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Supplement of

Mapping irrigation potential from renewable groundwater in Africa – a quantitative hydrological approach

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Supplement

The Supplement describes in details the computation method applied, including specific highlight on the green water data. The calculations are done for each of the 0.5°*0.5° grid cells using the following four equations:

$$GWIP = \frac{GW\ Available}{Irrig.\ Water\ Demand_{max}}\ [L^2] \quad (1)$$

$$GW\ Available = GW\ Recharge - Human\ GW\ Demand - Environ.\ GW\ Req.\ [L^3\ T^{-1}] \quad (2)$$

$$Irrig.Water\ Demand = \frac{Net\ Irrg.Water\ Demand}{Irrig.\ Efficiency}$$

$$= \frac{\{\sum_{i=1}^{n}\left(\left[\sum_{j=1}^{m}(Crop\ Water\ Demand - Green\ Water)_j\right] \times [\%\ of\ Area]_i\right)\}}{Irrig.\ Efficiency}\ [L\ T^{-1}] \quad (3)$$

$$Crop\ Water\ Demand_{\ j} = Crop\ Group\ Coefficient \times E_{0,max_j}\ [L\ T^{-1}] \quad (4)$$

Parameters of Eq. 2

GW Recharge is entered as annual values over the 41 years period (1960 – 2000). Annual values are calculated by summing monthly values directly extracted from the PCR-GLOBWB model.

Human GW Demand is calculated based on the map of population and livestock density from 2000 (FAO, 2007a, b) and data on unit daily water demand per capita (for domestic and industrial use) and per livestock type (Table 3). The calculated data represent the annual aggregated water requirement for domestic, industrial and livestock for the year 2000.

Environ. GW Req. is a percentage of the annual *GW recharge*, applying three scenarios: the environmental groundwater requirements represent 70% (Scenario 1), 50% (Scenario 2), and 30% (Scenario 3) of the recharge, respectively. It is calculated for every year of the 41 year period.

GW available represents the annual groundwater surplus for GWI. It is calculated for every year of the 41 year period, then averaged over the 41 years.

Parameters of Eq. 3 and Eq. 4

Crop Water Demand is the monthly crop water demand for each crop group and is determined using Eq. 4.

E_{0,max_j} is entered as the maximum of the monthly reference potential evapotranspiration over the 41 year period (1960 – 2000). The monthly E_0 values are directly extracted from the PCR-GLOBWB model.

The *Crop Group Coefficient* K_c is the monthly Crop Group Coefficient calculated using Table S1 - S4. Table S1 presents the monthly Crop Coefficient for each individual crop determined by disaggregating the seasonal *Crop Coefficient Kc* per growth period into monthly values using the length of the four common growth periods (initial, development, middle and late). Both seasonal K_c and growth periods are from the literature (FAO, 1986 and 1992).

