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Institute for the Study of Natural Resources and Environmental Management
MAE FAH LUANG UNIVERSITY

Economic, Environmental and Social Impacts of Hydropower Development in the Lower Mekong Basin

Apisom Intralawan, David Wood and Richard Frankel
Mae Fah Luang University, Chiang Rai

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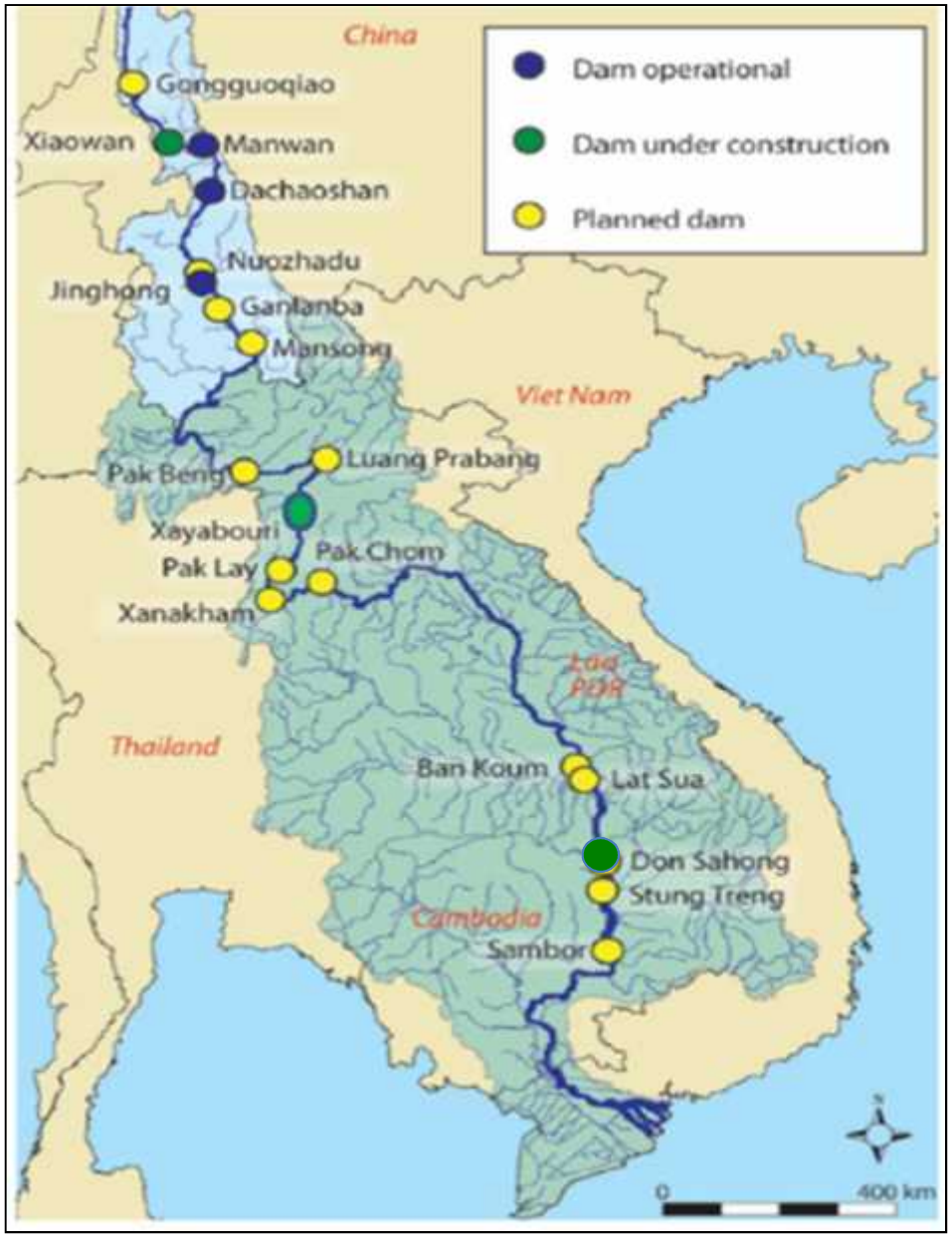
Map of Mainstream Dams from China to LMB



