3.6 Water pollution

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	thousand kilograms per day		kilograms per day per worker		% of total							
	1990	2005[a]	1990	2005[a]	Primary metals 2005[a]	Paper and pulp 2005[a]	Chemicals 2005[a]	Food and beverages 2005[a]	Stone, ceramics, and glass 2005[a]	Textiles 2005[a]	Wood 2005[a]	Other 2005[a]
Afghanistan	5.9	0.2	*0.16*	0.21	..	19.7	27.9	14.1	11.7	23.3	..	3.1
Albania	2.4	2.5	0.25	0.23	0.0	0.0	0.0	33.4	0.0	66.6	0.0	0.0
Algeria	*107.0*	..	*0.25*	..	..	..	..	..	..	..	..	..
Angola	*4.5*	..	*0.19*	..	..	..	..	..	..	..	..	..
Argentina	181.4	155.5	0.21	0.23	3.8	8.4	15.8	30.5	3.5	14.3	2.1	21.6
Armenia	*37.9*	*7.1*	*0.11*	*0.28*	..	..	..	*77.6*	..	*22.4*	..	..
Australia	*186.1*	*111.7*	*0.18*	*0.18*	*12.4*	*22.8*	6.7	*43.5*	*0.2*	*5.3*	*2.8*	6.3
Austria	90.5	85.2	0.15	0.14	5.5	7.2	9.2	12.4	5.2	4.8	5.9	49.7
Azerbaijan	41.3	18.1	0.15	0.18	9.6	2.4	19.3	18.1	6.5	13.7	1.2	29.3
Bangladesh	250.8	303.0	0.15	0.14	0.7	2.3	3.0	7.6	2.6	79.3	0.5	4.2
Belarus	..	..	..	..	..	..	..	..	..	..	..	..
Belgium	107.8	99.6	0.17	0.17	6.2	7.7	17.5	15.7	5.4	7.4	2.2	37.9
Benin	..	..	..	..	..	..	..	..	..	..	..	..
Bolivia	11.3	11.5	0.24	0.25	0.9	9.8	13.1	35.4	7.7	18.4	5.3	9.5
Bosnia and Herzegovina	*50.7*	..	*0.14*	..	..	..	..	..	..	..	..	..
Botswana	2.5	3.4	0.30	0.34	0.0	2.9	0.0	70.5	0.0	5.6	0.0	21.1
Brazil	*780.4*	..	*0.19*	..	..	..	..	..	..	..	..	..
Bulgaria	124.3	100.6	0.17	0.17	3.6	4.2	7.1	17.6	4.3	31.4	3.0	28.7
Burkina Faso	..	..	..	..	..	..	..	..	..	..	..	..
Burundi	*1.6*	..	*0.24*	..	..	..	..	..	..	..	..	..
Cambodia	3.6	..	0.21	..	..	..	..	..	..	..	..	..
Cameroon	*14.0*	*10.0*	*0.28*	*0.19*	*0.4*	*5.2*	*36.1*	*48.8*	*0.0*	*3.8*	*5.0*	*0.8*
Canada	300.9	310.3	0.17	0.16	4.4	9.1	10.6	13.9	2.8	7.9	6.7	44.6
Central African Republic	*1.0*	..	*0.18*	..	..	..	..	..	..	..	..	..
Chad	..	..	..	..	..	..	..	..	..	..	..	..
Chile	..	96.5	..	0.25	7.1	6.4	13.5	35.5	3.6	9.3	6.7	18.0
