

*C*hapter 12

Fresh Water

Data Table 12.1

Freshwater Resources and Withdrawals, 1970–98

Sources: Various

	Annual Internal Renewable Water Resources		Annual River Flows		Year of Data	Annual Withdrawals			Sectoral Withdrawals (percent)		
	Total (cubic km)	1998 Per Capita (cubic meters)	From Other Countries (cubic km)	To Other Countries (cubic km)		Total (cubic km)	Percentage of Water Resources	Per Capita (cubic meters)	Domestic	Industrial	Agricultural
WORLD	41,022.00	6,918			1987	3,240.00	8	645	8	23	69
AFRICA	3,996.00	5,133			1995	145.14	4	202	7	5	88
Algeria	13.87	460	0.4	0.7	1990	4.50	32	180	25	15	60
Angola	184.00	15,376	X	X	1987	0.48	0	57	14	10	76
Benin	10.30	1,751	15.5	X	1994	0.15	1	28	23	10	67
Botswana	2.90	1,870	11.8	X	1992	0.11	4	84	32	20	48
Burkina Faso	17.50	1,535	X	X	1992	0.38	2	39	19	0	81
Burundi	3.60	546	X	X	1987	0.10	3	20	36	0	64
Cameroon	268.00	18,711	0.0	0.0	1987	0.40	0	38	46	19	35
Central African Rep	141.00	40,413	X	X	1987	0.07	0	26	21	5	74
Chad	15.00	2,176	28.0	X	1987	0.18	1	34	16	2	82
Congo, Dem Rep	935.00	19,001	84.0	X	1990	0.36	0	10	61	16	23
Congo, Rep	222.00	78,668	610.0	X	1987	0.04	0	20	62	27	11
Côte d'Ivoire	76.70	5,265	1.0	X	1987	0.71	1	67	22	11	67
Egypt	2.80	43	55.5	0.0	1993	55.10	1,968	921	6	8	86
Equatorial Guinea	30.00	69,767	0.0	X	1987	0.01	0	15	81	13	6
Eritrea	2.80	789	6.0	X	X	X	X	X	X	X	X
Ethiopia	110.00	1,771	0.0	X	1987	2.21	2	51	11	3	86
Gabon	164.00	140,171	0.0	X	1987	0.06	0	70	72	22	6
Gambia, The	3.00	2,513	5.0	X	1982	0.02	1	29	7	2	91
Ghana	30.30	1,607	22.9	X	1970	0.30	1	35	35	13	52
Guinea	226.00	29,454	0.0	X	1987	0.74	0	142	10	3	87
Guinea-Bissau	16.00	14,109	11.0	X	1991	0.02	0	17	60	4	36
Kenya	20.20	696	10.0	X	1990	2.05	10	87	20	4	76
Lesotho	5.23	2,395	0.0	X	1987	0.05	1	30	22	22	56
Liberia	200.00	72,780	32.0	X	1987	0.13	0	54	27	13	60
Libya	0.60	100	0.0	0.0	1994	4.60	767	880	11	2	87
Madagascar	337.00	20,614	0.0	0.0	1984	16.30	5	1,579	1	0	99
Malawi	17.54	1,690	1.1	X	1994	0.94	5	98	10	3	86
Mali	60.00	5,071	40.0	X	1987	1.36	2	162	2	1	97
Mauritania	0.40	163	11.0	X	1985	1.63	407	923	6	2	92
Mauritius	2.21	1,915	0.0	0.0	1974	0.36	16	410	16	7	77
Morocco	30.00	1,071	0.0	0.3	1992	10.85	36	433	5	3	92
Mozambique	100.00	5,350	116.0	0.0	1992	0.61	1	40	9	2	89
Namibia	6.20	3,751	39.3	X	1991	0.25	4	179	29	3	68
Niger	3.50	346	29.0	X	1988	0.50	14	69	16	2	82
Nigeria	221.00	1,815	59.0	X	1987	3.63	2	41	31	15	54
Rwanda	6.30	965	X	X	1993	0.77	12	135	5	2	94
Senegal	26.40	2,933	13.0	X	1987	1.36	5	202	5	3	92
Sierra Leone	160.00	34,957	0.0	X	1987	0.37	0	98	7	4	89
Somalia	6.00	563	7.5	X	1987	0.81	14	99	3	0	97
South Africa	44.80	1,011	5.2	X	1990	13.31	30	359	17	11	72
Sudan	35.00	1,227	119.0	65.5	1995	17.80	51	666	4	1	94
Swaziland	2.64	2,836	1.9	X	1980	0.66	25	1,171	2	2	96
Tanzania	80.00	2,485	9.0	X	1994	1.16	1	40	9	2	89
Togo	11.50	2,594	0.5	X	1987	0.09	1	28	62	13	25
Tunisia	3.52	371	0.6	0.0	1990	3.07	87	376	9	3	89
Uganda	39.00	1,829	27.0	X	1970	0.20	1	20	32	8	60
Zambia	80.20	9,229	35.8	X	1994	1.71	2	216	16	7	77
Zimbabwe	14.10	1,182	5.9	X	1987	1.22	9	136	14	7	79
EUROPE	6,234.56	8,547			1995	455.29	7	625	14	55	31
Albania	44.50	2,903	11.3	X	1970	0.20	2	94	6	18	76 a
Austria	56.30	6,857	34.0	X	1991	2.36	4	304	33	58	9
Belarus, Rep	37.20	3,595	20.8	54.9	1990	2.73	7	264	22	43	35
Belgium	8.40	822	4.1	X	1980	9.03	108	917	11	85	4 a
Bosnia and Herzegovina	X	X	X	X	X	X	X	X	X	X	X
Bulgaria	18.00	2,146	187.0	X	1988	13.90	77	1,574	3	76	22 a
Croatia, Rep	61.40	13,663	X	X	X	X	X	X	X	X	X
Czech Rep	58.21	5,694	X	X	1991	2.74	5	266	41	57	2
Denmark	11.00	2,092	2.0	X	1990	1.20	11	233	30	27	43 a
Estonia, Rep	12.72	8,642	0.1	X	1995	0.16	1	107	56	39	5
Finland	110.00	21,334	3.0	X	1991	2.20	2	440	12	85	3 a
France	180.00	3,065	18.0	20.5	1990	37.73	21	665	16	69	15 a
Germany	96.00	1,165	75.0	X	1991	46.27	48	580	11	70	20
Greece	45.15	4,279	13.5	3.0	1980	5.04	11	523	8	29	63 a
Hungary	6.00	604	114.0	X	1991	6.81	114	660	9	55	36 a
Iceland	168.00	606,498	0.0	0.0	1991	0.16	0	636	31	63	6 a
Ireland	47.00	13,187	3.0	X	1980	0.79	2	233	16	74	10 a
Italy	159.40	2,785	7.6	0.0	1990	56.20	35	986	14	27	59 a
Latvia, Rep	16.74	6,685	18.7	X	1994	0.29	2	114	55	32	13
Lithuania, Rep	15.56	4,174	9.3	X	1993	0.25	2	68	81	16	3
Macedonia, FYR	X	X	X	X	X	X	X	X	X	X	X
Moldova, Rep	1.00	225	11.7	12.0	1992	2.96	296	667	9	65	26
Netherlands	10.00	635	80.0	X	1991	7.81	78	518	5	61	34 a
Norway	384.00	87,691	8.0	X	1985	2.03	1	488	20	72	8 a
Poland, Rep	49.40	1,278	6.8	X	1991	12.28	25	321	13	76	11 a
Portugal	38.00	3,878	31.6	X	1990	7.29	19	738	15	37	48 a
Romania	37.00	1,639	171.0	X	1994	26.00	70	1,139	8	33	59 a
Russian Federation	4,312.70	29,115	185.5	54.0	1994	77.10	2	521	19	62	20
Slovak Rep	30.79	5,745	X	X	1991	1.78	6	337	X	X	X
Slovenia, Rep	X	X	X	X	X	X	X	X	X	X	X
Spain	110.30	2,775	1.0	17.0	1991	30.75	28	781	12	26	62 a
Sweden	176.00	19,858	4.0	X	1991	2.93	2	340	36	55	9 a
Switzerland	42.50	5,802	7.5	X	1991	1.19	3	173	23	73	4 a
Ukraine	53.10	1,029	86.5	X	1992	25.99	49	504	18	52	30
United Kingdom	71.00	1,219	0.0	X	1991	11.79	17	204	20	77	3 a
Yugoslavia, Fed Rep	X	X	X	X	X	X	X	X	X	X	X

