

# Hydropower Dams, Water Governance, and Impacts on the Lower Mekong Basin

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## Objectives

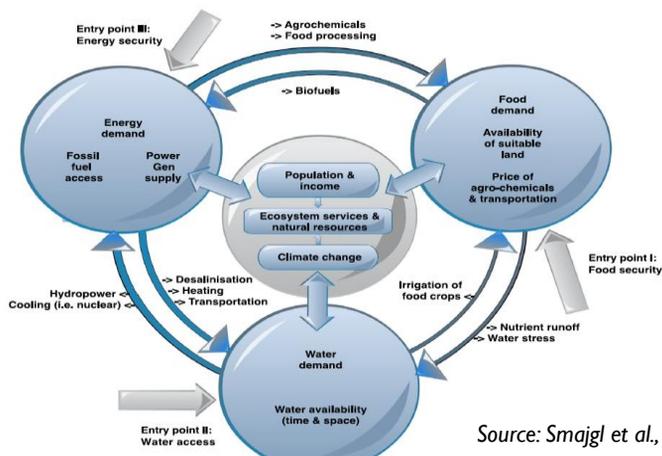
- To evaluate current environmental and resource use in the Lower Mekong Basin-LMB, especially issues relevant to Mekong River.
- What are major factors causing environmental changes in the LMB?
- What are challenges and opportunities in nature conservation for social and economic development?
- Policy implications for development in the Mekong Delta, Vietnam

## Regional Context

- Historic drought in the LMB and the Mekong Delta with massive consequences:
  - Long-lasting EL Nino and shorter return period
  - Climate change and its side effects
  - Hydropower dams construction plans in the upstream, Laos and Cambodia
  - Thailand's water diversion program
- Economic development and rapid population growth.
- Vietnam's agricultural restructuring.

## Multi-Sector Approach (Water-Energy-Food Nexus)

- Multi-dimensional relations between water sources, food security and electricity generation.
- Focus on transboundary impacts instead of local impacts
- Spillover effects of linkage and interdependence among sectors.



