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Contents

Abstract

Much experimental research has been conducted in laboratory settings on human behavior related to public goods, common-pool resources, and other social dilemmas. These studies have shown that when subjects are anonymous and not allowed to communicate, they tend not to cooperate. However, to the surprise of game theorists, simply allowing subjects to communicate in a laboratory setting enables them to achieve far more cooperative outcomes. The replication of the experiment in laboratory settings in multiple countries as well as in some initial field experiments has only confirmed this important finding. However, while carefully conducted laboratory experiments do have strong internal validity, external validity requires further research beyond the initial field experiments that researchers have begun to conduct. 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. We used two experimental designs in all eight villages: a "no-communication" game 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 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. Our findings suggest that the shared norms in these indigenous communities are so deeply embedded that communication is not essential to arrive at cooperative decisions. However, communication does homogenize group and individual outcomes so that communities that are overly cooperative tend to reduce cooperation slightly while those showing small deviations in the other direction move toward the optimal solution.

Keywords: Common-pool Resources; Indigenous Communities; Field Experiments; Cooperation; and Cultural Norms

Indigenous Communities, Cooperation, and Communication: Taking Experiments to the Field

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) as well as the now classic article in *Science* by Garrett Hardin (1968), many scholars and policy makers have presumed that individuals always maximize short-term profit opportunities. Thus, without external regulation, individuals would over-harvest and destroy resources over time. During the 1980s, however, a large number of case studies written by anthropologists, historians, sociologists, and other scholars drew attention to settings where the users of common-pool resources had organized and, in many cases, were successful in managing, a common-pool resource. That led to the creation of a committee of the National Research Council and several major publications related to these possibilities (Berkes, 1985; NRC, 1986; McCay and Acheson, 1987; Wade, 1988). Since then, researchers have devoted substantial effort to a meta-analysis of multiple CPR case studies which clearly demonstrate that many resource users, albeit not all, did self-organize so as to achieve cooperation to reduce harvesting to a sustainable level (see Schlager, Blomquist and Tang, 1994, and Ostrom, Gardner and Walker, 1994).

Experimental researchers also began to examine the presumption of universal maximization of short-term material returns in a series of laboratory experiments related to public goods (Isaac and Walker, 1988a and b; Marwell and Ames, 1979;) and other types of social dilemmas (Braver and Wilson, 1986; Liebrand, 1984; Orbell, Van de Kragt and Dawes, 1988) and found mixed evidence depending on the structure of the experiment. The initial experiments on common-pool resources found that in settings where the subjects in an experiment were unknown to each other and not allowed to communicate, substantial over-harvesting occurred as predicted (Ostrom and Walker, 1991). When allowed to communicate – that is, engage in "cheap talk" - subjects tended to cooperate with each other and to achieve much higher returns than predicted by game theory (Ostrom, Walker, and Gardner, 1992).

However, many of the initial experiments on public goods, common-pool resources, and other social dilemmas took place in laboratory settings in U.S. or European universities. While laboratory experiments do have strong *internal* validity given careful specification of a set of independent variables and substantial effort to minimize the impact of other variables, *external* validity could not be assessed from such experiments conducted with undergraduate and graduate students in university laboratories because participants in such lab experiments do not face a CPR or public goods problem on a regular basis. They are usually a heterogeneous group with different and unknown backgrounds. Cardenas (2000) was among the first to explore the external validity of experiments run in laboratory settings by running similar experiments in rural settings where participants regularly faced problems of potential overuse of their resources. He translated the experiments conducted by Ostrom, Gardner, and Walker into Spanish to run field experiments with *campesinos* in rural Colombia. In his efforts to carefully pretest the experiment, he found he needed to change the wording of the experiment in order to move away from the usual practice of having participants decide on the number of tokens to invest in a resource to one where they had to decide on the number of months spent in a forest harvesting trees. Running his first field experiments with rural farmers, who harvested trees from their local forest, he found that they easily understood making decisions about "the months they would harvest trees from the forest."

Keeping the same underlying mathematical structure, Cardenas (2000) also ran a series of field experiments that were similar in structure to the experiments run at Indiana University where 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

they were able to engage in face-to-face communication (see also Casari and Plott, 2003). A series of common-pool resource experiments run with postgraduate subjects in 41 countries (Ahn, Ostrom and Walker, 2010) also confirmed that subjects, who were not able to communicate with others in their group, cooperated at low levels. Cooperation increased substantially when participants were able to talk face-to-face with others in their group. In a new laboratory experimental design (Janssen et al., 2010), which represents a more complex resource in which subjects make many more harvesting decisions than in earlier experiments, they still over-harvest dramatically when they cannot communicate but substantially reduce harvesting when communication is feasible.

This large body of initial lab experiments, and now field experiments, have enabled scholars to reach substantial agreement on the importance of communication amongst individuals facing common-pool resource problems. In the absence of communication, such individuals tend to cooperate at low levels (or not cooperate at all) while, with communication, the level of cooperation tends to grow substantially[1]. But does this hold true in all kinds of societies? Or do variables like shared norms and a culture of judicious resource use, especially amongst close-knit communities that have frequent, day-to-day interactions, make communication itself superfluous? Do communities that are highly dependent on the resource develop a mutual understanding regarding sustainable harvesting which simply gets transmitted to future generations without much need for words?

We ask these questions as no field experiments have been conducted in homogeneous, indigenous communities where strong norms of mutual cooperation are present. This paper therefore reports on field experiments run in the context of indigenous communities in India that have unique ties and attachments to natural resources in their traditional habitats and ancestral territories. Through the series of experiments run in eight indigenous communities that traditionally share norms and mutual trust, we find that the need for communication to enhance cooperative behavior in such communities is minimal although, in our experiment, the eight study communities actually differed in terms of location, dialect, state of adjoining forests, and level of functioning of institutions set up by the Forest Department under the Joint Forest Management (JFM) program. Our findings therefore differ from earlier common-pool-resource laboratory and field experiments on the need for communication to enhance cooperation with regard to common pool resources. However, this study goes further in illustrating a different role that communication can play. It shows that communication may help enhance equity and moderation in harvesting in a community that already shares strong norms of cooperation.

In this paper we first present the background of the study communities and then a section providing important details of the study area, outlining their broad contextual similarities and differences. It is followed by a section on research methods, which includes the structure of the field experiments. A section presenting results of the experiments and discussion is next, and it includes a sub-section on how findings from other methods employed in the study validate the findings of the field experiments. The final section outlines the conclusions and policy implications of our study.

2. Background of the Present Study

The term 'indigenous people,' in the Indian context, 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) and, with time, certain images and perceptions have developed with respect to the term 'tribe' in India. These include the absence of exploitive classes (i.e., class hierarchies) and organized state structures; multi-functionality of kinship bonds; all-pervasiveness of religion; the segmented character of the socio-economic 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). The relationship of tribal communities with forests is reflected in their religious dictates, eclectic belief systems, and social norms which make them protective of the forests unless prevented in doing so by governmental policies (Gadgil and Guha, 1992).

We have been studying such tribal communities residing in central India for many years. Our earlier work, through the use of multiple methods, explored the nature and extent of dependence on forest of the indigenous

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

communities, the functioning of various institutions, and the impact of various government policies on their lives (Ghate, 2008; Ghate et al., 2006; Ghate et al., 2009). Among the methods we have used for this purpose are household surveys; focused group discussions; participatory methods; and the use of protocols developed by the International Forestry Resources and Institutions (IFRI) research program to study socio-politico-economic as well as biotic aspects.

These studies make it clear that forests provide the wherewithal for the survival of forest dwelling tribal communities and, hence, are an integral part of their life-system. However, there are presently three things that may impact on their relationship with forests: improvement in infrastructural facilities resulting in more exposure to mainstream society; spread of globalization and commercialization; and specific policies and programs of the government to reduce their dependence on forests. We feel that traditional research methods such as household surveys, focused group discussions, etc., might not be adequate in order to study these impacts since they may not realistically capture the community's actual behavior when harvesting forest products due to hypothetical, persona, and surveyor biases in the design of research. Encouraged by the results coming from studies on human behavior related to common pool resources based on experiments conducted in laboratories as well as in the field, we therefore decided to use field experiments to focus specifically on whether the harvesting behavior of tribal communities (with *broad* contextual similarities[2]) is primarily short-term and self-interested, or cooperative (i.e., non-exploitative and sustainable), and what role communication plays in decision-making.

