

## Chapter 2

# Are Forest User Groups Rational Economic or Social Agents? Experimental Evidence from India

Chander Shahi and Shashi Kant

**Abstract** The key pillar of Faustmann's forest economics that individuals have only self-regarding preferences was tested. An asymmetric public good game, termed the Joint Forest Management game, was used to test user groups' preferences for forest management. User groups were divided in four categories—rich, poor, landless, and women. Field experiments were conducted in 38 villages in Gujarat and Himachal Pradesh states of India under four different treatments—no communication, face-to-face communication, light punishment to defectors and heavy punishment to defectors. In Gujarat, in 70 % of cases, and in Himachal Pradesh, in 85 % of cases, user groups expressed preferences different than the preferences of a rational economic agent. The percentage of user groups with pure other-regarding preferences was also small. A majority of the user groups expressed mixed preferences—preferences between pure self-regarding and pure other-regarding preferences. There was a wide variation in preferences across the four user groups. Face-to-face communication and punishment of free riders was found to increase cooperation, but rich groups were less deterred by punishment. The recognition of the diversity of preferences, ranging from pure self-regarding to pure other-regarding, and their variation across the user groups, is one of the key elements of Post-Faustmann forest economics, and should be incorporated into economic theories and resource management policies and strategies. Policy makers also need to focus on alternate means to meet the subsistence needs of poor villagers, especially women and landless people, to strengthen cooperative behavior of these user groups with respect to forest management.

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## 2.1 Introduction

One of the key pillars of Faustmann's forest economics and neo-classical economics is a representative "rational economic agent" who has only self-regarding (SR) preferences irrespective of their outcomes. A Nash Equilibrium, an outcome of these preferences, may be socially undesirable in many situations such as management of common pool resources—forests, fisheries, and environment—that is termed "the tragedy of commons". The rational economic agent is unable to learn from the disastrous outcomes of its SR preferences, its context, and better outcomes from other categories of preferences. Sen (Sen 1977) called such an economic agent a "rational fool" and Hegel (Hegel 1967) termed him/her a "mindless individual". Irrespective of many such limitations of the rational economic agent suggested by many great economists, neo-classical economists have not shown any tendency to modify their assumptions, and reasonably so, because their whole paradigm is based on these simplistic assumptions.

Fortunately, during the last two decades or so, a new emerging field of economics—Behavioral Economics—has provided ample experimental evidence from around the world that human beings have preferences other than the SR preferences, such as other-regarding (OR) and pro-social (PS) preferences. Behavioral economists have proposed many economic theories to explain human preferences that go beyond the self-interest hypothesis and have categorized these preferences into pure altruism (Andreoni and Miller 2002), impure altruism (Andreoni 1989), inequality-aversion (Fehr and Schmidt 1999), reciprocity (Falk and Fischbacher 1999), self-reputation (Bénabou and Tirole 2004), and institutional-context-based preferences (Ostrom 2000). These studies, in general, have recognized the endogenous and heterogeneous nature of human preferences. For example, Andreoni and Miller (2002) found that 47 % people have SR and 53 % have OR preferences. Similarly, Fischbacher et al. (2001) found in a public good game that 30 % people behave like free riders and 50 % as conditional co-operators. These findings of behavioral economists have also motivated game-theory economists to incorporate real life processes such as learning and imitation of human behavior in evolutionary game-theoretic approaches of economic analysis. For example, in repeated plays of a game, players adapt their behavior through learning and copying successful strategies, and view equilibrium as the outcome of an adjustment process, a realistic version of human interactions (Fudenberg and Levine 1997; Samuelson 1997).

The most commonly used games in behavioral economics are the Dictator's Game, Ultimatum Game, and Trust Game. Some economists have also used

Common Pool Resource (CPR) games, but most of these games have been conducted in labs, where the subjects were university students and the results of these experiments were simulated to predict the behavior of local communities. Economists have predicted cooperation as equilibrium through these lab experiments (Axelrod 1984; Ostrom 2000) and shown that self-governance can emerge and be sustained (Ostrom 1990; Ostrom et al. 1994). Some economists (such as Molinas 1998 and Cardenas 2003) have also conducted games with community members. The number of such field experiments is very limited and there are many unexplored aspects of preferences of user groups of different resources such as forests that need to be studied for a better understanding of economic and managerial aspects.

