

Authors Response to Anonymous Referee #1

Comment	Authors Response
By adopting a hydrosocial systems perspective to conceptualize the Ganges–Brahmaputra basin as an interdependent socio-environmental system, this invited perspectives manuscript defines transboundary flood vulnerability through the lens of systemic governance disconnections and social inequalities and performs a critical review of the India–Nepal–Bangladesh floodplain to argue for a paradigm shift from infrastructure-heavy hydrological control toward more inclusive, justice-oriented governance that recognizes the dynamic interlinkages between water flows, social relations, and political power. The novelty of the ideas in this paper is not sufficiently stated in the introduction.	We sincerely thank the reviewer to provide constructive and insightful comments. We appreciate the recognition of the paper’s novelty, relevance and the opportunity to further clarify its conceptual contribution. The manuscript articulates the novelty of the proposed framework in several paragraphs. In particular, hydrosocial connectivity is introduced and defined as a diagnostic and governance-oriented concept in Lines 78–88, where we distinguish it from the hydrosocial cycle and hydrosocial territories by foregrounding relational disconnections and asymmetries across institutional, social, and hydrological domains. Further clarification of this contribution is provided in Lines 407–411 and Lines 462–466, where flood vulnerability is explicitly framed as a relational outcome produced through persistent disconnections between hydrology, governance structures, and lived experience, rather than as a deficit of integration or data. The manuscript also already differentiates hydrosocial connectivity from Integrated Water Resources Management (IWRM), particularly in Lines 420–430, where we acknowledge that IWRM formally promotes participatory and integrative principles, while arguing that hydrosocial connectivity focuses analytically on why these principles repeatedly fail to materialise in practice, especially in transboundary flood governance contexts shaped by sovereignty, power asymmetries, and data control. In this sense, the contribution does not lie in adding variables or reducing operational barriers to integration, but in diagnosing how risk is co-produced through systemic governance disconnections. That said, we recognise the reviewer’s point that this novelty, while present throughout the manuscript, may not have been sufficiently explicitly signposted, particularly in the Introduction. We will therefore, revise and refine the relevant introductory sentences to make the novelty statement more explicit, clearly positioning the contribution as diagnostic and governance-oriented rather than integrative or methodological.
The research gap presented is that current governance tools frequently overlook transboundary and relational dimensions of flood risk. Then it is argued that this gap is addressed in the presented framework by including spatial hotspot mapping and lived experiences of affected communities. But there are global studies of social vulnerability	We thank the reviewer for highlighting the important contribution of Fox et al. (2024), which integrates social vulnerability into high-resolution global flood risk mapping by operationalising vulnerability as a quantifiable modifier of exposure using socioeconomic proxies. Our manuscript addresses a complementary but analytically distinct question. Rather than advancing risk estimation or mapping, we focus on diagnosing how flood vulnerability is produced and sustained through systemic governance disconnections, power asymmetries, and institutional fragmentation in transboundary river basins. The emphasis is therefore not on where vulnerability is highest, but on why

towards flood risks that includes the characteristics of local population, for example: Fox, S., Agyemang, F., Hawker, L. <i>et al.</i> Integrating social vulnerability into high-resolution global flood risk mapping. <i>Nat Commun</i> 15, 3155 (2024). https://doi.org/10.1038/s41467-024-47394-2. 2. There needs to be better elaboration on how exactly the framework presented here differs from previous studies such as those.	vulnerability persists despite the availability of technical knowledge and modelling capacity. We argue that the concept of hydrosocial connectivity is better suited to interrogating these relational and political dynamics and identifying data gaps. In the revised manuscript, we will explicitly acknowledge global social vulnerability mapping studies, including Fox et al. (2024), and clarify that while such approaches integrate social indicators into flood risk models at national or global scales, hydrosocial connectivity differs by centring transboundary governance disconnections, conceptualising vulnerability as a relational and political outcome, and explicitly linking power asymmetries, data sovereignty, and institutional fragmentation to the production of downstream flood risk. A short comparative paragraph will be added to make this distinction explicit.
Perhaps reframing the novelty of the framework in terms of new concepts presented such as hydrosocial systems and connectivity would be better to explain the novel contribution of this paper.	Thank you for the suggestion. We will make the manuscript's core contribution explicit as a conceptual synthesis and extension of hydrosocial systems thinking. We will clarify that hydrosocial connectivity is not a generic call for an integrated or holistic approach, but a diagnostic concept that identifies where and how connections fail and links these failures to justice, governance capacity, and the reproduction of vulnerability in transboundary river basins. This reframing will be made explicit in the Introduction, Section 3.2 (Conceptual Foundation), and the Conclusions.
Figure 3C used data from academic literature to mark hotspots of floods caused by different factors (anthropogenic, governance, climatic, infrastructure). It is not known how many papers were reviewed to create this map and how/why they were chosen. This data source is highly biased to cover areas where research has been conducted, but it might miss spots where the literature is not available. Also, there could be many other regions with the same vulnerability factors that were not affected yet by chance. This bias should be acknowledged in the paper. It is not clear if this analysis belongs to the framework mentioned in the introduction.	Thank you for raising this important methodological concern. We agree that Figure 3C represents a qualitative, literature-informed synthesis rather than a systematic or exhaustive mapping exercise. In the revised manuscript, we will add a clear methodological clarification in Section 2 explaining that the hotspots are derived from a targeted narrative review and are intended to be illustrative and diagnostic, rather than predictive or comprehensive. However, we acknowledge existing biases, such as uneven spatial research coverage, under-representation of data-poor or politically marginal regions. The figure 3C presented to demonstrate relational convergence of vulnerability drivers, not to identify definitive flood risk zones.
The manuscript structure is hard to follow because each subsection introduces a new topic without previous mention in the	We appreciate this constructive suggestion. To improve clarity and coherence, we will revise the end of the Introduction to include a clearer roadmap explicitly linking section 2 (diagnosis of vulnerability), Section 3 (conceptual framework development) and will add a new simplified figure to showcase