China	*7,038.1*	*6,088.7*	*0.14*	*0.14*	*20.4*	*10.9*	*14.8*	*28.1*	*0.5*	*15.5*	*0.9*	*8.8*
Hong Kong, China	*86.1*	*34.3*	*0.12*	*0.20*	*1.2*	*43.5*	*3.9*	*30.5*	*0.1*	*16.2*	*0.2*	*4.6*
Colombia	..	87.0	..	0.20	2.3	8.9	17.3	21.3	5.3	24.1	0.9	19.9
Congo, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Congo, Rep.	*2.5*	..	*0.32*	..	..	..	..	..	..	..	..	..
Costa Rica	*27.2*	*31.2*	*0.20*	*0.22*	*1.6*	*10.0*	*8.2*	*65.7*	*0.1*	*10.2*	*1.3*	*2.9*
Côte d'Ivoire	*7.9*	..	*0.22*	..	..	..	..	..	..	..	..	..
Croatia	48.5	41.2	0.17	0.17	3.3	7.2	9.5	17.9	5.9	16.2	4.8	35.1
Cuba	*173.0*	..	*0.25*	..	..	..	..	..	..	..	..	..
Czech Republic	176.8	152.4	0.15	0.13	5.4	4.6	9.9	11.4	4.9	8.3	4.0	51.6
Denmark	84.3	62.0	0.18	0.17	1.0	12.3	13.8	17.6	4.2	2.4	4.0	44.8
Dominican Republic	88.6	88.6	0.18	0.18	0.1	1.3	2.3	18.6	1.4	73.1	0.1	3.1
Ecuador	28.6	44.7	0.24	0.28	1.8	7.8	12.8	46.4	4.4	12.3	2.2	12.3
Egypt, Arab Rep.	206.5	206.5	0.19	0.19	5.8	4.0	13.9	20.0	8.2	31.1	0.6	16.4
El Salvador	*5.5*	..	*0.22*	..	..	..	..	..	..	..	..	..
Eritrea	2.4	2.9	0.19	0.21	0.3	4.1	8.6	31.8	14.8	24.1	0.0	16.4
Estonia	21.7	16.5	0.15	0.15	0.3	7.3	7.8	15.8	4.7	10.9	16.9	36.4
Ethiopia	18.5	24.1	0.23	0.22	1.6	6.9	10.7	29.7	8.3	28.6	1.4	12.8
Finland	72.0	59.2	0.19	0.15	1.6	17.0	8.5	9.4	4.1	3.1	7.1	49.3
France	326.5	604.7	0.11	0.16	3.2	7.4	16.1	16.1	3.7	5.4	2.3	45.8
Gabon	*2.0*	..	*0.25*	..	..	..	..	..	..	..	..	..
Gambia, The	*0.8*	..	*0.34*	..	..	..	..	..	..	..	..	..
Georgia	..	..	..	..	..	..	..	..	..	..	..	..
Germany	806.6	960.3	0.13	0.14	3.8	7.1	12.1	11.7	3.4	2.6	2.1	57.2
Ghana	..	15.4	..	0.17	3.1	2.8	15.0	19.2	4.2	10.0	34.3	11.4
Greece	50.9	46.5	0.19	0.20	4.5	7.8	13.2	22.8	6.9	20.0	2.0	22.9
Guatemala	*21.6*	..	*0.23*	..	..	..	..	..	..	..	..	..
Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Guinea-Bissau	..	..	..	..	..	..	..	..	..	..	..	..
Haiti	0.1	0.0	0.01	0.01	0.0	2.0	0.0	0.0	0.0	0.0	0.0	98.0

