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Editorial: Advances in socio-hydrology for building resilience to a changing climate

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Editorial on the Research Topic

Advances in socio-hydrology for building resilience to a changing climate

Socio-hydrology, an emerging field of study, looks at the interaction of humans and water systems across different scales, and the contribution of these interactions to advancing water security. These interactions are bidirectional with anthropogenic activities impacting hydrological regimes, and the modified hydrological regimes, in turn, posing challenges to society for achieving water security. Further, emerging climatic changes and persistent social inequalities have made the dynamics of human-water interactions more complex creating new vulnerabilities and uncertainties.

This Research Topic, having seven research articles, presents applied research focusing on innovative approaches to assess complex dynamics of human-water interactions, and case studies reflecting the stakeholders' engagement and participatory approaches in building climate-resilient water and social systems.

The vision for addressing the societal impacts of climate change through water is presented in the article by [Zimmermann et al.](#). It highlights that climate-induced water insecurity affects livelihoods, gender roles, and cultural norms unequally, shaping human experiences and potentially intensifying social and political tensions. In response, three key pathways are proposed to build resilience into future water systems. These include innovative technologies that enable proactive adaptation to changing water resources; working alongside nature, embracing blue-green infrastructure, and collaborating with natural water entities for resilience; and strong community participation, empowered by awareness, education, and resources to realize the first two pathways.

On the technology front, [Šaponjić et al.](#) building on a case study from Maharashtra, India highlights that behavioral change can play an instrumental role in promotion of water saving and climate smart technologies. It identifies that non-adoption is not only due to a lack of awareness or financial resources but rather complex psychological and social barriers. These include a lack of trust in support programs, unfair treatment that discourages making a financial commitment, and doubt in one's ability to maintain the systems. The article concludes that effective promotion of micro-irrigation requires a socio-psychological approach that includes understanding the farmers' fears, beliefs, and emotions for designing effective and farmer-centric technologies.

Collaboration with nature for building adaptation and resilience is amply demonstrated by [Itsumi et al.](#) in Okazaki City, Japan. The research used a qualitative approach to conclude that urban river restoration holds potential value for community-engaged climate change adaptation by revitalizing the connection between urban society and rivers. The research recommends that for successful integration, river restoration must be supported by flexible community participation policies that evolve in response to the participants' shifting levels of perception, moving from merely gathering people to encouraging multi-stakeholder communication, and eventually ensuring independence from government restrictions.

Additionally, if the approach to work alongside nature and integrated blue-green infrastructure is not mainstreamed it can have serious adverse impacts. This was made evident by [Qi et al.](#) that presented the real-world implications of climate change driven extreme flood intensification in Pearl River Basin, China which is a major economic region in the country. The research projects a staggering 44–50 per cent increase in extreme floods by mid-century and up to a 68 per cent increase by the century's end, indicating a significant increase in extreme floods. The implications of intensification of floods are on homes, infrastructure, and livelihoods of millions, disrupting supply chains and impacting decades of development. The article suggests a two-pronged strategy of climate change mitigation and enhancing flood management. That is, curbing the root cause of the problem by transitioning away from carbon-intensive practices and enhancing flood management infrastructure.

The importance of social capital in resource management for livelihoods and ecosystem services is demonstrated by [Rengalakshmi et al.](#) using the case on the decline of the tank irrigation systems in Tamil Nadu, India. Such systems that were central to community-based collective surface water irrigation have undergone severe degradation because of a shift in farmers' priority to groundwater-based individual irrigation driven by energy subsidies. The findings serve as a critical call to action, suggesting that decline in tank irrigation systems is not just a hydrological problem but a socio-hydrological one.

Similarly, one other article by [Komori et al.](#) provides evidence of the importance of society's ability for adapting to flood risk in Wakayama City, Japan. Using the socio-hydrological system dynamics model, the research demonstrates that social vulnerability can be explained by residents' flood memory, capturing both adaptation and levee effects. The adaptation effect reduces social vulnerability because of the community's awareness of flooding situations in the past in both urban and rural areas agnostic of whether public drainage systems exist or not. In contrast, the levee effect that increases social vulnerability was found only in rural areas that have not experienced flooding and thus communities lack the awareness on the reasons accentuating the flood risk.

Lastly, strong governance is non-negotiable for achieving the pathways which are highlighted in the article by [Prakash et al.](#) It asserts that traditional water management is insufficient because it fails to account for how social dynamics, political structures, and cultural norms intersect with hydrological processes. Hence, the research advocates for adaptive governance, a flexible and inclusive

approach that utilizes various socio-hydrological models. The key recommendations include strengthening regional cooperation among South Asian countries on transboundary water issues, focusing on knowledge sharing and technology transfer; launching pilot projects to identify best practices and allow for trial-and-error learning; and fostering interdisciplinary collaboration to ensure equitable and resilient water management for future generations.

The innovative approaches and evidence based findings and recommendations in this Research Topic on “*Advances in Socio-hydrology for Building Resilience to a Changing Climate*” serves as a reminder to various stakeholders that reforms are needed at all levels—regional, national, and sub-national. In this transition, community action and local governance are paramount for the development of sustainable and climate resilient water systems and services. Each such intervention goes beyond engineered fixes and highlights the areas of future research at the science-policy-practice interface.

Author contributions

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