The Study on Sustainable Management and Development of the Mekong River, including Impacts by Mainstream Hydropower Projects (Council Study)

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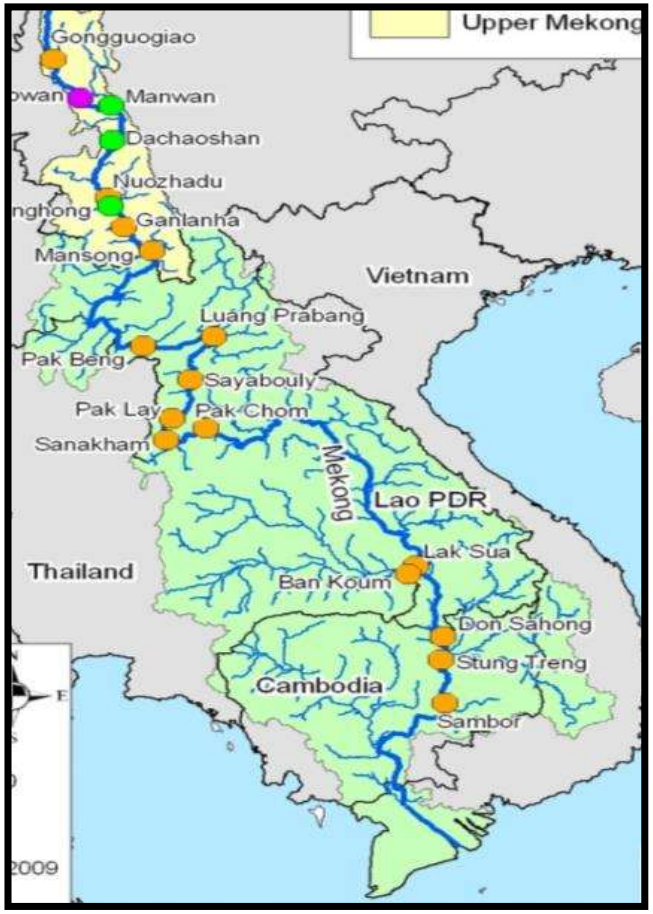
Outlines of Presentation

1. Background
2. Impact assessment approach
3. Key Results
4. Key messages

Background (1)

- **Nov 2011**: Four Prime Ministers at the 3rd Mekong-Japan Summit in Bali initiated the Council Study.
- **Dec 2011:** MRC Council Meeting agreed to implement the study.
- **At the same time**, Viet Nam government also initiated the Delta Study focusing on the impacts of Mekong mainstream dams on the Mekong Delta.

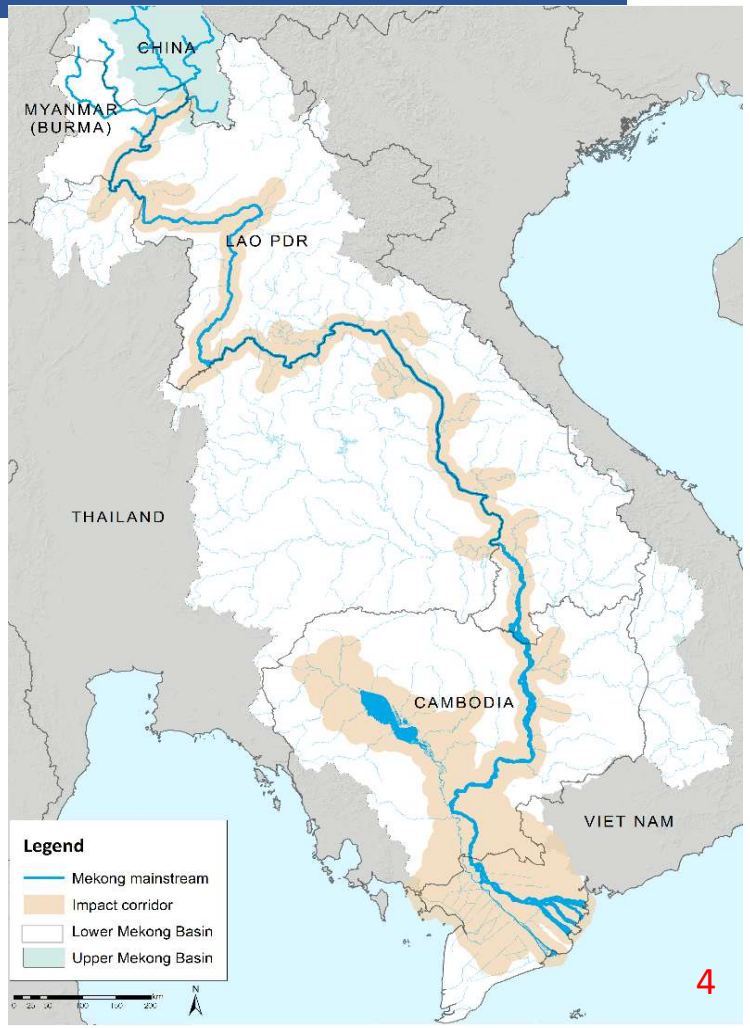


Background (2)

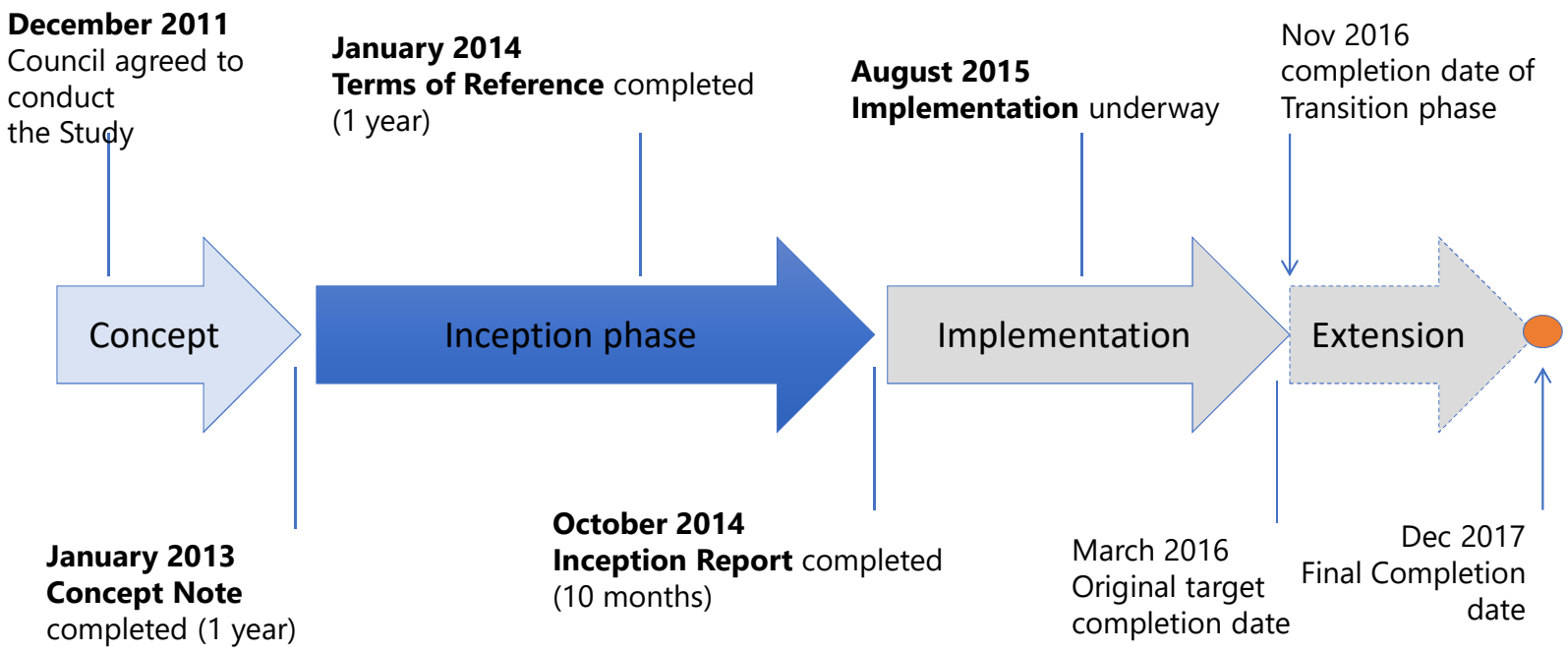
Key Objectives:

- Study positive and negative environmental, social, and economic impacts of water resources development
- Integrate results into the MRC knowledge base to enhance the Basin Development Planning process
- Promote capacity and ensure technology transfer to Member Countries

Scopes: The study asses both positive and negative impacts of different water development scenarios on the Lower Mekong Basin, focusing on **15 km corridor** on both sides of the Mekong mainstream, Tonle Sap area and Mekong delta.



