The study on impacts and monitoring of transboundary environment from hydropower development along the Mekong mainstream (TNMC Study)

The 2nd Meeting of Joint Working Group on Water Resources of Mekong-Lancang Cooperation, Chiang Rai, Thailand
1-2 March 2018
Presentation Overview

- Background
- Objectives
- Key scopes of study
- Tb environmental study
Background

This joint study (Dept of Water Resources & Office of National Resources and Environmental Policy and Planning) has been commenced since 2014 in 8 provinces along the Mekong corridor i.e. Chieng Rai, Loi, Nong Khai, Bueng Kan, Nakorn Panom, Mukdahan, Amnart Charoen, and Ubon Ratchatani. Local institutional consults were hired to study on multi-disciplinary tasks. Three phases of study (pre-during–post dam construction) have been planned for 15 years.
Objectives

- To study and monitoring transboundary (Tb) environmental and social impacts from hydropower development along the Mekong mainstream on pre-during-post construction
- To create Geo-Informatics database of transboundary environmental and social impact induced by hydropower development
- To grant awareness to the riparian stakeholders for good preparation on mitigation, adaptation due to hydropower development
- To build up the cooperation between civil society and government on monitoring transboundary environmental and social impacts from hydropower development along the Mekong mainstream
Key scopes of the study

- Literature review of secondary environmental impact data
- Primary data collections of the Tb environmental & socio-economic impacts by conducting field survey along the Mekong corridor
- Evaluate data & find out the potential Tb risk areas.
- Scenarios & mathematical models advance HP development
- Stakeholder information sharing forums
- Annual reports
Tb environmental study

1. Water level & Flow rate
2. Sedimentation
3. Bank erosion
4. Water quality
5. Fishery
6. Ecosystem services
7. Scenarios & Models
8. Stakeholder information sharing forums

For the fact finding of the potential risk areas affected by adverse impacts of these issues.
Crucial TbEI on the potential risk areas

6 considerate factors for the potential risk area selection

Physical
1. Water level & Flow rate
2. Bank erosion
3. Sedimentation
4. Water quality

Biological
5. Fishery

Socio-economic
6. Ecosystem services

<table>
<thead>
<tr>
<th>Impact area degree</th>
<th>Bank erosion</th>
<th>Sedimentation</th>
<th>Water level change</th>
<th>Flow rate</th>
<th>Fishery &amp; riparian ecology</th>
<th>Ecosystem services</th>
<th>Water quality, etc.</th>
<th>Total</th>
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</thead>
<tbody>
<tr>
<td>Chieng Rai</td>
<td></td>
<td>3</td>
<td>4</td>
<td>4</td>
<td>4</td>
<td>3</td>
<td>1</td>
<td>22</td>
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<tr>
<td>Chieng Khong</td>
<td></td>
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<td></td>
<td></td>
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</tbody>
</table>
Water level & Flow rate
Water level & Flow rate

- During the year 1985 – 2014 water level & flow rate data were contributed from 6 DWR Hydrological Cycling Observation System (HYCOS) stations
  - 1985 – 1991 No HP in mainstream
  - 1992 – 2014 HP development
Study periods

3. Dachaoshan HP 2003-2008
4. Jinghong HP 2009-2010
5. Xiaowan HP 2010-2011
6. Gongguoqiao HP 2012-2013
### Flow rate comparison at Chiang Sean station

<table>
<thead>
<tr>
<th>Month</th>
<th>1st</th>
<th>2nd</th>
<th>Diff</th>
<th>3rd</th>
<th>4th</th>
<th>Diff</th>
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<td>Jan.</td>
<td>1,185</td>
<td>1,136</td>
<td>4.2</td>
<td>1,079</td>
<td>20</td>
<td>9.0</td>
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<td>Feb.</td>
<td>977</td>
<td>934</td>
<td>4.4</td>
<td>882</td>
<td>13</td>
<td>9.7</td>
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<tr>
<td>Mar.</td>
<td>882</td>
<td>882</td>
<td>0.05</td>
<td>796</td>
<td>21</td>
<td>9.8</td>
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<tr>
<td>Apr.</td>
<td>966</td>
<td>920</td>
<td>4.8</td>
<td>900</td>
<td>18</td>
<td>6.8</td>
</tr>
<tr>
<td>May.</td>
<td>1,450</td>
<td>1,481</td>
<td>2.2</td>
<td>1,404</td>
<td>19</td>
<td>3.2</td>
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<td>Jun.</td>
<td>2,675</td>
<td>2,438</td>
<td>8.9</td>
<td>2,320</td>
<td>15</td>
<td>13.3</td>
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<td>Jul.</td>
<td>4,462</td>
<td>5,280</td>
<td>18.3</td>
<td>4,080</td>
<td>14</td>
<td>8.6</td>
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<td>Aug.</td>
<td>5,587</td>
<td>6,086</td>
<td>8.9</td>
<td>5,580</td>
<td>22</td>
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<td>Sep.</td>
<td>5,222</td>
<td>5,359</td>
<td>2.8</td>
<td>5,248</td>
<td>19</td>
<td>0.5</td>
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<td>Oct.</td>
<td>4,158</td>
<td>3,660</td>
<td>12.0</td>
<td>3,625</td>
<td>20</td>
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<tr>
<td>Nov.</td>
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<td>2,473</td>
<td>4.4</td>
<td>2,253</td>
<td>31</td>
<td>12.9</td>
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<td>Dec.</td>
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<td>1,578</td>
<td>3.6</td>
<td>1,373</td>
<td>22</td>
<td>16.1</td>
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### Notes:
- % SD = Percentage of standard deviation
- % Diff = Percentage of deviation between the 2nd and 1st values

01/03/2018
Flow rate comparison at Chiang Sean station (cont.)

