Climate Change, Conservation, and Sustainable Management Strategies in the Se Kong, Se San, and Sre Pok (3S) River Basins

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SCAN ME

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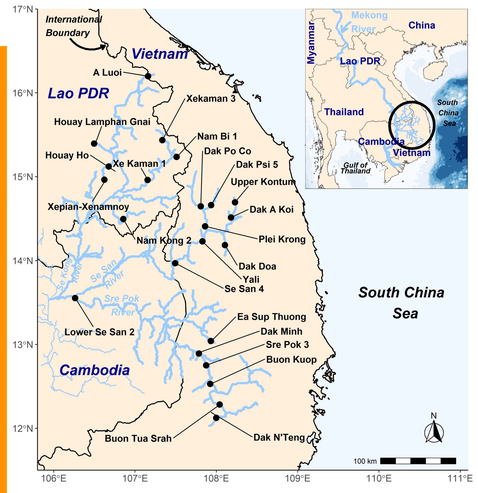
INTRODUCTION

- Freshwater availability is necessary to promote economic growth through agriculture, fisheries, transport, environmental health, and social equity.
- Water resources planning efforts in the Lower Mekong River region (Laos, Vietnam, Cambodia, Thailand, and Myanmar) are complicated by uncertainty stemming from patterns of economic growth, changes in water use patterns, land use change, and climate change.
- While these processes directly increase demands, or decrease supply, research has demonstrated that there are complex processes and dynamic feedbacks among physical processes, biological, biochemical and human-mediated processes that determine change in the water system.



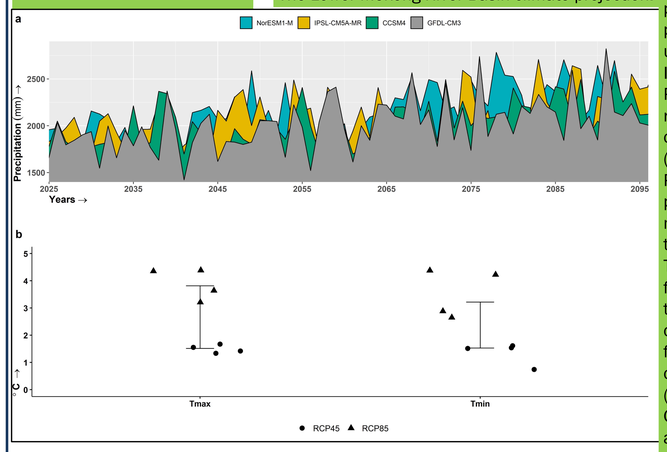
Modeled hydropower dams in the Se Kong Se San, and Sre Pok (3S) River Basin within the Mekong River Basin. The upper right map gives the location of the 3S River Basin within the Mekong River Basin. Black dots are existing and planned reservoirs examined under Business as Usual (BAU), Storage, and Release management scenarios. The 3S River Basin drainage area is about 78,714 km^2.

OBJECTIVE

The overarching goal of this work is to diagnose challenges and setting priorities for sustainable water resource management under climate change.

METHODS

The Lower Mekong River Basin climate projection.



Panel (a) gives the projected annual precipitation amounts under the Coupled Model Intercomparison Project Phase 5 (CMIP5) representative concentration scenario (RCP 8.5).
Panel (b) displays the projected increase of mean annual air temperatures (Tmin & Tmax). Climate analysis for precipitation and air temperature presented covers the time period from 2024 to 2095. Four climate model groups (NorESM1-M, IPSL-CM5A, GFDL-CM3, and CCSM4) are studied.

❖ Vollmer et al., (2018) have presented the social-ecological framework named the Freshwater Health Index (FHI), which takes account of the interplay between governance, stakeholders, freshwater ecosystems and the ecosystem services they provide. *The Fresh Health Index (FHI) is a conceptual framework for freshwater Social-Ecological Systems (SESs) comprised of Governance and Stakeholders, Ecosystem Vitality and Ecosystem Services.*

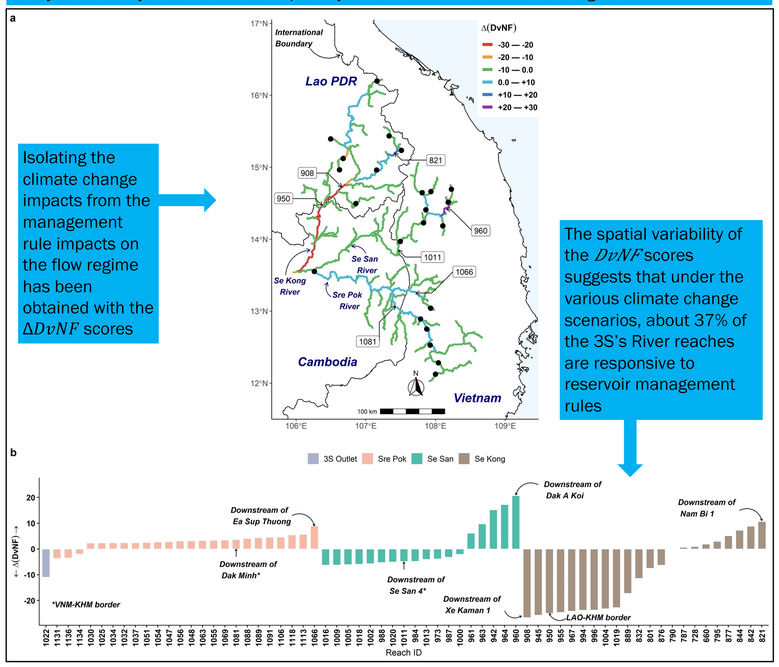
❖ Mohammed et al., (2018) modeling capabilities enable the integration of satellite-based daily gridded precipitation, air temperature, digital elevation model, soil characteristics, and land cover and land use information to simulate water flux framework.