Water pollution 3.6

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	thousand kilograms per day		kilograms per day per worker		% of total							
	1990	2005[a]	1990	2005[a]	Primary metals 2005[a]	Paper and pulp 2005[a]	Chemicals 2005[a]	Food and beverages 2005[a]	Stone, ceramics, and glass 2005[a]	Textiles 2005[a]	Wood 2005[a]	Other 2005[a]
Honduras	*17.8*	..	*0.23*	..	..	..	..	..	..	..	..	..
Hungary	7.0	123.2	0.36	0.15	2.5	6.5	10.3	16.1	3.7	12.1	3.5	45.3
India	*1,410.6*	*1,519.8*	*0.20*	*0.20*	*12.2*	*7.6*	*9.2*	*53.7*	*0.3*	*12.7*	*0.3*	*3.9*
Indonesia	721.8	731.0	0.18	0.18	1.3	3.8	13.1	21.7	3.5	30.5	8.0	18.1
Iran, Islamic Rep.	131.6	163.2	0.16	0.15	7.0	2.9	12.5	16.1	14.0	11.8	0.7	34.9
Iraq	7.7	7.7	0.27	0.27	13.1	25.6	29.9	16.9	5.4	9.1	..	..
Ireland	36.0	33.6	0.19	0.20	1.2	11.9	12.1	24.5	2.7	2.1	3.7	41.8
Israel	43.9	42.8	0.18	0.18	2.2	8.5	15.0	19.7	0.0	9.1	1.5	43.9
Italy	378.3	481.3	0.13	0.12	3.5	5.3	10.4	8.7	5.4	15.0	2.9	48.9
Jamaica	*18.7*	..	*0.29*	..	..	..	..	..	..	..	..	..
Japan	1,451.4	1,133.1	0.14	0.15	3.1	7.2	11.2	15.2	3.7	5.6	2.0	52.0
Jordan	15.0	27.1	0.18	0.18	2.7	6.4	15.0	21.9	11.3	16.1	2.7	23.9
Kazakhstan	1.3	1.7	0.40	0.41	0.0	50.0	0.0	47.6	0.0	0.0	0.0	2.4
Kenya	*42.6*	*56.1*	*0.23*	*0.24*	..	*11.5*	*5.4*	*66.8*	*0.1*	*12.8*	*1.7*	*1.8*
Korea, Dem. Rep.	..	..	..	..	..	..	..	..	..	..	..	..
Korea, Rep.	366.9	317.0	0.12	0.12	4.3	5.5	12.3	6.5	3.1	10.2	0.9	57.2
Kuwait	*9.1*	*11.9*	*0.16*	*0.17*	*2.1*	*16.6*	*11.1*	*50.2*	*0.4*	*11.6*	*2.8*	*5.2*
Kyrgyz Republic	28.9	11.5	0.14	0.19	7.1	6.2	8.3	23.6	15.2	12.0	1.8	25.9
Lao PDR	0.5	0.5	0.44	0.44	0.0	26.3	0.0	73.7	0.0	0.0	0.0	0.0
Latvia	39.8	29.9	0.12	0.18	2.4	7.3	5.2	21.7	3.6	13.5	20.2	26.1
Lebanon	14.7	14.7	0.19	0.19	0.5	7.5	6.0	25.5	12.9	16.7	4.5	26.3
Lesotho	..	13.2	..	0.13	1.0	0.5	1.4	3.4	0.5	90.8	..	2.4
Liberia	*0.6*	..	*0.30*	..	..	..	..	..	..	..	..	..
Libya	..	..	..	..	..	..	..	..	..	..	..	..
Lithuania	54.0	42.9	0.15	0.17	0.8	4.9	7.1	20.3	4.2	21.3	11.1	30.3
