The Demographics of Cooperation: Evidence from a Field Experiment in the Gori-Ganga Basin[1]

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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

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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 45 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.

Keywords: voluntary contributions mechanism, field experiments, gender, caste, minority

JEL classification: C93, C72, H41, Q23

1   Introduction

This paper examines the public goods game in a peasant society that is part of a larger market economy. Thus it lies in between industrial societies at one end of a spectrum and small-scale societies with minimal market integration at the other. Public goods experiments with subjects from market societies are part of the staple of the literature in experimental economics[2] while recent work by Henrich et al. (2001, 2005) examines societies at the other end of the spectrum. Thus this paper contributes to the literature on social differences in the propensity to contribute to public goods by examining a society that is part of a larger market economy but is still very much agricultural. In addition, it explores variation in the propensity to contribute by different demographic groups within this society.

The society we study, small village communities in the Gori-Ganga basin of the central Himalayas in northern India, is characterized by small-holder agriculture on privately owned land. However, in certain domains of social interaction, such as management of village forests and pastures, maintenance of local public goods, and informal labor exchanges, there is considerable interdependence and collective action. The society is, therefore, quite representative of the way a large section of

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[2]See Section 4 in Chakravarty et al. (2011) for a detailed survey of laboratory experiments in public goods.

the world's population lives, at least in the developing countries. See Andersen et al. (2008) for a study on a similar population in north-eastern India.

In the linear public goods (voluntary contributions mechanism or VCM) game that dominates the experimental literature (see Isaac and Walker, 1988a, 1988b, for the earliest experiments), it is a dominant strategy to contribute nothing. The main results from this body of experimental evidence are that contributions in a finitely repeated game start well above the Nash prediction of zero and drop significantly as the game nears the last round. Most subject pools consist of college students, whereas a large number of extractors of common pool resources 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. Henrich et al. (2010) discuss the pitfalls of using subjects from what they call WEIRD (Western, Educated, Industrialized, Rich and Democratic) societies.

The modal group size in laboratory experiments is four and the marginal per capita return (MPCR) varies between 0.3 and 0.5.[3] There is very little literature on group sizes larger than four. Exceptions to this are Marwell and Ames (1980) who use a group size of 80 (for some of their data), and Isaac and Walker (1988a, 1988b) who employ treatments that use group sizes of 10 and 8 respectively). Pre-play communication of various types (see Isaac and Walker, 1988b; Ostrom et. al., 1992, Bochet et al, 2006, Bochet and Putterman, 2009) have been explored in the literature. In experiments, communication is seen to have an impact in augmenting contribution behaviour. Bochet et al. (2006) find that communication (both face-to-face as well as anonymously through a chat room) allows subjects to cooperate efficiently.

Artefactual 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

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[3]If the payoff to player i from contributing x_i out of his total endowment e_i is $(e_i - x_i) + (a/n)X$, where X is the sum of all individual contributions and n is the number of players, then the MPCR is defined to be a/n.

theories using subjects who are not "sophisticated decision makers" often using games that are tailored to the local, rather than a completely abstract one.[4] 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.

Andersen 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. Bohnet and Greig (2009) use a VCM 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. Moreover, 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;Croson et al. 2005 and Sobel's (2005) review).

Our experiment provides a simple extension to the basic VCM game (Isaac and Walker, 1988a, 1988b) with a large group size (10)and face-to-face non-enforceable pre-play communication. We felt that a larger group size parallels the field better than the standard small groups used in the experimental literature.In our study, average aggregate contribution to the common pool does not decrease as sharply as that seen in most laboratory experiments. Our study differs from other field experiments such as Andersen et al. (2008), Henrich at al. (2001, 2005) and Bohnet and Greig (2009) in that we have static repetition of the VCM game. Most field experiments on public goods feature a one-shot interaction, which may show the cohort to be more cooperative (as it is typically in the first round of laboratory experiments) than they would be after a few rounds of interaction. This repetition, we feel is very important for subjects in the field, many of who have not gone

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[4] See Binswanger (1981) for an early field experiment and Harrison and List (2004) for a comprehensive review.

through formal education in the same way as urban students in colleges in the developed and developing world.   Another difference with Andersen et al. (2008) and Henrich at al. (2001, 2005) is that we have no sessions that are performed exclusively with one demographic or ethnic group (such as women or tribals) by design. In all sessions, individuals from all demographic classes are randomly recruited to form mixed groups, which is a good reflection of the heterogeneity seen in Indian societies. Of course certain sessions had more of one group than another. These intergroup differences generally reflect the demographic compositions of the specific villages. 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. This is followed by our results and the conclusion section discusses briefly an implication for economic policy that arises out of our experiment.

