Supplementary Information for "Integrated crop water management might sustainably halve the global food gap"

J Jägermeyr[1,2], D Gerten[1,2], S Schaphoff[1], J Heinke[1,3,4], W Lucht[1,2], J Rockström[5]

[1] Research Domain Earth System Analysis, Potsdam Institute for Climate Impact Research (PIK), Telegraphenberg A62, 14473 Potsdam, Germany
[2] Geography Department, Humboldt-Universität zu Berlin, Unter den Linden 6, 10099 Berlin, Germany
[3] International Livestock Research Institute (ILRI), P.O. Box 30709, Nairobi, 00100 Kenya
[4] Commonwealth Scientific and Industrial Research Organization (CSIRO), St. Lucia, QLD 4067, Australia
[5] Stockholm Resilience Centre, Stockholm University, Stockholm 106 91, Sweden

E-mail: jonas.jaegermeyr@pik-potsdam.de

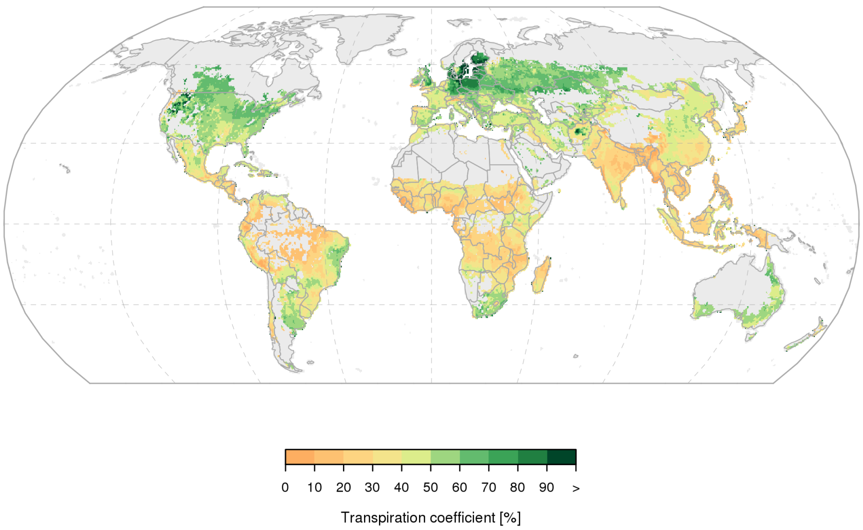

Figure S1. Spatial patterns in transpiration coefficient (transpiration per precipitation and abstracted irrigation water) averaged across rain-fed and irrigated crops during the growing seasons 1980 to 2009.

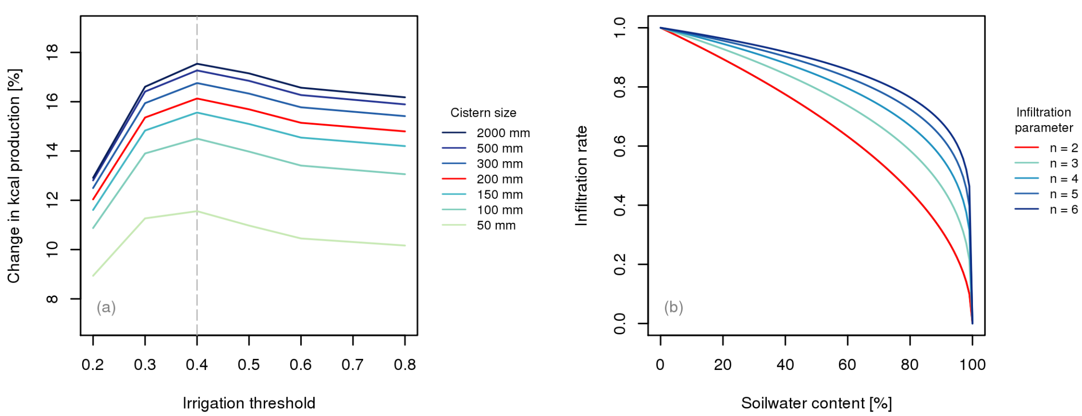

Figure S2. Sensitivity analysis for WH_{ex} parameters cistern size and irrigation threshold (a), and sensitivity analysis for WH_{in} infiltration parameter (p) (b), averaged over global rain-fed cropland for the time period 1980-2009. Default setting is $p = 2$, improved soil infiltration is realized through $p = 3, 4, 5, 6$.

