

The Lower Mekong Basin



Towards better investments in water
resource management and development

Snapshot of the MRC Council Study* findings and recommendations

How can we stimulate strong economic growth
without compromising environmental sustainability
and leaving anyone behind?

September 2019

*Study on Sustainable Management and Development of the Mekong River including Impacts of Mainstream Hydropower Projects

This publication is based on the Council Study reports. The Council Study reports are considered final drafts prepared by specialists of the Mekong River Commission (MRC) and international experts through an extensive process of consultation with representatives of the Member Countries and interested stakeholders. The contents, findings and recommendations serve as knowledge base and reference for the work of the MRC and its Member Countries in their ongoing technical and policy dialogues to ensure sustainable development of the Mekong River Basin, as declared in the Siem Reap Declaration of the Prime Ministers in the 3rd MRC Summit 2018.

This snapshot of the MRC Council Study findings and recommendations highlights the main potential benefits and impacts of water resource developments in different sectors, and underlines some of the key recommendations that reflect basin-wide needs and opportunities in the Lower Mekong Basin (LMB). The figures presented here should be interpreted considering the assumptions, methodologies and data sources of the Council Study. The Council Study framework is designed to be flexible, transparent, and replicable to accommodate new or improved data and continued refinements of the assessment tools.

The MRC Council Study is the first study of this scale for the LMB. It is open for review and has been commented on by various stakeholders during its development. Recent studies conducted by other organisations and stakeholders have verified the key trends the Council Study has brought to light.

The Council Study and other summary reports can be downloaded from the MRC website <http://www.mrcmekong.org/>.

The MRC is funded by contributions from its Member Countries and Development Partners: Australia, Belgium, the European Union, Finland, France, Germany, Japan, Luxembourg, the Netherlands, Sweden, Switzerland, the United States of America, and the World Bank.

Assessing national water resource development plans from a basin-wide perspective:

The Council Study

Sustainable development within the Lower Mekong Basin (LMB) requires mitigating the risks and seizing the opportunities that the Mekong River creates for the people of the LMB in a manner that conserves the river's functions for future generations. Achieving this goal is essential and urgent. Basin-wide cooperation is needed to ensure long-term water, energy and food security, address environmental needs, and realize opportunities for collaborative development that shares benefits across borders. Countries acting alone cannot achieve this goal.

The Study on Sustainable Management and Development of the Mekong River including Impacts of Mainstream Hydropower Projects, known as the Council Study, assesses current and potential future development plans of the Mekong countries in six water-related sectors – hydropower, land use, irrigation, navigation, flood protection and industry – and predicts both positive and negative impacts across economic, social and environment spheres.

To achieve this, the Council Study considers three main water resource development scenarios:

- (i) the 2007 early development scenario (baseline),
- (ii) the 2020 definite future scenario (medium-term plan), and
- (iii) the 2040 planned development scenario (long-term plan).

Developments include existing and planned mainstream and tributary hydropower projects, expanded agriculture and irrigation schemes, waterway navigation, flood protection, and domestic and industrial water use. The three main scenarios aggregate combinations of water resource developments according to the sectors so that cumulative impacts on the environment, social issues, and the economy can be assessed.

The 2007 scenario (including existing mainstream dams – Manwan and Dachaoshan – in Upper Mekong Basin, or Lancang in Chinese) represents the baseline conditions in the LMB and is the scenario against which the others are compared. The 2020 definite future scenario – called '2020 plans' – includes all existing, under-construction, and firmly-committed developments in the six sectors, including the Xayaburi and Don Sahong hydropower projects on the Mekong mainstream. The 2040 planned development scenario – called '2040 plans' – includes 2020 developments plus developments in the six sectors planned for implementation by 2040.

To isolate sector-specific contributions to the outcomes of the main 2040 scenario, the Council Study considers sub-scenarios. The sub-scenarios assume either increased or decreased investments in the six sectors in comparison to the 2040 main scenario. All the 2040 sub-scenarios contain the condition of climate change. The main climate change scenario assumes climate will become more seasonal with slightly wetter and drier conditions and sea level rise – referred to as the '2040 plans with climate change'. Two further climate change sub-scenarios assume either a wetter or drier climate and sea level rise for the 2040 plans.

Main scenarios

M1: 2007 baseline = 2007 LMB tributary and China mainstream hydropower dams (Manwan and Dachaoshan only) + agricultural land use + irrigation schemes + waterway navigation + flood protection + domestic and industrial water use

M2: 2020 plans = 2020 LMB tributary, LMB mainstream (Xayaburi and Don Sahong only) and China mainstream hydropower projects (11 dams) + agricultural land use + irrigation schemes + waterway navigation + flood protection + domestic and industrial water use

M3: 2040 plans = 2040 LMB tributary, LMB mainstream (11 dams) and China mainstream hydropower projects (12 dams) + agricultural land use + irrigation schemes + waterway navigation + flood protection + domestic and industrial water use

M3CC: 2040 plans with climate change = 2040 LMB tributary, LMB mainstream (11 dams) and China mainstream hydropower projects (12 dams) + agricultural land use + irrigation schemes + waterway navigation + flood protection + domestic and industrial water use + mean wetter and drier climate and sea level rise

Hydropower development in the Mekong River Basin under the main scenarios¹ and the Mekong impact corridor

The Mekong impact corridor covers:

- (i) the 15 km corridor on both sides of the Mekong mainstream from the Chinese border to the Viet Nam border downstream of Kratie, Cambodia,
- (ii) the Cambodian floodplains including the Tonle Sap River and Great Lake,
- (iii) the Mekong Delta in Cambodia and Viet Nam, and
- (iv) the coastal areas directly influenced by the Mekong River.

