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Economically efficient and socially inclusive river basin development: does a balance exist?

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Global trends in population growth and rising economic prosperity are expected to increase the demand for energy, food, and water, particularly affecting rapidly-growing African economies. To support the production of clean energy and extensive irrigation projects, investment in large dams is increasing. To promote development pathways that are socially inclusive as well as environmentally and economically sustainable it is crucial to assess the social, economic, and environmental impacts of such funding, taking into account the interests of local stakeholders.

In this work, we explore the effects of alternative development pathways on the water-energy-food nexus of the Omo River – Lake Turkana basin (Ethiopia and Kenya). In this peculiar region, dam infrastructure development and expanding agriculture might impact the local social, economic, and environmental structures. In the lower Omo valley, seasonal Omo floods support the practice of recession agriculture, which constitutes the livelihood of local indigenous tribes. Further downstream, on the Ethiopian-Kenyan border, the Omo river contributes about 90% of inflow volume to Lake Turkana. This endorheic lake is located in an extremely arid part of the Kenyan Rift Valley and its' water is key to support the local pastoralists and fishermen. We analyze the effects of alternative energy and food development pathways from a multi-sectoral perspective, assessing the trade-offs in respect of hydropower production, irrigation supply, indigenous recession agriculture and other ecosystem services in the Lower Omo as well as fish yield in Lake Turkana. In addition, we test the robustness of the designed pathways against a wide range of potential changes in both flow regimes and irrigation demands. We do so using a two stage framework to first identify optimal pathways using an optimization procedure with a simplified system model, and then testing the pathways identified as optimal using a more detailed (but computationally expensive) model of the nexus interactions. Results show that our approach provides an objective framework to identify solutions that are able to address the water-energy-food nexus tradeoffs and that perform robustly under changing climatic and societal conditions.