Pay, Talk or 'Whip' to Conserve Forests: Framed Field Experiments in Zambia

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Outline

Why forests matter for Zambia

- Forests cover 66% of land area, contribute 4.7% to GDP and ca. 22% of household incomes, and perform various ecosystem functions in Zambia (Turpie, et al., 2015; Angelsen, et al., 2014)
- **But there is a problem:** 167,000 - 300, 000 ha of forest area is lost every year due to deforestation
  - this threatens the products and services forests supply
- This is despite strong forest conservation policies, including;
  - the 2014 Forestry Policy; the Forest Act of 2015; the 2018 Community Forest Regulations (CFR), the 2015 Biodiversity and REDD+ Strategies etc

Forest conservation policy options in Zambia

Current forest conservation policies are based on:

- **Command and Control (CAC)**:
  - traditional bans and fines, (sticks) - e.g., protected forest areas
- **Payments for Environmental Services (PES)**:
  - incentive based mechanisms (carrots)
- **Community Forest Management (CFM)**:
  - use dialogue, 'cheap talk', (sermons) and main focus in Zambia

- **Question: Are these policy instruments effective or can they be?**

Evidence is thin in Zambia because:

1. some policy instruments are recent - not much to evaluate *ex-post*!
2. most are implemented singly, making cross comparisons difficult
3. the counterfactual is unobserved; forest users are only observable under one policy option at a time

Research question

- Which policy instruments (among CAC, CFM and PES) can deliver better forest conservation outcomes?
  1. will CFM outperform open access (OA), traditional ban and fine (CAC) or the incentive-based schemes (PES)?
  2. within PES, is paying individuals better than paying groups?

- We conducted economic framed field experiments (FFEs) with actual forest users to test the impacts of policy instruments on forest conservation
  - FFEs allow for a quick and inexpensive *ex-ante* evaluation of policy options

Framed field experiments

- FFEs designed to mimic how local dwellers use forests in real life
- Participants earned money based on their (and others') choices in the experiment
  - money incentivizes true preference revelation to mimic real world behavior
- Our experiment was framed as a common pool resource game:
  - participants harvest trees from a common pool (forest), and derive private benefits
  - but, a tree is worth more if left in the forest through the public goods it provides

This creates a social dilemma:

Pure Nash equilibrium (individual rationality) predicts that each participant is better off if he or she harvests the maximum allowable number of trees, yet the overall group reward (social optimum) is higher if everyone leaves the trees in the forest.

Experiment procedures, context and framing

- Field work in 4 villages with 48 randomly selected households per village or 191
- 8 people made a session and played the 10-round game in two-stages (after practice):
  - Stage 1: rounds 1-5 were pre - treatment and common to all
  - Stage 2: rounds 6-10 were for specific treatments and a control open access (OA)
- i harvests indicated on decision forms, group harvest announced and removed before next round but stock was replenished, no communication
- Games played near *real forest resources* with *actual forest users* using *real-50cm tree branches* with a task of *harvesting*
  - This framing of **location, commodity, task** and **participants** makes the games FFEs (Harrison 2004)
- Participants completed a short post-experiment survey and earned on average $5

Experiment procedures

No. of trees	Decision
5	
4	
3	
2	

Treatments

- **CFM**: 5 groups played the second stage with a 3 min communication allowed between rounds
- **CAC**: 5 groups played second stage with sanctions imposed for $x_i > 3$
- **PES, individual pay**: 5 groups played the second stage with an additional incentive of 80% (r) of p if $x_i < x^{RL}$
- **PES, individual pay**: 5 groups played the second stage with an additional incentive of 80% of p if $\sum(xi) < x^{RL}$
- **Open Access**: 4 groups played the based game for 10 rounds

Payoff function

- The benefit (π_{it}) is given by a simple base payoff function:

$$\pi_{it} = px_{it} + (q/N)\left[X_s - x_{it} - \sum x_{-it}\right], x_{it} < x^{\max} \quad (1)$$

