Agriculture and Climate Change

Impacts, Adaptation, Mitigation and Trade

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Presentation Overview

- Climate change will affect agriculture
  - Higher global temperatures, more precipitation, more variability and extreme events
  - Likely negative effects: Where and how much?

- Adaptation/resilience: Agriculture will need
  - New varieties, more infrastructure, changes in management practices and policies
  - International institutions that support resilience globally

- Mitigation: Agriculture can
  - Reduce emissions of greenhouse gases
  - Act as a sink for other sectors

- Climate Change, Agriculture and Trade
IMPACTS OF CLIMATE CHANGE ON AGRICULTURE
Rising average temperatures

Global Land-Ocean Temperature Index

Source: http://data.giss.nasa.gov/gistemp/graphs/
... could increase much more

Source: Figure 10.4 in Meehl, et al. (2007)
Consequences:

Higher temperatures and more but shifting precipitation…

Dec-Feb

Temperature A1B: 2080-2099

DJF Precipitation A1B: 2080-2099

Jun-Aug

Temperature A1B: 2080-2099

JJA Precipitation A1B: 2080-2099

GCM3.1 (T63). SRES A1B Scenario

... but uncertainty about where and how much
Climate Change Effects on Agriculture

What did we think in the mid-1990s?

- **No problems**
  - Agricultural effects of climate change would be manageable
  - Negative yield effects in temperate regions buffered by trade
  - CO$_2$ fertilization important
  - Increased trade flows needed
Climate Change Effects on Agriculture

What did we think in the early 2000s?

- **Potential problems but manageable**
  - Production in DCs benefit; declines in LDCs
  - Regional differences grow stronger over time
  - Substantial increases in risk of hunger in poorer nations
  - CO₂ fertilization important
  - Increased trade flows needed
Climate Change Effects on Agriculture

What did we think in the mid-2000s?

- Potential for problems is larger
  - Yields would likely increase somewhat in all regions
  - Smaller gains in the temperate regions than previous models
  - Small yield gains in the tropics
  - CO$_2$ fertilization important
  - Increased trade flows needed
What about the CO$_2$ fertilization effect?

- Needed in all models to offset some of productivity losses from climate change, but...
- Recent reports on field experiments on CO$_2$ fertilization are negative
  - Higher levels of atmospheric CO$_2$ increase susceptibility
    - Soybeans to the Japanese beetle
    - Maize to the western corn rootworm
Climate Change Effects on Agriculture

What do we think in 2009?

Irrigated rice yields decline 20%

Preliminary results
Maize, IMPACT model FPU Level
Maize Variety 990001
Maize Variety IB0041
Maize Variety IB0041
Suggested Negotiating Outcome for Agriculture

- Make funds available for research to improve our understanding of the interactions between climate change and agriculture
  - Higher spatial resolution and
    - more relevant outputs from climate models
    - better integration of agriculture into integrated assessment models
  - Better biophysical and socioeconomic modeling of climate change-agriculture interactions
AGRICULTURE AND CLIMATE CHANGE ADAPTATION
Adaptation in agriculture is essential

- **Good development policy** is important first step
  - Higher incomes from productive agricultural resources, used sustainably, provide resilience in the face of climate change

- **Location, location, location**
  - Climate change effects vary across the landscape
  - What’s needed?
    - Location-specific analysis
    - Location-specific programs and policy measures

- **International institutions that support resilience globally are critical**
Adaptation needs

- Increased expenditures in agricultural science and technology
- Increased investments in water storage and management
- More development of rural infrastructure, physical and institutional
- Policy improvements to internalize externalities associated with environmental services
Agriculture adaptation: Suggested negotiating outcomes

- Include funding modalities for agriculture
  - Recognize the connection between pro-poor development policies for sustainable growth and climate-change adaption
  - Recognize and support synergies between adaptation and mitigation
- Provide funds for
  - Technology, infrastructure and institutional innovations
  - Global data collection
    - improves understanding of the spatial context of agriculture
- Support international institutions that foster resilience
Agriculture’s GHG emissions are large, but shares differ by region

<table>
<thead>
<tr>
<th>Region</th>
<th>Total GHG emissions (Mt CO₂e)</th>
<th>Share from agriculture</th>
<th>Share from land-use change and forestry</th>
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</thead>
<tbody>
<tr>
<td>Europe</td>
<td>7,600</td>
<td>9.1</td>
<td>0.4</td>
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<tr>
<td>North America</td>
<td>7,208</td>
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<tr>
<td>South America</td>
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<td>23.6</td>
<td>51.6</td>
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<tr>
<td>Sub-Saharan Africa</td>
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<tr>
<td>Asia</td>
<td>14,754</td>
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<tr>
<td>Developing countries*</td>
<td>22,186</td>
<td>15.7</td>
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<tr>
<td>World</td>
<td>40,809</td>
<td>14</td>
<td>18.7</td>
</tr>
</tbody>
</table>

Source: WRI CAIT, 2009
* - Non Annex 1 countries
Agricultural mitigation: Cost-effective options

- Change crop mixes
  - plants that are perennial and/or with deep root systems
- Use cultivation systems that leave residues
  - reduce tillage, especially deep tillage
- Shift land use from annual crops to
  - Perennial crops
  - Pasture
  - Agroforestry
- KEY Issue – MRV - Measurable, Reportable, and Verifiable
Agricultural mitigation: Suggested negotiating outcomes

- Establish a chapter for agriculture-related mitigation (and adaptation) investments as part of any global mitigation funding mechanism
- Include agriculture and land-use change from the outset of any Post-Kyoto agreement but allow for long-term means-tested adjustment opportunities
- Fund development and implementation of low-cost monitoring systems
- Allow innovative payment mechanisms and support for novel institutions for agricultural mitigation
Climate Change, Agriculture and Trade

- Climate change will alter comparative advantage
  - Current trade flows will change
  - Direction and magnitude of changes are uncertain
  - LDC agricultural export growth has been in high value ecological niche products with uncertain futures
    - Exploiting seasonal differences (vegetables from south to north in north’s winter)
    - Unique climate/soil niches – coffee, tropical fruits

- Trade measures that restrict flows make adjustments more difficult
Concluding remarks

- Our children will pay the price of climate change

- We must start adaptation now if we are to feed the world sustainably and reduce poverty

- Agriculture can play an important role in mitigating GHG emissions

- Including agriculture in a Copenhagen agreement is essential