In this chapter, our focus is on the preferences of forest user groups from India. In developing countries, like India, a large population of local communities depends on forests for their day-to-day requirements of fuelwood, small timber, fodder and other non-timber forest products. Hence, the exclusion of local communities from forest use is almost impossible, and exclusionary policies have been the main reason for deforestation and forest degradation in these areas. In the last three decades, many developing countries, including India (Kant, 1996, The economic welfare of local communities and optimal resource regimes for sustainable forest management, “unpublished”; Kant 2000; Kant and Berry 2001), Nepal (Mathema 2004), China (Xu et al. 2004), Mexico (Klooster 2000), Ethiopia (Gebremedhin et al. 2003) and Cambodia (Marschke and Nong 2003) have tried to resolve this problem by involving local communities in forest management. These programs are known as Joint Forest Management (JFM), Co-management, or Community-Based Forest Management. In India, two main features of these programs are: (1) forest managers, normally state agencies, seek the cooperation of local communities in forest protection and forest management; and (2) local communities are ensured, by forest managers, of a share in the final harvest of timber in addition to an annual harvest of non-timber forest products and wages for their forest protection and management work. Even with the uniform provisions of these programs, the success of the programs varies across communities.

Our basic premise is that forest user groups’ preferences for cooperation or non-cooperation with respect to forest resource use are endogenous preferences, and these preferences will not be homogenous across user groups. For example, highly-dependent forest user groups may have quite different preferences than less-dependent user groups. The types and distribution of user groups and their preferences with respect to cooperation in forest management will lead to different outcomes of the same institutional arrangement across different communities. Hence, an understanding of the preferences of different user groups with respect to forests is critical for analyzing the outcomes of the JFM program and making appropriate managerial interventions.

In order to study different user groups’ forest preferences, we used an asymmetric public good game, where the payoff of each individual depends on his own action and on the actions of others. These games were organized in two states of India—Gujarat and Himachal Pradesh. The two states were selected to capture

social, economic, and resource diversity. Gujarat is one of the richest states of India, and therefore has a higher degree of market integration. Gujarat's forests are deciduous while the forests of Himachal Pradesh are evergreen coniferous. We conducted repeated rounds of the game under four different treatments—no communication, face-to-face communication among participants between different rounds of the game, light punishment for non-cooperators and heavy punishment for non-cooperators.

As far as we know, the organization of the games presented in this chapter is unique. Normally, participants in public good games or any other economic game are individuals. In the planning stage of our study, we planned to conduct these games among individuals from different user groups. However, when we visited different villages in these two states to organize these games, community members refused to participate individually in the games, and told us that they would like to participate as a group representing their respective user groups. Based on our discussions with community members, we identified four user groups—rich, poor, landless, and women. Hence, in our public good games, preferences were revealed by a group of people, after discussion and reaching consensus among themselves, representing different forest user groups of a village. In this chapter, therefore, we present the analysis of collective preferences of four user groups and not the preferences of individual members from four user groups.

The theoretical aspects of the JFM and a payoff matrix of the JFM game are presented in [Sect. 2.2](#). The details of the field experimental design are given in [Sect. 2.3](#). [Section 2.4](#) discusses the results of the field experiments. Conclusions and suggestions for management of forest resources are given in [Sect. 2.5](#).

## **2.2 Theoretical Aspects of Joint Forest Management and the Payoff Matrix of the JFM Game**

JFM is forest management in which representatives of a government agency (forest managers) reach an agreement with the representatives of local community with respect to the protection and maintenance of a given public forest area. The agreement defines the rights and duties of both the players (the government and the local community). Generally, the local community receives: (1) a fixed share of the net value of the timber harvest at the end of a rotation period; (2) the right to collect all non-nationalized non-timber forest products (NTFPs) (such as fuelwood, fodder, edible berries and plants, wild mushrooms, medicinal and herbal plants); (3) government wages for community labor towards the protection and maintenance of the forest resource. The local community has a duty to practise self-restraint, to avoid illegal harvesting of timber and over-exploitation of non-timber resources, and to keep a watch on the forest to protect it from outsiders. In case of a community's non-compliance of its duties, such as illegal harvesting, the government collects fines from the community members that are caught.

In addition, the government receives the remaining share of the net value of timber harvest at the end of the rotation period and an annual return from nationalized NTFPs.

Although the representatives of the community may sign the agreement and decide to cooperate as a group with government officials for preserving and proper management of forest resources, individual members of the community may refuse to cooperate depending on preferences that may be influenced by their economic conditions, social status, and dependence on forests. Therefore, in the JFM, community members can be either cooperators or defectors. In addition, some community members also take the role of enforcers. The payoffs of these three categories of members are different as explained next.

**Cooperators:** These are the people in the community who abide by the JFM agreement and do not resort to practices that are illegal under the JFM agreement. In turn, they get a share from the final timber harvest in addition to a proportional share from all the non-timber forest products.

**Defectors:** These are the people in the community who do not abide by the JFM agreement and resort to illegal removal of forest products that is not allowed under the agreement. On being caught, they are not given any share from the final timber harvest, but they cannot be excluded from community development activities because these activities are of public nature. Since collection of non-nationalized non-timber forest products is allowed under the agreement, they collect those products as would any other member of the community.

