

## Negotiating designs of multi-purpose reservoir systems in international basins

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Given increasing agricultural and energy demands, coordinated management of multi-reservoir systems could help increase production without further stressing available water resources. However, regional or international disputes about water-use rights pose a challenge to efficient expansion and management of many large reservoir systems. Even when projects are likely to benefit all stakeholders, agreeing on the design, operation, financing, and benefit sharing can be challenging. This is due to the difficulty of considering multiple stakeholder interests in the design of projects and understanding the benefit trade-offs that designs imply. Incommensurate performance metrics, incomplete knowledge on system requirements, lack of objectivity in managing conflict and difficulty to communicate complex issue exacerbate the problem. This work proposes a multi-step hybrid multi-objective optimization and multi-criteria ranking approach for supporting negotiation in water resource systems. The approach uses many-objective optimization to generate alternative efficient designs and reveal the trade-offs between conflicting objectives. This enables informed elicitation of criteria weights for further multi-criteria ranking of alternatives. An ideal design would be ranked as best by all stakeholders. Resource-sharing mechanisms such as power-trade and/or cost sharing may help competing stakeholders arrive at designs acceptable to all. Many-objective optimization helps suggests efficient designs (reservoir site, its storage size and operating rule) and coordination levels considering the perspectives of multiple stakeholders simultaneously. We apply the proposed approach to a proof-of-concept study of the expansion of the Blue Nile transboundary reservoir system.