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Reply on RC1

Yaogeng Tan et al.

Author comment on "Identifying the dynamic evolution and feedback process of water resources nexus system considering socioeconomic development, ecological protection, and food security: A practical tool for sustainable water use" by Yaogeng Tan et al., Hydrol. Earth Syst. Sci. Discuss., https://doi.org/10.5194/hess-2021-68-AC1, 2021

We are greatly impressed by the reviewer's decent tracks to our paper and give an opportunity to revise the paper. Below please find the point-to-point responses to your comments and help us to improve the quality of the paper.

1. There is a little bit of a poor connection between the first two paragraphs. The first paragraph discloses the background of the paper while the second paragraph outlines the main methods to solve the problem of water resources systems. From the perspective of the entire content of both paragraphs, the first paragraph implies the complexity of the water resources system that is reflected by multiple water uses while the second paragraph implies how to solve this problem. But the first sentence of the second paragraph (L48-50) is a little bit confusing and should tell the readers why "optimal algorithms", "decision support system", "MCDA" (or SAA) are suitable for tackling "water resource problems facing multiple water users". The general sentence that describes the characteristics of the water resources system (e.g. multiple water uses) is needed at the beginning of the second paragraph to connect the logic and then "SAA" is used to solve the problem. The details are marked in the preprint that is uploaded in the supplement.

Response: I totally agree with your opinion about your suggestions for the first two paragraphs. As the referee mentioned, the first paragraph disclosed the research background and research question, and the following paragraph should be the main methods that overcome this research question. The systematic analysis approach is exactly the main method to solve the systematic problem, exactly for water resources systems facing multiple objectives with high dimensions. In the revised paper, we will enhance the logical connection between the first two paragraphs based on your tracked supplement.

2. One or two sentences that further describes the optimal approach should be added in Line 59 to better connect the former (complexity of water resources system) and latter (disadvantages of optimal approach) information. I do know the optimal approach is the most effective approach to deal with the water management problems, but from the perspective of English language expression and rhetoric, the combination of optimal approach and water resources system should be added in Line 59 because the title includes "water resources system". Actually, as the author rightly mentioned in Line 40-41, water resources system "is susceptible to the influence of external conditions". From the system perspective, external conditions are influencing the status and

performance of a certain system and is able to stimulate both the entire system and its each agent to adjust and strengthen themselves to better adapt to the external changes, which can be explained by "complex adaptive system" theory (See Holland, 1995). Optimal approach can describe and quantify such an adaptive process.

Response: We agree with your suggestion, and will add the relative sentences that describe the characteristics of the optimal approach. I have also read the reference you mentioned (Holland, 1995) and optimal approach is essentially the adaptive adjustment of a certain system that can be summarized as a "complex adaptive system". In the revised paper, we will add the following sentence in line 59:
"In addition, the optimal approach is essentially the adaptive adjustment of a certain system that can be summarized as "complex adaptive system" (Holland, 1995), because the status of a certain system is susceptible to external conditions. As for water resources system, external conditions are able to stimulate both the entire system and its agents (i.e., water users) to adjust and strengthen themselves to better adapt to the external changes".

3. L67: There is lack of characteristics of nexus system, and should be described in two or three sentences. For example, its classification, their components, and feedback mechanism, etc. See Zhang et al.
Response: We have thoroughly read the reference from Zheng et al. Actually, the definition of nexus thinking can be classified into two categories: First, the nexus is interpreted as the interactions among different subsystems (or sectors) within the nexus system. Second, it is presented as an analytical approach to quantify the links between the nexus nodes.
The feedback mechanism not only includes the inner features of the coupled system by capturing the interactions between different sectors but also the external forces or actors that drive nexus system dynamics.
This will be added in the introduction section in Line 67.