Table S1: Seasonal and disaggregated monthly Crop Coefficient

Crop Group	Crop Type		K_c per Growth Period (mm)				Monthly Kc					
			Initial	Develop.	Middle	Late	1	2	3	4	5	6
Cereals	Maize	Period (days)	30	50	60	40	0.4	0.8	0.92	1.15	1.05	0.85
		Kc	0.4	0.8	1.15	0.85						
	Millet	Period (days)	20	30	55	35	0.35	0.77	1.1	0.97	0.58	
		Kc	0.35	0.7	1.1	0.7						
	Rice	Period (days)	30	30	80	40	1.05	1.1	1.2	1.2	1.05	0.75
		Kc	1.05	1.1	1.2	0.75						
	Sorghum	Period (days)	20	35	45	30	0.48	0.81	1.1	0.8	0.22	
		Kc	0.35	0.75	1.1	0.65						
	Wheat	Period (days)	15	30	65	40	0.53	0.9	1.1	0.83	0.3	
		Kc	0.35	0.7	1.1	0.3						
Oils	Groundnut	Period (days)	30	40	45	25	0.45	0.75	0.95	0.99	0.47	
		Kc	0.45	0.75	1.05	0.7						
	Soybean	Period (days)	20	30	70	30	0.48	0.87	1.1	1.1	0.6	
		Kc	0.35	0.75	1.1	0.6						
	Sunflower	Period (days)	25	35	45	25	0.42	0.75	1.15	0.85	0.18	
		Kc	0.35	0.75	1.15	0.55						
Roots	Potato	Period (days)	30	35	50	30	0.45	0.75	1.08	1.1	0.71	
		Kc	0.45	0.75	1.15	0.85						
Pulses	Bean	Period (days)	20	30	40	20	0.47	0.83	1.1	0.2		
		Kc	0.35	0.7	1.1	0.3						
	Lentil	Period (days)	25	35	70	40	0.5	0.75	1.1	1.1	0.7	0.33
		Kc	0.45	0.75	1.1	0.5						
Vegetables	Cucumber	Period (days)	25	35	50	20	0.49	0.7	0.9	0.85	0.25	
		Kc	0.45	0.7	0.9	0.75						
	Eggplant	Period (days)	30	40	45	25	0.45	0.75	1.02	1.09	0.53	
		Kc	0.45	0.75	1.15	0.8						
	Melon	Period (days)	30	45	65	20	0.45	0.75	0.88	1	0.92	0.25
		Kc	0.45	0.75	1	0.75						
	Onion	Period (days)	25	40	20	10	0.54	0.75	0.99	0.17		
		Kc	0.5	0.75	1.05	1						
	Pepper	Period (days)	30	40	40	20	0.35	0.7	0.93	1	0.3	
		Kc	0.35	0.7	1.05	0.9						
	Tomato	Period (days)	35	45	40	25	0.45	0.7	0.88	1.15	0.67	
		Kc	0.45	0.75	1.15	0.8						
Sugarcane	Sugarcane	Period (days)	35	70	180	80	0.4	0.9	1	1.13	1.25	1.25
		Kc	0.4	1	1.25	0.75	1.25	1.25	1.25	1	0.75	0.88

The *monthly Crop Coefficient* is calculated as follows:

$$monthly\ Crop\ Coefficient = \sum_{i=1}^{n}(Kc_{growth\ period_i} \times \frac{no\ days\ per\ month_{growth\ period_i}}{30}) \quad (5)$$

The case of tomato illustrates the calculation. Table S2 shows the growth period-based Kc values for tomato.

Table S2: Seasonal Crop Coefficient, Kc, and growth periods for tomato

	Growth periods (days)			
	initial	develop	middle	Late
Period (days)	35	45	40	25
Kc	0.45	0.75	1.15	0.8

Noting that the total cropping period for tomato is 145 days (approximately 5 months), the calculation of monthly Crop Coefficient is shown in Table S3.

Table S3: Calculation of monthly Crop Coefficient for tomato

Months	Monthly Crop Coefficient
Month 1	$K_c = \left(0.45 \times \frac{30}{30}\right) = 0.45$
Month 2	$K_c = \left(0.45 \times \frac{5}{30} + 0.75 \times \frac{25}{30}\right) = 0.7$
Month 3	$K_c = \left(0.75 \times \frac{20}{30} + 1.15 \times \frac{10}{30}\right) = 0.88$
Month 4	$K_c = \left(1.15 \times \frac{30}{30}\right) = 1.15$
Month 5	$K_c = \left(0.8 \times \frac{25}{30}\right) = 0.67$

Table S4 gives the crop calendar and the monthly *Crop Group Coefficient* for the 23 irrigation cropping pattern zones. The calendar indicates the cropping season of the crop groups for up to two cropping seasons per year (FAO crop calendar[1]; FAO, 1992 and FAO 1986). It also specifies the most prevalent (up to six individual) seasonal crops inventoried within each crop group of each irrigation cropping pattern zone (FAO crop calendar). The lumping of the crops has been done because these crops are similar in terms of season of cultivation. Because the crop coefficient of individual crops in a season and within a crop group may differ significantly, a conservative approach is applied, whereby the larger figure for the crops within a crop group have been applied, unless the difference between them is equal to or more than 0.05 and 0.1, in which case the larger

[1] http://www.fao.org/agriculture/seed/cropcalendar/welcome.do (last access: 31 March 2014)

coefficient is reduced by 0.01 or 0.02, respectively. The reason for applying the conservative approach is to ensure that the GWIP is not overestimated.