**Enforcers:** These are the people, authorized by the forest protection committee (FPC), who act as watchmen and are responsible for the enforcement of the JFM agreement. They are paid wages for their work. Therefore, enforcers are the people in the community who abide by the agreement and are also responsible for enforcing the provisions of the agreement on the community by sanctioning the defectors. Each enforcer receives the same payoff as a cooperator. In addition, enforcers get a reward from the share of fines collected from the defectors, however, enforcers have to bear a cost for sanctioning the defectors.

Suppose  $R_i$  is the annual payoff (net of labor cost) from illegal removals of forest products from forests,  $R_f$  is the annual fine (value of forest products and punishment for theft) paid by an illegal harvester if he is caught, and  $p$  is the probability of being caught by a forest manager, which is normally very small. The net annual payoff of a person who removes illegal forest products from the resource is  $(R_i - pR_f)$ . Further suppose  $R_t$  is the total annual payoff (an annual equivalent) from the final timber harvest,  $R_n$  is the total annual payoff obtained from non-timber forest products,  $R_w$  is the payoff of the enforcer from annual wages for protection and maintenance of the resource,  $R_r$  is the annual payoff of the enforcer from rewards, and  $R_c$  is the annual cost of the enforcer in sanctioning the defectors. The annual cost of the enforcer consists of two components—annual fixed costs ( $F_c$ ) incurred by the enforcer, whether he sanctions a defector or not, and variable costs ( $V_c$ ) per unit catch for extra time spent on catching and sanctioning a defector. Suppose  $s$  is the share of the community from the final timber harvest, a part of this share,  $s_1$ , is used for providing common infrastructural and

other community development facilities to the community and the rest,  $s_2$ , is equally distributed among the cooperators and enforcers. The annual payoff of each type of agent is given by

$$\text{Payoff of a cooperator, } \pi_{c_i} = \frac{s_2 R_t}{(s_c + s_e)n} + \frac{R_n}{n} \quad (2.1)$$

$$\text{Payoff of a defector, } \pi_{d_i} = \frac{R_n}{n} + (R_i - pR_f) \quad (2.2)$$

$$\text{Payoff of an enforcer, } \pi_{e_i} = \pi_{c_i} + \frac{R_f s_d}{s_e} - \left( F_c + \frac{V_c s_d}{s_e} \right) + R_w \quad (2.3)$$

Where,  $\frac{R_f s_d}{s_e} = R_r$  is the share of reward of each enforcer.

Shahi and Kant (2007) formulated an n-person asymmetric game using these payoffs, and used the concepts of evolutionary stable strategies and asymptotically stable states to analyze the variations in the JFM outcomes. However, one of the limitations of these payoff structures is that an individual's payoff is treated as the function of his/her efforts only. In the case of common pool resources, such as forests, the payoff from illegal felling of the defector ( $R_i$ ) depends not only on the extraction effort of the defector but also on the extraction efforts of other defectors. The individual's payoff from a forest is increasing with one's effort of extraction of forest products, but decreasing with the aggregate extraction efforts of others. Hence, player i's payoff from illegal felling,  $R_i$  can be expressed as:

$$R_i = \left( ax_i - \frac{1}{2} bx_i^2 \right) + K \sum (x_{\max} - x_{\text{others}}) \quad (2.4)$$

where a, b, and K are strictly positive and depend on the type of forest resource.  $x_i$  is the effort exerted by an individual to illegally remove forest products,  $x_{\max}$  is the maximum effort exerted by an individual and  $x_{\text{others}}$  is the effort exerted by all other players for illegal removal of forest products. The concavity of the function indicates diminishing marginal private returns to effort exerted in illegally removing forest products.

The main objective of this study was to understand the preferences of different user groups, so we incorporated only cooperators and defectors in our game and ignored enforcers. The game was designed to be played among five players (user groups) and each player can choose an effort level of 0–5. The players who choose 0 effort are cooperators as they do not apply any effort in illegally extracting forest products. The players who choose effort levels 1–5 (5 is the maximum effort) are defectors. We used the following parameter values to match the scale of payoffs from forests in the communities where we conducted these experiments:  $a = 60$ ,  $b = 5$ , and  $K = 20$ . The payoff matrix used in our study is given in Appendix Table A.1. In each round of the game, the payoff to each player depends on his own extraction effort and the extraction effort of other players in the game. This payoff is obtained by looking at the effort level in columns and the sum of all other

players' effort levels in rows in the payoff matrix. The Nash equilibrium in this game is the effort level 5 by each player, which is obtained as the best response to the choice of all other players. However, the social optimum is obtained if all the players apply an effort 0, as it gives the maximum payoff to each one. The socially optimum payoff is, therefore, different from the Nash equilibrium payoff. It may not be realistically possible for the community members to apply 0 efforts, as these communities are dependent on forest resources for their subsistence needs. It is, therefore, necessary to find out the conditions under which the community members apply the least effort in exploiting the public forest resource.

