



From project-based planning to strategic basin-scale assessments: opportunities and challenges for changing the paradigm of hydropower planning and sediment management

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Dams are mostly planned project-by-project, i.e. without a strategic consideration of trade-offs between the final dam cumulative impacts on a river's sediment budget, or other environmental externalities, and dam economic benefits. Strategic planning aims instead to find dam portfolios, i.e. groups of dam sites, that result in an optimal trade-off between dam impacts, e.g., sediment trapping, and hydropower production. Here, we provide evidence for why such a paradigm shift in hydropower planning away from the current project-by-project assessments towards strategic basin-scale planning is a prerequisite to develop hydropower more sustainably. We also point out challenges and a research agenda for mainstreaming strategic planning into hydropower planning and decision making based on several case studies.

We base our trade-off analysis on the CASCADE framework. CASCADE (CATCHment Sediment Connectivity and DELivery) is a flexible framework for determining sediment connectivity, sediment fluxes, and cumulative dam sediment trapping. CASCADE can be used on multiple scales and with a variable accuracy of process-representation as a function of available data. Using CASCADE for some major tributaries of the lower Mekong, we demonstrate a dam portfolio resulting from project-by-project construction leads to poor trade-offs between economic and environmental objectives of dams. The current, project-by-project planned portfolio will exploit 50 % of basins hydropower potential but trap 90 % of the basin's sediment load. An optimal dam portfolio derived from a strategic assessment of many alternative dam portfolios could have resulted in the same hydropower production for less than 20 % of sediment trapping.

Looking to the future of the entire Mekong Basin given the dams already built via the past project-by-project development approach, we identify a development pathway that would result in greatly expanded hydropower production without a major increase in sediment trapping. However, the identified optimal development pathway would require a shift from the current trajectory of hydropower development among the six riparian countries (China, Myanmar, Laos, Thailand, Cambodia, Vietnam), demonstrating the challenges for mainstreaming strategic hydropower planning into decision making in transboundary basins.

Last, we will present an outlook on two key challenges for changing the paradigm in hydropower planning from project-by-project to strategic planning. 1) how to enable robust predictions of future shifts in the sediment budget of basins that undergo both hydropower development and climatic and land use changes; 2) how strategic basin-scale assessments are a pre-requisite to include hydropower impacts on river systems into national or regional planning of renewable energy portfolios.