Mekong hydropower: drivers of change and governance challenges

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The Mekong River is the longest watercourse in Southeast Asia. Although China has an extensive hydropower program underway on the Upper Mekong, as yet there are no dams on the river's lower mainstream. However, as many as 12 additional projects, which would generate substantial energy and wealth especially for Cambodia and Laos, are currently in the proposal stage for the Lower Mekong (LM). The cumulative effects of the LM hydropower projects – if built, and together with existing Chinese dams – will transform the Mekong by altering natural flow patterns and disrupting fisheries and other ecosystem services, to the detriment of the millions of people who depend on the river for their livelihoods. Proposals for new dam construction are driven by several factors, including changing human demographics and development needs, energy and food security concerns, economic cooperation, and climate change. We link these social, ecological, economic, and political forces to ongoing regional governance issues and discuss how to improve the quality of Mekong hydropower decision making in a complex, transboundary setting.

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As it flows through Cambodia, the Lao People's Democratic Republic (hereafter Laos), Thailand, and Vietnam, the Lower Mekong (LM) River remains one of the world's last great stretches of undammed river. Since the 1990s, however, China has developed extensive hydropower infrastructure along the Upper Mekong (UM) River, with 17–19 projects in operation, under construction, or under consideration (Magee 2012). Downstream of China, much development is taking place along the Mekong's tributaries but, as yet, there are no hydropower projects on the mainstream. However, these LM countries are now exploring their options, with up to 12 mainstream projects under consideration. These would generate substantial energy and wealth, especially for Cambodia and Laos, while also making dramatic changes to the river itself.

Proposals for LM mainstream hydropower projects have re-emerged in the past decade, encouraged by rising regional power demand and enabled by the increasing number of existing and planned Chinese dams along the UM. These current and upcoming projects will change river flows at the same time as new sources of investment capital and associated prospects for substantial profits incentivize the dam-building industry that is already active on Mekong tributaries.

In September 2010, the Laotian government advised the Mekong River Commission (MRC) – an intergovernmental organization that was created to coordinate water resources development between LM countries – of its desire to build the Xayaburi Dam, the first of the proposed projects for the LM mainstream (Figure 1). A series of dams along the LM will exacerbate changes to natural flow patterns that already occur as a result of dam building in China. Substantial disruption to fisheries, as well as negative implications for the millions of people who depend on the Mekong River for their livelihoods, is likely. However, our understanding of the Mekong ecosystem is far from complete. For example, landings from the multispecies inland freshwater capture fishery are estimated at 2.2 million metric tons per year (Hortle 2009), but it is unclear to what extent the estimated catch is dependent on the LM mainstream channel remaining unobstructed (KG Hortle pers comm). Moreover, little is known about designing fish lifts and ladders that would be appropriate for the diversity and magnitude of the fishery (Dugan *et al.* 2010).

In this paper, we highlight the primary drivers of change

In a nutshell:

- The Mekong River is under intense development pressure, with multiple upstream dams under construction and downstream dam proposals that, in combination, would dramatically alter ecosystems and human livelihoods
- Major drivers (eg demographics, human development, water and food security, economic integration, climate change) and other factors (eg new dam financiers, inadequate governance, sectoral decision making) create momentum for new Mekong hydropower projects
- Impact assessments in the region are often focused solely on the country that carries them out, upstream and downstream impacts are not considered cumulatively, and ecological and social factors are often downplayed
- More deliberative water governance could improve decision making by contributing to more informed national and transboundary negotiations