	Annual Internal Renewable Water Resources		Annual River Flows		Annual Withdrawals			Sectoral Withdrawals (percent)			
	1998		From Other Countries	To Other Countries	Year of Data	Total (cubic km)	Percentage of Water Resources	Per Capita (cubic meters)	Domestic	Industrial	Agricultural
	Total (cubic km)	Per Capita (cubic meters)	(cubic km)	(cubic km)							
					1991	512.43	10	1,798	13	47	39
NORTH AMERICA	5,308.60	17,458			1991	512.43	10	1,798	13	47	39
Canada	2,849.50	94,373	51.5	X	1991	45.10	2	1,602	18	70	12 a
United States	2,459.10	8,983	18.9	X	1990	467.34	19	1,839	13	45	42
CENTRAL AMERICA	1,056.67	8,084			1987	96.01	9	916	6	8	86
Belize	16.00	69,565	X	X	1987	0.02	0	109	10	0	90 a
Costa Rica	95.00	26,027	X	X	1970	1.35	1	780	4	7	89 a
Cuba	34.50	3,104	0.0	X	1975	8.10	23	870	9	2	89 a
Dominican Rep	20.00	2,430	X	X	1987	2.97	15	446	5	6	89 a
El Salvador	18.95	3,128	X	X	1975	1.00	5	244	7	4	89 a
Guatemala	116.00	10,033	X	X	1970	0.73	1	139	9	17	74 a
Haiti	11.00	1,460	X	X	1987	0.04	0	7	24	8	68 a
Honduras	55.42	9,015	8.0	8.0	1992	1.52	3	294	4	5	91 a
Jamaica	8.30	3,269	0.0	X	1975	0.32	4	159	7	7	86 a
Mexico	357.40	3,729	X	X	1991	77.62	22	915	6	8	86 a
Nicaragua	175.00	39,203	X	X	1975	0.89	1	368	25	21	54 a
Panama	144.00	52,042	X	X	1975	1.30	1	754	12	11	77 a
Trinidad and Tobago	5.10	3,869	0.0	X	1975	0.15	3	148	27	38	35 a
SOUTH AMERICA	9,526.00	28,702			1995	106.21	1	335	18	23	59
Argentina	694.00	19,212	300.0	X	1976	27.60	4	1,043	9	18	73 a
Bolivia	300.00	37,703	X	X	1987	1.24	0	201	10	5	85 a
Brazil	5,190.00	31,424	1,760.0	X	1990	36.47	1	246	22	19	59 a
Chile	468.00	31,570	X	X	1975	16.80	4	1,625	6	5	89 a
Colombia	1,070.00	28,393	X	X	1987	5.34	0	174	41	16	43 a
Ecuador	314.00	25,791	X	X	1987	5.56	2	581	7	3	90 a
Guyana	241.00	281,542	X	X	1992	1.46	1	1,819	1	0	99 a
Paraguay	94.00	18,001	220.0	X	1987	0.43	0	112	15	7	78 a
Peru	40.00	1,613	X	X	1987	6.10	15	300	19	9	72 a
Suriname	200.00	452,489	X	X	1987	0.46	0	1,192	6	5	89 a
Uruguay	59.00	18,215	65.0	X	1965	0.65	1	241	6	3	91 a
Venezuela	856.00	36,830	461.0	X	1970	4.10	0	382	43	11	46 a
ASIA	13,206.74	3,680			1987	1,633.85	12	542	6	9	85
Afghanistan, Islamic State	55.00	2,354	10.0	X	1987	25.85	47	1,825	1	0	99 a
Armenia, Rep	9.07	2,493	1.5	5.2	1994	2.93	32	804	30	4	66
Azerbaijan	8.12	1,069	22.2	X	1995	16.53	204	2,177	5	25	70
Bangladesh	1,357.00	10,940	1,000.0	X	1987	22.50	2	217	3	1	96 a
Bhutan	95.00	49,557	X	X	1987	0.02	0	13	36	10	54 a
Cambodia	88.10	8,195	410.0	X	1987	0.52	1	66	5	1	94 a
China	2,800.00	2,231	0.0	X	1980	460.00	16	461	6	7	87 a
Georgia	58.13	10,682	5.2	20.2	1990	3.47	6	637	21	20	59
India	1,850.00	1,896	235.0	X	1975	380.00	21	612	3	4	93 a
Indonesia	2,530.00	12,251	X	X	1987	16.59	1	96	13	11	76 a
Iran, Islamic Rep	128.20	1,755	9.3	55.9	1993	70.03	55	1,079	6	2	92
Iraq	35.20	1,615	40.2	X	1990	42.80	122	2,368	3	5	92
Israel	1.70	289	0.5	0.0	1989	1.85	109	407	16	5	79
Japan	547.00	4,344	0.0	X	1990	90.80	17	735	17	33	50 a
Jordan	0.68	114	0.2	X	1993	0.98	145	201	22	3	75
Kazakhstan, Rep	75.42	4,484	34.2	32.0	1993	33.67	45	2,002	2	17	81
Korea, Dem People's Rep	67.00	2,887	X	X	1987	14.16	21	727	11	16	73 a
Korea, Rep	66.12	1,434	X	X	1992	27.60	42	632	19	35	46 a
Kuwait	0.02	11	0.0	X	1994	0.54	2,690	307	37	2	60
Kyrgyz Rep	46.45	10,394	25.9	35.6	1994	10.08	22	2,257	3	3	94
Lao People's Dem Rep	270.00	50,392	X	X	1987	0.99	0	259	8	10	82 a
Lebanon	4.20	1,315	0.6	0.9	1994	1.29	31	444	28	4	68
Malaysia	456.00	21,259	X	X	1975	9.42	2	768	23	30	47 a
Mongolia	24.60	9,375	X	X	1987	0.55	2	271	11	27	62 a
Myanmar	1,082.00	22,719	X	X	1987	3.96	0	101	7	3	90 a
Nepal	170.00	7,338	X	X	1987	2.68	2	154	4	1	95 a
Oman	0.99	393	0.0	X	1991	1.22	124	656	5	2	94
Pakistan	248.00	1,678	170.3	X	1991	155.60	63	1,269	2	2	97
Philippines	323.00	4,476	0.0	X	1975	29.50	9	686	18	21	61 a
Saudi Arabia	2.40	119	0.0	X	1992	17.02	709	1,003	9	1	90
Singapore	0.60	172	0.0	X	1975	0.19	32	84	45	51	4 a
Sri Lanka	43.20	2,341	0.0	X	1970	6.30	15	503	2	2	96 a
Syrian Arab Rep	7.00	456	37.7	32.0	1993	14.41	206	1,069	4	2	94
Tajikistan, Rep	66.30	11,171	50.3	86.9	1994	11.87	18	2,001	3	4	92
Thailand	110.00	1,845	69.0	X	1987	31.90	29	602	4	6	90 a
Turkey	196.00	3,074	7.6	60.4	1992	31.60	16	544	16	11	72
Turkmenistan, Rep	1.00	232	70.0	52.6	1994	23.78	2,378	5,723	1	1	98
United Arab Emirates	0.15	64	0.0	X	1995	2.11	1,405	954	7	1	92
Uzbekistan, Rep	16.34	704	34.1	X	1994	58.05	355	2,501	4	2	94
Vietnam	376.00	4,827	X	X	1992	28.90	8	416	13	9	78 a
Yemen	4.10	243	X	X	1990	2.93	72	253	7	1	92
OCEANIA	1,614.25	54,795			1995	16.73	1	591	64	2	34
Australia	343.00	18,596	0.0	X	1985	14.60	4	933	65	2	33 a
Fiji	28.55	34,732	0.0	X	1987	0.03	0	42	20	20	60 a
New Zealand	327.00	88,859	0.0	325.0	1991	2.00	1	589	46	10	44 a
Papua New Guinea	801.00	174,055	X	X	1987	0.10	0	28	29	22	49 a
Solomon Islands	44.70	107,194	0.0	X	1987	0.00	0	0	40	20	40 a

Notes: a. Sectoral withdrawal estimates are for 1987.

Regional and world totals include countries not listed.

Total withdrawals may exceed 100 percent due to groundwater drawdowns, withdrawals from river inflows, and the operation of desalination plants.