Development of Hydropower

Upper Mekong Basin (Lancang-Jiang Cascade) in China

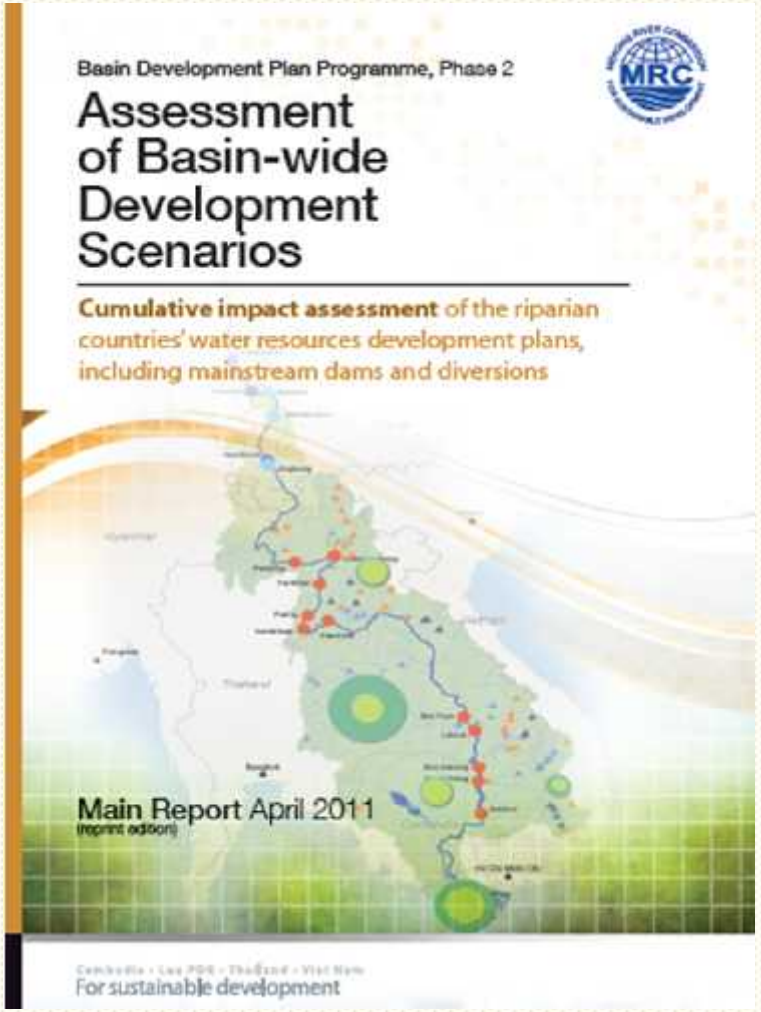
- Large releases of water during dry season (650m^3/sec)
- Dams trap 50% of suspended sediments
- Dams impact hydrology and ecology of the Lower Mekong Basin, including the Mekong Delta

Lower Mekong Basin (11 mainstream dams (9 in Laos and 2 in Cambodia)

- Large risks to reduction of capture fisheries and loss of ecosystem services
- Social/cultural impacts risk loss of livelihood for 20-30 million people

Mekong River Commission (MRC)

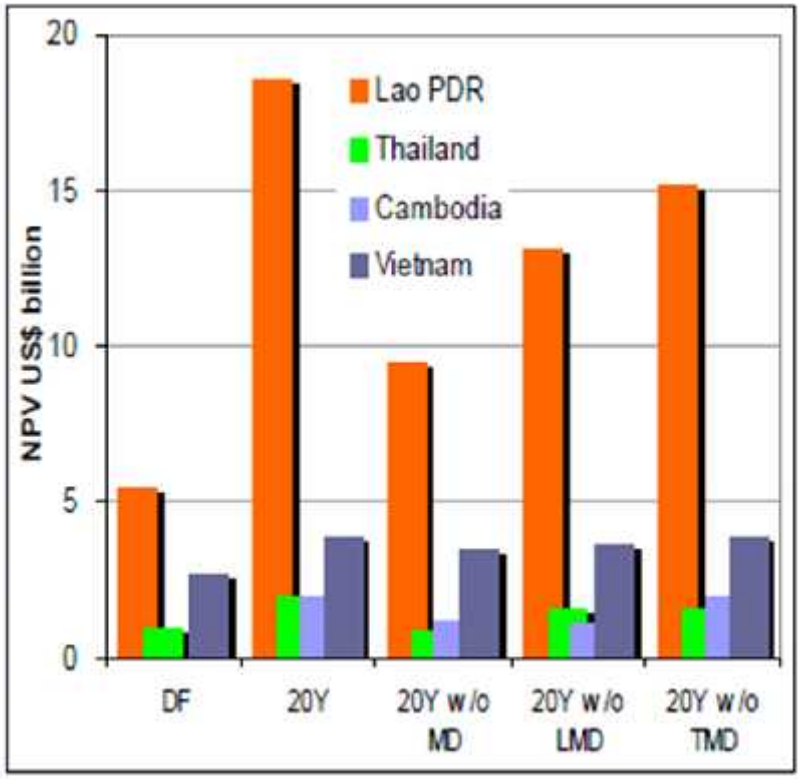
- MRC formed in 1995 by Lao PDR, Thailand, Cambodia and Vietnam
- To promote cooperation and facilitate joint decisions among LMB countries
- To implement goal of sustainable development of the Mekong River Basin
- LMB countries agreed to follow the Procedures for Notification, Prior Consultation and Agreement (PNPCA) established in 2003



