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*Supplement of*

## **Water savings potentials of irrigation systems: dynamic global simulation**

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## **Development of a new input for spatially explicit distribution of irrigation systems**

The extent of irrigated areas (both equipped and actually irrigated) is relatively well documented and has been disaggregated to grid cell level by Stefan Siebert and Petra Döll et al. (Siebert et al., 2005, 2007, 2010, 2014) which is included in the MIRCA2000 land use data set (Portmann et al., 2010) that we employ throughout our study (area equipped for irrigation). Information on the irrigation system that is in place is however less well documented. The FAO Aquastat data base (FAO, 2014) provides national irrigated areas separated for the three irrigation systems surface, sprinkler and drip (area equipped for irrigation). But such areas are not consistently available for all countries and significant gaps and errors are apparent. The International Commission on Irrigation and Drainage (ICID) also provides estimates on national shares of sprinkler and drip irrigated areas (ICID, 2012), but unfortunately not for all countries. Rohwer et al. (2007) also compiled a country statistic on the share of irrigation systems, based on FAO, ICID and other sources but it is not comprehensive for all countries.

Here we compile a new country-level database on the extent of the three main irrigation systems surface, sprinkler and drip, based on FAO (2014), ICID (2012) and Rohwer et al. (2007). In general, the total extent of actually irrigated areas is relatively consistent between MIRCA2000, AQUASTAT and ICID, but estimates of the extent of each system are often inconsistent or missing. We assume that the areas on which the three systems are implemented sum up to total area equipped for irrigation (i.e. that there are no other systems). Our primary data source is FAO (2014) and in case of missing or inconsistent data we fill in with data from ICID (2012) or Rohwer et al. (2007). In countries where only the total irrigated area is available, we allocate shares according to neighboring countries. The complete list is shown in Table A1.

Furthermore, we disaggregate country shares of each irrigation system to the irrigated area from MIRCA2000. For this, we developed and employed decision rules to decide which irrigation system is most suited for a CFT. These decisions are based on Brouwer et al. (1988), Sauer et al. (2010) and Fischer (2012) and are summarized in the suitability table (Tab. 2 in main paper). The basic rationale is that drip irrigation is most suitable for high value crops, and sprinkler irrigation is suitable for most row, field and tree crops (Brouwer et al., 1988). From the 12 CFTs in LPJmL we only excluded rice (always surface) and tropical roots (not irrigated at all) from this decision rule.

Our algorithm works in that first in each country all cells are selected that have areas with drip-suitable CFTs. From that pool, we randomly sample CFT fractions until the target area for drip systems is fulfilled in each country. This procedure is repeated 1000 times and we employ the iteration for which the target area is met most precisely. Then, sprinkler systems are attributed accordingly and the remaining free cell fraction for irrigation is assigned to surface irrigation. In the end, each CFT in each cell is assigned to one of the three irrigation systems.

**Table S1: Country-level extent<sup>a</sup> and shares of surface, sprinkler and drip irrigated areas, compiled from FAO (2014), ICID (2012) and Rohwer et al. (2007).**

