

Chapter 8

Water-Food-Energy Nexus Approach: Towards Green Regional Cooperation in Southeast Asia

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Key Messages

- Asia faces serious challenges in water, food and energy security for its growing and rapidly urbanising population.
- Scientific understanding of the mechanisms underpinning these three critical resources, as well as general awareness, have greatly improved of late, but little has changed on the ground.
- Rational use of these resources requires integrated planning that reflects interdependencies and trade-offs, but government planning is mainly sector-based and not open to an integrated approach.
- Shared international resources, such as of trans-border rivers, highlight the challenges of effective planning for sustainable use.
- This chapter analyses the Mekong River basin and discusses how this shared resource could be rationally used through nexus approach.
- It recommends strengthening the Mekong River Commission via bolstered resources and coordinating authority, and encourages China to participate as a full member. It also recommends Transboundary Environmental Impact Assessments of river projects be conducted to reflect synergic and trade off nexus effect across the whole river basin.

1. Nexus approach for sustainable regional integration in resources security

Water, energy and food are fundamental to human survival, economic growth and sustainable development. Rapid urbanisation and global population growth are placing huge pressures on these resources, the shortage of any one of which could lead to social and political instability, geopolitical conflict, human health hazards as well as irreparable environmental damage, both within individual countries and beyond national borders.

Ensuring human basic needs such as water, food and energy often extends beyond the capacity of a single nation, and although regional cooperation intends to promote resource access beyond national borders (Rosner and Granit 2012), efforts to date have

failed to focus on water, energy, and food security in an integrated or ‘nexus’ manner. Such a narrow-minded approach can create problems in international river basins, where critical decisions on upstream hydropower development that ignore basic human needs may well involve economic benefits, but at the expense of irreparable ecosystem damage as well as loss of water and food security further downstream.

This is particularly true for the Mekong River basin, where regional integration particularly in the energy sector, threatens water, food security and ecosystems, both in the countries with the dams and in others along the Mekong basin. In particular, investment in hydropower dam projects, aimed at promoting the international power trade, is likely to most adversely impact low-income groups, who will also likely receive scant benefits from such projects. For instance, construction of a series of dams in the upstream part of the river (Lancang River) in China has already altered river flow, fish production and affected communities along the Lower Mekong Basin (LMB). Pornrattanaphan (2004) states that construction of the Mawan dam in China will lead to a 25% reduction in mean annual minimum discharge and also decrease suspended sediments in the Mekong system (Fu and He 2007). This situation could significantly worsen if a planned cascade of mainstream dams goes ahead in the LMB. For instance, construction of the Xayaburi dam in Lao People's Democratic Republic (Lao PDR) will reduce nutrient-rich alluvial sedimentation in the Mekong Delta from 26 to 7 million tonnes annually (VNA 2011), and construction of the Yali Falls dam in the Viet Nam tributary has changed the river hydrology, which purportedly led to the random flood events affecting Cambodia further downstream (Lerner 2003).

Changing water flow patterns, loss of soil nutrients, inundation of agricultural land and damage to migratory fisheries due to uncoordinated development of hydropower plants in upstream countries have negative impacts on food security, livelihoods, biodiversity, and ecosystems (Piman et al. 2013; Cronin and Hamlin 2012). Consequently the 48 million people (about 80% of the total 60 million in LMB) who directly rely on the Mekong for their food and livelihood could be affected (Baran and Myschowoda 2009; ICM 2010).

Construction of the 11 or 12 proposed mainstream dams on the Mekong River would improve electricity supply in the region, but the net economic benefit of dam construction under most scenarios would be positive only for Lao PDR, while other countries including Viet Nam, Thailand and Cambodia could experience total net economic losses (Costanza et al. 2011). This situation—one of lop-sided economic benefit versus negative impacts due to uncoordinated development of hydropower plants in upstream countries—could raise geopolitical tensions in the region (see Box 8.1). Regional integration pursued based on such a single-sector approach, which focuses on short-term economic gains and ignores growing inequity, is not in line with sustainable development and not in the long-term interest of the region. Continued regional integration needs to be provided with effective safeguards and complementary regional mechanisms that can prevent adverse outcomes. For better regional integration, nexus approach is being viewed as a way to enhance cross-sectoral coordination and manage trade-offs among highly linked natural resources. The chapter makes concrete suggestions as to what form such mechanisms could take via exploring the following key questions:

- (i) What are the threats of the current uncoordinated and single-sector approach to sustainable resource management in the context of the Mekong River basin?
- (ii) What mechanisms can address these threats and enhance a nexus approach in regional integration and provide win-win solutions?

Box 8.1 Decision to construct Sahong Dam raises fear over Mekong

The Government of Lao PDR has decided to construct the Don Sahong hydropower dam with a capacity of 240 MW, arguing that it is on one of the many braided streams of the river, rather than damming the mainstream. The final Environmental Impact Assessment (EIA) report argued that the Don Sahong Dam will have no significant impact on local fisheries and migrating fish in the Mekong River, but it was claimed that the EIA used inappropriate methodology and contradictory evidence (RFA 2014; WWF 2014). A team of international fish passage experts assembled by WWF claimed that the project is unlikely to meet the requirements of the Mekong River Commission (MRC) Preliminary Design Guidelines for proposed mainstream dams in the LMB, which states that “the developer should provide effective fish passage upstream and downstream”; which means in actual practice safe passage for 95% of the targeted species under all flow conditions. The EIA also fails to address transboundary impacts of the dam construction even though the dam is to be located less than 2 km from the Lao-Cambodia border. The project has been facing opposition from neighbouring local communities, NGOs, and some fisheries experts in the region, who contend that construction of the dam will threaten the Khone Falls ecosystem (the largest waterfall of Asia), ecotourism in Siphandone, and food security in the region. Some examples of the opposition include:

- The Governments of Cambodia and Viet Nam demanded independent scientific studies on transboundary impacts before planning of any dam construction on the Mekong mainstream.
- In Thailand, a coalition of NGOs demanded the Thai Government to take action and stop construction of the dam.
- According to Chhith Sam Ath, Executive Director at Cambodian NGO Forum, the Don Sahong dam will push Cambodia and Viet Nam closer to food crisis through adverse effects on fisheries.

