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Trade-offs of water use for hydropower generation and biofuel production in the Zambezi basin in Mozambique

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Hydropower is the most important energy source in Mozambique, as in many other southern African countries. In the Zambezi basin, it is one of the major economic resources, and substantial hydropower development is envisaged for the next decades. In Mozambique, the extension of the large Cahora Bassa hydropower plant and the construction of several new facilities downstream are planned.
Irrigated agriculture currently plays a minor role, but has a large potential due to available land and water resources. Irrigation development, especially for the production of biofuels, is an important government policy goal in Mozambique.
This contribution assesses interrelations and trade-offs between these two development options with high dependence on water availability. Potential water demand for large-scale irrigated agriculture is estimated for a mix of possible biofuel crops in three scenarios with different irrigated area sizes. Impacts on river discharge and hydropower production in the Lower Zambezi and its tributaries under two projected future climates are simulated with a hydrological model and a reservoir operation and hydropower model. Trade-offs of increasing biofuel production with decreasing hydropower generation due to diminished discharge in the Zambezi River are investigated based on potential energy production, from hydropower and biofuels, and resulting gross revenues and net benefits.
Results show that the impact of irrigation withdrawal on hydropower production is rather low due to the generally high water availability in the Zambezi River. In simulations with substantial irrigated areas, hydropower generation decreases by -2% as compared to a scenario with only small irrigated areas.
The economic analyses suggest that the use of water for cultivation of biofuel crops in the Zambezi basin can generate higher economic benefits than the use of water for hydroelectric power production. If world oil prices stay at more than about 80 USD/barrel, then the production of biofuels for oil import substitution will yield strong benefits except for the least efficient producers. Producing biofuels for export is more challenging and requires highly efficient production. Generally, investment in irrigated agriculture is expected to have more impact on local economy and therefore poverty reduction than investment in hydropower development.