RC2: Comment on hess-2024-72

This study on the impacts of scientific knowledge development on society and policy within global river basins is both timely and insightful. The framework for measuring knowledge systems through network dimensions of multidisciplinarity and issue-connectivity is commendable. Here are some review comments:

Framework and Methodology: Elaborate on the theoretical underpinnings of your proposed framework and discuss its potential for long-term applicability.

Thank you for your comments. We will consolidate the theoretical underpinning that supports the knowledge network construction in a new Section 2.1. Specifically, the framework was developed based on:

1) The Science of Science (SoS) theory (Zeng et al., 2017) which conceptualised knowledge as a dynamic system consisting of numerous disciplinary knowledge and the issues studied, with complex and co-evolving relationships.
2) The network theory and our previous studies (Fortunato et al., 2018; Wei & Wu, 2022; Wu et al., 2021) which provide a systematic approach to quantifying such complex interactions as the structure of the knowledge system. The structure of the knowledge system then determined the functionality (i.e., impacts) of the overall knowledge system (Coccia, 2020; Huttenhower et al., 2012; Sayles & Baggio, 2017; Von Bertalanffy, 1968).

We will add an additional section in the Discussion section elaborating the implications of the framework, which will be contributing to future knowledge transformation for more sustainable river basin development by:

1) providing a method to explicitly measure the structure of a knowledge system as a discipline-issue network, which guides future knowledge development by identifying explicitly where and what to change or connect between disciplinary knowledge and issues at hand, therefore assisting in more suitable, more precise, and more predictable knowledge development in the future.
2) linking the structural configurations of knowledge systems with developments in the society and policy, thus contributing to better evaluation of research outcomes and action-oriented research for specifying the "credible, legitimate, and relevant" criteria in good governance (Cash et al., 2003; Kim, 2019).
3) enabling comparisons of knowledge development for river basins with varying management issues of focuses and contexts, thus enabling the design of tailored management strategies and co-learning according to different patterns of connections among river basin knowledge, society, and policy development.

Data and Analysis: Consider the inclusion of additional data sources beyond Web of Science, such as conference papers or government reports, to enhance the study's comprehensiveness.

Thank you for your comments. This study focused on the science-driven knowledge development, by using peer-reviewed articles indexed in the Web of Science (WoS) database. The WoS database was chosen because it provides consistent, systematic documentation of knowledge development across a broad range of disciplines for a long timeframe. However, we do acknowledge that use of additional data including conference paper, and government reports also contributes to the river basin knowledge development, which tends to focus on the practice-driven knowledge. This will be recognized as a limitation in the discussion section.

Address the potential variability in keyword extraction and clustering across different languages and regions.

Thank you for your comments. This study focused on extracting English keywords from scientific publications, and how knowledge development differed across different river basins globally. Other languages were not included for keyword processing. We will justify this limitation in the Discussion section: English remains the most used language for knowledge development across different regions, and many academics with other language backgrounds wrote in English for wider dissemination of findings on their river basins (Ramírez-Castañeda, 2020).

Results Interpretation: You note a strong correlation between knowledge structures and societal impacts, but a weaker link with policy. What might account for this discrepancy? Further analysis or discussion on this point would be beneficial.

Thank you for your comments. The weak link between knowledge and policy can be attributed to the challenge of productive knowledge transfer on decision making, which is commonly studied by research at the science-policy interface (Louder et al., 2021; Nguyen et al., 2017). We will provide additional discussions on this challenge in the Discussion section, noting that:

1) Such challenges arise mainly because that policy and practice decisions are informed by diverse values and beliefs, multiple sources of knowledge, and are shaped by cognitive factors and power dynamics beyond the direct influence of research activities (Hakkarainen et al., 2020; Pitt et al., 2018; Posner & Cvitanovic, 2019).

2) A potential solution will be encouraging the development of "boundary spanners" (Edwards & Meagher, 2020) for effective knowledge transfer between science and practice.

Discussion and Conclusions:

You highlight the importance of interdisciplinary research, particularly in Asian, African, and South American river basins. Could you suggest specific strategies to foster such research in these areas?

Thank you for your comments. We will more thoroughly discuss knowledge development in Asian, African and South American river basins in the revised manuscript, specifically:

1) Development towards an integrated knowledge structure should be most desirable, linking with the Knowledge For Environment (KFE) and the Knowledge For Resource Availability (KFA) patterns. About 15% of the river basins studied in America, Europe and Oceania (e.g., the Amazon River, the Colorado River, the Danube River, the Murray-Darling Basin) provide good examples in achieving a holistic integration of science, society and policy.

2) Recognizing that there are inevitable concerns and interests of these river basins with greater development pressures and inequalities. A more balanced and integrated knowledge development approach could be supported by raising awareness of human impacts on river basins and targeted research fundings that facilitate bridging between science and policy (Jabbour, 2022; Matsumoto et al., 2020).

The concept of "boundary spanning organizations" is introduced as a solution. Further details on the form and mechanisms of these organizations would be valuable.

Thank you for your comments. We will provide additional explanation on the "boundary spanning organization" in the Discussion section, specifically they can be creditable academic organizations for the policy community, individual or groups of scientists or professional consultants. They operate across otherwise disconnected communities (e.g., between policy-makers, local stakeholders and technical experts, between natural and social scientists) to facilitate knowledge and information exchange, and they generally process some power to synthesize different values and insights to facilitate collective sense-making (Bodin, 2017; Stovel & Shaw, 2012).

Overall, this manuscript is well-written, but certain sections could benefit from further linguistic refinement to enhance clarity and flow. This research provides valuable insights

into the structure of scientific knowledge within global river basins and offers constructive strategies for sustainable development. I look forward to your feedback on these comments and the revised manuscript.

Thank you for your comments. We will carefully improve the clarity and flow of language in the revised manuscript.

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