Source: Smajgl et al., 2016

## Relationships with 17 Sustainable Development Goals to 2030

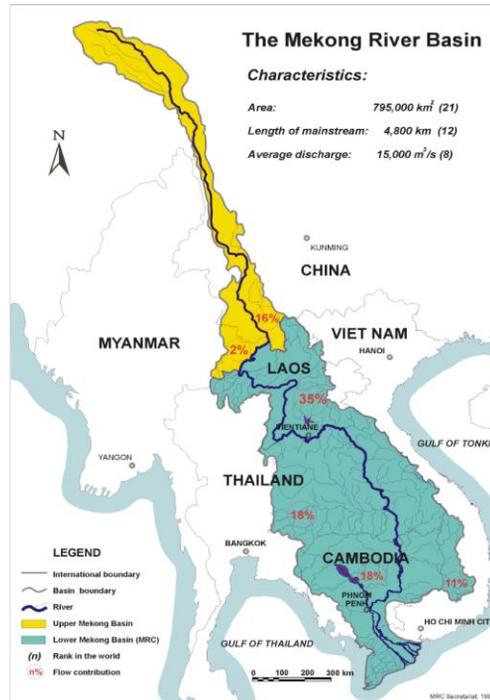


## Relationships with 17 Sustainable Development Goals to 2030

- **Goal 1: End all forms of poverty everywhere**
- **Goal 2: Eliminate hunger, ensure food security, improve nutrition and promote sustainable agricultural development**
- Goal 3: Ensure a healthy life and enhance welfare for all citizens in all age groups
- Goal 4: Ensure a quality, equitable, and inclusive education and promote life-long learning opportunities for all
- Goal 5: Achieve gender equality; empower and create enabling opportunities for women and girls
- **Goal 6: Ensure availability and sustainable management of water and sanitation for all**
- **Goal 7: Ensure access to sustainable, reliable and affordable energy sources for all citizens**
- **Goal 8: Ensure sustainable, comprehensive and continuous economic growth; and generate full, productive and decent employment for all citizens**
- **Goal 9: Develop a highly resilient infrastructure; promote inclusive and sustainable industrialization; and promote renovation**
- Goal 10: Reduce social inequalities
- **Goal 11: Promote sustainable, resilient urban and rural development; ensure safe living and working environments; ensure a reasonable distribution of population and workforce by region**
- **Goal 12: Ensure sustainable production and consumption**
- **Goal 13: Respond in a timely and effective manner to climate change and natural disasters**
- **Goal 14: Sustainably conserve and utilize the ocean, the sea and marine resources for sustainable development**
- **Goal 15: Sustainably protect and develop forests; conserve biodiversity; develop eco-system services; combat desertification; prevent the degradation of and rehabilitate soil resources**
- Goal 16: Promote a peaceful, democratic, just, equitable and civilized society for sustainable development; ensure access to justice for all citizens; develop effective, accountable and participatory institutions at all levels
- **Goal 17: Strengthen implementation modalities and promote global partnerships for sustainable development**

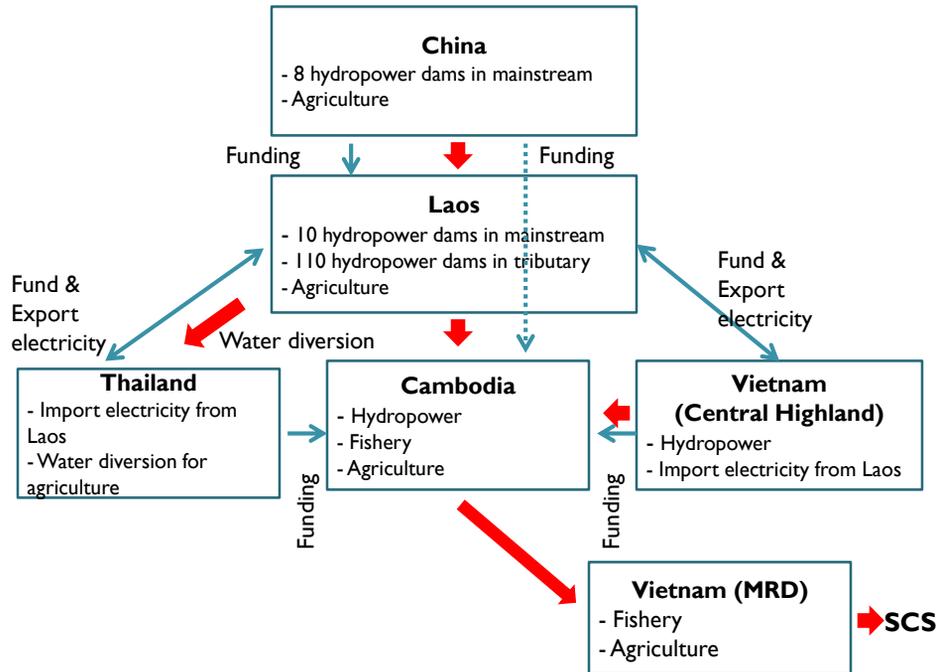
## Environmental Highlights in the LMB

- Population growth
- Industrial activities and urbanization
- Development in Mekong upstream region/ hydropower dam projects
- Large-scale agricultural production/ deforestation
- Natural resource exploitation.
- Climate change



## 2. Environmental Impact Factors in Lower Mekong Countries

- Laos:
  - Slow-developing agriculture
  - Hydropower is the only choice
- Cambodia:
  - Expanding agriculture
  - Promoting industrialization. Need for energy/electricity
  - Low hydropower potential
- Vietnam:
  - Irrigation-based agriculture in Mekong Delta
  - Utilizing hydropower in Central Highland
- Thailand:
  - Water need for agriculture development in Northern Provinces.
  - Electricity imported from Laos
- China:
  - High potential hydropower in upstream region.