(Source: Fawthrop 2013)

2. State of regional cooperation for resource security in Southeast Asia

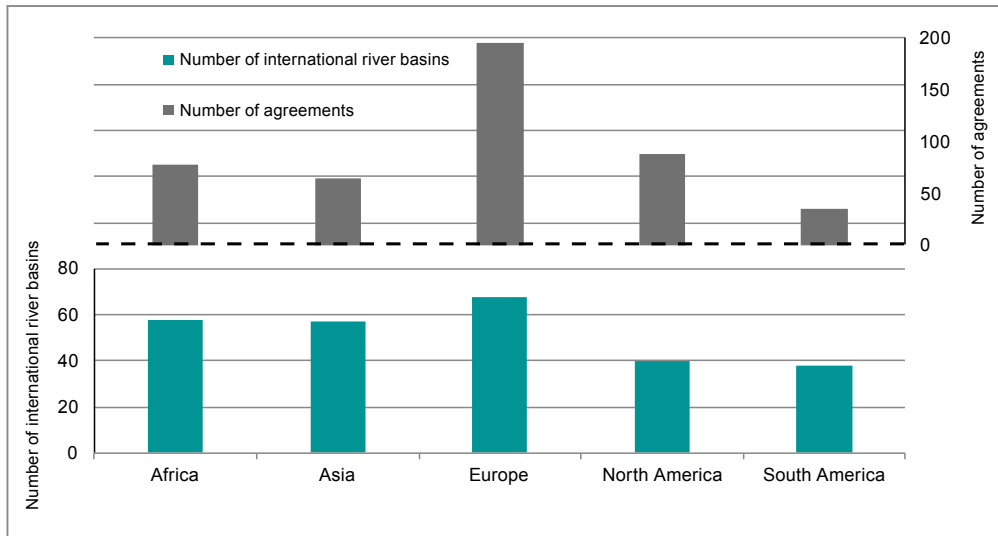
To meet growing electricity demands, several regions are targeting cross-border power transmission. Globally, a number of successful cases of regional cooperation on energy security has been taken place, including the Southern African Power Pool (SAPP) regional interconnections, Central American Electrical Interconnection System (SIEPAC) market institutions, the Gulf Coast Countries (GCC) power exchange trading agreement, the Nile Basin Initiative (NBI) joint investment project in the power sector, and the intergovernmental agreement (IGA) on regional power trade in the Greater Mekong Subregion (GMS) (ESMAP 2010).

Emerging food crises due to increasing prices has accelerated regional cooperation in Asian developing countries. For example, the Association of Southeast Asian Nations (ASEAN) approved the ASEAN Integrated Food Security (AIFS) Framework at the 14th ASEAN Summit in 2009 (ASEAN Secretariat 2011) and the heads of member states of the South Asian Association for Regional Cooperation (SAARC) signed an agreement on establishing a SAARC Foodbank in 2007, to ensure regional food security (SAARC 2014).

Similarly, regional cooperation on transboundary water resource management has been initiated in Asia and other parts of the world. For example, the Mekong River Commission (MRC) was established as an intergovernmental agency in the LMB under the 1995 Mekong Agreement for joint management of shared water resources and sustainable development in the Mekong River basin (MRC 2011). This agreement identified major roles for the MRC such as basin-wide planning, environmental protection, facilitation of equitable water use and navigation (MRC 1995).

2.1 Transboundary water resource management

More than 40% of the world's population relies on transboundary river basins for its survival (UN Water 2008). Conflicts between international and national interests are the main challenges confronting transboundary river basin management (Zeitoun et al. 2013). However, transboundary river basins have also provided opportunities for regional cooperation and promotion of peace and security in the region (UN Water 2008). The transboundary freshwater spatial database identified 464 agreements, both bilateral and multilateral, on transboundary water bodies (OSU 2014), but while Asia accounts for 21% of the world's transboundary river basins, 14% of agreements have been made in the region (Figure 8.1). Of these, several regional agreements have been signed to manage and use transboundary waters in an equitable and sustainable manner; such as (i) the 1996 treaty between India and Bangladesh on sharing of the Ganga/Ganges waters at Farakka; (ii) the 1996 treaty between Nepal and India concerning integrated development of the Mahakali river including Sarada Barrage, Tanakpur Barrage, and Pancheshwar Project; and (iii) the 1995 Mekong agreement on cooperation for sustainable development of the Mekong River Basin among the four LMB countries. However, in spite of the various agreements on transboundary water governance, lingering issues of trust coupled with regional political tension have hindered implementation. For instance, in 2010 Pakistan filed a case in the International Court of Arbitration accusing India's Kishanganga hydropower project on the Neelum River in Kashmir of violating the Indus Water Treaty of 1960 (Langton and Prasai 2012). In another case, Cambodia and Viet Nam continued to raise their concerns about the construction of Xayaburi and Don Sahong hydropower dams in Lao PDR at the Second Mekong Summit, Ho Chi Minh, in April 2014 (Phnom Penh Post 2014; Marwaan 2014).



Source: Prepared by the authors based on International Freshwater Treaties database <http://www.transboundarywaters.orst.edu/database/interfreshwaterdata.html> (accessed on 1st July 2014)

Figure 8.1 Number of agreements for management of international river basins

2.2 Regional initiatives for food security in Southeast Asia

There are several arrangements for regional cooperation aimed at promoting stable access to food in the region, such as the development of regional food reserves, the first such initiative in Asia and the Pacific. In 1979, ASEAN leaders signed an agreement on the ASEAN Food Security Reserve due to wide fluctuations in production as well as instability of the region’s food supply. The ASEAN Emergency Rice Reserve (AERR) was established to serve as a subset of national stocks voluntarily designated to address food emergencies throughout the region, with releases of stocks conditional on bilateral negotiations. Due to failure of this initiative during implementation owing to poor administration, lack of funding, complex procedure of prices and distribution, the ASEAN ministers agreed to re-launch a pilot scheme in 2004 named the East Asia Emergency Rice Reserve. Success of the pilot scheme and the food price crisis in 2008 fuelled formulation of a permanent mechanism agreed on by the ASEAN+3 countries, the ASEAN+3 Emergency Rice Reserve (APTERR). Established in 2011 this reserve includes both earmarked and physical stocks. With this agreement ASEAN countries commit in principle to regional cooperation in response to food emergencies. Technical, financial, economic, legal and institutional issues connected therewith, however, remain to be clearly laid out (Briones 2011).

2.3 Energy security through regional power trading

Regional integration through power trading in the GMS began as part of the GMS Economic Cooperation Programme launched in 1992. Energy trading could provide considerable benefits, including improved energy security and reliability, more efficient use of energy resources, optimisation of transmission networks to meet increasing demands in different countries, and reduced environmental damage via use of renewable energy sources such as hydropower. These advantages should lead to decreasing energy costs and a more reliable energy supply that would directly benefit societies and economies (ADB 2013).

According to a joint study conducted by the Asian Development Bank (ADB) and the Asian Development Bank Institute (ADBI) in 2012, the economic and environmental benefits of regional integration in the GMS energy sector together will enable savings of up to 19% of total energy costs (equivalent to USD 200 billion) by 2030. Expanding the interconnection of GMS power systems alone can provide a saving of USD 14.3 billion by 2030, mostly via substitution of fossil fuel generation with hydropower (ADBI 2013). Integration of power systems is also expected to result in slower growth of carbon emissions compared with the business as usual scenario.