Table S4: Crop calendar and monthly Crop Group Coefficient for each crop group within the irrigation cropping pattern zones

Irrigation Cropping Pattern Zones	Crop Groups	Crop(s) in Crop Group (depending on season)	Crop Group Coefficient											
			Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
1	Cereals	Millet/Wheat	0.95	0.56								0.51	0.88	1.1
		Maize/Wheat				0.51	0.89	1.08	1.13	1.03	0.83			
	Oil	Groundnut/Sunflower	0.45	0.75	1.13	0.97	0.45							
		Soybean						0.48	0.87	1.1	1.1	0.6		
	Roots	Potatoes		0.45	0.75	1.08	1.1	0.71						
		Potatoes							0.45	0.75	1.08	1.1	0.71	
	Pulses	Bean/Lentil	1.1	1.08	0.68	0.31							0.5	0.82
		None												
	Vegetables	Eggplant/Pepper/Tomato					0.44	0.74	1	1.13	0.65			
		Eggplant/Pepper/Tomato	1	1.13	0.65								0.44	0.74
	Sugarcane	None												
2	Cereals	Millet/Wheat	1.1	0.95	0.56								0.51	0.88
		Maize/Rice/Wheat					1.03	1.08	1.18	1.18	1.03	0.83		
	Oil	Groundnut/Soybean/Sunflower	0.47	0.85	1.13	1.08	0.58							
		Groundnut/Sunflower						0.45	0.75	1.13	0.97	0.45		
	Roots	Potatoes			0.45	0.75	1.08	1.1	0.71					
		Potatoes	0.71								0.45	0.75	1.08	1.1
	Pulses	Bean/Lentil	1.08	0.68	0.31							0.5	0.82	1.1
		None												
	Vegetables	Cucumber/Melon/Tomato	1.13	0.9	0.23							0.49	0.74	0.9
		Cucumber/Melon/Pepper/Tomato				0.47	0.74	0.92	1.13	0.9	0.23			
	Sugarcane	None												
3	Cereals	Maize/Millet/Rice	1.03	1.08	1.18	1.18	1.03	0.83						
		Maize/Millet/Rice							1.03	1.08	1.18	1.18	1.03	0.83
	Oil	Groundnut/Soybean				0.48	0.85	1.08	1.08	0.58				
		Sunflower	0.18								0.42	0.75	1.15	0.85
	Roots	Potatoes					0.45	0.75	1.08	1.1	0.71			
		Potatoes	1.08	1.1	0.71								0.45	0.75
	Pulses	Lentil						0.5	0.75	1.1	1.1	0.7	0.33	
		None												
	Vegetables	Eggplant/Onion/Pepper/Tomato		0.52	0.74	1	1.13	0.65						
		Eggplant/Onion/Pepper/Tomato								0.52	0.74	1	1.13	0.65
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88
4	Cereals	Maize/Millet/Wheat		0.51	0.88	1.08	1.13	1.03	0.83					
		Maize/Millet/Wheat	0.83							0.51	0.88	1.08	1.13	1.03
	Oil	Groundnut/Soybean/Sunflower		0.47	0.85	1.13	1.08	0.58						
		Groundnut/Soybean/Sunflower	0.58								0.47	0.85	1.13	1.08
	Roots	Potatoes			0.45	0.75	1.08	1.1	0.71					
		Potatoes	1.1	0.71								0.45	0.75	1.08
	Pulses	Bean/Lentil			0.5	0.82	1.1	1.08	0.68	0.31				
		Bean/Lentil	0.68	0.31							0.5	0.82	1.1	1.08
	Vegetables	Eggplant/Pepper/Tomato	0.65								0.44	0.74	1	1.13
		Eggplant/Pepper/Tomato		0.44	0.74	1	1.13	0.65						
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88