4. The novelty and characteristics are not purely extracted and the relevant language should be more concisely. For example, in line 100-104, the authors should describe the effects and advantages of the method that couples SD and optimal model, instead of just saying "identify the coevolution process and dynamic interactions". Actually, optimal model can give a water allocation scheme in an optimal way but cannot simulate the dynamic process precisely. If coupling it with SD, accurate coordination among different water users can be realized under the dynamic interactions of water resource nexus system, and further improves its reliability.

Response: Thank you. It is the key point. We agree with your opinion and will add such opinions in my paper (at the end of the Introduction section).

5. Section 2.1 is the crucial part of the entire paper and should tell the readers why coupling SD and optimal models are applicable. It is necessary to start from the expression of the interaction of external changes on the nexus system and the advantages (see point 4) of both models to describe the reason why coupling SD and optimal models are needed.

Response: This is exactly the most crucial part of this paper. As our paper mentioned, the external drivers can be summarized by the pendulum model. The water resources system is exposed to external drivers and will influence the status of the system. The system dynamic model is exactly the powerful tool to simulate the dynamic interaction of the water resources system and its components. However, according to the theory of "complex adaptive system" (CAS), the external drivers not only influence the system's status but also starts

the self-adjust process of both the whole system and its components to attain the adaptive status. Such a process can be characterized by the optimal model that can consider the coordination process among multiple agents, but it is unable to simulate the dynamic interactive process in a precise way. That's the reason why the SD and optimal model should be coupled.

6. In section 2.2.4, Line 220-223 and 229-232, it is not clear what the meaning of the symbol "+" and "-" is. I guess it represents increase and decrease. But in the following figures (Figs. 3 and 4) the "+" and "-" denotes the positive and negative feedback linkage. Are increase/decrease and positive/negative the same thing? If not, please note the meaning of "+" and "-" in lines 220-223 and 229-232, otherwise, it is confusing.

Response: Thank you for your suggestion, In Figs. 3 and 4 the symbol "+" and "-" is exactly the positive and negative feedback loop. But in Line 220-223 and 229-232, We want to express the increase and decrease of a certain variable. We will modify the "+" and "-" to "□" and "□" to express them precisely and make it clear.

7. Fig 1 outlines the coupling framework of the SD and optimal model, but the internal relationship is not so clear from this figure. That is, the optimal model should be based on the certain interaction simulated by SD model. I guess it is the negative feedback loop that drives the optimal model (as the authors mentioned in Line 625-626), but it still needs to make clear in the Methodology section. Also, consider adding it in the abstract if necessary. (Because for readers, they may read the abstract and methodology instead of results & discussion)

Response: Thanks for the decent suggestion. Yes, it is the negative feedback loop that drives the optimal model. I will make clear it also in the Abstract and Methodology section.

8. In conclusion, some expressions of the English language are not so precise, and please see my marked versions in the supplement.

Response: Thanks. I will revise it based on your tracked changes.

Technical comments:

1. Unify the terms of the entire paper. For example "nexus system", "complex system" (L735, L739). Are they the same thing? If yes, please unify them. Another case "food safety" and "food security"; "crop yield", "crop production", "food production". Different terms make the paper ambiguous, also they are (or exactly are) representing the same thing. (See my comment in Line 20)

Response: Yes. Thank you for your suggestion! We will check them to unify the terms.

2. Title: This paper is about the dynamic process and feedback linkage of a nexus system. I suggest the title should include that. See the marked version in the supplement.

Response: Good point! We will make changes.

3. Fig. 11: The x-axis should be from 2021 to 2045?

Response: I will make changes in the revised paper.

4. Samely Table 5: Why the year in this table is 2016, 2020, 2030, 2040? Typing error or

what? It is not consistent with other figures or tables.

Response: It should be 2021, 2025, 2035, 2045. Sorry, typing errors.

5: Line 500: should be sections 5.2 and 5.3?

Response: I will make changes in the revised paper.

6. Other technical comments are list in the supplement.

Response: Many thanks for your decent suggestions and tracks to our paper! We will thoroughly revise the paper to greatly improve the quality!