Country	Equipped for surface irrigation	Equipped for sprinkler irrigation	Equipped for drip/localized	Sum	Total area equipped (Aquastat)	Total area equipped (ICID)	Actually irrigated, % (FAO)	Surface Share	Sprinkler Share	Drip/localized Share	Notes
Afghanistan	3,094.00	114.00	0.00	3,208.00	3,208.00		53.99	0.964	0.036	0.000	added 3094 to surf to meet FAO total area
Albania	397.00	0.03	0.00	397.03	188.40		56.53	1.000	0.000	0.000	added 473.4 to surf to meet FAO total area
Algeria	473.40	40.00	0.00	513.40	513.40		88.29	0.922	0.078	0.000	
Andorra	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Angola	85.53	0.00	0.00	85.53	85.53		13.47	1.000	0.000	0.000	
Antigua and Barbuda	0.00	0.03	0.10	0.13	0.13			0.023	0.192	0.785	added 85 to surf to meet FAO total area
Argentina	1,949.00	281.00	127.00	2,357.00	2,357.00		91.73	0.827	0.119	0.054	
Armenia	247.50	25.00	1.00	273.50	273.50		64.35	0.905	0.091	0.004	
Australia	1,831.00	524.00	191.00	2,546.00	2,546.00	2,545.00		0.719	0.206	0.075	
Austria	0.00	115.00	2.00	117.00	117.00		37.13	0.000	0.983	0.017	added 115 to sprink to meet FAO total area
Azerbaijan	817.90	607.00	0.10	1,425.00	1,425.00	1,433.00	95.30	0.574	0.426	0.000	
Bahamas, The	0.00	0.00	0.00	0.00	0.00		0.00	0.000	0.000	0.000	
Bahrain	3.39	0.16	0.47	4.02	4.02		100.00	0.844	0.040	0.116	
Bangladesh	5,050.00	0.00	0.00	5,050.00	5,050.00		88.32	1.000	0.000	0.000	
Barbados				0.00	5.44			0.000	0.000	0.000	
Byelarus	0.00	131.00	0.00	131.00	115.00			0.000	1.000	0.000	
Belgium	0.00	23.35	0.00	23.35	23.35		24.33	0.000	1.000	0.000	added 23 to sprink to meet FAO total area
Belize	3.20	0.30	0.05	3.55	3.55		100.00	0.901	0.085	0.014	Shares based on neighboring countries
Benin	5.04	4.57	1.36	10.97	23.04		74.65	0.460	0.416	0.124	
Bhutan	27.68	0.00	0.00	27.68	31.91		100.00	1.000	0.000	0.000	
Bolivia	275.90	17.60	3.70	297.20	297.20		100.00	0.928	0.059	0.012	
Bosnia and Herzegovina	1.40	1.40	0.20	3.00	3.00			0.467	0.467	0.067	Shares based on neighboring countries
Botswana	0.22	0.89	0.27	1.38	1.44		100.00	0.158	0.646	0.196	
Brazil	2,619.00	2,446.00	334.80	5,399.80	5,400.00	4,450.00	96.81	0.485	0.453	0.062	

Brunei	0.59	0.35	0.06	1.00	1.00		63.00	0.589	0.350	0.061	Based on Rohwer et al. (2007)
Bulgaria	80.60	21.00	3.00	104.60	104.60	588.00	69.45	0.771	0.201	0.029	
Burkina Faso	25.39	3.90	0.44	29.73	29.73		85.00	0.854	0.131	0.015	
Burundi	6.96	0.00	0.00	6.96	6.96		64.08	1.000	0.000	0.000	
Cambodia	269.50	0.00	0.00	269.50	353.60		89.71	1.000	0.000	0.000	
Cameroon	17.02	5.43	0.00	22.45	22.45		100.00	0.758	0.242	0.000	
Canada	180.90	683.00	6.03	869.93	869.90	870.00	100.00	0.208	0.785	0.007	
Cape Verde	0.00	0.00	0.20	0.20	3.48		65.50	0.000	0.000	1.000	
Central African Republic	0.00	0.00	0.00	0.00	0.14		51.11	0.000	0.000	0.000	
Chad	26.52	3.75	0.00	30.27	30.27		86.55	0.876	0.124	0.000	
Chile	801.30	57.40	249.80	1,108.50	1,109.00	1,090.00	98.65	0.723	0.052	0.225	
China	59,338.00	2,841.00	759.50	62,938.50	62,938.00	59,300.00	86.15	0.943	0.045	0.012	
Colombia	856.80	36.90	6.30	900.00	1,087.00		36.25	0.952	0.041	0.007	Based on Rohwer et al. (2007)
Comoros	0.00	0.00	0.00	0.00	0.13		65.38	0.000	0.000	0.000	
Congo-Brazzaville	0.22	0.00	0.00	0.22	0.22		100.00	0.995	0.000	0.005	
Cook Islands	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Costa Rica	86.28	10.15	5.08	101.51	101.50		100.00	0.850	0.100	0.050	
Ivory Coast	11.75	36.00	0.00	47.75	47.75			0.246	0.754	0.000	
Croatia	1.84	1.67	0.12	3.63	3.63			0.506	0.462	0.032	
Cuba	366.60	402.70	19.49	788.79	788.80			0.465	0.511	0.025	
Cyprus	1.98	1.98	35.59	39.54	39.54			0.050	0.050	0.900	
Czech Republic	22.53	11.00	5.00	38.53	38.53	153.00	51.67	0.585	0.285	0.130	
North Korea	1,460.00	0.00	0.00	1,460.00	1,460.00		92.53	1.000	0.000	0.000	
DR Congo, former Zaire	10.00	0.00	0.00	10.00	10.00			1.000	0.000	0.000	
Denmark	0.00	391.50	43.50	435.00	435.40		58.36	0.000	0.900	0.100	Based on Rohwer et al. (2007)
Djibouti	0.00	0.00	0.00	0.00	1.01		38.34	0.000	0.000	0.000	
Dominica	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Dominican Republic	269.70	0.00	0.00	269.70	306.50		100.00	1.000	0.000	0.000	

