



Supplement of

Invited perspectives: reframing transboundary flood vulnerability through “Hydrosocial Connectivity” for just and adaptive governance

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S1: Research Methods

This study employed a systematic literature review to examine transboundary flood risk and governance in the Ganges–Brahmaputra basin, with particular attention to social vulnerability, institutional dynamics, and hydrosocial connectivity. The review adhered to the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) 2009 checklist (Moher *et al.*, 2009) to ensure transparency, reproducibility, and methodological rigour.

A structured search was conducted across Scopus and Web of Science, using Boolean operators and combinations of keywords including:

- “transboundary” AND “flood” AND “governance”
- “river basin” AND “vulnerability” AND “climate adaptation”
- “flood management” AND “social justice” AND “South Asia”

The search was limited to English-language sources published between 2001 and 2025, and focused on peer-reviewed journal articles, book chapters, and relevant industry and institutional reports (e.g. UN reports, NGO publications, and regional policy documents).

S1.1 Inclusion Criteria

Studies were included if they addressed:

- Floods in transboundary river basins.
- Physical or social drivers of flood risk.
- Regional relevance to South Asia, particularly India and Bangladesh.

Following deduplication and title/abstract screening, 62 publications were selected for full-text review and inclusion. This included 32 sources from Scopus, 18 from Web of Science, and 12 institutional and industry sources that were judged to be influential or highly cited. The search results and selection process are summarised in Table 2 below.

Table S1: Search Strategy and Selection Summary

Search formula	Date	Criteria	Wed of science total	Wed of science selected	Scopus total	Scopus selected
Transboundary river flooding	2001-2025	Above 50 citations or published last 5 years	434	64	139	58
Transboundary river flooding + climatic drivers	2001-2025	Above 50 citations or published last 5 years	3	1	3	1
Transboundary river flooding + anthropogenic drivers	2001-2025	Above 50 citations or published last 5 years	1	1	2	0
Transboundary river flooding + flood risk	2001-2025	Above 50 citations or	12	2	8	5

management infrastructure		published last 5 years				
Transboundary river flooding + dam	2001-2025	Above 50 citations or published last 5 years	22	11	72	30
Transboundary river flooding + institutional capacity	2001-2025	Above 50 citations or published last 5 years	4	0	13	6
Transboundary river flooding + organisational capacity	2001-2025	Above 50 citations or published last 5 years	0	0	0	0
Transboundary river flooding + community preparedness	2001-2025	Above 50 citations or published last 5 years	5	3	5	4
Transboundary river flooding + flood early warning system	2001-2025	Above 50 citations or published last 5 years	18	5	22	12
Transboundary river flooding + flood characteristics	2001-2025	Above 50 citations or published last 5 years	36	11	2	2
Transboundary river flooding + flood exposure	2001-2025	Above 50 citations or published last 5 years	15	3	11	4
Transboundary river flooding + South Asia	2001-2025	Above 50 citations or published last 5 years	13	3	17	7
Transboundary river flooding + India and Bangladesh	2001-2025	Above 50 citations or published last 5 years	18	10	26	11

S1.2: Integration of Academic and Industry Sources

To ensure data triangulation, the review incorporated both academic research and grey literature (e.g. institutional reports, policy white papers, regional strategy documents). This enriched the analysis by combining empirical evidence, conceptual development, and practitioner insights, providing a comprehensive understanding of how transboundary flood risk is framed, governed, and experienced.

Notably, several industry publications from the United Nations, International Centre for Integrated Mountain Development (ICIMOD), and regional water commissions were found to

address the gaps in academic literature, particularly around early warning, data access, and community-based risk reduction.

S1.3 Flood Vulnerability Mapping and Indicator Synthesis

Insights from the literature review informed the development of a composite flood vulnerability indicator set. These indicators spanned both physical (e.g. rainfall variability, sedimentation, infrastructure failure) and social dimensions (e.g. poverty, exclusion, institutional support). They were spatialised using GIS tools to create a vulnerability hotspot map for the Ganges-Brahmaputra basin.

Reference

Moher, D., Liberati, A., Tetzlaff, J., and Altman, D. G.: Preferred reporting items for systematic reviews and meta analyses: the PRISMA statement, *Brit. Med. J.*, 339, <https://doi.org/10.1016/j.ijisu.2010.02.007>, 2009.