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Cultural norms, cooperation, and communication: taking experiments to the field in indigenous communities[1]

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Abstract: Extensive experimental research has been devoted to the study of behaviour in laboratory settings related to public goods, common-pool resources, and other social dilemmas. When subjects are anonymous and not allowed to communicate, they tend not to cooperate. To the surprise of game theorists, however, simply allowing subjects to communicate in a laboratory setting enables them to achieve far more cooperative outcomes. This finding has now been replicated in many laboratory experiments in multiple countries and in some initial field experiments. Carefully conducted laboratory experiments do have strong internal validity. External validity, however, requires further research beyond the initial field experiments that have already been conducted. In this paper, we report on a series of common-pool resource field experiments conducted in eight indigenous communities in India that have very long traditions of shared norms and mutual trust. Two experimental designs were used in all eight villages: a "no-communication" game that was repeated in ten rounds where no one was allowed verbal or written communication and a "communication game" in which the same five participants were allowed to communicate with each other

[1] This paper is dedicated to the memory of Elinor Ostrom.

at the beginning of each round before making their decisions. The findings from these field experiments are substantially different from the findings of similar experiments conducted in experimental laboratories. Subjects tended to cooperate in the first design even in the absence of communication. The shared norms in these indigenous communities are so deeply embedded that communication is not needed to adopt cooperative decisions. Communication does, however, tend to homogenize group and individual outcomes so that communities that are overly cooperative tend to reduce cooperation slightly and those with small deviations in the other direction tend to move toward the optimal solution.

Keywords: Collective action; common pool resources; forestry; India; institutions

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1. Introduction

The past half-century has witnessed substantial rethinking about how individuals make decisions regarding harvesting from common-pool resources including forests, fisheries, and water bodies. Based on the economic models of Scott Gordon (1954), Mancur Olson (1965), and Harold Demsetz (1967), and the now classic article in *Science* by Garrett Hardin (1968), many scholars and policymakers presumed that individuals always maximized short-term financial opportunities. Thus, without external regulation, individuals would overharvest and destroy resources over time. During the 1980s, however, attention was directed to the large number of case studies written by anthropologists, historians, sociologists, and other scholars that described settings where the users of common-pool resources had organised and in many cases were successful in managing a common-pool resource. The meta-analysis of multiple common-pool resource (CPR) case studies clearly demonstrated that many, but not all, resource users did self-organize and cooperated to reduce harvesting to a sustainable level (see Ostrom et al. 1994; Schlager et al. 1994). Brooks (2001) has concluded from her research that a community's economic characteristics affect its ability to generate adherence to social norms that are more efficient for a community over the long run.

Experimental researchers also began to examine the presumption of universal maximisation of short-term material returns in a series of laboratory experiments

related to public goods (Marwell and Ames 1979; Isaac and Walker 1988a,b), bargaining games (Bolton 1997), and other types of social dilemmas (Liebrand 1984; Braver and Wilson 1986; Orbell et al. 1988) and found mixed evidence depending on the structure of the experiment. The initial experiments on common-pool resources found that in experiments where the subjects were unknown to each other and not allowed to communicate, substantial overharvesting occurred as predicted (Ostrom and Walker 1991; Ito et al. 1995). When allowed to communicate – engage in "cheap talk" – subjects tended to cooperate with each other and to achieve much higher returns than predicted by game theory (Ostrom et al. 1992; see also Bochet et al. 2006).

Most of the initial experiments related to public goods, common-pool resources, and other social dilemmas were conducted in laboratory settings in US or European universities. Laboratory experiments do have strong *internal* validity due to the careful specification of a set of independent variables and substantial effort to minimize the impact of other variables. *External* validity, however, could not be assessed from the experiments conducted with undergraduate and graduate students in university laboratories. The participants in a laboratory experiment themselves do not face a major CPR or public good problem on a regular basis. They are usually a heterogeneous group with different and unknown backgrounds (Henrich et al. 2001).

Cardenas (2000) was among the first to explore the external validity of experiments run in laboratory settings by running similar experiments in rural settings, with *campesinos* in rural Colombia where participants regularly faced problems of potential overuse of their resources.

His series of field experiments were similar in structure to the experiments run at Indiana University and he found similar outcome patterns to those obtained in the laboratory experiments. Rural farmers, who used local forest resources, cooperated at very low levels in the experiments where no communication was allowed, but they cooperated rather extensively when face-to-face communication was enabled (see also Casari and Plott 2003).

As a result of a large number of laboratory experiments, and now field experiments, scholars have reached substantial agreement that without communication, individuals facing common-pool resource problems tend to cooperate at low levels (or not cooperate at all). With communication, however, the level of cooperation tends to grow substantially[2]. Decentralization efforts in India through programmes like Joint Forest Management (in the 1990s) and Forest Rights Act, 2006[3], provide platform for forest dependent indigenous communities to come together and take decisions regarding forest management. Indigenous

[2] In a meta-analysis of 35 years of published experiments on another form of social dilemmas, Prisoner's Dilemma games, Sally (1995) found that discussion among the subjects has the most significant influence on the average rate of cooperation in repeated experiments.