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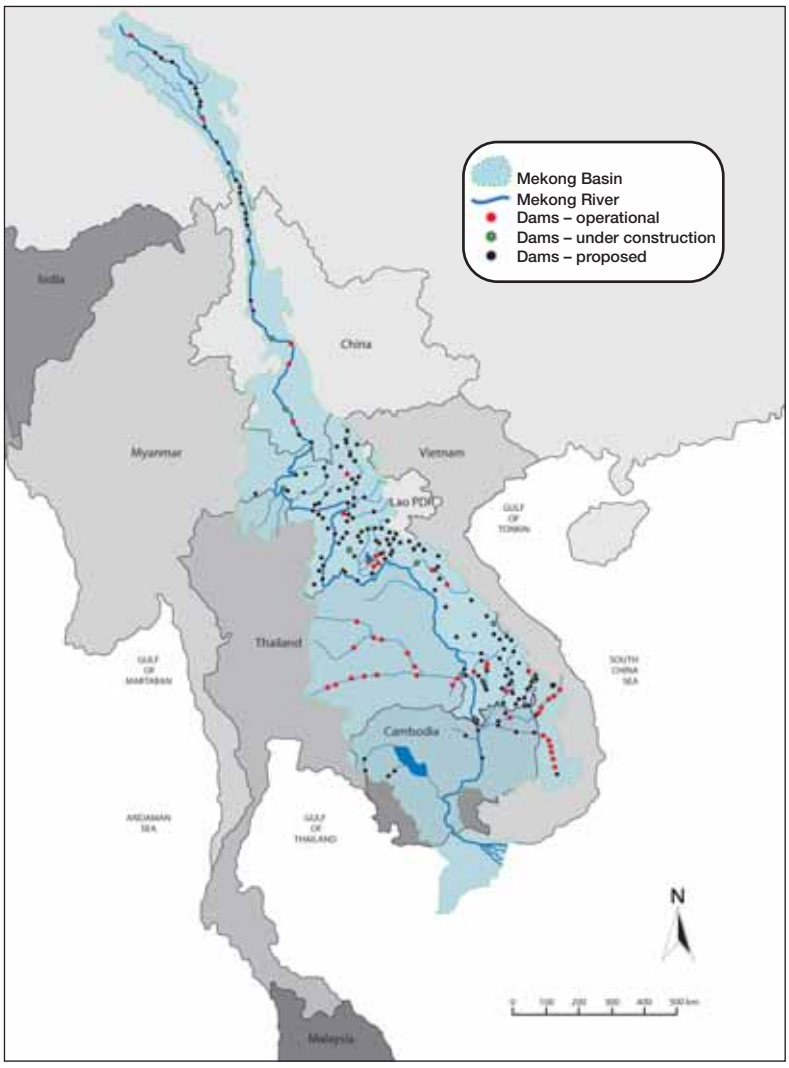

Challenge Program on Water and Food – Mekong

Figure 1. *Map of hydropower projects in the Mekong Basin.*

in the LM. Focusing on hydropower, we link these forces to a general assessment of basin governance. Finally, we discuss specific actions for improving the quality of hydropower decision making in both the upper and lower Mekong Basin. We wish to encourage more informed and collaborative water governance by Mekong countries, while they simultaneously pursue improvements in livelihoods, maintenance of ecological functions, food production, and energy supply.

■ Many Mekongs

The Mekong River – the eighth largest river in the world in terms of mean annual discharge (475 km^3) – is at the heart of the debate over water resource development in Southeast Asia. The river begins on the Qinghai-Tibetan Plateau in China and flows almost 2200 km through Qinghai, Tibet, and Yunnan Provinces – where it is called *Lancangjiang* in Chinese. The river then winds for an additional 2700 km through Myanmar and the LM countries (Cambodia, Laos, Thailand, and Vietnam) before emptying into the South China Sea (Figure 1). On average, 18% of the river's mean annual water discharge originates in the UM countries (China and Myanmar); the remaining 82% comes from the LM countries (MRC 2010). However, these summary data conceal important nuances. For example, 30% of dry season flows originate from the UM. Key features along the length of the Mekong include: numerous tributary rivers; Cambodia's Tonle Sap, the largest freshwater lake in Southeast Asia, which is critical to Cambodian food security; one of the major freshwater capture fisheries in the world; acclaimed biodiversity and cultural values; and the Mekong delta, the primary rice growing area of Vietnam, the world's second largest exporter of the grain. About 60 million people live within the Mekong River Basin (MRC 2011a) in LM countries, with about another 10 million residing in the UM, mostly in Yunnan Province.

While new scientific research can resolve many technical issues, there remain "many 'Mekongs' – river, basin, and various regional framings" (Dore and Lebel 2010). Likewise, the waters provide a range of vital benefits: drinking water, freshwater food supplies, biodiversity hotspots, agricultural irrigation, and industrial uses.

