Can Communities Plan, Grow and Sustainably Harvest from Forests?

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Extensive experimental research has been devoted to the study of behaviour related to public goods, common-pool resources and other social dilemmas. In a majority of these studies, it is found that subjects tend to cooperate if they are allowed to communicate and make their own rules of use. In the context of the Forest Rights Act, 2006, a number of questions are being raised at public forums. Are communities capable of managing a valuable resource like a forest? Will transfer of authority not result in large-scale deforestation? Are traditional norms of sustainable harvesting still effective even after increased access to markets and commercialisation? This paper reports on the findings of four field experiments that evolved in the course of a study conducted in two indigenous communities in Maharashtra. Both of the communities have had past traditions of shared norms and mutual trust, and their behaviour in the experiments shows that the communities still tend to be non-exploitative, non-commercial, and cooperative for prioritising, planning, and managing resource sustainably.

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Ever since the Forest Conservation Act, 1980, no other piece of legislation in India has received as much attention as the Forest Rights Act (FRA), 2006.[1] While the former severely restricted altering forestland for any use, the FRA has extended rights over the forestland that has traditionally been used by forest dwellers. Although both the houses of Parliament almost unanimously passed the Act, the Ministry of Environment and Forests (MOEF) and the wildlife conservationists had vehemently opposed it as a bill. Tribal rightists called the passing of the bill a "watershed event" through which the forest-dwelling communities would get a political space in forest management for the first time in the history of Indian forests (Ghosh 2007). The MOEF and other conservationists termed it an "ideal recipe" to ensure the destruction of India's forests and wildlife by "legalising encroachments" (Krishnan 2007). Undoubtedly, this shift in forest policy, from its emphasis on building state authority in the mid-19th century, to a move toward greater stress on devolution, decentralisation, and community rights over the past decade, will prove to be of crucial importance for forests as well as for the "forest people" (Poffenberger 2006). Presently, the debates are centred on questions such as: Are communities capable of managing such a valuable resource? Will transfer of authority not result in large-scale deforestation? Are traditional norms of sustainable harvesting and equitable benefit-sharing still effective in the communities? It is generally assumed that access to markets and commercialisation has affected local communities' attitude and behaviour regarding forests. In this paper, we present results of field experiments conducted in two predominantly tribal communities in the Vidarbha region of Maharashtra that address some of these issues.

This paper is an extension of our earlier work studying the attitudes of communities towards forests in India. We had conducted field experiments in eight villages predominantly inhabited by indigenous people in Maharashtra, wherein we studied the harvesting patterns of individuals and the impact of communication through a set of experiments. It was observed that irrespective of the presence of formal institutions and the quality of the forest in which the indigenous communities live, the attitude of indigenous communities was non-exploitative and non-commercial (Ghate and Ghate 2010). Moreover, the study established that communication leads to moderation, and brings about an intra- and inter-community equity of harvest (Ghate et al 2011). It is implicit that norm-based rules, traditions, and behaviour in the

experiments are beyond the control of the experimenter (Mitra and Gupta 2009).

1 Background

Although our earlier field experiments were able to capture the overall attitude of resource users towards forests, in order to obtain further insight into the nature of their dependence, the experiment needed modification that segregated the forest products that are collected from the forests. In one of the post-experiment discussions, a villager mentioned that:

> ...we frequent the forest mainly for fuelwood and fodder. We rarely harvest trees, and it is done only when we have to replace a pole or a shaft in the house, or make agriculture implements. As fuelwood we mostly collect fallen branches or dead wood. Apart from grass as fodder, we may chop a few branches of some trees known to enhance nutrition, but we rarely cut a tree for fodder or fruits (Participant 2, Kargata Village, 26 January 2010).

To incorporate this and other new issues, we decided to modify our experiments accordingly, and chose two of the communities from the previous study for a series of experiments. The original experimental design has thus evolved thrice on the basis of inputs from the participants, with the primary objective of understanding the finer aspects of the nature of their dependence, priorities, shared norms, and role of pecuniary considerations.

In the following section, we present the details of two villages that form our current study area, followed by the structure of each of the four experiments. The results of each experiment are succeeded by analysis and some interesting observations. We conclude with the policy implications that these experiments offer.

2 Study Area

Maharashtra is one of the larger states of India, of which almost 20% (approximately 60,955 sq km) of its area is classified as forests. Six districts of the state – Thane, Dhule, Nandurbar, Amravati, Chandrapur and Gadchiroli – have relatively more proportion of forest area, and it is in these six districts that the majority of the state's indigenous population is settled. Both of the study villages – Kargata and Bhagwanpur – are located in Chandrapur district.[2]

Kargata is well-connected by a tarred road with its sub-district headquarters at Sindewahi, 6 km away, and is surrounded by good-quality dry deciduous forest. It is a small village with only 40 households, living in a neatly organised settlement, at subsistence level. Vikalp, a non-governmental organisation, has been active in this village, basically involved in awareness building. It has helped the community establish a forest protection committee under the joint forest management (JFM) programme.