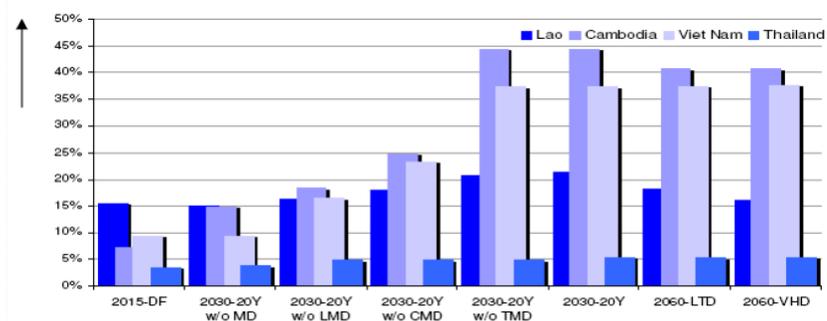
## Laos

- 40% flow contribution to Mekong River
- Least developed country in LMB, intends to take advantage of natural resources, especially water resource to develop
- Hydropower is the only approach to reach development goal of 8-8.5%/year.

## Laos' Perspectives on Hydropower

- Both Thailand and Vietnam have developed hydropower and agricultural irrigation for 50 years.
- Laos and Cambodia could not implement exploitation projects due to unstable economy and war
- Therefore, more developed countries cannot prevent less developed ones from using their resources.
- MRC accepts member countries to use water resource for sustainable development.

- MRC's research shows the potential for hydropower development upstream and in Lao.
- Hydropower may have positive impact on water distribution and water regulation that benefits the downstream
- Biggest impact on fishery is 2-3%.
- Downstream dams (Cambodia) have great impacts.



- Both Thailand and Viet Nam benefits from importing Laos's electricity. In 2020:
  - Export 7,000Mw electricity to Thailand.
  - 5,000Mw to Viet Nam.
- 25 Hydropower Plants are running at **3,244Mw**.
- 40 Hydropower Plants and 1 Thermal power plant at **6,512Mw** are being constructed.
- 52 Hydropower Plants are signed by partners or under consideration with total capacity of **8,805Mw**.
- Total Lao's electricity potential: **26,000Mw**.

## Cambodia

- Nearly 80% population live in rural area and more than 70% live on agriculture. Agriculture contributes 31% to GDP.
- Develops agriculture for poverty reduction, food security, and prioritizes rice for export
- Prioritizes to expand irrigation. Agriculture land is mostly used for only one crop.
- Rice field area may expand one and a half, which raises water needs.

## Land-use Comparison between Cambodia and Vietnam



Figure 1: Different cultivation schemes evident between Cambodia and Vietnam. In Cambodia (upper left corner) cropland is harvested once per year, while in Vietnam (lower right corner) cropland is intensified up to three harvests per year.

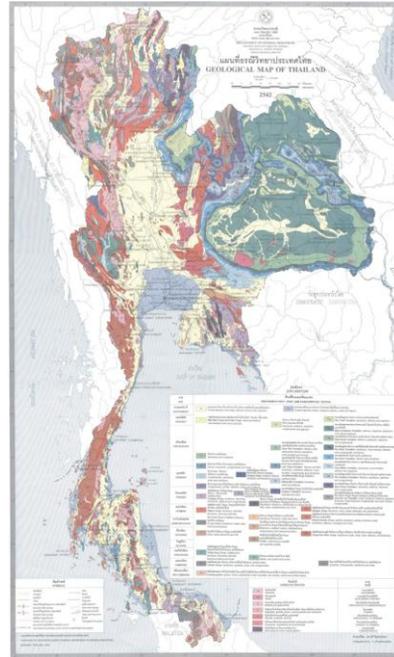
tions. Particularly in the economically powerful countries in the region, changes in cropping patterns (e.g. the shift from traditional crops to cash-crops or aquaculture) and intensities (e.g. the shift from one harvest to multiple harvests per year) are well observed phenomena (Vo et al. 2013, Kuenzer and Knauer 2013). The effects of economic development, knowledge, and technology on land use patterns, are for example, clearly evident along the Cambodian-Vietnamese border (figure 1): While soil and climatic conditions are about the same here for both countries, on the Vietnamese side, modern, early maturing, irrigated rice varieties are cultivated for the world market with up to three harvests per year. On the Cambodian side, however, less intensively managed and non-irrigated single season rice crops dominate due to the lack of agricultural knowledge and technology, which were lost as a consequence of the Khmer Rouge regime. Although these highly efficient agricultural practices allow for higher yields and revenues, it is important to note that very intensive farming, inappropriate irrigation, the increased use of fertilizers and pesticides (Toan et al. 2013), and the trend to mono-species cash-crop cultivation may cause an inevitable deterioration of water and soils as well as endangering the ecological equilibrium in the long term.

