Economics of conservation, part 2

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Poverty and conservation

- How poverty affects optimal policy for promoting conservation
- How poverty & economic development affect conservation levels

Protecting the environment without further impoverishing the poor

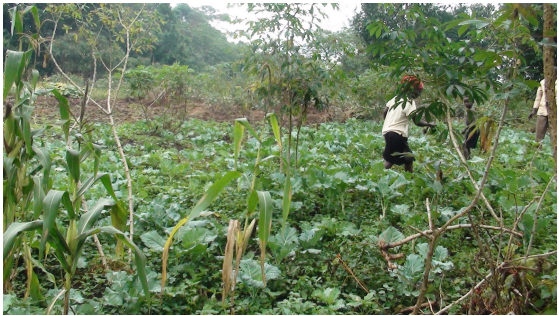
- Policy objective is to raise the private cost of environmental degradation
- Possible approach: Command-and-control regulation
- Problem #1: Governance challenges
- Problem #2: Banning/punishing environmental harm might also be undesirable if it further impoverishes the poor

Financial rewards for protecting the environment

- Use carrot instead of stick: Reward people for conservation
- Payments for ecosystem services (PES) = Payment in exchange for specified pro-environment behavior
- Voluntary: If the payment is less than your cost to comply, you don't need to participate $\rightarrow$ No one should be made financially worse off
  - Goal is not to reduce poverty but to protect the environment without exacerbating poverty

PES to reduce deforestation in Uganda

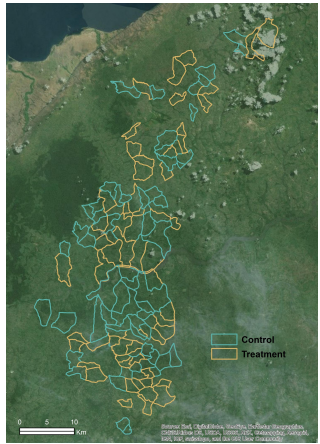
Why deforest? Clear land for cultivation or sell tree products



Reasons why PES might not work

- Many people who sign up and comply would have kept their forests intact even absent the program (“additionality”)
- Deforestation just shifts elsewhere (“leakage”)

Randomized trial in 121 villages in western Uganda

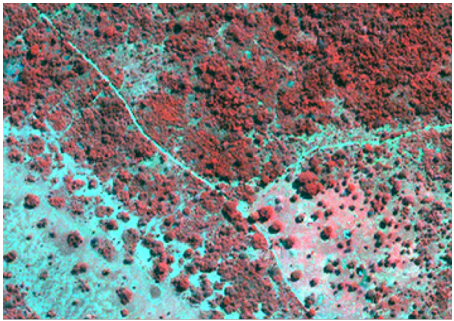


Jayachandran, S., J. de Laat, E.F. Lambin, C.Y. Stanton, R. Audy, & N.E. Thomas (2017): “Cash for Carbon: A Randomized Trial of Payments for Ecosystem Services to Reduce Deforestation,” *Science*.

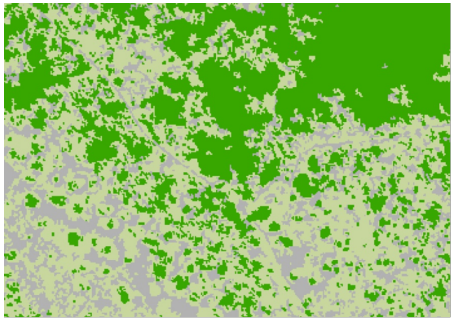
PES program details

- PES program ran for 2 years from 2011 to 2013
- Implemented by NGO, Chimp Trust
- Households that owned primary forest in 60 treatment villages were offered money if they left their forest intact
- Offered 70,000 UGX ($28) per hectare per year for compliance
  - Typical landowner had 2 hectares of forest so could earn $56/year
- Boots-on-the-ground monitoring of compliance by Chimp Trust
- Must enroll all your forest + after non-compliance detected, no longer eligible