BDP2

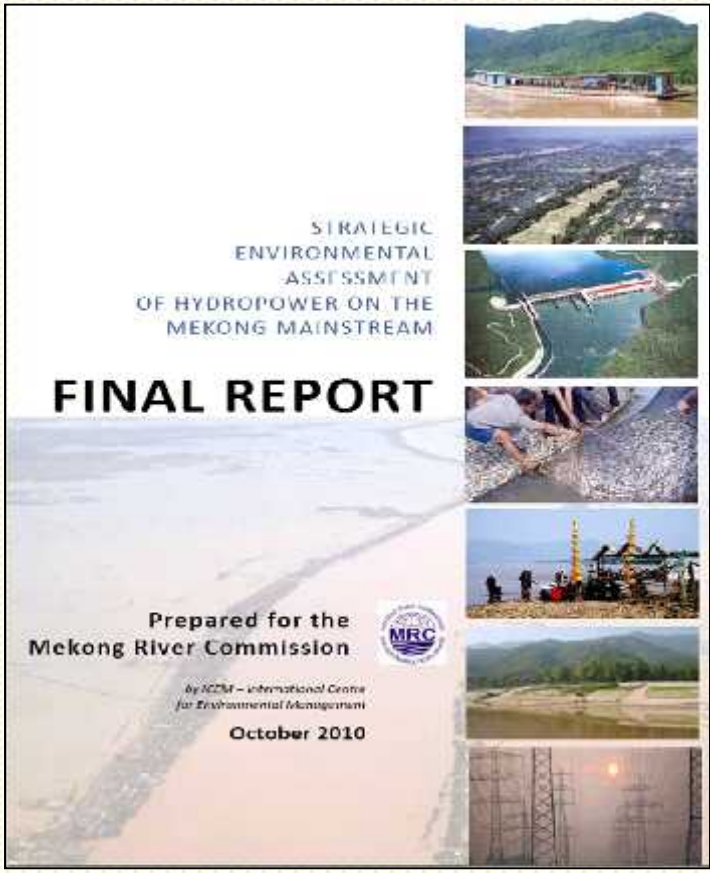
Economic Assessment by MRC (BDP2)

- Net economic benefits in the 20-Year Plan Scenarios are mainly due to proposed hydropower development.
- Other benefits in irrigated agriculture, reservoir and rice field fisheries.
- Main negative impacts due to loss of capture fisheries.
- All four countries show positive Net Present Value (NPV) for BDP2.



Strategic Environmental Assessment (SEA)

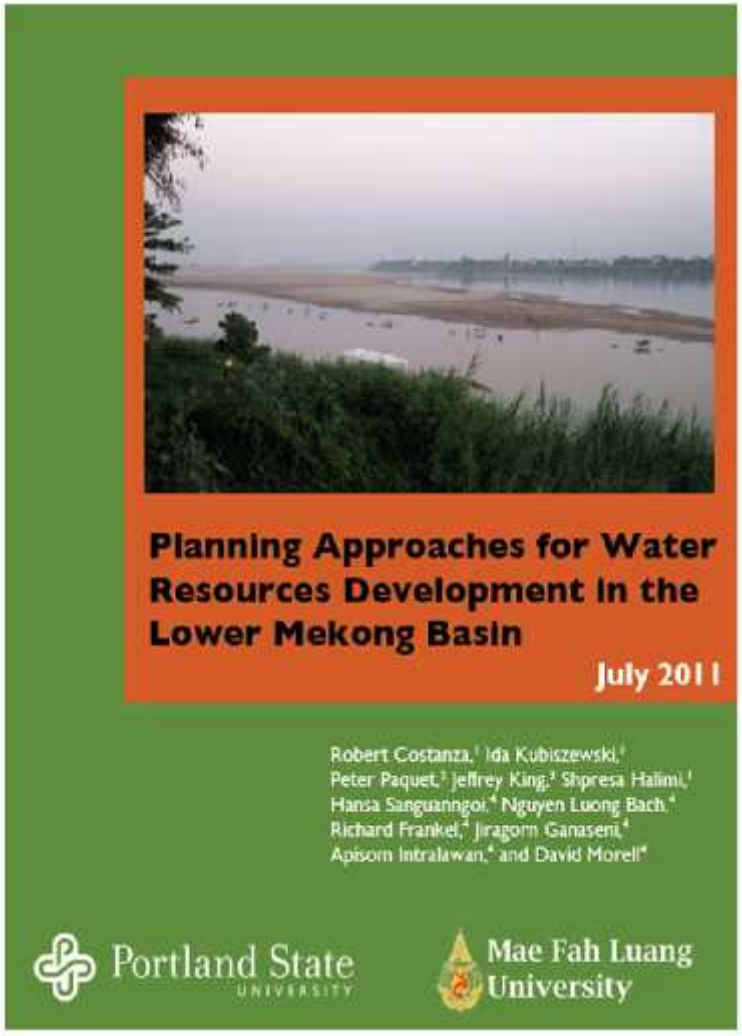
- Prepared for MRC in 2010 with focus on mainstream dams; based on MRC development scenarios
- 11 proposed dams would provide 6-8% LMB power demand
- Major negative impact on fisheries and agriculture
- Irreversible environmental damage
- Increase in poverty in rural riparian area (30 million people)