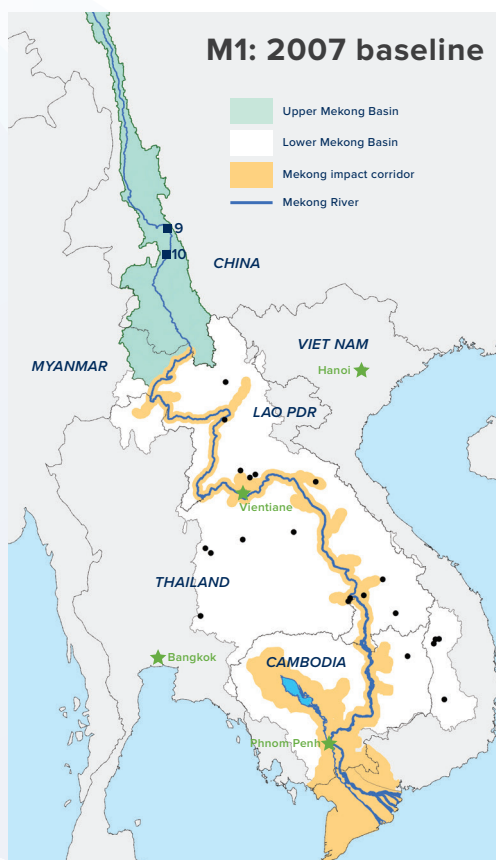
- **Tributary hydropower dams**
- **Mainstream hydropower dams**

Upper Mekong Basin

- 1 Wunonglong
- 2 Lidi
- 3 Tuoba
- 4 Huangdeng
- 5 Dahuaqiao
- 6 Miaowei
- 7 Gongguoqiao
- 8 Xiaowan
- 9 Manwan
- 10 Dachaoshan
- 11 Nuozhadu
- 12 Jinghong

Lower Mekong Basin

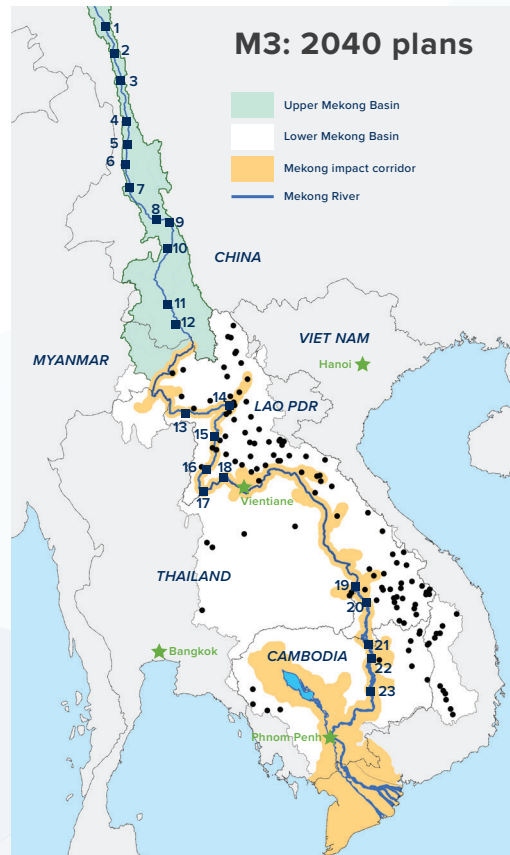
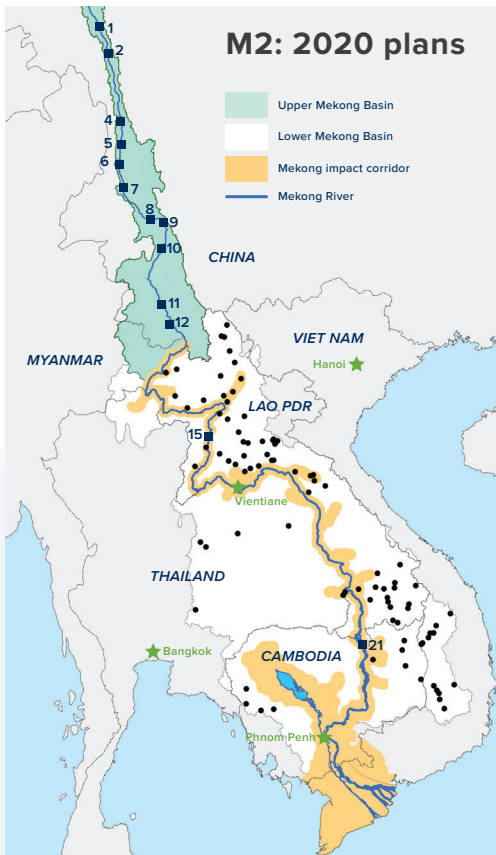
- 13 Pak Beng
- 14 Luang Prabang
- 15 Xayaburi
- 16 Pak Lay
- 17 Sanakham
- 18 Pak Chom
- 19 Ban Koum
- 20 Lat Sua / Phou Ngoy
- 21 Don Sahong
- 22 Stung Treng
- 23 Sambor