Anomaly since 2014

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<th>ช่วงเวลา</th>
<th>สภาพน้ำ</th>
<th>%</th>
<th>สภาพน้ำ</th>
<th>%</th>
<th>สภาพน้ำ</th>
<th>%</th>
<th>สภาพน้ำ</th>
<th>%</th>
<th>สภาพน้ำ</th>
<th>%</th>
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<th>%</th>
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<td>20 (9.0)</td>
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<td>-</td>
<td>21</td>
<td>-</td>
<td>1,207</td>
<td>7</td>
<td>2</td>
<td>1,237</td>
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<td>4</td>
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<td>13 (9.7)</td>
<td>1,083</td>
<td>-</td>
<td>11</td>
<td>-</td>
<td>802</td>
<td>35</td>
<td>(18)</td>
<td>1,031</td>
<td>33</td>
<td>6</td>
<td>1,081</td>
<td>24</td>
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<tr>
<td>21 (9.8)</td>
<td>987</td>
<td>-</td>
<td>1</td>
<td>-</td>
<td>929</td>
<td>39</td>
<td>5</td>
<td>960</td>
<td>26</td>
<td>2</td>
<td>2,486</td>
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<tr>
<td>18 (6.8)</td>
<td>1,142</td>
<td>-</td>
<td>18</td>
<td>-</td>
<td>1,090</td>
<td>14</td>
<td>13</td>
<td>974</td>
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<td>1</td>
<td>2,381</td>
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<td>19 (3.2)</td>
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<td>(4)</td>
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<td>1,461</td>
<td>31</td>
<td>1</td>
<td>1,176</td>
<td>36</td>
<td>(19)</td>
<td>2,147</td>
<td>22</td>
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<tr>
<td>15 (13.3)</td>
<td>2,036</td>
<td>-</td>
<td>(24)</td>
<td>-</td>
<td>2,057</td>
<td>22</td>
<td>(22)</td>
<td>1,322</td>
<td>21</td>
<td>(51)</td>
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<td>23</td>
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<tr>
<td>14 (8.6)</td>
<td>3,334</td>
<td>-</td>
<td>(21)</td>
<td>-</td>
<td>3,370</td>
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<td>(24)</td>
<td>2,422</td>
<td>14</td>
<td>(46)</td>
<td>3,031</td>
<td>9</td>
</tr>
<tr>
<td>22 (0.1)</td>
<td>4,961</td>
<td>-</td>
<td>(13)</td>
<td>-</td>
<td>4,303</td>
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<td>(23)</td>
<td>4,261</td>
<td>25</td>
<td>(24)</td>
<td>4,246</td>
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<tr>
<td>19 (0.5)</td>
<td>4,351</td>
<td>-</td>
<td>(17)</td>
<td>-</td>
<td>4,225</td>
<td>2</td>
<td>(19)</td>
<td>3,595</td>
<td>7</td>
<td>(35)</td>
<td>3,714</td>
<td>5</td>
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<td>20 (12.8)</td>
<td>2,337</td>
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<td>-</td>
<td>3,022</td>
<td>24</td>
<td>(27)</td>
<td>2,669</td>
<td>4</td>
<td>(36)</td>
<td>2,801</td>
<td>18</td>
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<tr>
<td>31 (12.9)</td>
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<td>-</td>
<td>(36)</td>
<td>-</td>
<td>1,874</td>
<td>8</td>
<td>(28)</td>
<td>2,319</td>
<td>37</td>
<td>(10)</td>
<td>2,207</td>
<td>14</td>
</tr>
<tr>
<td>22 (16.1)</td>
<td>1,371</td>
<td>-</td>
<td>(16)</td>
<td>-</td>
<td>1,386</td>
<td>6</td>
<td>(15)</td>
<td>2,068</td>
<td>39</td>
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<td>28</td>
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<tr>
<td>20 (8)</td>
<td>2,172</td>
<td>-</td>
<td>(18)</td>
<td>-</td>
<td>2,147</td>
<td>17</td>
<td>(19)</td>
<td>1,961</td>
<td>24</td>
<td>(15)</td>
<td>2,609</td>
<td>16</td>
</tr>
</tbody>
</table>

คำานวณค่าอัตราการไหลในช่วงเดือนต่อเดือนในช่วง 2534-2558.