SEA RECOMMENDED TO DEFER DECISIONS ON MAINSTREAM DAMS FOR 10 YEARS

Costanza Report

- Study carried out by PSU and MFU in 2011, sponsored by USAID
- Changed BDP2 assumptions– fish price, discount rate for natural resources.
- BDP2 conclusion reversed – net economic impact of hydropower development became **negative**.
- Recommended further work on ecosystem services and social impacts.



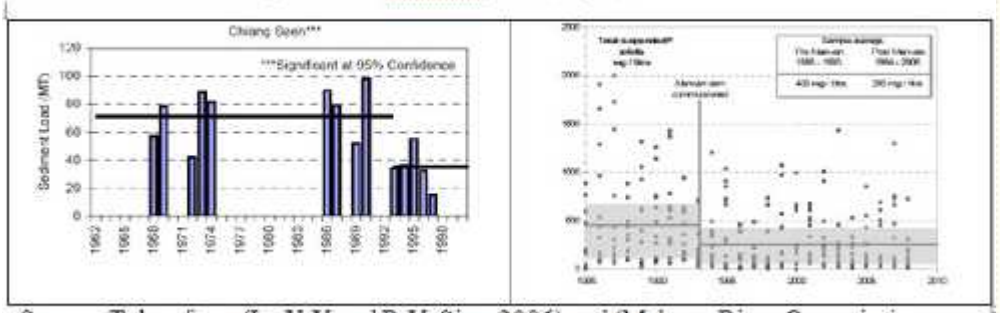
Scope of 2015 MFU Study

- To update fish catch and fish loss data
- To update the Costanza economic evaluation
- To write a condensed report suitable for all hydropower project stakeholders
- To translate into LMB languages
- Focus on impacts of mainstream dams
- Scope extended to include brief assessment of social impact costs and sediment/nutrient flows
- Scope extended due to BPD2 data inconsistencies

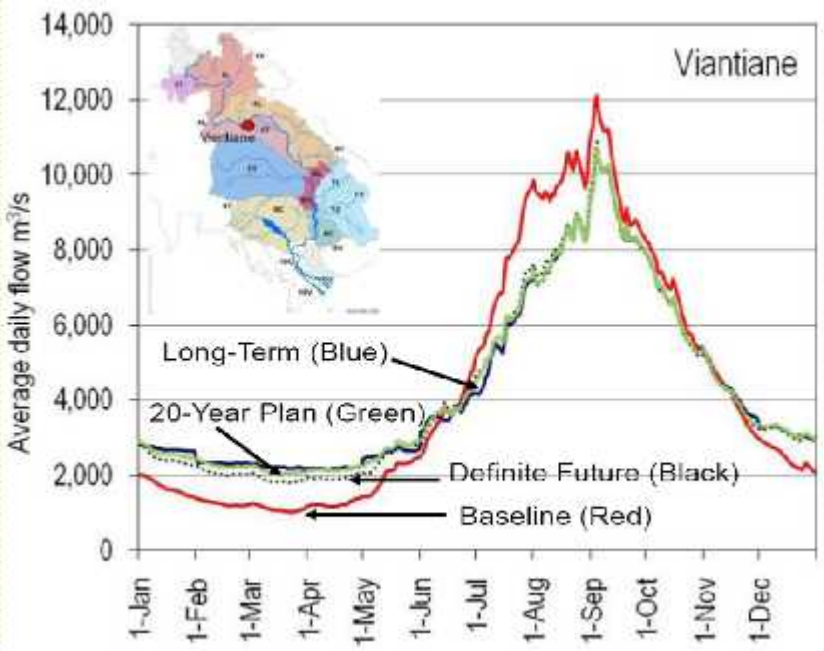
Environmental Impacts

- Change in hydrological regime
- Loss of sediment/nutrients
- Erosion of embankments
- Water quality in reservoirs behind dams
- Reduction of Wetlands
- Block fish migration routes
- Ecosystem changes