1. Based on overall list of dams considered for Council Study modelling and scenario assessments.

Sub-scenarios of the main M3: 2040 scenario

- H1a:** 2040 plans with climate change, but 2007 dam situation
- H1b:** 2040 plans with climate change, LMB tributary and Chinese mainstream dams, but no LMB mainstream dams
- H3:** 2040 plans with climate change, mitigation measures and joint operation of key dams
- A1:** 2040 plans with climate change, but 2007 agricultural land use conditions
- A2:** 2040 plans with climate change and maximum level of agricultural land expansion
- I1:** 2040 plans with climate change, but 2007 irrigation infrastructure
- I2:** 2040 plans with climate change and maximum level of irrigation development
- F1:** 2040 plans with climate change, but 2007 flood and bank protection infrastructure
- F2:** 2040 plans with climate change, urban flood protection at 1:100 ARP (100 year return period) and floodplain management at 1:20 ARP
- F3:** 2040 plans with climate change and joint operation of key dams for flood management and protection
- C2:** 2040 plans with wetter climate and sea level rise
- C3:** 2040 plans with drier climate and sea level rise



Water resource developments

Potential benefits

- ▶ **Hydropower makes up almost half of the growth potential** of the four sectors (hydropower, fisheries, agriculture and navigation) combined.
- ▶ Hydropower development can increase electricity security. Increased access to electricity from hydropower or other energy sources has the potential to improve the livelihoods of rural communities and reduce costs in the agricultural sector; e.g. for sprinklers and water pumps.²
- ▶ **Expansion of agricultural areas in combination with increasing irrigation capacity contributes to food security**, increasing rice production and reducing production variability.
- ▶ **Increased flow of the Mekong River** during the dry season due to discharges from hydropower **may be beneficial for irrigated agriculture** in certain river reaches and reduce sea water intrusion in the Mekong Delta.
- ▶ River stretches with sufficient water depth created by hydropower dams improve navigation and reduce the need for dredging, allowing larger vessels to navigate year-round.
- ▶ Development of **navigation enhances the low-carbon waterway transport** of cargo and passengers and may enhance river tourism.
- ▶ **Flood and drought issues may be better managed** through responsible and joint operation of those hydropower dams that are able to store water during the wet season and assist in the management of flood peaks downstream.
- ▶ **Flood protection works in the areas at most risk can offset the predicted increase in future flood damage.**

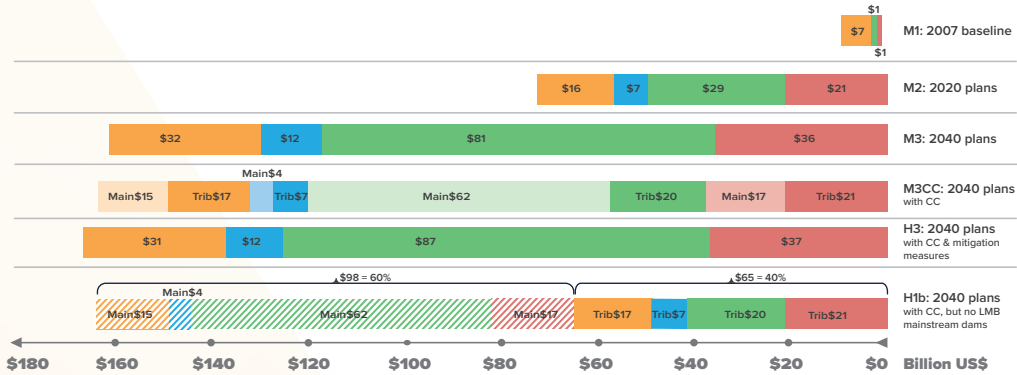
2. Common knowledge, not specifically assessed in the Council Study.

Potential adverse impacts

- ▶ **The developments proposed are likely to reduce resilience and increase vulnerability of rural communities** in the Mekong impact corridor, with the main benefits going to power companies and consumers mainly outside the corridor at the expense of fishing and rural households.
- ▶ The **connectivity related impacts of mainstream and tributary hydropower dams**, such as trapping of sediment, disruption of fish migration paths and alteration of flow regimes, are substantial and far-reaching, and **overshadow those of all other planned water resource developments in the LMB.**
- ▶ **Trapping of bed and suspended sediment** in tributary and mainstream dams of the Mekong Basin, including China, significantly increase river erosion in the LMB requiring significant **expenditure on bank protection** in Cambodia and Viet Nam's Mekong Delta, and **reduce the deposition of nutrient-rich sediment** on floodplains with low soil fertility.
- ▶ Reservoirs created by mainstream hydropower dams, the construction of bank and flood protection structures, and barriers to fish migration have wide-ranging ecosystem impacts, especially on Mekong fish species. However, deeper lake-like habitats are beneficial for others such as bivalves, frogs and snails.
- ▶ **Reduction in the wet season flood pulse** limits the duration, depth and extent of inundation of floodplain habitats and therefore reduces productivity, particularly of the Xe Bang Fai floodplains in Lao PDR, the Cambodian flood plains, the Tonle Sap system and the Mekong Delta.
- ▶ **Agricultural expansion comes at the cost of losing forests and wetlands, accelerated soil erosion, increased use of agro-chemicals, land degradation** and reductions in the stocks of natural capital, and associated flows of ecosystem services.
- ▶ **Navigation-related channel improvement activities, their maintenance, the construction of infrastructure** such as ports and operational activities can potentially affect the environment and fisheries.
- ▶ **Rapid industrialization and urbanization tends to result in the pollution of water bodies** adjacent to development areas, where untreated wastewater is discharged into natural water systems or leached into soils.