■ Interconnected drivers of change

Both the LM and the wider region are changing rapidly, and there is much uncertainty associated with the complex interplay of the major drivers along the entire Mekong, including demographic shifts, human development needs, energy and food security concerns, increasing investment and trade, and climate change.

Demography

Three demographic trends stand out in the LM countries: population growth, the large cohort of young people, and migration from rural to urban areas. Even though the population growth rate in the region is falling, the four countries are projected to increase cumulatively by 33 million people by 2025 (PRB 2010). This growth is set to continue well into the future, as about 30% of the population of LM countries are 15 years old or younger (PRB 2010). Furthermore, the ongoing movement – from rural to urban areas – of people seeking work means that an additional 17 million or so will likely be living in LM cities by 2025 (Figure 2; UNESCAP 2009). Taken together, these trends will increase pressure on states to provide assistance with employment, education, energy, and water resources.

Human development

The Mekong River flows through a region characterized by high poverty and limited development. Much pro-

gress has been made, as regional poverty levels (defined as earnings of less than US$1.25 per day) fell from 48.4% in 1990 to today's average rate of about 19% (CIA 2010; PRB 2010). However, about 21% of LM residents do not have access to clean water, and over 30% do not use closed sanitation systems. The governments of the LM countries spend less on education than the average across other countries in Asia, while health care expenditures are even lower (UNDP 2010). Investment in upland areas is disproportionately lower than that in the lowlands. Combined expenditures to meet UN Millennium Development Goals, such as providing clean water and sanitation and improving education standards, have never been tallied in the wider Mekong region.

KG Hortle

Figure 2. *Bangkok, Thailand – the ultimate destination for much of the hydro-energy produced along the Mekong River.*

Food security

Against this backdrop of population and development issues, regional food demand is expected to double by 2050 (FAO 2010). Three factors bear on this projection. First, there is decreasing investment in traditional agriculture, as well as a substantial reduction in agricultural lands under irrigation, mainly as a result of the catastrophic impacts of the 2010 drought (Qiu 2010; FAO 2011). Second, farmers across the wider Mekong region are moving, or are being directed by governments, away from subsistence farming and toward plantation agriculture (rubber, biofuels, and other cash crops). Incomes are rising, but these changes have ecological implications; monocultures threaten biodiversity, reduce total carbon biomass, and deplete groundwater (Ziegler *et al.* 2009). Farmers are increasingly subject to fluctuations in global commodity prices, and this leads to a third factor: market volatility. In 2010, food-price inflation prevented some 20 million people in the Asia Pacific region from escaping poverty (UNESCAP 2011).

Economic investment and trade

Since 1992, the main strategy adopted by governments in the Mekong region in reaction to the issues outlined above has been to pursue economic linkages, connect infrastructure, and promote cross-border trade and collaborative responses to social and environmental problems. Up to early 2010, the Asian Development Bank and its partners had allocated US$11 billion for investment in roads, rail, shipping ports, hydropower, and transmission lines, with a focus on three cross-border economic corridors. Consequently, from 1999–2008, regional economic growth was twice that of the world's average (CIE 2010). However, governments and multilateral development banks must now focus not just on increasing the flow of goods but also on the types of goods that are produced and how they are produced, as well as on who benefits and who is vulnerable. There are also questions about the extent to which new economic development, including additional hydropower projects, may further impair the provision of ecosystem services, upon which other measures of prosperity depend.

Climate change

While degrees of uncertainty characterize all of the forces for change discussed above, climate change is the "wildcard" driver in the LM. By 2050, projected regional impacts of climate change include decreasing overall water availability, increasing temperatures and flood likelihood, decreasing food production capacity, and rising sea level in the Mekong delta (Cruz *et al.* 2007; Mainuddin *et al.* 2010). Specific impacts will vary by location (Kingston *et al.* 2011). Extreme events such as droughts – together with impacts resulting from land-use change (eg rubber plantations) – are already contributing to cumulative effects on watershed streamflow (Guardiola-Claramonte *et al.* 2010; Qiu 2010). Regional rice production may decline sharply (Rerkasem 2011), and sea-level rise could submerge 19–38% of Vietnam's Mekong delta, which currently produces 25% of the country's gross domestic product or GDP (Thuan 2011). Climate change may also trigger technological innovation in the hydropower sector; for example, there is potential in pumped storage hydropower to better manage increased climatic variability (Pittock 2010). Until recently, however, LM dams have been planned under the assumption that baseline water flows will remain unchanged, with limited consideration of models that combine hydropower impacts with future climate projections.

