Representative Agricultural Pathways and Scenarios: A Trans-Disciplinary Approach to Agricultural Model Inter-comparison, Improvement and Climate Impact Assessment

Roberto Valdivia\textsuperscript{1}, John Antle\textsuperscript{1}, Lieven Claessens\textsuperscript{2}, Gerald Nelson\textsuperscript{3}, Cynthia Rosenzweig\textsuperscript{4}, Alex Ruane\textsuperscript{4}, and Joost Vervoort\textsuperscript{5}

\textsuperscript{1}Oregon State University; \textsuperscript{2}International Crops Research Institute for the Semi-Arid Tropics, ICRISAT; \textsuperscript{3}Professor Emeritus, University of Illinois, Urbana Champaign; \textsuperscript{4}NASA Goddard Institute for Space Studies; \textsuperscript{5}University of Oxford/CCAFS
The global IAM and IAV communities need a ‘small’ set of possible future worlds for integrated assessment modeling and analysis (“reference scenarios”)

- Earlier version: “Special Report on Emissions Scenarios” linked emissions to socio-economic development narratives and assumptions
- But in fact there are many socio-economic development pathways consistent with each emission trajectory

- IPCC process for new “pathway” concepts
  - RCPs: Representative Concentration Pathways
  - SSPs: Shared Socio-Economic Pathways
RCPs, SSPs and RAPs

Representative Ag Pathways
- economic & social development narratives
- soil & water resource trends
- agricultural technology trends
- prices and costs of production
- ag, mitigation & other policy
Representative Agricultural Pathways (RAPs): linking agriculture-specific pathways to SSPs

- **Global RAPs**: Global Economic Models and other non-modeled global socio-economic conditions:
  - GDP, population & policy and trade, etc

- **Regional RAPs**: Allow us to include key drivers that can’t be modeled, but are likely to affect future bio-physical and socio-economic conditions:
  - ag productivity trends, land use, policy, regional development
  - farm size, system-specific productivity & management, infrastructure, etc

- **Adaptation and Mitigation Strategies**
  - need meaningful level of detail on changes in systems:
    - system characterization (crop vs livestock, etc), crop and livestock varieties, crop mix, management (fertilization...)

**AgMIP Regional IA Framework:** Parallel development of system design, data and modeling to couple crop & livestock models with economic impact models

- Climate data
- RCPs
- SSPs
- Crop, Livestock Models
- Regional RAPs
- Global RAPs
- Relative yield distributions
- Economic Impact Model (TOA-MD)
- Global & Regional Econ Models
- Prices and Costs
- Economic, Environmental, Social Impacts

Experiments, Surveys & Expert data
Representative Agricultural Pathways

- Economic, social and bio-physical development narratives
  - agricultural technology trends
  - prices and costs of production trends
  - ag, conservation, other policy

- These “pathways” are combinations of economic, technology and policy drivers that represent a plausible range of possible futures.
- They are not meant to be predictions, but rather provide researchers with a range of plausible scenarios that can be used to simulate possible future outcomes in a consistent and transparent way.

**RAPs narratives provide a framework in which qualitative information can be translated into model parameters (quantification!)**
**RAPS Development Process**

**First meeting:**
1. Start with a “Business as usual” (BAU) RAP  
2. Team members identify key parameters that will likely be affected by higher level pathways and draft RAP narrative  
3. Team members are assigned variables for research  
4. Team members conduct research – use of templates for reporting and supporting documentation  
5. Templates can be distributed to experts for feedback

**Second meeting:**
5. Team members report findings and discuss storylines for each variable  
6. BAU RAP is finalized  
7. Additional RAPs are identified  
8. Process similar to BAU is carried out  
9. Additional background research

Create Additional RAPs

RAPS distributed to stakeholders and outside experts

Modelers develop scenarios
Tools for RAPs development:

- **DevRAP matrix and software:** Construct RAPs narratives and quantify scenarios parameters for TOA-MD. Template to parameterize TOA-MD and document model scenarios

- **Reporting Templates:** Help team members document background information specific to drivers under research