- x_{it} and x_{-it} are individual i and group harvest in round t; X_s initial stock; $x^{\max}$ is the max allowable harvest; p private benefit; q benefit to society for standing tree
- Eq. (1) is modified for individual and group PES as:

$$\pi_{it} = px_{it} + (q/N)\left[X_s - x_{it} - \sum x_{-it}\right] + Max\left\{r\left(x^{RL} - x_{it}\right), 0\right\}, x_{it} < x^{\max} \quad (2)$$

$$\pi_{it} = px_{it} + (q/N)\left[X_s - x_{it} - \sum x_{-it}\right] + Max\left\{r\left(x^{RL} - \left(\sum_{i=1}^{N} x_{it}/N\right)\right), 0\right\}, x_{it} < x^{\max} \quad (3)$$

Drivers of harvest rates

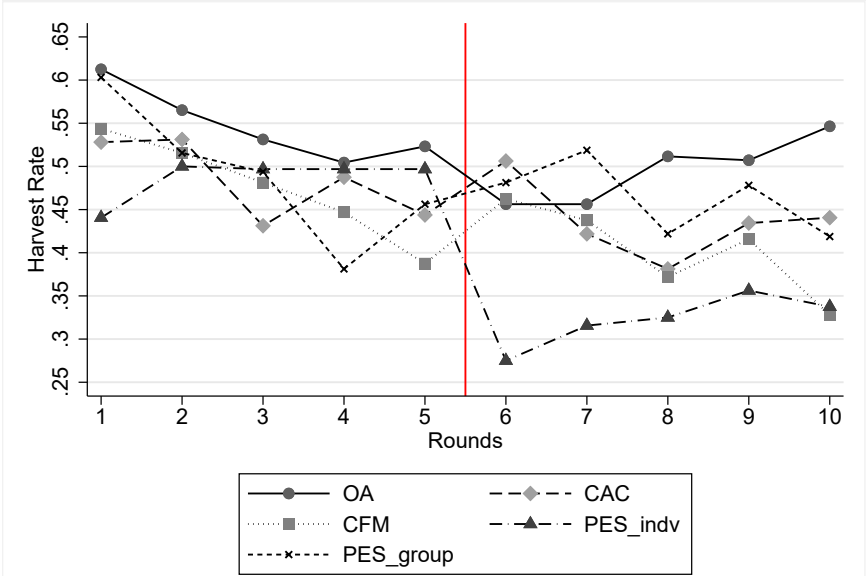
- We used fractional probit model because the dep. var is within [0,1] and panel data methods because the games were played over 10 rounds (t) for each i

$$harvrate_{it} = \beta_0 + \beta_1 CFM_{it} + \beta_2 CAC_{it} + \beta_3 PES1_{it} + \beta_4 PES2_{it} + \beta_5 FPsales_i + \beta_6 FUfreq_i + \boldsymbol{wealth}_i\sigma + \boldsymbol{preference}_i\alpha + \boldsymbol{X}_i\gamma + c_i + \epsilon_{it} \quad (4)$$

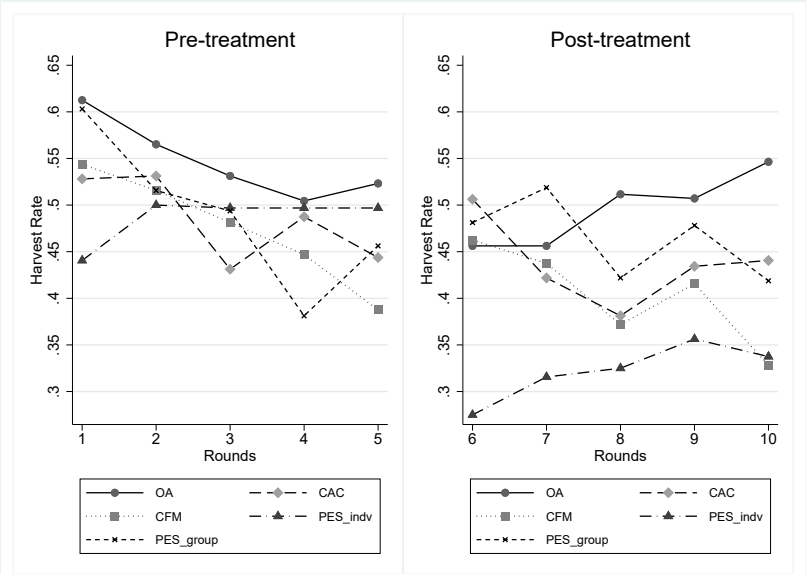
- where: $harvrate_{it}$ is harvest rate for individual i in round t; ***preferences*** index social, time and risk preferences; ***wealth*** measured by TLU and landholding size; $\boldsymbol{X}$ include gender, age, education; treatments CAC, CFM and PES relative to OA; and $FPsales$ and $FUfreq$ capture forest reliance