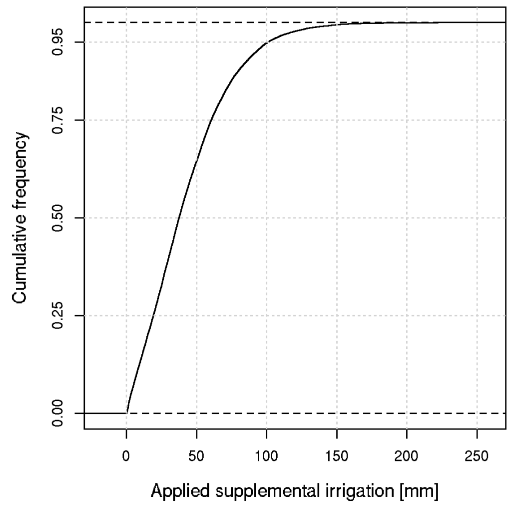

Figure S3. Cumulative frequency distribution of applied supplemental irrigation for the "ambitious" scenario (defined in section 2.1.5).

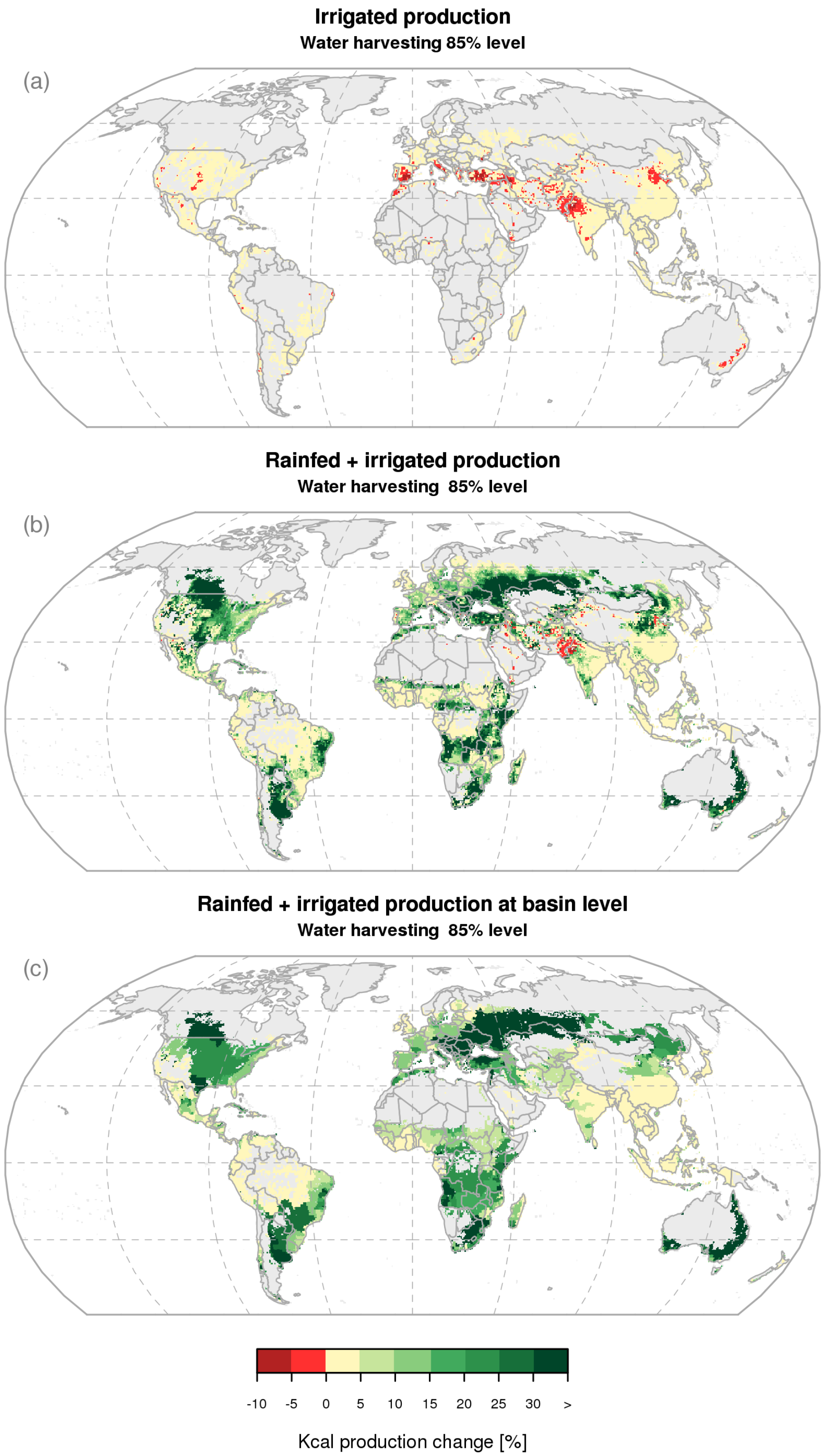

Figure S4. Downstream effect of water harvesting (WH_{ex} and WH_{in}) at the extreme 85% level. WH is implemented in rainfed systems only, but affects discharge for downstream users. Panel (a) shows the effect on irrigated kcal production, panel (b) on total kcal production (rainfed