5	Cereals	Maize/Rice/Wheat	1.08	1.18	1.18	1.03	0.83							1.03
		Maize/Millet/Rice						1.03	1.08	1.18	1.18	1.03	0.83	
	Oil	Groundnut		0.45	0.75	0.95	0.99	0.47						
		Groundnut							0.45	0.75	0.95	0.99	0.47	
	Roots	Potatoes	1.08	1.1	0.71								0.45	0.75
		Potatoes					0.45	0.75	1.08	1.1	0.71			
	Pulses	Bean						0.47	0.83	1.1	0.2			
		Bean	1.1	0.2									0.47	0.83
	Vegetables	Eggplant/Melon/Pepper/Tomato			0.44	0.74	1	1.13	0.9	0.23				
		Tomato	1.15	0.67								0.45	0.7	0.88
	Sugarcane	None												
6	Cereals	Maize/Rice			1.03	1.08	1.18	1.19	1.05	0.84				
		Maize	1.05	0.85							0.4	0.8	0.92	1.15
	Oil	Groundnut/Soybean				0.48	0.85	1.08	1.08	0.58				
		Groundnut/Soybean	0.58								0.48	0.85	1.08	1.08
	Roots	Potatoes					0.45	0.75	1.08	1.1	0.71			
		Potatoes	1.1	0.71								0.45	0.75	1.08
	Pulses	Bean				0.47	0.83	1.1	0.2					
		Bean	0.2									0.47	0.83	1.1
	Vegetables	Onion/Pepper/Tomato	1.13	0.65								0.52	0.74	0.97
		Cucumber/Eggplant/Pepper/Tomato				0.47	0.74	1	1.13	0.65				
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88
7	Cereals	Millet						0.35	0.77	1.1	0.97	0.58		
		Sorghum	1.1	0.8	0.22								0.48	0.81
	Oil	Groundnut							0.45	0.75	0.95	0.99	0.47	
		None												
	Roots	Potatoes				0.45	0.75	1.08	1.1	0.71				
		Potatoes	1.1	0.71								0.45	0.75	1.08
	Pulses	Lentil						0.5	0.75	1.1	1.1	0.7	0.33	
		None												
	Vegetables	Cucumber/Tomato	1.13	0.65								0.49	0.7	0.9
		Eggplant/Melon			0.45	0.75	1	1.08	0.9	0.23				
	Sugarcane	None												
8	Cereals	Maize/Rice				1.03	1.08	1.18	1.19	1.05	0.84			
		Maize/Rice	1.19	1.05	0.84							1.03	1.08	1.18
	Oil	Groundnut/Soybean			0.48	0.85	1.08	1.08	0.58					
		Groundnut/Soybean	1.08	0.58								0.48	0.85	1.08
	Roots	Potatoes		0.45	0.75	1.08	1.1	0.71						
		Potatoes								0.45	0.75	1.08	1.1	0.71
	Pulses	Bean	1.1	0.2									0.47	0.83
		Bean					0.47	0.83	1.1	0.2				
	Vegetables	Cucumber/Melon/Onion/Tomato		0.53	0.74	0.97	1.13	0.9	0.23					
		Cucumber/Melon/Onion/Tomato	0.23							0.53	0.74	0.97	1.13	0.9
	Sugarcane	None												
9	Cereals	Maize/Rice	1.18	1.19	1.05	0.84							1.03	1.08
		Wheat					0.53	0.9	1.1	0.83	0.3			
	Oil	Groundnut/Soybean	0.48	0.85	1.08	1.08	0.58							
		Groundnut/Soybean						0.48	0.85	1.08	1.08	0.58		
	Roots	Potatoes			0.45	0.75	1.08	1.1	0.71					
		Potatoes	1.1	0.71								0.45	0.75	1.08
	Pulses	Bean				0.47	0.83	1.1	0.2					
		Bean	1.1	0.2									0.47	0.83
	Vegetables	Onion/Tomato		0.53	0.74	0.97	1.13	0.65						
		Onion/Tomato								0.53	0.74	0.97	1.13	0.65
	Sugarcane	None												
10	Cereals	Maize/Rice/Sorghum					1.03	1.08	1.18	1.18	1.03	0.83		
		Rice/Sorghum/Wheat	1.19	1.18	1.03	0.73							1.03	1.08
	Oil	Groundnut					0.45	0.75	0.95	0.99	0.47			

