Metrics for Measuring Adaptation to Climate Change in Agriculture Sector

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Today’s Headlines

- Our ongoing work on adaptation metrics
- Need for adaptation metrics
- Determinants, criteria and types of adaptation metrics
- Adaptation metrics in Agriculture
  - Methods to identify metrics
  - Suggested metrics
- Outcome from our consultations
- Future line of work
Our work on Metrics

- Project on ‘Adaptation Metrics’, with funding from WB

- Objectives
  - To identify suitable adaptation metrics for agriculture and water sectors
  - To test metrics for their validity in varied conditions and projects

- Methodology
  - Literature review
  - Expert consultation and policy dialogues
  - Questionnaires (web, Climate L) and field visits
  - Multi-criteria analysis
  - Test the validity of metrics

Only some concepts and preliminary results are presented here
From this Symposium…

- Climate change is **bad** (well, for many)
- Mitigation is **important** (for global good)
  - A whisper that developing countries can do...
- Adaptation is **more important** (more for developing and probably less for developed countries)
- And, adaptation is **even more important** in agriculture and water sectors
  - and that there are **several adaptation options**
## Adaptation Metrics: Mitigation vs Adaptation

<table>
<thead>
<tr>
<th>Mitigation</th>
<th>Adaptation</th>
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<tbody>
<tr>
<td>Has a <strong>protocol</strong> (KP) that governs</td>
<td>No ‘<strong>protocol</strong>’ to govern adaptation</td>
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<tr>
<td>There are <strong>GHG reduction targets</strong> to meet with coordinated efforts</td>
<td>There are no ‘<strong>adaptation targets</strong>’ to meet</td>
</tr>
<tr>
<td><strong>Ways and means to measure</strong> the impact of collective actions</td>
<td><strong>No streamlined measurement system</strong> for adaptation</td>
</tr>
<tr>
<td>Global actions and global benefits (more organized at global level)</td>
<td>Mostly local actions and local benefits (with some undeniable global spillover benefits)</td>
</tr>
<tr>
<td><strong>Physical principles</strong> that govern mitigation</td>
<td>At nascent stages: Complex interaction of biophysical and socioeconomic elements</td>
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</table>
And...in addition

- Adaptation deals with systems
  - that are at different levels of adaptive capacity
  - Several adaptation options deferring in their effectiveness and outcomes
Need for Metrics: BAP on Adaptation (Section c, i-v)

- “Enhanced action on adaptation with consideration of ... *prioritization of actions*...and support adaptation in a coherent and integrated manner”

- “Positive incentives for developing countries for enhanced mitigation and adaptation actions”
How to Prioritize and Incentivize Adaptation Actions?

- By
  - Knowing where we want to go (adaptation targets?)
  - Setting a time frame
  - Knowing how much ‘adaptation’ we want to achieve at each stage to meet the target

- This is facilitated by
  - Setting a base line of adaptation (to compare the progress and effectiveness)
  - And agreeing on a measurement system (adaptation metrics)
Adaptation Metrics

- Metric:
  - A system of measurement
  - The unit of measurement
  - Value of the unit
Advantages of Adaptation Metrics

- Ability to **measure adaptation** at any given point of time
- Provide a **means to compare** the level of adaptation reached across locations, regions, societies, and nations
- Help in decision making related to **identification and prioritization** of appropriate adaptation actions and for funding
- **Help track the progress** over the time scales
- Help in **minimizing the risk of mal-adaptation**
Adaptation Metrics and Determinants of Adaptation

System in question

Determinants of adaptation
- Economic resources
- Technology
- Information and skills
- Infrastructure
- Institutions
- Equity

Climatic Stimuli (Stress)

Enhanced vulnerability
- Determinants inadequate

Net high impacts

Reduced vulnerability
- Determinants adequate

Net low impacts
Criteria for Adaptation Metrics

- Measurable
  - Cost effective
- Scalable
- Comparable
  - Across time and geographical scales
- Context specific
  - Specific to system being measured
- Sensitive to degree of adaptation
- Learning and evolving
Different metrics

- Qualitative and quantitative
  - Cost and time resources, effectiveness
- Direct and proxy
  - To accommodate those cannot be directly measured
- Ex-ante vs. Ex-post
  - To chose options and to measure outcomes
- Local vs National
  - To accommodate differential impacts of climate change at different scales
## Methods for Choosing Adaptation Metrics in Agriculture

<table>
<thead>
<tr>
<th>Methodology</th>
<th>Geographical Scope</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Benefit-cost analysis</td>
<td>Local (L), national (N) and regional (R) scales</td>
<td>Tubiello and Rosenzweig, 2008</td>
</tr>
<tr>
<td>Cost-effectiveness analysis</td>
<td>L,N,R</td>
<td>Rosenzweig and Tubiello, 2006</td>
</tr>
<tr>
<td>Multi-criteria analysis</td>
<td>L,N,R</td>
<td>Dolan et al., 2001</td>
</tr>
<tr>
<td>Expert consultation (workshops)</td>
<td>L,N,R</td>
<td>Rosenzweig and Tubiello, 2007</td>
</tr>
<tr>
<td>Dynamic crop models</td>
<td>L,N,R</td>
<td>Tubiello and Rosenzweig, 2008</td>
</tr>
<tr>
<td>Modelling relationship between stressor and outcome variables</td>
<td>L</td>
<td>Luers et al., 2003</td>
</tr>
<tr>
<td>GIS based index based on normalization and aggregation of determinants</td>
<td>Sub-national</td>
<td>Swanson et al., 2007</td>
</tr>
<tr>
<td>Historical trend analysis and constructing conceptual models</td>
<td>Sub-national</td>
<td>Allison and Hobbs, 2004</td>
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## Some Suggested Adaptation Metrics

