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The Demographics of cooperation: Evidence from a field experiment in the Gori-Ganga Basin[1]

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Abstract

The public goods problem (Hardin, 1968) either viewed as a problem of extraction or that of contribution has had a long history in the Social Sciences. Our experimental design uses a standard Voluntary Contributions Mechanism (VCM) game with a moderately large group of ten and face-to-face communication. The subjects, who are villagers in the Gori-Ganga Basin of the Central Himalayas, are not re-matched every period. Our results are somewhat different from laboratory experiments using a similar design such as Isaac and Walker (1988a, 1988b). A noteworthy general observation is that even with a relatively low Marginal Per Capita Return (MPCR = 0.2) and a large group we find a steady contribution rate around 55 percent which diminishes slightly at the end of the session to around 50 percent. We also delve into the demographic characteristics of our subject pool and find that individual contribution to the common pool is determined by gender, age, caste, literacy and history of cooperation in the experiment. However, face-to-face communication is not seen to increase average individual contribution to the common pool.

Key words: voluntary contributions mechanism, field experiments, gender, caste, minority

JEL: C93; C72, H41; Q23

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1 – Introduction

The public goods problem (Hardin, 1968) either viewed as a problem of extraction or that of contribution has had a long and varied history in Economics and indeed in other social sciences like Anthropology, Sociology and Political Science. Central to these problems is the idea that a good or service that is non-excludable and non-rival in consumption is bound to lead to the problem of over-extraction or under-contribution due to the presence of free riders, who either over extract or under contribute in equilibrium (Ostrom, 1990). The public goods problem may be viewed generally as an N-player Prisoner's Dilemma (NPD) game with one Pareto dominated Nash equilibrium and numerous outcomes that are Pareto superior.

Early studies of the Prisoner's Dilemma with human subjects robustly revealed that people do not defect from the cooperative outcome to the extent predicted in equilibrium and indeed this paradox of rationality has led to there being numerous experimental studies in both economics and psychology that have explored this deviation from Nash equilibrium for this game in a variety of settings (see Lave, 1962 and Andreoni and Miller, 1993). For both the Common Pool Resource (CPR) and Voluntary Contributions Mechanism (VCM) variants of the public goods game, numerous experiments have been published which explore not just contribution/extraction behaviour but also the effect of punishment both non-monetary (Masclet et al 2004) as well as those arising from costly payoff reducing sanctions on contribution behaviour (Fehr and Gachter, 2000, Ostrom et. al., 1992, Falk et. al. 2005). [6] Furthermore, pre-play communications of various types (see Isaac and Walker, 1988; Ostrom et. al., 1992, Bochet et al, 2006, Bochet and Putterman, 2009) have been explored in the literature. The main results from this body of experimental evidence (for the VCM game, which we use in our paper) is the following – contribution behaviour over rounds of a finitely repeated static game starts well above the Nash prediction of zero (depending on the marginal per capita return) dropping somewhat as the game nears the last round. Communication and punishment are both seen to have an impact on augmenting contribution behaviour. Though costly punishment is effective it is seen to be socially wasteful as excessive use (for example spiteful punishments by co-operators towards other co-operators) lowers total surplus. Bochet

[6] See Kim and Walker (1984), Isaac et al (1985) for the earliest experiments of the VCM game. See Ostrom et al (1994) for details on both field and laboratory studies of CPR game.

et al (2006) find that communication (both face-to-face as well as anonymously through a chat room) allows subjects to cooperate efficiently.

The literature on laboratory experiments has some issues that have been largely ignored. For one, most laboratory public goods games use groups that have four or less members. There is very little literature on group sizes larger than four (an exception being Marwell and Ames (1980)). Furthermore, most subject pools consist of American and European college students, whereas a large number of extractors of CPRs and contributors to public goods are individuals who may not have even a high school or college degree, yet make decisions which have great import for their own payoffs as well as those of the community. This relative homogeneity of the subject pool has meant that there is very little exploration of the demographics of contributors versus free riders in most of the well known experimental articles on public goods contribution.

Fortunately Artifactual Field Experiments (field experiments henceforth) give us a chance to study decision makers in the field in controlled situations involving subjects who would be difficult to get to a laboratory in an urban setting. Field Experiments test theories using subjects who are not "sophisticated decision makers" often modifying institutions and/or environments that are more specific to them, rather than an abstract game/decision theoretic one. See Binswanger (1981) for an early field experiment and Harrison and List (2004) for a comprehensive review. This opening up of the subject pool has spawned a small but growing experimental literature on public goods that is concerned with studying the effects of demographic variables like age, gender, education and social status on public goods contribution. Anderson et. al. (2008) investigate whether contributions to a public good in matrilineal societies differs significantly from that in patriarchal societies and find that participants in matrilineal societies contribute more on average. Bouma et. al. (2008) present a Trust Game (an NPD game just like the VCM) experiment combined with a household survey in rural India to explore the interlinkages between social capital, community characteristics, and the provision of a local semi-public good (investments in soil and water conservation maintenance) and find that cooperation in the trust game is positively correlated with community participation in the provision of public goods (only in the case of activities not subsidized by the government) and social homogeneity. Greig and Bohnet (2009) use a one-shot Public Goods game to explore the effect of sex and a group's gender composition on the voluntary provision of public goods in a Nairobi slum. Gender heterogeneity hurts the voluntary provision of public goods because women (but not men) contribute less in mixed-gender than same-gender groups. Women contribute as much as men in same-gender groups. Croson and Shang (2008) use a VCM game to explore the effect of social influence on contribution behaviour. Frey and Meier (2004) use University of Zurich students who contribute to two Social Funds to examine the effect of "pro-social" behaviour on contribution. They find that people are willing to contribute the more others contribute, in accordance with the Theory of Conditional Cooperation (see also Sugden, 1984; Croson, 1998, 2005 and Sobel's [2005] review).

We use a standard VCM game with a moderately large group of ten and face-to-face communication enacted before the first, sixth and eleventh period of fifteen periods. The subjects, who were villagers in the Gori-Ganga Basin of the Central Himalayas, were not re-matched every period. Our experiment provides a simple extension to the basic VCM game (Isaac and Walker, 1988a, 1988b) with a large group size in the field and explores motivations behind contribution that potentially go beyond the standard laboratory setting due to the uniqueness of our subject pool and experimental setting. In doing so, it adds to small but growing literature that takes this abstract game and investigates it with "real" people in "real" settings. On average, aggregate contribution to the common pool does not decrease as sharply as that seen in most laboratory VCM experiments but is comparable to the field results from one of the three societies investigated by Anderson et. al. (2008) and fifteen societies investigated in Henrich et. al. (2005). Demographic variables like age, gender, caste and literacy are all seen to affect individual and therefore group contribution. The next section gives a brief background of the area and population that we have used for our field study. Following this we describe the experimental design and our field setting, followed by the results and our conclusions.

2- Background on the area where the study is conducted

Our population is that of the Gori-Ganga Basin of the Central Himalayas in the state of Uttarakhand, India. The villages used for the experiment lie between 500 and 2500 m above sea level. The number of households in these villages ranged from 11 to 120 with an average 42 families per village. Less than 50 percent of villages are at locations that are remote from the main highway. The vegetation is primarily Sal (Shorea Robusta) dominated up to 900 m and a Chir Pine (Pinus Roxburghii) zone from 900 m to 1800 m. Above that, from 1800 m to 2400 m the main species is Banj Oak (Quercus Leucotrichophora). For more details regarding the economic geography of the Central Himalayas refer to Somanathan (1991). Over 90 percent of the population are farmers cultivating rice, wheat, several kinds of millets and pulses. Most of the crops grown are for subsistence though a small proportion of the cultivated area is used to grow potatoes, a cash crop. The villages typically rear cattle (goats, oxen, buffaloes and cows) for meat, milk and very importantly in this area manure production. As in most such societies, the animals graze in common lands and forests. The average daily wage in the villages of this area is Rs.90 (1.40 Euro) with an in-sample dispersion of [Rs. 70, Rs. 140] and with outside labour opportunities that can pay on average up to Rs. 105 per day.

