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Evidence in Agriculture: Lessons from over 40 Randomized Evaluations

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Cereal Yields (Metric Tons/Hectare)







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Fertilizer Use (Kilograms/Hectare)





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ATAI Background

- The Agricultural Technology Adoption Initiative (ATAI) tests programs that improve the adoption of technology by smallholders in Sub-Saharan Africa and South Asia.
- ATAI funds randomized controlled trials (RCTs) that tell us what is effective in promoting adoption or the impact technology on smallholder farmers' lives.
- With generous support from DFID and The Bill & Melinda Gates Foundation, ATAI has funded 40 unique projects









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Market Inefficiencies

- 1. Credit markets
- 2. Risk markets
- 3. Information
- 4. Input and output markets
- 5. Externalities
- 6. Labor markets
- 7. Land markets





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I. Policy Insights: Credit





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Findings on microcredit:

- From seven RCTs, researchers found...
 - Low demand
 - Increased business activity for those who had a business
 - No impacts on income, social wellbeing

Angelucci et al., 2015 (**Mexico**); Attanasio et al., 2015 (**Mongolia**); Augsburg et al., 2015 (**Bosnia and Herzegovina**); Banerjee et al., 2015 (**India**); Crépon et al., 2015 (**Morocco**); Karlan et al., 2015 (**The Philippines**); Tarozzi et al., 2015 (**Ethiopia**)





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Hard to push financing to agriculture:

- Lenders dislike agricultural loans because
 - Risks are high due to correlated weather shocks
 - Costs of servicing clients are high, particularly for smallholders
 - Smallholder farmers have no credit histories; land tricky as collateral
- Borrowers appear to have low demand for loans
 - Profits in farming may be low absent complementary investments
 - Risks of unavoidable default are high





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So how can we make credit work?

- Flexible collateral arrangements
- Improved information about borrowers
- Account for seasonal distribution of farmer income





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1. Flexible collateral

- Land may be an unacceptable form of collateral
 - Banks: titles unclear, seizure under default costly
 - Farmers: 'risk rationing' may prohibit farmers from being willing even if expected profits positive
- However, many large agriculture investments can be self-collateralizing (leasing)
- 'Inventory as collateral'; crops can be used to collateralize harvest-time loans





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Rainwater harvesting tanks in Kenya

- Variation in loan offers
 - Standard: 100% secured
 - 25% deposit, tank as collateral
 - 4% deposit, 21% pledge from guarantor, tank as collateral
 - -4% deposit, tank as collateral





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De Laat et al. forthcoming



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2. Improving information

- Credit bureaus are the transformative institution when lender info is poor, competition high (McIntosh & Wydick 2006)
- Credit bureaus can allow borrowers to substitute 'reputational collateral' for physical collateral (de Janvry et al. 2010)
- Alternate technologies such as fingerprinting borrowers (Gine et al. 2011)





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Fingerprinting borrowers in Malawi

- Lack of information makes banks unwilling to lend
 - Cannot credibly threaten to cut off future credit
- Treatment group fingerprinted during application process
 - Biometric identification cannot be lost, forgotten, stolen







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UNPAID BALANCE (MWK) 2 MONTHS AFTER LOAN WAS DUE

STATISTICALLY SIGNIFICANT DIFFERENCES ARE BOLD







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3. Accounting for seasonal variation in income





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Harvest-time loans in Kenya

• Loans allowed farmers to:

- Buy/keep maize at low prices
- Store while prices rose
- Sell later at higher prices
- Temporal arbitrage increased profits
 - Concentrated in areas where fewer farmers offered loans (sign of spillover effects)







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Summary: Credit

- Credit is key to investment, but many markets are too risky and too low-return to be viable without additional investment
- Complementary institutions critical for 'moving up' with credit: credit bureaus, credit registries
- Some promising ways of using information, timing, and new types of collateral to unlock credit





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II. Policy Insights: Information





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Information is key:

- To assess the value of technology, a farmer needs to know...
 - Existence and availability
 - Appropriateness
 - Desirability
 - How to use





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However, traditional extension has relatively low impacts on adoption

Traditional models:

- Test plots
- Farmer field schools
- Train and visit

Duflo et al 2008, Blair et al. 2013, Kondylis et al. 2014, Beaman et al. 2015, Duflo and Suri, forthcoming; **However, traditional** extension has relatively low impacts on adoption





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However, the effects of traditional extension models are unclear...

