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Mekong River In the Economy



Report prepared by Pegasy's Consulting

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FOREWORD

Water is liquid capital that flows through the economy as it does through our rivers and lakes.

Regionally, the Mekong River underpins our agricultural systems, our energy production, our manufacturing, our food security, our ecosystems and our wellbeing as humans. The Mekong River Basin is a vast landscape, deeply rooted, for thousands of years, in an often hidden water-based economy. From transportation and fish protein, to some of the most fertile crop growing regions on the planet, the Mekong's economy has always been tied to the fortunes of the river. Indeed, one only need look at the vast irrigation systems of ancient cities like the magnificent Angkor Wat, to witness the fundamental role of water in shaping the ability of this entire region to prosper.

In recent decades, the significant economic growth of the Lower Mekong Basin countries Cambodia, Laos, Thailand and Viet Nam — has placed new strains on this river system. These pressures have the ability to impact the future wellbeing including catalysing or constraining the potential economic growth — if they are not managed in a systemic manner. Indeed, governments, companies and communities in the Mekong are not alone in this regard; the World Economic Forum has consistently ranked water crises in the top 3 global risks facing the economy over the coming 15 years. Water challenges are further compounded by the effect of climate change in the region - from increased droughts to more extreme floods, the regional water future is far from stable.

This “river in the economy” report explores the role of water in the Lower Mekong Basin country economies. It comes at a time when the Mekong is facing the worst drought in decades, and on the heels of some of the worst flooding in recent years. It also comes at a time when hydropower development, the newly-minted Sustainable Development Goals, and water governance mechanisms such as the Mekong River Commission and Lancang-Mekong Cooperation Initiative, face growing challenges and opportunities.

With this report, we hope to shed light upon some of the key narratives that policy makers must address in developing joint solutions to shared water challenges. It is our hope that it inspires strategies, policies and collective action in the coming years. It is also our call to the current policy leaders in the region to harness the courage and political will to shape a future that will benefit the collective wellbeing of all in this mighty river economy.

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EXECUTIVE SUMMARY

The Lower Mekong Basin is entering into a critical period in which upcoming development decisions will echo in the economy for decades to come.

It is important that the Basin countries are made more aware of the connections between water resources, planning, and economic development. It is essential that any development trajectory ensures the possibility of a resilient and prosperous economic future for all of the countries involved.

This Mekong River in the Economy (MRitE) report is intended to reframe the debate around development and water resources management. The focus of the report is to reduce the compartmentalisation that takes place between water resources planners and economic development planning along the Mekong Basin. With looming decisions around hydropower development, industrial expansion, fisheries and, in general, regional economic growth within the Basin, the time for integration of understanding across sectors and countries in the basin is of paramount importance. Short narratives or stories for each country have been created, highlighting the major risks and opportunities for different sectors within the country. Each of these is dependent on a different factor within the Mekong Basin. These narratives have been developed to capture the attention of major policy makers across different countries and sectors in the Mekong Basin.

The Mekong River is one of the world's great rivers. It begins in the mountains of the Tibetan plateau and then travels some 4,800 kilometres to the massive, and hugely productive, Mekong Delta. Its flow regime is unique – most notably the flow reversal into the Tonle Sap – and these elements have created the conditions for the world's largest inland fishery, and the foundation for some of the most magnificent civilizations the planet has ever seen. It is also a system of extremes from wet to dry – both in space and through time.

In recent years, the story of the economies of the lower Mekong countries (LMC) has been one of growth and future promise. Average growth rates have been in the 5-8 percent range¹, and it is a region that is inextricably linked to China – not only via the Mekong itself, but via both historic and current trade routes. The high economic growth experienced in the region has

¹ World Bank (2015) <http://data.worldbank.org>

come at the cost of land and water resources degradation, declining biodiversity and a reduction in ecosystem services. Throughout much of the lower Mekong basin (LMB) aquatic ecosystems are under pressure from settlement, economic development (including poorly planned dams), overexploitation and habitat destruction. Increased water resources use, extraction of sand and gravel, overfishing, deforestation have resulted in increased vulnerability to drought and floods, water pollution, geomorphic changes of the river bed (soil erosion upstream and river bank erosion and lowering of the river bed downstream). The purpose of this report is to try and highlight how sustainable management of water resources is necessary to continue the growth projections experienced by the region without further detriment to the ecosystem.

Viet Nam

In Viet Nam, the Mekong Delta covers a relatively small portion of the entire country. However, the region represents about one fifth of the total population and a quarter of the gross domestic product (GDP) of Viet Nam. Major aspects include the importance of sediments to support a functioning delta system, including agriculture and fisheries. However, the halving of sediment loads through existing dams, sand mining, and groundwater abstraction has resulted in the subsidence of parts of the delta. In addition to concerns around sediment flows, upstream hydropower releases have caused uncertain flow regimes for Viet Nam. This affects saline intrusion, navigation within the delta and ecosystem functioning. Flooding is also a challenge for the delta. Dykes have been built to prevent saline intrusion, which is especially challenging during the dry season. However, dyke construction has also increased flooding during the wet season by preventing the natural flow of water in the flood plains and into the sea. This may become more severe with changing climate alongside increasing development within the delta as well as upstream.

Cambodia

Cambodia is almost completely reliant on the Mekong for water-related economic activity and domestic supply. Approximately 86 percent of Cambodia's territory is included in the Mekong Basin. The remaining 14 percent drains directly into the Gulf of Thailand. Many livelihoods are dependent upon fish protein and flood irrigation from the Mekong. In urban areas, the expansion of industries including textiles are dependent upon affordable labour. This is enabled through the availability of inexpensive protein, food and construction materials such as reeds, clay or sand from the Mekong. These industrial

sectors have downstream water quality impacts, which together with the absorption of labour from agriculture, poses challenges to both ecosystems and rice expansion. Both tributary and main-stem hydropower opportunities will support energy demands, but may have profound consequences on fisheries, sediments and hydrological regimes. For instance, livelihoods are threatened by main stem hydropower development through a disruption of sediment flows and fish migration.

Thailand

Thailand is home to approximately 18 percent of the total Mekong Basin area. This region is the north-eastern part of Thailand. The region is becoming increasingly important politically in the frame of the peace and reconciliation efforts. As a result, increasing investments have been made into local production such as agriculture, food and beverage manufacturing and sand mining for construction. Other important linkages of the Thailand economy to the Mekong River are through energy supply. The electricity demands of Thailand, as a diversified economy are partly dependent on Laos as an energy supplier. The downstream impacts of the hydropower generation in Laos (used by Thailand) are in-turn felt by Thailand and other downstream countries. This has often been portrayed as the benefits of the power going to healthy Bangkok population, while the rural poor suffer the negative impacts. As a result of the negative impacts downstream, Thai communities have enabled legal enquiries into the Thai investments and the purchase of hydropower from Laos upstream. This could be perceived as a form of benefit sharing, an accepted way to spread resource utilisation benefits across the economy, catalyse broader-based growth and support social equity policies. To further increase the benefit sharing, Laos have imposed innovative approaches to target hydropower revenue to support poverty alleviation in the country ².

Laos

Laos is intrinsically connected with the welfare and the flow of the Mekong. The country is dependent upon the Mekong for hydropower, upon which the entire country's economic development trajectory is linked. Laos is also currently “undergoing a construction boom with infrastructure, especially electricity supplies and real estate projects” ³. The boom in construction has the potential to cause significant environmental

² Mekong river Commission, 2011. MRC Initiative on Sustainable Hydropower, Summary and guide to the knowledge base compendium.

³ Devonshire-Ellis, 2016

challenges within the Mekong, especially for downstream neighbours. Managing these impacts, through measures such as fish passes or sediment purges will reduce the potential for power generation, making energy more expensive. Climate and sediment impacts on the dams may also have longer-term consequences for sustained power generation. A large proportion of the Laos population is dependent on agriculture to support their livelihoods. Commercialisation and export opportunities from this sector are limited. The future of the agricultural sector needs to take into account climate vulnerability alongside the livelihoods of the local population.

Therefore, the Mekong River functions as a lifeline for the entire basin. This includes the different sectors and livelihoods that are present in the area. Water, energy and food are all fundamentally dependent upon a single river: The Mekong. However, our understanding of processes within the Mekong remains fragmented across a number of levels including geography, sectors and time. Improved integration across these forms of fragmentation is required for the entire Basin. Interconnectedness and interdependence on this single river result in the need to see the portfolio of development across the entire system. Therefore, strengthened and more inclusive regional planning integration is the only option to ensure optimal sustainable growth in the Mekong Basin.

For governments in the Basin, it is crucial that development plans are taken into consideration, not only in terms of their impact on neighbouring countries, but also in terms of their impact on different sectors in the economy. This cannot be done purely at a normative level, but requires an in-depth analysis of the different scenarios that are plausible. Sustainable river related resources management, including improved governance and integration from all of the Mekong countries and sectors, is necessary to ensure a viable future in the basin.

One initiative that is available to the governments in the Mekong Basin to improve policy alignments is to consider market-based policy instruments. This will help to shift the way that markets affect water resources negatively due to misalignment. We define water-related market-based mechanisms here as a set of *“government-led formal or informal rules consciously designed to change behaviour – of individuals, businesses, organisations or governments – to influence how markets work and their outcomes [on water]”*⁴.

⁴ Modified from Blackmore, Emma (May 2011). “Shaping Sustainable Markets: Research Prospectus” ([PDF](#)). International Institute for Environment and

Furthermore, we would offer five general options available to public sector agencies tasked with ensuring economic health:

- 1) Water-related taxes and subsidies
- 2) User fee systems (pricing/tariffs, user charges, deposit-refund, performance bonds)
- 3) Public spending on water-related goods and services
- 4) Tradeable water permits (cap-and-trade or effluent/withdrawal trading schemes)
- 5) Information and voluntary approaches (notably standards and disclosure)

For the private sector, everything in their business is either directly or indirectly provided by the Mekong Basin.

This makes the private sector risk profile unlike many in the world – specifically linked to a single basin system. For instance, sediment in the river provides material for construction, which is used for the development of infrastructure. The flows of water and sediment provide fertile soils for agriculture, which in turn provide agro-processing opportunities for business from a strong agricultural sector. Livelihoods are supported by the river system through the form of affordable access to protein (fish) as well as housing (sand for construction or reeds and grasses). This ensures an affordable labour source for business. Therefore, the business sector would be wise in creating a platform through which to communicate with their colleagues situated within the same basin. Leveraging common risks and opportunities in the basin will support more sustainable development for the benefit of many. The private sector investment community need to not only consider the cumulative impacts of a number of investments in the basin, but they also need to realise the very specific natural conditions in the Mekong. The fact that the Mekong has a bounty of services it provides has associated risks in that it is more fragile than many other rivers, and therefore is reacting fast and with high magnitude to the current level of development. The Mekong River is linked to everything that the economy relies on, translating into risks being more critically linked to how the river is managed as a whole.

For development agencies, donors and DFIs, it is important we take cognisance of the multitude of projects taking place. It is important that strategic oversight is provided to ensure that efforts are pooled to achieve the development outcomes without foreclosing on possible future options. In a complex and

Development. Retrieved 2016-09-21

complicated system such as the Mekong, this will require more than purely coordinating programs. This will require an in-depth understanding of the spatial and sectoral interconnections. This includes the natural system such as flows, sediment and fisheries, in addition to food, hydropower and goods such as textiles that are produced in the region. Furthermore, consideration of the impacts on investment and labour need to be included. A fuller understanding is critical to ensure the multitude of goals in the Mekong including; poverty eradication, support of livelihoods, economic growth and development, as well as climate resilience are met. These goals need to be achieved in a transparent and inclusive manner with particular emphasis on addressing the failure of large water resources development projects to meet their development objectives and holding the actors -both public and private - accountable for the harm done to the environment, communities and to the long term economic sustainability. It is of paramount importance that developments in the Mekong ensure real benefit sharing for all actors involved. Failing to do so will put both the river and the economy at risk. If donor projects are promoted in the basin, it is important that donors carry the full responsibility and obligation of accountability in ensuring benefits are shared among the basin.

1. INTRODUCTION

*“Water, water,
everywhere,
And all the boards
did shrink;
Water, water,
everywhere,
Nor any drop to
drink.”*

— Samuel Taylor
Coleridge, *The Rime of
the Ancient Mariner*

1.1 Why a “river in the economy” study?

Information, like water, can sometimes simultaneously both overwhelm and be lacking. This apparent contradiction is certainly true – both for water and information – in the context of the Mekong. Since 2004, the Mekong River Commission (MRC), academia, NGOs, World Fish and others have published nearly 150 reports and yet despite this abundance of information, policy makers continue to be stymied. The challenge, as we see it, is not so much a lack of information (although the right information is also sometimes missing), as much as a lack of synthesis into meaningful, and accessible messaging. Simply put, policy makers are swimming in a sea of data, and yet not able to consume the information they need. They are in need of better information and incentives to make appropriate and informed decisions.

Fundamentally, a “River in the Economy” (RitE) report is intended to reframe the debate as indicated in the figure below. The focus of the report is to reduce the compartmentalisation that takes place between water resources planners and economic development planning along a particular watercourse. With looming decisions around hydropower development, industrial expansion, fisheries and in general, regional economic growth, the Lower Mekong Basin is entering into a critical period in which upcoming development decisions will echo in the politics and the economy for decades to come. Making clear the connections between water resources, planning, and economic development pathways will be essential if policy makers are to make wise decisions that ensure the possibility of a resilient and prosperous economic future for all of the countries involved.

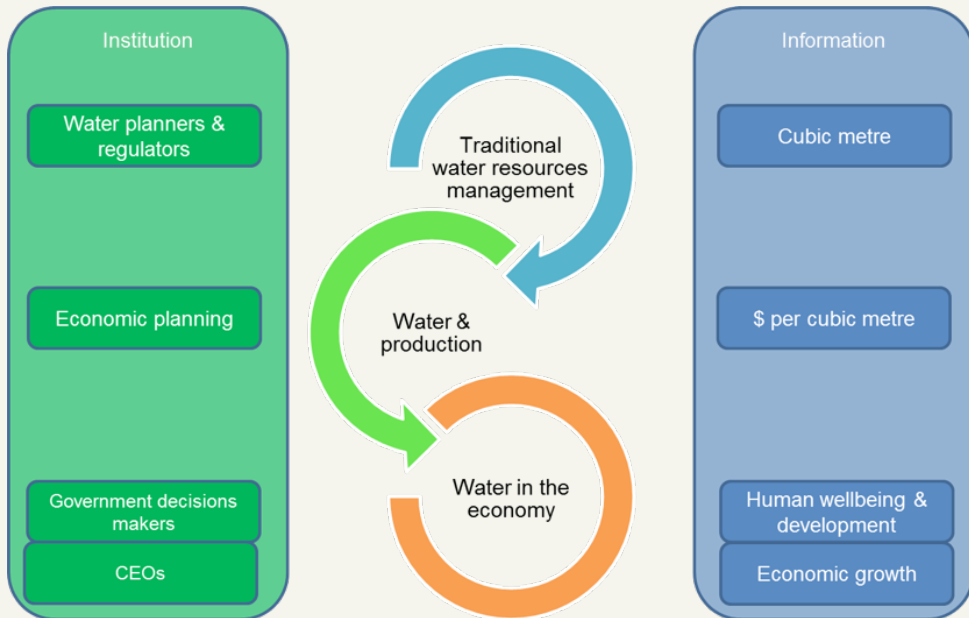


Figure 1: Reframing the water planning and economic development debate

1.2 Scope of the study

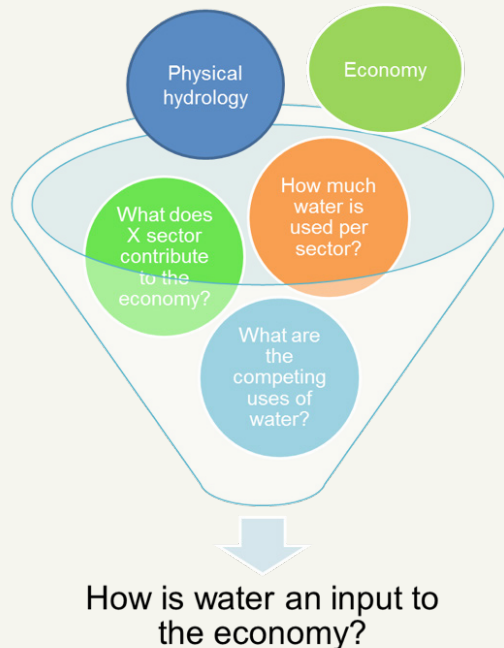
At a geographic level, this report concentrates on the four Lower Mekong Countries (LMC) that make up the vast majority of the Lower Mekong Basin (LMB): Cambodia, Laos, Thailand and Viet Nam. While technically Myanmar does occupy a small portion of the LMB, it is less than 5 percent by area and less by flow contribution or use, and as such, has been left out of this report. Furthermore, the focus within those LMCs is the portion of those countries that lies within the LMB.

China, which is a critical element of the broader story, controls the vast majority of the Upper Mekong Basin, but is not a part of the LMB. Indeed, the hydrology and economies of the LMCs are significantly different than China's portion of the Mekong Basin. There are some elements within the report that do reference China and its linkages to the economic story of the Mekong, however, it has been left out of scope for the aforementioned reasons.

From a content level, the report concentrates on the role of the LMB in supporting the economy and livelihoods in the region. The report considers water and the river-related resources that are beyond purely water as a commodity. The value of sand, nutrients and fish, for instance, are also investigated.

1.3 Approach and methodology

A RitE study is anything but a standardized process. It is an exercise in integration, information immersion, synthesis, questioning, understanding, dialogue and simplifying. Like most synthetic processes, the approach employs a funnel-like methodology in which large volumes of high-quality information are integrated, digested and summarized.



The Mekong is particularly unique in terms of RitE studies. Most cases tend to focus on water scarcity and the traditional narratives around availability, but in this case, the central fabric is understanding the river itself. The Mekong is the most at risk and poses the greatest risk, so the team focused the initial deep dive around understanding areas like sediment, connectivity, fisheries, and hydropower, for example, which could have the greatest traction.

The team began by conducting a deep dive into the background information on the Mekong. As the Mekong is an extensively studied area and information abounds, the team was particularly focused on understanding the trade corridors and interactions in the region and, in particular, key sectors that carry an economic and social weight. For each of these sectors, the team then tried to

think strategically about the role of the private sector and how best to engage them and economic planners. This background exercise helped the team to establish a baseline of reference.

From this initial scoping report, the team conducted the first of two in-country missions. The team, with guidance from national WWF offices and thought leaders in Viet Nam and Thailand, identified people in government, donor institutions, private sector companies, CSOs and NGOs that could provide insight into the political economic situation of the way water is used by people and businesses. In addition to meeting with WWF staff in Viet Nam and Thailand, some of the groups that the team engaged with included:

- Government entities in Viet Nam such as: The National Committee on Climate Change, The Directorate of Fisheries, The Department of Resource Management; The Institute for Policy and Strategy on Agriculture and Rural Development, The Institute of Strategy and Policy on Natural Resources and Environment, and The Institute of Policy and Strategy for Industry;
- Water planning commissions in Viet Nam such as: The Viet Nam Mekong River Commission, and The Viet Nam River Network;
- Private sector groups operating in the Delta working in industries such as: fisheries, aquaculture, and seafood processing; and
- Donors working in Thailand such as: The World Bank, AusAid and the Embassy of the Kingdom Netherlands.

In these interviews, some of the challenges that sectors faced with regard to their water use began to emerge. Understanding these challenges was key to building the initial narratives around the way in which the private sector engaged with continued economic development and growth. This first scoping visit was also critical to identifying firms that had an appetite for stewardship, both at a local and national level, but also those that could engage stewardship through their regional and global offices that would then, in turn, impact what happened in the Mekong.

The team returned from the Mekong to analyse the information gathered. As they cross-checked the interviews with the information gathered during the baseline assessment, a series of common issues interviewees were worried about began to emerge. These issues then started to translate into story lines for each country. The aim in building these story lines was to construct relevant, rather than comprehensive, narratives that teased out key aspects of water and

its linkages to material socio-economic trends. These narratives were built to understand how shared water resources have the ability to affect various sectors in the economy. The team then used this information to identify key drivers, and, in particular, find ways to encourage non-water experts to consider how economic development is tied to water resources allocation, management and planning.

The team returned to the field for a second mission, this time to Thailand, Cambodia and Myanmar (Myanmar's visit served primarily to understand the Irrawaddy). Again, the team, with guidance from national WWF offices and thought leaders, identified people in government, donor institutions, private sector companies, CSOs and NGOs that could provide insight into the national political economic situation and help to further refine some of the emerging narratives. In addition to meeting with WWF staff, some of the groups that the team engaged with included:

- Water planning agencies such as: The Tonle Sap Authority (Cambodia), National Water Resources Committee (Myanmar);
- Private sector affiliates such as: Coca Cola (Cambodia), Cambodian Fisheries Administration (Cambodia), The Cambodian Chamber of Commerce, (Cambodia), Coca Cola (Myanmar), Heineken (Myanmar), H&M (Myanmar), and The Myanmar Centre for Responsible Business (Myanmar), Nestle (Thailand); and
- Donor organisations such as: Oxfam (Cambodia), GIZ (Myanmar), AFD (Myanmar), SIDA (Thailand), USAID (Thailand).

After returning from the second field mission, the team took the findings from the first round of interviews, continued desktop research, and the second round insights to build the narratives that appear in this document. These refined story lines allow us to tell a tight and compelling story that is representative of issues in the Mekong that have the ability to mobilise discussion. The selected issues and narratives reflect the Mekong's water economic problems that have economic and social validity and consequence.

No two RitE processes are the same. The methodology for developing a report of this nature is highly dependent on with whom the team can engage and what evidence they are able to gather. Key to a robust report in any RitE is the ability to go into the process without preconceived ideas and a reliance on using an evidence-based approach to listen to what industry leaders are most concerned about. From there, clustering issues around commonalities and

developing stories that have economic, as opposed to water, traction is where the richness of a RitE study comes to life.

1.4 Framing the narratives against the main sectors

There are a series of underlying sectors that are drivers of change in the Mekong River Basin (MRB). These high-level economic sectors are underpinned by the water resources that drive them. Together they support broader macro-economic drivers that tie together the economies of the region. Our analysis began with a keen understanding each of the major sectors present within each MRB countries. Thereafter, we have pulled out the sectors we perceive to be the highlights with regards to water constraints or opportunities within the basin. We use the term “sector” loosely, due to the fact that this may include community livelihoods in addition to purely economic sectors such as mining. We have also used the term “narratives” loosely, as these are really stories of particular interest or importance that we would like to highlight for major stakeholders in the basin. Through meetings with key stakeholders, the narratives began to emerge. The narratives are expanded upon further at a later stage in this document.

In the figure below, we have tried to simplify the relationship between different sectors and macro-economic drivers in the region. The ten outside circles below represent the key water-related economic sectors that are driving growth in the region, and whose success is fundamentally linked to a healthy and thriving system. The inner level of circles represents the four meta-drivers that are dependent on functioning sectors in the basin. We have developed narratives that take into consideration the role that the MRB plays in supporting the sectors, which in turn supports the broader socio-economic drivers such as labour or investments. These are dependent upon a functioning MRB that is able to provide water, energy, food and ecosystem goods and services (nature) as indicated by the figure.

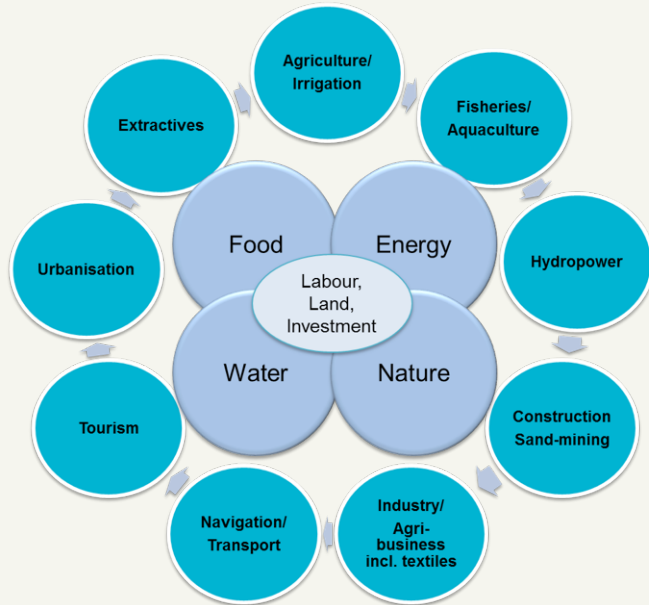


Figure 2: Key economic drivers of change in the Mekong River Basin

The underlying issues within the MRB that we have tried to reflect in the narratives are as follows:

-Livelihoods within the region are deeply dependant on goods and services supported by resources from the Mekong River. This may be through fisheries within the river itself, wetlands or valuable estuaries in the delta. Alternatively, livelihoods are supported through rain-fed or irrigated agriculture in the basin. For instance, the staple food for much of the population is rice. In 2014, lower Mekong countries (Myanmar, Laos, Cambodia, Thailand and Viet Nam) produced more than 100m tonnes of rice, around 15 percent of the world’s total production.

-Urbanisation in the region is linked to the significant economic growth that has been witnessed. However, with urbanisation comes increased construction. This, in turn, is related to changing sediment regimes in the Mekong River, which can be attributed to sand mining and other extractives to support the construction boom.

-Growing regional energy demand is also linked to the economic boom in some parts of the region. The estimated hydropower potential of the lower Mekong Basin (i.e., excluding China) is 30,000 MW, while that of the upper Mekong Basin is

28,930 MW. Hydropower is deemed a major source of energy for the region, which naturally has significant requirements and impacts on the Mekong River. Numerous new investments are being built, while many more are being planned.

-Growth and employment, linked to **irrigation, agri-business and industry**, is also a key narrative through the region. Growing productivity for food production and regional or international trade forms an important part of the labour economy, providing employment and income to a large proportion of the Mekong economy.

-**Export, trade and foreign exchange** is emerging as a critical narrative to understand who is making the decisions in each country, how those decisions are being financed and what is a stake for each country—both from an investing country perspective and from the host country perspective.

-From the 2004 tsunami to the 2011 flooding, and droughts in Thailand, Cambodia and Viet Nam in 2015, **disasters linked to natural events** are an integral narrative in understanding how communities in the Mekong build up their resilience to disaster and the financial implications that are required from donors and treasury to prevent and clean up after the disasters.

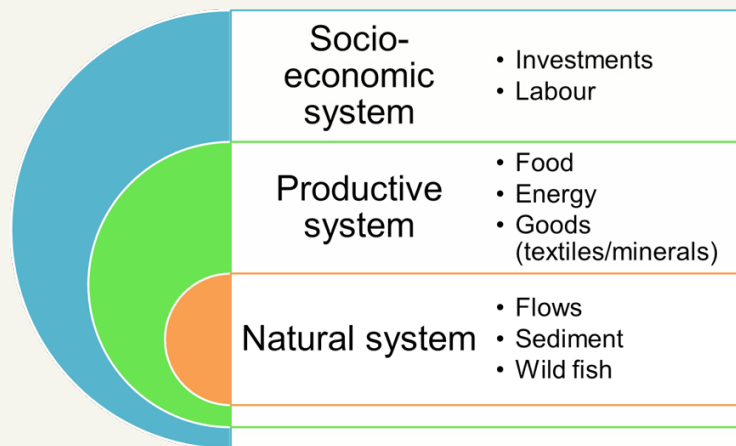
-Projected reliance on **affordable labour** has been a dominant narrative throughout the economic development of the Mekong. Indeed, the growth in the region is predicated on an often unskilled, reliable, cheap and flexible labour force.

-**Investments** in the region have been growing substantially in recent years. These investments, whether in hydropower, industry or domestic urbanisation, will fundamentally change the landscape within the Mekong Basin. The rise in investments needs to be considered cumulatively alongside all of the other developments taking place in the basin.

While the approach to the narratives is a country-specific one, the reader will notice similar themes throughout each narrative, which allow for comparisons between sectors and countries. There are six distinct reaches from a hydrological perspective within the Mekong River. While we've structured our analysis to go country by country through each reach, we have also started to see similar underlying aspects emerge in each of the narratives. These underlying aspects, in turn, have significant implications on the direction of investment financing, regional trade and development trajectories.

1.5 Understanding interconnections between countries and sectors

The narratives and stories that are expanded upon later in this report are used to synthesize and simplify the complexity of the Mekong Basin economies and hydrology. The stories show the interconnectedness and inter-relations between water and the economy in the Mekong Basin. Below, in order to focus attention on these relationships, we have highlighted the main types of natural, productive and socio-economic flows that occur within and between the Mekong countries related to the Mekong River.



Physical flows related to the river:

• **Flooding** demonstrates the interconnectedness among the countries. In some places flooding can be seen as a negative impact, with substantial damage to infrastructure. In other areas, flooding is lauded as a positive impact, bringing rich silt to the farming regions and supporting fisheries.

• While **sediment** plays a vital role in driving the success of the construction industry, its harvesting has also had extremely detrimental impacts downstream on the fisheries as well as coastal erosion.

• **Wild fisheries** help us to understand the tangible connectivity and migration between the countries. Ecological flows for livelihoods are supported by ecosystem functioning of the wild fisheries. Moreover, a functioning river for fisheries helps us understand the added benefits of goods and services harvested from the Mekong River.

Productive flows with embedded water:

- Power production is mostly related to the production of hydropower and the costs and benefits associated with developing the sector or preserving the current status quo within the Mekong flows. Another important aspect of this sector is how hydropower is generated and then traded within the region.
- Agriculture including aquaculture is important in terms of food production for domestic consumption vs. export. Considerations include the importance of rice, fish and agricultural processed goods such as textiles (i.e. Cambodia). Another inclusion is the trade among the countries within the region and globally.

Socio-economic enabling factor flows include the flows of investments within the countries in addition to the importance of labour and migration within the LMB.

Each of the above points has a value, whether monetarily in terms of the investments that are tied to it or from the value that the subject carries in the minds of decision makers. These values can include the financial economic return of the decision, opportunity cost of decisions or value at risk of a particular decision. Where possible, these values have been identified or estimated to give an indication of the linkages within the Mekong.

1.6 Target audience

This report is unlike many water reports in that it is not targeted directly at the water resources community. Rather, the target audiences for this report include economic planners, policy makers, companies and civil society. From a public sector perspective, the report is targeting Ministries (or Commissions) of Finance, Commerce, Economy, the Interior, Planning and Investment. The report is important for business leaders as they are tied to the economic consequences of strong or weak water resources planning. A further critical audience for these reports is the investment community that is driving many of the changes in the LMB landscape. The loosely-phrased “financial community”, includes both donors, such as multi-lateral aid agencies, as well as direct foreign investors. These audiences have a key stake in not only shaping the future economies of the Lower Mekong, but will also see their investments placed at risk if water resources are not managed correctly by the various actors involved. It is important that such audiences recognize that their short and long term investment interests are directly linked to the ability of policy makers to harness water for sustainable economic development.

The figure below indicates how sustainable water management lies at the core focal point for business, government and civil society. For each, there are key questions they should be asking with regards to their role in sustainable water management. Communities that benefit from opportunities within the LMB or impacted by the risks in the basin are represented by different civil society groupings.

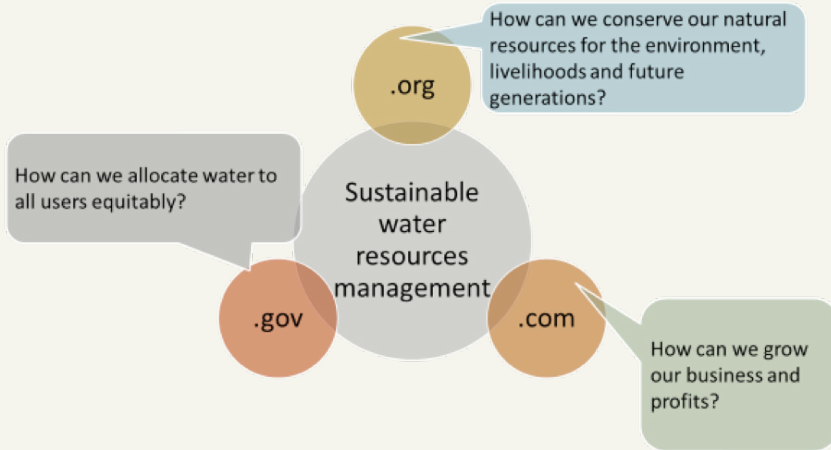


Figure 3:Major focal points for communication

In summary, ensuring a robust understanding of the role of the river and its water in the economy is critical for policy makers, but equally so, to those who help to shape economic development through the infusion of capital. The overall objective of these reports is to contribute to sustainable water resources management. This is in alignment with the needs of a range of actors, including government, civil society and business.

2. HYDROLOGICAL CONTEXT ON THE LOWER MEKONG BASIN

The Mekong River is one of the world's great rivers. It begins in the mountains of the Tibetan plateau and then winds some 4,800 kilometres to the massive, and hugely productive, Mekong Delta.

Its flow regime is unique in some aspects – most notably the flow reversal into the Tonle Sap – and these elements have created the conditions for the world's largest inland fishery, and the foundation for some of the most magnificent civilizations the planet has ever seen. It is also a system of extremes from wet to dry – both in space and through time. This chapter sets the stage for the RitE report by first exploring an overview of some of the key hydrological aspects of the Mekong River, which are critical to explore the economic linkages and story lines.

2.1 Dividing the river

The Mekong Basin is home to the following countries. As indicated by the table, the Mekong Basin is home to the majority of land area in both Laos and Cambodia.

| Basin | Area | | Countries included | Area of country in basin (km ²) | As % of total area of the basin | As % of total area of the country |
|--------|-----------------|---------------------|--------------------|---|---------------------------------|-----------------------------------|
| | km ² | % of Southeast Asia | | | | |
| Mekong | 795 000 | 38 | China | 165 000 | 21 | 2 |
| | | | Myanmar | 24 000 | 3 | 4 |
| | | | Lao PDR | 202 000 | 25 | 85 |
| | | | Thailand | 184 000 | 23 | 36 |
| | | | Cambodia | 155 000 | 20 | 86 |
| | | | Viet Nam | 65 000 | 8 | 20 |

Figure 4: Country areas in the Mekong River Basin⁵

Being such a large river system, it is useful to break down the Lower Mekong Basin into five primary reaches, recognizing the Upper Mekong Basin as a sixth reach⁶. These reaches capture distinct elements of its flow regime and precipitation contributions. The following figure gives an indication of the entire profile of the river.

⁵ FAO Aquastat, 2011, Statistics on the Mekong Basin

⁶ <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

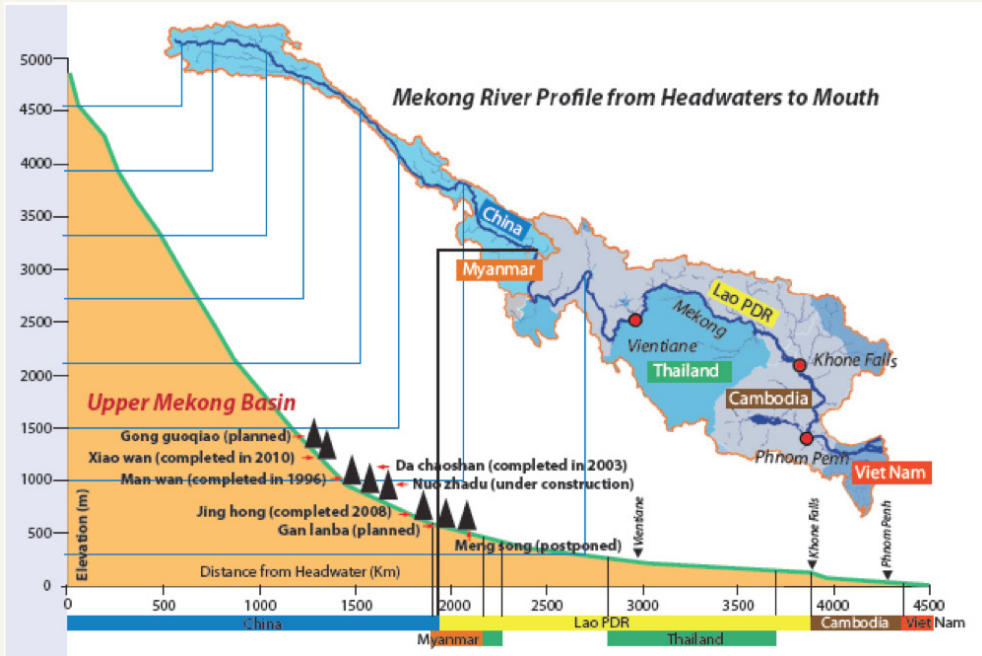


Figure 5: Mekong River profile from headwaters to mouth

The Mekong River Commission (MRC) describes these reaches as follows:

Reach 1: Lancang Jiang or Upper Mekong River in China.

Reach 1, provides an estimated average contribution of 16 percent of the waters to the Mekong. It derives its contributions from melting snow on the Tibetan Plateau. This base flow is critical to the low-flow hydrology of the lower mainstream and can make up almost 30 percent of the average dry season flow. Reach 1, with its high-energy flows that incise deep valleys in Yunnan, is also a critical source of sediment for the rest of the basin.

Reach 2: Chiang Saen to Vientiane and Nongkhai. A highly mountainous section of the basin, Reach 2 is heavily forested, though it has experienced loss through slash-and-burn practices. It is the least developed portion of the LMB, but is also critical from a flow contribution perspective, providing an average of some 35 percent of the flow to the river, but is also considerably affected by the seasonal flows of Reach 1.



Figure 6: Reaches of the Mekong River

Reach 3: Vientiane and Nongkhai to Pakse.

Reach 3 is influenced by contributions from the large left bank tributaries in Laos, namely the Nam Ngum, Nam Theun, Nam Hinboun, Se Bang Fai, Se Bang Hieng and Se Done rivers. The Mun - Chi river system from the right bank in Thailand also enters the mainstream within this reach. Loss of forest cover in the Thai areas of the Lower Basin has been the highest in all the Lower Mekong countries over the past 50 years. On the Korat Plateau, which includes the Mun and Chi tributary systems, forest cover was reduced from 42 percent in 1961 to 13 percent in 1993.⁷ The Mun and Chi rivers are highly developed low-relief, agricultural basins with low runoff potential and significant reservoir storage for dry season irrigation. The left bank Laos People's Democratic Republic (hereafter, "Laos") tributaries are in an accelerating phase of development in terms of water demand for agriculture and hydropower.

Reach 4: Pakse to Kratie.

The main hydrological contributions to the mainstream in this reach come from the

Se Kong, Se San and Sre Pok catchments. Together, these rivers make up the largest hydrological subcomponent of the Lower Basin. Over 25 percent of the mean annual flow volume to the mainstream at Kratie comes from these three river basins. These rivers are a key element in the hydrology of the Tonle Sap flow reversal. One of the major issues with regard to the river hydrology is the potential impact of hydropower development on the upper Se San in Viet Nam.

⁷ <http://www.mekonginfo.org/assets/midocs/0001968-inland-waters-overview-of-the-hydrology-of-the-mekong-basin.pdf>

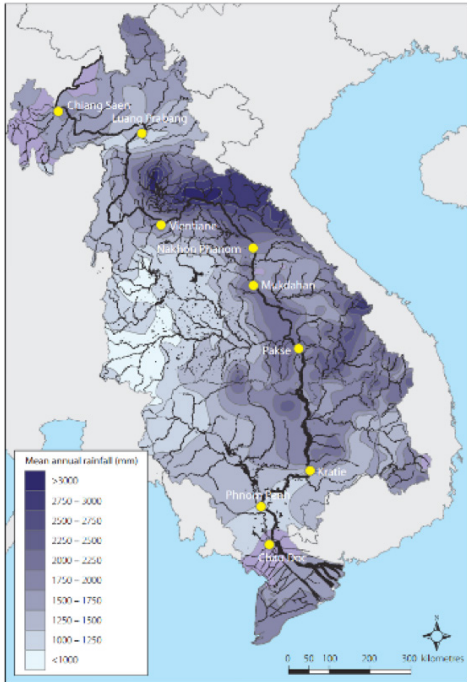


Figure 7: Precipitation patterns of the LMB

Reach 5: Kratie to Phnom Penh. This reach includes the hydraulic complexities of the Cambodian floodplain, the Tonle Sap and the Great Lake. By this stage, over 95 percent of the total flow has entered the Mekong system. The focus turns from hydrology and water discharge to the assessment of water level, overbank storage and flooding and the hydrodynamics that determine the timing, duration and volume of the seasonal flow reversal into and out of the Great Lake.

Reach 6: Phnom Penh to the Sea. Here the mainstream divides into a complex and relatively controlled system of branches and canals. Although densely populated with a complex irrigation and transport system in place, the Mekong is still less developed in comparison to the Yangtze, for example. Key features of flow behaviour in the Mekong Delta are tidal influences and salt water intrusion. Every year, 35 to 50 percent of this reach is flooded during the rainy season. The impact of road embankments and similar

infrastructure developments on the movement of this flood water is an increasingly important consequence of development.