Net Present Value (NPV) of sectors over a common period of time under different scenarios

NPV of the hydropower sector for a period of 24 years³



The economic benefit of the hydropower sector* is forecast to increase in all LMB countries. Under the modelled scenarios, Thailand would be the main beneficiary of Lao mainstream dams and Viet Nam the main beneficiary of mainstream dams in Cambodia due to returns on investments and power purchases. Investment returns related to mainstream dams would also flow to non-Mekong countries, such as China and Malaysia.

* The NPV of the hydropower sector is based on the difference between the average retail tariff of electricity and the price paid to the hydropower project.

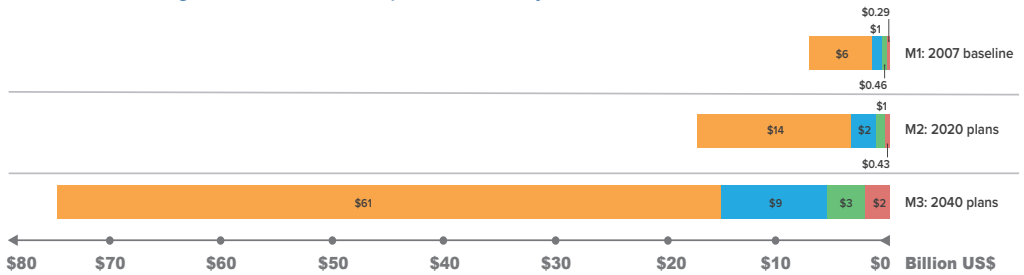
NPV of the agriculture sector for a period of 24 years if labour demands could be met



The economic benefit of the agricultural sector is likely to increase with the planned agricultural land expansions (including irrigated agriculture); particularly in Cambodia, but also in Viet Nam and Lao PDR, whereas in Thailand the agricultural land stays the same. For all countries, except Viet Nam, irrigation is also further developed.

3. The 24 year period approximates 2017 to 2040. For all the scenarios (2007/2020/2040), the same time span was considered.

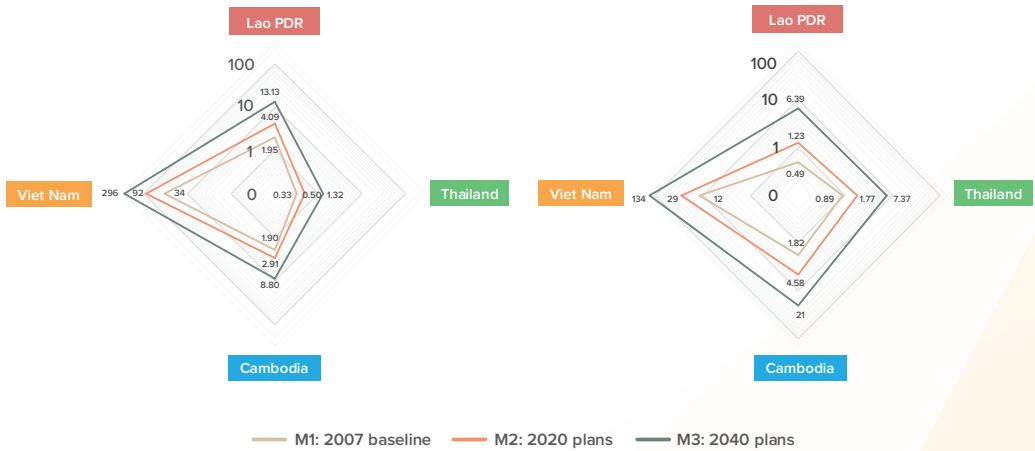
NPV of the navigation sector for a period of 24 years



2020 and 2040 plans increase the economic benefit of the navigation sector in the LMB. 2040 plans assume the implementation of the MRC navigation Master Plan. Viet Nam would be the main beneficiary, followed by Cambodia, Thailand and Lao PDR. Investments in the navigation sector boost cargo and passenger transport, especially in Viet Nam. Changes in total cargo value and passenger numbers constitute important flow-on effects for the broader economy.