Traditional models:

- Test plots
- Farmer field schools
- Train and visit (T&V)

Evaluations:

- Evidence base is small and at risk of bias (Waddington et al, 2015)
- Low impacts on adoption, consumption, or incomes (Blair et al. 2013)
- Ineffective if promoting a technology, which is unprofitable (Duflo et al. 2008)





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How to improve extension?

Technology (ICT)

Social Diffusion





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ICT to Reach Farmers More Efficiently

- Technology can be used to...
 - Make information more accessible
 - Tailor message to specific farmers
 - Target particular moments in time





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Mobile Phone-Based Agricultural Extension

- Gujarat, India
- 2011-2012
- Center for Microfinance
- Awaaz.De







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Mobile Phone-Based Agricultural Extension

- High take up and use of mobile platform (IVR)
- Switch to more effective pesticides
- Increased adoption of cumin
- Some evidence of increased yields in cotton and cumin





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The Last Mile: Social Learning

- Most extension systems will not be able to directly contact everybody
- Instead, most farmers will learn about a new technology through social learning
- Can we take social learning for granted?





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The Messenger Matters

Socialization:

A farmer is more likely to demand a new technology if a greater proportion of his/her network is demonstrating it

 For Pit Planting in Malawi: 70% of people needed to see at least 2 connections to be persuaded to adopt (Beaman et al. 2015)

Heterogeneity:

Heterogeneity may inhibit learning

For high-yield maize in Kenya: Heterogeneity in soil quality made farmers less likely to respond to their peers' experiences (Tjernstrom 2015)





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Summary: Information

- Innovation is needed to enhance traditional extension
 - Use of mobile technology to provide information have been shown to increase adoption and improve yields
 - Need for careful incorporation of extension targeting approaches and social learning





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III. Policy Insights: Risk





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Protecting farmers through formal insurance

- Agricultural insurance to hedge risk ubiquitous in developed countries
 - Large number of small farmers, poor regulatory environments make most traditional products ill-suited to smallholders
- Weather index insurance as innovation to insure smallholders
 - Payouts made on observable variable (e.g. rainfall)
 - Avoids some disadvantages of conventional insurance: lengthy claims process, adverse selection, moral hazard
 - But has basis risk: official observation does not accurately predict farmers' losses





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A decade of experimentation on weather index insurance

- 10 randomized evaluations in various contexts
 - India, Ethiopia, Ghana, Malawi
 - Differences in crops insured, conditions that triggered payout, etc.
 - Effects of discounts, other encouragements to purchase insurance
 - Effects on production decisions







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Demand was low at market prices but increased with large discounts



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• Karlan et al 2013; Mobarak & Rosenzweig 2012; "Make it Rain"



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Downsides of Risky Production

Figure 4: Lowess-Smoothed Relationship Between Log Per-Acre Output Value and Log Rain per Day in the *Khaif* Season, by Insurance Treatment



Crop output in insured villages loses the 'normal is best' curvature and becomes monotonically responsive to rainfall

Mobarak & Rosenzweig 2014





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Conclusions on weather index insurance

- Index insurance unlikely to thrive as a commercial product
 - 'Make it Rain'
- When farmers have insurance, they take more risks on their farms
 - This is good for average yields but exposes laborers to additional income risk
- So where do we go from here?





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An alternative: risk-mitigating crops and technologies

- Agricultural R&D on varieties that tolerate flood, drought, salinity
 - Increasingly important with climate change
- Swarna-Sub1 is a flood-tolerant rice variety
 - No yield penalty in normal conditions
 - Researchers tested effect in real-life conditions in Odisha, India







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Farmers given Swarna-Sub1 invested more

- Farmers given Swarna-Sub1 had higher yields in 2011 floods
- Farmers invested more in their farms
 - Cultivated more land
 - Applied more fertilizer
 - Switched to more effective, but higher-labor techniques
- Scale-up would benefit marginalized populations the most





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Summary: Risk

- Risk is a constraint for smallholder farmers
- Commercial index insurance targeted directly at farmers unlikely to solve the problem
 - Price, distrust, lack of financial literacy, basis risk
- Alternatives to help farmers manage risk
 - Rethink insurance: provide subsidized policies as an alternative to cash transfers
 - Sell to institutions such as ag lenders
 - Promising preliminary results on risk-mitigating crops





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Thank you! Questions?