The precipitation patterns of the LMB (Figure 7) are heavily disparate with some regions receiving three to four times the amount of the lower regions ⁸. In general, there is an east-west division, with the eastern, mountainous region (largely within Laos) receiving high levels of precipitation, while the low-lying plains of Eastern Thailand and Cambodia being much dryer. Much of the flow of the Mekong comes from a few, large, left-bank tributary systems, notably: (A) Nam Ngum and Nam Kading (between Vientiane and Mukdahan) and (B) Se Kong, Se San and Sre Pok (between Pakse and Kratie).

This precipitation gradient is also reflected in the discharge volumes and contributions by country (Figure 8 and Figure 9), which in turn differ considerably between wet and dry seasons. These figures highlight the importance of the Laotian tributaries of the Mekong

⁸ <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

during both wet and dry seasons. This low-flow/high-flow, dry-season/wet-season disparity is illustrated through Figure 10 with peak flows occurring from Kratie to the Delta in the late summer months of August and September.

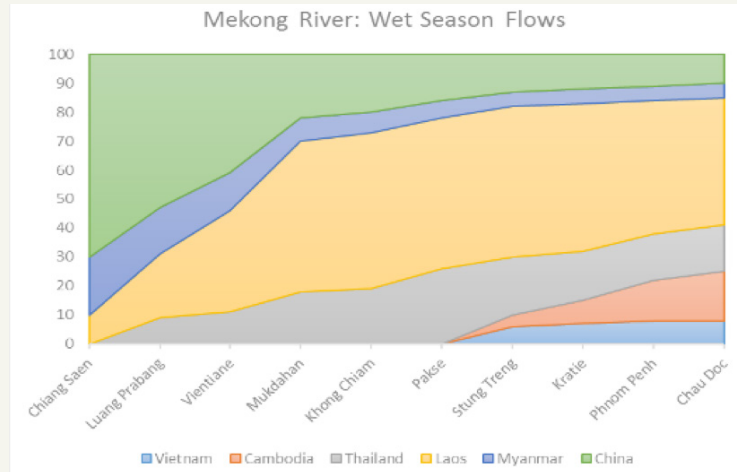


Figure 8: Mekong River wet season flows

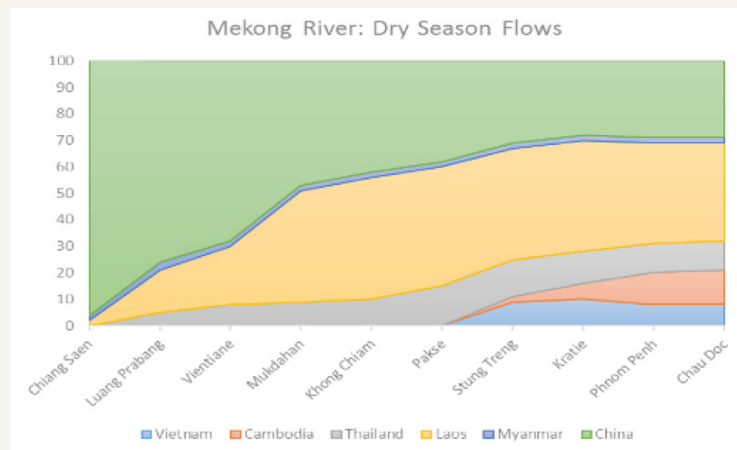


Figure 9: Mekong River dry season flows

The Mekong is characterized by highly variable annual flows with a pronounced dry period (November to April) and wet period (May to October). At its extremes, the Mekong is prone to extreme floods, as well as significant droughts as evidenced by severe flooding recent years (e.g., 2008, 2013) and the severe drought of early 2016.

In short, the Lower Mekong Basin is a system characterized by spatial and temporal variation in precipitation and water availability. A system that in some places at some times has water, water everywhere, while others places have not a drop to drink.

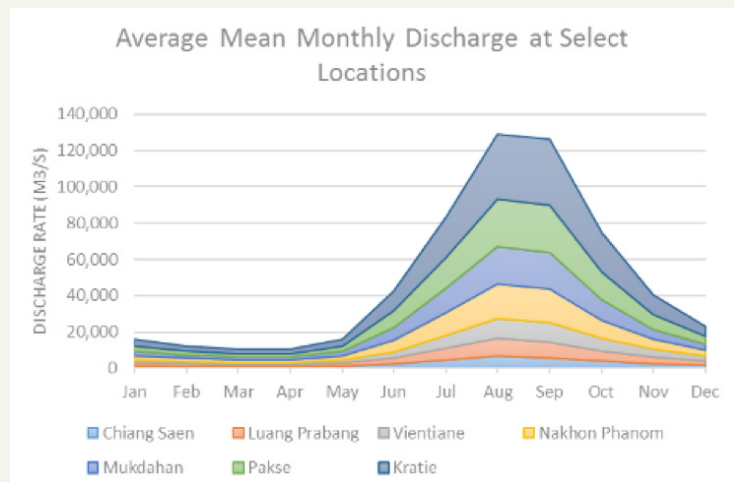


Figure 10: Average mean monthly discharge at select locations

2.2 From liquid to solid - exploring the issue of sediment in the Mekong

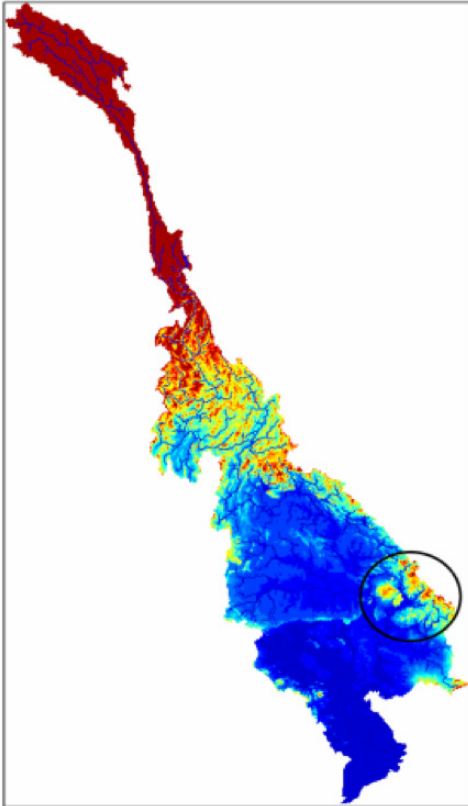


Figure 11: High sediment generating areas in the Mekong Basin

The Mekong is not only important for its water, but for the services it provides in sediment transport. The Mekong River is richer than the Amazon, the largest river in the world, in terms of sediment⁹. Sediment, which is a term encompassing various sizes of solid earthen particles (from clay to boulders), is critical to the economies of the LMCs. Indeed, without estimated 165+ Million Tons (MT) of annual sediment discharge¹⁰, the huge productivity of Tonle Sap and the Delta as a whole would not exist.

In understanding sediment, it is important to understand that not all sediment is the same, and that different flow levels move different sizes of sediment.

Of the total sediment load, over half – an estimated 90-100 million tonnes per year (pre-Manwan dam) – comes from China's Lancang (Reach 1). In comparison, the so-called 3S Rivers (Se Kong, Se San, Se Pok) contribute an additional 10-25 million tonnes per year (with some estimates as high as 60MT/yr), with the remaining 30 percent coming from the remainder of the LMB. Figure 13 illustrates the relief of the Mekong, identifying the high elevation/high sediment generating areas in red (the circle demarcates the 3S Rivers).

9 Baran E., Guerin E., Nasielski J. 2015 Fish, sediment and dams in the Mekong. Penang, Malaysia: WorldFish, and CGIAR Research Program on Water, Land and Ecosystems (WLE). 108 pp.

10 Wolanski, E., Nguyen Huu Nhan 2005. Oceanography of the Mekong River Estuary. pp. 113-115 in Chen, Z., Saito, Y. and Goodbred, S.L., Mega-deltas of Asia Geological evolution and human impact. China Ocean Press, Beijing, 268 pp; Sarkkula, J., Koponen, J., Lauri, H., Virtanen, M. (2010) "Origin, fate and impacts of the Mekong sediments" Mekong River Commission. Available: http://www.mpowernetwork.org/Knowledge_Bank/Key_Reports/PDF/Research_Reports/DMS_Sediment_Report.pdf

The deposition of this sediment is critical to two areas: the Tonle Sap (which receives roughly seven million tonnes per year) and the Delta (which receives the remainder). Tonle Sap retains about 80 percent of its annual deposition and much of this is very fine sediment (i.e., clays) is critical in the productivity of this region (both crops and fisheries).

The Mekong Delta is equally dependent upon sediment input and recent studies suggest that over 50percent of the delta is now receding in large part due to sediment loss linked to upstream dams, sand mining (as well as groundwater pumping and subsidence)¹¹.

2.3 The curious case of the reversing river - Tonle Sap



SOURCE: TAGUELMOUST / WIKICOMMONS

The floating houses of Tonle Sap are an adaptation to the lake's huge seasonal variation in water levels.

One aspect of the hydrology of the Mekong is worth particular attention: the flow reversal into the great Tonle Sap Lake. This is the largest flow reversal of water in the world. This process, which involves high water flows reversing from Phnom Penh back up the Tonle Sap River, followed by low water flows coming back down the Tonle Sap River and re-joining the Mekong out to the Delta. This seasonal flow-reversal phenomenon is the basis for the large productivity of the Lake, and is also a critical aspect to not only mitigating flooding downstream during heavy-flow periods of the year by siphoning off water, but to maintaining low-season base flows to the Delta.

The seasonal storage of water in the Great Lake acts as a water regulator for flows downstream in Phnom Penh. The stored water flowing out of the system in the dry season increased the low flows that would otherwise have been present, providing increased water for irrigation and reducing saline intrusion in the Delta. In essence, this critical piece of natural infrastructure acts as a hydrological buffer that provides the LMB with much greater productivity and resilience.

¹¹ Anthony, E.J., Brunier, G., Besset, M., Goichot, M., Dussouillez, P. & Nguyen, V.L. (2015) Linking rapid erosion of the Mekong River delta to human activities, Nature Scientific Reports, 5, Article number: 14745. Available online: <http://www.nature.com/articles/srep14745>

2.4 The Future Hydrology of the Mekong

The general consensus on the future climate of the LMB is one that is warmer and wetter¹². “Studies show that the basin is vulnerable to several climate change impacts that include a predicted mean temperature rise of approximately 0.8 degrees Celsius by 2030, as well as a regional increase in annual precipitation of 200mm.”¹³ This is likely to result in more extreme weather events such as typhoons. The basin is will become more vulnerable to floods and drought, affecting people’s livelihoods and reducing agricultural productivity The wet season is also projected to contract slightly. The corresponding extension of the dry season, when combined with warmer temperatures, suggests greater potential for drought periods.

These trends must also be factored into the varied geography of the LMB, which is already prone to extreme wet and dry in select areas. Should these general climatic trends prove true, when combined with the already highly variable conditions in the different regions, it suggests that the potential for regional catastrophic flooding and drought is high.

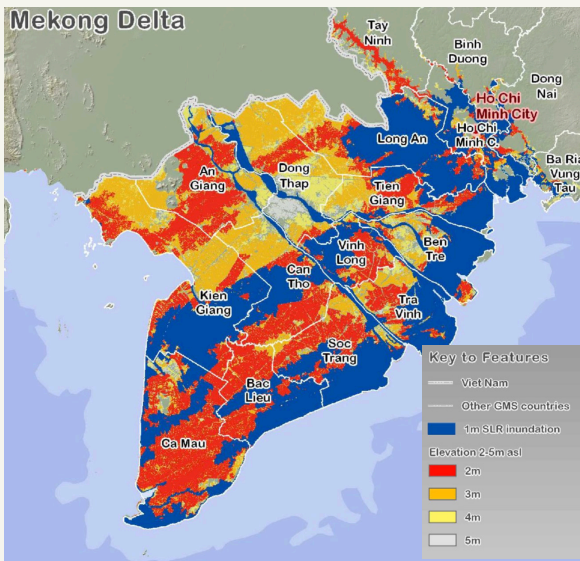


Figure 12: Impacted area of the Mekong Delta with sea level rise (Source: ICEM)

It is also worth noting the various projections of sea level rise. The latest research^{14,15} suggests at least a 30cm sea level rise by 2050 and that by 2100, sea level rise could be upwards of two meters, placing the majority of the Delta under water (denoted in blue, 1m, and red, 2m, in Figure 12).

12 WWF Greater Mekong Programme (2009) The Greater Mekong and Climate Change: Biodiversity, Ecosystem Services and Development Risk. Available online: http://d2ouvy59podg6k.cloudfront.net/downloads/final_cc_reportlowres_3.pdf

13 Mekong River Commission: Climate Change. <http://www.mrcmekong.org/topics/climate-change/>

14 A. Smajgl, A., Toan, T.Q., Nhan, D.K., Ward, J., Trung, N.H., Tri, L.Q., Tri, V.P.D., & Vu, P.T. (2015) Responding to rising sea levels in the Mekong Delta, *Nature Climate Change*, 5, 167–174. <http://www.nature.com/nclimate/journal/v5/n2/full/nclimate2469.html>

15 DeConto, R.M., and Pollard, D. (2016) Contribution of Antarctica to past and future sea-level rise, *Nature*, Vol. 531: 591

These impacts are further at risk due to the subsiding delta as a result of limited sediment deposition. This would jeopardize more than 15 percent of Viet Nam's GDP, displace more than 20 million people and roughly 25 percent of its food production, including a very large part of its fruit and rice production. The complex dynamic construction of the Mekong Delta as a result of sediment, subsidence, tides, currents, waves and wind mean that this is purely an estimate, and the real costs associated with future climate change without adequate sediment deposition may be larger.

3. ECONOMIC CONTEXT OF THE LOWER MEKONG BASIN

3.1 Growth, diversification & trade with regional partners: the general economic trends in the region

3.1.1 The next set of little dragons?

In recent years, the story of the economies of the LMCs has been one of growth and future promise. As one academic notes, "Understanding the region's promise requires a grasp of not just its growing interconnectedness but also its demographics. Together, the mainland Southeast Asian economies now constitute a consumer and labour market of over 300 million people, with rising incomes and a combined GDP that could exceed USD 1 trillion by 2020."¹⁶ Average growth rates have been in the 5-8 percent range¹⁷, and it is a region that is inextricably linked to China – not only via the Mekong itself, but via both historic and current trade routes. The growth explosion of Thailand in the 1980s, followed by Viet Nam in the early 2000s is now starting to be mirrored by Cambodia and Laos, as shown in Figure 13.

Beyond their common growth trajectories, the LMC economies share significant similarities in their composition, with an average of 45 percent (+/- 8 percent) of GDP coming from the service sector, 22 percent (+/- 11 percent) from agriculture, and 33 percent (+/- 6 percent) from industry. Of the LMC economies, Thailand differs

¹⁶ Pongsudhirak, 2013. http://www.viet-studies.info/kinhte/FA_MekongRegion.htm

¹⁷ World Bank (2015) <http://data.worldbank.org>

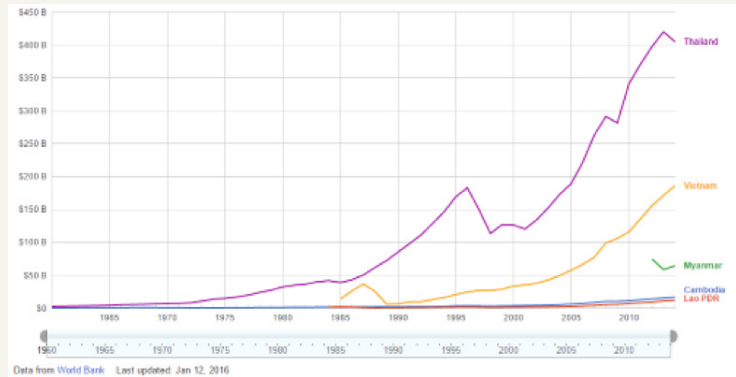


Figure 13: Economic growth in the Lower Mekong Countries

most greatly from the others in this allocation with 53 percent, 11 percent and 37 percent respectively¹⁸. The agricultural sector is particularly notable in that it is the main source of employment in the LMCs, engaging between 38 percent (in Thailand) and 74 percent (in Laos) of the labour force¹⁹. A number of factors are thought to be responsible for this success: strong consumer spending, good agricultural performance, higher export levels and appropriate fiscal stimuli provided in some economies²⁰.

In much of LMB, investment in land, including foreign direct investment, has been promoted as an effective development tool by governments. For example, in Laos, 1.1 million hectares – approximately 5 percent of Laos' national territory and an area greater than the total area under rice cultivation – has been granted for development. A range of products are cultivated or extracted from lands under investment, including: rubber, teak, sugarcane and jatropa. Such a vast expansion of land investment has brought significant transformation to national landscapes with likely substantial, but as yet unquantified, impacts on water (let alone other socioeconomic and environmental impacts).

The high economic growth experienced in the region has come at the cost of land and water resources degradation, declining biodiversity and a reduction in ecosystem services. Throughout much of the LMB, aquatic ecosystems are under pressure from settlement, economic

¹⁸ World Bank (2015) <http://data.worldbank.org>

¹⁹ World Bank (2015) <http://data.worldbank.org>

²⁰ The Cross Border Economies of Cambodia, Laos, Thailand and Viet Nam (2005) <http://www.cdri.org.kh/webdata/download/dan/ddan4.pdf>

development (including dams), overexploitation and habitat destruction. Inappropriate and excessive use of agro-chemicals (fertilizers, pesticides) and increasing water use have resulted in unsustainable levels of water depletion, water pollution, soil erosion and downstream silting. The decline in biodiversity and loss of culture and heritage are other important manifestations of damage to ecosystem functions. Increasingly government initiatives are focused on protecting the environment and safeguarding ecosystem services, but the effectiveness of these policies is not yet apparent. The purpose of this report is to try and highlight how sustainable management of water resources is necessary to continue the growth projections experienced by the region without further detriment to the ecosystem.

3.1.2 A tale of economic haves and have-nots

The economies of the region tell a story of vast differences. As Figure 14 shows, the economy of Thailand is more than 33 times the size of that of Laos. Indeed, the large disparity between the poorer Laos and Cambodia (with GDPs of USD 12B and USD 17B respectively) and the wealthier Viet Nam and Thailand (with GDPs of USD 186B and USD 405B respectively) tells the tale of the relative “have” versus “have not” economies of the LMB.

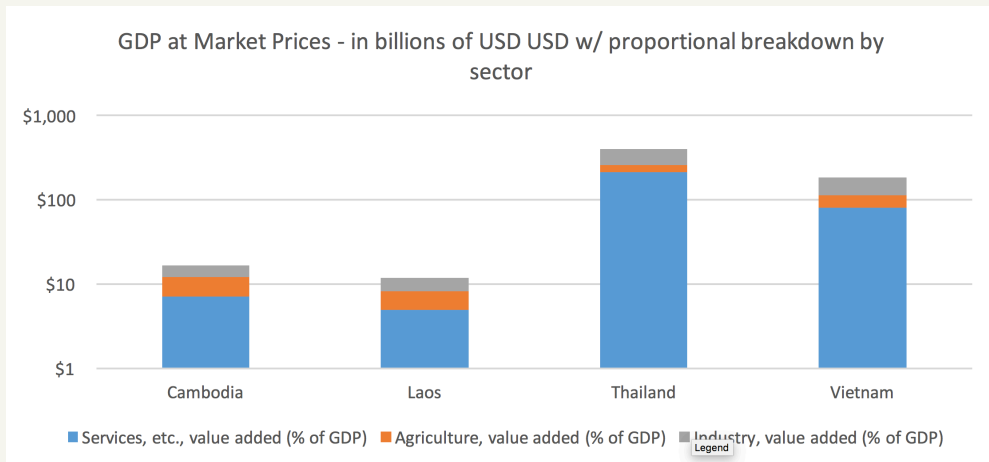


Figure 14: GDP at market prices indicating the differential economies of the LMCs²¹

21 Agriculture includes farming, fishing, and forestry. Industry includes mining, manufacturing, energy production, and construction. Services cover government activities, communications, transportation, finance, and all other private economic activities that do not produce material goods. Source: <http://data.worldbank.org/indicator/NY.GDP.MKTP.CD/countries>

In many respects, the Thai economy reflects the future of all of the countries in the region having shifted from the agricultural/extractive nature of the Cambodian and Laotian economies into an economy tied to transport, logistics, communications development, manufacturing and services. Viet Nam lies in between, and increasingly we see Cambodia following a similar pathway towards greater industrialization and services. Laos is unique in its reliance upon mining rent for revenues (10 percent).

It is difficult to understate the degree to which the economies of the LMCs are tied to the domestic service and agricultural sectors, with the latter being particularly important for employment (especially in rural areas)²². This is especially true in terms of livelihoods, poverty alleviation and food security.

Although significant economic growth in recent decades has contributed to poverty alleviation and improvement in living conditions (e.g. increases in HDI), significant segments of the total population in the Lower Mekong countries, especially those living in rural areas, continue to suffer from poverty and food insecurity. “More than 40 percent of the population of Viet Nam and more than 50 percent of the population of Cambodia and Laos continue to live on less than USD \$2 a day”²³. The number of malnourished infants (especially in Laos) continues to be unacceptably high. Both Cambodia and Laos are currently characterized as least developed countries, but are hoping to graduate from this status by 2020. This is driving a lot of their current government policy.

3.1.3 The Regional Economy: the importance of China and LMCs as trading partners

While the vast majority of the economic activity is formed from domestic spending, in recent years, all four countries have exhibited a positive trade balance ranging from 7-27 percent of the GDP. Perhaps unsurprisingly, exports are particularly important for Cambodia and Laos, for which their trade balance is a critical contribution to their economies (13 percent and 27 percent respectively).

Key trading partners include China, the United States, Japan, and regional counterparts (i.e., the other LMCs). More specifically, China is a key trading partner to all of the LMCs with Laos, Thailand and

²² World Bank (2016) <http://data.worldbank.org/indicator/SL.AGR.EMPL.ZS>
²³ <http://sea.iwmi.cgiar.org/iwmi-in-southeast-asia/about-the-region/>

Viet Nam all exporting >10 percent of their exports to their large northern counterpart. The US forms another key trading partner in the region with three of the four countries again, trading >10 percent of their exports to America. However, there are some notable difference in trading partners with Laos being heavily dominated by its immediate neighbours: China, Thailand and Viet Nam collectively accounting for some 83 percent of all exports and 88 percent of imports. Conversely, Cambodia has very minimal reliance upon exports to China (a mere 4 percent of exports) with exports heavily oriented to Europe and North America, but does rely heavily upon Chinese imports (22 percent of all imports). Finally, it is worth noting the importance of regional trading partners in most cases. The LMCs are important trading partners to one another providing not only formal, but also informal, trading of goods, services and even labour that shifts across porous borders.

Table 1 provides an overview of some of the key trading partners in terms of key exports, with those accounting for >5 percent, >10 percent and >20 percent highlighted in green²⁴.

Table 1: Key export trading partners with LMB countries

| | Cambodia | Laos | Thailand | Viet Nam |
|-------------|-----------------|-------------|-----------------|-----------------|
| China | 3.7% | 45% | 12% | 11% |
| Japan | 6.1% | 3.0% | 9.0% | 9.2% |
| South Korea | 1.5% | | 2.2% | 4.8% |
| Germany | 10% | 2.4% | 2.5% | 4.6% |
| USA | 22% | | 11% | 18% |
| Malaysia | | | 5.1% | 2.8% |
| Hong Kong | | | 5.0% | 3.2% |
| Indonesia | | | 4.1% | 2.0% |
| Australia | | | 4.0% | 2.7% |
| Thailand | 4.6% | 22% | | 2.4% |
| Viet Nam | 4.8% | 16% | | |
| UK | 10% | | | |
| Canada | 5.9% | | | |
| France | 4.1% | | | |

²⁴ NOTE: There are two different data sets for this: (A) MIT (2016) Observatory of Economic Complexity <http://atlas.media.mit.edu/en/> & ITC (trademap.org). Both sources ultimately use UN COMTRADE statistics.

Table 2 provides an overview of some of the key trading partners in terms of key imports, with those accounting for >5 percent, >10 percent and >20 percent highlighted in shades of green.

Table 2: Key import trading partners with LMB countries

| | Cambodia | Laos | Thailand | Viet Nam |
|-------------|-----------------|-------------|-----------------|-----------------|
| China | 22% | 26% | 18% | 30% |
| Japan | | 2.0% | 16% | 7.9% |
| South Korea | 4.4% | 2.2% | 3.9% | 14% |
| Germany | | | 2.6% | 1.7% |
| USA | 2.2% | | 5.9% | 3.9% |
| Thailand | 30% | 56% | | 5.0% |
| Singapore | 7.0% | | 3.8% | 5.3% |
| Viet Nam | 17% | 6.4% | | |
| Hong Kong | 6.1% | | | |

In terms of products traded among the LMB countries, as noted in Table 3, key export sectors include textiles and apparel, machines (broadcasting equipment, computers, etc.), mining and minerals (including mining, petroleum, and processing), wood products (largely timber), as well as vegetables and rubber. In terms of agricultural commodities, in particular, rice, coffee, nuts, cassava are all key export crops. Nevertheless, export markets for commodities only make up a small portion of the agricultural economy with the vast majority being consumed domestically.

Table 3: Summary of Regional Trade²⁵

| | Cambodia | Laos | Thailand | Viet Nam | China |
|---|--|--|--|--|--|
| Important export products | <i>Apparel, footwear</i> | <i>Oil, copper, ores, electronics, wood, electricity</i> | <i>Electronics, machinery, vehicles</i> | <i>Fertilizer, iron, fabric, oil</i> | <i>N/A</i> |
| Summary of regional trade patterns | Cambodia is dependent upon Thailand (for: Oil, Machinery, Salt, sulphur, earth, stone, plaster, lime and cement) and Viet Nam (for: Fertilizers, Oil) for imports, none of the regional partners for exports (western-country oriented). | Laos is heavily dependent upon Thailand for imports and exports. The export of hydropower to Thailand being an important linkage. Laos is also dependent upon Viet Nam for wood export (34 percent). | Thailand is not heavily dependent for imports or exports of merchandise goods on regional partners. However, they are dependent on the import of hydropower from Laos. | Viet Nam is not heavily dependent for imports or exports on regional partners, but there are some select products. | China is the import trade partner for the LMCs (with 19-35 percent of imports coming from China); exports are variable from 3 percent (Cambodia) to 38 percent (Laos). |

Table 4 below indicates the grouping of particular export commodities within each country. Material (>10 percent of national total) export commodities are flagged in green, with the highest values denoted in bold font. Of particular interest is the high proportion of textiles and apparel exports in Cambodia (78 percent), in addition to the significance of the wood exports from Laos (39 percent). Of particular relevance is considering what the relationship with water is within each of the sectors.

²⁵ Data source behind numbers ITC Trademap.org (authors' interpretation).

Table 4: Percentage of national exports by product grouping. Source: MIT (2016) Observatory of Economic Complexity <http://atlas.media.mit.edu/en/>

| | Cambodia | Laos | Thailand | Viet Nam | Average |
|--------------------------------|-----------------|-------------|-----------------|-----------------|----------------|
| Textiles & Apparel | 77.80% | 7.60% | 3.50% | 24.90% | 28.45% |
| Machines | 3.70% | 4.60% | 34% | 35% | 19.33% |
| Mining & Minerals | 1.00% | 31% | 12.30% | 10% | 13.58 |
| Wood Products | 3.20% | 39% | 1.00% | 1.60% | 11.20% |
| Fruits & Vegetables | 4.90% | 6.70% | 4.60% | 6.40% | 5.65% |
| Plastics & Rubber | 1.70% | | 12% | 3.20% | 5.03% |
| Transportation | 3.50% | 0.10% | 12% | 1.40% | 4.25% |
| Processed Foods | 0.90% | 3.10% | 7.60% | 2.50% | 3.53% |
| Chemical Products | | 2.70% | 5.30% | 1.70% | 3.23% |
| Instruments | | | 2.50% | 1.10% | 1.80% |
| Animal Products | 0.10% | | 1.40% | 3.50% | 1.67% |

The Asian Development Bank (ADB) has initiated the concept of developing economic corridors connecting neighbouring countries in the GMS through infrastructure development and trade and tourism facilitation measures²⁶. Such corridors have seen some success. The Friendship Bridge from Nong Khai in Thailand to Tarnaleng in Laos facilitated increased cross-border truck traffic, growing by 16 percent per annum in the five years after it opened and now accounting for 88 percent of all passenger traffic and 55 percent of all cargo traffic between the two countries.

3.1.4 Exploring the Impact of China as a Driver

The Mekong's ties to China are not only geographic, but historic as well. For thousands of years' goods have flowed up and down the Mekong between various Chinese dynasties and the civilizations from the Mekong. Even today, China's importance in the region is hard to underestimate.

²⁶ The Cross Border Economies of Cambodia, Laos, Thailand and Viet Nam (2005) <http://www.cdri.org.kh/webdata/download/dan/ddan4.pdf>

As a trading partner, China dominates regional trade as the major provider of inputs for all of the LMCs, and a key importer of goods, especially for Laos and Viet Nam. For example, wood exports from Laos to China alone account for 14 percent of the total of Laos' global exports (ITC, 2016).

Specifically, from a hydro-economic perspective, China controls the headwaters of the Mekong, and based on MRC estimates, at least half of its sediment load²⁷. China also controls roughly 30 percent of dry season flow (Figure 11: High sediment generating areas in the Mekong Basin), the second largest amount aside from Laos. Furthermore, as trade opens up, both workers and economic goods are moving more freely throughout the region, including from and into China's southern Yunnan Province²⁸.

What is worth noting is that via the tight (and highly disproportionate in terms of power) economic relationship between China and Laos, China can effectively dictate the policies driving hydrological flows in the basin (between 54 percent and 65 percent of total flow in the wet and dry seasons respectively). One example of this taking place is through the new Lancang-Mekong Cooperation (LMC) initiative, which indicates a rise of China as the Mekong River Commission retreats from its traditional leadership role²⁹. Simply put, China has a strong ability to influence the flows of water, and in turn the food-energy-water security, and ultimately the economies, of the LMCs.

3.1.5 Economic Overview of Each of the Mekong Countries

The Mekong Basin is critically important to the countries that are found within it. The Mekong represents about 90 percent of the population of Cambodia (13 million), 97 percent of the population of Laos (6 million), 37 percent of the population of Thailand (23 million), and 20 percent of the population of Viet Nam (16 million in the Delta and 2 million in the Central Highlands). Therefore, the Basin is important not only due to the resources that it provides, but also the number of people it supports within each country. Annual population growth in the basin is 1-2 percent in Thailand and Viet Nam and 2-3 percent in Cambodia and Laos. Although slowing, this population growth is still significant. With more mouths to feed,

27 Anthony, E.J., Brunier, G., Besset, M., Goichot, M., Dussouillez, P. & Nguyen, V.L. (2015) Linking rapid erosion of the Mekong River delta to human activities, *Nature Scientific Reports*, 5, Article number: 14745. Available online: <http://www.nature.com/articles/srep14745>

28 http://www.viet-studies.info/kinhte/FA_MekongRegion.htm

29 <http://thediplomat.com/2016/01/mekong-river-commission-faces-radical-change>

Southeast Asia will need to increase food production and meet an increased energy demand. Demographic changes are also taking place as young people move to cities in search of better employment opportunities. Therefore, rural migration has also resulted in an ageing population as well feminisation of agriculture.

There are over 100 different ethnic groups living within the Basin's boundaries, making it one of the most culturally diverse regions of the world. Population density in the Mekong Basin is highest in Viet Nam (260 inhabitants/km²) and lowest in Laos People's Democratic Republic (24 inhabitants/km²).³⁰

Table 5: Overview of basic population and growth statistics for LMB countries

| Country | Population growth (annual %) | Urban population growth (annual %) | Population density (people per sq. km of land area) | Population, total |
|----------|------------------------------|------------------------------------|---|-------------------|
| Cambodia | 1.54 | 2.27 | 81.37 | 14,363,586 |
| Laos | 1.73 | 5.23 | 27.13 | 6,260,544 |
| Thailand | 0.22 | 3.29 | 130.54 | 66,692,024 |
| Viet Nam | 1.05 | 3.16 | 280.36 | 86,932,500 |

The GDP contribution per sector of each country is indicated in the figure below. Evident in the figure is the change in relative importance of sectors such as agriculture or industry between 2000 and 2010³¹.

Thailand is seen as the gateway to the Lower Mekong sub-region. It has the largest and most developed market and is an important source of technology, knowledge and capital. Thailand is the second-largest economy in Southeast Asia after Indonesia. The country also ranks second in Southeast Asia in external trade volume, after Singapore. Thailand is an active member of WTO, Association of Southeast Asian Nations (ASEAN) Free Trade Area(AFTA) and (Asian Pacific Economic Cooperation (APEC)³².

³⁰ FAO Aquastat, Mekong Basin. <http://www.fao.org/nr/water/aquastat/basins/mekong/index.stm>

³¹ World Bank Database, own graph

³² The Cross Border Economies of Cambodia, Laos, Thailand and Viet Nam (2005) <http://www.cdri.org.kh/webdata/download/dan/ddan4.pdf>

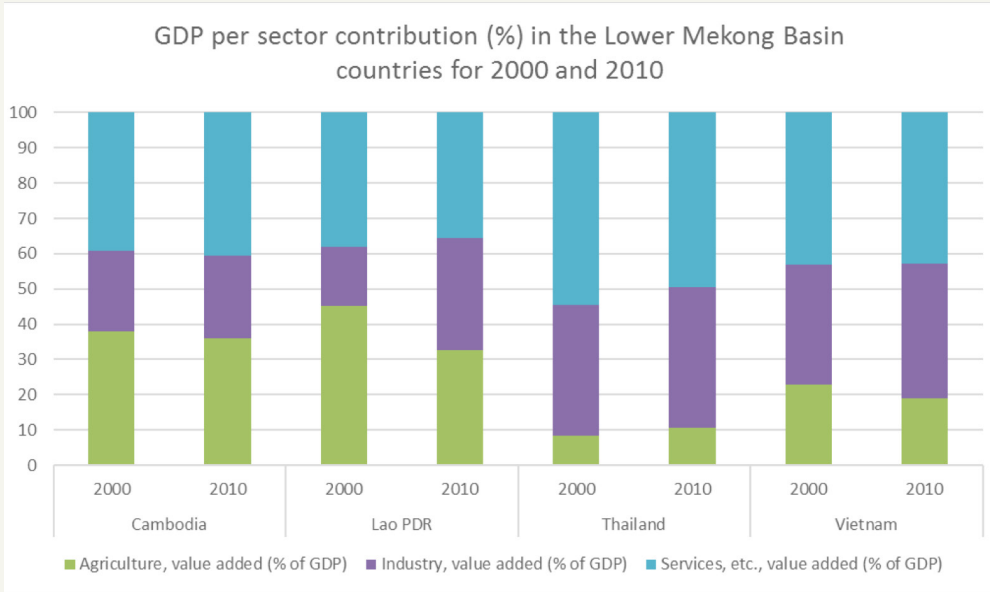


Figure 15: GDP per sector contribution in the Lower Mekong Basin (2000 and 2010)

Thailand is a newly industrialized country. Its economy is heavily export-dependent, with exports accounting for more than two-thirds of its GDP. The industrial and service sectors are the main sectors in the Thai GDP, with the former accounting for 39.2 percent of GDP. Thailand’s agricultural sector produces 8.4 percent of GDP—lower than the trade and logistics and communication sectors, which accounts for 13.4 percent and 9.8 percent of GDP respectively. The construction and mining sector adds 4.3 percent to the country’s GDP. Other service sectors (including the financial, education, and hotel and restaurant sectors) account for 24.9 percent of the country’s GDP.

Thailand’s unemployment rate is low, reported as 0.9 percent for the first quarter of 2014. This is due to a large proportion of population working in subsistence agriculture or on other vulnerable employment (own-account work and unpaid family work).

Cambodia began economic liberalisation in the late 1980s and early 1990s, by ending the state monopoly of foreign trade, enactment of a foreign investment law, lifting of quantitative restrictions on imports and abolishing licensing requirements for trade. In the late 1990s, Cambodia joined ASEAN and became a signatory to the ASEAN Free

Trade Area (AFTA). In 2001, the tariff structure was reorganised to improve trade into and out of Cambodia. The economically active populations living in Cambodia along the border with Thailand are heavily dependent on cross-border related activities—garments, trade, transport, construction and services. There is also a significant seasonal movement of agricultural labour to Thailand.

Cambodia's recent economic growth is largely due to the textile and tourism industries, with a large percentage of rural Cambodians garnering their income from agricultural activities. In particular, this success has been driven by performance in garment manufacturing, tourism, paddy and milled rice and a booming construction industry. Although this growth remains promising, Cambodia is incredibly vulnerable to shocks and natural disasters, making future economic stability tenuous.

Although the civil unrest in the late 90s saw a decrease in foreign investments, by 1999, the Cambodian economy had stabilised and has since continued to grow at 6-8 percent per annum.³³ The 2000s saw continued growth, with GDP growing by roughly 18 percent in 2007. Foreign direct investment, in particular from U.S. investors, coupled with an increasing garment exporting industry and booming tourism industry, painted a very rosy picture for Cambodia's economy. In late 2007, however, the picture shifted again, as Viet Nam moved in on Cambodia's market. The 2008 economic crisis was an even greater blow. Exports in garment industry to the United States and Europe fell by 23 percent and 60,000 workers were laid off.³⁴ While poverty rates in the country have fallen—from 2007 to 2012, poverty rates fell from 50 percent to below 20 percent—more than 70 percent of Cambodia's population lives on less than USD 3 a day.

Viet Nam is a relatively new entrant to the world of open markets. Viet Nam is part of ASEAN-AFTA and APEC. Growth in exports has also been due to stabilisation of foreign political relations with China as well as with the West, after years of conflict and isolation. Trade liberalisation was introduced to generate rapid growth, in addition to significant FDI inflows. Unlike Thailand, Viet Nam has not initiated many free trade or bilateral trade agreements. However, it did sign a bilateral trade agreement with the USA in 2001, helping it to expand rapidly exports to the USA.

³³ Un, Kheang. "Cambodia in 2011: A Thin Veneer of Change." *Asian Survey* 52.1 (2012): 202-09. Web.

³⁴ Lee, Joosung J. "An Outlook for Cambodia's Garment Industry in the Post-Safeguard Policy Era." *Asian Survey* 51.3 (2011): 559-80. Web.

This is evident in the export statistics of Viet Nam, indicating the USA as a major trade partner.

Viet Nam's socialist-oriented market economy is a developing planned economy and market economy. Since the mid-1980s, Viet Nam has made a shift from a highly centralized planned economy to a mixed economy experiencing rapid growth. Almost all Vietnamese enterprises are small and medium enterprises (SMEs). Viet Nam has become a leading agricultural exporter and served as an attractive destination for foreign investment in Southeast Asia. Viet Nam is one of the top rice exporting countries in the world and the world's second largest exporter of coffee. Seafood exports are also significant, with catfish and shrimp exports to the United States increasing fourfold between 1990 and 2002.

Laos is in a unique category amongst the four countries. Because it is a landlocked country, cross border trade for Laos is synonymous with foreign or international trade. Cross border trade for Laos is thus vital to its economy. Like Viet Nam and Cambodia, Laos is a transitional economy, grappling with the problem of moving towards a market-driven (as opposed to a centrally planned) economy. Laos suffers from a lack of investments, poor bargaining power and poor governance to leverage upon the strategic position with borders with Myanmar, Cambodia, Viet Nam, Thailand and China.³⁵ Currently, the economy grows at 8 percent a year, and the government is pursuing poverty reduction and education for all children as key goals. Domestic savings are low, forcing Laos to rely heavily on foreign assistance and concessional loans as investment sources for economic development.

Agriculture, mostly subsistence rice farming, dominates the economy, employing an estimated 85 percent of the population and producing 51 percent of GDP. Agricultural products include sweet potatoes, vegetables, corn, coffee, sugarcane, tobacco, cotton, tea, peanuts, rice, water buffalo, pigs, cattle, poultry. In mid-2012, the Laos government issued a four-year moratorium for new mining projects. The reasons cited were environmental and social concerns relating to the use of agricultural land.

35 The Cross Border Economies of Cambodia, Laos, Thailand and Viet Nam (2005)
<http://www.cdri.org.kh/webdata/download/dan/ddan4.pdf>

3.1.6 Key Economic Sectors in the Mekong

Agriculture/Irrigation

Agriculture provides food security and livelihoods to approximately 60 percent of the Mekong River Basin's population. The agricultural sector employs 60 percent of the region's labour, but the average share of the GDP is only 14 percent. It means that the GDP per unit of labour in agriculture is only 10 percent of that in the other sectors.³⁶ Therefore, it is important that Mekong countries increase their agricultural yields in an effort to reduce poverty in the Basin. Water shortages in the dry season lead to poor agricultural productivity in Cambodia, Northeast Thailand, Laos and the Central Highlands of Viet Nam. The Viet Nam Delta is the only area in the Basin where water shortages do not impact productivity.