## Energy Development

- Cambodia's Energy sector was destroyed during war.
- Low land use ratio, from 18% in 2007 to 31% currently (VWB).
- Average electricity use in 2011 was 164Kwh, compared to VN at 1,073Kwh, and China at 3298Kwh.
- Hydropower potential: 10,000Mw.

# Thailand

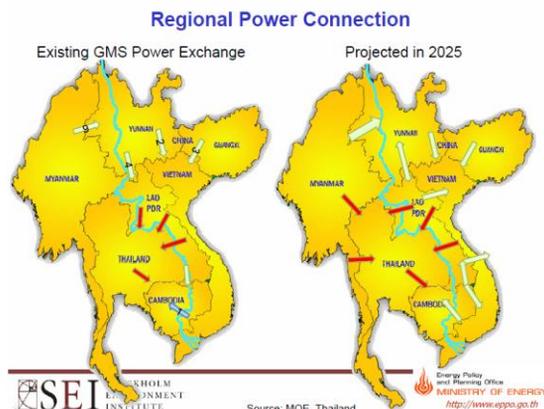
- Water diversion projects for irrigation in North and North East Thailand



## Energy Development

- Fast economic growth but limited fossil fuel
- Low hydropower potential and under exploitation
- Trend to import electricity from Laos and Myanmar, including directly invest in hydropower projects.

Countries	Capacity as MOU (MW)
Lao PDR (MOU 22 December 2007)	7,000
Myanmar (MOU 4 July 1997)	1,500
China (MOU 12 November 1998)	3,000
Cambodia (MOU 3 February 2000)	Not Specified
Malaysia 300 MW (HVDC) (MOU 6 May 2004)	



## Vietnam

- Vast agriculture potential with most area of Mekong Delta used for agricultural production
- Vast water demand for increasing number of crops and expanding agriculture land.
- 2,9 million ha agriculture land and major water source is Mekong river.
- As calculated, 332km<sup>3</sup> of water (out of 475 km<sup>3</sup> of water coming to Mekong Delta) needed only for rice production

## Risk of Water Shortage

- Increasing use
- Limited water supply due to other countries' intensive exploitation
- Risk for abnormal weather phenomena
- Risk for water shortage during dry season and salt intrusion
- Short-term solution (pump underground water, build reservoir) may exacerbate the problem in future.

## China

- Lancang basin is exploited by 50%, lower than other regions.

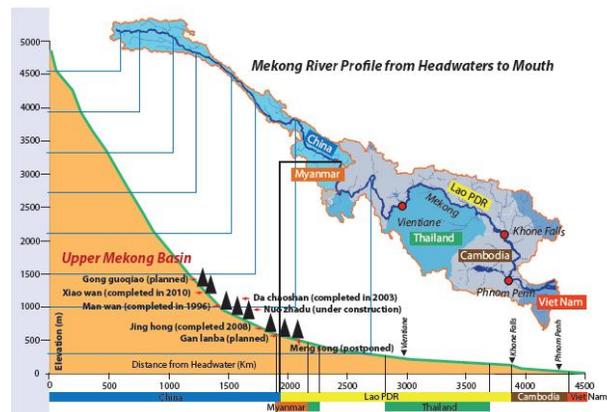


- Hydropower dams help increase water flow during dry season, control floods, assist transportation, have positive impacts on the region
  - Dry season flow in Chiang Saen (Northern Laos) increases 30-50%.
  - Flooding season flow decreases 10-20%.