Overall Process & Timeline



Planing (2012 – 2015 or est. 2.5 years)

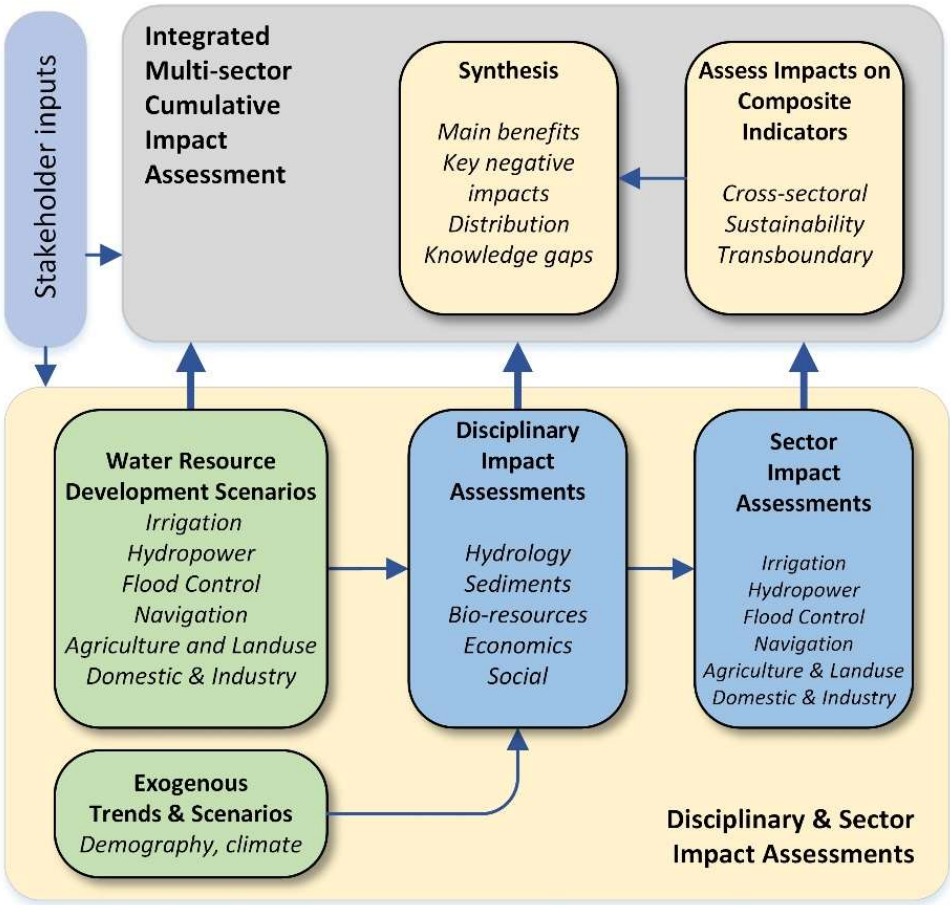
Implementation (2015 – 2017 or est. 2.5 years)

- **Total budget: 4.6 million USD** (not including in-kind contribution from MRCS and MCs
- **Donors:** Australia, Finland, Germany, Luxemburg, Switzerland, USA...

Impact Assessment Approach

Steps:

- Define the scope and scenarios
- Data collection
- Impact assessment
- Consultation
- Reporting



Main Development Scenarios

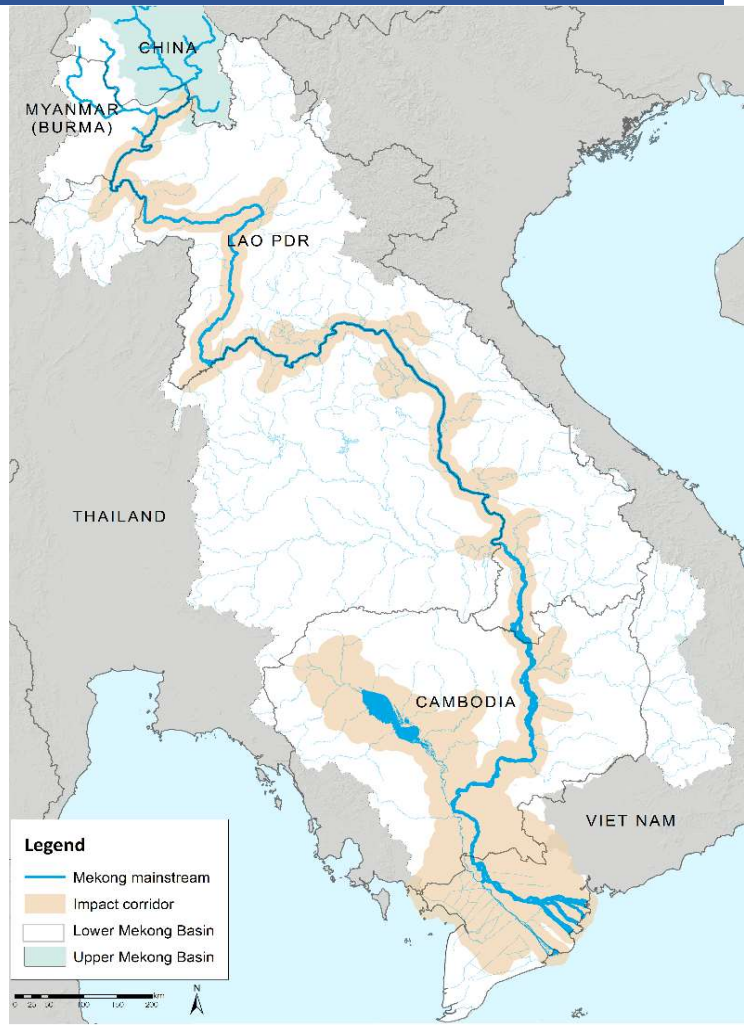
	Scenario	Level of Development for water-related sectors						Climate
		ALU	DIW	FPF	HPP	IRR	NAV	
M1	Early Development Scenario 2007 (Base Sc.)	2007	2007	2007	2007	2007	2007	1985-2008
M2	Definite Future Scenario 2020	2020	2020	2020	2020	2020	2020	1985-2008
M3	Planned Development Scenario 2040	2040	2040	2040	2040	2040	2040	1985-2008
M3 CC	Planned Development Scenario 2040	2040	2040	2040	2040	2040	2040	More seasonal

Sub-scenarios: Hydropower development

	Scenario	Level of Development for water-related sectors						Climate
		ALU	DIW	FPF	HPP	IRR	NAV	
M3 CC	Planned Development Scenario 2040	2040	2040	2040	2040	2040	2040	More seasonal
H1 a	**Planned Development 2040 without HPP**	2040	2040	2040	**2007**	2040	2040	More seasonal
H1 b	Planned Development 2040 **(Chinese and tributary dam and No Mainstream dam)**	2040	2040	2040	**HPS1**	2040	2040	More seasonal
H3	Planned Development 2040 with HPS3	2040	2040	2040	**HPS3**	2040	2040	More seasonal

Data Requirement and Scope of Assessment

- Data and information used for Council study
  - Types of data: All types of spatial, non-spatial and time series data
  - Period requirement: 1985-2008
  - Plan development Level: 2007, 2020 and 2040
- Scope of Impact Assessment
  - Cumulative Impact Assessment (+/- CC)
  - Main development scenarios (2007, 2020 and 2040) for all Sectors
  - 2040 Sub-development scenarios
    - Agriculture & Land use: 2 Scen.
    - Irrigation: 2 Scen
    - Flood protection: 3 Scen.
    - Hydropower: 3 Scen.
    - Climate change: 2 Scen.
  - Costal impact assessment