Over 10 million hectares of cultivated land is dedicated to rice production. Rice is the most important crop in Asia, and rain-fed cultivation is the most prevalent agricultural method throughout the Basin. Rice paddy fields also serve as flood mitigation measures, soil erosion control and fisheries. Other crops such as cassava, sugar cane, soybean and maize are grown. However, in comparison to rice, these crops are very small.

Irrigation is the leading use of water in the Lower Mekong countries (70 percent of total water use). The total irrigated area in the Basin is approximately 4 million hectares, and irrigated areas are expanding steadily in all four member countries. Viet Nam accounts for 42 percent, Thailand 30 percent, China 12 percent, Cambodia 8 percent, Laos 7 percent and Myanmar 2 percent of the total irrigation in the Basin. The equed area irrigated by surface water accounts for 98 percent, while groundwater accounts for 2 percent³⁷. The Northeast of Thailand and the Viet Nam Delta are home to the majority of irrigation, where there is a trend toward commercialisation³⁸. Yields in irrigated paddy in dry season and wet seasons are higher than those in rain-fed paddy by 35-65 percent and 20 percent respectively with higher radiation during dry seasons.³⁹

Currently, expansion of agriculture in its present level in the basin is limited by water availability in the dry season. Reservoir dams

³⁶ <http://www.mrcmekong.org/assets/Publications/Programme-Documents/AIP-Pogramme-Doc-V4-Final-Nov11.pdf>

³⁷ FAO Aquastat, 2011, Statistics on the Mekong Basin

³⁸ <http://www.mrcmekong.org/topics/agriculture-and-irrigation/>

³⁹ <http://www.mrcmekong.org/assets/Publications/Programme-Documents/AIP-Pogramme-Doc-V4-Final-Nov11.pdf>

upstream may be able to support the storage of water during the dry season, providing a boost to the agricultural sector. In the next 20 years, there are plans to increase the dry season irrigation by 50 percent (1.2 to 1.8 million ha). Laos is planning to expand irrigation from less than 100 000 ha to more than 300 000 ha. In addition, major expansion in irrigation is being considered in Cambodia. This is being linked to flood control in the undeveloped Cambodian delta as well as hydropower developments elsewhere⁴⁰.

Fisheries / Aquaculture

The Mekong Basin fish harvested every year represent about 18 percent of the world's freshwater fish yield and make it the largest inland fishery in the world⁴¹. The resource provides a lifeline to millions of people as their primary source of protein. The sector also supports many small to medium-sized businesses through the supply chains and secondary sectors such as boat building or fishing gear supply.

The Mekong is home to at least 1 500 species of freshwater fish, the second highest species count in the world after the Amazon River. However, there is still insufficient knowledge of the migratory behaviour and ecosystem requirements of many species. Important zones for migratory fish have been identified by MRC as: (i) dry season refuge habitats - deep pools, particularly in the Kratie-Stung Treng stretch of the Mekong mainstream; (ii) flood-season feeding and rearing habitats—floodplains in the Mekong delta in Viet Nam, in southern Cambodia, and in the Tonle Sap system; and (iii) spawning habitats—rapids and deep pool systems in Kratie-Khone Falls, and in the Sesan catchment, plus floodplain habitats in the South (e.g. flooded forests associated with the Tonle Sap).

Total catches and production from Mekong fisheries (including aquaculture) amounted to about 3.9 million tonnes in 2008, of which about 2 million tonnes was from capture fisheries. Fisheries accounts for nearly 12 percent of Cambodia's GDP and contributes more to the country's economy than rice production. In Laos, the fisheries value is equivalent to 7 percent of the country's GDP. Although proportionally less significant to the national economy, the Mekong fishery sectors in Thailand and Viet Nam add well over USD

⁴⁰ FAO Aquastat. Mekong Report.

⁴¹ Baran E., Guerin E., Nasielski J. 2015 Fish, sediment and dams in the Mekong. Penang, Malaysia: WorldFish, and CGIAR Research Program on Water, Land and Ecosystems (WLE). 108 pp.

750 million to their GDP each year⁴².

Capture fisheries make the largest contribution to the fishery sector. However, due to the growing number of fishers, catch sizes have started to decrease. At the same time, there has been a significant growth in the aquaculture sector. The inland fisheries of the LMB are among the world's largest, with surveys indicating that the total production is now in the order of 3.6 million tonnes (mt) per year. It is estimated that about 2.1 mt is from capture fisheries and 1.5 mt from aquaculture, of which about one million tonnes is exported. Commercial fishing and aquaculture employs several million people, and the LMB's fisheries are of particular importance for the millions of rural people for whom fishing is a secondary occupation that provides food security and supplementary income⁴³. In 2008, production was estimated at about 1.9 mt, five times more than in 2000. About 1.6 mt originates from the Mekong Delta in Viet Nam. The production of inland aquaculture in Cambodia, Laos and Thailand is also increasing, but remains less important than capture fisheries.

The high productivity of the fisheries in the Mekong is linked to the provision of sediment and nutrients provided through the connectivity of flows in the Mekong River. At least 35 percent of the fish species are migratory. There are 13 unique, yet connected, ecosystems that exist. Despite long-term intensive human use, the freshwater system has maintained connectivity between 11 of the 13 ecosystems in about 60 percent of the system by area. However, the growing need for energy in the GMS has led to an unprecedented rate of dam building, impacting freshwater ecosystems, the river's connectivity and flow and the people that rely on these. Eleven dams are planned on the Mekong main stem.

Energy

At present, only 10 percent of the estimated hydroelectric potential in the Lower Mekong Basin is developed. How Mekong countries decide to pursue future hydropower development is perhaps one of the most challenging strategic decisions they have faced since the signing of the 1995 Mekong Agreement. It is important that member countries work together to balance sustainability with development opportunities.

⁴² <http://www.mrcmekong.org/topics/fisheries/>

⁴³ <http://www.mrcmekong.org/assets/FP-2011-2015-Documents-FINAL.pdf>



Map of GMS Planned and Current Transmission Line Interconnections. Credit: GMS Atlas of the Environment, October 2013 <www.gms-eoc.org>

Figure 16: Map of GMS Planned and Current Transmission Line Interconnections

The most advanced example of power trading is the Greater Mekong Sub Region Economic Cooperation Program (GMS). Launched in 1992, GMS includes Cambodia, Laos, Myanmar, Thailand, Viet Nam, and extends beyond ASEAN to include a portion of China (Guangxi Zhuang Region and Yunnan Province). As of 2011, there were 11 operational hydropower plants in the GMS and seven under construction, with the majority located in Laos. Trade among GMS members is based on long-term bilateral power purchase agreements signed between utilities and independent power producers (s). Regional integration in the GMS is expected to provide significant economic savings and environmental benefits, and serves as an indication of the possible benefits for ASEAN. The ADB estimates that the interconnection of GMS power systems has resulted in USD 14.3 billion in savings, coming mainly from the substitution of fossil fuel generation with hydropower⁴⁴.

44 https://www.iea.org/publications/freepublications/publication/Partnercountry_DevelopmentProspectsoftheASEANPowerSector.pdf

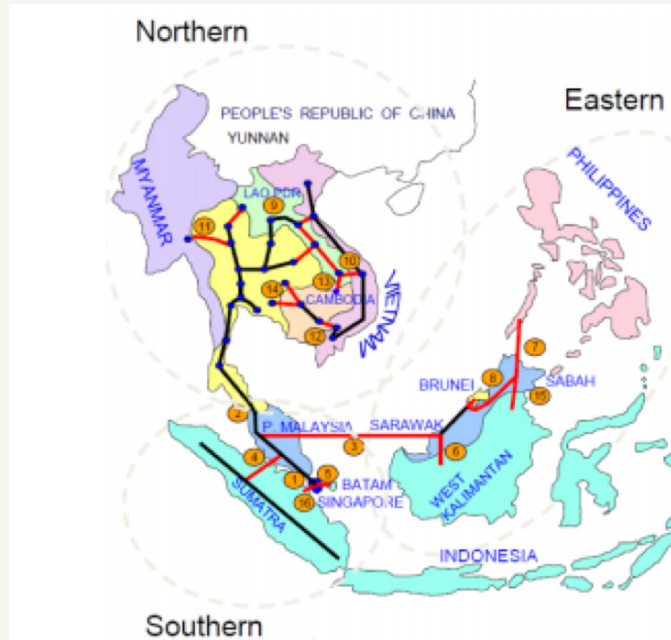


Figure 17: Electricity connectivity in the Mekong Basin Region

Table 6: List of connectivity plans in the Mekong Basin Region

| | |
|--|-------------|
| Thailand - Lao PDR | |
| • Roi Et 2 - Nam Thuen 2 | Existing |
| • Sakon Nakhon 2 - Thakhek - Then Hinboun (Exp.) | Existing |
| • Mae Moh 3 - Nan - Hong Sa | 2015 |
| • Udon Thani 3 - Nabong (converted to 500KV) | 2019 |
| • Ubon Rachathani 3 - Pakse -Xe Pian Xe Namnoy | 2018 |
| • Khon Kaen 4 - Loei 2 - Xayaburi | 2019 |
| • Thailand - Lao PDR (New) | 2015 - 2023 |
| Lao PDR - Vietnam | 2016 - 2020 |
| Thailand - Myanmar | 2018 - 2026 |
| Lao PDR - Cambodia | 2016 |
| Thailand - Cambodia (New) | Post 2020 |

The Thailand-Laos hydropower interconnection, established in 1971, is one of the longest standing electricity interconnections in the region and supports exports of approximately 2 293 MW of electricity from Laos to Thailand via four existing sites. From this connection, Thailand was able to gain access to cheaper electricity fuelled by hydro, whereas its own national resources were previously mainly dependent on oil and gas. In turn, Laos was able to use part of Thailand's transmission network to provide electrical access to its own remote areas. This is possible under an agreement that Thailand re-exports part of the electricity to Laos, since Laos does not have the infrastructure to provide access to remote border towns. Laos also earns income from the export of electricity. The electricity exchange encourages the strong commercial interest in Thailand's and Laos's energy development. In order to further maximise the exchange of electricity, Thailand has acted as a developer of power generation and transmission and development (T&D) projects in Laos. Thailand has served as a long-standing electricity customer to Laos based on memorandum of understanding agreements between the two governments and power purchase agreements. Laos is also currently developing hydropower projects to export to Viet Nam (approximately 1 410 MW between 2015 and 2020) under similar exchange models⁴⁵.

Cambodia

Cambodia's installed capacity totals 732 MW. In 2011, Cambodia had a peak demand of 671 MW and a total annual demand of 3 400 GWh. Cambodia relies heavily on Independent Power Producer (IPP) generation, with 91 percent of generated electric power coming from s in 2011. In 2012, diesel/heavy fuel oil made up 55 percent of Cambodia's power generation mix. Hydropower comprises a 39 percent share of generating capacity. Additionally, coal and biomass energy contribute approximately 6 percent of Cambodia's power mix. In 2012, an estimated 35 percent of Cambodia's general population had access to electricity. Since 2010, Cambodia imports over half of its electricity from neighbouring countries – Thailand, Viet Nam and Laos – through existing interconnections. Cost-effective and reliable electrification of rural Cambodia through renewable energy technologies is a priority for government programmes. Cambodia aims to achieve 70 percent of household electrification with grid quality electricity by 2030. This can be assisted by establishing

⁴⁵ https://www.iea.org/publications/freepublications/publication/Partnercountry_DevelopmentProspectsoftheASEANPowerSector.pdf

significant future interconnections with Thailand (2 200 MW) and Laos (300 MW) in the ASEAN Power Grid (APG) plan. Most importantly, electricity exports could provide export earnings as Cambodia becomes a net electricity exporter.

Laos

The country's total installed capacity is approximately 2 978 GW, with Electricité du Laos (EDL), the state-owned power utility, owning 20 percent and 80 percent owned by IPPs. Annual total demand was approximately 2 174 GWh in 2011. Laos has significant local resources for power generation, such as wood fuel, coal, and hydropower. Hydropower, the most abundant and cost-effective energy resource, accounts for 97 percent of power generation. Laos has several power co-operation agreements with neighbouring countries, such as Thailand, to meet domestic demand during hydroelectric-supply shortages in the dry season. Revenue from cross-border sales has enabled the financing of domestic projects as well as investment in electrification. EDL is steadily expanding the power grid throughout the country; in 2011, electrification rates reached 78 percent. Rural electrification has been an important component of achieving national electrification, with the government target set at 90 percent electrification by 2020. Significant hydropower potential has resulted in the conception of the Laos-Singapore multilateral trading project. In addition, multiple interconnection projects with Thailand, Cambodia and Viet Nam have been planned in the next five to ten years. Regional interconnection could help Laos monetise its hydro resources for export and boost its national economy.

Thailand's total installed capacity is approximately 34 335 W. In 2013, Thailand's peak demand was 26 121 MW. Natural gas makes up approximately two-thirds of power generation, as domestic oil and coal reserves are very limited. Dependency on gas-fired power generation makes Thailand vulnerable to fluctuations in the international market and poses important concerns for electricity supply and power security. Thailand's National Power Development plan focuses on increasing green energy to maintain the security and adequacy of the power system. The state-owned generator Electricity Generating Authority of Thailand (EGAT) still dominates 47 percent of the electricity market share, though it is followed by IPPs, which hold 37 percent. As of 2012, Thailand had an electrification rate of 99.3 percent. Thailand's electricity imports have tripled in the past decade as demand and grid interconnections expand. In 2012, Thailand imported 10.3 GWh from existing interconnections

with Malaysia and Laos. Against this backdrop, Thailand will play a major role in the APG as future interconnections with Laos, Cambodia, Myanmar and Peninsular Malaysia have the potential to boost security of supply and present the opportunity of additional electricity imports. Increasing import capacity would help Thailand to decrease its gas dependency, decarbonise its electricity sector and increase access to generation capacity.

Viet Nam

Viet Nam's total generation capacity stood at 26 926 MW with peak demand at 18 649 MW in 2012. Total generation amounted to 122.8 TWh, while estimated consumption was 109.6 TWh. Viet Nam's generation mix is made up as follows: 56 percent from coal, oil and gas, 35 percent from hydropower, and approximately 2 percent from renewable resources. Viet Nam has seen the strongest increase in electricity demand of all ASEAN countries in the past decade. In order to further ensure the security of power supply, Viet Nam plans to develop more than 10 000 MW of nuclear energy by 2030. Viet Nam is actively promoting domestic and foreign IPPs, which accounted for 29 percent of installed capacity in 2009. Viet Nam has a 99.6 percent electrification rate as of 2014. The state power company aims to achieve 100 percent electrification by 2020 by connecting regional grids into one national grid. Viet Nam presently exports electricity to Laos and Cambodia and purchases electricity from China through transmission lines. In the APG, additional interconnections with Laos may enable Viet Nam to import lower-cost hydropower and effectively reduce the country's dependence on fossil fuels. Viet Nam could decrease its reliance on coal and imports and decarbonise its electricity sector.

Hydropower in SE Asia

Southeast Asia has significant untapped hydropower potential – on the Mekong River alone, only 10 percent of its estimated hydropower potential has been developed. In a region where millions lack electricity, hydropower is seen as a way to increase access to electricity without importing fuels or increasing carbon dioxide (CO₂) emissions. Some countries see hydropower as their key to economic growth - Laos, for instance, aims to become the “battery of Southeast Asia” by increasing hydroelectricity exports to neighbouring countries. Its total hydropower potential is estimated at 23 000 MW, but only 3 205 MW had been developed by 2012. In the Greater Mekong Sub region, 11 hydropower plants were operating in 2011 and another seven were under construction, mostly in Laos.

Despite this potential, hydroelectric dam construction can cause serious social and environmental disruptions in Southeast Asia. In parts of the region, dam construction has already displaced communities, flooded farmland and reduced water quality. An estimated one-third of the 60 million people living in the Lower Mekong River Basin have a primary occupation linked to the river - in fishing, farming and other sectors. Hydropower development is likely to disrupt the ecosystems that this population relies on for food and income, such as fisheries and the seasonal flood cycles that fertilise agricultural land. Hydropower generation itself may be disrupted by changes in Southeast Asia's precipitation patterns that are linked to climate change. While precipitation in the region is predicted to increase overall, Southeast Asia is also expected to face more extreme periods of drought and flooding. Drought (and even annual dry seasons) could reduce hydropower generation, as occurred on Thailand's Mun River. Dam construction can also make seasonal floods more extreme and dangerous, as reports on devastating floods in India have shown. Given the pressures that population growth, electricity demand and climate change are expected to put on shared water resources such as the Mekong River Delta, Southeast Asian countries will need to co-ordinate their hydropower development and share information on water usage to avoid interfering with the other useful resources that waterways provide. Also, with more interconnected power grids, ASEAN nations could take advantage of complementarities between different river systems to develop hydropower in ways that are more efficient and sustainable.

Navigation / Transport

For hundreds of years, the Mekong River has been a vital passageway for people and goods. Today, the Mekong is still an essential means of transportation for many of the people living in the region and plays an increasingly important role in international trade and tourism. For example, in Viet Nam, roughly 73 percent of cargo tonnage and about 27 percent of passengers travel by water annually.

Within the LMB, the Mekong River and its major tributaries are navigable during the high-water season (about eight months of the year), with the exception of a 14-km section just north of the border between Cambodia and the Laos – the impassable Khone Falls.

In the LMB, river-based trade in Viet Nam and Cambodia has grown significantly in recent years. In 2009, Mekong trade received a

significant boost with the opening of a new deep-water port at Cai Mep in Viet Nam. The Cai Mep container terminals can accommodate some of the largest container ships in the world. These vessels sail directly to Europe and the United States.

Extractives

The Lower Mekong countries are rich in mineral resources. The region has proven reserves of approximately 1.2 billion cubic meters of natural gas, 0.82 billion tons of oil, and 28.0 billion tons of coal. Myanmar, Thailand and Viet Nam possess large natural gas deposits, while Cambodia is opening up for natural gas exploration. Within the region, Thailand and Laos possess the greatest coal deposits and Viet Nam has the largest oil reserves. Other mineral resources in the Lower Mekong, in addition to the energy-related commodities above, include: gold, copper, jade, lead, zinc, phosphate, potash and gemstones, including rubies and sapphires. Myanmar, which is mostly outside the river basin, is endowed with substantial quantities of copper, nickel, zinc, manganese and tin, as well as gemstones ruby, sapphire and jade⁴⁶.

The Lower Mekong countries were amongst the top ten producers by quantity for several minerals in 2014: Viet Nam was the number two world producer of both tungsten and bismuth, and number five for titanium; Thailand was the number three producer of gypsum and number five for feldspar; Myanmar was the number three producer of tin globally; and Laos was ranked as number 18 producer of copper globally⁴⁷.

Flooding and drought

Cycles of flooding and drought in the Mekong are a natural occurrence and have continued for millennia. However, as the basin has become increasingly developed, the impacts of flooding and drought have changed. For instance, the average annual cost of floods in the Lower Mekong Basin equates to USD 60 – 80 million⁴⁸. However, flooding in the Mekong also provides important benefits to the basin too. The average annual value of these benefits is approximately USD 8 – 10 billion⁴⁹. Therefore, flood management needs to try and balance the competing benefits and costs associated with flooding in the Mekong.

⁴⁶ <https://opendevelopmentmekong.net/topics/extractive-industries>

⁴⁷ <https://opendevelopmentmekong.net/topics/extractive-industries>

⁴⁸ <http://www.mrcmekong.org/topics/flood-and-drought/>

⁴⁹ <http://www.mrcmekong.org/topics/flood-and-drought/>

The environmental, social and economic benefits of flooding are greater in the Mekong than any other basin in the world. The pulse of the flood drives the productivity of the fisheries sector. In addition, flood-deposited sediments improve soil fertility, while floodwaters are stored for use in the dry season, particularly irrigation. Floods also flush and dilute stagnant and polluted waters, recharge groundwater tables and maintain river morphology⁵⁰.

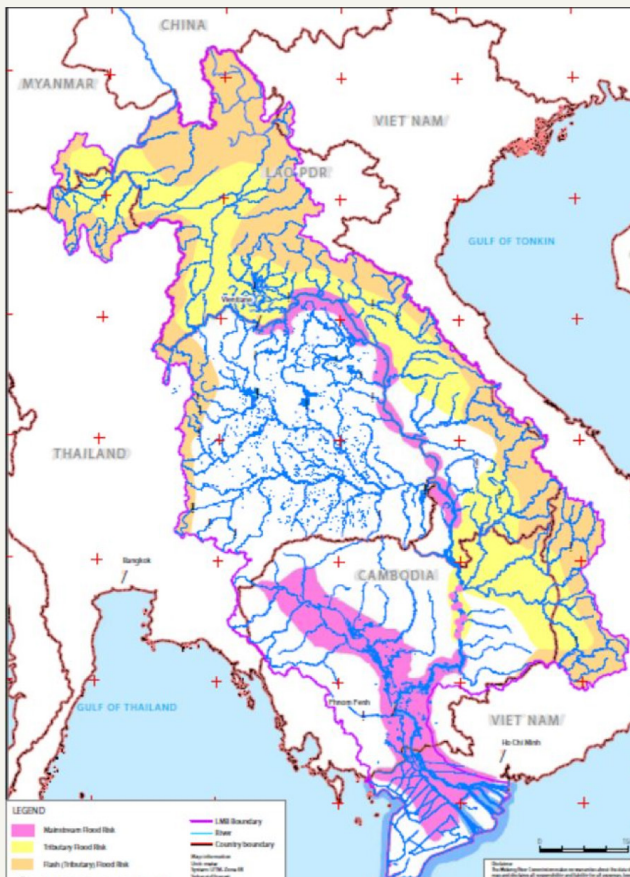


Figure 18: Indicative Areas Subject to Significant Flood Risk in the LMB.

Source: MRC (<http://www.mrcmekong.org/topics/flood-and-drought/>)

However, as indicated, flooding also causes major damage including the loss of life, damage to agriculture as well as infrastructure. Some regions are especially sensitive to flooding damages. Cambodia and Viet Nam alone commonly account for approximately two-thirds of the region's total annual flood damage⁵¹.

The cost of drought in the LMB is far larger than the cost of flooding. This is compounded by the fact that droughts have no apparent benefit. Droughts in the Mekong have resulted in food and water shortages, loss of income and higher levels of disease. Agriculture, in particular rice, is sensitive to drought. However, livestock and fisheries may also be affected. Because droughts occur at a relatively high frequency in the Mekong and therefore the costs are higher than flooding⁵².

⁵⁰ <http://www.mrcmekong.org/topics/flood-and-drought/>

⁵¹ <http://www.mrcmekong.org/topics/flood-and-drought/>

⁵² <http://www.mrcmekong.org/topics/flood-and-drought/>

3.1.7 The Zones of Productivity: the economic importance of select regions in the Mekong

Beyond a general picture of the LMCs, it is also worth noting some of regional aspects at play. In particular, there are specific regions that play a disproportionate role in the production of some of these goods. Some of the notable areas include: (A) the key cities along the Mekong (Phnom Penh, Vientiane, Can Tho), (B) Mekong Delta⁵³, (C) the Tonle Sap, and (D) the “water/sediment towers” of the Tibetan Plateau, Nam Ou, Nam Ngum and Nam Kading systems and the 3S Basin.

Cities: Urban areas are increasingly a key aspect of the economies of the LMCs. As the service and industrial economies of these countries grow, so too have the urban areas with populations. As an example, Ho Chi Minh City has grown from 4.3 million in 2000 to a current estimate of over 7 million⁵⁴. This rapid growth has brought with it the formation of a middle class throughout the LMCs (most notably in Thailand/Bangkok and Viet Nam/Ho Chi Minh, but to a lesser extent in Phnom Penh and Vientiane). Bangkok, in particular, is of interest, as it is not situated within the Mekong Basin. However, resources such as building material like sand are sourced from the Mekong Basin. As these cities grow, they become increasingly dependent upon water resources for drinking water and sanitation, inexpensive labour to fuel the growing service sector (and industrial sector), as well as energy. Wealth in urban areas is not equally distributed, with youth and women having much lower levels of affluence. In short, the success or failure in the management of the Mekong will most greatly be felt in the urban areas throughout the region.

Mekong Delta: More than most places in the Mekong, the Delta is a disproportionately important area from an economic angle. The Delta contributes about 70 percent of Viet Nam’s fruit production, over 40 percent of its fish products from aquaculture and over 74.6 percent of the total fishery production in Viet Nam. The Delta produced an agriculture value added of VND 23.430 billion in 2011, corresponding to about 41 percent of regional GDP, broken down by 50 percent of rice production, 65 percent of aquaculture production and 70 percent of fruits of the country. It also accounted for 95 percent of rice export and 60 percent of fish export of Viet Nam

⁵³ <http://www.mrcmekong.org/topics/flood-and-drought/>

⁵⁴ Note that Ho Chi Minh City is not technically on the Mekong, (but on the Saigon River) however, it is still a key hub or influence on the Mekong Delta.

during the past decade⁵⁵. The story of the flows, and moreover the flows of sediment, will dictate the economic vitality of this region.

Tonle Sap: The high productivity of Mekong fisheries is largely linked to the presence and dynamics of sediments and nutrients. The Tonle Sap Lake and its floodplains are especially linked to sediment. They retain 61 to 69 percent of the sediments they receive. The “*Dai*” (bagnet) fishery in the Tonle Sap River illustrates the correlation between fish catches and sediment inflows. Some studies have shown that an 80 percent reduction in Mekong sediment input would result in a 36 percent decline of the total fish biomass in the Tonle Sap.⁵⁶

The fisheries, which are concentrated in the Delta and Tonle Sap, provide an estimated value of up to USD 17 billion⁵⁷. Indeed, fisheries provide 47 percent - 80 percent of animal protein consumed in the Greater Mekong Sub region (ADB, 2015). Without the sediment and flow feeding the Tonle Sap, this protein source faces a questionable future, begging the question of how to replace the primary protein source for some 30+ million people.

Water Towers: Not all regions across the LMB are equally important when it comes to flow contribution, which also can be referred to as water yield. The mountainous areas that receive a disproportionate amount of the precipitation within the basin are key areas to consider when engaging in a systemic approach to planning. These “water towers” – the source water regions for the Mekong – are located primarily in China in the Himalaya, as well as the Annamite and Luang Prabang Ranges. These regions are critical in terms of what happens to their flows and sediment, as the decisions there will determine much of the economic fate of the regions downstream.

55 Green Growth Initiative, *Unleashing Green Growth in the Mekong Delta: A Multi-Stakeholder Approach to Identify Key Policy Options*, 2014

56 Baran E., Guerin E., Nasielski J. 2015 *Fish, sediment and dams in the Mekong*. Penang, Malaysia: WorldFish, and CGIAR Research Program on Water, Land and Ecosystems (WLE). 108 pp.

57 *Catch and Culture*: A publication from the MRC Volume 21, No 3 Dec 2015 (ISSN 0859-290X)

4. WATER IN THE MEKONG REGIONAL ECONOMY

Economic dependency on water from the Mekong

4.1 Viet Nam: an unstable delta

The Mekong Delta covers a relatively small portion of Viet Nam, starting in Phnom Penh where the river divides into two main distributaries: the Mekong and the Bassac. The entire delta is less than 5 m above sea-level, where large areas are flooded every year. The region represents about one fifth of the total population and a quarter of the GDP of Viet Nam. The movement of water within the complex channel network cannot be considered natural, owing to the long history of modification. Levees were built hundreds of years ago along some of the main natural channels. Hydrology is not only dominated by the rivers but also by the tide, which has a large expansion in the dry season and which can slow down the drainage of the river during heavy flood periods, mainly downstream⁵⁸.



Figure 19: The Mekong Delta in Viet Nam

As a major river delta, sediment is critically important to the functioning of the delta, and the economic activities that stem from it. The halving of sediment loads through existing dams and dredging, and groundwater abstraction has resulted in the subsistence of parts of the delta. In addition to concerns around sediment flows, upstream hydropower releases have caused uncertain flow regimes for Viet Nam. This affects saline intrusion, navigation within the delta and ecosystem functioning.

Flooding is also a challenge for the delta. Dykes have been built to prevent saline intrusion which is especially challenging during the dry season. However, dyke construction has also increased flooding during the wet season by preventing the natural flow of water in the flood plains and into the sea. This may become more severe with changing climate alongside increasing development within the delta as well as upstream.

⁵⁸ FAO Aquastat, 2011, Statistics on the Mekong Basin

Characterisation of water risks to the economy

- The delta faces a number of very real and increasing physical water risks, ranging from subsidence, deteriorating water quality (and salinization), flooding and erosion of river bank and coastal environments. These risks are compounded by irregular sediment, nutrient and water flows at an inter and intra-annual temporal scale. These are especially significant for the **farmers and fishers** that depend on the physical water resources for their livelihoods.
- Socio-political risks are increasingly likely to arise as the decreasing delta productivity and uncertain flow regimes impact negatively on local communities. This is something that the **local government** in the region will need to be aware of in order to mitigate social unrest possibilities. These may translate into reputational risks for “brand Viet Nam” and companies sourcing products from the delta, with consequences for GDP growth and exports.
- **Investor caution** is linked to physical and reputational risk in the absence of strong institutional ability to manage the competing needs between industrial and urban development alongside ecosystem function to support rural livelihoods.

4.1.1 The Business of the Delta - Agri-business, Industrialisation and the Export Economy

4.1.1.1 The Economy

The Viet Nam Delta is a cornerstone to the Vietnamese economy. In Viet Nam, the Mekong Delta is home to 21 percent of the total population (17 million people). The region forms a 3.9-million-hectare triangle, representing one of the most fertile deltas in the world. The region is the most densely populated agricultural region and produces more than 50 percent of the staple food crops (rice), 70 percent of fruit production and 65 percent of fish production. It also accounts for approximately 95 percent of rice export and 60 percent of fish exports from Viet Nam⁵⁹. As a result, the production in the region equates to 27 percent of the total Vietnamese GDP. According to a study carried out the Global Green Growth Initiative, in 2010, export turnover in the region was USD 6.8 billion (accounting for

⁵⁹ Global Green Growth Institute. Unleashing Green Growth in the Mekong Delta. A Multi-stakeholder approach to Identify Key Policy Options

90 percent export volume of the nation), of which 51 percent from fisheries and 46 percent from agricultural products (mainly rice). The industrial value of the Delta reached VND 156,000 billion in 2010. The contribution of economic sectors to the regional economy has changed in the last two decades as a result of expansion of the industrial and service sectors. In 2010, the primary sector contributed 39 percent of regional GDP, the secondary sector 26 percent and the tertiary sector 35 percent⁶⁰.

Rice exports from the Mekong Delta in Viet Nam account for 15 percent of the national export earnings in the country⁶¹. Other important export sectors include textiles and garments (17.1 percent), footwear (10 percent) and fisheries products (9.4 percent).

Since the 1980s, rapid economic growth has taken place in Viet Nam. Viet Nam has become an attractive country for foreign investments with a cheap, well-educated labour force and large domestic market. Economic growth has been driven by the continued expansion of investment in infrastructure, labor-intensive manufacturing and service activities. The share of GDP contribution per sector has shifted markedly from agriculture to the industry and service sectors. In the late 1980s, agriculture comprised more than 40 percent of the GDP, while the service and industry sectors contributed about 30 and 25 percent to GDP respectively. In 2007, industry's GDP contribution rose to more than 40 percent, while agriculture contributed only 20 percent.⁶² Although the sectoral structure of the national economy changed sharply with an important reduction of the agriculture's share, in the Mekong Delta, this share is 40 percent of GDP in comparison with 20 percent of the country's GDP for the national agricultural sector. This implies that the economy of the Mekong Delta is still very much water based. The stability of the Vietnamese economy in the past three decades has been driven by a consistently growing agricultural economy (4 percent per annum). As a result, Viet Nam has moved from a rice-importing country, to one of the largest rice exporting countries in the world⁶³.

60 Global Green Growth Institute. Unleashing Green Growth in the Mekong Delta. A Multi-stakeholder approach to Identify Key Policy Options

61 <http://pubs.iclarm.net/Pubs/wetlands/pdf/Chapter03.pdf>

62 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

63 Global Green Growth Institute. Unleashing Green Growth in the Mekong Delta. A Multi-stakeholder approach to Identify Key Policy Options

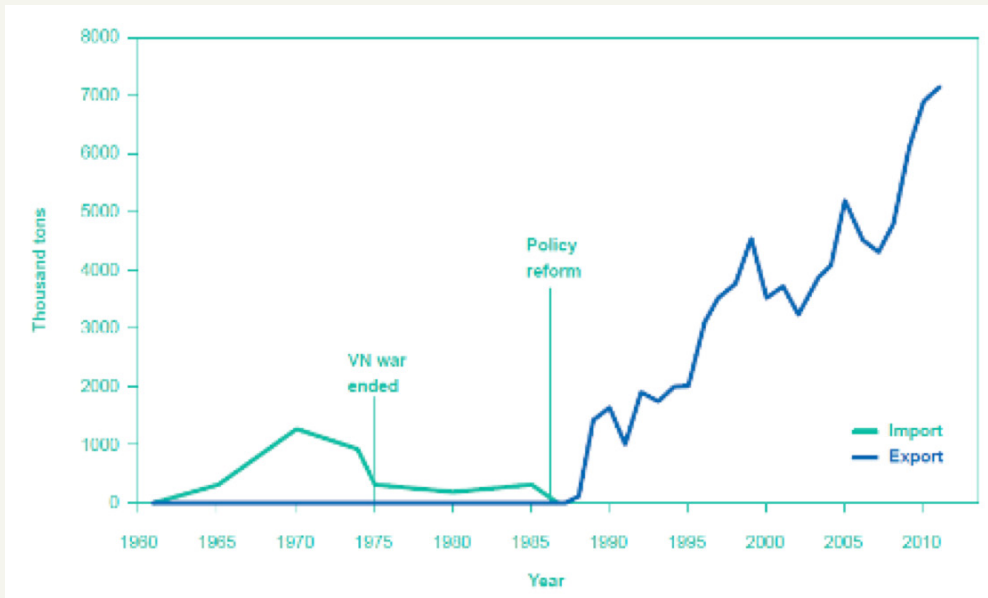


Figure 20: Shift from rice imports to rice exports in Viet Nam⁶⁴

4.1.1.2 Fisheries

Fisheries form an important part of the economy within the Mekong Delta in Viet Nam. Fishing and aquaculture in the Mekong Delta employ over 2.8 million people – 10 percent of Viet Nam’s labour force⁶⁵. The population in the Mekong Delta is heavily dependent on the fisheries for protein, providing 56 kg/person of fish and other aquatic animals for consumption a year. This represents the highest figure within the LMB countries. The following table indicates the summary details for the MRC fisher catch monitoring study. As indicated, Viet Nam represents 60 percent of all catch caught in the LMB. Upstream of the delta, in Laos, Thailand and Cambodia, most gear used includes gill nets. In the Viet Nam Delta, active gears from boats are the most important method used. The size of the fish catch is influenced by the region’s population as well as the type of gear used and the dependency of livelihoods upon fisheries.

64 Global Green Growth Institute. Unleashing Green Growth in the Mekong Delta. A Multi-stakeholder approach to Identify Key Policy Options

65 http://awsassets.panda.org/downloads/greater_mekong_ecosystems_report_020513.pdf

Table 7: Summary of details of MRC fisher catch monitoring survey (2003 - 2005)

| Country | Fishing gear | Species | No. of fish (in thousands) | Total catch (tonnes) |
|----------|--|---------|----------------------------|----------------------|
| Laos | Gill nets, cast net | 153 | 1,348 | 348 |
| Thailand | Gill net, cast net, seine net, hook and line | 137 | 148 | 4.7 |
| Cambodia | Gill net, seine net, lift net, cast net | 172 | 1,223 | 43.6 |
| Viet Nam | Push-net, trap-net, trawl-net, dai | 252 | 5928 | 121.7 |
| Total | | 277 | 8,647 | 204.3 |

Growth in fisheries has been significant, with the majority being exported. Growth in the aquaculture sector has been significant in the LMB as indicated below (Figure 21). Aquaculture production has been increased by expanding the area used, from about 417 km² in 2000 to about 726 km² or about 18 percent of the Delta's area by 2006, as well as by increasingly intensive and efficient production and processing. The majority of production is exported, with Viet Nam dominating exports from the Mekong. Total production in the LMB equated to 1.9 Mt in 2008. It is assumed that 0.6 Mt (32 percent) was consumed directly in the LMB, with the remainder being exported. Domestic consumption is supplied mainly from small-scale capture and culture fisheries, and therefore may be underestimated in these numbers. The Viet Nam Delta is highly productive for both captured and culture fisheries, however data for small-scale catches is difficult to come by. Therefore, the following estimates consider mainly the commercial sector.

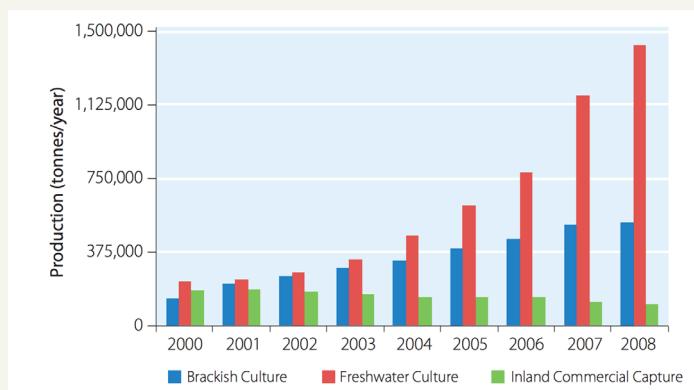


Figure 21: Fisheries production from the Viet Nam Delta. Source: MRC

Although important in earning foreign exchange, the fisheries sector is also critical for women's employment.

Reliable data to investigate the markets of where fish are bought, sold and consumed is difficult to accurately measure due to the moulding of both formal and informal fishing sectors. Markets provide important livelihood opportunities. This is especially true for women, who represent 80 – 90 percent of traders.

Table 8: Summary of data from markets based on interviews of all inland fresh fish sellers over a one-year period

| Location | Markets | Source | Total sales (tonnes/year) | Annual value (US\$) | % of wt | % of value | Mean price (\$/kg) |
|----------------------|----------------|--------------|---------------------------|---------------------|---------|------------|--------------------|
| Vientiane, Lao PDR | 2 city markets | Capture | 162.4 | \$449,720 | 32.0 | 49.3 | \$2.77 |
| | | Culture | 2.95.3 | \$402,929 | 68.0 | 50.7 | \$1.36 |
| | | <i>Total</i> | <i>457.7</i> | <i>\$852,649</i> | | | <i>\$1.86</i> |
| Northeast Thailand | 3 city markets | Capture | 194.3 | \$455,989 | 39.8 | 50.7 | \$2.35 |
| | | Culture | 294.3 | \$442,541 | 60.2 | 49.3 | \$1.50 |
| | | <i>Total</i> | <i>488.6</i> | <i>\$898,531</i> | | | <i>\$1.84</i> |
| Phnom Penh, Cambodia | 1 city market | Capture | 673.6 | \$795,398 | 70.5 | 73.5 | \$1.18 |
| | | Culture | 282.3 | \$286,070 | 29.5 | 26.5 | \$1.01 |
| | | <i>Total</i> | <i>955.9</i> | <i>\$1,081,468</i> | | | <i>\$1.13</i> |
| Viet Nam delta | 5 city markets | Capture | 1046.9 | \$1,563,134 | 56.3 | 64.1 | \$1.49 |
| | | Culture | 812.9 | \$874,693 | 43.7 | 35.9 | \$1.08 |
| | | <i>Total</i> | <i>1859.8</i> | <i>\$2,437,826</i> | | | <i>\$1.31</i> |

Monitoring period 20 days, except Phnom Penh 15 days. Values are based on approximate conversions. US\$1 = Kip 10,000; Riel 4,000; THB 33; VND 15,000. Source: [MRC State of the Basin](#)

The high value of fisheries in the brackish delta necessitates increased habitat conservation. 82 percent of aquaculture takes places in brackish water. Representing only 36 percent of the production by weight, the brackish area of the estuary contributes 72 percent of the total value (Figure 23). Black tiger shrimp are the most common species caught in this region, accounting for the majority of the value from aquaculture. Therefore, a healthy functioning ecosystem in the Delta is critically important for the higher value fisheries that are dependent on the brackish water.

Increased industrialisation causing pollution alongside significant changes to the sediment flows within the Delta are creating poor environments for continued fisheries production.