Figure 1.5a Mean Annual Sediment Load Pre and Post dam period (left), Figure 1.5b Observed Sediment Impacts from Manwan Dam (Right)

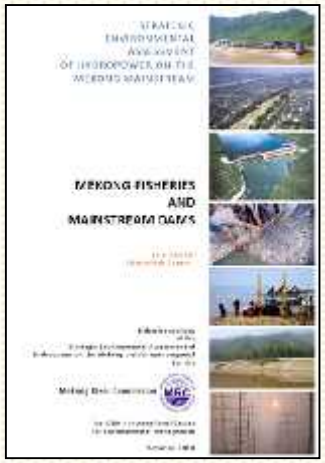


Source: Taken from (Lu X.X and R.Y. Siew 2006) and (Mekong River Commission 2010)

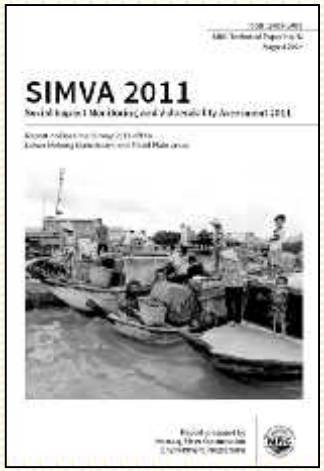


Social Impacts

- 30 million people live in LMB corridor
- Hydropower development will pose threats to:
  - food security (loss of main source of protein for Cambodia)
  - livelihoods and well-being of millions of rural poor
  - sustainability of ecosystem services and natural resources



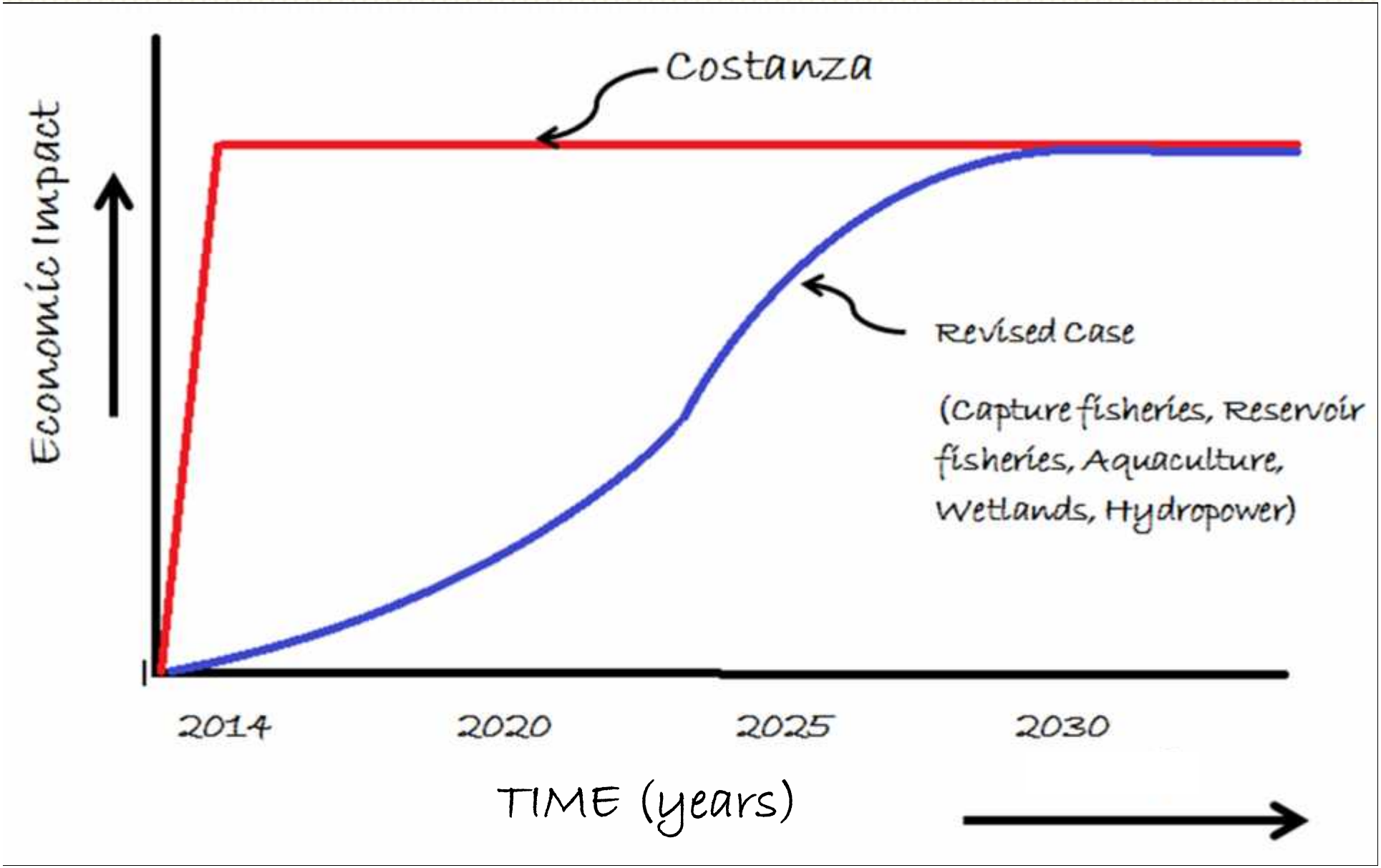
Zone	Total	Number		Percentage	
		Urban	Rural	Urban	Rural
Zone 2	1,327,300	330,893	996,407	24.9%	75.1%
Zone 3	4,557,311	1,044,662	3,512,649	22.9%	77.1%
Zone 4	7,372,095	1,274,782	6,097,313	17.3%	82.7%
Zone 5	3,843,302	285,191	3,558,111	7.4%	92.6%
Zone 6	16,679,923	1,982,318	14,697,605	11.9%	88.1%
Total	33,779,931	4,917,846	28,862,085	14.6%	85.4%



