Impact of Robust Wheat Seeds on Earnings

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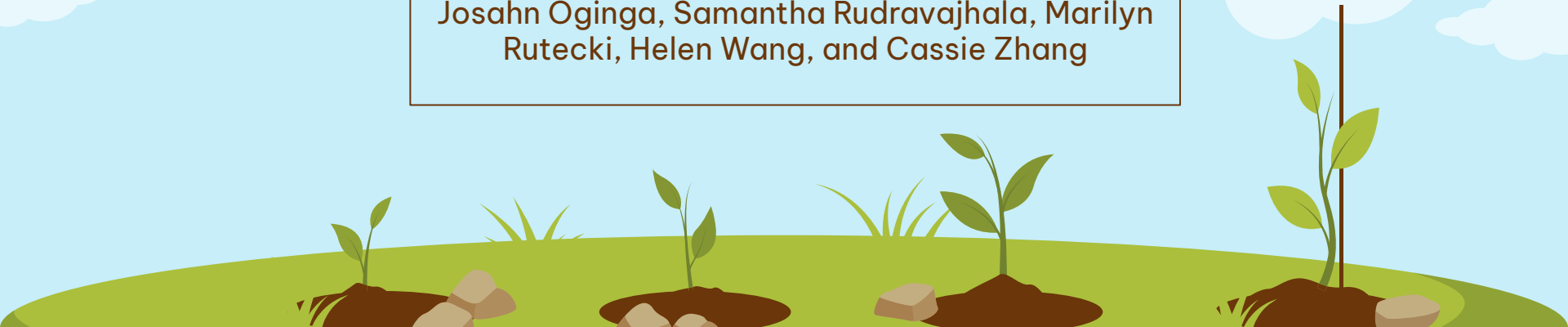
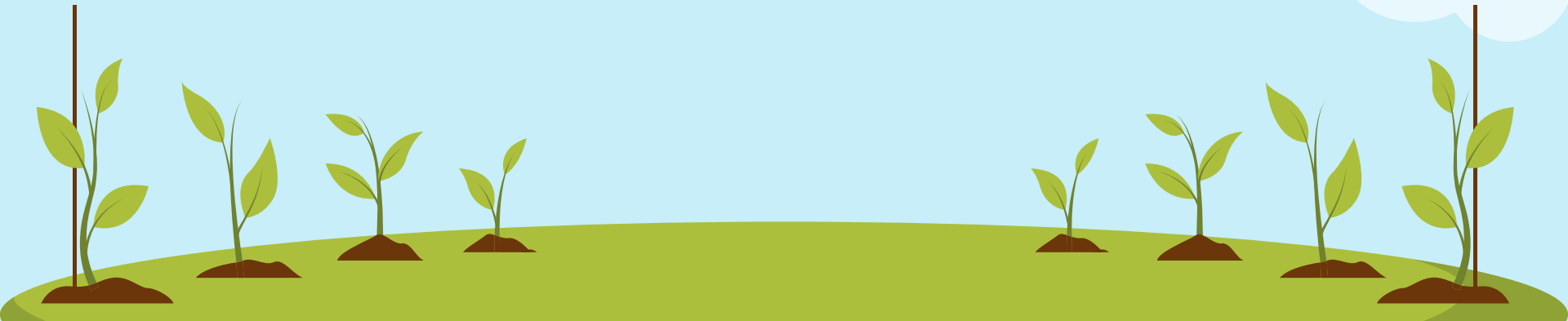


Background



Climate Change & the Need for Climate-Robust Seeds

- **Challenges:**
  - Rising Risks to Agriculture
  - Global Population Growth

- **Key solution: Climate-robust seeds**
  - Critical for protecting productivity and farmers' livelihoods
  - Proven economic benefits – in Malawi and Tanzania, climate-robust seeds generated 984 million-2.1 billion USD in benefits (Cacho et al., 2020)

- Our project will evaluate the impact of climate-robust wheat seeds on farmers' earnings, where new seeds designed to withstand extreme heat and drought conditions

Research Question

What is the causal effect of adopting new climate-robust wheat seeds on farmers' household earnings?

