Using Artefactual Field Experiments to Learn about the Incentives for Sustainable Forest Use in Developing Economies

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One vexing problem facing mankind is how to promote sustainable use of common property resources. Within developed and developing countries alike, misuse of fresh water, pastures and forests is commonplace. While developed countries have in many cases designed principles and laws to promote sustainable resource use, developing countries often lack the institutional know-how and means to enforce property rights. This has lead researchers to look for alternative means to address common property resource problems.

We study behavior and attitudes towards forest conservation in Sierra Leone, and aim for two contributions related to common property resources. First, we attempt to establish if artefactual field experiments (AFEs) can explain behavior in the field. If AFEs can explain variability in treatment of the commons, then we can have greater confidence in testbedding mechanisms in the laboratory and transferring the lessons learned to naturally occurring settings. This approach relies on the framework of Levitt and List (2007, hereafter LL), who propose that behavior in laboratory experiments is influenced by not only monetary calculations but also by at least five other factors: (a) the presence of moral and ethical considerations, (b) the extent to which one's actions are scrutinized by others and the nature of that scrutiny, (c) the context in which the decision is embedded, (d) the subject pool of respondents, and (e) the stakes of the game.

The most straightforward version of the LL model predicts that behavior in AFEs will correlate perfectly with behavior in the field so that those who exhibit stronger social

preferences in the lab will also do so in the field. The factors in the most generic LL model serve as shift parameters, and if these shifters are isomorphic across people, then relative rankings are preserved across lab and field settings. The older psychology literature and more recent economics work provide evidence that suggests one should reject this most straightforward version of their model (see, e.g., Hartshorne and May 1928). Alternatively, allowing heterogeneity in the shift parameters yields potentially very different relative rankings across the lab and field. Given that we both i) observe people in the lab (in AFEs) and ii) gather information on their behavior in the field (via unrelated surveys), we can test whether relative rankings are preserved across the lab and field (see also Jeffrey Carpenter and Erika Seki, 2010, and Jetske Bouma et al. 2008). Moreover, if they are not preserved we can examine which observables explains heterogeneity in the shift parameters.

Our second contribution is to examine if factors that are previously unexplored, such as if the person was disenfranchised via having a relative killed in civil war, directly influences their treatment of the common property resource. Since we examine behavior in the region of the Gola Forest Reserve, in south-eastern Sierra Leone, we observe the activities of people who have experienced a wide variety of treatments. For example, Sierra Leone has a recent history of civil war, with episodes of extreme violence, and the Gola Forest region was at the core of this war.

I. Experiments and data

We collected experimental and survey data in the region of the Gola Forest Reserve, in south-eastern Sierra Leone. The Gola Forest is one of the largest remnants of Upper Guinea Tropical forest in west Africa, a major stock of standing carbon, and a global biodiversity hotspot. However, it is located in one of the poorest regions in the world, torn by a recent civil war. Local populations depend to a large extent on forest-related goods and services. The Gola Forest Reserve was established in the 1990s, and restricts the exploitation of

resources within the designated area of the reserve. Local by-laws govern extraction behavior outside the reserve. In what follows we focus on extraction behavior and conservation efforts with respect to the forest reserve — while strictly speaking located on private lands, this amounts to a regulated common pool resource providing locally and globally valued ecosystem services.

We ran two different public good games (among various other AFEs) in the summer of 2010 in 35 villages across the seven chiefdoms comprising the Gola Forest region. These villages lie within one mile of the Gola forest. In total, 632 households participated in these studies. The first game consists of a variant of the standard public goods game ("PG-Aid"), in which we allocated each household representative with a large endowment of $20 (or 80,000 Le — more than a month's worth of unskilled wages). We asked participants to (anonymously) split this endowment between private goods for themselves and a project that would benefit the entire village (a community project fund). On average, 75% of the endowment was used for private livelihood support goods and 25% for a community project.

The second game was a conventional public goods game ("PGG") with three players. Players were endowed with 5 tokens. The payoff under full co-operation amounted to 7,500 Le, and the maximum possible payoff for a free rider (assuming its peers invested their complete endowment in the common pot) was 10,000 Le. On average households allocate 2 tokens in each round, and the average payoff is 6,000 Le.[1]

Interestingly, and somewhat to our surprise, behaviour in the two games is uncorrelated (ρ=0.04, p=0.33). We therefore include both types of behavior as explanatory variables in the regression analysis that follows. The framework by LL suggests several reasons to explain the differences in measured behavior. The stakes are much higher in PG-

[1] Other games we played included a bilateral ultimatum game, a coordination game, a time preference experiment and a risk preference experiment. The relationship between behavior in these games and forest management behavior will be explored in subsequent work..

aid than in PGG. Moreover, PG-aid is framed as a livelihood support initiative so the context within which the decision is embedded also varies. This suggests carelessly applying the outcomes of one particular PG experiment and interpreting them as "the proxy" of social preferences may be problematic.

