

Blue and Green Water Use by Irrigated Crops

Stefan Siebert and Petra Döll

WHAT ARE THESE MAPS TELLING US?

In these maps, blue water refers to irrigation water while green water is precipitation stored in the soil that is also used by irrigated crops. The values refer to the amount of water that is evapotranspired, or converted from soil water to vapor and evaporated off plant stems and leaves. Blue and green water use by irrigated crops is highest in regions with a large extent of irrigated land (p. 18), high cropping intensity (p. 28), and climate conditions causing a high evaporative demand, for example, along the Nile River, in the northern African countries of Morocco, Algeria, Tunisia, and Libya, and in South Africa (Maps 1 and 2). The contribution of blue water to total water use of irrigated crops (Map 3) depends on the aridity of the site because irrigation is mainly used to replace missing precipitation. The staple food crops with the highest irrigation water use are rice (12.1 km³ per year), wheat (11.1 km³ per year), and maize (9.0 km³ per year) (Figure 1). Combined they account for a third of the total blue water used for irrigation in Africa. More than 77 percent of the total irrigation water use is in northern Africa.

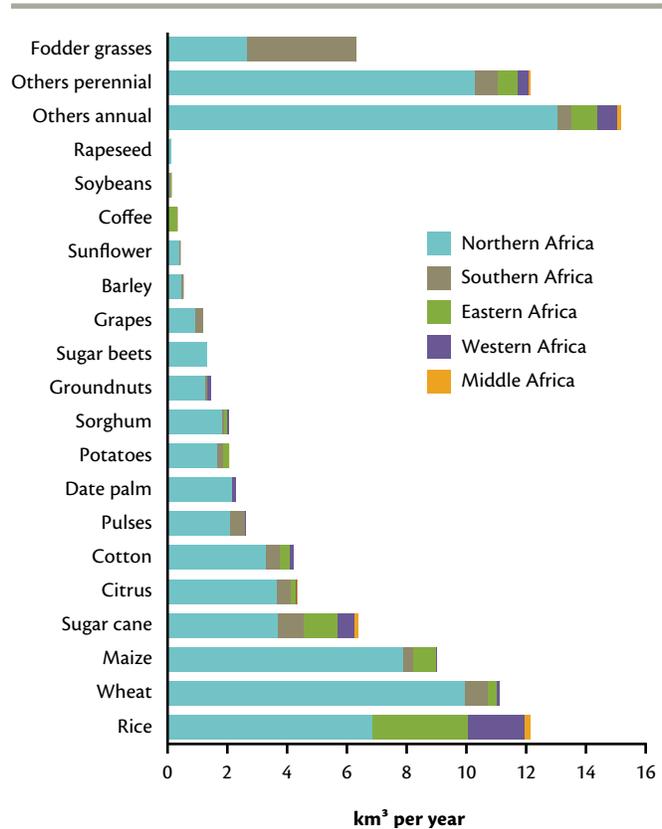
WHY IS THIS IMPORTANT?

Although only 9 percent of the harvested crop area in Africa is under irrigation, cereal production would decline by about 24 percent in Africa without the use of irrigation (Siebert and Döll 2010). This highlights the importance of irrigation for food security. On the other hand, irrigation accounts for 86 percent of global consumptive freshwater use (Döll et al. 2012) with contributions of more than 90 percent in many African countries. Availability of freshwater therefore may limit the use of irrigation in many regions. To identify regions where expanding irrigation could increase future crop production, it is necessary to consider irrigated crops' blue water use along with freshwater availability (Bruisma 2009). Green water use is also important to consider, because blue and green water can be substituted for each other.

WHAT ABOUT THE UNDERLYING DATA?

Crop evapotranspiration was calculated by the Global Crop Water Model (GCWM, Siebert and Döll 2008, 2010), distinguishing blue water use, or the evapotranspiration of irrigation water (also called consumptive irrigation water use) from green water use (evapotranspiration of precipitation). GCWM is based on the global land use dataset MIRCA2000 (Portmann, Siebert, and Döll 2010), which provides monthly growing areas for 26 irrigated and rainfed crop classes for

FIGURE 1 Blue water use by irrigated crop and region, 1998–2002



Data source: Siebert and Döll 2010 and FAO 2012.

Note: Blue water use refers to the net irrigation water used by irrigated crops.

the period 1998–2002 and also represents multicropping. By computing daily soil water balances, GCWM determines evapotranspiration of blue and green water for each crop and grid cell. GCWM assumes that crop evapotranspiration of irrigated crops is always at the potential level and not restricted by water shortage. Water withdrawals for irrigation are higher than consumptive use because of losses and water requirements for soil preparation and salt leaching.

