Sidestepping Science:
Review of the Pöyry Report on the Xayaburi Dam

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Failure to address the Mekong River Commission's requirements

The MRC has issued a set of technical guidelines, which member governments use to evaluate proposed projects in the Mekong River basin. The MRC's Preliminary Design Guidance on Mainstream Dams sets forth specific requirements related to fish passage, sediment transport and river morphology, water quality and aquatic ecosystems, dam safety, and navigation systems.[2] The MRC's 2011 technical review of the Xayaburi Dam identifies recommendations and areas of non-compliance based on the project developer's reports and studies by expert panels.[3] When the four governments met in April 2011 to discuss the project, the Lao government committed to comply with the MRC's Preliminary Design Guidance and promised that major impacts could be mitigated to acceptable levels.[4]

The Pöyry report concludes that the Xayaburi Dam is principally in compliance with these guidelines, and recommends that the project proceed as planned, despite the concerns raised by its neighbors. A closer look, however, reveals major scientific and technical shortcomings.

Most notably, the Pöyry report lacks baseline data on which to draw its conclusions. The Pöyry report lists numerous areas where baseline data is lacking (see Annex 1 for details), but downplays their significance. The MRC's own review of the Xayaburi Dam, on the other hand, "highlights a number of areas of uncertainty on which further information is needed to address fully the extent of transboundary impacts and mitigation measures required."[5] For example, the MRC's technical review of the Xayaburi Dam emphasizes "a need for a detailed baseline study on the socio-economic impacts both in the immediate Xayaburi reach, including to the most upstream area likely to be impounded, and any transboundary areas likely to be impacted by the

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[2] **Mekong River Commission (Aug. 2009),** ***Preliminary Design Guidance for Proposed Mainstream Dams in the Lower Mekong Basin*** **[hereinafter "MRC preliminary design guidance"].**
[3] MRC technical review of Xayaburi Dam..
[4] Mekong River Commission media release (19 Apr. 2011), "Lower Mekong countries take prior consultation to ministerial level," http://ns1.mrcmekong.org/MRC_news/press11/Lower-mekong-coutries-take-prior-consultation19Apr11.html.
[5] MRC technical review of Xayaburi Dam, p. i.

development."[6] Without this baseline data, it is impossible to comply with the MRC's requirements.

Impacts on the Mekong's fisheries

Fisheries play a central role in the lives of millions of people across the Mekong River Basin. The MRC notes that dams can have "effects on the fisheries resources of the Mekong, the world's largest inland fishery, especially the barrier effect that dams could have for migratory species, fish biodiversity and the subsequent consequences for people's livelihoods."[7] The value of the Mekong's fisheries is an estimated US$1.4 to $3 billion per year. Taking into account secondary industries such as fish processing and marketing, these fisheries have an economic value of between US$5.6 and $9.4 billion each year.[8]

Permanent and irreplaceable loss of fisheries

The full extent of the Xayaburi Dam's impacts on fisheries is still unknown. The dam will create a barrier that makes fish migrations difficult or impossible to cross. Scientists are concerned because of the huge diversity of migratory species in the Mekong and the sheer number of migrations that occur annually. As the MRC noted in its technical review of the Xayaburi Dam, "gaps in knowledge—on the number of migratory fish species, their biomass and their ability to pass a dam and reservoir—lead to considerable uncertainty about the scale of impact on fisheries and associated livelihoods, both locally and in a transboundary context. This raises significant questions about whether the full extent of impacts can be estimated and adequate mitigation measures planned."[9]

An estimated 70 percent of the Mekong's commercial fish catch migrate long distances.[10] According to the MRC's Fisheries Expert Group, the Xayaburi Dam and its reservoir "could affect between 23 and 100 species, including five on the IUCN Red List of Threatened Species."[11] The MRC expressed concern about the impacts of the Xayaburi Dam, the first of a proposed cascade of six dams in upper Lao PDR:

> The Xayaburi dam is the first of six dams, a cascade that would block 69% of the accessible [Lower Mekong Basin (LMB)] habitat for migratory fish in both the mainstream and LMB tributaries. If the cascade is built, 39% of the riverine habitat will be lost in the mainstream, representing 90% of the upper migration system. At least 23 but probably more than 100 fish species will be directly affected by disrupted migration routes. Fish will have major problems in adapting to unstable and unsuitable habitat conditions in reservoirs resulting in probably 90% loss of fisheries yield in reservoirs. Intended flushing of reservoirs might have detrimental effects on