Changes from Costanza report

- Wetlands value based on LMB studies
- Economic impacts phased over 15 years
- Social/cultural impact cost added
- Sediment/nutrients loss added
- Hydropower benefit split 30% host country and 70% for country funding project and importing electricity
- Fish price based on recent market data
- Other values (including total hydropower NPV, same as BDP2 and Costanza report

Phasing of Economic Impacts

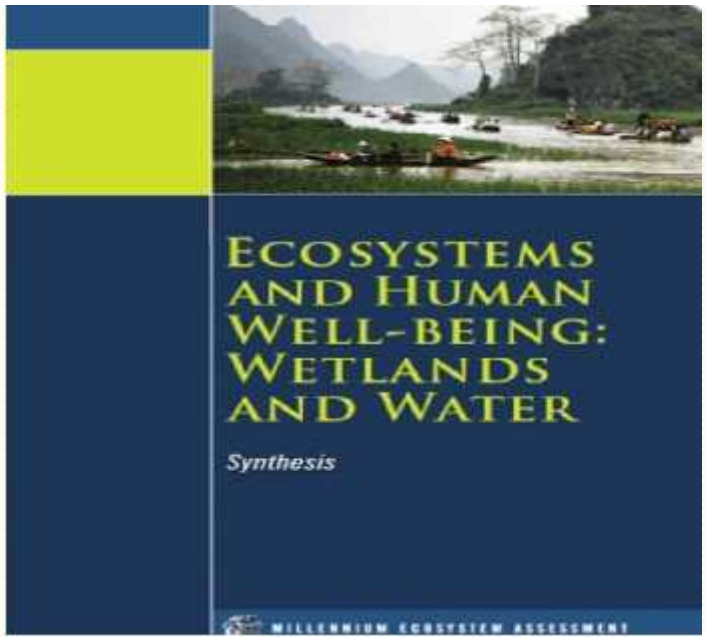


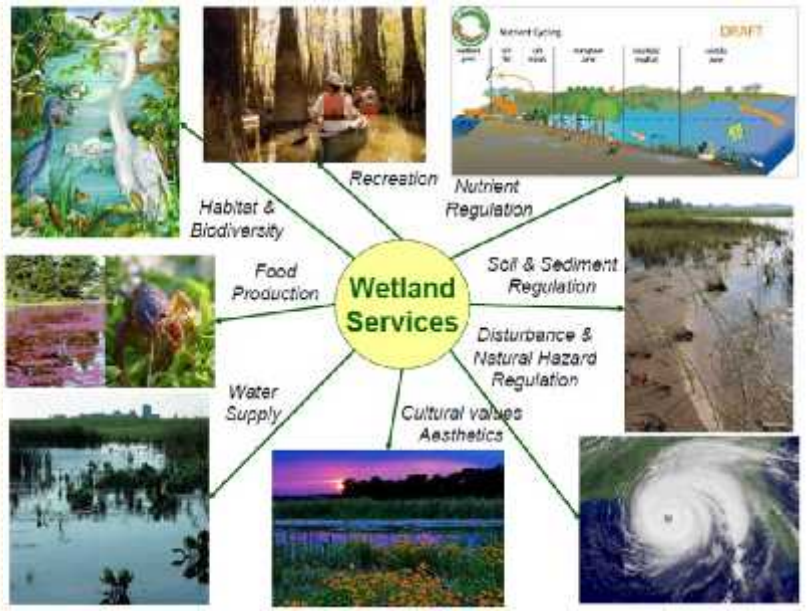
Key Parameters and Assumptions

- Discount Rate for natural resources
- Capture fisheries loss for 6 dams and 11 dams
- Reservoir fisheries - increase with reservoir capacity
- Aquaculture - increase in production to mitigate loss of capture fisheries
- Wetlands - value based on LMB studies
- Hydropower - capacity, investment and NPV
  - cost / benefit allocation
- Others – assumed same as BDP2 and Costanza report

Wetlands

- Full cost accounting for Ecosystem Services not applied in BDP2
- Costanza estimate of $3,000/ha/year based on Mississippi study
- Global estimate of $ 26,000/ha/year for ecosystem services of inland wetlands (de Groot 2012).
- Mekong Region estimate of $ 12,600/ha/year (USAID 2015)
- Value of wetlands needs to be significantly increased





Net Present Value

- Net Present Value (NPV) of a project is the sum of all future project discounted cash flows (investment, revenues, costs, loans) over project evaluation period.

- Future cash flows are converted to a base time (usually today) by discount factors related to interest rates. A 10% discount rate is typically used for project evaluations. If project NPV(10) is positive, then project is considered viable; if project NPV(10) is negative, then it is not viable.
- MFU study follows the methodology in the Costanza report and used a 3% discount factor for natural resources. To be consistent with BDP2 and the Costanza report, NPVs were calculated without inflation.