We also collected data with household and village level surveys, ascertaining demographic, socio-economic, institutional and conflict related information. We collected survey data in 25 of the 35 villages included in the study, and sampled 170 households from the 632 participating in the AFEs. The household surveys provided data on behavioral and attitudinal variables related to forest management and use. The three variables we focus on in this paper are: (i) "*commercial interests,*" a variable indicating the degree to which an individual is involved in business with commercial miners, loggers or hunters (an activity that violates national law as well as local by-laws, average = 4.5, s.d. = 1.5);[2] (ii) "*illegal extraction,*" the total per capita value (consumption and sales) of illegally hunted animals (typically endangered species, av = 5,485 Le, s.d. = 20,430); and (iii) "*pro conservation,"* the answer to a 5-point scale question *Do you support conserving the Gola Forest*? (average = 3, s.d. = 1.5).

We include a series of conventional household controls (age, income, education) and use sector fixed effects to control for inter-sector heterogeneity. In addition, we include two unconventional household variables that we believe are relevant in the Sierra Leone context. First, we expect victims of civil war violence to display more pro-social behaviour (John Bellows and Edward Miguel 2006), so we control for household exposure to violence during the war in the 1990s. Second, we control for witchcraft beliefs as this has been viewed as a key mechanism to enforce social norms in Africa (Jean-Philippe Platteau 2000). While economists have studied witchcraft before (e.g. Miguel 2005), such work has focused on

[2] Additive scale based on answers to: *Do you think that miners, traders and loggers are welcome in your village?* and *Do you do business with the commercial miners, and/or hunters and/or loggers*. Scale 0-8.

studying the causes of witchcraft accusations, not the consequences. Witchcraft may have evolved to enforce social order, and facilitate punishment in the context of failure to provide public goods.

The estimation strategy at this stage is exploratory and aims at unearthing robust correlations. It does not aim to fully address endogeneity issues; this is left for future work.

II. Regression results

To analyse household characteristics associated with forest conservation, we estimate models with village-level fixed effects. For the "illegal extraction" models we use OLS, and for the models explaining "commercial interests" as well as "pro conservation" attitudes we use ordered probit models:

$$Cons_{ij} = \alpha + \gamma_1 AFE_{ij} + \gamma_2 X_{ij} + V_j + \mu_{ij}^{FE} \quad (1)$$

where $Cons_{ij}$ is one of the three conservation outcomes of individual i (with i = 1, …, 170) in village j (j = 1, …, 25), AFE are experimental outcomes in both types of public goods games, X_{ij} is a vector of individual household controls, and V_j is a vector of community fixed effects. Finally, μ is an error term. To explore whether there is evidence of heterogeneity in shift parameters, as advanced by LL, we next introduce a full set of interaction terms:

$$Cons_{ij} = \alpha + \gamma_1 AFE_{ij} + \gamma_2 AFE_{ij} X_{ij} + \gamma_3 X_{ij} + \gamma_4 V_j + \mu_{ij} \quad (2)$$

Regression results are summarized in Table 1. Columns (1,3,5) present estimates for model (1), and columns (2,4,6) include interaction terms as in model (2).

Table 1: Experimental Play and Forest Conservation FE model

	(1) Commercial Interests	(2) Commercial Interests	(3) Illegal Extraction	(4) Illegal Extraction	(5) Pro Conservation	(6) Pro Conservation
PG Aid	-0.00000307	-0.0000900*	-0.395*	-2.259**	0.00000415	0.0000748*
	(0.00000940)	(0.0000525)	(0.236)	(1.111)	(0.00000754)	(0.0000442)
PGG	-0.145	-0.275*	-2281.2	-2663.8	-0.213*	-0.179
	(0.108)	(0.142)	(2157.8)	(3091.1)	(0.123)	(0.158)
Age	-0.00869	-0.00805	-74.95	5.248	-0.00745	0.0250
	(0.00591)	(0.0201)	(173.0)	(443.9)	(0.00621)	(0.0197)
Education level	0.0346	-0.669	-2001.5*	-9012.9*	-0.204***	-0.580*