Power trading in the GMS is probably the most advanced within Southeast Asia. Rapid economic growth in the region, particularly in Thailand during the 1980s and the early 1990s, as well as resolution of several regional armed conflicts, led to exploitation of the abundant hydropower potential in China, Viet Nam, Lao PDR and Myanmar to reduce dependency of the region on expensive fossil fuels (ECA 2010). To meet the growing demand for electricity Thailand has become the largest power importer in the region and signed several MOUs related to power imports with Lao PDR, Myanmar and China. Countries with abundant hydropower potential such as Lao PDR and Myanmar have invested in export-oriented hydropower generation projects based on power trading commitments with high economic growth countries like China, Thailand and Viet Nam. Based on a commitment of 10,000 MW of power imports by Thailand (ECA 2010), a number of hydropower plants such as Theun Hinboun and Houay Ho have already been commissioned in Lao PDR.

Like Thailand, Viet Nam also started importing hydropower from neighbouring countries to meet its double-digit growth in power demand. In 2010 it accounted for 20% of the annual power trading in the region (ADBI 2013). Meanwhile, China, a power exporter to Viet Nam, will become a power importer from Lao PDR and Myanmar to fuel its own rapid economic growth. Cambodia's interest in the regional power trade stems from its desire to reduce its dependency on expensive fossil fuel options, but the country is also exploring hydropower development to meet rapidly growing domestic demand.

Table 8.1 Nature of power trade in GMS countries

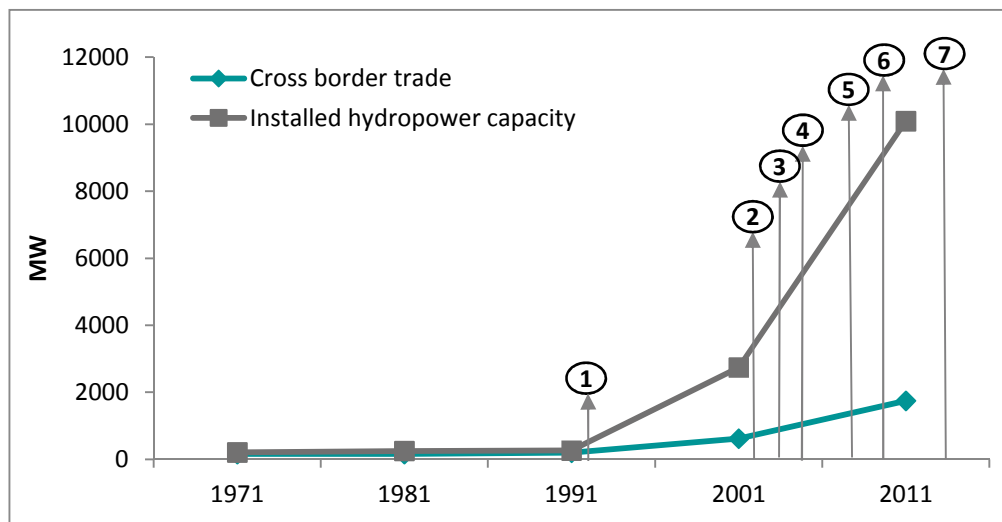
Country	Hydropower potential (GW)	Export orientated projects (actual, planned and proposed)	Imports (GWh)	Exports (GWh)	Net Imports (GWh)
Cambodia	15	8	1,546	-	1,546
China (Yunnan)	150	1	1,720	5,659	-3,939
Lao PDR	26	38	1,265	6,944	-5,679
Myanmar	100	12	-	1,720	-1,720
Thailand	13	0	6,938	1,427	5,511
Viet Nam	30	0	5,599	1,318	4,281

Source: Baardsen (2008); ADBI (2013)

Regional power trading began with active support of ADB in the early 1990s. Other development partners such as the World Bank and Swedish International Development Agency (SIDA) are also involved in promoting power trading initiatives in the Mekong region.

Furthermore, ASEAN has been proactive in promoting regional economic cooperation, including in the energy sector, to promote economic development in poorer member countries such as Lao PDR, Myanmar, and Viet Nam. It is expected that with the support of external partners, exploitation of hydropower will inevitably increase under the regional power trading initiative to fuel economic growth in the region. Under this initiative, expansion of hydropower plants will be driven by export-oriented projects in Lao PDR, Myanmar and Cambodia to meet the high demand from neighbouring countries like Thailand, Viet Nam and China.

Figure 8.2 shows the total amount of hydropower installed and cross-border trade with some key milestones in the GMS regional power trade cooperation to date.



Source: ECA 2010

Notes: Key milestones in power trade cooperation in GMS

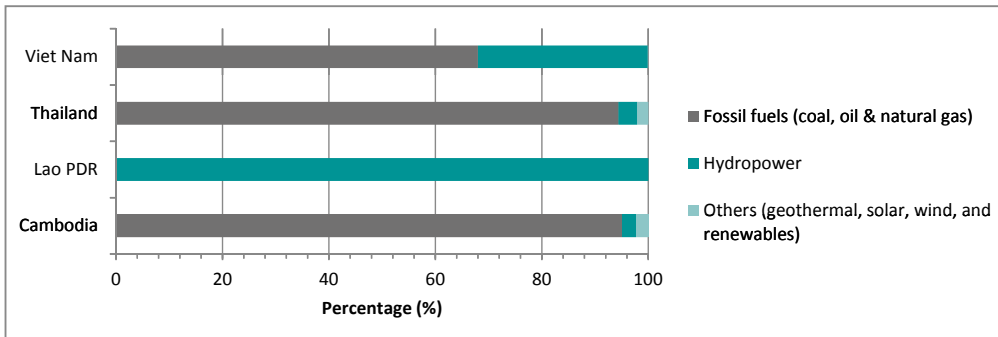
- 1- GMS Economic Cooperation Program launched (1992)
- 2- Regional Power Trade Coordination Committee (RPTCC) established (2002)
- 3- Intergovernmental agreement (IGA) on regional power trade ratified by all six GMS countries (2004)
- 4- Guidelines for the Implementation of Stage 1 of the Regional Power Trade Operating Agreement (MOU-1) signed (2005)
- 5- Road Map for Implementing the GMS Cross-Border Power Trading (MOU-2) signed (2008).
- 6- Second update of the GMS regional master plan completed (2010)
- 7- Regional Power Coordination Centre (RPCC) established in 2013 with legal identity dedicated to manage cross-border power infrastructure and trade in the GMS