Ecuador	663.90	170.10	19.40	853.40	1,500.00		62.80	0.778	0.199	0.023	
Egypt	3,029.00	171.90	221.40	3,422.30	3,422.00	3,420.00	100.00	0.885	0.050	0.065	
El Salvador	41.56	2.49	1.18	45.22	45.23		74.82	0.919	0.055	0.026	
Equatorial Guinea	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Eritrea	4.10	0.00	0.00	4.10	4.10		100.00	1.000	0.000	0.000	
Estonia	0.00	3.68	0.00	3.68	0.46	1.00	71.18	0.000	1.000	0.000	
Ethiopia	283.20	6.36	0.01	289.57	289.60		100.00	0.978	0.022	0.000	
Faroe Islands	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Fiji	3.00	0.00	0.00	3.00	3.00			1.000	0.000	0.000	Shares based on neighboring countries
Finland	0.00	58.78	9.80	68.58	68.58	70.00	21.90	0.000	0.857	0.143	
France	1,416.90	1,379.80	103.30	2,900.00	2,642.00	2,900.00	57.23	0.489	0.476	0.036	Based on ICID (2012) and Rohwer et al. (2007)
Gabon	1.58	1.58	0.00	3.15	3.15		100.00	0.500	0.500	0.000	Shares based on neighboring countries
Gambia, The	2.15	0.00	0.00	2.15	5.00		46.53	1.000	0.000	0.000	
Georgia	373.00	0.00	28.31	401.31	401.30		31.42	0.929	0.000	0.071	
Germany	10.70	500.00	5.00	515.70	515.70	540.00	45.49	0.021	0.970	0.010	
Ghana	24.60	6.30	0.00	30.90	30.90		90.32	0.796	0.204	0.000	
Greece	77.75	1,088.50	388.75	1,555.00	1,555.00		82.32	0.050	0.700	0.250	Shares based on neighboring countries
Grenada	0.00	0.03	0.19	0.22	0.22			0.000	0.132	0.868	
Guatemala	198.60	94.43	19.08	312.11	337.50		100.00	0.636	0.303	0.061	
Guinea	19.93	0.30	0.16	20.39	20.39		100.00	0.977	0.015	0.008	
Guinea-Bissau	8.56	0.00	0.00	8.56	8.56		100.00	1.000	0.000	0.000	
Guyana	143.00	0.00	0.00	143.00	143.00		89.16	1.000	0.000	0.000	
Haiti	91.50	0.00	0.00	91.50	97.00		71.50	1.000	0.000	0.000	
Holy See	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Honduras	73.21	0.00	0.00	73.21	89.70		92.92	1.000	0.000	0.000	
Hungary	18.90	118.00	4.00	140.90	140.90	220.00	62.19	0.134	0.837	0.028	
Iceland	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
India	61,938.00	1,446.00	578.20	63,962.20	66,334.00	60,900.00	93.90	0.968	0.023	0.009	
Indonesia	6,722.00	0.00	0.00	6,722.00	6,722.00		100.00	1.000	0.000	0.000	