Another important reason for understanding the attitude of tribal communities towards forests is that, along with many other developing countries across the world, India too has accepted the concept of 'sharing authority' on forest use with communities through both legislation like the Forest Rights Act[3] and programs like Joint Forest Management (JFM). Since JFM encourages communities to take decisions collectively regarding forest use, it is important to understand the role of communication in enhancing cooperation in common-pool field experiments.

3. Study Area

The eight study villages are all located in the state of Maharashtra in India. Maharashtra is the second largest state in India with 9.4% of the country's 3,287,263 sq km. geographical area and 9.29% of the country's population. Slightly over 10% of the country's 84.3 million tribal population resides in Maharashtra which, on this count, is home to the second largest population of tribal people in India.

Six districts of the state, namely, 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. However, presently, 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 Forest Department. The six districts are also populated with indigenous/tribal people, belonging mainly to Gond, Warli, Bhil, Madia, Korku, Padavi, and Katkari tribes. Eight villages, namely, Khongda (in Amravati district), Kargata and Bhagwanpur (in Chandrapur district), Talwada and Zimela (in Gadchiroli district, which also has the maximum forest cover in the state), Bijrigavan (in Nandurbar district), Gadhaddeo (in Dhule district), and Aire (in Thane district) are the research sites of our study. Figure 1 shows the geographic locations of the study villages while Table 2 provides details of the district forest area and tribal population, and Table 3 other village level details.

3.1 Broad Contextual Similarities

It is worthy of mention that the forests on which the tribal communities in India depend belong to the government. There is evidence that until the end of the nineteenth 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,

[2] Predominantly indigenous communities living together for generations; forest dwelling with subsistence dependence on forest products; have own dialects; used to having traditional leadership; history of shared norms and mutual trust; deities located in forests and a tradition of sacred groves.

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

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

1996). This trend has however continued in independent India. Under the JFM program, which was introduced as a result of The Forest Policy of 1988 that promoted participatory management, selected communities/villages were given some area of the forest for protection in return for the immediate benefits of usufructs as well as a share in incremental growth in the long run although ownership of the resource still vests with the Department of Forest.

In addition to the lack of ownership over the forest lands in which they live where they enjoy only limited usufruct rights on some forest products under JFM, the eight communities[5] studied share several other similarities. More than 75% of the population belong to the indigenous/tribal communities and have lived in specific locations for generations with only the Bhagwanpur community experiencing relocation from its old location in 2007. Almost 95%[6] of the households in these villages are also below the official poverty line. All the villages are located in or on the fringe of forests. Although the quality of forest at present is different from village to village, the villagers are not directly responsible for the state of their forest. Moreover, the dependence of the 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 forest is degraded, households have had to find alternatives for firewood.

Agriculture is the dominant occupation in all the villages, with average land holding 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 the mainstream society, the older generation still communicates in traditional dialects. Most of these communities, it could be said, have their traditions intact: they worship deities located in forests, have preserved their sacred groves, and celebrate traditional festivals. Traditional leadership continues to be strong and villagers take many decisions collectively. Since the communities have a shared history that has impacted their ownership of resources, they can be said to display shared norms of behavior and mutual trust when it comes to resource use.

3.2 Broad Contextual Variations

Contextual differences also exist among these communities despite similarities. The size of the villages varies from 40 households (with 180 individuals) in the case of Kargata to 522 households (with 2160 individuals) in the case of Gadhaddeo. Five out of the eight villages report seasonal migration in the non-agriculture 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 Zimela and Kargata, other villages have a fair price shop and an *anganwadi* (pre-school facility). However, only Talwada has a Primary Health Care Center while Bhagwanpur has the sole post office in the entire study area. None of the villages has a Range Forest Office, a bank or an agriculture extension center. Moreover, the location of the eight villages differs with regard to proximity to towns and cities. While 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. While Bijrigavhan is close to the neighboring state of Gujarat, Khongda is located on 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. While four communities have good quality forest and two have somewhat degraded forests, two villages have highly degraded forest. While there is a Forest Protection Committee set up under the Joint Forest Management (JFM) Program in seven of the eight villages, there were variations in how it functioned in the different villages. Two communities were completely unaware of its existence while in two communities, the institution was partially functional and in one functioning poorly. Only in one community was JFM completely and successfully functional.

4. Research Methods

In this section we present our results based on field experiments conducted in the 8 communities. We designed the experiment to capture the harvesting behavior of communities where participants take decisions individually.

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

6 This is according to the Micro Plans prepared for villages by the Forest Department.

This experimental design has two treatments–individual decision-making without communication and with communication. We conducted the experiments between January 2009 and April 2011, as part of two different research studies.

4.1 Structure of the Experiment[7]

Taking experiments to the field presents several challenges. The most difficult challenge is to make the experiment relevant to the participants so that their behavior in the experiment collates with their behavior in "real world" situations with regard to relevant common-pool resources. Keeping this in mind, we developed two basic 'within subjects' experimental designs. 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 make decisions. The researchers also inform them that they will individually harvest from this forest. For this purpose, an appropriate number (which is the allowed maximum harvest size for that round) of trees is kept next to an empty box on a table in another isolated room. In turn, participants enter this room, and drop the number of trees in the box that they wish to harvest in that round. A participant can refrain from dropping anything in the box to indicate that he does not wish to harvest at all in that round. The organizer records the number of trees harvested by each participant, takes out the trees 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 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 researchers did not allow the five participants to communicate with each other throughout all the rounds. We call this the no-communication game. In the second design–the communication game–the same five participants can communicate with each other at the beginning of each round for the duration of the game. In both of these games, decisions regarding harvesting are taken in private, which are not revealed to the group until the end of each round, when the group learns only about the total (group) harvest made at the end of each round. Participants receive a pay-off 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 in each design, contrary to the practice adopted in other experiments, where payments are made in private. This is done to capture the reality of small communities where everyone knows who is harvesting what in the village and what the pay-offs are. It also facilitates discussion upon the introduction of communication in the second design.

In both the designs, the researchers tell participants at the beginning that s/he will add 10% of the trees remaining at the end of the each round 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 researchers do not disclose the number of rounds that the game would be played 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 (see Table 1). If the resource size falls to less than four trees after taking regeneration into account, the game is stopped but, otherwise, the game ends after the tenth round.

At the outset, researchers explain the structure of the experiments to the participants. The participants are seated in a semi circle at a distance from each other, and researchers impress upon the participants the importance of not communicating in the first game. During the communication game, the participants are free to draw close to each other for the purpose of discussing with each other their options. In each community the experiment is started with three practice rounds in which the researchers ask participants to calculate their pay offs and the count of trees to make sure that they have understood the implications of their decisions. Participants may use paper and pencil or calculators if they wish.

[7] We broadly adopt the field experiment designed by Cardenas, Janssen, and Bousquet in "Dynamics of Rules and Resources: Three New Field Experiments on Water, Forests and Fisheries", in the Handbook on Experimental Economics and the Environment, edited by John List and Michael Price.

[8] USD 1=INR 45. The average wages per day in the study villages were INR 40 in agriculture, INR 70 in forestry work and INR 62 for other manual labor.

4.2 Participants in the Experiments

We identified willing participants for the experiments at the time of conducting household survey in the community. We made an effort to select participants that would be representative of different age groups, education levels, and land ownership in order to capture economic variations and to make it representative in terms of socio-political classes (hierarchies) at village level by including a *sarpanch* (head of the *gram panchayat*, a democratically-elected village-level governing body), a police *patil* (the village-level employee of the Police Department), the president of the JFM committee, or a representative of the Resettlement Welfare Committee (in the case of Bhagwanpur). The participants in the experiment were thus familiar with each other in their respective villages though not with participants from other villages[9]. As the participants of an experiment were all from the same village, they were aware of the use of forest products by other participants, making it easy for them to guess others' likely behavior in the experiment. They were also aware that they were likely to live in the same village for many years to come. This does not happen when researchers conduct such experiments in laboratory settings where participants could be complete strangers, with neither a known prior history of behavior nor the likelihood of meeting each other again after the experiment is over, which would impact their behavior in the experiment.

