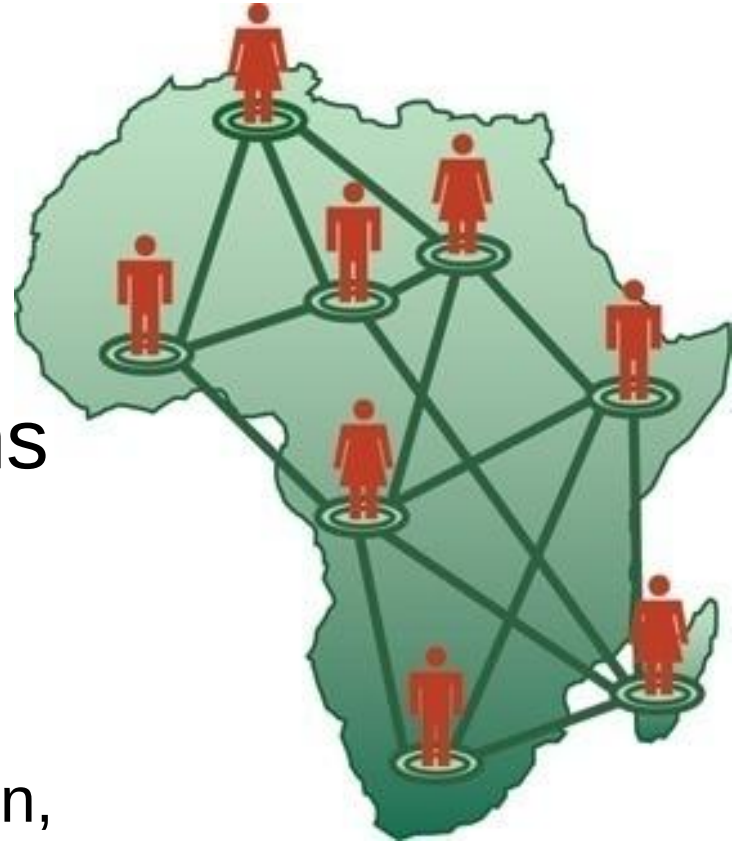
Climate Change:

An overview of research questions



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AGRODEP Workshop on Analytical Tools for Climate Change Analysis

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CLIMATE CHANGE

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AGRODEP MEMBERS' MEETING AND WORKSHOP

JUNE 6 -8, 2011

DAKAR, SENEGAL

Direct impacts on agriculture

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 enhance instability

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

Agriculture's Response to climate change

- 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 effect may not be significant, but the regional effects may be substantial.

