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Agricultural adaptation to climate change

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September 21, 2012

Overview

- Assessing direct impacts on agriculture
- Importance of heterogeneity
- Mitigation and adaptation options
- Policy issues

Direct impacts on agriculture

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Movement of warmer climate from the tropics to the Poles

- Mexican climate will migrate to California.
- The Sahel will expand
- California climate will migrate to Oregon.
- Most of Texas and Oklahoma will become a desert, and some areas in Russia will increase in productivity.

Increased snow melt flooding and changes of volume and timing of irrigation water

Climate change will increase instability

- Rising water levels
- More extreme weather events
- Damage to ecosystems
- Increase vulnerability
- Leads to political instability

Agriculture's Response to climate change

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- Adaptation-farmers will change inputs use and switch crops
- Redesign and reconstruction of water systems
- Some areas near the tropics will be deserted; some areas close to the Poles will be farmed.
- The net aggregate effect may not be significant, but the regional effects may be substantial.

Climate change impact on yields

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Desertification at equator; transition of prod. to poles

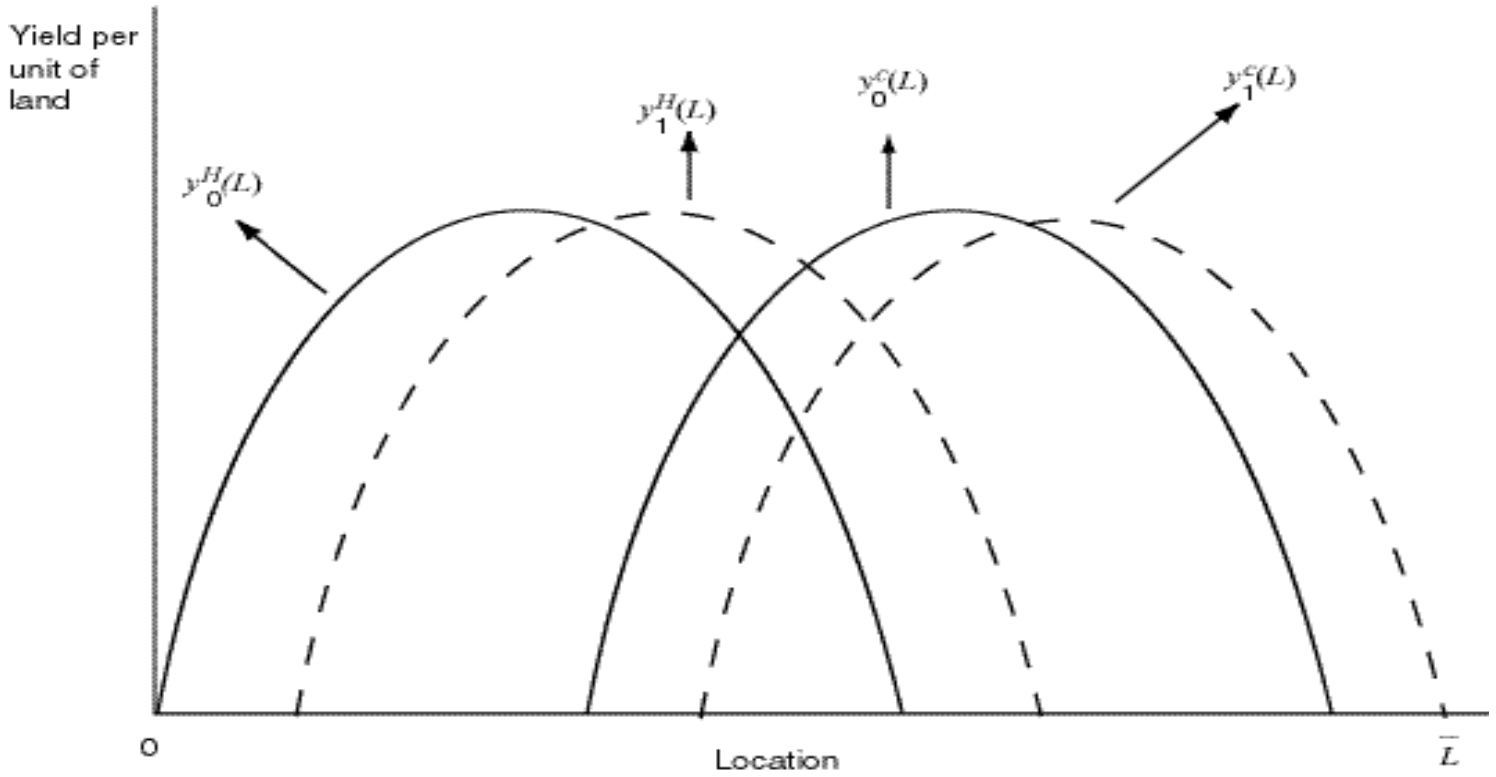

Figure 1. Impact of Climatic Change on Yields (Ignoring Pest and Fertilization Effects)

Yield and weather

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- Higher temperatures; change in rainfall lead to drastic yield reductions
  Some studies suggest that in some region yield losses will be 20% and higher
