Climate change impacts, vulnerability and adaptation in drought severity in the Lower Mekong Basin

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MRC Drought Management Programme
Outline

- Drought impacts and vulnerability in the LMB
  - Historical extreme droughts in the LMB
  - Low flow condition
  - Socio economic impacts
  - Types of drought impacts and vulnerability
- Drought monitoring system and projection
- Adaptation options
- Conclusion
Drought impacts and vulnerability in the LMB

Present statistics indicate that most Mekong Region countries have fairly high amounts of renewable water resources per capita. However, at a closer look, the region (at number locations) faces a series of critical water issues, such as:

- Water shortages in Thailand;
- Intensive salinity intrusion in Viet Nam’s Mekong delta;
- Floods and drought in most parts of the LMB;
- Water quality, land-subsidence, and morphological changes in Delta areas; and
- Intensification of sectoral competition within and among the Mekong countries (MRC, 2010a).
Drought impacts and vulnerability in the LMB

The Mekong River has an average annual discharge of 13,700 m$^3$/s, a peak wet season average discharge of 52,400 m$^3$/s, causing widespread flooding, and a minimum discharge of 1,600 m$^3$/s (approximately 30 times less than the peak wet season discharge) during dry season, when water demand for food production is higher (ADB and SEI, 2002, and MRC, 2003).

Figure 1: Mekong at Kratie – the two most extreme annual hydrographs observed over the 86 years since 1924.
Drought impacts and vulnerability in the LMB

- Historical extreme drought in the LMB

Drought events in the region have increased in frequency and severity during the past decades. Regionally, the timing of the onset and end of the south west monsoon is highly predictable, historically having a very low variance from year to year. As recent experience has shown, any significant deviation from these dates can have substantial economic consequences. Twelve ‘significant’ and four ‘extreme’ drought episodes have occurred since 1924, making them an integral part of the hydrological landscape of the LMB.

Drought impacts and vulnerability in the LMB

Hydrological drought in the LMB

**Figure 2:** Scatter plots of the joint distribution of the annual maximum discharge (cumecs) and the volume of the annual maximum hydrograph (km³) Vientiane/Nong Khai (1913 - 2006) and at Kratie (1924 – 2006). Source: Adamson and Bird, 2010.
Drought impacts and vulnerability in the LMB

Hydrological drought in the LMB

Figure 3: Hydrograph at Mekong – Vientiane and Kratie.
Drought impacts and vulnerability in the LMB

- **Socio economic impacts**

  **Table 1  Typical examples of impact of drought and floods in Cambodia.**
  IDD = International Disaster Database; ADB = Asian Development Bank

<table>
<thead>
<tr>
<th>Disaster</th>
<th>Date</th>
<th>Affected (person)</th>
<th>Damage (1000s US$)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flood</td>
<td>June 1996</td>
<td>1,470,000</td>
<td>100</td>
<td>IDD</td>
</tr>
<tr>
<td>Flood</td>
<td>July 2000</td>
<td>1,300,000</td>
<td>1,500</td>
<td>IDD</td>
</tr>
<tr>
<td>Flood</td>
<td>August 2001</td>
<td>3,448,053</td>
<td>160,000</td>
<td>IDD</td>
</tr>
<tr>
<td>Flood</td>
<td>August 2002</td>
<td>1,669,182</td>
<td>15,000</td>
<td>IDD</td>
</tr>
<tr>
<td>Drought</td>
<td>2003 to 2005</td>
<td>2,000,000</td>
<td>Unknown</td>
<td>ADB</td>
</tr>
<tr>
<td>Drought</td>
<td>June 2004</td>
<td>5,000,000</td>
<td>100,000</td>
<td>IDD</td>
</tr>
</tbody>
</table>

  **Table 2  Typical examples of impact of drought and floods in Lao PDR (1966-2002).**
  WFP = World Food Programme

<table>
<thead>
<tr>
<th>Disaster</th>
<th>No. Events</th>
<th>Affected (person)</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>5</td>
<td>4,250,000</td>
<td>WFP</td>
</tr>
<tr>
<td>Flood</td>
<td>16</td>
<td>3,244,150</td>
<td>WFP</td>
</tr>
</tbody>
</table>
Drought impacts and vulnerability in the LMB

**Socio economic impacts**

Table 3: Typical examples of impact of drought and floods in Thailand.
ADB = Asian Development Bank; GAR = Global Assessment Report

<table>
<thead>
<tr>
<th>Disaster</th>
<th>Date</th>
<th>Affected</th>
<th>Impact</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>2003 to 2005</td>
<td>650,000 ha</td>
<td>Increased farm production cost 40%</td>
<td>ADB</td>
</tr>
<tr>
<td>Drought</td>
<td>2009</td>
<td>2,444,010 persons</td>
<td>Decreased agricultural product</td>
<td>GAR</td>
</tr>
<tr>
<td>Flood</td>
<td>2009</td>
<td>819,822 persons</td>
<td>Unknown</td>
<td>GAR</td>
</tr>
<tr>
<td>Drought</td>
<td>2010</td>
<td>Unknown</td>
<td>Lost 75% of Cassava production &amp; increased price 60%</td>
<td>Bangkok Post</td>
</tr>
</tbody>
</table>

