Regional Integrated Assessment of Climate Change Impacts, Vulnerability and Adaptation of Agricultural Production Systems

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• How to best use available data and models to assess future food and environmental security of farm populations – especially the most vulnerable – i.e., the small-scale semi-subsistence systems typical of the poorest regions of the world?

• How to provide better answers to stakeholders with more robust projections of climate change impacts and benefits of Adaptation? What is meaningful to Stakeholders? (poverty, food security, health, etc).

• Many Challenges:
  – Small but complex systems (crops, livestock, off-farm activities, etc).
  – Heterogeneous populations (gainers and losers)
  – Multi-dimensional outcomes: economic, environmental, social *tradeoffs*
  – Out-of-sample assessments: space and time
  – Multiple scales: sub-national, national, global
  – Data limitations: experimental survey, aggregated, modeled, expert
• **AgMIP: Need for protocol-based approach**
  - To evaluate uncertainties
  - To use ensembles (possible for econ models?)
  - To improve models
  - To address challenges mentioned above

• **AgMIP RIA methodology**
  – Pathways and scenarios (RCPs, SSPs, RAPs)
  – Global models: prices, prod trends
  – Regional models: “hybrid structural models” combine bio-physical & econ models
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 are the benefits of adaptation in current agricultural systems?** This question addresses the benefit (e.g., economic and food security resilience) of potential adaptation options to current agricultural systems given current climate.

Q3: **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.

Q4: **What are the benefits of climate change adaptations?** Assessment of the benefits of potential adaptation options in the future production system.
Linking Agriculture-Specific Pathways to SSPs: Representative Agricultural Pathways (RAPs)

Hierarchical structure (nested approach)

SSPs: Framework for development of sectoral (e.g. agricultural) global and regional scenarios.

- 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 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

AgMIP: Developing and implementing Representative Agricultural Pathways and Scenarios (RAPS)
Pathways - Nested approaches

Global physical and economic water scarcity

Sub-national

A1a  A1b  A1c  A2a  A2b  A2c  A3a  A3b  A3c

Future socio-economic scenarios: Linking SSPs, RCPs, RAPs and price/productivity trends to be used in AgMIP Phase II:

**RAP 4: “Sustainable low growth (SLG)”**. This RAP will be combined with RCP 4.5 and with global economic model outputs associated with SSP1.

**RAP 5: “Unsustainable high growth (UHG)”**. This RAP will be combined with RCP 8.5 and with global economic model outputs associated with SSP3 – (or SSP5?)

### AgMIP Regional Research Teams RAPs Trends Table: SSA (AgMIP, Phase I)

#### Variable

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#### Direction and magnitude

- No change: →
- Small increase: →
- Moderate increase: →
- Large increase: →
- Small decrease: →
- Moderate decrease: →
- Large decrease: →
- Not included in RAP or under revision: ⬤

**BAU Pessimistic**

**SSP2, period 2050**
Methodological issues relevant for the CGRA discussions

- Global models: price, productivity trends & uncertainties
- Regional models: dimensionality = GCMs x RCPs x SSPs x Crop models x RAPs x Adaptations
- Pathway/scenario uncertainty
- Scaling down, up with scenarios, adaptations
  - Adaptation: global-regional inconsistencies
  - (disaggregation, aggregation)