[3] The complete title of the act is: Scheduled Tribes and Other Traditional Forest Dwellers (Recognition of Forest Rights) Act, 2006.

communities in India are historically known for shared norms and a culture of judicious resource use. However, it is feared that the attitude of these communities towards forests may be changing with globalisation and commercialisation. But what is the ground reality? In our study we wanted see if the attitude of the communities continues to be non-exploitative and non-commercial and the role of communication in decision-making. For cooperation, do shared norms undermine the role of communication in indigenous communities? We explore these issues as none of the field experiments of CPR games have been run thus far in homogeneous, indigenous communities. We find that the need for communication to enable cooperative behaviour in such communities is limited, but communication helps in bringing equity and moderation in harvesting. And the attitude of these communities continues to be non-commercial and non-exploitative (Ghate et al. 2013). The eight study communities differed in their locations, dialects, state of adjoining forests, and level of functioning of institutions set up by the Forest Department under the Joint Forest Management (JFM) program. However, all these communities being predominantly indigenous, there is no variation in the "norm variable". We do not know what would be the behaviour of non-indigenous communities in such field experiments.

2. Context of the study

In the Indian context, the term "indigenous people" is synonymous with the word "tribal", indicating these communities to be *Vanvasi* (forest dwellers) and *adivasi* (original inhabitants). Etymologically and spatially, the lives and livelihoods of tribal communities in India are intrinsically linked with forests (Mitra and Gupta 2009). Certain images and perceptions have developed with respect to the term "tribe" in India. These include absence of exploitive classes and organised state structures; multi-functionality of kinship bonds; all-pervasiveness of religion; segmented character of the socioeconomic unit; frequent cooperation for common goals; distinct taboos, customs, and moral codes; a low level of technology; common names, territories, descent, language, and culture (Pathy as cited in Xaxa 1999). Although there are many tribes in India with linguistic and cultural differences, their relationship with forests is commonly reflected in their religious dictates, eclectic belief systems, and social norms that make them protective of the forests unless prevented by governmental policies (Gadgil and Guha 1992). Since forests play an important role in their lives, their traditions in general exhibit pro-social behaviour (Gurven and Winking 2008).

Through common-pool field experiments we establish that the faith shown in the indigenous communities is not ill found. In this paper, we first present the background and the details of the study area in Section 3. Broad contextual similarities and differences of the study communities are outlined in Sections 4 and 5. Section 6 explains the research method including structure and participants of the experiments. Section 7 discusses experimental results, and for external validation some other methods are also discussed. Some interesting observations

are presented in Section 8. Finally, we present discussion and policy implications in Section 9.

3. Background of the study area

The eight study villages are all located in the state of Maharashtra in India. Maharashtra is the second largest state with 9.4% of the country's geographical area, 9.29% of the country's population and about 10% of the country's 84.3 million tribal population.

Six districts of the state – Amravati, Chandrapur, Dhule, Gadchiroli[4], Nandurbar, and Thane – have a relatively high proportion of land categorized under "forest," indicating that in the past, there was sufficient forest cover, prompting the Forest Department to take these areas under its jurisdiction. Presently, however, only Amravati, Chandrapur, and Gadchiroli districts can boast of a good cover of "mixed" forest, which is all under the ownership and management of the state Forest Department. The six districts are also populated with indigenous/tribal people, belonging mainly to the Gond, Warli, Bhil, Madia, Korku, Padavi, and Katkari tribes. The eight study villages are: Khongda (Amravati district), Kargata and Bhagwanpur (Chandrapur district), Talwada and Zimela (Gadchiroli district, which has the maximum forest cover in the state), Bijrigavhan (Nandurbar district), Gadhaddeo (Dhule district), and Aire (Thane district). Figure 1 shows the geographic locations of the study villages. District forest area and tribal population details are shown in Table 1. Other village-level details are shown in Table 2.

The tradition of collective decision-making in the study villages is apparent from the various forums that operate presently. All of the study villages have more than one self-help group separately for men and women. Committees like *Tanta Mukti Samiti* (conflict-resolving committees), water-supply managing committees, *Gram Sudhar Samiti* (village development committee) are functioning in most of the villages. The study villages depend on forests for grazing of cattle and firewood. For the households without electricity connection, firewood also serves the purpose of lighting.

4. Broad contextual similarities

The forests on which the tribal communities in India depend belong to the government. There is evidence that until the end of the 19th century, at least 80% of India's natural resources were common property (Singh 1986), which was taken over gradually under colonial rule (Guha 1983; Rangarajan 1996). This policy continued in independent India as well. Under the JFM program, which was introduced as a result of the forest policy adopted in 1988 promoting

[4] Gadchiroli district was carved out of Chandrapur district in 1982, and Nandurbar out of Dhule district in 1998.

