Harvesting the rain:
The adoption of environmental technologies in the Sahel

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November 2023
Agricultural losses from climate change

Climate change is already lowering productivity in the parts of the world that depend most on agriculture

Source: Ortiz-Bobea et al. 2021
Rainwater harvesting in Niger

Niger: Among the lowest HDI countries in the world
- Very exposed to both current and future climate change
- 94% of the (large) population lives on 20% of the land
- Arable area is shrinking, options for improving soil fertility are limited
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Agronomic trials show rainwater harvesting (RWH) techniques restore degraded land, increase yields and increase resilience
- Yet across the Sahel, adoption levels remain low
Investing in agricultural adaptation

Costs are upfront, benefits are in the future and depend on climate state

- May appear unattractive compared to more immediate and certain needs

Demi-lunes: Upfront costs are in labor, benefits spread over >3 years

- Potential barriers to adoption:
  - Lack of information?
  - Cash on hand?
  - High discount rates?
Increase adoption by relaxing barriers

Randomized controlled trial (RCT) across 180 villages (2,861 households)

- Interventions in year 1
- Track outcomes for 3 years with in-person field visits and household surveys
  - Demi-lune adoption, crop revenue, labor allocation, soil quality

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<tr>
<th>Control</th>
<th>Training only</th>
<th>Training plus unconditional cash transfer (early)</th>
<th>Training plus conditional cash transfer (late)</th>
<th>Training plus unconditional cash transfer (late)</th>
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<td>Information</td>
<td>Liquidity constraints</td>
<td>Discount rates</td>
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Sample and compliance

Sample: 180 villages with degraded soil in Zinder region
- Within each village, 16 farmers randomly selected for data collection
- Additional 4 farmers per village in a spillover sample
- Randomize whether male or female household head was treated

Training take up was very high
- 95% of invited individuals attended
Information alone resulted in widespread adoption

90 percentage point increase in likelihood of any adoption

Adoption sustained for at least 3 years
Short lived response to cash incentives

Year 1: 23-35% higher adoption numbers in UCT-early and CCT

Year 3: No remaining difference in number of DL on fields
Measuring adaptation

Ex post: Same climate shock has less impact

Source: Carleton and Hsiang (2016)
Measuring adaptation

Ex post: Same climate shock has less impact

Ex ante: Adoption?

Source: Carleton and Hsiang (2016)
Adoption as adaptation?

Agricultural technology adoption as a proxy for adaptation

- A long history of testing barriers to agricultural technology adoption in LMICs
- Adoption is (relatively) easy to measure, quantify
- Other benefits are conditional on adoption
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Adoption may not be sufficient
1. Adaptation benefits *expected* but not verified
2. Adoption helps in bad states but hurts in good states
3. Adoption changes other decisions, ambiguous net effect
   - May crowd in investment, risk taking (Dar et al. 2013, Lane 2023)
Average effects: Improvements in soil quality, income, resilience

Year 3: Treatment effects on soil quality

Other outcomes:
- 12-14% increase in crop income
- 2x as likely to restore land to production
- Lower reported crop failure
Adaptation benefits of RWH?

Ideal test: Heterogeneity on poor rainfall realizations
  • Compare villages with good and bad years (3 years and 180 villages)
  • Prediction: Treatment villages show less sensitivity to weather shocks

Main challenge: Lack of high resolution precip data in Niger
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Work in progress: Use remote sensing

1. Measure deviations from NDVI in neighboring (non-study) villages
2. Constructed measure of good/bad output years
Scaling up (and further testing adaptation benefits)
Collaboration with Ministry of Environment, Niger

Moving from evidence to policy often involves changes to program design

In our case:
- Bigger trainings
- Monitoring with remote sensing
- Train on multiple RWH techniques

Do changes undermine training effectiveness?
- Build further testing into scale up process
- E.g., vary whether trainings are small (RCT) or large (policy)
Questions?

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