Hydropower Development on the 3S Rivers

The Sekong, Srepok, and Sesan (3S) Rivers are the most critical tributaries to the lower Mekong River. They provide essential water and sediment flows to the downstream floodplains and serve as major routes for fish migration. However, rapid hydropower development is drastically altering the 3S Rivers and the services they offer to local populations.

Overview

The 3S River Basin covers an area of 78,650 km^2 in the lower Mekong, is shared by Laos (29%), Vietnam (38%) and Cambodia (33%) (Fig. 1). Despite only covering 10% of the entire Mekong Basin, it contributes 23% of the mean annual Mekong water volume (Adamson et al., 2009). The average water flows from the 3S to the Mekong measure roughly 3,000 cubic metre per second during the dry season and 4,500 cubic metre per second in the wet season.

In addition to water flows, the 3S provides a great deal of ecosystem services to the Mekong River, its downstream floodplains, and the Mekong Delta:

• Nearly 15% of suspended sediment discharge in the Mekong (20 metric tons per year) originates in the 3S (Koehnken, 2012). These sediments are a key source of nutrients to the Tonle Sap and the Mekong Delta important for agriculture.

• The 3S is the most important catchment in the entire Mekong for maintaining migrating fish populations (Ziv et al., 2012).

• Because of its proximity to the lower Mekong floodplains, the 3S strongly influences the hydrology and productivity of the Tonle Sap and Mekong Delta.

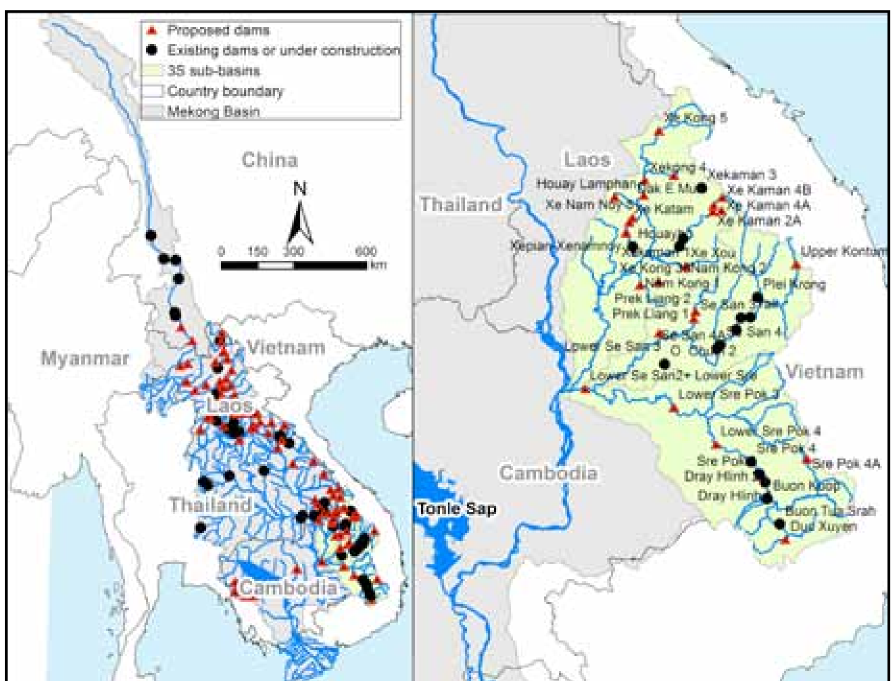

Figure 1. Overview maps of the Greater Mekong, 3S basin, and hydropower development.

Hydropower Development

Over 42 dams are being constructed or are planned for the 3S River Basin (Fig. 1). These hydropower projects are of similar scale to the Lancang cascade in the upper Mekong in China and contain a similar level of active storage, the fraction of a reservoir in which water levels fluctuate in relation to demand for electricity. Because these active storage levels are much higher than in the Lower Mekong Basin mainstream dams, the dam construction is very controversial. (Fig. 2).

Not all dams are expected to significantly alter hydrological patterns. Scientists are able to identify which dams will have the greatest impact on water flows and cause severe environmental alterations consequences. Location and size of the project is a good indicator of these. Generally, the larger the project and the closer downstream, the greater the disruptions (Table 1). The larger issue, is the cumulative impact of the construction and operation of multiple dams.