Figure 8.2 GMS regional power trade cooperation – Key milestones

3. Necessity of a water-food-energy nexus perspective: The case of regional power trading in the Mekong region

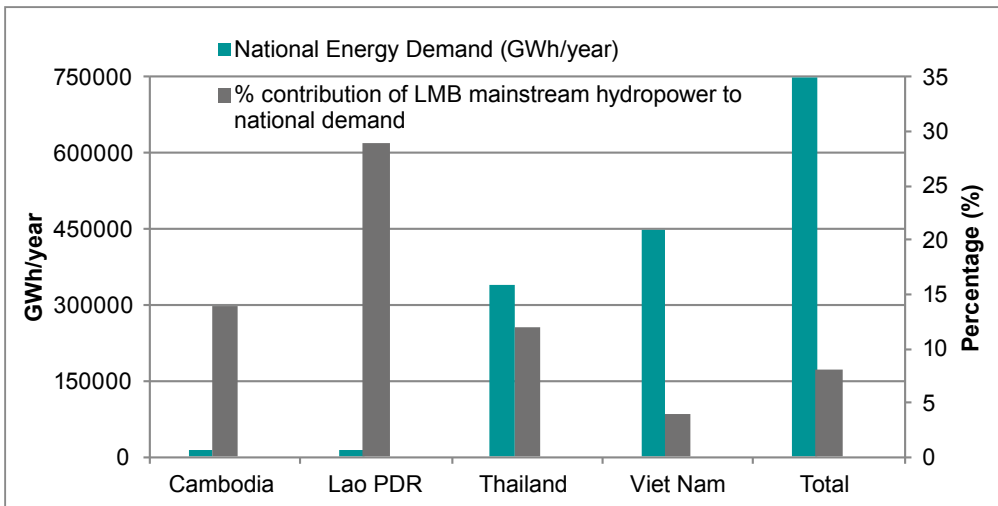
Addressing the growing demand for energy, the regional trade in electricity has become an integral part of the electricity supply plan in the Mekong countries. Table 8.1 shows that 59 export-oriented hydropower projects are under construction. However, none of the projects were developed based on a truly regional power market, and instead were based mainly on bilateral cooperation. As of 2011, 10,879 MW of hydropower generation capacity had been established in the region (Dore et al. 2007; Dore and Xiaogang 2004; King et al. 2007). Most of the export-oriented hydropower projects have been planned

and established based on import commitments between Thailand and Viet Nam and countries such as Lao PDR and Myanmar, which have abundant hydropower potential. Other than bilateral cross-border trading of electricity, LMB countries have also exhibited political willingness to establish interconnection arrangements for electricity via the ASEAN Power Grid through adoption of “ASEAN Vision 2020” at the Second ASEAN Informal Summit in 1977 (ASEAN Centre for Energy 2013). The ASEAN Power Grid is anticipated to provide a secure regional energy network and promote win-win economic relationships in the region.



Source: ADB 2013

Figure 8.3 Share of power generation outputs in LMB countries by 2010



Source: ICEM 2010

Figure 8.4 National energy demand forecasts for LMB countries by 2025

3.1 Addressing water-food-energy nexus perspective in hydropower planning leading to changes in social and environmental outcomes

Economic development is one of the main goals of current hydropower-based regional integration in the GMS. However, policy limitations on the mitigation of social and environmental impacts represent one of the major challenges to hydropower-based energy security in the region. Under current development plans it is predicted that the region will experience negative social and environmental impacts, particularly in downstream countries like Cambodia (Baran and Myschowoda 2009; ICEM 2010; Zaffos 2014; The Economist 2013), which are directly relevant to the water-food-energy nexus. Although hydropower has been acknowledged as the cheapest clean energy technology, narrow-scaled sectoral planning may have negative impacts on water and food security in the region and intensify upstream-downstream conflicts.

It is clear that the waters of the Mekong are profitable for those who see development in terms of energy production. However, hydropower development may create negative impacts on food security, specifically on the fisheries and agriculture sectors of the downstream countries such as Viet Nam and Cambodia. The construction of Xayaburi hydropower dam in Lao PDR represents a typical example of a hydropower project, and which has significant potential impact on the environment and poor populations of Cambodia. According to Vannarith (2012), when the dam were to be constructed on the mainstream of the Mekong River, the primary food source (fish) of 80% of Cambodia's population would be affected. The Tonle Sap lake area, which represents 60% of Cambodian inland fisheries, would be most seriously affected (Matsui et al. 2006). Consequently, the livelihood of 1.2 million people in the areas surrounding Tonle Sap Lake would be under threat.

A critical review of the latest Environmental Impact Assessment (EIA) Report of the Xayaburi dam by the World Wide fund for Nature (WWF) reported that the EIA not only fails to address major concerns such as impact on fish species, aquatic habitats, and targeted species for fish passage, but also fails to address transboundary impacts (WWF 2011). Although this dam is built on a transboundary river basin, the EIA was carried out based on the national EIA requirements and the potential impacts were only assessed to a distance of 10 km downstream, completely ignoring downstream neighbouring countries (International Rivers Network 2014). As a result, the report faced strong objections from neighbouring countries and NGOs, who all requested a more comprehensive study and assessment of transboundary and basin-wide environmental impacts, including a cumulative impact assessment. The International Rivers Network criticised the construction of Xayaburi dam in a recent report and claimed that Lao PDR had gravely violated the 1995 Mekong Agreement (Herbertson 2013). Despite this strong opposition, the Government of Lao PDR declared that 30% of construction work had been completed and dam construction would continue according to plan (Phnompenh Post 2014)—an example of private sector actors taking advantage of government agencies to push through unsustainable projects that would not be acceptable elsewhere (WWF 2014).

More recently, Rewat Suwanakitti, the Deputy Managing Director of Xayaburi Power, has stated that the spillway and fish passage system have been redesigned to mitigate transboundary impact, which has enabled governmental support from Cambodia and Viet Nam for construction of the dam to proceed (Globaltimes 2013). However, at the Second Mekong Summit (held in Ho Chi Minh in April 2014), Cambodia, Viet Nam and donor agencies continued to voice their concern over the project (Phnom Penh Post, 2014, Marwaan, 2014).

Impacts of hydropower development are not limited to mainstream dams and are also caused by dams constructed on the Mekong's tributary systems. One of the most important tributary systems of the Mekong is the "3S" river basin, comprising the Sekong, Sesan and Srepok River basins, accounting for about 17% of the Mekong's annual flows. Due to the growing demand for electricity supply in Viet Nam and Cambodia, an increasing number of hydropower projects in the 3S river basin are being considered, with more than 20 hydropower projects already built or under construction, and 26 additional dams slated for construction in the near future (Grimsditch 2012). Recently, a plan for the construction of the 420 MW Lower Sesan 2 hydropower dam and 375 MW Lower Sesan 3 hydropower dam in Cambodia (invested in by Chinese companies) were approved by the Government of Cambodia (Cambodiadaily 2013). Ziv et al. (2012) reported that the Lower Sesan 2 dam alone would cause a 9.3% drop in fish stocks basin-wide, threaten over 50 fish species, alter the Mekong hydrological low flows and lead to reduced sediment flows of approximately 6–8%.