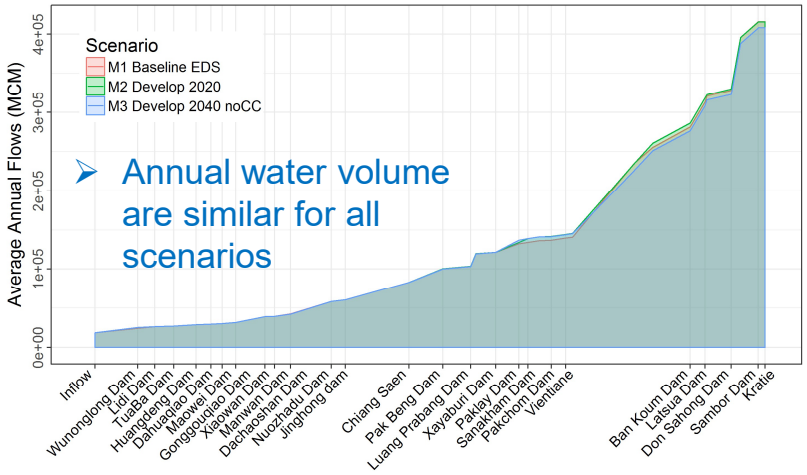


KEY RESULTS

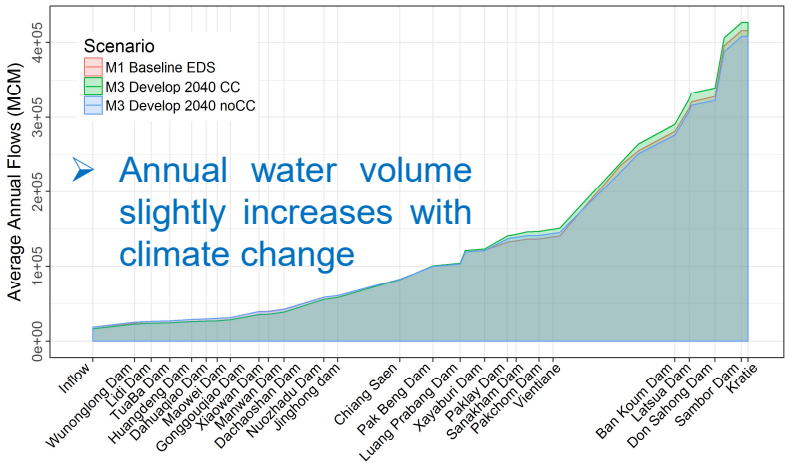
Disciplinary Impact Assesment

1. Hydrology and Sediment

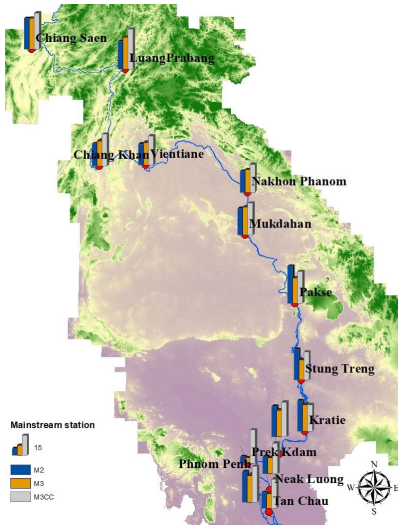
HYDROLOGY



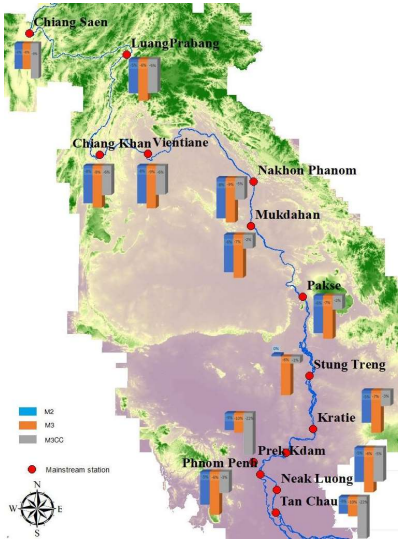
➢ Annual water volume are similar for all scenarios