Data Table 12.2

Groundwater and Desalination, 1998

Sources: Economic Commission for Europe, Organisation for Economic Co-Operation and Development, and Food and Agriculture Organization of the United Nations

	Average Annual Groundwater Recharge			Annual Groundwater Withdrawals						1990 Desalinated Water Production (million cubic meters)
	1998		Year	Total (cubic km)	Percent of Annual Recharge	Per Capita (cubic meters)	Sectoral Share (percentage)			
	Total (cubic km)	Per Capita (cubic meters)					Domestic	Industry	Agriculture	
WORLD										
AFRICA										
Algeria	1.70	56	1985	2	117.6	91	X	X	X	30.00
Angola	72.00	6,017	X	X	X	X	X	X	X	0.14
Benin	1.80	a 306	X	X	X	X	X	X	X	X
Botswana	1.70	a 1,096	X	X	X	X	X	X	X	X
Burkina Faso	9.50	a 833	X	X	X	X	X	X	X	X
Burundi	2.10	b 319	X	X	X	X	X	X	X	X
Cameroon	100.00	b 6,982	X	X	X	X	X	X	X	X
Central African Rep	56.00	b 16,050	X	X	X	X	X	X	X	X
Chad	11.50	b 1,669	1990	0	0.7	15.3	29.4	0.0	70.6	X
Congo, Dem Rep	421.00	b 149,185	X	X	X	X	X	X	X	0.20
Congo, Rep	198.00	b 70,163	X	X	X	X	X	X	X	X
Côte d'Ivoire	37.70	a 2,588	X	X	X	X	X	X	X	X
Egypt	1.30	a 20	1985	3	261.5	68.3	X	X	X	10.00
Equatorial Guinea	10.00	b 23,256	X	X	X	X	X	X	X	X
Eritrea	X	X	X	X	X	X	X	X	X	X
Ethiopia	44.00	b,c 708	X	X	X	X	X	X	X	X
Gabon	62.00	b 52,991	1989	0	0.0	0.6	100.0	0.0	0.0	X
Gambia, The	0.50	b 419	X	X	X	X	X	X	X	X
Ghana	26.30	a 1,326	X	X	X	X	X	X	X	X
Guinea	38.00	b 4,952	X	X	X	X	X	X	X	X
Guinea-Bissau	14.00	b 12,346	X	X	X	X	X	X	X	X
Kenya	3.00	a 103	X	X	X	X	X	X	X	X
Lesotho	0.50	b 229	X	X	X	X	X	X	X	X
Liberia	60.00	b 21,834	X	X	X	X	X	X	X	X
Libya	0.50	a 84	1985	2	420.0	554.7	13.3	4.3	82.5	3.00
Madagascar	55.00	b 3,364	1984	5	8.7	461.2	100.0	0.0	0.0	X
Malawi	1.40	b 135	X	X	X	X	X	X	X	X
Mali	20.00	a 1,690	1989	1	0.5	11.2	7.1	0.0	92.9	X
Mauritania	0.30	a 122	1985	1	293.3	498.3	X	X	X	1.70
Mauritius	0.68	a 589	X	X	X	X	X	X	X	X
Morocco	7.50	a 268	1985	3	40.0	138.6	X	X	X	4.00
Mozambique	17.00	b 910	X	X	X	X	X	X	X	0.10
Namibia	2.10	b 1,270	X	X	X	X	X	X	X	3.00
Niger	2.50	a 247	1988	0	X	17.9	57.7	3.8	38.5	X
Nigeria	87.00	b 714	X	X	X	X	X	X	X	3.00
Rwanda	3.60	b 551	X	X	X	X	X	X	X	X
Senegal	7.60	b 844	1985	0	3.3	39.2	25.0	0.0	75.0	0.05
Sierra Leone	50.00	b 10,924	X	X	X	X	X	X	X	X
Somalia	3.30	b 310	1985	0	9.1	38.1	X	X	X	0.10
South Africa	4.80	b 108	1980	2	37.3	61.4	10.6	5.6	83.8	17.50
Sudan	7.00	245	1985	0	4.0	13.0	X	X	X	0.40
Swaziland	X	X	X	X	X	X	X	X	X	X
Tanzania	30.00	b 932	X	X	X	X	X	X	X	X
Togo	5.70	a 1,286	X	X	X	X	X	X	X	X
Tunisia	1.21	a 127	1985	1	101.7	167.7	13.6	0.0	86.4	9.00
Uganda	29.00	b 1,360	X	X	X	X	X	X	X	X
Zambia	47.10	b 5,420	X	X	X	X	X	X	X	X
Zimbabwe	5.00	b 419	X	X	X	X	X	X	X	X
EUROPE										
Albania	7.00	b 2,032	X	X	X	X	X	X	X	X
Austria	22.30	b 2,716	1990	1	5.0	144.7	52.1	42.7	5.1	f X
Belarus, Rep	18.00	1,740	1985	1	5.9	106.0	55.6	14.1	30.3	X
Belgium	0.86	a 84	1980	1	90.7	79.2	68.3	27.0	4.8	X
Bosnia and Herzegovina	X	X	X	X	X	X	X	X	X	X
Bulgaria	13.40	a 1,598	1988	5	37.3	566.1	X	X	X	X
Croatia, Rep	X	X	X	X	X	X	X	X	X	X
Czech Rep	X	X	1990	1	X	77.9	X	X	X	X
Denmark	30.00	b 5,706	1985	1	3.7	215.1	40.2	22.0	37.9	f X
Estonia, Rep	4.00	2,718	X	X	X	X	X	X	X	X
Finland	1.90	369	1990	0	12.4	47.3	64.9	10.8	24.3	f X
France	100.00	b 1,703	1990	6	6.2	109.5	52.5	30.2	17.3	f X
Germany	45.70	b 555	1990	8	g 16.9	97.4	48.6	47.5	3.9	f X
Greece	2.50	h 237	1980	2	74.8	193.9	12.8	2.7	84.5	X
Hungary	6.80	b 685	1990	1	15.1	99.1	35.0	47.5	17.5	f X
Iceland	24.00	b 86,643	1985	0	0.4	394.2	X	X	X	X
Ireland	3.46	a 971	1980	0	4.9	50.0	34.5	36.8	28.7	X
Italy	30.00	b 524	1985	12	40.0	211.4	53.1	13.3	33.7	X
Latvia, Rep	2.20	879	X	X	X	X	X	X	X	X
Lithuania, Rep	1.20	322	X	X	X	X	X	X	X	X
Macedonia, FYR	X	X	X	X	X	X	X	X	X	X
Moldova, Rep	0.40	90	X	X	X	X	X	X	X	X
Netherlands	4.50	h 286	1985	1	25.3	78.7	32.0	44.5	23.4	f X
Norway	96.00	b 21,923	1985	0	0.1	26.5	27.3	72.7	0.0	X
Poland, Rep	36.00	931	1990	2	6.7	63.2	70.0	30.0	0.0	f X
Portugal	5.10	a 521	1990	3	60.1	310.6	38.6	22.8	38.6	f X
Romania	8.30	h 368	1975	1	14.2	55.5	61.0	38.1	0.8	X
Russian Federation	788.00	5,320	X	X	0.0	X	X	X	X	X
Slovak Rep	X	X	1990	1	X	142.5	X	X	X	X
Slovenia, Rep	X	X	X	X	X	X	X	X	X	X
Spain	20.70	i 521	1990	6	26.6	140.0	X	22.2	77.8	f X
Sweden	20.00	a 2,257	1990	1	3.0	69.8	91.7	8.3	0.0	X
Switzerland	2.70	369	1990	1	35.1	138.6	94.7	5.3	0.0	f X
Ukraine	20.00	388	1985	4	21.1	82.8	30.3	17.5	52.1	X
United Kingdom	9.80	168	1990	3	27.6	47.1	51.3	46.6	2.1	f X
Yugoslavia, Fed Rep	X	X	X	X	X	X	X	X	X	X