2   Background on the Area where the Study Is Conducted

Our population is that of the mountainous Gori-Ganga Basin of the Central Himalayas in the state of Uttarakhand, India. The numbers of households in these villages range from 11 to 120 with an average 42 families per village. Somewhat fewer than half of the villages are not connected by road. Over 80 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. Farmers 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 is 90 rupees (~$US 6 at PPP) 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.

Much of the forest is managed by *Van Panchayats* (literally, forest councils), and considered by villagers to be collective property. *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. Collective action in various activities like labour exchange in agriculture, in social functions (such as marriages and illness in the community),and the provision of local public goods such as construction and repair of roads, ropeway trolleys, bridges and schools has an important role in these communities. Even though collective action is prominent, the extent of cooperation varies across villages and activities.[5]

Gender and ethnicity may have a significant bearing on collective action. Women have an important role to play in agriculture and animal husbandry, and labour exchanges related to these activities are mostly between women. Table 1 shows that about 70 percent of the subjects were upper caste Hindus, with the remainder being roughly equally distributed between Scheduled Castes (SC) and Scheduled Tribes (ST). These latter are government classifications and both groups are considered to be disadvantaged minorities. They are eligible for various government development benefits as well as for affirmative action in education and government employment. In this region, the Scheduled Tribes are called Bhotias and are further subdivided into Shaukha and Barpatia Bhotias. The Shaukhas were traditionally engaged in trade with Tibet using pack animals. After the closure of the trade half a century ago, they went into retail trade, government reserved jobs, and other mainly non-agricultural occupations. The Barpatias, on the other hand, are predominantly engaged in agriculture.

3 Experimental Design

The experimental setting emulates a situation in which a group 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

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[5]Details may be found in Chakravarty et al. (2009).

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

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.[6] Thus each player's payoff at the end of each round is:

$$\pi = 0.2X + (10\text{-}x), \tag{1}$$

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.

We use a partner design that has the same cohort interacting repeatedly for 15 periods. In each period, players make a decision to contribute as many rupees (whole numbers only) as he/she wants from her 10 rupee endowment to the common pool. Subjects know from the instructions that for each rupee they place in their *private account* they would receive 1 rupee. For each rupee they place 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 (MPCR = 0.2).In our game, we allowed for face-

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[6]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.

to-face communication enacted before the first, sixth and eleventh period of fifteen periods. The subjects are not re-matched every period.

3.2　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. The subjects were informed at the beginning of the session that they would be paid anonymously an amount in cash according to their decisions and the decisions of the others.

The sessions took place in early 2008, and involved groups of ten subjects. This is a larger group size than those considered in standard VCM experiments.[7] 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[8] in the Gori-Ganga basin of Kumaon, Uttarakhand were recruited for this experiment. Experimental groups were demographically heterogeneous though (for example) certain sessions had significantly more tribal participation than others. This was due to the presence of a large number of individuals from this demographic group at the location of the 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 (14 to 72 years, with a median age of 35 years) that is much wider than most experimental studies in the literature. Table 1 below indicates the demographic spread of our sample. The subject pool is primarily agrarian, literate, middle class and Hindu.

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[7]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.
[8]Except in one village, we recruited two groups of ten people in each village.

Table 1: Demographic Classification of Our Experimental Sample

Occupation	No. of Individuals	% of Total
Farmer	325	83.33
Non Farmer	65	16.67
Total	390	
Literacy		
Illiterate	23	7.19
Literate	297	92.81
Total	320	
Caste		
Uppercaste	273	70.00
Scheduledcaste	62	15.90
Scheduledtribe	54	13.85
OBC	1	0.26
Total	390	
Income		
Poor	21	5.83
Lower-middle	1	0.28
Middle	259	71.94
Upper-middle	1	0.28
Rich	78	21.67
Total	360	
Gender		
Male	271	69.49
Female	119	30.51
Total	390	

Note : Income classes have been constructed from annual income as follows: Poor : less than Rs. 1,00,000, Lower middle : income between Rs. 1,00,000 and Rs. 2,00,000. Middle : income between Rs. 2,00, 000 and Rs. 4,00,000. Upper middle : income between Rs. 4,00,000 and Rs. 5, 00, 000. Rich : Income greater than Rs. 5,00, 000.