➢ Annual water volume slightly increases with climate change

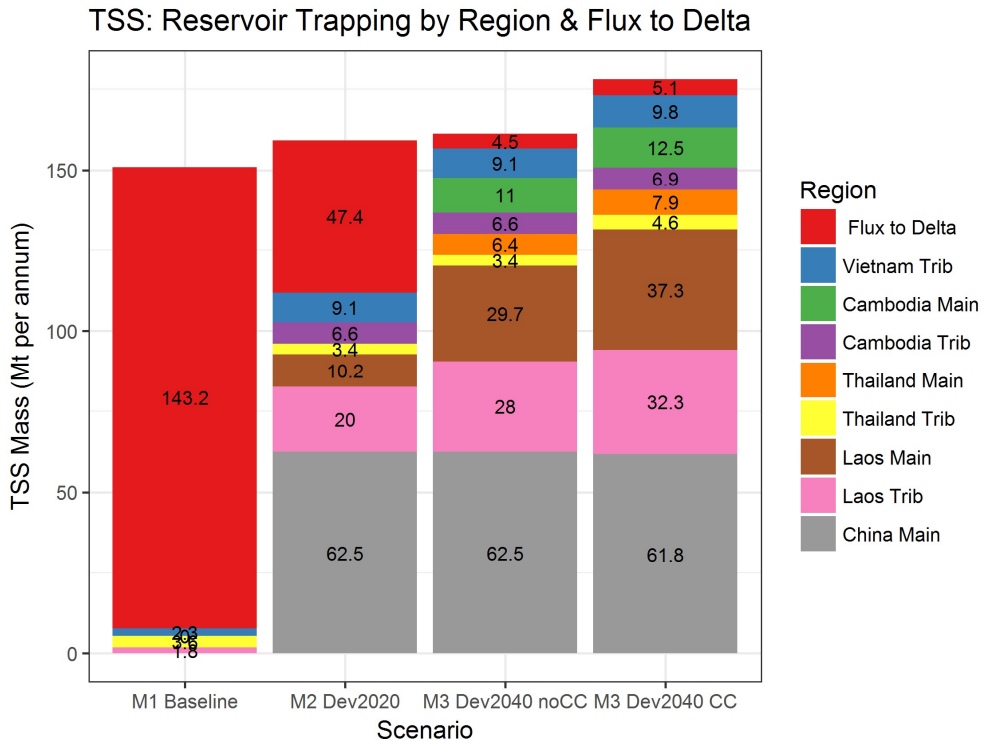


Dry season flow increases



Wet season flow decreases

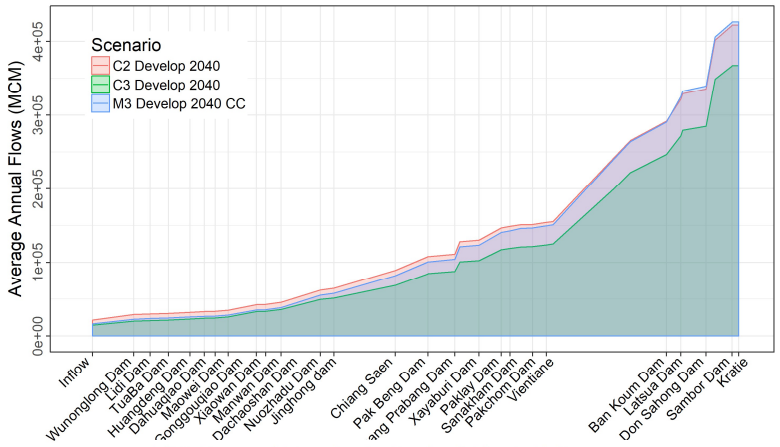
SEDIMENT

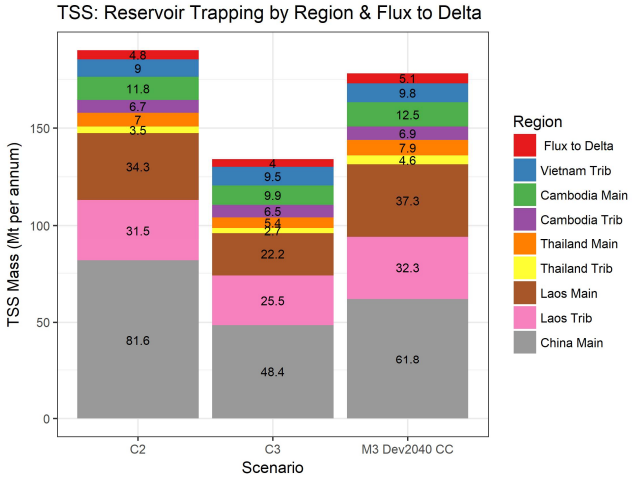


Reduction up to 97% in Mekong delta for 2040 scenario

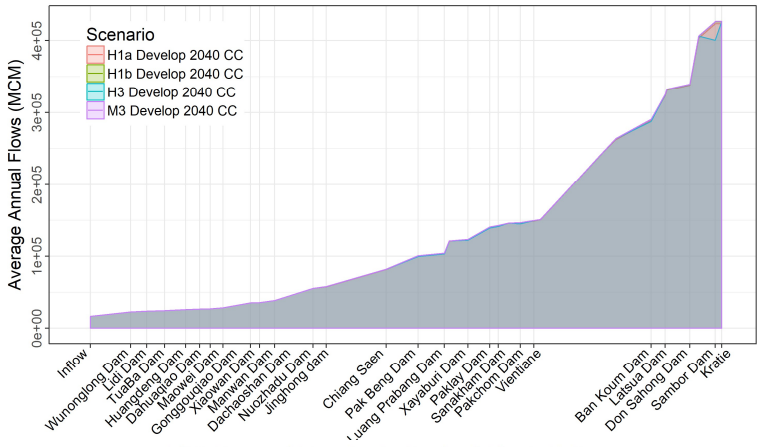
SUB-SCENARIOS

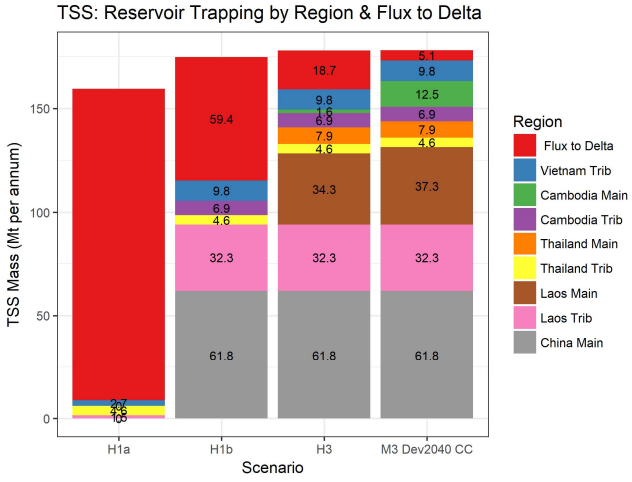
Climate Change





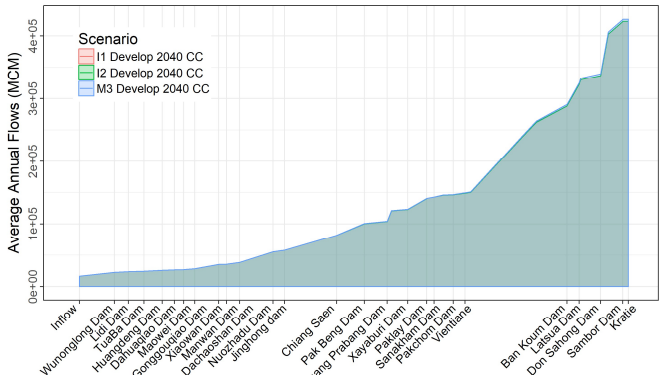
Hydropower

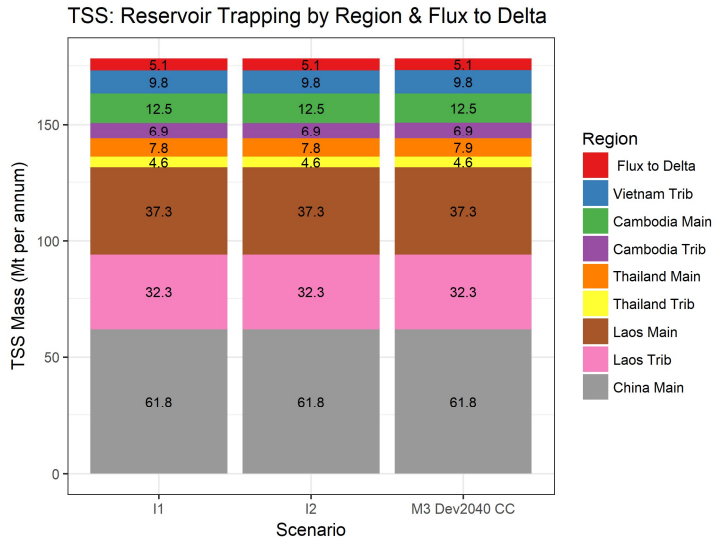




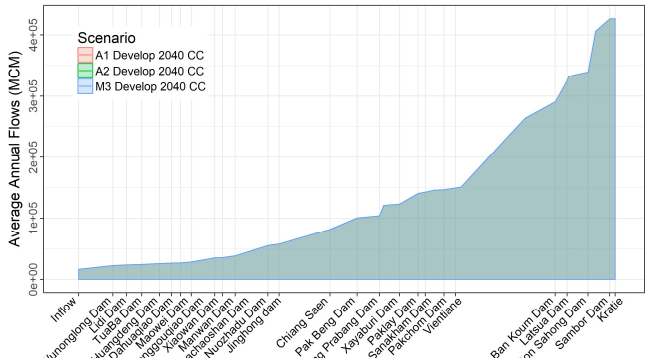
SUBSCENARIOS

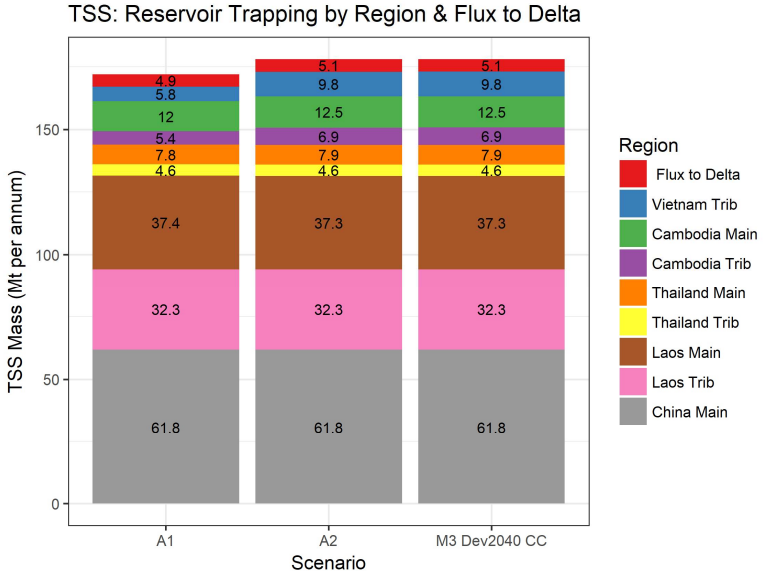
Irrigation





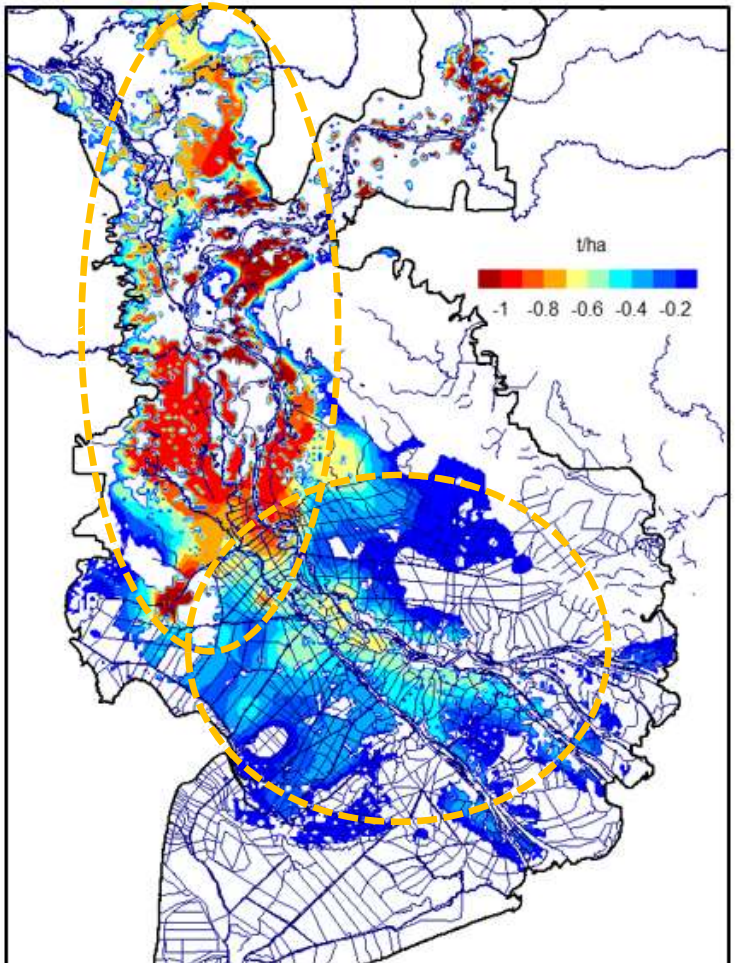
Land Use Change





IMPACT ON IRRIGATED RICE (1)

Sediment impact on irrigated rice production

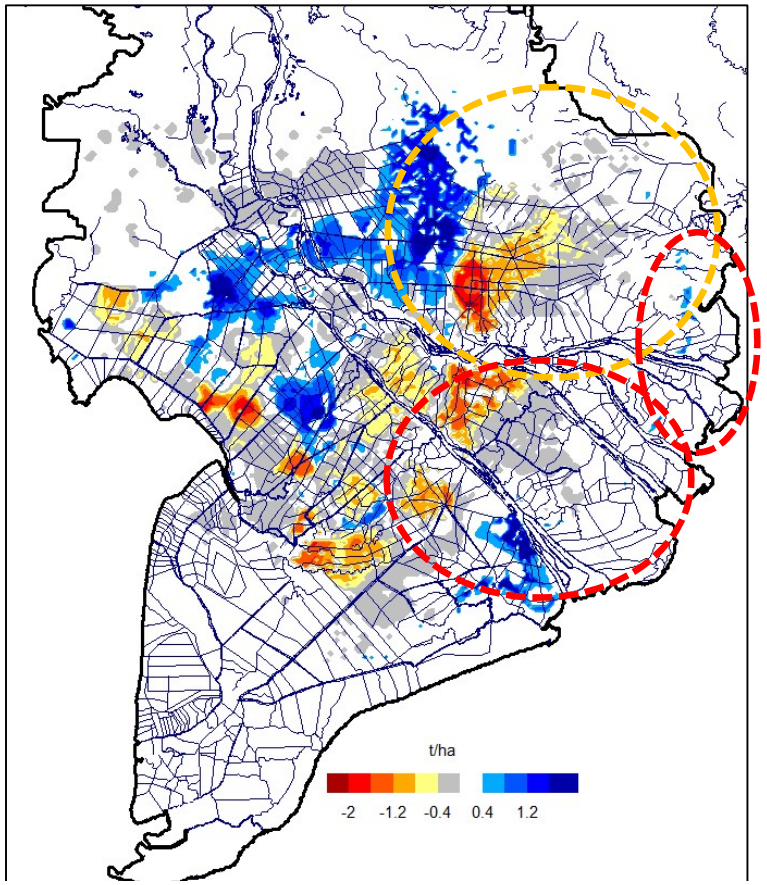


Decrease of rice production in scenario M3.
(No flooding impact included)

- ***Near*** the Mekong ***mainstream*** where sediment loads and sedimentation are largest, **crop yields are decreased about 0.6-1 t/ha** (compared to baseline)**.**
- Further ***out from the mainstream*** crop yield **decrease is 0.0-0.5 t/ha.**

IMPACT ON IRRIGATED RICE (2)

Future development impact on irrigated rice production



Irrigated rice production change in M3 scenario

- Due to **increased dry season flow** and **decreased salinity intrusion**, there is **small increase in dry season rice** production in number of areas (0.0-0.2 t/ha).
- However, some areas experience **decrease of production (0.0-2.4 t/ha)** because of the **complexity of flow and in 2040 sea level rise.**

