

## Response to Reviewer 2

We thank anonymous reviewer 2 for their considered and constructive comments on our manuscript "A framework for modelling the complexities of food and water security under globalisation".

Following is our response. The reviewer's comments are written in *Italics*.

*This is a timely paper presenting a framework for modelling the water-food nexus in a globalised world. The topic goes across disciplines and is relevant for the ESD journal.*

### GENERAL COMMENT

*While the approach proposed here is scientifically interesting, the structure of the paper does not seem appropriate. Also, some statements are far too strong, e.g. "the approach unifies and extends the existing fields of hydrology, Integrated Assessment Modelling and agent-based modelling". My general suggestion is to focus on the framework and its novel aspects, without making overstatements about it. I report below some specific comments that I hope can help improve the description of the proposed framework.*

### SPECIFIC COMMENTS

*1) The modelling framework, which is the core of this paper, comes abruptly after 10 pages of literature review. I propose to introduce it early on, provide more details about the framework (e.g. have you tried to build an actual model based on this?), while avoiding too much text for literature review (Chapter 2 and 3 are really too long).*

We agree in reflection that the paper can benefit from a more concise structure which presents the core elements of the framework earlier. In the revised manuscript, we have rewritten section 1 to immediately outline the knowledge gaps in understanding food and water security under globalisation that we set out to fill with our framework. Namely, it remains a knowledge gap to capture regional and sectoral interdependencies and cross-scale feedbacks associated with food and water security within a single model framework. Following this, we introduce the main aspects of the framework: cities and hinterlands and the networks that connect them. We explain why these are important elements to capture in order to understand food and water security under globalisation.

In addition, in the revised manuscript we have integrated section 2 and 3 into a new section 2 which is more concise. In the new section 2, we have focused on explaining how regional interdependence, sectoral interdependence and cross-scale feedbacks are captured to differing extents in existing models and approaches. We then outline the knowledge gaps in existing approaches that our framework sets out to fill. Namely, integrating regional and sectoral interdependencies and cross-scale feedbacks within a single model framework.

The model is not yet built. However, elements are in operation already. In the revised manuscript, we are explicit about the level of development of each component of the framework. This will be shown in a revised version of figure 8.

*2) Introduction: Is the text up to line 34 really needed? It is very basic, it reads like a textbook and it is not much related with the framework.*

We agree with reviewer 2 and have deleted this text in the revised manuscript.

*3) An entire section of sociohydrology (Section 3.2) seems a bit too much here, as the proposed framework is in fact an upgrade of IAM coupled with a biophysical model. In any case, while I agree that "sociohydrological studies so far have explained the observed emergent phenomena by allowing*

*human agency: : :”, there are studies of this kind that were published before 2014. So, if reference to sociohydrology is really needed, previous efforts made by other scholars should not be ignored here. Also, if there is an entire section in Chapter 3 about sociohydrology, there should be at least an entire paragraph later on in the paper discussing the link between the proposed framework and sociohydrological research.*

In the revised manuscript, we have integrated section 2 and 3 into a new section 2 which is more concise. The text given over sociohydrology is shortened and included in the subsection dealing with cross-scale feedbacks (new section 2.3). In this section, we outline that sociohydrology studies set out to understand cross-scale spatiotemporal feedbacks by capturing how short term or small-scale interactions between humans and the environment can bring about long term and large scale emergent changes in water resources (Sivapalan et al., 2012; Sivapalan and Blöschl, 2015). We highlight that sociohydrological studies suffer from a disciplinary focus on water and do not capture important sectoral interdependencies. Equally, they have so far assumed the systems of concern are isolated entities in space, e.g., an agricultural river basin whereas, in a globalised world, many different such entities may interdependent with other regions owing to trade in goods (e.g., food). In the discussion section of the revised manuscript, we add a short discussion about how sociohydrological studies can benefit from incorporating regional and sectoral interdependence in order to better understand human-water dynamics in a globalised world.

In the revised manuscript, have made efforts to include a more comprehensive literature review, incorporating literature prior to 2014.

*4) The paper states that “currently 30% of energy produced is used in food production, with fluctuations in energy costs having direct impacts on agriculture and thus water resources”. Yet, the interlink with energy production is then almost forgotten in the rest of the paper. I understand the focus on food, but the water-food-energy nexus cannot be completely neglected.*

In the revised manuscript, we have focused on three core topics: regional interdependence, sectoral interdependence and cross-scale feedbacks. The water-food-energy nexus falls under sectoral interdependence and we have expanded our discussion of this important topic in section 2 of the revised manuscript.

*5) What do the authors exactly mean by resilience/resilient and sustainability/ sustainable? These “buzzwords” are used a number of times, but in different contexts and, in my opinion, with a completely different meaning. I’m fine with any definition, as long as these terms are used consistently throughout the entire article. Still, I must confess that I feel a bit uncomfortable to figure out the exact meaning of statements like “the optimally resilient and sustainable solution”.*

We have provided definitions for these terms in the revised manuscript so readers are clear on what statements like “optimally resilient and sustainable solution” mean.

*6) Typos: “it challenging it challenging”, references with first name abbreviation, etc...#*

Corrected in the revised manuscript

## **References**

- Sivapalan, M., Blöschl, G., 2015. Time scale interactions and the coevolution of humans and water. *Water Resour. Res.* 51, 6988–7022. doi:10.1002/2015WR017896
- Sivapalan, M., Savenije, H.H.G., Blöschl, G., 2012. Socio-hydrology: A new science of people and water. *Hydrol. Process.* 26, 1270–1276. doi:10.1002/hyp.8426