and irrigated) and panel (c) shows the change in total kcal production aggregated to the basin level.

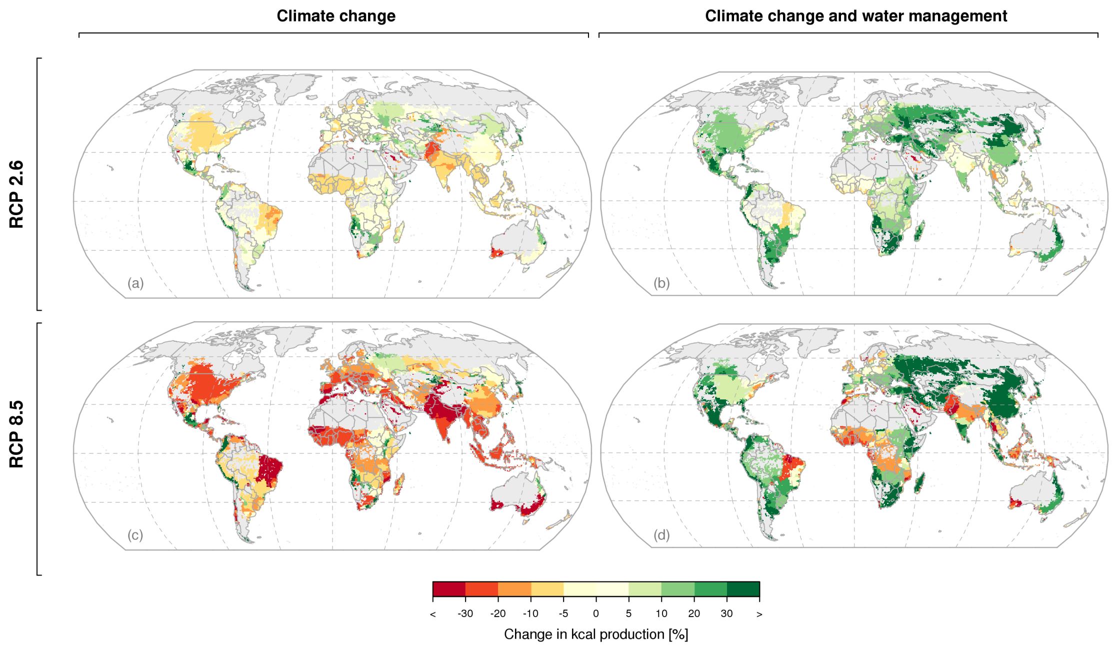

Figure S5. Spatial patterns of potential climate change impact on global kcal prodcution under RCP 2.6 (a) and opposed to "low" water management (b); under RCP 8.5 (c) and opposed to "ambitious" water management (d), all for the time period 2070 to 2099 vs. 1980-2009 as averages across 20 GCMs and with **constant** CO_2 concentration (compare table 4).