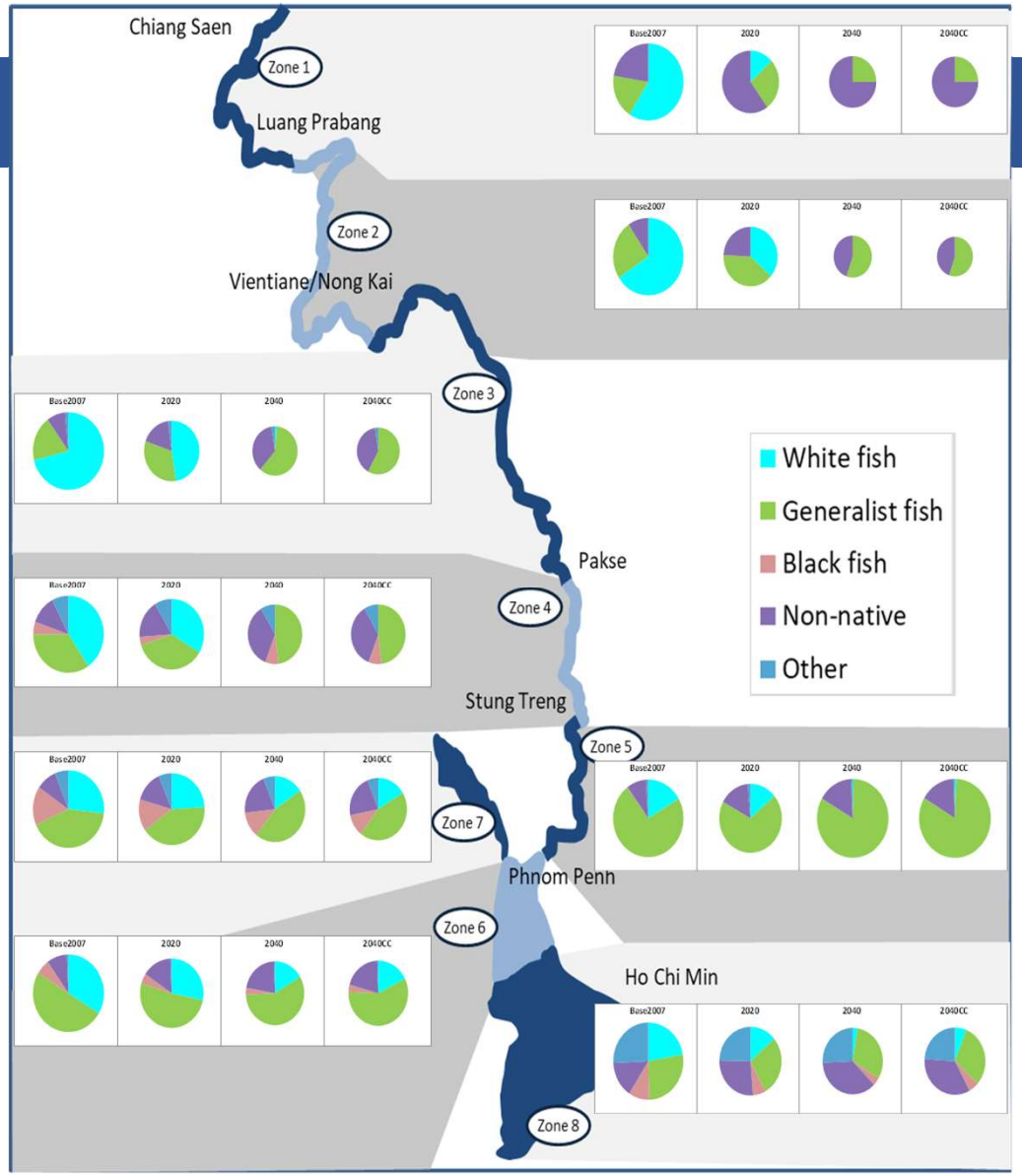
KEY RESULTS

Disciplinary Impact Assesment

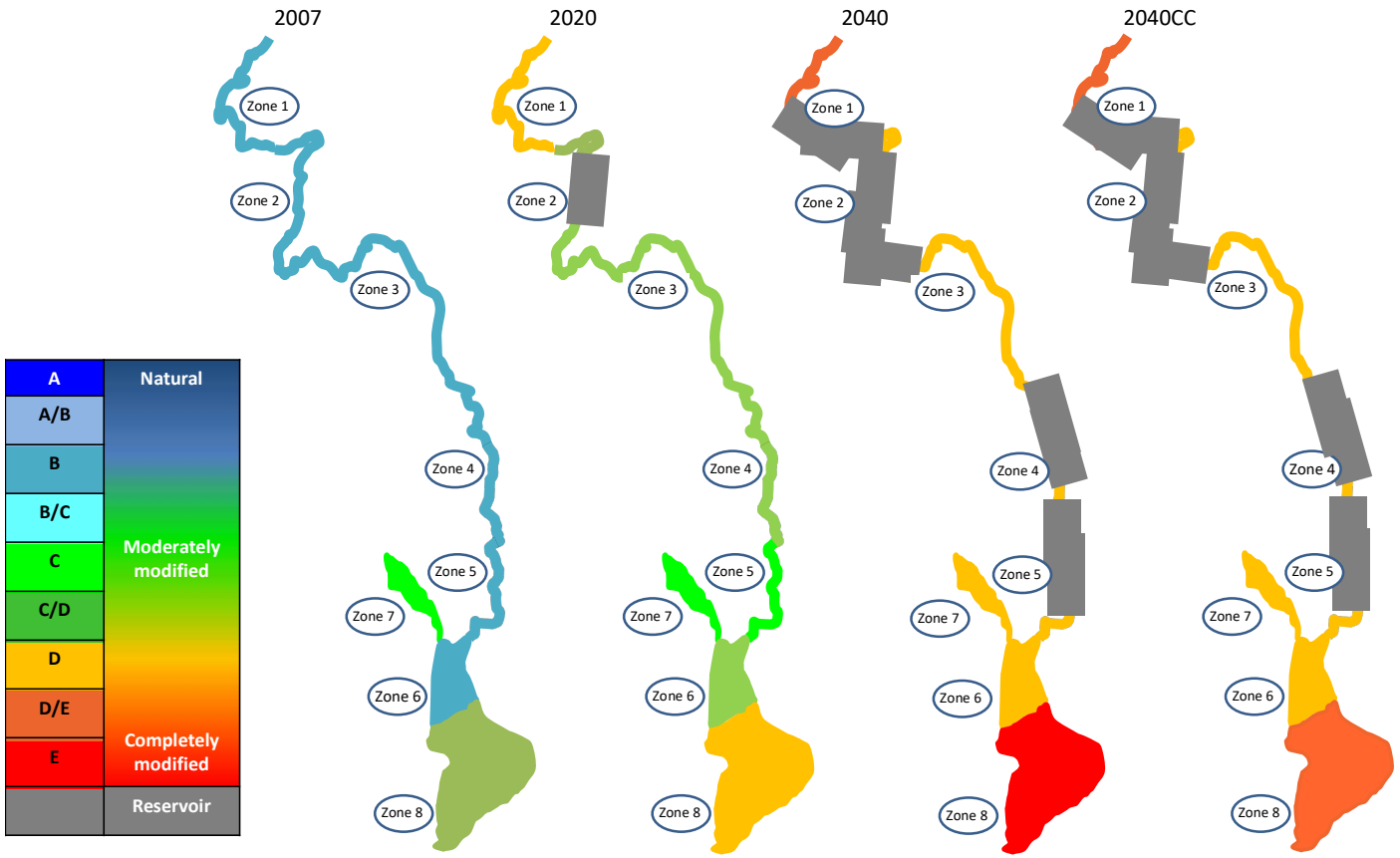
2. Ecosystem and Bioresources

Fisheries

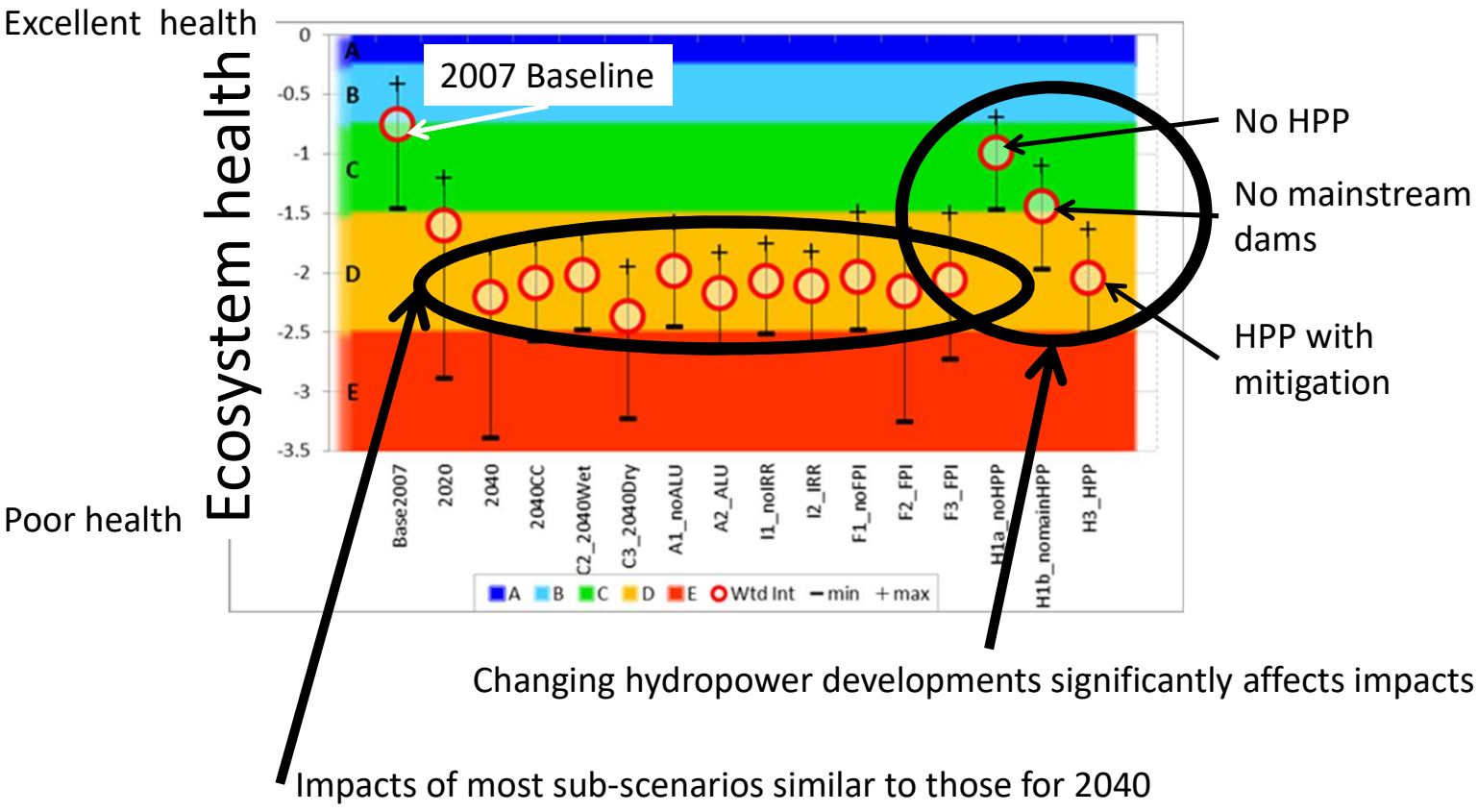
FISHERIES
Fish biomass drops
White fish lost
Alien fish dominate



Overall ecosystem condition



Ecosystem Health vs sub-scenarios



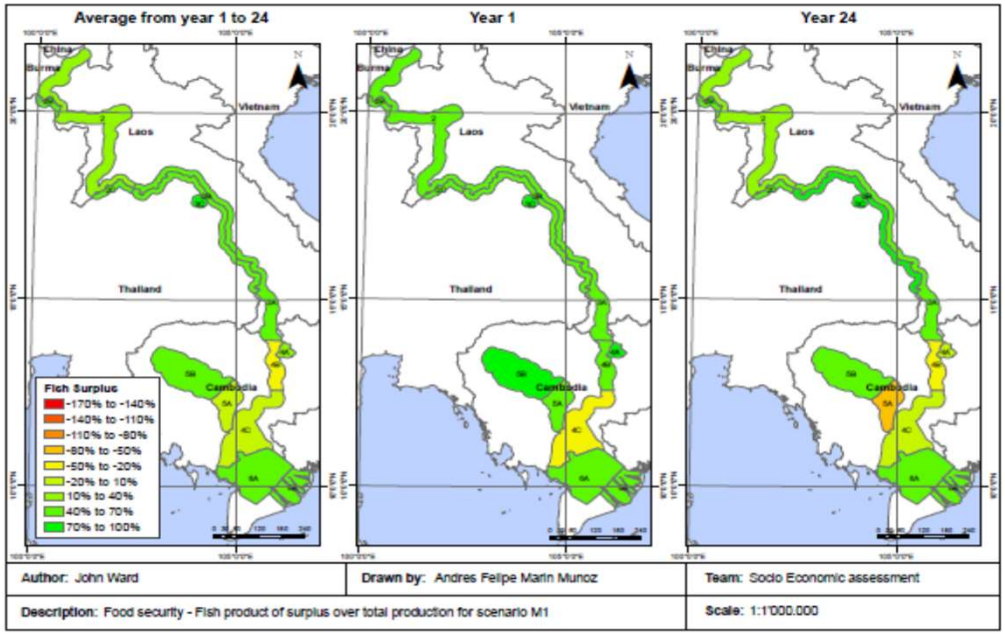
KEY RESULTS

Disciplinary impact assessment

3. Socio-economic Impact Assessment

- Food security
- Food surplus
- Undernourishment
- Income security
- Employment
- Poverty

Agricultural productivity and surpluses



M1 year 24: fish surplus reduced due to population growth

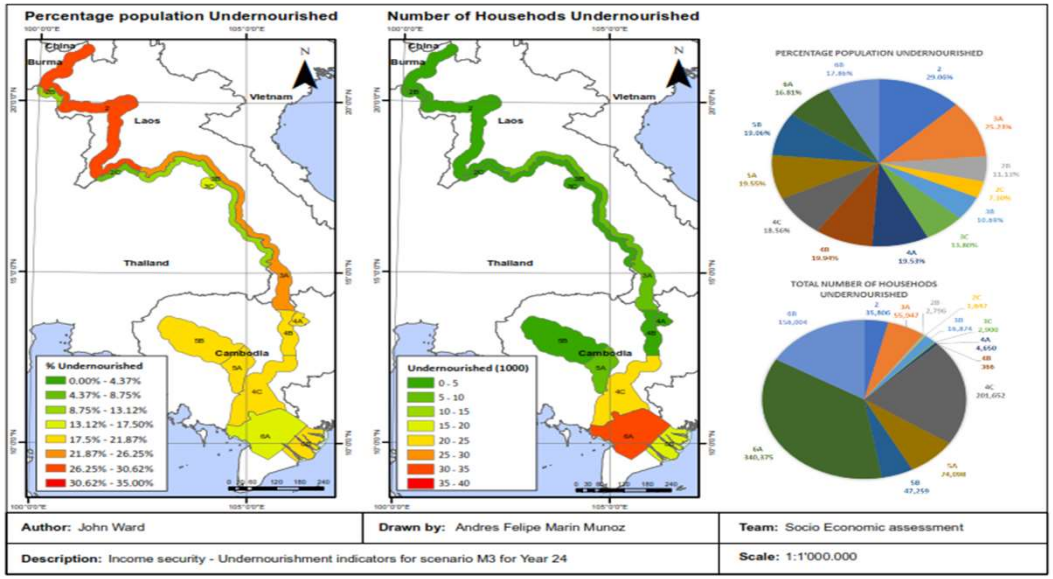
M2 year 24: fish surplus reduced mainly in Lao PDR and Cambodia due to impoundments –32% (cf M1)

