Introduction on the Mekong Delta Study of Viet Nam with respect to climate change impacts assessment

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The “Study on the Impacts of Mainstream Hydropowers on the Mekong River” (the Mekong Delta Study - MDS) initiated by Viet Nam focuses on the accumulative impact assessment of the entire cascade of 11 mainstream hydropower projects on the Mekong Delta of Viet Nam and Cambodia.

The “Study on the Sustainable Management and Development of the Mekong river including Impacts of Mainstream Hydropower Projects” (MRC Council Study) will have a wider scope in terms of the causes of impacts (not only focusing on mainstream hydropower but also on other areas of development) and a wider geographical scope in terms of impact areas (almost entire Mekong river basin).

The MDS and the Council studies will complement each other during implementation aimed to avoid duplication and independently and objectively cross-check relevant conclusions on the impact of mainstream hydropower
1. To develop a complete database on baseline conditions for the LMB, particularly the Mekong Delta (floodplains of Viet Nam and Cambodia).

2. To quantitatively assess impacts of proposed mainstream hydropower projects on the downstream system including (i) the flow regime, (ii) transport of sediments and nutrients, (iii) biodiversity, (iv) water quality, (v) fisheries, (vi) navigation, and (vii) related socio-economic issues.

3. To facilitate achieving consensus on the results of impact assessment of the proposed mainstream hydropower projects on the Mekong Delta and determine avoidance, mitigation and enhancement measures through close consultation with relevant stakeholders.
**Study phases**

**Inception Phase**
- Identification of objectives, scope
- Impact assessment methodology
- Plan and Implementation Arrangements

**Baseline Assessment Phase**
- Baseline data collection and surveys
- Linking water-related models to other sectors
- Linking bio-physical models to socio-economic values
- Development of assessment framework and indicators

**Impact Assessment Phase**
- Linking models, EIA framework for each sector
- Scenario formulation
- Scenario simulation
- Impact assessment for each sector
- Evaluation and prioritization of avoidance measures

**Avoidance, Enhancement and Mitigation**
- Avoidance measures
- Enhancement measures
- Mitigation measures
Work Plan

2013
- Inception

2014
- Baseline Assessment
- Impact Assessment

2015
- Avoidance, Enhancement and Mitigation
- Additional Studies
Review and collect existing data

Additional studies

Assessment

Sediment

Nutrients

Fishery

Navigation

Agriculture

Livelihoods

Water Quantity and Quality

Outcomes

Economy

Sediment

Nutrients

Fishery

Navigation

Agriculture

Livelihoods

Outputs: Water Quantity and Quality

Nutrients

Sediment

Fishery

Navigation

Agriculture

Livelihoods

Economy

Review and collect existing data
1. Hydrological model (SWAT);
2. Basin simulation model (MikeBasin);
3. A 1-D-hydrodynamic river model simulating flow and morphology of the Mekong Mainstream (MIKE11);
4. Detailed 2-D hydrodynamic and morphological models (MIKE21C) simulating flow and morphology of mainstream reservoirs and dams;
5. A coastal and estuary model (MIKE21)
6. Water quality model (Ecolab)
Input data:
- Land cover
- Soil type
- DEM
- Structure
- River network
- Cross-section

Modeling System:
- SWAT
- Tributaries
- MIKE BASIN
- MIKE 11/Ecolab
- MIKE 21C/Ecolab (Reservoirs)
- Delta
- MIKE 21/Ecolab (Tonle Sap)
- East Sea
- MIKE 21
- Coastal
- MIKE 21/Ecolab

Output data:
- Q(t), Se(t), N(t)
- Q(t), H(t), Se(t), N(t)
- Q(t), H(t), Se(t), N(t), Sa(t)
1. Baseline Scenario, year 2008 conditions (will be extended to 2011/2012)

2. Impacts of LMB Hydropower cascade; combinations of dams covering different levels of impacts; operations and dam-break

3. Cumulative impact with others: **Climate change**, Chinese cascade of reservoirs, hydropower development in tributaries, water abstraction/diversion in the catchments, basin changes (hydrology and water demands) etc.

   **Climate change**: Basin-wide change + Sea level rise

4. Assessing levels of impacts of development activities to the Mekong Delta
Impact assessment areas

- Hydrological Impact Assessment
- Nutrient and Sediment Assessment
- Fisheries Assessment
- Biodiversity Assessment
- Agriculture Assessment
- Navigation Assessment
- Economy Assessment
- Livelihood Assessment
Biodiversity assessment
Impact Causative Factors

- Sediment
- Transport
- Hydrology

Model outputs

- Rare & Vulnerable Species
- Landscape – Level habitat
- Sediment and Nutrient Transport
- Biodiversity Analyses

Water quality
- Biodiversity
- Hotspot

Variations in seasonal Flows

- Inundation depths
- Extent of Flooded Areas
- Timing Tonle Sap Flow Reversals

Habitat connectivity

- Migration Routes
- Nutrient Deposition
- Floodplain Sedimentation
- In Channel Feature Morphology
- Erosion
# Biodiversity Indicators