Macedonia, FYR	*32.4*	..	*0.18*	..	..	..	..	..	..	..	..	..
Madagascar	*11.0*	88.9	..	0.14	0.3	1.6	12.4	7.6	2.8	58.9	6.3	10.0
Malawi	37.2	32.7	0.40	0.39	..	1.4	3.7	82.1	0.6	7.5	1.1	3.6
Malaysia	*104.7*	187.6	..	0.12	2.8	4.7	15.1	9.2	3.7	8.1	7.6	48.9
Mali	..	..	..	..	..	..	..	..	..	..	..	..
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mauritius	0.3	0.4	0.05	0.06	0.0	13.7	0.0	0.0	..	0.0	0.0	86.3
Mexico	370.8	..	0.19	*0.20*	*7.8*	*12.5*	*10.4*	*55.6*	*0.2*	*7.5*	*0.9*	5.1
Moldova	29.2	22.4	0.44	0.45	0.0	3.4	0.0	95.6	0.0	0.0	..	1.0
Mongolia	*10.2*	..	*0.18*	..	..	..	..	..	..	..	..	..
Morocco	..	72.8	..	0.16	0.9	3.0	9.3	16.0	7.1	45.5	1.9	16.3
Mozambique	*20.4*	*10.2*	*0.27*	*0.31*	*1.1*	*7.1*	*2.7*	*81.2*	*0.1*	*5.8*	*1.4*	*0.7*
Myanmar	*7.7*	*6.2*	*0.17*	*0.18*	*56.5*	*4.6*	*13.2*	*14.9*	*0.4*	*2.9*	*1.7*	*5.8*
Namibia	*7.4*	..	*0.35*	..	..	..	..	..	..	..	..	..
Nepal	26.4	26.8	0.14	0.16	1.6	3.9	7.2	19.2	29.9	29.4	2.0	6.8
Netherlands	137.0	119.2	0.20	0.18	1.3	13.1	15.6	18.8	3.7	2.9	2.6	42.1
New Zealand	46.7	55.6	0.24	0.22	2.2	10.4	8.4	28.9	3.0	7.2	8.3	31.7
Nicaragua	*10.5*	..	*0.27*	..	..	..	..	..	..	..	..	..
Niger	..	*0.4*	..	*0.32*	..	*17.0*	*4.4*	*76.9*	*0.3*	..	*0.8*	*0.6*
Nigeria	*70.8*	..	*0.22*	..	..	..	..	..	..	..	..	..
Norway	51.8	49.2	0.20	0.20	3.9	14.6	7.6	21.0	3.8	2.1	5.7	41.2
Oman	3.8	6.5	0.15	0.18	3.9	6.2	16.1	22.1	23.4	6.2	2.2	19.8
Pakistan	*104.1*	..	*0.18*	..	..	..	..	..	..	..	..	..
Panama	10.3	12.9	0.30	0.31	1.6	10.2	8.2	53.8	5.6	7.5	1.7	11.4
Papua New Guinea	*5.7*	..	*0.25*	..	..	..	..	..	..	..	..	..
Paraguay	15.3	10.8	0.20	0.28	3.1	9.3	16.7	42.6	5.9	11.0	4.5	6.9
Peru	*56.1*	..	*0.20*	..	..	..	..	..	..	..	..	..
Philippines	118.4	98.5	0.26	0.24	6.7	6.9	15.2	34.7	7.3	3.4	0.0	25.9
Poland	446.7	364.2	0.16	0.16	3.1	5.1	10.7	19.0	5.6	11.8	5.2	39.6
Portugal	140.6	107.2	0.14	0.15	2.3	7.0	6.2	14.5	8.6	25.3	3.9	32.2
Puerto Rico	*19.0*	*9.2*	*0.15*	*0.18*	*1.9*	*14.9*	*21.9*	*34.4*	*0.2*	*15.5*	*1.4*	*9.7*