In every village, one session comprised two separate groups[9] of ten players. We encouraged illiterate people to participate[10]. We 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

[9]No interaction was possible between the two groups during all the experiment.
[10]During the decision making process monitors were available to help illiterate people to write on their payment card. The presence of monitors from the community was also a good way to get women to participate from the more patriarchal village communities.

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 coins without ID numbers to the lottery. The people who 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.

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 approximately equalled the value of 2.5 days of work, i.e. 225 rupees. The participants filled out an exit survey questionnaire on demographic data. We present the main experimental results in the following subsection.

4　Results

Observation 1: The average contribution to the common pool begins at 55 percent and decreases only slightly over 15 rounds.
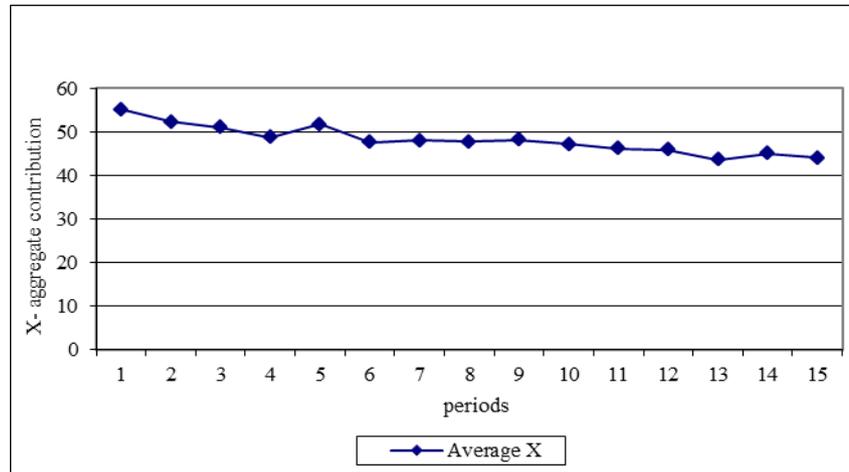
Figure 1: Aggregate Contribution to the Common Pool over Periods

The average (using 39 groups) of aggregate contribution per period, is X=Rs. 48.17 (i.e. 48.2 percent of total possible contribution). Thus a little less than half of the total endowment is invested in the common pool. Andersen et al.(2008) study in the field the behaviour of different peasant societies in the North Eastern Himalayas with a VCM framework. Strictly speaking the averages are not comparable, as their study was a one-shot interaction and not a static game with repetition like ours. However, given that their subject pools like ours are peasant societies from India, we perform comparisons but with a caveat. In their positively framed treatment, Andersen et al. (2008) find that the contributions to the common pool for the Khasi (tribal) and the Assamese Hindu societies are 45 and 53 percent respectively. Bohnet and Greig (2009) focus on gendered behaviour in the field with one shot VCM experiments in a Nairobi (Kenya) slum. They find in mixed groups (male/female, like in our experiment) a lower aggregate contribution to the public good (27.6 percent) with relatively high MPCR (0.5).

From period 1 to 15 there is a total decrease of 20 percent of the aggregate amount invested in the common pool (X= Rs. 55.15 at period 1, and X= Rs. 44.10 at period 15, see Figure 1). This is a slight decrease of aggregate contribution over periods compared to Isaac et al. (1988b) who find a decrease of 50 percent 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 percent) in period 6 right after participants had the opportunity to communicate (Figure 1). This decrease in contribution after a communication round is consistent with Isaac and Walker (1988b) 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 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.[11] Notice that compared to all the studies our contribution levels do not fall as sharply. 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 (Isaac and Walker, 1988b), and from 50 percent to 10 percent (1988a) over the experiment. Our subjects start at approximately 55 percent and their contribution decays only to 44 percent of their endowment approximately 11 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 sustains over 15 periods of static repetition*. 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 setting vis-à-vis laboratory