introduction. It is not clear how all subsections are connected. Usually there should be a figure early in the paper, clearly indicating the scope of the framework, before presenting the application of the framework in a study site.	connection across hydrology, governance and social relations in section 3.1 so that readers will have an overview of the framework before the framework's connection to empirical discussion. These changes will improve narrative flow and accessibility, particularly for interdisciplinary readers.
The concept of hydrosocial connectivity seems like a different term for considering a systemic or holistic view applied to flood risks. When comparing hydrosocial connectivity approach and Integrated Water Resources Management (IWRM) in Figure 4, the authors do not fairly depict the IWRM approach. One of the core principles of IWRM is to promote democratic participation in governance, which is conveniently omitted under 'actors' and 'knowledge context', for example. The authors could argue that the core principles of IWRM are not implemented in practice. But if that is the case, how would creating a new theoretical concept such as hydrosocial connectivity help to solve this problem?	We thank the reviewer for this crucial point. We agree that IWRM in its foundational building explicitly promotes democratic participation and stakeholder engagement. Although we did not overlook this core principle, and we acknowledge that Figure 4 may insufficiently reflected on this issue. We will revise the figure to explicitly include participatory governance under IWRM and will showcase in the figure and in the text that our comparison does not concern IWRM as a normative ideal, but rather the way it is typically operationalized in flood risk governance. While IWRM formally promotes coordination and participation, empirical research shows that its implementation often remains institutionally centred, technocratic, and focused on sectoral integration rather than on interrogating underlying power relations and socio-material dynamics. In response to these barriers, we introduced Hydrosocial connectivity not as a replacement for IWRM but as an analytical lens that conceptualizes flood risk as co-produced through dynamic interactions between water flows, infrastructures, political-economic processes, knowledge systems, and social relations. While IWRM seeks coordination across sectors and scales, hydrosocial connectivity foregrounds relationality, power, and historical processes that shape how such coordination unfolds in practice. In this sense, the added value of hydrosocial connectivity lies in its diagnostic capacity. It enables us to examine why participatory and integrative principles embedded in IWRM frequently fail to translate into transformative flood governance outcomes. Specifically, it directs attention to asymmetries in knowledge and decision-making power, the socio-material configuration of infrastructures, historical patterns of exclusion and marginalization, and the relational production of flood risk across urban and peri-urban spaces. By shifting the analytical focus from institutional design to socio-hydrological relations, hydrosocial connectivity helps identify structural constraints that may remain obscured within conventional IWRM frameworks. We will clarify this distinction in the revised manuscript and refine Figure 4 to ensure a fair and conceptually precise comparison.
The manuscript presents interesting examples and experiences showcasing recent issues related to flood vulnerability. But given the mentioned issues on methods, novelty, and	Thank you for your kind remark. We will revise the overall manuscript based on the very insightful comment by the reviewers.

structure of the manuscript, I recommend substantial revisions to the article for improving the scientific significance and quality.	
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'Comment on egusphere-2025-4546', Anonymous Referee #2, 28 Dec 2025 [reply](#)

The paper examines transboundary flood vulnerability in the India–Nepal–Bangladesh Ganges–Brahmaputra floodplain through the application of a hydro-social systems approach. It argues for the necessity of adopting a new framework for understanding and managing flood risk. As a review paper, it identifies and discusses key weaknesses in existing flood governance systems across the Ganges–Brahmaputra floodplain, illustrating these shortcomings with examples from recent flood events. Drawing on the hydro-social systems perspective, the authors contend that more effective flood governance requires an integrated understanding of hydrological processes alongside social, institutional, and political dimensions. The paper claim that neglecting the social and political contexts of flooding undermines risk management efforts and highlights the importance of interactions between hydrological and social factors for effective water governance. To address these gaps, the authors introduce a new conceptual framework—*hydrosocial connectivity*—which seeks to link water flows, social relations, and governance processes.

The paper thus proposes a novel concept based on a critical assessment of current flood governance practices in Asian countries and their limited effectiveness. Overall, my impression of the paper is positive; however, several issues warrant further attention.