Summary of NPV Calculations for 11 dams

	BDP2 NPV ($ millions)	Costanza NPV ($ millions)	Revised Case NPV ($ millions)
Hydropower	32,800	32,800	32,800
Reservoir fisheries	200	26,100	4,300
Aquaculture	1,300	4,000	800
Capture fisheries	-1,900	-133,600	-54,900
Wetlands	100	3,500	1,100
Social/Cultural	0	0	-1,500
Sediment/Nutrient	0	0	-5,400
Others	900	900	900
Total	33,400	-66,300	-21,800

Country split for 11 dams scenario - NPV ($ millions)

	BDP2	Costanza	MFU Revised Case
Lao PDR	22,600	20,400	3,400
Thailand	4,500	-39,100	11,000
Cambodia	2,600	-33,700	-26,400
Vietnam	3,700	-13,900	-9,800
Total	33,400	-66,300	-21,800

Thailand is main beneficiary in MFU Revised Case
Huge negative impacts for Cambodia and Vietnam

MRC Basin Development Plan 2

MAIN CONCLUSIONS

- Huge hydropower benefit (NPV $ 50 billion)
- Positive economic impact for all LMB countries
- 25% reduction of capture fisheries
- 4 million people exposed to livelihood risk

BUT MAIN CONCLUSIONS BASED ON FLAWED DATA

- Loss of capture fisheries understated
- Hydropower benefit overstated
- Impact on wetlands understated
- Social impact cost not included in economics
- Loss of sediment/nutrients not included in economics

BPD2 Hydropower Evaluation

- TWO KEY ASSUMPTIONS ARE NOT REALISTIC
  - **Host country is Owner of hydropower projects and will receive all revenues and profit**
  - **BDP2 economic model (electricity trading) not used in existing/planned hydropower projects**
- BPD2 DATA INCONSISTENT WITH TECHNICAL NOTES
  - **Profitability numbers unrealistic (Xayaburi IRR of 80% reported but 10-15% more likely)**
  - **Capital investment data too low (Xayaburi capital of $ 1.9 billion but latest capital is $ 3.8 billion)**

Xayaburi Hydropower Electric Project

Construction of 820m barrage across the Mekong river will create river pondage upstream of the barrage with total length of 60 km and surface water area of 49 km2 at normal operating water level of 275 MSL.