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[6] MRC technical review of Xayaburi Dam, p. 42, see also pp. 34, 41.
[7] MRC preliminary design guidance, p. 1.
[8] See **Patrick Dugan (2008), Mainstream dams as barriers to fish migration: international learning and implications for the Mekong, Catch and Culture, vol. 14, no. 3 [hereinafter "Dugan 2008"]**, citing Hortle 2009: "With an estimated annual harvest of 2.2 million tones of wild fish, the Mekong supports the world's largest inland fishery, annually worth US$2.2-3.9 thousand million at first sale and between US$4.3 and US$7.8 thousand million on retail markets."
[9] MRC technical review of Xayaburi Dam, p. ii.
[10] Dugan 2008.
[11] MRC technical review of Xayaburi Dam, p. i.

> downstream fish communities in un-impounded river sections. In the case of multiple mainstream dams, viable fish populations of migratory species will not be maintained even if highly efficient fish-pass facilities are built. If the cascade of six dams above Vientiane is built, fisheries yield of river-floodplain wetlands will be reduced by 73% in Lao PDR...[12]

As the MRC noted, "experience from other areas suggests that most of the loss would be associated with construction of the first dam in the cascade."[13] Because the risks of the Xayaburi Dam are so high, the MRC recommended thorough analysis of the potential impacts on local communities, their ability to adapt to changing conditions, and options for compensation.[14]

Build first, comply later?

On several occasions, the Pöyry report acknowledges major gaps in knowledge about fisheries impacts,[15] even stating that "the missing baseline data concerning fish species, migration pattern, behavior, swimming ability, biomass, economic value, etc, should be carried out with the utmost urgency to allow the design changes within the existing time frame."[16]

Whereas the MRC recommends collecting baseline data *before* designing mitigation measures, Pöyry claims that any baseline studies can be conducted and mitigation measures designed *after* construction on the Xayaburi dam is already underway.[17] Pöyry found, for example, that "for a proper handling of fish passes, there is a need to improve the base line data. Such data must be obtained and developed and there is sufficient time to complete such work during the early part of the construction phase, which will allow any necessary technical adaptations to be made."[18]

This approach runs contrary to established science. Because construction activities can affect the river, baseline data need to be collected before construction in order to accurately assess a project's impacts. The MRC's technical review of the Xayaburi Dam provides a compelling reason why baseline studies should be conducted before construction proceeds:

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[12] MRC technical review of Xayaburi Dam, p. 39.
[13] MRC technical review of Xayaburi Dam, p. i.
[14] According to the MRC technical review, p. 32: "It is recommended that a thorough situation analysis be carried out to determine the capacity of the local fishing communities to adapt to the potential changes that will arise from the proposed dam," p. 33: "There is also a need to undertake an alternative-livelihoods analysis within the communities to identify possible compensation for losses incurred by the dam," p. 33: "There is no definitive solution to mitigate the lost fish production in the Xayaburi dam area. The changes in topography and flow dynamics preclude alternative solutions such as stocking and cage farming and no single fisheries solution to lost livelihoods will probably have to be sought."
[15] Pöyry report, p. 25: "The main issues recognized concerning the compliance with the MRC Design Guidance on baseline data require still further investigations and improvement, leading to the current situation that the knowledge concerning the specific requirements of the aquatic fauna on the fish passage facilities is not sufficient"; see also, Pöyry report, p. 58: "The Consultant agrees with the gaps identified by the MRC Fishery Experts and the recommendations are considered reasonable."
[16] Pöyry report, p. 26.
[17] See e.g., Pöyry report, p. 14; p. 58 also emphasizes: "The developer of Xayaburi HPP has the responsibility to assess the impacts related to the Xayaburi project, but a cumulative impact assessment of multiple dams on the Mekong Mainstream on the basin wide fishery goes beyond his responsibility and will have to be carried out by the Government of Laos and the riparian countries when necessary information are available."
[18] Pöyry report, p. 14; see also p. 10, where Pöyry optimistically claims that "all of the recommended works can be carried out during detailed design and construction of the spillway, since the main fish passage facility is on the left bank and the construction of this part will start 3 years after the right bank part. The developed data can then be used to adapt the fish passage facilities, concerning biomass capacity and design details."