Women did not volunteer in these experiments, which was consistent with available information that women in the study villages were not active participants in the management committees formed under JFM.

5. Experimental Results and Discussion

This section reports the experimental results in the eight communities. As mentioned in the design of the experiments, we did consider the behavior of the participants over ten rounds of the game which would potentially be indicative of their actual long term behavior in forest resource use.

First, we report their behavior in the experiments. One may treat harvesting decisions to be cooperative if they do not affect the regenerative capacity of the resource, and thus ensure sustenance of the forest over a long period. On the other hand, if the harvesting decisions, taken individually or in a group, are causing the fast depletion of the forest leading to its destruction, they are considered non-cooperative. With the help of the field experiments, we are able to show that relatively isolated, indigenous communities in India are cooperative in general. We further show that communication has a positive role to play although the role differs from that obtained in laboratory experiments.

Given the structure of this experiment, we can envision three harvesting patterns related to three different scenarios as follows:

1. In the absence of any communication and knowledge of the 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 5th round when the game ends. In this situation, each player would harvest 23 trees (and would receive INR 230) while the group harvest would be 115 trees. Maximizing individual gains without any consideration to resource size and regeneration leads therefore to complete depletion of the resource within a short period of time, and thus elucidates poignantly the tragedy of the commons as shown in Figure 2[10]. This is also representative of over-exploitative, non-cooperative behavior.

2. With communication permitted, the group may decide on a strategy by guessing (from the previous no-communication game) the total number of rounds the game would go, and then plan on maximizing the harvest[11]. Doing backward calculations, the group can then 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 the full ten rounds at the end of

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

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

[11] We are aware that the harvesting decision in the last round depends on whether the experimenter announces this or gives a clue about it. However, from discussions among the participants in the communication round, we found that the participants had guessed that the communication game would last 10 rounds as in the non-communication game.

which there is no tree 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 per participant. Although a very thoughtful, short-term strategy, it is still based on an attitude of exploitation of the resource to its maximum leading to its complete depletion within a given period of time. It thus represents a commercial/economic/ rational but non-cooperative behavior as shown in Figure 3.

When the organizer allows communication, keeping in mind the maximum possible size of the forest and the rate of regeneration, the group may decide to harvest 9 trees in each round. The game goes on as the resource size would not diminish at all. At the end of tenth round, the forest would have remained as it was in the first round (100 trees) and the group would have harvested 90 trees (with an individual harvest of 18 trees)[12]. The main characteristic of this strategy is the maintenance of the resource size at its optimum, and maximizing gains within that limit. It ensures the preservation of the resource over time. It is a positive and sustainable solution to the CPR dilemma because it represents a model of cooperative behavior as can be seen in Figure 4.

5.1 Observed Pattern of Experimental Harvesting in the Eight Communities: Cooperative Behavior

The most striking feature of the harvesting pattern in this field experiment is that many participants cooperated even in the absence of communication. We can show this trend, averaging across all eight communities, in three explicit ways – average round-wise harvest, average resource size, and average group harvest.

1. The average number of trees harvested by all 8 communities in each round with or without communication lies below 7.5, which is 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, which was reached only once in the no-communication game. In only 16 of the 80 rounds (i.e., 20%) did the group harvest exceed 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 the round harvest of a group exceeded 9 and interestingly none of them were in the villages of Talwada, Zimela, and Kargata.

2. A consideration of all 8 communities shows that 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 the experimenter restores back to 100 immediately at the beginning of the tenth round. This is much higher than the resource size reported by Cardenas et al. In the no-communication game, the resource size remained 100 at the beginning of each round throughout the game in five of the eight villages (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 93 trees or above in all 8 villages. The average size of the forest at the end of the game (that is, after the tenth round and without considering regeneration) remains very high at 85 and 93 trees respectively in the no-communication and communication games.

3. The average group harvest is just 70 trees in the no-communication game and 58 in the communication game, which is much below the sustainable harvest size of 90 trees.

If we consider harvesting behavior in the communities, the highest harvest in the no-communication game is from Talwada (125) while the lowest harvest is from Bijrigavan (29). The next two communities that harvested high in the no-communication game were Zimela and Kargata (harvest size of 91 and 88 respectively) but 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 two participants harvesting 50 and 25 trees. In the communication game, the highest harvest was only 70 trees in the Bijrigavan community while the harvest in Talwada as well as Zimela and Kargata went down considerably (see Figure 7).

[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 5 players beyond the tenth round. Although our interviews support the view that the members of the community had high value for forest and our experiments showed the priority given by the players to 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 because in reality we do not always see indigenous villagers refraining from exhausting a forest, or keeping it at a growth which is equal to extraction rates equilibrium.

When we take all 40 participants into consideration, the average individual harvest over the course of the game was just 14 and 11 for the no-communication and communication games respectively. In the no-communication game, out of 40 participants there were only 5 participants who had 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, this tendency is curbed in the communication game and each participant harvests less than 18 trees. A more surprising observation is that in all the three communities, where there were participants with 'non-cooperating' strategies, the other individuals were not affected by that fact and they continued with their 'cooperative' behavior. 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; in no round did they change their behavior. This shows the existence of unconditional cooperators (at least 10), who out-number non-cooperators (only 5 in the sample of 40) in our experiments.

5.2 Does Communication Lead to Moderation and Homogenization?

A comparison of the harvesting pattern in the two games with the results of prior laboratory experiments reveals that the role played by communication is somewhat different in our experiment. Unlike in lab experiments where communication tends to foster cooperation amongst non-cooperating players, in the case of the indigenous communities in our study, where there is a high level of initial cooperation to begin with, communication results in both moderation and homogenization of harvesting behavior, and consequently, a more equitable distribution of payoffs.

In our sample we found that with communication, the communities that harvested a low quantity in the no-communication game increased their harvest rates (as in the case of Bijarigavan and Gadhaddeo) while the communities that harvested a higher quantity in the no-communication game reduced their harvest rates (as in the case of Talwada, Zimela and Kargata) and thus moderated the behavior of the over-harvesting individuals. This is clearly depicted in Figure 7.

We also found that the impact of communication is significant not only for the high harvesters/non-cooperators but for the low harvesters/cooperators as well. This is clear from the two Figures showing the relative harvests of the top 12 high harvesters and the bottom 12 harvesters in the no-communication game and their respective harvests in the communication game. The average harvest of the top 12 harvesters in the no-communication game was 24.75 which in the communication game came down to 12.83. Similarly, the average harvest of the 12 harvesters that harvested the least in the no-communication game was 4.5, which increased to 9.83 in the communication game as shown in Figure 9. Both these changes are statistically significant with a t-value of 0.002 and 0.008 (the Wilcoxon signed rank test) for high harvesters and low harvesters respectively.

Homogenization in the harvesting behavior among participants is not limited to those from within a community but can be seen between communities too as is clear from the reduction in the standard deviation of harvesting patterns. Table 4 gives the values of the mean of the individual harvests in each of the eight communities for both 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 gives similar statistics for the group harvest of the eight communities and for all forty participants. The results indicate that the standard deviation in individual harvest increased marginally from 2.17 to 4.64 and 6.44 to 7.79 in only two communities. The standard deviation in the case of individual harvests has reduced in the remaining six communities, the maximum reduction being in Talwada from 14.73 to 3.43. While the standard deviation in the harvest of all eight communities together reduced from 30.19 to 11.71, the standard deviation for all forty participants together reduced 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. Thus, we can deduce from our experimental values that communication enables homogenization of harvest (inter- as well as intra-community), thereby bringing equity of pay offs amongst participants.