Iran	7,970.00	460.00	270.00	8,700.00	8,700.00	8,700.00	77.41	0.916	0.053	0.031	Based on ICID (2012)
Iraq	3,402.33	96.59	26.09	3,525.01	3,525.00		54.89	0.965	0.027	0.007	Based on Rohwer et al. (2007)
Ireland	0.00	0.50	0.60	1.10	1.10		100.00	0.000	0.455	0.545	Shares based on neighboring countries
Israel	0.00	60.00	168.80	228.80	225.00	231.00	80.67	0.000	0.262	0.738	
Italy	2,399.00	981.20	570.60	3,950.80	3,951.00	2,670.00	67.48	0.607	0.248	0.144	
Jamaica	19.04	4.41	1.76	25.22	25.22		100.00	0.755	0.175	0.070	
Japan	2,010.00	430.00	60.00	2,500.00	2,500.00	2,500.00	92.86	0.804	0.172	0.024	
Jordan	13.86	1.00	64.00	78.86	78.86		95.11	0.176	0.013	0.812	
Kazakhstan	713.00	1,400.00	17.00	2,130.00	1,200.00	2,130.00	98.50	0.335	0.657	0.008	Based on ICID (2012)
Kenya	39.22	61.99	2.00	103.21	103.20		94.19	0.380	0.601	0.019	
Kiribati	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Kuwait	3.02	0.60	1.15	4.77	10.14		69.53	0.633	0.126	0.241	
Kyrgyzstan	1,021.00	0.40	0.00	1,021.40	1,021.00		100.00	1.000	0.000	0.000	
Laos	155.40	0.00	0.00	155.40	310.00		87.32	1.000	0.000	0.000	
Latvia	0.00	0.00	0.00	0.00	0.83		74.70	0.000	0.000	0.000	
Lebanon	66.13	29.04	8.84	104.01	104.00		86.54	0.636	0.279	0.085	
Lesotho	1.32	1.00	0.32	2.64	2.64		2.54	0.500	0.379	0.121	Shares based on neighboring countries
Liberia	0.10	0.00	0.00	0.10	0.10		100.00	1.000	0.000	0.000	Shares based on neighboring countries
Libya	423.00	23.50	23.50	470.00	470.00		67.23	0.900	0.050	0.050	Shares based on neighboring countries
Liechtenstein	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Lithuania	0.00	9.25	0.00	9.25	1.34	4.40	74.63	0.000	1.000	0.000	
Luxembourg	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Madagascar	1,084.00	2.40	0.00	1,086.40	1,086.00		50.64	0.998	0.002	0.000	
Malawi	6.36	43.19	5.45	55.00	73.50	55.00	98.18	0.116	0.785	0.099	
Malaysia	373.00	2.00	5.00	380.00	380.00	380.00	76.37	0.982	0.005	0.013	
Maldives	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Mali	166.90	0.03	0.14	167.07	167.10		83.72	0.999	0.000	0.001	
Malta	0.11	0.15	0.50	0.76	3.20		87.81	0.148	0.197	0.655	
Marshall Islands	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Mauritania	43.70	1.31	0.00	45.01	45.01		50.74	0.971	0.029	0.000	Shares based on neighboring countries