Climate Change and Agriculture

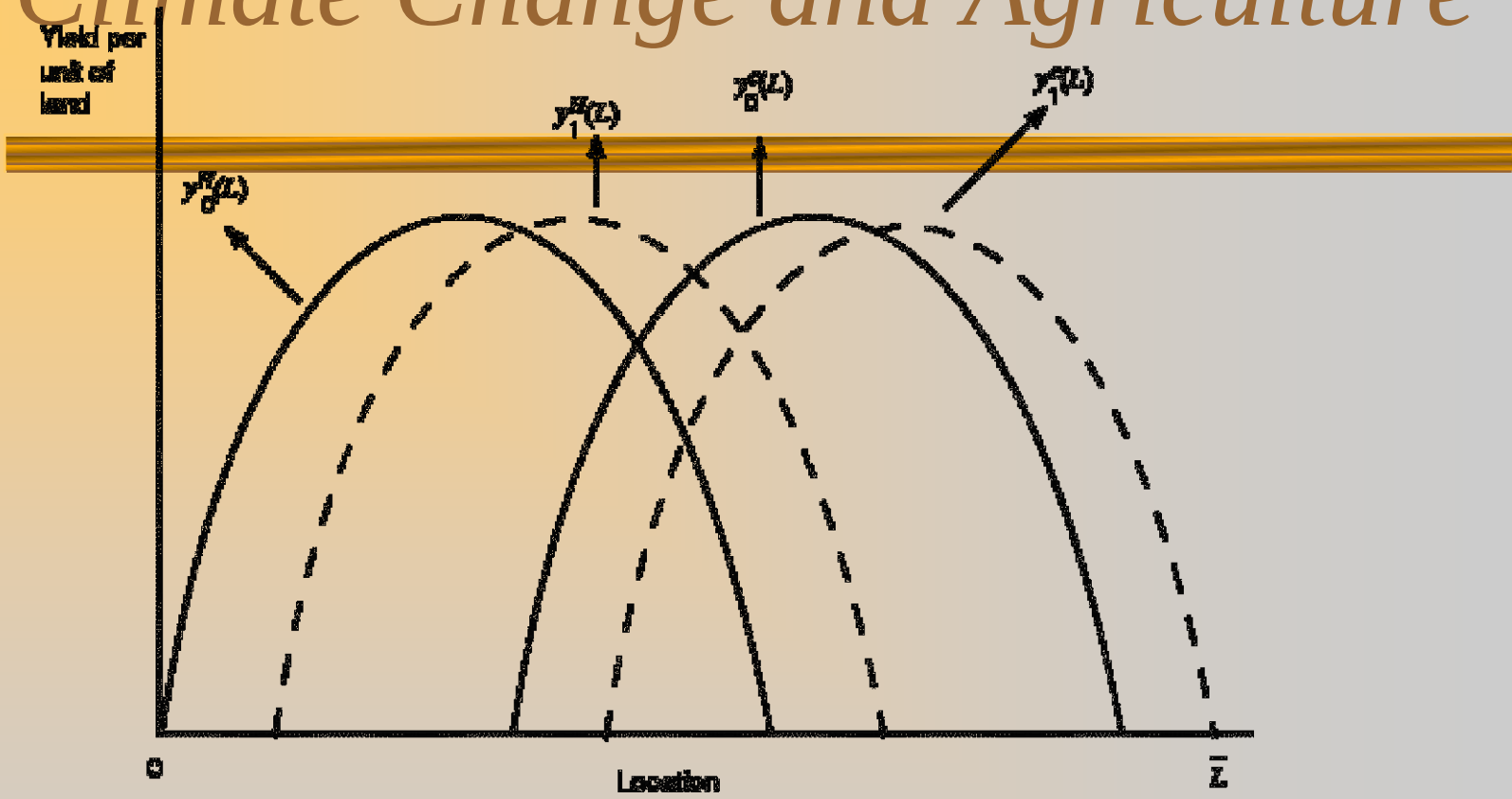


Figure 1. Impact of Climatic Change on Yields (Ignoring Past and Fertilization Effects)

Hot crop near equator,cold one near poles.

With CC movement to the pole,settlement close to poles transition from cold to hot,desertification

Other impacts on agriculture

Fertilization effect: Higher levels of carbon will increase yield.

Daylight effect: Moving north will reduce exposure to the sun and reduce yield.

Pest effect: Warmer climate will lead to northward movement of pest and reduce yield.

Protein effect: Increase in carbon will lead to higher yields but less protein production.

Fertilization and Pest Effects

- Higher amounts of carbon in the atmosphere will increase photosynthesis and plant productivity and thus increase overall supply.
- The fertilization effects may be associated with less production of protein.
- Pests will migrate with the warmer weather towards the Poles, causing damage to trees.
- Overall, productivity may decline if the pest effect is greater than the fertilization effect.
- There also will be high adjustment costs because developing new crop systems is costly.

Methods for modeling climate change

- Hedonic Price (Ricardian) Models Impacts of climate change will be reflected in asset values.
- Agro-economic models Agronomic estimates of CG impacts on on yields and cost are used to simulate land-use output and prices
- Stochastic Simulations Consider impacts of estimated changes in mean and variability of yields and profits and land use
- Regional Case Studies Interdisciplinary--combine quantitative estimates with expert interviews to assess response to changes.

Yield and weather

- Higher yield lead to drastic result in yield 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
- But research and new technologies can compensate for these losses

Problems of current impact models

- Food Prices reflect temporal market situations
  - Currently there is excess supply of food.
  - Future conditions depend on the race between **population growth and productivity growth**
- Rents reflect commodity support and hide variability among regions
- Models underemphasize pest, fertilization and similar effects
- Models ignore transition and infrastructure costs-they compares equilibria-**but transition matters**
- Under emphasize regional effects

