Mekong ARCC Climate Change Impact and Adaptation Study for natural and agricultural systems

Jeremy Carew-Reid,
ICEM – International Centre for Environmental Management
www.icem.com.au

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Assessing climate change threats to agriculture and subsistence livelihoods

Climate changes

Hydrological changes

Agricultural zones

Ecological zones

Species “zones”

- Commercial crops
- Subsistence crops
- Aquaculture
- Traditional crops
- Livestock

- Crop wild relatives
- NTFPs
- Wild fish catch
- Wildlife

Adaptation options

ICEM, 2012
Agricultural systems and climate change continuum

VULNERABLE

Homogenous
Weak linkages
Uniform
Unstable

Intensive inputs
High maintenance

Diverse
Interconnected
Complex
Stable

Low inputs
Low maintenance

RESILIENT

LIVESTOCK

AQUACULTURE

COMMERCIAL CROPS

INDUSTRIAL CROPS

WILD LIFE

SUBSISTENCE CROPS

WILD FISH

CROP WILD RELATIVES

NTFPs
CAM method

Source: ICEM, 2012
Climate and hydrological changes

Climate changes

Regular (daily and seasonal)
- Increase in C02
- Change in temperature
- Change in rainfall

Extreme events
- Storms
  - Rainfall
  - Wind
  - Low pressure

Hydrological changes

Regular (daily and seasonal)
- Water availability
- Runoff and flow
- Regular flooding
- Evapotranspiration
- Saline intrusion
- Sea level rise

Extreme events
- Flooding (fresh and salt water)
- Flash flooding
- Drought
- Storm surge
System assets

Top commercial crops

<table>
<thead>
<tr>
<th>Vietnam</th>
<th>Laos</th>
<th>Thailand</th>
<th>Cambodia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rice, paddy</td>
<td>Rice, paddy</td>
<td>Rice, paddy</td>
<td>Rice, paddy</td>
</tr>
<tr>
<td>Coffee, green</td>
<td>Maize</td>
<td>Rubber</td>
<td>Cassava</td>
</tr>
<tr>
<td>Cashew nuts, with shell</td>
<td>Coffee, green</td>
<td>Cassava</td>
<td>Maize</td>
</tr>
<tr>
<td>Cassava</td>
<td>Tobacco,</td>
<td>Sugar cane</td>
<td>Bananas</td>
</tr>
</tbody>
</table>

Fruit trees: Bananas and mangoes

Vegetables: Sweet potatoes, tomatoes, beans, chilli

Subsistence crops
- Lowland and upland rice
- Cassava
- Maize
- Peanuts

Traditional crop varieties
- Rice (more than 13,000 identified in Lao)
- Eggplant (more than 3000 in Lao)
- Papaya
- Banana (centre of origin)
- Mango (centre of origin)
- Pineapple
- Water melon
- Passion fruits

Wild plants
- Cardamom,
- Rattan and bamboo
- Orchids
- Mushrooms

Crop wild relatives
- Glutinous rice (centre of origin)
- Eggplant (centre of origin)

Centre of origin for: coconut palm, sugarcane, clove, nutmeg, black pepper, onion, cucumber
Key assessment concepts

**Zones**
- Climate change, Ecological, Agricultural

**Shifts**
- Geographic, Elevation, Seasonal

**Hotspots**
- Exposure, Sensitivity, Adaptive capacity
Climate change overlaid on “zones”

Zones provide the common analytical framework for the study team

**Purpose of zoning** is to:

- Identify areas of the basin with common bio-physical and socio-economic characteristics
- Observe “shifts” in the zones with climate change

**Three types of zones:**

1. **Climate change zones** – temperature, rainfall and hydrology
2. **Agricultural zones** – agricultural land uses and natural conditions
3. **Ecological zones** – natural habitat, species and genetic resources
Climate change zones

Areas experiencing similar climate change

1. Annual + seasonal rainfall averages & extremes
2. Annual + seasonal temperature averages & extremes
3. Specific tolerance & threshold maps
Agriculture zones
Ecozones
Climate change shifts

Regular climate
1. **Geographic shifts** – change in area of suitability
2. **Elevation shifts** (for highly restricted habitats and species) – change in (i) location and (ii) elevation
3. **Seasonal shifts** – change in (i) yields, (ii) cropping patterns

Extreme events
4. **Extreme event shifts**
   - Micro – eg flash flooding and soil loss in uplands
   - Macro – eg saline intrusion in Delta; cyclone landfall
Geographic shift

Original extent of natural habitat

Paddy rice and commercial crops

Remaining natural habitat

Shift in zone of suitability for habitat and crops

Subsistence crops and NTF collection

ICEM, 2012
Seasonal shifts

Kratie

- Increase in flood duration
- Quicker onset of flood & shortening of transition season
- Increase in flood magnitude & volume

Source: ICEM, 2012
Identifying climate change “hot spots” – i.e. highly vulnerable areas

• High exposure:
  ▪ significant climate change relative to base conditions
  ▪ exposure to new climate/hydrological conditions

• High sensitivity:
  ▪ limited temperature and moisture tolerance range
  ▪ degraded and/or under acute pressure
  ▪ severely restricted geographic range
  ▪ rare or threatened

• Low adaptive capacity
  ▪ Poor connectivity
  ▪ Low diversity and tolerances
  ▪ Homogenous systems
Sensitivity assessments: climate tolerances

Optimal growing conditions: mean annual precipitation

- Sweet potato
- Mango
- Rubber
- Robusta coffee
- Cassava
- Cashew Nuts
- Banana
- Arabica coffee

Optimal growing conditions: mean annual precipitation

Annual precipitation (mm)
Maize growth cycle

AquaCrop

- Assesses water requirements at each growth phase relative to a reference norm and quantifies changes in biomass => yield

Source: FAO, 2010
Models

- CC downscaling (6GCMs, A1B)
- Hydrological & flood modeling (VMod, MIKE 11)
- LUSET – Land Use Suitability Evaluation Tool (IRRI)
- AQUACROP (FAO)

Outputs

- Geographical shifts in climate (CC zones)
- Geographical shifts in natural systems (ecozones)
- Geographical shifts in crop suitability
- CC exposure for natural systems, agricultural, fisheries and socio-economic systems
Predicting future changes in land suitability

Basin – crop suitability
• Agro & eco zoning of basin characteristics
• Historic suitability of basin for a range of commercial and subsistence crops
• Suitability with climate change
• Assessment of transitions and shifts in geographical and seasonal suitability

Target areas – crop yields
• Losses in crop yields within transition zones
• Yield potential for new crops in transition zones
Lowland rice
upland rice
rubber
Coffee (coffea canephora)
Black pepper
Maize
Adaptation Pathway - addressing the adaptation deficit

- Response to CLIMATE CHANGE - addressing additional threat
- Response to CLIMATE VARIABILITY - addressing extreme weather events
- Response to REGULAR CLIMATE - addressing existing development challenges

ADAPTATION PATHWAY
1. Addressing the adaptation deficit
2. Reinforcing successful coping mechanisms
3. Taking new high priority adaptation action

Action at any level will build resilience to climate change.