Ag Technologies for Climate Change: Innovation & Tech Transfer to Developing Countries

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3 Levels of Climate Change Divergence

1. **Climate Changes**
   - Tropical regions may be hardest hit
   - Hot and extreme → Hotter and more extreme
2. **Agricultural Impacts**
   - Nonlinear crop response
   - Heavy dependence on agriculture
3. **Policy & Institutional Mediation**
   - Information, incentives and responsiveness
   - Not all hard hit poor countries will look alike in 2080!

What policy and institutional changes are needed to encourage the innovation and diffusion of appropriate agricultural technologies?

Our Primary Focus

What policy and institutional changes are needed to encourage the innovation and diffusion of appropriate agricultural technologies?

Introduction | Ag Technologies for Climate Change | Innovation & Diffusion | Policy Principles & Priorities

Points of Departure

- Development and effective diffusion of technology will largely shape how and how well farmers mitigate and adapt to climate change
- Innovation needed in technologies, but also in institutions and policies
  - Multiple (nested) scales: Macro, meso, micro
  - Combination of global and local responses is required
- Distributional concerns hinge on heterogeneity at different scales
  - Agro-ecological zones and climate
  - Country-level development, institutions and policies
  - Infrastructure
  - Farm and farmer types

Outline & Focus of Presentation

1. Climate change & agriculture
2. A catalog of agricultural technologies
3. Innovation, transfer and access/use considerations
   - Intellectual property issues
   - Farmers' perspective on access / use
   - Distributional impacts derive from heterogeneity
4. Policy principles and priorities

A Look at the End…from the Beginning

Policy Principles

- Promote rural economic development
- Improve information flows, incentives, & flexibility
- Provide technology options & complements
- Appreciate local perspective & global inter-linkages
- Nurture trade linkages & integrated markets

Policy Priorities

Climate Change & Agriculture: A few points

- We will likely produce more food in 2080, but it may also be more expensive in real terms
  - Most of the poor, including farmers, are net food buyers
- Agriculture may collapse in some marginal areas, which may spark migration and regional tensions
- Local responses may fit changes in mean temperature and rainfall, but regional and global responses are required for volatility changes
- Despite these serious impacts, most poor countries will likely see dramatic improvements in living standards in the coming decades

A Quick Catalog of (Current) Technologies

- New traits, varieties & crops
  - Direct and indirect impacts on mitigation and adaptation
  - Ag biotech: 14.2M tons of CO_2 less in 2007 due to GM crops
- Water management & irrigation
- Other production inputs
  - E.g., biochar
- Production management & practices
  - Conservation agriculture
- Post-harvest marketing & supply chains
  - Efficient transportation
  - Reducing post-harvest losses as an effective productivity boost
- Information & forecasts
- Insurance
  - Innovations in index insurance

Index Insurance Innovations

- Index-based insurance can reduce administrative and moral hazard problems
- NDVI-based index insurance for livestock in Kenya
- Extreme rainfall / heat event index in West Bengal
- "Index Insurance Innovation Initiative" at UC Davis
  - USAID, OXFAM, FAO

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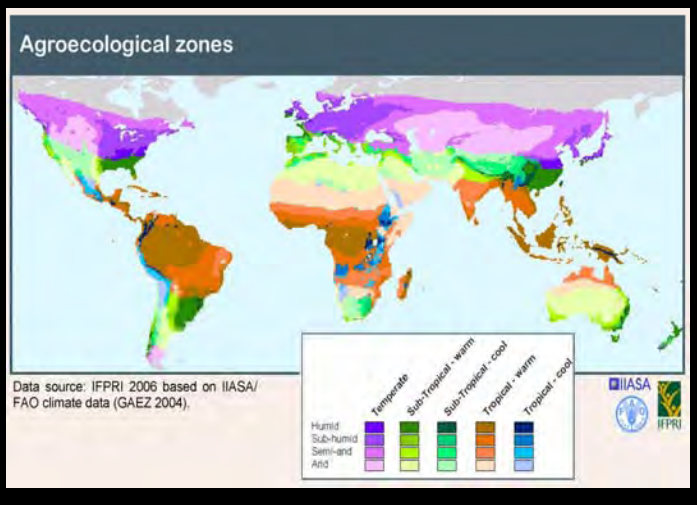
Innovation Considerations

