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?

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

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’

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

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... especially for poor, marginal farmers.

Our Full Set of Principles & Priorities

**Policy Principles**
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**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