The forest is managed by *Van Panchayats* (literally, forest councils) which represents one of the most diverse experiments in devolved common property management ever developed in collaboration with the State. In fact they form one of the earliest examples anywhere in the world of decentralized resource management through formal state community partnerships. It is important to note that forests managed by the Van Panchayats are considered by local villagers to be collective property in a real sense. *Panchayat* or Council members are elected by a show of hands in front of a government official once every five years. The forests maintained by these councils are not completely immune from misuse and their condition varies from poor to very good. However the forests in the communities studied here are (as well as in Baland et. al. 2008) in averagely in better shape than in other areas of the Central Himalayas. The conservation of forests as public goods is important especially for communities living in remote areas of the Central Himalayas as they provide them with livelihoods that would otherwise be impossible. Furthermore, in this environment of subsistence, collective action in various activities like labour exchange in agriculture, construction and social functions (such as marriages and illness in the community) as well as the provision of local public goods such as construction and repair of roads, ropeway trolleys, bridges and schools becomes essential to the survival of these communities. Even though collective action is so crucial, the level of efficiency in cooperation is not the same in every village and more details may be found in Chakravarty et al. (2009). However it is undeniable that the population of this area understand and depend on collective action for their survival and in a majority of productive activities they engage in. This very fact makes this population a good one for our field study.

3 - Field experiment

The experimental setting emulates a situation in which a group/family must make a decision about the contribution in rupees to a common pool, or public good (like a bridge or school construction). The framework is one of the Linear Voluntary Contributions Mechanism

(VCM) game as investigated by Isaac and Walker (1988a, 1988b). The individual's benefit from the public good decreases in one's own contribution to the pool, but increases with aggregate contribution due to an increase of the amount dedicated to the public good. This creates an individual incentive to free ride on one's contribution in equilibrium though the Pareto optimal outcome for each player is to contribute his or her entire endowment.

3.1- The linear VCM game

Following much of the experimental literature on public good experiment, we design a decision making exercise where a group of players invest in a common pool. Individual payoffs depend on the individual's choices and the choices by the rest of the group. Our design is equivalent to a positive group externality case where subtractibility is low and exclusivity is difficult (Ostrom et al 1994).

The endowment of each player in each round is 10 rupees. The total contribution to the pool is multiplied by 2 and divided among the 10 players.[7] Thus each player's payoff at the end of each round is:

$$\Pi = 0.2X + (10\text{-}x) \qquad (1)$$

where X is the total contribution to the pool, and x is the particular player's contribution. This can be re-written as $0.2(y + x) + 10 – x = 0.2y – 0.8x + 10$, where y is the total contribution of all the other players. Thus, in each round, the payoff-maximising action for any player is to choose $x = 0$, and this is true regardless of the contributions of other players. This is the Dominant Strategy Equilibrium (DSE) and results in a payoff of 10 rupees per round to each player. The total payoff per round is obtained by summing equation (1) over all 10 players, which is equivalent to multiplying by 10 to get $2X + 100 – X = X + 100$. So total payoffs to players are maximized when $x = 10$ for every player, which is at the other extreme from the DSE. Then $X = 100$ so each player earns 20 rupees per round. Actual payouts may be considerably less than this because subjects will free-ride to some extent.

Note that if everyone contributes everything (the efficient outcome), then players make a total of 20 x 15 = 300 rupees each from the game with 15 rounds of play. The theoretical maximum earning in any round for a player arises when everyone else contributes 10 each, and he contributes 0. This gives a payoff of (90 x 2)/10 + 10 = 28. The theoretical minimum

[7] One real-world analogy to this game is one of contributing to the (forest council) van panchayat watchman's salary, where the players are households. The idea is that the van panchayat is guarded more effectively when the watchman gets paid more, and this may be worth (to the villagers) double the cost of contributions in payoff terms.

earning arises when a player contributes 10 and everyone else contributes nothing. Then the player gets 2 rupees in that round.

3.2. Experiments, participants and field setting

In our decision-making exercise, the public good (the common pool) was described to the subjects in an example as a fund that could be used for the construction of a common property resource like a bridge or school construction[9]. In order to make the decision non-hypothetical, the subjects were informed at the beginning of the session they would be paid anonymously an amount in cash according to their decisions and the decisions of the others.

The sessions involved groups of ten subjects which is a larger group than those considered in standard VCM experiments.[10] The subjects participated in a series of rounds, in each of which they chose their individual contributions to the public good. A total of 390 subjects from 20 different villages[11] in the Kumaon region of Central Himalayas were recruited for this experiment. An interesting contribution of our experiment to the literature on public goods games is the fact that many of the villages where we ran our experiment were small enough that our cohort sizes were between 15 and 25 percent of the population of the villages. Thus our results capture the attitude of the population towards cooperation in a way that no laboratory experiment (most of which use very small samples of specific populations, like college students) could do. On a related point, our subjects were livelihood earners with a spread in ages that is much wider than most experimental studies in the literature. This makes our results far more relevant than those done with a small sampling of college age adolescents between the ages of 18 and 25. Table 1 below indicates the demographic spread of our sample.

[9] The context of the public good depended on the existing cooperative systems of the villages.

[10] The usual group size in public goods experiments such as Cason et al. (2002), Fehr and Gachter (2000), Isaac and Walker (1988b) and Bochet et al (2006) is usually two or four. We felt that a larger group (as in Isaac and Walker (1988a)) parallels the field better than the standard small groups used in the experimental literature.

[11] Except in one village, we recruited two groups of ten people in each village.

Occupation	No. of experimental observations	No. of individuals	% of Total
Farmer	4875	325	83.33
Non farmer	975	65	16.67
Total	**5850**	**390**	
Literacy			
Illiterate	345	23	7.19
Literate	4455	297	92.81
Total	**4800**	**320**	
Caste			
Upper caste	4095	273	70.00
Schedule caste	930	62	15.90
Schedule tribe	810	54	13.85
OBC	15	1	0.26
Total	**5850**	**390**	
Income			
Poor	315	21	5.83
Lower-middle	15	1	0.28
Middle	3885	259	71.94
Upper-middle	15	1	0.28
Rich	1170	78	21.67
Total	**5400**	**360**	
Gender			
male	4065	271	69.49
female	1785	119	30.51
Total	**5850**	**390**	

Table 1: Demographic classification of our experimental sample

Before running experiments in each village, we made sure that information regarding the experiment was not revealed to the potential participants.[12] They were merely told a day in advance that a "survey" would be conducted in their village. In every village, one session comprised two separate groups[13] of ten players. Before an experimenter explained the general instructions, we made sure that every participant was older than 18, and that only one member per family and per group participated. We also encouraged illiterate people to participate[14]. We then assigned ID numbers in the experiment by conducting a lottery with 10 blue coins and 10 red coins, on each of which was written an identification number (from 1 to 10). A colour corresponded to a group in the experiment to which the participants were randomly allocated. If more than 20 villagers stayed and wanted to participate in the experiment, we added black

[12] For instance, if two villages were nearby in the valley, we run sequentially the experiments in the same day. Each village was selected in order to avoid this communication problem.
[13] No interaction was possible between the two groups during all the experiment.
[14] During the decision making process monitors were available to help illiterate people to write on their payment card. It was also a good way to recruit women.

coins without ID numbers to the lottery. The people that drew these black coins were politely informed that they would not be able to participate. The game instructions were read aloud to all the participants. We controlled the subjects' understanding of the instructions by administering a questionnaire with the answers to this questionnaire checked by an experimenter before the start of the experiment (see the instructions in Appendix). Subjects sat individually and randomly according to their identification number in a circle with enough space so they would not be aware of another subject's decision. Except when communication was allowed, subjects always had their backs turned to the centre of the circle.

We use a partner design that has the same cohort interacting repeatedly for 15 periods. In each period, players made a decision to contribute as many rupees (whole numbers only) as he/she wanted from her 10 rupees endowment to the common pool. Subjects knew from the instructions that for each rupee they place in their *private account* they would receive 1 rupee. For each rupee they placed in the *group account* all members of the group, including themselves would receive 0.2 rupee each; in other words, the total contribution to the group account is multiplied by 2 and divided among the 10 players.[15] Before periods 1, 6 and 11, the ten participants were allowed to communicate for five minutes. A table of possible gains in rupees according to their own contribution in rupees to the group account (x) and according to the total contribution of the group to this account (X) was made available for each subject. During the 15 periods, they wrote down anonymously (subjects were identified through an identification number) their own contribution to the group account for each game (the payment card is shown in the appendix). Once the 10 players of each group made their decision, they handed their decision slip to the experimenter. The aggregate contribution to the pool and the individual's payoff were then calculated.

