Green innovation for agriculture: Prospects and lessons from other sectors

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Motivation

• Challenges:
  • Demand for food
  • Demand for GHG mitigation
  • Effects of climate change

• Gradual, continuous productivity improvement unlikely to be good enough

• Can we imagine a set of public and private decisions that would make agriculture in 2050 look fundamentally different from how it looks today?
Market failures abound

- Environmental externalities
- Knowledge is non-rival and hard to exclude
- Discovery, development, diffusion of new technology typically involve very different agents, so transactions costs can be major issue
- Adoption externalities
- Adoption decision subject to demonstrable cognitive biases
The Past

- Public science
- Commercial research and patents
- Agricultural extension
- Food safety and environmental regulation

- Are these systems up to the task?
Possibly Helpful Case Study

• Has the world ever witnessed the kind of qualitative transformation of a physical/economic system that we need in agriculture?

• The communications/IT revolution, circa 1970-2010

• What appear to have been the key drivers and facilitators of this revolution?
The communications/IT revolution

• Lots of relatively unrestricted research money
• Transformational scientific breakthroughs
• Scope for qualitative transformation of products
• Large innate external demand
• Large government purchases of latest stuff
• Relatively small role for patents
• Diverse potential user base, including dispositional early adopters
Science for agricultural innovation

• Public research spending is inadequate, and probably insufficiently “blue sky”
• Possible breakthroughs, but will require openness to qualitative change
  • Genetic modification
  • Engineered food
  • Direct photosynthesis of fuel or food
  • …
• Redefinition of the “industry” or the “sector”
External demand for agricultural innovation

- Plenty of demand for food and fibre
- No commercial demand for GHG reduction
- Need taxes or quotas that include methane
- Broken records sometimes play the right song
Could public acquisition foster agricultural innovation?

• Acquisition of weapons, satellites, etc. in competitions where price was not the main selection criteria were very important in advancing technology

• Could the same happen in agriculture?

Purchase commitment for:

• Non-belching cows
• Catalyst that fixes Nitrogen from animal waste
• ??
Role of Patents

• Lubricant or sand in the gears?
• Hard to say overall, because we have no empirical comparisons of advanced economies with and without patent systems
• Small countries’ protection of big countries’ IP benefits the latter, not the former
  – Agreement to U.S.-style IP protection should be given only if we get enough in return
Can patents be designed to encourage innovation?

• In theory, the patent system fosters innovation by balancing several forces:
  – Limited monopoly allows inventors to invest in development of their ideas with some protection against appropriation of markets they thereby create
  – The disclosure of inventions in the patent document allows others to learn from and build upon inventions
  – Clear property rights minimize transaction costs, allowing firms to buy/sell IP, and to raise capital against it
  – Clear property rights allows all potential innovators to know the lay of the land: who has rights, and what are the rights that they have: Innovation Cartography (Richard Jefferson)

• Only the first of these actual works today
Patent transparency is crucial

• Many issues in patent policy involve difficult balancing of competing public interests (e.g. patent term extension)

• Obfuscation serves no *public* interest.
  – Disclosure obligation should be enforced
  – Ownership and control should be public information

• Governments and foundations could then seek to build true innovation ecosystems

• E.g., can find patents that cite particular scientific articles
Technology Diffusion

• New technologies everywhere and always diffuse slowly
  – Mechanical reaper
  – Electric motor
  – Enterprise software
• When does slow diffusion become a “paradox”?
• “Expert” analysis of some kind demonstrates that some technology or practice “pays for itself” but lots of agents are not using it.
  – Various energy efficient equipment, insulation, etc.
  – “Best management practices” in various agricultural settings
• Interest in paradox may be motivated by the environmental benefits of underused choice
• But not necessarily: Human Resources
How to think about “paradoxes” – I

• Not really economically superior
  – Real versus hypothetical implementation
  – Soft costs
  – Option value of waiting
  – Heterogeneity

• Market failures
  – Principal/agent issues
  – Regulatory or quasi-regulatory rules or practices
How to think about “paradoxes”—II

• Information
  – It’s costly to learn that you are ignorant
  – Adoption externalities and network effects
  – Heterogeneity again

• Cognitive biases
  – Satisficing versus optimizing
  – First cost bias
  – Salience bias
  – Loss aversion (inertia)
Policy Response to Paradoxes

• No optimal solutions
• Presence of cognitive biases limits value of reasoning from first principles
  – E.g. information provision versus appliance standards
• Policy superiority becomes an entirely empirical question
• Which takes me to…
Policy effectiveness is understudied

• Very few policy choices can be made on theoretical or conceptual grounds.
• Policy success or failure rarely evaluated systematically.
• Randomized Control Trials (RCT) are increasingly used in social policy; less accepted in technology policy.
• If RCT is not practical or politically acceptable, still need systematic evaluation
Parting shots

• Challenges are great. Need profound innovation.
• Market failures abound. No reason to think market will get it right.
• But problems are intrinsically hard. Need systematic evaluation as to what government actions improve the situation.
• Stakes are high. Cannot afford to rule out possible approaches *ex ante*. 