



AGRICULTURAL TECHNOLOGY ADOPTION: AN INTRODUCTION TO ATAI

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Defining “technology”



Any input, practice, or other intervention that affects the production process – including management, labor, supply chains, human capital

Examples of new tech (according to ATAI):

- ☐ new seed
- ☐ different planting process
- ☐ improved marketing strategy

Determinants of adoption



Rich literature on determinants & constraints:

- ☐ Riskiness: yield variability, crop failures, uncertain land tenure
- ☐ Information about new technology, benefits
- ☐ Access to markets for inputs or output
- ☐ Landholdings/assets, access to credit

What are the important constraints to adoption?

Can we explain low take-up?



In a well-functioning market, adoption failure suggests:

- Technology is not appropriate, profitable
 - ▣ *Should not be trying to promote adoption*

In reality there are market inefficiencies that introduce barriers to adoption

- Not profitable to farmer: cost outweighs benefit
- Not available or not known about
 - ▣ *Not profitable for middlemen to advertise/sell?*
- Not appropriate

Identifying market inefficiencies



1. Credit markets
2. Risk markets
3. Information (missing, asymmetric, noisy)
4. Externalities
5. Input and output markets
6. Land markets
7. Labor markets

In many cases, numerous inefficiencies exist at once. But does that mean have to tackle all at once?

Overall Approach



Market inefficiencies create barriers to profitable adoption of appropriate technologies

- Understand which market inefficiencies are most constraining
- Propose intervention (for firms, cooperatives, villages, households, individuals)
- Test to find the cheapest ways to overcome constraints

Credit markets



Credit market inefficiencies



- Many technologies require upfront investment
 - ▣ High interest rates, minimum balances, and lack of collateral
 - ▣ Upfront investments with high returns may go unadopted
- Particularly hard for women and landless to access
- Lenders face risks too
 - ▣ Small farmers hard to monitor, have limited liability
 - ▣ Leads to high interest rates

Relax liquidity constraints



- Randomly assigned smallholder cash crop farmers formal savings accounts in Malawi
- Two treatments:
 - “Ordinary” accounts
 - “Ordinary” + commitment (locked until future date)
- Results:
 - Only commitment had significant results
 - Large, positive effects on: deposits, withdrawals before planting, agricultural inputs, future crop sales, future household consumption

Reduce lender's risk



- High value crop (paprika) requires inputs
- Trader lends voucher for inputs, money recouped when farmer sells paprika

Risk: Farmer could use input on other crops & default

- Default rates drive out interest rates for everyone, reduces take up of high value crop and use of inputs

Problem: Information asymmetry. Which borrowers are risky?

Eliminate info asymmetries



- Randomize introduction of finger printing so that defaulters can't reapply
 - Types of people who default in control, borrow less with finger printing
 - Reduced default covers cost of monitoring
 - Lower interest rates in the long run?
- Bad risks expand their investment in paprika, ie less diversion
- Good risks unaffected

Credit markets – future work



Collateral substitutes

- ▣ Additional work is needed on feasible alternatives to traditional collateral for poor borrowers

Other innovations that reduce the risk of lending to poor borrowers

- ▣ Credit bureaus can increase access to financial products

Do better financial products lead to higher adoption?

Water tanks in Kenya



Collateralized rainwater harvesting tanks in Kenya

- Water harvesting tanks in Kenya improve productivity of zero graze cattle
- Without effective collateral, lenders often ask for cosignatories, may present a particular barrier to women
- If lending for a valuable asset, can use that as collateral, ideally not a movable asset

Water tanks continued



- Lending by dairy, which collects payment from milk income
- Usually require 3 guarantors and some money in the SACCO savings account
- Random sample offered loan using tank as collateral with a small down payment
- Take up rate 42 percentage points higher, particularly big increase for women
- Project ongoing but currently little difference in repayment rate

Risk markets



Risk market inefficiencies



- Adopting a new technology can be risky...
 - ▣ If downside is loss of subsistence crops, **any** risk may be too much
 - ▣ First adopters face high risk (unknown returns in local conditions)
- Informal insurance prevalent, but correlated risk
- Formal insurance should help solve the problem but
 - ▣ Moral hazard and asymmetric information
 - ▣ Link payout to objective criteria like rainfall in an area
 - ▣ Are insurance products just too hard to understand?