A session lasted approximately 3 hours. The average gain for a player during an entire session of 15 rounds equalled the value of 2.5 days of work, i.e. 250 rupees. Thus the payment was high (with respect to their regular income) in comparison to most previous laboratory public goods experiments and it is safe to say that for most subjects the reward was substantial enough to overcome decision costs they may have incurred. Finally, they filled out an exit survey questionnaire on demographic data. We present the main experimental results in the following subsection.

[15] This is referred to in the experimental literature as the Marginal Per Capita Return (MPCR).

3-3 Experimental results

3-3-1 Aggregate observations

According to the literature on VCM, contributing to the group account constitutes a voluntary provision of a public good. It is well known that the individual's average contribution, while initially positive, decreases with repeated opportunities to contribute (Isaac et al. 1985, Isaac and Walker, 1988a). However a higher Marginal per Capita Return (MPCR) favours cooperation compared to low MPCR. Other additional instruments promote cooperation, such as communication (Isaac and Walker 1988b), punishment (Fehr and Gachter, 2000), or the size of groups (Isaac et al 1994, Isaac et al 1988a).

<u>Observation 1:</u> The aggregate contribution to the common pool is decreasing somewhat over time.

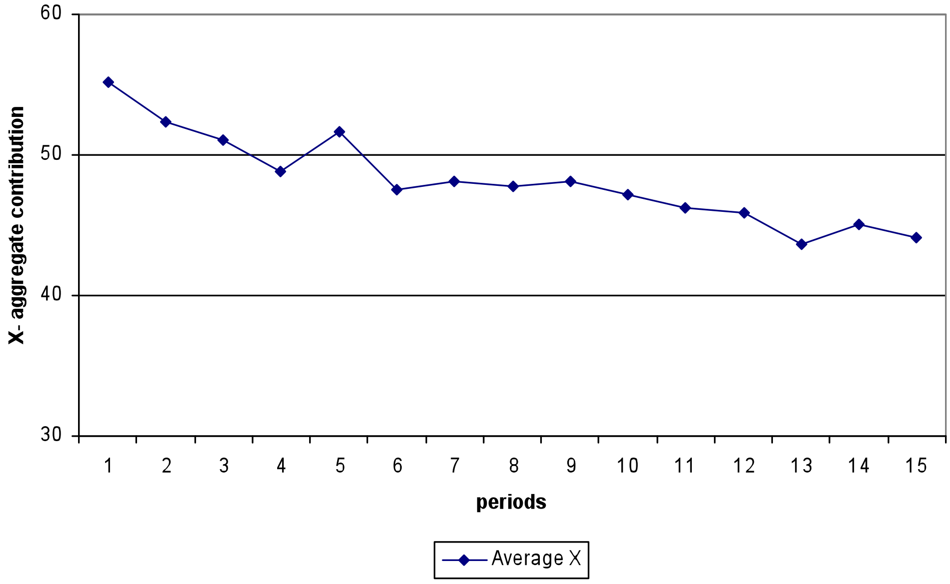

Figure 1: Aggregate contribution to the common pool over periods

Overall the average of aggregate contribution, i.e. the sum of individual's investment, is equal to X=48.17 (i.e. 48.2% of total possible contribution). Thus less than half of the total endowment is invested in the common pool. Andersen et al. (2008) also study in the field the behaviour of different societies in the North Eastern Himalayas (India) with a VCM framework. In their study, the Assamese Hindu society, which is the society closest to the dominant religious sub-group in our sample, the average contribution as a percentage of the optimum is similar to our result and equal to 53.3%. The slightly higher contribution rate for Andersen et al. (2008) may be due to a higher MPCR of 0.5 in their experiment as compared to 0.2 for our study. Greig and Bohnet (2009) focus on gendered behaviour in the field with experiments in a Nairobi slum (Kenya). They find in mixed groups (male/female, like in our experiment) a lower aggregate contribution to the public good (27.6%) with relatively high MPCR (=0.5).

From period 1 to 15 there is a total decrease of 20% of the aggregate amount invested in the common pool (X= 55.15 at period 1, and X= 44.10 at period 15, see Figure 1). This is a slight decrease of aggregate contribution over period compared to Isaac et al. 1988b results who find a decrease of 50% between period 1 and 10 (see Figure 2).

The communication rounds do not augment aggregate investment. In fact there is an increase just before the second communication round and a small decrease (of 8%) right after when participants have communicated (Figure 1). This decrease in contribution after a communication round is consistent with Isaac and Walker (1988b) results who find that face-to-face communication in a larger group (8 participants) does not reduce the incidence of free riding behaviour. However this result is contradictory with Bochet et al (2006) where they find higher contribution in communication treatments with smaller groups (4 participants). The lack of efficacy of communication in our setting may be due to the small marginal per capita return (MPCR) of the public good in our experiment (0.2 as opposed to 0.4 for Bochet et al (2006)) and the larger size of the group. This increase in free riding behaviour due to a small marginal return on the public good is documented in Isaac and Walker (1988a). In conclusion, our study obtains a relatively high level of individual contribution which is quite stable over periods, in comparison to most studies in the literature with similar group size/MPCR.

Figure 2 compares our results with some important linear VCM experiments over the last 20 years. Notice that compared to all the studies our contribution levels do not fall as sharply as in other studies. The two most relevant studies to compare our results to are Isaac and Walker (1988a, group size equal to 10, no communication, MPCR equal to 0.3) and Isaac and Walker (1988b, group size equal to 8, face-to-face communication, MPCR equal to 0.3). In both these studies, the average contribution as percent of total possible contribution decreases from 90 percent to 40 percent (1988b), and from 50 percent to 10 percent (1988a) over the experiment. Our subjects start at approximately 50 percent and their contribution decays only by approximately 5 percent over 15 periods. *Thus with a lower MPCR than Isaac and Walker (1988a, 1988b) and a similar group size we get a persistence of cooperation that is not seen in* *their seminal studies*. It may be conjectured that populations like ours that are engaged in collective action in almost every sphere of their economic activity may manage to collectivize more efficiently even in an abstract game settings vis-à-vis laboratory subjects who are primarily wealthy, urban and live in societies where private property and individualism in decision making are normative.

Another interesting point of comparison is between Bochet et al (2006) and our study. Notice that with face-to-face communication and an MPCR = 0.4 they achieve similar consistent cooperation over the whole experiment. Their steady pattern of contribution is similar to ours except that it is almost double the average percentage contribution in our experiments. Thus small group size (4 as compared 10 for our study) and a high MPCR (0.4 as compared to 0.2 in ours) can ensure an almost 100 percent contribution rate provided there is face-to-face pre-play communication.