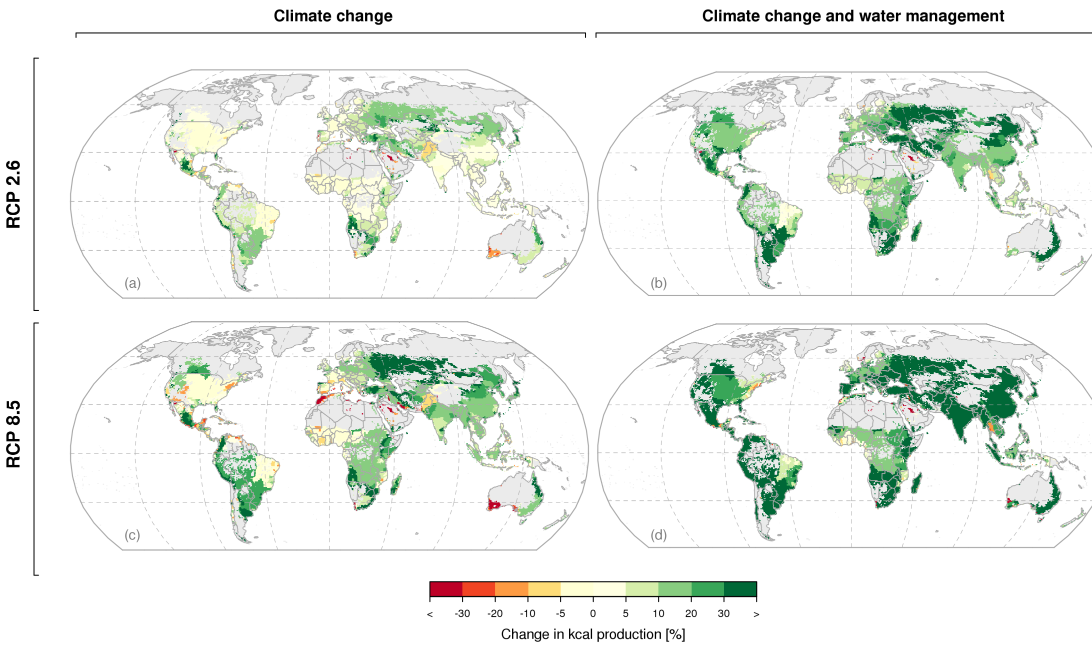

Figure S6. Spatial patterns of potential climate change impact on global crop yields under RCP 2.6 (a) and opposed to "low" water management (b); under RCP 8.5 (c) and opposed to "ambitious" water management (d), all for the time period 2070 to 2099 vs. 1980-2009 as averages across 20 GCMs and with **transient** CO_2 concentration (compare table 4).

Table S1: Selection of reference studies for water management interventions (WH_{ex}: *ex situ* water harvesting, WH_{in}: *in situ* water harvesting, SI: supplemental irrigation).

Study	**Method**	**Region**	**Result**
AgWater Solutions (2012)	WH_{in} and fertilizer, modeling study	sub-Saharan Africa	Potential to expand WH_{in} to 52 million ha in SSA, massive yield increases (Maize, Sorghum, Millet)
Andersson et al. (2011)	WH_{ex}, modeling study (SWAT)	South Africa	˜0% (due to high nitrogen stress, +30% with ecological sanitation)
Araya & Stroosnijder (2010)	WH_{in}, tied ridges, mulch	Ethiopia	Barley yield +44%, soil evaporation reduced by 50 to 80%
Barron et al. (1999)	WH_{ex} + SI	Kenya	$70mm$ SI increase yields by 70% on average and prevent crop failure during drought
Barron & Okwach (2005)	WH_{ex} + SI	Kenya	Maize yields +36%
Biazin et al. (2012)	WH review	sub-Saharan Africa	Micro catchments can increase soil moisture by 30%, surface runoff reduced by 60%
Bos et al. (2009)	SMC, plastic mulching SMC, organic mulching	General	Yields +10 to 30%, soil evaporation reduced by 50 to 80% Soil evaporation reduced by 25% (50% soil surface covered by organic crop residues)
Botha et al. (2007)	WH_{in}	South Africa	Maize and soy yields +50% over six seasons
Bu et al. (2013)	Mulching	China	Maize yield +17 to 70% (gravel mulching) and +28 to 88% (plastic mulching)
Enfors et al. (2011)	WH_{in}, conservation tillage	Tanzania	Maize yield +17 to 41%
Fox & Rockström (2000)	WH_{ex} + SI	Burkina Faso	Sorghum grain yield +41% (+181% SI + fertilizer)
Fox & Rockström (2003)	WH_{ex} + SI	Burkina Faso	Sorghum grain yield +56% (+208% SI + fertilizer)
Hensley et al. (2000)	WH_{ex} + SI, conservation tillage	South Africa	Maize and Sunflower yields +50%
Kahinda et al. (2007)	WH_{ex} + SI, case study and modeling (APSIM)	Zimbabwe	Yield gap reduced by 53% (kg ha^{-1})
Kronen (1994)	Conservation tillage (tied-furrow)	Zimbabwe	Cotton, sorghum, maize yields +42, 21, and 25%, respect. over 7 seasons
Lebel et al. (2015)	WH_{ex} + SI, modeling study	sub-Saharan Africa	Maize yields +9 to 39%, water gap bridged by up to 40%
Liu et al. (2014)	SMC, plastic mulching	China, nationwide	Yields +20 to 35% (grain) +20 to 60% (cash crop), plastic film mulching in China reached ca. 20 million ha