	Average Annual Groundwater Recharge		Year	Annual Groundwater Withdrawals						1990 Desalinated Water Production (million cubic meters)
	Total (cubic km)	1998 Per Capita (cubic meters)		Total (cubic km)	Percent of Annual Recharge	Per Capita (cubic meters)	Sectoral Share (percentage)			
							Domestic	Industry	Agriculture	
NORTH AMERICA										
Canada	369.60	12,241	1990	1	0.3	38.8	43.3	14.2	42.5	X
United States	1,514.00	5,531	1990	110	7.3	432.9	22.7	6.1	71.1	X
CENTRAL AMERICA										
Belize	X	X	X	X	X	X	X	X	X	X
Costa Rica	21.00	b 5,753	X	X	X	X	X	X	X	X
Cuba	8.00	b 720	1975	4	47.5	408.3	X	X	X	X
Dominican Rep	3.00	b 364	X	X	X	X	X	X	X	X
El Salvador	X	X	X	X	X	X	X	X	X	X
Guatemala	31.00	b 2,681	X	X	X	X	X	X	X	X
Haiti	2.50	b 332	X	X	X	X	X	X	X	X
Honduras	39.00	b 6,345	X	X	X	X	X	X	X	X
Jamaica	X	X	X	X	X	X	X	X	X	X
Mexico	139.00	b 1,450	1985	24	16.9	311.4	13.2	23.0	63.8	X
Nicaragua	59.00	b 13,217	X	X	X	X	X	X	X	X
Panama	42.00	b 15,179	X	X	X	X	X	X	X	X
Trinidad and Tobago	X	X	X	X	X	X	X	X	X	X
SOUTH AMERICA										
Argentina	128.00	b 3,543	1975	5	3.7	180.4	10.6	19.1	70.2	X
Bolivia	130.00	b 16,338	X	X	X	X	X	X	X	X
Brazil	1,874.00	b 11,347	X	X	X	X	X	X	X	X
Chile	140.00	b 9,444	X	X	X	X	X	X	X	X
Colombia	510.00	b 13,533	X	X	X	X	X	X	X	X
Ecuador	134.00	b 11,006	X	X	X	X	X	X	X	X
Guyana	103.00	b 120,327	X	X	X	X	X	X	X	X
Paraguay	41.00	b 7,851	X	X	X	X	X	X	X	X
Peru	303.00	b 12,219	1973	2	0.7	139.4	25.0	15.0	60.0	X
Suriname	80.00	b 180,995	X	X	X	X	X	X	X	X
Uruguay	23.00	b 7,101	X	X	X	X	X	X	X	X
Venezuela	227.00	b 9,767	X	X	X	X	X	X	X	X
ASIA										
Afghanistan, Islamic State	29.00	b 1,241	X	X	X	X	X	X	X	X
Armenia, Rep	4.20	b 1,154	X	X	X	X	X	X	X	X
Azerbaijan	6.50	b 856	X	X	X	X	X	X	X	X
Bangladesh	34.00	b 274	1979	3	10.0	39.6	12.9	0.9	86.2	X
Bhutan	X	X	X	X	X	X	X	X	X	X
Cambodia	30.00	b 2,790	X	X	X	X	X	X	X	X
China	870.00	b 693	1985	75	8.6	69.7	X	46.4 j	53.6	X
Georgia	17.23	b 3,166	X	X	X	X	X	X	X	X
India	350.00	b 359	1979	150	42.9	222.4	3.1	1.3	95.7	X
Indonesia	226.00	b 1,094	X	X	X	X	X	X	X	X
Iran, Islamic Rep	49.00	b 671	1980	29	59.2	738.8	X	X	X	2.90 k
Iraq	1.20	b 55	1985	0	16.7	13.1	55.6	44.4	0.0	X
Israel	1.10	a 187	1986	1	109.1	279.1	X	X	X	X
Japan	185.00	b 1,469	1990	13	7.0	104.3	29.3	40.7	30.1	X
Jordan	0.58	a 97	1985	0	70.7	107.0	X	X	X	2.00 l
Kazakhstan, Rep	35.87	b 2,133	X	X	X	X	X	X	X	X
Korea, Dem People's Rep	X	X	X	X	X	X	X	X	X	X
Korea, Rep	X	X	1985	1	X	29.4	0.0	83.3 j	16.7	X
Kuwait	X	X	X	X	X	X	X	X	X	231.00 l
Kyrgyz Rep	13.60	b 3,043	X	X	X	X	X	X	X	X
Lao People's Dem Rep	50.00	b 9,332	X	X	X	X	X	X	X	X
Lebanon	3.20	b 1,002	1985	1	18.8	224.9	X	X	X	X
Malaysia	71.00	b 3,310	X	X	X	X	X	X	X	X
Mongolia	23.00	b 8,765	X	X	X	X	X	X	X	X
Myanmar	156.00	b 3,276	X	X	X	X	X	X	X	X
Nepal	X	X	X	X	X	X	X	X	X	X
Oman	0.96	b 381	1985	0	41.9	280.7	X	X	X	34.00 m
Pakistan	55.00	b 372	1980	45	81.8	527.6	X	11.1 j	88.9	X
Philippines	180.00	b 2,494	1980	4	2.2	82.8	0.0	50.0	50.0	X
Saudi Arabia	2.20	b 109	1985	7	337.7	587.4	5.4	8.1	86.5	714.00 m
Singapore	X	X	X	X	X	X	X	X	X	X
Sri Lanka	17.00	b 921	X	X	X	X	X	X	X	X
Syrian Arab Rep	4.29	b 280	1985	4	85.5	353.0	X	X	X	X
Tajikistan, Rep	6.00	b 1,011	X	X	X	X	X	X	X	X
Thailand	43.00	b 721	1980	1	1.6	15.0	60.0	25.7	14.3	X
Turkey	20.00	b 314	1990	6	31.5	112.3	42.9	0.0	57.1	0.50
Turkmenistan, Rep	3.36	b 778	X	X	X	X	X	X	X	X
United Arab Emirates	0.12	b 51	1985	0	X	251.3	X	X	X	385.00 m
Uzbekistan, Rep	19.68	b 848	X	X	X	X	X	X	X	X
Vietnam	84.00	b 1,078	X	X	X	X	X	X	X	X
Yemen	1.50	b 89	1985	1	90.0	139.2	X	X	X	10.00 n
OCEANIA										
Australia	X	X	1983	2	X	162.2	X	22.6 j	77.4	X
Fiji	72.00	a 87,591	X	X	X	X	X	X	X	X
New Zealand	198.00	b 53,804	X	X	X	X	X	X	X	X
Papua New Guinea	X	X	X	X	X	X	X	X	X	X
Solomon Islands	X	X	X	X	X	X	X	X	X	X

Notes: a. Sum of all aquifer recharge flows. b. Sum of all groundwater flows (as a constituent of surface water flows). c. Ethiopia includes Eritrea. d. 1988. e. 1992. f. Sectoral data predate other withdrawal data. g. Sum of the total groundwater flow that is exploitable. h. Combined with 1975 withdrawal data from the former German Democratic Republic. i. Sum of groundwater flows collected by water courses and those that discharge directly to the sea. j. Domestic and industrial withdrawals combined. k. 1991. l. 1993. m. 1995. n. 1989.