- Adds to low growth in productivity that contribute to large current food price rises
- Research and new technologies can compensate for these losses

Impact on biodiversity

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- Pest move faster than trees
- Destruction is faster than natural adjustments
- Adjusting farming system is time consuming &uncertain- it took 20-50 years
- Natural tendency is to have quick solution resulting in few dominant varieties
- But even this adjustment is likely to be slowed

Major forms of adaptation

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- Migration outside the affected region- happened in the past
- Innovation
- Mitigation
- Adoption of new technologies/crops
  - Sometimes the adoption is from other regions
- Trade
- Inventories and stabilization

Adaptation- vary by location

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- Optimal Adaption strategies vary by location to accommodate heterogeneity
  - In some parts of Africa there is a capacity to expand irrigation – but not in others
  - Technologies should take advantage of abundant resources and save scarce one
  - There is a value in improving input use efficiency – and reduce residues polluting residues
- All require strong research planning and management capacity
- Ability to dare and change

Importance of quantification

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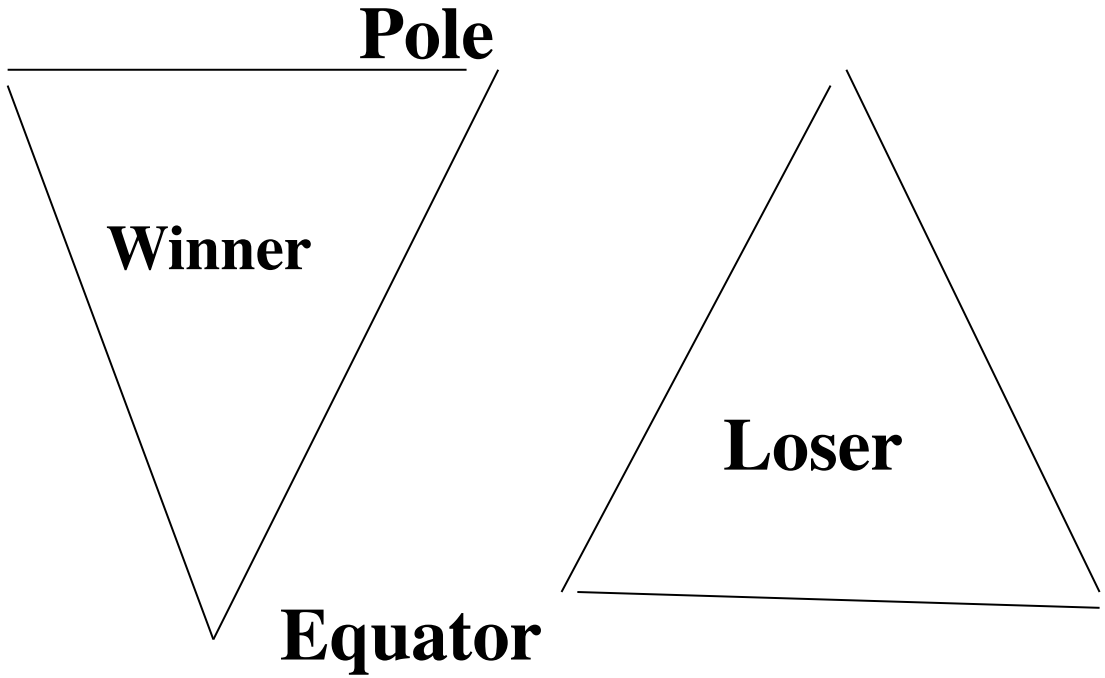
- The assessment of impacts and design of adjustment policies that vary over space & time depends on understanding of
  - Impact of climate change on temperature and rainfall
  - Impact of these changes on yield distribution
  - How human choices can affect impacts
  - Behavioral patterns that are affect human choices
- There are new opportunities to conduct multidisciplinary research