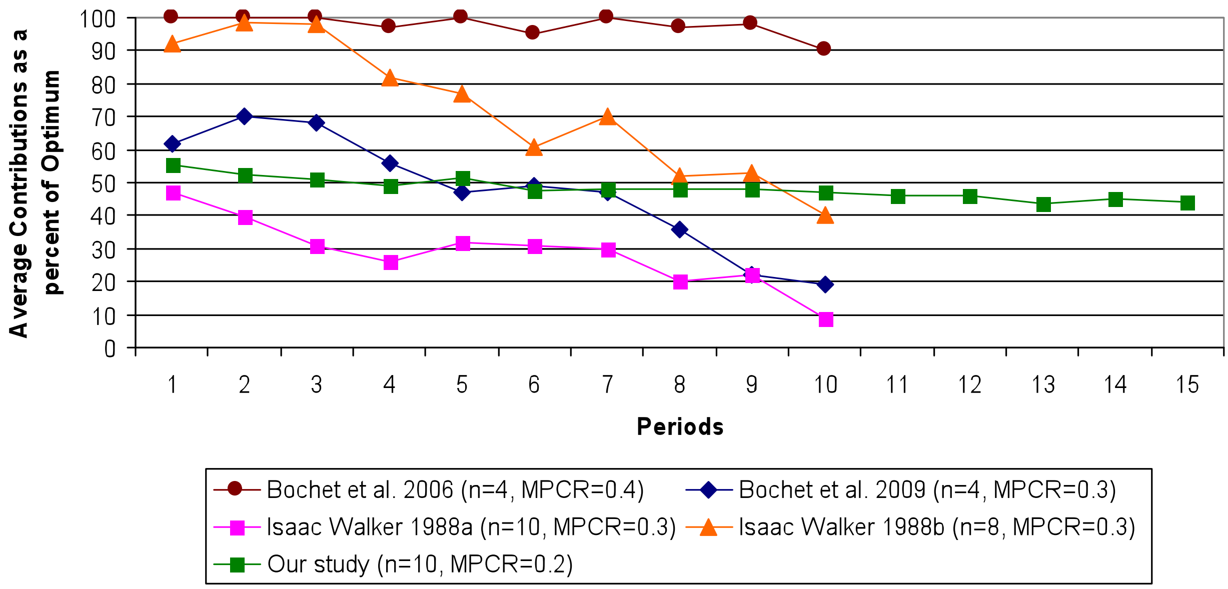

Figure 2: Aggregate % contribution to the common pool over periods in various VCM studies (laboratory) compared to our field study

Observation 2: The number of strong free-riders does not decrease with communication

Like Isaac and Walker (1988b), we find significant levels of free riding (see table 3 and figure 3). And the extent of free riding increases throughout the experiment. This is due to endgame effects of a finitely repeated static game. Indeed, in Figure 3, the number of strong free-riders, i.e. - a participant who invests nothing in the group account (x=0), increases over periods. Communication has a negative effect on contribution since the number of strong free-riders is increasing significantly right after a communication round (see period 6 and 11 in figure 3). This is consistent with Isaac and Walker (1988b).

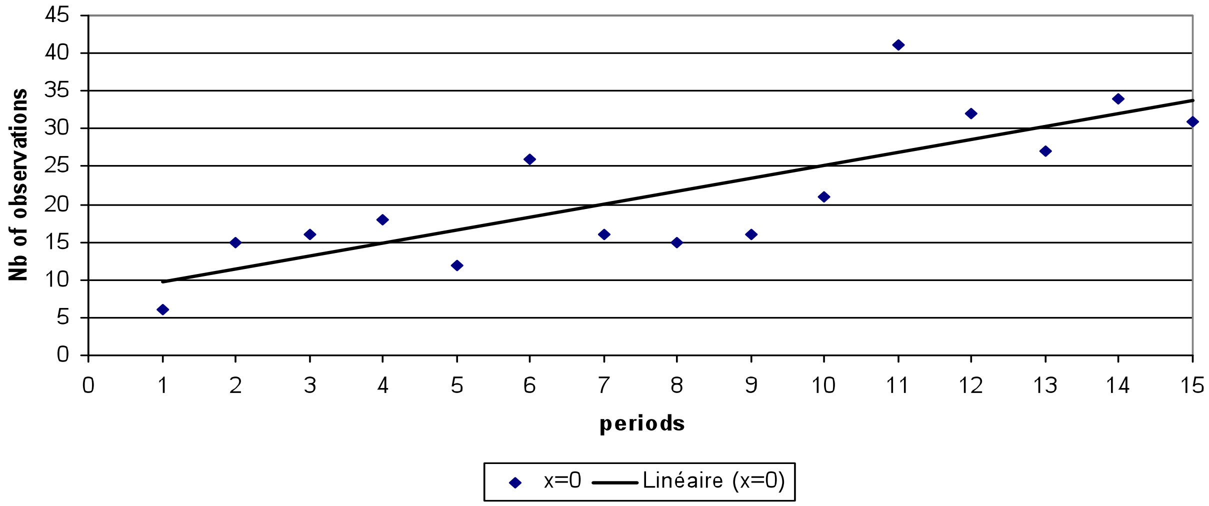

Figure 3: Distribution of strong free-riders (that play x=0) across periods

The results presented above tell us something important – *Though the number of strong free riders increases over the periods, there are contributors who through heightened contribution do not allow the overall size of the common pool to decrease significantly.* This heterogeneity in the subject pool (arising potentially from demographics, environment or social norms) is what we attempt to capture by crossing observed contribution behaviour with demographic data like gender, age, caste, literacy, and income. Table 2 below represents the average investment to the common pool according to demographic characteristics.

Table 2: Mean of individual investment according to demographic classification

Individual investment (x)	**Observations**	**Mean**
Total population	5850	4.82
Age: Age > 50	1110	5.06
Age ≤ 50	4740	4.766
Gender: Male	4065	4.576
Female	1785	5.37
Castes: Upper caste	4095	4.72
Scheduled caste (SC)	930	4.56
Other Backward Caste (OBC)	15	5.67
Schedule tribes (ST)	810	5.59
Occupation: Farmers	4875	4.79
Non-farmers	975	4.92
Literacy: Literate	4455	4.92
Illiterate	345	4.72

Observation 3: Women contribute more to the common pool on average

With a panel comprising 271 males (69.5% of total population) and 119 females (30.5% of total population), we find that males contribute on average significantly less to the pool compared to females (x=4.7 for males vs. x=5.4 for females; Wilcoxon, $p > 0.000$), see Figure 4. This result of less free riding among women is also in agreement with the results in Anderson et al. (2008) who conduct a field experiment involving public goods, in the North Eastern states of India. Greig and Bohnet (2009) find an opposite result: in a mixed group (composed of both males and females), males invest on average 34.1% of the total possible contribution to the pool compared to only 21.16% for female. However, when a group is not mixed (only one gender in one group), female contribution to the public good increases significantly and becomes higher than that of the male group. The fact that in our study women contribute more, could potentially be an effect arising out of minorities being more cooperative (Olson, 1965). A study by Brown-Kruse and Hummels (1993) also reviews earlier experimental studies of NPD games where there is mixed evidence of women being more cooperative though in general it can be concluded from the experimental literature that women are generally more socially minded than men (see Croson and Gneezy, 2004 and Eckel and Grossman, 2008 for comprehensive reviews of gender effects in experimental decision making).

The experiment yields some observations regarding norms related to gender roles and relations that we did not start out intending to study, but are nevertheless interesting enough to list: First, when the participants arrived at the experiment they formed natural gender groupings as it is true for numerous social events in India (though during the experiment they took their decisions seated at spots which were randomized by the experimenters). Second, during the communication rounds, men formed groups which often did not include women but no corresponding significant aggregations of women were observed by the experimenters. Thirdly, it seemed from their communication that some men in the groups urged the women to contribute a larger amount compared to average contributions. The fact that women contribute on average a Rupee more than men may be partially affected by this communication and crucially highlight the fact that earning decisions in families in India are still a male dominated activity, and women who are less individually rational may actually believe the advice given by their male players in their group in what they consider an income generating activity. We find later in this study that even this effect is not homogeneous across demographic groupings related to caste.

Since men free-ride more they earn on average higher profits than women (men's profit=15 per period and women's profit=14.5 per period, Wilcoxon, $p > 0.000$;). Notice that as aggregate investment to the public good decreases, profits are consequently affected and decrease over successive periods (figure 5).