## 2.3 Field Experimental Design

The JFM program is implemented by constituting Forest Protection Committees (FPC) for the management of different forests, normally located within the physical boundaries of a village. At the time of study, there were 1,734 FPCs in 26 districts of Gujarat and 914 FPCs in 12 districts of Himachal Pradesh (Govt. of India, Govt. of India (2005)). We randomly selected three districts in Gujarat (Sabarkantha, Dahod, and Vadodra) and two districts in Himachal Pradesh (Shimla, and Mandi), where the JFM program has been implemented. In Gujarat, we selected 8 FPCs/district and in Himachal Pradesh 7 FPCs/district. Hence, field experiments were conducted in 24 villages of Gujarat and 14 villages of Himachal Pradesh. The game players were grouped in three resource and economic categories—rich (annual income more than Rs. 50,000), poor (annual income more than Rs. 25,000 but less than Rs. 50,000), and landless (annual income less than Rs. 25,000 and does not own any land in the village). The fourth user group consisted of women because women have the responsibility of fuelwood and other non-timber forest products collection in a household. Since, the game was designed for five players, we created the fifth group with mixed representation for the purpose of conducting the experiments, but we ignored the data from this group from our analysis. As stated earlier, the games were played by groups and not individuals. In the game, every village was represented by only one group each of rich, poor, landless, women, and mixed. Hence, the game was played by five groups in each village.

First, the game was played for the no communication situation. In this case, each player (group) allocated an effort in extracting forest products from the forest resource. The decision was made privately by the group, i.e., it was not told to the rest of the groups during or after the session. Once the groups made their decisions and wrote on the game form, they handed this to the game organizer, who added the total group efforts, which he announced publicly. Knowing this total, each group was able to calculate its payoff. Each individual group recorded its payoff for each round in the decision form. The game was repeated for three rounds. Second, the players (groups) were allowed to have face-to-face communication with the other groups before they took a decision in each round for the next 3 rounds.

Third, the organizer announced that each player (group) exerting an effort from 1 to 5 would be liable for light punishment. The punishments were a reduction in the payoff of the player by 10, 15, 20, 25, and 30 units for exerting an effort level of 1–5 respectively. The game was played with the light punishment possibility for 3 rounds. In real life, all illegal harvesters are not caught and punished, and therefore to catch the real life situation it was announced at the beginning of the game that in each round only one or two players (using the effort levels from 1 to 5) would be punished. These players were selected randomly. Finally, the game was repeated for 3 rounds with heavy punishment, which was also assigned at random, similar to the light punishment rounds. Under the heavy punishment, the payoff of each player was reduced by double the amount for each effort from 1 to 5.

## 2.4 Results of Field Experiments

The results of the field experiments confirm our original intuition that different forest user groups may have different preferences with respect to cooperation in forest management, and even the preferences of the same user group (rich, poor, landless, and women) may vary across communities. Some of these groups may have SR preferences while others may have OR preferences. ANOVA analysis of the data confirmed that the effort levels vary significantly from village to village and from treatment to treatment, and within a village the effort levels significantly vary among user groups and among treatments. Next, we present the analysis of our results in terms of the preferences of the four user groups and average effort levels applied by the four user groups.

### 2.4.1 *Preference of the Four User Groups*

The results of the field experiments for four treatments (no communication, communication, light punishment, and heavy punishment) are given in Table 2.1. In our analysis, a player means one user group from one community. Under the no communication treatment, the majority of players (user groups from different communities) used the effort levels ranging from 1 to 4 in both states, Gujarat and Himachal Pradesh. A small percentage of players in both states used zero effort level indicating their OR preferences; similarly, some players also expressed their SR (effort level 5) preferences. In Gujarat, the percentage of players with SR references was quite high among the poor (36 %), women (38 %), and landless (27 %) while among rich it was only 18 %. However, the percentage of players with SR preferences as compared to OR preference was higher among all four user groups in both states, but this difference was smaller in Himachal Pradesh than Gujarat. Communication had a very clear effect in both states: it increased the percentage of players with OR preferences, as compared to the situation of no



**Table 2.1** User groups preference distribution expressed in percentage of players for the treatments of no communication, communication, light punishment and heavy punishment