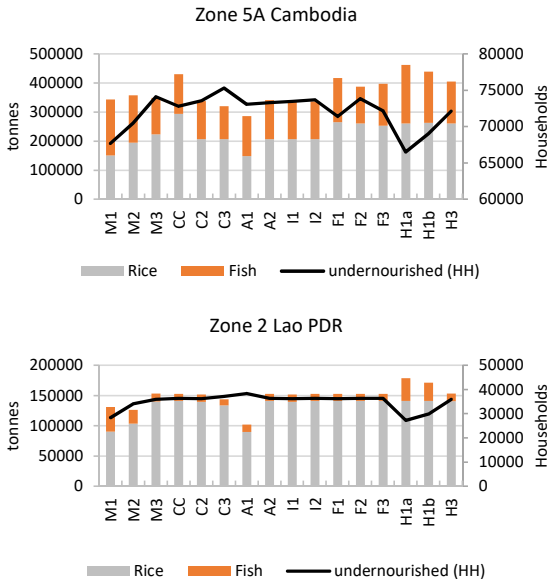
M3: -43%

M3CC: -40%

- Food surpluses in the corridor zone are a measure of capacity to respond to food shortfalls
- Nutrition security levels were held constant for all scenarios (100% of population are food/nutrition secure)
- In all scenarios there is a fish and rice surplus at whole of basin level but with regional shortfalls. Dependent on distribution systems and household capacity to purchase fish.

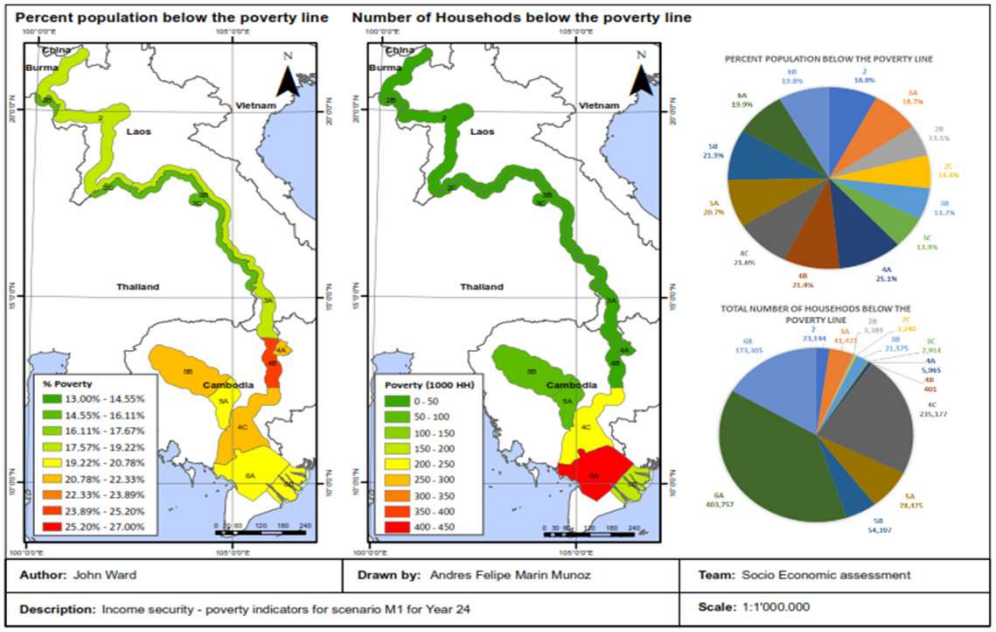
Under nourishment





- M1 → M2, M3 and M3CC: increasing rice + decreasing fish = increasing undernourishment, mainly affecting households in Lao PDR and Cambodia.
- A1 sub-scenario: less rice: ↓ 12,500 tonnes rice ~1000 additional households undernourished
- H1a sub-scenario: more fish: ↑ 3,800 tonnes fish ~1000 less households undernourished