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicators</th>
<th>Measurement Unit</th>
<th>Area</th>
<th>Methodology</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Change in the extent of floodplain wetlands</td>
<td>Hectares</td>
<td>Landscape-level wetland habitat change</td>
<td>Modeling; GIS</td>
<td>Quantitative</td>
</tr>
<tr>
<td>2</td>
<td>Change in wetlands composition within biodiversity hotspots</td>
<td>Hectares</td>
<td>Biodiversity Hotspots</td>
<td>Modeling; GIS</td>
<td>Quantitative</td>
</tr>
<tr>
<td>3</td>
<td>Change in primary productivity caused by changes in nutrient deposition</td>
<td>Tons of carbon</td>
<td>Sediment and Nutrient Transport</td>
<td>Empirical; Expert judgement</td>
<td>Quantitative</td>
</tr>
<tr>
<td>4</td>
<td>Species affected by loss of important floodplain habitat types</td>
<td>Relative risk of effects</td>
<td>Landscape-level wetland habitat change</td>
<td>Expert judgement</td>
<td>Qualitative</td>
</tr>
<tr>
<td>5</td>
<td>Risk of reduction in biodiversity</td>
<td>Relative risk of effects (scale of 1 to 5)</td>
<td>Biodiversity Hotspots</td>
<td>Expert judgement</td>
<td>Qualitative</td>
</tr>
<tr>
<td>6</td>
<td>Risk of extirpation</td>
<td>Relative risk of extirpation (scale of 1 to 5)</td>
<td>Effects on Rare Species</td>
<td>Expert judgement</td>
<td>Qualitative</td>
</tr>
<tr>
<td>7</td>
<td>Loss of riverine habitat caused by changes in sediment transport</td>
<td>Relative risk of loss of riverine habitat</td>
<td>Sediment and Nutrient Transport</td>
<td>Modeling; Expert judgement</td>
<td>Qualitative</td>
</tr>
<tr>
<td>8</td>
<td>Loss of coastal wetlands (mangroves) caused by changes in sediment transport</td>
<td>Relative risk of loss of coastal wetlands</td>
<td>Sediment and Nutrient Transport</td>
<td>Modeling; Expert judgement</td>
<td>Qualitative</td>
</tr>
</tbody>
</table>
Initial Results

<table>
<thead>
<tr>
<th>Area (km²)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total wetlands area in the floodplain of the MK delta of VN</td>
<td>19,985</td>
</tr>
<tr>
<td>Area impacted</td>
<td>2,251</td>
</tr>
</tbody>
</table>

Legend
- Giam
- Tang

Legend
- kb2300-rf
  - Value

Kilometers
- 012 25 50 75 100

Mekong River Commission
2nd Mekong Climate Change Forum
6 – 8 October 2014
Siem Reap, Cambodia
Initial Results

Change in Flooding extent of Tram Chim Hotpots
Additional data collection on Biodiversity

- **Field surveys** – to gather additional data on wildlife and vegetation communities
  - Dry season (Feb – Apr)
  - Transition period (May – June)
  - Rainy season (Aug – Sep)

- **Wetlands classification maps** – based on the most recent and available aerial photography and/or satellite imagery of the Delta and the flood plains.

**Legend**
- Coastal habitat
- Wetland habitat
- Country boundary
- River
- Sea

MAP OF RIVERINE AND COASTAL WETLAND HABITAT

Bassac Marsh
Tram Chim
Lang Sen
Ha Tien
Thanh Phu
Fisheries assessment
Fisheries Assessment Framework

Drivers

Flows

- River flows volumes
- Floodplain inundated and duration
- Inundation depths
- Timing and duration of floods
- Timing and duration of low flow periods

Sediment, Nutrient

- Salinity Intrusion
- River sediment deposition, nutrient

Physical Barriers

- Migration Routes
- Habitat connectivity

Causative Factors

Sectors

Capture fisheries yield

Aquaculture Production

Diversity and Fish Migration
# Fisheries Indicators

<table>
<thead>
<tr>
<th>No.</th>
<th>Indicators</th>
<th>Sub-Indicators</th>
<th>Units</th>
<th>Method</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Yield total</td>
<td>Cambodia and Viet Nam</td>
<td>tonnes</td>
<td>Modeling outputs, analysis additional data and professional judgment</td>
<td>Quantitative</td>
</tr>
<tr>
<td>2</td>
<td>Yield of economically important species</td>
<td>Cambodia and Viet Nam</td>
<td>tonnes</td>
<td>professional judgment</td>
<td>Quantitative</td>
</tr>
<tr>
<td>3</td>
<td>Fish catch diversity</td>
<td>Cambodia and Viet Nam</td>
<td>percent of total catch</td>
<td>professional judgment</td>
<td>Semi-quantitative</td>
</tr>
<tr>
<td>4</td>
<td>Catch per unit effort</td>
<td>Mainstream, tributary, floodplain, and hotspots</td>
<td>kg/gear/day</td>
<td>Modeling Outputs and professional judgment</td>
<td>Semi-quantitative</td>
</tr>
<tr>
<td>5</td>
<td>Extent of aquaculture area per species group</td>
<td>Mainstream, tributary, and floodplain</td>
<td>hectares</td>
<td>Modeling Outputs and professional judgment</td>
<td>Semi-quantitative</td>
</tr>
<tr>
<td>6</td>
<td>Production by aquaculture method</td>
<td>Focus on Viet Nam Mekong delta, a part for MK Delta's Cambodia</td>
<td>tonnes</td>
<td>Modeling Outputs and professional judgment</td>
<td>Semi-quantitative</td>
</tr>
</tbody>
</table>
Initial Results

Change in fish habitat area

<table>
<thead>
<tr>
<th>Item</th>
<th>Area (km²)</th>
<th>(%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total fish habitat area in the MK delta</td>
<td>38,469</td>
<td>100</td>
</tr>
<tr>
<td>Area impacted</td>
<td>1,537</td>
<td>4.07</td>
</tr>
</tbody>
</table>

Legend:
- Giam
- Tang

Kilometers
- 0
- 25
- 50
- 75
- 100
Initial Results
Thank you for your kind attention