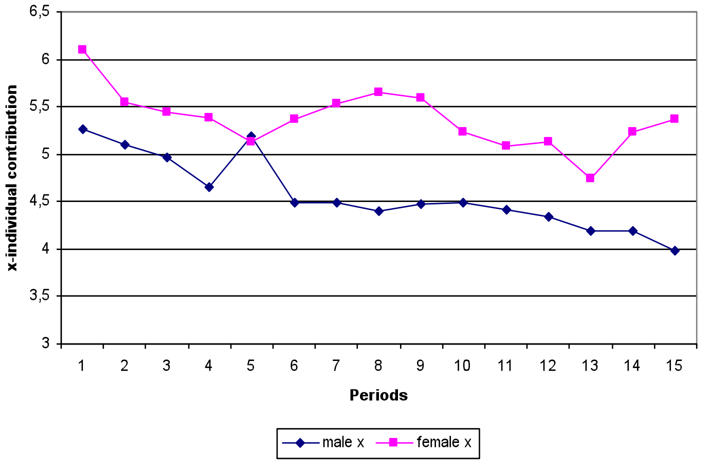

Figure 4: Individual contribution to the common pool by gender

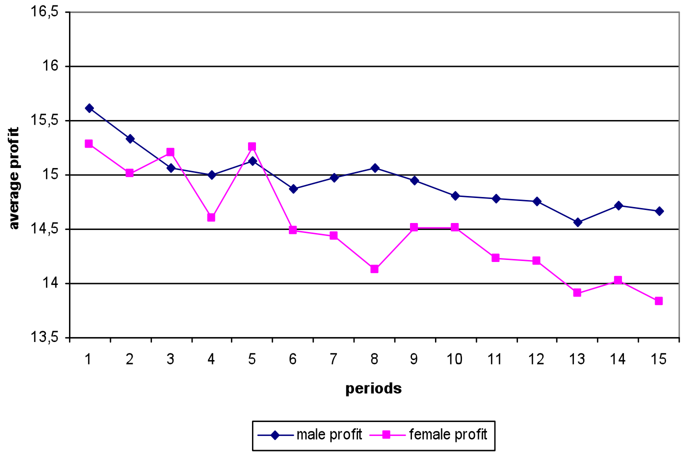

Figure 5: Individual profits by gender

Observation 4: Participants from scheduled tribes (STs) invest more in the common pool compared to upper caste and scheduled caste (SC) participants.

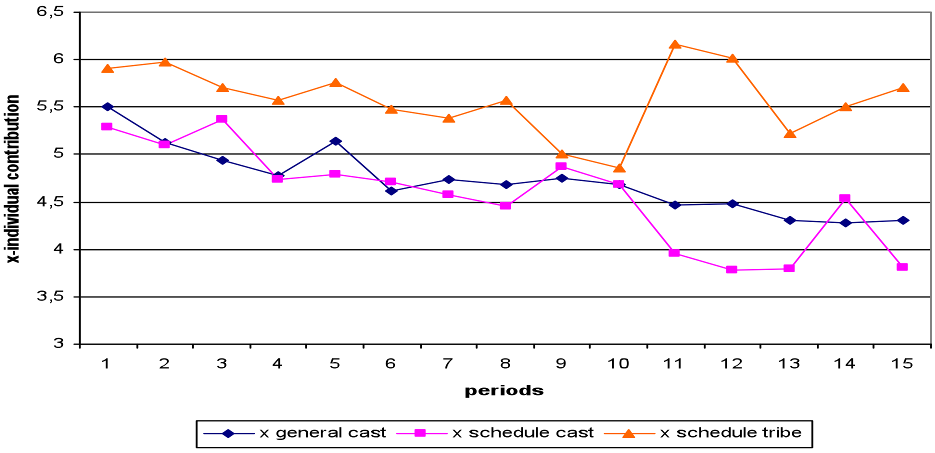

Figure 6: Individual contribution to the pool according to caste over periods

It is clear from figure 6 that participants belonging to the scheduled tribe (ST) category invest more on average in the common pool compared to general caste and schedule caste participants (Wilcoxon, $p > 0.000$; $x = 5.6$ for schedule tribe, $x= 4.7$ for general caste and $x=4.6$ for schedule caste). And on average the schedule tribes earn more than the other castes (Wilcoxon, $p > 0.000$, profit=15.3 for schedule tribe, profit=14.7 for general caste, and profit= 14.8 for schedule caste), see figure 6. It may be that scheduled tribe participants interact more during the communication step and coordinate better than other groups, leading to efficient outcomes.

In general, societies that display higher levels of cooperation are ones which have strong norms regarding formal and informal sanctions against free-riders and non-cooperators (Keefer and Knack, 2008). The reason why tribal communities may succeed better at collective action may also be related to a main argument in Olson (1965) who posits that large groups will face relatively high costs when attempting to organize for collective action while small groups will face relatively low costs. Furthermore, individuals in large groups will gain relatively less per capita of successful collective action; individuals in small groups will gain relatively more per capita through successful collective action. Thus, given that the dominant upper caste mainstream has higher costs as well as lower rewards from collectivization than smaller minority groups (like SCs and STs), one may well see a higher prevalence of free riding among the former vis-à-vis the latter.

An interesting observation from figure 6 is that in the 11th period (after face-to-face communication), the general category participants as well as the SC participants show a decrease in contribution while the ST participants show a sharp increase in contribution, indicating that they may have communicated more effectively than the other participants in the communication round. This behaviour of the non-STs is in agreement with Isaac and Walker (1988a) for their larger group, whereas the STs even in a larger group manage to coordinate better to the efficient outcome.

<u>Observation 5:</u> Cross effects between castes and gender

Figure 7 (below) shows cumulative distribution functions (CDF) of individual investment by a group's gender and caste composition, and Table 3 shows contribution rates by sex and caste. When we look more precisely at the individual contribution to the common pool according to caste and gender, we see a difference between genders in the upper caste: males contribute less compared to women (Wilcoxon, $p > 0.000$, t-test p value = 0.000, $x=4.72$ for male and $x=5.4$ for female). However there is no significant difference in individual contribution between male and female for the schedule castes (Wilcoxon, $p > 0.485$, t-test p value = 0.6452, $x=4.58$ for male and $x=4.47$ for female) and the schedule tribes (Wilcoxon, $p > 0.465$, t-test p value = 0.3938, $x=5.52$ for male and $x=5.7$ for female). Furthermore, the schedule tribe participants (both males and females) behave as women participants from the general caste and the schedule caste participants (both males and females) behave as the men participants from the general caste (see table 4 with the T-tests). In figure 7 notice that the CDFs of scheduled castes, (both male and female) and males from the upper caste are First-

Order Stochastically Dominated (FSD) by the CDFs of the Scheduled tribe (both male and female) and the females of the upper caste.

A conjecture that may explain these facts is that there is a “marginalization effect” which makes contribution to the common pool from marginalized communities (women, SC, ST) higher as well as more equal across genders. Greater gender equality in tribal cultures in India (as compared to the Hindu mainstream) has been documented in Von Furer-Haimendorf (1960, 1983). Furthermore, as stated in the last section, the payoff to cooperation is less costly and more rewarding in smaller communities like SCs and STs (Olson, 1965). Table 3 shows that SCs and STs have more equal contributions across men and women than the general caste participants where there is a significant difference in contribution with men free riding more frequently. The STs who are traditionally more marginalized (due to both poverty as well as their way of life being so divergent from the mainstream population) have higher rates of contribution than both SCs (who are on average more a part of the mainstream than tribal people in India) as well as the dominant upper caste hindu mainstream.

Table 3: Composition of free-riders according to gender and caste

	All population	**Upper caste**	**Schedule tribe**	**Schedule caste**
Aggregate:				
N	390	273	54	62
Male	271	185	34	51
Female	119	88	20	11
Investment (mean)	4.82	4.72	5.59	4.56
Male (mean)	4.57	4.39	5.52	4.58
Female (mean)	5.37	5.40	5.7	4.47
Strong free-riders:				
Total population	5.5%	6.71%	2.71%	3.66%
Male	6.84%	8.54%	3.33%	3.00%
Female	2.68%	2.87%	1.66%	3.03%
Medium free-riders:				
Total population	27.17%	29.33%	18.02%	25.7%
Male	30.18%	33.48%	20%	25.1%
Female	20.33%	20.60%	14.7%	28.5%

Notes: *Investment* denotes money invested in the public good. *Strong free-riders* denotes the share of subject investing zero in the public good. *Medium free-riders* denotes the share of subject investing between zero and two rupees in the public good.