		Groundnut/Soybean/Sunflower	1.08	0.58								0.47	0.85	1.13
	Roots	Potatoes		0.45	0.75	1.08	1.1	0.71						
		Potatoes	0.71								0.45	0.75	1.08	1.1
	Pulses	Lentil	1.1	0.7	0.33							0.5	0.75	1.1
		Bean				0.47	0.83	1.1	0.2					
	Vegetables	Melon/Onion/Tomato	0.9	0.23							0.53	0.74	0.97	1.13
		Melon/Onion/Pepper/Tomato			0.52	0.74	0.97	1.13	0.9	0.23				
	Sugarcane	None												
11	Cereals	Maize/Sorghum/Wheat				0.51	0.89	1.08	1.13	1.03	0.83			
		Maize/Rice/Sorghum	1.18	1.03	0.83							1.03	1.08	1.18
	Oil	Groundnut/Soybean/Sunflower					0.47	0.85	1.13	1.08	0.58			
		Groundnut/Soybean/Sunflower	1.13	1.08	0.58								0.47	0.85
	Roots	Potatoes				0.45	0.75	1.08	1.1	0.71				
		Potatoes	1.1	0.71								0.45	0.75	1.08
	Pulses	Bean/Lentil			0.5	0.82	1.1	1.08	0.68	0.31				
		Bean/Lentil	0.68	0.31							0.5	0.82	1.1	1.08
	Vegetables	Cucumber/Melon/Onion/Pepper/Tomato	0.52	0.74	0.97	1.13	0.9	0.23						
		Eggplant/Melon/Onion/Pepper/Tomato							0.52	0.74	1	1.13	0.9	0.23
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88
12	Cereals	Wheat					0.46	0.81	1.08	1.13	1.03	0.83		
		Maize/Millet/Sorghum	1.1	0.83	0.3								0.53	0.9
	Oil	Groundnut						0.45	0.75	0.95	0.99	0.47		
		None												
	Roots	Potatoes	1.08	1.1	0.71								0.45	0.75
		Potatoes				0.45	0.75	1.08	1.1	0.71				
	Pulses	Bean/Lentil	0.68	0.31							0.5	0.82	1.1	1.08
		Bean					0.47	0.83	1.1	0.2				
	Vegetables	Cucumber/Eggplant/Tomato		0.49	0.74	1	1.13	0.65						
		Cucumber/Melon/Onion/Pepper	0.23							0.52	0.74	1	1.13	0.9
	Sugarcane	None												
13	Cereals	Maize/Rice/Sorghum					1.03	1.08	1.18	1.18	1.03	0.83		
		Rice/Sorghum	1.19	1.18	1.03	0.73							1.03	1.08
	Oil	Sunflower	0.85	0.18								0.42	0.75	1.15
		Sunflower				0.42	0.75	1.15	0.85	0.18				
	Roots	Potatoes	1.1	0.71								0.45	0.75	1.08
		Potatoes				0.45	0.75	1.08	1.1	0.71				
	Pulses	Bean				0.47	0.83	1.1	0.2					
		Bean								0.47	0.83	1.1	0.2	
	Vegetables	Eggplant/Onion/Pepper/Tomato				0.52	0.74	1	1.13	0.65				
		Onion/Pepper/Tomato	1.13	0.65								0.52	0.74	0.97
	Sugarcane	None												
14	Cereals	Maize/Rice	1.19	1.05	0.84							1.03	1.08	1.18
		Maize/Millet/Rice/Sorghum				1.03	1.08	1.18	1.18	1.03	0.83			
	Oil	Groundnut/Soybean/Sunflower			0.47	0.85	1.13	1.08	0.58					
		Groundnut/Soybean/Sunflower	0.58								0.47	0.85	1.13	1.08
	Roots	Potatoes	0.71								0.45	0.75	1.08	1.1
		Potatoes		0.45	0.75	1.08	1.1	0.71						
	Pulses	Bean	0.2									0.47	0.83	1.1
		Bean			0.47	0.83	1.1	0.2						
	Vegetables	Eggplant/Onion/Pepper/Tomato				0.52	0.74	1	1.13	0.65				
		Eggplant/Onion/Pepper/Tomato	1.13	0.65								0.52	0.74	1
	Sugarcane	None												
15	Cereals	Maize/Rice/Sorghum				1.03	1.08	1.18	1.18	1.03	0.83			
		Maize/Rice/Sorghum	1.18	1.03	0.83							1.03	1.08	1.18
	Oil	Groundnut/Soybean/Sunflower	0.58								0.47	0.85	1.13	1.08
		Groundnut/Soybean/Sunflower			0.47	0.85	1.13	1.08	0.58					
	Roots	Potatoes			0.45	0.75	1.08	1.1	0.71					
		Potatoes	0.71								0.45	0.75	1.08	1.1

