**Title**

Co-producing environmental conservation and social equity: Is conditionality in Payments for

Ecosystem Services a necessity or impediment?

**RCT ID**

AEARCTR-0008286

**Updates to registry, December 2022**

1. Set end date to 2023-12-31 (instead of 2022-12-31)
2. Add IRB protocol number for 2021 data collection
3. Add analysis plan (below)

**Analysis plan**

Data sources

1. Fundación Natura Bolivia (“Natura”) administrative data
   * Includes list of participants in Natura’s program (Acuerdos Recíprocos por Agua, ARA), hectares enrolled, incentive chosen.
   * Includes data on compliance with program conditions, in both conditional and unconditional groups. In conditional group, compliance was measured yearly. In unconditional group, compliance was measured once, in 2020-2021, to allow for comparison with conditional group (not enforced with participants).
2. Community survey
   * Survey up to 3 authorities in each village. E.g., president of the community (“Organización Territorial de Base,” OTB), vice-president of OTB, doctor/nurse, teacher.
3. Household survey
   * In all in-sample villages offered Natura’s program between 2016 and June 2021.
   * Included participants and non-participants in Natura’s program. The list of participants was given to us by Natura. The list of non-participants was created in several steps: (1) community survey enumerator obtained list of households living in the village (e.g. from health center), (2) program participants were taken out of the list, (3) survey supervisor randomly selected half of the number of participants in that village (round up if odd number of participants) and 5 households if that number was <5. From the list, surveyors used a (pre-printed) list of random numbers (range: 0-1) to select households for the survey: match the list with a column of random numbers, survey households for whom the number was ≥0.500, starting from the top of the list and until the desired number of households (with random number ≥0.500) was reached.
4. Satellite data on forest cover
   * We are exploring options for downloading satellite imagery on forest cover pre- and post-program (2010-2016, and 2020-2022, respectively).

Hypotheses and Outcomes

The analysis will test 7 hypotheses that were included in the project proposal (National Science Foundation award #1660481; “Co-Production of Environmental Conservation and Social Equity: Is Conditionality in Payments for Ecosystem Services a Necessity or an Impediment?”; 06/15/2017-11/30/2022; Principal Investigator: Zhao Ma). Specific outcomes are listed in bullet points below each hypothesis.

**H1:** Compared to traditional (conditional) Payments for Ecosystem Services (PES) programs, unconditional PES results in higher participation rates, because removing conditionality alleviates household members’ concerns about penalty for non-compliance and lowering barriers to participation.

* Share of land-owning households that signed up in a village
* Descriptive statistics on reasons for participating and not participating

**H2**: Compared to traditional (conditional) Payments for Ecosystem Services (PES) programs, unconditional PES results in similar rates of household adoption of conservation behaviors because removing conditionality (i.e., offering payments without a coercive enforcement mechanism that imposes penalty) reinforces the intrinsic motivations of household members to conserve the environment. Indicators of conservation behavior included:

* Whether the household’s cows drink in stream
* Whether the household fenced its pastureland
* Whether the household restricts movement of its cattle
* Whether the household cut any forest in the last 6 or 12 months

**H3:** Compared to traditional (conditional) Payments for Ecosystem Services (PES) programs, unconditional PES produces a similar or higher amount of environmental benefits, because of the combined effect of H1 and H2, thus maintaining or increasing the overall level of environmental conservation outcomes in communities offered labeled unconditional PES.

* Forest cover
  + Households’ share of land that is forested (self-reported from household survey)
    - Analyzed at the community level (using average share to account for larger and more populated communities)
    - Analyzed at the household level
  + Satellite estimates (Normalized Difference Vegetation Index) of share of community land that is forested. We are in the process of obtaining analyzable satellite data; the exact definition may change based on final data available.
* Rates of compliance with program conditions (self-reported and Natura administrative data)

**H4:** Compared to traditional (conditional) Payments for Ecosystem Services (PES) programs, unconditional PES attracts different types of participants, because removing conditionality alleviates concerns of those who are poorer, more marginalized, and more risk-averse and who would not participate in a conditional PES program.

* Household demographics: particularly rate of women participants, but also education of household head, age of household head
* Household economic status (income, land ownership, asset ownership)
* Household civic engagement and participation in local institutions (clubs, political parties, etc.)

**H5:** Compared to traditional (conditional) Payments for Ecosystem Services (PES) programs, unconditional PES reduces economic inequalities within communities, because household members who are poorer, more marginalized, or more risk-averse are more likely to sign up for labeled unconditional PES, thus the overall benefits of payments are more evenly distributed within communities.

* Income inequality
* Assets inequality

**H6:** Compared to traditional (conditional) Payments for Ecosystem Services (PES) programs, unconditional PES results in higher levels of perceived fairness within communities, because non-participants are less likely to perceive themselves as being excluded by an unconditional PES program, while participants are less likely to feel coerced to adopt conservation practices and feel powerless.