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

5.3 Some Interesting Observations

We observed that it was common for participants in a majority of the experiments in the communication game to discuss harvesting decisions with each other mainly in the first round. Once the decisions were taken, the participants followed those decisions for the remaining rounds. There were few infractions and no need for verbal sanctioning in contrast with results in laboratory experiments. In most of the communities, either participants who held high-ranking official positions or older participants took the lead in deciding what everyone should do. Rarely were they explicitly challenged. Except in two villages, Aire and Kargata, in all other villages the participants asked the experimenters to leave the room when communication was introduced. In Gadhaddeo, the participants communicated at times in their own dialect which was not known to us. In this village, the leader of the village (or *sarpanch*) asked the youngest participant to bring a calculator with which they did some calculations in order to come to decisions regarding how many trees should be harvested. It is in this village that the youngest player did not harvest any tree in the no-communication game. At the beginning of the communication game, the 'leader' was unhappy at this and scolded the 'non-harvester' saying, "you young, educated people are very lazy, you do not want to go to the forest to bring fuelwood, etc. Look at your old parents, they have to do all the work...." The non-harvester, a science graduate, responded by citing carbon sequestration and the role of forests in ensuring rain fall, etc., as his reasons for non-harvesting. While this discussion did not have an impact on the harvest of the 'leader', it had an impact on the young participant who went on to harvest a total of nine trees in the communication game! The four players (from Aire, Gadhaddeo, and Khongada) who either did not harvest a single tree, or just one or two trees for the entire duration of the 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.

While we would have liked to validate our results from the field experiments with the communities' actual behavior in forests by comparing the results with the condition of their respective forests, we could not do so because none of the communities in question had any control over their forests.

5.4 Other Methods Used and Evidence of Cooperative Behavior

Since the main aim of this paper is to ascertain the role of communication in the harvesting behavior of indigenous communities towards forests, in the previous sections we have presented the main findings of the experimental designs relating to this aspect. However, we had collected data at multiple levels, using different methods, which we wish to discuss here because they support our experimental findings. Before running the experiment, we had held at least one focus group discussion and 3-4 key informant interviews at the village level; collected association-level and forest-level information through the IFRI protocols[14]; 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, collected information from 112 household heads, using a structured questionnaire.

We collected a variety of information using the above-mentioned multiple methods. Here we present only a few observations pertinent to the argument we make in this paper. The high level of dependence in the sample villages on forest is quite clear. All villages graze their cattle in the adjoining forest. Only in Khongada were there buffaloes that were stall fed with fodder brought from the forest or from agricultural residue. The only villages that use means other than firewood for cooking and heating are Bijrgavhan and Gadhaddeo. These two villages have degraded forest in their vicinity. Although there is electricity in seven of the eight villages, only 1.9% of the households in Gadhaddeo (the largest village in our sample) have a connection. For the households without an electricity connection, firewood serves the purpose of lighting. Not surprisingly, more than half of the respondents said that they did not want the forest land 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 they were asked what would be the result if forest ownership was given to the communities, almost two thirds of the households mentioned that it would lead to sustainable harvesting, with 17 households adding that they would take up plantations in order to improve the quality of forest. Only five households felt that transfer of ownership would lead to commercial harvesting. Forest officials seem to agree with the majority view, since 13 out of 18 officials agreed with the statement that "communities are capable of working collectively" while 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".

[14] A set of protocols developed by the International Forestry Resources and Institutions, Indiana University, and University of Michigan, USA. These are available on http://www.sitemaker.umich.edu/ifri/files/ifri_blank_forms_v13_with_rev8-08.pdf

There is evidence that the communities work collectively in other forums too. All the study villages had more than one self-help group which included both women and men. In addition, there were a number of *Tanta Mukti Samiti* (conflict-resolving committees), water-supply-managing committees, and *Gram Sudhar Samiti* (village development committees) in the study villages. During fieldwork, we were able to witness the Aire community in action, where men and women, children as young as five years old, and the elderly engaged collectively in fishing. In the month of January, when there was less water in the river that runs through the village separating it into two settlements, 60 to 70 individuals from one settlement gathered to divert the flow. They first built one dam with sand from the riverbed and some mud from the riverbank, which allowed fish to flow to the bank. They then built another dam to stop the fish from going back to the main flow. Once the water was thus segregated, everyone started removing water from it. The process lasted about four hours. After a couple of hours, the team realized that it would take much longer than expected to remove all of the water. A few of them quickly exchanged words, wherein four men left and returned within minutes with a water pump that they carried on a bamboo pole on their shoulders. The machine soon pumped the water out, and every member of the group started catching the small fish with their bare hands. The most interesting part of this process was the scant communication that participants used to organize the collective harvesting of fish.

6. Conclusions and Policy Implications

Research into social dilemmas has shown that human beings are not always *homo economicus* (Gintis, 2000), but can be *homo reciprocans*[15] 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). Communities in developing countries, for whom forests are an important common-pool resource which contributes to rural livelihoods, are more likely to form norms of societal behavior than those in other socio-economic settings. And these cultural and social norms seem to strongly influence resource use among indigenous communities which dissuade them from adopting commercial or exploitative strategies (Ghate and Ghate, 2010). Furthermore, these norms are so deeply embedded in the communities that they do not need to communicate with each other much for making private decisions regarding use of the resource. However, this does not mean that communication has no role to play. With communication, as seen in this study, the gap between high and low harvests decreases due to moderation in behavior among participants, which also reduces the inequity in pay offs.

Our study substantiates the general characterization of indigenous communities as those governed by 'shared norms of behavior in case of forests.' The results of our study confirm the existence of some communities that are ready to extend unconditional cooperation, which provides support to present efforts of forest management decentralization like JFM and the Forest Rights Act, which envisage community control of forest lands that fall within the revenue boundaries of a village.

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[15] Homo Economicus, or the Economic Human, refers to the concept in some economic theories that see humans as rational and narrowly self-interested actors who have the ability to make judgments toward their subjectively defined ends. This theory stands in contrast to the concept of Homo Reciprocans, which see human beings as primarily motivated by the desire to be cooperative and improve their environment. (http://en.wikipedia.org/wiki/Homo_economicus). But we believe that the reciprocans reciprocate only if others cooperate; otherwise they refuse to be exploited by others.

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

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Tables

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

Table 2: District-wise Percentage of Forest Area and Tribal Population

Sr. No.	Name of District	%of Forest Area of the District Area	% 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

Source: India State of Forest Report, 2009; Ministry of Tribal Affairs, 2001 Census, http://trti.mah.nic.in/static_pages/frm_CenPopu3.htm