> In addition to fish-passage facilities and impacts on fish migration, the technical review also addresses impacts that may occur during the construction phase of the proposed Xayaburi dam. Considering the construction phase exceeds 7 years, these impacts are potentially long term and it is possible that the fish populations will not recover from any disruption of stocks if the construction process is not well managed. Therefore, impacts during the construction phase are equally as important as those during dam operation. Fisheries will potentially be heavily impacted during the construction phase. Construction impacts have been given little attention in the submitted documents.[19]

Furthermore, many of the MRC's requirements depend on the collection of adequate baseline data. The Pöyry report mentions several ways in which the lack of baseline data prevents the Xayaburi Dam from complying with the Commission's requirements. Pöyry finds, for example that "the knowledge concerning the specific requirements of the aquatic fauna on the fish passage facilities is not sufficient."[20] To conduct an appropriate fish baseline study, Pöyry estimates, would take two years.[21]

When impacts on fisheries cannot be mitigated, the MRC requires the developer to provide adequate compensation. Pöyry notes the project developer's lack of a compensation program for affected people who rely on fisheries, stating, "baseline data, like how many people and to which extent are using the aquatic fauna and flora including any depending businesses, need to be developed and investigations on trans-boundary effects also need to be carried out in the forthcoming project phase."[22] Gathering such baseline data during the construction phase, when impacts are already happening, would undermine the intent of the MRC's guidelines.

Saving three million fish per hour?

Despite lacking adequate baseline data, Pöyry recommends "fish passage" technology as the solution to allow migrating fish to pass over the dam. Fish passages have been used in dam projects around the world, but need to be designed to match local conditions such as the range of fish species, number of migrating species at a given time, behavior of these species, height of the dam, variations in river flow, and cumulative impacts of fish passing through multiple dams along the river, among other factors.

The MRC requires that any fish passages on the Mekong Mainstream must be able to provide safe passage for 95 percent of target species under all flow conditions.[23]

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[19] MRC technical review of Xayaburi Dam, p. 32.
[20] Pöyry report, pp. 25-26.
[21] See generally, Pöyry report, pp 25-26. To conduct an appropriate fish baseline study, Pöyry notes, would take two years. (although this does not account for transboundary impacts): "The fish survey has to start as soon as possible to have an adequate set of data. The survey needs to cover at least one yearly up- and down-migration cycle with fish eggs, larvae, juvenile and adults including total biomass migrating upstream and downstream. After one migration cycle the target species should be selected due to size, commercial and livelihood importance, ecological guilds, conservation status, and the swimming ability and behavioural studies need to be started. The fish survey should go on for an additional year to receive an adequate set of data. Sampling should be carried out at least twice a month."
[22] Pöyry report, p. 26, 28.
[23] According to the MRC, "the developer should provide effective fish passage upstream and downstream. Effective fish passage is usually defined as 'providing safe passage for 95% of the target species under all flow conditions.' The success rate for fish passage both upstream and downstream necessary to ensure continued population viability can be refined for the particular species concerned, based on its life history and the number of dams the species may have to pass to complete its life-cycle."

Pöyry's report does not consider, or even mention, the MRC's "95 percent" requirement. Rather, the report proposes a fish passage solution in uncertain terms: it is "state of the art and has a very complex design, but it needs to be taken into account that the basic knowledge concerning the fish species of the Mekong River, their swimming ability and behavior needs to be greatly improved."[24]

The technology that Pöyry proposes has only been tested in Europe and North America, and has not been tested for the unique conditions, massive fish migrations, and biodiversity of the Mekong River Basin.[25] In 2008, a group of fisheries experts convened by the MRC concluded "that there is currently no evidence that fish-passage facilities used in large tropical rivers in Latin America, Africa and Asia can cope with the massive fish migrations and high species biodiversity in the Mekong."[26] For example, Eric Baran of the WorldFish Center estimated that the volume of fish migrations in parts of the Mekong can reach up to three million fish per hour at peak migration times.[27] Based on the opinions of fisheries experts, the MRC expressed

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MRC preliminary design guidance, p. 12, para. 61. MRC also notes…"Movement of fish past the barriers may be possible only if effective fishways can be designed to accommodate the biology and numbers of migratory fishes in the Mekong. On hydropower dams (or any dams greater than approximately six metres in height), fish ladders or natural fish passages are unlikely to be effective for upstream migration. Fish lifts or fish locks are theoretically a possibility, but the technology has not yet been successfully applied elsewhere in the world, and the systems would not be able to cope with the large volumes of migratory fish in the Mekong. Problems are also encountered for downstream migration, mainly because of the mortality of fish passing through turbines and over spillways. Consequently, a number of different options for fish passage upstream and downstream need to be considered for the range of species, volume of migrations and flow conditions encountered at the dam site." MRC preliminary design guidance, p. 11, para. 51.