Adjustment costs will hamper adaptation

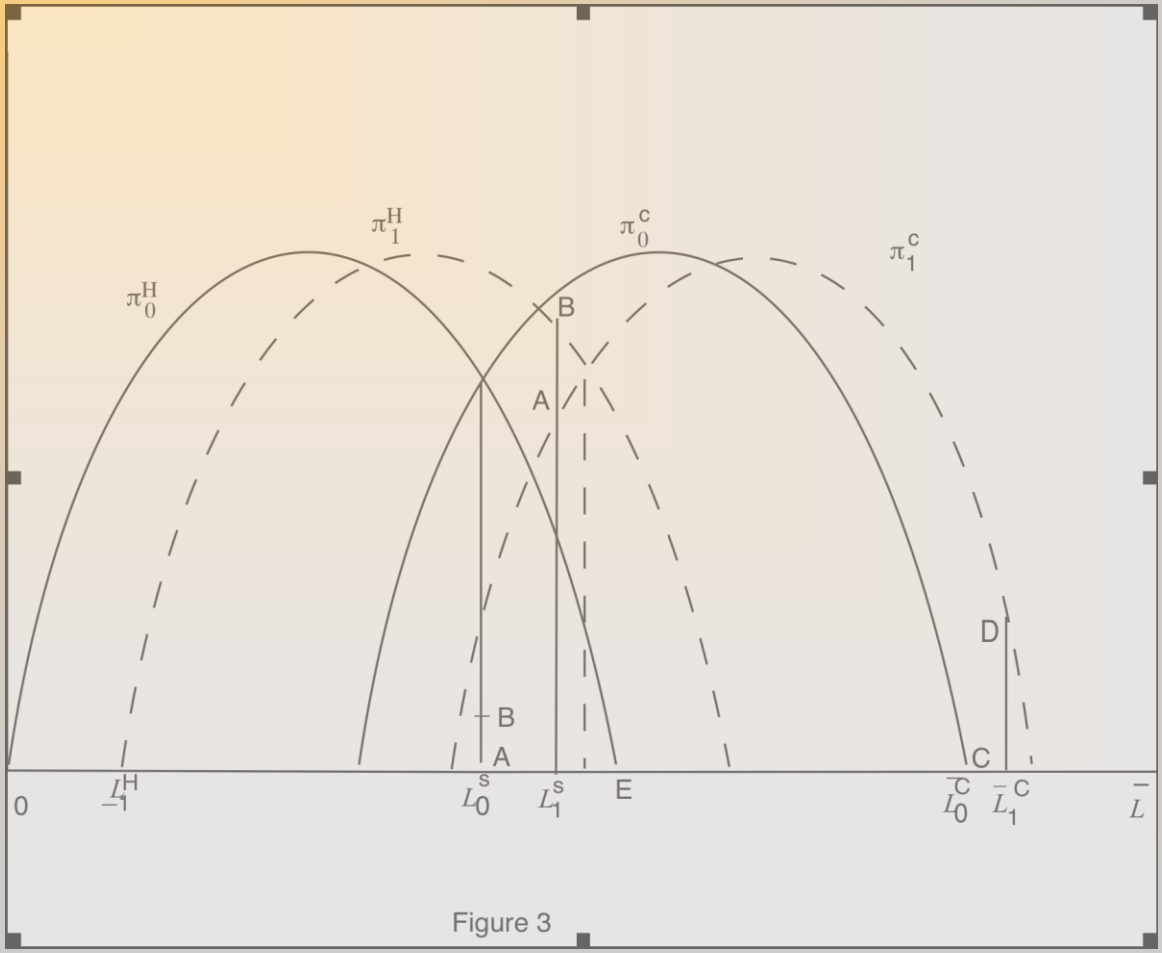


Figure 3

Impact on biodiversity

- 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

- Migration
- Innovation
- Adoption of new technologies/crops
- Trade –
- Inventories and stabilization
- All require strong research planning and management capacity
- Ability to dare and change