Main outcome: Tree cover in village, based on satellite imagery



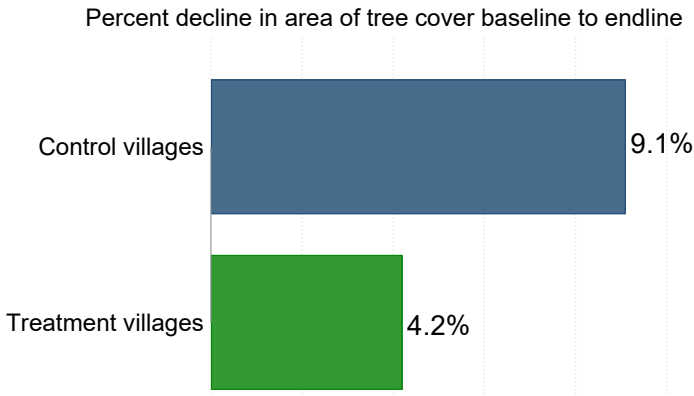
Satellite image



Tree Cover Classification

- 2.4 m resolution commercial satellite imagery

PES cut deforestation by more than half



Equivalent to 5.5 additional hectares of tree cover per treatment village

Valuing the CO_2 benefits of the program

Benefit-cost ratio = 14.8

Valuing the CO_2 benefits of the program

- 5.5 hectares per village $\rightarrow$ 3000 metric tons of delayed CO_2 per village
- Each ton of delayed CO_2 $\rightarrow$ \$1.11 social value
  - Assumes treatment group has 2x deforestation rate until they catch up
- Total program costs: \$0.46 per delayed ton of CO_2
- *Science* paper reported benefit-cost ratio of 2.4
- Update: Jayachandran et al. (2023) and Wang (2020) analyze longer-run imagery: Treatment group deforests at same rate as control group afterwards
- **Benefit-cost = 14.8**
- Most US government carbon policies have benefit-cost ratio < 1

Does PES reduce poverty?

Poverty reduction benefits of PES

- Win-win of environmental and development benefits of PES is often emphasized, but with double-counting
- Some of the payment is (hopefully!) compensating people for their costs to comply, not improving their economic well-being
- In what way is it accurate to call PES a win-win?
  - Doesn't increase poverty, unlike alternative of a ban
  - Some incidental poverty reduction when payment exceeds costs to comply
- The more successful PES is at environmental conservation, the less so it is at increasing economic well-being $\rightarrow$ inherent trade-off

Jayachandran (2023): "The Inherent Trade-Off Between the Environmental and Anti-Poverty Goals of Payments for Ecosystem Services". *Environmental Research Letters*.

Conceptually decomposing the PES transfer

- A PES program payment has two parts:
  - The amount that compensates cost of changing participant's behavior
  - Remaining amount which is a pure transfer
- The pure transfer — or inframarginal payment — is the only component of the payment that increases a participant's income

Payment amount vs. (opportunity) cost to comply

- Consider a PES program that pays a participant M if she undertakes the required behavior, for example, keeping her primary forest intact
- The participant incurs a cost, C, to undertake the pro-environment behavior
  - Costs include monetary outlay, time costs, opportunity costs

Three cases among those offered PES

An eligible person falls under one of three categories:

- If $C > M$: Does not undertake the pro-environment behavior
- $C \leq 0$: Undertakes the behavior and would have done so even w/o payment
  - No environmental benefit; full payment M is a pure transfer (rents)
- $0 < C \leq M$: Undertakes the behavior only because of PES payment if
  - Environmental benefits
  - Amount C compensates them for behavior change; $M - C$ is pure transfer

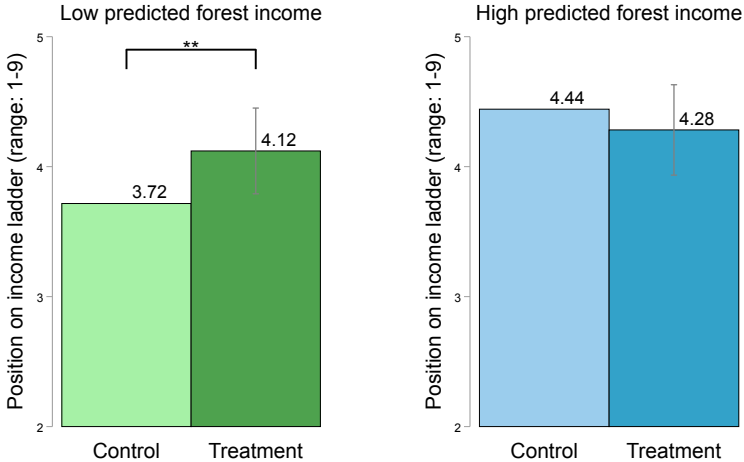
Tradeoff between environmental efficacy and improvements in economic well-being