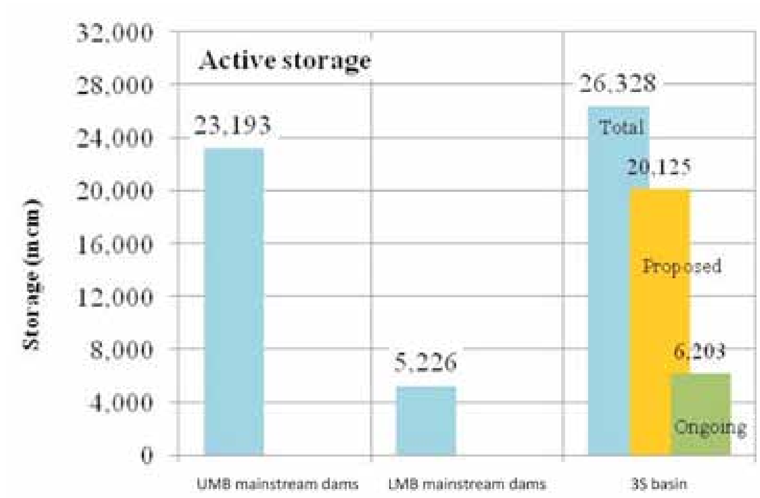

Figure 2. Comparison of reservoir active storage (in millions of cubic meters, mcm) in the Lancang cascade in the upper Mekong (UMB), lower Mekong mainstream dams (LMB), and 3S dams (3S River Basin).

Large dams (active storage > 1000 mcm)	Lower 3S	Lower Srepok 3, Lower Sesan 3, Lower Srepok 4
	Upper 3S	Xekong 4, Xekong 5, Srepok 3
	Sub-tributaries	Xe Xou, Xekaman 1
Medium dams (active storage > 100-1000 mcm)	Lower 3S	Lower Sesan 2+ Lower Srepok
	Upper 3S	Yali, Buon Tua Srah, Duc Xuyen, Sesan 4, Xekong 3d
	Sub-tributaries	Plei Krong, Xepian-Xenamnoy, Houayho, Nam Kong 1, Xe Kaman 2B, Prek Liang 2, Dak E Mule, Nam Kong 2, Houay Lamphan, Upper Kontum, Xe Katam, Prek Liang 1, Xekaman 3
Small dams (active storage 0-100 mcm)	Lower 3S	---
	Upper 3S	Xekong 3up, Buon Kuop, Sre Pok 4, Sesan 4A, Sesan 3A, Sesan 3, Dray Hlinh 2, Dray Hlinh 1, Sre Pok 4A, Srepok 4A
	Sub-tributaries	O Chum 2, Xe Kaman 4B, Xe Kaman 4A, Xe Nam Noy 5, Xekaman-Sanxay

Table 1. Classification of 3S dams according to active storage volume and location in the basin. As a general rule, the larger the reservoir and the closer it is to the Mekong River, the greater the impacts.

Conservation International

Conservation International (CI) has worked in Cambodia for over twelve years. The Greater Mekong Region is one of our six global priority geographies for conservation due to the immensely important ecosystem services it provides to tens of millions of people in the region.

Building upon a strong foundation of science, partnership and field demonstration, Conservation International empowers societies to care for nature in order to ensure the long-term well-being of people.

Every human life on Earth depends on a natural world capable of supporting our needs. But we are taking more from nature than it can replace, weakening the Earth's ability to provide the clean air, fresh water and food we depend on. That is why CI is working at every level—from remote villages to the offices of presidents and CEOs—to help move whole societies toward a healthier, more sustainable development path that values and accounts for nature's role in our well-being. Through science, policy and field work, CI is applying smart, innovative solutions to protect the biodiversity and the ecosystems we all depend on.

Local and Downstream Environmental Impacts

Water Flows

Water flows drive important interactions, govern sedimentation, carbon storage, and the life cycles of plants and animals associated with this system. Downstream ecosystems are used to a set water regime, so changes to this will disrupt ecological diversity and productivity.

- Full hydropower development in the 3S Rivers is expected to increase dry season flows by 63% and reduce wet season flows by 22% at the Mekong discharge (Piman et al., 2012).
- 55% of the dry season alterations will be caused by seven dams: Lower Srepok 3, Lower Srepok 4, Lower Sesan 3, Lower Sesan 2 + Srepok, Xekong 5, Xekong 4, and Xe Xou.
- Flow regulation in the 3S will likely alter Tonle Sap environmental flows.
- Full development in the 3S will produce a comparable magnitude of hydrological alterations as the upper Mekong dams (Fig. 3).
- Dams have higher impact on daily and seasonal flows than climate change. Also climate change may increase long-term uncertainty in water flows (Lauri et al., 2012).
- Sediment trapped behind dams could account for 92% of all 3S catchment yield (Kummu et al., 2010).
- Basin-wide disruptions to water flows and sediment yields could decrease annual primary production in the Tonle Sap by 31% on average (Arias et al., 2013). Development activities in the 3S would greatly contribute to these disruptions.

