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Hydrology and Earth System Sciences
Discussions

Interactive comment on "Changing global cropping patterns to minimize blue water scarcity in the world's hotspots" *by* Hatem Chouchane et al.

Anonymous Referee #3

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The research on "Changing global cropping patterns to minimize blue water scarcity in the world's hotspots" used a linear optimization algorithm to assess how to change global cropping patterns to reduce blue water-scarce hotspots, with the constraints of global production per crop and current cropland areas. Below are my comments and suggestions:

1. The linear optimization algorithm is set for an optimal reduction of blue water scarcity by changing global spatial cropping patterns. The algorithm set an upper limit of the expansion in cropland by a certain maximum rate for each crop per country (the factor ðİŻij), and also limit total cropland to the reference extent. However, there is no lower

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limit of decrease in cropland area, which means cropland area (or crop production) for some crop types would decrease a lot or even disappear (as shown in results part). Why you set an upper limit, but without a lower limit? If you also set both upper and lower limits of changes in cropland for each crop, do the results change?

2. Blue water scarcity (BWS): BWS is defined as the total blue water footprint divided by the blue water availability in the country. Here blue water footprint only includes agriculture sector, without water footprint for domestic and industrial. Blue water availability is the natural runoff, which follows Hoekstra et al. (2012), right?

3. L145: "A country is considered to be under low, moderate, significant or severe water scarcity when BWS is lower than 20%, in the range 20-30%, in the range 30-40% and larger than 40%, respectively (Hoekstra et al., 2012)". Hoekstra et al (2012) analyzed the BWS at basin level and monthly time scale. But this study assesses water scarcity at country level and annual time scale, I think more discussion is needed to illuminate whether the index used here is suitable.

4. L148: why you choose maximum national blue water scarcity in the world as the indicator for optimization?

5. There are too much results about the changing cropping patterns and comparative advantages. I think the authors could add more explanation on the mechanism behind the changes, especially for some typical countries.

6. Discussion part: Previous studies have done a lot of works on the impacts of changing cropping patterns, international food trade and better water productivity on water scarcity (as list in introduction part). I think the discussion part should add more about the similarity and difference between the results in this study and previous studies.

7. More discussions should focus on how the results represented in this study could guide global international food trade, as well as cropping patterns to cope with global water scarcity, especially under future climate change and socioeconomic develop-

ment. For example, blue water scarcity would intensify in the future as reported in previous studies. And following the results in this study, a water-scare country could reduce agriculture water scarcity by reducing cropland area for some crop types, and import crop production from other countries.

8. L188ïijŽ" When α is equal to 1.3, 1.5 and 2.0, the maximum national blue water scarcity in the world is reduced to 6%, 4% and 2%, respectively." In my view, a larger α would result in greater global blue water scarcity reduction, but current study shows the opposite result. So I just wonder the definition of "the maximum national blue water scarcity in the world"?

9. Figure 4. This figure is not clear. Please give the unit and meaning of this figure.

10. Figure 5. There are only tiny differences between figures in the left and right. It's better to show the differences or relative changes.

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