Box 8.2 China factor and their impacts on the Mekong's mainstream

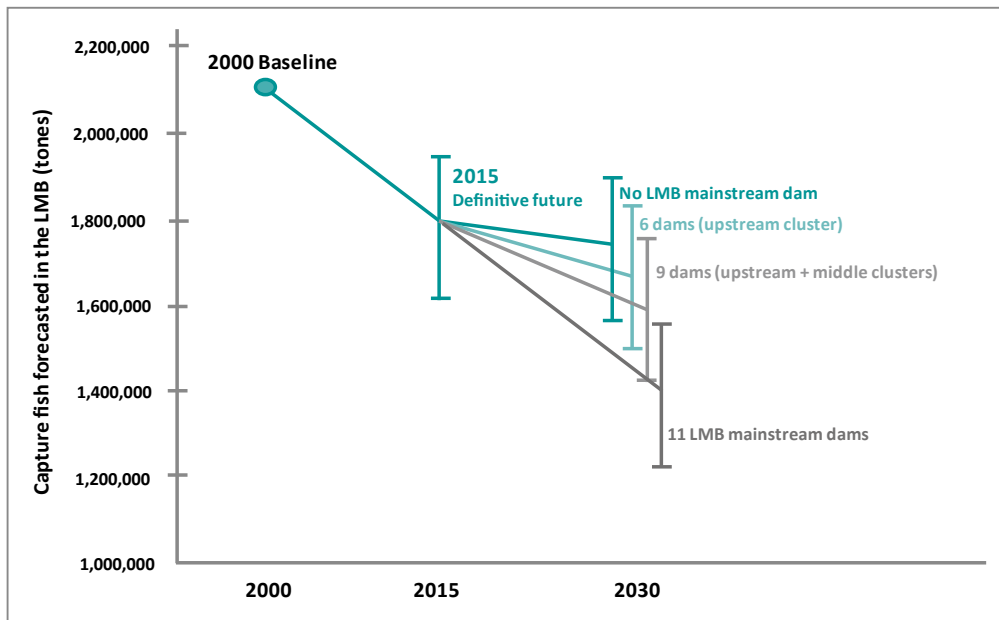
It would be insufficient and incomplete to discuss hydropower dams on the Mekong's mainstream without mentioning the role of China.

Rising demand for energy led to China's decision to construct a cascade of dams on the upstream section of the Mekong River, comprising eight large dams under construction or completed. China has also made plans for a further 12 large dams on the Lao, Lao-Thai, and Cambodia stretches of the Lower Mekong mainstream. Currently, four mega-sized dams have been constructed on the Langcang Jiang in Yunnan Province; the remaining four are in various stages of planning and construction.

A Strategic Environmental Assessment (SEA) conducted by MRC experts estimated that the livelihoods of nearly a million people will be at risk due to the impacts of these dams alone. The dams will also reduce sediment flow from China by about 22% from normal levels, leading to huge impacts on food security in the downstream countries, as overland floods deposit massive amounts of nutrients along with the sediment. Whether Yunnan dams were planned to facilitate mainstream dams on the Lower Mekong cannot be determined due to lack of sufficient and useful data on the critical design characteristics of the Yunnan dams and how these dams will be operated (Cronin and Hamlin 2012). Consequently, the downstream countries can only make assumptions based on the known physical characteristics and configurations of the dams. Thus, investments on downstream dam construction will face huge risk and uncertainty. Cronin and Hamlin (2012) suggest that the four LMB countries should adopt a more unified stance and demand greater transparency and due consideration of downstream interests in how China operates these upstream dams. The ideal approach to regional cooperation for environmentally sustainable management, including hydropower development, should involve all six countries of the Mekong basin, including China and Myanmar, through participation in the MRC.

Construction of mainstream dams on the lower Mekong is estimated to cause colossal losses in the fisheries sector, equivalent to USD 476 million/year, loss of 54% of riverbank gardens, and reduction in nutrient loading, requiring an estimated USD 24 million/year to maintain the productivity of floodplain agriculture (ICEM 2010).

ICEM (2010) estimated that by 2030 the loss of fish production is expected to be 210,000–540,000 tonnes or 10–26% of the year 2000 baseline with no LMB mainstream dam scenario. Meanwhile, if 11 mainstream dams are constructed the total loss in fish resources would increase to 550,000–880,000 tonnes or 26–42% compared to the 2000 baseline, meaning a 340,000 tonne fisheries loss would be the direct result of mainstream dam construction (Figure 8.5). This annual loss represents 110% of the current total annual livestock production of Cambodia, under the 11 mainstream dam scenario.



Source: ICEM, 2010

Figure 8.5 Potential incremental impacts of LMB mainstream dams on fish production basin-wide

From the discussion above it is envisioned that if the planned mainstream and tributary dams go ahead without due consideration and comprehensive assessment of their impacts—for the whole basin—food security, livelihood, soil fertility, biodiversity and ecosystem will all be heavily negatively affected.

3.2 Can the current approach of hydropower generation provide net benefit in the region?

Energy cooperation as part of the GMS Economic Cooperation Programme has been identified as one of nine areas of sub-regional cooperation. Recent estimates of energy resources in the GMS include about 229 GW of potential hydropower generation annually, as well as proven reserves of about 1.2 billion cubic meters of natural gas, 0.82 billion tonnes of oil and 28.0 billion tonnes of coal. Despite this, the energy reserves are unevenly distributed throughout the sub-region. Lao PDR, Myanmar, Viet Nam, and the two Chinese provinces in the GMS account for about 94% of the hydropower resources (ADB 2013). The peak power demand in the GMS, which stood at about 83 GW in 2010, is expected to more than triple to about 277 GW by 2025 (ECA 2010).

In view of sharing benefits from diversifying energy resources to meet various demands across the region, energy cooperation in GMS has so far focused on regional power trade and grid interconnections. Over the past few years investors and developers mostly from China, Malaysia, Thailand and Viet Nam, but mainly Chinese and Thai companies and banks, have submitted proposals for 12 hydropower projects for the LMB mainstream, 10 in Lao PDR (two of which are on the Lao-Thailand reaches of the mainstream) and two in Cambodia (Figure 8.6). Based on the current design, if all mainstream dams are developed, they could significantly increase generated power in the region and represent up to 14,697 MW or 23–28% of the national hydropower potential of the four LMB countries and 5–8% of the total hydropower potential in the GMS region. They would also provide economic benefit, but mostly to Lao PDR (ICEM 2010).

All of these proposed dams are commercial projects that would be constructed, operated and owned by foreign investment companies. To a certain extent, this was brought about by slackened environmental controls offered by some countries as an inducement for foreign investment (King et al. 2007).