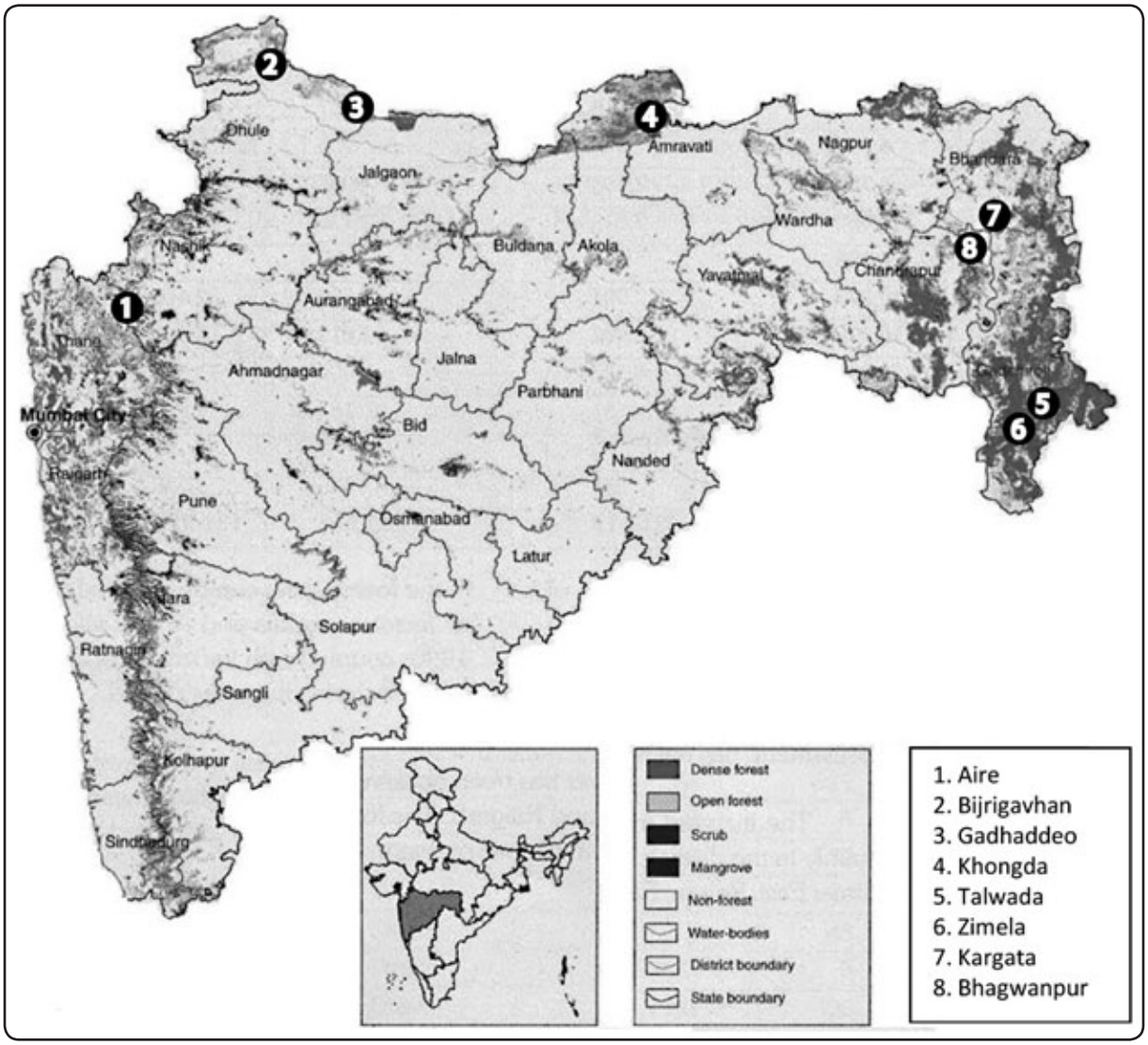
Table 3: Village Details

Village	**Aire**	**Gadhaddeo**	**Bijrigavhan**	**Talwada**	**Zhimela**	**Khongda**	**Kargata**	**Bhagwanpur**
Population	1429	2160	1040	246	392	469	180	320
No. of HHs	243	522	189	66	78	82	40	110
Percentage of Tribal Population	100	90	100	90	100	80	75	90
Distance from Nearest Town(km)	9	3	5	10	18	9	6	14
Percentage of Households with Electricity	4.5	1.9	27.5	0	10.2	18.2	87.5	100
Average Land Holding (ha)	2	1.2	1.2	0.8	1	1	1	1.5
Out Migration?	Yes	Yes	Yes	No	No	Yes	No	Yes
Forest Area (ha)	634.41	1781.6	154.63	522.05	575.26	871.52	526	550
Year JFM Was Estd.	2003	2005	2006	2004	1999	2000	2000	-

Table 4: Experimental Harvesting Behavior

Communities	Mean &Standard Deviation of Individual Harvest		Wilcoxon Signed Rank Test (2-tailed)
	No Com	Com	
1. Aire	11.4 (13.65)	6.8 (4.32)	-0.674 (0.5)
2.Bijrigavan	5.8 (2.17)	14 (4.64)	-2.023** (0.043)
3. Gadhaddeo	9 (6.04)	11 (3.16)	-0.677 (0.498)
4. Khongda	12 (6.44)	13.2 (7.79)	-0.577 (0.564)
5. Zimela	18.2 (6.22)	13.2 (2.39)	-1.841* (0.066)
6.Talwada	25 (14.73)	12.6 (3.43)	-2.032** (0.042)
7. Kargata	17.6 (5.77)	12.4 (0.89)	-1.769* (0.077)
8. Bhagwanpur	13.2 (4.60)	10.0 (0)	-1.342 (0.180)
9. Eight Communities Together	70.125 (30.19)	58.25 (11.71)	-1.120 (0.263)
10. Forty Participants Together	14.025 (9.59)	11.65 (4.26)	-1.404 (0.160)

Figure 1: Location of the case study villages



Source: Adapted from http://www.mahaforest.nic.in/internal.php?id=28.

Figure 2: Exploitative Behavior of Homo Economicus in the Absence of Information on Number of Rounds to be played

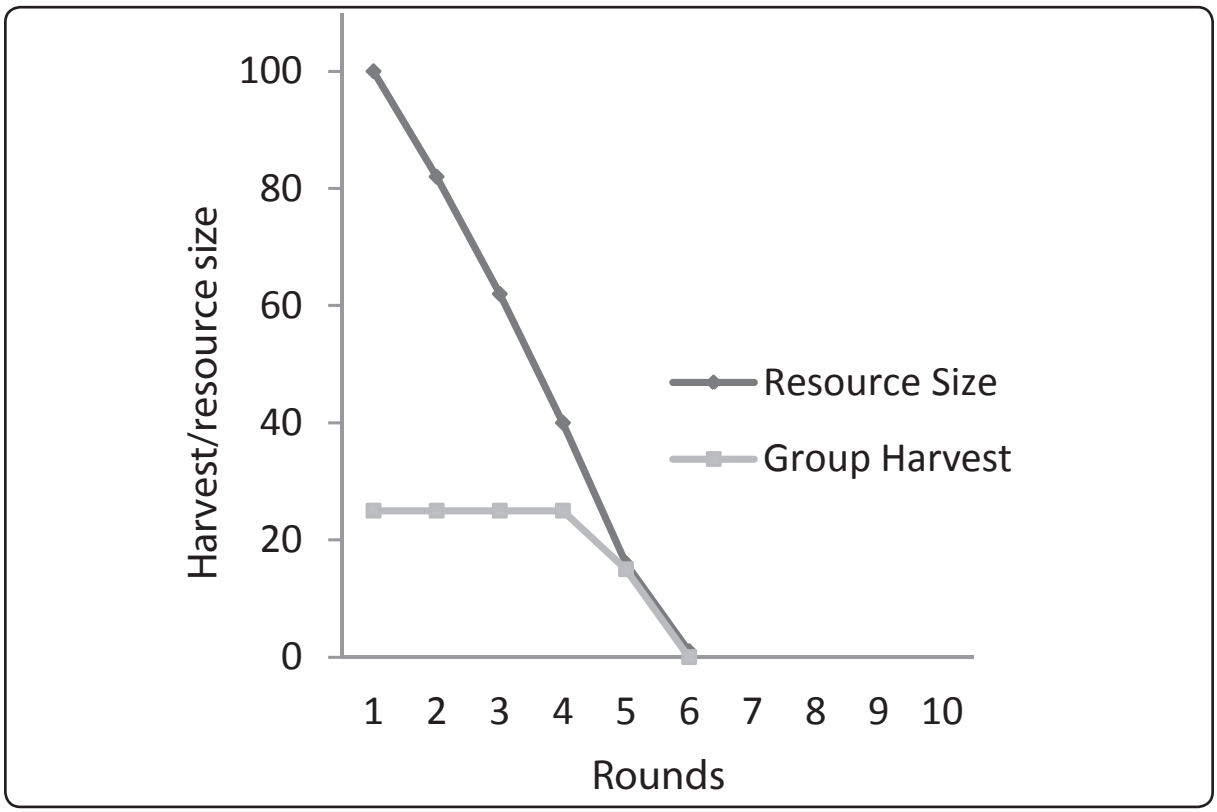


Figure 3: Rational Behavior of Homo Economicus with Information on Number of Rounds to be played