State	Effort	Rich	Poor	Landless	Women
<i>No communication</i>					
Gujarat	0	15	8	7	8
	1–4	67	56	66	54
	5	18	36	27	38
Himachal Pradesh	0	9	3	12	0
	1–4	76	85	73	82
	5	15	12	15	18
<i>With communication</i>					
Gujarat	0	25	27	21	14
	1–4	50	46	44	62
	5	25	27	35	24
Himachal Pradesh	0	9	12	12	12
	1–4	88	79	79	85
	5	3	9	9	3
<i>Light punishment</i>					
Gujarat	0	59	54	27	53
	1–4	36	31	44	35
	5	5	15	29	12
Himachal Pradesh	0	22	11	25	19
	1–4	70	86	58	67
	5	8	3	17	14
<i>Heavy punishment</i>					
Gujarat	0	73	74	72	77
	1–4	22	15	20	16
	5	5	11	8	7
Himachal Pradesh	0	31	39	28	58
	14	43	55	55	39
	5	6	6	17	3

communication in both states for all the four categories—rich, poor, landless, and women. With respect to SR preferences, communication decreased the percentage of players in all four categories of user groups in Himachal Pradesh, but in Gujarat it had mixed effects.

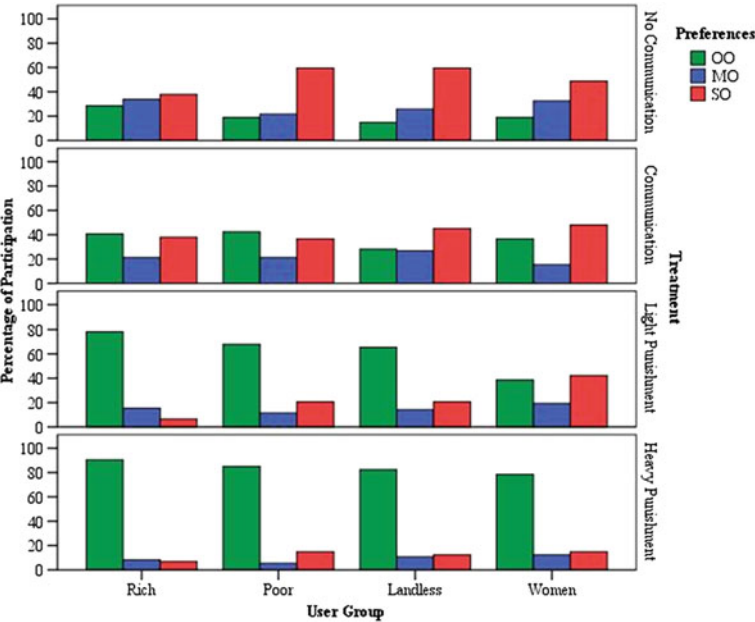
The results of punishment clearly indicate that all four user groups care about punishment but the impacts of punishment are not even across the four categories of user groups. In the state of Gujarat, under light punishment conditions, the majority of the players expressed OR preferences; 59 % of rich, 54 % of poor, and 53 % of women user groups expressed OR preferences, and only in the landless category was the percentage of the players having SR preferences higher than the players having OR preferences. In the case of Himachal Pradesh also, light punishment increased the percentage of the players expressing OR preferences as compared to the case of no communication among all four categories of user groups, but this increase was not as large in Gujarat. Heavy punishment also had a

greater impact in Gujarat than Himachal Pradesh. Under the heavy punishment treatment in Gujarat, more than 70 % of the players in all four categories of user groups expressed OR preferences, while in Himachal Pradesh, the percentage of players expressing OR preferences were 31 % in rich, 39 % in poor, 28 % in landless, and 38 % in women.