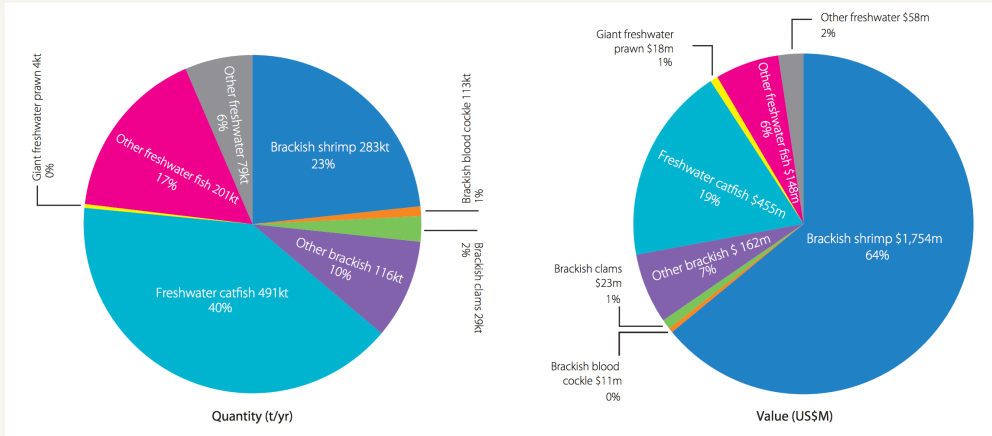


Figure 22: Composition by weight and value of aquaculture production in the Viet Nam Delta (2006), excluding small-scale aquaculture. Unites are thousands of tonnes (kt) per year and USD m/year, estimated approximately USD 1 = VND 15,000. Source: [MRC State of the Basin Report](#)

Fisheries data has indicated a decline in catches. This decline may be as a result of the increasing use of pesticides, environmental pollution or obstruction of fish passages. There have been cases where a decline in catch was recorded as a result of a dyke construction to cut off saltwater flow into a mangrove habitat for rice farming. Estuarine fish and other species rely on the inter-tidal habitats for feeding and breeding, hence the noticeable reduction in production of fish. An alternative explanation is that subsistence catches are continuing to increase at the expense of commercial catches. Without reliable small-scale data however, this cannot be confirmed.

4.1.1.3 Rice

The Mekong Delta is Viet Nam’s major rice growing area, accounting for nearly half of the farms in the whole country. Approximately 60 percent of the rice grown in the Viet Nam Delta is irrigated. As a result, yields are far higher than in other countries. The major farming areas within the Mekong Basin in Viet Nam are separated among the Delta and Central Highlands region.

The relative area has changed for agriculture in each of these regions, as indicated by Table 9 below. Permanent crops have been increasing in area, while the relative area for agriculture has decreased in the Mekong Delta.

Table 9: Change in area of agricultural production in the Mekong Delta and Central Highlands (2001 - 2006) Source: GSD 2007

| | Mekong Delta | | Central Highlands | |
|---|--------------|------|-------------------|------|
| | 2001 | 2006 | 2001 | 2006 |
| Agricultural production land (thousands ha) | 2619 | 2567 | 1256 | 1615 |
| Annual crop land (thousands ha) | 2120 | 2032 | 522 | 757 |
| Annual paddy land | | 1893 | | 161 |
| Permanent crop land (thousands ha) | 499 | 535 | 743 | 859 |

Due to an increase in productivity, although the area under agriculture has declined in the past two decades, production levels have continued to climb. Rice farming in the Central Highlands of Viet Nam has a lower yield as irrigation is limited. Instead, the Central Highlands are home to perennial crops and trees due to the preferable growing conditions. The Delta represents the major rice growing region due to the availability of water and the altitude.

Table 10: Area of selected (non-rice) crops. Note: areas for Cambodia and Lao PDR are harvested area; areas for Viet Nam are planted area.

| | Cambodia (ha) | | Lao PDR (ha) | | Northeast Thailand (ha) | | Viet Nam Mekong Delta (ha) | | Viet Nam Central Highlands (ha) | |
|-----------|---------------|---------|--------------|--------|-------------------------|---------|----------------------------|--------|---------------------------------|---------|
| | 1999/00 | 2005 | 1999 | 2005 | 2000 | 2003 | 1999 | 2005 | 1999 | 2005 |
| Maize | 59,739 | 61,757 | 40,700 | 86,000 | 334,000 | 263,107 | 39,000 | 34,900 | 60,100 | 236,600 |
| Cassava | 14,003 | 28,560 | | 6,765 | 646,000 | 491,370 | 9,200 | 6,400 | 32,300 | 89,400 |
| Soybean | 34,945 | 114,890 | 6,800 | 9,535 | 38,000 | 11,196 | 9,100 | 14,000 | 11,200 | 26,600 |
| Sugarcane | 8,375 | 4,498 | 4,700 | 5,500 | 206,000 | 596,557 | 102,800 | 64,100 | 27,900 | 26,700 |

In addition to rice, Viet Nam has recently seen the growth of sugar production for domestic use and rubber for export. Expansion and contraction will continue in terms of rice production for domestic use. However, it is estimated that the expansion of non-rice crops will continue to rise.

4.1.1.4 Textiles

In addition to the agricultural sector, Viet Nam's textile and garment sector has seen fast and sustainable growth over the past years, playing an important role in national socio-economic development. Viet Nam is one of the top 10 countries in textile and garment exports. Despite the recent global economic downturn, the sector is seeing impressive export performance. Export revenue exceeded USD 11 billion in 2010, up 24 percent against 2009, USD 14 billion in 2011, accounting for 16.5 percent of the country's total export revenue and up 38 percent against 2010.

Demand for labour in the sector is huge, providing employment for 2.2 million people. From an export perspective, the industry is ranked second in terms of value. One of the major advantages of the textile industry in Viet Nam is the availability of affordable labour amidst an economy with significant domestic consumption (Viet Nam is home to 90 million people)⁶⁶.

Cotton is one of raw materials to produce natural fibres, however the percentage of cotton production within Viet Nam has plunged dramatically. Thus, domestic production satisfies just 0.2 percent demand, of which fabric product meets only 15-16 percent, resulting in the fact that Viet Nam virtually relies on the import sector for material.⁶⁷

4.1.1.5 Industrial Development

Investments are significant in the Mekong Delta of Viet Nam for a range of reasons, which include the large domestic demand, strong economic growth, good investment climate, a strong workforce with high social standards and a booming agriculture and aquaculture industry. Although FDI in the Mekong Delta has been historically low compared to other parts of Viet Nam, the region is rapidly emerging as an attractive destination for foreign investment. The number of FDI projects in

⁶⁶ [http://www.vietrade.gov.vn/en/index.php?option=com_content&id=1330:strengths-ofthe-Viet Nam-textile-and-garment-industry&Itemid=232](http://www.vietrade.gov.vn/en/index.php?option=com_content&id=1330:strengths-ofthe-Viet-Nam-textile-and-garment-industry&Itemid=232)

⁶⁷ [http://www.businesswire.com/news/home/20160429005779/en/Viet Nam-Textile-Garment-Report-2015-2016---Research](http://www.businesswire.com/news/home/20160429005779/en/Viet-Nam-Textile-Garment-Report-2015-2016---Research)

the Mekong Delta increased by 73 percent from 2010, driving total FDI growth of nearly 20 percent per annum since then – more than double the national average⁶⁸. While virtually all provinces of the Mekong Delta are attracting FDI, Long An has emerged as the biggest investment magnet. Located directly to the south of Ho Chi Minh City, it is home to 609 projects and USD 4 billion in registered investment capital – more than half of all the registered FDI projects and a third of all registered investment capital in the Delta. The level of investment taking place in the delta is indicated by the figure below.

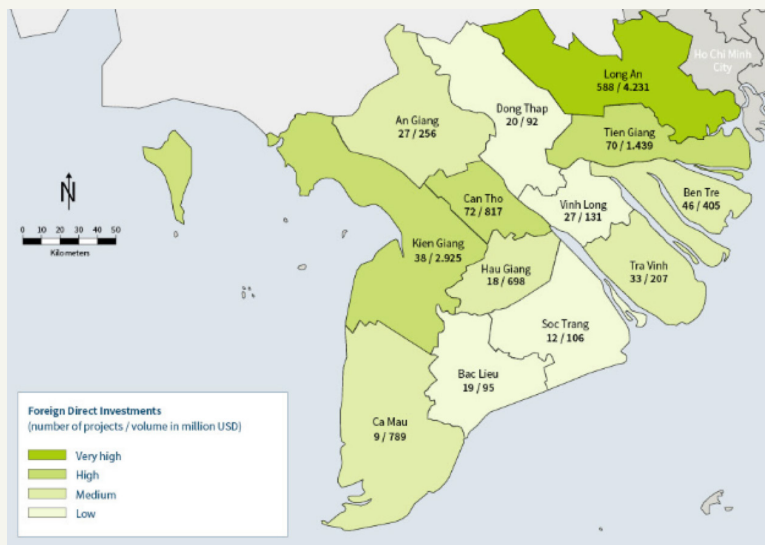


Figure 23: Foreign Direct Investment in the Mekong Delta is significant

The increase in agricultural production, together with the increase in industrial and urban development in the Mekong Delta has resulted in a significant shift in land-use. This has resulted in a reduction in forestland and an increase in agricultural land, residential land and specially used land (for purposes others than agriculture, homestead or forestry). During the period from 2008 to 2012, the largest increase was the expansion of agricultural land (about 40,000 ha), followed by an expansion of specially used land (some 23,000 ha) and residential area (12,000 ha). The loss of forestland during the period was about 32,000 ha⁶⁹.

⁶⁸ <http://www.invest-mekong-delta.com/map.html>

⁶⁹ Global Green Growth Institute. Unleashing Green Growth in the Mekong Delta. A Multi-stakeholder approach to Identify Key Policy Options

KEY MESSAGES

- Sediments and nutrients from upriver sustain the productive Mekong Delta, which in turn supports more than 50 percent of Viet Nam’s staple food crop production and marine fisheries and aquaculture, worth up to USD 2.7 billion annually.⁷⁰ Therefore the sediment not only supports the rural livelihoods, but also domestic consumption and a growing export economy (including rice and fisheries).

- The growing industrial development and FDI investments taking place in the Delta also require sediment. However, in this case, it is for land reclamation or for construction of infrastructure such as buildings, roads or dykes. The value of the GDP contribution of investments in infrastructure need to be weighed against the value of a functioning ecosystem for fisheries and agriculture indicated by the table below.

Table 11: Water plays an important role in the economy of the Mekong Delta

| Indicator | Unit | 2003 | 2008 | 2010 | 2011 | 2012 |
|--------------------------------------|------------------|------------|------------|------------|------------|-----------|
| GDP from water distribution services | million VND/Year | | 632,553 | 1,005,423 | 1,215,743 | 1,589,850 |
| Agricultural GDP | million VND/Year | 19,991,314 | 21,805,480 | 22,497,206 | 23,430,036 | |
| Fisheries GDP | million VND/Year | 3,389,598 | 4,764,497 | 5,219,129 | 5,391,913 | |
| Aquaculture GDP | million VND/Year | 5,126,959 | 9,330,883 | 10,043,817 | 10,647,324 | |
| Water transport GDP | million VND/Year | | 2,561,150 | 2,792,327 | 2,988,137 | 3,360,641 |

Table by author (Hien); data source: (Provincial Statistical Offices 2013).

4.1.2 Changing Flows – Transport, Flooding and Salt-water intrusion

Although Viet Nam has abundant water resources, the temporal and spatial spread of water across the country is not even. Viet Nam has abundant surface water resources in terms of total runoff, of which the Red and Mekong rivers carry 75 percent, while each of the other basins carries 1-3 percent. The mean annual runoff totals approximately 878km³/yr, of which about 354km³/yr (40 percent) is generated within the country. The distribution of water resources in the country during the year is highly variable due to unevenly distributed monsoon rainfalls. High variations combined with limited storage and flood control

⁷⁰ wwf.panda.org/what_we_do/footprint/water/dams_initiative/examples/Mekong

infrastructure result in devastating floods in the wet season and extreme low flows in the dry season. About 70-75 percent of the annual runoff is generated in three to four months⁷¹. In addition to changes in the flow, there are also differences in the quality of water through the Mekong Delta. For instance, as indicated by the figure below, salinity is a challenge that is faced by many of the regions in the Delta.

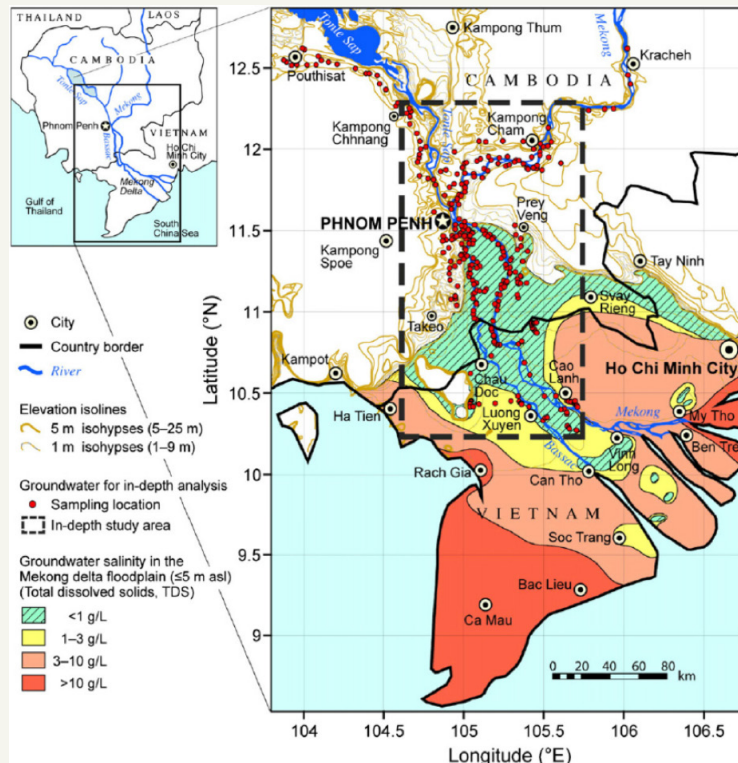


Figure 24: Map of the Mekong Delta depicting groundwater salinity in the Holocene aquifers⁷²

Viet Nam is by far the largest user of water out of the Mekong Basin countries. Total water withdrawal in the Mekong river basin is estimated at 62 km³, or 13 percent of the Mekong's average annual discharge, of which Viet Nam accounts for approximately

71 WWF Water Risk Filter. Viet Nam Country Profile. <http://waterriskfilter.panda.org/en/CountryProfiles#84/profile>

72 https://www.researchgate.net/figure/222026308_fig1_Fig-1-Map-of-the-Mekong-delta-depicting-groundwater-salinity-in-the-Holocene-aquifers

52 percent, Thailand 29 percent, China 9 percent, Laos 5 percent, Cambodia 3 percent and Myanmar 2 percent. Irrigation withdrawal accounts for 56 km³, or 90.5 percent of the total⁷³. Existing storage of water resources behind dams corresponds to less than five percent of the average annual flow and does not significantly redistribute water between seasons. The water flows that reach Viet Nam in the dry season are fully used for economic, environmental and social purposes.

There have been major concerns by Viet Nam regarding the use of water upstream on the Mekong. For instance, the current drought in Thailand has resulted in many farmers abstracting increased volumes of water from the River. As a result, Viet Nam has recorded the lowest levels of the Mekong River since 1926. The impact of increased low flows is salinity, which is the most debilitating for rice farmers in the region. This has been compounded by sea level rise pushing saline water further upstream. Modelling conducted by the Mekong River Commission predicted salt intrusion on Viet Nam's main Mekong channel would reach up to 162 kilometres inland this year, which is nearing the Cambodian border. These impacts are further exacerbated by climate forces such as El Nino⁷⁴. The hydropower potential of the Lower Mekong basin is estimated at more than 30 000 MW and about 10 percent of this potential has been developed to date. Many of the hydropower projects on the tributaries will include significant reservoirs, which will increase the dry season flows through the re-regulation of water resources from the wet to the dry season. This is of further concern to Viet Nam in terms of water supply.

Not only does Viet Nam depend on water resources in the Mekong for consumption and production, but the river and Delta are also important for navigation. The channel network of the Mekong Delta provides a vital gateway for people and passengers. According to the Mekong River Commission, 73 percent of cargo tonnage and 27 percent of passengers in Viet Nam travel by water. Transport by water is therefore an important driver of economic competitiveness in the Viet Nam Delta, generating a total value of approximately VND 3.360 billion in 2012. Waterborne trade in Viet Nam has been growing significantly until 2009 when the global financial crisis hit. Part of the reduction in containers was

⁷³ <http://www.fao.org/nr/water/aquastat/basins/mekong/index.stm>

⁷⁴ <http://www.abc.net.au/news/2016-03-18/mekong-river-thailand-diverts-worries-neighbours/7256678>

attributed to the decline in demand for the export of garments to the USA. The construction of the deep water port in Cai Mep renewed focus for the Mekong as a trade route.

In addition to the importance of navigation for trade purposes is the importance of navigation for everyday life in the Delta. People living in the Delta have no alternative to the channels of the Mekong for transport, as the road network does not reach many communities. Navigation in the Delta is also important for tourism purposes. The Mekong Delta in Viet Nam is an area of great beauty. Viet Nam received 157 198 visitors by boat in 2008. Tourism contributes 6.6 percent to GDP (as of 2016). After the heavy industry and urban development, most foreign investment has been concentrated in tourism, especially in hotel projects. Tourism has an important contribution promoting development of related sectors such as transportation, entertainment and cuisine.

There are a number of issues challenging the navigability of rivers, including the construction of dams and other infrastructure, as well as sedimentation due to deforestation. An integrated development planning approach is essential to address these trade-offs and maximize the economic advantages deriving from river commercial and passenger transport⁷⁵.

The cost of flooding in Viet Nam is debilitating to the economy. The average annual flood damage for the LMB is estimated to be USD 60–70 million per year and is concentrated in Viet Nam and Cambodia, which between them account for about two-thirds of the total. These estimates include direct costs to agriculture, infrastructure and buildings, but exclude indirect costs, such as health impacts of waterborne diseases and stalling the economy for entire weeks. The regular flooding of the Delta also disrupts schooling. According to a report by WWF on the ecosystem services provided in the Mekong Basin, restoring mangroves can be a cost-effective option for improving coastal protection. “For example, a USD 1.1 million mangrove restoration scheme in northern Viet Nam saved an estimated USD 7.3 million a year in sea dyke maintenance, and provided effective protection during typhoons⁷⁶.” Continued focus on further industrialisation and urbanisation in the Delta is going to compound the impact of flooding on the economy

⁷⁵ Global Green Growth Institute. Unleashing Green Growth in the Mekong Delta. A Multi-stakeholder approach to Identify Key Policy Options

⁷⁶ http://awsassets.panda.org/downloads/greater_mekong_ecosystems_report_020513.pdf

if proactive measures, such as mangrove restoration, are not taken.

The impacts of flooding are further compounded by water quality challenges in the Delta. Natural challenges with water quality in the Viet Nam Delta occur due to inundation from the sea during high tide combined with high flows from the river. This is a major challenge in the northern part of the Mekong Delta called the long Xuyen Quadrangle and the Plain of Reeds. The flooding challenges are compounded by significant saline intrusion along the 600 km coast during the dry season. Salinity intrusion affects 50 percent of the basin area during the dry season⁷⁷. This is a limiting factor for crop production such as rice. Saline intrusion is also common in the groundwater of coastal areas affecting household consumption. In addition, in low level areas, the soil is covered with acid sulphate. These naturally occurring challenges are further compounded by human activity in the basin such as fertilizer and pesticide use in addition to industrial and domestic effluent. The following map gives the output of the WWF Water Risk Filter according to pollution levels in the Mekong Delta.⁷⁸

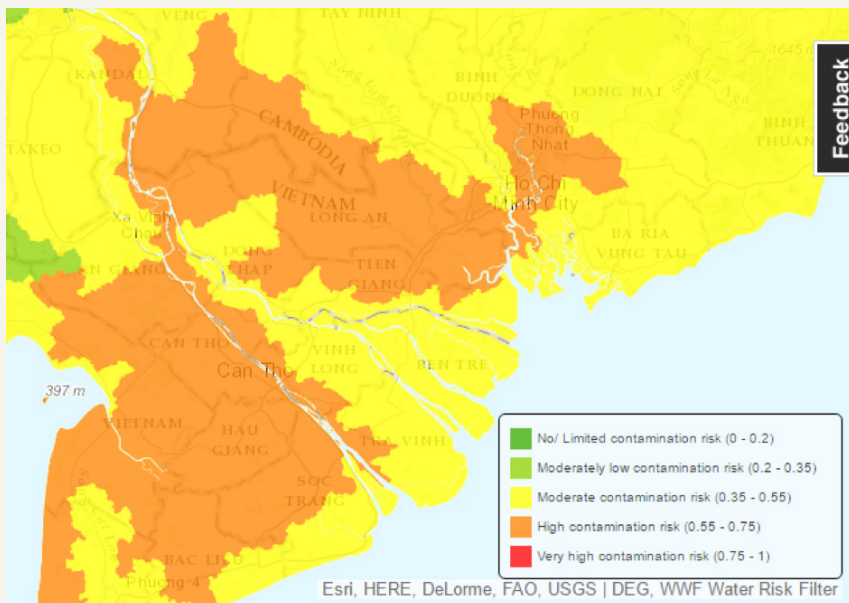


Figure 25: Water Pollution in the Mekong Delta

⁷⁷ https://www.researchgate.net/publication/255718114_Agriculture_and_Water_Quality_in_the_Viet_Namese_Mekong_Delta

⁷⁸ <http://waterriskfilter.panda.org/en/Maps>

Climate change impacts on the Delta are likely to be significant for the economy of Viet Nam. At the national level, climate change impacts are projected to affect about 10-12 percent of the population and cause the loss of 10 percent of GDP. In the Mekong Delta region, the impacts are believed to be far higher. Sea level rise, fluctuating rainfall patterns and higher temperatures are expected to modify water inflows and outflows dynamics, eventually impacting the social and economic life of the region. In particular, the government estimates that about 40 percent of the Mekong Delta area would be inundated if sea level rises by 1 meter, affecting 35 percent of the population⁷⁹.

In addition, existing and planned transport infrastructure in Ho Chi Minh City is at risk from the effects of climate change. In 2050, a study has shown that all roads will be affected by extreme flooding as indicated below. In addition to the challenges associated with flooding, the climate analysis also indicates that saline intrusion is likely to increase. Close to 60 percent of Ho Chi Minh City's agricultural land is expected to be affected by salinity by 2050. During times of extensive saline intrusion, it will not be possible to irrigate from rivers and canals.

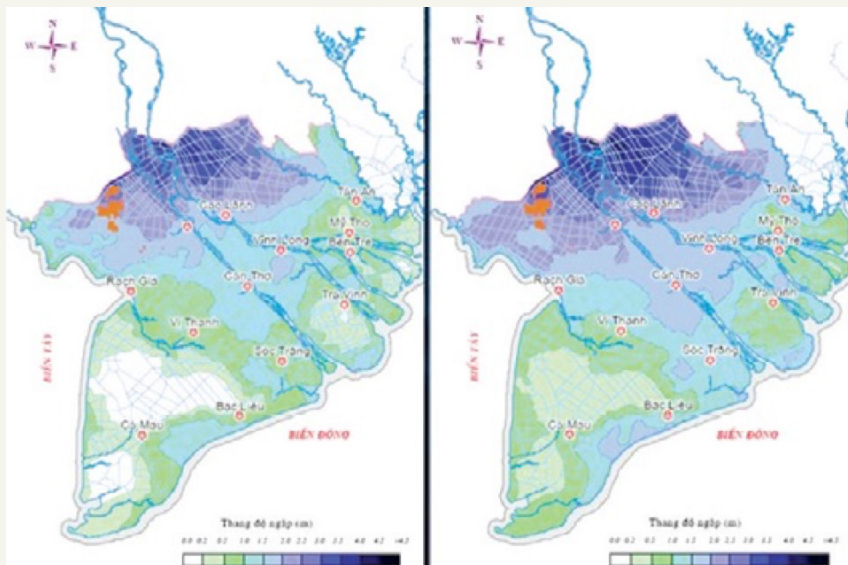


Figure 26: Flooding extent in the Mekong Delta in 2012 (left) and 2050 (right) with a sea level rise of 30 cm.

⁷⁹ Green Growth Initiative, *Unleashing Green Growth in the Mekong Delta: A Multi-Stakeholder Approach to Identify Key Policy Options*, 2014

KEY MESSAGES

- Abstraction of water out of the Mekong River in the Delta as well as upstream is causing low flows in the dry season. This is causing major challenges with regards to saline intrusion. These impacts are further exacerbated by poor water quality due to inadequate wastewater treatment and agricultural pesticide and fertilizer use. In 2005, deep intrusion, high salinity and long-lasting salinization occurred frequently in Mekong Delta province, with salt intrusion reaching up to 140 km into the Delta and the total economic loss amounting to VND16 billion⁸⁰.
- Low flows in the Delta are also detrimental to the important navigation sector that underpins transport. Trade and tourism as well as domestic transport are all negatively impacted by inadequate water levels in the Delta.

4.1.3 Slowly Sliding into the Sea – Sand mining and Sediment dynamics

The Mekong Delta in Viet Nam is heavily dependent upon the sediment, which is deposited by the Mekong River.

However, the functioning of the Delta is at risk due to changes in sediment flux and flow. The changes in sediment are as a result of decreased input from upstream (as a result of hydropower dam construction and in-channel sand mining), the large quantity of material being extracted from the river and the flow-on effects of these changes on the geomorphic processes operating in the Mekong (bank instability, channel deepening, changes to sediment delivery patterns, changes to water levels associated with channel changes, etc.). Significant ground water extraction is also causing subsidence of the Delta, further compounding the challenges being faced.

Satellite imagery of the large-scale shoreline erosion and land loss between 2003 and 2012 indicates that over 50 percent of the once strongly advancing >600km-long delta shoreline is affected. Findings indicate that without a change in the river's discharge and in wave and wind conditions over this recent period, the drivers of erosion are due to three major factors: 1) a reported significant decrease in coastal surface suspended sediment from the Mekong that may be linked to dam retention of its sediment, (2) large-scale commercial sand mining in the river and delta channels and

80 Green Growth Initiative, Unleashing Green Growth in the Mekong Delta: A Multi-Stakeholder Approach to Identify Key Policy Options, 2014.

(3) subsidence due to groundwater extraction. Shoreline erosion is already responsible for displacement of coastal populations⁸¹. An indication of the processes taking place within the Delta is shown in the following figure.

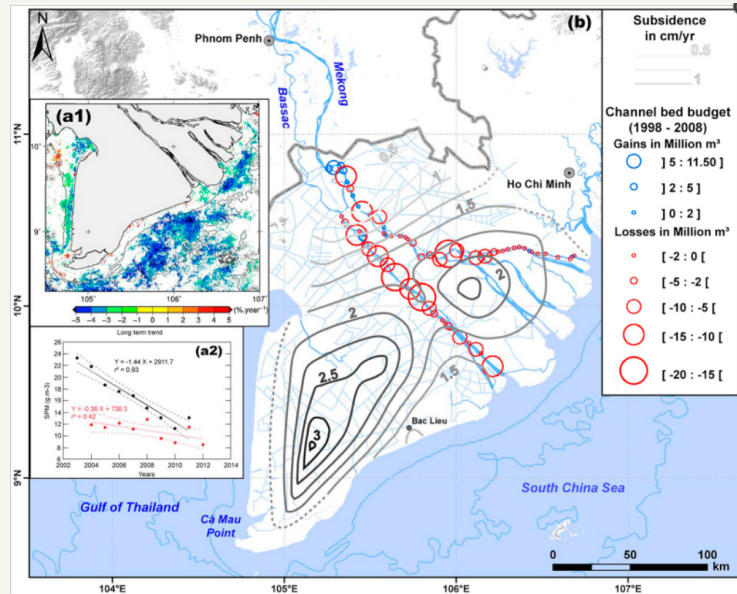


Figure 27: Aspects of the recent sediment balance and subsidence in the delta mediated by human activities^{82,83}

81 Anthony EJ, Brunier G, Besset M, Goichot M, Dussouillez P, Nguyen VL. Linking rapid erosion of the Mekong River delta to human activities. *Scientific Reports*. 2015;5:14745. doi:10.1038/srep14745.

82 (a) Map and graph of significant monotonic trend in percent per year (seasonal Kendall test, $p < 0.05$) of SPM off the Mekong delta⁴⁶. Non-significant areas are shown in white. The graph shows time series of averaged SPM values as a function of year during low (red dots) and high (black dots) river flow conditions. The linear regression equations are shown for each sub-data set, with dashed lines representing the 95 percent confidence interval (with permission from Elsevier). The data show a net reduction of up to 5 percent a year in SPM off the mouths of the delta and along much of the nearshore area in the SCS attributed to dam trapping of sediment⁴⁶. A net annual decrease in SPM of 2 to 4 percent is also depicted along the GT coast. (b) Map of the Mekong delta showing: (i) compaction-based subsidence rates redrawn from³². These rates are highest in the most critically eroding southwestern part of the delta; (ii) 10-year (1998–2008) bedload budget changes in the My Tho and Bassac channels, characterised by net cumulative losses of 200 Mm³ that have been attributed to large-scale commercial river-bed mining⁴⁸(with permission from Elsevier). Base map from National Geographic and Esri (Source:http://goto.arcgisonline.com/maps/NatGeo_World_Map); hydrography, relief, and bathymetry from³⁹.

83 Anthony EJ, Brunier G, Besset M, Goichot M, Dussouillez P, Nguyen VL. Linking rapid erosion of the Mekong River delta to human activities. *Scientific Reports*.

The booming construction industry in the Delta has been both a benefit and a curse. Viet Nam has the third highest growth rate in construction in Asia. The construction cycle is closely linked to the economic cycle, which tends to last for 3 – 10 years. The industry and construction sector represent 40 percent Viet Nam's total economy. In the period of 2000-2009, the industry growth rate reached 9.6 percent per year. However, this rate has fallen to only 4.6 percent per year in 2010-2013, due to the real estate crisis. The private sector accounts for more than 80 percent of the total construction output. Although economic development is a positive development for Viet Nam, the dredging of sand to meet domestic construction needs has negatively impacted the hydrology of the Mekong River. As a result of the rapid economic growth in Viet Nam, construction of buildings in the major towns and cities has been growing. Although there have been recent agreements put in place to curb the dredging by banning the export of sand, local consumption is still driving significant sand and gravel dredging.

The extraction of material for construction is also causing erosion along the river banks, as well as along the coastline. It has been found that dykes and embankments constructed within the Delta are increasing the velocity of water flowing in the river channels. This has resulted in significant erosion of mud that has washed offshore during high flows in the monsoon season. The result is that the mud washed offshore is not directed in a south-westerly direction during the low-flow season. In addition, during the low-discharge season, the saltwater intrusion forces some of the fine river sediment back into the mouth of the estuary. These two factors result in a decrease of deposition, resulting in erosion of the coastline. The impact of riverbed deepening caused by sand mining has been documented for the estuarine dynamics and stability of the densely populated Pearl Delta. It is assumed that similar negative impacts can be expected in the Mekong.

Groundwater exploitation is a major cause of land subsidence in the Mekong Delta of Viet Nam. Compounded by the extraction of aggregate for construction in the Mekong is the abstraction of water from underground. A study undertaken to monitor the rate of groundwater extraction relative to subsidence found that the average rate of head decline is 0.3m/yr. For a region where the average altitude is less than 2 metres above sea-level, this poses a flood inundation hazard that is compounded by the threat of

2015;5:14745. doi:10.1038/srep14745.

sea-level rise (SLR)⁸⁴.

Flooding provides important benefits to the Mekong Delta in Viet Nam. The Mekong Delta stretches from Kampong Cham in Cambodia through Viet Nam to discharge into the South China Sea. Every year floods inundate 3.9 million hectares of land in the Delta, providing valuable ecosystem services to support the livelihoods that depend on the system⁸⁵. The deposition of sediment is critical to the functioning of the Delta. For instance, it has been estimated that each year mainstream flooding delivers 79 Mt of nutrient-rich sediments to the Viet Nam Delta. Some 9 – 13 Mt are deposited on floodplains, the remainder enlarging the delta. Calculations have shown that the Viet Nam Delta, near the Ca Mau peninsula is growing seawards by 150 m annually. In addition to providing improved soil fertility through sediment deposition, receding flood waters may be captured through sluices or dykes to provide water supply. This provides a fertilizing role for the coastal fisheries.⁸⁶ Floods also wash agriculture land from excess salt and act as a natural pesticide.

There are approximately 20 wetlands in the Delta that provide valuable support to livelihoods. However, these wetlands are fast disappearing due to population growth, poverty, agriculture and upstream infrastructure development; less than two percent of the original wetlands remain in the Mekong Delta. In an effort to improve the environmental functioning of the Delta, there have been some recent developments in improving wetland management. For instance, there has been the creation of a wetlands technical advisory group in Dong Thap province, Viet Nam. The approval of a separate Wetlands Management Statute for Tram Chim wetlands is a key achievement of this initiative. This statute allows the hydrological and fire regime of Tram Chim to be managed in line with its priority wetland values.

84 Groundwater extraction, land subsidence, and sea-level rise in the Mekong Delta, Viet Nam. <http://iopscience.iop.org/article/10.1088/1748-9326/9/8/084010/meta;jsessionid=88240E6C04117EAB49B51985D631EFF5.ip-10-40-2-73>

85 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

86 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

KEY MESSAGES

- Flooding in the Mekong Delta of Viet Nam provides a major risk to the highly productive system. Flooding in 2011 resulted in damages to houses up to VND 327 billion, and infrastructure losses by VND 5,304 billion. Floods and storms affected 0.7 percent of agricultural land, with crop losses amounting to about VND 1,020 billion⁸⁷. However, the flooding also provides a benefit through the delivery of fertile soil for the agricultural and fisheries economy, which represents 23 and 16 million VND/year respectively. Investment into infrastructure to protect the low-lying lands of the delta has in turn exacerbated the flooding risk to the region.

- The productive capacity of the Delta is at risk due to the subsidence of the Delta as a result of decreased sediment flowing down the river, over-abstraction of groundwater and sea level rise. The excavation of sediment for construction is one of the major risks in the region. The industry and construction sector is the smallest contributor to the Delta's GDP, accounting for about 25 percent (of which Industry represents 18 percent). Therefore, excavation for the construction and hydropower sectors, is putting the entire economy of the delta at risk due to subsidence.

4.2 Cambodia: between a rock and a hard place

Economic dependency on water from the Mekong

Cambodia is almost completely reliant on the Mekong for water-related economic activity and domestic supply. Approximately 86 percent of Cambodia's territory is included in the Mekong Basin, the remaining 14 percent drain directly into the Gulf of Thailand. Many livelihoods are dependent upon fish protein and flood irrigation from the Mekong. In urban areas, expansion of industries including textiles are dependent upon affordable labour. This is enabled through the availability of inexpensive protein, food and construction materials such as reeds, clay or sand from the Mekong. These industrial sectors have downstream water quality impacts, which together with absorption of labour from agriculture poses challenges to both ecosystems and rice expansion. Both tributary and main-stem hydropower opportunities will support energy demands, but may have profound consequences on fisheries, sediment and hydrological regimes. For instance, livelihoods are

⁸⁷ Green Growth Initiative, Unleashing Green Growth in the Mekong Delta: A Multi-Stakeholder Approach to Identify Key Policy Options, 2014.

threatened by main stem hydropower development as the flow regime of the river is likely to change.

Characterisation of water risks to the economy

- The risks of hydropower on livelihoods is significant, which may have knock on effect into the agricultural and industrial economy through costs and productivity of labour.
- Multi-nationals sourcing from industries that have impacts on water quality face reputational (and financial) risk through their involvement in a deteriorating Mekong.
- Investors in hydropower and industries may be deterred by the risks facing production in Cambodia.
- Serious regulatory risk associated with non-transparent decision making and policy stability / consistency leads reduce investor appetite.

4.2.1 Industrialisation - the promise and the curse

Cambodia's economy grew rapidly from the early 2000s.

The growth rate sustained 11.1 percent from 2004 to 2007. This strong growth was supported by increases in clothing exports, tourism, real estate development and agricultural production. Growth continued into the first half of 2008 before the economy suffered under the combined effect of political instability in Thailand and the global financial crisis. These factors contributed to slow growth and double digit inflation in late 2008 to early 2009, due to a surge in the price of imported commodities, especially oil and food items. As with many countries experiencing rapid growth, there are challenges. The main constraints to industrial development in Cambodia are the lack of power and raw materials. The major water using industries are food processing and textiles. Water use in food processing and textiles is still significantly smaller than agriculture, for example. In 2006, total water withdrawal in Cambodia was about 2.184 km³, of which 2.053 km³(94 percent) for agriculture, 0.98 km³ (4.5 percent) for municipalities and 0.33 km³(1.5 percent) for industries.

A proportion of the significant growth monitored has been through the GMS program. The program has increased the connectivity of road infrastructure and power providing great benefits for the LMB countries and the region through savings in travel time, lower travel costs for passengers, lower maintenance costs for vehicles, an increase in value of trade and other spill over

benefits such as an increase in tourism and business opportunities. One such project includes the Phnom Penh-Ho Chi Minh City project, which was completed in 2005 and increased the estimated volume of trade through the Moc Bai-Bavet border between Viet Nam and Cambodia by about 40 percent per annum from 2003 to 2006.⁸⁸ Further investments are still required however, as in 2011, Cambodia recorded the highest international tourism receipts of any ASEAN country as a share of GDP (15 percent). However, its regional ranking is low when it comes to travel facilitation and competitiveness. Improvement is required in areas such as tourism infrastructure, accommodation, and financial facilities such as ATMs that accept Visa cards. Another vitally important factor is the investment in ecosystem function of the Mekong River, where many of the tourists are visiting⁸⁹.

In Cambodia, urban areas enjoy the highest levels of human development alongside significant water quality challenges. The provinces in the northeast that are part of the LMB have the lowest HDI values (0.30 – 0.36). The provinces on the Tonle Sap Great Lake fall in the middle range. However, human poverty is the highest in this region, which coincides with the high rate of consumption-based poverty levels, where livelihoods are dependent upon the ecosystem services of the Mekong. Pollution in the Mekong is particularly pronounced in urban areas in the dry season when flows are reduced. Water pollution from industrial sources has been identified in the LMB, especially in the capital cities of Vientiane and Phnom Penh, and more generally in northeast Thailand and the Mekong Delta. Generally, treatment of industrial wastewater is limited and handling and disposal of industrial hazardous waste are insufficient.

Major challenges with regards to water in Phnom Penh are related to poor quality as a result of pollution. However, like persistent organic pollutants, the data about heavy metals and other trace elements is scarce and scattered for the Mekong River. Elevated levels have been found in areas with significant boat traffic and/or with high population densities, mainly in downstream areas of Phnom Penh. In addition, arsenic has been reported as one of the more significant toxic elements in the region. In 2003 and 2004, somewhat elevated levels were found in downstream areas of Phnom

⁸⁸ Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

⁸⁹ <https://www.oecd.org/site/seao/Cambodia.pdf>

Penh.

Industrial waste-water management in Cambodia is very poor, few factories have waste-water treatment facilities and control of industrial waste-water discharge is not enforced. Of the approximately 194 factories in Phnom Penh, only eight have on-site primary treatment and their effluents generally exceed Cambodia's water quality standards. Another pollution problem relates to gemstone mining activities in the western part of the country. Most manufacturing and warehouses in Phnom Penh are located along the embankment of the Tonle Sap river north or the Bassac river south of the city, with mixed commercial and residential areas. Such locations allow direct access to river transport and high consumption of water⁹⁰.

Phnom Penh faces the risk of flooding every year from the Mekong River. Here, the indirect uses of wetlands are sometimes less obvious, but no less important. Natural wetlands absorb floodwaters that could otherwise be disastrous during the wet season. Cambodia's Tonle Sap, for example, expands in surface area as much as four to five times during the wet season. Without this natural absorption, Phnom Penh would be completely flooded every year⁹¹.

Wetlands also play other important roles locally in Phnom Penh with regards to flooding. In both Vientiane and Phnom Penh, for example, urban wetlands play a central role in purifying waste water from domestic and industrial use. Three urban wetlands in Phnom Penh – Boeng Trabek, Koeng Tumpun and Boeng Cheung Ek – absorb large quantities of household waste water, storm water and industrial effluents each day. This mitigates flooding with large economic impacts every day. In addition to the pollution remediation services that they provide, the wetlands provide valuable land for vegetable production. Most growers produce 5–10 tonnes of water spinach a year, earning USD 350–700 per household per year⁹². This compares favourably with average rural and urban (Phnom Penh) household incomes. However, pollutants in the waste water are cause for concern.