KG Hortle

Figure 3. *Jullien's barb (*Probarbus jullieni*), one of several migratory fish species common near the proposed Xayaburi Dam.*

Taken together, these large-scale drivers certainly influence development (including hydropower) in the Mekong region, though there may be few precise causal connections to any specific project. If regional population growth were flat, human development levels average, food and water needs stable, economic growth static, and climate impacts projected to be beneficial, then there would be less pressure to build dams to solve some aspects of these problems. However, none of these are true for the Mekong region.

■ Hydropower expansion and the Xayaburi Dam

The scale of Mekong hydropower expansion makes it a critical driver of change in the LM in its own right, whereas the proposed Xayaburi Dam project highlights several more specific drivers of change in action. First, the governments of LM countries are recognizing increased opportunities to proceed with large-scale development because of their decreasing dependence on multilateral funding provided by international institutions, such as the World Bank and the Asian Development Bank. This is due to a combination of factors, including greater national creditworthiness, improved regional relations, and an associated willingness among private financiers to supply capital (Middleton *et al.* 2009). So far, most private hydropower investors have demonstrated limited commitment to environmental review, mitigation, or human livelihood safeguards, though this is slowly changing. Second, although there are considerable differences between individual countries, in general, all LM countries have substantial room for improvement in filling knowledge gaps and in implementing legal regimes and other public policies. Compliance with national environmental regulations is not always enforced, and current transnational private-sector protocols are mostly advisory, non-binding, and experimental (Foran 2010). Finally, there is little deliberative governance in the region, where various stakeholders come together to discuss issues and debate competing claims. Instead, public policy decisions are often taken that serve narrow economic interests without seeking substantive input from those segments of society that will be most affected. As a result, high-quality, integrated assessments and associated deliberative processes involving stakeholders are still the exception rather than the norm (Grumbine and Xu 2011).

However, in response to the 12 proposed LM mainstream projects, the MRC commissioned a Strategic Environmental Assessment (SEA) to assess their associated cumulative impacts, costs, and benefits (ICEM 2010). The SEA portrays the projects as having major benefits but also substantial costs. If all LM projects were to proceed, they could generate 6–8% (~65 terawatt-hours [TWh] per year) of the projected power demand (~325 TWh per year) in LM countries by 2025. Gross income from hydropower generation could total US$3.7 billion per year. Operators and investors (including governments) would garner most of this income during the first 25 years of dam operations. Laos and Cambodia, two of the poorest countries in the Mekong region, could gain annual income equivalent to some 18% and 4% of their 2009 GDP, respectively.

The risks to livelihoods and food security posed by these 12 hydropower projects would also be very high. More than 100 000 people would need to be resettled, and a further 2.1 million would be at high risk of indirect, negative impacts, such as diminished river-bank agricultural and fishing opportunities (Barlow *et al.* 2008). Dams would turn more than half of the length of the main river channel into reservoirs characterized by slow-moving water conditions, thereby increasing the risk of water-borne diseases like schistosomiasis and opisthorchiasis (Andrews and Sithithaworn 2011). Despite the migratory nature of many Mekong fish species (Figure 3), only three of the proposed dams currently incorporate fish ladders, none of which, according to fisheries experts, are likely to be adequate for local species (Dugan *et al.* 2010). In addition, existing and planned mainstream dams in China would have the largest impact in terms of decreasing sediment, given that more than 60% of the Mekong's suspended sediment load originates from this part of the river. Models project that at least 50% of total basin sediment load will be trapped annually by the Chinese dams (Figure 4; Kummu *et al.* 2010). Proposed dams in the LM would trap even more sediment, with substantial negative impacts expected in Cambodia (including within the entire Tonle Sap system) and parts of the Mekong delta in Vietnam.