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[11]Of these, Isaac and Walker (1988a) did not incorporate unenforceable pre-play communication. It has been included for its large group size.

subjects who are primarily wealthy, urban and live in societies where private property and individualism in decision making are normative.
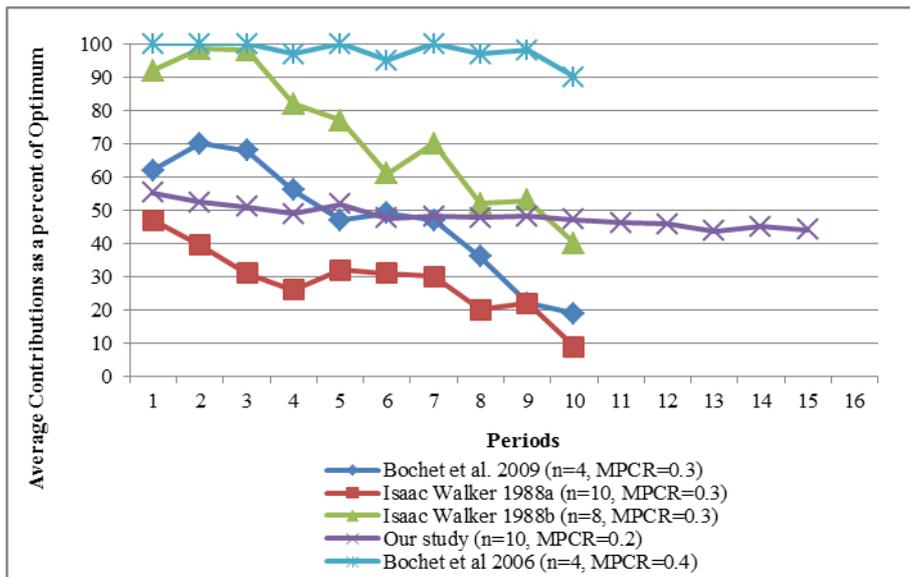

Figure 2: Aggregate % Contribution to the Common Pool over Periods in Various VCM Studies (Laboratory) Compared to Our Field Study

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.

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 (individual contribution 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). Though we did not formally document this, the experimenters noticed a tendency of some(primarily upper caste) men to mislead the group in the communication round by exhorting members to contribute more while they themselves contributed very little in the following rounds. Perhaps the large group size heightens the individual's belief that the group will not be able to coordinate efficiently, and thus promotes self-serving behaviour of this kind. This conjecture may also help explain why Isaac and Walker (1988b) get almost 100 percent average contribution in most periods of the (face to face) communication sessions that involve 4 subjects and an average contribution that decays rapidly from around 100 percent (period 2) to 40 percent (period 10) when they use 8 subjects.
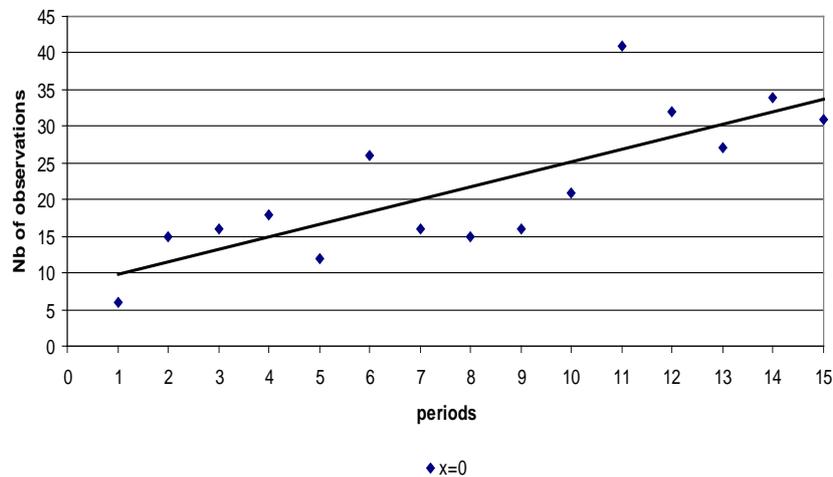

Figure 3: Distribution of Strong Free Riders (that Play x=0) Across Periods

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 3 provides a two-way classification of strong and medium free riders by gender and caste. As discussed in observation 5, there is considerable heterogeneity in behaviour of different caste/gender groupings.