Currently, the three predominant communities in Kargata are the Gond tribe (70%), Mana (15%; a special backward class) and Dhiwar (13%; a fishing community), while the other 2% belong to the Pradhan and Koli tribes. The 40 households constitute 180 persons, living in typical family structures consisting of husband, wife, and dependent children and elderly parents. Like most indigenous communities, the Kargata is also agrarian, either cultivating its own land or working for wages on other people's land. Paddy is the major crop grown. Employment is available with the forest department as well as wage labour under the National Rural Employment Guarantee Act (NREGA). Landownership is the defining aspect of the economic status of families; those who own land are considered to be wealthy, while the landless are regarded as poor. There are only four households in the village regarded as rich and 17 households as distinctly poor. Every household depends on the forest for fuelwood, timber for housing and making agricultural implements, livestock grazing, as well as to collect grass (used as thatch roofs) for cowsheds.

In the last two decades, the number of households in Kargata has doubled. Most of the people in this village are literate. Primary education is offered in the village by the zilla parishad (district-level government) school, whereas for high school, students have to go to Sindewahi, which is also the closest marketplace and administrative centre. There are a number of government offices in Sindewahi, including the range forest office, office of the Agricultural Department, Rice Research Institute (a centre of Panjabrao Deshmukh Krishi Vidyapeeth, which is a state agriculture university), and a police station. Sindewahi is a hub for ground transport where buses ply to Nagpur (the divisional headquarters) and Chandrapur (the district headquarters). This shows that despite being forest-based and indigenous, the community has a fair amount of exposure to the outside world.

Bhagwanpur is a resettled village, comprising two villages – Botezari and Kolsa – that were removed from the Tadoba-Andhari Tiger Reserve (TATR) in 2007. It has 550 hectares of forest towards its north-east, which is presently in a degraded state. The village is about 10 km from Mul, a sub-district place, and is 3 km from a railway station.

It has 56 households from Botezari village, and 48 households from Kolsa village. The families split into nuclear families before and after relocating, and now a typical family consists of husband and wife and young dependent children. The village now constitutes 110 households as a pre-designed settlement, with a population of 320 individuals. The village is dominated by an indigenous community with around 80% of households belonging to the Gond tribe, with the remaining belonging to Dhiwar, Khati and Other Backward Classes (OBCs).

The village was settled after clear-felling 550 hectares from a patch of 1,100 hectares of forest belonging to the Forest Development Corporation of Maharashtra (FDCM), which was handed over for relocation purposes. Four villages – Tolewahi, Nagala, Mandatukum and Chiroli – had already been using this forest. The agriculture land handed over to the community is poor in quality and not well-prepared for cultivation. Yet, agriculture continues to be the predominant traditional occupation, often supplemented by seasonal migration and employment generated through NREGA. Except for two families that are marginally better off than others, the remainder can be considered as poor. Every household depend on the

forest for fuelwood and fodder. As their houses are made of bricks and tiles, their dependence on timber is restricted to extending sheds in front of houses, agricultural implements, and cowsheds. They also use bamboo for fencing.

Kargata has a long history of settlement, continued de jure dependence on a good quality forest, and exposure to mainstream society due to its physical proximity and easily available transportation links to towns and marketplaces. On the other hand, the Bhagwanpur community has been recently relocated. In its earlier location, it was surrounded by good-quality forest but had to face severe restrictions being in the buffer of a tiger reserve. It was cut off most of the time due to absence of proper roads and modes of transport. In its present location, the community has to be content with a degraded forest in its neighbourhood with de facto open access. It is also now in the proximity of mainstream society with easy and inexpensive means of transport to towns and marketplaces (for more details of the two case studies see Ghate et al 2011).

The forest-dwelling indigenous communities are no longer a static lot. They are undergoing continuous change, hastened due to the penetration of electronic media, improved transport, and communication. Apparently, this could affect the qualitative and quantitative dependence of communities on forests resulting in changed social capital, traditional norms and cultural relevance. Experiments conducted in these two communities have enabled us to show that the symbiotic nature of the relation of forest-dwelling communities with forests does not easily change due to changes in external factors. The relationship is so deeply embedded in the psyche of the communities that even though they have been deprived of any role in the management of forests for generations, given an opportunity, they can still plan their use and manage the resource sustainably.

3 Data Collection

Observations of the harvesting behaviour of participants in the experiments constitute the core data. However, we collected supporting data at multiple levels, using different methods. At the village level, we held one focused group discussion in both of the communities. At the household level, we collected information through household surveys using a structured questionnaire. Forest-level information was collected using the International Forestry Resources and Institutions (IFRI) research programme protocols.[3] In both case studies, we held three to four key informant interviews using IFRI's "Association Protocol" to collect information at the institutional level. The results of the field experiments are in conformity with data collected through these methods.

