

Interactive comment on “Socio-hydrologic perspectives of the co-evolution of humans and ground water in Cangzhou, North China Plain” by Songjun Han et al.

Anonymous Referee #1

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Han et al. present a well-researched historical case study on the groundwater use in Cangzhou in the North China Plain. The authors make the important point that hydrological outcomes, such as groundwater declines, are influenced by both social and natural forces. The case study data is a useful addition to the field and presents a good opportunity to test ideas and models generated through socio-hydrological analysis in other locations. However, the manuscript has left me with unanswered questions in terms of the paper objectives and methods applied. I believe the following comments will help the authors address these concerns.

General Comments

1) The objective(s) of the paper did not come across clearly. The authors state that

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one objective of the paper is to “analyze the co-evolution of the human-groundwater system in Cangzhou throughout history, focusing on the interactions between the social productive force and natural variability.” Are there other objectives? The objective should also be introduced sooner to focus the reader. Both the “pendulum swing” concept and Taiji-Tire model are relatively new and untested ideas. The authors have not yet convinced me that they can assume these fit the case before completing the analysis. If assessing this fit is an additional paper objective, it should be made clear. Alternatively, if the paper seeks to further specify the model or test a specific aspect of it, that should also be clarified.

2) The methods section needs expanding as it is not clear what methods were used to develop and analyze the historical narrative. The authors use the concept of a “pendulum swing” to introduce and organize the narrative. However, it is not clear what criteria were used to determine if and when a “pendulum swing” occurs. Five eras are presented, what criteria were used to determine that a new era had begun? The Taiji-Tire model is used to frame the analysis. How was the case mapped to the Taiji-Tire? How, for example, was the spatial boundary of the internal Tire determined? And how were forces classified as productive or restorative?

3) The authors nicely demonstrate how variability in precipitation can alter the simple story of reaching a tipping point and adjusting behavior to adapt. I think this is a good contribution. However, in complex systems such as socio-hydrological systems there is great potential for multi-causality and teleconnections. In addition to groundwater levels and precipitation, were other drivers of water use behavior change considered? How were the historical narrative and data set used to focus on these drivers? Please clarify.

4) While the writing did not interfere with my ability to review the manuscript there are a substantial number of grammatical errors and instances of unclear syntax. I have pointed out several, but not all, of these below. Thorough proof reading is needed before publication.

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Specific Comments

- 1) On Page 1, Line 30, define or explain what is meant by the term human forcing.
- 2) On Page 2, Line 2, define or explain what is meant by the term salience threshold.
- 3) In Section 2, the authors do a great job describing the hydrological and geological setting of the case. A paragraph on the governance and institutional structure of the study region would be an excellent addition here, particularly for international readers. This would help readers less familiar with Chinese governmental divisions better follow the roles of the various entities in the narrative.
- 4) On page 4, line 2, the authors specify the sources of hydrological, agricultural and water use data sources. However, it is not clear what the data source is for policy initiatives (Table 1) or how relevance of policy initiatives was determined.
- 5) On page 9, line 11, in the description of the drought era (1997-2002) the authors state that well drilling “seemed to be the only choice to resist the drought.” Yet, in section 3.5 they describe measures such as water licensing (1999) and irrigation efficiency improvements (1998). Why aren't these measures discussed in conjunction with the expansion of well drilling?
- 6) On page 9, section 3.5, the description of era 5 (2003-present) contains several events that occur before 2003 such as the 1999 water licensing system. Why aren't these events considered as part of era 4?
- 7) On page 11, figure 3, I appreciate the qualitative plotting of the level of emphasis on production and restoration. However, I would like to understand how these levels were estimated. What data sources (either quantitative or qualitative) were used? I am also unsure of the meaning of the emphasis level of “healthy status” in this context. Does healthy refer to environmental or public health? And if it refers to environmental health how does the emphasis on environmental health differ from the focus on restoration (or the restorative force)? Please clarify.

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- 8) Page 12, figure 4a and page 13 figure 5a: clarify the directionality of shallow water table changes. Is a negative change a decline in groundwater levels or a decrease in the depth the ground water table?
- 9) On page 12, figure 4c conveys change in the relationship between shallow groundwater table depth and the ratio of deep to shallow groundwater. The reader needs more information to properly interpret this figure. How was this data set separated into these two groups (before and after 2002)? Was the division determined solely based on the narrative or were statistical tests used? Does any of the qualitative historical data collected aid in interpretation of this plot? What does this plot illustrate about the behavior of water users in the basin?
- 10) On page 13, line 3, the authors emphasize that the social restorative force is not necessarily in opposition to the restorative force and can be considered a subset of the productive force. Is this a modification to the original Taiji-Tire model? Please clarify.
- 11) On page 13, lines 8 and 24 the authors make reference to the system steady state and the date in which it was broken. Please clarify what in this instance was in steady state as I am skeptical that the socio-hydrological system broadly defined was ever in steady state. Please also describe how 1965 was identified as the end to this steady state period.
- 12) On page 13, figure 5b, more information is also needed to interpret this figure including how the data set was divided into two periods.
- 13) On page 14, line 6 the authors discuss the accumulation of community sensitivity. What data, either quantitative or qualitative, can back up this statement? It would also be helpful to clarify what is meant by community sensitivity. In the article referenced, Elshafei et al (2014), the authors specify what community sensitivity is theorized to depend on, that would also be useful here.
- 14) On page 14, line 12 the authors state that costly new technologies are adopted

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solely to protect the environment. Please note how were other motivations or causes ruled out.

15) On page 14, figure 6b same comment as figure 5b above.

16) On page 15, the authors note that groundwater withdrawal no longer varies with precipitation. What enabled this decoupling?

Technical Corrections

1) Page 1, Line28: Syntax is awkward: "Except for the social forcing, natural variability is another external forcing." Could rephrase as: "In addition to the social forcing, natural variability is an external forcing."

2) Page 2, Line 27: Correct grammatical errors: "Because that groundwater pumping from the aquifer increases obviously since middle of the 1960s, the NCP aquifer system becomes one of the most overexploited aquifer in the world" perhaps as: "Because groundwater pumping from the aquifer has increased significantly since middle of the 1960s, the NCP aquifer system has become one of the most overexploited aquifers in the world."

3) Page 9, line 2: missing closing parentheses after the word year.

4) Page 14, line 14: replace development with developed.

5) The citation Liu et al. (2014) is missing from the references.

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