- **Pathways summary trends table:** Helps to visually inform users about trends and magnitudes of key driver changes included in RAP narratives
<table>
<thead>
<tr>
<th>CATEGORY</th>
<th>VARIABLE / INDICATOR</th>
<th>Leader</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bio-Physical*</td>
<td>Soil erosion</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Crop genetic improvement (yield potential)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Water supply - irrigated land and dryland</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Pests, weeds and diseases</td>
<td></td>
</tr>
<tr>
<td>Institutional/Policy*</td>
<td>Subsidies</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Conservation programs</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Environmental regulation</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Governance (quality &amp; functioning v.s laws &amp; regulations)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Climate policy</td>
<td>NA</td>
</tr>
<tr>
<td>Socio-Economic*</td>
<td>Farm Size - commercial size and small numbers</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Commodity prices</td>
<td></td>
</tr>
</tbody>
</table>

**Definition**
- No change
- Low increase
- High increase
- Small decrease
- Large decrease

**Arrows**
- Supply and demand from 2000 to 2050 and for Agricultural Commodities to 2010
- See Figure 1 from IFPRI report of “2011 global food security”
- See Figure 2 from IFPRI report of “2011 global food security”
# AgMIP Regional Teams: RAPs development and implementation summary

<table>
<thead>
<tr>
<th>Regional Research Team</th>
<th>Location</th>
<th>RAPs type</th>
<th>Stakeholder involvement</th>
<th>Number of Model Scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td>CLIP</td>
<td>Zimbabwe, Matabeleland</td>
<td>Positive</td>
<td>Yes</td>
<td>3</td>
</tr>
<tr>
<td>CLIP</td>
<td>Zimbabwe, Matabeleland</td>
<td>Negative</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>CLIP</td>
<td>Mozambique, Manica</td>
<td>Positive</td>
<td>Yes</td>
<td>1</td>
</tr>
<tr>
<td>CLIP</td>
<td>Mozambique, Manica</td>
<td>Negative</td>
<td>Yes</td>
<td>0</td>
</tr>
<tr>
<td>East Africa</td>
<td>Kenya, Embu</td>
<td>Positive</td>
<td>Yes</td>
<td>n/a</td>
</tr>
<tr>
<td>SAMIIP</td>
<td>Namibia</td>
<td>Positive</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>SAMIIP</td>
<td>South Africa</td>
<td>Positive</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>CIWARA</td>
<td>Senegal, Nioro</td>
<td>Negative</td>
<td>No -Planned Nov ‘13</td>
<td>n/a</td>
</tr>
<tr>
<td>CIWARA</td>
<td>Senegal, Nioro</td>
<td>Positive</td>
<td>No -Planned Nov ‘13</td>
<td>n/a</td>
</tr>
<tr>
<td>South India</td>
<td>India - ANGRAU</td>
<td>Positive</td>
<td>Some</td>
<td>1</td>
</tr>
<tr>
<td>IGB</td>
<td>India - IGB</td>
<td>Negative</td>
<td>Yes</td>
<td>2</td>
</tr>
<tr>
<td>IGB</td>
<td>Nepal - IGB</td>
<td>Positive</td>
<td>No</td>
<td>0</td>
</tr>
<tr>
<td>Pakistan</td>
<td>Pakistan, Wheat-Rice Region</td>
<td>Positive</td>
<td>Yes</td>
<td>2-4?</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>Sri Lanka, Kurunegala dist</td>
<td>Positive</td>
<td>n/a</td>
<td>n/a</td>
</tr>
<tr>
<td>Sri Lanka</td>
<td>Sri Lanka -FECT</td>
<td>Positive</td>
<td>n/a</td>
<td>1</td>
</tr>
</tbody>
</table>

Note: This list includes RAPs reported by teams by October 30, 2013
n/a : Not reported
Acknowledgements:

- AgMIP Regional Teams for providing current RAPs status

- Regional Approaches to Climate Change (REACCH) Project (US Pacific Northwest) for their contribution to methodology for RAPs development

Thanks!