[24] Pöyry report, p. 23; the fish passage technology is discussed in more detail on pp. 9-10; p. 14 also states: "For a proper handling of fish passes, there is a need to improve the base line data. Such data must be obtained and developed and there is sufficient time to complete such work during the early part of the construction phase, which will allow any necessary technical adaptations to be made."

[25] Dugan 2008.

[26] Dugan 2008. The MRC brought together a group of seventeen international experts on fisheries and fish passes in September 2008. The group concluded: "(i) Existing mitigation technology cannot handle the scale of fish migration on the Mekong mainstream; (ii) If dams are built upstream and on tributaries, specific mitigation measures should be designed from the start and integrated into dam engineering and operation; (iii) In considering the design of mitigation measures existing off-the-shelf designs cannot be used, but the basic concepts used in developing these can be drawn upon; (iv) These experts also recognized that the ability to provide the partial mitigation measures seen in North America and Europe has been dependent on substantive site-specific research and development over several decades, and that similar investments will be needed in the Mekong." The group further noted that, "best evidence from South America (Oldani & Baigin 2002) is that the success of fish ladders and lifts there is low even though the number of species and volume of migration there is lower than in the Mekong"; Similarly, "the group agreed that the technologies used on high dams in North America and Europe (mainly fish ladders and fish lifts) have been developed for a very limited range and number of fish species (generally about 5 to 8 species). Most of this experience has been with salmonid fish which have remarkable jumping abilities that enable them to scale waterfalls and fish ladders more successfully than any other group of fish. Biomass of fish involved is relatively small, at around 3 million fish per year on the Columbia River in the USA. This experience from North America and Europe contrasts with the Mekong where there are at least 50 important migrant species, none of which are salmonids, and biomass is in the order of 100 times greater"; Furthermore, "on the basis of this analysis of available information, the meeting concluded that current fish-passage technology would not be effective in maintaining the migration of the large number and diverse fish species found in the Mekong."

[27] Eric Baran (2005), *Cambodia Inland Fisheries: Facts, Figures and Context*, WorldFish Center and Inland Fisheries Research and Development Institute, Phnom Penh. This calculation is based on peak migrations near Tonle Sap of 34 tonnes per hour, and an estimated average 10 grams per fish. Peak biomass at the Xayaburi site is still unknown. As reported by the MRC, "Construction of a dam and reservoir at Xayaburi will introduce barrier affects to fish migration that the MRC Fisheries Expert Group considers could potentially affect from 23 to 100 species including 5 in the IUCN Red List. The Xayaburi location is considered important to the Upper LMB migration zone and includes several spawning sites, habitats and deep pool refuges. This importance is not fully recognized in the submitted documents. Uncertainty remains high due to knowledge gaps on migratory fish, particularly in the peak wet season, but estimates suggest sustained migration biomass in the order of 10,000 kg per hour." MRC technical review of Xayaburi Dam, p. 92.

concern that "effective fish passage at Xayaburi would need to pass a migratory biomass that is likely to be much higher than previously recorded in any fish-passage facility globally."[28]

Impacts on the Mekong's ecosystems

The MRC's requirements for Mekong Mainstream Dams describe how "healthy riverine ecosystems support the livelihoods of many people living along the banks of the Mekong River (e.g. nutrition and income). At the same time they provide a variety of 'ecosystem services' that contribute to water resource and water quality protection. River floodplains, wetlands and riparian vegetation trap silt and nutrients, provide fertile soils, and protect the upland areas from flooding and erosion. The regulation of river flow affects the complex food-web and aquatic ecosystem dynamics that support fish productivity, especially changes in flow pulses."[29]

As a result, the MRC requires dam developers to conduct an "environmental flows assessment" to examine several key, interrelated factors related to ecosystems—such as impacts on water quality and flows, risks of waterborne diseases, and the impacts of cascades of dams on sediment flows.[30] The MRC's technical review of the project concludes "that several pressures resulting from the [proposed Xayaburi Dam] will alter aquatic ecology," and that the impacts on water quality, aquatic ecosystems, and biodiversity have the potential to be transboundary.[31] Yet the project developer has not conducted any studies to understand the impacts of the Xayaburi Dam on ecosystems.