Mauritius	2.37	17.03	1.82	21.22	21.22		98.02	0.112	0.802	0.086	
Mexico	5,168.00	310.80	143.10	5,621.90	6,460.00	6,200.00	86.06	0.919	0.055	0.025	
Federated States of Micronesia	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Monaco	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Mongolia	13.90	43.40	0.00	57.30	57.30		61.08	0.243	0.757	0.000	
Montenegro	0.00	0.90	1.50	2.41	2.41		100.00	0.002	0.375	0.624	
Morocco	1,209.00	151.70	97.97	1,458.67	1,459.00	1,650.00	99.04	0.829	0.104	0.067	
Mozambique	131.04	156.00	24.96	312.00	118.10		33.92	0.420	0.500	0.080	Based on Rohwer et al. (2007)
Myanmar (Burma)	2,083.00	0.00	0.00	2,083.00	2,083.00		100.00	1.000	0.000	0.000	
Namibia	2.95	3.28	1.35	7.57	7.57		100.00	0.390	0.433	0.178	
Nauru	0.00	0.00	0.00	0.00	0.00			0.000	0.000	0.000	
Nepal	1,134.00	0.00	0.00	1,134.00	1,168.00			1.000	0.000	0.000	
Netherlands	152.40	152.40	152.40	457.20	457.20		44.25	0.333	0.333	0.333	Based on Rohwer et al. (2007)
New Zealand	110.90	491.40	41.66	643.96	619.30		82.19	0.172	0.763	0.065	
Nicaragua	61.37	0.00	0.10	61.47	199.10		72.38	0.998	0.000	0.002	
Niger	13.74	0.00	0.00	13.74	13.74		77.00	1.000	0.000	0.000	
Nigeria	238.10	0.05	0.00	238.15	238.20		91.86	1.000	0.000	0.000	
Niue				0.00				0.000	0.000	0.000	
Norway	61.35	0.01	0.00	61.36	114.90		47.84	1.000	0.000	0.000	
West Bank		12.00	12.00	24.00	24.00		100.10	0.000	0.500	0.500	Shares based on neighboring countries
Oman	46.66	6.65	5.54	58.85	58.85		100.00	0.793	0.113	0.094	
Pakistan	19,270.00	0.00	0.00	19,270.00	19,270.00		100.00	1.000	0.000	0.000	
Palau				0.00				0.000	0.000	0.000	
Panama	23.90	3.74	4.50	32.14	32.14		100.00	0.744	0.116	0.140	
Papua New Guinea	45.73	14.77	1.05	61.55	62.55			0.743	0.240	0.017	Based on Rohwer et al. (2007)
Paraguay	108.96	13.62	13.62	136.20	136.20		100.00	0.800	0.100	0.100	Shares based on neighboring countries
Peru	1,697.00	21.74	10.63	1,729.37	1,729.00		64.14	0.981	0.013	0.006	
Philippines	1,864.00	4.50	10.92	1,879.42	1,879.00	1,520.00	100.00	0.992	0.002	0.006	
Poland	102.70	5.00	8.00	115.70	115.70	100.00	62.28	0.888	0.043	0.069	