	Pulses	Bean	0.2									0.47	0.83	1.1
		Bean			0.47	0.83	1.1	0.2						
	Vegetables	Cucumber/Eggplant/Onion/Tomato			0.53	0.74	1	1.13	0.65					
		Eggplant/Onion/Tomato								0.52	0.74	1	1.13	0.65
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88
16	Cereals	Maize/Millet/Rice/Wheat	1.18	1.03	0.83							1.03	1.08	1.18
		Maize/Millet/Rice/Wheat				1.03	1.08	1.18	1.18	1.03	0.83			
	Oil	Groundnut/Soybean/Sunflower			0.47	0.85	1.13	1.08	0.58					
		Groundnut/Soybean/Sunflower	1.08	0.58								0.47	0.85	1.13
	Roots	Potatoes			0.45	0.75	1.08	1.1	0.71					
		Potatoes	1.1	0.71								0.45	0.75	1.08
	Pulses	Bean	0.2									0.47	0.83	1.1
		Bean			0.47	0.83	1.1	0.2						
	Vegetables	Cucumber/Eggplant/Melon/Onion/Pepper/Tomato		0.52	0.74	1	1.13	0.9	0.23					
		Cucumber/Eggplant/Melon/Onion/Pepper/Tomato	0.23							0.52	0.74	1	1.13	0.9
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88
17	Cereals	Maize/Millet/Rice/Sorghum/Wheat					1.03	1.08	1.18	1.18	1.03	0.83		
		Maize/Millet/Rice/Sorghum/Wheat	1.18	1.18	1.03	0.83							1.03	1.08
	Oil	Groundnut/Soybean/Sunflower			0.47	0.85	1.13	1.08	0.58					
		Groundnut/Soybean/Sunflower								0.47	0.85	1.13	1.08	0.58
	Roots	Potatoes				0.45	0.75	1.08	1.1	0.71				
		Potatoes	1.1	0.71								0.45	0.75	1.08
	Pulses	Bean				0.47	0.83	1.1	0.2					
		Bean	0.2									0.47	0.83	1.1
	Vegetables	Cucumber/Eggplant/Melon/Onion/Pepper/Tomato				0.52	0.74	1	1.13	0.9	0.23			
		Cucumber/Eggplant/Melon/Onion/Pepper/Tomato	1.13	0.9	0.23							0.52	0.74	1
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88
18	Cereals	Maize/Millet/Rice/Wheat				1.03	1.08	1.18	1.18	1.03	0.83			
		Maize/Rice/Sorghum/Wheat	1.18	1.03	0.83							1.03	1.08	1.18
	Oil	Groundnut/Soybean			0.48	0.85	1.08	1.08	0.58					
		Groundnut/Soybean	1.08	0.58								0.48	0.85	1.08
	Roots	Potatoes			0.45	0.75	1.08	1.1	0.71					
		Potatoes	1.1	0.71								0.45	0.75	1.08
	Pulses	Bean				0.47	0.83	1.1	0.2					
		Bean	0.2									0.47	0.83	1.1
	Vegetables	Cucumber/Eggplant/Melon/Onion/Pepper/Tomato			0.52	0.74	1	1.13	0.9	0.23				
		Cucumber/Eggplant/Melon/Onion/Pepper/Tomato	0.9	0.23							0.52	0.74	1	1.13
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88
19	Cereals	Maize	1.15	1.05	0.85							0.4	0.8	0.92
		Millet/Sorghum/Wheat				0.51	0.88	1.1	0.95	0.56				
	Oil	Groundnut/Sunflower	0.45	0.75	1.13	0.97	0.45							
		Groundnut/Sunflower						0.45	0.75	1.13	0.97	0.45		
	Roots	Potatoes	0.45	0.75	1.08	1.1	0.71							
		Potatoes						0.45	0.75	1.08	1.1	0.71		
	Pulses	Bean		0.47	0.83	1.1	0.2							
		None												
	Vegetables	Melon/Onion/Tomato		0.53	0.74	0.97	1.13	0.9	0.23					
		Melon	0.25							0.45	0.75	0.88	1	0.92
	Sugarcane	None												
20	Cereals	Millet/Rice/Sorghum	1.19	1.18	1.03	0.73							1.03	1.08
		Maize/Wheat					0.51	0.89	1.08	1.13	1.03	0.83		
	Oil	Groundnut/Soybean/Sunflower	0.85	1.13	1.08	0.58								0.47
		Groundnut/Soybean					0.48	0.85	1.08	1.08	0.58			
	Roots	Potatoes	1.08	1.1	0.71								0.45	0.75
		Potatoes				0.45	0.75	1.08	1.1	0.71				
	Pulses	Bean	0.47	0.83	1.1	0.2								
		None												
	Vegetables	Cucumber/Eggplant/Melon/Onion/Tomato			0.53	0.74	1	1.13	0.9	0.23				

