



## **Supporting negotiations on new water infrastructure in shared river basins**

Robel Geressu (1,2) and Julien Harou (2,1)

(1) Department of Civil, Environmental and Geomatic Engineering, University College London, Chadwick Building, Gower Street, London, WC1E 6BT, UK, (2) School of Mechanical, Aerospace and Civil Engineering, The University of Manchester George Begg Building, Sackville Street, Manchester, M13 9PL, UK

New reservoirs could negatively affect performance of existing downstream uses, making system changes difficult to agree upon. Considering cost and benefit sharing strategies (e.g., payments or access to energy trade) in negotiations could facilitate agreement as this could make system changes more acceptable to all parties. This work proposes a five-step multi-criteria approach for facilitating negotiations on new dam development and reservoir operation. The first three steps include identifying objectives and constraints for each negotiating group (Step 1), many objective optimization to identify the most efficient attainable trade-offs between all objectives (Step 2) and prioritizing of objectives by each group (Step 3). Step 2 identifies, among many alternatives, a select group of system designs (reservoirs and their operations) by considering the interdependence of new reservoir designs, their operating rules and performance (energy, irrigation, etc.) of the new and existing downstream system. The prioritization of objectives in Step 3 includes weighting both performance metrics in each group's part of the water system (e.g., energy generation) and weighting coordination strategies (e.g. to express preference for extent of energy sharing relative to other performance goals). In Step 4, a second many objective optimization, using priority information from Step 3, optimizes the combined multi-criteria score of each group. This allows finding, for each stakeholder group simultaneously, either one or a few bundles (system design + coordination measures) with higher satisfaction score than system designs without coordination. The final Step 5 assesses the sensitivity of decisions to preference weighting to ascertain the robustness of solutions to stakeholder provided criteria weights. The proposed five-step approach uses plots of optimized trade-offs to help each negotiating group articulate their goals and prioritize objectives. The method is applied to a stylized Blue Nile case-study to help select the location, sizing, and operating rules of a single new dam. In our study, we use example stakeholder priorities and consider cost-sharing and power trade as the coordination strategies between the Nile countries. The proposed approach incorporating coordination strategies in assessing and negotiating Blue Nile development (i.e. dam and reservoir operating rule designs) helps formulate efficient solutions that could increase the satisfaction of stakeholders beyond compromise solutions that concede benefits. Results show coordination assessments that start with fixed system designs could underperform compared to the proposed approach that searches for system designs and coordination strategies jointly.