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Abstract

Title of thesis: Engineering Compliance with Environmental Law in Lao Hydropower

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Hydropower is the backbone of the Lao People's Democratic Republic's electricity system and a central pillar of its ambition to become the "Battery of Southeast Asia". Dozens of large dams now operate on the Mekong mainstream and major tributaries, exporting power to neighbouring countries while reshaping river flows, sediment transport and aquatic ecosystems. At the same time, Laos has adopted national environmental standards, modern environmental legislation and participates in regional frameworks such as the Mekong River Commission. This raises a core question: do hydropower projects actually operate in ways that comply with these environmental rules in everyday practice, especially for water quality, sediment continuity and fish migration? The thesis therefore investigates how "engineering compliance" with environmental

law can be assessed for Lao hydropower projects using publicly available information and simple, reproducible checking tools.

The research combines a literature-based analytical framework with case studies. Lao ambient surface water standards are converted into numeric decision rules for key parameters such as pH, dissolved oxygen (DO), biochemical oxygen demand (BOD_5) and chemical oxygen demand (COD), which are then applied to monitoring data from reservoirs and downstream river sections. A sediment management scorecard evaluates the presence and likely performance of measures such as flushing, sluicing and bypassing, while fish passage is assessed using an "available evidence–potential effectiveness" approach that considers both structures and limited monitoring data. A documentation and transparency scorecard examines how well projects report monitoring, operational rules and performance in forms that can be independently verified. This combined framework is applied to selected projects, including Nam Ngum 1, Nam Ngiep 1, Xayaburi and Pak Lay, to illustrate how engineering compliance can be evaluated in practice.

The findings suggest that many surface monitoring stations usually meet national water quality limits, but deep reservoir layers often show low dissolved oxygen and occasional COD exceedances that are not visible from surface data alone. Sediment and fish-passage measures exist at some sites, yet their effectiveness cannot be robustly judged from currently available information, and transparency is the most consistent weakness across projects. Overall, the analysis indicates that Lao hydropower projects largely achieve formal, "on-paper" compliance, but that verifiable engineering compliance remains limited. The thesis proposes a practical framework that links legal standards to explicit operational rules, traceable monitoring records and standardised reporting, and argues that applying such a framework could support more transparent, evidence-based environmental management and help align hydropower development more closely with national and regional sustainability goals.