90 WWF Water Risk Filter, Cambodia Country Profile. <http://waterriskfilter.panda.org/en/CountryProfiles#13/profile>

91 Ratner et al. 2004

92 Khov et al. 2007

The high level of urban growth and increasing energy demand has a significant impact on the Mekong River through the need for material for construction in addition to hydropower for energy. Both construction and hydropower fundamentally impact the hydrology and sediment flow of the river. Poorly designed roads obstruct the natural flood cycle, with detrimental impacts on flood dependent habitats and species as well as the local livelihoods dependent upon them. At the same time, these same roads are periodically damaged by particularly strong floods, in a constant cycle of damage and repair, which does not seem to be an efficient use of limited development resources. The benefits of urban development need to be balanced with the devastation of the environment in which they are taking place.

In terms of industrialisation, the ready-made garment market from Cambodia into Thailand is a major industry.

All fabric is imported from factories in Thailand. The fabric is then produced in Cambodia, only to be exported again into Thailand and then globally. The textile industry represents a large portion of the Cambodian economy (16 percent national GDP), and at times, up to 60 percent of exports GDP. Most textile factories are owned by foreign companies (90 percent), of which the majority are based in other parts of Asia. The majority (60 percent) of activities in the Cambodian garment industry are at the lowest end of the value chain, primarily consisting of CMT (Cut, Make, Trim). The CMT process uses mostly imported fabric⁹³. Retail brands sourcing from Cambodia include H&M, Inditex, N Brown Group, Tchibo, Next, New Look, Gap, Banana Republic, Nike, Levi, C&A, Walmart, Puma, Old Navy, Adidas, Calvin Klein, Clarks, Marks and Spencer and Tesco. Prior to the war, Cambodia had a significant cotton industry. Since the war, the industry has not recovered⁹⁴.

93 <https://cleanclothes.org/resources/publications/factsheets/cambodia-factsheet-february-2015.pdf>

94 <https://cleanclothes.org/resources/publications/factsheets/cambodia-factsheet-february-2015.pdf>

KEY MESSAGES

- Development and industrialisation is positive for Cambodia. This needs to be supported in an effort to grow the economy further. However, alongside industrialisation, is a large population dependent on natural resources gathered from the Mekong for their livelihoods. The value of ecosystem services supporting agriculture and livelihoods needs to be weighed against the benefits and costs of development.

4.2.2 Digging the River - Construction, Sand mining and Sediment

There is massive concern regarding the widespread practise of sand dredging from the Mekong in Cambodia, as indicated by the following quote: “Phnom Penh’s construction frenzy is fuelling the need for sand dredging, the practice of sucking up debris from riverbeds. The sand is normally used to clear waterways and to provide material for development projects. According to the Cambodian government, between 15,000 to 20,000 cubic meters of sand per day is needed in Phnom Penh to sustain the city’s building boom. Sand dredging, which in Khmer translates to ‘getting the sand out of the water,’ is a common practice around the world. But for many here, it’s a symbol of what ails the city: shoddy urban planning and a Wild West approach to development”⁹⁵.

The following figure gives an indication of the extent of sand mining taking place along the course of the Mekong River. As indicated by the size of the circles, the volume of extraction taking place from Cambodia is the largest among the riparian countries⁹⁶.

There are significant negative impacts of the removal of sediment and building material from the river. For instance, the geometry and morphology of the Mekong analysed between 1998 and 2008 displays important irregular bed incision, with expansion and deepening of numerous pools resulting in erosion and the collapse of river banks. The mean depth of the channel increased by more than 1.5 m between 1995 and 2008. It is assumed that sand mining and aggregate extraction, currently practised on a very large scale, is the main driver of these recent changes in the river morphology.

⁹⁵ <https://nextcity.org/daily/entry/sand-dredging-phnom-penh-cambodia-hot-commodities>

⁹⁶ <https://echogeo.revues.org/docannexe/image/13659/img-1.jpg>

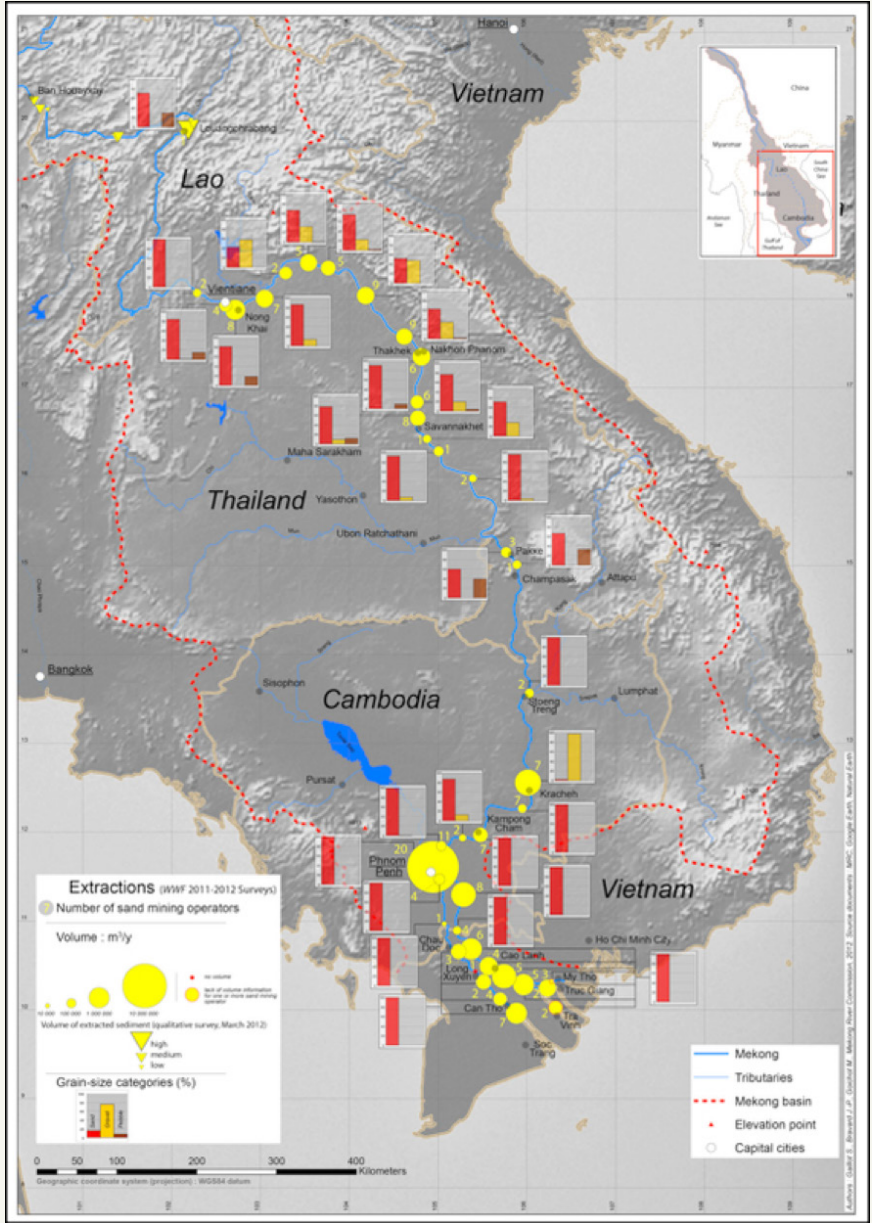


Figure 28: Map of extraction sites along the Mekong River, showing the extracted volumes and grain-size categories. Source: <https://echogeo.revues.org/13659?lang=en#illustrations>

In Cambodia, sand dredging has been controversial for a number of years. In 2009, Prime Minister Hun Sen announced a ban on sand exports, which were being used for land reclamation projects abroad, mainly in Singapore. According to a 2008 report from the London-based NGO Global Witness, the sand, extracted for the most part from the winding Tatai River in the southwestern province of Koh Kong, was worth at least USD 8.6 million annually at the point of extraction – and some USD 35 million in retail value once in Singapore⁹⁷. This is illustrated by the newspaper headline indicated below.



Figure 29: Sand for construction to feed the boom in Phnom Penh. Source: [Next City](#)

Sand dredging for export was banned in 2009 due to collapsing riverbanks and disturbances to marine life. A growing eco-tourism sector was also cited as a driver to reducing sand dredging. Although the ban has been implemented, dredging is still allowed where sand replenishes itself naturally in the riverbed to help unblock waterways, and, crucially, to meet domestic consumption. Due to the significant growth taking place in Phnom Penh, construction, and therefore dredging, has continued at a great speed. In 2013, the government became concerned about the combination of massive flooding and dredging, putting a stop to the practice within the city limits, however, it has continued to allow dredging in specific areas.

Sedimentation, and the flow of sediments through the Mekong is a complicated and complex system. In the recent past, sedimentation of Lake Tonle Sap has given cause for concern. This concern is mainly due to the Mekong silt load, and to deforestation in the upper reaches of the Tonle Sap watershed. The thesis is that although sediment levels have decreased upstream, as a result of hydropower dam construction, the total sediment entering the Tonle Sap has remained stable, due to the influx of locally sourced sediment from deforestation. This system is not

⁹⁷ <https://nextcity.org/daily/entry/sand-dredging-phnom-penh-cambodia-hot-commodities>

sustainable however, and negative impacts are projected. In the absence of reliable data on hydrology and sediments in this area, many scenarios have been developed. The most pessimistic forecast a drying-up of the lake within ten years, while other studies estimate that the lake would take 600 years to dry up. All these estimates reveal a need for reliable hydrological and sediment data. What is agreed by all concerned is the negative effect of sedimentation on the environment, particularly on fish.⁹⁸

KEY MESSAGES

- Sediment in the Mekong Basin is used as a filling material for land reclamation of wetlands, so that continued industrial development can take place. The benefits of using sediment for increasing GDP through development need to be weighed against the ecosystem function of the Mekong, which is hugely dependent on the sediment. Although replaceable with other materials and not necessarily high value, sediment is the largest volume of material being extracted from the river course.
- Sand and gravel are also materials extracted from the Mekong to support development in the basin through the construction industry. Sand and gravel are extracted in smaller volume relative to sediment for land reclamation. However, the materials are higher in value, and there are fewer alternatives for the construction industry.

4.2.3 The Vulnerability of Crop Production - Agriculture, Irrigation and Variability

Cambodian agriculture is in the midst of a rapid transformation. Its annual production growth during 2002-2012 averaged 9.6 percent, far exceeding agricultural production growth in Asia and around the world. This high agricultural growth has greatly contributed to poverty reduction, exports, agribusiness development, and farm commercialization in the last decade. In the last decade, Cambodia's agriculture sector has undergone significant structural transformation. Although still playing a large role, the agriculture sector became relatively less "important" in overall GDP and the total labour force, but more "productive", i.e. agricultural land and labour productivity has increased. This transformation was driven

⁹⁸ WWF Water Risk Filter, Cambodia Country Profile. <http://waterriskfilter.panda.org/en/CountryProfiles#13/profile>

by vibrant and pro-poor agricultural growth. This exceptional growth, among the highest in the world, was driven by crop production, mainly of paddy rice (annual growth of 9 percent), but also maize (20 percent), cassava (51 percent), sugarcane (22 percent), and vegetables (10 percent). The growth in livestock and fisheries was modest.⁹⁹ The relative contribution of each of the agricultural sub-sectors is indicated by the figure below. However, challenges in the sector remain, particularly in access to irrigation and increasing productivity rather than just expansion of farmed land.

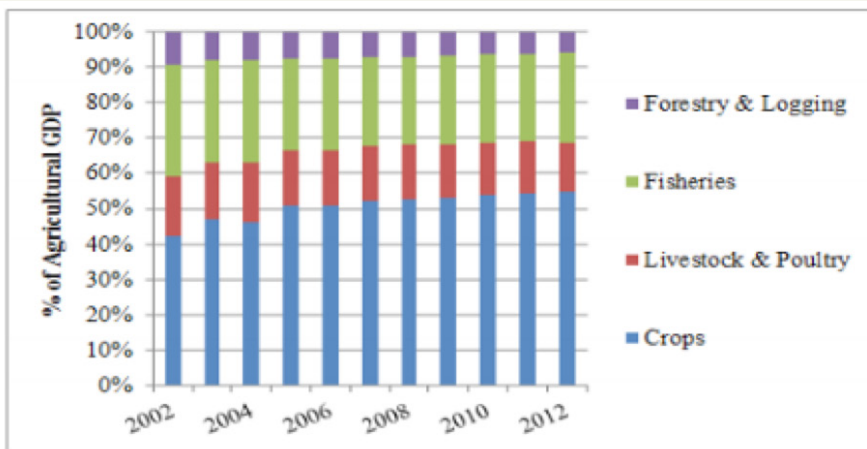


Figure 30: Share of subsectors in agricultural GDP, Cambodia, 2002 -2012. Source: World Bank

In Cambodia, rice production has slowly increased in both area and yield since the early 1990s, due to ongoing post-war rehabilitation and infrastructure reconstruction. Between 2000 and 2005, the total wet season area increased from 1.93 million ha to 2.08 million ha, while the dry season area grew from 233,000 ha in 2000 to 321,000 ha in 2005. Average yields at the same time increased from less than 2 t/ha to 2.48 t/ha, with distinct differences between wet and dry season yields¹⁰⁰. The share of dry season output, however, has been steadily growing, driven by irrigation investments. In 2008,

99 Cambodia Agriculture in Transition: Opportunities and Risks. 2015. Economic and Sector Work. World Bank. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/08/17/090224b08307affe1_o/Rendered/PDF/Cambodianoagrioortunitiesoandorisks.pdf

100 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

the planting area for the dry season crop accounted for 13 percent of total planting rice area. In 2013, it increased to 17 percent¹⁰¹.

A major challenge facing the sector is that of the value chain and markets. Except for rice, the agro-processing industry has played a limited role in agricultural growth. Almost all crops were exported to neighbouring countries unprocessed. This indicates serious weaknesses in the value chain, particularly in the post-harvest system of supply chain management (collection of raw material, storage, finance, logistics, transportation and information).¹⁰²

In Cambodia, other food crops, which were traditionally considered secondary to rice, have grown in popularity due to local rice deficits and the clearing of upland areas suitable for their cultivation. Maize production, in particular, has increased as a result of this trend. High-value commercial crops such as soy, mungbean and vegetables have also been planted over a larger area¹⁰³. According to the Mekong State of the Basin Report, rice is likely to expand in production through migration. Other crops that are likely to expand include rubber, sugar cane, tree crops, cassava (minor) and jatropha. Agriculture is still primarily focussed on food security and subsistence in Cambodia, rather than industrialisation and commercialisation. The expansion of agricultural areas, although good for the production of food for consumption, does have impacts on the hydrology of the catchment due to the deforestation of natural upland vegetation. These costs need to be balanced with the increased food production in a systemic and planned manner.

101 Cambodian agriculture in transition: opportunities and risks. Economic and Sector Work, Report No. 96308-KH, 2015.

102 Cambodia Agriculture in Transition: Opportunities and Risks. 2015. Economic and Sector Work. World Bank. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/08/17/090224b08307affe/1_0/Rendered/PDF/Cambodianagricultureopportunitiesandrisks.pdf

103 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

Table 12: Area of Selected Non-Rice Crops. Note: Areas for Cambodia and Lao PDR are harvested area; areas for Viet Nam are planted area. Source: MRC 2005

| | Cambodia (ha) | | Lao PDR (ha) | | Northeast Thailand (ha) | | Viet Nam Mekong Delta (ha) | | Viet Nam Central Highlands (ha) | |
|-----------|---------------|---------|--------------|--------|-------------------------|---------|----------------------------|--------|---------------------------------|---------|
| | 1999/00 | 2005 | 1999 | 2005 | 2000 | 2003 | 1999 | 2005 | 1999 | 2005 |
| Maize | 59,739 | 61,757 | 40,700 | 86,000 | 334,000 | 263,107 | 39,000 | 34,900 | 60,100 | 236,600 |
| Cassava | 14,003 | 28,560 | | 6,765 | 646,000 | 491,370 | 9,200 | 6,400 | 32,300 | 89,400 |
| Soybean | 34,945 | 114,890 | 6,800 | 9,535 | 38,000 | 11,196 | 9,100 | 14,000 | 11,200 | 26,600 |
| Sugarcane | 8,375 | 4,498 | 4,700 | 5,500 | 206,000 | 596,557 | 102,800 | 64,100 | 27,900 | 26,700 |

Cambodia exports a large proportion of its agricultural production. For instance, rice, cassava, and other cereals are the major agricultural export items. In 2011, formal cereal exports were estimated at 180,300 tons, a fivefold increase compared to 2006. The largest increase in exports was for rice. But the informality of cross-border trade does not allow estimation of the true extent of agricultural exports. In 2013, for example, the formal export of rice was 378,850 tons. At the same time, informal cross-border trade of rice is estimated to have been 1,536,000 tons, or five times larger. Most exports of cassava, maize and vegetables also take place via cross-border trade. Official statistics do not properly capture this information, including imports of vegetables in apparently large volumes¹⁰⁴.

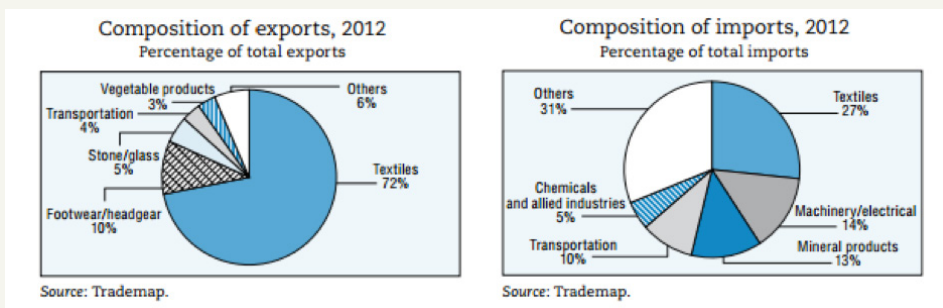


Figure 31: Composition of Cambodian exports and imports. Source: OECD

¹⁰⁴ Cambodia Agriculture in Transition: Opportunities and Risks. 2015. Economic and Sector Work. World Bank. <http://www-wds.worldbank.org/external/default/>

The formal exports of rice mainly go to the EU. Cambodia primarily exports quality rice to European countries, benefiting from access to the EBA, which provides price benefits to Cambodia relative to competitors India, Viet Nam and Thailand. Viet Nam and Thailand, two major rice exporters, are highly diversified globally in terms of their destination markets¹⁰⁵. Going forward this may pose a risk to Cambodia, if environmental and social concerns around the Mekong influence consumer perceptions.

Much of the informal irrigation sector is developed, financed, operated and maintained by individual farmers, communities or local businesses. In Cambodia, local communities are implementing ring dike systems in the flood plains of the Tonle Sap Basin, including some quite large systems. Throughout the basin, individual farmers are developing farm ponds and using water pumps to irrigate their otherwise rain-fed fields. Governments in the LMB countries have recognised that institutional reform is needed to improve the performance of existing infrastructure. For instance, the main policy approach in Cambodia is to transfer small and medium-scale irrigation schemes to communities of farmer water users. The Ministry of Water Resources and Meteorology has launched a program on participatory irrigation management and development to establish farmer communities as legal entities¹⁰⁶. Since 1990, with grants and loans from development partners, the Government of Cambodia has made significant investments in irrigation development. However, widespread expansion of irrigation across the entire country is currently unlikely, as pumping for irrigation water is too costly to reconcile with the existing simple farming methods.

In order to leverage upon local community investments, irrigation support deserves special attention in Cambodia. Without reliable access to affordable water, it is hard to expect intensification and commercialization. Farmers' access to water in the dry season, when it is mostly needed, has improved only marginally. Irrigation coverage in Cambodia is among the lowest

WDSContentServer/WDSP/IB/2015/08/17/090224b08307affe/1_o/Rendered/PDF/Cambodianoagrioortunitiesoandorisks.pdf

105 Cambodia Agriculture in Transition: Opportunities and Risks. 2015. Economic and Sector Work. World Bank. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/08/17/090224b08307affe/1_o/Rendered/PDF/Cambodianoagrioortunitiesoandorisks.pdf

106 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

in Asia. Irrigation expansion needs to go hand-in-hand with the extension of secondary canals, rehabilitation and upgrade of the existing systems, investments in participatory management of irrigation and drainage infrastructure and better coordination of irrigation/flood management with the delivery of other agricultural public services¹⁰⁷. Challenges in the investment climate related to regulatory stability, consistency and predictability restrict the opportunities for the significant foreign investment required to rapidly expand irrigation. A further challenge is the migration of men between the ages of 25 – 40 into cities for employment. Women left behind in the rural areas often do not have access to tenure or finance to leverage investments in irrigation.

KEY MESSAGES

- Agriculture contributes 28 percent to the economy of Cambodia. A large proportion of this value is attributed to the export of agricultural produce to the region and globally. For instance, Cambodia is the third largest rice exporter in the world. The highly productive land in Cambodia is a direct result of the Mekong Basin.
- Irrigation investment remains limited in the region. This is further compounded by the climate projections for the region. For Cambodia to meet its projected increases in agricultural production, significant investments into optimisation will be necessary. The water-related impacts of this shift will need to be understood in the context of broader basin development.

4.2.4 Fish Tails: Protein, Fisheries, Connectivity and Flows
Cambodia's freshwater fisheries are among the most productive in the world due to the presence of large floodplains around the Great Lake and along the Tonle Sap and the Mekong rivers. Cambodia's fisheries produced an estimated 515 000 tonnes in 2009. These inland fisheries are thought to have produced around 390 000 tonnes in 2009. By comparison, the total marine fishery production was small (75 000 tonnes) as is the aquaculture sector (50 000 tonnes). Much of the production generated is consumed domestically, although exports in

107 Cambodia Agriculture in Transition: Opportunities and Risks. 2015. Economic and Sector Work. World Bank. http://www-wds.worldbank.org/external/default/WDSContentServer/WDSP/IB/2015/08/17/090224b08307affe1_0/Rendered/PDF/Cambodianagricultureopportunitiesandrisks.pdf

2009 totalled 30 000 tonnes in product weight. The fisheries sector employs around 420 000 people directly and more than 2 million people are thought to derive some type of livelihood benefit from involvement in the sector¹⁰⁸. In 2008, the fisheries sector contributed about 7 percent to the national GDP and 21.5 percent of the country's output of goods and services in the agriculture, fisheries and forestry sectors. Fish exports represented about 1 percent of total merchandise trade in 2008.¹⁰⁹

The fisheries industry is estimated to account for about 12 percent of Cambodia's GDP, ahead of rice production, which contributes 10 percent to GDP. Most fish caught in Cambodia are consumed locally, but fish and fish products are also exported to many other countries, especially Thailand, Viet Nam and Laos, with minor quantities exported to other Asian and to some Western countries. So although Cambodia's fish consumption is about one quarter of the total of the LMB, its share of LMB fisheries production would be greater, due to exports to the other LMB countries¹¹⁰.

The lower Mekong and Tonle Sap Great Lake floodplains are the major fisheries hotspots in Cambodia. Cambodia's inland fisheries productivity stems from the annual inundation by the Mekong River of the large floodplains found in central Cambodia around the Great Lake (Tonle Sap) and Mekong River floodplains, where important ecological habitats such as flooded forests are found. In Cambodia, the total inland fish catch was estimated at 395,000 tonnes in 2007. The inland fisheries of Cambodia produce between 289 000 - 431 000 tonnes of fish each year. The Great Lake alone accounts for 235 000 tonnes.

The functioning hydrology of the Mekong is very important to the health of the fisheries. In some regions of the basin, this hydrology is rather unusual. For instance, during the monsoon season, the Great Lake expands by 4-6 times, to cover around 6 percent of Cambodia's total land area. This expansion is caused mainly by the flow reversal of the Tonle Sap River. During the rainy season, these shallow flooded areas created provide extremely high fisheries productivity and diversity. At the beginning of the

108 Cambodia Fisheries Overview. 2011. FAO. <http://www.fao.org/fishery/facp/KHM/en>

109 Cambodia Fisheries Overview. 2011. FAO. <http://www.fao.org/fishery/facp/KHM/en>

110 Hortle, K.G., S. Lieng and J. Valbo-Jorgensen. 2004. An introduction to Cambodia's inland fisheries. Mekong Development Series No. 4. Mekong River Commission, Phnom Penh, Cambodia. 41 pages. ISSN 1680-4023

dry season, the Tonle Sap River level decreases and water begins to drain from the Great Lake, reversing the flow of the Tonle Sap River. In addition, certain stretches of the Cambodian Mekong mainstream contain a large number of deep pools. The most important stretch is between Kratie and Stung Treng, where 58 deep pools have been identified, and where a large number of fish species congregate during the dry season. Some of the pools are also the habitat of the river dolphin, *orcaella brevirostris*. The table below gives an indication of the estimated inland fisheries that are produced in Cambodia across three major categories.

Table 13: Estimates of inland fisheries production in 2007 in Cambodia

| Type of fisheries | Estimated Production (tonnes) (2007) |
|--------------------------|--------------------------------------|
| Large scale/middle scale | 159,900 |
| Small-scale | 135,00 |
| Rice fields | 100,100 |
| Total | 395,000 |

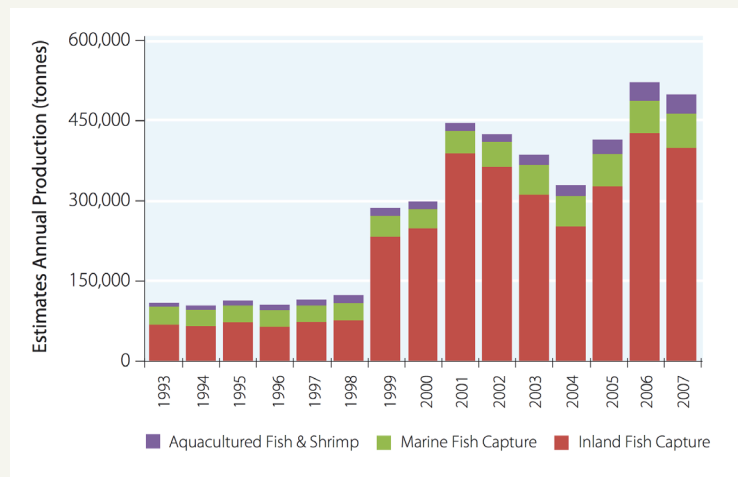


Figure 32: Estimates of fisheries production in Cambodia Note: The large increase in capture fisheries indicates an adjustment to estimates rather than actual increases. Source: MRC 2010

Connectivity between different regions of the Mekong River is critical to support migration of fish species to support the highly productive system.

One of the most important spawning areas for migratory fish is northeast Cambodia, while the most significant feeding grounds are the floodplains along the Tonle Sap, Great Lake and in the Mekong Delta. Deep pools upstream of Kratie to the Laos Border provide refuge during the dry season. Migratory fish stocks are thus shared between Viet Nam, Cambodia and Laos and some species migrate into Thailand as well. Migratory fishes represent at least 37 percent of the total fish biomass harvested, i.e. about 800,000 tonnes per year and are therefore an important factor in the productivity of the Mekong¹¹¹.



SOURCE: GETTY IMAGES

Figure 33: Flooded forests of the Tonle Sap.

One of the most critical elements within the Tonle Sap system is the movement of sediment.

Around 80 percent of the sediment that the system (Tonle Sap) receives from the Mekong is stored in the Lake and the floodplain. The sediment does not settle evenly across the lake, becoming predominately trapped among vegetation within the floodplain. The flooding of the forests, capture of sediment and reversal of flow between the seasons plays an important role in supporting the highly productive ecosystem in the Tonle Sap. This includes the fisheries and harvesting of natural goods and services from the ecosystem.

A major risk to the natural flows of sediment in the Tonle Sap (and more broadly in Cambodia) is deforestation.

One of the major drivers of deforestation is the expansion of agricultural land. In particular, the expansion of cassava in Cambodia has been identified as a major cause of deforestation. This is especially true in the upland areas. Farmland expanded annually by 4.7 percent, with very large increases (128 percent) for cassava¹¹². Thailand and Viet Nam have also become major importers of timber, which they obtain from countries such as Myanmar, Laos

111 Baran E., Guerin E., Nasielski J. 2015 Fish, sediment and dams in the Mekong. Penang, Malaysia: WorldFish, and CGIAR Research Program on Water, Land and Ecosystems (WLE). 108 pp.

112 Cambodian Agriculture in transition: opportunities and risks, 2015. The International Bank for Reconstruction and Development

and Cambodia, exacerbating large-scale illegal logging activities in these forested countries.¹¹³

Aquaculture is a relatively minor component of total production, but is increasing in importance and was officially estimated as 35,000 tonnes in 2007. Field surveys found production in 2004 was about 60–80,000 tonnes, about twice as much as official estimates. The estimate for total national production now is becoming more closely aligned to the estimates from consumption, but may still be an underestimate¹¹⁴. The aquaculture sector remains of minor significance to the overall fishery production of Cambodia, accounting for less than 9.7 percent of total fish production in 2009. Until recently, poor infrastructure limited the distribution of fish feed, fingerlings and the products of the industry¹¹⁵.

Freshwater fish is of great importance for food security and nutrition of the Cambodian people. Average per capita fresh fish consumption nationally is estimated at 33.0 kg per annum with 14 kg of processed fish. Fish paste is of vital importance for many poor Cambodians during periods of low fresh fish availability. Traditionally, people from all over the country have come to the Tonle Sap River in December to February to take advantage of the cheap and abundant fish from the Dai fishery¹¹⁶. By contrast other animal protein sources account for about 5 kg per person per year. In some areas with large-scale fisheries, fish consumption can be as high as 123 kg fish per person per year. Even in relatively less important fishing areas, the seasonal availability of fish and other aquatic animals is an essential part of the diet, contributing up to 56 kg per person per year. The catch of the small-scale and rice field fishers is of high socio-economic importance as most output from those activities is directly consumed by the fishing family, with the surplus, or high quality fish, sold for cash¹¹⁷.

Fish, which provide an important source of protein to the

113 WWF 2013. Ecosystems in the Greater Mekong: Past trends, current status, possible futures.

114 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

115 Cambodia Fisheries Overview. 2011. FAO. <http://www.fao.org/fishery/facp/KHM/en>

116 Cambodia Fisheries Overview. 2011. FAO. <http://www.fao.org/fishery/facp/KHM/en>

117 Cambodia Fisheries Overview. 2011. FAO. <http://www.fao.org/fishery/facp/KHM/en>

majority of the population, are at risk. Estimates show that the replacement of the protein provided by the fisheries will demand significant water and land resources, which will put pressure on the currently stretched environment. Scenarios were developed to investigate the impact of the 11 proposed main stem dams on the productivity of fisheries in the Mekong Basin. Findings included a 4–7 percent increase overall in water use for food production, with much higher estimations for countries entirely within the Basin: Cambodia (29–64 percent) and Laos (12–24 percent). Land increases run to a 13–27 percent increase¹¹⁸.

In addition to provision of protein, the fisheries sector is important for employment in Cambodia. FIA statistics for 2009 suggest that over 420 000 people were employed in the fisheries sector, accounting for almost 5 percent of the Cambodian workforce. However, more than 85 percent of the population in Cambodia lives in rural areas and survive on agriculture and fisheries. During the wet season, virtually all rural households engage in fishing for subsistence purposes; it can be argued that around six million people or 50 percent of the population are ‘employed’ on a part-time basis in fisheries¹¹⁹.

Cambodia’s fisheries face serious threats to their continued productivity, i.e. an excessive fishing effort, including significant unregulated foreign fishing activity, and habitat degradation. The number of subsistence fishers and fishery workers has increased, partially as a result of the improved management in the forestry sector, forcing ex-forestry workers to the coastal zone where many become involved in fishing. Export demand is also encouraging additional fishing effort, especially for the high value species. The destruction of flooded forest has reduced spawning and nursery areas for many Great Lake fish species. Flooded forest areas have been greatly reduced from 795,400 ha in 1985. It is estimated that only 19,517 hectares of inundated forest now remain. Much of the forested areas has been converted into agricultural land and has increased the siltation rate in the Great Lake¹²⁰.

In 2001, the Tonle Sap Biosphere Reserve was established by Royal

118 Orr, S., et al., Dams on the Mekong River: Lost fish protein and the implications for land and water resources. Global Environ. Change (2012), <http://dx.doi.org/10.1016/j.gloenvcha.2012.06.002>

119 Cambodia Fisheries Overview. 2011. FAO. <http://www.fao.org/fishery/facp/KHM/en>

120 Cambodia Fisheries Overview. 2011. FAO. <http://www.fao.org/fishery/facp/KHM/en>

Decree and divides the lake area into three core areas for protection and sustainable management. These areas are: Prek Toal Battambang Province, Boeng Tonle Chhmar and Stoeng Sen in Kompong Thom Province. Boeng Tonle Chhmar has been selected as a Ramsar Site, which designates wetlands of international importance. The core areas cover 42,300 ha and function in a manner similar to national park areas¹²¹.

The urgent need for greater domestic generation capacity in Cambodia is detrimental to the fisheries. National energy demand is comparatively low, but is being met by a very expensive diesel-dependent electricity generation system. Cambodia also has few attractive tributary projects, only meeting half of the projected incremental national demand between 2010 and 2025. Cambodia has no national grid and the lowest rate of electrification in the region. However, the two projects (Sambor and Stung Treng) are some of the most problematic projects with regards to environmental flows and function in the Mekong. In effect, the investment into hydropower generation in Cambodia will negatively impact upon the very resource they harvest from the Mekong: protein through fisheries.

KEY MESSAGES

- The availability of protein from fisheries is a major benefit to Cambodia. Scenarios were developed to investigate the impact of the 11 proposed main stem dams on the productivity of fisheries in the Mekong Basin. Findings indicated a 29–64 percent increase in water requirements to meet the equivalent protein through livestock or crop production¹²². Fish for food, nutrition and livelihoods income should not be swapped. The benefits that fisheries provide are not met through access to electricity through hydropower. Therefore, hydropower development cannot be seen as a poverty reduction measure if fisheries are destroyed.

- Fisheries provide 7 percent to national GDP in the economy of Cambodia. These fisheries are wholly dependent on the ecosystem function of the Tonle Sap, and migration within the broader catchment. The fisheries contribute to food and nutritional security across all of Cambodia, representing the largest source of animal protein.

121 Cambodia Fisheries Overview. 2011. FAO. <http://www.fao.org/fishery/facp/KHM/en>

122 Orr, S., et al., Dams on the Mekong River: Lost fish protein and the implications for land and water resources. Global Environ. Change (2012), <http://dx.doi.org/10.1016/j.gloenvcha.2012.06.002>

4.3 Thailand – gaining benefit with few costs

*Economic
dependency on
water from the
Mekong*

Approximately 18 percent of the total Mekong Basin area falls within Thailand¹²³. This north-eastern part of Thailand represents a small portion of the Thailand GDP and is therefore less directly important to the country's overall GDP. However, the region is of increasing political importance. As a result, increasing investments have been made into local production such as agriculture, food and beverage manufacturing and sand mining for construction. All of these sectors depend heavily on a stable water supply from the Mekong River. The future for the region includes a possible corridor development into Laos, which will catalyse further development and therefore water demand. The impacts of future development on the Mekong and other tributaries in Thailand need to be understood. Other important linkages of the Thailand economy to the Mekong River are through energy supply. The electricity demands of Thailand, as a diversified economy are partly dependent on Laos as an energy supplier. The downstream impacts of the hydropower generation in Laos (used by Thailand) are in-turn felt by Thailand and other downstream countries. This has often been portrayed as the benefits of the power going to healthy Bangkok population, while the rural poor suffer the negative impacts. For instance, a report carried out on the downstream impacts of hydropower has shown the negative Net Present Value (NPV) for the capture of fisheries is far larger than the hydropower generated¹²⁴. As a result of the negative impacts downstream, Thai communities have enabled a court enquiry into the Thai investments and the purchase of hydropower from Laos upstream.

Characterisation of water risks to the economy

- From a water risk perspective, Thailand faces major reputational **investment risks**. The possible positive and negative consequences of using the Laos main-stem hydropower need to be fully interrogated by financial institutions in Thailand, as global supply chains are increasingly understood and disclosed.
- These risks are likely to be compounded as the **legal-regulatory consequences** of the court case regarding livelihoods in

¹²³ WWF Water Risk Filter: Thailand Country Profile. <http://waterriskfilter.panda.org/en/CountryProfiles#74/profile>

¹²⁴ Working Paper on Economic, Environmental and Social Impacts of Hydropower Development in the Lower Mekong Basin. 2015. Apisom Intralawan, David Wood and Richard Frankel.

Thailand negatively impacted by upstream Thai investments in Laos. Whether this court case is successful or not, the presence of the court case indicates the socio-political context, and the potential for Laos hydropower investments to reduce.

- At this stage it is unclear whether Thai investors or businesses are exposed to downstream water risks in Cambodia or Viet Nam in addition to their internal Thai risks.

4.3.1 Developing the Northeast - Water supply/irrigation Political importance and economic growth are growing in the water stressed North-East Thailand.

The Northeast of Thailand is a hugely important area politically and geographically. The area accounts for 85 percent of the Mekong Basin in Thailand and represents one-third of Thailand's 68 million people who live there. While the rest of Thailand experiences a slowing in economic growth, the northeast is experiencing a boom. In 2013, economic growth in the region reached 40 percent from 2007 to 2011, against 23 percent for the country and just 17 percent for greater Bangkok¹²⁵. Politically, resentment toward Thailand's latest military coup is palpable, reinforcing a long-standing sense of ethnic separateness among its Laos-speaking people. For the last half-century, significant attention and funds have been channeled into the development of water resources in North-East Thailand. However, it is also the poorest and most densely populated region in Thailand.

Urbanisation and the associated decline in the percentage for the rural population is a phenomena found in all four countries. These trends are most visible in the northeast of Thailand where major economic growth has taken place in the non-agricultural economy (both in the region and country as a whole). This has absorbed a growing number of rural people, drawing them away from farming. In turn, agricultural expansion has declined as a result of the importance of other sectors¹²⁶.

In response to the economic boom in the northeast, a number of private companies are gravitating towards the area. These include Thai manufacturers such as CP All Pcl, Thai Beverage Pcl and Siam Cement, plus foreign firms with Thai plants such as Panasonic Corp, Kraft Foods Group Inc. and Fraser and Neave Ltd. One of the

¹²⁵ <http://www.reuters.com/article/us-thailand-northeast-idUSBRE95FooH20130616>

¹²⁶ Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

drivers for the migration is the 2011 devastating flood in Bangkok, which impacted businesses. “Logistics providers and consumer products are moving upcountry because of the floods,” said Patan Somburanasin, general manager of TPARK, a logistics company and subsidiary of TICON Industrial Connection Pcl, which is investing up to 2 billion baht in a 79-acre logistics park in the north-eastern city of Khon Kaen¹²⁷.

Regardless of the economic growth, the agricultural sector remains the main user of water in Thailand, accounting for 71 percent of the total water demand while contributing 12 percent. The industrial sector accounts for two percent, the domestic sector for five percent and the remaining 22 percent for ecological balance. The current trend is a reduction in the share of agricultural water use, with a corresponding increase in both industrial and domestic water usage¹²⁸.

The demand for water in the northeast of Thailand is shifting as irrigation increases. Although this part of northeast Thailand has an annual rainfall of more than 1,000 mm, a high evaporation rate means it is classified as a semi-arid region¹²⁹. Agriculture in the northeast of Thailand has gradually made a transition into more commercialized modes of agricultural production¹³⁰. Farming is mostly rain-fed, but irrigation facilities have been stepped up and now occupy some 17 percent of the farm areas. Most of the irrigation facilities were invested and administered by the public agencies. They deal mainly with rice and vegetable farming¹³¹. Sandy and saline soils are the most common soil types, which makes much of the land unsuitable for wet rice cultivation. Drought is by far the major hydrological hazard in this region.

In northeast Thailand, more than 80 percent of the cultivated area is used for growing rice, or a mix of rice and upland crops. The harvested area under rice production in northeast Thailand fell slightly between 2000 and 2005 as indicated by the table below¹³².

127 <http://www.reuters.com/article/us-thailand-northeast-idUSBRE95FooH20130616>

128 FAO, 2000. Thailand's water vision: A case study. <http://www.fao.org/docrep/004/ab776e/ab776e04.htm>

129 <http://www.mekonginfo.org/assets/midocs/0001968-inland-waters-overview-of-the-hydrology-of-the-mekong-basin.pdf>

130 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

131 http://siteresources.worldbank.org/INTAFRICA/Resources/Thailand_CCAA_report.pdf

132 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/>

Another interesting characteristic is the higher yield of rice during the dry season, which is likely as a result of the use of irrigation. Two thirds of rice production are for local consumption, while the remainder is exported.