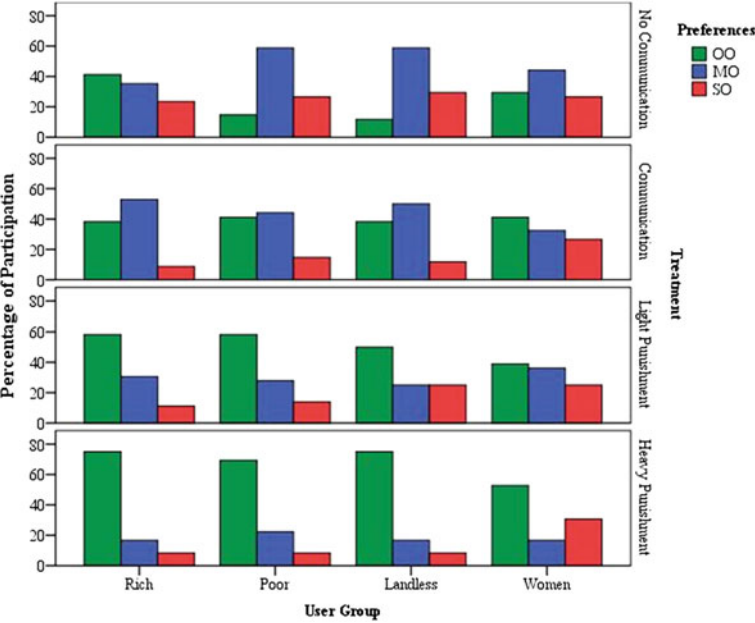
These results confirm that only a small percentage of players has the preferences of an idealized rational economic agent or so called SR preferences. The no communication treatment is representative of neo-classical economic assumptions and under this treatment only 18 % of the rich user groups expressed SR preferences, while this percentage was 36, 27, and 38 % among the poor, landless, and women, respectively. Under this treatment, the percentage of the players using zero effort (OR preferences) was not very high, but a very high proportion of the user groups used effort levels between 1 and 4. In fact, the players using the effort level of 1 were also quite concerned about the welfare of others. Similarly, the players using the effort level of 4 were more concerned about themselves than others. Hence, it may be useful if, instead of focusing only on the effort level of 0, which can be termed as a pure OR preference, and 5, which can be termed as a pure SR preference, we divide the effort levels into three categories: (1) effort levels of 0 and 1, labeled as “other-oriented” (OO) preferences; (2) effort levels of 4 and 5, labeled as “self-oriented” (SO) preferences; and (3) effort levels of 2 and 3, labeled as “mixed-oriented” (MO) preferences—mixed between self and other-oriented preferences. Using these three categories of preferences, preference distributions for four user groups and for four treatments are given in Figs. 2.1 and 2.2 for Gujarat and Himachal Pradesh, respectively.

Figure 2.1 shows that in Gujarat, in the case of no communication, the proportion of players (villages) having SO preferences is greater than the proportion of players having OO preferences as well as from the proportion of players having MO preferences for all four categories of user groups. Communication increases the proportion of players having OO preferences in all four categories of user groups, but in the case of landless and women user groups, the proportion of players having SO preferences is greater than the players having OO preferences. However, the impact of penalties is pronounced. In the case of the rich, poor, and landless user groups, the proportion of players with OO preferences is much higher than the proportion of players with SO preferences even with light punishment; with high punishment the proportion of players with SO preferences becomes very small among these three user groups. In the case of women, the impact of light punishment is not as high as the three other user groups, but heavy punishment has a pronounced impact even in the case of women.

The results from Himachal Pradesh are slightly different than the results from Gujarat. As shown in Fig. 2.2, in the no communication case, the proportion of the players with MO preferences was higher than the proportion of the players with SO preferences for all four user groups, and it was higher than the proportion of the players with OO preferences for all user groups except the user group of rich people. Communication reduced the proportion of the players with SO preferences and increased either the proportion of people with MO preferences (rich user



**Fig. 2.1** Distribution of self-oriented, other-oriented, and mixed-oriented preferences among the four user groups under four treatments for Gujarat



**Fig. 2.2** Distribution of self-oriented, other-oriented, and mixed-oriented preferences among the four user groups under four treatments for Himachal Pradesh

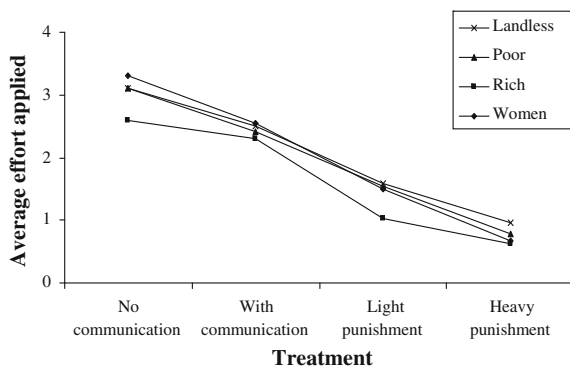
group) or with OO preferences (poor, landless, and women). Light punishment made the proportion of the players with OO preferences higher than the proportion of players with either SO or MO preferences for all the four user groups. Heavy punishment further enhanced the proportion of the players with OO preferences and decreased the proportion of players with MO and SO preferences for all the user groups.