คำานวณค่าอัตราการไหลในช่วงเดือนต่อเดือนในช่วง 2534-2558.
av. monthly flow rates of each station
Sedimentation
Sedimentation at CSE station

Comparison with base line

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<tr>
<th></th>
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<th></th>
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<tbody>
<tr>
<td>Base-line</td>
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<td><img src="image" alt="down" /></td>
<td><img src="image" alt="down" /></td>
<td><img src="image" alt="down" /></td>
<td><img src="image" alt="down" /></td>
</tr>
</tbody>
</table>
Av. yearly sedimentation at each station
Bank erosion
Bank erosion along 8 provinces

1. Bank erosion in 8 provinces affected by the river.
2. Erosion control measures have been implemented.
3. The erosion is increasing year by year.

4. A sign indicates the affected area.
5. A road damaged by erosion.
6. A path along the riverbank.
7. An erosion control structure.
8. A damaged bank.

[Map with locations and notes]
Bank protection

- Rock fill bank protection mostly used

Type of Bank protection

<table>
<thead>
<tr>
<th>Type of Protection</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rock fill</td>
<td></td>
</tr>
<tr>
<td>Rock fill</td>
<td></td>
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<tr>
<td>Rock fill</td>
<td></td>
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<td>Rock fill</td>
<td></td>
</tr>
<tr>
<td>Rock fill</td>
<td></td>
</tr>
<tr>
<td>Rock fill</td>
<td></td>
</tr>
</tbody>
</table>
Wieng Kaen district, Chiang Rai

Khong Chiem district, Ubon
Khong Chiem district, Ubon

Bank protection collapse
Water quality
# Water analysis

<table>
<thead>
<tr>
<th>Indices</th>
<th>Methodology</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Temperature</td>
<td>Thermometer</td>
</tr>
<tr>
<td>2. pH</td>
<td>Electrometric Method</td>
</tr>
<tr>
<td>3. Conductivity</td>
<td>Electrometrical Conductivity Method</td>
</tr>
<tr>
<td>3. Dissolved Oxygen</td>
<td>Membrane Electrode Method</td>
</tr>
<tr>
<td>4. Total suspended solids</td>
<td>Gravimetric Method; Dried at 103-105 °C</td>
</tr>
<tr>
<td>5. Total NO$_3$-N</td>
<td>Cadmium Reduction Method</td>
</tr>
<tr>
<td>6. Total PO$_4$-P</td>
<td>Ascorbic Acid Method</td>
</tr>
<tr>
<td>7. Colour / transparency</td>
<td>Visual comparison method, Nephelometric</td>
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</tbody>
</table>
Total suspended solids

สารแขวนลอย

สถานีตรวจวัด

- ก.ต. 59 (น้ำเริ่มขึ้น)
- ต.ค. 59 (น้ำขึ้นสูงสุด)
- ธ.ค. 59 (น้ำเริ่มลด)
- พ.ค. 60 (น้ำเริ่มขึ้น)
- ก.ต. 60 (น้ำขึ้นสูงสุด)
pH

DO
Fishery
Fishery study

Beach Seine  Dipnet  Market approach
Periods of sampling

3 times a year

1. Water rising (April-May)
2. Max. water level (July-August)
3. Water declining (December-January)
Fishes

156 species found, 152 native species and 4 alien species namely: *Oreochromis niloticus*, *Pterygoplichthys disjunctivus*, *Clarias* spp., and *Ictalurus punctatus*

- 130 economic species
- 10 threatened species, e.g., *Probarbus jullieni*, *Tenualosa thibeaudaui*, *Hemitrygon laosensis*
Factors for evaluating fishery potential risk areas

1. Diversity & abundance
2. Migration
3. Spawning areas
4. Fishery livelihood areas
Diversity
Diversity in the past
Spawning area
Fish catch
Aquaculture

MRC Environmental Hotspot

Chiang Saen-Chiang Khong

Luang Prabang-Vientian

Kuting

Nam Songkram

Mukdahan-Leephe
Ecosystem service
Ecosystem service surveys
Value from Ecosystem Services
(Baht/mth)
Worry about the change of the Mekong
Scenarios & Models
Mathematical Model

- Hydrological model – Soil and Water Assessment Tools: SWAT
- Basin simulation model – Integrated Quantity and Quality Model: IQQM
- Hydrodynamic model - ISIS

Scenarios

- Reference scenario: Baseline condition in the past no longer dam at all in the Lancang-Mekong
- If there are 6 dams in the Lancang and 2 dams in the Mekong
- If there are 6 dams in the Lancang and 6 dams in the Mekong
Stakeholder information sharing forums
โครงการศึกษาผลกระทบและดีดิฉันทางสังคม
ผลกระทบด้านทรัพยากรน้ำจากโครงการพัฒนากิจการน้ำในแม่น้ำโขงกลุ่มประเทศ
ปัจจุบัน ปีพ.ศ. 2559
คณะกรรมการ กรมทรัพยากรธรรมชาติและสิ่งแวดล้อม

www.tnmcstudy.org
Thank you for your attention