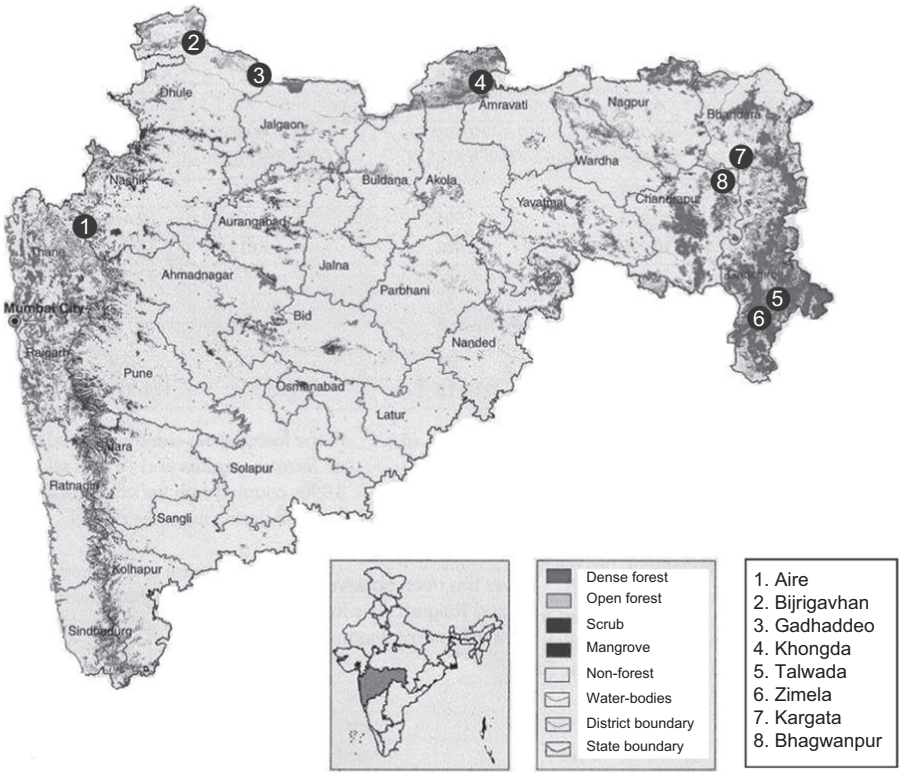

Figure 1: Location of the study villages (adapted from http://www.mahaforest.nic.in/internal.php?id=28).

Table 1: District-wise percentage of forest area and tribal population.

Serial number	Name of district	Percentage of forest area of the district area	Percentage of tribal population of the district population
1.	Amravati	26.10	13.69
2.	Chandrapur	35.60	18.10
3.	Dhule	4.47	25.99
4.	Gadchiroli	70.05	38.35
5.	Nandurbar	20.37	65.54
6.	Thane	30.47	14.74

Sources: India State of Forest Report (2009) (http://www.fsi.nic.in/sfr_2009.htm); Ministry of Tribal Affairs (2001) census (http://trti.mah.nic.in/static_pages/frm_CenPopu3.htm).

participatory management, selected communities/villages are assigned some area of the forest for protection in return for immediate benefits of usufructs as well as a share in incremental growth in the long run. But the ownership of the resource continues to be with the government.

Table 2: Village details.

Village	Population	Number of households	Percentage of tribal population	Distance from nearest town (km)	Percentage of households with electricity	Average landholding (ha)	Out-migration	Forest area (ha)	Year JFM was established
Aire	1429	243	100	9	4.5	2	Yes	634.41	2003
Gadhaddeo	2160	522	90	3	1.9	1.2	Yes	1781.6	2005
Bijrigavhan	1040	189	100	5	27.5	1.2	Yes	154.63	2006
Talwada	246	66	90	10	0	0.8	No	522.05	2004
Zimela	392	78	100	18	10.2	1	No	575.26	1999
Khongda	469	82	80	9	18.2	1	Yes	871.52	2000
Kargata	180	40	75	6	87.5	1	No	526	2000
Bhagwanpur	320	110	90	14	100	1.5	Yes	550	–

In addition to the lack of ownership of the forest lands in which they live with limited usufruct rights under JFM, the eight communities[5] studied have several other similarities. They are predominantly indigenous/tribal communities (more than 75% of the population), living in specific locations for generations. Only Bhagwanpur community was relocated from its old location in 2007. The majority (almost 95%)[6] of the households in these villages are below the official poverty line. All of the villages are located in or on the fringe of forests. At present, the quality of forest differs from one place to another, although the villages are not directly responsible for this. For example, the highly degraded forests near two villages are a direct fallout of shift in forest ownership from private forest chieftains to the Forest Department in 1975. The chieftains leased out the forest to contractors at low rates and in the absence of any proper supervision, the forests were plundered during the short transition period (Ghate 1992, 161). The dependence of communities on forests for fuel wood, fodder, bamboo, and small timber for construction of their huts, agricultural implements, and fences continues to be high, although in two of the villages, where the forest is degraded, households are now using alternatives to firewood.

Agriculture is the dominant occupation in all of the villages, with average landholding varying from 0.8 ha in Talwada to 2.0 ha in Aire. Many of these communities have recently come into contact with mainstream society due to increased means of transport and communication. While the younger generation has adopted the languages of mainstream society, the older generation still communicates in traditional dialects. Most of these communities have their traditions intact: they worship deities located in forests, have preserved sacred groves, and celebrate traditional festivals. Traditional leadership continues to be strong, and many decisions are taken collectively. They have shared a history that has impacted their ownership of resources, and therefore have shared norms of behaviour and mutual trust.

5. Broad contextual variations

Contextual differences among these communities also exist despite similarities. The size of the village varies from 40 households (180 individuals) in Kargata to 522 households (with 2160 individuals) in Gadhaddeo. Of the eight villages, five report seasonal migration in the non-agricultural months for employment to nearby villages. The study villages are located between 3 and 18 km from the closest towns and are connected by all-weather roads. The villages have primary schools and facilities for potable water. Except for Zimela and Kargata, the other villages have a fair price shop and an *anganwadi* (preschool facility). Talwada alone has a Primary Health Care Centre, and only Bhagwanpur has a post office. None of the villages have a Range Forest Office, a bank, or an agriculture extension

[5] We use the terms "communities" and "villages" synonymously.

[6] According to the micro plans prepared for villages by the Forest Department.

centre. The location of the eight villages differs in regard to proximity to towns and cities. Aire is located only 70 km from the large industrial town of Thane (near Mumbai); Talwada and Zimela are quite far from the district headquarters, getting cut off during the rainy season almost every year. Bijrigavhan is close to the neighbouring state of Gujarat. Khongda is located at the fringe of the Melghat Tiger Reserve.

