Representative Agricultural Pathways and Scenarios for Regional Integrated Assessment of Climate Change Impact, Vulnerability and Adaptation

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AgMIP The Agricultural Model Intercomparison and Improvement Project

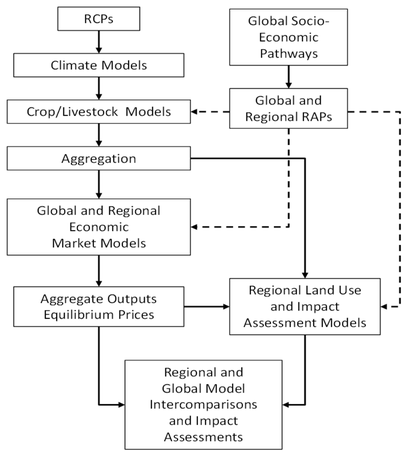
USDA

UKaid from the British people

Improving Methods for Climate Change Impact Assessment

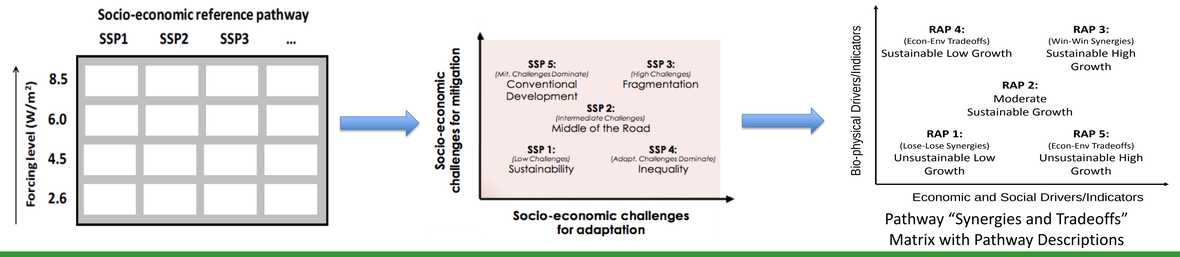
The global change research community has recognized that new pathway and scenario concepts are needed to implement impact and vulnerability assessment that is logically consistent across local, regional and global scales (Moss et al. 2008, 2010). For global climate models, Representative Concentration Pathways (RCPs) have been developed (Moss et al. 2008, 2010; van Vuuren et al. 2011); for impact and vulnerability assessment, new socio-economic pathway and scenario concepts have also been developed (Kriegler et al. 2012; van Vuuren et al. 2012), with leadership from the Integrated Assessment Modeling Consortium (IAMC). "The new scenarios will provide quantitative and qualitative narrative descriptions of socioeconomic reference conditions that underlie challenges to mitigation and adaptation, and combine those with projections of future emissions and climate change, and with mitigation and adaptation policies. They will provide a framework for underpinning, creating, and comparing sectoral and regional narratives." (Carter et al. 2012)

AgMIP's Global and Regional Integrated Assessment Modeling Framework



Representative Agricultural Pathways and Scenarios

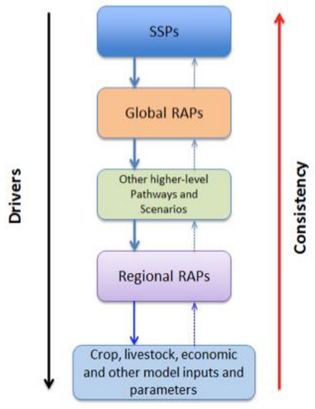
These Pathways and Scenarios are based on the integrated assessment framework developed by the Agricultural Model Inter-comparison and Improvement Project. This framework shows that both bio-physical and socio-economic drivers are essential components of agricultural pathways and logically precede the definition of adaptation and mitigation scenarios that embody associated capabilities and challenges. This approach is based on a trans-disciplinary process for designing pathways and then to translate pathways into scenarios for both bio-physical and economic models that are components of agricultural integrated assessments of climate impact, adaptation and mitigation. To implement this trans-disciplinary approach, we propose a step-wise process similar to the "story and simulation" (SAS) approach to scenario design (Alcamo 2008) that brings together expertise from the relevant disciplines to design pathways, and then use these pathways to design consistent scenarios (i.e., model-specific parameters) for crop and livestock simulation models and economic impact assessment models .



