Hydrology and
Earth System
Sciences
Discussions

Interactive comment on "An integrated modeling framework for coevolution and feedback loops of nexus across economy, ecology and food systems based on the sustainable development of water resources" *by* Yaogeng Tan et al.

Anonymous Referee #2

Received and published: 31 August 2020

This study seeks to provide insights into co-managing economic, ecological and food production objectives in a river basin using multi-criteria optimisation and systems dynamics modelling, with a case study in the Guijiang River Basin, China. I have a number of major concerns with this work:

(1) I don't see what is transdisciplinary about this study, i.e. where non-academic actors were involved in any part of the research. I don't think it fits with this special issue.

(2) The chain of models the authors employ is very complex and not always transpar-

ent; this obscures a lot of the uncertainty in those models.

I would have wished for more sensitivity analyses as those done for the "theta" parameter, which –as the authors rightly say – probably reflects most of the decision uncertainty as they set it up, but misses uncertainty in numerically representing the decision processes themselves in the first place, and uncertainty in the underlying hydrological models. More specifically:

L501-503: Not automatically, only when parameter uncertainty is low. When different parameter sets can lead to similarly "good" matches between simulations and observations – which I would expect for such a complex model – then anyone "optimal" parameter set cannot expected to reliably predict into the future – only if parameter uncertainty is propagated (not to mention other neglected uncertainties).

Sections 3.3.2-3.3.5: Here I'm missing an assessment of the numerical stability of the optimisation algorithm. For example, how unique is the solution found at each timestep, and how would small deviations change the dynamics presented here?

L689: "Can be mathematically expressed" – yes, but how do we know this expression is sensible?

(3) I find the goals ascribed to the 3 modules quite limited (e.g. illustrated in Figure 3). They should at least be underpinned by a thorough literature research that justifies why focussing on these is sensible. It should also be at least discussed what is left out and with what likely effect. For example in the ecological module, I'm missing a goal related to agricultural pollution and goals related to other ecosystem elements besides vegetation. And "minimum alteration of natural flow" and "maximum sewage treatment" are not so much ecosystem related goals but measures to achieve some other goals. On the goals of the food system another reviewer already commented eloquently, to which I would add the path-dependency build into the model when one of the goals is meat production and not some more flexible agricultural production responding to possibly changing diets. Some comments on the equations:

L145: In what ways is this growth rate "natural"?

Equation 2d: Are the constant considered universal? And what would be the justification for that?

Equation 3: How can the "natural flow" ever be determined?

Equation 7: How do the authors make sure that the data for variable W_L really isolate the water use of livestock? I can't imagine this is metered.

L302-304: Argument and justification for numerical algorithm unclear.

(4) The research gap that the authors wish to address doesn't become clear in the introduction. This section contains a lot of repetitions which makes it hard to understand the motivation for this study. It also remains unclear why the authors chose to frame their study in an economy-ecology-food nexus and not a more popular nexus variant reviewed in the introduction. Also:

L33-35: Singling out productive activities is downplaying the importance of water here.

L49: The concept of environmental stewardship should be introduced more carefully here.

L63: Why single out "optimisation" here?

(5) The language needs a thorough revision, e.g.:

L30: What's meant by "ambiguity and applicability" here?

L38-40: Sentence unclear.

L44-46: Argument unclear.

L76: I don't think these authors "achieved sustainable development"

L431-432: Meaning of "restoration" unclear.

(6) All in all, I'm left wondering what we have learned from this study that we didn't know

before, and hence hasn't been built in to the model in the first place. The conclusions are not informative in this respect.