Four field experiments in a series were conducted in Kargata village (in 2009) and in Bhagwanpur village (in 2011) with a group of the same five participants from respective villages over a period of two months. The games were designed to capture (1) attitudinal aspects underpinning individual behaviour expressed through privately taken decisions regarding forest use, such as harvesting trees; (2) individual decisions regarding forest use arrived at after communication among participants; (3) nature of dependence on forests/forest products collected; (4) priorities for plantations in a degraded forest; and (5) responses to increases in payoffs.

4 Participants in the Experiments

Before conducting the actual experiments, we identified willing participants for the experiments at the time of conducting household surveys in the communities. We made an effort to select participants to be representative of different age groups, educational levels, and landownership in order to capture economic variations and to make it representative in terms of sociopolitical classes. The participants in the experiment were thus familiar with each other in their respective villages, though not with participants of other villages. 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 is not the case 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 affect their behaviour in the experiment. In order to avoid personal bias or the "surveyor effect",[4] we spent considerable time building rapport with the communities, conducting village-level interviews and household surveys, and collecting forest information before conducting the experiments.

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 committees formed under JFM and resettlement as well.

5 Design of Field Experiments and Results

Experiment 1

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 the relevant common-pool resource. Keeping this in mind, we developed two basic "within subjects" experimental designs (used by Cardenas et al forthcoming). Each game begins 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 tree in that round. The organiser 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 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 (Game 1a). In the second design – the communication game (Game 1b) – the same five participants can 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 Rs 10 for each tree harvested during the experiment.[5] 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 1. If the resource size falls to less than four trees after taking regeneration into account, the game is stopped. Otherwise, the game ends after the 10th round.

Table 1: Maximum Allowed Individual Harvest in a Round

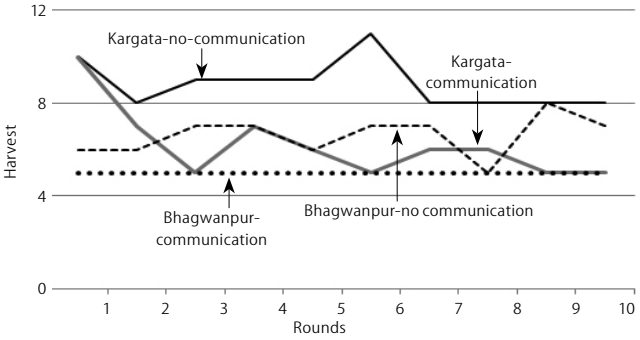
Resource level	100–25	24–20	19–15	14–10	9–5	4–0
Harvest	5	4	3	2	1	0

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 begins 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.

Results

The most important result of this game is that harvesting in both of the communities is non-exploitative and non-commercial. But it is also suboptimal; i e, the communities could have harvested more trees sustainably without adversely affecting resource size. The total harvest (by all five participants) in Kargata in the no-communication game (Game 1a) was 88 trees; after introducing communication, it was 62 (Game 1b). Individual harvest by the five participants was 17, 22, 8, 19, and 22 trees in the no-communication game. In the communication game, these harvests changed to 12, 12, 12, 14, and 12 trees, respectively. Thus, with communication, the harvesters who had higher harvests reduced their harvest, and the one who had harvested the least, increased his harvest to be at par with the others. In the case of Bhagwanpur, the no-communication group harvest was low at 66 trees, which was further reduced to 50 trees after the introduction of communication.

Figure 1: Roundwise Group Harvest in the Two Communities



The individual harvest in the no-communication game was 10, 10, 10, 20, and 16 trees. In the communication game, each individual harvest was 10 trees. It seems that two harvesters in the no-communication game harvesting relatively more trees took a cue from the others and fell in line. It should be observed that in both of the communities, group harvests in both of games were suboptimal, and the introduction of communication saw further reductions. The resource size (at the beginning of each round) remained 100 throughout in both the games in Bhagwanpur. In Kargata, it was marginally reduced to 97 in the no-communication game, while in the communication game it was reduced to 99 in the second round to be restored back to 100 for all of the remaining rounds (see Figure 1).

The second important result is that communication tends to homogenise the harvesting behaviour of the individuals. For Kargata, the standard deviation in the case of individual harvest (over the game) decreased from 5.77 to 0.89, while in Bhagwanpur, it decreased from 4.6 to 0.0 after introducing communication. These results are in sync with the results when these two villages formed a part of the bigger sample of villages.[6]

It is interesting to note that the behaviour of Kargata and Bhagwanpur communities differs significantly (statistically)