Thus, the SEA team concluded that the immensity of risks was beyond the current capacities of regional governments to address, and recommended deferring all LM mainstream dam building for at least 10 years (ICEM 2010). However, the SEA is for informational purposes only and is not binding on decision makers.

K Lazarus

Figure 4. *Jinghong Dam on the Lancang–Mekong mainstream in Yunnan Province, China.*

Transboundary water governance in the Mekong

The MRC acts on behalf of LM governments through the 1995 Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin to "cooperate…in the sustainable development of the Mekong River basin…in a manner to optimize…benefits…and to minimize harmful effects" (MRC 1995). The Agreement was an important milestone in LM water governance and, since the 1990s, the MRC has negotiated other integrated river basin management policies to guide its operations.

Yet, for much of its existence, the MRC has been marginalized by its member states from major basin development decision making. At the same time, it is often criticized by non-governmental organizations and civil society for not being responsive to human livelihood concerns, nor to demands for a more transparent and participatory decision-making process (Dore and Lazarus 2009). Much of this criticism is due to negotiated elements of the 1995 Mekong Agreement and subsequent Procedures and Guidelines for action. Member states have, until now, been able to discount the work of the MRC when it served their interests to do so. This, in combination with the major and more specific change drivers discussed above, has resulted in underdevelopment in the Mekong region of well-known elements for effective transboundary cooperation – trust, converging interests, strong regional identity, government institutions, and a vibrant civil society (Hirsch and Jensen 2006; Sneddon and Fox 2007; Molle *et al.* 2009b).

Nevertheless, there are prospects for improvement in transboundary water governance in the LM, as much recent effort has been put into allowing the MRC to play a more prominent role in decision making. Three actions have been particularly noteworthy. First, in April 2010, the inaugural MRC Summit was convened, which brought together the Prime Ministers of Cambodia, Laos, Thailand, and Vietnam with high-level representatives from China and Myanmar. This Summit succeeded in giving the MRC greater legitimacy. Second, the SEA raised the MRC's profile in terms of information production and debate facilitation. Subsequently, the organization gained the necessary political traction to complete this work, a signal achievement in a region where data are rarely released for public scrutiny. Finally, the MRC facilitated discussions between LM countries about Laos' proposed Xayaburi Dam. External pressure for disclosure was very high, and by the end of the designated period, sufficient information had been shared for the MRC to release a high-quality advisory report (MRC 2011b).

Consequently, the MRC's Joint Committee of agency leaders decided, in April 2011, to send Laos' proposal to the ministerial level. This decision was no surprise, because there had already been numerous bilateral meetings between the countries, during which the Xayaburi project had been discussed. Nevertheless, "preparatory" work has continued, with at least the dam developer gambling that permission to proceed will eventually be given.

An MRC Xayaburi working group has been convened under the auspices of the Procedure for Notification, Prior Consultation and Agreement (PNPCA), which is designed to ensure that MRC countries engage in informed "prior consultation" about any proposed water use that may have major impacts on water quality or flow regimes along the Mekong (MRC 2003). Neither the 1995 Mekong Agreement nor the subsequently negotiated PNPCA provides a right to veto or a unilateral right to "use"– in this case, to build and operate a hydropower project that will likely have transboundary impacts. However, signatories are bound to consult with each other and take into account each others' interests in the pursuit of equitable and reasonable utilization of the Mekong's water resources.

If Laos is unable to reach agreement with its neighbors, the country may yet choose to go ahead with the Xayaburi project (and other, similar developments; Figure 5). The decision regarding the Xayaburi Dam will either represent the initiation of high-impact LM mainstream hydropower development or lead to a postponement of such development, as recommended by the SEA. Either way, further studies that will contribute to more integrated transboundary river basin understanding and management will be performed.

