

## Uncertainty and complexity in ecological and social mitigation of hydropower in developing countries

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**ABSTRACT:** Hydropower project development is increasing in developing countries and poses potential threats to eco-sociological systems if they are not sufficiently planned and mitigated. Despite the widely recognized importance of basin-wide energy development plans to adequately protect biodiversity and local communities (including indigenous communities), high-level energy planning to determine the best type and place for situating energy production projects (including hydropower) remain rare, which places the burden on potential developers to identify ecological and social feasibility. In developing countries this is often compounded by a context of high levels of uncertainty resulting from a general lack of information on species distribution and ecology in many regions, which can often hamper the transferability of evaluation and mitigation tools developed in Europe or North America to these areas (for example, microhabitat simulations, detailed hydropeaking impact assessments for target species, etc). Finally, the implementation of ecological mitigation is even more contingent on social aspects in developing countries than elsewhere, as most mitigation measures and offsets require integration of changes in livelihood practices (high dependence on ecosystem services) and overall social adherence, particularly in areas outside of direct project control, which are often subject to cumulative impacts. This last challenge can also be an opportunity for the project to contribute to the implementation of more sustainable practices (for example, in resource extraction) over an extended spatial area.

Drawing upon examples from several projects in developing countries from three continents and at different stages (in development, construction or operation), some solutions to the specific challenges that hydropower development poses in the developing country context (particularly tropical ecosystems) will be illustrated, as well as the unresolved issues and perspectives on how to address them. Examples of good practice from these projects include benchmarking potential projects in the pre-development phase (tools and criteria), developing local capacity for environmental monitoring over the long-term and community-based fisheries and forest management, conducting holistic environmental flows assessments and eco-social feasibility assessments for river-based offset programs including perspectives on how developing governance structures and community-based conservation (multi-use forests for example) can potentially contribute to mitigation goals, particularly of non-Project lands that are not legally protected. In particular, the lack of ecological information has been addressed by anticipating long-term research programs (on fish distribution, ecology, taxonomy and migration patterns), which associate local expertise with international experts to also increase local capacity in the long-term (notably for eDNA and genetic analysis).