* Perceptions of fairness in general, and of PES programs in particular (e.g., perception of fairness in compensation)
* Trust in the program and the NGO implementing it
* Perception of equity
* Perception of/attitude toward conditionality

**H7:** Compared to traditional (conditional) Payments for Ecosystem Services (PES) programs, unconditional PES increases gender equalities, because removing conditionality lowers barriers for women to sign up for unconditional PES, thus increasing bargaining power of more women within households and communities.

* Index of decision-making about general household decisions
* Decision-making about complying with PES program conditions
* Women’s and men’s time spent in activities related to the program

How variables will be constructed

See bullets points in hypothesis section above.

Treatment effect equation to be estimated

Analyses will be conducted at the community (e.g., impact of the treatment on share of households in a community that participate) and household levels (e.g. impacts of the treatment on compliance, ha of forest preserved).

Community-level intent-to-treat (ITT) regressions: Yc = α + β\*Uc + λ\*Sc + εc

* c: community
* Y: outcome
* U: binary=1 if unconditional community, =0 if conditional community
* S: binary=1 if community was previously offered Natura’s program, =0 if not previously offered Natura’s program (we stratified our randomization by this variable)
* ε: heteroskedasticy-robust standard errors (clustering would be by municipality but there are only 5 municipalities – too few (Cameron & Miller, 2015))
* Depending on results of tests of randomization balance and attrition, additional variables may be added as control variables.

Household-level, intent-to-treat (ITT) regressions: Yhc = α + β\*Uc + λ\*Sc + εhc

* h: household
* Y: outcome
* U: binary=1 if unconditional community, =0 if conditional community
* S: binary=1 if community was previously offered Natura’s program, =0 if not previously offered Natura’s program (we stratified our randomization)
* ε: standard errors clustered at the community level (68 communities)
* Depending on results of tests of randomization balance and attrition, additional variables may be added as control variables.

Depending on the impact of the treatment on participation rate, household-level treatment-on-the-treated (TOT) estimates of the impact of actual participation (instrumented by the random assignment) on household-level outcomes may be implemented: Yhc = α + β\*Phc + λ\*Sc + εhc; instrument Phc with Uc. h: household

* P: dummy=1 if household participated (signed a contract), =0 if didn’t sign a contract
* Y: outcome
* U: binary=1 if unconditional community, =0 if conditional community
* S: binary=1 if community was previously offered Natura’s program, =0 if not previously offered Natura’s program (we stratified our randomization)
* ε: standard errors clustered at the community level
* Depending on results of tests of randomization balance and attrition, additional variables may be added as control variables.

We will also explore the use of propensity score matching in which we will predict the effects of take up of the program on outcomes, with take up predicted by knowledge about PES and human capital variables. While this approach does not allow us to measure the causal effect of the assignment to conditional or unconditional PES on the outcomes of interest, it may yield valuable insights on the relationship between participation in the program and outcomes.

Multiple outcomes and multiple hypothesis testing?

We will correct standard errors in our main analyses to account for multiple hypotheses testing using Anderson’s sharpened q-values (Anderson, 2008).

Attrition

We will calculate the number and percentage of households that signed up for Natura’s program but could not be found for the household survey. To estimate whether attrition creates bias in our estimates of the impacts of the program, we will test for differential attrition by regressing a dummy variable indicating that a household was not found in the survey on a dummy variable for the treatment group (=1 if household lives in village assigned to the unconditional program, =0 if conditional program) and a dummy variable indicating whether the household lived in village previously offered Natura’s program. We will also test for selective attrition by regressing key variables (not impacted by the program, akin to a baseline measure) on a binary variable indicating that a household attrited and a binary variables indicating whether the household lived in village previously offered Natura’s program.

If attrition was systematic (related to the treatment assignment), we will calculate Lee bounds for our impact estimates (Lee, 2009).

There is no attrition for non-participants since they were recruited from the villages and sampled with replacement.

References

Anderson, M. L. (2008). Multiple Inference and Gender Differences in the Effects of Early Intervention: A Reevaluation of the Abecedarian, Perry Preschool, and Early Training Projects. *Journal of the American Statistical Association*, *103*(484), 1481–1495. https://doi.org/10.1198/016214508000000841

Cameron, A. C., & Miller, D. L. (2015). A Practitioner’s Guide to Cluster-Robust Inference. *Journal of Human Resources*, *50*(2), 317–372. https://doi.org/10.3368/jhr.50.2.317

Lee, D. S. (2009). Training, Wages, and Sample Selection: Estimating Sharp Bounds on Treatment Effects. *The Review of Economic Studies*, *76*, 1071–1102. https://doi.org/10.1111/j.1467-937X.2009.00536.x