Comment	Response
(A) While the paper identifies shortcomings in the concepts of the hydrosocial cycle and hydrosocial territories, it does not sufficiently demonstrate how these conceptual limitations directly contribute to failures in current flood governance practices. A clearer and more explicit linkage is needed.	We thank the reviewer for this insightful observation. We agree that our earlier framing differentiated hydrosocial connectivity from the hydrosocial cycle and hydrosocial territories primarily at a conceptual level, without sufficiently articulating how these differences translate into governance consequences. In the revised manuscript (Section 3.2), we have added a clarifying paragraph that explicitly links the analytical focus of the hydrosocial cycle and hydrosocial territories to specific blind spots in transboundary flood governance. We now demonstrate how an emphasis on co-production processes (hydrosocial cycle) and spatialised power regimes (hydrosocial territories), while theoretically valuable, may not adequately diagnose

	institutional fragmentation, cross-border data-sharing failures, or early warning asymmetries that directly shape flood vulnerability in the Ganges–Brahmaputra basin. We further connect this clarification with empirical examples illustrating how delayed alerts, fragmented treaty structures, and sovereignty-first governance logics persist despite recognition of hydrosocial dynamics. This revision strengthens the connections between conceptual framing and governance outcomes and clarifies the added diagnostic value of hydrosocial connectivity.
(B) The figures require clarification and reorganization. The data presented in Figure 1 lack source citations, whereas Figure 2 includes a reference in its caption. Given its general and introductory nature, Figure 2 should precede Figure 1. Figure 3A presents a geographic scope that appears excessively broad for the purposes of the paper. Additionally, the construction of the social vulnerability index used in this figure requires further explanation. In Figure 3B, the map depicts flood frequency, while the accompanying description refers to population exposure; this inconsistency needs clarification. For Figure 3C, the methodology used to identify flood “hot spots” should be explicitly described.	We thank the reviewer for these detailed and constructive comments regarding the figures. The images presented in Figure 1 were sourced from publicly available news outlets, and the corresponding links are provided on page 22 of the manuscript. We acknowledge that this sourcing and attribution were not clearly articulated in the main text and figure captions. In the revised version, we will (i) clarify the image sources directly within the figure captions, (ii) ensure consistent and complete citation formatting in accordance with journal guidelines, and (iii) verify that image permissions and usage comply with copyright requirements. Where necessary, we will replace any images that do not meet licensing standards with appropriately licensed alternatives or schematic representations. We agree that Figure 3C represents a qualitative, literature-informed synthesis rather than a systematic or exhaustive mapping exercise. In the revised manuscript, we will add a clear methodological clarification in Section 2 explaining that the hotspots are derived from a targeted narrative review and are intended to be illustrative and diagnostic, rather than predictive or comprehensive. However, we acknowledge existing biases, such as uneven spatial research coverage, under-representation of data-poor or politically marginal regions. The figure 3C presented to demonstrate relational convergence of vulnerability drivers, not to identify definitive flood risk zones.
(D) The paper repeatedly refers to a “political dimension” without defining the term or clearly explaining its role within the proposed framework. This limits the analytical clarity of the argument.	We agree that the term “political dimension” required clearer justification. In the revised manuscript, we have added a line in Section 3 to more explicitly articulate the political dimensions of transboundary flood risk. We have also incorporated additional

	references to support this framing and guide readers to the relevant theoretical foundations.
(E) Finally, the authors should clarify the extent to which the proposed concept of hydrosocial connectivity represents a substantive theoretical advance rather than an incremental extension of existing frameworks through the addition of further elements. A more explicit discussion of the concept's novelty would significantly enhance the paper's contribution and accessibility to readers.	We appreciate this critical question and agree that the novelty of hydrosocial connectivity requires clearer articulation. In the revised manuscript, we clarify that hydrosocial connectivity is not intended as a fundamental breakthrough from hydrosocial theory, nor merely as an incremental extension through the addition of further analytical elements. Rather, it represents a theoretical advance in emphasis and application. While existing hydrosocial frameworks, such as the hydrosocial cycle and hydrosocial territories have powerfully demonstrated the co-production of water and society, they primarily illuminate relational processes or spatialised power configurations. Hydrosocial connectivity advances this scholarship by explicitly centring the relational gaps, asymmetries, and institutional disconnections through which flood risks are produced and redistributed in transboundary contexts. Its novelty lies not in expanding the list of variables, but in reframing analysis around the connections, disconnections/blind spots across hydrological flows, governance systems, and social relations. In this sense, hydrosocial connectivity functions as a diagnostic lens. It enables systematic examination of why participatory and integrative principles embedded in frameworks such as IWRM often fail to translate into transformative flood governance outcomes. Specifically, it directs attention to cross-border institutional fragmentation, data-sharing discontinuities, socio-material infrastructure configurations, historical marginalisation, and asymmetries in decision-making power. By shifting analytical focus from institutional design alone to the socio-hydrological interfaces through which risks circulate, hydrosocial connectivity offers a distinct contribution: it connects systemic disconnections to justice outcomes and governance capacity in a way not explicitly theorised in existing hydrosocial approaches. We will revise Section 3 to make this theoretical positioning more explicit and refined Figure 4 to clarify the conceptual distinctions.