3.6 Water pollution

	Emissions of organic water pollutants				Industry shares of emissions of organic water pollutants							
	thousand kilograms per day		kilograms per day per worker		% of total							
	1990	2005[a]	1990	2005[a]	Primary metals 2005[a]	Paper and pulp 2005[a]	Chemicals 2005[a]	Food and beverages 2005[a]	Stone, ceramics, and glass 2005[a]	Textiles 2005[a]	Wood 2005[a]	Other 2005[a]
Romania	407.0	235.1	0.12	0.15	4.8	3.2	6.7	12.7	4.0	28.9	5.2	34.4
Russian Federation	1,521.4	1,425.9	0.16	0.17	9.8	4.8	11.7	17.5	7.9	6.8	4.3	37.3
Rwanda	7.1	7.1	0.44	0.44	..	..	0.0	97.0	0.0	0.0	0.0	3.0
Saudi Arabia	*18.5*	..	*0.15*	..	..	..	..	..	..	..	..	..
Senegal	6.1	6.6	0.30	0.29	4.9	6.3	23.8	44.6	3.9	10.5	0.8	5.3
Serbia	..	..	..	..	..	..	..	..	..	..	..	..
Sierra Leone	*4.2*	..	*0.32*	..	..	..	..	..	..	..	..	..
Singapore	*32.4*	*34.3*	*0.09*	*0.10*	*1.4*	*24.6*	*16.0*	*25.4*	*0.1*	*3.9*	*1.6*	*26.9*
Slovak Republic	72.8	54.6	0.13	0.14	7.3	4.8	8.0	10.5	5.7	14.3	3.2	46.3
Slovenia	*55.6*	*38.4*	*0.16*	*0.16*	*33.7*	*14.7*	*8.3*	*23.7*	*0.2*	*10.8*	*2.0*	*6.7*
Somalia	*6.2*	..	*0.38*	..	..	..	..	..	..	..	..	..
South Africa	260.5	183.8	0.17	0.17	6.7	7.3	11.7	16.5	5.0	7.0	4.6	41.3
Spain	348.0	372.5	0.16	0.15	3.1	7.8	10.6	14.9	7.6	9.6	3.8	42.6
Sri Lanka	*53.0*	*78.4*	*0.19*	*0.18*	*0.5*	*7.2*	*6.6*	*51.5*	*0.2*	*31.6*	*1.1*	*1.2*
Sudan	..	38.6	..	0.29	0.6	1.9	7.0	57.5	14.2	8.0	1.7	9.1
Swaziland	*146.0*	..	*0.16*	..	..	..	..	..	..	..	..	..
Sweden	116.8	100.1	0.15	0.15	5.3	12.4	9.7	9.0	2.5	1.4	5.4	54.3
Switzerland	..	..	..	..	..	..	..	..	..	..	..	..
Syrian Arab Republic	6.6	4.5	0.45	0.45	0.0	6.2	0.0	93.8	0.0	0.0	0.0	0.0
Tajikistan	29.1	16.1	0.17	0.23	21.9	1.4	5.1	20.2	7.6	37.5	0.4	5.9
Tanzania	*31.1*	*35.2*	*0.24*	*0.25*	*1.5*	*9.4*	*2.7*	*69.3*	*0.1*	*14.0*	*1.5*	*1.4*
Thailand	369.4	333.8	0.15	0.16	1.8	4.1	13.2	16.5	3.4	22.5	2.4	36.1
Timor-Leste	..	..	..	..	..	..	..	..	..	..	..	..
Togo	..	..	..	..	..	..	..	..	..	..	..	..
Trinidad and Tobago	7.0	7.6	0.23	0.29	0.0	18.1	21.4	39.1	0.4	7.6	8.5	4.9
Tunisia	*44.6*	*55.8*	*0.18*	*0.14*	*2.5*	*6.1*	*5.5*	*35.8*	*0.4*	*43.3*	*1.9*	*4.6*
Turkey	174.9	177.7	0.18	0.16	5.2	3.0	9.8	15.2	6.2	35.7	1.0	24.0
Turkmenistan	..	..	..	..	..	..	..	..	..	..	..	..
Uganda	2.7	2.1	0.27	0.23	..	7.8	7.3	34.8	13.3	17.2	0.0	19.6
Ukraine	..	527.2	..	0.19	14.6	4.1	10.3	19.0	6.4	6.6	2.2	36.8
United Arab Emirates	*5.6*	..	*0.14*	..	..	..	..	..	..	..	..	..
United Kingdom	599.9	539.7	0.16	0.17	2.5	12.4	13.6	14.4	3.8	4.6	2.4	46.2
United States	2,307.0	1,960.3	0.14	0.14	3.4	9.0	13.0	11.8	3.6	5.0	4.0	50.3
Uruguay	*38.7*	*15.8*	*0.23*	*0.28*	*1.2*	*3.7*	*6.6*	*79.2*	*0.1*	*7.4*	*0.6*	*1.2*
Uzbekistan	..	..	..	..	..	..	..	..	..	..	..	..
Venezuela, RB	*96.5*	..	*0.21*	..	..	..	..	..	..	..	..	..
Vietnam	141.0	470.2	0.16	0.15	1.4	3.7	6.6	14.3	7.1	40.3	3.7	22.9
West Bank and Gaza	..	..	..	..	..	..	..	..	..	..	..	..
Yemen, Rep.	1.5	1.0	0.43	0.41	..	79.9	0.0	20.1	0.0	0.0	0.0	0.0
Zambia	*15.9*	..	*0.23*	..	..	..	..	..	..	..	..	..
Zimbabwe	29.3	29.3	0.20	0.20	8.0	4.7	11.0	21.5	6.3	25.2	1.7	21.5