## China's Hydropower Dams

Reservoir volume (Wiki):

- Gong guaqiao: 120mcm
- Xiao wan: 15km<sup>3</sup>
- Man wan: 920mcm
- Dachaoan: ??
- Nuo zhadu: 21.7km<sup>3</sup>
- Jing hong: 250mcm



**China:**

- \* No official speech about Hydropower in Lower Mekong Basin
- \* Assume that China's dams do not affect and even benefits downstream.
- Information about hydropower dams are national secrets, not to announce
- \* Flow contribution accounts for only 16% but increases to 30% during dry season.
- \* Broken dams may harm Laos and Thailand
- \* Biggest beneficiary when investing in infrastructure, hydropower dams and trade in other countries

**Myanmar:**

Does not join MRC and does not make official speech about LMB

**Thailand:**

- Most benefits from hydropower in Laos and is one sponsor
- Water diversion projects for agriculture

**Laos:**

- Highest hydropower potential for economic development
- Impacts on other countries
- \* Thailand imports electricity from Laos
- \* China, Thailand, Vietnam invest in Laos' hydropower.

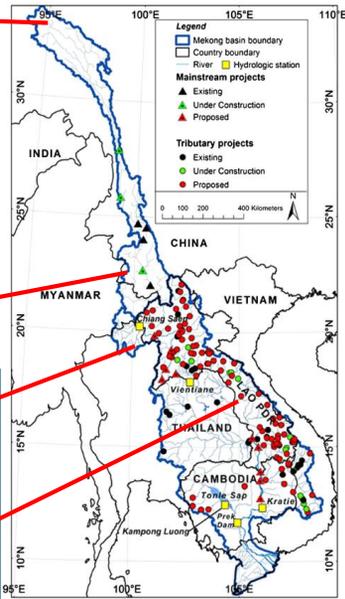


Figure 1. The Mekong River Basin and hydropower projects

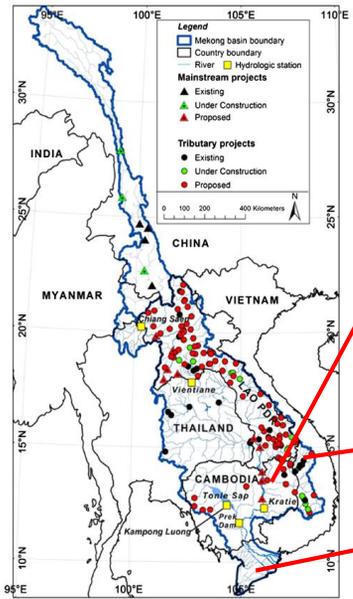


Figure 1. The Mekong River Basin and hydropower projects

**Cambodia:**

- Big capacity dams were constructed or under construction in tributaries such as Lower Sesan 2 at 400Mw. 2 major dams in mainstream can potentially be built are Stung Treng và Sambor.
- Big impacts on fishery and large budget
- \* Suffers lost from development activities in upstream, including hydrology, sediment and fishery. If Don Sahong dam in Lao-Cambodia border brokes, Cambodia will suffer all lost.
- \* If dams are built in mainstream, Vietnam will be affected

**Vietnam:**

- MRD downstream with no potential for hydropower, but rely on water and sediment for agriculture and daily use.
- Dam projects in Central Highland were opposed by Cambodia but still under construction
- \* Invests in hydropower dam construction in other countries
- \* Tends to import electricity from Laos

### 3. Challenges and Opportunities in Nature Conservation for Socio-economic Development

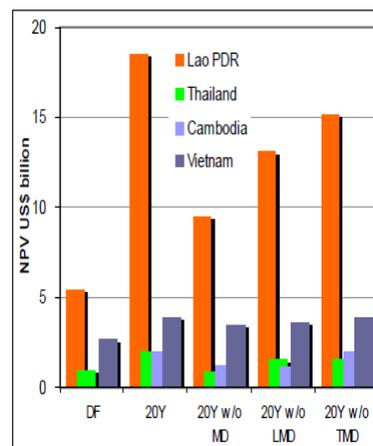
- Irrigation and water diversion for agriculture during dry season
- Hydropower dams in mainstream and tributaries

#### **Conditions:**

China and Lower Mekong basin countries collaborate in overall governance, ensuring primary flow and water quality and evaluating cross-country environmental impacts.

