

## ***Interactive comment on “A global and high-resolution assessment of the green, blue and grey water footprint of wheat” by M. M. Mekonnen and A. Y. Hoekstra***

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The study estimates green, blue and grey water footprint of wheat with a high spatial resolution on a global scale. The assessment is made from both the production and consumption perspectives. The methodology follows the procedure described in Water Footprint Manual ([www.waterfootprint.org](http://www.waterfootprint.org)). The paper is easy to follow and the structure is clear. However, I have some comments and suggestions on this study and hope the authors can address them in the revision of the paper.

General comments:

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1. Liu et al. (2009) and Siebert and Döll (2010) have estimated the green and blue water footprint on a global scale. The Discussion section in this paper merely compared the estimates derived from different studies. As the authors stated, however, due to a large set of assumptions made in each of these studies, it is difficult to judge which estimates are more accurate or reliable. The authors did not mention that the difference in the study periods is also a source of discrepant results among different studies (this point should be added in the discussion). Hence, a mere comparison of the estimates among different studies per se adds little new insight into the existing literature. I suggest the authors to rewrite the Discussion section to address water and environmental implications and policy relevance of the mighty numbers derived in their study.

2. I agree that water pollution caused by chemical fertilizer applications is a problem and should be addressed in the agricultural water policy. However, I am not convinced that the way it is incorporated in the water footprint accounting is appropriate. The fundamental problem is that grey water footprint (as it is defined) is not on the same dimension to the green and blue water footprint. Concerning crop production, green and blue water footprint refers to the quantity of water consumed through evaporation/transpiration during crop growth. This part of the water is ‘no longer available’ for the local and down stream uses (ignoring the vapor circulation). Grey water footprint is defined as the water required for diluting polluted water to meet the existing ambient water quality standards. In this study, the pollution caused by nitrogen fertilizer is considered. There are two problems concerning such accounting. One is that the grey water is not ‘gone’, but is still available for local and down stream uses (although it may have environmental and health consequences). Therefore, a summation of green, blue and grey water leads to a conceptual inconsistency. Another problem is that in wheat production, the nitrogen fertilizer lost to water bodies could be even beneficial to crops as additional fertilizer through the supply of irrigation. In this case, including the water loaded with nitrogen in water footprint accounting can be confusing and even misleading. The authors need to provide more justification for including nitrogen fertilizer in the

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wheat water footprint accounting.

Specific comments:

p.2502, lines 15-17. 'For trading purposes, wheat is classified into distinct categories....'. I assume that water footprint of different wheat varieties differ. It is not clear if the authors considered these differences in their calculation of water footprint.

p.2509-2510. The text of Section 4 contains mainly the numbers estimated. It mostly repeats what are reported in Tables and Figures in the section. I suggest the authors to drop the report of numbers, but provide supplementary information in the text. Also the numbers in Table 3 can be easily (and should be) incorporated into Table 1.

p.2514, lines 15-18. 'If we assume that wheat export from the USA comes from the different states proportional to their production....'. This assumption cannot be sustained because most states do not produce sufficient wheat for self-consumption. They actually import wheat from other states (or countries). Suppose a state's production is 10% of the national total but is only able to meet 80 % of its consumption, assigning a weight of 10% to this state in the calculation of virtual water export is not appropriate.

p.2513-2516. Section 7. This whole section is mostly compiled with numbers. The text basically repeats the same information as shown in Tables and Figures. The authors should provide some analysis of the impacts of the water use in wheat production on the local water resources and environment in the case study regions.

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