Data Table 12.3

Water Quality in European Lakes, 1994

Source: European Environment Agency

Lake	Countries	Surface Area (km ²)	Volume (km ³)	Maximum Depth (m)	Mean Depth (m)	Catchment Area (km ²)	Years of Data	Secchi Depth (m) (a)	pH	Concentration of			
										Chlorophyll (µg/l)	Phosphorous (µg/l)	Nitrogen (mg/l)	Chloride (mg/l)
Ammersee	DE	47	1.8	81	38	993	1975	4.0	X	X	55	X	X
Arreso	DK	42	0.1	6	3	258	1990	0.4	9.5	345	514	3.5	X
Attersee	AT	46	3.9	171	84	464	1975-79	8.0-9.0	8.0	X	7	X	X
Balaton	HU	593	1.9	12	3	5,181	1979-83	0.6	8.4	8-36	30-86	0.7-1.4	X
Bodensee	AT, DE, CH	539	49.0	252	90	10,900	1991	X	X	X	32	1.0	X
Bolsena	IT	114	9.2	151	81	273	X	7.0	X	X	25	X	X
Bracciano	IT	57	5.1	165	89	147	X	6.0	X	X	10	X	X
Chiemsee	DE	80	2.0	73	26	1,399	1983	X	X	6	30	X	X
Como	IT	146	22.5	410	153	4,570	X	1.0	X	X	48	X	X
Corrib	IR	170	X	X	X	X	1991	4.7	X	3	11	X	X
Derg	IR	116	0.9	36	8	10,280	1991-92	1.7	X	17	43	X	X
Dospat reservoir	BG	22	0.4	46	20	432	1984-86	X	6.5	45	60	0.8	X
Dubasari	MD	68	0.3	20	4	53,590	1991	X	8.0	X	111	1.9	49.0
Eemmeer & Gooimeer	NL	54	X	10	2	X	1990	X	8.8	130	680	0.4	X
Femunden	NO	204	6.0	150	30	1,723	1991	11.0	6.7	1	4	0.2	X
Garda	IT	368	49.0	350	133	2,290	X	5.0	X	X	10	X	X
Haringvliet	NL	86	X	38	10	X	1990	1.0	8.1	9	195	0.3	X
Hjalmaren	SE	478	3.0	20	6	3,569	1990	2.0	7.6	12	46	0.7	12.0
Ijsselmeer	NL	2,000	X	6	5	X	1990	1.0	8.5	81	170	0.1	X
Ilmen	RS	1,124	2.9	10	3	66,400	X	X	X	3	70	0.9	28.0
Inari	FI	1,102	15.1	96	14	13,400	1991	8.0	7.2	1	4	0.2	X
Iseo	IT	61	7.6	251	123	1,736	X	4.0	X	X	32	X	X
Lac Léman	FR, CH	584	89.0	310	153	7,975	1991	8.0	X	6	52	0.7	6.0
Lac Lucerne	CH	114	11.8	214	104	1,831	1991	X	X	X	5	0.6	X
Lac Neuchâtel	CH	218	14.0	152	64	2,670	1991	12.0	8.4	1	20	1.3	X
Ladoga	RS	17,670	908.0	258	51	258,600	1976-85	3.0	X	3	27	0.6	X
Lago Maggiore	IT, CH	213	37.5	372	177	6,598	X	2.0	8.8	3	14-25	0.9	X
Lago Trasimeno	IT	124	0.6	6	5	396	X	1.0	X	X	55	X	X
Lebsko	PL	71	0.1	6	2	1,536	1990	1.0	X	100	137	1.6	X
Loch Awe	UK	39	1.2	94	32	780	1977-78	3.0	6.9	2	X	X	X
Loch Lomond	UK	71	2.6	190	37	781	1991-92	X	8.9	137	120	2.2	X
Loch Morar	UK	27	2.3	310	87	142	1977-78	6-10	6.6	1	X	X	X
Loch Ness	UK	56	7.5	230	132	1,775	1977-78	4.0	6.7	1	X	X	X
Lough Neigh	UK	396	4.8	34	12	4,453	1975-87	1.1	8.3	49	108	2.2	X
Mälaren	SE	1,140	14.0	61	13	21,463	1990	1.0	7.6	10	32	0.9	8.0
Mamry Polnocne	PL	26	0.3	44	12	596	1990	4.0	X	3	60	1.0	X
Markemeer	NL	670	X	5	4	X	1990	X	8.3	10	45	0.1	X
Mask	IR	80	X	X	X	X	1991	4.5	X	3	11	X	X
Mjøsa	NO	362	56.2	449	153	16,420	1991	9.0	7.1	3	7	0.4	X
Muritz	DE	114	0.9	31	8	X	X	2.0	X	X	80	X	X
Neusiedlersee	AT, HU	300	0.3	2	1	1,000	1977	X	8.7	12	102	X	X
Niegocin	PL	26	0.3	40	10	378	1990	1.0	X	34	300	1.3	X
Ohri	AL	363	52.6	287	145	599	X	X	X	X	X	X	X
Omega	RS	9,670	292.0	120	30	52,970	1967-89	4.0	X	4	12	0.6	2.0
Oulujärvi	FI	893	6.8	35	8	19,000	1991	2.0	6.7	7	14	0.4	X
Øyeren	NO	85	1.1	70	13	40,000	1991	3.0	7.2	4	9	0.4	X
Paijanne	FI	1,054	17.8	98	17	25,400	1991	X	7.1	X	7	0.5	X
Peipus	EE, RS	3,570	27.0	47	7	44,350	1980-86	1.8-3.6	7.8-8.1	14	X	0.8	5.3-11.8
Pielinen	FI	867	8.5	60	10	12,823	1991	4.0	6.4	3	10	0.5	X
Prespa	AL, GR	329	5.9	35	18	599	X	X	X	X	X	X	X
Randsfjorden	NO	137	6.1	121	44	3,663	1991	8.0	7.3	1	5	0.5	X
Ree	IR	105	0.7	35	6	4,530	1993-94	1.5	X	15	40	X	X
Saimaa	FI	1,147	13.9	82	12	60,100	1991	4.0	6.9	3	6	0.5	X
Shkrodra	AL, FYROM	368	2.9	10	8	1,026	1972-73	4.0	7.8	X	X	X	X
Sniardwy	PL	114	0.7	23	6	2,425	1990	2.0	X	17	115	1.1	X
Snäsvatnet	NO	121	5.5	121	46	1,433	1988	4.0	7.1	2	5	0.2	X
Starnberger See	DE	56	3.0	128	53	258	1978-79	8.0	X	6	26	X	X
Storsjøen	NO	51	7.1	309	145	1,912	1990	X	7.0	2	8	0.2	X
Thingvalla	IS	84	2.9	114	34	X	1975	X	7.3	X	X	0.1	7.0
Thrichonis	GR	97	X	58	X	215	1978	6.0	8.3	1	24	0.2	X
Tyrfjorden	NO	121	13.8	295	114	9,808	1991	7.0	X	2	5	0.4	X
Volvi	GR	67	0.9	23	14	1,247	1985-86	1.6	8.5	X	X	0.0	X
Vänern	SE	5,670	152.0	106	27	41,180	1990	5.0	7.4	2	9	0.8	6.0
Vättern	SE	1,912	74.0	128	39	4,447	1990	12.0	7.5	1	6	0.7	9.0
Vörtjärn	EE	270	0.8	6	3	3,100	1991	X	7.8	22	43	2.4	17.0
Windermere	UK	15	0.3	64	24	231	1991-92	X	7.0	23	20	1.0	X
Zürich See	CH	90	3.9	143	51	1,740	1991	X	X	X	45	0.8	X

Notes: a. Indicates water transparency. AL: Albania; AT: Austria; BG: Bulgaria; CH: Switzerland; DE: Germany; DK: Denmark; EE: Estonia; FI: Finland; FR: France; FYROM: Former Yugoslav Rep of Macedonia; GR: Greece; HU: Hungary; IR: Ireland; IS: Iceland; IT: Italy; MD: Moldova; NL: the Netherlands; NO: Norway; PL: Poland; RS: Russian Federation; SE: Sweden; UK: United Kingdom.