Transaction costs and uncertainty

- Uncertainty about timing of change is a major problem **– uncertainty deters action.**
- Adjustment costs increase as pace of change **accelerates**
- Flood control, rising water levels and relocation require slow and costly adjustments
- Immigration policies and land use regulations slow responses
- **CC increases vulnerability to crisis – drought, disease etc. Effective response is measured by ability to deal with extreme situations**

Shape and location matter



- Poorer countries with lower adjustment capacity and changing climate patterns will suffer most
- Trade and aid will reduce effect of change

New environmental thinking

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- Traditional instinct is to preserve, protect, conserve
- Ideal return to sustainability- some sort of steady state
- That justifies policies to slow CC such as carbon tax
- But process already in motion changes require adaptation
  - Zoning laws that ban or restrict farming needs to be modified to allow flexibility
  - Policies to support adapted technologies over heterogenous conditions

Human are part of evolution

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- Human capacity to change nature should be viewed in context of co-evolution and not fought against
- **Not using science** to find solutions to CC will lead to a back lash. Need bioscience that can introduce responsible changes that will increase capacity to combat tough reality

Biotechnology: a major tool for adaptation

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- Adaptation will require rapid development of new varieties; addressing new pest and resource constraints
- Biotechnology (including GMOs, tissue culture etc)
  - We will need to use as many tools we can have
  - GMOs has had strong impacts on yield in developing countires addressing pest problems not treated before
- Biotechnology can enhance biodiversity
  - They can be used to restore lost species
  - With correct infrastructure can introduce traits to local varieties
- For biotechnology to meet its potential we need sound regulation- not overbearing ones

A long-term perspective on mechanisms to reduce climate change impact

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- Research - and flexible yet sound regulatory framework
- Utilize all tools – it is an emergency
- But consider other tools
  - Know when to give up and encourage migration
  - Improve international system to handle emergencies
  - Enhance inventories
- Do not give up on mitigation: slowing climate change is crucial

A long-term perspective on mechanisms to reduce climate change impact

- The impact of climate change depend on population growth and technological change.
- If population grows slower(faster) than food productivity, CC impacts are less (more) severe
- International arrangements to handle emergencies and relocations will improve response to climate change.
- Introduction of rapid assessment and response institutions that will facilitate the design and implementation of “climate smart agriculture” strategies
  - develop and transfer technologies
  - help developing countries with implementation

Principles of policies to support CSA

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- Incentives to develop capacity to deal with CC
- Pick up low lying fruits
  - Identify synergies between adaptation, mitigation and FS
  - Emphasis on cost effective policies to delay CC
- Consider incentives and their impacts
  - Carbon pricing – may occur sometime – whats its impact
- Emphasis on adaptive management-learn as you go
  - No regret policies.
  - Harmonized ag. and CC policies
- Emphasis increased R&D to develop resource-conserving and monitoring technologies
- Framework for relocation and resettlement.

Mitigation provides new opportunities

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- Biofuels- can be a new sector that will provide jobs – income and reduce GG emissions
- Soil and tree carbon sequestration can be source of income- once an agreement is established
- Do not hold your breath- source for some poor – but of limited capacity

Conclusions

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- Climate change increases the value of good management and flexibility
- Will benefit from investment in research and international collaboration
- Needs public buy-in and willingness to sacrifice- requires education and building awareness

Methodological lessons

- Identify the key questions and how economics can answer
- Combine modeling data and econometrics
- Operate at various levels micro/macro/global
- There is a premium to multi-disciplinarity