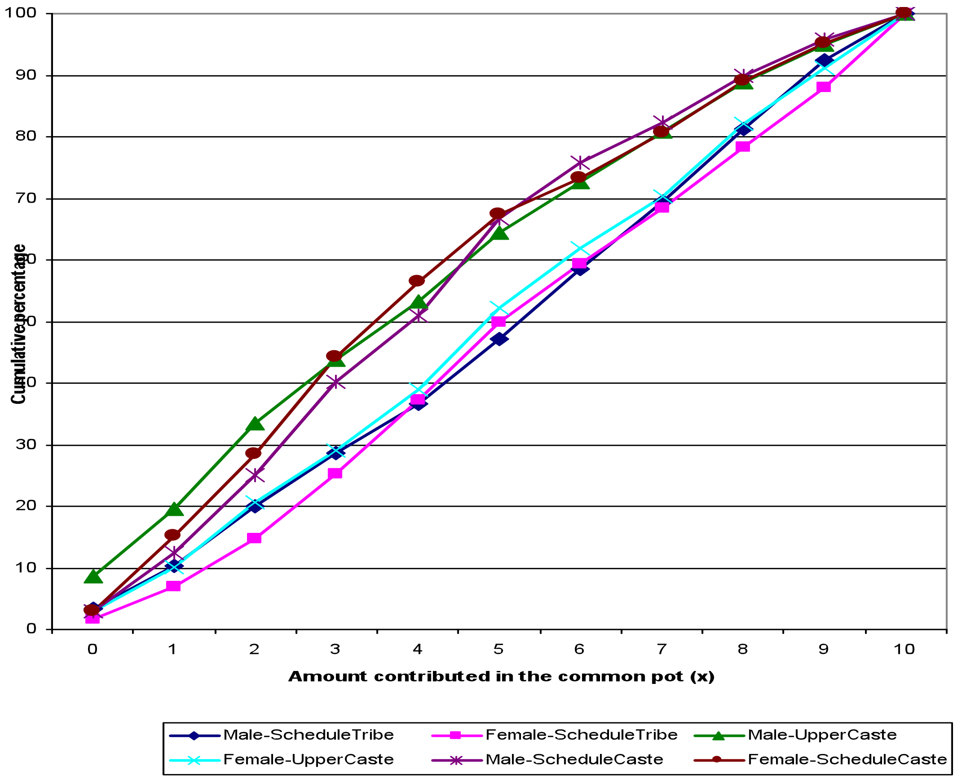

Figure 7: Cumulative distribution of amount contributed by group's sex and caste composition

Andersen et al. (2008) compare individual investment between male and women in different Indian societies. They also find different characteristics according to communities, gender and religions. For instance, there is no big difference between genders in the Assamese Muslim society, where both are strong free-riders (this group is similar to our SC group). In Khasi society (matrilineal and tribal) both men and women free-ride infrequently, and on average contribute the same amount. In the Assamese Hindu society, which is comparable to our general caste sample, males contribute less compared to women. Thus our results parallel Anderson et. al.(2008) closely. Table 4 compares the mean contribution of these demographic groups and presents the probability values corresponding to the t-statistics.

Table 4: T-Tests between caste and gender

T-test (p-values)		Upper caste		Schedule caste		Schedule tribe	
		Male	Female	Male	Female	Male	Female
Upper caste	Male	-					
	Female	0.000	-				
Schedule caste	Male	0.8800	0.0000	-			
	Female	0.7208	0.0001	0.6452	-		
Schedule tribe	Male	0.0000	0.4371	0.0000	0.0000	-	
	Female	0.0000	0.1058	0.0000	0.0000	0.3938	-

Observation 6: ST and women participants contribute more in groups with a higher proportion of their own types.

An interesting question that is related to the analysis of the earlier section is the following – Do ST and women participants contribute more in groups where there is a higher proportion of their own type? Figures 8 and 9 below illustrate the gender/ST breakup of our 39 experimental sessions.

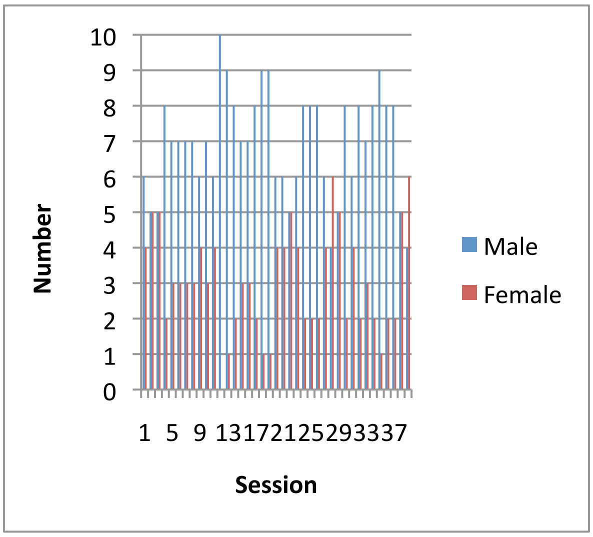

Figure 8: Gender composition of sessions

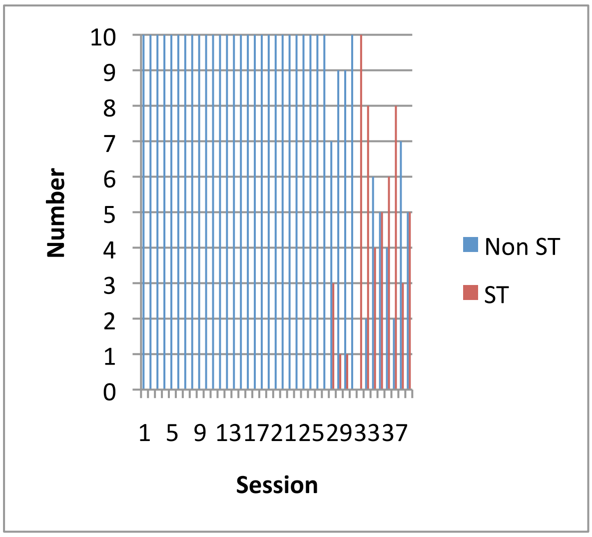

Figure 9: ST/ Non-ST composition of sessions

Notice from the figures that whereas the women are present in all but one session (session 12) out of 39, ST participation is concentrated over only 11 sessions out of the 39. In six out of these 11 (55%), STs comprise half or more of the group strength. On the other hand women constitute half or more of the group in only seven out of 38 sessions (18%) in which women were present. Figure 10 below graphs the time series of contribution of ST participants in groups with a low proportion of STs (less than half) vis-a-vis those in groups with a high proportion of STs (half or more). It is interesting to observe that ST participants in groups with higher proportion of their own type contribute on average Rs. 5.71 and realize higher profits as compared to those that participate in groups with a lower proportion of STs who contribute 5.14 on average per period. Figure 12 graphs the contribution behaviour of non-ST participants in groups with higher and lower proportions of STs. Interestingly we see that the non-ST participants' contribution in high ST groups (per period average is 5.14) also exceeds that in groups with a lower proportion of STs (4.67). Comparing the means of contribution of STs in groups with higher and lower proportions of STs gives us a two sided t-test p-value of 0.017

and a Wilcoxon p-value of 0.02. For non-STs, the t-test p-value is 0.01 and the Wilcoxon p-value is 0.01. In the figures depicting profit (figures 11 and 13), both STs and non-STs made higher profits in groups with a higher proportion of STs. This is understandable as both groups contributed more in sessions with a higher proportion of STs. ST participants make a significantly higher average per period profit of 15.8 in the sessions with a higher proportion of STs as compared to 14.7 for the other sessions (t-test p-value = 0.0007, Wilcoxon p-value = 0.0021). The same pattern is observed for the non-STs, with 15.7 in sessions with a higher proportion of STs as compared 14.7 in sessions with a lower proportion of STs (t-test p-value = 0.0000, Wilcoxon p-value = 0.0000).