Table 4: Typical examples of impact of drought and floods in Viet Nam. (ADB = Asian Development Bank)

<table>
<thead>
<tr>
<th>Disaster</th>
<th>Date</th>
<th>Affected</th>
<th>Impact</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drought</td>
<td>2003 to 2005</td>
<td>Unknown</td>
<td>$ 60 million (Cuu long delta)</td>
<td>ADB</td>
</tr>
<tr>
<td>Drought (North central)</td>
<td>June 2010</td>
<td>40,000 households, 250,000 ha</td>
<td>Not enough clean water; crops dried up; high tem.</td>
<td>Viet Nam Net</td>
</tr>
</tbody>
</table>
Drought impacts and vulnerability in the LMB

- Socio-economic impacts - Cambodia

Figure 4 Rice cultivated areas affected & destroyed by disasters

Source: Ministry of Agriculture, Forestry and Fisheries
Drought impacts and vulnerability in the LMB

- Socio economic impacts - Cambodia

Figure 5: Total Crop Area Damaged by Drought 1982-2007
Figure 6: Dry Season Rice Cultivated Area, 1980-2010

Source: MAFF 2010b, MAFF 2011a, NIS 2008
Drought impacts and vulnerability in the LMB

- Socio-economic impacts - Laos

![Laos PDR Drought Hot Spots](image1)
![Laos PDR Irrigation Hot Spots](image2)
Drought impacts and vulnerability in the LMB

- Socio economic impacts - Thailand
Drought impacts and vulnerability in the LMB

- Socio economic impacts – Vietnam
Drought impacts and vulnerability in the LMB

- Drought Risk Map of the LMB
  - Drought Risk Model using 6 weighing factors:
    - Meteorology
    - Irrigation
    - Ground water rate
    - Surface water
    - Soil drainage
    - Land use
Drought impacts and vulnerability in the LMB

- Types of drought impacts and vulnerability
  - Economic
    - Annual and perennial crop losses and damage to crop quality
    - Reduced productivity of cropland (wind erosion, etc.)
    - Insect infestation
    - Crop disease
    - Loss of farmers through bankruptcy
    - Unemployment from drought-related production declines
    - Increase in food prices
    - Increased importation of food (higher costs)
    - Reduction and degradation of fish and wildlife habitat
    - Lack of feed and drinking water
Drought impacts and vulnerability in the LMB

- Types of drought impacts and vulnerability
  - Environment
    - Damage to plant species
    - Forest fires
    - Estuarine impacts (e.g., changes in salinity levels)
    - Loss of biodiversity
    - Soil erosion and water quality degradation
Drought impacts and vulnerability in the LMB

- Types of drought impacts and vulnerability
  - Social
    - Mental and physical stress (e.g., anxiety, depression, loss of security, domestic violence)
    - Reductions in nutrition (e.g., high-cost-food limitations, stress-related dietary deficiencies)
    - Inequity in the distribution of drought relief
    - Increased poverty in general
    - Population migrations (e.g., rural to urban areas, migrants into neighboring Country to seek for work)
Drought monitoring system and projection

- Drought Indicator Indices being studied by DMP
  - NDVI: 250m of 8 days composite with signed 16 bite data with atmosphere correction. The products will be 8 days and monthly basis.
  - TDVI/SMI: Temperature Vegetation Index, is using 1 km resolution data with 8 days composite. The products will be 8 days and monthly basis.
  - GSmap: Global Satellite Mapping of Precipitation, is using 1km resolution data with daily and monthly products.
  - KBDI: is using 1km resolution data with daily and monthly products.
  - SPI: is using observed data of MRC with triangular method to cover the whole LMB by GSmaP.
Adaptation options

- Water diversion to dried crop land by generators
- Changing crop varieties
- Micro finance/loans from bank
- Irrigation system rehabilitation and extension through new development projects
- Building water storages
- Migration out for additional incomes
- Building dykes to prevent sea water from intruding to rivers
- Pumping ground water
- Reforestation
Conclusion

- Ground water exploration and use should be encouraged and applied more efficiently for agricultural irrigation specifically in Cambodia and Lao PDR
- Drought projection is still at the study stage where there is no accurate model available yet
- Downscaling climate change projection on potential drought risks and vulnerability is the most significant task to be carried out in order to project long-term scenarios on climate change impacts in drought severity for a better adaptation option and planning
- Adaptation planning to mitigate drought and climate change impacts needs to consider trans-boundary inter-connection especially hydrological factor in both natural and man-made activities specifically hydro power operations in the main rivers and tributaries.
Thank you