Ngigi et al. (2005)	WH_{ex} + SI	Kenya	50 m^3 farm pond and drip irrigation prevent crop failure; adequate for supplemental irrigation 300–600 m2
Oweis (1997)	WH_{ex} + SI	Syria	Wheat yields +28% to 356%
Oweis & Hachum (2006)	WH_{ex} + SI	Syria	Wheat yields +176% on average over three seasons
Pretty et al. (2006)	Various conservation agriculture interventions	57 countries	Average yield increases by 79%
Rockström et al. (2009)	Conservation farming (zero tillage, water harvesting, fertilizer)	Ethiopia, Kenya, Tanzania, Zambia	Maize and Tef yields +20 to 200%
Rost et al. (2009)	WH_{ex} + SI, WH_{in}, modeling study	Global	Global crop NPP +27 to 82% (different scenarios)
Sauer et al. (1996)	Residue mulching	US	Maize yield +34 to 50%
Sivannapan (1992)	SI	southern India	Yield (various crops) +70 to 120%
Somme et al. (2004)	WH_{in}	Syria	Shrub survival rate increased by +70 to 90%
Tsubo & Walker (2007)	WH_{ex} + SI, modeling study	South Africa	Maize yields +12 to 62%
Welderufael et al. (2008)	Conservation tillage	Ethiopia	Maize yield +25 to 35%
Zhu & Yuanhong (2006)	WH_{ex} + SI	China, large-scale study	Crop yields +20 to 88%, +40% on average
Walker et al. (2005)	WH_{ex} + SI, WH_{in}, modeling study	South Africa	Maize yields +50%
Wisser et al. (2010)	WH_{ex} + SI, modeling study	Global	Cereal production +35% (medium scenario)

Table S2: CMIP5 model and group names used in this study

Modeling Center (or Group)	**Institute ID**	**Model Name**
Beijing Climate Center, China Meteorological Administration	BCC	BCC-CSM1.1 BCC-CSM1.1(m)
National Center for Atmospheric Research	NCAR	CCSM4
Community Earth System Model Contributors	NSF-DOE-NCAR	CESM1(CAM5)
Commonwealth Scientific and Industrial Research Organization in collaboration with Queensland Climate Change Centre of Excellence	CSIRO-QCCCE	CSIRO-Mk3.6.0
The First Institute of Oceanography, SOA, China	FIO	FIO-ESM
NOAA Geophysical Fluid Dynamics Laboratory	NOAA GFDL	GFDL-CM3 GFDL-ESM2G
NASA Goddard Institute for Space Studies	NASA GISS	GISS-E2-H GISS-E2-R
National Institute of Meteorological Research/Korea Meteorological Administration	NIMR/KMA	HadGEM2-AO
Met Office Hadley Centre (additional HadGEM2-ES realizations contributed by Instituto Nacional de Pesquisas Espaciais)	MOHC (additional realizations by INPE)	HadGEM2-ES
Institut Pierre-Simon Laplace	IPSL	IPSL-CM5A-LR IPSL-CM5A-MR
Japan Agency for Marine-Earth Science and Technology, Atmosphere and Ocean Research Institute (The University of Tokyo), and National Institute for Environmental Studies	MIROC	MIROC-ESM MIROC-ESM-CHEM
Atmosphere and Ocean Research Institute (The University of Tokyo), National Institute for Environmental Studies, and Japan Agency for Marine-Earth Science and Technology	MIROC	MIROC5
Meteorological Research Institute	MRI	MRI-CGCM3
Norwegian Climate Centre	NCC	NorESM1-M NorESM1-ME

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