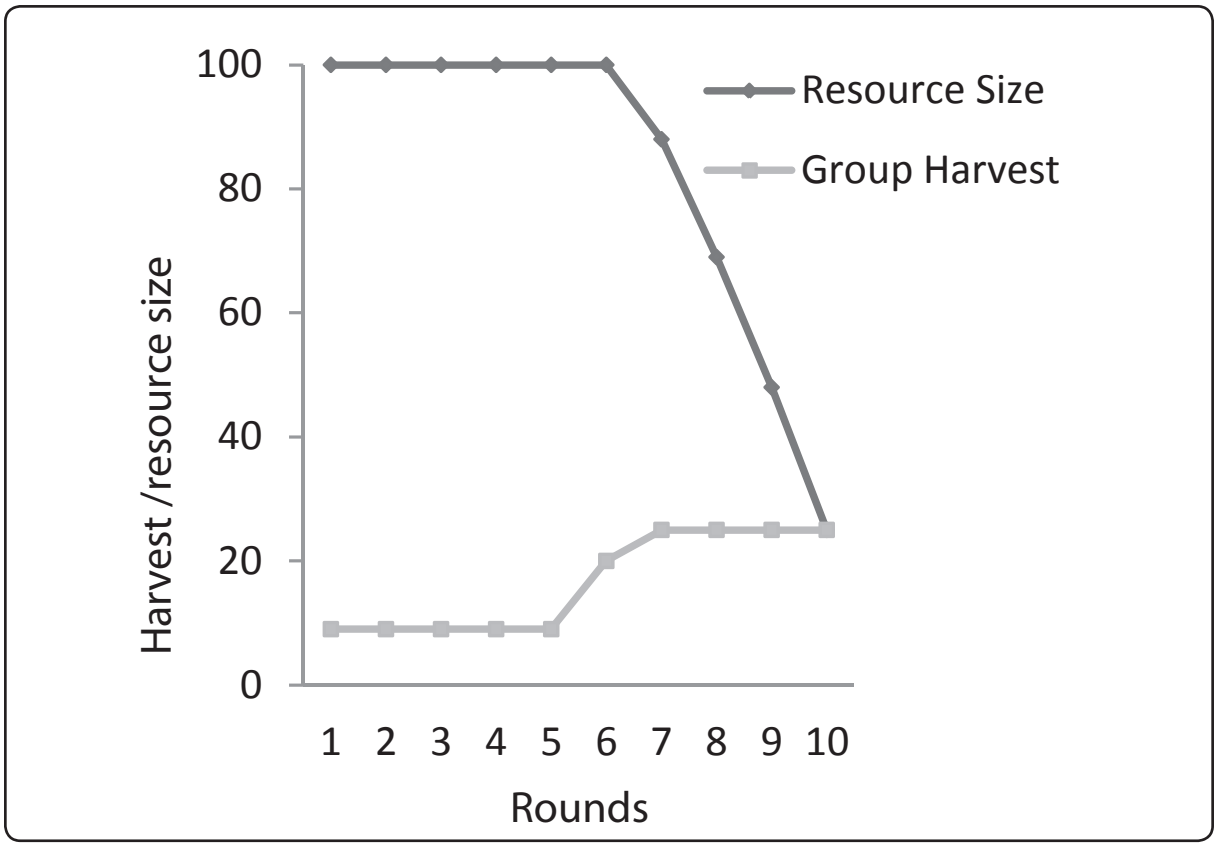


Figure 4: Optimal and Sustainable Behavior of Homo Reciprocus

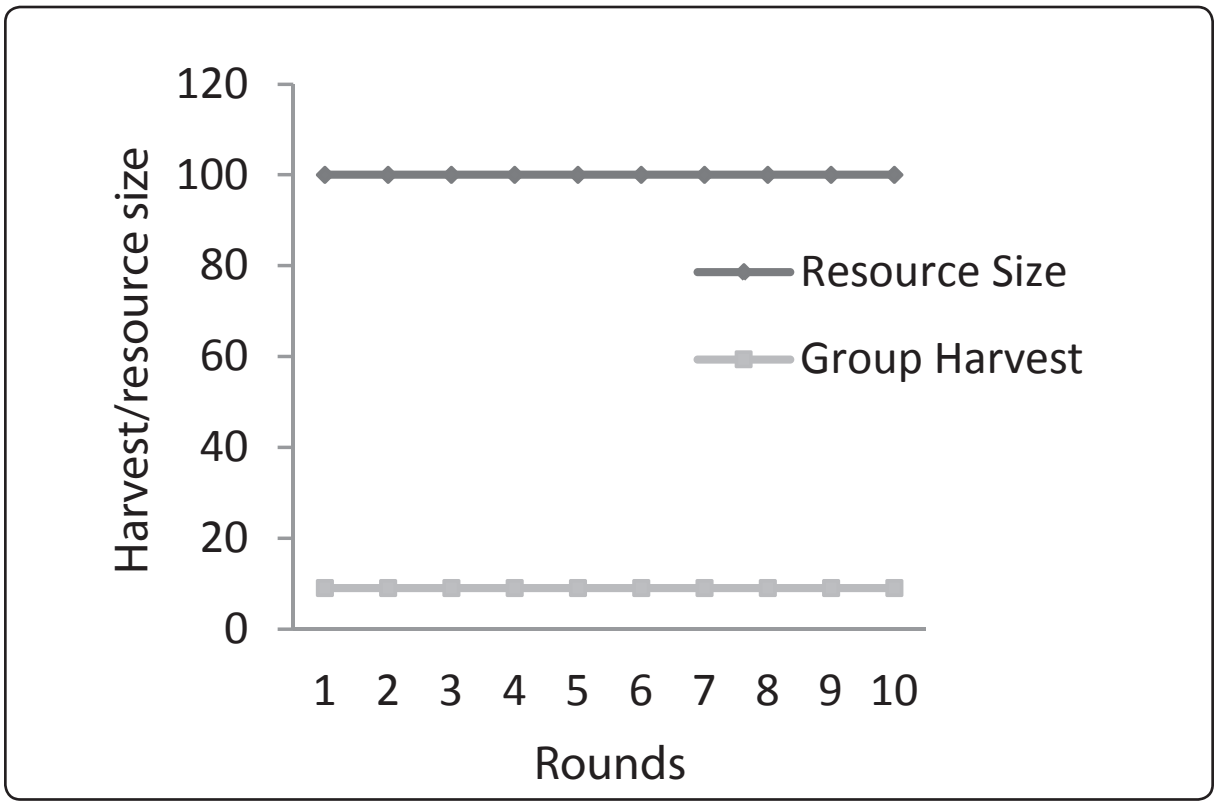


Figure 5: Round-wise Average Harvest of All Eight Communities

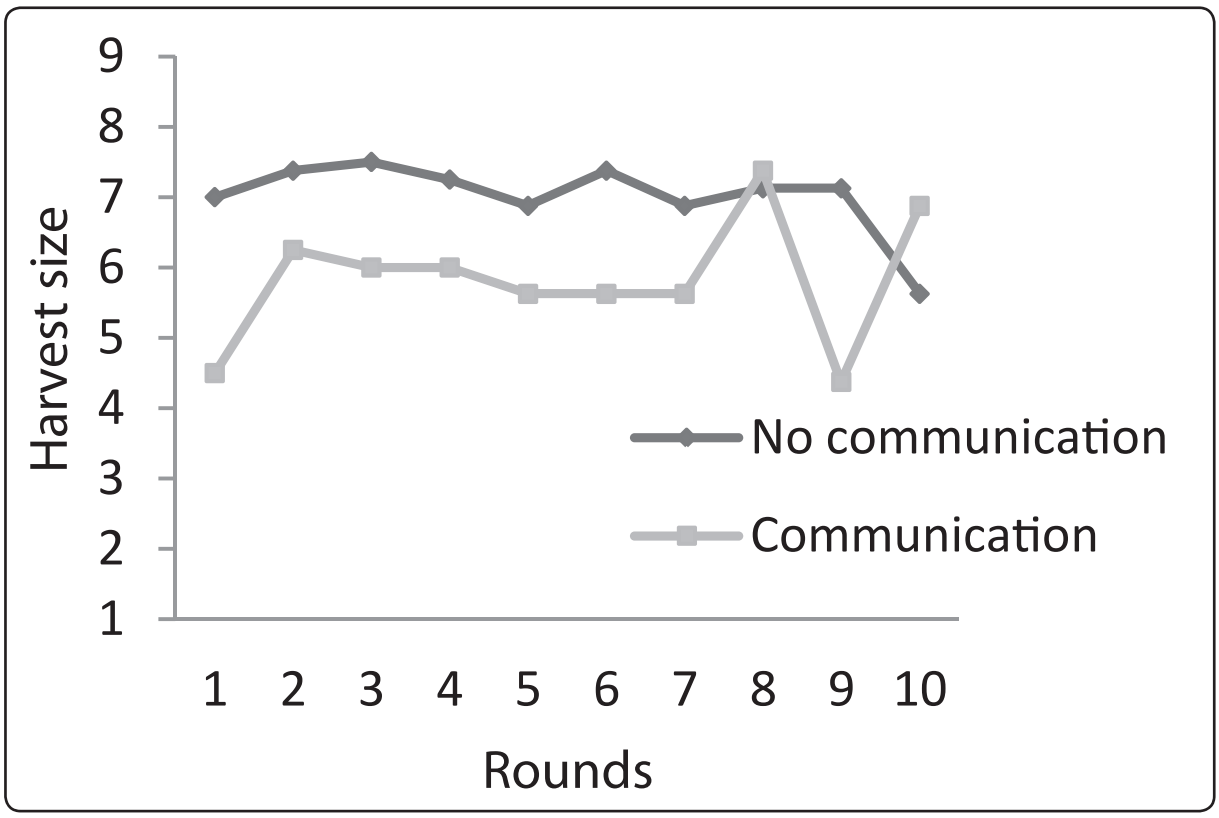


Figure 6: Round-wise Average Resource Size