The SEA for all mainstream dams and the first implementation of the PNPCA for Laos' Xayaburi proposal are


KG Hortle

Figure 5. *Site of the proposed Xayaburi Dam on the Mekong mainstream, Laos.*

important steps. The next step will be to build on these processes, to better ensure that high-quality impact assessments are implemented for such projects in the future. To that end, the MRC has drafted a transboundary environmental impact assessment framework that may become a backbone of regional cooperation in the LM. However, this new framework has yet to be approved. Despite its absence, in December 2011, ministers from LM countries agreed that further studies would be undertaken to clarify the potential transboundary impacts of the Xayaburi Dam and other LM projects.

Improving transboundary governance

There are inextricable links between water, food, energy, and all the drivers of change in the countries that share the Mekong River. Connections exist across different scales and sovereign state boundaries, and efforts to nurture trust-building between and within LM countries, as well as between LM and UM countries, could turn environmental and social risks into development and security opportunities. There are many specific transboundary water governance actions that could further improve cooperative relations across the entire basin; here, we highlight just a few.

The MRC must persist with efforts to help nations negotiate water resource issues through joint exploration of specific development scenarios to quantify uncertainties. In addition to the PNPCA, there are other procedures that focus on data information and exchange, water-use monitoring, real-time flood forecasting, maintenance of flows along the river, and water quality. Some of this important work is hampered by ambiguity in the 1995 Mekong Agreement, where several terms – such as "significant tributaries" and "acceptable minimum flow" – are poorly defined (MRC 1995). This ambiguity is due, at least in part, to the fact that both the Agreement and the subsequent negotiated Procedures and Guidelines were the best outcomes that could be agreed upon at the time (Browder 2000; Radosevich 2010).

In the near term, as negotiations continue, further data sharing and a culture of pilot program experimentation employing more stakeholder dialogue need to be encouraged throughout the Mekong region. This could include wider use of: the sub-basin-focused Rapid Basin-wide Hydropower Sustainability Assessment Tool, which supports river basin management by providing a structured set of questions to aid planning (MRC *et al.* 2010); a new, multifaceted Sustainability Protocol from the International Hydropower Association, which assesses project performance in planning, construction, and operation phases (IHA 2010); and environmental flow assessments (Dyson *et al.* 2003) that provide opportunities for interdisciplinary, multi-stakeholder engagement (Lazarus *et al.* 2012). These will all require more deliberative approaches to negotiation, given that stakeholders still have few opportunities to participate in decision making in the region (Dore and Lebel 2010).

To support this process, we argue that it will be necessary to strengthen Mekong governance and knowledge networks across borders. Numerous opportunities for collaboration exist, including risk management, benefit-sharing, alternative energy futures, power trading, quality aspects of production and trade, improving livelihoods of people affected by the project, multipurpose management of dams, and nuanced adaptation to climate change. Formal intergovernmental cooperation is complemented by the emergence of transboundary knowledge networks, such as the Mekong Program on Water, Environment and Resilience (M-POWER), which focuses on improving water governance through published research (Lebel *et al.* 2007; Molle *et al.* 2009a; Lazarus *et al.* 2011), encouraging dialogue between stakeholders and governments (IUCN *et al.* 2007; Dore *et al.* 2010), and assembling independent panels of experts (Sokhem *et al.* 2010). Experience from other transboundary river basins has shown that national policy makers need to improve their capacity to better engage in transboundary/transnational policy analysis and integrated problem-solving (Howlett and Joshi-Koop 2011); this is also true for the Mekong region.

There is also an essential need to establish or strengthen genuine local engagement in "higher" level public policy making and monitoring. When transboundary decisions impact water supply, food security, and other critical social goods and services that are difficult to replace, affected citizens should be given the opportunity to participate directly in decision-making processes (Folke *et al.* 2005; Arthur *et al.* 2011). This is necessary

for Mekong decision making to advance toward a transboundary framework capable of addressing multiple ecological functions entwined with human livelihood goals (Lemos and Agrawal 2006).

Progress is being made on many fronts – poverty reduction, power provision, food security, cross-border trade, biodiversity protection, and climate-change adaptation – in the Mekong region. Yet in an era of rising uncertainty and declining resilience, each Mekong country must understand that sovereign security increasingly depends on cooperative environmental decision making. Hope for the future of the Mekong lies with new definitions of what constitutes "reasonable and equitable" utilization, crafted within a context of informed regional diplomacy.

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