Number of million passengers for inland waterway transport

Cargo in million tonnes for inland waterway transport



Irrigated and rain-fed agricultural area under different scenarios

In ha	M1: 2007 baseline		M2: 2020 plans		M3: 2040 plans		A2: 2040 plans with CC & agri. max		I2: 2040 plans with CC & irrig. max	
	Irrigated area	Rain-fed area*	Irrigated area	Rain-fed area	Irrigated area	Rain-fed area	Irrigated area	Rain-fed area	Irrigated area	Rain-fed area
Cambodia	504,245	3,719,442	778,499	6,073,999	1,156,025	6,073,999	1,156,025	6,440,754	1,156,025	6,073,999
Lao PDR	209,116	1,925,550	309,068	2,060,156	597,893	2,148,168	597,893	2,577,802	717,265	2,148,168
Thailand	809,671	13,484,104	1,582,554	13,423,818	2,215,274	13,391,904	2,215,274	13,391,904	2,396,711	13,391,904
Viet Nam	3,348,398	3,057,032	3,244,017	3,590,710	3,188,660	3,745,498	3,188,660	3,745,498	3,188,660	3,745,498
LMB	4,871,430	22,186,129	5,914,138	25,148,683	7,157,852	25,359,570	7,157,852	26,155,959	7,458,661	25,359,570

* also covers areas that are irrigated in the dry season

Cross-sector comparison of hydropower, fisheries, agriculture and navigation NPVs

In billion US\$		Hydropower	Fisheries	Agriculture	Navigation	SUM	%
M1: 2007 baseline	Cambodia	0.0	30.5	62.2	0.9	93.7	
	Lao PDR	1.2	8.3	42.5	0.3	52.3	
	Thailand	1.0	15.0	154.8	0.5	171.3	
	Viet Nam	6.8	18.9	98.7	5.6	130.0	
	LMB	9.1	72.9	358.1	7.3	447.4	
Differences to M1							
M2: 2020 plans	Cambodia	6.6	-4.7	65.3	1.3	68.4	+73%
	Lao PDR	19.8	-3.7	3.2	0.1	19.5	+37%
	Thailand	27.6	-6.4	2.2	0.4	23.9	+14%
	Viet Nam	9.2	-1.7	21.0	8.2	36.6	+28%
	LMB	63.3	-16.5	91.7	9.9	148.4	+33%
M3: 2040 plans	Cambodia	12.0	-6.3	67.3	8.5	81.6	+87%
	Lao PDR	34.8	-5.0	5.8	1.9	37.5	+72%
	Thailand	80.1	-8.2	4.1	2.9	78.9	+46%
	Viet Nam	24.9	-3.2	26.3	55.5	103.6	+80%
	LMB	151.8	-22.6	103.5	68.9	301.6	+67%

The comparison of the four sectors suggests substantial economic improvements for the 2020 and 2040 scenarios. This narrow sector perspective is only considering effects within each of these sectors, but does not look at economy-wide implications and how sustainable these sector developments are.

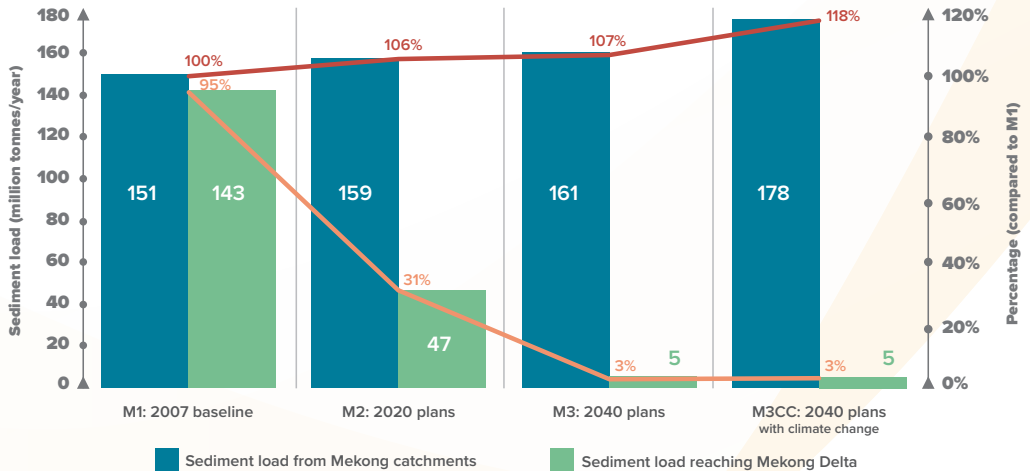
NPV of the capture fisheries sector for a period of 24 years



The capture fisheries sector is likely to experience a substantial decline in economic benefits for the 2020 and 2040 scenarios. From a macro-economic perspective, the fisheries sectors in Lao PDR and Thailand are likely to lose most of their economic relevance. Overall, the changes to the fisheries sector through hydropower development are substantial and likely to change the market structure for fish throughout the LMB. To what extent aquaculture could provide relief has not been considered.

