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Modelling and assessing impacts of hydropower projects on the ecohydrology of Myanmar rivers

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Hydrological modifications to the natural flow regime through the regulation of a river threaten the integrity of river ecosystems. For river and wetland ecosystems, the flow regime is the most significant determinant of ecosystem functioning. In Myanmar, the exponentially growing hydropower sector poses a threat to some of the last large free-flowing rivers in the world. The potential disturbances these dams cause to the ecosystems and their services impact the livelihoods of many people in Myanmar. In order to make recommendations for environmental flows, the quantity and timing of flows necessary to help sustain ecosystems and the services they provide, an analysis of how flow was modified and how that might be degrading ecosystems is necessary. This research modelled the natural flow regime of the dammed Myitnge and Myittha rivers in Myanmar using the distributed hydrological rainfall-runoff Wflow_sbm model, which consists of a set of python programs to perform hydrological simulations. It uses PCRaster, which in turn makes use of a dynamic modelling language within a GIS framework. The surface runoff was modelled using a kinematic wave routine. The model was forced using static and dynamic data which is mostly globally available from different satellites, and derivatives of this, and calibrated and validated on data collected during field visits in 2018 as well as some secondary data sources. The field data collection focused on river bathymetry and soil properties such as sediment geometrical grading characteristics and infiltration capacity. Furthermore, scenarios were developed that varied in land cover, irrigation demand, and dam-management. These scenarios were incorporated into the WFlow_sbm model to estimate the impact on flow components. Using modelled discharge results, multiple environmental flow assessments were carried out, comparing pre- and post-dam and scenario situations. These assessments were split up into two categories: hydrological alteration indicator analyses and habitat simulation models. Furthermore, changes in sediment load due to the hydro dams were estimated using empirical formulas in combination with collected soil parameter data. Finally, these analyses were combined and linked to macroinvertebrate biomonitoring samples that were collected in 2016 and 2017 to assess if the dams have impacted a vital part of the ecohydrology of the Myitnge and Myittha rivers. Some potential impacts on other ecological processes were highlighted based on observations and ecohydrological relationships from literature. Based on the results, dam-management recommendations were given for environmental flows in the study areas to help sustain ecosystems and the associated services they provide.