The forest area of the study villages varies from 1781.6 ha in the case of Gadhaddeo to 154.63 ha in the case of Bijrigavhan. Four communities have good-quality forests, two have highly degraded forests, and for the remaining two, the forest is somewhat degraded. While there is a Forest Protection Committee set up under the JFM program in seven of the eight villages, two communities were completely unaware of it, in two communities the institution was partially functional, and in one it was functioning poorly. Only in one community was JFM completely and successfully functional (for further details, see Ghate and Ghate 2010). Thus the eight communities selected for the study had different backgrounds in terms of forest quality as well as forest related formal institution.

6. Research method

The experiment was designed to capture the harvesting behaviour of the communities where participants make decisions individually. It is an experimental design with two treatments – individual decision-making without communication and with communication. The experiments were conducted between January 2009 and April 2011 as part of two different research studies.

6.1. Structure of the experiment

Taking experiments to the field presents several challenges. The most important one is to make the experiment relevant to the participants so that their behaviour in the experiment collates with their behaviour related to relevant common-pool resources. Keeping this in mind, we developed two basic "within subjects" experimental designs.[7] Each game starts with 100 trees (made of paper) stuck on a board placed prominently in a room where the participants are sitting. The five participants are informed that this represents the forest about which they will be making decisions. They are told that they will be individually harvesting from this forest. For this purpose, an appropriate number (allowed maximum harvest size for that round) of trees is kept next to an empty box on a table in another isolated room. On his turn, a participant enters this room, and drops the number of trees in the box that he wishes to harvest in that round. He may not drop anything in the box to indicate that he does not wish to harvest any trees in that round. The organizer records the number of trees harvested by each participant, takes the trees out from inside the box, and places them back on the table. Thus, the next

[7] We broadly adopt the field experiment designed by Cardenas et al. (2013).

participant in the same round has the same number of trees available to harvest, without knowing the number of trees harvested by the previous participant. Each participant keeps track of the number of trees he has harvested in all of the rounds. At the end of each round, the total number of trees harvested by the five participants together is disclosed to the group.

In the first design, the five participants are not allowed to communicate with each other throughout all rounds. We call this the no-communication game. In the second design – the communication game – the same five participants can verbally communicate with each other at the beginning of each round and they remain in the same group over the length of these designs. In both of these games, decisions regarding harvesting are taken in private and are not revealed to the group, who learn only about the total (group) harvest made at the end of each round. Participants receive a payoff of INR 10 for each tree harvested during the experiment.[8] The funds are paid openly to each participant at the end of the full experiment. Contrary to the practice adopted in other experiments, we made payment to the participants after each game to capture the reality where in small communities everyone knows who is harvesting what in the village, and what the payoffs are. It also facilitates discussion on the introduction of communication.

Before the beginning of the subsequent round, the participants are told that 10% of the trees remaining at the end of the previous round will be added by the organiser to the forest as a form of regeneration. This is physically done on the board by first pulling off the total number of trees harvested by the group and then pinning additional trees to the "forest" on the board, attributed to regeneration. However, the maximum size of the forest is never allowed to exceed 100. Thus at the beginning of each round, the participants are aware of the group harvest of the previous rounds and the current size of the forest resource. The number of rounds that the game would be played is not disclosed to the participants. The maximum number of trees that could be harvested in a given round depends on the size of the resource at the beginning of that round and is given in Table 3. If the resource size falls to less than 4 trees after taking regeneration into account, the game is stopped. Otherwise, the game ends after the tenth round.

At the outset, the structure of the experiments is explained to the participants. The importance of not communicating in the first game is emphasised, and they are seated in a semicircle apart from each other. During the communication game, they are free to pull their chairs close for discussion. In each community, the experiment is started with three practice rounds in which the participants are asked to calculate their payoffs and the count of trees to make sure that they have understood the implications of their decisions. They are allowed to use paper and pencil or calculators if they want.

[8] $1=INR 45. Average wages per day in the study villages was INR 40 in agriculture, INR 70 in forestry work, and INR 62 for other manual labour.

Table 3: Maximum allowed individual harvest in a round.

Resource level	100–25	24–20	19–15	14–10	9–5	4–0
Harvest	5	4	3	2	1	0

6.2. Participants in the experiments

Before conducting the actual experiments, we identified willing participants for the experiments at the time of conducting household surveys in a community. We made an effort to select participants to be representative of different age groups, educational levels, and land ownership in order to capture economic variations; and to make it representative in terms of socio-political classes by including a *sarpanch* (head of the *gram panchayat*, a democratically elected village-level governing body), president of the JFM committee and the like. The participants in the experiment were thus familiar with each other in their respective villages, though not with participants of other villages.[9] As the participants of an experiment were all from the same village, they were aware of the use of forest products of other participants, making it easy to guess others' likely behaviour in the experiment. They were also aware that they were to live in the same village for many years to come. This does not happen when experiments are conducted in laboratories where participants could be complete strangers, with no known prior history of behaviour; nor are they likely to meet again so as to impact their behaviour in the experiment.

We purposely chose not to involve women in these experiments given the marginal role assigned to them in these rural indigenous communities. Women in the study villages reportedly did not participate in the management committee formed under JFM as well.

