

# ***Interactive comment on “A framework for modelling the complexities of food and water security under globalisation” by Brian J. Dermody et al.***

**Anonymous Referee #3**

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## General comments

Although Integrated Assessment Models (IAMs) are powerful tools to investigate complex long-term issues of global change, their coarse spatial resolution hampers effective treatment of spatiotemporally heterogeneous phenomena such as water constraint in food production. The framework proposed in this manuscript has a potential capability to relieve this limitation by expressing the cities as agents that are interlinked with transportation network and receiving information from both IAM and spatially detailed biophysical models.

If a numerical model was successfully developed based on this framework, it would largely enhance the capability of IAMs. Consequently, it would contribute to seek prac-

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tical solutions for complex global issues such as achievement of the Paris Agreement and the Sustainable Development Goals, which will be an important advancement in the global environmental science. Nonetheless, it was hard for me to comment on this manuscript as a referee because this paper only shows the framework of a forthcoming model (i.e. I took this paper as an elaborated research plan). One can hardly judge the validity of the authors' framework unless the concept is actually implemented and validated. What I could do was to comment on the validity of logical flow of the paper.

I observe two major concerns in the logic of this paper. First, the authors little refer to the published land use models. Land use models allocate land use under given socio-economic conditions and shocks which largely overlap with the key concepts and functions of the authors' framework. For example, Lotze-Campen et al. (2008), Wise et al. (2009), Konar et al. (2013), Hejazi et al. (2015), Bonsch et al. (2016), and Hasegawa et al. (2017) have already resolved multiple challenges raised by the authors. It should be more clearly elaborated what are the literary unresolved challenges of IAMs and what would be the key differences between the approaches of the forerunners and the authors. Further focused review should be added to text. Second, I am wondering the authors may overvalue the international food trade. Although important, for example, the fraction of the traded major grains to the total production is approximately 15% in 2005. A major part of food production is consumed domestically. An excessive emphasis on trade might distort the reality. Further discussion should be added on non-traded food production and water use.

#### Specific comments

Page 2 Line 14 "The redistribution of food via trade is central to determining water resources use": I don't believe this statement is right. Only a limited portion of food is internationally traded, and it only partly determines the water. I would like to see here the total production of agricultural products and the fraction of internationally traded. I believe similar figures can be easily made using the total water use for food production (NB: include green water as well) by consulting earlier works (e.g. Aldaya et al., 2010;



Hanasaki et al. 2010; Hoff et al. 2010; Fader et al. 2011; Gerten et al. 2011).

Page 7 Line 18 “Water footprint studies . . . (van Beek et al. 2011; Wada et al. 2011)": I don't believe these two papers are on water footprint. The works by Hanasaki et al. (2010) and Fader et al. (2011) are more directly relevant in this context. Hanasaki (2016) provides an overview of the water footprint studies by applying global hydrological models.

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Page 8 “3.2 Sociohydrological Studies”: I hardly found any direct or concrete linkage of the sociohydrology and the framework proposed in this study. I would see more focused discussion why and how sociohydrology is relevant to this study.

Page 12 “Food production and water use”: As mentioned in General Comments, a review on earlier efforts linking water-land-food models and IAMs seems largely missing here. I note that earlier studies seldom applied agent-based model (ABM), but still clarifications are needed what has been achieved without ABM, and what would be potentially achieved by adopting ABM based on a fair literature survey.

Page 14 “The framework can be applied across scales to investigate changes at catchment, city or global scale”: The statement sounds a bit too strong since no concrete evidence of the capability of framework is presented in this paper. The dominant force or process of linkage between cities would be substantially different across scales. For instance, even if the connection between New York and London and that of Seoul and its commuter towns can be both expressed as nodes and links, their link must be formulated fundamentally differently. More specifically, local connections are strongly influenced by local non-market circumstances such as regulations, custom, and cultures, which is hardly obtained from neither IAMs nor biophysical models. If you wish to keep this argument, elaborate how the scale issues would be basically resolved.

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