Figure 2: Game 2(a): Kargata (No-Communication) Resource Size Variation

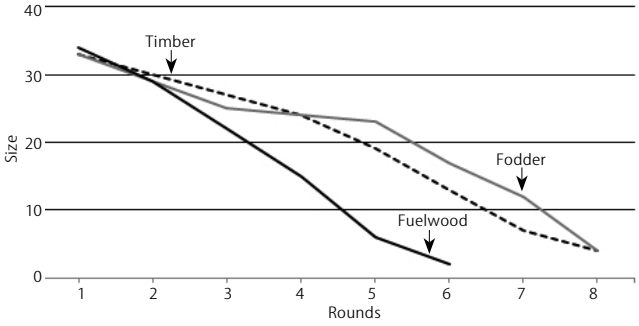
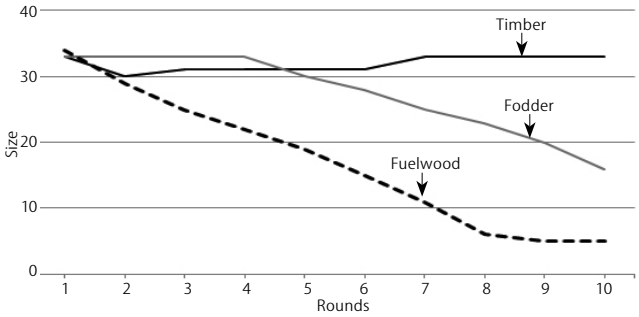


Figure 3: Game 2(b): Kargata (Communication) Resource Size Variation



for both of the games. In the communication game, it was different at a 95% confidence level, while it was at a 99% level for the no-communication game (z=0.023, and z=0.0, respectively: Mann-Whitney two independent sample test). Similarly, communication changed the harvesting behaviour of both communities significantly at a 99% level of confidence (z=0.007 for Kargata, and z=0.006 for Bhagwanpur: Wilcoxon Signed-Rank test for two related samples). This indicates the independence of the two village samples (perhaps due to their different backgrounds), and also emphasises the impact of the introduction of communication in the harvesting pattern. It is also in conformity with the observation made by Ostrom (2010).

Interesting Observations

In both villages, participants mentioned that for fuelwood they collect only fallen branches and old trees, no fresh felling is performed. In Kargata, one of the participants mentioned that "even if a household has to build a house or undertake major repair and require large number of poles (30-35), they do not harvest all these in one single year. They collect the required amount in a period of two to three years then they start constructing the house" (Participant- 5, Kargata village, 26 January 2009). During the post-experiment discussion, we asked the participants why they did not harvest their maximum allowed quota. Everyone responded that they did not want their forest to deteriorate, and thus this was their usual practice. Even before the JFM committee was formed, the villagers harvested only the required amount and did not use the forest for any commercial activity. Participants from Bhagwanpur also mentioned that their top priority is maintenance of tree cover, and their maximum needs are fulfilled without harvesting trees. One participant added, "If we harvest trees indiscriminately, from where will we get rain and fresh air?" (Participant 1, Bhagwanpur village, 9 April 2011).

As mentioned earlier, the participants had expressed their inability to translate their dependence on the forest merely in the form of tree harvesting. Therefore, we modified this experiment into Experiment 2, incorporating itemised harvesting of fuelwood, fodder and timber.

Experiment 2

Structure

In the second experiment, we created a forest on the board that had 33 trees (representing timber), 33 bundles of fodder, and 34 loads of fuelwood, once again restricting the maximum size of forest to 100 units. Participants could choose any combination of these three with the sum of units restricted to follow Table 1. However, depending on the size of the three individual forest products at the beginning of any round, the maximum the participants could harvest varied item-wise. For example, there could be 30 trees, 18 fodder units, and 12 fuelwood units in the forest at the beginning of a round. In this scenario, a player could harvest all of five trees, or a combination of trees, fuelwood, and fodder units summing to no more than five, with fodder units not exceeding three, and fuelwood units not exceeding two. All other rules remained the same as in Experiment 1. Regeneration for each product was 10%, and the price of each product was Rs 10. Although it is difficult to equate the prices of one tree with one bundle of fuelwood or one bundle of fodder, we found that the value of one tree was comparable with fuelwood and fodder requirements of a household in a year. Even the regeneration of the three products is different; the logic of keeping it the same at 10% was that although grass grows at a faster rate, its life span is one year. Similarly, no more than 10% of trees would dry up or branches of trees would fall off, which the villagers collect as fuelwood. In this experiment, harvesting of any product continues unless there are less than five units. We decided to first have a maximum of 10 rounds of the no-communication game (Game 2a) followed by a maximum of 10 rounds of the communication game (Game 2b), without revealing it to the participants.

Results

An important observation of this game is regarding its structure. Segregation of the forest into timber, fuelwood, and fodder units apparently captures the nature of relative dependence of communities on forests. In comparison to the first experiment, the total harvest of both of the communities for both types of games increased. In the case of Kargata, the total harvest increased from 88 (Game 1a) to 113 (Game 2a) in the no-communication game (see Figure 2), and from 62 (Game 1b) to 101 (Game 2b) in the communication game (see Figure 3). For Bhagwanpur, the change was 66 (Game 1a) to 69 (Game 2a) and 50 (Game 1b) to 93 (Game 2b), respectively (see Figures 4 and 5, p 64).

Productwise, harvesting also reveals the relative importance of the forest products. In the no-communication game in Kargata, the bundles of fuelwood decreased to two at the end of the fifth round, while timber and fodder stocks decreased to four at the end of the seventh round ending the game.

