

## ***Interactive comment on “Assessing water footprint of wheat production in China using a crop-model-coupled-statistics approach” by X. C. Cao et al.***

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Many thanks for your very patient and professional interactive comments again. We appreciate and quite approve of most of your views. However, there are still several academic issues needed to discuss with you.

1. We assess the WF of crop production from a way slightly different from most of the previous studies. But we have never argument that, in neither the manuscript nor interactive reply, we have done better.

2 The actual the crop water use (evapotranspiration, ET) is not equal to crop water

C221

requirement (CWR). Actual ET, which determined by irrigation guarantee rate, may well below the CRW for lack of irrigation water supply. Many reasons may cause the insufficient irrigation, such as 1) there is not enough water in the source, 2) farmer is not willing to irrigation for some reason, 3) the irrigation facilities are deficient and 4) other reasons of management.

As we know, lots of parameters, including irrigation water, are needed for every crop growth and development simulation model. The actual ET could only be simulated when the actual irrigation water amount was an input for the model. But it is not the case for most of the literatures you enumerated to our understanding:

Mekonnen and Hoekstra (2010, 2012); Liu and Yang (2010) and Liu et al. (2009) assumed that the irrigation water is sufficient for crops cultivated in the land equipped for irrigation (not meaning it is the irrigated crop!). It is stated in Mekonnen and Hoekstra (2010) that ‘In the second scenario we have assumed that the amount of actual irrigation is sufficient to meet the irrigation requirement’, and ‘In the second soil water balance, it is assumed that soil receives sufficient irrigation’ and ‘Soil water balance II is carried out by assuming the soil receives sufficient irrigation water’ in Liu and Yang (2010) and Liu et al. (2009) respectively. Hanasaki et al. (2010) and Fader et al. (2011) used a similar approach by ‘In this study, the conceptual water source is available everywhere without limit and is not recharged’ and ‘It is assumed that the CFTs’ gross irrigation water requirements. . . . can always be fulfilled’ respectively.

Rost et al. (2008) adopted two alternative approaches for estimating the amount of blue irrigation water that can be withdrawn and brought to the field, and the only considered that ‘in the limited irrigation simulation ILIM Wd is restricted by the available water in rivers, lakes, reservoirs, and renewable groundwater’.

Liu et al. (2007) seems to take advantage of the actual irrigation water withdrawal by stating ‘AQUASTAT (FAO, 2005a) provides the data for agricultural water withdrawal and irrigation efficiency in individual countries’ in the paper. However, only total agri-

C222

cultural water withdrawal is available from the AQUASTAT. The agricultural water withdrawal is gross irrigation water amount providing for all of the crops! The paper hasn't illustrated how is the water allocated to wheat production.

All of these excellent works have given us great inspiration in agricultural WF study. However, the function of 'taking the daily soil water balance and accounting for the potential soil water stress' is estimating the irrigation water requirement accurately, but not the actual irrigation water use strictly speaking.

3. We are relieved and grateful for you have not denied the keeping conveyance loss in water utilization evaluation. The only remaining question is whether or not the loss could be considered as a part of WF.

We could not agree more with you opinion that 'it clearly state that the WF is estimated by considering water consumption and pollution'. However, the 'water consumption' in the manual is far from the evapotranspiration (also called consumption water use in some studies).

You should refer to two sentences in the 2nd page of the manual, which reads as: "Consumption' refers to loss of water from the available ground-surface water body in a catchment area. Losses occur when water evaporates, returns to another catchment area or the sea or is incorporated into a product" (Hoekstra et al. 2011). Let us to state our understandings of these sentences, especially the presentation 'returns to another catchment area or the sea':

1) The spatial scale of the 'catchment area' is not strictly defined and it depends on the study area size. As we know, any structure in which water is collected is a catchment. In other words, most of the irrigation water withdrawal is the water 'returns to another catchment area'.

2) The time scale of the 'returns to the sea' is not strictly defined in the manual either. As we know, most of the conveyance loss return the river will flows into the sea

C223

ultimately, if the irrigated land located inside an exorheic river.

The premise of understanding and applying the water footprint concept is delimiting the spatial and time scale. In fact, Chapagain and Hoekstra (2004) have assumed a constant percolation loss of 300 mm of water per year from the rice field and added that to the total water footprint of rice in 2004. The goal of discussion is not to prove the other is wrong, but to find a common fulcrum. The 'water footprint' concept should not only be a stiff or narrow definition. We don't try to improve a concept by changing its definition, but expect it to have a more tolerant and broader connotation. As long as that, WF research will be extended, and it will play a greater role in water resources management.

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C224

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