		Eggplant/Onion/Tomato	0.65								0.52	0.74	1	1.13
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88
21	Cereals	Millet/Sorghum/Wheat					0.51	0.88	1.1	0.95	0.56			
		Maize/Millet/Sorghum/Wheat	1.08	1.13	1.03	0.83							0.51	0.88
	Oil	Groundnut/Soybean/Sunflower	0.85	1.13	1.08	0.58								0.47
		None												
	Roots	Potatoes				0.45	0.75	1.08	1.1	0.71				
		Potatoes	1.08	1.1	0.71								0.45	0.75
	Pulses	Bean	1.1	0.2									0.47	0.83
		Bean			0.47	0.83	1.1	0.2						
	Vegetables	Cucumber/Eggplant/Onion/Pepper/Tomato		0.52	0.74	1	1.13	0.65						
		Eggplant/Onion/Pepper/Tomato							0.52	0.74	1	1.13	0.65	
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88
22	Cereals	Maize/Millet/Sorghum/Wheat				0.51	0.88	1.08	1.13	1.03	0.83			
		Maize/Millet/Sorghum/Wheat	1.13	1.03	0.83							0.51	0.88	1.08
	Oil	Groundnut/Sunflower	0.75	1.13	0.97	0.45								0.45
		None												
	Roots	Potatoes	0.71								0.45	0.75	1.08	1.1
		Potatoes		0.45	0.75	1.08	1.1	0.71						
	Pulses	Bean		0.47	0.83	1.1	0.2							
		Bean							0.47	0.83	1.1	0.2		
	Vegetables	Onion/Pepper/Tomato			0.52	0.74	0.97	1.13	0.65					
		Pepper/Tomato	0.65								0.44	0.7	0.92	1.13
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88
23	Cereals	Maize	1.15	1.05	0.85							0.4	0.8	0.92
		Sorghum					0.48	0.81	1.1	0.8	0.22			
	Oil	None												
		None												
	Roots	Potatoes	0.45	0.75	1.08	1.1	0.71							
		Potatoes						0.45	0.75	1.08	1.1	0.71		
	Pulses	None												
		None												
	Vegetables	Cucumber/Onion/Pepper/Tomato			0.52	0.74	0.97	1.13	0.65					
		None												
	Sugarcane	Sugarcane	0.4	0.9	1	1.13	1.25	1.25	1.25	1.25	1.25	1	0.75	0.88

% of Area in Eq. 3 is the percentage of crop group area relative to total crop group area. It is taken from data for the 2000 crop distribution at 5 min resolution used by Monfreda et al. (2008) and Ramunkutty et al. (2008). The data have been rescaled at 0.5° resolution. The percentage is assumed constant for every month over the 41 year period.

Green Water corresponds to the water that plants can access from rainfall through soil moisture. The monthly values over the 41 year period are directly extracted from the PCR-GLOBWB global hydrological model and constitute the sum of the simulated actual transpiration of natural vegetation and rainfed crops from the first and second soil layer of the model (Wada et al., 2011). This definition can be contested as green water is sometimes expressed as the actual evapotranspiration. Falkenmark and Rockström (2006) distinguish two components of green water: the productive part, i.e. transpiration, involved in biomass production, and the non-productive part, i.e soil evaporation. As opposed to Schuol et al. (2008), who consider that evaporation has potential to be partly used as

productive green water for food production, a conservative approach is applied in this study to ensure that the GWIP is not overestimated, hence considering transpiration as the only water available from precipitation for crop growth. Figure S1 presents the distribution of average annual rainfall and green water over Africa as used in the calculations, as well as the ratio of green water to rainfall. The equatorial regions, except east Africa, have higher precipitation and higher absolute green water availability than the rest of Africa. However, the green water availability is not strictly proportional to the rainfall as the ratio of green water to rainfall decreases to less than 40% in tropical areas where evaporation is the main factor of water losses.