Pöyry omits ecosystems

The Pöyry report only touches briefly on the Mekong's ecosystems.[32] To date, Ch. Karnchang's studies have only described preexisting water quality conditions near the Xayaburi site and have not assessed the broader range of impacts of the project on water quality and aquatic ecosystems. In describing the potential impacts of the Xayaburi Dam, Pöyry only states that "it should be the target to maintain good water quality and the environmental health downstream and upstream of

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[28] MRC technical review of Xayaburi Dam, p. 25.
[29] MRC preliminary design guidance, p. 27, para. 142.
[30] MRC preliminary design guidance, p. 31, paras. 163-164. According to para. 164: "the focus of the EFA would be on systematically looking at the localized impacts on river morphological processes, erosion and bank stability and aquatic ecosystem functions, as well as impacts on natural habitat such as riverine wetlands, fish habitat and related social and livelihood aspects." Furthermore, p. 27, para. 146: "Water related diseases should be foreseen and prevented at all potential dam sites in the mainstream"; pp. 27-28, para. 147: "Water quality is one of the environmental factors to be considered as part of the project-specific EIAs. Water quality parameters to be considered are generally cited in national regulations and include temperature, concentration of dissolved oxygen, PH, phosphorus, nitrogen, biological oxygen demand and faecal coliform bacteria concentrations"; p. 32, para. 168: "Developers should systematically assess the effect of combination of flow releases from the dam to address downstream impacts at different times of year, also taking into account the position of the dam in the possible cascade series of dams. This should be done by introducing appropriate environmental flow assessment methodologies at the EIA and feasibility study stage, appropriate to the scale and significance of the flow changes, and referring to good practice techniques and methodologies."
[31] MRC technical review of Xayaburi Dam, p. 70: "Impacts on water quality, aquatic ecosystems and biodiversity have the potential of transboundary and - in combination with other hydropower schemes –cumulative effects. An effective set of mitigation measures is recommended to prevent those basin-wide and long-term effects." Furthermore, p. 70: "This review concludes that several pressures resulting form the proposed Xayaburi dam project will alter aquatic ecology."
[32] Pöyry only mentions that "the water quality sampling carried out [in the environmental impact assessment] indicates that the water quality is both in the rainy and in the dry season mainly within the relevant standards." Pöyry report, p. 43.

the Xayaburi Hydropower plant."[33] The report does not further consider the complex issue of ecosystems.

The Pöyry report is overly simplistic in that it disaggregates the key interacting components— physical, chemical, and biological— required to accurately describe the water quality and aquatic ecology of the Mekong Mainstream ecosystem. Instead, the report should have considered issues related to sediments, water, biota, and public health as key ecological components that are interconnected and inseparable. Changes to physical conditions, for example, can affect biological conditions and vice versa.

Pöyry finds the project out of compliance?

Without further explanation, the report finds that the project is "principally in compliance with the MRC design guidance" on water quality and aquatic ecology.[34] In contradiction to this statement, however, the Pöyry report also suggests that the Xayaburi Dam is not in compliance, recommending that "to be in compliance with the MRC guidelines it will be necessary to carry out following investigations and studies..."[35] Pöyry states that "the main issue is that the work which has been carried out is often described not in the required detail (especially the environmental issues) and the impacts have not been assessed in sufficient detail."[36] One of Pöyry's findings is that the developer needs to prepare an "up-dated/ graded" environmental management plan as soon as possible.[37]

Impacts on sediment flows

The Mekong Mainstream plays a crucial role in transporting sediments and nutrients throughout the region, which is important for the fertility of the river's surrounding land. According to the MRC, there is a risk that "dams interrupt the natural continuity of sediment transport in river systems, inducing deposition within the reservoir and releasing sediment-starved water downstream…"[38] This, in turn, can affect the people living, farming, and fishing downstream.