Table 2: Mean of Individual Investment According to Demographic Classification

Demographic Group	Number of Individuals	Mean (x)
Total Population	390	4.82
Age: Age > 50	74	5.06
Age ≤ 50	316	4.77
Gender: Male	271	4.58
Female	119	5.37
Castes: Upper Caste	273	4.72
Scheduled Caste (SC)	62	4.56
Other Backward Caste (OBC)	1	5.67
Scheduled Tribes (ST)	54	5.59
Occupation: Farmers	325	4.79
Non-farmers	65	4.92
Literacy: Literate	297	4.92
Illiterate	23	4.72

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

With a panel comprising 271 males (69.5 percent of total population) and 119 females (30.5 percent 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-value = 0.000), see Figure 4. This result of less free riding among women is also in agreement with the results in Andersen et al. (2008). Bohnet and Greig (2009) find an opposite result: in a mixed group (composed of both males and females), males invest on average 34.1 percent of the total possible contribution to the pool compared to only 21.16 percent for females. 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) reviews earlier experimental studies of (N-player Prisoner's Dilemma or 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).

Our 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 the experimenters observed no corresponding significant aggregations of women. Thirdly, as mentioned in observation 2, some men in the communication rounds 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-value = 0.000). Notice that as aggregate investment to the public good decreases, profits are consequently affected and decrease over successive periods (figure 5).
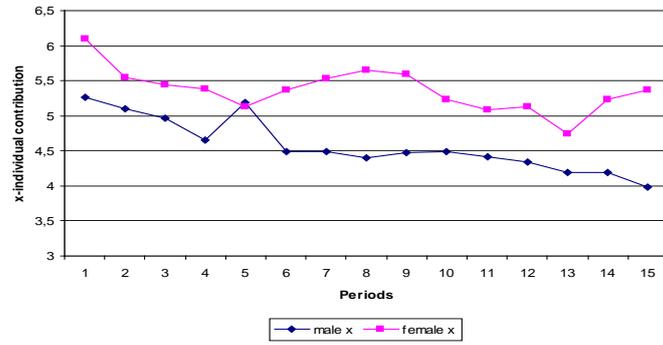
**Figure 4: Individual Contribution by Gender**
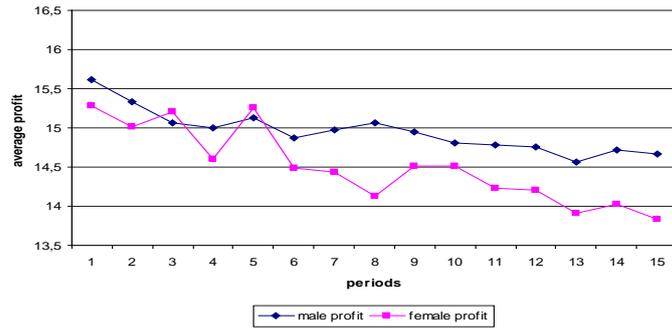
Figure 5: Individual Profits by Gender

Observation 4: Participants from ST invest more in the common pool compared to upper caste and SC participants.
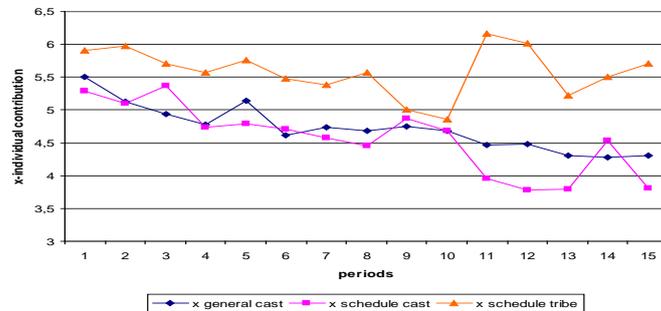

Figure 6: Individual Contribution to the Pool According to Caste over Periods

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It is clear from figure 6 that participants belonging to the ST category invest more on average in the common pool compared to general caste and SC participants (x = 5.6 for ST, x= 4.7 for general caste and x=4.6 for SC, Wilcoxon, p-value = 0.000). On average the STs earn more than the other castes (profit=15.3 for ST, profit=14.7 for general caste, and profit= 14.8 for SC, Wilcoxon, p-value = 0.000). It may be that tribal participants interact more during the communication round and coordinate better than other groups, leading to efficient outcomes. In general, societies that display higher levels of cooperation are ones that have strong norms regarding formal and informal sanctions against free riders and non co-operators (Keefer and Knack, 2005). 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 SC and ST), 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 upper caste participants as well as the SC participants show a decrease in contribution while the ST participants show a sharp increase, indicating that they may have communicated more effectively than the other participants in the communication round.

