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Empirically-Informed Agent Based Modeling of Incentivized Forest Conservation - June 2019

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Empirically-informed agent based modeling of incentivized forest conservation

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Overview









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Background

Payment for ecosystem services (PES):

- popular and 'easy', BUT
- complex to design
 - do they work?
 - how (why) do they (not) work?
 - crowding out effect?
 - heterogenous effect?
- context dependent

(B)

Background...

Framed field experiment (FFE):

- Nine villages in Ethiopia
- Sample of 432 household heads
- Formed groups of 8 randomly
- Each group endowed with 60 tree branches ('forest stock')

The experiment: baseline

Payoff $\pi_{it} = x_{it} + 2\left(\frac{60 - \sum x_{it}}{8}\right), where \ x_{it} \le 5$

- Individuals face social dilemma
- We observe history without policy

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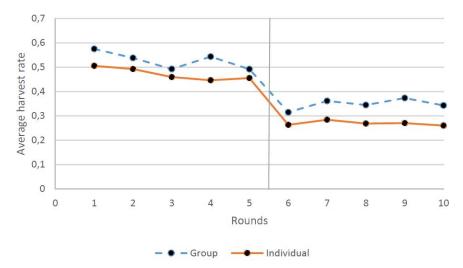
Payoff with PES

Individual PES:

$$\pi_{it} = \begin{cases} x_{it} + 2\left(\frac{60 - \sum_{i=1}^{8} x_{it}}{8}\right) + 0.75(RL - x_{it}), & \text{if } x_{it} \le RL \\ \\ x_{it} + 2\left(\frac{60 - \sum_{i=1}^{8} x_{it}}{8}\right), & \text{if } RL \le x_{it} \le 5 \end{cases}$$

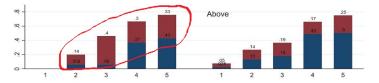
RL = Above | Historical | Below• Group PES: $\frac{\sum_{1}^{8} x_{it}}{8}$

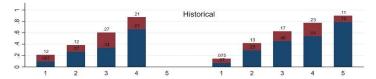
With and without PES

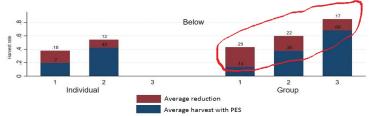


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Pay type and reference levels







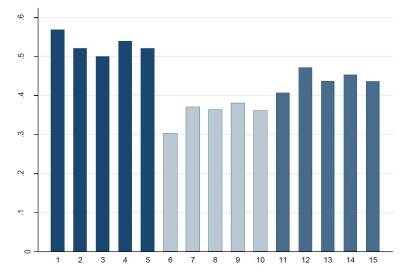
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Baseline, PES and post-PES



- previous results are only aggregate values
- address the *how* of behavioral patterns, i.e., mechanism-based explanation
- formalize micro-level mechanisms that generate the phenomenon observed in experiments
- individual behavior affects group outcome, and group behavior affects individual behavior.

ABM of FFE

AgentEx (Schill et al, 2016)

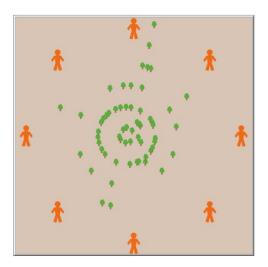
- Cooperation in CPR games
 - focus of experiments
 - trust, communication (reduces social uncertainty)
 - not enough for sustainability (complexity in SES and uncertainty about resource dynamics)
 - environmental uncertainty
- "Cooperation is not enough...for sustainable common-pool resource use"
- sustainable ecosystem management depends on both social-social and social-ecological interactions (both affected by social and environmental uncertainties)

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Netlogo







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Pseudo-code

- Setup: users and stock (60 trees)
- Harvest: start random
- Identify: assign type (free rider, (un)conditional cooperators)
- Update: group average, others' vs. own harvest
- Reset: show remaining trees and reset stock to 60
- Report: group total, group average, others'

What is next?

- Set rules for harvest (random?)
- Replicate behavioral patterns
- Explain heterogenous responses
- Explain interaction effects in treatments
- Show the role of individuals in group outcome
- Experiment level comparisons

- Can we use behavior to explain behavior?
- How to determine types of players:
 - Free rider: harvest highest or maximum?
 - Conditional cooperator: start random?
 - Unconditional cooperator: zero or least harvest?
- Validation?

Thank you!

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