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Analysis

Breaking the elected rules in a field experiment on forestry resources

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ABSTRACT

Harvesting from common resources has been studied through experimental work in the laboratory and in the field. In this paper we report on a dynamic commons experiment, representing a forest, performed with different types of communities of resource users in Thailand and Colombia, as well as student participants. We find that all groups overharvest the resource in the first part of the experiment and that there is no statistical difference between the various types of groups. In the second part of the experiment, participants appropriate the common resource after one of three possible regulations is elected and implemented. There is less overharvesting after the rules are implemented, but there is a significant amount of rule breaking. The surprising finding is that Colombian villagers break the rules of the games more often than other groups, and even more so when they have more trust in members of the community. This observation can be explained by the distrust in externally proposed regulations due to the institutional and cultural context.

1. Introduction

Communities are frequently able to govern their shared resources despite the temptation to overharvest (Ostrom, 1990). A tragedy of the commons is frequently avoided if resource users have the ability to participate in decision making on regulations and if there is graduated sanctioning, monitoring and enforcement, and trust among the resource users.

Experiments in the laboratory and field have shown that without communication and without costly sanctioning groups will overharvest the common resource (Janssen et al., 2010; Ostrom, 2006; Ostrom et al., 1992). However, allowing participants to communicate and/or sanction others at a cost to themselves leads to more cooperative results (Cardenas, 2001; Janssen et al., 2010; Ostrom, 2006; Ostrom et al., 1992).

Notably, rules imposed by the experimenter which are designed to improve the performance of the groups do not always lead to better performance (Ostrom et al., 1992). This is also observed in field experiments (Cárdenas et al., 2000; Vollan, 2008). One explanation for this is the crowding-out behavior of group-oriented decisions that are initially made because of intrinsic motivations, but due to external interventions, end up with behavior that is more self-oriented. Crowding-out of pro-social behaviors has been found in various social dilemma situations. A classic example is blood donations. Titmuss (1970) found that voluntary arrangements in the UK led to higher quantities and quality of blood donated than the incentive-based US system. Donating blood is often done because of intrinsic motivation, not because of financial rewards.

Vollan (2008) found that external interventions that are enabling instead of restricting reduce the likelihood of crowding out. Furthermore, he found that the more people support the new regulation, the higher the compliance.

In this paper we describe a series of experiments in which participants had to elect a regulation from a limited set of possible institutional arrangements. We analyze whether the elected rules lead to better performance and how compliant the participants are. The field experiments are performed with actual resource users in Colombia and Thailand and we will show that the results depend on the social context of the participants.

The experiments presented in this paper are part of a larger study that focused on understanding the role that experience with resource management plays on decisions made in a common pool resource game (Cardenas et al., in press). Experiments framed as forestry, fishery and irrigation dilemmas were performed in rural villages and urban university campuses in Colombia and Thailand. Participants were randomly drawn to participate in only one of the experiments. The rural villages had forestry resources, fishery or irrigation as the main common resource uses. In each village each of the three games was performed. We also performed return visits, a

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year after the original experiments, to discuss the experimental results, to perform role playing games, and do ethnography which helped to interpret the findings of the experiments. This paper discusses the forestry experiments. Irrigation experiments and fishery experiments are discussed elsewhere (Castillo et al., 2011; Janssen et al., 2012).

The experiment is a dynamic game to represent resource dynamics over time. Such experiments have been performed in laboratory settings (Herr et al., 1997; Janssen et al., 2010; Osés-Eraso et al., 2008) but to our knowledge not yet in a field experiment.

Despite doing experiments with resource users in the field we are aware of the mixed findings on the interpretation of observed behavior in the experiments and the actual behavior of the participants. Voors et al. (2012) report that experimentally measured tendencies to cooperate in an experiment in Sierra Leone does not correlate with actual behavior derived from survey responses. On the other hand, Rustagi et al. (2010) find that behavioral types from experiments explains performance effects of the communities in the physical change of forest management in an Ethiopian study. Because of the challenges of interpreting experimental results we combine field experiments with additional qualitative information derived during a return visit.

The rest of the paper is composed as follows. In Section 2 we present the experimental design, as well as four specific hypotheses we test in this study. Section 3 describes the context in which the experiments took place and Section 4 the experimental results. Qualitative results of field work which supplement the experimental results are described in Sections 5 and 6 concludes.