Table 14: Northeast Thailand Rice Production

| Northeast Thailand | Wet Season | | Dry Season | | Total | |
|-------------------------------------|------------|------|------------|------|-------|------|
| | 2000 | 2005 | 2000 | 2005 | 2000 | 2005 |
| Average harvested (thousands of ha) | 4675 | 4305 | 138 | 112 | 4813 | 4417 |
| Production (thousands of tons) | 9046 | 7914 | 451 | 358 | 9497 | 8272 |
| Yield (tons/ha) | 1.9 | 1.8 | 3.3 | 3.2 | 2.0 | 1.9 |

According to the Mekong State of the Basin Report (2010), “In northeast Thailand, diversification into non-rice crops has taken place to a greater extent than in the other LMB countries. However, they still only cover about 20 percent of the cultivated area in the region. The largest increase was in the area of sugarcane which expanded corresponding to a decrease in the area of cassava. In Thailand sugar and rubber are the major alternative crops, grown mainly for export”.¹³³ In the 2000s, cassava and sugar cane were the two dominant cash crops in the northeast; cassava slightly surpasses sugar cane in terms of areas planted.¹³⁴

[Publications/basin-reports/MRC-SOB-report-2010full-report.pdf](#)

¹³³ Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

¹³⁴ http://siteresources.worldbank.org/INTAFRICA/Resources/Thailand_CCAA_report.pdf

Table 15: Area of selected (non-rice) crops. Note: areas for Cambodia and Lao PDR are harvested area; areas for Viet Nam are planted area.

| | Cambodia (ha) | | Lao PDR (ha) | | Northeast Thailand (ha) | | Viet Nam Mekong Delta (ha) | | Viet Nam Central Highlands (ha) | |
|-----------|---------------|---------|--------------|--------|-------------------------|---------|----------------------------|--------|---------------------------------|---------|
| | 1999/00 | 2005 | 1999 | 2005 | 2000 | 2003 | 1999 | 2005 | 1999 | 2005 |
| Maize | 59,739 | 61,757 | 40,700 | 86,000 | 334,000 | 263,107 | 39,000 | 34,900 | 60,100 | 236,600 |
| Cassava | 14,003 | 28,560 | | 6,765 | 646,000 | 491,370 | 9,200 | 6,400 | 32,300 | 89,400 |
| Soybean | 34,945 | 114,890 | 6,800 | 9,535 | 38,000 | 11,196 | 9,100 | 14,000 | 11,200 | 26,600 |
| Sugarcane | 8,375 | 4,498 | 4,700 | 5,500 | 206,000 | 596,557 | 102,800 | 64,100 | 27,900 | 26,700 |

Future trends in northeast Thailand are unlikely to include an expansion of rice due to the limited space available. However, sugarcane and rubber production have continued to grow in addition to cassava and eucalyptus. Jatropha for biofuel is currently at an experimental phase. Access and availability of water is one of the most critical constraints to determining the future potential for agricultural production. In northeast Thailand, for example, farmers often employ different strategies on their generally more drought-prone upper paddy fields than on the flood-prone lower fields¹³⁵. A reduction in water supply has led to increased exploration of alternative crops in the region, as indicated by the following news headline recently¹³⁶.

A farmer inspects a parched rice field in Nonthaburi province near Bangkok on March 23. Drought is pushing Thailand away from the grain that has defined a way of life for generations. | AFP-JIJI

ASIA PACIFIC

Low rain forces Thai rice farmers to consider growing other crops instead

AFP-JIJI

¹³⁵ Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

¹³⁶ <http://www.japantimes.co.jp/news/2016/04/08/asia-pacific/low-rain-forces-thai-rice-farmers-consider-growing-crops-instead/#.VxSdMPL97cc>

Most of the installed irrigation infrastructure is found in the northeast of Thailand relative to the rest of the Basin. In the past 10 years, the area of irrigated agriculture in the region has remained static despite large investments and water usage has remained low outside of the wet season. This is because irrigation schemes in the northeast of Thailand are mainly used to provide supplementary irrigation during the dry season (the irrigated area is as low as 10 – 15 percent of the installed irrigable area at this time)¹³⁷.

Table 16: Area of irrigated rice and other crops

| Country | Irrigable area | Rice (ha) | | | Non-rice crop area (ha) | Annual irrigated area (ha) |
|-------------|----------------|------------------------|------------------------|------------------------|-------------------------|----------------------------|
| | | 1 st season | 2 nd season | 3 rd season | | |
| Cambodia | 504,245 | 273,337 | 260,815 | 16,713 | 12,172 | 563,037 |
| Lao PDR | 166,476 | 166,476 | 97,224 | - | 6977 | 270,677 |
| Thailand | 1,411,807 | 1,354,804 | 148,255 | - | 252,704 | 1,755,763 |
| Viet Nam | 1,919,623 | 1,669,909 | 739,594 | 1,478,740 | 329,740 | 4,217,983 |
| - Delta | | 1,528,225 | 663,410 | 1,478,740 | 294,899 | 3,965,274 |
| - Highlands | | 141,684 | 76,184 | | 34,841 | 252,709 |
| Total LMB | 4,002,151 | 3,464,526 | 1,245,888 | 1,495,453 | 601,593 | 6,807,460 |

Source: MRC (2009a)

The low intensity of irrigation use has changed in recent years, however, due to drought leading to a reduction in rainfall. Therefore, instead of only 10 – 15 percent of irrigation infrastructure being used for irrigation, the proportion is now far higher. Due to the dry conditions this year, increased pumping began to take place out of the Mekong in order to irrigate crops in the northeast of Thailand.

Thailand facing its worst drought in 20 years

Production of rice, sugar cane, shrimp and fish farms suffering from drought that has seen water levels at dams drop to under 10 percent

10.04.2016



Bangkok



politics, world, economy, science-technology, asia - pacific



¹³⁷ Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

This has led to a significant reduction in dam levels as seen in the following quote from a recent news report, “The water level in the Ubolrattana dam in northeastern Khon Kaen province has decreased to the point where irrigation authorities have stopped any pumping to avoid causing structural damage. In an attempt to ease the water shortage, the irrigation agency has asked rice-farmers to suspend planting the grain if their fields are not connected to the irrigation system -- a request mostly aimed at farmers of the north and the north-east”¹³⁸. This has been further compounded by the fact that Thailand did not inform the MRC of the increased abstraction from the river, creating tensions when news of the Thai extractions was picked up in Viet Nam as indicated by the newspaper clipping shown below.

Mekong River diverted into Thailand's waterways, worrying drought-stricken neighbours like Vietnam

By South-East Asia correspondent [Liam Cochrane](#)

Updated 18 Mar 2016, 3:43am

KEY MESSAGES

- The northeast of Thailand is a hugely important area politically and geographically in the context of large living standard gap between the urban rich and the rural poor. The area accounts for 85 percent of the Mekong Basin in Thailand and represents one-third of Thailand’s 68 million people who live there.
- In 2013, economic growth in the region reached 40 percent from 2007 to 2011, against 23 percent for the country and just 17 percent for greater Bangkok.
- In northeast Thailand, more than 80 percent of the cultivated area is used for growing rice, or a mix of rice and upland crops. Irrigation has continued to expand over time. This year, the higher extraction of water for irrigation during the dry season began to create concerns for downstream riparian water supply. What is the opportunity cost of reduced flow to countries downstream?

¹³⁸ <http://aa.com.tr/en/world/thailand-facing-its-worst-drought-in-20-years-/552381>

4.3.2 Building the cities - Construction, Sand mining and Sediment

The Mekong River provides important resources to Thailand in supplying raw materials such as sand and gravel for construction. Developing economies with sand and gravel that are used for the construction of infrastructure and buildings, for elevating land in floodable areas and raising levees against floods, for reclaiming urban land offshore, etc. There are numerous uses for this apparently plentiful, clean and cheap resource and demand is increasing rapidly. Gravel and sand is of particular value in places where silt and clay are the main resources for construction, as is the case in the LMB¹³⁹.

Due to the richness of resources, Thailand is one of the world's leading producers of cement, feldspar, gypsum and tin. The mining and quarrying sector is important to the country's economy, but is not a large contributor to GDP¹⁴⁰.

The northeast of Thailand and Mekong Delta are the most advanced industrial regions in the Mekong Basin. Industrial activity in the Thai part of the LMB is dominated by manufacturing including agro-industry, textiles, light assembly and rubber processing. Industrial waste is expected to expand as the industries expand. In northeast Thailand, for example, the generation of hazardous wastes is expected to increase by about 72 percent over the next five years.¹⁴¹

As a result of economic growth and a growing industrial sector, significant sand mining has been taking place in the Mekong River for construction. A report by WWF has found that in 2011, 35 million cubic metres of aggregates (sand, gravel and pebbles) were mined from the Lower Mekong main stem for construction in Laos, Cambodia, Viet Nam and Thailand. The coarser the material extracted from the river, the more valuable. Therefore, pebbles are the most valuable, followed by gravel, coarse sand, fine sand and then silt and clays. The estimated 35 million cubic metres of aggregates extracted is recognised as a conservative assessment and only based on main stem of Lower Mekong (excluding mining in the tributaries). A more in-depth study was recently done in

139 Geography of sand and gravel mining in the Lower Mekong River. 2013. <https://echogeo.revues.org/13659>

140 <http://minerals.usgs.gov/minerals/pubs/country/2010/myb3-2010-th.pdf>

141 <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

the Mekong Delta by the Southern Institute for Water Resources Research, who found the annual sand mining rate in the Mekong delta was 18M³ (when WWF study estimate was 7M³). The table below shows the relative size and source of abstraction. Of the total, 90 percent was sand, which equates to approximately 31 million cubic metres in 2011.

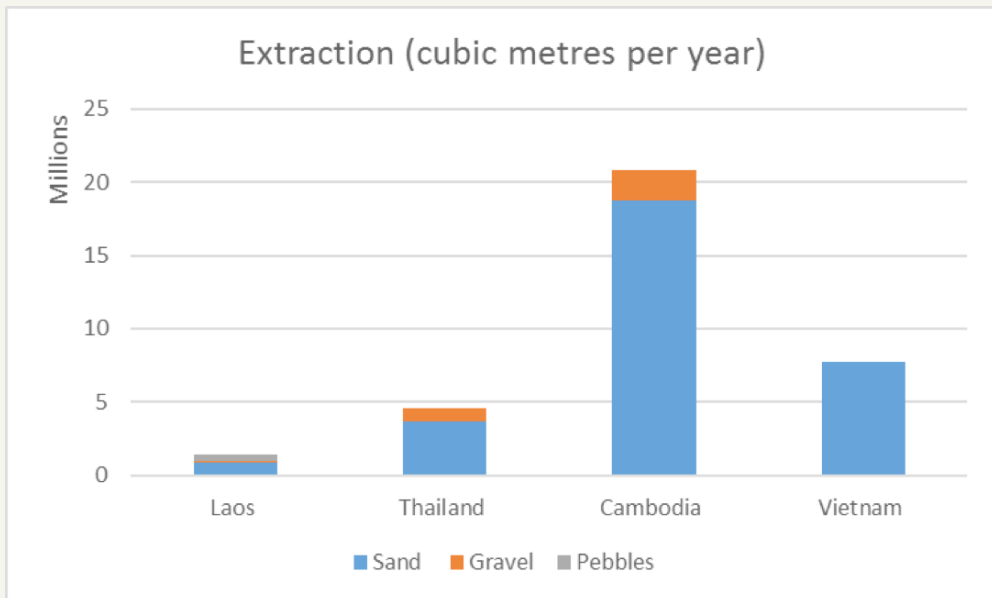


Figure 34: Volumes and percentage of grain-size categories per country. ¹⁴²

According to a sediment report published by the MRC Information and Knowledge Information Platform in collaboration with WWF, the geography of sediment extraction reveals that Cambodia was the largest extractor in 2011-2012, accounting for 60 percent of the extractions, with Viet Nam (22 percent) and Thailand (13 percent) 2nd and 3rd respectively. Extractions in Laos accounted for only 4 percent of the catchment total, but Laos was extracting the coarser grain size, including pebbles¹⁴³.

¹⁴² Knowledge of sediment transport and discharges in relation to fluvial geomorphology for assessing the impact of large-scale hydropower projects. 2015. MRC Information & Knowledge Information Program (IKMP) & World Wide Fund for Nature (WWF).

¹⁴³ Knowledge of sediment transport and discharges in relation to fluvial geomorphology for assessing the impact of large-scale hydropower projects. 2015. MRC Information & Knowledge Information Program (IKMP) & World Wide Fund

One of the major drivers of sediment extraction is the construction industry, resulting in major clusters of extractive activity near towns. The construction sector is projected to continue growing in Thailand due to investments in residential infrastructure and commercial construction projects driven by economic growth. Forecasts indicate an increase in the value of the Thai construction industry from USD 17.4 billion in 2014 to USD 19.9 billion in 2019 in real terms, at an annual growth rate of 2.79 percent. A construction activity breakdown shows residential construction to be the largest sector, at 37 percent of the industry's total value, followed by infrastructure construction at 24.6 percent¹⁴⁴. Construction has been boosted in Thailand through tax incentives encouraging foreign investments into agriculture, renewable and alternative energies, IT and tourism. The government has also initiated a national development plan aimed at the development of Thailand's road, rail and port infrastructure and running up to 2022. However, questions regarding the financial stability as well as political stability of Thailand have put the upper projections of growth on hold, with a more tempered growth projection instead¹⁴⁵.

KEY MESSAGES

- Construction of infrastructure is a critical component of development in a country. It is difficult to temper economic growth, especially when the development needs within a country (such as Thailand) are significant. However, continued sustained mining of sediments may in fact undermine the successful economic development that has taken place. The analogy of building a castle on a foundation of sand may have relevance in the case of continued development within the MRB using the very sediments that ensure a functioning and productive system.
- A further complication with the construction sector and its reliance on sediment is the potential impact of hydropower dams on the availability of sediment downstream. Thailand, Cambodia and Viet Nam may be negatively impacted through a significant reduction of sediment flowing down the river.

for Nature (WWF).

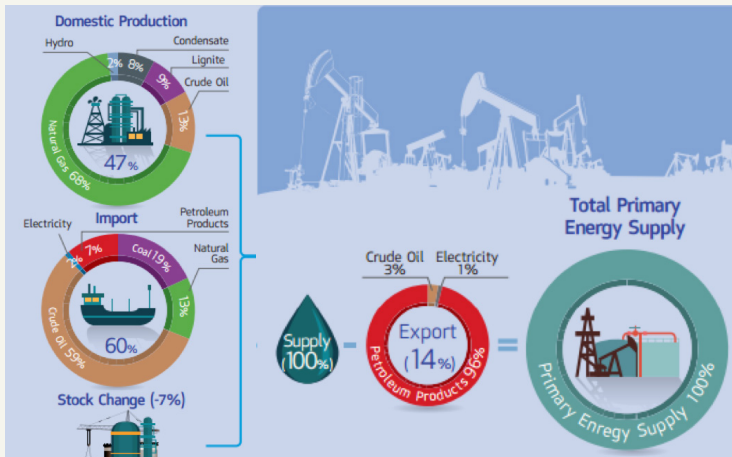
144 <http://www.khl.com/magazines/international-construction/detail/item113275/>

145 <http://www.bmiresearch.com/news-and-views/momentum-building-in-thailands-construction-sector>

4.3.3 Mekong Hydropower for Thailand

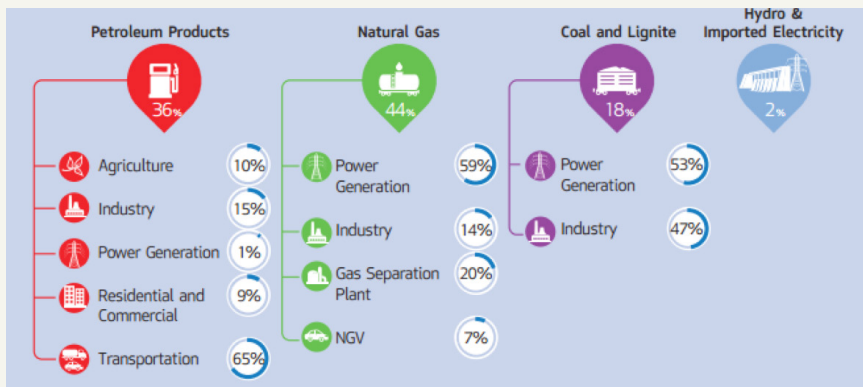
The Mekong has become one of the most active regions in the world for hydropower development with a comparatively high number of large hydropower projects planned, relative to the size of the basin. Hydropower development in the LMB is being driven by regulatory systems introduced to encourage investment in strategic infrastructure for water and energy due to

the recognition that they are stretched. Private developers are leading the investment in the Basin, with most funding sourced from the Asian region itself¹⁴⁶. Thailand is one of the major actors in the energy system.



The 2014 Thailand energy overview is shown to the left¹⁴⁷.

Demand of energy is used by the following sectors in the following forms:



146 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

147 <http://www.eppo.go.th/info/cd-2015/pdf/info1.pdf>

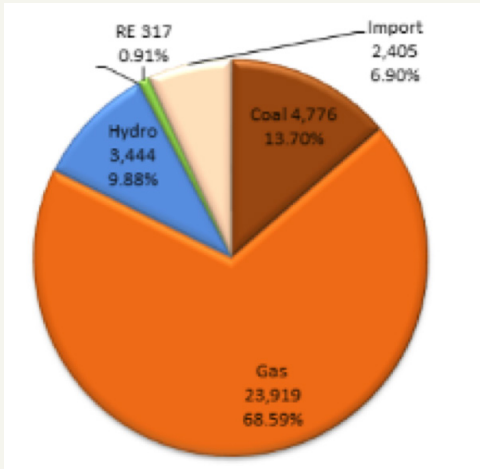


Figure 35: Thailand capacity mix by type of generation (2014). Source: WWF

In terms of electricity, natural gas (69 percent) is the largest provider of power followed by coal (13 percent).

The Mekong River plays an important role in powering Thailand through hydropower generated upstream in the region. Currently, hydropower meets 10 percent of the total Thailand electricity supply, while the majority of electricity needs are met by natural gas¹⁴⁸. Electricity demand in Thailand has risen approximately 7 percent a year as a result of the country's economic growth¹⁴⁹. The industrial and commercial sectors are the biggest consumers of electricity in Thailand consuming 42.4 percent and 35.56 percent, respectively, predominately in urban areas¹⁵⁰.

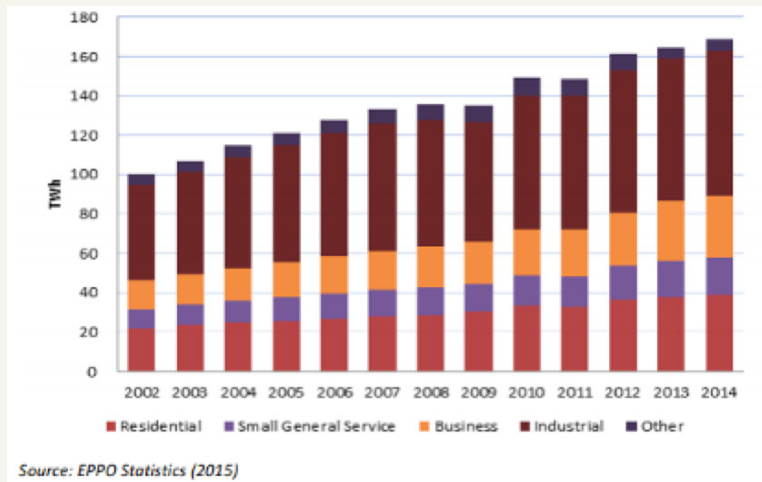


Figure 36: Thailand electricity demand by category (2002 - 2014). Source: EPPO Statistics via WWF

148 http://d2ouvy59podg6k.cloudfront.net/downloads/thailand_power_sector_vision_full.pdf

149 Wisuttisak, 2012b

150 Matthews, N. 2012. Water grabbing in the Mekong Basin. Water Alternatives. <http://crawl.prod.proquest.com.s3.amazonaws.com/fpcache/084213cbbec3e53e25cf536909103a0e.pdf?AWSAccessKeyId=AKIAJF7V7KNV2KKY2NUQ&Expires=1460987215&Signature=v3VS7DTbhNxCVm6z%2BLlIXcSbYes%3D>

Due to Thailand’s limited internal electricity generation possibilities, and the rapid growth of investments in Laos through hydropower, Thailand has become intrinsically linked to the Mekong River through electricity consumption. This differentiates Thailand from other regional investors¹⁵¹. An analysis shows that “the structure and politics of the Thai electricity sector, private-sector profiteering and a strong domestic civil society are driving Thailand’s hydropower investment into neighbouring Laos. Thai investments are enabled by the need for investments in Laos. These drivers and enabling factors combine with short-term economic focused regional development to create opportunities for water grabbing. The winners of this water grabbing are the powerful actors who control the benefits, while the losers, local livelihoods and the environment, are negatively impacted”¹⁵².

Table 18: Installed capacity of existing, under construction and planned/proposed hydropower projects in the LMB (2009)

| Country | Installed capacity (MW) | | | Total |
|----------|-------------------------|--------------------|--------------------|--------|
| | Existing | Under construction | Planned / proposed | |
| Cambodia | 1 | – | 5589 | 5590 |
| Lao PDR | 662 | 2558 | 17,686* | 20,906 |
| Thailand | 745 | – | – | 745 |
| Viet Nam | 1204 | 1016 | 299 | 2519 |
| Total | 2612 | 3574 | 23,574 | 29,760 |

*Lao PDR and Thailand share borders on two of the proposed mainstream dams. These projects are included under Lao PDR in this table.

Source: Hydropower database, Basin Development Plan, MRC (2008). The planned/ proposed and total columns includes mainstream project potential.

There are reputational risks associated with the investments Thai investors are making in upstream territories, without the required impacts downstream being fully understood. In Thailand, civil society has played a role in regulating state investments in energy. Until 1990, Thai state

151 Matthews, N. 2012. Water grabbing in the Mekong Basin. Water Alternatives. <http://crawl.prod.proquest.com.s3.amazonaws.com/fpeache/084213cbbc3e53e25ccf536909103a0e.pdf?AWSAccessKeyId=AKIAJF7V7KNV2KKY2NUQ&Expires=1460987215&Signature=v3VS7DTbhNxCVm6z%2BLIIXcSbYes%3D>

152 Matthews, N. 2012. Water grabbing in the Mekong Basin. Water Alternatives. <http://crawl.prod.proquest.com.s3.amazonaws.com/fpeache/084213cbbc3e53e25ccf536909103a0e.pdf?AWSAccessKeyId=AKIAJF7V7KNV2KKY2NUQ&Expires=1460987215&Signature=v3VS7DTbhNxCVm6z%2BLIIXcSbYes%3D>

energy policies focused on domestic hydropower projects to build capacity. However, there was strong civil society opposition to the Pak Mun and Rasi Salai dams in the 1990s, putting a stop to domestic hydropower projects¹⁵³.

Without internal generation opportunities in Thailand, EGAT has been forced to look to its neighbouring countries where hydropower could be constructed with fewer constraints. Current concerns involve the controversial USD 3.6 billion Xayaburi dam in Laos, the first mainstream dam on the lower Mekong funded by Thai banks and developed by a Thai construction company. Xayaburi and other proposed mainstream dams have become potentially more economically viable due to the ability to generate more power in the low flow season because dams in China and sites are closer to Thailand, thus shorter transmission lines. Cumulative impacts of the mainstream dams are now being assessed in a similar way to the approaches for the tributary dams of the 3S area. A strategic environment assessment has been prepared for the mainstream dams in the LMB.

Some measures are in place to ensure that investments in hydropower are correctly investigated and researched with regards to their impacts on livelihoods downstream.

Thailand signed a MOU for power trade with Laos in 2003 for up to 3,000 MW. This was to accommodate imports of power from the Theun Hinboun (187 MW) and Huay Ho (126 MW) hydropower projects in Laos. The quantum of power under the MOU was raised to 5,000 MW in 2006 and subsequently raised to 7,000 MW to accommodate additional Laos exports, such as those anticipated from the Nam Ngum 2, Nam Ngum 3 and Nam Theun 2 projects¹⁵⁴. Thailand has entered into similar agreements with Cambodia and other GMS countries. Laos, in addition to the MOU with Thailand, has power trade agreements with Cambodia and Viet Nam. Yunnan Province and Viet Nam, similarly, have agreements to cover cross-border trade between the China Southern Power Grid and Electricity of Viet Nam (EVN) to supply electricity to six provinces in Viet Nam. The cross-border trade in power between Mekong countries will largely determine the scale and pace of hydropower development in the lower Mekong. In 2003, all six governments of the GMS signed

153 Matthews, N. 2012. Water grabbing in the Mekong Basin. *Water Alternatives*. <http://crawl.prod.proquest.com.s3.amazonaws.com/fpccache/084213cbbc3c53e25ccf536909103a0e.pdf?AWSAccessKeyId=AKIAJF7V7KNV2KKY2NUQ&Expires=1460987215&Signature=v3VS7DTbhNxCVm6z%2BLIIXcSbYes%3D>

154 <http://www.internationalrivers.org/blogs/254-0>

an Intergovernmental Agreement on Power Interconnection and Trade. A ‘road map’ to implement the 2003 agreement and, as an initial step, develop a regional power interconnection master plan was supported by the ADB.

In 2015, the National Energy Policy Council approved Thailand’s new Power Development Plan (PDP 2015), which lays out Thailand’s energy and investment plans for the next 21 years, from 2015-2036. An Alternative Energy Development Plan and Energy Efficiency Development Plan was included as part of the PDP. However, despite these measures, the final plan shows that Thailand still plans to double its installed energy capacity over the next 20 years to reach 70,410 MW by 2036. The increase in capacity is mostly as a result of additional imports from projects in Laos and Myanmar. While these decisions may be driven by political interest and the push for economic growth, the hidden cost of Thailand’s plans and the implications for Thai people and the Mekong region are significant. Impacts include the inundation of homes and farmland in addition to environmental impacts on siltation levels in the river¹⁵⁵.

KEY MESSAGES

- Currently, hydropower meets 10 percent of the total Thailand electricity supply, while the majority of electricity needs are met by natural gas, but national reserves are low¹⁵⁶.
- Without internal generation opportunities in Thailand, EGAT has been forced to look to its neighbouring countries where hydropower could be constructed with fewer constraints. Current concerns involve the controversial USD 3.6 billion Xayaburi dam in Laos, which is the first mainstream dam on the lower Mekong funded by Thai banks and developed by a Thai construction company.
- However, Thailand has the opportunity to take on a modern mix (see WWF “Power Sector Vision”). This is less risky for national and economic security, as well as providing less detrimental impacts to the Mekong River itself.

¹⁵⁵ <http://www.internationalrivers.org/blogs/254-0>

¹⁵⁶ http://d2ouvy59podg6k.cloudfront.net/downloads/thailand_power_sector_vision_full.pdf

*Economic
dependency on
water from the
Mekong*

4.4 Laos – to power or not to power

Laos is intrinsically connected with the welfare and the flow of the Mekong. The country is dependent upon the Mekong for hydropower, upon which the entire country's economic development trajectory is linked. Laos is currently undergoing massive growth in the construction of infrastructure, especially electricity supplies and real estate projects¹⁵⁷. The boom in construction has the potential to cause significant environmental challenges within the Mekong, especially for downstream neighbours. Managing these impacts, through measures such as fish passes or sediment purges, will reduce the potential for power generation, making energy more expensive. Climate and sediment impacts on the dams may also have longer-term consequences for sustained power generation.

Water usage is predominantly agricultural, 82 percent, followed by industrial at 10 percent, and domestic use at 8 percent. Usages of other sectors are negligible. There is available water of 270 Billion cubic meters and 5.7 billion has been used and the remaining amount of 264.3 Billion cubic meters flows in the natural rivers. Currently most of the water use occurs in the agricultural sector, such as irrigation, fisheries, plantations and livestock watering. In addition, the water is used for hydro-power; the country has the potential to produce 23,000 megawatts of electricity. Currently only 5 percent of that capacity has been exploited¹⁵⁸.

A large proportion of Laos' population is dependent on agriculture to support their livelihoods. Commercialisation and export opportunities from this sector are limited. The future of the agricultural sector needs to take into account climate vulnerability alongside the livelihoods of the local population.

Characterisation of water risks to the economy

- Development of hydropower in Laos is heavily dependent upon factors within Thailand. These include the Thai investors risk appetite, the ability for Thailand to assure a sustained energy offtake and the regulatory climate in Thailand.
- The aim to become the “battery of Asia” with the development of hydropower in Laos has certain trade-offs. For instance, there may be socio-political risks associated with a loss of livelihoods

¹⁵⁷ Devonshire-Ellis, 2016

¹⁵⁸ State of the Environment: Lao. <http://www.wepa-db.net/policies/state/laos/overview.htm>

from power generation. It is important that these impacts are kept in consideration.

- Currently, there does not seem to be significant corporate (agricultural or other) supply chain or trade risks at this stage. However, considering the development ambitions in the region, this may change. It is important that policy makers pre-empt possible conflict around resources.

4.4.1 Mining/ extractive/ transport corridor infrastructure story, linked to energy

Laos is rich in natural capital that is in the process of being explored and used. Forests, agricultural land, water and hydropower potential and mineral resources comprise more than half the country’s total wealth. While projected electricity production and mineral extraction may not be large by international standards, they are significant relative to the size of Laos’ economy and the government’s fiscal revenues. The expansion of hydropower and mining contributed to 2.5 percent of the annual 7 percent growth in Laos in the last three years. Hydropower and mining have also contributed significantly to fiscal revenues, now representing 20 percent of total revenues¹⁵⁹.

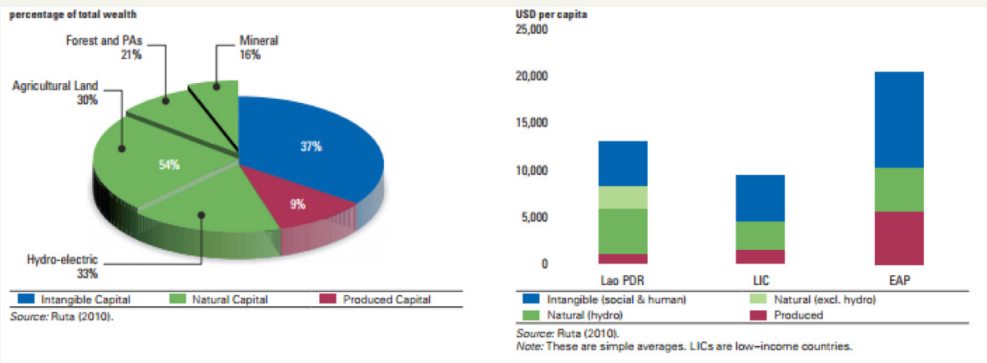
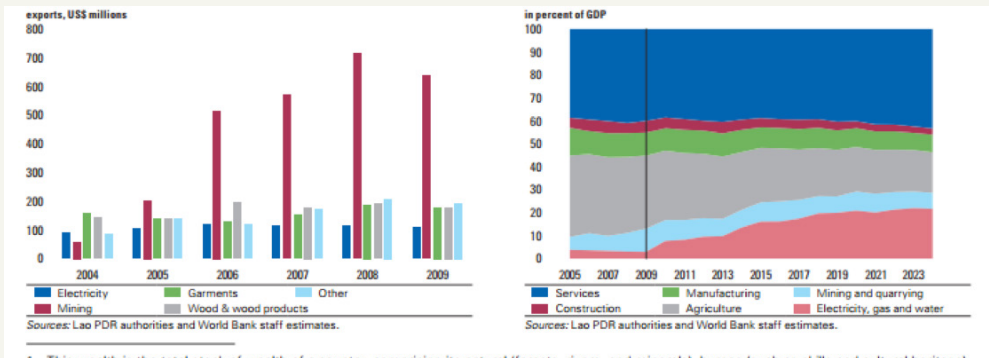


Figure 37: A major part of Laos’ wealth is in natural capital (L), Laos has more natural capital per capita than other LICs or its neighbours (R)

159 World Bank. 2010. Laos Development Report: Natural resource management for sustainable development: Hydropower and mining

Mining in particular is of interest to the economy. The sector currently dominates exports by a significant margin, as indicated by the figure below. Mining together with hydropower generation have been growing in GDP contribution to Laos, while agriculture and manufacturing have been declining in relative terms.



¹ This wealth is the total stock of wealth of a country, comprising its natural (forests, rivers, and minerals), human (such as skills and cultural heritage).

Figure 38: Mining currently dominates exports (L), Shares of mining and hydro are growing while those of agriculture and manufacturing are declining (R)

There are, however, some negative risks associated with the rapid development of hydropower and mining in the region. Only 10 percent of the 200 proposed mining and hydropower projects are being implemented thus far. At a national level, the risks are macroeconomic or involve opportunity costs of large-scale investments. For instance, there is a risk that investments in hydropower or mining may not represent the best possible use of the natural resources given the socioeconomic goals of the country. At a local level, environmental risks include the possible degradation of the current natural resource base due to hydropower and mining, and the country's inability to implement and enforce existing environmental regulations. Social risks arise from the relocation of communities or destruction of natural resources upon which poorer communities rely. This may lead to poverty, inequality and malnutrition. Lastly, there is a risk that the institutional and governance gap between the demand for natural resources and the capacity of the government to manage their sustainable use will grow as more resources come on line.

Cumulative effects of all of the investments further complicate matters. The most prominent example of this in Laos is the Nam Ngum catchment, which has a number of operating and planned large-scale mining (Phu Bia Mining's Copper-Gold Operation and

Gold Heap Leach Operation) and hydropower projects (Nam Ngum1, Nam Ngum 2, Nam Ngum 3, Nam Ngum 5, and Nam Lik 1 and 2), as well as plantations and other development projects. Individually these projects are plausible considering the resource availability. However, cumulatively, all of their individual resource needs may result in degradation to the Mekong system. For instance, the negative impacts of a single mine or a single hydropower station may be buffered by the ecosystem function in the Mekong. However, the impact of numerous mines and hydropower facilities compounded by other development may be too much for the system.

Hydropower and mining development inevitably have environmental implications at the local level. Some effects occur only during the construction phase (for example, when quarries and borrow pits are being dug), whereas others continue for the duration of the project (for example, access roads, power transmission lines and changes in water quality and flow)¹⁶⁰. It is important that Laos implements a system planning screening that would allow the country to meet its hydropower production target to generating income from selling power in parallel to reducing impacts to ecosystems and biodiversity, livelihoods and other sectors.

Infrastructure corridors are a common outcome of major mining or hydropower investment. Infrastructure corridors are both a cause for celebration and concern. Linked to the economic development that they bring is the realisation that access to numerous regions in the LMB may also bring challenges. For instance, investment into roads in the LMB may have detrimental impacts on the already pressured forest resources. Transboundary forests are particularly vulnerable and new economic corridors in the region are already having an impact. Road developments undertaken as part of the ADB's Greater Mekong Sub-region programme are having a direct impact on forest cover and on the accessibility of forest areas. Concerns are that the programme will increase access to and facilitate illegal trade in wildlife, timber and other forest products. The 1,500 km long East-West Economic Corridor links the Indian and Pacific Oceans through Myanmar, Thailand, Laos and Viet Nam and passes close to, or through, a number of protected areas. The areas particularly affected include the northwest and southern parts of Laos and northeast Cambodia¹⁶¹.

¹⁶⁰ World Bank. 2010. Laos Development Report: Natural resource management for sustainable development: Hydropower and mining

¹⁶¹ Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/>

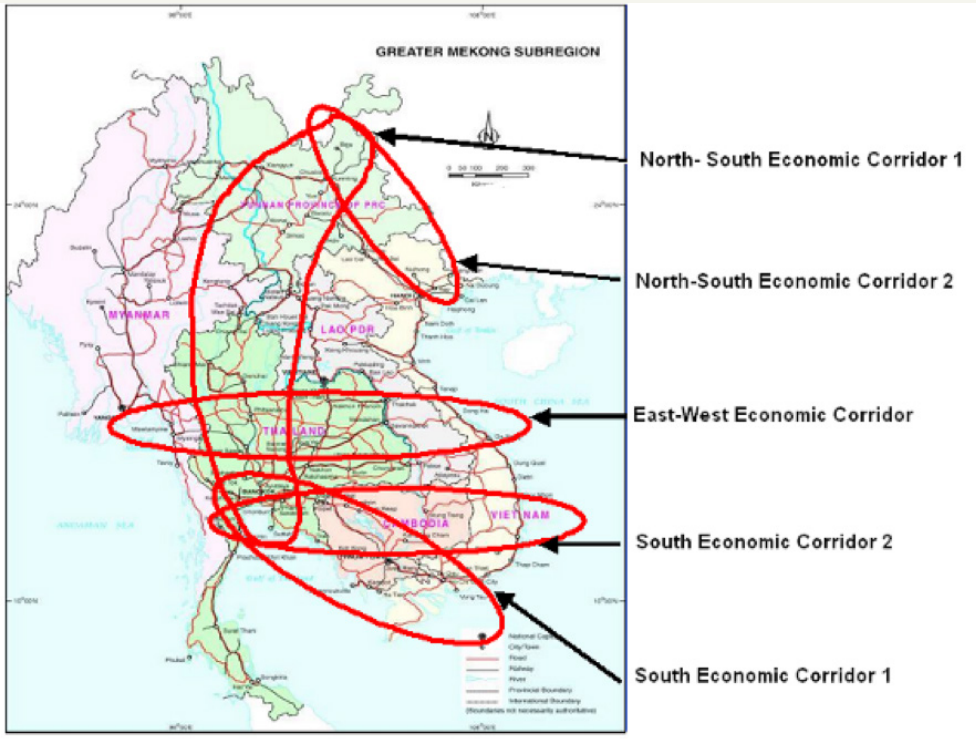


Figure 39: GMS economic corridors

KEY MESSAGES

- The expansion of hydropower and mining have contributed significantly to growth in Laos in recent years. For instance, hydropower and mining now contribute 20 percent of total revenues. In the past 3 years, mining and hydropower have contributed 2.5 percent of the 7 percent growth realised in the country¹⁶².

- A number of questions remain regarding the impact of continued hydropower and mining growth on the Mekong Basin. This includes the impact on sediment flows, fisheries and agriculture. Additional understanding is required on whether or not the impacts of hydropower and mining development in Laos are likely to be felt by local livelihoods or are the impacts likely to be felt by downstream countries?

[Publications/basin-reports/MRC-SOB-report-2010full-report.pdf](#)

¹⁶² World Bank, 2010. Laos Development Report: Natural resource management for sustainable development: Hydropower and mining

•Finally, companies investing in the development of hydropower and mining in Laos need to think deeply regarding the potential reputational risk that they face as a result of these investments.

4.4.2 Powering Thailand - Hydropower for export
Thailand is powering hydropower development in Laos through the provision of finance and construction expertise to Laos. Laos and Viet Nam have significant hydropower resources relative to the other Lower Mekong countries. While Thailand and Viet Nam have developed most of their potential hydropower resources, Laos has developed a smaller percentage of its potential. One of the major drivers of investment in hydropower in Laos is the income generated through export of power to “energy-hungry” states such as Thailand. For instance, the Theun Hinboun Hydropower is a cross-boundary project, which started commercial operations in March 1998. Its main economic benefits are the export revenues for Laos from the sale of hydropower to Thailand¹⁶³. Thailand signed a MOU for power trade with Laos in 2003 for up to 3,000 MW. This was to accommodate imports of power from the Theun Hinboun (187 MW) and Huay Ho (126 MW) hydropower projects in Laos. The quantum of power under the MOU was raised to 5,000 MW in 2006 and subsequently raised to 7,000 MW to accommodate additional Laos exports, such as those anticipated from the Nam Ngum 2, Nam Ngum 3 and Nam Theun 2 projects.¹⁶⁴ There are now on-going discussions to further raise the production capacity of this project to 9,000 MW¹⁶⁵. In addition to the agreement with Thailand, Laos has made similar power trade agreements with Cambodia and Viet Nam. Therefore, water for hydropower generation fundamentally underpins the economy of trade between Laos and other Mekong countries in terms of energy.

163 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

164 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

165 <http://www.bangkokpost.com/business/news/1038989/thailand-considers-buying-more-power-from-laos>



Figure 40: Overview of the large dams and their purpose in the Lower Mekong Basin. Source: CIGAR

From Laos hydropower production, 90 percent of the hydropower is purchased by Thailand and Viet Nam.¹⁶⁶

This is seen by Laos as an important way to generate income for the country. Hydropower has been chosen as the main means to achieve this, resulting in 80 percent of the electricity generated in Laos coming from hydropower dams and 20 percent from coal, since the opening of the Hongsa coal power plant in early 2015. In terms of benefits accrued from the hydropower development, it is often assumed that the host country is likely to be the project owner, gaining maximum benefit from the investment. However, due to the significant funding requirements for the developments in Laos, the allocation of hydropower costs and benefits have been reassessed. A split of 30 percent for the host country and 70 percent for the country

¹⁶⁶ Working Paper on Economic, Environmental and Social Impacts of Hydropower Development in the Lower Mekong Basin. Intralawan, A. Wood, D. Frankel, R. 2015. Mae Fah Luang University, Thailand

funding the project and importing the electricity is assumed¹⁶⁷. In the case of Laos hydropower development, the main financier from a Thai perspective is Egat International Co., the wholly owned subsidiary of the Electricity Generating Authority of Thailand.

