

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

### **Anonymous Referee #1**

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The paper assess the water footprint of wheat in China using the CROPWAT model together with regional data on irrigation and yield level of wheat. The paper contains very few new things but it adds some valuable information to the literature.

General comments:

#1. The title of the paper “using crop-model-coupled-statistics” is not proper to the content of the paper. It gives the impression that you have done some advanced statistical analysis. In fact what you have done is to model the crop water use using CROPWAT and support your calculation with data from the regional administration bureau. Re-

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move the “coupled-statistics approach” sentence from the title. It also appears in the abstract and other sections.

#2. I think you have missed the proper meaning of the water footprint by including the conveyance water loss in the estimate. Water lost in conveyance includes deep percolation to soil layers underneath the canals, evaporation from the water surface, runoff the drain, and overtopping the bunds. All this water is not lost in its proper sense except the water evaporated from the water surface. Most of the water lost in the conveyance remain in the catchment. What you try apply is the classical definition of irrigation efficiency that ignores the value of return flows, i.e. irrigation water runoff and seepage that re-enters the water supply system (Keller and Keller 1995; Perry, 2007; Seckler et al. 2003). When the return flow is reused, the overall efficiency increases. Thus, while the individual systems could have a low level of efficiency (“lost water”), the actual basin-wide efficiencies can be much higher. Therefore, taking the conveyance loss into account in the WF estimate is wrong.

#3. Your blue WF estimates should be the one on the field level without the conveyance loss. That means all the blue WF estimate need to be revised. The equations in the methodology section also need to be revised to reflect this change.

#4. What is your general conclusion regarding the water productivity of rainfed vs irrigated agriculture? What is your advice to policy makers? In many part you have stated increased irrigation will raise yield. Is this the only solution? What about in the rainfed areas?

Specific comments:

#5. You stated “. . .the assessment improves upon earlier research . . .” (line 4 in the abstract). It is good you have used local data to improve the estimate. However, your final result doesn’t show that much of a difference to the other studies. For example your field level estimate (table 3) of 67% green is very close to the one by Mekonnen and Hoekstra (2010) who have estimated the green component as 64%. Your WF

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values in absolute term are not neither different to the other studies. What do you really improve upon the earlier research beside using local data?

#6. Page 558, line 8-9: the statement "...should have contributed more, ..." is in conflict with your statement on page 574, line 15-17 where you stated the climate condition is not favourable for wheat in this regions.

#7. Page 558, line 3-5: your statement that the blue WF per unit of production reflect irrigation efficiency quite wrong. WF accounts the actual water consumption so it doesn't show the level of irrigation efficiency.

#8. Page 558, line 18: Gerbens et al. (2009) is not a proper reference in this context. In any case I couldn't either find it in the reference list.

#9. Page 558, line 24: Mekonnen et al. (2010) should be Mekonnen and Hoekstra (2010)

#10. Page 559, line 12: Replace "quantization" with "estimation or calculation"

#11. Page 566, line 19: Replace "contrastively" with "comparatively"

#12. Page 566, line 22: Replace "accumulatively" with "together"

#13. Page 567, line 9: the word "withdrawal" in the sentence "... blue water withdrawals .." need to be replaced with "footprint". This is due to the confusion you have from the beginning – water footprint (actual consumption) is not the same as withdrawals!!

#14. Page 567, line 23-25: the values are direct copy of the blue WF from line 9-11 in the above paragraph. Revise the numbers to reflect the total WF in the irrigated field.

#15. Page 572, line 23: Replace "reaping" by "producing"

#16. Page 572, line 23-25: the sentence "Irrigation not only promotes crop yield but also increases WF of China's ..." seems to imply that larger WF to be positive aspect of irrigation. Please reword the sentence.

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#17. As the discussion in page 573 and 574 shows, the interpretation of your index (QW) is not straight forward or it has little meaning without other relevant information. For example for Category I countries, the value of QW indicate irrigation can increase water productivity so it suggest expand irrigation and production in those regions. However, the regions are not favourable to wheat production as you also stated. It would be interesting to see how the result of the QW and its interpretation changes when you exclude the conveyance loss from the blue WF estimate.

#18. Section 5: the 2nd and 3rd paragraphs are discussion rather than conclusion so please change the heading to “Discussion and conclusion”

#19. Page 576, line 14: you claimed that your result is more accurate. What do you mean by that? Have you tested your result against actual crop water use (CWU) values measured in the region and tested the difference using statistical significance? I can't find any discussion or test to show how accurately you modelled the CWU and WF in the different regions.

Table 1. It would be better if you sort the table within the sub-region based on the magnitude of the WF or the province. Currently there is no logic in the arrangement.

Figure 7. It is difficult to differentiate the two lines in black-white print. Change the symbol or the line type for one of the parameters.

## References

Keller, A.A. and Keller, J. (1995) Effective Efficiency: A water use efficiency concept for allocating freshwater resources, Discussion Paper 22, Centre for Economic Policy Studies, Winrock International, Arlington, USA.

Perry, C. (2007) Efficient irrigation; inefficient communication; flawed recommendations, *Irrigation and Drainage* 56(4): 367-378.

Seckler, D., Molden, D. and Sakthivadivel, R. (2003) The concept of efficiency in water resource management and policy, in *Water productivity in agriculture: Limits and op-*

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