### 2.4.2 Average Effort Levels of the Four User Groups

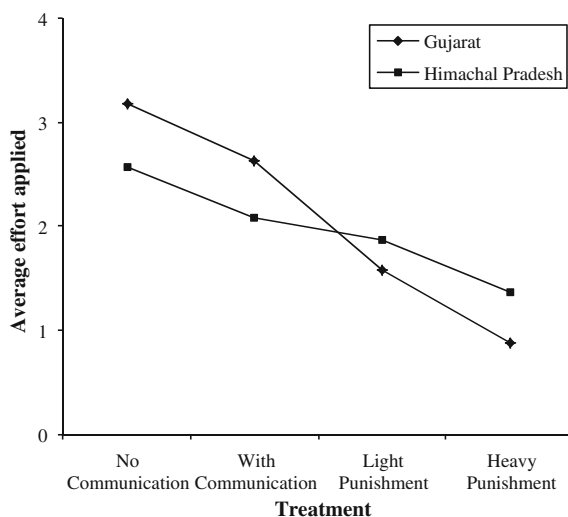
The average effort applied across both states by four user groups for four different treatments are shown in Fig. 2.3. The average effort is the maximum when there is no communication or fear of punishment, but even in this case the average effort applied by the four user groups varies between about 2.5 and 3.5 which is much below the effort that should be applied by the rational economic agent 5. In the case of no communication, more members tend to maximize their own private benefits from the resource without bothering about the negative externality imposed on others. Women, poor, and landless groups apply much higher effort than rich people in extracting forest products from forest resources. This is because women are primarily responsible for collecting fuelwood and some edible non-timber forest products to meet the subsistence needs of the family, and it shows higher dependence of poor and landless people on forest resources as compared to rich people.

The average effort applied by user groups decreases with communication. It was also noticed that the rich user group applied a lower average effort than other groups under the treatment of face-to-face communication. Although women and landless people reduced their efforts with communication, they continued to apply a higher average effort than rich and poor user groups in exploiting forest resources. The treatment of communication is similar to the situation where villagers sit together, form a Village Forest Protection Committee (FPC) and discuss the implications of over exploitation of the common forest resources. Although

**Fig. 2.3** Average effort applied by community members for different treatments



**Fig. 2.4** Interstate comparison of average effort applied by community members for different treatments

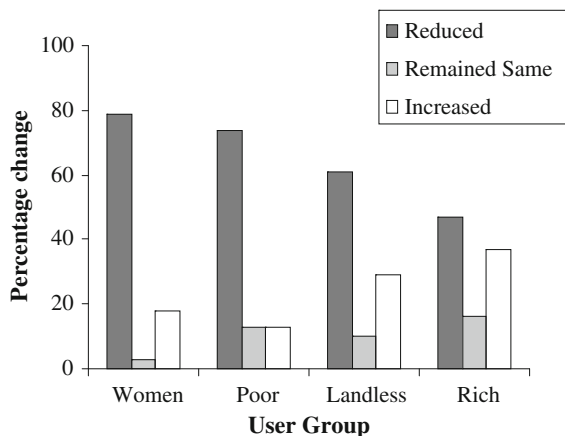


individuals are still tempted to apply higher efforts to over exploitation of the resource, the committee tries to convince them about the long-term implications of their actions. Communication is based on the premise that individuals in a community always have some common shared values and norms. Communication uses these values and norms to establish trust and reciprocity, which are the key triggers of cooperation (Ostrom et al. 1994). The results of our experiment are consistent with most experimental evidence in public good and common property resource (CPR) lab and field experiments (Axelrod 1984; Ostrom 1990, 2000; Ostrom et al. 1994; Molinas 1998; Cardenas 2003).

Figure 2.4 shows a comparison of the interstate average effort. The comparison shows that the average effort applied by user groups in Gujarat is higher than in Himachal Pradesh without and with communication. However, the amount of effort applied by user groups is higher in Himachal Pradesh than Gujarat under the treatments of light and heavy punishment. This indicates that people are more law abiding because of the fear of punishment in Gujarat than Himachal Pradesh. The treatment of light punishment is similar to the situation where the FPC appoints watchmen for the protection and maintenance of the forest resource. The treatment of heavy punishment is similar to the situation where the watchmen are assisted by Forest Guards, who are generally much better equipped and trained to catch defectors. It was observed that all the individuals/groups further reduced their average efforts under these treatments as compared to the treatment of communication, indicating that people cooperate more under threat of punishment.

A comparison of the results of effort applied by different players for treatments of no communication and face-to-face communication between rounds indicates that a higher percentage of people reduced their effort after communication than the percentage of people who increased their effort or who did not change after communication (Fig. 2.5). It was also noticed that women outnumbered all other

**Fig. 2.5** Percentage of players who changed average effort after communication



groups in reducing their effort after communication. They were able to better comprehend the long term consequences of depletion of forest resources and as such applied lower effort in exploiting these resources. These results show that face-to-face communication has a strong impact on mobilizing people to cooperate and preserve the common pool resources.

These results are similar to those of other researchers found in the experimental lab. Ostrom et al. (1994) studied the effects of costly punishment in a repetitive common pool resource game conducted in a lab. The authors found that there were material incentives for cooperation under the treatment of punishment, since the subjects could develop an individual rapport as they interacted repeatedly with the same group. Fehr and Gächter (2000) have shown that in the presence of punishment opportunities, there will be less free riding in the context of a public good experiment. The externally imposed regulation increases the private cost of over extraction and, therefore, reduces the incentives for free riding. However, there is an associated social cost of enforcing such regulations. Therefore, policy makers usually evaluate the capacity of enforcers to enforce the rules to achieve socially optimum behavior.