Information



Information inefficiencies



Farmers need information about a technology and how to use it. But why doesn't market provide the information?

- Information about profitability could be specific to area, requiring costly local experimentation
 - Experimentation may be local public good—ie others gain from it and first adopter cannot recoup benefit
- Some “information” technologies (eg better ways to plant) cannot be captured by a seller (no market)
- Lots of questions about most efficient way to disseminate info
- Evidence from health suggests how info is delivered is as important as what info, too much information can be bad

Ongoing information RCTs



- Magruder et al.: Does extension targeted to key individuals improve the spread of information?
- Duflo et al.: What is the role of farmer groups in sharing information, and what are the implications for technology adoption?
- Casaburi et al.: Text message reminders to improve farmer decision making
- Karlan et al.: Mobile delivery formats to make information more salient
- Additional work on the role of gender in information delivery and diffusion is needed

Externalities



Externalities



Some technologies generate benefits and costs that accrue to others... *since these externalities aren't "owned", they don't get factored into the adoption decision.*

We know externalities exist...

- ▣ Environmental (eg water use, deforestation, fertilizer run off...)
- ▣ Information – e.g. early adopters generate information for others to learn from

What do we do about it?

Externalities – ongoing work



- Payments for environmental services (PES)
 - Environmental investments are long term; how best to structure payment?
 - Jack (2011) tests alternative ways to structure payments to get best outcome from given subsidy
- Glennerster & Suri: looking at subsidizing local experimentation by first adopters vs. more traditional extension

Input/output market inefficiencies



Infrastructure and market access



- High transport costs (roads, electricity) lowers farmers' profits
- Poor competition among input suppliers and middlemen
 - ▣ Cooperatives could help with bargaining, but not equitable
 - ▣ De Janvry et al.: Improving farmer groups' ability to negotiate may improve outcomes for all of their members
- Infrastructure is expensive & often a public good, so market signals absent— don't know the likely returns to investment (or users' willingness to pay)
 - ▣ Nonrandomized evidence on dams in India suggests low return
 - ▣ What about other infrastructure investments (irrigation,)? Need **evaluations...**

Information and output markets



- Better information about input or output market prices, to improve efficiency?
- Jensen et al (2007): nonrandomized roll-out of cell phones helped fishermen find best prices among nearby markets
 - ▣ Could be unusual case: goods that are highly perishable but with choice of several possible markets
- Cooperatives could again play a role

Land market



Land market inefficiencies



- Insecure land tenure undermines the incentive to invest in new technologies
 - ▣ Especially for technologies with medium- to long-run payoff.
 - ▣ Lack of formal land title hinders access to credit
 - ▣ Renters/tenants responsible for production may not gain from adopting more efficient technologies
 - ▣ Women are disproportionately affected by weak land tenure

Land markets – lessons learned



■ Land titling can improve outcomes... for some

- Land tenure regularization (LTR) pilots in Rwanda
- Regression discontinuity design

■ Outcomes:

- Increased land-related investment (soil conservation practices)
- Female land ownership/inheritance: Married women gain control over agricultural decision-making; unmarried women lose access to informal use rights
- No change in frequency of land transactions

Conclusion



- RCTs can be used to understand more about the barriers to adopting (profitable) agricultural technologies, as well as to understand if they are profitable and for whom
- Can also test what are cost effective ways to overcome barriers
- Already some practical ideas are emerging
- Many more questions and ideas to test
- Rest of the training focused on designing new studies

What “is” ATAI?



- Research fund with support from Gates & an anonymous donor (\$5 million total)
- Network of 60+ academic researchers competing for grants and participating in dissemination
- Hub for learning about rigorously evaluated adoption-promotion strategies
- Newly expanded to measure household-level impacts of technology adoption (with DFID support)
- Co-led by J-PAL and CEGA

- Center for Effective Global Action
- Headquartered at UC Berkeley
- Network of 30 economists, political scientists, public health and education researchers, agricultural economists
- Supports quasi-experimental and experimental evaluations of social interventions
- Fellowship opportunities for East African social scientists