Figure 4: Game 2(a): Bhagwanpur (No-Communication) Resource Size Variation

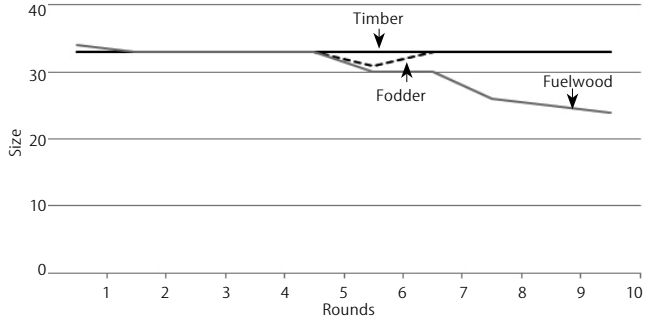
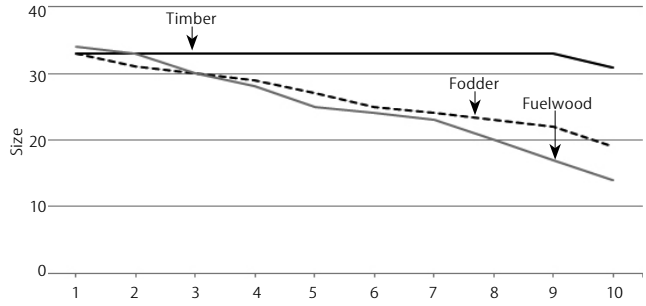


Figure 5: Game 2(b): Bhagwanpur (Communication) Resource Size Variation



However, with communication, none of the stock depleted below the level of five, and the game lasted the full 10 rounds. At the end of the game, the forest had five units of fuelwood, 12 units of fodder, and 28 units of timber. It clearly shows that the communities' first priority is fuelwood, followed by fodder. And, with communication, the participants try to manage the resources sustainably. This is clear from the fact that when at the end of the seventh round there were just six fuelwood units remaining in the forest, the participants planned the harvest in such a way that the stock of fuelwood did not fall below five. They started harvesting fodder and timber, taking precautions to ensure that the stocks did not diminish quickly.

In the no-communication game in Bhagwanpur, stocks for all of the three items lasted the full 10 rounds. The timber stock was 32; fodder, 29; and fuelwood, 22. With communication, the participants could better the harvest without endangering the forest (the game could last the full 10 rounds) and the stock at the end of the game was 28 timber, 17 fodder, and 11 fuelwood units.

Thus, communication enabled the Kargata community to plan their harvest by reducing the total harvest marginally to see that the game continued until the end as opposed to just seven rounds (fuelwood lasted for only five rounds) in the absence of communication. The Bhagwanpur community could plan and improve its harvest from the overcautious no-communication situation while ensuring that the resource supply did not get exhausted.

One thing is clear from this experiment: forest-dependent communities do not just harvest trees, they also need fuelwood and fodder. In the case of Bhagwanpur, more than 40% of the harvest was for fuelwood and around 35% was for fodder. For Kargata, the proportion of the three products considered here is almost equal. The high proportion of tree harvest in relation to Bhagwanpur is most likely because a majority of the houses in Kargata are made of thatch and grass, requiring timber shafts and poles to be replaced every few years. The villagers of Bhagwanpur have been provided with brick houses, and thus no longer need timber for housing. This result also underlines the robustness of field experiments as a research tool, which could capture this variation appropriately.

Another significant observation that can be made from this experiment is that if the resource size is small, even a low level of harvesting can lead to fast resource depletion. In the case of Kargata, fuelwood stock was the first (i e, before fodder and timber) to get depleted in the fifth round in the no-communication game, though in the communication game, the community adjusted its harvesting in a manner that the resource did not get depleted completely (i e, below five).

Interesting Observations

In Kargata, after the no-communication game, there was some serious discussion among the participants, but the focus was mainly on saving trees. It was mentioned that fodder is not a problem since it has an alternative-like agriculture residue. But if trees are lost, that is something difficult to replace. With regard to fuelwood, there was some discussion on the use of biogas. It was mentioned that women do not like the idea of using this medium of cooking since they consider it unhygienic. Participants also mentioned that the food cooked on wood tasted better. Therefore, no one wanted to change the type of fuel. A participant from Kargata opined that if fuelwood could be used prudently, they could still have enough from the forest. Therefore, everyone was asked to harvest a lesser amount of fuelwood. There was no specific rule formed, but in general each person was asked to harvest judiciously. In the communication game, participants were carefully calculating the total harvest and remaining products, and telling each other to be more stringent. One elder participant said that now they need less fuelwood: "earlier we needed fire for keeping us warm, especially during rains as we did not have enough clothes. But now, with increase in temperature the need for fuelwood has reduced. In earlier times we had to burn fire throughout night for almost eight months in a year, but now we use electricity for light" (Participant 2, Kargata village, 17 February 2009).