Fisheries

In Cambodia, fish provide a major proportion of the population's protein needs and an essential source of fat. A reduction in fish populations will affect health and nutrition of the general population, as well as decrease livelihoods from fish yields and deepen already severe poverty levels

- Completion of proposed 3S dams will have greater impacts on fish diversity than the Lancang cascade (Ziv et al., 2012).
- The Lower Sesan 2 + Lower Srepok and the Xekong dam cascade are expected to have the most impact on fish migration and diversity (Ziv et al., 2012).
- Despite having similar active storage and greater hydrological alterations than the Lancang cascade (UMB mainstream) and the LMB mainstream dams, energy generation from the 3S dams will be considerably low (Fig. 4).
- New hydropower proposals are low energy, high impact projects. A large increase in proposed reservoir storage capacity in the 3S Basin will result in a relatively small production of electricity, but significant hydrological alterations. 20,125 mcm of proposed storage will only produce 2,721 MW. In contrast,the current 6,203 mcm storage capacity produces 3,642 MW.

In addition to hydropower development, deforestation, climate change, irrigation development, and other drivers of change contribute to the alteration of the 3S River Basin.

Conservation International (CI) is not against hydropower development.

We support the development of electricity generation for domestic consumption and exportation, as it is critical for development in Laos, Cambodia, and Vietnam. We believe this type of development should be considered carefully. CI urges integrated hydropower development and conservation planning so that the trade-offs between energy production and other ecosystem services, particularly those vital for the survival of the poor people that depend on them are more fully understood before dams are developed.

A two to five year delay on the decision to implement these dams will allow time for research to be undertaken that will provide a better understanding of the impacts of these dams. This will deliver decision support tools to the Cambodian government that explain how different scenarios, such as variances in the dam location, design and operation, will influence the dams impacts so they can choose a path of least negative impact for the region.

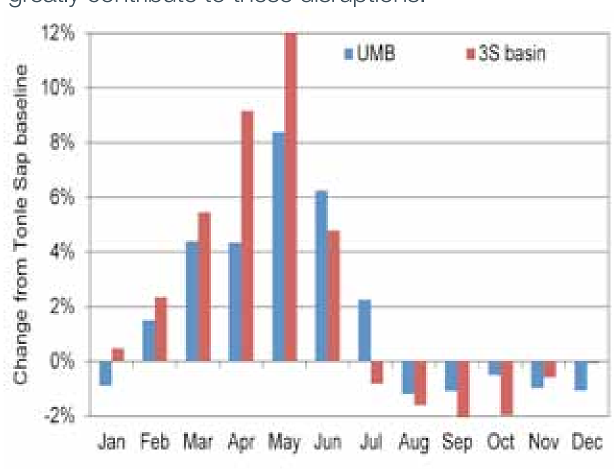

Figure 3. Changes in monthly water levels in the Tonle Sap caused by full hydropower development in the upper Mekong (UMB) and the 3S Basin.

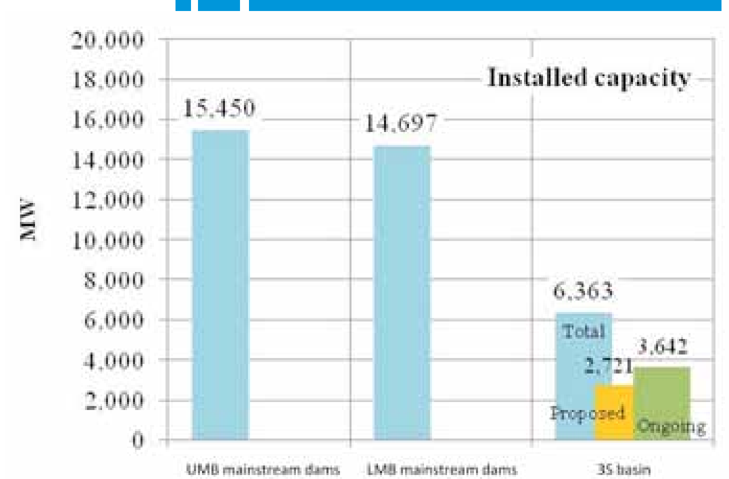

Figure 4. Comparison of electricity generation capacity (in Megawatts, MW) in the Lancang cascade in the upper Mekong (UMB), lower Mekong mainstream dams (LMB), and 3S dams (3S Basin).

Solutions

- Alternative sites for high impact dams.
- Alternative reservoir operations to minimize alternation of natural flows.
- Design sediment release mechanisms and schedule seasonal discharges.
- Design, test, and monitor fish passage alternatives.
- Avoid development on pristine sections of river and forested areas of high conservation value.
- Implement payment for ecosystem services to conserve forest in critical catchments while benefiting hydropower and irrigation development by avoiding erosion and regulating runoff.

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