There are social and economic considerations regarding the changing nature of the economy towards hydropower.

The investments in hydropower in Laos have dramatically changed the nature of the economy. Historically, agriculture has been the cornerstone to Laos' economy, shifting the GDP of the country following a good harvest and providing more than 70 percent of the labour force. However, agriculture's contribution to GDP has fallen to about 42 percent (whereas before it was more than 50 percent), while industry's contribution has increased (from about 15 percent in 1989 to more than 30 percent in 2007) due to the mining of copper, gold, other minerals and hydropower development. The services sector remains unchanged, contributing about 25 percent to GDP¹⁶⁸.

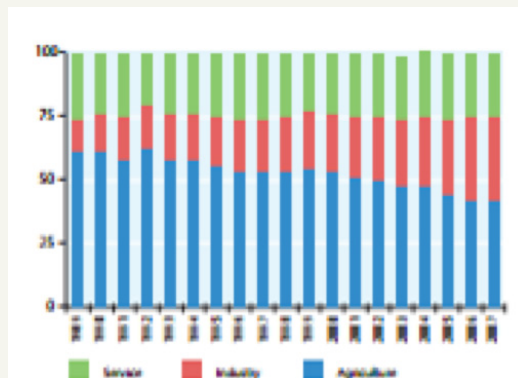


Figure 41: Percentage of GDP by sector (Laos).
Source: World Bank database, 2009

The shift towards investing in hydropower has brought significant benefits to the economy of Laos. However, long-term implications need to be considered in terms of debt repayment, political linkages and also the social and environmental impacts of hydropower development. For instance, large scale bank erosion has been monitored along the Mekong in Laos. This is believed to be closely

¹⁶⁷ Working Paper on Economic, Environmental and Social Impacts of Hydropower Development in the Lower Mekong Basin. Intralawan, A. Wood, D. Frankel, R. 2015. Mae Fah Luang University, Thailand.

¹⁶⁸ Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

linked with both sand mining and hydropower development in the area.

Furthermore, there is an interesting dilemma in Laos selling all of its hydropower generation to Thailand, only to curtail its own mining or industrial development due to a lack of energy. Currently, Laos is exporting cheap base load power to Thailand and continues keeping expensive generation power for use domestically. Electrification in Laos is not complete. For instance, in Laos, biomass is not currently a major source of power generation, but the primary source for general energy use (68 percent of total energy supply in 2014) as wood (56 percent) and charcoal (12 percent) are traditionally used for cooking and heating. The use of biomass for energy further contributes to catchment degradation through deforestation. An additional complexity with regards to hydropower is that hydropower is capital intensive that remains for a large amount of time. It is important that future development projections of the region are taken into account. The high cost of hydropower generation, both in terms of current financial costs in addition to potential future opportunity costs need to be interrogated.

Sediment and flow regime changes along the Mekong can be expected with significant hydropower growth. These need to be taken into account when investing in the Basin. A recent controversial development is the shift to consider mainstream hydropower on Laos, Laos–Thai and Cambodian reaches of the mainstream. The proposed mainstream dams have become potentially more economically viable due to the ability to generate more power in the low flow season because of the dams in China. In addition, they are closer to Thailand, resulting in a shorter grid. At least 11 sites are at various stages of feasibility study under agreement with governments. The proposed mainstream hydropower projects in the lower Mekong vary in scale from 360 MW to 3300 MW. The 11 proposed dams would span at least part of the mainstream channel. Generally, the dams located in Laos would form long (up to 80-100 km) reservoirs within the existing channel¹⁶⁹.

The table below shows a list of the projects being planned in the Lower Mekong for hydropower. Note the heavy weighting of dams being developed on the main stem of the river in Laos with Thai investments. Nine of the proposed mainstream dams would be

¹⁶⁹ Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

built in Laos (Sanakham and Ban Khoum dam sites are shared with Thailand) and two in Cambodia.

Table 19: Hydropower projects in the Mekong Basin

| Country | Installed capacity (MW) | | | |
|----------|-------------------------|--------------------|--------------------|--------|
| | Existing | Under construction | Planned / proposed | Total |
| Cambodia | 1 | – | 5589 | 5590 |
| Lao PDR | 662 | 2558 | 17,686* | 20,906 |
| Thailand | 745 | – | – | 745 |
| Viet Nam | 1204 | 1016 | 299 | 2519 |
| Total | 2612 | 3574 | 23,574 | 29,760 |

*Lao PDR and Thailand share borders on two of the proposed mainstream dams. These projects are included under Lao PDR in this table.

Source: Hydropower database, Basin Development Plan, MRC (2008). The planned/ proposed and total columns includes mainstream project potential.

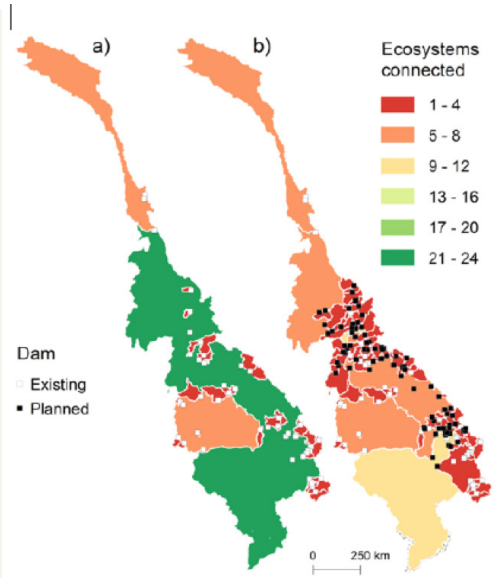


Figure 42: Number of ecosystems connected in each section of the Mekong River Basin for (a) current conditions and (b) a future scenario in which all currently planned dams are built. Source: Grill G. and Lehner B. 2016. Hydropower development options and their environmental impact in the Greater Mekong Region for different energy development scenarios. WWF – Greater Mekong

The effect of dams on fisheries production is highly dependent on the location, design and operation of the dams. Most production originates from floodplains in the middle and lower parts of the basin. So, dams built on the mainstream will have a much greater impact than dams built on tributaries, and those located in the middle and lower parts of the Mekong Basin will have a greater impact on fish production than dams located in the upper part of the basin¹⁷⁰. The projected impacts of the 11 proposed dams in the Lower Mekong are devastating for fisheries within the basin. It is estimated that the negative NPV for the capture fisheries loss (using 3 percent discount rate for natural resources) is much larger

¹⁷⁰ Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>
World Bank. 2010. Laos Development Report: Natural resource management for sustainable development: Hydropower and mining

than the positive NPV for hydropower generated. A sensitivity analysis (fish loss, fish value, discount rate) was also carried out. It is concluded that the proposed mainstream hydropower projects would not have a net economic benefit in both the 6 dams and 11 dam's scenarios. Furthermore, assuming a profit split of 30 percent for the host country and 70 percent for the country funding the project and importing the electricity over the concession period (typically 25 years), results in Thailand and Laos being the beneficiaries whereas Cambodia and Viet Nam would bear the main cost of hydropower developments. It is also clear that project developers and electricity importers would benefit, however, the poorer rural farming and fishing communities would suffer. Taking into account the numerous externalities to calculate the overall benefits of hydropower to the economy of Laos is challenging, and the differences vary very much from one site to another.

The table below indicated the projected losses in fish catch as a result of all the dams being built.

Table 20: Projected fish losses as a result of dams being built in the Lower Mekong Basin

| Country | Current Fish Catch (tons/year) | 11 Dams Scenario Forecast Fish Catch Loss (tons/year) |
|-----------------|---------------------------------------|--|
| Laos | 220 000 | 50 000 |
| Thailand | 840 000 | 50 000 |
| Cambodia | 700 000 | 340 000 |
| Viet Nam | 340 000 | 140 000 |
| Total | 2 100 000 | 580 000 |

In the hydropower sector, there is no clear management plan in place and every project is considered on a case-by-case basis. While this approach is convenient when dealing with the specifics of each project, it also involves a significant risk that the government may not capture the full economic rents from hydropower development in some cases, especially through taxation. In order to make sure that the government's expectations are made clear to developers, legislation is needed to define a standard method for determining the fiscal benefits from hydropower projects (particularly export projects)¹⁷¹.

According to a report from International Rivers, Viet Nam is also a contributing factor to the demand for hydropower from Laos. "The

¹⁷¹ World Bank. 2010. Laos Development Report: Natural resource management for sustainable development: Hydropower and mining

Laos – Viet Nam Power Transmission Interconnection involves the building of more than 150 kilometers of transmission lines to transmit power from eight associated hydropower dams in southern Laos to Viet Nam. All associated hydropower projects for this transmission line project are planned in the transboundary Sekong River Basin in Laos. Damming the Sekong and Sekaman rivers at multiple sites will not only affect the livelihoods of tens of thousands of people who live along the riverbanks in Laos and Cambodia, but also cause a significant loss of fish biomass (estimated 4percent loss) and biodiversity throughout the entire Mekong Basin due to the high numbers of migratory species that inhabit the region.¹⁷² These negative effects of hydropower development need to be taken into full account regarding their sustained and irreversible impacts upon the environment and local economy.

KEY MESSAGES

- Laos is set to benefit through selling hydropower generation to Thailand. However, these benefits come at a cost to downstream users. Some of these impacts will be felt locally on other national economic sectors and livelihoods, while others are felt by downstream countries. Impacts will be felt by changes in sediment fluxes, river flow and fish migration and productivity. This is especially true for the downstream countries of Thailand, Cambodia and Viet Nam.
- The investments made by Laos into hydropower may be at risk due to climate impacts or a negative reputation politically from their downstream neighbours.

4.4.3 Feeding the people - Water supply, Irrigation and Livelihoods

Laos is rich in water resources. The total of annual water flow in Laos is estimated at 270 billion cubic meters, equivalent to 35percent of the average annual flow of the whole Mekong Basin. The monthly distribution of the flow of the rivers in Laos closely follows the pattern of rainfall: about 80percent during the rainy season (May-October) and 20percent in the dry season, from November to April. For some rivers in the central and southern parts of the country (particularly

¹⁷² https://www.internationalrivers.org/sites/default/files/attached-files/gms_energy_investments_briefing_-_english_o.pdf

Se Bang Fai, Se Bang Hieng and Se Done) the flow in the dry season is less: around 10 to 15 percent of the annual flow¹⁷³.

General water supply and sanitation access in Laos is improving. Recent improvements have especially benefitted the rural population, which makes up 70percent of the national total in Laos. The country nevertheless remains very poor in comparison to regional neighbours, and the benefits of economic development are not equally spread across the country. Urban areas and districts along the Thai border (where the five largest urban centers are located) have experienced rapid growth and poverty reduction, but other areas continue to lag behind: the northern part of the country remains poorer than the southern and central regions, as do upland areas in comparison to lowlands¹⁷⁴. Data indicating access to water supply and sanitation is variable as indicated by the table below.

Table 21: Water supply and sanitation status in Laos, 2015. Source: WSP

| | Status | |
|---------------------|------------|-------------|
| | 2011 (JMP) | 2011 (LSIS) |
| Water supply | | |
| Urban | 83% | 88% |
| Rural | 63% | 64% |
| National | 70% | |
| Sanitation | | |
| Urban | 87% | 91% |
| Rural | 48% | 48% |
| National | 62% | |

Agriculture in Laos is still focussed on food security and subsistence living. Poor households depend on own-grown rice production for 94 percent of their total consumption, and even those in urban centres depend on it for 50 percent of their consumption. The reliance on wild protein is also very high; up to 80 percent of fish and more than 20 percent of meat consumed comes from the

173 State of the Environment: Lao. <http://www.wepa-db.net/policies/state/laos/overview.htm>

174 Water supply and sanitation in Laos, 2015. <https://www.wsp.org/sites/wsp.org/files/publications/WSP-LaoPDR-WSS-Turning-Finance-into-Service-for-the-Future.pdf>

wild. This is unlike Thailand and Viet Nam, where agriculture is focussed on commercialisation and intensification. The Laos economy remains largely agricultural, with more than 70 percent of the labour force employed in this sector, the GDP itself relies heavily on a good harvest. Rice is the dominant crop with a total area of 736 000 hectares (2005). The majority of rice grown is for subsistence. Rice consumption is on average 162 kg/head per year in the Laos. In addition to rice, the area cultivated for maize more than doubled between 1999 and 2005. Coffee (the country's major agricultural export earner) also expanded and, over the same period, vegetable production increased greatly, mainly due to demand in urban centres and exports to Thailand. The harvested area of vegetables increased from 7168 ha in 1990 to 118,509 ha in 2003.

Table 22: Area of selected non-rice crops

| | Cambodia (ha) | | Lao PDR (ha) | | Northeast Thailand (ha) | | Viet Nam Mekong Delta (ha) | | Viet Nam Central Highlands (ha) | |
|-----------|---------------|---------|--------------|--------|-------------------------|---------|----------------------------|--------|---------------------------------|---------|
| | 1999/00 | 2005 | 1999 | 2005 | 2000 | 2003 | 1999 | 2005 | 1999 | 2005 |
| Maize | 59,739 | 61,757 | 40,700 | 86,000 | 334,000 | 263,107 | 39,000 | 34,900 | 60,100 | 236,600 |
| Cassava | 14,003 | 28,560 | | 6765 | 646,000 | 491,370 | 9200 | 6400 | 32,300 | 89,400 |
| Soybean | 34,945 | 114,890 | 6800 | 9535 | 38,000 | 11,196 | 9100 | 14,000 | 11,200 | 26,600 |
| Sugarcane | 8375 | 4498 | 4700 | 5500 | 206,000 | 596,557 | 102,800 | 64,100 | 27,900 | 26,700 |

Source: MRC 2005a
Note: areas for Cambodia and Lao PDR are harvested area; areas for Viet Nam are planted area.

Projections for agriculture in Laos continue to see an expansion in rice cultivation, followed by sugar cane and rubber, which is the smallest relative amount, but facing the fastest growth. However, constraints are also perceived in terms of growing agriculture due to labour shortages. In the Vientiane plain (one of the most important agricultural areas of the country) agriculture is increasingly shifting towards a peri-urban environment as the expanding city of Vientiane attracts increasing numbers of farmers into paid labour. Other parts of rural Laos are also being drawn into the wider non-agricultural and regional economies, as farmers are reported to frequently work in neighbouring Thailand. This, in turn, means that Laos farmers perceive labour shortage as one of the most important constraints for agricultural production¹⁷⁵.

¹⁷⁵ Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

Dry-season rice production in Laos is fully dependent on irrigation water supplies and has only become significant since the installation of more than 7000 diesel and electric pumps in the mid-1990s. According to national statistics, the achievement of the self-sufficiency target was mainly due to the increase in wet-season production. Irrigation is also used for vegetable production. Other mechanisation in Laos with regards to agriculture remains low. For instance, less than 10 percent of land is prepared by tractor. Findings also suggests that the cross-border impact along the borders with Thailand and Viet Nam is positive. It attributes generally higher agricultural yields along the Thai border due to easier access to Thai technology and inputs for example.¹⁷⁶

Table 23: Area of irrigated rice and other crops (2007)

| Country | Irrigable area | Rice (ha) | | | Non-rice crop area (ha) | Annual irrigated area (ha) |
|-------------|----------------|------------------------|------------------------|------------------------|-------------------------|----------------------------|
| | | 1 st season | 2 nd season | 3 rd season | | |
| Cambodia | 504,245 | 273,337 | 260,815 | 16,713 | 12,172 | 563,037 |
| Lao PDR | 166,476 | 166,476 | 97,224 | - | 6977 | 270,677 |
| Thailand | 1,411,807 | 1,354,804 | 148,255 | - | 252,704 | 1,755,763 |
| Viet Nam | 1,919,623 | 1,669,909 | 739,594 | 1,478,740 | 329,740 | 4,217,983 |
| - Delta | | 1,528,225 | 663,410 | 1,478,740 | 294,899 | 3,965,274 |
| - Highlands | | 141,684 | 76,184 | | 34,841 | 252,709 |
| Total LMB | 4,002,151 | 3,464,526 | 1,245,888 | 1,495,453 | 601,593 | 6,807,460 |

Source: MRC (2009a)

In Laos, most (if not all) livestock production is traditional, extensive and with low inputs. The greatest difference exists between the predominantly lowland areas of the Mekong corridor and the sloping uplands (FAO 2005c). Cattle and buffalo are mostly found in the central region, where they graze on the vacant cropping area for most of the year and also extensively on the slopes. Pig production is an important livelihood activity for highland people and most farmers raise chickens. Commercial pig production and poultry operations, which are found near population centres such as Vientiane, are mostly small cottage industries with few employees. Like Cambodia, supply of meat has increased, with most of the growth due to more

176 <http://www.cdri.org.kh/webdata/download/dan/ddan4.pdf>

animals, rather than productivity gains.

The primary reason for forest conversion in continental Southeast Asia is establishment of cash crop plantations and agriculture, which in recent years have had a greater impact on forest cover than logging. Rubber is one of the major causes for conversion of forests in Laos. Industrial wood production levels in the LMB have fallen as a result of resource depletion and forest protection measures. Development of industrial tree plantations has been held back by social and tenure issues as well as market and technical constraints. However, demand for forest products remains high. Thailand and Viet Nam have continued to grow their wood production and paper production industries. Some of this increased demand has been met with supply from Cambodia and Laos where logging bans have not been imposed. As a result, overall rates of deforestation were highest in Laos and Cambodia, where losses amounted to about 1 and 2.5 million hectares respectively. The impact of deforestation on water resources is significant. Without the buffering function of forest cover, runoff is not slowly allowed to filter into the soil, but instead creates more runoff, resulting in faster and more extreme flooding. These negative impacts are compounded by increased erosion. During the dry season, without tree-cover, soil moisture is lost faster, resulting in poor water retention. This creates significantly lower dry season flows as there is less soil or ground water contribution.

Table 24: Area of forest in the LMB countries in 2005 and rate of change in forest area

| | Forest area 2005 (000s ha) | Forest area per capita (ha) | Forest cover 2005 (%) | Annual change in forest area (%) | |
|----------|-------------------------------|--------------------------------|--------------------------|----------------------------------|-----------|
| | | | | 1990–2000 | 2000–2005 |
| Cambodia | 10,447 | 0.75 | 59 | -1.1 | -2.0 |
| Lao PDR | 16,142 | 2.74 | 70* | -0.5 | -0.5 |
| Thailand | 14,520 | 0.22 | 28 | -0.7 | -0.4 |
| Viet Nam | 12,931 | 0.15 | 42 | 2.3 | 2.0 |

Source: FAO 2005a; *The figure for Lao PDR is based on 10% canopy cover and 5 m minimum tree height; bamboo areas and unstocked forest and shifting cultivation areas that will be restocked are also included. Forest cover determined by the Lao Forest Inventory and Planning Division in 2004 using 20% canopy cover and 10 m minimum tree height equalled 41.5%.

Table 25: Natural and plantation forest area in the LMB countries in 2005

| | Total forest (000s ha) | Total natural forest (000s ha) | Natural forest* | | Plantation forest | |
|-----------|---------------------------|--------------------------------------|-----------------------------|--|-----------------------------------|---|
| | | | Primary Forest (000s ha) | Modified natural & semi- natural Forest (000s ha) | Plantation Forest (000s ha) | Per cent of total forest in plantations (%) |
| Cambodia | 10,447 | 10,388 | 322 | 10,066 | 59 | 0.6 |
| Lao PDR | 16,142 | 15,918 | 1490 | 14,428 | 224 | 1.4 |
| Thailandz | 14,520 | 11,421 | 6451 | 4970 | 3099 | 21.3 |
| Viet Nam | 12,931 | 10,236 | 85 | 10,151 | 2695 | 20.8 |
| Total | 54,040 | 47,963 | 8348 | 39,615 | 6077 | 11.2 |

*Primary forest is forest unmodified by human activity whereas modified natural forest and semi-natural forest are modified to an increasing extent (see FAO 2005a for full definitions). †Figures do not include private plantations.

In May 2016 Laos imposed a log export ban to encourage more domestic processing and reduce forest degradation. There have, however, been doubts over the efficacy of enforcement and it has been estimated that about 500,000 cubic metres of logs move every year from Laos to Viet Nam. In Laos, the national code of harvesting practice is not yet implemented on an operational basis and the capacity of the logging companies is very limited. Therefore, forests that are not logged sustainably or at the correct time or manner are destroyed.

A balance between the benefits of hydropower generation and the impacts of hydropower on livelihoods supported by fisheries is needed. In Laos, more than 70 percent of rural households depend on fishing to varying degrees for subsistence livelihoods and additional cash income. At Siphandone (four thousand islands), on the Laos mainstream in southern Laos, just under 40 percent of households get some income from fish, far more than in Thailand or Viet Nam, where less than 10 percent of households obtain income from this source. Not only fisheries, but the entire aquatic environment around the Mekong is critical for livelihoods¹⁷⁷.

177 Mekong State of the Basin Report, 2010. <http://www.mrcmekong.org/assets/Publications/basin-reports/MRC-SOB-report-2010full-report.pdf>

The Siphandone area is a 50 km stretch of river that consists of a maze of extensively braided channels, islands and sandbars, including the largest complex of waterfalls in Asia. Downstream of the falls, on the border of Laos and Cambodia is a deep pool, home to the last group of the Mekong-Irrawaddy Dolphins living in the country. While the Khone Falls act as a natural barrier that prevent some fish species from migrating upstream, the Siphandone area is critical to the life cycle of many other fish species, which in turn support the livelihoods of millions of people in Laos, Thailand, Cambodia and Viet Nam. For instance, up to 75 percent of the fish catch in Tonle Sap depends on fish that migrate to deep pools found from Kratie to Siphandone for the dry season. The lower Mekong supports one of the most productive fisheries in the world – 2.6 million tons of fish each year provide 80 percent of the protein intake for 56 million people.¹⁷⁸ 100 000 people live along the river banks and islands of Siphandone, growing rice, raising livestock and cultivating vegetables.

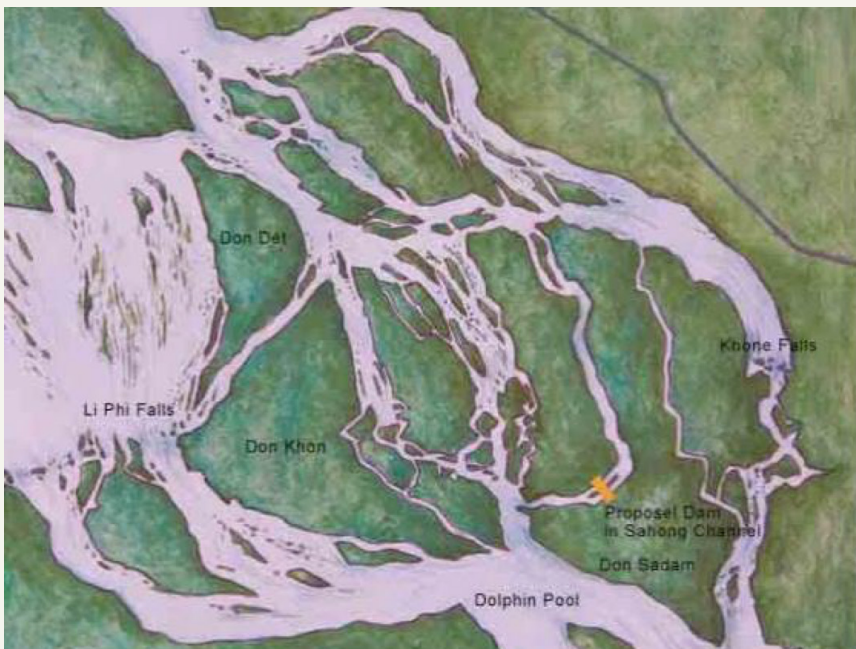


Figure 43: Siphandone, showing the proposed dam in the Sahong channel¹⁷⁹

¹⁷⁸ Mather, R. Kritsanavarin, S. Pangare, G. Weerapong, D. 2009. Siphandone: The Mekong Under Threat. Gland, Switzerland: IUCN Mekong Region Water Dialogues. Publication No. 1.

¹⁷⁹ Mather, R. Kritsanavarin, S. Pangare, G. Weerapong, D. 2009. Siphandone: The

The proposed mainstem dams on the Mekong pose a real challenge to the fishermen dependent on the natural flow fluctuations and natural migration abilities of the fish that they live off. Dams have the potential to block natural fish migration routes, while the flow amounts, timing and speed of the river will change. The most immediate of these risks is the Don Sahong dam, which, although a run-of-river dam, will cause retention of water in a channel where, for thousands of years, water had been flowing with dramatic force and might. By blocking the Hou Sahong channel, fisheries in the Mekong Delta, as well as the Tonle Sap will be effected as migratory patterns of fish in the Mekong will be silted.

In addition to the environmental challenges, there are social and health impacts that need to be considered in terms of hydropower impacts. Stunting and malnourishment are highest (more than 50 percent) among children from those households that are most reliant on wild foods and subsistence rice production. Therefore, the disappearance of land and forests along with these non-cash traditional and significant sources of food as a result of the large-scale development of hydropower stations and mineral extraction could lead to serious negative consequences for these families¹⁸⁰.

KEY MESSAGES

- Agriculture is still at a subsistence level in Laos. Major changes are likely to take place in commercialising the sector. This will fundamentally change the way that farming takes place, and therefore the economic landscape of the region. Water use as well as land management need to be a core focus to ensure landscape degradation does not become the norm.

Mekong Under Threat. Gland, Switzerland: IUCN Mekong Region Water Dialogues. Publication No. 1.

¹⁸⁰ World Bank. 2010. Laos Development Report: Natural resource management for sustainable development: Hydropower and mining

THE CONSEQUENCES AND POSSIBILITIES FOR DEVELOPMENT

As the Lower Mekong Countries continue along their rapid economic development trajectories, they all face significant trade-offs.

There lies a fine balance between economic prosperity today and sustained economic development for future generations.

The ultimate balance lies between maximisation of economic development or optimisation of regional sustainable development, which takes into account the ecosystem functioning of the Mekong Basin as a whole.

The following chapter explores some of these potential development pathways, their logical consequences, and considerations on how to adjust the pathways to improve not only the economic futures of the respective countries, but the social and environmental wellbeing of Mekong residents as well. Starting with sector development pathways, we also explore potential pathways for finance and the institutions that will ultimately determine the future of the Mekong.

5.1 Sector Development Pathways

The key question of this sector is with regards to the diverse development pathways that are available to the Basin. In short, as indicated by the figure: what are the possible futures?



How can we balance competing needs to ensure sustainable water management?

Figure 44: What are the possible futures in the Mekong Basin?

5.1.1 Hydropower under all costs pathway

Hydropower is already an aspect of the Mekong's future and will continue to play a key role in the economic story of how the river system is harnessed. China's five mainstream dams in the upper reaches of the catchment have already affected both the hydrology and the sediment of the system. Likewise, assuming both the Xayaburi and Don Sahong dams are completed as planned, further impacts are pending. However, the extent to which additional hydropower is prioritized over other uses remains an open question.

The decision to whether hydropower be fully developed lies largely in the hands of Thailand and Viet Nam, who collectively account for 90 percent of the power demand generated by the mainstream Mekong hydropower projects¹⁸¹. Depending on their influence, the economic future of the basin could look quite different.

As dams are built, sediment will continue to drop and flows will be further affected, resulting in significant impacts to the countries closer to the delta – namely agriculture and aquaculture in Cambodia and Viet Nam. Indeed, the loss of sediment is likely to undermine the agricultural economy in Viet Nam, as well as fisheries, while the flow modifications may interrupt the Tonle Sap flow reversal, which has the potential to jeopardize much of the productivity of the lake and its surrounding agricultural lands. Impacts on the water levels of the Tonle Sap could also jeopardize the economy of Siem Reap, which is counting on the Tonle Sap for future water supplies¹⁸². Given the importance of fisheries and agriculture to food security and in particular, employment, in these two countries, such a pathway could result in significant economic consequences. The probable influx of unemployed rural farmers into urban areas is likely to further exacerbate challenges facing large urban centers, affordability, and government resources.

Studies of the proposed 11 mainstream Mekong Dams suggests some of the following impacts:

- Overall, the proposed mainstream hydropower cascade may lead to approximately 50 percent decline in capture fishery yields in both Viet Nam and Cambodia. Tributary dams and diversion may

181 ICEM (2010) Strategic environmental assessment of hydropower on the Mekong mainstem: summary of final report <http://www.mrcmekong.org/assets/Publications/Consultations/SEA-Hydropower/SEA-FR-summary-13oct.pdf>

182 Phnom Penh Post (2012) Water Supply Dries Up. Source: <http://www.phnompenhpost.com/siem-reap-insider/water-supply-dries>, Accessed June 6, 2016.

cause additional marginal impacts on fisheries¹⁸³.

-Though low to moderate changes are expected for a normal hydrological year, high to very high short-term adverse impacts on river flow regimes would occur as a result of dam hydropeaking operations and dry-season drawdowns for maximum power production. The river course of Cambodia downstream of the cascade is projected to suffer the highest impacts from high fluctuating flows and water level¹⁸⁴.

-Sediment and nutrient deposition would decrease as much as 65 percent at Kratie and Tan Chau – Chau Doc, potentially causing a substantial decline in biological productivity, reduction in agricultural production, increase in erosion and a decrease in the rate of build-up of riparian and coastal sites.

Based on a value of 12,000 riels per kilogram (a rough average from Cambodia for fresh fish¹⁸⁵), a wage of USD 177 per month (the minimum wage agreed upon by Cambodian garment workers trade union¹⁸⁶) and an estimated 33 kg fish per year¹⁸⁷, fish protein already accounts for a significant 5 percent of a worker's expenditures. If fish prices (or alternative protein) were to increase, it is reasonable to expect that there would be further upward pressure on minimum wages, thereby further raising costs on the growing manufacturing industries, like textiles.

Similarly, employment statistics from Cambodia and Viet Nam indicate that nearly 50 percent of workers in Viet Nam¹⁸⁸ are employed in agriculture, forestry or fisheries, which would affect roughly 4.8 million workers in the Mekong Delta¹⁸⁹. If one were to assume a 5 percent increase in unemployment due to water and sediment-related hydropower impacts to the Delta's agricultural production, it would result in roughly an additional 250,000 workers becoming unemployed. Assuming a standard 4-person household size (4.16 in

183 DHI, 2015. Study on the Impacts of Mainstream Hydropower on the Mekong River: Final Report.

184 DHI, 2015. Study on the Impacts of Mainstream Hydropower on the Mekong River: Final Report.

185 Ministry of Agriculture, Forestry & Fisheries, Government of Cambodia, Agricultural Market Office (2016) Agricultural Market Information Available online: <http://www.agriculturalmarketinformation.org.kh/en/price-and-production-data/price-data/commodity-price-by-market>

186 <http://www.opendevdevelopmentcambodia.net/tag/minimum-wage/>

187 <http://www.fao.org/fishery/facp/KHM/en>

188 http://www.gso.gov.vn/default_en.aspx?tabid=467&idmid=3&ItemID=12889

189 http://www.gso.gov.vn/default_en.aspx?tabid=467&idmid=3&ItemID=12894

Mekong Delta as of 2008¹⁹⁰) and dual employment of both household heads, this in could still result in some 500,000 low-education migrants. Such workers are likely to head to urban areas such as Ho Chi Minh City and could face employment challenges in traditional employment sectors like manufacturing given the tendency to hire educated, single workers¹⁹¹.

Cambodia could face even greater consequences with over 50 percent of the population employed in agriculture alone and is already seeing some of the highest rural-urban migration rates in all of Southeast Asia¹⁹². This in turn has consequences for affordability and infrastructure demands in such urban areas.

In particular, the development of hydropower in the 3S region is likely to impact sediment and sand movement for Cambodia and Viet Nam, which in turn has implications for the construction sector in addition to the aforementioned agricultural and fisheries impacts. With construction now accounting for some 8.8 percent of GDP¹⁹³ in Cambodia and 8.35 percent¹⁹⁴ in Viet Nam, the loss of this critical building supply could significantly jeopardize the ongoing development of the wealthy urban centers of Phnom Penh and Ho Chi Minh City.

In summary, a hydropower at all costs development pathway is likely to significantly impact domestic food security (notably capture fisheries throughout the Mekong and agriculture in the Delta), unemployment, affordability and infrastructure demands in urban areas, as well as potentially curtail GDP from construction due to sand constraints.

What is the alternative?

If we alter the focus from “hydropower” to “ensuring energy for economic development”, we allow some alternative options to come onto the table. Most notably, the recent Mekong Power Sector Vision 2050 Report (WWF) concluded that electricity production can be increased significantly without compromising the hydrology nor carbon emissions. Indeed, the proposed advanced sustainable

190 <http://www.ipedr.com/vol20/10-ICHSC2011-M00023.pdf>

191 Loc Duc Nguyen, Katharina Raabe, Ulrike Grote (2015) Rural–Urban Migration, Household Vulnerability, and Welfare in Viet Nam, World Development, Volume 71: 79–93.

192 <http://www.phnompenhpost.com/capitals-rapid-urban-migration>

193 <http://www.cambodiainvestment.gov.kh/investment-enviroment/economic-trend.html>

194 https://www.gso.gov.vn/default_en.aspx?tabid=622&ItemID=14252

energy scenario envisions the energy production in Laos alone to increase 16 fold from 2016 levels (when exports are included)¹⁹⁵, while resulting in no large hydropower development and achieving zero carbon emissions in the process. More importantly, the economics of such an approach increasingly make sense providing resilient, distributed energy production and distribution systems that do not require expensive distribution networks and are already cost competitive with large hydropower projects (and projected to potentially get cheaper). Furthermore, such an approach is not accounting for potential revenue from REDD+ mechanisms, which may make for an even more compelling economic case.

In short, given the economic uncertainty of proceeding (i.e., hydropower costs and fisheries/agriculture/sediment impacts), and the increasingly compelling financial case for alternative low-carbon energy sources, large hydropower development no longer appears to be a logical approach for economic development.

5.1.2 Agricultural & agri-business development

Like hydropower, agriculture and agri-business already form a central part of the LMC economies. The extent to which this remains an ongoing priority versus other uses of Mekong flows, however, remains to be determined. In the event that water for agriculture is prioritized, there are several consequences.

Prior to exploring the consequences, it is worth bearing several issues in mind:

A) Irrigation is present and growing the lower Mekong:

While there is significant irrigation in north-eastern Thailand and the Mekong delta in Viet Nam, Laos and Cambodia have relatively small amounts of irrigation infrastructure in place at present, though there is more scheduled (an estimated USD 1B slated in Cambodia alone¹⁹⁶). Currently around 75 percent of crops are rain-fed¹⁹⁷ and as this percentage drops due to shifting growing season demands, climate change-driven rainfall patterns, and seasonal

195 WWF Greater Mekong Programme (2016) Mekong Power Sector Vision 2050 Report. Available online: http://d2ouvy59podg6k.cloudfront.net/downloads/wwf_greater_mekong_power_sector_vision_2050.pdf

196 IWMI-ACIAR (2013) Investing in Water Management to Improve Productivity of Rice-Based Farming Systems in Cambodia Project. Issue brief #1, June 2013. Available online: http://www.iwmi.cgiar.org/Publications/issue_briefs/cambodia/issue_brief_01-awm_planning_in_cambodia.pdf

197 http://www.iwmi.cgiar.org/Publications/Other/PDF/Summary-Rethinking_Agriculture_in_the_Greater_Mekong_Subregion.pdf

water availability due to increased demand driven by commercial scale production, irrigation is likely to play a significantly larger role.

B) Water allocation for irrigation was at the heart of the establishment of the MRC: The original formation of the Mekong River Commission was borne out of concerns for water allocation and use for irrigation. With the drought of 2015/2016, and the expectations that such conditions may become more of the new norm, irrigation concerns were raised once again as crop losses mounted, and as irrigation draws were increased to maintain food production in Thailand.

C) Agriculture remains the dominant livelihood: Throughout all of the LMC economies, agriculture remains a critical source of employment, especially in rural areas, even as its importance in the economy is steadily eclipsed by service and industrial sectors.

In the event that agricultural expansion was prioritized, it is reasonable to see some or all of the following:

1) In-stream flows from the Mekong would be affected: Starting with the Vientiane Plains, the Mekong would suffer heavy withdrawals from Thailand, and in turn the Delta (including both Cambodia and Viet Nam). Such flow impacts would have potential implications for fisheries, transportation, and even hydropower production in the lower reaches of Southern Laos and Cambodia. Agriculture is already the largest user of water in the LMCs, consuming between 68 and 98 percent of total water withdrawals in the Mekong. Should agriculture be prioritized, it is probable that Mekong flows would be impacted with the results felt by downstream users (Cambodia and Viet Nam).

2) Non-point source pollution would likely increase significantly and potentially form a dead-zone in the Mekong Delta: As greater productivity is sought, additional fertilizers would be required to grow productivity. While the crop mix would determine the specifics, in general, it is safe to assume that there would be additional nitrogen and phosphorus applied, which would result in primary productivity increases both on land and in the waters. Should the Mekong follow traditional patterns in places where such agricultural expansion has been prioritized (e.g., mid-western US, parts of Europe), we have seen

the emergence of so-called dead zones (e.g., Mississippi/Gulf of Mexico, Lake Erie, Baltic Sea, etc.). Should a dead zone form in the Mekong Delta, the impacts on capture fisheries would compound impacts from low-flows, likely resulting in the collapse of numerous fish stocks.

3) Significant financial investment would be required: Productivity and efficiency throughout the region remains at a relatively low level. There would need to be considerable further investments in infrastructure, agricultural extension services, nutrient optimization (i.e., agrochemical use), mechanization, and so forth to drive the necessary productivity improvements under such a scenario. While agricultural production in Thailand and Viet Nam is at an industrial scale in many parts, the LMCs as a whole (and Laos and Cambodia in particular) still have considerable small-scale production. Accordingly, investments would require a mix of private sector funds (both traditional sources of finance as well as microfinance), as well as public sector investments in distribution. Since the funds would be distributed across a large number of projects, the transaction costs would be much more significant than many of the other development pathways explored in this section.

4) Commodity selection would likely change: Throughout the region, rice remains the key crop, while recent years have also seen the rise of other commodities, notably rubber, sugar, and palm oil. As urban populations grow and increase in affluence, dietary changes towards meats and vegetables are likely to affect regional food production trends. The extent to which these crop selections affect water consumption patterns remains to be seen, but has a large impact on the availability of water resources under the agricultural prioritization scenario. With growing demand and the need for domestic food security, agricultural trade balances could revert from rice export to greater domestic consumption.

5) Land degradation and ecosystem service loss would continue: Land degradation due to forest loss and agricultural activities is significant throughout the region with up to 40 percent of the landscape suffering some degree of degradation. This degradation has disrupted ecosystem services by reducing the capacity of ecosystems to mitigate flows contributing to floods, control erosion and limit damage from pests¹⁹⁸.

198 http://www.iwmi.cgiar.org/Publications/Other/PDF/Summary-Rethinking_

6) Rural-urban development dynamics would be affected: All of the LMCs are seeing a rural-urban shift, most notably with single, educated rural workers coming into cities to secure jobs in industry and services. With a push on industrial agriculture, two conflicting forces would be at play. In one regard, industrial agriculture with its increased mechanization typically employs fewer workers, would continue the present trends. However, should it require more skilled labour, we could see more of the rural, educated workers remain as higher-paying industrial agriculture positions emerge. Nevertheless, this would see greater unemployment in the rural, undereducated population, and affect vulnerable populations such as women and the elderly.

7) **Aquaculture is likely to continue to grow:** The past decade has seen exponential growth in aquaculture production. The prosperity within the LMB is fundamentally based upon the availability of affordable protein through the form of fisheries. As population numbers continue to climb, the only alternative is to increase aquaculture. Already wild fish catches have shown a decline, forcing an increase in farmed fish. This trend is only likely to continue.

What is the alternative?

There are various options within this pathway that could modify the impacts and improve the economic outcomes in the various LMCs. Agriculture will remain a key aspect of the Mekong's economies under any scenario, so it is more a matter of how this development pathway plays out rather than *if* it plays out.

A) **Enhance agricultural resilience.** Climate change is already affecting livelihoods and agriculture in the Mekong. People's capacity to adapt to change is closely linked to wealth, income diversification, education and access to both information and technology. Furthermore, resilience is also enhanced through the maintenance of ecosystem services (which are in turn tied to a strong ecosystem service identification and landscape planning/protection system). Such resilience measures, including dedicated extension services and technologies like cell phone-based weather and commodity market alerts, are likely to be particularly important in the Mekong Delta, where impacts from extreme weather events are likely to be felt more strongly.

B) Revisit water and pollution allocations in conjunction with efficiency improvements. As industrial development and commercial agriculture grow, there are likely to be negative impacts in terms of water quality. Proactive measures to mitigate water quality impacts before they are devastating is far more efficient in the longer term than remediation and repair of already damaged environments.

C) Explore environmental fiscal incentives to optimize commodity water use. There are a number of possible techniques, such as incentives, that could be explored in terms of optimising water use. These need to be explored carefully to ensure perverse impacts do not take place.

