LETTER

Reply to Ridoutt and Huang: From water footprint assessment to policy

According to Ridoutt and Huang (1), "environmental relevance must be taken into consideration if water footprints are to inform wise decision making and policy development." Indeed, reduction targets regarding water footprints (WFs) within catchments should be formulated on the basis of relative water scarcity per catchment, because local environmental impact of water use is generally larger when scarcity is higher. In many river basins, the blue WF exceeds blue freshwater availability, causing substantial environmental impact (2). However, local environmental impact is only one of a range of factors to be considered when prioritizing options for WF reduction (3). Other relevant factors are global sustainability, social equity, and economic efficiency.

The key issue concerning humanity's WF is that the world's available freshwater resources are limited, so that it is important to quantify how available water volumes are appropriated: for producing certain commodities, for certain people. Because water-intensive commodities can be traded internationally, wise allocation of freshwater resources to alternative purposes is a question with a global dimension. Water-abundant areas often show low water productivities (tons per cubic meter) and thus large product WFs (cubic meters per ton). Even though local environmental impact of water use can be small, one would be mistaken to leave these areas out of the scope of water policy. An important component of the solution to overexploitation of blue freshwater resources in water-stressed catchments is to increase water productivities (reduce product WFs) in water-abundant areas (3). Particularly the efficient use of the world's green water resources in rain-fed agriculture can help to reduce the need to consume blue water resources (4). A mere focus on reducing WFs in water-stressed catchments displays a limited perspective on the question of what is globally sustainable and efficient water use.

WFs need to be seen from the perspective of equity as well. By comparing the WF of consumption for different nations, we showed that some people consume and pollute more freshwater than others (5). The fact that US consumers have a WF per capita 2.6 times larger than people in China and India justifies a debate about equitable appropriation of freshwater resources. The world's spatially distributed freshwater resources are accessible from anywhere through trade in water-intensive commodities. The widespread inefficient use, overexploitation, and pollution of water must be a concern for all that have a water-intensive consumption pattern, not only for those that directly depend on the areas where environmental impact of water use is greatest.

We acknowledge that reducing the aggregate WF in environmentally stressed catchments deserves priority (3), but given the competition over the globe's freshwater resources, increasing water productivities (lowering product WFs) in nonstressed basins can be an instrument to reach that goal. Priorities to reduce WFs of specific products, WFs of nations as a whole, or WFs within specific catchments need to be formulated in the context of a variety of considerations, including local environmental impact, global sustainability, equity, and economic efficiency. In addition, decisions on WF reduction need to be embedded in policy that considers the use and allocation of other finite resources as well.

Arjen Y. Hoekstra*[1] *and Mesfin M. Mekonnen
Department of Water Engineering and Management, University of Twente, 7500 AE Enschede, The Netherlands

1. Ridoutt BG, Huang J (2012) Environmental relevance—the key to understanding water footprints. *Proc Natl Acad Sci USA* 109:E1424.
2. Hoekstra AY, Mekonnen MM, Chapagain AK, Mathews RE, Richter BD (2012) Global monthly water scarcity: Blue water footprints versus blue water availability. *PLoS ONE* 7(2):e32688, 10.1371/journal.pone.0032688.
3. Hoekstra AY, Chapagain AK, Aldaya MM, Mekonnen MM (2011) *The Water Footprint Assessment Manual: Setting the Global Standard* (Earthscan, London).
4. Falkenmark M, Rockström J (2004) *Balancing Water for Humans and Nature: The New Approach in Ecohydrology* (Earthscan, London).
5. Hoekstra AY, Mekonnen MM (2012) The water footprint of humanity. *Proc Natl Acad Sci USA* 109:3232–3237.

Author contributions: A.Y.H. and M.M.M. wrote the paper.

The authors declare no conflict of interest.

[1]To whom correspondence should be addressed. E-mail: a.y.hoekstra@utwente.nl.