Data Table 12.4

Major Watersheds of the World, 1998

Sources: Various

Major Watershed	Modeled Watershed Area (a) (000 km ²)	Number of Countries within Watershed (b)	Population Density (per km ²)	Land Use		Percent Developed Area (c)	Percent Original Forest Loss (d)	Percent Arid Area	Percent Wetlands Area	Percent Protected Area	Number of Ramsar Sites (e)	Nutrient Concentration	
				Percent Cropland	Percent Forest							Nitrate (mg/l)	Phosphate (mg/l)
AFRICA													
Chari	549	5	11.0	1.9	0.6	0.1	99.9	34.2	22.5	13.4	0	X	X
Congo	3,807	9	14.5	7.8	43.4	X	45.9	0.0	9.0	4.7	3	X	X
Juba-Shibeli	834	3	18.7	5.6	2.1	0.1	76.5	75.1	2.8	1.4	2	X	X
Limpopo	421	4	35.1	27.9	0.8	X	99.0	47.3	2.8	8.1	1	X	X
Niger	2,262	10	31.2	5.0	0.3	1.1	95.9	65.4	4.1	4.9	6	X	X
Nile	3,255	f	42.7	10.3	2.0	1.1	92.1	67.4	6.1	4.4	2	0.80	0.03
Okavango	721	g	2.6	5.5	1.9	X	0.2	75.8	4.1	12.1	1	X	X
Orange	941	4	12.3	6.6	0.2	X	99.9	77.0	0.8	4.7	1	0.72	X
Senegal	420	4	11.8	4.9	0.0	0.1	99.9	82.0	3.6	5.7	4	X	X
Volta	407	6	42.2	10.8	0.3	0.8	96.6	59.9	4.6	7.7	3	X	X
Zambezi	1,332	8	17.7	20.4	4.1	X	43.1	8.7	7.6	7.7	1	0.13	X
EUROPE													
Danube	796	13	103.5	66.5	20.4	11.3	63.1	2.6	1.4	6.6	47	X	0.10
Dnieper	502	3	67.0	85.4	3.0	9.9	77.6	3.6	6.2	1.2	0	0.20	0.01
Dniester	69	3	104.7	82.2	7.2	9.8	85.0	5.8	1.1	1.4	0	1.00	0.10
Don	459	2	48.1	83.0	1.8	9.0	75.4	33.1	0.5	0.4	1	X	X
Ebro	83	1	37.8	57.1	10.3	15.4	84.8	39.8	0.9	8.2	4	1.50	0.04
Elbe	149	4	164.1	73.5	4.7	20.7	74.6	0.0	1.7	12.5	11	3.00	0.38
Garonne	54	3	56.2	74.8	6.7	16.4	84.6	0.0	0.1	7.1	0	1.50	0.10
Glåma	42	1	26.3	1.2	51.2	19.4	5.9	0.0	1.9	4.2	3	0.42	0.01
Guadalquivir	53	1	67.9	49.4	3.1	22.6	95.5	34.6	3.1	13.7	3	X	X
Kemijoki	52	3	2.3	0.3	75.7	9.2	2.9	0.0	2.9	7.1	1	X	X
Loire	115	1	66.1	82.3	1.5	15.8	89.4	0.0	0.9	9.8	3	1.70	0.10
Po	77	2	215.3	48.4	13.9	22.0	80.4	0.0	1.8	9.1	9	1.40	0.08
Rhine-Maas	199	8	304.1	64.2	7.2	26.2	71.0	0.0	1.0	18.0	20	3.88	0.40
Rhone	101	2	97.3	61.3	11.3	21.0	68.6	0.0	0.9	13.6	4	4.01	0.10
Seine	79	1	200.7	77.8	1.6	20.4	92.7	0.0	0.1	4.7	1	4.30	0.40
Tajo (Tagus)	75	2	113.1	45.4	3.9	20.1	90.4	28.1	1.7	4.5	2	0.66	1.31
Ural	244	2	13.0	57.8	2.9	6.0	32.2	99.5	0.2	1.0	0	X	X
Vistula	180	4	131.4	80.1	3.9	14.9	82.0	0.0	3.2	10.2	2	X	X
Volga	1,484	2	41.4	59.2	23.0	10.3	53.0	18.6	2.6	1.1	3	0.62	0.02
Weser	45	1	198.1	76.9	2.6	20.2	78.2	0.0	0.1	18.5	4	4.95	0.57
NORTH & CENTRAL AMERICA													
Brazos	137	1	20.0	24.3	3.0	15.5	81.4	80.1	14.8	0.1	0	X	X
Colorado	703	2	10.0	0.8	23.5	7.7	42.8	89.1	2.5	8.1	0	0.30	0.10
Columbia	657	2	9.0	6.2	49.4	8.5	21.5	48.7	6.3	7.5	1	0.11	0.03
Fraser	248	2	5.8	0.5	89.0	X	7.0	2.5	1.7	11.8	0	0.09	0.05
Mackenzie	1,706	1	0.2	3.0	62.7	X	7.9	0.0	48.9	5.0	3	0.14	0.04
Mississippi	3,202	2	21.5	34.8	22.1	14.3	51.7	35.5	20.0	1.5	6	1.06	0.20
Nelson-Saskatchewan	1,093	2	2.2	54.3	34.0	X	24.3	21.5	86.8	4.0	5	0.03	0.05
Rio Grande	608	2	15.8	5.2	13.8	6.5	52.1	96.0	2.1	2.3	1	0.29	X
St. Lawrence	1,049	2	41.6	16.7	46.1	18.4	22.7	0.0	47.2	7.9	7	0.22	0.02
Yukon	848	2	0.2	0.0	51.0	X	23.1	0.0	27.8	28.9	1	0.12	0.01
SOUTH AMERICA													
Amazon	6,144	7	4.3	14.9	72.9	0.5	13.2	4.0	8.3	7.0	3	0.17	0.02
Magdalena	264	1	78.8	38.6	36.6	10.0	87.5	7.2	0.2	4.0	0	0.25	0.12
Orinoco	954	2	13.1	18.8	49.6	2.8	22.5	8.5	15.3	23.7	0	0.08	0.01
Parana	2,583	4	23.5	44.5	11.7	3.5	70.6	9.9	10.9	2.8	7	0.03	0.07
São Francisco	618	1	17.6	61.4	0.8	2.4	64.4	32.0	9.7	0.5	0	X	X
Tocantins	764	1	5.9	62.7	8.6	1.0	49.7	0.0	19.1	1.3	1	0.02	0.00
Uruguay	297	3	24.6	44.1	6.7	3.0	92.4	0.0	3.9	1.5	0	0.30	0.02
ASIA & OCEANIA													
Amur	1,930	3	35.2	18.2	67.7	3.2	33.4	15.1	4.4	1.6	7	0.12	0.04
Brahmaputra	651	4	173.8	29.2	18.4	2.5	73.2	0.0	20.7	3.7	1	0.82	0.06
Ganges	1,016	4	374.6	70.8	4.2	8.0	84.5	26.0	17.7	5.6	4	0.19	X
Godavari	320	1	194.5	63.3	6.8	7.2	76.9	43.0	1.2	3.5	0	X	X
Hwang Ho	945	1	162.2	28.9	3.3	6.9	78.1	37.5	1.1	1.3	0	0.17	0.02
Indus	1,082	4	145.4	23.7	0.4	4.4	90.1	62.6	4.1	4.4	10	0.40	0.13
Irrawaddy	414	3	79.5	30.6	56.3	1.7	60.9	0.0	6.2	0.6	0	X	X
Kolyma	680	1	0.5	0.0	5.2	X	55.9	0.0	1.0	0.2	0	0.05	X
Krishna	226	1	248.2	66.5	2.8	8.4	80.2	41.3	16.2	4.2	0	0.16	X
Lena	2,307	1	1.3	1.7	83.6	0.6	19.1	0.7	0.6	1.3	0	0.09	0.01
Mahanadi	146	1	191.8	58.4	8.2	6.1	79.4	0.0	0.2	3.6	0	X	X
Mekong	806	6	77.6	37.9	41.5	2.2	69.2	0.0	8.7	5.4	0	X	X
Murray-Darling	1,050	1	2.1	28.9	8.1	X	63.8	67.1	3.1	4.2	9	0.03	0.10
Narmada	96	1	191.9	75.5	0.8	7.6	71.3	25.8	0.8	3.9	0	0.12	0.02
Ob	3,028	4	9.4	23.3	21.1	5.2	38.4	42.2	11.1	1.9	4	0.09	0.06
Salween	272	3	75.6	5.6	43.5	0.4	72.3	0.0	9.5	2.3	0	X	X
Tapti	75	1	232.7	77.6	0.1	7.8	61.0	63.6	0.8	4.0	0	0.60	X
Tigris & Euphrates	766	4	57.6	24.6	1.3	9.0	99.9	90.9	2.9	0.4	0	X	X
Xun Jiang	409	2	209.6	76.4	11.4	6.3	80.4	0.0	1.3	1.1	0	0.60	0.00
Yangtze	1,722	1	223.7	56.3	10.5	3.5	84.9	0.0	3.0	1.7	2	0.77	0.01
Yenisey	2,499	2	2.3	12.3	49.5	1.7	19.2	10.5	2.7	3.3	1	0.10	0.01

Notes: a. Watershed area was digitally derived from elevation data. b. Number of countries may differ from the U.N. listing under the Registry of International Rivers due to recent changes in political boundaries of many countries. c. Based on stable nighttime lights data. These figures overestimate the actual area lit. Data were not available for all regions of the world.

d. Closed forest cover estimated to exist 8,000 years ago assuming current climate conditions. e. Wetlands of international importance. f. The number of countries sharing the Nile basin has increased to 10 with the independence of Eritrea. g. Watershed includes intermittent tributaries in Botswana (Northern Kalahari desert). h. Excludes countries that have <1% area in the watershed. i. Basin excludes the tidal area of the St. Lawrence River.

Sources and Technical Notes

Data Table 12.1

Freshwater Resources and Withdrawals, 1970–98

Sources: Water resources and withdrawal data come from a variety of sources: J. Forkasiewicz and J. Margat, *Tableau Mondial de Données Nationales d'Economie de l'Eau, Ressources et Utilisation* (Département Hydrogéologie, Orléans, France, 1980); J. Margat, Bureau de Recherches Géologiques et Minières, Orléans, France, April 1988 (personal communication); and Alexander V. Belyaev, Institute of Geography, U.S.S.R. National Academy of Sciences, Moscow, September 1989 and January 1990 (personal communication). Withdrawal and sectoral use data for the United States: Wayne B. Solley, Robert R. Pierce, and Howard A. Perlman, "Estimated Use of Water in the United States, in 1990," *U.S. Geological Survey Circular*, No. 1081 (U.S. Geological Survey, Reston, Virginia, 1993); European Communities–Commission, *Environment Statistics 1989* (Office des Publications Officielles des Communautés Européennes, Luxembourg, 1990); United Nations Economic Commission for Europe (ECE), *The Environment in Europe and North America* (U.N., New York, 1992); ECE, *ECE Environmental Statistical Database*, on diskette (Statistical Division, U.N./ECE, 1995); Organisation for Economic Co-Operation and Development (OECD), *OECD Environmental Data Compendium* (OECD, Paris, 1995); Food and Agriculture Organization of United Nations (FAO), *Water Resources of African Countries, A Review* (FAO, Rome, 1995); FAO, *Irrigation in Africa in Figures, Water Reports No. 9* (FAO, Rome, 1997); FAO, *Water Resources of the Near East Region, Water Report* (FAO, Rome, 1997); FAO, *Irrigation in the Near East Region in Figures, Water Reports No. 7* (FAO, Rome, 1995); FAO, *Irrigation in the Former Soviet Union in Figures, Water Report* (FAO, Rome, forthcoming); and FAO, *Water Resources of the Former Soviet Union, Water Report* (FAO, Rome, in preparation).

Population: United Nations (U.N.) Population Division, *World Population Prospects, 1950–2050 (The 1996 Revision)*, on diskette (U.N., New York, 1996). Withdrawal data in this table were updated or confirmed from individual country reports when possible. For example, this was accomplished for Egypt, Morocco, South Africa, the Republic of Korea, Vietnam, Honduras, Brazil, Guyana, and Japan, based on reports prepared by each country for the United Nations Conference on Environment and Development in Rio de Janeiro, Brazil, in 1992. In general, data are compiled from published documents (including national, United Nations, and professional literature) and from estimates, when necessary, of resources and consumption from models using other data, such as area under irrigated agriculture, livestock populations, and precipitation.

Annual internal renewable water resources refers to the average annual flow of rivers and recharge of groundwater generated from endogenous precipitation. Caution should be used when comparing different countries because these estimates are based on differing sources and dates. These annual averages also disguise large seasonal, interannual, and long-term variations. When data for *annual river flows from and to other countries* are not shown, the internal renewable water resources figure may include these flows. When such data are shown, they are not included in a country's total internal renewable water resources. *Per capita* annual internal renewable water resources data were calculated using 1998 population estimates. Actual annual renewable water resources available for use is usually less than the sum of internal renewable resources and river flows. This is due to the fact that not all resources can be mobilized for use and that part of the flow coming from upstream countries or leaving for downstream countries might be reserved to those countries by treaty or other agreement. For example, Sudan's actual water resources include the flow of the Nile, less the amount that it is committed by treaty to deliver to Egypt at Aswan.

