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

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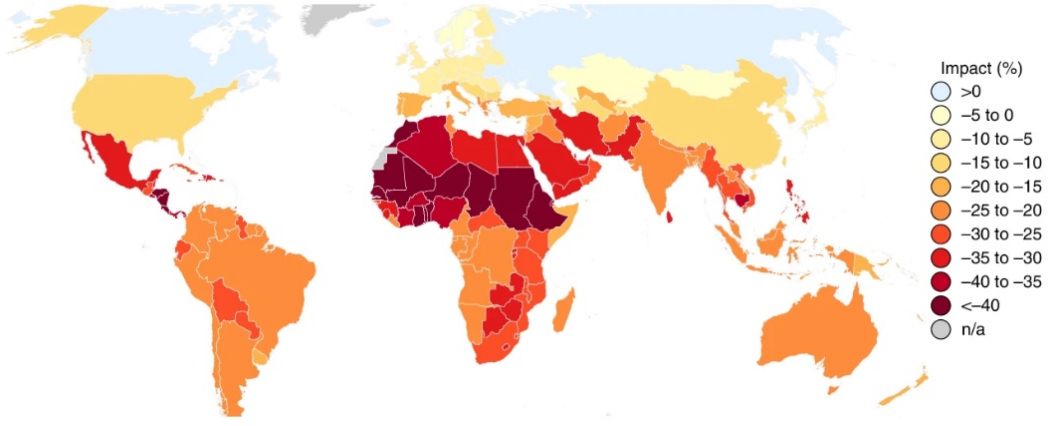
Agricultural losses from climate change

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

Control	Training only	Training plus unconditional cash transfer (early)	Training plus conditional cash transfer (late)	Training plus unconditional cash transfer (late)
	Information	Liquidity constraints	Discount rates	

Sample and compliance

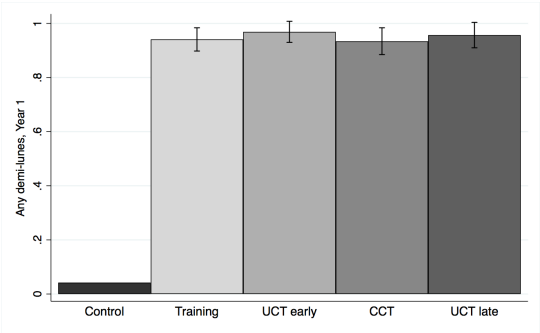
Sample: 180 villages with degraded soil in Zinder region