7. Experimental results

This section reports the experimental results in eight communities. As mentioned in the design of the experiments, we did consider the behaviour of the participants over ten rounds of the game potentially to be indicative of their actual long-term behaviour in forest resource use, but first we need to report their behaviour in the experiments. Harvesting decisions are considered cooperative if they do not affect the regenerative capacity of the resource, and thus ensure sustenance of the forest over time. On the other hand, if the harvesting decisions are causing fast depletion of the forest leading to its destruction, they are considered non-cooperative. We use simple statistical techniques such as mean values, standard deviation and Wilcoxon signed rank test for analysis. With the help of the field experiments, we are able to show that relatively isolated, indigenous communities in India are

[9] The eight villages are spread over a large geographical area and there is no exchange of ideas between them.

cooperative in general. We further show that communication has a positive role to play, but one that differs from that obtained in laboratory experiments.

Given the structure of this experiment, three harvesting patterns related to three different perspectives can be envisioned. These are as follows:

1. In the absence of any communication and knowledge of number of rounds to be played, each player tries to maximize his immediate private gain by harvesting the maximum possible in each round. To do this, each player would harvest 5 trees in each of the first four rounds and 3 trees in the fifth round. The resource would be depleted rapidly with just 1 tree remaining at the end of the fifth round when the game ends. In this situation, each player would harvest 23 trees (and would receive INR 230), and the group harvest would be 115 trees. Maximizing individual gains without any consideration to the resource size and regeneration leads to complete depletion of the resource in the short-term, and thus represents the tragedy of the commons as shown in Figure 2.[10] This is also representative of over exploitative, non-cooperative behaviour.
2. In the presence of communication, the group may decide on a strategy by guessing (from the previous no-communication game) the total number of rounds the game would last, and then plan to maximize the harvest.[11] Doing backward calculations, the group can harvest 9 trees in the first five rounds, 20 trees in the sixth round, and 25 trees in the remaining four rounds. Thus, the game lasts a full ten rounds, at the end of which there are no trees left in the forest. The group harvests a total of 165 trees (this is the maximum possible group harvest given the structure of the game), with an individual harvest of 33 trees. Although a very thoughtful, short-term strategy, it is based on the attitude of exploitation of the resource to its maximum, leading to its complete depletion in the given period of time. It thus represents a commercial/economic/rational but non-cooperative behaviour as shown in Figure 3.
3. When communication is allowed, keeping in mind the maximum possible size of the forest and rate of regeneration, the group may decide to harvest 9 trees in each round. The game continues, as the resource size would not diminish at all. At the end of the tenth round, the forest would have remained as it was in the first round (100 trees) and the group would

[10] In all of the figures, resource size signifies resource size at the beginning of a given round, unless mentioned otherwise.

[11] We are aware that harvesting decisions in the last round depend on whether the experimenter announces this or gives a clue about it. However, from the discussion among the participants in the communication round, we found that they had guessed that just as in the no-communication game, the communication game would also last ten rounds.

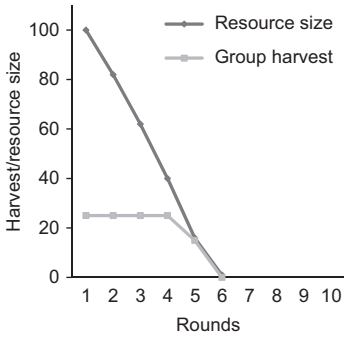

Figure 2: Exploitative behaviour of homo economicus in the absence of information regarding rounds to be played.

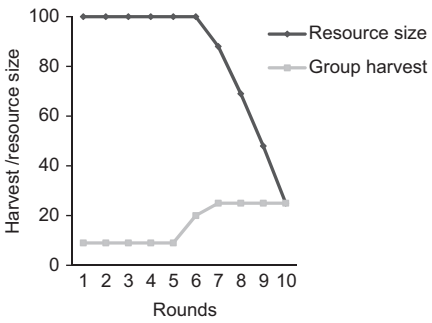

Figure 3: Rational/commercial behaviour of homo economicus with information of number of rounds to be played.

have harvested 90 trees (an individual harvest of 18 trees).[12] The main characteristic of this strategy is the maintenance of the resource size at its optimum, and within that limit maximizing the gains. It ensures the preservation of the resource over time. It is a positive and sustainable solution to the CPR dilemma and thus represents cooperative behaviour, as can be seen in Figure 4.

[12] We are aware that this strategy would generate long-term assured benefits if the players believe that they will have further chances to play the game or in essence continue to harvest trees from the forest. Otherwise, it is hard to believe that the board would have the same 100 trees if they will have no use for the five players beyond the tenth round. Although our interviews support that the members of the community had high value for the forest and our experiments showed the priority of the players in maintaining the forest at its maximum size, it is hard to predict how many trees would be left at the end of the tenth round. Also, in reality, we do not always see indigenous villagers refraining from exhausting a forest, or keeping it at a growth that is equal to extraction rates equilibrium.

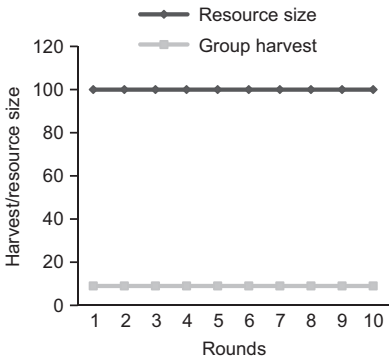

Figure 4: Optimal, sustainable behaviour of homo reciprocans.