Table 8.2 Status of mainstream dams in Lao PDR

Name	Location	Capacity (MW)	Planned market	Investors	Status
Xayaburi	Luangprabang	1285	Domestic, export to Thailand	Electricité du Laos (EdL) 20% Ch.Kanchang (Thailand) 30% EGCO (Thailand) 12.5% Natec Synergy 25% Bang KIK Expressway 7.5%	Under construction
Don Sahong	Champasak	360	Domestic, export to Thailand	EdL 20% Mega First Corporation Berhad MFCB (Malaysia) 80%	Planning stage
Sanakham	Xayaboury	660		Government of Lao 19% Datang Overseas Investment Co., Ltd. 81%	Planning stage
Phou Ngoy	Champasak	651	Domestic, export to Thailand	Charoen Energy and Water Asia Co., Ltd. (Thailand)	Planning stage
Pakbeng	Oudomxay	921		Government of Lao 19% Datang Overseas Investment Co., Ltd. 81%	Planning stage
Ban Koum	Champasak	1872	Domestic, export to Thailand	Italian-Thai Development Co. (Thailand) and Asia Corp Holdings Limited	Feasibility stage
Luangprabang	Luangprabang	1200	Domestic, export to Viet Nam	Petro Vietnam Power Corporation (Viet Nam)	Feasibility stage
Pak Lay	Xayaboury	1320	Domestic, export to Thailand	CEIEC+ SINOHYDRO	-

Source: Department of Energy Business-Powering Progress (2014)

In contrast with private companies and banks, multilateral financial agencies such as Asian Development Bank and the World Bank have confirmed they would not support or invest in hydropower projects on the mainstream Mekong because doing so would grossly

violate their guidelines for environmental and socioeconomic impacts (Thanhniennews 2011). According to MRC (2011), the 11 proposed dams in LMB would turn 55% of the Mekong river into reservoirs and lead to estimated agricultural losses topping USD 500 million per year, slashing the average protein intake of Thai and Lao populations by 30%.



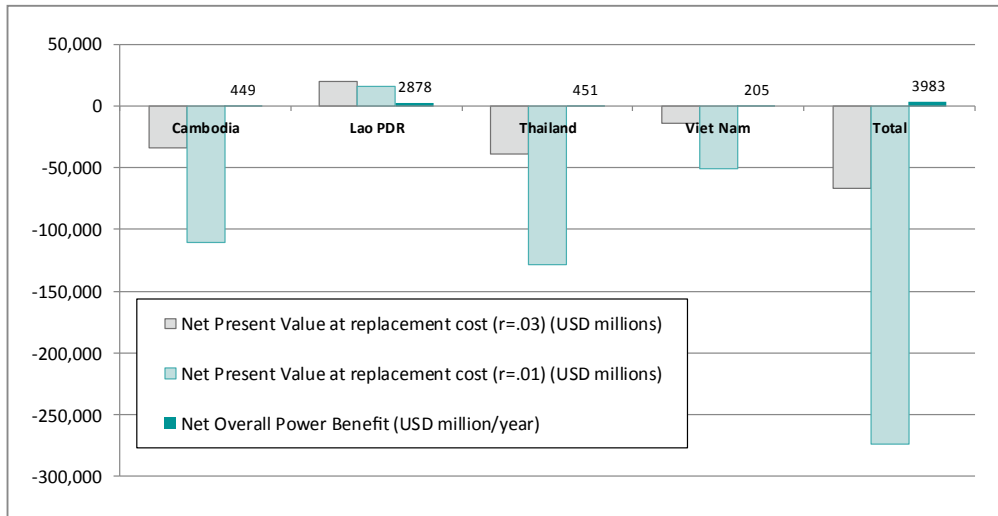
Source: Modified from Cronin & Hamlin 2012

Figure 8.6 Map of Mekong mainstream dams

A study conducted by the Portland State University & Mae Fah Luang University demonstrated that under most scenarios, especially under the most adverse revised assumptions for an 11-dam scenario, Lao PDR is still a USD 15.5-billion winner after 20 years, while Thailand, Cambodia, and Viet Nam are losers by USD 129.9, 110.3, and 50.7 billion, respectively (Figure 8.7) (Costanza et al. 2011).

Lao PDR, together with power importing countries and investors, could play a role in reducing the risk of total net economic loss in the region due to construction of uncoordinated mainstream dams by utilising the tributaries instead, and also consider the ecological and socioeconomic consequences and possible mitigation measures until appropriate solutions for sustainable development of a mainstream dam of mutual benefit to riparian countries are identified. Adopting this stance could also encourage multilateral financial agencies to invest in hydropower projects, as occurred in the Nam Theun 2 hydropower dam in Lao PDR tributary, which secured international investment via multilateral development banks (including World Bank, Asian Development Bank, European Investment Bank, and Nordic Investment Bank), export credit agencies, bilateral financing agencies, international commercial banks, and Thai commercial banks. An extensive review of hydropower development in Lao PDR indicates that the country has 18,000 MW of hydropower potential—*without* the need for any mainstream dams. Only 15% of the country's hydropower potential has been developed over the past 40 years (GIZ 2014). As a result, this country has a huge hydroelectric capacity derived from its tributaries; in fact the combined capacity of these plants *exceeds* demand. By

2020, the country's electricity demands will reach 2,500 MW, which is still only 14% of the hydropower potential (excluding mainstream dams). Therefore Lao PDR could consider delaying construction of new mainstream dams until a more comprehensive transboundary impact assessment is performed. In this case, importing countries like Thailand and investors could play a vital role by encouraging Lao PDR to harness hydropower potential from the tributaries.



Source: Prepared by the authors based on data from Costanza, et al. 2011

Figure 8.7 Net economic benefits of hydropower dam construction on Mekong River

Alternatively, WWF (2014) suggested that some other existing less destructive and environmentally more sustainable electricity generation and hydropower options could be used. Employing user-friendly assessment tools such as Hydropower Sustainability Assessment Protocol (HSAP) or the Rapid Basin-wide Sustainability Assessment Tool (RSAT) can help to incorporate regional factors into the project site, design and operation.

4. Water-Food-Energy nexus approach for green development in the Mekong region

Resource scarcity, which emphasises water, food and energy as human basic needs, is one of the most urgent shared concerns in the region (Griggs 2013). Moreover, water, food and energy have moved to the top of the global agenda following the food and energy price increases that started in 2007. Addressing the water, food and energy nexus is considered increasingly important for transparently and equitably meeting increasing global demand without compromising sustainability (Lele et al. 2013). In the "Global Trends 2030" report (NIC 2012), the US National Intelligence Council described the interconnected nature and risks in water, food, energy supply security as a "megatrend" that will gain global momentum in the near future. Actions or solutions for one single resource or sector may bring positive or negative impacts on the other two. Disconnected approaches and silo-like thinking are more likely to make matters worse and risk serious unintended consequences. Similarly, the conventional approach

of hydropower development in isolation of other sectoral considerations fails to support green development concepts. Therefore, an integrated water, food and energy approach needs to be introduced for further regional power trading and cooperation in the GMS. Following are some policy options for introducing water, food, and energy nexus in regional integration in the GMS.

4.1 Benefit sharing among sectors and riparian countries

The earlier sections clearly demonstrate that heavy infrastructure development on the mainstream by one riparian country would affect downstream countries by changing the pattern of water flow, reducing sediment transportation, and reducing fisheries stocks. While some predict rising water conflicts and potential war (Starr 1991; Gleick 1993; Lowi 1993; Homer-Dixon 1994; Klare 2001), others have suggested that water may serve as a catalyst for cooperation (Wolf et al. 2003; Turton 2000). In this context, benefit sharing has been suggested as a sensible strategy to move towards cooperative use of international waters. It is argued that benefit sharing from water facilitates engagement of riparian countries in development and management of transboundary water bodies, equitable distribution of transboundary benefits from water cooperation, and win-win options instead of potentially conflicting water sharing (Sadoff and Grey 2002, 2005; Phillips et al. 2006; Rossouw 2010). According to Bachurova (2010), common management of transboundary water resources generates net benefits compared to unilateral development of water resources.