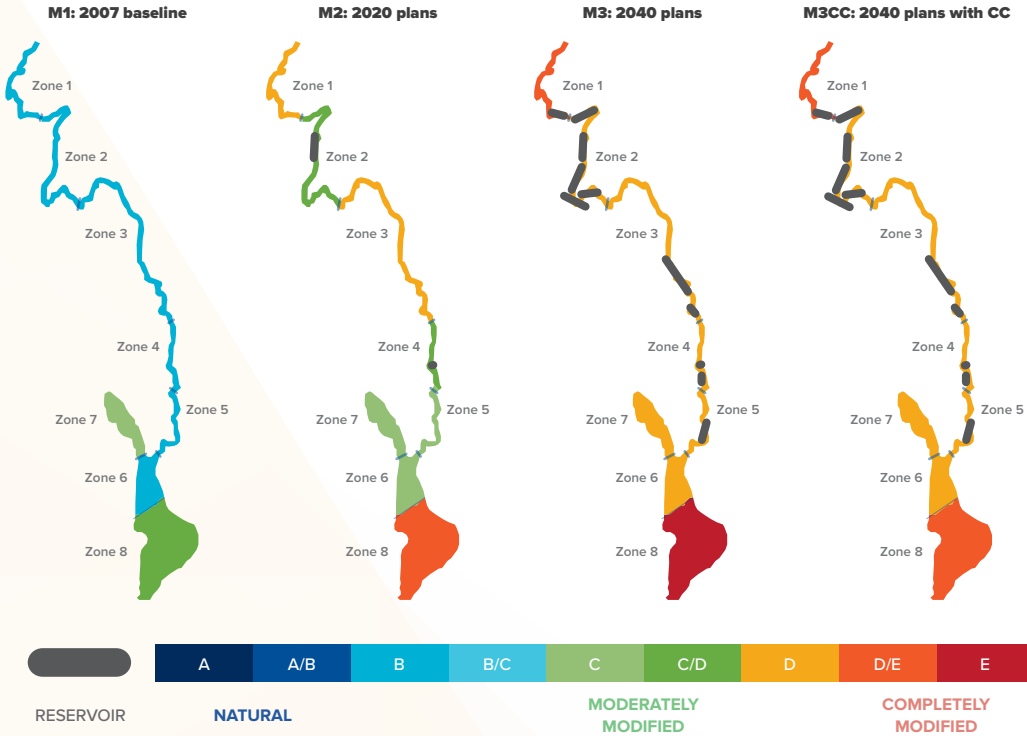


Comparison of annual sediment load from the Mekong catchments with the annual sediment load reaching the Mekong Delta



An opposing dynamic takes place in the Mekong regarding sediment input and transport downstream. On the one hand, total sediment loads entering the Mekong River under the 2020 and 2040 scenarios may increase due to land use changes (blue bars). On the other hand, there may be a drastic reduction in the amount of sediments actually transported downstream towards the Mekong Delta due to trapping in the growing numbers of dams (green bars). Mitigation measures may partially reduce this trend. Other factors such as sand mining have not been considered due to data limitations.

Overall ecosystem conditions across different scenarios



The riverine ecosystem health of the LMB is predicted to decline through the development sequence: from the 2007 baseline when most parts of the river are in a Category B condition, to a mostly Category C condition for the 2020 scenario, and a mostly Category D condition for the 2040 scenarios with and without climate change.

Change in fish biomass in the Mekong corridor of the LMB



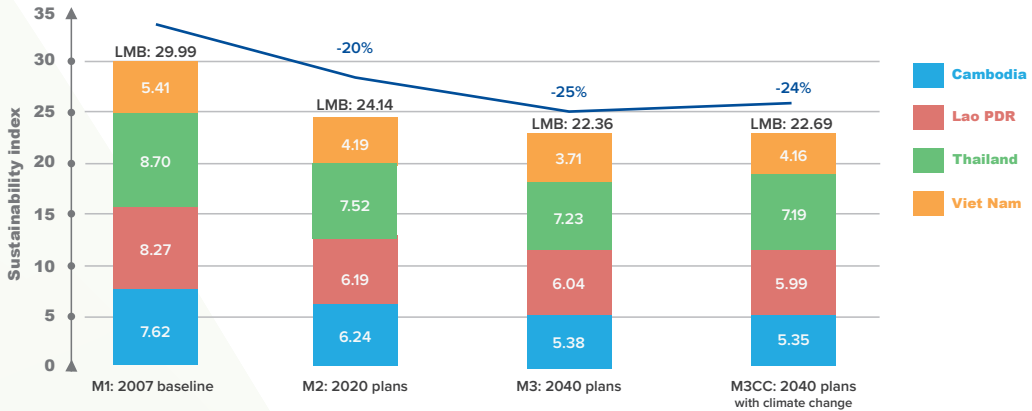
Overall, fish biomass is anticipated to decline under 2020 and 2040 scenarios, especially in the upper part of the LMB, and in particular white fish, the biggest contributor to fish biomass in the LMB. However, changing environments, such as reservoirs, are expected to increase generalist and non-native fish.

What can be concluded from the Council Study?

- ▶ Current national development plans combine a group of highly beneficial and a **group of non-beneficial hydropower and agricultural expansion projects** as these plans are not optimal and sustainable from a basin-wide perspective.⁴
- ▶ **Excessive investment in hydropower and labour intensive agriculture may reduce GDP growth** due to external costs and effects on other sectors.
- ▶ **Current national development plans are likely to trigger a decline in resilience and increase vulnerability in the Mekong impact corridor** as food and income security may not improve proportionately unless benefits from these developments are distributed appropriately. Changes in poverty levels across the scenarios are predicted to be modest, but nevertheless increase overall.
- ▶ Under current national development plans, maintaining food security for the entire population of the LMB requires effective, willing distribution networks and cooperation amongst the LMB countries to avoid significant increases in undernourishment in parts of the Mekong impact corridor.
- ▶ The **trade-offs between hydropower development and fisheries are substantial**. The impacts on fish species composition and biomass cannot be totally eliminated even with advanced mitigation measures.
- ▶ In the absence of cross-sector benefit sharing, the sustainability index of the LMB countries would drop substantially if current national development plans were implemented.
- ▶ **With no additional investments in the navigation sector, inland waterway transport growth in the LMB would be very low**. Some stretches of the Mekong River would see no growth or decline due to competition with faster, but more expensive and polluting road transport.
- ▶ **Climate change is likely to amplify negative impacts**, particularly under the drier climate scenario, and poses a significant risk to both food security and GDP growth in the LMB, particularly for Cambodia. These include impacts from sea level rise, such as more salinity intrusion, variability in mean annual flows of the Mekong River, and extreme flood and drought conditions.