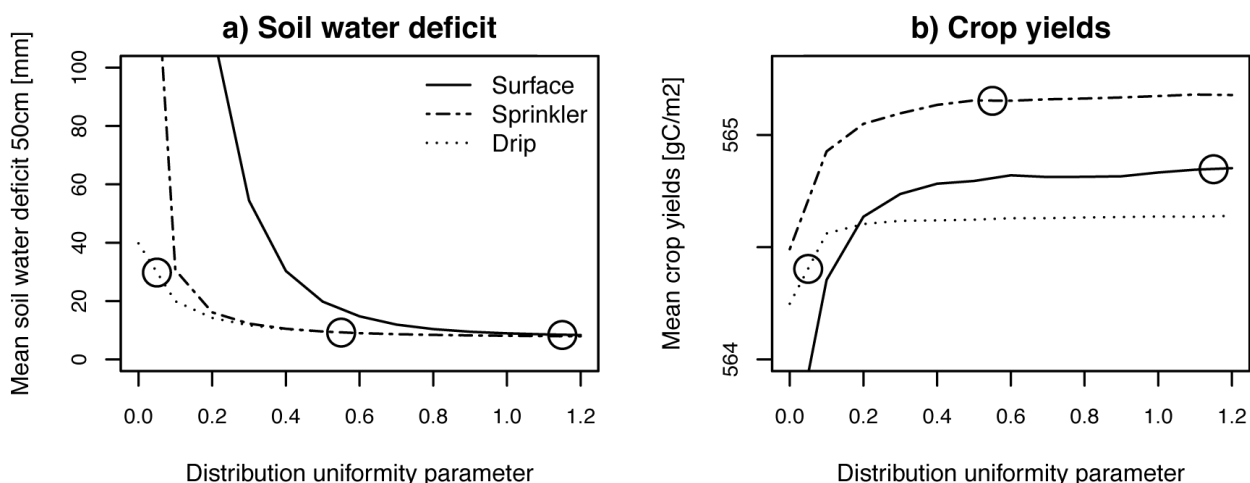
Portugal	585.00	40.00	25.00	650.00	583.70	630.00	72.21	0.900	0.062	0.038	Complemented with ICID (2012) and Rohwer et al. (2007)
Puerto Rico	1,460.00	95.38	23.84	1,579.22	22.04		71.60	0.925	0.060	0.015	Based on Rohwer et al. (2007)
Qatar	9.71	1.81	1.42	12.94	12.94		46.85	0.750	0.140	0.109	
South Korea	888.80	0.00	0.00	888.80	880.40	1,010.00		1.000	0.000	0.000	
Moldova	68.00	145.00	15.00	228.00	228.30		72.12	0.298	0.636	0.066	
Romania	420.00	448.00	4.00	872.00	615.30	1,500.00	28.18	0.482	0.514	0.005	
Russia	1,953.00	2,500.00	47.00	4,500.00	2,375.00	4,500.00		0.434	0.556	0.010	Based on ICID (2012)
Rwanda	3.50			3.50	4.63		43.24	1.000	0.000	0.000	
Saint Kitts and Nevis	0.00	0.00	0.02	0.02	0.02			0.000	0.000	1.000	
Saint Lucia				0.00	3.00			0.000	0.000	0.000	
Saint Vincent and the Grenadines				0.00				0.000	0.000	0.000	
American Samoa				0.00				0.000	0.000	0.000	
San Marino				0.00				0.000	0.000	0.000	
Sao Tome and Principe				0.00	9.70			0.000	0.000	0.000	
Saudi Arabia	706.00	716.00	198.00	1,620.00	1,620.00	1,620.00	100.00	0.436	0.442	0.122	
Senegal	102.20		0.40	102.60	102.20		67.51	0.996	0.000	0.004	
Serbia	64.37	22.99	4.59	91.95	91.96		37.16	0.700	0.250	0.050	Shares based on neighboring countries
Seychelles	0.02	0.04	0.20	0.26	0.26		76.92	0.077	0.154	0.769	
Sierra Leone	1.00	0.00	0.00	1.00	1.00		100.00	1.000	0.000	0.000	
Singapore				0.00				0.000	0.000	0.000	
Slovakia	0.35	310.00	2.65	313.00	172.00	313.00	22.73	0.001	0.990	0.008	Based on ICID (2012)
Slovenia	0.00	5.27	2.34	7.60	7.60	7.30	46.04	0.000	0.693	0.307	
Solomon Islands				0.00				0.000	0.000	0.000	
Somalia	50.00			50.00	50.00		100.00	1.000	0.000	0.000	
South Africa	385.00	920.00	365.00	1,670.00	1,670.00	1,670.00	95.87	0.231	0.551	0.219	
South Sudan				0.00				0.000	0.000	0.000	
Spain	1,029.00	783.00	1,658.00	3,470.00	3,470.00	3,470.00	89.14	0.297	0.226	0.478	
Sri Lanka	570.00	0.00	0.00	570.00	570.00		81.14	1.000	0.000	0.000	