- 95% of private ag R&D takes place in developed countries
- ~50% of public ag R&D is in developing countries
  - Strong in China, Brazil & India, but very weak in most of Africa
- CGIAR system is critical to developing country agriculture, but funds have fallen and NARS capacity often limited
  - Need healthy professional incentives and dynamic workplace to attract and retain cutting-edge scientists
- Competitive and dynamic private sector often needed to convey price signals and to provide incentives
- Water Efficient Maize for Africa (WEMA) Project
  - Monsanto, African Agricultural Technology Foundation, CIMMYT & NARS in Kenya, South Africa, Tanzania, Mozambique, Uganda

Technology Transfer Considerations

- Agro-ecological zones 'cut both ways'



IPRs & The Golden Rice Catalyst

- In 2000, Golden Rice was propelled into the ag biotech and globalization debates
- Later that year, a Freedom-to-Operate analysis identified 70+ patents and patent applications implicated in Golden Rice
- This sparked a wave of negotiations for Humanitarian Use licenses
  - Distance between profitable and humanitarian markets
  - Royalty free access for farmers earning <$10,000
  - IP stewardship matters more than royalties
- The African Agricultural Technology Foundation (AATF) and Public Intellectual Property Resource for Agriculture (PIPRA) emerged in the wake of these negotiations
  - Public-private partnerships
  - Public IP in agriculture & public domain tools
  - "IP Handbook" online

IP Constraints Going Forward

- How will next wave of agricultural technologies differ?
- Space for HU negotiation may shrink
  - 'Plug-and-play' traits with complementary capacity and other less agronomic technologies may relax agro-ecological constraints to transfer, but raise IP constraints
  - Continued economic development will turn some of today's poor farmers into promising markets for patented, royalty-bearing technologies
- IPRs (patents, PVP and copyright) will continue to play a role, but they are one of many other constraints
  - New traits, varieties & crops
  - Water management & irrigation
  - Other production inputs
  - Production management & practices
  - Post-harvest marketing & supply chains
  - Information & forecasts
  - Insurance

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Access & Use Considerations

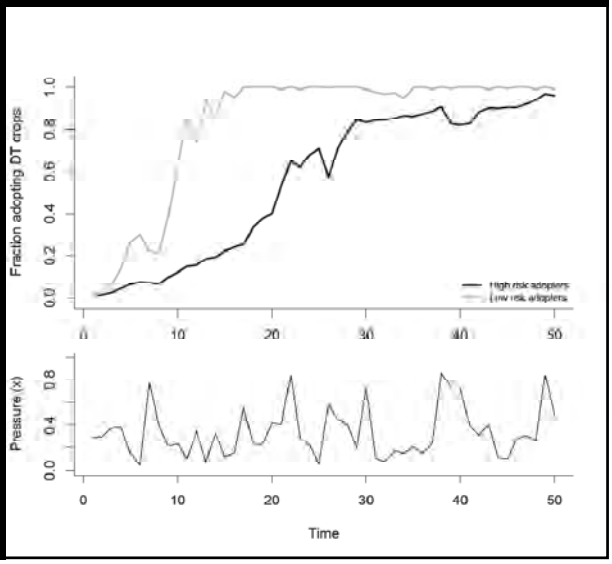
- What does mitigation and adaptation look like from the perspective of African farmers? Landless laborers?
- Input & output markets
- Information and price signals
- Physical and financial infrastructure
- Mixed crop-livestock systems
  - Implications for conservation agriculture?

Access & Use: Learning Stochastic Benefits

Is drought tolerance a pro-poor trait?

If we build it, will they come?

Drought tolerance can be difficult to appreciate…esp ecially for poor, marginal farmers



Our Full Set of Principles & Priorities

Policy Principles

- Improve information flows, incentives, & flexibility
- Promote rural economic development
- Provide technology options & complements
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- Nurture trade linkages & integrated markets

Policy Priorities

- Ag R&D in developed countries
- Research capacity in developing countries
- Ag biotechnology
- 'Flexible' IPRs & partnerships
- Market integration & infrastructure
- Competitive, dynamic ag markets

Concluding Thoughts

- Twin imperatives of climate change for agricultural development: greater complexity and greater urgency
- Policies and institutions will critically shape how and how well poor farmers mitigate and adapt to climate change
  - Especially in developing countries
  - Not all hard hit poor countries will look the same
- "Build it and they will come" approach is not good enough
  - Need to empower farmers to search for solutions
  - This requires incentives, information and price signals