Experiment 3

Structure

When the JFM programme was initiated in the 1990s, their committees were given forests that were at various levels of degradation. One of the first activities to be offered for

restoration of the forests under the JFM programme were plantations, with communities supposed to be having some say in choosing the species to be planted. We tried to replicate this more prevalent situation in our third experiment. This was a communication game, wherein the initial forest was now a degraded one, left at the end of the no-communication game (Game 2a) in Experiment 2. The participants were reminded that the forest was reduced to this condition when they harvested it in the absence of any communication. And, as is a common practice under JFM in Maharashtra, wherein around 50 hectares of plantations are undertaken in the JFM forest, the committee (all five participants in our experiment) was offered a plantation with a maximum of 50 units, giving it the choice of any combination of timber, fodder, and fuel units.[7]

In the case of Kargata, the forest that remained at the end of the no-communication game (Game 2a) of Experiment 2 consisted of four trees, four fodder units, and two fuelwood units. After some deliberation, the participants decided to choose 30 trees, 10 fuelwood units, and 10 fodder units. We observed that in arriving at this decision, they had difficulty in deciding how to use the units of fuelwood plantations because what they usually collect is fallen branches for use as fuel. While deciding upon these figures, the committee's main concern was trees in general, as the trees not only support their timber requirements, but also fuelwood requirements in the long run. This was reflected in the higher number of trees chosen in comparison to fodder and fuelwood units.

Thus, the first round in Experiment 3 started with a forest that had 34 trees, 14 fodder, and 12 fuelwood units, altogether making a total of 60 units in the Kargata forest. Therefore, at the beginning of the game, participants could harvest at the most five units, as in Experiment 2.

In the case of Bhagwanpur, the remaining forest at the end of the no-communication game (Game 2a) of Experiment 2 consisted of 32 trees, 29 fodder units and 22 fuelwood units. Since the maximum capacity of the forest was decided to be 100 units, this community was offered only 17 units for plantation. The group decided to go for all "timber tree" units. Thus, at the beginning of the game, the Bhagwanpur forest had 49 trees, 29 fodder units and 22 fuelwood units.

Results

The plantation units chosen by the participants of the two communities clearly emphasise their priority for trees. Unlike Experiment 2, both communities harvested more trees than fuelwood and fodder units. This is mainly because the already smaller amounts of fuelwood and fodder were further depleted quicker than the trees, and the participants have to depend on trees for harvesting.

For example, in Kargata, when at the end of the sixth round there were only five fodder units and five fuelwood units, the participants, for the first time in the experiment, asked about the number of rounds the game would last, since they had to make a decision regarding harvesting of different units. They chose to harvest more trees. At the end of the game (10th round), there were four, four, and 33 units of fodder, fuelwood, and timber, respectively. In all, the group harvested 11 fodder units, eight fuelwood units, and 28 timber units. From the eighth round onward, they could only harvest timber units, as the number of fuelwood and fodder units in the forest had reduced to four (see Figure 6).

Figure 6: Harvest of Forest Products – Kargata

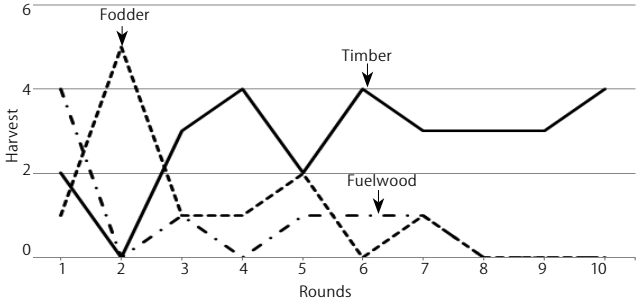


Figure 7: Harvest of Forest Products – Bhagwanpur

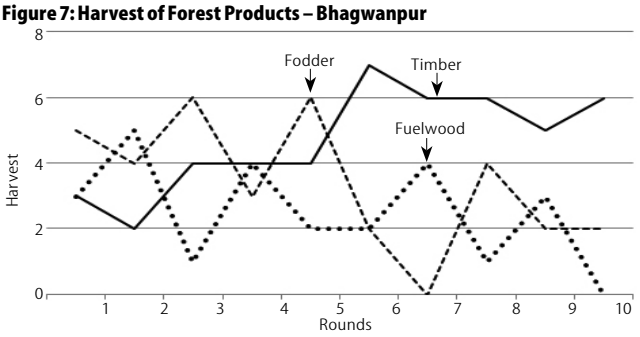
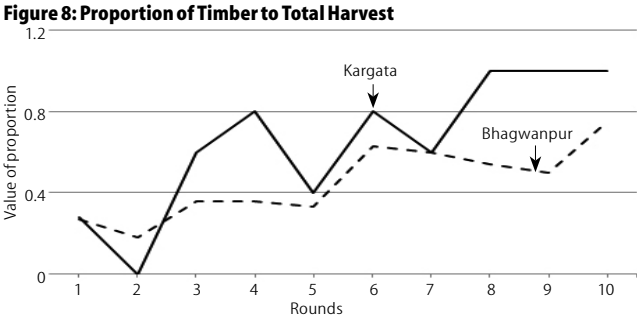