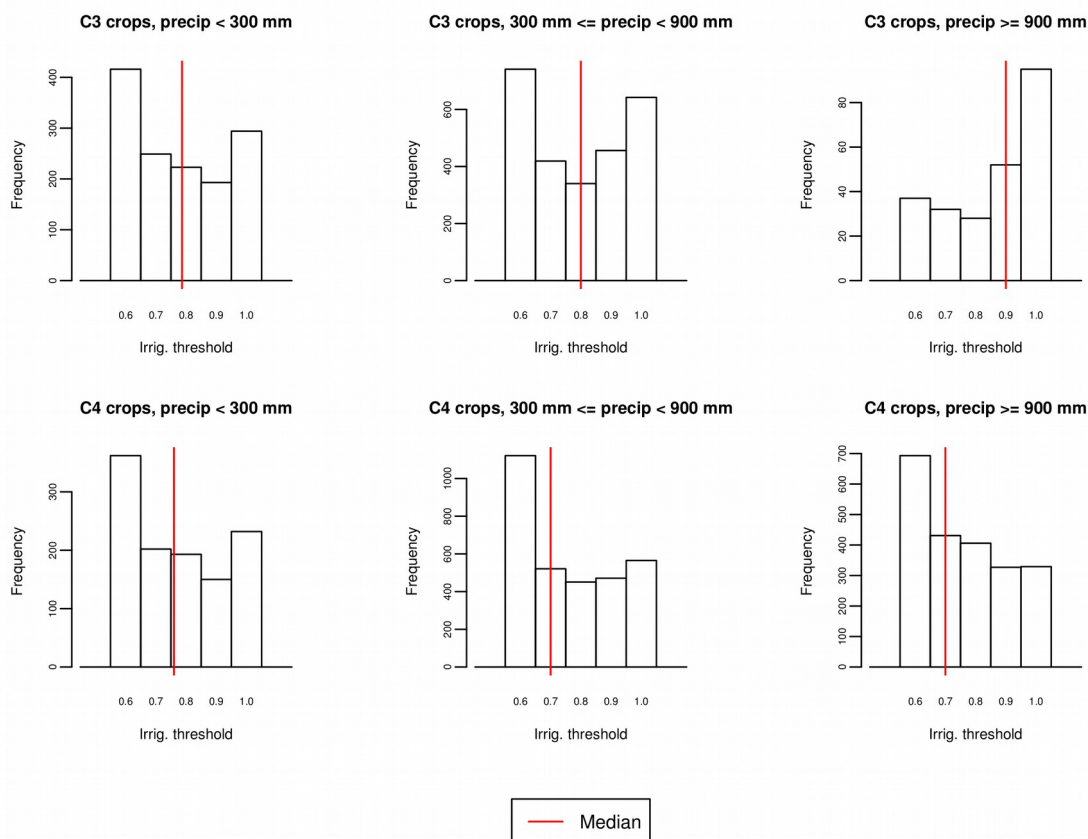
Sudan	1,758.00			1,758.00	1,758.00			1.000	0.000	0.000	
Suriname	50.32	1.10	0.00	51.42	57.00		100.00	0.979	0.021	0.000	
Swaziland	25.89	20.91	3.05	49.85	49.85		89.95	0.519	0.419	0.061	
Sweden	0.00	159.70	0.00	159.70	159.70		33.92	0.000	1.000	0.000	
Switzerland	0.83	59.17	1.00	61.00	61.00		59.31	0.014	0.970	0.016	Shares based on neighboring countries
Syria	1,043.00	187.10	110.90	1,341.00	1,341.00	1,280.00	95.50	0.778	0.140	0.083	
Tajikistan	742.10	0.00	0.00	742.10	742.10		90.88	1.000	0.000	0.000	
Thailand	6,415.00			6,415.00	6,415.00		78.88	1.000	0.000	0.000	
Macedonia	49.00	5.00	1.00	55.00	127.80		62.32	0.891	0.091	0.018	Based on ICID (2012)
Timor-Leste				0.00	34.65		83.43	0.000	0.000	0.000	
Togo	2.30	0.55	0.01	2.86	2.30		47.39	0.804	0.192	0.003	
Tokelau				0.00				0.000	0.000	0.000	
Tonga				0.00				0.000	0.000	0.000	
Trinidad and Tobago	2.89	0.71	0.12	3.71	3.60		85.00	0.778	0.190	0.032	
Tunisia	215.00	90.00	62.00	367.00	367.00		100.00	0.586	0.245	0.169	
Turkey	4,690.00	500.00	150.00	5,340.00	5,340.00	5,340.00	84.63	0.878	0.094	0.028	
Turkmenistan	1,991.00	0.00	0.00	1,991.00	1,991.00		100.00	1.000	0.000	0.000	
Tuvalu				0.00				0.000	0.000	0.000	
Uganda	5.35	0.23		5.58	12.08		100.00	0.959	0.041	0.000	
Ukraine	525.00	2,080.00	0.00	2,605.00	2,175.00	2,180.00		0.202	0.798	0.000	
United Arab Emirates	27.10	4.00	195.50	226.60	92.00		82.61	0.120	0.018	0.863	
United Kingdom	117.00	105.00	6.00	228.00	228.00	110.00	60.61	0.513	0.461	0.026	
Tanzania, United Republic of	184.30			184.30	184.30		100.00	1.000	0.000	0.000	
United States	12,696.00	12,333.00	1,615.00	26,644.00	26,644.00	24,700.00	85.97	0.477	0.463	0.061	
Uruguay	200.00	18.00	20.00	238.00	238.00		100.00	0.840	0.076	0.084	
Uzbekistan	4,276.00	0.00	4.51	4,280.51	4,198.00	4,233.00	88.14	0.999	0.000	0.001	
Vanuatu				0.00				0.000	0.000	0.000	
Venezuela	735.50	275.50	44.30	1,055.30	1,055.00		92.78	0.697	0.261	0.042	