7.1. Observed pattern of experimental harvesting in the eight communities: cooperative behaviour without communication

The most striking feature of the harvesting pattern in this field experiment is that many participants cooperated even in the absence of communication. Averaging across all eight communities, this can be shown explicitly in three ways: average round-wise harvest, average resource size, and average group harvest.

1. The average number of trees harvested by all of the eight communities in each round with or without communication lies below 7.5, even below the sustainable harvest level of 9 trees in each round (see Figure 5). Of the 80 rounds of group harvests (10 each in the 8 villages), the highest round harvest of a group was 15, attained only once in the no-communication game, and there were just 16 out of 80 (i.e. 20%) rounds where the group harvest exceeded 9 trees. Of these, 10 were in Talwada, 4 in Zimela, and 2 in Kargata villages. In the communication game, there were just 6 instances out of 80 (i.e. 7.5%) where round harvest of a group exceeded 9; interestingly, none of them were in the villages of Talwada, Zimela, and Kargata.

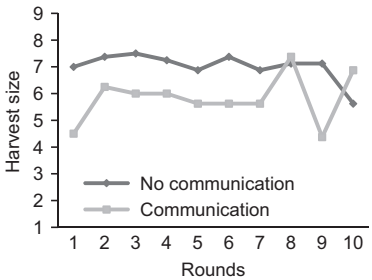

Figure 5: Round-wise average harvest of all eight communities.

2. Considering all of the eight communities, the average resource size at the beginning of the tenth round does not fall below 90 trees in the no-communication game, and remains as high as 99 trees in the communication game at the beginning of the ninth round, which is restored back to 100 immediately at the beginning of the tenth round. This is much higher than the resource size reported by Cardenas et al. (2013). In the no-communication game, in five of the eight villages, the resource size remained 100 at the beginning of each round throughout the game (see Figure 6). It was only in Talwada that it fell to 40 trees. In the communication game, the resource size at the beginning of each round remained at 93 trees or above in all of the eight villages. Even considering the average size of the forest remaining at the end of the game (after the tenth round and without considering regeneration), it remains very high at 85 and 93 trees in the no-communication and communication games, respectively.
3. The average group harvest is just 70 trees in the no-communication game and 58 trees in the communication game, which is far below the sustainable harvest size of 90 trees.

If we consider harvesting behaviour in the communities, the highest harvest in the no-communication game is in Talwada (125), and the lowest harvest is in Bijrigavhan (29). The next two communities that harvested high in the no-communication game were Zimela and Kargata (harvest size of 91 and 88, respectively), and their harvest is close to the sustainable harvest of 90 trees. Further, it is important to mention here that the high harvest in Talwada is not due to all participants harvesting on the higher side, it is because of the two participants harvesting 50 and 25 trees. In the communication game, the highest harvest was only 70 trees in the Bijrigavhan community, and the harvest in Talwada as well as in Zimela and Kargata decreased considerably (see Figure 7).

Taking into account all 40 participants, the average individual harvest over the game was just 14 and 11 for the no-communication and communication

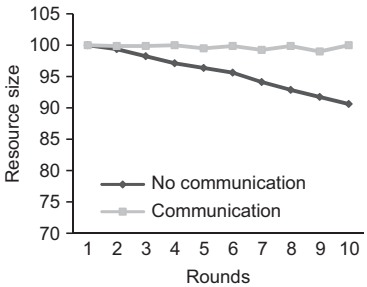

Figure 6: Round-wise average resource size.

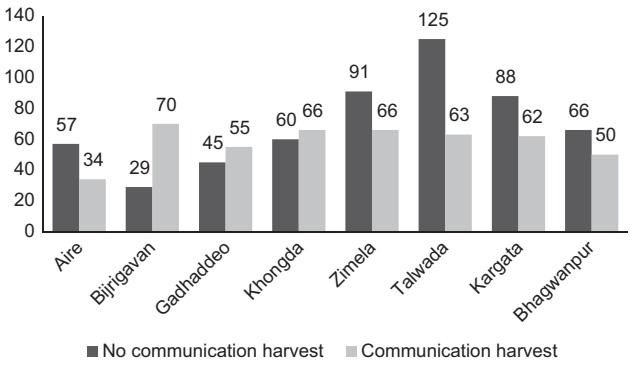

Figure 7: Village harvest.

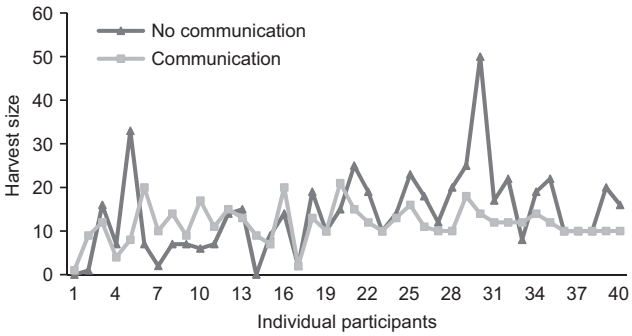

Figure 8: Pattern of individual harvest in two designs.

games, respectively. In the no-communication game, there were only 5 out of 40 participants who harvested more than 23 trees[13] (50 and 25 in Talwada, 33 in Aire, 25 and 23 in Zimela). In the communication game, the highest individual harvest was just 21 trees by one participant (see Figure 8, which shows the game harvest of all 40 participants). Thus, although there is a slight indication of exploitative harvesting by two participants in Talwada, it gets curbed in the communication game where these harvesters each harvest less than 18 trees. A more surprising observation is that in all three communities in which there were participants with "non-cooperating" strategies, other individuals were not affected and they continued with their "cooperative" behaviour. For example, in the no-communication game played at Aire, where one of the participants harvested 33 trees, three participants harvested just 0, 1, and 7 trees over the entire game, and in no round did they