- 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

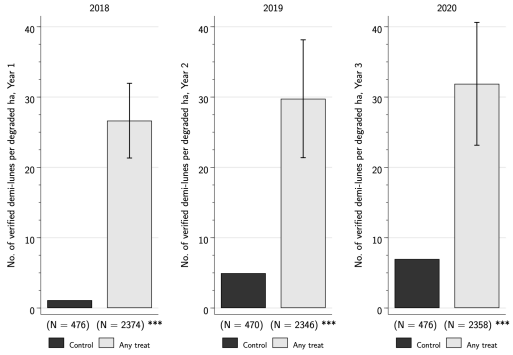
Training take up was very high

- 95% of invited individuals attended

Information alone resulted in widespread adoption

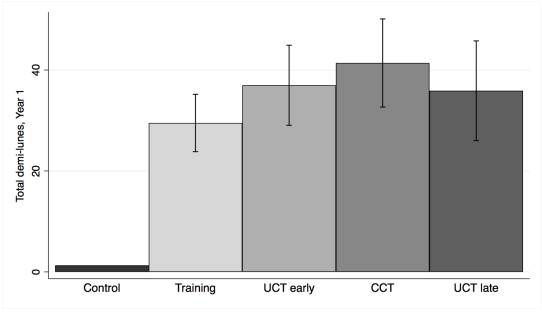


90 percentage point increase in likelihood of any adoption

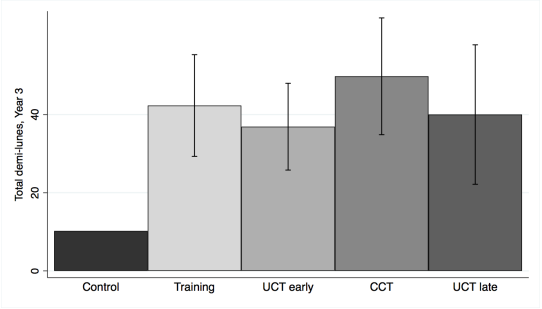


Adoption sustained for at least 3 years

Short lived response to cash incentives



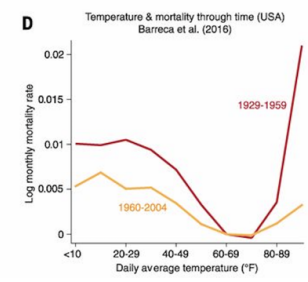
Year 1: 23-35% higher adoption numbers in UCT-early and CCT

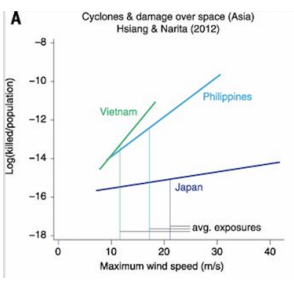


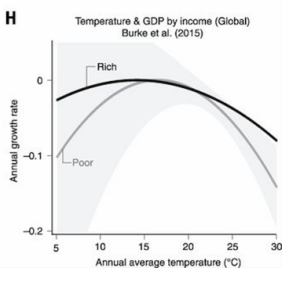
Year 3: No remaining difference in number of DL on fields

Measuring adaptation

Ex post: Same climate shock has less impact







Source: Carleton and Hsiang (2016)

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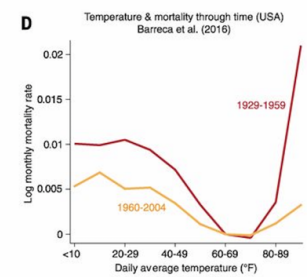

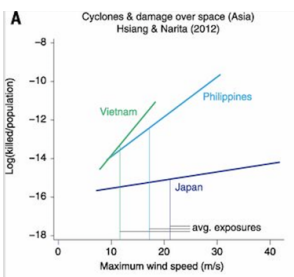

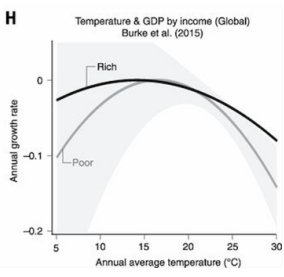

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Ex ante: Adoption?

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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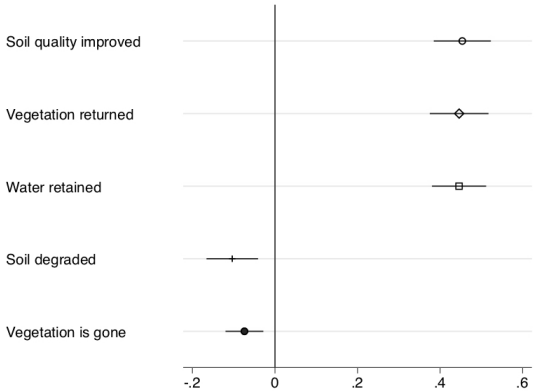
Adoption may not be sufficient

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

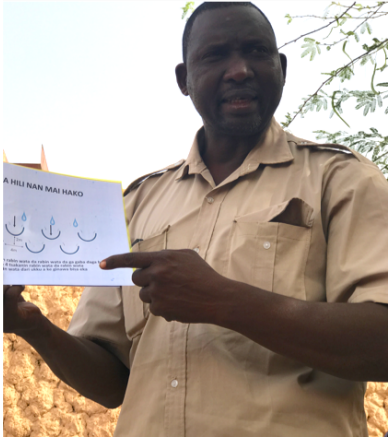
Moving from evidence to policy often involves changes to program design

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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