



## **Visualising Pareto-optimal trade-offs helps move beyond monetary-only criteria for water management decisions**

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Water related eco-system services are important to the livelihoods of the poorest sectors of society in developing countries. Degradation or loss of these services can increase the vulnerability of people decreasing their capacity to support themselves. New approaches to help guide water resources management decisions are needed which account for the non-market value of ecosystem goods and services. In case studies from Brazil and Kenya we demonstrate the capability of many objective Pareto-optimal trade-off analysis to help decision makers balance economic and non-market benefits from the management of existing multi-reservoir systems. A multi-criteria search algorithm is coupled to a water resources management simulator of each basin to generate a set of Pareto-approximate trade-offs representing the best case management decisions. In both cases, volume dependent reservoir release rules are the management decisions being optimised. In the Kenyan case we further assess the impacts of proposed irrigation investments, and how the possibility of new investments impacts the system's trade-offs. During the multi-criteria search (optimisation), performance of different sets of management decisions (policies) is assessed against case-specific objective functions representing provision of water supply and irrigation, hydropower generation and maintenance of ecosystem services. Results are visualised as trade-off surfaces to help decision makers understand the impacts of different policies on a broad range of stakeholders and to assist in decision-making. These case studies show how the approach can reveal unexpected opportunities for win-win solutions, and quantify the trade-offs between investing to increase agricultural revenue and negative impacts on protected ecosystems which support rural livelihoods.