[13] The individual harvest is 23 when all of the participants adopt the exploitative strategy as discussed earlier in this section.

change their behaviour. This shows the existence of unconditional cooperators (at least 10 in number) outnumbering non-cooperators (only 5 in the sample of 40) in our experiments. It would be pertinent to add here that in reality forest in Talawada was most dense, and the one in Bijrigavhan was smallest in size and poor in quality. In the experiments, one can observe typical behaviour especially in Bijrigavhan where post communication harvest increased substantially. During the time of our visit, a management plan was being prepared and forest department staff had promised the villagers that their forest would improve in few years after the plan was implemented. But basically with no experience of forest dependence, the community did not know how to make harvesting decisions.

7.2. Communication leads to moderation and homogenization

Unlike laboratory experiments where communication tends to foster cooperation among non-cooperating players, for the indigenous communities where there is a high level of initial cooperation, communication results in moderation, homogenization of harvesting behaviour, and a more equitable distribution of payoffs.

In our sample, we find that with communication, the communities that harvested a low quantity in the no-communication game increased their harvest sizes (as in the case of Bijrigavhan and Gadhaddeo), while the communities that harvested a higher quantity in the no-communication game decreased their harvest sizes (as in the case of Talwada, Zimela, Kargata, and the overharvesting individuals therein). This is clearly depicted in Figure 7.

Another observation is that the impact of communication is significant for both high harvesters/non-cooperators and low harvesters/cooperators. This is clear from Figures 9 and 10, which show relative harvests of the top 12 high harvesters and bottom 12 harvesters in the no-communication game, and their respective harvest in the communication game. The average harvest of the top 12 harvesters

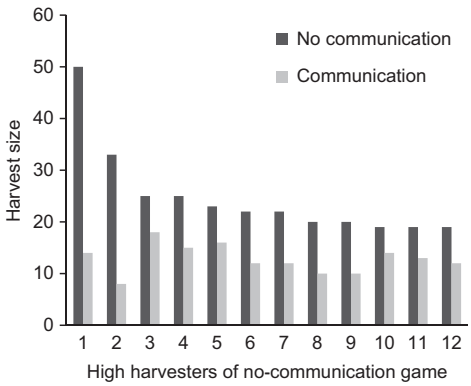

Figure 9: Change in harvest of top 12 harvesters in no-communication game.

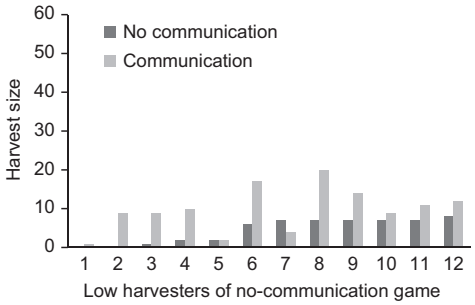

Figure 10: Change in harvest of bottom 12 harvesters in no-communication game.

in the no-communication game was 24.75, which in the communication game fell to 12.83. Similarly, the average harvest of the bottom 12 harvesters in the no-communication game was 4.5, which increased to 9.83 in the communication game as shown in Figure 9. Both of these changes are statistically significant with t-values 0.002 and 0.008 (Wilcoxon signed-rank test) for high harvesters and low harvesters, respectively.

Homogenization in the harvesting behaviour among participants from a community as well as within communities is clear from the reduction in the standard deviation of harvesting patterns. Table 4 shows the mean values of the individual harvests in each of the eight communities in no-communication and communication games along with the values of standard deviation in the two games, and the Wilcoxon signed-rank test statistics. The table also shows similar statistics for the group harvest of the eight communities and all 40 participants. The standard deviation in individual harvest increased marginally in only two of the communities, from 2.17 to 4.64 and 6.44 to 7.79. The standard deviation in individual harvest decreased in the remaining six communities, the maximum reduction being in Talwada, from 14.73 to 3.43. The standard deviation in harvest for all eight communities together decreased from 30.19 to 11.71, while that for all 40 participants together decreased from 9.59 to 4.26. Considering the values of variance in harvests for the eight communities in the two games, the Wilcoxon signed-rank test indicates that there is a statistically significant change (at 95% confidence) in variance from no-communication to communication games (z=–2.100; Assym sig, 2 tailed=0.036). Thus, from our experimental values, it can be concluded that communication brings in homogenization of harvest (inter- as well as intra-community), thereby bringing equity of payoffs among participants.

We would have liked to validate our results from the field experiments with the communities' actual behaviour in the forests by relating it with the condition of their respective forests. But we could not do so because none of the communities under study has control over its forest.

Table 4: Experimental harvesting behaviour.

Communities	Mean and standard deviation of individual harvest[14]		Wilcoxon signed-rank test (two-tailed)
	No communication	Communication	
1. Aire	11.4	6.8	–0.674
	(13.65)	(4.32)	(0.5)
2. Bijrigavhan	5.8	14	–2.023**
	(2.17)	(4.64)	(0.043)
3. Gadhaddeo	9	11	–0.677
	(6.04)	(3.16)	(0.498)
4. Khongda	12	13.2	–0.577
	(6.44)	(7.79)	(0.564)
5. Zimela	18.2	13.2	–1.841*
	(6.22)	(2.39)	(0.066)
6. Talwada	25	12.6	–2.032**
	(14.73)	(3.43)	(0.042)
7. Kargata	17.6	12.4	–1.769*
	(5.77)	(0.89)	(0.077)
8. Bhagwanpur	13.2	10.0	–1.342
	(4.60)	(0)	(0.180)
9. Eight communities together	70.125	58.25	–1.120
	(30.19)	(11.71)	(0.263)
10. Forty participants together	14.025	11.65	–1.404
	(9.59)	(4.26)	(0.160)

*Statistically significant at the 10% level.
**Statistically significant at the 5% level.