Pathway "Synergies and Tradeoffs" Matrix with Pathway Descriptions

Designing RAPs and Scenarios

1. A multi-disciplinary team of scientists and other experts is established.
   - Team members need to have knowledge of the agricultural systems and regions to be covered
2. The team reviews general goals and define the time period for analysis and selected higher-level pathways (SSPs, Global RAPs) to follow the nested approach.
3. Main drivers from higher level pathways are identified (and quantified if possible, e.g. outputs from global models)
4. Based on drivers and specific agricultural systems, a draft of a title and a short narrative of a RAP is constructed
5. Based on the draft narrative, the team identifies key parameters that will likely be affected by driving forces
6. The team draft storylines for each one of the parameters
7. The team checks for consistency within the RAP components and with higher level pathways and models' outputs
8. Based on consistency check, agreement and confidence levels among team participants, steps 4 -7 are repeated until an acceptable draft of consistent storylines and levels of agreement and confidence are achieved.
9. The team identifies parameters that will need additional revision (expert opinion, modeled data, etc.) or that will likely be subject to sensitivity analysis.
10. The team elaborate full RAP narrative
11. The RAP narrative is documented and distributed to other experts and scientists for comments
12. The final RAPs are distributed to the modeling teams for parameters quantification and scenario development



Hierarchical Structure: Linkages from higher level pathways for dis-aggregation and model specific-scenario development.

Scenarios Development

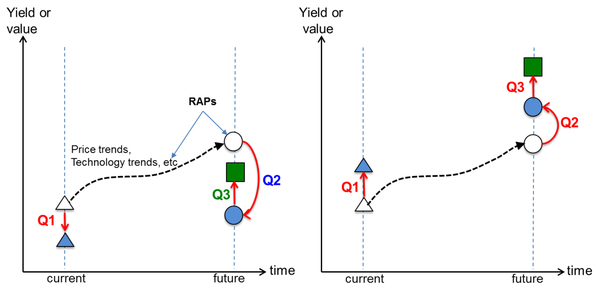
RAPs must be designed to be part of a logically consistent set of drivers and outcomes from global to regional and local. To create pathways and corresponding scenarios at global, regional or local scales, teams of scientists and other experts with knowledge of the agricultural systems and regions work together through a step-wise process similar to the "Story and Scenario" approach (Alcamo 2008). Valdivia and Antle (2012) have developed an Excel spreadsheet tool called DevRAP (in Beta version) to facilitate this process. DevRAP provides a structure to guide this process and to record and document the information systematically, and then use it to develop model-specific quantitative scenarios

AgMIP Core Research Questions

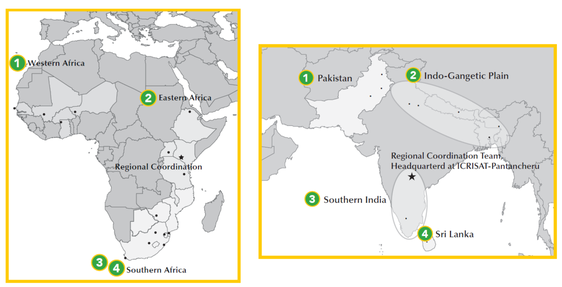
Q1: What is the sensitivity of current agricultural production systems to climate change? This question addresses the isolated impacts of climate changes assuming that the production system does not change from its current state.

Q2: What is the impact of climate change on future agricultural production systems? Assessment of climate impacts on the future production system, which will differ from the current production system due to development in the agricultural sector

Q3: What are the benefits of climate change adaptations? Assessment of the benefits of potential adaptation options in the future production system



AgMIP Regional Teams RAPs development



- **Period of analysis:** Mid-century
- **Higher level Pathways:**
  - ❖SSP2
  - ❖No Global RAPs. Data from IMPACT model (productivity and price trends)
  - ❖Some teams have used information from CCAFS multi-country scenarios
- **Types of RAPs : Business as Usual (BAU)**
  - ❖Pessimistic
  - ❖Optimistic