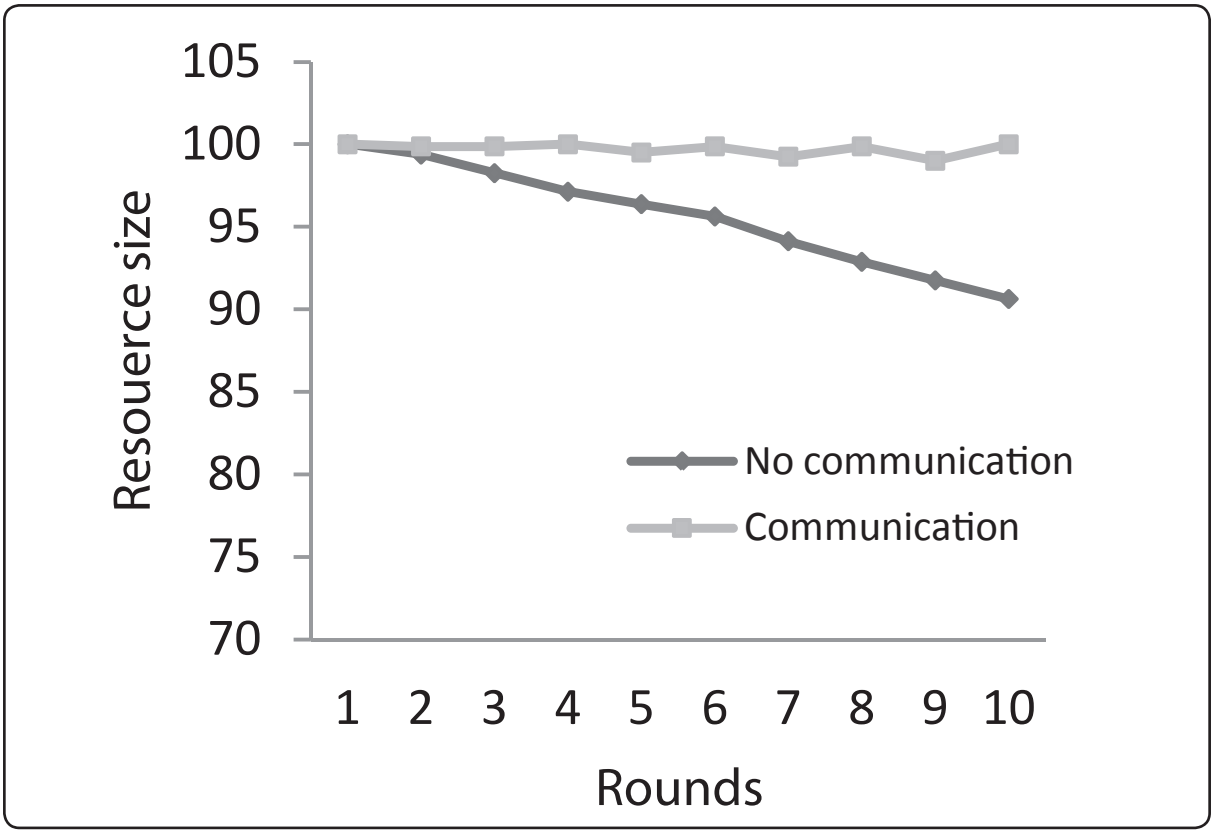


Figure 7: Village Harvest

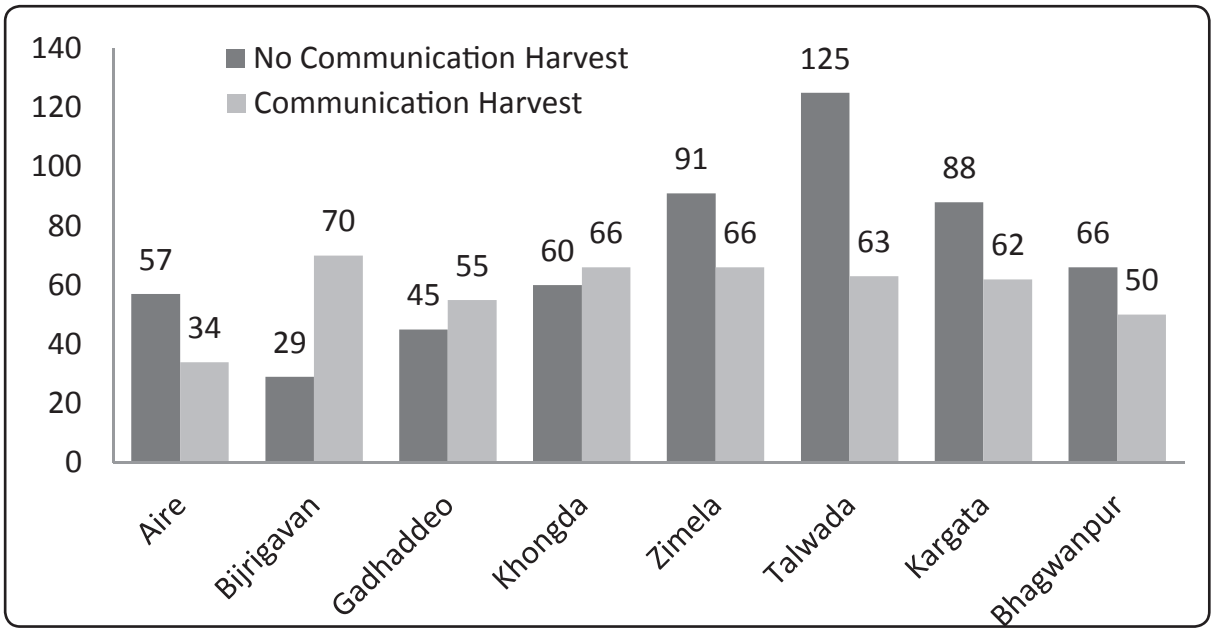


Figure 8: Pattern of Individual Harvest in Two Designs

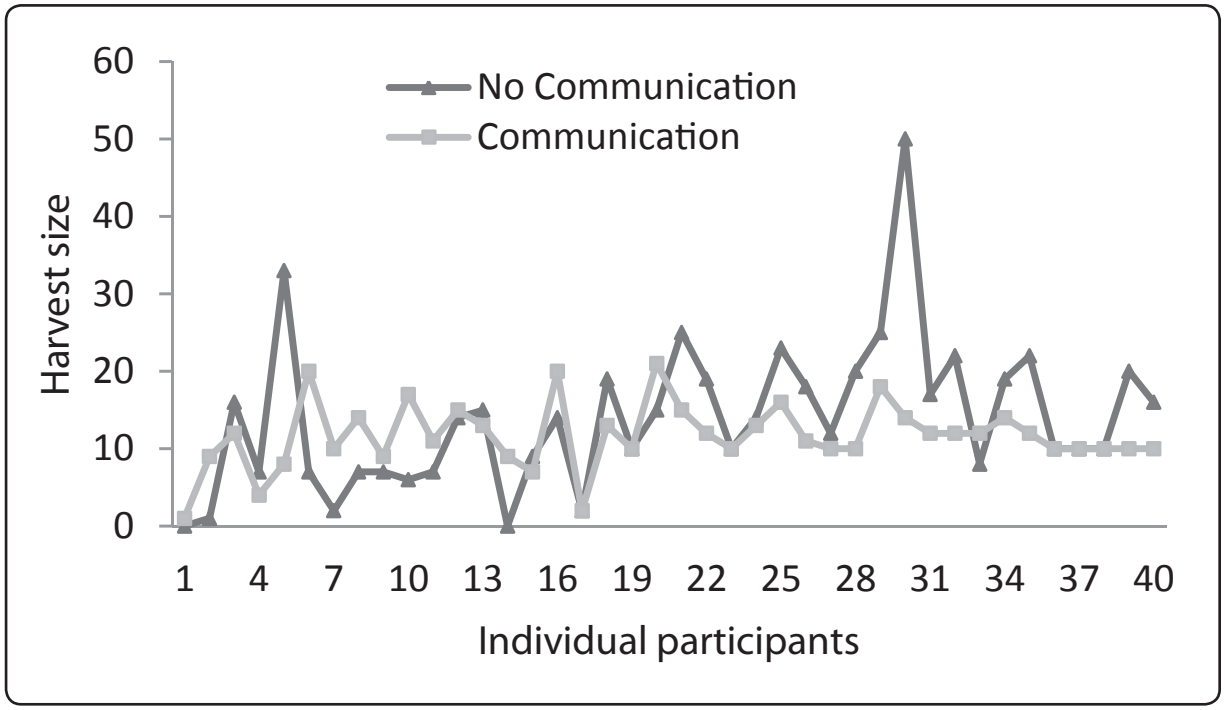


Figure 9: Change in Harvest of Top 12 Harvesters in No-communication Game