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

About the data

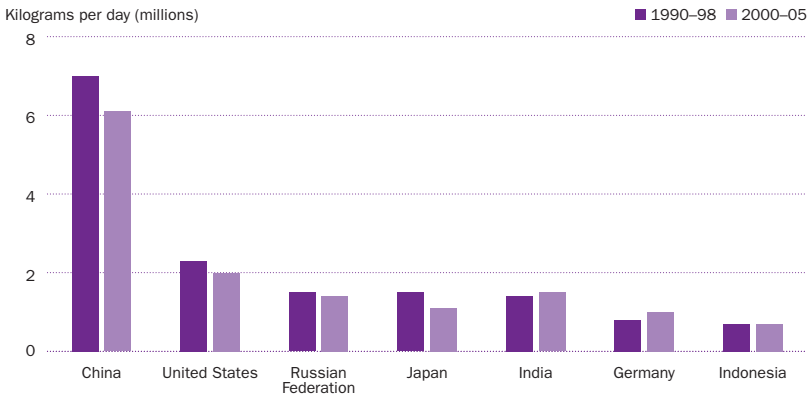
Emissions of organic pollutants from industrial activities are a major cause of degradation of water quality. Water quality and pollution levels are generally measured as concentration or load—the rate of occurrence of a substance in an aqueous solution. Polluting substances include organic matter, metals,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

The data in the table come from an international study of industrial emissions that may have been the first to include data from developing countries (Hettige, Mani, and Wheeler 1998). These data were updated through 2005 by the World Bank's Development Research Group. Unlike estimates from earlier studies based on engineering or economic models, these estimates are based on actual measurements of plant-level water pollution. The focus is on organic water pollution caused by organic waste, measured in terms of biochemical oxygen demand (BOD), because the data for this indicator are the most plentiful and reliable for cross-country comparisons of emissions. BOD measures the strength of an organic waste by the amount of oxygen consumed in breaking it down. A sewage overload in natural waters exhausts the water's dissolved oxygen content. Wastewater treatment, by contrast, reduces BOD.

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

Hettige, Mani, and Wheeler (1998) used plant- and sector-level information on emissions and employment from 13 national environmental protection agencies and sector-level information on output and employment from the United Nations Industrial Development Organization (UNIDO). Their econometric analysis found that the ratio of BOD to employment in each industrial sector is about the same across countries. This finding allowed the authors to estimate BOD loads across countries and over time. The estimated BOD intensities per unit of employment were multiplied by sectoral employment numbers from UNIDO's industry database for 1980–98. These estimates of sectoral emissions were then used to calculate kilograms of emissions of organic water pollutants per day for each country and year. The data in the table were derived by updating these estimates through 2005.

Emissions of organic water pollutants declined in most economies from 1990 to 2005, even in some of the top emitters 3.6a



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

Source: Table 3.6.

Definitions

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

Data sources

Data on water pollutants are from the 1998 study by Hemamala Hettige, Muthukumara Mani, and David Wheeler, "Industrial Pollution in Economic Development: Kuznets Revisited" (available at www.worldbank.org/nipr). The data were updated through 2005 by the World Bank's Development Research Group using the same methodology as the initial study. Data on industrial sectoral employment are from UNIDO's industry database.