2. Experimental Design

The common resource is a dynamic resource representing a forest (see Appendix A for the instructions of the experiment). Each round participants can extract trees, and there is a limited regrowth of the forest. The initial amount of the resource is 100 trees. In each round each of the five participants can take a maximum of 5 trees from the resource (Table 1). The game has a maximum duration of 10 rounds. The stock will regenerate in each round. For every 10 trees remaining in the resource, one tree is added as regrowth, with a maximum resource size of 100 trees. When the stock is below 25 trees, the maximum number of trees each individual is allowed to extract is given in Table 1.

When participants collect as much as possible as fast as possible, the stock will be depleted in 5 rounds, and the trees collected by the group are 115. When they cooperate and maximize the group earning over the 10 periods, the group total can increase to 165 by harvesting just 10 trees per round in the first five rounds, before increasing the harvest rate (Fig. 1).

After ten rounds the participants must vote for one of the three following rules, which will be enforced for another ten rounds, and restarting with a 100 units resource:

- *Rule 1* (*Lottery*). Each round two participants are randomly drawn who can harvest. If somebody harvest when (s)he is not allowed to do so, a penalty may be applied. In each round a die is thrown, and when a six is thrown, an inspector comes and rule breakers get a penalty. The penalty consists of paying back the harvested amount plus an extra 3 tokens.
- *Rule 2* (*Rotation*). A fixed schedule is defined where two participants are allowed to harvest each round. In round 1, A and B can harvest, then C and D, then E and A, etc. The same mechanism of monitoring and sanctioning is used as rule 1.
- *Rule 3* (*Property*). Everybody has the right to harvest 0, 1 or 2 units per round. If a higher amount is harvested, a die determines whether the participant is inspected, and if in violation returns back the harvest plus 3 tokens.

Table 1
Maximum harvest table.

Current resource level	Individual maximum harvest level
25–100	5
20–24	4
15–19	3
10–14	2
5–9	1
0–4	0

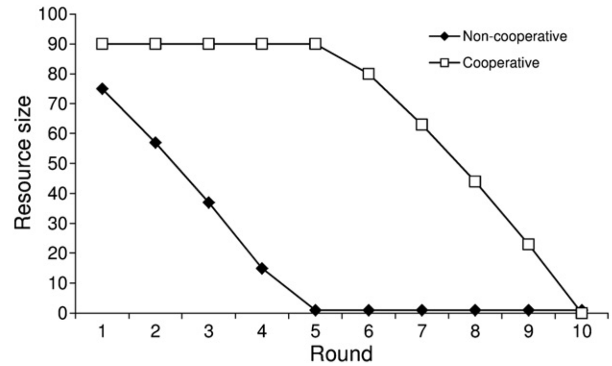

Fig. 1. Resource size patterns for non-cooperative and cooperative equilibria.

These rules were designed based on the most common rules found in field studies on common-pool resources (Janssen et al., 2007; Schlager et al., 1994). In our design, participants must vote for their preferred rules which will be implemented in a subsequent series of rounds if three or more players vote for it. If two rules get two votes, an additional round of votes between those two candidates is used to determine the final chosen rule. All rules are aimed at solving the resource dilemma by regulating the over-extraction of the resource in the appropriation stage, and thus achieving the goal of sustaining the resource through all ten rounds and each of the five players harvesting an equal share of the resource over the duration of the game.

Ten rounds are played with the new rule implemented. The first round after the election has the same starting situation as round 1 of the experiment. If participants are selfish and rational the non-cooperative equilibria would be the same. The reason for this is that expected earnings by breaking a rule are higher than complying with the rule. For rules 1 and 2 the expected penalty for breaking a rule is 8/6 while gaining 5 tokens if one is not allowed to harvest. For rule 3 the expected penalty is again 8/6 but this time the gain is 3 tokens. Due to penalties, the expected group earnings in the non-cooperative equilibrium are reduced to 96 for rules 1 and 2, and 81 2/3 for rule 3. The expected level of penalties for rules 1 and 2 is equal to have each round 3 players a 1/6 probability being caught and pay 8 (5 + 3) tokens for the first four rounds and 6 (3 + 3) for the last round before the resource is depleted. This leads to an expected penalty of 19 tokens. For rule 3, 5 players have each round the risk of being caught. This leads to an expected penalty of 33 1/3 tokens.

If the rules are followed, the resource size declines only slowly (Fig. 2). Since the resource is not fully depleted when the experiments end, the total earnings are 100 trees for all three rules. This is higher than the Nash equilibrium. If a group was able to coordinate to increase its earning, a profitable strategy would be to follow the rules for 6 rounds, and then harvest the maximal level for four rounds. This would lead to expected earnings of 144 for rules 1 and 2, and 123 1/3 for rule 3.