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[33] Pöyry report, p. 43.
[34] Pöyry report, p. 44.
[35] Pöyry report, p. 44. The report includes a list of additional studies on pp. 44-45 that need to be carried out in relation to ecosystems.
[36] Pöyry report, p. 44: "The reviewed reports (Feasibility study, EIA SIA, EMP RAP) are principally in compliance with the MRC design guidance. The main issue is that the work which has been carried out is often described not in the required detail (especially the environmental issues) and the impacts have not been assessed in sufficient detail. Even if an impact is expected to be small e.g. Xayaburi will be a run-of-river scheme and the retention time f the water within the reservoir is short, it needs to be assessed and proven by the developer that the impact is negligible. To be in compliance with the MRC guidance additional investigations will have to be carried out, data will have to be sourced and evaluated. An environmental flow assessment as required in the guidance has not yet been carried out and a monitoring on the environmental flow remains to be performed in the next project step. The monitoring described in the EIA and EMP needs to be in more detail, it mainly covers the chemical and physical parameters but any biological parameters need to be added."
[37] Pöyry report, p. 45: "The up-dated/ graded EMP including all Sub-Management Plans will need to be prepared by the developer as soon as possible and then be reviewed and approved by the relevant national authorities."
[38] MRC preliminary design guidance, p. 16, para. 90.

To mitigate this risk, the MRC requires project developers to "design mainstream dams to pass fine suspended sediment and coarse bedload material in a way that most closely mimics the natural timing of sediment transport dynamics in the river."[39]

Natural sediment conditions remain unknown

Both the MRC and Pöyry point out gaps in information needed to better understand sediment transport in the Mekong.[40] The Pöyry report finds, for example:

> There are only a limited amount of sediment measurements (e.g. sieve analysis) available and especially bed load data are rarely available. Additionally, little information is available of an average annual distribution of recent suspended sediment concentrations. Due to this uncertainty the results of any sedimentation modeling will vary in its results... Such baseline information would allow to understand possible deposition development in more detail leading to a more profound estimation of possible operation sequences.[41]

The Pöyry report recommends using a technology called "flushing outlets" to "best mimic the current sediment transport conditions."[42] As the natural sediment transport conditions are still unknown, Pöyry's recommendations amount to guesswork. The report acknowledges this, explaining that Pöyry's "approach…is based on a semi-quantitative assessment of available information and does not include any results from own numerical or physical modeling."[43] As if to emphasize that its recommendations are based on guesswork, Pöyry states that "physical [and] numerical modeling is recommended in terms of verifying and refining the foreseen measurements."[44]

What happens when other dams are built?

The Lower Mekong Mainstream faces a particular challenge, because sediment transport is already being affected by several Chinese dams on the Upper Mekong. As a result, the MRC requires coordination of sediment management among any cascade of Mainstream Dams.[45] Pöyry mentions that "it would be important to understand the influence of the upstream developments in China and have data covering the start of the operation period of these

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[39] MRC preliminary design guidance, p. 22, para. 120.

[40] MRC technical review of Xayaburi Dam, p. 54: "Multiple unknowns and large uncertainties concerning current parameters and future conditions in the Mekong Basin were encountered during the review. Uncertainties are particularly significant with respect to sediment yields, sediment properties and the potential geomorphic responses to altered sediment loads." Furthermore, p. 54: "The best available information has been used to estimate future sediment loads that are likely to be input to the Xayaburi Reservoir. Such estimates are uncertain concerning future sediment yields from the basin. This is particularly true when considering climate change and possible future development of the Mekong Basin for agriculture and primary industries, and how such developments might change sediment yields." Additionally, p. 54: "Lack of information also limits the type of geomorphic assessment that can be performed. Based on the data currently available, it is not possible to be precise about how the river morphology would respond to changes in sediment loads triggered by construction and operation of the dam."

[41] Pöyry report, pp. 41-42.

[42] Pöyry report, p. 14: "In connection with sediment transport, flushing outlets are recommended to best mimic the current sediment transport conditions."

[43] Pöyry report, p. 30.

[44] Pöyry report, p. 42.

[45] MRC preliminary design guidance, p. 22, para. 116; see also, MRC technical review of Xayaburi Dam, p. 94: "Regarding cumulative effects, the sedimentation of Xayaburi reservoir would initially be reduced with construction of Pak Beng and Luang Prabang dams upstream. As with other aspects, a coordinated sediment management regime would be needed."

schemes."[46] Without more careful investigation, Pöyry's models potentially fail to capture the reality of sediment transport conditions in the Mekong Mainstream.