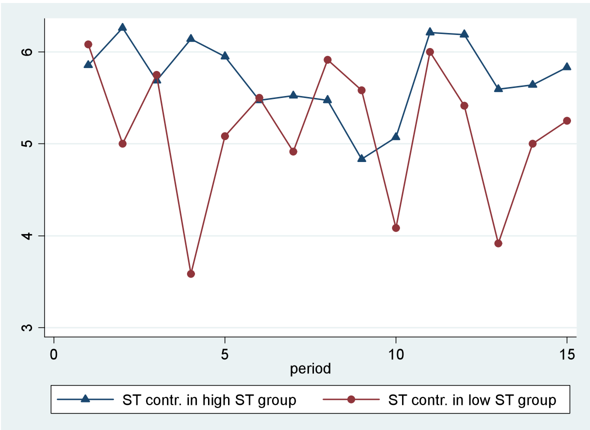

Figure 10: ST contr. in high and low proportion groups

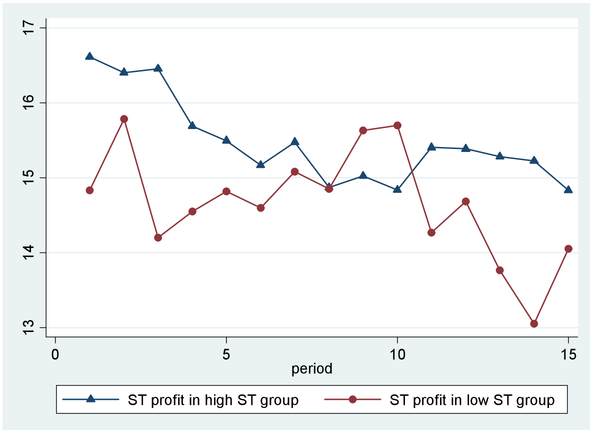

Figure 11: ST profit in high and low proportion groups

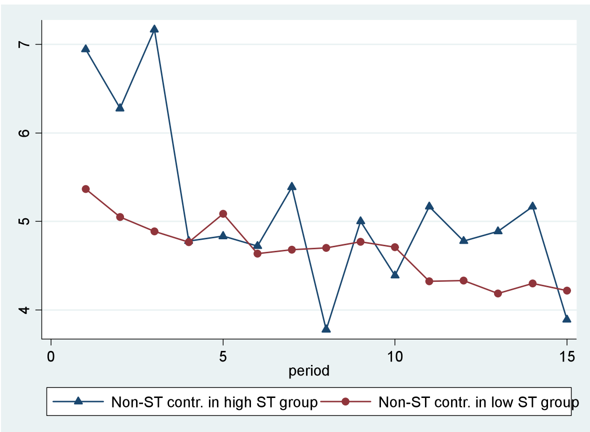

Figure 12: Non-ST contr. in high and low proportion groups.

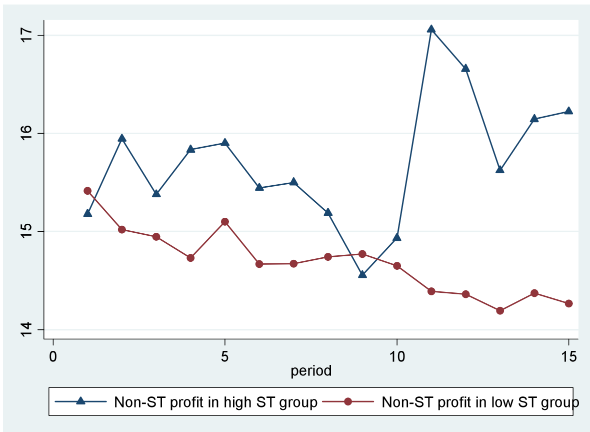

Figure 13: Non- ST profit in high and low proportion groups.

A similar pattern of contribution is seen for women participants. Partitioning our data into sessions with a high (half or more) and low (less than half) proportion of women, a similar analysis to that presented above is given in figures 14-17.

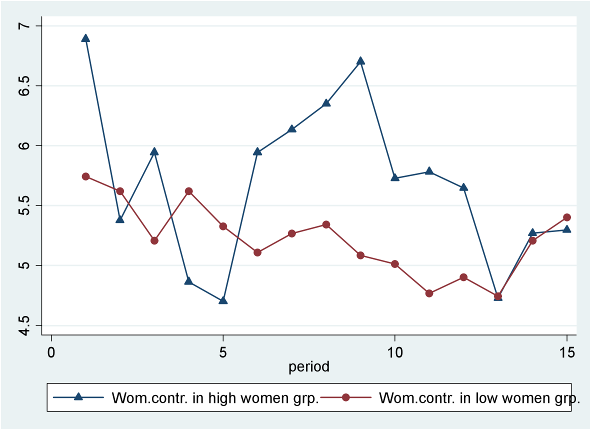

Figure 14: Women's contr. in high and low proportion groups

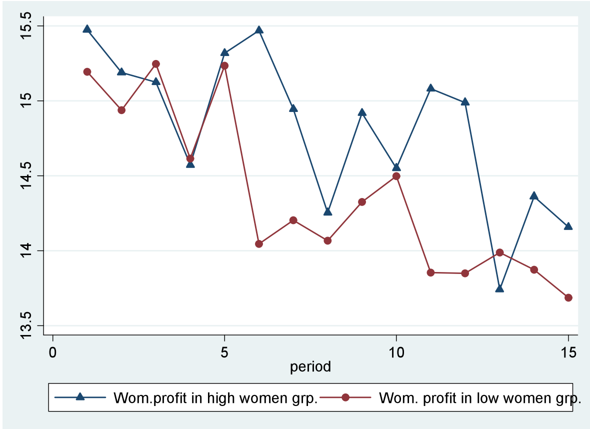

Figure 15: Women's profit in high and low proportion groups

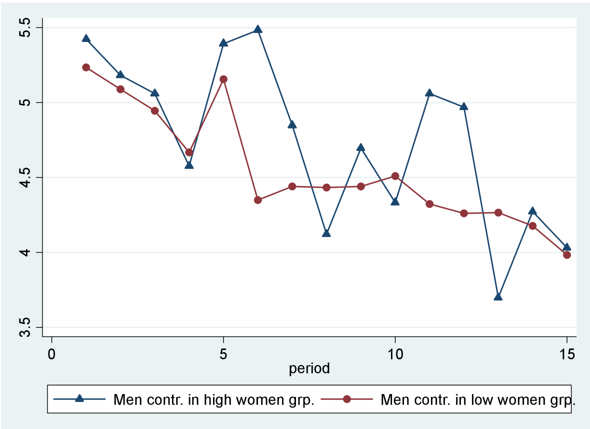

Figure 16: Men's contr. in high and low proportion groups

Figure 17: Men's profit in high and low proportion groups

On average women contributed 5.69 per period when they were in the high proportion groups than in the low proportion groups where they contributed 5.22. This difference is significant using both a t-test (two-sided p-value = 0.0014) as well as a non-parametric Wilcoxon test (two-sided p-value = 0.0017). Men in high proportion of women groups on average contributed 4.74 per period while men in low proportion of women groups contributed 4.55, though the difference is not significant at the 5 percent level (t-test p-value = 0.17 and Wilcoxon p-value = 0.24). The fact that men on average did not contribute substantially more in high proportion of women groups coupled with substantially higher per period contribution of women in the higher proportion groups has led to men making significantly (t-test p-value = 0.004, Wilcoxon p-value = 0.003) higher profits in groups with a majority of women where on average they made 15.7 per period as compared to groups with a lower proportion of women where they made 14.8 per period. Women too made a significantly (t-test p-value = 0.000, Wilcoxon p-value = 0.000) higher profit in groups with a higher proportion of women but the difference between their profits in high proportion groups vis-a-vis lower proportion groups (14.8 and 14.4 respectively) is not as much as for men.

Observation 8: Cooperation increases with age.

The average age of our sample is 36, and the population is quiet well distributed and representative. When look at the table below it's easy to see a positive correlation between age and individual investment. The regression analysis in the next section formalizes this relationship between contribution and age and gives us the marginal increase in contribution with age. It is interesting to note that up to the age of 60 average individual contribution increases and then falls.

Table 5: Average individual contribution to the pot according to age

	x- mean	**No. of observations**
Age<50	4.76	4740
Age>49	5.06	1110
Age<20	4.32	600
19<Age<30	4.67	1575
29<Age<40	4.92	1455
39<Age<50	4 .91	1110
49<Age<60	5.4	645
59<Age<70	4.5	390
69<Age<80	4.65	75

3-3-2 Determinants of contribution

Below we present some regression analysis results in order to more formally establish the observations presented in the earlier section. The regressions employ the OLS technique with clustering on individual subjects to obtain robust standard errors. The variables age, gender, the ST indicators, the indicator variable for literate participants (literate) and the first lags of group contribution (clag1) are all significant at the 1 % level.[16] Women invest more than men, scheduled tribe participants invest more than the scheduled castes and upper caste participants.[17]

[16] We also ran regressions with the lags of individual contribution and found those to be positively and significantly related to individual contribution in the immediate next period at the 1 % level. These are not reported above.