<table>
<thead>
<tr>
<th>Metric/s</th>
<th>Reference</th>
<th>Description on availability and limitations (includes authors judgement)</th>
</tr>
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<tbody>
<tr>
<td>Mean and variability of yield and production, income, aggregate of value added</td>
<td>Tubiello and Rosenzweig, 2008</td>
<td>Measured and computed metrics. Available at local, national, regional and international levels in many countries. The aggregate of value added may need to be computed at the local level as such statistics will not be readily available.</td>
</tr>
<tr>
<td>Nutrition index</td>
<td>Tubiello and Rosenzweig, 2008</td>
<td>Computed metric (sum of local production and net imports divided by total food demand). Can be computed at national and regional level.</td>
</tr>
<tr>
<td>Yield estimates (remotely sensed), yield variability, highest relative yield/yield percentile</td>
<td>Luers et al., 2003</td>
<td>Estimates could help in filling the gaps in the existing yield data, validating the measured yield data etc. Accuracy could be an issue when resolution of remote sensing is low.</td>
</tr>
<tr>
<td>Agricultural export, farm income, out-migration from farming, emergency payments</td>
<td>Venema, 2006</td>
<td>Agricultural exports and out-migration of farming are mostly applicable at the macro-economic level, while data on rest of the metrics (emergency payments) could be sparingly available.</td>
</tr>
<tr>
<td>Sources of income, livestock number, source of fertilizer</td>
<td>Brooks and Adger, 2005</td>
<td>It was not clear on how many sources of income is considered as optimal, and also the number of cattle. However, it is suggested that the higher the sources of income, with more diversification into non-farm sources, the higher the adaptive capacity.</td>
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</table>
Problems with Earlier Suggestions

- Mostly single metrics and doesn’t often provide an overall picture of adaptation in agriculture sector.
- Policy makers may often prefer single composite index representing the entire sector with a single number (not withstanding their intrinsic limitation).
Some Composite Indices

- GDP, HDI...
  - Grossly averages out, and even nullifies, the impacts at the sectoral and sub-national level
  - Criticized as either too primitive or too unattainable (e.g. HDI)
  - Lack of consensus among various stakeholders
Some Composite Indices

- Index of Usefulness of Practices for Adaptation to climate change (IUPA) Index (Claudio Szlafsztein, Federal University of Para, Brazil)
  - Integrates both qualitative and quantitative parameters into a single index
  - Choosing the weightings for individual parameters is a question
Some Consultation Outcomes

- Adaptive capacity of people and policies are important for identifying metrics.
- Stress on community-based perspective of adaptation: linkages between causes, effects, and responses – Preference for qualitative indicators.
- Challenges to initiate action: Long-term, cause-effect relations, lack of attribution, baseline data, inadequate understanding.
- Criteria: Reliability, cost effectiveness, measurability, comparability, local applicability etc.
- Double exposure: Climate change and global change vulnerability.
- Adaptive capacity indicators: biophysical, socioeconomic and technological.
- Metrics at various scales – to reflect impacts on various sectors, provide basket of options, and be simple for monitoring.
Points of Consensus

- Metrics are forward looking & are essential for prioritizing adaptation; However, many barriers besides metrics exist.
- Lack of consensus on quantitative vs. qualitative metrics
- Purpose (e.g. project screening) and context are important (global adaptation targets)
- Metrics have to be scalable, transferable, independent, comparable & cost-effective – Modify criteria through experience; Perhaps two different sets – before and after adaptation intervention
- Involvement of policy makers and local communities in deciding metrics
- Adaptive learning and management must be reflected while developing adaptation metrics
- Actual process of developing indicators is important as it helps communities learn about adaptation
- Need for considering linkages between mitigation goals & mechanisms in adaptation metrics (carbon offsets/land value)
Points to Debate/Research

- Emphasis on quantitative vs. qualitative metrics; direct vs. proxy indicators
- Methods for evaluation of metrics
- Further explore the potential disadvantages of over-reliance on metrics (managing metrics than managing adaptation)
- Need for metrics vs. other information (climate risks at local level, long term climate information) for decision making
Future Line of Work

- Establishing a theoretical framework governing adaptation metrics based on understanding from the field of risk management
- Identifying a set of metrics (or a single Adaptation Index) that capture the multiple dimensions of adaptation
- Prioritizing the adaptation metrics using multi-criteria approaches
- Validation of identified metrics under different conditions
To read or trash our interim report, visit:

www.iges.or.jp/en/cp/index.html

or, write to

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