Main Results

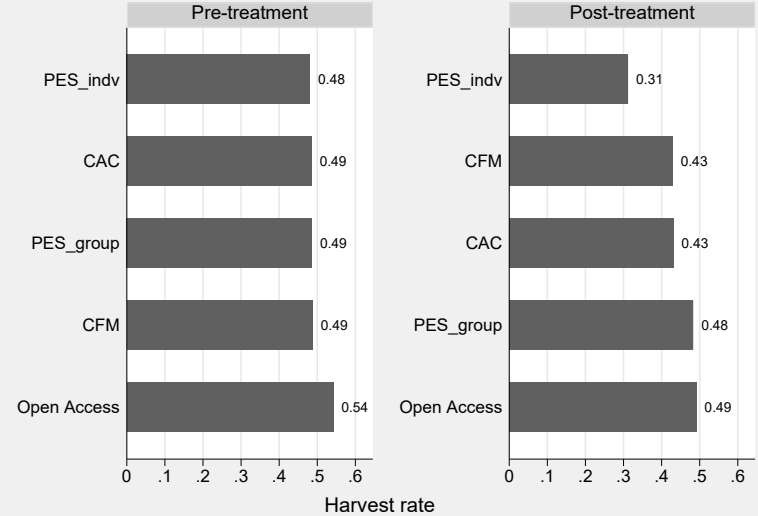
Trends in harvest rates by treatment



Trends in harvest rates pre- and post-treatment



Harvest rates below the Nash equilibrium



Test for mean equality within treatment

	Harvest rate	Harvest rate	Diff	
	Pre-treatment (1)	Post-treatment (2)	(1)-(2)	N
OA	0.542 (0.024)	0.492(0.027)	0.05	310
CAC	0.485(0.021)	0.431(0.019)	0.054*	400
CFM	0.488(0.023)	0.429(0.022)	0.059*	400
PES, individual pay	0.481(0.021)	0.312(0.017)	0.169***	400
PES, group pay	0.486(0.023)	0.483(0.024)	0.003	400
Overall effects	0.494(0.010)	0.426(0.010)	0.068***	1,910

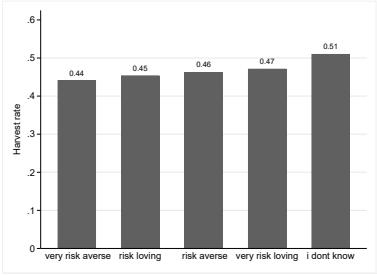
Notes: ***, **, * significant at 1%, 5% and 10% respectively

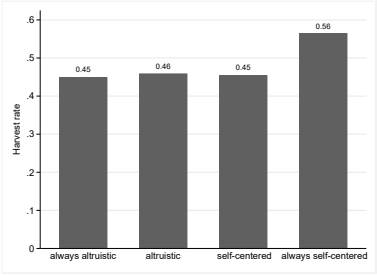
Between treatment mean harvest rates in second stage