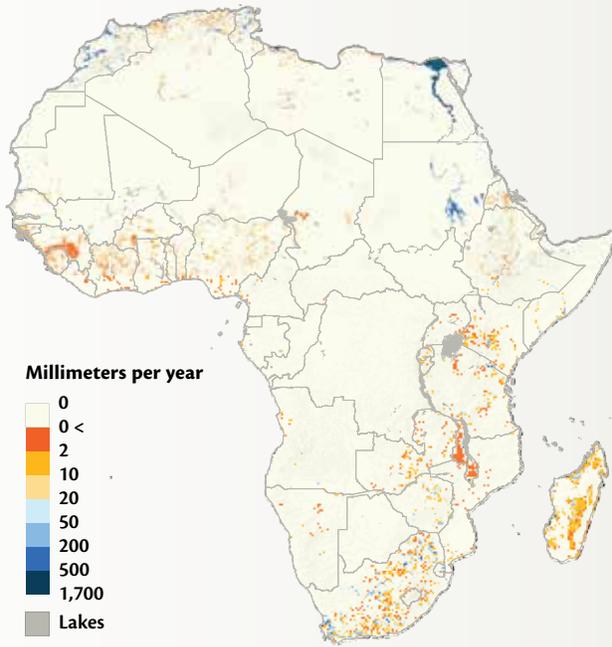
WHERE CAN I LEARN MORE?

FAO Aquastat: <http://bit.ly/1dUQWqj>

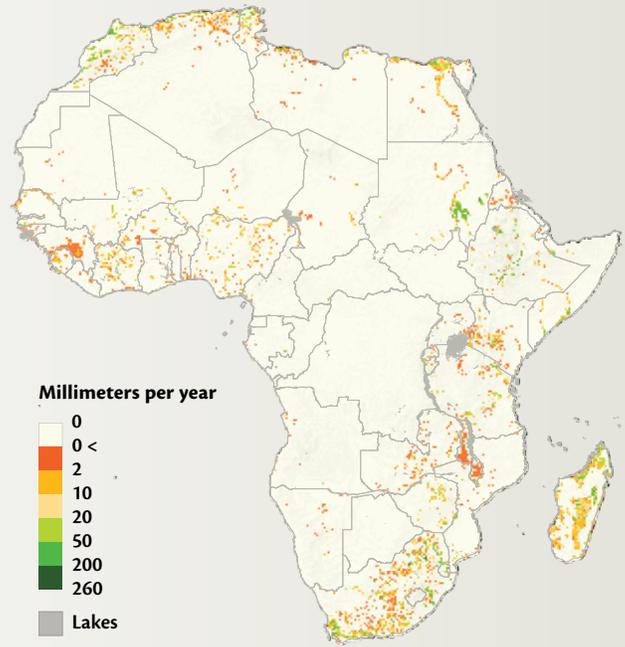
The Global Crop Water Model (GCWM): Documentation and First Results for Irrigated Crops. Siebert and Döll 2008..



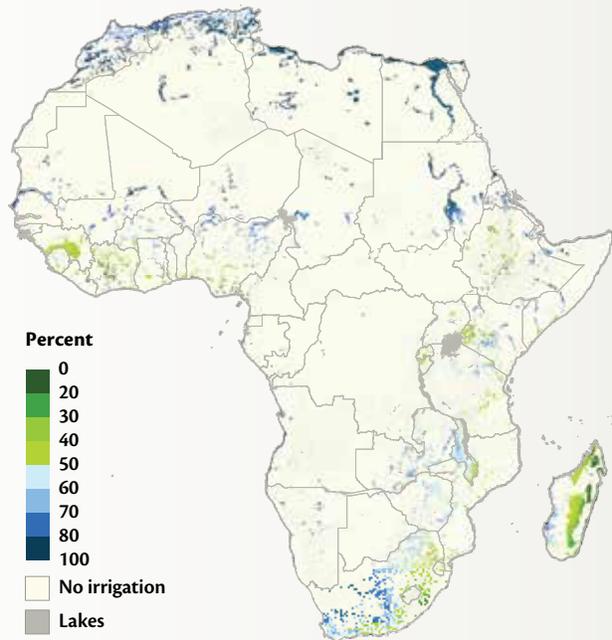
MAP 1 Blue water use by irrigated crops, 2000



MAP 2 Green water use by irrigated crops, 2000



MAP 3 Contribution of blue water to total water use of irrigated crops



Data source (all maps): Siebert and Döll 2010.

Note: Blue water use refers to the net irrigation water used by irrigated crops. Green water use refers to precipitation water stored in the soil and used by irrigated crops.