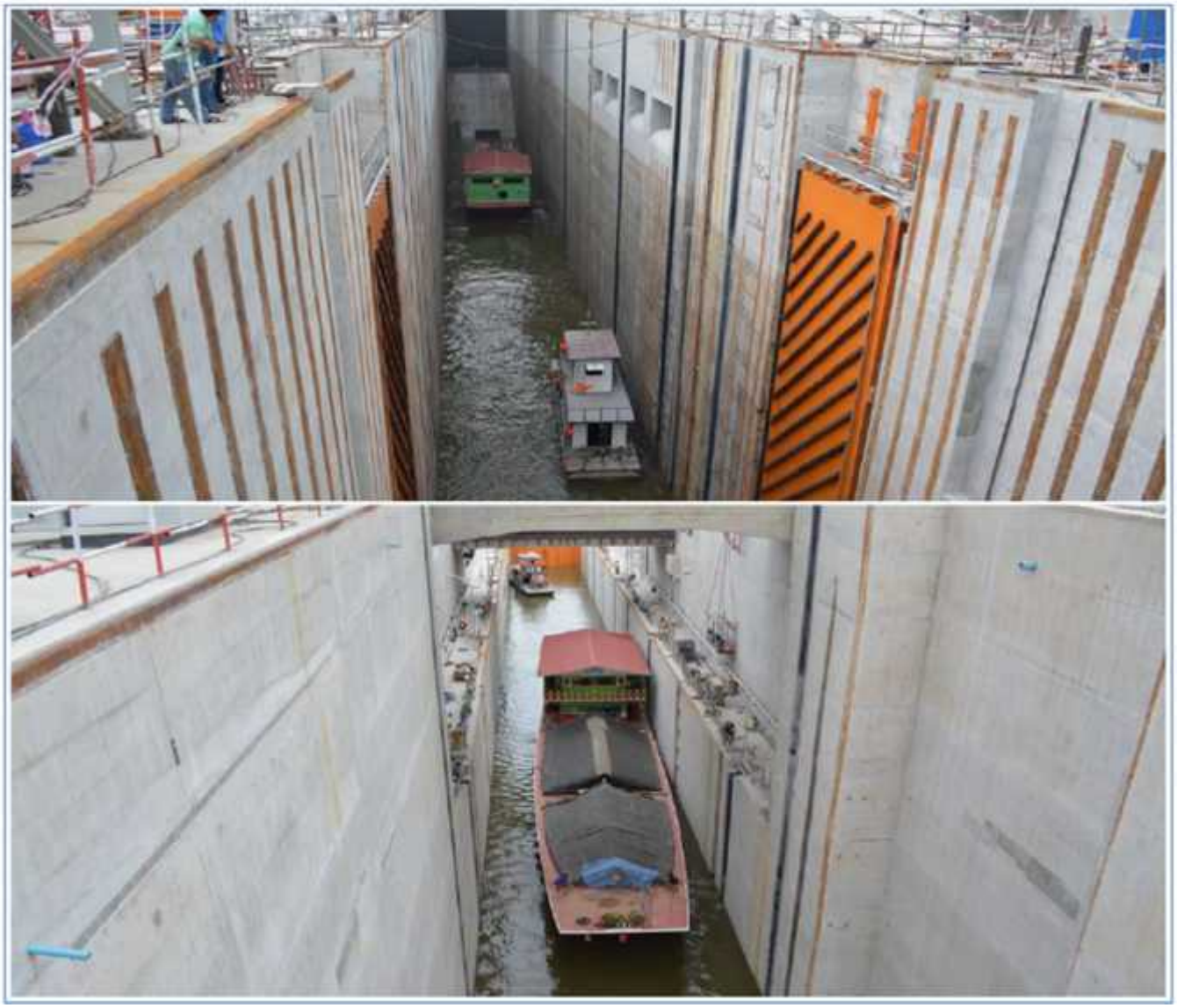
Xayaburi Dam Construction Progress

Overview of Main Dam Construction Progress
(11,719 workers)

Environmental & Social Xayaburi Dam

Ongoing concrete work at the fish ladder early 2016

Navigation Locks Operation, Xayaburi Hydropower Dam, May 2016



Conclusions

- Costanza report approach validated
- Capture fisheries loss is larger than hydro benefit
- Costs and benefits are not distributed equitably; huge negative impact on Cambodia and Vietnam
- Social/cultural costs not accounted for in BDP2
- Sediment costs not accounted for in BDP2
- Capture fisheries loss understated and hydropower benefit overstated in BDP2
- No electricity supply risk if no mainstream dams
- How do we include social and environmental mitigation costs in economic valuation of the mainstream dams?
- How do we stop the construction??

Options for Thailand

Reduce Power Demand

- Improve energy efficiency and operations
- Promote incentives for energy savings
- National program can reduce energy demand by 30%

Promote Development of Renewable Energy Options

- Shift to renewable solar farms, wind, biogas, geothermal, and biomass energy sources
- Future is overwhelmingly positive and economically viable