4. Some national plans derive from previous Mekong Committee hydropower master plans.

Sustainability index* across different scenarios



The comparison of the scenarios shows that the 2020 and 2040 plans are likely to result in sustainability losses.

* The sustainability index is based on the UN Sustainable Development Goals covering social, environmental and economic dimensions of the MRC Indicator Framework. Due to limited data, not all sub-indicators could be covered. Therefore, the absolute values of the current sustainability index (with 14 per country being the maximum) are subordinate to the ordinal comparison between scenarios, which is more robust and unlikely to change after adding indicators.

What should be done following the Council Study:

Making better investments

How can we stimulate strong economic growth without compromising environmental sustainability and leaving anyone behind?

We can make smart or even joint investment decisions based on sound scientific assessments that consider trade-offs and synergies among sectors and the full costs and benefits to the sustainable management of the environment and society; including developing bold governance approaches to meet basin-wide needs and considering new technologies.

- ▶ **Comprehensive integrated energy and water planning on a basin scale, and adjustments in planned investments in hydropower and agriculture are needed** to reduce or avoid substantial ecosystem and sustainability losses.
- ▶ Only low impact and high return hydropower and agricultural projects should proceed to implementation. As current development scenarios combine both highly positive and negative hydropower and agriculture projects, **project-by-project assessments are needed that adequately consider cumulative impacts**. Substantial economic benefits can be gained from closer regional integration of power planning and investment. National hydropower development plans that are sub-optimal from a basin point of view need to be adapted accordingly.
- ▶ To minimize and monitor environmental risks and impacts, performing **transboundary and cumulative environmental impact assessments, and joint environmental monitoring and adaptive management** is a must for all planned water resource development projects.
- ▶ Investments in emerging energy generation technologies should continue to be explored. Considering the irreversible effects and path dependency of hydropower development, current and future energy planning should consider replacing potentially high adverse impact hydropower projects by more sustainable forms of power generation; i.e. **other renewable power generation technologies**, such as solar and wind power where appropriate, possibly in combination with hydropower plants.
- ▶ **Mitigation measures** can reduce fishery losses. Mitigation measures should be seriously considered during the design phase and operation of dams to reduce impacts. MRC dam design guidelines can be applied to both mainstream and tributary dams.

- ▶ Managing **trade-offs between hydropower and fisheries** is achieved by more efficiently sharing benefits across sectors rather than compensating losses between countries. A possible solution is to reallocate benefits by implementing a levy on hydropower. These funds could then be applied to active monitoring, management and conservation of fisheries and ecosystem resources; e.g. via the implementation of the MRC Basin-wide Fisheries Management Development Strategy, MRC Strategy for Basin-wide Environmental Management, and the MRC Joint Environmental Monitoring for all major dams.
- ▶ Effective national mitigation could also involve sustainable intensification of aquaculture (less labour requirement) and diversification away from river-based livelihoods, including investments in manufacturing and services, to reduce vulnerabilities. To ensure the sustainability of fish farming, the development of agreed aquaculture production standards, monitoring protocols and graduated enforcement processes represent an opportunity for transboundary cooperation.
- ▶ **Small and more focused intensification of agricultural extension combined with productivity improvements for existing areas** would lead to more sustainable outcomes. This is in line with the 2018 World Economic Forum (WEF) on Association of Southeast Asian Nations (ASEAN) theme of developing entrepreneurship and new enterprises to shape the future of production and the future of food security. Modern farming technologies, such as agricultural machinery and precision farming, and climate-smart agriculture practices; e.g. adapted crops or crop calendars, seed varieties and improved soil management, can help to mitigate food security risks and reduce labour demand in the agricultural sector. Agro-ecotourism, agro-forestry and organic farming has the potential to access the growing demand for 'clean' food and increased farming incomes.
- ▶ **Sustainable irrigation** should be supported through a programme aimed at reducing water delivery losses and promoting efficient water use through enlarging water storage capacity, rehabilitating old irrigation facilities such as dams, headworks, and canals, and improving the operation and maintenance of existing facilities. Transboundary cooperation is necessary to plan irrigation and mitigate reduced flows that facilitate salinity intrusion; for example, for a joint examination of water balance and use, including irrigation return flows between Cambodia and Viet Nam, and future risks.
- ▶ Investing in food processing instead of food production and stimulating additional growth in manufacturing and services, such as navigation and education, is recommended, especially in Thailand and Viet Nam. More production of rice and cash crops; e.g. maize and cassava in Cambodia and Lao PDR would support food security for their growing populations and enhance exports. To avoid conflicting labour demands and underutilized infrastructure in the agricultural and secondary sector, the development of a dynamic modelling approach capable of including key influencing factors, such as labour migration patterns within and outside the corridor and price variations, is recommended as a central feature of transboundary planning.
- ▶ **Investments for the MRC navigation Master Plan** could be obtained from several funding sources: National budgets, private sector funds, and regional/international loans and grants. The plan can be down-scaled depending on the development of mainstream dams.