[17] Following up on observation 6, we also ran regressions where we included as a covariate the interaction term between the gender/ST dummy and the proportion of women/ST in a particular session. However the gender/ST

Furthermore, literate participants invest on average Re. 0.60 more than illiterate individuals controlling for other demographic characteristics. However the effect of communication is negligible. In the regressions, the dummies for period 6 (the period immediately following the second round of face-to-face communication after period 5) and period 11 (the period immediately following the second round of face-to-face communication after period 10) are not significant at the 5 % level. The fact that the aggregate contribution in one period makes subjects contribute higher in the next may be driven by the idea of conditional cooperation (or reciprocity), i.e. - a subject contributes more if everyone in the group contributes more, and the group composition is unchanged over the course of the 15 periods. Croson (1998, 2005) uses lagged variables in the same way we do and obtains the same reciprocity result as we do, i.e. – a subject's behaviour in the current period is positively and significantly related to the total contribution by the group in the last period.

Table 6 Determinants of individual contribution

	Estimation 1		**Estimation 2**		**Estimation 3**	
No. of obs.	**390**		**360**		**320**	
R^2	**0.1263**		**0.1352**		**0.1241**	
Variable	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**	**Coefficient**	**(Std. Err.)**
Age	0.015***	(0.005)	0.012**	(0.005)	0.013***	(0.005)
Gender	0.744***	(0.151)	0.656***	(0.151)	0.651***	(0.161)
Schedule caste	-0.005	(0.172)	0.107	(0.180)	-0.06	(0.182)
Schedule tribe	0.458**	(0.182)	0.459**	(0.180)	0.37**	(0.179)
Occupation farmer	0.098	(0.177)	0.097	(0.185)	0.083	(0.165)
Lagged total contribution	0.061***	(0.004)	0.063***	(0.004)	0.06***	(0.004)
Period 6	-0.232*	(0.137)	-0.263*	(0.142)	-0.28*	(0.157)
Period 11	-0.093	(0.159)	-0.191	(0.164)	-0.206	(0.179)
Income level	-	-	0.078	(0.065)	0.054	(0.067)
Literacy	-	-	-	-	0.583**	(0.271)
Constant	0.991***	(0.262)	0.858***	(0.300)	0.547	(0.434)

dummy was highly correlated with this interaction term (the correlation for gender/ST was 0.92, significant at the 1 percent level). The regression with these highly correlated regression terms have not been reported.

4 – Conclusion

We ran a field experiment using a linear VCM and a population comprising villagers from the Gori-Ganga basin in the Kumaon region of Uttaranchal. Our results are somewhat different from laboratory experiments using a similar design such as Isaac and Walker (1988a, 1988b). A noteworthy general observation is that even with a relatively low MPCR and a large group we find a steady contribution rate around 55 percent which diminishes slightly at the end of the session to around 45 percent. We also delve into the demographic characteristics of our subject pool and find interestingly, that individual contribution to the common pool is determined by gender, age, caste, literacy and history of cooperation in the experiment. However, face-to-face communication is not seen to increase average individual contribution to the common pool.

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APPENDIX

A- INSTRUCTION READ TO THE SUBJECTS

We will not allow more than one person from the same household in the same game.

This is an experiment about decision-making. There are other people in this room who are also participating in this experiment. You are available to talk to them or communicate only when experimenters allow you to do so, and only when you are not making decisions. So please stay silent throughout the decision-making process unless otherwise instructed. If you have any questions during the experiment, please raise your hand and an experimenter will come to you.
The experiment will take about ***1*** hour, and at the end you will be paid in private and in cash. Your contributions and earnings will not be revealed by the experimenters to anyone else. The amount of money you will earn depends on the decisions that you and the other participants make.

In this experiment you will perform a decision task 15 times. We refer to each decision task as a game. In each game you will be in a group with *nine* other people. The decisions made by you and the nine other people in your group will determine how much you earn.

In this game, it is intended to simulate a situation in which a group/family must make a decision about the contribution in rupees to a common interest (the construction of bridge—has to find the example according to the survey). In each game you will have 10 rupees which you can place in your private account or in a shared group account (the construction of bridge—have to find the example according to the survey). The other members of your group will also have ten rupees each, and can place them in either their own private accounts or the shared group account. Your earnings depend on how much you place in your private account and the total amount placed in the group account by you and the other group members. You are free to make whatever decisions you like. The game is repeated 15 times, the instruction remains the same, and we will have 10 rupees per period.

For each rupee you place in your *private account* you will receive 1 rupee. For each rupee you place in the *group account* all nine members of the group, including you will receive 0.2 rupee each. The total contribution to the group account is multiplied by 2 and divided among the 10 players. Likewise, if another member of your group places 1 rupee in their own private account, that person will receive 1 rupee, and for each rupee that person places in the group account all nine members of your group will receive 0.2 rupee each.

Suppose for example Person A places 1 rupee in the group account and the other 9 rupees in his or her private account. Suppose also that the other nine group members place a total of 19 rupees in the group account. This means that there are a total of 20 rupees in the group account. Thus, Person A will earn 4 rupees from the group account (20 rupees × 0.2 per rupee) plus 9 rupees from the private account, for a total payoff of 13 rupees. The other nine group members' earnings will be calculated in a similar way.

In order to help your decision making, you will set for each game a table of possible gains according to your own contribution in rupee to the group account (rows of the table) and according to the total contribution of the group to this account (columns of the table). The table indicates the total gain in rupees. During the 15 games, you will have a card with your identification number (from 1 to 10) on which you will write in private your own contribution to the group account for each game. We will keep the same number and the same card during all the experiment, please do not show it to the others. At the end of each game, experimenters will collect cards, will add up contributions and write down the total contribution to the group account and the player's payoff in row of each card. Your final earning will correspond to the sum of the payoffs you earned during the 15 games. The amount of money you will earn depends on the decision that you and the other participants make. You can write on each row for each period a number corresponding to your own contribution of the group account (bridge) from 0 rupee to 10 rupees. For instance, if you put 0 on the card it means you keep all money for you and do not participate to the pool. If you write 8 on the card, you keep for you 2 rupees and invest 8 in the pool. If you put 10 rupees you invest all your money into the group account. So the question is how many rupee are willing to put in the group account?

You are allowed to talk to each other for five minutes prior to game 1, 6 and 11. For instance before game 1, you can discuss the game while sitting in a circle. After five minutes, you sit in a circle facing outwards, far apart so that you cannot see each other's cards, and you write in privacy on your own card in row 1 your contribution to the group account. The experimenter then collects the cards, adds up contributions, writes down the total contribution to the group account and your own payoff in row 1.

The experimenter will then announce the start of game 2. You will write your contribution in row 2, experimenter will collect your card, and so on. At the end of game 5 and 10 you are again allowed to communicate to each other without having your own card present with you.

(ANNOUNCEMENT)To make sure everyone understands how earnings in a game are calculated, we are going to have a short quiz.

QUIZ

At the beginning of each game, I have 10 rupees that I
can put on group account and/or private account. **True**/False

If I place 8 rupees in the group account, I keep 3 rupees in my private account. True /**False**

If I keep 4 rupees in my private account
I put 6 rupees in the group account **True**/False

The total contribution to the group account is multiplied by 5
and divided among the 10 players. True/**False**

I am allowed to speak to the others during all of the experiment. True /**False**

I have to write my contribution to the group account
on a card in private. **True** /False

If each of the ten members place 5 rupees in the group account,
and 5 rupees in the private account then each earn 5 rupees
from private account and 10 rupees from group account,
for a total payoff of 15. **True**/False

I am allowed to show my card to the others during all of the experiment. True /**False**

B- PAYMENT CARD

Village:

Date:

Session:

Ident N°……

Round	My contribution in group account	Total Contribution in group account	My Total payoff
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
			Total payoff to player from 15 rounds

C-EXPERIMENTAL PICTURES

Picture 1: Instructions, natural gender grouping

Picture 2: Individual decision rounds

Pictures 3 and 4: Communication rounds, exclusion of women