

Interactive comment on “Analysis of virtual water flows associated with the trade of maize in the SADC region: importance of scale” by J. M. Dabrowski et al.

J. M. Dabrowski et al.

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The authors would like to thank this reviewer for a detailed, critical review of our paper.

1. The reviewer is correct in stating that improved agronomic management can improve yields and therefore reduce the virtual water content of a crop. Agronomic management is a key input into determining the virtual water content of crops as the virtual water content is highly dependant on the yield of a crop. This point is highlighted on Page 13, Line 6-13. Obviously the lower the yield the higher the virtual water content and vice versa. In the context of this study, the virtual water content of SA is the lowest of all countries included in the analysis (with the exception of Mauritius). Although the

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average maize yield may be low in comparison to other countries throughout the rest of the world, in the context of this study, the yield for SA is amongst the highest in the SADC region. This is undoubtedly as a result of better agronomic practices in South Africa, as climatically, many of the other SADC countries are just as well or better suited to producing maize (Table 3).

Whether South Africa could improve yields through better agronomic management is debatable. One must remember that the figure provided is an average figure and yields range from 2.0 (dryland) to 10 (irrigated) tonnes/ha. Furthermore, given that South Africa is self sufficient in maize as well as a major exporter of maize and that in a normal year is a net food exporter further suggest that maize and crops in general are produced under relatively efficient agronomic management systems. This is highlighted even further by the main limiting factor on agricultural production in SA, which is the availability of water. The average annual rainfall for South Africa is approximately 495 mm, ranging from less than 100 mm/year in the west to about 1 200 mm/year in the eastern part of the country. Only 35 percent of the country has a precipitation of 500 mm or more, while 44 percent has a precipitation of 200-500 mm and 21 percent has a precipitation of less than 200 mm. Therefore, 65 percent of the country does not receive enough rainfall for successful rainfed crop production and crops grown in this area are grown under irrigation (FAO, 2005) and in total, approximately 60% of SAs available water resources are used for irrigation. The main conclusion derived from the SADC trade analysis is that South Africa is a net exporter of blue water; this despite the fact that it is one of the most water scarce countries in the region. Only if dryland yields were increased to such an extent that irrigation was greatly reduced would the conclusions be different, in that SA would no longer be exporting large volumes of scarce blue water resources. However, given the rainfall patterns as described above, the importance of maize as a staple food and the dependence on irrigation, this is unlikely to occur. We therefore feel that the conclusion stated above is a valid one to make.

Improving yields and therefore reducing the virtual water content of a crop is true not

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only for SA but also the rest of the SADC region. The issue of increased productivity (and by implication, the associated agronomic practices that improve yield) is mentioned in this paper (Page 14, Line 13-15). We specifically mention that if crop productivity were to be improved in importing countries this could result in a net water saving for the region as a whole, particularly where it is needed most (Page 14, Line 24-29). Of course there are socio-economic consequences associated with implementing such a strategy (addressed in point 2 below).

Overall, we feel that the conclusions made in this study are largely justified by our findings and generally address the concerns raised by the reviewer. A revised version of the paper will however mention poor agronomic management as a reason for the low productivity experienced in most SADC countries.

2. The application of a virtual water trading strategy does need to take many other socio-economic factors besides the availability of water into account. These include national and food security and effects on employment and economics. This is specifically mentioned on Page 14, Line 16 - 20. The paper also stressed, that given these factors, as well as the dependence of other SADC countries on maize exports from South Africa that it is difficult to envisage a national reduction in maize output aimed at alleviating water scarcity (Page 16, Line 2-4). We therefore feel that the paper does address and explicitly mention the concerns raised by the reviewer.

3. The study is limited to a single year. For the purposes of this paper we feel that an analysis based on a single year is sufficient to achieve the objectives of the paper, which were to a) highlight the importance of analysing green and blue water trade as opposed to total virtual water trade and b) highlight the importance of analysing the virtual water content at different spatial scales (i.e. national vs WMA). Given the variability in rainfall and other climatic conditions on an annual basis, the analysis as presented here, will vary over time and this is a point that will be mentioned in a revised version of this manuscript. However, for the purposes of achieving the objectives of the paper (as stated in points a. and b. above), we feel that an analysis based on a single

year is sufficient to illustrate our point. A revised version of the manuscript will also explicitly mention that the analysis is based on a single year.

4. The reviewer makes the point that 91% of maize is grown under dryland conditions and that analysis of virtual water flows associated with this crop is therefore not crucial. We feel that this fact (i.e. 91 % of maize is rain-fed) only emphasises our point even further (specifically point b in section 3 above). First of all maize is by far the largest grown crop in SA and it accounts for the overwhelming majority of virtual water trade for the country (Table 1) and therefore justifies its choice as a crop for this analysis. Secondly, the paper establishes that, despite the net water loss associated with maize and blue water trade, overall, maize is produced relatively efficiently at a national scale (particularly in comparison to other countries in the SADC region). This is because, as the reviewer correctly points out, the majority of maize is produced under rain-fed conditions and therefore uses water relatively efficiently. However, when one investigates the virtual water content of maize at smaller spatial scales (i.e. WMA) then one can find that there are WMAs where maize is produced highly inefficiently with respect to water use. Given the heterogeneous distribution of rainfall and water resources in the country, the calculation of the virtual water content of a crop at these smaller spatial scales can therefore provide valuable information as to where crops are using water inefficiently and which parts of the country may benefit from some form of an internal national virtual water trading strategy.

References

FAO (2005). Irrigation in Africa, AQUASTAT Survey. Food and Agriculture Organisation of the United Nations. Rome, Italy.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 5, 2727, 2008.

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