5.1.3 Urbanisation & industrialisation

Economic patterns in recent years clearly show that the LMCs are entering into a phase of shifting their economies from agriculture to service and manufacturing. Furthermore, a broad rural-urban migration trend is evident. The cities of the Mekong have a series of needs to maintain this positive urban economic development pattern.

First, urban growth requires construction and construction needs concrete. In turn, concrete needs both cement and sand. Sand, in much of the Mekong Basin, is sourced from the sediment brought from the mountainous regions down to the cities lying along the river. As sediment levels begin to drop with the hydropower dams, it begs the question: where will the urban economies source their sand from? Coastal regions remain one option, but desalinisation and transportation along vast distances could drive up building costs considerably and affect growth rates. Challenges with regards to sourcing material from coastal regions include: heavy salt content, which is not compatible with armed concrete (causing rapid rusting of steel); competition with the tourism sector for pristine beaches; and the compounding effect of extraction of material from beaches with the reduction in sediment leading to erosion. An alternative is to source materials from pits and grind it mechanically. This is costlier to produce, although there are smaller externality costs.

Second, urban growth requires energy. While potential hydropower is sufficient to meet such demand, it affects both sediment and food (fisheries & agriculture). Food, in turn, impacts labour costs, an issue for a region counting on labour cost-competitiveness to attract manufacturing (e.g., textiles). Furthermore, as urban residents

grow their affluence, their demand for protein and vegetables will increase. How will urban economies produce the energy they will require to grow without affecting sediment and food? In addition, what will the implications on energy and water, if food production must meet the needs of the increasingly affluent diets of urban residents? If affordable protein is lost, the cost of living will drive up wages. If high quality protein is unavailable, talent attraction and retention may prove challenging.

Third, urban growth requires financial capital. Currently, the investment climate of some countries in the Mekong is challenging, preventing a large flow of international capital from entering the region. For example, the Cambodian banking system was crippled in the mid-to-late 1970s with the collapse of the National Bank of Cambodia and has only recently entered into an era of international finance. Still, foreign banks are few and far between with ANZ Royal Bank being amongst the largest (~8 percent market share). The ongoing political risk and questionable stability of the banking sector in the LMCs remains a concern. This is exhibited by the fact that various institutions, including ADB and UN Capital Development Fund's SHIFT programme, recently hosted the inaugural Mekong Financial Inclusion Forum¹⁹⁹, which sought to explore and discuss the challenges in achieving financial inclusion, including how to encourage microfinance in this region. Securing financial capital will be critical not only for urban development, but also for the various forms of water infrastructure necessary to serve both urban populations and their food and energy needs.

Should an urban economic development agenda be prioritized by the various LMC governments, there are several implications:

- 1) New sources of sand will be necessary.
- 2) New energy infrastructure will be necessary.
- 3) The cost of living in urban areas will increase.
- 4) Additional capital flows will be required.
- 5) Rural-urban divide will grow.

What is the alternative?

The LMCs will continue to urbanize, regardless of any plans from the various governments. How they urbanize is a very different question.

¹⁹⁹ http://bwtp.org/event/mekong_forum/

Perhaps most critical to the growing urban economies are higher-paying industrial jobs. In order to grow those sorts of roles, inflation must be kept in check, which means ensuring housing (construction), food and energy (as well as financing) costs remain manageable.

To do so, some of the following elements could be explored:

A) Attract and support financial institutions. Affordable finance is at the heart of most growth and the Mekong will be no exception. Moreover, enabling citizens to employ loans to increase spending will not only stimulate the economy, but catalyse the equally-important service economy. If linked to microfinance development, it also has the ability to help draw lower-income residents up into middle income brackets, which will further stabilize the economy.

B) Explore urban energy sources. Many cities around the world are now exploring decentralized urban forms of energy ranging from solar (PV & hot water), waste-to-energy, biogas, and even peri-urban wind farms. Such options, combined with finance (as noted above), could help to enable the energy without impacting sediment and food systems.

C) Invest in water infrastructure and planning. Healthy cities are contingent upon safe water and sanitation management. Investment in water service providers (or enabling healthy private sector providers) is an important aspect of maintaining urban economic development as sick people do not earn and do not spend. Robust water systems will help not only industrialization, but the service economy as well. However, without coordinated planning linked to national and transboundary water plans, such investment could be jeopardized. Accordingly, concentric levels of basin planning in the Mekong are a critical element to ensure that food and energy needs support, rather than hinder, urban development.

D) Develop national (and urban) food system plans to incentivize desirable commodities. As water becomes increasingly scarce, and food demand grows (and shifts to urban markets), which crops are grown (along with how and when) is a critical, systemic, challenge facing all of the LMCs. Various regulatory approaches can be employed to encourage (and discourage) certain commodities from being produced. This will help to optimize water use, protein supplementation (from loss of

fish protein), and meet urban demand.

E) Explore less sand intensive construction technologies and alternative sourcing of sand.

5.2 Financial Flows

5.2.1 Private Sector Investment

The GMS regional cooperation program, supported by ADB, has been actively promoting the participation of the private sector in its activities. Since the inception of the GMS program in 1992, FDI has increased, registering USD 3.4 billion in 2003. Combined exports have expanded by an annual rate of 15 percent and intra-regional exports have grown by a striking 21 percent per year. Meanwhile, annual GDP growth across the region has averaged over 6 percent during the last few years. As a result of rapid economic growth, the number of people earning less than USD 1 a day has fallen by half.²⁰⁰

There is significant pressure, however, that the private sector is able to fill the infrastructure investment gaps to meet the growth projections of the Mekong region. “Greater involvement of the private sector is crucial to meeting the Mekong region’s development and infrastructure investment needs - estimated at USD 10 billion to USD 15 billion over the next 5 to 10 years,” an ADB Vice-President told a forum in Tokyo²⁰¹.

Private Sector Must Fill Infrastructure Investment Gap in Mekong, ADB VP Tells Tokyo Forum

News Release | 14 July 2005

The following are short excerpts regarding the role that FDI has played in each country ²⁰²:

²⁰⁰ <http://www.adb.org/news/private-sector-must-fill-infrastructure-investment-gap-mekong-adb-vp-tells-tokyo-forum>

²⁰¹ <http://www.adb.org/news/private-sector-must-fill-infrastructure-investment-gap-mekong-adb-vp-tells-tokyo-forum>

²⁰² <http://www.adb.org/sites/default/files/publication/159369/adbi-mekong-direct-investment.pdf>

In **Cambodia**, the rapid expansion of FDI-driven clothing exports has become a major source of employment and income for women, reducing poverty and helping narrow the urban-rural income gap. Recently, FDI has also begun expanding into other labour-intensive export industries, such as shoes, toys, and wood products, which is further contributing to employment generation.

In the **Laos**, foreign investment in the hydroelectric power and mining sectors are boosting GDP growth and creating substantial employment opportunities in this landlocked country. Furthermore, through taxes, royalties and dividends, the citizens of Laos stand to be significant beneficiaries of such FDI projects, as long as these revenue streams are well managed. FDI is also behind the rapid increase in mining-related exports and there appears to be significant untapped potential in this area.

FDI has played an important role in transforming the economy of **Viet Nam**. There is a substantial amount of evidence that highlights the role of FDI in driving growth in GDP, exports and employment, as well as positive spill over effects in the economy through enhanced productivity. As long as the investment climate remains open and receptive, Viet Nam has the potential to further diversify FDI inflows, shifting it from the light-manufacturing sector to assembly and related activities in the electronics industry. If this happens, Viet Nam looks well placed to emulate the developmental achievements of its more advanced ASEAN neighbours.

The current account reverted to a deficit in **Thailand** for the first time since the 1997 financial crisis, partly reflecting higher oil imports and subdued tourism revenues, and partly imports required for the strong growth in investment in the past several years as the economy recovered from the crisis.

In Thailand, net capital inflows turned positive for the first time since the 1997 crisis, mirroring the trend in the current account deficit. The private and state enterprise sector recorded capital inflows of USD 11 billion, compared with an outflow of USD 3.8 billion in 2004. Part of these inflows included a tripling in net FDI to USD 3.4 billion. The government and the banking sectors showed net capital outflows, partly reflecting continued net repayments on their debt. For the economy as a whole, external debt declined further to 32 percent of GDP from 36 percent in 2004.

FDI inflows into Viet Nam increased in 2005 to above USD 2 billion, equivalent to 4 percent of GDP. Coupled with disbursements of about USD 1.5 billion from official development assistance (ODA), this was more than sufficient to fund the current account deficit. External debt has fallen steadily as a share of GDP to 33 percent in 2005 and debt service payments are a modest 5.2 percent of exports of goods

and services.

Cambodia and the Laos are more reliant on ODA to finance their current account deficits. However, FDI inflows are assuming greater importance in these countries as well, especially as debt levels are high. Total external public debt in Cambodia amounted to an estimated USD 3.2 billion (52 percent of GDP), nearly two thirds of which is owed to the Russian Federation and the US and is not being serviced while they are under renegotiation.

In the Laos, external public debt in 2005 was an estimated USD 2.4 billion (78 percent of GDP), of which about USD 390 million is owed to the Russian Federation and is under renegotiation. Most of the external debt is on concessional terms, so that the debt service payments are modest in terms of exports, although they are significant in terms of government revenues, reflecting low revenue mobilization.

FDI is important in Cambodia, Laos, and Viet Nam as an additional source of funds to fill the savings-investment gap, as reflected in their current account deficit and, perhaps more significantly, to boost overall economic productivity.

Although FDI has been growing, the domestic private sector in Cambodia, Laos and Viet Nam is still relatively undeveloped after a long history of centralized planning and government control. While the business communities in these countries are diverse in nature, all face common problems in developing competitive market economies. Cambodia and Laos for example still have agrarian economic structures with limited manufacturing industries. Spill overs from FDI to the domestic private sector have been limited. This is partly because of a “missing middle” of larger domestic private firms, since SMEs account for well over 90 percent of all enterprises, and up to 75 percent of employment. Many operate informally and are disadvantaged as a result. Women-run enterprises tend to remain informal.²⁰³

From a private sector perspective, the environment in Cambodia, Laos and Viet Nam is still too complicated to operate in easily. There is weak implementation of business laws, despite past and ongoing regulatory reforms. Policies are sometimes inconsistent with commitments under the regional

²⁰³ <http://www.adb.org/sites/default/files/project-document/150263/48270-001-tar.pdf>

economic integration agenda, while business laws are often poorly implemented.

There are a number of risks associated with investing in the lower Mekong countries. These include the perception that policy uncertainty and perceived political interference or instability will hinder investment inflows. In general, the investment environment is compromised by challenges, such as poor physical infrastructure, limited domestic capacity in the form of human capital and entrepreneurial skills and underdeveloped legal, judicial, and administrative structures. Weaknesses in the financial and banking sectors and vulnerabilities in the corporate sector add to the perception of high risk²⁰⁴.

There are also potential negative impacts to FDI as indicated by a paper by the ADB. The paper quotes, “The discussion so far has highlighted the positive impacts that FDI can have in host countries. Large investment projects involving the exploitation of natural resources in particular can have a range of negative social and environmental impacts however. Although this does not necessarily depend on the source of funding (whether domestic or foreign) these costs are real and can be quite significant. The Nam Theun II project in the Laos provides a useful illustration of such costs, since they are likely to apply to most large projects not only in the hydropower sector but also other forms of resource-based industry principal adverse environmental impact is likely to be the loss of habitats (both terrestrial and aquatic) in and around the project site area. This loss of habitat will increase population pressures on wildlife that are dependent on these habitats. There are water quality issues associated with the reservoir and downstream receiving waters as well, which are cross-boundary in nature. Poor water quality in the reservoir could affect the viability of reservoir fisheries programs, and greenhouse gas emissions from the reservoir could contribute to global carbon dioxide levels”²⁰⁵.

5.2.2 Development Agency Financing (DFIs and Donors)
Countries of the Mekong region receive both financial and policy advice from multilateral and bilateral agencies. As key financiers of development projects in the region, such agencies have influence over the direction of development agendas and

²⁰⁴ <http://www.adb.org/sites/default/files/publication/159369/adbi-mekong-direct-investment.pdf>

²⁰⁵ <http://www.adb.org/sites/default/files/publication/159369/adbi-mekong-direct-investment.pdf>

decision making in borrowing countries. Of the multilateral agencies, the ADB (who funded the Greater Mekong Sub-Region Program) and the World Bank are both critical actors in the region, while a number of Western-based donors contribute bilateral aid.

A new development in the region in terms of finance is the Asian Infrastructure Investment Bank (AIIB). The AIIB focusses on sectors such as the development of infrastructure and other productive sectors in Asia, including energy and power, transportation and telecommunications, rural infrastructure and agriculture development, water supply and sanitation, environmental protection, urban development and logistics. The influence of the AIIB in the region has come under some scrutiny regarding the imbalance of costs and benefits accrued from investments in each country.

A few of the other development agencies or donors that have provided bilateral finance include the Australian Department of Foreign Affairs and Trade (DFAT), Swedish International Development Agency (SIDA), Danish International Development Assistance (DANIDA), Japan International Cooperation Agency (JICA), Norwegian Agency for Development Cooperation (NORAD), United States Aid (USAID), German KfW and Finland, to name a few²⁰⁶.

According to a publication by Chatham House, the regional approach to climate change is recognised by a number of donor agencies, such as the ADB, US AID and the United Nations Environment Programme. For example, the ADB has established the Regional Cooperation and Integration Fund (RCIF) and the Investment Climate Facilitation Fund (ICFF) under the Regional Cooperation and Integration Financing Partnership Facility. These help pool and provide financial and knowledge resources to support regional cooperation projects²⁰⁷.

5.3 Institutional Possibilities

The shared and linked water challenges affecting the LMCs' economies will require multiple, coordinated efforts. To that extent, this report offers a set of unilateral policy options as well as a series of multi-lateral institutional possibilities. We encourage both of these approaches to be considered in parallel.

²⁰⁶ http://sydney.edu.au/mekong/documents/current_projects/mli_policyworkshop_mekonginstitutions_mar05.pdf

²⁰⁷ https://www.chathamhouse.org/sites/files/chathamhouse/public/Research/Energy,%20Environment%20and%20Development/0610pp_baumuller.pdf

5.3.1 Unilateral policy instrument options

In one regard, the various market forces affecting the Mekong Basin's waters, are misaligned. The incentives to conserve water, reduce pollution, ensure a healthy flow of sediment and to maintain freshwater ecosystem services are currently insufficient to prevent the negative economic impacts that are emerging. Thankfully, however, public sector authorities have, through market based policy instruments, the ability to shift the way markets affect water resources.

We define water-related, market-based mechanisms here as a set of *“government-led formal or informal rules consciously designed to change behaviour – of individuals, businesses, organisations or governments – to influence how markets work and their outcomes [on water]”*²⁰⁸. Furthermore, we would offer five general options available to public sector agencies tasked with ensuring economic health:

- 1) Water-related taxes and subsidies
- 2) User fee systems (pricing/tariffs, user charges, deposit-refund, performance bonds)
- 3) Public spending on water-related goods and services
- 4) Tradeable water permits (cap-and-trade or effluent/withdrawal trading schemes)
- 5) Information and voluntary approaches (notably standards and disclosure)

Each of these is explored briefly in the table below with brief description along with advantages and disadvantage. Note that the intention is not to comprehensively outline these various policy instruments, but rather flag the general approaches for further consideration.

²⁰⁸ Modified from Blackmore, Emma (May 2011). “Shaping Sustainable Markets: Research Prospectus” (PDF). International Institute for Environment and Development. Retrieved 2016-09-21

Table 26: Market based policy instruments

| Market-based Mechanism | Definition & description | Example | Advantages | Disadvantages |
|--|---|--|--|--|
| User fee systems (pricing/tariffs, user charges, deposit-refund, performance bonds) | <i>“A sum of money paid by the individual/company who chooses to access a service or facility.”</i> | Water tariffs charged for clean water provision; a deposit paid on hazardous chemicals (to ensure safe return). e.g., Los Angeles Department of Water & Power’s tiered residential water prices for clean water provision ²⁰⁹ . | More politically appealing than an outright “tax”; consistent with polluter (consumer) pays principle; encourages efficiency & awareness of impacts; can be tiered to nuance impact | Fees may be insufficient to drive change; costs get passed on and drive inflation (making basic goods/services unaffordable to the poor) |
| Public spending on water-related goods and services | The part of a nation’s fiscal policy that relates to government spending. | Government procurement of low-flow toilets; government acquisition of land that sits over a key aquifer or provides ecosystem services. e.g., Government spending on restoration of the Lang Sen Wetlands Reserve in Long An ²¹⁰ . | Provides a strong incentive for water conservation/low or no pollution technologies; can incubate/ scale promising beneficial water technologies; can stimulate the economy of water-related services & technologies | Potentially costly for the government; politically challenging to secure money for water (vs. climate or other options) |

²⁰⁹ LADWP (2016) Your Water Rates. Accessible online: http://www.myladwp.com/understanding_your_water_rates. Last accessed: September 23, 2016.

²¹⁰ See: <http://vietnamnews.vn/environment/262842/project-to-restore-wetlands-reserve-launched.html#E6UEXJ7mPC8kmBYg.99>

| | | | | |
|---|---|---|---|--|
| <p>Water-related (Pigouvian) taxes and subsidies (rebates)</p> | <p><i>“A tax levied on an agent causing an environmental externality (environmental damage) as an incentive to avert or mitigate such damage.”²¹¹ It aims to address inefficient market outcomes by charging the social/environmental cost back to those causing it via a tax.</i></p> | <p>Taxing high water consumption crops and subsidizing low water consumption crops in an effort to encourage farmers to use less water through their crops (and therefore make more water available to other users and/or environmental flows). e.g., Netherlands Waste Water Levy (1970 Surface Waters Pollution Act) which taxes various pollutants and recycles revenue into municipal treatment and pollution abatement subsidies .</p> | <p>Potentially highly efficient for correcting water-related externalities; consistent with polluter (consumer) pays principle; can be used as both an incentive and disincentive</p> | <p>May be politically unappealing; determining the specific tax amount (and ensuring this equals the externality, especially where the impact is shared)</p> |
| <p>Information and voluntary approaches (notably standards and disclosure)</p> | <p>The provision of water-related information to encourage market responses.</p> | <p>Promotion of companies or standards engaged in responsible water management; water use disclosure guidance (regulations). e.g., National Pollutant Release Inventory or Toxic Release Inventory</p> | <p>Harnesses investor markets rather than directly affecting markets (politically more appealing); range of levels (voluntary to mandatory); useful as a supplement to other MBIs</p> | <p>May lack influence or measurable impact; reliance upon additional actors to affect markets (i.e., investors)</p> |

| | | | | |
|---|---|---|--|--|
| Tradeable water permits (a.k.a., “cap-and-trade” or emissions/ withdrawal trading schemes, water quality trading) | “A government regulatory program designed to limit, or cap, the total level of specific chemical by-products resulting from an activity” ²¹³ . It effectively creates a market (& price) for pollutants (or water) that allows users in the basin to trade, while simultaneously lowering cumulative totals. | A defined water withdrawal or pollution license (volume) that can be traded with surrounding users. e.g., Ontario South Nation River Total Phosphorus Management Program, which is a water quality trading system involving agricultural phosphorus reduction between point sources and non-point sources at a 4:1 ratio ²¹⁴ ; or Murray-Darling Basin Authority Water Markets ²¹⁵ . | Highly efficient at finding the most cost-effective methods of reducing water pollution/ consumption; well established in many places; can be expensive to implement; can leverage private equity markets; successful case examples in place | Potential for abuse if there is insufficient monitoring & oversight; requires correct regulatory environment; challenges around establishment and distribution of land & water rights; few successful case studies of use for water quality management (especially non-point source) |
|---|---|---|--|--|

211 United Nations (1997) Pigouvian Tax from Glossary of Environment Statistics, Studies in Methods, Series F, No. 67, United Nations, New York, 1997.

212 Ecotec Research & Consulting (2001) Study on Economic and Environmental Implications of the Use of Environmental Taxes and Charges in the European Union and its Member States, Chapter 7: Waste Water http://ec.europa.eu/environment/enveco/taxation/pdf/ch7_waste_water.pdf

213 Modified from Investopedia (2016) Cap and Trade Definition. Available online: <http://www.investopedia.com/terms/c/cap-and-trade.asp#ixzz4L6dBZln8>; Accessed: September 22, 2016.

214 See: <http://www.rff.org/files/sharepoint/WorkImages/Download/RFF-DP-03-20.pdf>

215 See: <http://www.mdba.gov.au/publications/mdba-reports/water-markets-murray-darling-basin>

All of these various market-based economic policy instruments are available to the LMCs. In all cases, there are additional case studies, some of which are noted above, but the aim of this section is not to be exhaustive but rather illustrative.

There has been extensive research into market-based policy instruments in general, which offer various learning lessons, such as:

- To effectively introduce a market based policy instrument, it needs support. In this regard, education and awareness raising can be powerful supporting tools.
- Substitution effects can have unintended consequences, which sometimes leads to lower resource efficiency.
- Administrative burdens vary considerably, but can be high.
- The type and objectives of an instrument tax can be crucial to its desired environmental impact(s). In particular, it is important to ensure that the tax is set at the correct level to ensure its desired impact on water resources. It is also important to note that the environmental impacts of tax measures tend to erode over time, but revenues typically continue to increase.
- Monitoring and data relating to market based instruments is typically weak, so should be supported through revenues raised, and would benefit from additional, detailed econometric analysis.
- Economic impacts of the studied MBIs were estimated to be slightly negative, which could in many cases be offset by the revenues raised.
- Lastly, and importantly, such market instruments need to work in conjunction with more traditional regulatory policy instruments to drive successful environmental impacts.

In summary, market based policy instruments that drive water outcomes and are within the control of economic planners remain underutilized. When combined with traditional regulatory instruments, and additional information, market-based approaches offer countries a useful set of tools to shift water use in the economy. While this section has not provided an in-depth analysis of these options, it is important to note that these instruments remain a powerful (and underutilized) set of tools that can be harnessed to help to ensure water is used efficiently, effectively and ultimately

optimized in the economy.

5.3.2 Multilateral institutional options

In addition, there are a number of multi-lateral institutional options available to the LMCs.

First, all of the LMB countries are part of the following institutional mechanisms that support collaboration:

-The GMS programme, which is an initiative supported by the ADB that brings together Laos, Cambodia, Viet Nam, Thailand, Myanmar and Yunnan province of China to promote sub-regional economic cooperation. The programme includes activities in a range of sectors, including transport, energy, agriculture, environment, trade, investment, tourism and telecommunications.

-The ASEAN, a regional inter-governmental organisation of ten countries located in Southeast Asia with a particular focus on economic relations. ASEAN is progressively moving towards lowering barriers to investments and trade in goods and services in the region. The trading bloc is also negotiating bilateral agreements with a number of countries in the region (e.g. China, Korea, Japan) and beyond.

Second, the countries are part of the Mekong River Commission (MRC). The MRC was formed in 1995 by the Mekong Agreement between the governments of Cambodia, Laos, Thailand and Viet Nam. The four countries signed *The Agreement on the Cooperation for the Sustainable Development of the Mekong River Basin* and agreed on joint management of their share water resources and development of the economic potential of the river.

However, economic growth and development in the Mekong Basin has been rapid and uneven. Thailand and Viet Nam are investing in generating more electricity to support local production, while Cambodia and Laos are still investing in basic irrigation for agricultural production (although Thai and other investments are happening within Laos, for example, in hydropower). While co-riparian states tend to be more cooperative when it comes to water than other resources, the degree of cooperation still depends on self-interest and the capacity of the individual states to accommodate individual development interests²¹⁶.

An important challenge of regional cooperation is the

²¹⁶ FAO Aquastat, Mekong Basin Overview

cost of upstream effects such as hydropower investment on ecological systems such as sediment flux and flow downstream. Article 7 of the 1995 Mekong Agreement requires each co-riparian state to make every effort to avoid, minimize and mitigate harmful effects that might occur to the environment, especially the water quantity and quality, the aquatic (ecosystem) conditions, and the ecological balance of the Mekong Basin water resources or discharge of wastes and return flows²¹⁷.

However, Laos and Viet Nam, for example, have been building dams in the upper catchment of the Kong River Basin, to generate electricity for sale to Thailand and Viet Nam. These hydroelectricity dams affect hydrological flows and the livelihoods of the people who live along the San and Srepok rivers, the Kong's tributaries and the flow into the Mekong, affecting aquatic eco-systems, fish and fish production in the Tonle Sap²¹⁸.

The transboundary implications of hydropower projects on water quality and quantity are numerous. The first risk of hydropower projects development in the upstream area of the Mekong is the negative impact on the environment and society. The second risk is that of geo-politics in the region. For instance, the dependence upon hydropower for energy from neighboring countries. Cambodia, for example, is particularly vulnerable as it becomes increasingly dependent on Thailand, Laos and Viet Nam for power. A cut in power would significantly affect the economy of Cambodia.

Another example where transboundary cooperation is critical is fisheries. Any change in the ecosystem occurring upstream will affect and impact on the livelihoods of millions of people whose food as well as economic activities rely heavily on fisheries. Water quality, water availability, and preservation of the flooded forest are key conditions for the survival and sustainability of fishery resources in Cambodia for instance. Some of these conditions are controlled by upstream riparian countries.

Opportunities going forward for the MRC
In light of the above challenges with regards to the MRC and development in the Mekong Basin, it is important that each country implements strict internal and international environmental codes of conduct and makes sure every water-related development project is compliant with

²¹⁷ FAO Aquastat, Mekong Basin Overview

²¹⁸ FAO Aquastat, Mekong Basin Overview

human water rights. The current form of the MRC has not been able to ensure that this is undertaken fully. Stronger transboundary coordination and negotiation mechanisms including enforcement of agreed institutional arrangements and laws and regulations for equal rights of access and sharing benefits from the Mekong River are required.

Additional opportunities exist in the form of donor and private sector engagement. For instance, there are increasing opportunities for private sector investment in the development of hydropower, navigation, large-scale irrigation and industry. The MRC could leverage this interest. In comparison with conventional public sector investments, private sector developments are more opportunity-driven with shorter planning cycles and assessment processes. While private sector participation is welcomed, it needs to be open to public scrutiny and sensitive to civil society concerns. This will require effective regulatory systems, including enabling legislation and regulations and enforcement capacity, as well as strong and empowered water resource management agencies²¹⁹.

Therefore, there is an emerging role of the private sector (under a liberalising environment) to support institutions as well as provide financial input into major investments taking place in the region. With the interest of the private sector, alongside the continued efforts of donors and DFIs, it is important that we take cognisance of the multitude of projects taking place. It is important that strategic oversight is provided to ensure that efforts are pooled to achieve the development outcomes without foreclosing on possible future options. If this is not done, the finance provided by FDIs may in fact have a perversely negative impact, resulting in the loss of ecosystems and livelihoods in the Mekong Basin.

219 FAO Aquastat, Mekong Basin Overview

MESSAGES AND RECOMMENDATIONS

6.1 Overall Messages

The Mekong River functions as a lifeline for the entire basin. This includes all of the different sectors and livelihoods that are present in the area. Key resources such as sediment, water flows or wild fisheries are provided by the River. These are linked to the economy through natural or productive processes such as fisheries or construction. This makes the basin unlike many others in the world, where water, energy and food are all fundamentally dependent upon a single river: the Mekong.

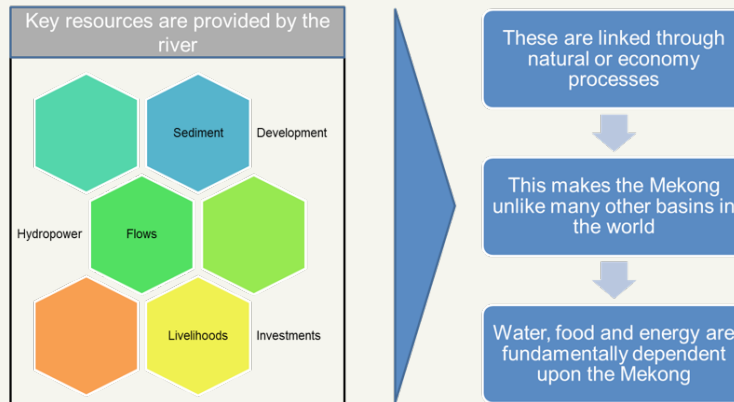


Figure 45: The Mekong River functions as a lifeline for the entire basin

Our understanding of processes within the Mekong remains fragmented. Fragmentation is taking place at three different levels:

- o Geographic fragmentation due to the fact that we have different countries within a single basin that are all developing individual futures without consideration of each other. The borders of countries do not consider the functions of the river.
- o Thematic fragmentation in terms of the development plans of different sectors, and the fact that they are not often well aligned within countries and also between countries.

o Temporal fragmentation as a result of inadequate consideration of short, medium and long-term impacts of different development futures within the Mekong.

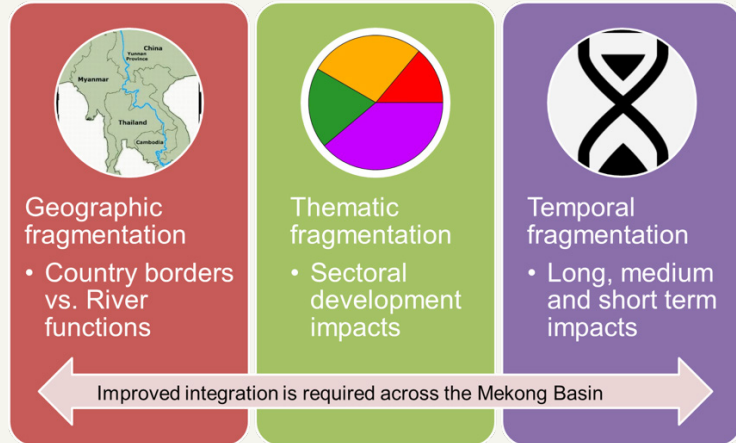
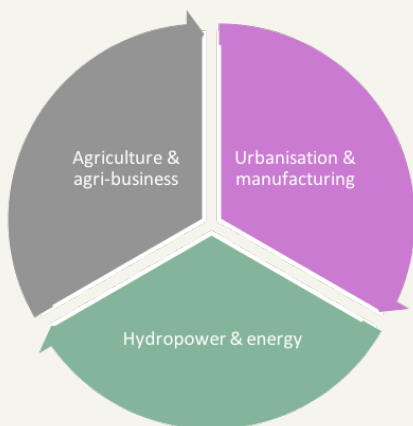


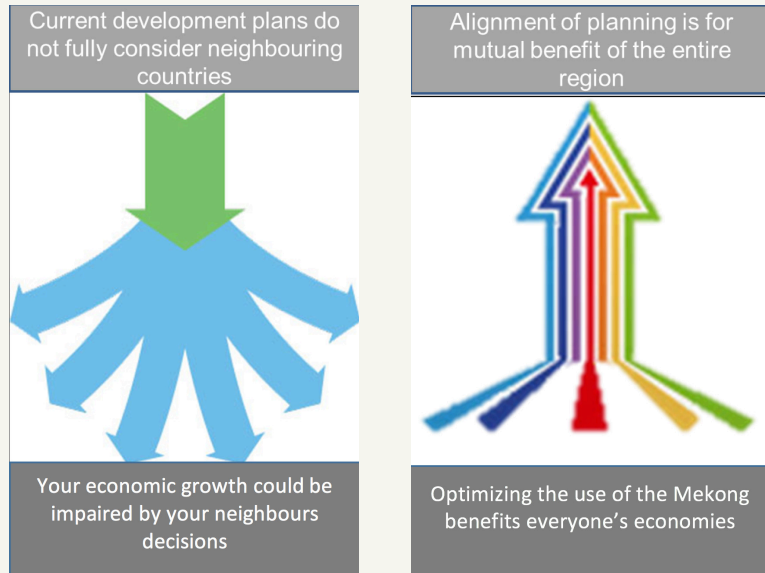
Figure 46: Our understanding of the processes within the Mekong River Basin remains fragmented

As the Lower Mekong Countries continue their rapid economic development, they all face significant trade-offs between prosperity today and sustained economic development for future generations. Decision makers must balance maximizing national and sectoral economic development and optimizing sustainable development of regional economies that respects the ecosystem functioning of the Mekong Basin as a whole.



The story of the Mekong is a continual tension between the development of hydropower with its power benefits and downstream externalities, food cultivation and agribusiness to support livelihoods and trade, and urbanisation and manufacturing with their demand for sediment, food and electricity to catalyse growth and trade.

Improved integration across these forms of fragmentation is required for the entire Basin. Interconnectedness and interdependence on this single river result in the need to see the portfolio of development across the entire system. Therefore, regional planning integration is the only option to ensure optimal sustainable growth in the Mekong Basin.



It is crucial that development plans are taken into consideration, not only in terms of their impact on neighbouring countries, but also in terms of their impact on different sectors in the economy. This cannot be done purely at a normative level, but requires in-depth analysis of the different scenarios that are plausible. Sustainable water management, including improved governance and integration from all of the Mekong countries and sectors is necessary to ensure a viable future in the basin.

6.2 A Call to Action

It is evident that the Mekong Basin remains fragmented across geographic, thematic and temporal scales. Therefore, integration between sectors and countries in the Mekong is the only solution to secure the long term economic viability of the region. This is important not only for government and the public sector, but also for private business and development partners that are active within the region. These actors have an important role to play in ensuring the entire interconnected, interdependent Mekong river system is developed to optimise benefits equitably among the Mekong countries – and minimize associated trade-offs – within the ecological limits of the basin.

One of the overarching opportunities for all actors in the basin is the concept of “benefit sharing,” or conversely “cost sharing” of the consequences of basin development. Benefit sharing is an accepted way to spread resource utilisation benefits across the economy, catalyse broader-based growth and support social equity policies. It is imperative that the diverse, and sometimes contested development trajectories for individual countries in the Mekong are cognizant of the alternative development trajectories possible using the paradigm of benefit sharing. Ultimately, in an increasingly globalised and stressed world, these countries will become increasingly connected by flows of water and sediment down the river, goods through trade, finance in investment and possibly people through migration.

Private businesses and investors in the Mekong

For the private sector, there is little in their business that is not either directly or indirectly provided by the Mekong river system. For instance, sediment in the river provides material for land reclamation and construction, which is used for manufacturing, settlement and infrastructure development. The flows of water and sediment provide fertile soils for agriculture, which in turn provide agro-processing inputs and opportunities. Livelihoods are supported by the river system through affordable access to protein (fish) as well as housing (sand for construction or reeds and grasses). This, in turn, ensures an affordable labour source for business, especially those in manufacturing and services. The analysis in this paper reinforces the concept that in addition to the common wisdom that all businesses have impacts downstream,

they are all also dependent on and at risk from the Mekong River, through inputs, labour and land. Even the investment community faces risks to their investment over the medium term, particularly for infrastructure that has long term repayment periods.

While acknowledging that every sector is distinct and has varying risks and opportunities, there is a strong argument that to ensure sustained economic growth that sustains business value creation, it is necessary to overcome the geographic and sectoral fragmentation that currently plagues the basin. Experience from around the world indicates that when resources are stressed, it is large multinational and state companies that receive disproportionate blame for the problems. While the private sector would benefit from taking a basin-wide view of investments in the Mekong and their cumulative impacts on the resources upon which they all depend, it will require government to create the investment environment that will ensure predictable, stable, consistent and fair development of the basin resources for business, people and nature in all countries. Therefore WWF calls on businesses to:

1. Take a broader perspective on investment and operating decisions that consider the impacts on the basin and the potential physical, regulatory and reputational risks, including for labour and investment.
2. Use associations and trade platforms to communicate with other businesses, share data and lessons, and ultimately create better collective outcomes to manage common risks.
3. Advocate for business associations to dialogue and engage with government economic planners around the risks and opportunities for economic development considering the entire basin.
4. Investors should require disclosure on the strategic and operational business risks faced by their clients.

Development agencies, donors and direct foreign investors

With the interest of the private sector, alongside the continued efforts of development agencies, donors and DFIs, it is important that we take cognisance of the multitude of projects taking place. It is important that strategic oversight is provided to ensure that

efforts are pooled to achieve the development outcomes without foreclosing on possible future options. If this is not done, the finance provided by FDIs may in fact have a perversely negative impact, resulting in the loss of ecosystems and livelihoods in the Mekong Basin.

In a complex and complicated system such as the Mekong, this will require more than purely coordinating programs. This will require an in-depth understanding of the spatial and sectoral interconnections. This includes the natural system such as flows, sediment and fisheries, in addition to food, hydropower and goods such as textiles that are produced in the region. Furthermore, consideration of the impacts on investment and labour need to be included. A fuller understanding is critical to ensure the multitude of goals in the Mekong including: poverty eradication, support of livelihoods, economic growth and development, as well as climate resilience are met.

The concept of benefit sharing across the entire basin geography is a useful manner through which Development Agencies can plan investments in the basin. It is important that development agencies are held fully accountable in ensuring these benefits are accrued to all relevant stakeholders within the basin. This is especially true of large investments projects that are likely to shift the flow and level of the river. Benefit sharing applies at different scales in the Mekong (e.g. regional, basin, national and local scales). Development agencies need to take this into account and support a movement towards developing a critical mass of multi-stakeholder partners and a dialogue platform to identify the sort of leadership, coalitions and practical next steps to adapt many successful models for benefit sharing to the Mekong situation²²⁰.

Government and public sector

For sustainable economic development, Mekong countries governments' plans need to consider their impact on different sectors in the economy, as well as their impact on neighbouring countries. The Mekong River is the lifeblood of the economies and societies through which it flows, with most livelihoods and business activities being highly dependent upon it for crops, fish, energy, sediment and water and at risk from periodic

²²⁰ MRC Initiative on Sustainable Hydropower, 2011. Knowledge base on benefit sharing: Volume 1 of 5.

flooding. The rapid growth rates will pose increasing pressures on the river over the next couple of decades. The primary agricultural and extractive economies, as well as secondary construction and manufacturing economies will continue to be coupled to the state of the river over the next decades. While this is obvious in the case of Cambodia and Laos, that same holds for the Vietnamese and Thai Provinces located in the basin, which as currently important engines of national growth. Depending upon the way it is managed, the river will either be a continued enabler or catalyst of growth or more concerning it may become a constraint or disruptor to development. For governments, the potential impacts on people's livelihoods may have profound consequences for social stability and for the cost of labour, both of which are critical for the growth paradigm that is currently being pursued.

As global investors become increasingly aware of their risks around water, a deteriorating Mekong basin may have a negative impact on the basin countries as low risk investment destinations, due to the physical, regulatory and even reputational risks. This may affect the significant requirement for foreign direct investment to enable the necessary infrastructure and business development in these countries. This will require a new way of looking at economic planning that considers the Mekong River as the platform for development, supported by in-depth analysis of plausible development scenarios and projects. Though not an easy fix, sustainable management of river-related resources, including improved governance and alignment between the Mekong countries and sectors, is necessary to ensure a viable economic future in the basin. Therefore, WWF calls on governments to:

1. Be aware of the interconnected nature of the economies, sectors and livelihoods associated with the Mekong River, and consider this in national economic planning, investment promotion and business development.
2. Promote and support the economic analysis of the dependency of growth and livelihoods on the river, and use this to articulate the need for regional cooperation between countries.
3. Explore approaches to benefit sharing (or cost sharing) to avoid disastrous projects and support sustainable development projects in the basin.
4. Adopt new market-based approaches that improve river

resources management by incentivising appropriate and disincentivising perverse business behaviour, by realigning markets that negatively affect the Mekong.

6.4 WWF in the Mekong

WWF is committed to continuing evidence based advocacy and convening of platforms to improve the governance of the Mekong River to serve the needs of people, nature and business. To this end, our work will be on three broad fronts:

1. To collaborate with development partners, research institutions and companies in the generation and synthesis of relevant information that improves the understanding of (a) the economic linkages between countries, sectors and investors, (b) the economic consequences of projects on downstream communities and enterprise, and (c) the livelihood impacts of development and changing conditions in the basin.
2. To disseminate information that advocates for national governments and companies to take a systemic economic perspective on the basin in their planning and analysis of projects and programmes.
3. To convene partners to collaborate in the development of knowledge about the systemic economic linkages in the basin and to change decision making processes between water and economic development planning at a national level.

1,100

The Greater Mekong region has over 1,100 species of fish

60 MILLION

Over 60 million people live in the Mekong River basin



80%

Of people in the lower Mekong basin depend directly on natural systems like rivers for their food security, livelihoods and customs.

\$17 BILLION

Estimated worth of Lower Mekong fisheries per year, in USD

Funding for the Mekong River in the Economy report comes from the HSBC Water Programme, a 5 year, \$100 million initiative with Earthwatch, WaterAid and WWF to secure healthy, flowing rivers in 5 priority areas around the world, including the Mekong River basin.



Why we are here

To stop the degradation of the planet's natural environment and to build a future in which humans live in harmony with nature.

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