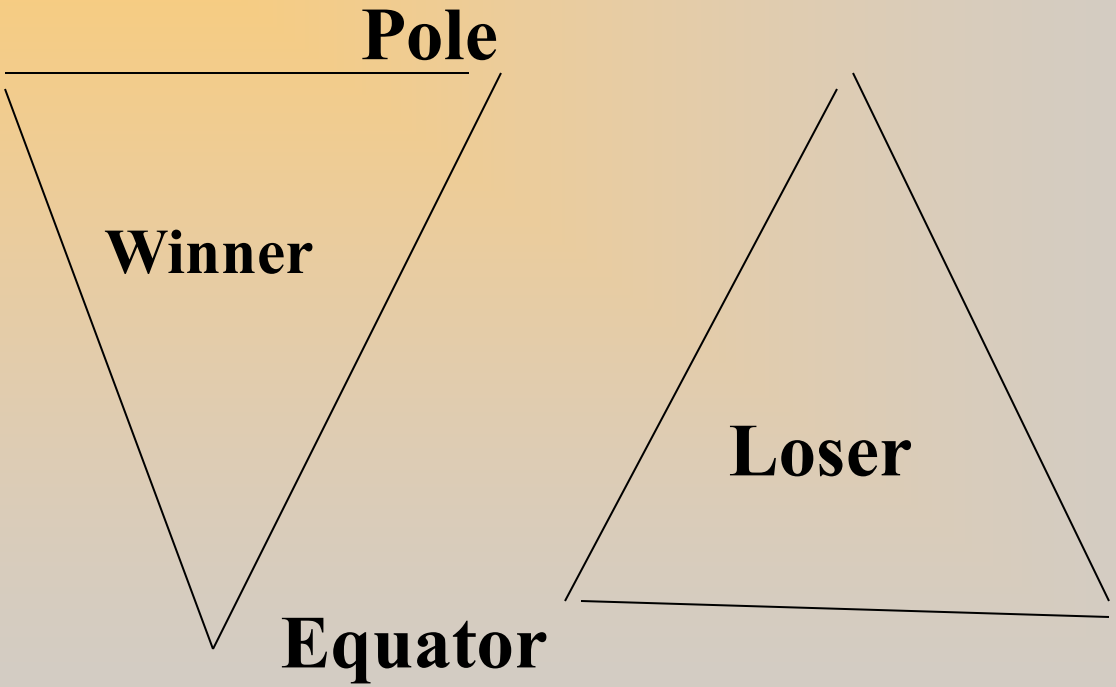
Transaction cost and uncertainty

- Uncertainty about timing of change is a major problem- **uncertainty deters action.**
- Adjustment costs increase as the 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 - draught disease etc Quality of response is measured by ability to deal with extreme situation**

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

- Traditional instinct is to preserve, protect, conserve
- Ideal return to sustainability- some sort of steady state
- That justifies policies to slow CC-carbn tax etc which I support
- But the changes require adaptation
  - Zoning laws that ban or restrict farming needs to be modified to allow flexibility

Biotechnology tools for adaptation

- They can develop new varieties
- They can expand existing biodiversity
- They can be used to restore lost species
- Needed Regulation
  - Sound environmental safety- taking some risk
  - Reduce barrier to access to biotechnology and transaction cost for introducing traits to species
- Need large local capacity to introduce traits to local varieties

A Long-Term Perspective on Impact Analysis

- 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 - design strategies
  - develop and transfer technologies
  - help developing countries with implementation

Human are part on evolution

- 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

Principles of Climate Change Policies

Incentives to develop capacity to deal with CC

- Emphasis on increased R&D to develop resource-conserving technologies and improved monitoring technologies.
- Emphasis on adaptive management.
- Framework for relocation and resettlement.
- Emphasis on cost effective policies aimed to delay climate change.
- No regret policies.

Mitigation provides new opportunities

- 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

The Management of Sink Activities-soil carbon

- Can help in gaining time
- Are subject to uncertainty in terms of impact and measurement
- Issues of enforcements of contracts to modify behavior permanently.
- Decide whether voluntary or mandatory program (voluntary open to abuse)

Monitoring of sink activities is difficult. Carbon flow measurement is impossible--need to measure proxies.

Pay based on crop and technology selection

Contribution depends on past activities-need base line measurement

Payment schemes

- 1.Pay as you go-based on action and past activities - including penalties for emissions
- 2.Long term contracts- pay for a commitment to sequester a target level within a specific period- enforcement is tricky
- 3.Pay for conservation activities regardless of sequestration.

Establishment efficient institutional set up-

- regional aggregators that will buy from farmers and sell to market
- A monitoring body-to oversee aggregators
- An exchange &clearing house

Sequestration is not a panacea

- Payment for carbon will be low ($5-50/ton,net to farmer even smaller)
- Limit on contribution per acre (5-10 tons)
- Joining program will restrict flexibility
- Is useful on marginal land when contributes to other activities
- May entail paybacks to “buy” emission rights
- Trees can bring more income

conclusion

- Climate change increase 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