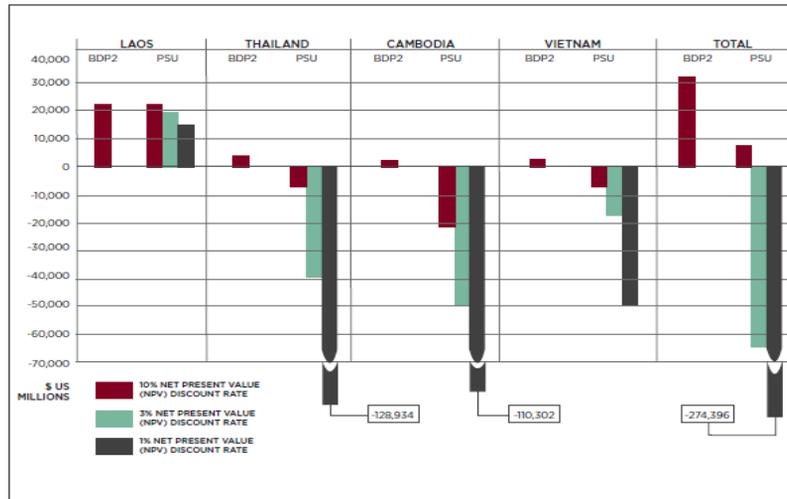
### Economic Impacts in Baseline Scenarios

- Substantial economic benefit in the 20-year Plan Scenario, Laos is biggest beneficiary in all scenarios.
- May have positive impact on irrigation in countries.
- Negative impact on capture fishery especially for Cambodia.
- Impacts on MRD depends greatly on Cambodia's response.



# Sensitivity Analysis

Expected Gains/Losses by Country from Mainstream Dam Scenarios under Revised Assumptions LMB 20-Year PLan Scenario-Chinese Dams plus 11 dams; Laos (9) Cambodia (2)<sup>7</sup>



PSU Report assumes alternative values from MRC's Basin Development Plan (PBD2) for NPV discount rates: 0.10% (Plan), 0.03%, and 0.01%, reassessment of the value of lost capture fisheries, future aquaculture production in the LMB, and the value of lost ecosystem services from wetlands, and adjustments for climate change.

## Conclusion and Questions for Discussion

### Opportunities:

- Food security and sustainable livelihood
- Energy security
- Environmental protection
- Flood and draught resistance
- Water-based transportation

### Challenges:

- Tradeoffs between exploitation and other fields
- Unpredictable impacts of climate change may increase/decrease human's impacts
- Weak collaboration/implementation mechanism among countries.
- Inadequate scientific information
- Limited human resources

- The LMB is facing unprecedented risks coming from both manmade and natural disasters
- Without regional collaboration, individual country development will cause a race to the bottom
- A benefit sharing mechanism for sustainable development is needed, exploitation at a certain level and frequency should be accepted and experiences should be shared.

## For the Mekong Delta

- Transform agricultural structure towards more efficient water use, adaptable to water fluctuations and water shortage, sediment lack, and increased salt intrusion.
- Adaptive solution:
  - At micro-scale, farmers can effectively implement but need to inform and share experiences
  - Macro-scale solutions should be careful not to undertake large-scale construction that changes natural structure of the delta.
  - Regional-scale solutions need breakthrough ideas.

## Questions for Discussion

1. What can Vietnam expect from international institutions to prevent or limit upstream countries exploiting the Mekong?
2. What strategy does Vietnam have to influence the decisions of Mekong upstream countries?
3. Is it possible to correct mistakes (if any) in Mekong Delta Development Strategy that Vietnam has pursued for decades? What is the policy direction? What tradeoffs do you accept?