Table 3: Composition of Free Riders According to Gender and Caste

	All Population	Upper Caste	Scheduled Tribe	Scheduled 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 rider* denotes the share of subjects investing zero in the public good. *Medium free rider* denotes the share of subjects investing between zero and two rupees in the public good.

Observation 5: Cross effects between caste 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 gender 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 (x=4.72 for male and x=5.4 for female, Wilcoxon p-value 0.000, t-test p-value = 0.000). However there is no significant difference in individual contribution between male and female for the SC (x=4.58 for male and x=4.47 for female, Wilcoxon, p-value 0.485, t-test p value 0.6452) and ST (x=5.52 for male and x=5.7 for female, t-test p value = 0.3938, Wilcoxon p-value = 0.465). Furthermore, ST participants (both males and females) display contribution behaviour similar to women participants from the general caste and the SC participants (both males and

females) behave like male participants from the general caste (see table 4 for t-tests). In figure 7 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 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 (in our study the SC and ST communities) 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 (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 contribution across men and women than the general caste participants where there is a significant difference in contribution with men free riding more frequently. The ST who are traditionally more marginalized (due to poverty, geographical isolation, as well as their way of life being so divergent from the mainstream population) have higher rates of contribution than both SC (who are more integrated with the mainstream population) as well as the dominant upper caste Hindus.
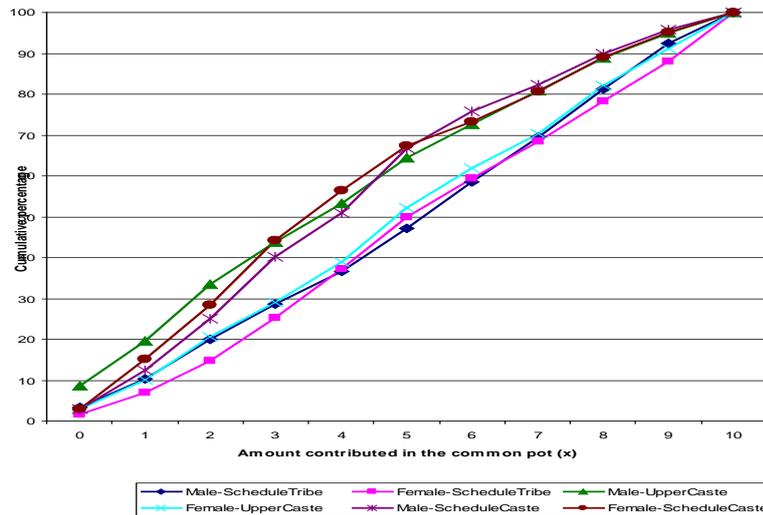

Figure 7: Cumulative Distribution of Amount Contributed by Group's Gender and Caste Composition

Andersen et al. (2008) compare individual investment between male and women in different Indian societies. They too find different characteristics according to communities, gender and religions. For instance, there is an insignificant 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 females. Thus our results parallel Andersen et al. (2008) in an interesting way. [12] 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		Scheduled Caste		Scheduled Tribe	
		Male	Female	Male	Female	Male	Female
Upper Caste	Male	-					
	Female	0.000	-				
Scheduled	Male	0.8800	0.0000	-			
Caste	Female	0.7208	0.0001	0.6452	-		
Scheduled	Male	0.0000	0.4371	0.0000	0.0000	-	
Tribe	Female	0.0000	0.1058	0.0000	0.0000	0.3938	-

<u>Observation 6:</u> 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 female participants contribute more in groups where there is a higher proportion of their own type? This analysis is important as Tables 5 and 6 below illustrate the gender/ST breakup of our 39 experimental sessions.

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[12]However the comparison needs to performed with some caution as Andersen at al. (2008) create demographically constrained groups in their experiment (for example: Muslim and Khasi) by design, whereas our groups are formed by a randomized assignment.