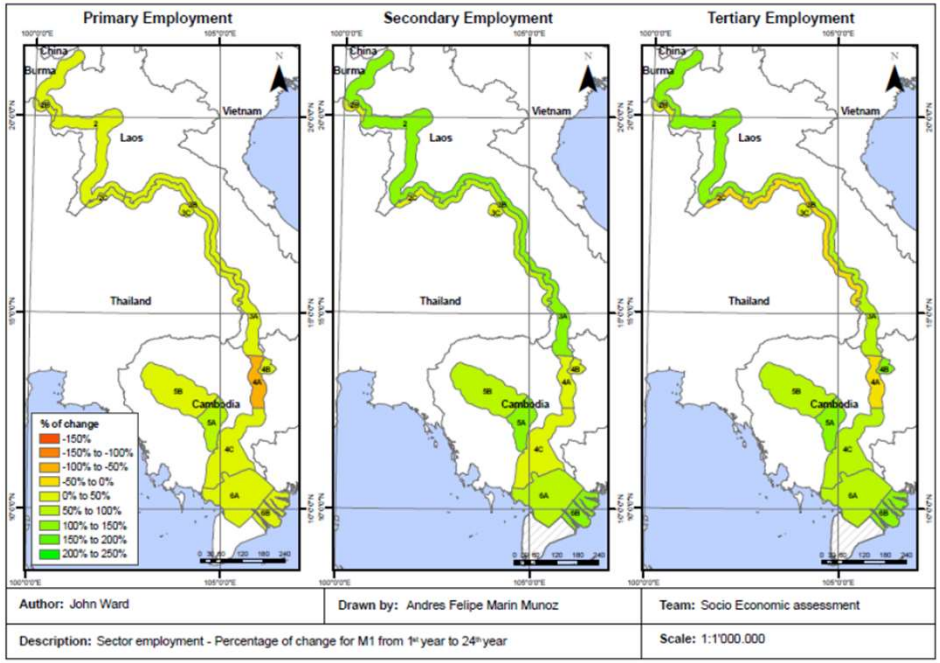
Poverty levels



	Percent population below the poverty line.				
	M1 yr1	M1 24	M2	M3	M3CC
Zone 2-Lao	21.7%	18.8%	19.1%	20.6%	20.6%
Zone 3 A-Lao	21.2%	18.7%	19.7%	22.4%	22.0%
Zone 2 B-Thailand	13.6%	13.5%	13.6%	13.8%	13.6%
Zone 2 C-Thailand	14.5%	14.4%	14.8%	15.0%	15.0%
Zone 3 B Thailand	14.2%	13.7%	14.3%	14.5%	14.4%
Zone 3 C Thailand	14.1%	13.9%	13.8%	13.8%	13.6%
Zone 4 A Cambodia	24.0%	25.1%	25.9%	24.7%	23.1%
Zone 4 B Cambodia	25.2%	21.9%	23.7%	23.8%	22.5%
Zone 4 C Cambodia	23.5%	21.6%	21.9%	23.2%	23.9%
Zone 5 A Cambodia	23.5%	20.7%	20.9%	21.1%	21.5%
Zone 5 B Cambodia	23.0%	21.9%	21.9%	21.9%	22.1%
Zone 6 A VietNam	19.4%	19.9%	20.0%	20.0%	20.0%
Zone 6 B VietNam	19.0%	19.8%	19.9%	19.9%	19.7%

- Poverty estimated as HHs less than median income,. matched to national poverty lines
  (reported as total number of HHs and % change across scenarios)
- M1: (year 24) tends to have lowest levels of poverty (small % change in zone 3c).
- M3: highest levels in Lao PDR, Thailand and Vietnam: Cambodian zones vary across M2, M3 and M3CC

Sector employment



M1 year 24: primary sector decreases, secondary and tertiary increase

M2, M3 and M3CC year 24: primary sector increases, secondary and tertiary decrease

- At current rates of productivity: labour constraints mean either agricultural expansion **OR** increases in secondary and service sectors: **not both**
- Agricultural expansion: >10-20% increases in productivity (Lao PDR and Cambodia) are estimated to meet both primary and secondary sector labour demands
- **OR migration patterns within and outside zones need to be accounted for**

Sector incomes

	M1 (year1)-M1 (year 24)		M1-M2		M1-M3		M2-M3	
	Primary	M'facturing & Service	Primary	M'facturing & Service	Primary	M'facturing & Service	Primary	M'facturing & Service
Lao PDR	-2%	109%	18%	-8%	69%	-30%	44%	-24%
Thailand	-5%	14%	25%	-16%	40%	-25%	12%	-11%
Cambodia	-15%	101%	7%	-3%	34%	-16%	25%	-13%
Vietnam	-5%	82%	-1%	1%	-4%	3%	-2%	2%
Total Income	-6%	81%	1%	-2%	4%	-9%	3%	-6%
Total income change (US$)	-$1.48	+$7.9 B	+$0.19 B	-$0.44 B	+$0.88 B	-$1.5 B		
Total income change (US$)	**↑ +$6.4 B**		**↓ -$0.25 B**		**↓ -$0.63 B**		**↓ -$ 0.38 B**	

M1 year 24: primary sector incomes tends to decrease, secondary and tertiary increase

M2, M3 and M3CC year 24: primary sector tends to increase, secondary and tertiary decrease

KEY RESULTS

Disciplinary impact assessment

4. Macro-economic Impact Assessment

- Sector-specific cost-benefit assessment
- GDP impacts
- Future growth potential

Sector-specific cost-benefit analysis

1. **16-fold increase in economic benefits of in hydropower (2040 scenario)**
2. **Hydropower benefits partly lost in fisheries (2020 scenario: 26% , 2040 sc.:15%)**

Differences to M1		Hydropower	Fisheries	Agriculture	Navigation	SUM
		B$	B$	B$	B$	
M2	Cambodia	+6.6	-4.7	+65.3	+1.3	68.4
	Lao PDR	+20.1	-3.7	+3.2	+0.1	19.7
	Thailand	+29.5	-6.4	+2.2	+0.4	25.8
	Vietnam	+9.2	-1.7	+21.0	+8.2	36.6
M3	Cambodia	+11.3	-6.3	+67.3	+8.5	80.8
	Lao PDR	+35.0	-5.0	+5.8	+1.9	37.7
	Thailand	+82.0	-8.2	+4.1	+2.9	80.8
	Vietnam	+24.9	-3.2	+26.3	+55.5	103.6

3. **Agricultural expansion could provide large sector benefits**
4. **Navigation expansion very promising**

Gross Domestic Product for 2040

GDP in billion US$ (deflated to 2017 dollar)		M1 (2007)	M2 (2020)	M3 (2040)	M3CC (2040)	A1 (2007)	A2 (2020)	C2 (Wet)	C3 (Dry)	H1a (noHPP)	H1b (noMain)	H3 (HPP)
Cambodia	Upper bound	$50.3	$45.6	$46.6	$47.7	$50.6	$46.8	$46.4	$46.3	$48.5	$47.6	$47.5
	Average	$48.3	$41.8	$39.6	$38.5	**$48.0**	$40.8	$40.7	$40.8	$40.2	$39.6	$39.5
	Lower bound	$46.2	$38.0	$32.6	$29.3	$45.5	$34.9	$35.0	$35.4	$31.8	$31.5	$31.5
Lao PDR	Upper bound	$42.0	$40.4	$40.0	$39.7	$39.1	$40.0	$39.7	$39.9	**$43.4**	$41.6	$39.8
	Average	$39.2	$35.1	$30.2	$30.3	**$36.3**	$30.2	$30.6	$30.7	$32.5	$30.9	$30.4
	Lower bound	$36.3	$29.8	$20.5	$21.0	$33.5	$20.5	$21.6	$21.6	$21.6	$20.3	$21.0
Thailand	Upper bound	$98.0	$101.5	$98.3	$98.1	$97.8	$98.4	$98.1	$98.3	**$103.9**	$102.6	$97.9
	Average	$79.8	$73.7	$68.9	$70.4	**$78.2**	$69.0	$71.2	$70.9	$73.2	$72.1	$70.3
	Lower bound	$61.5	$45.9	$39.5	$42.7	$58.6	$39.7	$44.3	$43.6	$42.5	$41.5	$42.8
Vietnam	Upper bound	$92.3	$93.6	$92.9	$92.9	$93.3	$92.8	$92.4	$92.5	**$94.3**	$93.6	$93.0
	Average	$82.3	$82.7	$82.5	$81.3	**$84.4**	$84.1	$83.8	$83.9	$83.9	$84.0	$82.1
	Lower bound	$72.2	$71.7	$72.0	$69.7	$75.6	$75.4	$75.1	$75.3	$73.5	$74.4	$71.3
LMB	Upper bound	$282.6	$281.1	$277.8	$278.4	$280.8	$277.9	$276.5	$276.9	**$290.2**	$285.5	$278.1
	Average	$249.5	$233.2	$221.2	$220.6	**$247.0**	$224.2	$226.3	$226.4	$229.8	$226.6	$222.3
	Lower bound	$216.3	$185.3	$164.6	$162.8	$213.1	$170.4	$176.0	$175.8	$169.4	$167.7	$166.6