## 2.5 Conclusions

The results of a public good game, called as the JFM game, organized in 38 villages of Gujarat and Himachal Pradesh, India, were reported and analyzed in this chapter. Members of four user groups, rich, poor, landless, and women, participated in these games, and members of each group expressed their collective preferences of the group, and not their individual preferences. In fact, the insistence by the members of each user group to express the preferences of their

respective groups itself indicated that these members are not rational economic agents. In addition, a consensus-based agreement on a group's preferences by all participating members of each group indicated that the members of all four user groups can develop informal institutions for mutual agreements and collaboration. These two observations from 38 villages of India are contrary to two key foundations of neo-classical economics – the rational economic agent and use of external formal institutions to force collaboration among different people.

The results of the games confirmed that a large percentage of players do not have the preferences of an idealized rational economic agent. In the case of the no communication treatment (a standard assumption of neo-classical economics), in aggregate forest user groups of Gujarat expressed non-self-regarding preferences in 70 % of cases while the user groups of Himachal Pradesh expressed SR preferences in 85 % of cases. These results confirm that there are some user groups with preferences similar to the rational economic agent, but their numbers are small as compared to the user groups with preferences different than the rational economic agent. Similarly, the proportion of the user groups who have pure other-regarding preferences (effort level 0) was also very small—about 10 % in Gujarat and 6 % in Himachal Pradesh. A large percentage of the user groups expressed preferences between the pure SR and pure OR, and this is a very important message to economic theorists and policy makers. Similarly, a substantial difference in the preferences of different user groups is also very important information for developing new economic theories as well as designing resource management policies and strategies.

Our results also supported the intuition that face-to-face communication may lead to a reduction in SR preferences as the percentage of the user groups who reduced their effort levels was much higher than the percentage of the user groups who increased their effort levels after communication. These results support some previous observations that face-to-face communication encourages cooperation among players. In real life, specifically in small places such as these villages in India, most of the people know each other and it is hard to imagine the situation where there is no communication between the different members of a village. Hence, in real life the percentage of the players who have pure SR preferences will be even smaller than the percentage we found in the case of no communication.

Our results for light and heavy punishment are also similar to those of other researchers under lab settings that self-governed solutions can emerge and succeed (Ostrom 2000). Although full cooperation cannot be achieved and maintained under any of the treatments, it is possible to reduce and limit the extraction effort of local communities so as to protect and sustainably manage these forest resources. The results from these experiments also support the idea that the tragedy of commons is not always the most likely outcome when a group has joint access to a resource, but rather that people cooperate in the use of common forest resources if they are ensured their subsistence needs will be met, and then communication and externally imposed regulations play a role to achieve cooperative behavior.

The results also suggest that it may not be possible to achieve a socially optimum extraction effort due to the dependence of community members on these natural resources for their daily subsistence needs. However, it is observed that cooperative behavior evolves under certain institutional conditions, which is better than Nash equilibrium based on self-regarding maximization of payoffs in a non-cooperative game. There is a need to pay careful attention to the role that preferences play in human behavior when designing institutions, and the needs of the individual groups to create trust and reciprocity to reduce the probability of free-riding by others. The government (forest managers) needs to build trust among community members by first ensuring their subsistence needs. This could be done by starting some income generation activities like forming self-help groups of women or providing employment to the landless for protection and maintenance of forests and engaging them in the collection of non-timber forest products so that they can become economically independent. In addition, the policy makers need to tackle defections with a heavy hand by equipping the enforcers better to deal with the defectors.

## Appendix

**Table A.1** Payoff matrix of the JFM game

		My extraction effort					
Their extraction effort		0	1	2	3	4	5
	0	90	89	92	95	97	100
	1	88	87	90	93	95	97
	2	86	85	88	91	93	95
	3	84	83	86	89	91	93
	4	82	81	84	87	89	91
	5	80	79	82	85	87	89
	6	78	77	80	83	85	87
	7	76	75	78	81	83	85
	8	74	73	76	79	81	83
	9	72	71	74	77	79	81
	10	70	69	72	75	77	79
	11	68	67	70	73	75	77
	12	66	65	68	71**	73	75
	13	64	63	66	69	71	73
	14	62	61	64	67	69	71
	15	60	59	62	65	67	69
	16	58	57	60	63	65	67
	17	56	55	58	61	63	65
	18	54	53	56	59	61	63
	19	52	51	54	57	59	61
	20	50	49	52	55	57	59



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