	(0.0780)	(0.420)	(1136.8)	(5273.3)	(0.0710)	(0.323)
Total household Income	0.00418 (0.0299)	-0.0492 (0.0920)	-349.7 (798.6)	-1602.4 (2689.2)	-0.0720** (0.0287)	0.0536 (0.106)
Witchcraft is a Problem	0.161* (0.0985)	0.178* (0.106)	2541.0 (2608.0)	2215.5 (2593.0)	0.144 (0.109)	0.176 (0.127)
Family member died due to war	0.880* (0.473)	-3.804* (2.093)	-5692.4 (8122.6)	822.4 (35269.1)	0.545 (0.399)	-5.238** (2.112)
Age x PG Aid		0.000000386 (0.000000472)		-0.00110 (0.00933)		-0.000000469 (0.000000512)
Education x PG Aid		0.0000200 (0.0000136)		0.269 (0.171)		-0.00000133 (0.00000844)
Income x PG Aid		0.00000235 (0.00000372)		0.100 (0.0659)		-0.00000241 (0.00000236)
Witchcraft x PG Aid		0.0000171 (0.0000185)		0.649 (0.484)		-0.0000643*** (0.0000194)
War dead x PG Aid		0.0000586 (0.0000410)		1.197 (0.944)		0.0000410 (0.0000448)
Age x PGG		-0.00443 (0.00581)		-32.06 (167.7)		-0.00925 (0.00777)
Education x PGG		0.125 (0.0823)		1027.0 (1254.5)		0.142* (0.0838)
Income x PGG		0.0177 (0.0263)		-91.02 (648.7)		-0.0329 (0.0328)
Witchcraft x PGG		0.638 (0.497)		6080.6 (5550.4)		0.692 (0.460)
War dead x PGG		2.065** (0.951)		-17791.5 (14182.1)		2.667*** (0.941)
Constant			13881.5 (11275.4)	44319.4 (28664.6)		
Community FE	yes	yes	yes	Yes	yes	yes
N	99	99	104	104	103	103
R^2	0.06	0.10	0.19	0.25	0.09	0.14

Robust standard errors in parentheses * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

When simply considering the signs of the coefficients for the two AFE variables (PGG and PG-aid), we observe they tend to match intuition. Specifically, more "pro-social play" in the PPG and PG-aid games tends to be correlated with (i) a reduced willingness to interact with commercial parties with commercial interests damaging the forest and its biodiversity; (ii) a lower level of involvement in the illegal extraction of wildlife, and (iii) more positive attitudes towards forest conservation. However, the latter finding is only true for PG-aid – the reverse is true for PGG which enters with the "wrong sign" in column (5).

This counter-intuitive result, however, should perhaps not be unexpected in light of the earlier remark about the lack of correlation between behavioral play in the two PG games.

PGG and PG-aid enter "differently" across many of our models. While both PGG and PG-aid enter significantly in the interaction model explaining "commercial interests," we find that only PG-aid is correlated with illegal extraction. Moreover, PG-aid and PGG enter with opposite signs in the "pro-conservation" models, and only enter significantly in different specifications.

Our three dependent variables are intended to capture related dimensions of the household's willingness to contribute to the provision of a public good (sustainable forest management). However, it appears that these dimensions are somehow "distinct" in the sense that they correlate with different behavioral proxies and controls. Taken together, we interpret this as evidence that either (a) there is not a general cross-situational trait called "social preferences," and/or (b) one situation activates certain social preferences, while the other situation is treated by subjects as governed by alternative social norms or preferences.

Turning to the issue of heterogeneity, a few insights stand out. Importantly, including interaction terms matters. For the PG explanatory variables, coefficient size is affected, and so is the significance level. Specifically, including interaction terms implies that PGG and PG-aid enter significantly in the "commercial interest" model. Including them also alters the significance of the PG proxies in the "pro-conservation" models. We interpret this as strong evidence of considerable heterogeneity in terms of how lab evidence can be transferred to naturally-occurring behavior.

Some of the interaction terms are significant, but again there is variation across our dependent variables (no interaction term is significant in the illegal extraction model). Interestingly, it appears as if especially the unconventional control variables interacted with AFE play have explanatory power. The witchcraft and war interaction terms are sometimes significant, while interaction terms based on the conventional controls (age, education and income) tend to be not significant. (The one exception is the interaction term of education

and PGG in the pro-conservation model, which enters with a positive correlation.) Hence, heterogeneity matters, but one should think "out of the box" when considering the dimensions along which to explore heterogeneity.

Finally, turning to our controls, we note that age and income are not significantly correlated with common pool management and attitudes towards conservation (when controlling for play in AFEs). Education is negatively correlated with illegal extraction, but also with pro-conservation preferences – a mixed outcome. Respondents who state that witchcraft is a problem in the village tend to be the same ones consorting with private parties with commercial interests. Perhaps this reflects that such individuals stand to lose more from informal enforcement of by-laws associated with forest conservation. Exposure to war also appears to be relevant. For example, in the "commercial interests" model it enters directly, but also via the interaction term. Interestingly, and reflecting some of the discussion above, the interaction term with PGG is significant, but the interaction term with PG-aid is not. The direct effect of war on conservation is negative, but this is mediated via increased sharing in the PGG.

III. Concluding remarks

We have explored the relation between behavior in two distinct artefactual field experiments and various forest conservation behavior and attitudes. One main result is that there does not appear to be one simple metric of pro-social preferences. There is no correlation between behavior as measured in the two AFEs, and no robust pattern of correlations between play in the games and conservation behavior and attitudes in the real world.

Our second main result is that heterogeneity matters. It may not be feasible to simply transfer laboratory evidence to the real world – individuals behaving in a pro-social manner in the lab may not necessarily be the same individuals who provide most of the public goods in the field. That is; the "ranking" of individuals and communities in terms of pro-sociality,

based on lab experiments, may not carry over to the field. Hence, NGOs and government agencies should not expect to be able to select the most responsive partners for project interventions based on simple behavioral games.

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