Since the main aim of this paper is to ascertain the role of communication in the harvesting behaviour of the indigenous communities toward forests, we are presenting the main findings of the experimental designs. However, we have also collected data at multiple levels using different methods that we wish to discuss here for supporting our experimental findings. Before running the experiment, at the village level we held at least one focused group discussion and held three to four key informants' interviews; collected association-level and forest-level information through the IFRI protocols[15]; interviewed 18 forest officials ranging from the rank of Range Forest Officer to the Principal Chief Conservator of Forests, Maharashtra; and at the household level, we collected information from 112 heads of households using a structured questionnaire.

Not surprisingly, more than half of the respondents said that they do not want the forest land to be used for any other purpose, though they expected some income to accrue from it. The households were also confident about being able to manage the resource. When asked what would it lead to if forest ownership was given to

[14] For statistical analysis, SPSS 13 was used.
[15] A set of protocols developed by the IFRI research program, Indiana University and University of Michigan, USA (http://www.sitemaker.umich.edu/ifri/files/ifri_blank_forms_v13_with_rev8-08.pdf).

the communities, almost two-thirds of the households mentioned that it would lead to sustainable harvesting, with 17 households adding that they will take up plantations to improve the quality of the forest. Only five households felt that transfer of ownership would lead to commercial harvesting. Forest officials seem to agree with this view, since 13 out of 18 officials agreed with the statement that "communities are capable of working collectively" and 11 officials agreed that the "communities have the capacity to manage the forest," and that the communities have the "capacity to evolve rules to monitor."

8. Some interesting observations

It was common observation that the participants in the majority of the experiments in the communication game discussed harvesting decisions with each other mainly in the first round. Once the decisions were taken, they were followed for the remaining rounds. There were few infractions, and no need for verbal sanctioning as contrasted to results in laboratory experiments. In some villages the participants felt comfortable communicating in their own dialect. In one village, the leader asked the youngest participant to bring a calculator to make calculations about the number of trees to be harvested. It was in this village that in the no-communication game the youngest player did not harvest any trees. At the beginning of the communication game, the "leader" was very upset with this and scolded the "non-harvester" by saying, "you young, educated people are very lazy, you do not want to go to the forest to bring fuel wood, etc. Look at your old parents, they have to do all the work.…" The non-harvester, a science graduate participant, responded by talking about carbon sequestration, the role of forests in ensuring rainfall, and so on. The four players (from Aire, Gadhaddeo, and Khongada) who did not harvest a single tree, or just one or two trees during the entire no-communication game, would stand in front of the box in which they had to put the harvested trees, make a sign of respect, and walk back.

9. Discussion and policy implications

Research in social dilemmas arising due to conflict of individual and group interest has shown that human beings are not always "Homo economicus" (Gintis 2000), but can be "Homo reciprocans"(Gurven and Winking 2008; Henrich et al. 2001) and "Homo cooperators"[16] in the case of common-pool resources. It is also possible for individuals to achieve results that are "better than rational" in certain conditions (Ostrom 1998). It has also been shown that cooperation in experimental and field settings is affected by context and context may be more important than individual propensities (Gurven and Winking 2008). For indigenous communities in developing countries for whom forests are an important common-pool resource,

[16] We are introducing this term to separate it from Homo reciprocans to highlight that there are some communities that are culturally cooperators, not needing any incentive or communication to behave in a non-exploitative manner.

which contributes to rural livelihoods, norms of societal behaviour are more likely to be formed (Vollan 2008). And these cultural and social norms seem to strongly influence resource use among indigenous communities, which dissuades them from adopting commercial or exploitative strategies (Ghate and Ghate 2010). Although the field experiments we conducted were not specifically designed to address the role of communication among indigenous communities, it seems that it is the shared norms, deeply embedded in the communities that made the need of communication superfluous. Our results are in sync with the observation made by Kerr et al. (2012, 226), that "participation in communal tasks can be high irrespective of the incentive if social norms favouring participation are present." However, this does not mean that communication has no role to play in taking such pro-conservation decisions. What we find in this study is that with communication, the gap between high and low harvests is reduced by moderating the behaviour, whereby the inequity in payoffs is also reduced. There is scope for further study to test the specific role of cultural norms in cooperation by comparing experimental behaviour of non-indigenous communities.

As Axelrod (1986) suggests, individuals who adopt meta norms that have evolved in a group increase the probability that norms are followed (see also Hayakawa 2000). It is not only that individuals adopt norms, but also that the structure of a situation generates sufficient information about the likely behaviour of others so that an individual who cooperates will share the cost of overcoming a dilemma with the others in the situation (Ostrom 2010). The main characteristic of tribal communities, namely "shared norms of behaviour in the case of forests," gets substantiated by this study. We can say with some confidence that there are some communities that are ready to extend unconditional cooperation, which provides some support to the present efforts of decentralization like JFM and the Forest Rights Act, which envisages community control of forest lands within the revenue boundaries of a village.

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