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# Impacts of Inter-basin Water Diversion Projects on the Feedback Loops of Water Supply-Hydropower Generation-Environment Conservation Nexus

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**Abstract:** To balance water resource distribution among different areas, inter-basin water diversion projects (IWDPs) have been constructed around the world. The unclear feedback loops of water supply-hydropower generation-environmental conservation (SHE) nexus with IWDPs increase the uncertainty in the rational scheduling of water resources for the water receiving and water donation areas. To address the different impacts of IWDPs on the dynamic SHE nexus and explore synergies, a framework is proposed to identify these impacts across the multiple temporal and spatial scales in a reservoir group. The proposed approach was applied to the Hanjiang River Basin (HRB) in China as a case study. Runoff series from the HRB at multiple temporal and spatial scales were provided through the Variable Infiltration Capacity hydrological model. Multi-level ecological flows were determined by the Modified Tennant Method based on the Multilevel Habitat Conditions method. 30 scenarios were set and modelled in a multisource input-output reservoir generalization model. Differences between scenarios were quantified with a response ratio indicator. The results indicate that without IWDPs, there are negative feedbacks between water supply (S) and hydropower generation (H), between S and environmental conservation (E), while positive feedbacks between H and E. The negative feedbacks of S on H and the positive feedbacks of E on H are weakened or even broken in abundant water periods. With IWDPs, the water donation basins experience strengthened feedback loops, while water receiving basins experience weakened feedbacks. Feedback loops exhibit intrinsic similarity and stability across different time scales. Feedbacks in reservoirs with a regulation function remain stable under the varying inflow conditions and feedbacks for downstream reservoirs are influenced by their upstream reservoirs, especially in low flow periods. Simply increasing water receiving cannot resolve inherent SHE conflicts because of the persistent feedback polarity with IWDPs, and adaptive allocation rules are needed that account for these stable feedback patterns. The proposed approach can help quantify the impacts of IWDPs on SHE nexus and contribute to the sustainable development of SHE nexus.

## REFERENCES

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