Annual withdrawals as a percentage of water resources refer to *total* water withdrawals, not counting evaporative losses from storage basins, as a percentage of internal renewable water resources. Water withdrawals also include water from nonrenewable groundwater sources, river flows from other countries, and desalination plants in countries where that source is a significant part of all water withdrawals. *Per capita* annual withdrawals were calculated using national population data for the year of data shown.

Sectoral withdrawals are classified as *domestic* (drinking water, homes, commercial establishments, public services [e.g., hospitals], and municipal use); *industrial* (some countries include water withdrawn to cool thermoelectric plants, while others do not; these can be significant amounts of total water withdrawals); and *agricultural* (irrigation and livestock).

Totals may not add because of rounding.

Data Table 12.2

Groundwater and Desalination, 1998

Sources: Groundwater resources and withdrawal data come from several sources: J. Margat, *Les Eaux Souterraines Dans Le Monde* (BRGM—Services Sol et Sous-Sol, Département Eau, Orléans, France, December 1990); Organisation for Economic Co-Operation and Development (OECD), *OECD Environmental Data Compendium 1993*, (OECD, Paris, 1993); and Economic Commission for Europe (ECE), *The Environment in Europe and North America* (U.N., New York, 1992). Groundwa-

ter resources and desalination activities: Food and Agriculture Organization of the United Nations (FAO), *Irrigation in Africa in Figures, Water Reports 7* (FAO, Rome, 1995); FAO, *Water Resources of African Countries: A Review* (FAO, Rome, 1995); FAO, *Water Resources of the Near East Region, Water Report* (FAO, Rome, 1997); FAO, *Irrigation in the Near East Region in Figures, Water Reports No. 7* (FAO, Rome, 1995); FAO, *Irrigation in the Former Soviet Union in Figures, Water Report* (FAO, Rome, forthcoming); and FAO, *Water Resources of the Former Soviet Union, Water Report* (FAO, Rome, in preparation).

Average annual groundwater recharge is the amount of water that is estimated to annually infiltrate soils, including water from rivers and streams that lose it to underlying strata. In general, this figure would represent the maximum amount of water that could be withdrawn annually without ultimately depleting the groundwater resource. These data are estimated in a variety of ways (see footnotes and J. Margat), and caution should be used in comparing values for different countries.

Per capita recharge is the amount of water that annually infiltrates soils on a per-person basis, using 1998 population estimates.

Annual total groundwater withdrawals refer to abstractions from all groundwater sources—even nonrenewable sources. The *percent of annual recharge* refers to *total* groundwater withdrawals.

Per capita annual withdrawals were calculated using national population data for the year of data shown for withdrawals.

Sectoral share of withdrawals of groundwater is classified as *domestic* (drinking water, homes, commercial establishments, public services [e.g., hospitals], and municipal use or provision); *industry* (including water withdrawn to cool thermoelectric plants); and *agriculture* (irrigation and livestock).

Desalinated water production refers to the removal of salt from saline waters—usually seawater—using a variety of techniques including reverse osmosis. Most desalinated water is used for domestic purposes.

Totals may not add because of rounding.

Data Table 12.3

Water Quality in European Lakes, 1994

Source: Physical lake characteristics and water quality data: P. Kristensen and H.O. Hansen, *European Rivers and Lakes—Assessment of Their Environmental State*, European Environment Agency Environmental Monographs No. 1 (European Environment Agency, Copenhagen, 1994).

These data were compiled from questionnaires distributed to the European countries, scientific literature, National State of the Environment reports,

and from the International Lake Environment Committee Foundation database. Because these data are from very different primary sources, lake data are not strictly comparable. The table, however, provides a good indication of the lake water quality in various European regions.

The majority of European lakes have a small surface area between 0.01–1.0 square kilometers. There are 16,000 lakes with a surface area larger than 1 square kilometer. Of these, 14,525 are located in the Nordic countries and the Russian Federation. For the purpose of this table, a subset of the most well-known lakes in Europe was selected. These were data-rich lakes representing different regions in Europe. Lakes are identified by the name most commonly used in the country or region where they are located.

Measurements of *surface area* are generally reported as the largest area for lakes subject to normal size variations and usually include the area of any islands within the lakes.

Calculation of *volume* and *mean depth* requires detailed knowledge of the lake bottom and is usually estimated. *Maximum depth* can be measured directly. Mean and maximum depths and water volume are important factors in understanding potential productivity.

Catchment area is the area of the drainage basin (excluding the area of the lake) that provides water to the lake.

Years of data shows the years for which water quality data were available. Some countries specified annual averages, while others provided only summer averages. For countries showing more than one year, water quality data represent an average for the period shown. Therefore, care should be taken when making comparisons. For some countries, the year or period of the data is unknown and has been marked as missing data.

Secchi depth is a measure of transparency of water obtained by lowering a white disk into the water until it is no longer visible.

The *pH* of the water can range from pH 4 for acidic waters to a pH 11 for alkaline waters. A pH 7 is neutral.

Concentrations of *chlorophyll*, *phosphorous*, *nitrogen*, and *chloride* provide information on the nutrient and pollution levels of a lake. Lakes located in pristine areas usually have low nutrient levels (total phosphorous concentrations are less than 10 to 20 micrograms per liter and total nitrogen concentrations are less than 0.5 milligrams per liter). The nutrient levels in a lake depend on the external loading and on the characteristics of the catchment area. Lakes in catchment areas with intensive agriculture have more nutrient loadings from fertilizer runoff, etc. High nutrient levels produce an increase in phytoplankton (chlorophyll levels), which in turn increases the turbidity of the water (low water transparency) and can alter the biological composition of the aquatic community.

Data Table 12.4

Major Watersheds of the World, 1998

Sources: Watershed selection and nutrient concentration: United Nations Environment Programme (UNEP)/Global Environment Monitoring System (GEMS), *Water Quality of World River Basins*, UNEP Environmental Library No. 14 (UNEP, Nairobi, 1995), and Oxford University Press, *Atlas of the World*, Second Edition (Oxford University Press, Inc., New York, 1993). Modeled watershed area: Center for Remote Sensing and Spatial Analysis (CRSSA), Cook College, Rutgers University, and U.S. Army Corps of Engineers Construction Engineering Research Laboratories (CERL), *Major Watershed Basins of the World* in Global ARC GIS Database CD-ROM (CRSSA, New Brunswick, New Jersey, 1996) and edited by the World Resources Institute. Number of countries within watershed: Environmental Systems Research Institute (ESRI) software (ESRI, Redlands, California, 1995). Mean population density: National Consortium for Geographic Information and Analysis (NCGIA), Global Demography Project, *Gridded Population of the World*, data set for 1995 distributed by the Consortium for International Earth Science Information Network (CIESIN), available online at: <http://www.ciesin.org/datasets/gpw/globldem.doc.html> (CIESIN, 1995). Cropland and forest: U.S. Geological Survey (USGS), University of Nebraska–Joint Research Center for the European Commission, *Global Land Cover Characterization* database, distributed by USGS Earth Resources Observation System (EROS) Data Center, available online at: <http://edcwww.cr.usgs.gov/landdaac/glcc/glcc.html> (USGS, 1992–93). Developed area: National Oceanic and Atmospheric Administration National Geophysical Data Center (NOAA-NGDC), *Nighttime Lights of the World* database, available online at: <http://www.ngdc.noaa.gov/8080/production/html/BIOMASS/night.html> (NOAA-NGDC, 1994–95). Original forest data: D. Bryant, D. Nielsen, and L. Tangley, *The Last Frontier Forests: Ecosystems and Economies on the Edge* (World Resources Institute, Washington, D.C., 1997). Arid area: UNEP, *World Atlas of Desertification Global Aridity Zone Map* (UNEP, Nairobi, 1992). Wetlands areas and protected areas: World Conservation Monitoring Centre (WCMC), *Biodiversity Map Library* software (WCMC, Cambridge, U.K., 1996). Ramsar sites: Ramsar Convention Bureau, *List of Wetlands of International Importance* (Ramsar Convention Bureau, Gland, Switzerland, 1997).

The *major watersheds* included in the table are from the 82 major watersheds of the world identified by UNEP/GEMS. This list includes major river systems and smaller river systems of regional significance. Sixteen watersheds were excluded for their small size or because our derived basin area differed considerably from the United Nations estimate of river basins in the *Register of International Rivers* (Center for Natural Resources, Energy, and Transport of the Department of Economic and So-

cial Affairs of the United Nations, Pergamon Press, Oxford, U.K., 1978). Several additional river basins were added to this table from the *Atlas of the World* list of major river basins to gain more complete geographic coverage. The basins in this table represent approximately 42 percent of the world's land area.