Endogeneity concerns:

- Possibility that farmers who choose to adopt the new seeds differ systematically from those who do not
- For example, a skilled worker with more resources might be more likely to adopt new technologies, and perhaps have higher earnings already, regardless of the new seeds

Design:

- 283 towns in a single province were randomly assigned to four treatment groups (0–3).
- Farmers in treatment towns received varying seed offer rates:
  - Group 0: 0% offered
  - Group 1: 25% offered
  - Group 2: 50% offered
  - Group 3: 75% offered

Methods

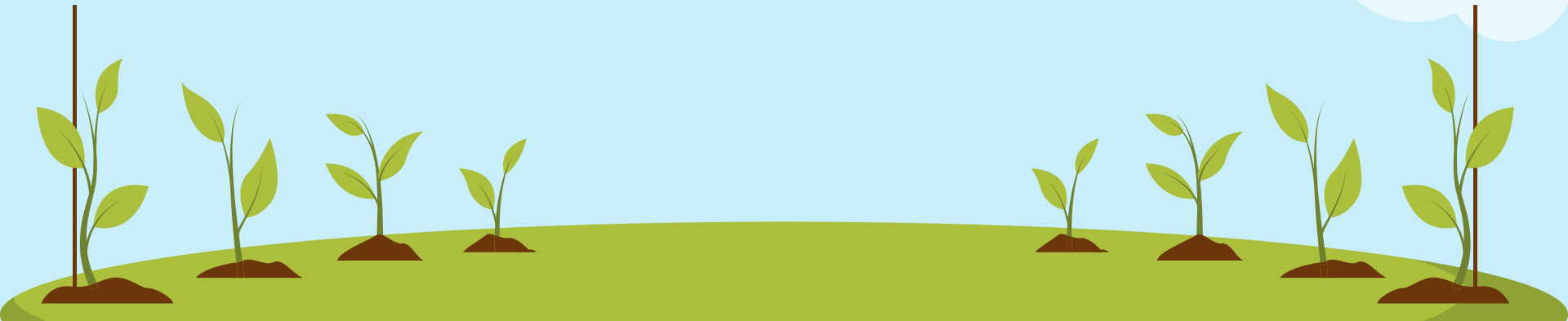
Methods and Data

- Employ a quasi-experimental research strategy, using randomized individual level assignment to treatment groups
- Ideally, this random assignment will ensure that, on average, treated and control group farmers are comparable in both their observed and unobserved characteristics, allowing us to estimate the causal effect of seed adoption on farmers' earnings
- Use a randomized controlled trial (RCT) design to estimate the causal effect of adopting climate-robust wheat seeds on farmers' household earnings
- The dataset constrains individual-level observations on 283 towns in a single province, with variables including the farmer's treatment assignment, whether the new seeds were used, household characteristics (size, age of household head, marital status), and log earnings (lnearnings).

RCT Steps

1. Identify missing data, create a binary attrition indicator, and check attrition by our covariates.
2. Check attrition by each town group
3. Check for balance across treatment and control groups to confirm that there are no systematic differences between those who use the new seeds vs those who do not.
4. After checking for balance, we determine whether there were any peer effects to farmers who were not offered the climate-robust seeds.
5. After these validity checks, we determine treatment effects, answering whether treatment increased the use of seeds as well as the impact of using the new seeds on farmers' earnings.

Results



Attrition

- **Individual covariates (household size, age, marital status):**
  - Not strongly linked to missing earnings data
  - Only marital status marginally significant (p = 0.0469)
- **By treatment assignment:**
  - Control attrition is 10.6% while Treatment is 8.4%
  - Therefore, treatment was less likely to attrit than control
- **By town group (treatment intensity):**
  - Attrition decreases as treatment intensity increases:
    - Group 0 (control): 18% attrition
    - Group 1: 16% lower
    - Group 2: 13% lower
    - Group 3: 3% lower
  - All highly significant (p < 0.001)
- **Key concern:**
  - Systematic attrition by treatment group may introduce bias if unobserved traits differ