Vietnam	4,584.00	1.10	0.00	4,585.10	4,585.00		100.00	1.000	0.000	0.000	
Yemen	453.80	0.35	0.49	454.64	454.30		100.00	0.998	0.001	0.001	
Zambia	32.19	17.57	5.63	55.39	55.39		100.00	0.581	0.317	0.102	
Zimbabwe	46.85	112.80	13.88	173.53	173.50		71.41	0.270	0.650	0.080	

<sup>a</sup> in 1000 ha, <sup>b</sup> calculated from the extent of areas with surface, sprinkler and drip irrigation (column 1-3)



**Figure S1:** Parameter sensitivity analysis for the distribution uniformity scalar ( $du$ ). Panel (a) shows the dependency on annually cumulated soil water deficit in the upper 50 cm (irrigation depth) that could not be fulfilled by irrigation, as mean over irrigated cells. Panel (b) shows the dependency on mean annual crop yield. Simulations are based on All-Surf, All-Sprinkler, and All-Drip scenarios (see main text, 2.5) assuming unrestricted water availability for irrigation. Employed parameter estimates are indicated. Surface and sprinkler systems are parameterized to meet net irrigation requirement (field capacity in upper 50 cm) and thus yield production is at its potential. Drip systems are parameterized to represent a modest form of deficit irrigation, not to maximize yields but to save water.



**Figure S2:** Sensitivity analysis for the *irrigation threshold* ( $it$ ) parameter. Stacks represent the number of cells that achieve their maximum harvest at the respective  $it$  and the red line is the median across all cells. The two rows represent C3 and C4 crops, respectively, and the columns represent the indicated precipitation regimes.

## References

- Brouwer, C., Prins, K., Kay, M., & Heibloem, M. (1988). *Irrigation Water Management : Irrigation Methods. Training manual no. 5.*
- FAO. (2014). AQUASTAT database - Food and Agriculture Organization of the United Nations (FAO). Retrieved from <http://www.fao.org/nr/water/aquastat/data/query/index.html?lang=en>
- Fischer, G. (2012). *Global Agro-ecological Zones Model Documentation 3.0.*
- ICID. (2012). Sprinkler and micro irrigated area - Commission on Irrigation and Drainage (ICID).
- Portmann, F. T., Siebert, S., & Döll, P. (2010). MIRCA2000—Global monthly irrigated and rainfed crop areas around the year 2000: A new high-resolution data set for agricultural and hydrological modeling. *Global Biogeochemical Cycles*, 24(1). doi:10.1029/2008GB003435
- Rohwer, J., Gerten, D., & Lucht, W. (2007). *Development of functional irrigation types for improved global crop modelling - PIK report No. 104.* Potsdam, Germany.
- Sauer, T., Havlík, P., Schneider, U. a., Schmid, E., Kindermann, G., & Obersteiner, M. (2010). Agriculture and resource availability in a changing world: The role of irrigation. *Water Resources Research*, 46(6), n/a–n/a. doi:10.1029/2009WR007729
- Siebert, S., Burke, J., Faures, J. M., Frenken, K., Hoogeveen, J., Döll, P., & Portmann, F. T. (2010). Groundwater use for irrigation – a global inventory. *Hydrology and Earth System Sciences*, 14(10), 1863–1880. doi:10.5194/hess-14-1863-2010
- Siebert, S., Döll, P., Feick, S., Hoogeveen, J., & Frenken, K. (2007). Global Map of Irrigation Areas Version 4.0.1 [CD-Rom], FAO Land and Water Digital Media Ser. 34. Rome, FAO.
- Siebert, S., Döll, P., Hoogeveen, J., Faures, J.-M., Frenken, K., & Feick, S. (2005). Development and validation of the global map of irrigation areas. *Hydrology and Earth System Sciences*. doi:10.5194/hessd-2-1299-2005
- Siebert, S., Kummu, M., Porkka, M., Döll, P., Ramankutty, N., & Scanlon, B. R. (2014). A global dataset of the extent of irrigated land from 1900 to 2005. *Hydrology and Earth System Sciences Discussions*, (11), 13207–13258. doi:10.13019/M2MW2G

