunisia	20,294	45,806	0.16	0.16	6.4	7.9	6.0	40.4	0.4	34.0	1.7	3.2
Turkey	160,173	177,161	0.20	0.17	12.7	7.6	7.3	43.8	0.3	22.5	0.9	4.9
Turkmenistan	..	..	..	..	..	..	..	..	..	..	..	..
Uganda	..	16,728	..	0.30	1.6	5.2	1.0	81.6	0.1	8.0	1.5	1.0
Ukraine	..	539,490	..	0.16	20.5	3.7	7.5	50.7	0.4	6.7	1.6	8.9
United Arab Emirates	4,524	..	0.15	..	..	..	..	..	..	..	..	..
United Kingdom	964,510	642,362	0.15	0.15	7.4	26.3	10.6	35.7	0.2	7.5	2.0	10.4
United States	2,742,993	2,584,818	0.14	0.15	8.8	32.8	10.1	27.3	0.2	7.3	2.7	10.9
Uruguay	34,270	27,727	0.21	0.25	1.5	11.4	5.6	67.7	0.1	11.1	0.8	1.9
Uzbekistan	..	..	..	..	..	..	..	..	..	..	..	..
Venezuela, RB	84,797	92,026	0.20	0.21	14.1	11.5	9.9	51.8	0.2	7.3	1.7	3.4
Vietnam	..	..	..	..	..	..	..	..	..	..	..	..
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	..	7,823	..	0.25	0.0	9.1	12.9	71.1	0.3	4.9	1.0	0.9
Yugoslavia, FR (Serb./Mont.)	..	123,247	..	0.16	9.7	12.6	7.6	43.4	0.3	16.1	2.1	8.1
Zambia	13,605	11,433	0.23	0.22	3.4	10.8	7.3	63.6	0.2	9.3	3.0	2.4
Zimbabwe	32,681	33,223	0.20	0.19	14.0	11.4	5.6	47.3	0.2	14.9	3.4	3.2

Note: Industry shares may not sum to 100 percent because data may be from different years.
a. Data refer to most recent year between 1993 and 1997.

Water pollution | 3.6

About the data

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

The data in the table come from an international study of industrial emissions that may be the first to include data from developing countries (Hettige, Mani, and Wheeler 1998). Unlike estimates from earlier studies based on engineering or economic models, these estimates are based on actual measurements of plant-level water pollution. The focus is on organic water pollution measured in terms of biochemical oxygen demand (BOD) because the data for this indicator are the most plentiful and reliable for cross-country comparisons of emissions. BOD measures the strength of an organic waste 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 emissions of organic water pollutants. Such data are fairly reliable because sampling techniques for measuring water pollution are more widely understood and much less expensive than those for air pollution.

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 1980–97. The sectoral emissions estimates were then totaled to get daily BOD emissions in kilograms per day for each country and year.

Figure 3.6

As per capita income rises, pollution intensity falls

Water pollution intensity index

Per capita income ($)

Note: The water pollution intensity index measures the organic pollutant per unit of industrial output.
Source: Hettige, Mani, and Wheeler 1998.

A recent World Bank study shows a continuous relationship between per capita income and the intensity of organic water pollution. For each 1 percent increase in per capita income, there is a 1 percent decline in pollution intensity. The fastest decline occurs before countries reach middle-income status.
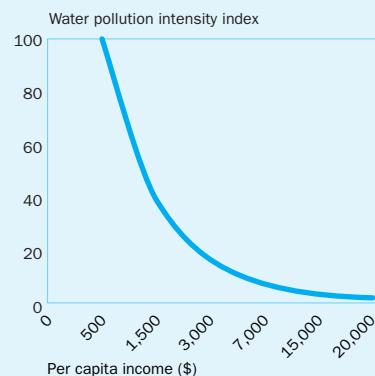
Definitions

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

Data sources

Indicators for 1980–93 were drawn from a 1998 study by Hemamala Hettige, Muthukumara Mani, and David Wheeler, "Industrial Pollution in Economic Development: Kuznets Revisited" (available on the World Wide Web at www.worldbank.org/nipr). These indicators were then updated through 1997 by the World Bank's Development Research Group using the same methodology as the initial study. Sectoral employment numbers are from UNIDO's industry database.