❖ We have examined how climate change and dam development could impact the Se Kong, Se San and Sre Pok Rivers. We have demonstrated an integrated approach exploring balancing tradeoffs of sustainable water use and coping with climate uncertainty through the lens of socio-ecological system, combining remote and in-situ earth observations, hydrologic and climate models, and social surveys using a case study from the Lower Mekong basin (3S River Basins).

RESULTS

- We find that climate change will lead to increased precipitation, necessitating a shift in dam operations, from maintaining low flows to reducing flood hazards. We also find that existing water governance systems in Laos, Vietnam, and Cambodia are ill-prepared to address the problem (Mohammed et al., 2022).

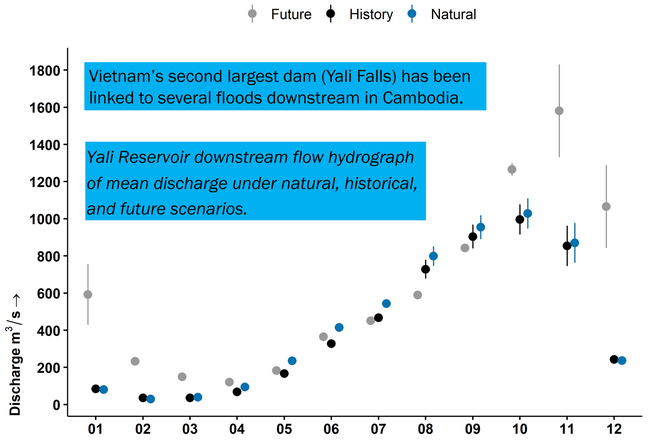
Ecosystem Vitality Indicator – Water quantity – Deviation from natural flow regime



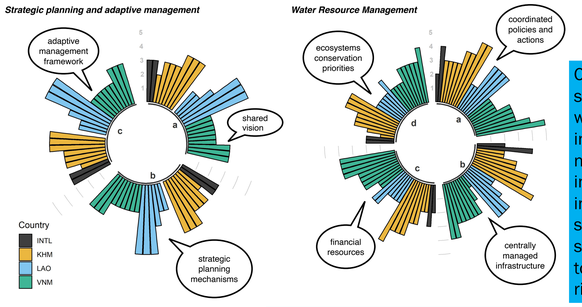
Isolating the climate change impacts from the management rule impacts on the flow regime has been obtained with the $\Delta DvNF$ scores

The spatial variability of the $DvNF$ scores suggests that under the various climate change scenarios, about 37% of the 3S's River reaches are responsive to reservoir management rules

Change in deviation from natural flow ($\Delta DvNF = DvNF_{Storage} - DvNF_{Release}$) within the Se Kong, Se San, and Sre Pok (3S) River Basin under the Coupled Model Intercomparison Project Phase 5 (CMIP5) representative concentration scenario (RCP 8.5) with the GFDL—CM3 climate group in response to different management scenarios, (a) spatial variation of the change in deviation from natural flow, and (b) bar plot of the change in deviation from natural flow. Black dots are modelled existing and planned reservoirs. A zero in $\Delta DvNF$ refers to 3S River segments that are insensitive to management scenarios. The DvNF results shown were calculated from 2025 to 2050 time period. The 3S River segments are labeled with Reach ID numbers (e.g., Reach ID # 1022 is the 3S Outlet).



Climate change impacts are predicted to substantially increase discharge from October to April, peaking one month later than historically and at levels > 50% over baseline



Our survey results suggest that water governance in the region needs to improve in terms of information sharing and strategic planning to mitigate future risks.

Governance and Stakeholder Survey Response

HIGHLIGHTS

- ❑ The utility of satellite earth observation data has enabled us to investigate the Lower Mekong ecosystem health and develop decision awareness tools that can be applied on a global scale.
- ❑ Future reservoir operational policies need to shift dramatically towards flood mitigation in the wet season.
- ❑ Transparency and cooperation (across sectors and jurisdictions) are foundational to the Mekong countries' ability to adapt to a changing flow regime.
- ❑ Our results indicate that the solution space needs to consider the predicted climate induced impacts on water resources in the 3S River basin—while this is not surprising, *it is not yet common practice in the region*, and our approach of using widely available data and a limited set of indicators can be a starting point.

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