A preliminary methodological framework for developing climate-related risk indicators and adaptive capacity of developing countries

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- What is a climate hazard?
- Which adaptation measures can be adopted?
- Why is important to identify climate-related risk indicators?
- Proposed methodology framework
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Climate change vulnerability as a risk

Risk =

Probability of occurrence of a climate hazard with significant loss of infrastructure and livelihoods.

Assuming that an extreme weather event (heavy rainfalls) or human activity happens.
Which adaptation measures can be adopted?

**Turning excess water to advantage**

**Current land usage**
- Crops include rice, maize, cassava, bananas, onions

**Camellones project**
- Raised earth platform
  - Canal
  - Fish and aquatic plants
  - Up to 2m

**Rainy season**
- Large expanses of land under water for several months, no crops left

**Dry season**
- Floodwater drains off taking nutrients with it, leaving a sandy soil in which it is hard to grow crops
  - Sandy soil

- Canals provide a source of irrigation and nutrients
  - Nutrients

Source: Painter J., 2009
Why is important to identify climate-related risk indicators?

- Better allocate financial resources for adaptation programs.
- Identify the degree of climate-related risk of a particular population, community or sector.
Proposed methodology framework

Identify the vulnerable system to climate change impacts (Fussel, 2007)

Source: Ramirez E., 2005
Source: Costa A., 2007
Source: Correo del sur., 2007
Source: NASA, 2006
Source: Painter J., 2009
Proposed methodology framework

Identify the main effects of climate hazard

Selection of extreme weather events or human activities

\[ Pr(A \mid B) = \frac{Pr(A \cap B)}{Pr(B)} = \frac{Pr(A)}{Pr(B)} \]

Pr (A): Let A be the event that a destructive flooding occurs with significant loss of infrastructure and livelihoods.

Pr (B): Let B the probability of occurrence of a heavy rainfalls.
Overview of climate hazards hotspots in Tropical Eastern lowlands

### Table 1: Overview of climate hazards hotspots in the Tropical Eastern Lowlands

<table>
<thead>
<tr>
<th>Resources</th>
<th>Observed climate hazards</th>
<th>Possible Consequences</th>
<th>Society</th>
<th>State of infrastructure and livelihoods</th>
</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Increased in precipitation produce more frequent inundations during ENSO events</td>
<td>Economic losses because of roads and bridge destruction</td>
<td>Loss of human life and cattle Indigenous poor communities are more vulnerable</td>
<td>Destruction of roads, bridges small dams. Loss of crops</td>
</tr>
<tr>
<td></td>
<td>Reduction of water availability in rivers and lakes in the sub-tropical valleys (STV) because of more evapotranspiration</td>
<td>Loss of aquatic ecosystem services (e.g. freshwater, recreation, agricultural)</td>
<td>Farmers rely on ecosystem services for their livelihoods</td>
<td>Water supply for humans and cattle can be affected</td>
</tr>
<tr>
<td></td>
<td>Longer dry seasons might reduce water availability for agricultural sector in STV</td>
<td>Economic losses for small farmers</td>
<td>Migration from rural to urban areas</td>
<td>Loss of arable land</td>
</tr>
<tr>
<td>Land</td>
<td>Increased of deforestation in south-eastern of Santa Cruz for soybean crops expansion</td>
<td>Forest loss could reduce water cycle and precipitation during dry seasons which impact in small farms</td>
<td>Negative effect on forest industry one of the main of the province</td>
<td>Shortage of timber and other food fiber for forest industry</td>
</tr>
<tr>
<td></td>
<td>Deforestation threatens Chapare tropical forest because of coca crops expansion</td>
<td>A possible inflationary effect on week and isolated communities because coca crops can generate fast and high earnings rather than other crops</td>
<td>Escalating violence and armed conflict spread by illicit drug business and international drug cartels</td>
<td>National parks are fragmented by coca crops causing deforestation, and erosion</td>
</tr>
</tbody>
</table>

(a) By order of appearance of each climate hazard, the sources are: (see Ronchail et al., 2005, pp 225) (see Montaño et al., 2006, pp 105) (see Mertens et al., 2004, pp 272) (see Gonzales et al., 2006, pp 133) (see Parry et al., 2007, pp 586, 587).
Overview of climate hazards hotspots in the Altiplano western highlands

<table>
<thead>
<tr>
<th>Resources</th>
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</tr>
</thead>
<tbody>
<tr>
<td>Water</td>
<td>Drought due to increased variability of ENSO</td>
<td>Monetary losses for small farmers</td>
<td>Population migration from east to west part of Bolivia</td>
<td>Reduction on high-altitude water stocks during dry season</td>
</tr>
<tr>
<td>Temperature increases 4.5 - 5 oC, reduce glacier-supplied river water</td>
<td>Potential impact on water supplies for human consumption</td>
<td>Spread of waterborne diseases</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Increased rainfall in the South Altiplano of Cochabamba, cause floods and landslides</td>
<td>Local communities depend on products ecosystems for fuels, animal food, building material, food and medicines for their livelihoods</td>
<td>Low-income peasants with limited human resources to cope with these events</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Land</td>
<td>Intensive overgrazing and slash and burn in the North Altiplano of La Paz (NALP)</td>
<td>Reduce land’s productivity</td>
<td>Increased poverty in rural areas</td>
<td>Reduction of agricultural production capacity</td>
</tr>
<tr>
<td>Longer dry seasons due to more ENSO conditions</td>
<td>Land erosion impact at the NALP</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

(a) By order of appearance of each climate hazard, the sources are: (see Parry et al., 2007, pp 285) (see Vuille et al., 2008, pp 79) (see Aparicio et al., 2006, pp 36,92) (see Parry et al., 2007, pp 285) (see Aparicio et al., 2006, pp 91).
Questions to face in modelling extreme events

- Difficult to predict the occurrence of extreme weather events (Lack of past-data, uncertainty in climate change projections).

- Subjectivity in the estimation of climate-related risk indicator (e.g. selection of variables, measurement technique).
!!Thank you for your attention!!

References