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Interactive comment on "Water saving through international trade of agricultural products" *by* A. K. Chapagain et al.

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The authors wish to thank the reviewer for his elaborate comments and to apologize for the late response. The sequence of our response follows the points made by Hermans in his review comments:

1. Databases used: Country average data for actual vapour pressure, daily maximum temperature, daily minimum temperature and percentage cloud cover have been taken from the on-line database of the Tyndall Centre for Climate Change and Research (Mitchell, 2004). The data available here are averages over the recent past (1961-90) for nine climate variables. Data on average elevation, latitude and wind speed have been taken from the database CLIMWAT (FAO, 2004a). Crop coefficients for different crops and crop calendars have been taken from FAO (Allen et al., 1998; FAO, 2004b). Data on average crop yield (ton/ha) and annual production (ton/yr) per primary

crop per country have been taken from the on-line database of FAO (FAO, 2004c). Trade data have been taken from the Personal Computer Trade Analysis System of the International Trade Centre (ITC, 2004).

Allen, R.G., Pereira, L.S., Raes, D., and Smith, M. (1998) Crop evapotranspiration - Guidelines for computing crop water requirements - FAO Irrigation and drainage paper 56, Food and Agriculture Organization, Rome.

FAO (2004a) 'CLIMWAT database', Food and Agriculture Organization, Rome. http://www.fao.org/ag/AGL/aglw/climwat.stm

FAO (2004b) Review of global agricultural water use per country, crop water requirements, Food and Agriculture Organization, Rome. http://www.fao.org/landandwater/aglw/aquastat/water_use/index5.stm

FAO (2004c) FAOSTAT on-line database, Food and Agriculture Organization, Rome. http://apps.fao.org/default.jsp

ITC (2004) PC-TAS version 1997-2001 in HS or SITC, CD-ROM, United Nations Statistics Division, New York.

Mitchell, T. (2004) 'TYN CY 1.1', Tyndall Centre for Climate Change Research, Climatic Research Unit, University of East Anglia, UK. http://www.cru.uea.ac.uk/~timm/cty/obs/TYN_CY_1_1.html

We will include the references above that are missing in the current manuscript.

2. Reviewer is right in observing that we focus on quantifying savings in physical terms and address issues of green versus blue water use and opportunity cost of water use only qualitatively by treating some specific cases. Indeed, the main body of the paper addresses 'water saving' in physical terms, not 'water saving' in economic terms. This will be stressed in the introduction in the revised manuscript.

3. Yes, right: use of green water for livestock raising in for instance the pampas in

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Argentina can imply relatively intensive water use (in terms of m3/kg meat produced), and even imply a physical water loss if the meat is exported to regions with more water efficient livestock production, but this is not necessarily economically inefficient.

4. Indeed, next to the water resources perspective and next to the economic perspective, there is the political perspective, which in case of Egypt is dominant.

5. Export of rice from Thailand to countries such as Indonesia, Malaysia, China and the USA does not create a global water saving but a global water loss, as we show in Figure 6. The reviewer is right that we do not show full evidence that some of the water for rice production in Thailand could have been applied more efficiently. We cannot, because we only analysed water as an input factor, whereas there are other input factors indeed. The only thing we can do based on our results is to give an upper limit of the value of water when applied in the production of rice for export. Since 0.12 US$/m3 (the upper limit!) is not much, this suggests that higher returns could be achieved (indeed without proving that). We have made a more precise formulation in the final manuscript in this respect.

6. We have calculated with country averages.

7. Right, land scarcity in Japan is more important than water scarcity, but we earlier showed (Chapagain and Hoekstra, 2004) that if water scarcity is measured as total water footprint divided by annual renewable resources the picture of water scarcity is much more serious if compared to the case that water scarcity is measured in terms of actual water use divided by annual renewable water resources. The difference comes by the fact that Japan highly depends on virtual water import (having an water import dependency of 64%, see page 67 of Chapagain and Hoekstra, 2004).

8. We have purposely put the discussion of blue-green water in the end of the paper, because, as the re viewer rightly observed earlier, the main analysis does address national and global savings/losses in an aggregate way, without distinguishing between green and blue water. However, because we acknowledge that it is highly relevant to

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say something about the distinction (because saving blue water is something different from saving green water), we decided to add a case study on this issue. We did not manage in this state of the research however to carry out a blue-green partitioning with global coverage. For that we would have required specific data on the volumes of green versus blue water use per crop per country, which we did not have.

9. The concepts of absolute versus comparative advantage are discussed in any text-book on international trade, so we felt that we can leave further explanation and just refer to Wichelns.

10. Whether water is a local resource, a basin resource, a regional resource or a global resource is and will remain subject of debate. In reality we think that many 'water problems' can be understood only by a combination of local, national, river basin, regional and global factors. In our paper we specifically highlight the relevance of the global component of water scarcity, without denying that other components are relevant as well.

11+12. We fully agree with the reviewer that if it comes to definite policy recommendations, many more aspects have to be added, including other factors than water and other scales than just the global scale. Also the character of the various savings and losses should be analysed in more detail (blue versus green, consumptive versus non-consumptive, etc).

13. Thanks for the suggestions. We will put some of the debate already in the intro and better position our paper.

14-17. The issue of how to assess the value of water in its different alternative uses is a highly relevant one, addressed by many, but not definitely solved yet. Nevertheless it seems that most scholars agree with the general economic principle that water should be allocated such that it generates highest benefits, provided that the term 'benefit' is interpreted broadly so that it can include the achievement of social or environmental objectives such as poverty alleviation and environmental conservation as well (see e.g.

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Rogers et al. 1998, water as a social and economic good, TAC Background Paper No.2, GWP). We think that economic considerations in water allocation are very important, but one has to acknowledge that in the end water is a public good, which requires public choice about how to allocate and use it. In this sense, economic considerations should be embedded in a political debate (and not the other way round!).

Interactive comment on Hydrology and Earth System Sciences Discussions, 2, 2219, 2005.