- How to design PES payment to maximize environmental benefit-cost ratio?
- Set $M = C$: Everyone complies and no pure transfers
- In practice, participants differ in compliance costs, policy maker cannot observe them, or barriers to first-degree price discrimination
- Thus, $M > C$ for some participants who comply, and they enjoy pure transfers

Mapping concepts from framework to this setting

- Compliance costs, C: Forgone income from selling trees
  - Use data on income from selling trees absent PES, from control group
  - Use machine learning (LASSO) with control group to predict forgone income
- Economic gain from participation, $M - C$: Self-assessment of economic well-being

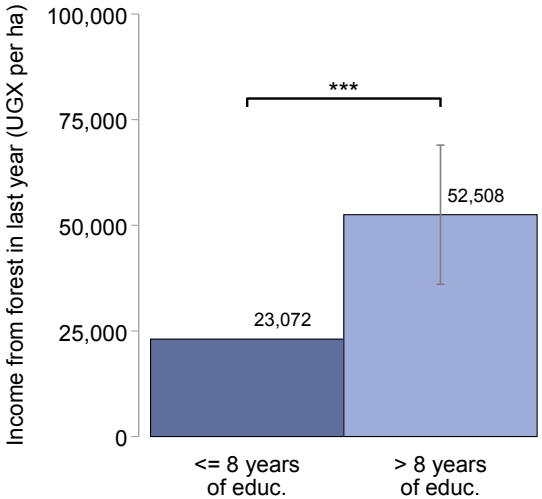
Economic benefits only among those with low cost to comply



How pro-poor are the pure transfers?

- Who the pure transfers are made to is incidental: Who has the low costs to comply?
- Highly unlikely they are exactly the same people one would prioritize for a poverty-reduction program
- How much PES reduces poverty depends on how poor the recipients of the pure transfers happen to be

Poorer households earn less income from selling trees, absent PES



Poorer households forgo less income when they comply with PES, so they enjoy more benefits from PES

	Enrolled in and complied with PES program (1)	Forest income in last year (in 100,000's UGX per ha) (2)	Self-assessed position on income ladder (3)
$\leq$ 8 years of education	-0.031	-0.287***	-1.037***
	[0.035]	[0.071]	[0.172]
Treated		-0.214***	-0.001
		[0.080]	[0.187]
Treated $\times \leq$ 8 years of education		0.213**	0.191
		[0.093]	[0.251]
Number of observations	592	967	1,099
Observations included	Treated only	All	All

Recap on PES

- If societal benefits of conservation $>$ private costs, it is efficient to conserve
- How? Put a price on degradation and thereby discourage it, e.g., fines, taxes
- But can decouple the market-based approach from who should pay
- PES: Uses pricing, but w/ weakly positive income effect for would-be polluters
- Other policy options too: Subsidize an alternative
- PES is not development aid: Only raises income if there is no additionality or policymaker overpaid for it
- Many open questions on PES: How to target program to increase additionality, leakage and GE effects, contract design to increase efficacy, etc.

How poverty & economic development affect conservation levels

Anything goes

- Economic development sometimes leads to more and sometimes less environmental harm
- Consider an increase in a household's income
- They will likely consume more, e.g., purchase a refrigerator or consume more meat
- But they might also be willing to sacrifice more to protect the environment, e.g., pay more for greener product

"How Economic Development Influences the Environment," *Annual Review of Economics*, volume 14, 2022, pp. 229-252

Same theoretical ambiguity for different facets of development

- Improved productivity
  - Increase in agricultural productivity $\rightarrow$ Can produce same amount of food using less land
  - But cheaper to produce food, so supply curve shifts down
  - Borlaug hypothesis (on net helps conservation) or Jevons paradox (on net bad)?
- Better road networks
  - In Mexico, lack of roads meant communities relied on local production for goods they consumed so deforested more, e.g., to meet demand for milk and meat (Alix-Garcia et al., 2013)
  - Roads might enable a forest owner to reach lucrative market for timber or create demand for industrial land use, so more deforestation (Asher et al., 2020)
- Better access to credit