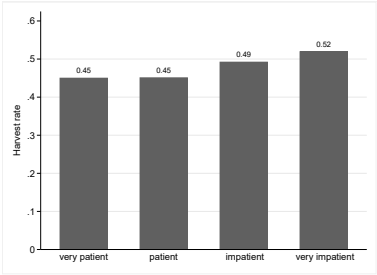
Variable (1)	Variable (2)	Mean/SE (1)	Mean/SE (2)	Diff. (1)-(2)	T-stat
OA	CFM	0.49(0.03)	0.43(0.02)	0.06	1.82*
	CAC	0.49(0.03)	0.43(0.02)	0.06	1.87*
	PES individual pay	0.49(0.03)	0.31(0.02)	0.18	5.74***
	PES, group pay	0.49(0.03)	0.48(0.02)	0.01	0.24
CFM	CAC	0.43(0.02)	0.43(0.02)	0	-0.07
	PES individual pay	0.43(0.02)	0.31(0.02)	0.12	4.27***
	PES, group pay	0.43(0.02)	0.48(0.02)	-0.05	-1.64
CAC	PES individual pay	0.43(0.02)	0.31(0.02)	0.12	4.78***
	PES, group pay	0.43(0.02)	0.48(0.02)	-0.05	-1.69*
PES ind. pay	PES, group pay	0.31(0.02)	0.48(0.02)	-0.17	-5.78***

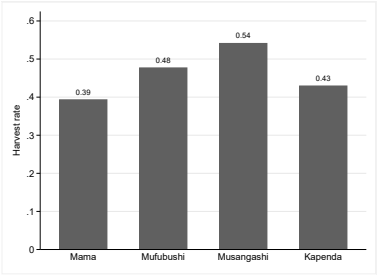
Notes: ***, **, * significant at 1%, 5% and 10% respectively

Harvest rates by preferences and location









Selected APES on drivers of harvest rates (fractional probit)

	(1)	(2)	(3)	(4)
	Treatments only model	SE	Full model	SE
CFM (yes = 1)	-0.051	0.051	-0.083*	0.048
CAC (yes = 1)	-0.056	0.048	-0.021	0.052
PES, ind. pay (yes = 1)	-0.123***	0.046	-0.152***	0.042
PES, group pay (yes = 1)	-0.031	0.053	-0.021	0.048
Sold fores prod (yes =1)			0.050	0.039
Altruistic (yes =1)			-0.047	0.036
Risk loving (yes =1)			0.004	0.031
Impatient (yes =1)			0.140***	0.051
Tropical Livestock Units			-0.032*	0.017
Female (yes=1)			0.119***	0.030
Village and session FE			yes	yes
...	.	.	.	.
Observations	1,910		1,880	

Notes: ***, **, * significant at 1%, 5% and 10%; OA is the base treatment; square terms for age, education, tropical livestock units and landholding size included; the dependent variable is harvest rate [0,1]

Discussions and conclusion

- Non-significant differences in OA harvest rate pre- and post-treatment validate our experimental designs
- The 0.49 pre-treatment harvest rate is below the Nash equilibrium (1) and suggests strong non-pecuniary motives
- Harvest rates 0.31 - 0.49 comparable to findings in Handberg and Angelsen (2015) for Tanzania; Andersson, et al. (2018) across five tropical countries; Hailu and Angelsen (2018) for Ethiopia
- Our harvest rates are lower than those for similar treatments in Ostrom, et al. (1994) and Cardenas, et al. (2000)
  - Context and framing could account for any differences

Discussions and conclusion

- Better conservation outcomes under individual PES show the need to pay actual forest users and is akin to the core REDD+ idea
- That individual pay performs better than group pay corroborates findings in Gatiso, et al. (2018) and Hailu and Angelsen (2018)
  - whether individual PES is feasible depends on transaction costs
- Although currently emphasized in Zambia, CFM alone is not the panacea:
  - both pecuniary and non-pecuniary motives matter; combinations of CFM and individual PES hold promise for win-win outcomes as in Andersson, et al. (2018)
  - individuals need to see tangible benefits to participate in conservation efforts and benefit sharing mechanisms that deliver pecuniary benefits to compensate for reduced forest use are key [1]

[1] see for details `http://www.iapri.org.zm/images/WorkingPapers/wp140.pdf`

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Thank you

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