In more detail, the benefits provided by water cooperation are (i) benefits to the river (protecting watersheds, conserving aquatic and riverine terrestrial biodiversity, preserving soil fertility, preserving water quality, and maintaining natural buffering capacity of the river stream), (ii) benefits from the river (food production, and power generation), (iii) reduced costs via shift of policy from dispute to cooperation and ideological change from energy-food sufficiency to energy-food security benefits due to cooperation on transboundary river, and (iv) catalysing benefits beyond the river such as integration of regional infrastructure, markets and trade (Sadoff and Grey 2002). Table 8.3 shows that a number of benefit-sharing mechanisms, including monetary benefit sharing (e.g., revenue sharing, property tax, preferential rates, and securing income) and non-monetary benefit sharing are in use in different parts of the world. Although most benefit sharing mechanisms have been established for domestic impact, a few can be seen in transboundary river basins as well—such as in Senegal, Mali and Mauritania, who have agreed to share developmental costs and benefits of jointly-operated common infrastructure in the Senegal River basin using a burden-sharing formula (Qaddumi 2008). Bilateral power-trading projects also create win-win opportunities for both participating countries, although impacts on other riparian countries are ignored.

Table 8.3 *Benefit sharing mechanisms under two different spatial contexts*

Type of benefit sharing mechanism		Description
Monetary Benefit Sharing	Revenue sharing (e.g., in Norwegian, Colombian, Brazilian, Argentina and Nepalese legislation) (Source: iwawaterwiki.org; MRC, 2011)	Revenue sharing with local or regional authorities tied to output of power generation.
	Preferential rates (e.g., in Norwegian legislation)	Preferential electricity rates can be negotiated between local or regional authorities and infrastructure operators.
	Property taxes (e.g., in Norwegian legislation)	Taxing of infrastructure operators based on project's property value or other factor.
	Development funds (e.g., Nam Theun 2; in Norwegian legislation)	Development funds from power sales are used to foster economic development, compensate affected people and conserve ecosystems in project-affected areas.
	Livelihood restoration, socioeconomic development (e.g., Nam Theun 2)	Securing income through job creation.
Non-Monetary Benefit Sharing	Equitable sharing of project services for community development (e.g., Viet Nam)	Households in project areas receive improved access to energy services in return for having hydropower project located in their area. The infrastructure project should facilitate access to markets and common resources.
	Transboundary resource development (e.g., bilateral power trading projects in GMS)	Transboundary resource development triggered by power infrastructure projects could create win-win opportunities

Source: Qaddumi 2008; Rossouw 2010; MRC 2011

Box 8.3 *Nam Theun 2 Hydropower, a good example of benefit sharing*

The Nam Theun 2 Hydropower Project in Lao PDR, one of the largest project in operation with 1,075 MW (about 1,000 MW is exported to Thailand), funded by 27 international banks, including World Bank Group, the Asian Development Bank (ADB), the European Investment Bank (EIB) and Agence Francaise de Developpement (AFD). Nam Theun 2 was expected to provide 12% of active storage capacity in the Mekong Basin in 2010 and 7% in 2025 (GIZ 2014). The multipurpose use of water from Nankai reservoir, including electricity production, flood amelioration and water for irrigation, is considered a key element in the success of such a project. A good indicator of benefit sharing is the restoration of livelihoods of the local people around the project and facilitation of poverty alleviation in Lao PDR. Revenue from the project, about US\$ 1 million/year, is contributed for the protection of a 4,000 km² national protected area for the 30 year construction and operation period. About 159 affected villages downstream receive US\$16 million allocated for compensation and livelihood restoration. A further US\$ 2.3 million was added later for the programme's supplementary budget. The Nam Theun 2 project will generate about US\$ 2 billion for the Government of Lao PDR, and these revenues may be used to improve living conditions, health care, education, provide access to roads, electricity, contributing to poverty reduction as well as environmental protection (GIZ 2014). According to EDF Group et al. (2012), on the Nakai Plateau, households now enjoy significant higher incomes and living standards, as well as better access to health, education, water and sanitation.

In the Mekong River basin direct regional benefit sharing, especially revenue sharing can reduce negative externalities on food and water security of downstream countries caused by hydropower development in the upstream countries. As discussed in section 3, most of the benefits from hydropower generation in LMB will fall to Lao PDR. In contrast, livelihoods of millions of poor people and food security would be adversely affected in the downstream countries, including Cambodia and Viet Nam. In this case, transboundary benefit sharing and national-to-local benefit sharing in the framework of a nexus approach can mitigate diplomatic anxiety and contribute to sustainable development throughout the river basin. A good example of benefit sharing of hydropower development in LMB is the Nam Theun 2 Hydropower Project. This project is committed to providing compensation from revenue for socioeconomic development to improve living conditions, healthcare, education, access to roads, electricity, poverty reduction and environmental protection (see Box 8.3).

In transboundary river basins, development projects should focus on optimisation of basin-wide benefits. For motivation and sustainable cooperation, the riparian countries should agree on sharing generated benefits in a fair manner. Political willingness to share benefits plays a key role for the realization of benefit sharing in the context of transboundary river basins (Sneddon 2008).

4.2 Introduction of transboundary EIA under the overall umbrella of relevant international conventions

Maximisation of indigenous energy resources to fuel economic growth is the driver of hydropower promotion in all LMB countries. However, a number of studies have demonstrated that uncoordinated dam construction in the Mekong mainstream will create huge environmental and social issues in the region (ICEM 2010; WWF 2014; RFA 2014) and also threaten sub-regional power trading initiatives. For sustainability of sub-regional power trading and cooperation, environmental issues need to be addressed in national and regional energy planning and policies. Although all LMB countries have basic environmental legislation regarding EIA, none of them have specific environmental criteria for hydropower development (King et al. 2007). This lack of both environmental and social safeguard policies has been seen by certain foreign investors as an incentive to advance into hydropower projects. Therefore, adoption of a transboundary EIA framework by the LMB (and preferably the six GMS) countries will enable adoption of common environmental criteria for hydropower projects in the region.

