Pre-Analysis Plan for "Paying Farmers Not to Burn: A Randomized Trial of Payments for Ecosystem Services in India"

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This document pre-specifies analyses for our randomized evaluation on the impact of a conditional cash transfer program – also known as payments for ecosystem services, or PES, when applied to environment-protecting behavior – in Punjab, India. Baseline data collection is scheduled to begin at the end of September 2019.

We offer a standard PES contract that promises farmers a certain amount of money if they don't burn their rice fields (T2), which we compare to a business-as-usual control group (T1). We include a variant that gives a portion (25%) of the payment upfront unconditionally upon enrollment (T4). This variant could increase the impact and cost-effectiveness of PES. Providing an upfront payment could ease liquidity constraints or increase eligible individuals' trust that they will indeed be paid if they comply with the conditions. However, giving individuals who then don't comply with the conditions upfront payments adds to program costs without adding benefits. We also vary the standard PES amount in T2; in some T2 villages, the amount matches the T4 total amount and, in other T2 villages, it matches the T4 conditional amount.

To understand the importance of easing liquidity constraints, one treatment arm (T3) will receive only an unconditional cash transfer, equivalent in amount to the upfront component in T4.

Randomization will be at the village level. Sample sizes are approximate.[1]

	No PES	**PES**
No upfront payment	T1: Pure control (38 villages)	T2: Standard PES (72 villages) Half of villages at full payment level (T2a), half at 75% (T2b)
25% upfront (unconditional)	T3: Unconditional cash transfer (30 villages)	T4: PES with 25% paid as unconditional cash transfer; 75% conditional (60 villages)

Outcomes

Our primary outcome is whether the farmer burned his paddy fields, which will be measured via remote-sensing for both treatment and control farmers (with self-reports collected through an endline survey as a secondary measure).

We will analyze several secondary outcomes. (1) Enrollment in the PES program, which entails signing a contract and giving the research team permission to monitor the fields. (2) Respiratory

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[1] One risk for the project is that we will be unable to recruit enough surveyors to conduct the fieldwork within the timeline required by the harvesting/burning/planting schedule. Other logistical delays would similarly interfere with the required roll out schedule. If we are unable to complete the project with this specified scope, we will instead implement a simplified design and update the trial registry accordingly.

problems for children under age 5 years, measured as an index of caregiver-reported survey responses. (3) Crop residue management choices by farmers using self-reports at endline.

Hypotheses

- H1: PES reduces burning
  - Comparison of T2+T4 to T1+T3, controlling for whether upfront payment is given
  - Regression equation is $y = a + b1*PES + b2*Upfront + e$
  - Prediction is $b1<0$ where outcome y is *burned*
- H2: Upfront payment reduces burning and increases takeup
  - Comparison of T2 to T4
  - Regression equation is $y = a + b1*StandardPES + b2*UpfrontPES + e$
  - Prediction is $b1>b2$ for burning (and $b2>b1$ for takeup).

Definitions
PES = T2 or T4
Upfront = T3 or T4
StandardPES = T2
UpfrontPES = T4

Auxiliary hypotheses

To help understand mechanisms and benchmark effect sizes, we will test the following auxiliary hypotheses, for which we have lower statistical power.

- H3: Upfront payment eases liquidity constraints so decreases burning
  - Comparison of T1 to T3
  - $y = a + b1*Upfront + e$,
  - Prediction is $b1<0$ for burning
- H4: Effects are larger when the payment level is higher
  - As a benchmark for the other effect sizes, we will compare the effect of the higher PES payment level (T2a) to the 25% lower payment level (T2b)
  - $y = a + b1*LowPay + e$
  - Prediction is $b1>0$ for burning
- H5: PES with upfront component has an ambiguous effect on cost-effectiveness, specifically reduction in burning per payment amount
  - Regression equation is $y = a + b1*StandardPES + b2*UpfrontPES + e$
  - No signed prediction for size of $b1$ versus $b2$ for burning

Heterogeneity analysis
Our heterogeneity analysis will be aimed at testing for frictions that limit the effectiveness of PES: (1) liquidity/credit constraints (2) distrust in being paid and (3) other barriers to using crop residue management (CRM) equipment to clear fields.

Specifically, we will use baseline survey data to construct 6 heterogeneity variables:
- Liquidity constraints, measured using self-reported difficulty finding/borrowing cash
- Distrust in being paid, measured using general distrust
- Distrust in being paid, measured using PES-specific distrust
- Barrier to CRM equipment use: Lack of awareness
- Barrier to CRM equipment use: Perceived high cost or low access
- Barrier to CRM equipment use: Perceived harm to soil or agricultural yield

Appendix 1 of this document describes in detail how these six variables will be constructed.

We will analyze heterogeneity along these dimensions by interacting the constructed heterogeneity variables with treatment indicators. In particular, we predict:

- Larger effects of UpfrontPES, relative to StandardPES, among more credit and liquidity constrained farmers.
- Larger effects of UpfrontPES, relative to Standard PES, among farmers with low trust in general and PES-specific trust index.
- Either bigger or smaller effects of pooled PES treatments, relative to the non-PES arms, for farmers facing other barriers to CRM equipment use; sign of this prediction is theoretically ambiguous.

Control variables

The regression equations above are a basic equation with no controls. We will control for stratification variables and use LASSO to select other controls, using a large set from our baseline survey and administrative data.

Appendix 1: Construction of heterogeneity variables

1) Liquidity constraints:

If you needed to spend Rs 5000/10,000 for agricultural equipment, would you have savings to draw on?
If you needed to spend Rs 5000/10,000 for agricultural equipment, how easy would it be for you to get a loan for that amount?

We will construct a variable for financial constraints that uses an index based on responses to these questions, splitting the sample at the median. We will also construct liquidity and credit constraints specific indices, as separate variables.

2) Trust in payment:

1. Generally speaking would you say that most people can be trusted or that you need to be very careful in dealing with people?
2. I'd like to ask you how much you trust people from various groups. Could you tell me for each whether you trust people from this group completely, somewhat, not very much or not at all?
a. People in your family?
b. People in your neighborhood?
c. Strangers?
3. Even if you have had very little or no contact with these following institutions, please base your answer on your general impression of these institutions.
a. The Punjab Government?
b. The village Panchayat?
c. The co-operative society?
d. NGOs?
e. Financial Institutions like Banks/Insurance Companies?

We will categorize respondents into (1) low/high on a general trust index constructed off of responses to all of the above, splitting the sample at the median, (2) low/high on a trust index related to the PES payments constructed off of responses to (1), (2c), (3d) and (3e).

3) Barriers to CRM equipment use:

1. Are you familiar with [CRM equipment]?
2. Do you own [CRM equipment] as an individual or member of a CHC or Coop?

3. How does [CRM equipment] perform relative to burning in the following:
a. More expensive or less expensive?
b. Better for long-term soil health or worse for soil health?
c. Helps yield of rabi season or hurts yield of rabi season
4. How long would it take you to access CRM equipment at harvest time? (in days)
5. Where can you rent it from?
6. How much would it cost per acre   (including all costs)?
7. How long would it take to manage residue in this way? (in days)

Three indices of barriers to CRM equipment use will be created based on these questions, corresponding to: (a) information about CRM equipment, (b) time/money/access barriers, (c) negative impacts of CRM equipment.

Index a will use questions 1 and 5. Index b will use questions 2, 3a, 4, 6 and 7. Index c will use questions 3b and 3c.