Figure 8: Proportion of Timber to Total Harvest



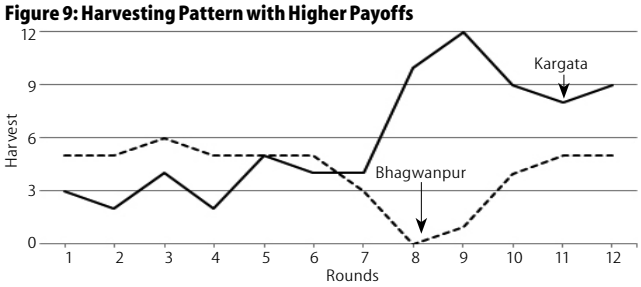
The Bhagwanpur community had relatively better forests in this experiment. But, here also, the fuelwood and fodder units diminished faster. They could not harvest fuelwood in the 10th round as the stock had fallen to three units. At the end of the game, the forest had four, three, and 38 units of fodder, fuelwood and timber, respectively. The group harvested 34, 25 and 47 units of fodder, fuelwood and timber, respectively, a substantially higher number as compared to that of Kargata, with more or less similar forests remaining at the end (see Figure 7). It is important to note that as the stock of fodder and fuelwood decreased, the proportion of tree (timber) harvest increased (see Figure 8).

This game reiterates the observation from the previous game – that if the availability of fuelwood, which mainly consists of fallen branches and dried up/dead trees, and fodder is in short supply, communities will choose to harvest standing trees.

Interesting Observations

In this game, participants in both the villages were curious to learn the number of rounds the game would be played since they wanted to plan accordingly. In Bhagwanpur, when asked why they opted for all trees for plantation purposes, the response was, "From plantations, around 25% of saplings dry up within a year or two. This provides us with fuelwood. And if fodder rich trees are planted, we can always lop off leaves/branches" (Participant 2, Bhagwanpur village, 16 April 2011). One participant also mentioned that they had not yet seen a successful fuelwood plantation. It should be mentioned here that the mandatory plantation of fuelwood species at the time of relocation is in a poor state. When asked why they did not harvest more when they knew that the forest would regrow, the answers were: "There are so many restrictions imposed by the forest department" (Participant 1, Bhagwanpur village, 16 April 2011) and "What is the use of harvesting trees more than required?"(Participant 3, Bhagwanpur village, 16 April 2011). The first answer reveals that the influence of a strict protected area regime continues to affect the villagers. When probed further, Participant 3 responded, "If we had control over the forest we would have planned better, and harvested optimally as we do in our own agricultural fields".

Figure 9: Harvesting Pattern with Higher Payoffs



Experiment 4

Structure

In this experiment, two changes were made. First, in order to bring into the picture the impact of commercialisation and market demand for forest resources, the payoff for each harvested tree was doubled. The second change was in terms of conservation benefits. These were of two types: (1) at the end of each round, the low level of harvest in that particular round was awarded with a number of additional trees in the forest for the next round, and (2) the form of cash incentive to the community depended on the number of trees that remained in the forest over and above the initial number of trees at the end of the game. In order to keep the game as simple as possible, only trees were considered in the forest.

The experiment began with 50 trees in the forest (a degraded forest), which could grow to a maximum size of 100 trees. At the end of each round, there was the usual 10% regrowth. If the net harvest of a round was at the most five trees, then 10 trees would be added to the forest stock to be considered for the next round as an additional incentive. If the net harvest of a round was between six and 10 trees, then five trees would be added to the forest stock to be considered for the next round. For a net harvest of more than 10 trees in a round, there was no conservation incentive. At the end of the game, if the number of trees in the forest was more than 50 (the starting resource size), then the group as a whole would be paid Rs 10 per additional tree. It was the group's right to decide the distribution of this cash incentive. To begin with, the game was played with no communication, and when we observed that the harvesting behaviour was more or less stabilised toward the seventh round, communication was introduced and continued over the next five rounds.

Results

The higher payoffs seemingly did not affect the pro-conservation behaviour of both of the communities. The total harvest (in 12 rounds) in Kargata was 72 (individual harvests of 13, 13, 15, 16, 15), while that for Bhagwanpur was 49 (individual harvests of 10, 10, 9, 10, 10). The results are consistent with the earlier observations, that overall harvest was higher in Kargata than in Bhagwanpur. In reality, this could be due to different forest conditions. The major concern of both the communities was to bring the forest to its optimum capacity in terms of trees. Beginning with 50 trees, the Bhagwanpur forest continued to increase, reaching the mark of 100 trees at the beginning of the seventh round and remaining at that level until the end of the game. The Kargata forest reached the mark of 100 rather quickly at the beginning of the fifth round. Maintaining its maximum size, it decreased to 96 at the beginning of the 10th round but was immediately restored back.

It was observed that in the first seven rounds where no communication was allowed, the roundwise harvest showed very little variation. Immediately after communication was allowed, there was a marked change in the roundwise harvest size (a decrease in Bhagwanpur and an increase in Kargata). Very soon, however, this again stabilised (see Figure 9).