Adoption of the 1997 Convention on the Non-Navigational Uses of International Watercourses by the United Nations General Assembly provided the framework for inter-State cooperation on international watercourses but is yet to be enforced. The United Nations Economic Commission for Europe (UNECE) Water Convention on the Protection and Use of Transboundary Watercourses and International Lakes is the basis of hundreds of multilateral and bilateral agreements on transboundary water bodies in Europe. The principle objectives of the Convention are to prevent, control and reduce transboundary impact, to promote reasonable and equitable use of transboundary waters and to ensure their sustainable management. Another successful convention in Europe is the Convention on Environmental Impact Assessment in a Transboundary Context (informally called the Espoo Convention). The Espoo Convention acknowledged that separate political identities and national goals together represent one of the main barriers in transboundary environmental management, and even more so for transboundary river basins, where upstream states are less motivated to consider the interests and rights of downstream states. Espoo obliges parties to carry out transboundary environmental impact assessments for certain activities in initial planning stages. The success of Espoo

in Europe motivated countries of other regions such as Canada and central Asia to sign into the convention. Core attributes of Espoo are in the areas of transboundary impact assessments, inter-party consultation, cooperative arrangements, dispute resolution and public participation—all crucial for transboundary basin development. Introduction of transboundary EIA in the Mekong basin under an international convention such as Espoo would help assess the adverse impacts of hydropower projects across the river basin by involving any potentially affected neighbouring countries in EIA and decision-making processes. Such assessments would aid in formulating measures to mitigate the adverse impacts across the river basin under the framework of a nexus approach. Furthermore, transboundary EIA can enhance international cooperation through better understanding of the possible tradeoffs and equitable sharing of benefits. Transboundary EIA also facilitates early information sharing with potential victims and ensures public participation in decision making so that project implementation can avoid diplomatic issues at later stages.

Existing relevant protocols and tools such as HSAP and RSAT could provide a raft of basic requirements for transboundary EIA for hydropower projects as they are designed to measure social, environmental and economic impacts. RSAT can address key issues of hydropower sustainability, including transboundary impacts of ongoing improvements to practices; basin-wide understanding; integration between basin-planning and hydropower development frameworks; cooperation among riparian countries; equal weighting of socio-economic, environmental and socio-culture factors in hydropower-related decision-making processes; consistent objective of sustainable development across the basin; and engagement stakeholders in all decision-making processes (USAID and ADB 2010).

4.3 Strengthening governance of Mekong River Commission to enable win-win cooperation

Since its establishment in 1995, the Mekong River Commission (MRC) is the only intergovernmental agency mandated to focus on water resource management and sustainable development in the LMB. According to the agreement signed by the governments of four riparian countries in 1995, MRC will play a role in basin-wide planning, environmental protection, facilitation of equitable water use and navigation (MRC 1995). Establishment of MRC has broadened the scope of regional cooperation in basin development, resource management, power security, food security and environmental protection and it coordinates and promotes cooperation towards sustainable development as well as management and conservation of water and related resources. Since its formal establishment, MRC contributed initially at the project-scale level and then progressed into strategic planning. Considering the potential negative impacts of hydropower dams on food security, livelihoods and environment, MRC is exploring sustainable options for hydropower development in the region. It has formulated design guidelines for mainstream dams and RSAT and is actively involved in development of the HSAP. MRC also provides guidance for member country decision-making through valuable scientific and strategic research. Despite its long list of achievements MRC faces a number of challenges before an integrated planning approach can be introduced at the basin. Conflicts of interests among riparian countries are a significant barrier to integrated planning; while the primary interest of Thailand and Viet Nam in the Mekong River is as a water source for agriculture, Lao PDR considers the river a primary source of hydropower generation for export, and for Cambodia the Mekong is the main source of fisheries (Gupta 2005). Unless integrated resource management planning is implemented across the basin these conflicts will intensify, threatening sustainable development. However, under the current governance structure the MRC can only act as a coordinating advisory body on the water resources of the Mekong basin and cannot enforce any legally binding

agreements that are needed to cover all the development activities occurring in the basin (Tu 2011). In order to change this, it is vital to establish enabling conditions to realise supranational authority, starting from regional cooperation with benefit sharing among the GMS countries. Reforming the governance structure of MRC with supranational authority would create an enabling environment to allow more involvement in key development decisions across the basin. MRC therefore needs to attain the status of an intergovernmental committee tasked with sustainable development of the Mekong basin, and be led by the heads or Prime Ministers of the member states. Under the existing MRC governance structure, either water or environment ministers of member countries form the MRC Council and act as Chairperson of the National Mekong Committee. However, hydropower development in a transboundary river basin has cross-sectoral impacts and is multi-dimensional in nature, including elements of economy, diplomacy and security. Thus, members of the MRC Council under the current governance structure may lack the required authority to take the necessary joint decisions towards sustainable development in the region. By changing the governance structure as proposed above, the Council and National Mekong Committee would have full authority to approve all development projects in the basin so that MRC could play a mediatory role in establishing coherence between country-level development and the regional development framework. However, as discussed in Box 8.2, in the long run even the above-mentioned restructuring of MRC governance would not be sufficient if China and Myanmar do not join in. Therefore the ideal approach for sustainable regional cooperation would be to involve all six countries of the Mekong basin, including China and Myanmar, in the MRC governance structure. In addition, strengthening regional cooperation through the MRC would create enabling conditions to adopt the nascent transboundary EIA framework for the basin and provide win-win solutions for member countries. Consequently, future conflicts on water security, food security and energy security would be prevented.

5. Conclusions

It is likely that investment in potential hydropower mainstream dams will be increased in the coming years to fuel regional economic growth. Relatively lax enforcement of environmental controls is one of the reasons behind unsustainable dam construction planning in the basin. Moreover, the hydropower projects, both under construction and planning, do not adequately consider transboundary impacts. The Mekong River is a major source of food and livelihood in the region, but current approaches of dam construction do not consider transboundary environmental costs and social costs when estimating net benefits of projects. As a result, food security and livelihoods of millions of people will be under threat. Early recognition of the nexus between hydropower development and cross-border food security, water security and livelihoods can minimise the risk of diplomatic conflicts and social unrest and is only enabled when member states are willing to divert high-level government priorities from national interests to transboundary interests, as implementing the nexus approach throughout the river basin could contribute to reducing trade-offs between hydropower development and basin-wide socio-economy, and increase synergies through implementation of benefit-sharing mechanisms towards win-win outcomes. In this regard, MRC could play a greater role in the transition to sustainable regional integration in resource security.

In order to facilitate and implement the nexus approach towards sustainable resource security throughout the river basin, it is critical to strengthen the MRC's governance structure. Based on the above discussions the following are our recommendations:

- Grant the MRC supra-national authority to enable transboundary water governance in the region, which would provide it a mandate for initiating a move from softer agreement to harder legal rules. To realise this, stronger political commitment of the member states is crucial.
- Revise national water policies and environmental and resource management laws of the member states to reflect the goal of the 1995 Mekong Agreement and the MRC programme. As a precondition, MRC should facilitate a capacity building programme for the National Mekong Committee and water governance-related agencies in the member states.
- Transform the role of MRC from that of coordinator to supranational authority, to enable engagement of river basin stakeholders in all decision-making processes. Through engagement of stakeholders MRC will get more acceptability in decision making on transboundary water resource management.
- Extend the geographical reach of the MRC to the most upstream countries such as China and Myanmar to achieve the status of independent transboundary water governance authority in the region. This will ultimately require China and Myanmar to join the MRC, something that appears unlikely at the present. Member states of the MRC should thus take the initiative in discussions with China and Myanmar governments to set up a timeline in order to ensure they join.

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