Dam safety

The MRC emphasized that "from a transboundary perspective, dam safety is a concern to the governments and MRC stakeholders in the four countries at a number of levels."[47] Pöyry fails to measure dam safety against the MRC's requirements, which are not even mentioned in the report.

No mention of the World Bank

The World Bank's dam safety standards are widely considered international best practice. As such, the MRC requires mainstream dams to comply with the World Bank's operational policy on the safety of dams, including the establishment of an independent panel of experts to review the dams' safety from the design through operational phase.[48] The Pöyry report makes no mention of the World Bank's policy, and does not assess whether the Xayaburi Dam has met these requirements.[49] Most notably, the project developer has not commissioned an independent panel of experts to participate in project design, as required by the World Bank's standards.[50]

Guesswork on earthquake risks

The Xayaburi Dam is potentially at risk from earthquakes. In the past five years, at least three earthquakes have occurred within 300 km of the project site—a 7.1 magnitude earthquake in March 2011, a 5.4 magnitude earthquake in February 2011, and a 6.4 magnitude earthquake in 2007. According to the Xayaburi Dam's environmental impact assessment, which reviewed studies on seismicity in Thailand and Lao PDR, an earthquake of magnitude 6.0 occurs on average once every 56 years.[51] This level of risk warrants a precautionary approach. As Pöyry

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[46] Pöyry report, p. 42.

[47] MRC technical review of Xayaburi Dam, p. 82: "This review on the Xayaburi dam project is mainly concerned with potential transboundary impacts. From a transboundary perspective, dam safety is a concern to the governments and MRC stakeholders in the four countries at a number of levels. (1) MRC stakeholders in Lao PDR and Thailand are concerned for the safe operation of the project to protect their investments in the dam for power supply, in the case of Thailand and Lao, and for the revenue generation benefits in the case of Lao PDR. (2) All MRC countries (governments and public) are interested in understanding the risks and probabilities of potential impacts and threats to lives, property and livelihoods posed to downstream communities in the Mekong mainstream in the event of a failure of the dam in extreme flood events. (3) The Thai border is 200 km downstream from the Xayaburi site. The province and communities in Thailand have concerns to understand the potential for emergency releases that would impact water levels and any related public safety considerations. (4) All MRC stakeholders have an interest in seeing that future scenarios for climate change, as developed by the MRC, are reflected in dam safety measures. (5) All MRC Member Countries similarly have a stake in the monitoring, reporting and compliance activities related to the safety of the Xayaburi dam in the design, construction and operation phases and to be informed and able to respond to general public concerns at any time."

[48] MRC preliminary design guidance, p. 37, para. 188; see also, p. 35, para 181. The MRC reiterated this requirement in its technical review of the Xayaburi Dam, p. 81: "Formation of an Independent Dam Safety Review Panel (DSRP) for the Xayaburi dam project and assignment of the task to review the Design Report in a timely manner."

[49] See Pöyry report, p. 47, where Pöyry discusses other standards but does not mention the World Bank operational policy.

[50] The Pöyry report, p. 51, mentions independent expert panels but not in a manner consistent with World Bank criteria. World Bank dam standards require the developer to assemble the panel "as early in project preparation as possible" and specifically during the investigation, design, and construction of the dam and start of operations. See World Bank OP 4.37 (2001).

[51] EIA for Xayaburi Hydroelectric Power Project, Lao PDR, Prepared by Team Consulting Engineering and Management Co.,

notes, "at present investigation works are ongoing at site and at the wider site area to explore the presence of potentially active faults to be considered in the determination of the relevant design ground motions. The current investigations have not shown any evidence of an active fault at the site."[52] Pöyry concludes, however, that "it is very un-likely that the dam will fail during strong earthquakes."[53] Because the investigations are not complete, however, it is premature to declare compliance with the MRC's dam safety requirements.

Ltd., August 2010, p. 4-66, citing Bott et al. 1997, on seismicity in northern Thailand & northwestern Laos province, compiling an historical seismicity catalogue for the region.

[52] Pöyry report, p. 8. Prof. Punya Charusiri of Chulalongkorn Univ. reported that studies are still ongoing to determine whether the Xayaburi site sits on an active fault, Press Conference: Xayaburi Dam, 10 Oct. 2011, Foreign Correspondents Press Club, Bangkok, Thailand.

[53] Pöyry report, p. 50.