Changes of Natural Capital

- **NPV 24 years - Difference to M1**

Comparing with M1	Effects for M2 in B$			Effects for M3 in B$		
in billion US$	MIN	Mean	MAX	MIN	Mean	MAX
Cambodia (without reforestation Plan	-$18	-$28	-$39	-$47	-$83	-$120
Cambodia (with reforestation Plan)	-$12	-$28	-$45	+$41	+$80	+$119
Lao PDR	-$11	-$12	-$15	-$13	-$14	-$15
Thailand	-$9	-$5	-$2	-$12	-$6	-$3
Vietnam	-$4	-$5	-$7	-$6	-$7	-$5

KEY RESULTS

Integrated multi-sector cumulative impact assessment

5. Cumulative Impact Assessment

- Community Resilience & Vulnerability
- Sustainability (based on SDGs)
- Trade-offs: Cross-sector and Transboundary

Community Resilience (1)

		Social	Economic	Environmental
Lao PDR ↘	Zone 2A	↓	↘	↘
	Zone 3A	↓	→	↘
	Rest of Lao	→	↗	→

		Social	Economic	Environmental
Thailand →	Zone 2B	↘	→	↘
	Zone 2C	↘	→	↘
	Zone 3B	↘	→	↘
	Zone 3C	↘	→	↘
	Rest of NE Thailand	→	↗	→

Community Resilience (2)

		Social	Economic	Environmental
Cambodia ↘	Zone 4A	↘	→	↘
	Zone 4B	↘	→	↘
	Zone 4C	↘	→	↘
	Zone 5A	↘	↘	↘
	Zone 5B	↘	↘	↘
	Rest of Cambodia	↘	→	→

		Social	Economic	Environmental
Vietnam ↘	Zone 6A	↘	↘	↘
	Zone 6B	↘	↗	↓

Sustainability (1)

- **Sustainability defined by 14 indicators (so far, based on SDG)**
- **Min/Max per country: 0/14 points; Min/Max LMB: 0/56 points**
- **Scenarios 2020 and 2040 trigger a decline in sustainability**

	Scenarios							
	M1	M2 -M1	M3 -M1	M3CC -M1	ALU1 -M3CC	ALU2 -M3CC	CC2 -M3CC	CC3 -M3CC
Cambodia	**7.62**	-1.38	-2.24	-2.27	0.31	-0.05	-0.01	-0.23
Lao PDR	**8.27**	-2.08	-2.24	-2.28	-0.07	-0.02	-0.05	-0.09
Thailand	**8.70**	-1.18	-1.47	-1.51	0.02	-0.03	-0.02	-0.27
Vietnam	**5.41**	-1.22	-1.70	-1.24	0.04	-0.38	0.04	-0.17
LMB	29.99	-5.85	-7.63	-7.30	0.30	-0.49	-0.04	-0.76

Sustainability (2)

- **Hydropower has largest impact on sustainability**
- **Mainstream dams trigger about 50% of the hydropower losses**

	Scenarios						
	M1	M2 -M1	M3 -M1	M3CC -M1	H1a -M3CC	H1b -M3CC	H3 -M3CC
Cambodia	**7.62**	-1.38	-2.24	-2.27	1.73	0.79	0.20
Lao PDR	**8.27**	-2.08	-2.24	-2.28	1.41	0.37	-0.09
Thailand	**8.70**	-1.18	-1.47	-1.51	1.12	0.58	-0.08
Vietnam	**5.41**	-1.22	-1.70	-1.24	1.18	0.52	-0.11
LMB	29.99	-5.85	-7.63	-7.30	5.44	2.27	-0.08

Transboundary and cross sector trade-offs (1)

- **Largest trade-offs hydropower related**
  - **Positive: Return on investment**
  - **Negative: Fisheries**
- **Benefit sharing more about sectors than countries**

	In B$	Hydropower benefits	Fisheries costs	National Cost-Benefit Ratio	Possible Benefit Transfer Levy
H3	**Cambodia**	11.1	6.5	58%	Mainstream HPP: 18.9%
	Lao PDR	36.3	4.0	11%	
	Thailand	82.9	6.5	8%	
	Vietnam	26.7	2.5	9%	
H1b	**Cambodia**	3.7	2.3	61%	On tributary HPP: 8.6%
	Lao PDR	17.3	2.1	12%	
	Thailand	63.7	3.1	5%	
	Vietnam	15.2	1.2	8%	

Transboundary and cross sector trade-offs (2)

- Third trade-off: Hydropower driven erosion
- Resulting riverbank protection would require country level cost-sharing mechanism
- Transboundary levy approx. 1.2% on hydropower profits

M3	M3CC	F2
$5.7 billion	$6.8 billion	$8.2 billion

Key Messages (1)

- **Development plans** contribute to the economy of the region. However, the combined development plans for 2020 and 2040 are likely to trigger a decline in resilience, vulnerability, and sustainability of communities in the lower Mekong basin.
- **Hydropower** is predicted to provide nearly half of the combined sector growth under the 2040 scenario, but hydropower at the same time also cause greater impacts comparing with other sectors. Many hydropower projects seem unsustainable and weaken resilience.
- Hydropower projects reduce wet season flows and increase dry season flows under normal operation (with the exception of extreme climatic conditions):
  - Reduce wet season flow means: reducing **flood damage** but introducing potential negative effects on riparian ecosystems, sustainability and food security associated with **fish production**.
  - Increase dry season flow means: more opportunity for **irrigation expansion**
  - Dam development could enhance farm productivity by reducing the risks of flood and drought.
- Reduced **sediment and nutrient transport** downstream caused by hydropower projects in the Mekong Basin including China is expected to reduce soil fertility, rice production and fish yields (most vulnerable areas: Cambodia floodplains, the Tonle Sap and the Mekong Delta) ***- reduction up to 97% in Mekong delta for 2040 scenario.***
- **Mitigation measures** could reduce fish losses by an estimated 11% (2040 scenario).

Key Messages (2)

- **Bank and bed erosion due to hydropower development** is expected to increase substantially, especially in Vietnam's Mekong Delta and along the Mekong River from Vientiane to Stung Treng.
- Reservoirs will convert much of the Mekong River into deeper lake-like habitats. Such habitats are not suitable for many species that inhabit the Mekong but are suitable for others such as bivalves, frogs and snails.
- Upstream hydropower dams would create river sections with sufficient water depth over the whole year for larger vessels to sail (**navigation**). This will substantially reduce the need for dredging investments.
- **Flood-protection infrastructure** may also yield wide-ranging negative ecosystem impacts.
- Negative impacts predicted for **food security and poverty** (in the corridor). Aggregate household incomes are predicted to decline. Poverty levels are expected to rise in most zones. The total dollar value of fish catch in the Mekong corridor is expected to decline by $1.57 billion.

Key Messages (3)

- The **benefits and trade-offs** are not evenly distributed throughout the LMB and are not necessarily confined to the source country.
- The developments potentially **over-invest in agriculture and hydropower** to the detriment of existing food security and GDP growth. Agricultural expansion increases labour demand and raise the possibility of underutilised or abandoned agricultural infrastructure.
- **Climate change** will likely amplify negative impacts. Drier climate change poses a significant risk to both food security and GDP growth, reduce hydropower benefits by up to $2.2 billion in net present value, and increase fish losses by ca 15%.
- Future growth potential depends on the availability of **natural capital** (e.g. forests and fish). Predicted declines in natural capital (in net present value) amount to nearly the entire GDP of the lower Mekong basin in 2017 – ***~US$141 billion.***
- Due to the development plans, the average of growth potential of GDP for LMB can be reduced ~US$ 29 B comparing between M1 and M3 (Cambodia: lost ~ US$ 9 B, Lao PDR: lost ~ US$ 9 B, Thailand: lost ~ US$ 11 B and Vietnam: no impact).

Key Messages (4)

- The management of trade-offs between hydropower and fisheries is more efficiently achieved by cross-sector benefit sharing than by the compensation of losses between countries. A possible solution to reallocate benefits acquired by energy companies at the expense of fishing households faced with lower catches in all four countries, for example, could be a levy of around 9 percent of annual profits for tributary dams and 19 percent of annual profits for mainstream dams.
- **Member Country's consideration of emerging energy technologies that are competitive with hydropower is a main recommendation emerging from the Council Study.**
- **Sustainable water resources development in the LMB, the central tenet of the MRC 1995 agreement, will not be achieved by a singular reliance on unilateral investment decisions of the Member Countries.**
- **The transboundary connectivity, mutual dependencies, shared resources, opportunities of scale and cooperation necessities require a set of supra-national joint development and planning policies for the advancement of integrated beneficial projects.**

THANK YOU!