Most of the data in this table were obtained through geographic information system (GIS) analysis of multiple data sets. The base data layer used for geographic definition of the watersheds was a 5-minute resolution data set (one-twentieth of a degree latitude longitude) of major watershed basins. There are some limitations associated with the scale of this base data: watershed boundaries are coarse, and some smaller basins and small tributaries are not identified. Subbasins were then aggregated to include all tributaries of the major river systems. Summary statistics for each watershed were digitally extracted by overlaying the basin map onto other existing digital data sets.

Modeled watershed area was estimated using an equal area projection and summing the number of 1 km² cells within each basin. The derived basin area was compared to the U.N. data from the *Register of International Rivers* and only those whose area did not vary more than 10–15 percent from the U.N. data were included in the table. There are two exceptions to this: the Okavango and the St. Lawrence River basins. Intermittent tributaries are included in the northern part of the Kalahari desert in Botswana within the Okavango basin. The tidal area of the St. Lawrence River is excluded. Water surface of rivers and lakes (e.g., the Great Lakes in the St. Lawrence River watershed) are included in the drainage area.

Number of countries within watershed were identified using updated 1995 country boundaries from the Environmental Systems Research Institute (ESRI). Countries included in each basin are listed below. Countries are listed in descending order as to their share of the basin (i.e., countries with more land within a basin are listed first). The countries listed may differ with the U.N. due to the recent independence of many countries (i.e., the Nile basin now includes both Ethiopia and Eritrea). *Chari*: Chad, Central African Republic, Cameroon, Sudan, and Nigeria. *Congo*: Dem. Rep. Congo, Central African Republic, Angola, Rep. Congo, Tanzania, Zambia, Cameroon, Burundi, and Rwanda. *Juba-Shibeli*: Ethiopia, Somalia, and Kenya. *Limpopo*: South Africa, Botswana, Mozambique, and Zimbabwe. *Niger*: Mali, Nigeria, Niger, Algeria, Guinea, Cameroon, Burkina Faso, Benin, Côte d'Ivoire, and Chad. *Nile*: Sudan, Ethiopia, Egypt, Uganda, Tanzania, Kenya, Dem. Rep. Congo, Rwanda, Burundi, and Eritrea. *Okavango*: Botswana, Namibia, Angola, and Zimbabwe. *Orange*: South Africa, Namibia, Botswana, and Lesotho. *Senegal*: Mali, Mauritania, Senegal, and Guinea. *Volta*: Burkina Faso, Ghana, Mali, Togo, Côte d'Ivoire, and Benin. *Zambezi*: Zambia, Angola, Zimbabwe, Mozambique, Malawi, Botswana, Tanzania, and Namibia. *Danube*: Romania, Hungary, Serbia, Austria, Germany, Slovakia, Bosnia and Herzegovina, Bulgaria, Croatia, Ukraine, Czech Republic, Slovenia, and

Moldova, and with less than 1 percent of the basin area: Switzerland, Italy, Poland, and Albania. *Dniester*: Ukraine, Belarus, and Russia. *Dniester*: Ukraine, Moldova, and Poland. *Don*: Russia and Ukraine. *Ebro*: Spain, and with less than 1 percent of the basin area: France and Andorra. *Elbe*: Germany, Czech Republic, Austria, and Poland. *Garonne*: France, Spain, and Andorra. *Gläma*: Norway. *Guadalquivir*: Spain. *Kemijoki*: Finland, Norway, and Russia. *Loire*: France. *Po*: Italy and Switzerland. *Rhine-Maas*: Germany, France, Switzerland, Austria, Belgium, Netherlands, Luxembourg, and Liechtenstein. *Rhone*: France and Switzerland. *Seine*: France. *Tajo (Tagus)*: Spain and Portugal. *Ural*: Kazakhstan and Russia. *Vistula*: Poland, Ukraine, Belarus, and Slovakia. *Volga*: Russia and Kazakhstan. *Weser*: Germany. *Brazos*: United States. *Colorado*: United States and Mexico. *Columbia*: United States and Canada. *Fraser*: Canada and United States. *Mackenzie*: Canada. *Mississippi*: United States and Canada. *Nelson-Saskatchewan*: Canada and United States. *Rio Grande*: United States and Mexico. *St. Lawrence*: Canada and United States. *Yukon*: United States and Canada. *Amazon*: Brazil, Peru, Bolivia, Colombia, Ecuador, Venezuela, and Guyana. *Magdalena*: Colombia. *Orinoco*: Venezuela and Colombia. *Parana*: Brazil, Argentina, Paraguay, and Bolivia. *São Francisco*: Brazil. *Tocantins*: Brazil. *Uruguay*: Brazil, Uruguay, and Argentina. *Amur*: Russia, China, and Mongolia. *Brahmaputra*: China, India, Bangladesh, and Bhutan. *Ganges*: India, Nepal, China, and Bangladesh. *Godavari*: India. *Hwang Ho*: China. *Indus*: Pakistan, India, Afghanistan, and China. *Irrawaddy*: Myanmar, China, and India. *Kolyma*: Russia. *Krishna*: India. *Lena*: Russia. *Mahanadi*: India. *Mekong*: Laos, Thailand, China, Cambodia, Vietnam, and Myanmar. *Murray-Darling*: Australia. *Narmada*: India. *Ob*: Russia, Kazakhstan, China, and Mongolia. *Salween*: China, Myanmar, and Thailand. *Tapti*: India. *Tigris and Euphrates*: Iraq, Turkey, Iran, and Syria. *Xun Jiang*: China and Vietnam. *Yangtze*: China. *Yenisey*: Russia and Mongolia.

Population density was extracted from a global 5-minute resolution population map. Basins were

overlaid on population data, and the population density was calculated for each basin. Data are presented as the number of people per square kilometer.

Land use: The USGS Global Land Cover Characterization database with the International Geosphere Biosphere Programme (IGBP) classification was used to identify the extent of different land cover types within each basin. The land cover database is derived from 1-km resolution satellite data spanning April 1992 through March 1993. *Percent cropland* indicates the percentage of the basin defined as cropland or a crop/natural vegetation mosaic. *Percent forest* indicates the percentage of the basin defined as evergreen needleleaf forest, evergreen broadleaf forest, deciduous needleleaf forest, deciduous broadleaf forest, or mixed forest. The *Nighttime Lights of the World* database used for the *percent developed area* is a 1-km by 1-km resolution map derived from nighttime imagery from the Defense Meteorological Satellite Program (DMSP) Operational Linescan System (OLS) of the United States. The data set contains the locations of stable lights, including frequently observed light sources such as gas flares at oil drilling sites. Time series analysis is used to exclude transient light sources such as fires and lightning. The extent of "lit" area may be slightly overestimated due to the sensor's resolution and factors such as reflection from water and other surface features. It is a good indicator of the spatial distribution of settlements and infrastructure but should not be interpreted as a measure of population density. (The mean settlement size required to produce enough light to be detected is much greater in developing countries than in industrialized countries because of differences in energy consumption.) The *Nighttime Lights of the World* data are more highly correlated with measures of economic activity and energy consumption and are therefore considered a measure of relative development within the watershed. The percentage of developed area was calculated by dividing the area within a watershed indicated as "lit" by the total area of the watershed. Data were not available for regions below the equator in Africa and Asia or for

regions above 50°N in North America and above 80°N in Asia.

Percent original forest loss was calculated by dividing the difference between original and current forest cover by the extent of original forest cover within each basin. For definitions of original and current forests, please refer to the Sources and Technical Notes of Data Table 11.2.

Percent arid area indicates the percentage of the basin that falls in an area defined as semiarid, arid, or hyperarid on the *World Atlas of Desertification Global Aridity Zone Map*. This map is based on an aridity index derived from the ratio of mean annual precipitation to the mean annual potential evapotranspiration.

Percent wetlands area was calculated by dividing the sum of the areas of wetlands within the basin by the total watershed area. It includes all areas designated as wetland in the *Biodiversity Map Library* software.

Percent protected area was calculated by dividing the sum of the protected areas that fall within the World Conservation Union (IUCN) I-V management categories in the watershed by the total watershed area. For a description of the IUCN categories, please refer to the Sources and Technical Notes of Data Table 14.1.

Ramsar sites are sites designated as "wetlands of international importance" according to the terms of the Convention on Wetlands (Ramsar, Iran, 1971). Spatial accuracy of the coordinates varies. For more information, please refer to the Sources and Technical Notes of Data Table 14.1.

The *concentration of nitrates and phosphates* provide information on the nutrient and pollution levels of rivers and lakes. Nutrient levels will depend in part on the runoff from agricultural lands and water discharge from urban centers that carry high loads of phosphorous and nitrogen from fertilizers, animal waste, and municipal sewage. High nutrient levels produce eutrophication of rivers and lakes (i.e., an increase in biomass such as algae that can alter the chemical makeup of the water and therefore the biological composition of the aquatic community). For more detailed information on nutrient concentration, please refer to the original source.