In Kargata, the group harvest increased substantially, from an average of 3.42 to 9.6, after the introduction of communication in the eighth round. This is possibly due to the fact that through communication, the group could strategise to increase the payoffs without compromising on conservation goals. Later, when asked why they did not opt for maximising their payoffs by harvesting more trees, which they could have done even by maintaining the forest size, one participant (president of JFM committee) said, "I did not harvest much thinking that if others harvested more the forest will get degraded". This is an example of a prisoner's dilemma in "reverse direction". In the later rounds, when the participants could communicate with each other and decided on the harvest level of each individual, the payoffs increased, but the harvest was still below the optimum. Even when the last round was announced beforehand, the behaviour was identical to the previous rounds, that is, low-level harvesting. The harvesting rules made by the committee were followed with no infractions.

In Bhagwapur, in the eighth round when communication was introduced, the group harvest was zero, becoming one in the ninth round. The group harvest then increased to the average of no-communication rounds. This community used communication to protect their plantations.

Even with the lure of doubled payoffs, the net harvest remained low (72 for Kargata: 24 in the first seven rounds and 48 in the remaining five rounds; 49 for Bhagwanpur: 34 in the first seven rounds and 15 in the remaining rounds).

Interesting Observations

In Bhagwanpur, the third-round harvest was six trees (instead of five in previous rounds, which gave them the maximum incentive) and hence the incentive diminished. There was an immediate discussion that "someone had stolen one tree". We had to remind them that they were not supposed to communicate. Surprisingly, when communication was introduced in the eighth round, not a single tree was harvested, although the resource size had reached the maximum of 100 trees. When asked about it, the response was: "Plantation has just taken place, the saplings are young, we have decided to let them grow" (Participant 2, Bhagwanpur village, 16 April 2011). Another comment was, "We want to get the final incentive, it is like getting reward from the Forest Department (FD)" (Participant 3, Bhagwanpur village, 16 April 2011). One of the participants commented that the 10% regrowth provision was incorrect. "These days most of the seeds are collected by FD or others, so there is no natural regrowth. There is high demand for teak and *tendu* seeds. Only bamboo grows naturally. In the season of *tendu* leaf collection, people put fire to ground for fast regeneration. But because of all this the tendu seedling doesn't grow into a tree" (Participant 3, Bhagwanpur village, 16 April 2011). One of the participants was in urgent need of money since his daughter was to get married in a few days. He asked for financial help after the experiment was over, but this did not reflect in his behaviour during the experiment. He was one of the low-scoring participants.

6 Conclusions

The non-exploitative and non-commercial attitude of the two predominantly indigenous communities is clear from their harvesting behaviour in the experiments. Most of the time, their harvest has been suboptimal, and communication helped to bring in parity of payoffs. The nature of dependence on forests is primarily for fuelwood and fodder, and not on timber, leading to prioritisation of tree-cover conservation. The results further reinforce the well-known fact that if the resource size goes below a critical minimum, even with planning and conservative use, it is not possible to revive the resource. Communities understand this and are capable of dealing with scarcity by looking for alternatives. Trees are harvested as fuel only if no fallen or dried branches are available in the forest, preferring benefits for perpetuity rather than higher gains in the short run. This confirms 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". It is quite clear that those who depend on common-pool resources on a daily basis attain their own understanding of the relation between use and regeneration capacity of a resource and the necessity of cooperation among them (Vollan 2008).

These experiments indicate that indigenous communities can be trusted with forest management responsibilities, and steps like JFM and FRA are moving in the right direction. With ownership of forests bestowed in them, communities are likely to address the issue of equity as well. Under programmes like JFM, plantations of fast-growing trees that can be used as fuelwood and making fodder easily and sufficiently available can help protect high-value timber trees. Utmost precaution needs to be taken, however, to ensure that the forest patch does not degrade below the critical minimum. However, at least in the initial period, some failures of community management should not be generalised, because "once altruist and reciprocal motivations are crowded out, it takes some time to re-establish trust and reciprocity" (Vollan 2008: 563).

NOTES

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

2 Gadchiroli district was carved out of Chandrapur district in 1982.

3 A set of protocols developed by the IFRI research programme at Indiana University and the University of Michigan, US (http://www.sitemaker.umich.edu/ifri/files/ifri_blank_forms_v13_with_rev8-08.pdf).

4 The idealised personal bias occurs when people respond to questions as the person that they wish they were, rather than the person that they really are. The surveyor effect means that survey takers often try to figure out what the researcher would like to hear and then respond in that way or the opposite way.

5 $1= Rs 45. The average wages per day in the study villages was Rs 40 in agriculture, Rs 70 in forestry work, and Rs 62 for other manual labour.

6 Detailed discussion of this experiment and the results can be found in Ghate et al (2011).

7 Under JFM, fuelwood plantations consist of fast-growing, low-value species usually used as fuelwood; fodder plantations consist of grass used as high-nutrition fodder, and trees for timber are high-value species that take many years to come to maturity.

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