	Estimate	Std. Error	t value	Pr(>|t|)	
(Intercept)	0.106150	0.001401	75.777	<2e-16	***
treatment	-0.021969	0.002294	-9.577	<2e-16	***

Balance Checks

- To assess balance between treatment and control groups: regressed the treatment on baseline covariates household size, age of the household head, marital status.
- All covariates, are statistically insignificant meaning there is no difference between treatment and control status:
    - The observables appear balanced across treatment and control groups

```
Call:
lm(formula = treatment ~ hhld_size + age_head_hhld + married,
    data = data)

Residuals:
    Min      1Q  Median      3Q     Max
-0.3788 -0.3737 -0.3703  0.6261  0.6323

Coefficients:
                Estimate Std. Error t value Pr(>|t|)
(Intercept)    0.3588720  0.0112301  31.956   <2e-16 ***
hhld_size      0.0001552  0.0013862   0.112    0.911
age_head_hhld  0.0003797  0.0002559   1.483    0.138
married       -0.0009487  0.0036468  -0.260    0.795
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Signif. codes:  0 ‘***’ 0.001 ‘**’ 0.01 ‘*’ 0.05 ‘.’ 0.1 ‘ ’ 1
```
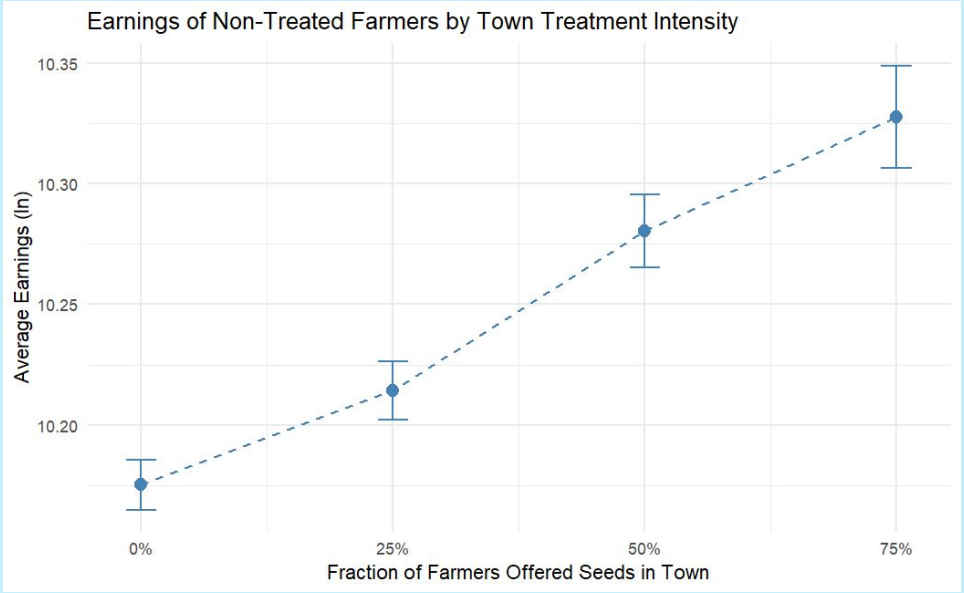

Peer Effects

- To examine peer effects among farmers who were not offered the climate-robust seeds, we restricted the sample to non-treated individuals(treatment=0) and estimated how their earnings varied by the intensity of seed offers in their towns
- Farmers in towns with higher treatment intensities experienced significantly higher earnings compared to those in towns where no farmers were offered seeds (the reference group).
- Specifically, earnings increased by approximately 0.039, 0.105, and 0.153 log points for town groups 1, 2, and 3 respectively, with all coefficients being highly statistically significant ($p < 0.001$).
- Even farmers who were not directly treated benefited indirectly through peer effects.



Treatment Effects

- The use of new seeds increases earnings
- Farmers who adopted the new climate-robust seeds experienced an estimated 25% increase in log household earnings compared to those who did not adopt the seeds

- Farmers using the new seeds have higher average log earnings
- The results are robust to clustering at the town level, confirming the positive association between seed use and income holds