Net Irrig. Water Demand is calculated for each month over the 41 year period for the six (n=6) crop groups (cereals, oil crops, roots, pulses, vegetables and sugar crops), taking into account available green water and share of crop groups of total crop group area. The monthly values are summed per year, and then over the six crop groups.

Irrig. Efficiency is the irrigation efficiency coefficient (FAO, 1989). It is used to express the fraction of abstracted groundwater not lost along the water transport from the abstraction point to the crop. These distributed values (FAO, 1997) are assumed constant.

Irrig Water Demand (gross) is calculated from *Net Irrig. Water Demand* divided by the constant *Irrig. Efficiency*)

Parameters of Eq.1

GWIP is the groundwater irrigation potential, expressed in terms of area irrigable by the available groundwater and considering the gross irrigation water demand. It is calculated using average annual value for groundwater availability to account for the buffering effect of groundwater storage and using the maximum annual gross irrigation water demand over the 41year period, yielding one value per cell.

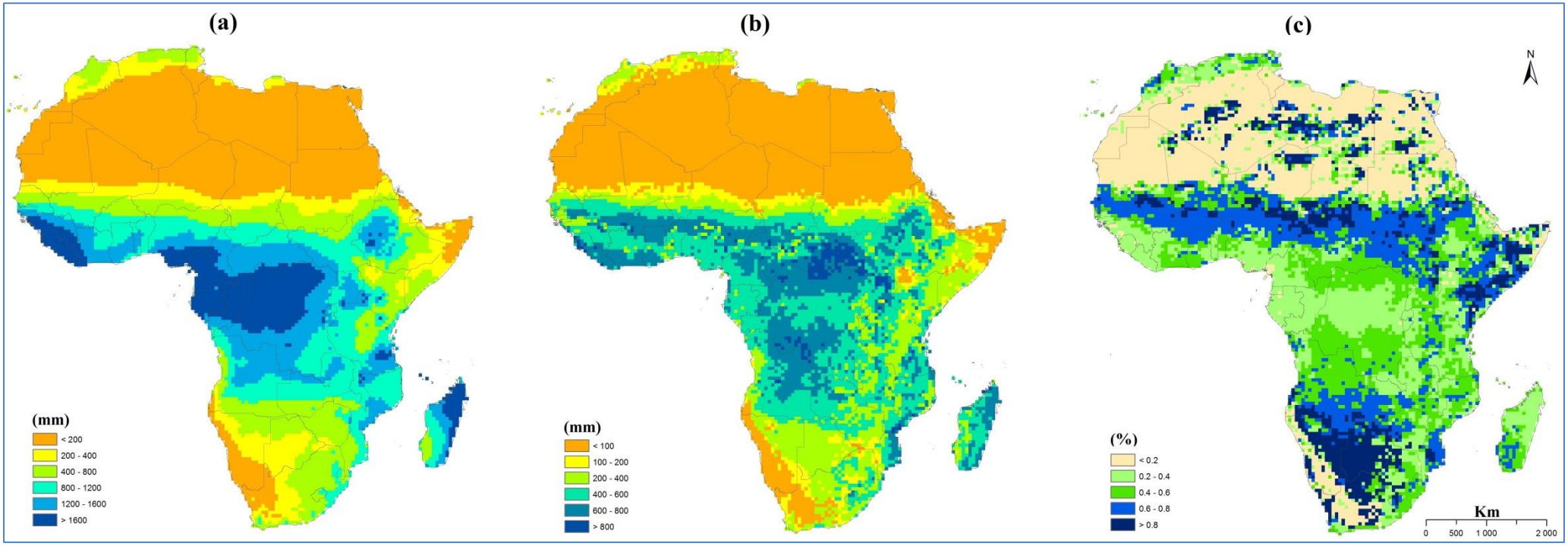

Figure S1. Average of (a) the annual rainfall and (b) the annual green water and (c) ratio of annual green water to rainfall, all given as averages over the 41 year period (1960-2000)

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