- ▶ A better understanding of the impact of reduced sediment on bed, bank and coastal erosion and river morphology would assist the development of a sediment management plan with measures for erosion protection in the LMB. Such a plan should look at sediments from hydropower reservoir trapping, navigation dredging, sand mining and the need for building materials and land raising.
- ▶ To invest in carefully chosen sustainable flood defences and bank protection, and in the management and protection of floodplains, **strategies for floodplains and flood protection measures** are essential. This requires consideration of floodplains in land-use planning and development control, as well as mapping and prioritization of areas where flood risks need to be reduced. The positive impacts of inundation of the floodplain must be incorporated into cost-benefit assessments of flood defences and bank protection development as well as flood damage calculations.
- ▶ **Environmentally-sound technologies to treat urban and industrial wastewater** are available and should be adopted, incorporated into urban planning instruments, and enforced.

Ongoing implementation of the Council Study results

At the regional level, the MRC has worked to incorporate and build on the information and findings of the Council Study in its various works, including the State of the Basin Report and the updating of the Sustainable Hydropower Development Strategy, and various tools, thematic strategies and guidelines (see the information box on MRC strategies and guidelines).

MRC is also working with partners to help further understand the data and results of the Council Study and their application such as using a shared vision planning tool – a collaborative approach to formulating water management solutions that integrates traditional planning processes with structured public participation and collaborative computer modelling.

Finally, the MRC is supporting its Member Countries to consider the Council Study findings, data and tools in national planning and implementation. To implement these activities, additional financial support and technical collaboration with development partners and international and regional partners is required.

MRC strategies and guidelines

Better basin-wide and integrated planning, mitigation measures and monitoring, and management and governance mechanisms are needed. In addition to the implementation of the MRC Procedures, including the Prior Consultation process for proposed mainstream dams, the MRC is working on a number of basin-wide strategies and guidelines to optimize national planning and mitigate transboundary impacts.

The updated **Mekong Sustainable Hydropower Development Strategy (SHDS)** considers regional energy needs and integration, national development goals, emerging forms of renewable energy, climate change, transboundary social and environmental issues, cost and benefit sharing and joint projects. The SHDS and other basin strategies would help inform the updating of the Basin Development Strategy for the next period.

The updated Preliminary **Design Guidance for Proposed Mainstream Dams in the LMB** provides performance targets and principles for the design and operation of mainstream (and tributary) dams, to mitigate transboundary impacts. The **Technical Guidelines for Transboundary Environmental Impact Assessments (TbEIA Guidelines)** should be used to ensure transboundary environmental impacts are identified, and measures planned for their avoidance and minimization. The MRC **Joint Environmental Monitoring** of mainstream hydropower projects would ensure data sharing among MRC countries and developers, transparent monitoring and adaptive management of dams.

The **Master Plan for Regional Waterborne Transport in the Mekong River Basin** aims to increase waterborne transport and make navigation safer and more sustainable. The plan also considers intermodal terminals serving regions connected by rail and/or road transport. The **Mekong Climate Change Adaptation Strategy and Action Plan (MASAP)** sets out the strategic priorities and actions at basin level through which the MRC can contribute to addressing climate change risks and strengthen basin-wide resilience. **The Basin-wide Fisheries Management and Development Strategy** aims to manage and develop fisheries resources.

Further basin-wide strategies under development or update include: The **Drought Management Strategy, Flood Management and Mitigation Strategy**, and the **Strategy for Basin-wide Environmental Management for Prioritised Environmental Assets**. Regarding irrigation, the MRC is developing **guidelines for the design and operation of irrigation systems and for fish-friendly irrigation**.

Council Study reports available on the MRC website

Thematic reports

- ▶ Report on the positive and negative impacts of hydropower development on the social, environmental, and economic conditions of the Lower Mekong River Basin
- ▶ Report on impacts of non-irrigated agriculture development and general trends in major land-use categories in the Lower Mekong River Basin, including recommendations for impact avoidance and mitigation measures
- ▶ Report on the positive and negative impacts of irrigation on the social, environment, and economic conditions of the Lower Mekong River Basin and policy recommendations
- ▶ Report for navigation thematic area – Cambodia, Lao PDR, Thailand, Viet Nam
- ▶ Flood sector key findings report – Flood protection structures and floodplain infrastructure
- ▶ Report on the positive and negative impacts of domestic and industrial water use on the social, environmental, and economic conditions of the Lower Mekong River Basin and policy recommendations

Discipline reports

- ▶ Macro-economic assessment report
- ▶ Social-economic impact assessment
- ▶ Biological resources assessment – Assessment of planned development scenarios
- ▶ Climate change report – Climate change impacts for Council Study sectors
- ▶ Modelling the impacts of climate change and development infrastructure on Mekong flow, sediment regimes and water quality
- ▶ IWRM scenario modelling report
- ▶ Coastal modelling report

Cumulative impact assessment

- ▶ Cumulative impact assessment – Key findings report

Key results and policy recommendations

- ▶ Policy recommendations
- ▶ Key findings of the Council Study
- ▶ Key messages of the Council Study reports



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