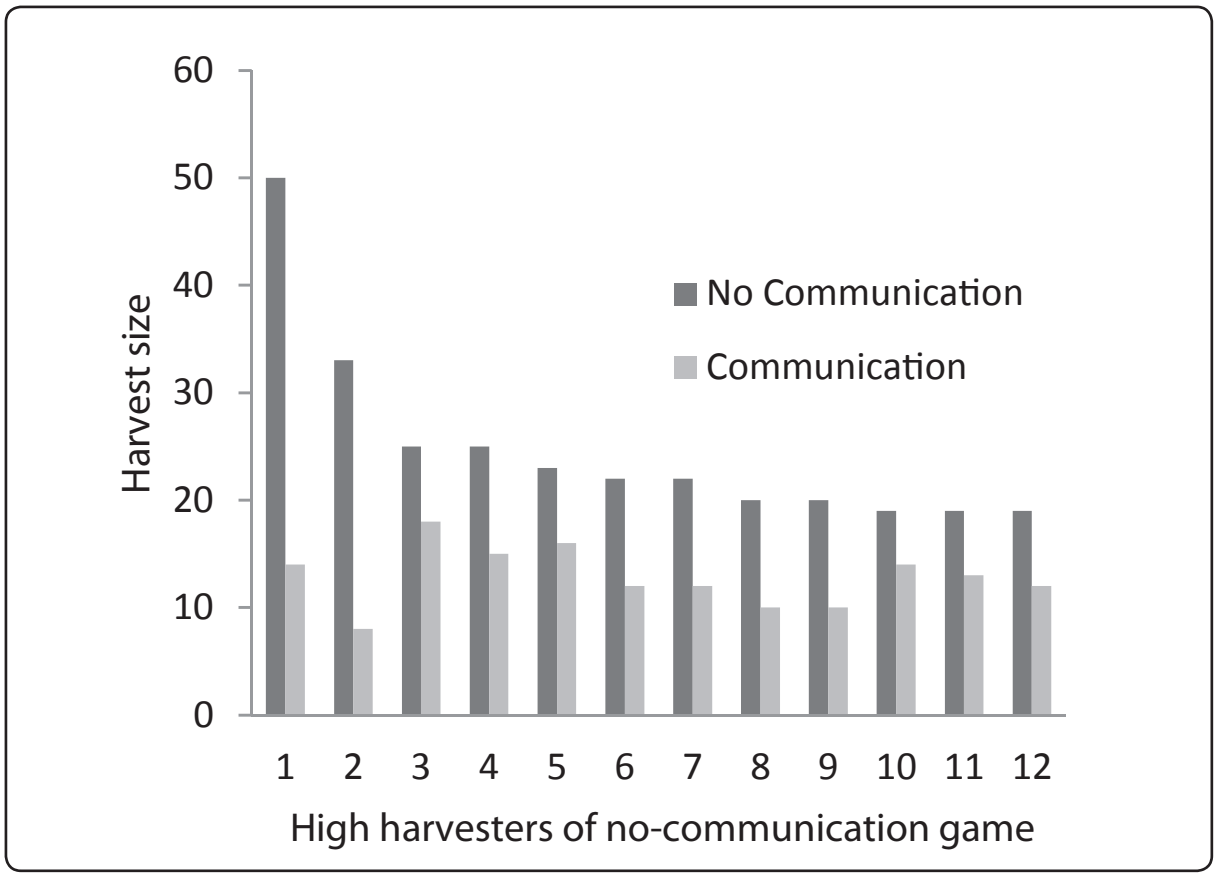
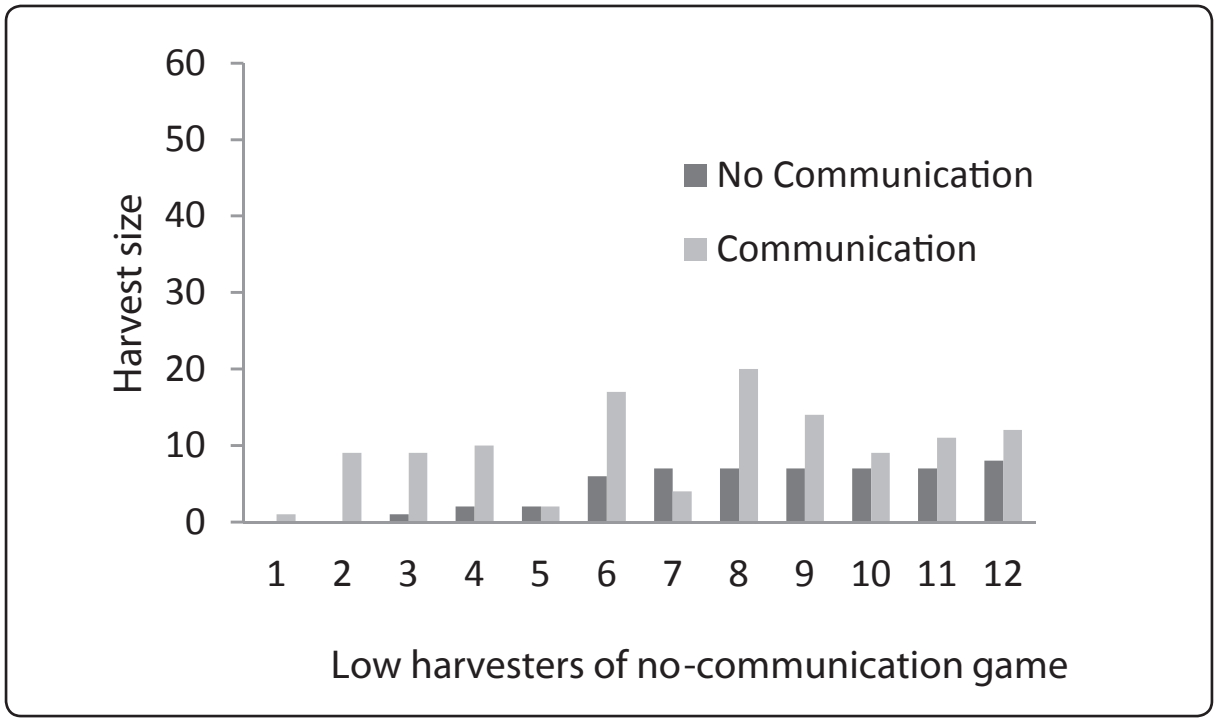
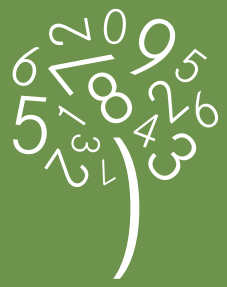


Figure 10: Change in Harvest of Bottom 12 Harvesters in No-Communication Game





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