AgMIP RRTs Trends Tables

Sub-Saharan Africa

Variable	CLIP – R1 Zimb	CLIP – R2 Zimb	CLIP – R1 Mozamb	CLIP – R2 Mozamb	East Africa Embu, KE	West Africa R1 Nioro	West Africa R2 Nioro	SAAMIP South Africa	SAAMIP Namibia
Soil degradation	↘	↗	↗	→	↗	↗	↘	↗	↗
Pest and diseases	●	●	●	●	↗	●	●	●	●
Extreme events	↗	↗	●	●	↗	●	●	●	●
Water availability	●	●	●	●	↘	●	●	↘	↘
Farm size	↘	↘	→	→	↘	↗	↗	↘	↘
Household size	↗	→	→	→	↗	↘	↘	●	↘
Herd size	↗	↘	→	↗	●	↗	↘	●	●
Livestock Productivity	↗	↘	→	↗	●	↗	↗	●	●
Fertilizer prices	→	↗	↘	→	↗	→	→	●	●
Fertilizer use	↗	↘	↘	↗	↗	●	●	↗	↗
Subsidies (inputs)	↗	→	→	→	●	↗	↘	●	●
Off-farm income	↘	↘	↗	↗	↗	↗	↗	↗	↘
Improved crop use	↗	↘	→	↗	●	↗	↗	↗	→
Information availability	●	●	●	●	↗	●	●	●	●
Public invest in agriculture	↗	→	↘	↗	●	●	●	↗	→
Labor availability	↗	↘	→	↗	↘	●	●	●	●

	No change	Small increase	Moderate increase	Large increase	Small decrease	Moderate decrease	Large decrease	Not included or under revision
Direction and magnitude	→	↗	↗	↗	↘	↘	↘	●

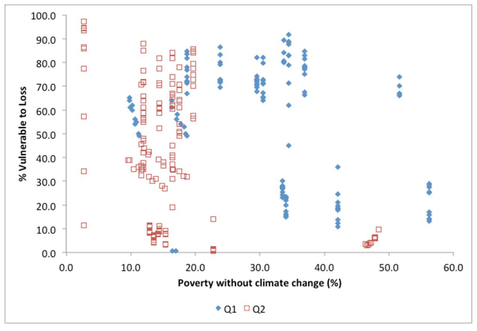
Shaded columns are BAU-Pessimistic RAPs

South Asia

Variable	Pakistan	Sri Lanka - FECT	Sri Lanka - Kuneg	IGB North India	IGB Nepal	South India TNAU	South India ANGRAU
Soil degradation	↗	↗	→	↗	↗	→	↗
Pest and diseases	↗	●	●	●	↗	↘	↗
Extreme events	↗	↗	●	●	↗	●	↗
Water availability	↘	●	↘	●	●	●	↗
Farm size	↘	●	↘	↘	→	↗	↗
Household size	↗	→	→	↘	●	→	●
Herd size	↗	●	●	●	●	●	●
Livestock productivity	●	●	●	●	●	●	●
Fertilizer prices	↗	↗	↗	●	↗	→	↗
Fertilizer use	↗	●	●	●	●	●	↘
Subsidies (inputs)	↗	↘	↘	→	↗	→	↘
Off-farm income	↗	●	●	●	↗	↗	↗
Improved crop use	↗	↗	↘	●	↗	→	↗
Information availability	↗	↗	●	↗	↗	●	↗
Public investment in agriculture	↗	↗	→	●	↗	●	↘
Labor availability	↗	↘	↘	●	↘	↘	↗

- **Pathways summary trends table:** Helps to visually inform users about trends and magnitudes of key driver changes included in RAP narratives

Importance of Future Scenarios (RAPS) for Regional Integrated Assessments



Future socio-economic conditions (with no climate change) tend to reduce poverty rates (Q2) compared to current conditions (Q1). However, the percentage of farms vulnerable to loss due to climate change is still high.

Challenges

Identification of indicators
- Need a comprehensive list of indicators with definitions

Data availability
- Finding reliable data (e.g. trends) at regional or local level, in particular for non-modeled activities

Agreement on trends direction and magnitude
- *Disciplinary bias*
- *"predictions" vs "plausible projections"*

Interaction with Stakeholders
- Policy or personal agendas, non-scientific description of RAPs

Uncertainty
- Productivity and price trends, production costs

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3 University of Oxford, UK
4 University of Faisalabad, Pakistan
5 Prospective Agricole et Rurale, Senegal
6 International Crops Research Institute for the Semi-Arid Tropics, Zimbabwe
7 University of Nairobi, Kenya
8 Human Sciences Research Council, South Africa
9 Tamil Nadu Agricultural University, India
10 Department of Agriculture, Peradeniya, Sri Lanka
11 Indian Council of Agricultural Research, India

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