Table 5: Gender Composition of Sessions

Percentage of Women	Number of Sessions
0	1
10	4
20	11
30	8
40	8
50	5
60	2
TOTAL	39

Table 6: ST Composition of Sessions

Percentage of ST	Number of Sessions
0	28
10	2
20	0
30	2
40	1
50	2
60	1
70	0
80	2
90	0
100	1
TOTAL	39

Notice from the tables that whereas 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 percent), 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 percent) in which they were present. Figure 8 below graphs the time series of contribution of ST participants in groups with a low proportion of ST (less than half) vis-à-vis those in groups with a high proportion of

ST (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 ST who contribute 5.14 on average per period. Figure 10 graphs the contribution behaviour of non-ST participants in groups with higher and lower proportions of ST. 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 ST (4.67). Comparing the means of contribution of ST in groups with higher and lower proportions of ST participants gives us a two-tailed t-test p-value of 0.017 and a Wilcoxon p-value of 0.02. *Thus the higher contribution of ST is at least partially driven by higher contributions in groups with more of their type.* For non-ST, the t-test p-value is 0.01 and the Wilcoxon p-value is 0.01. In the figures depicting profit (figures 9 and 11), both ST and non-ST made higher profits in groups with a higher proportion of ST. This is understandable as both groups contributed more in sessions with a higher proportion of ST. ST participants make a significantly higher average per period profit of 15.8 in sessions with a higher proportion of ST 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-ST, with a profit of 15.7 in sessions with a higher proportion of ST as compared to 14.7 in sessions with a lower proportion of ST (t-test p-value = 0.0000, Wilcoxon p-value = 0.0000).
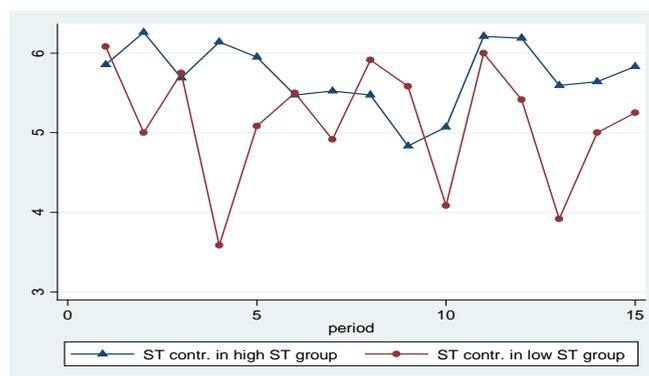

**Figure 8: ST Contr. in High and Low Proportion Groups**
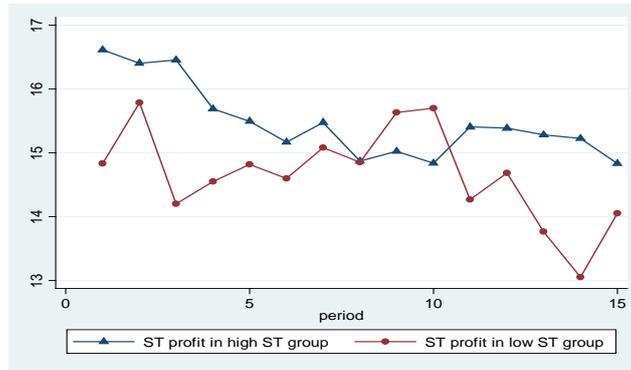
Figure 9: ST Profit in High and Low Proportion Groups
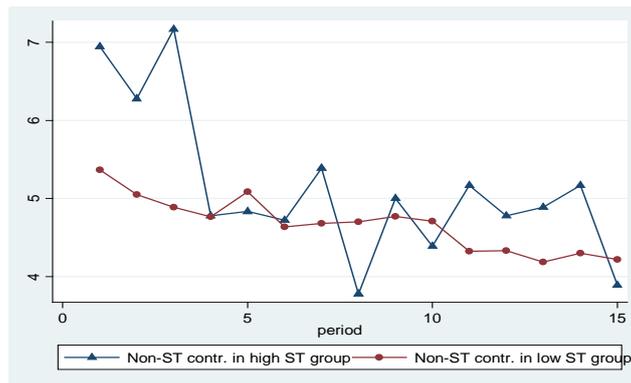
Figure 10: Non-ST Contr. in High and Low Proportion Groups
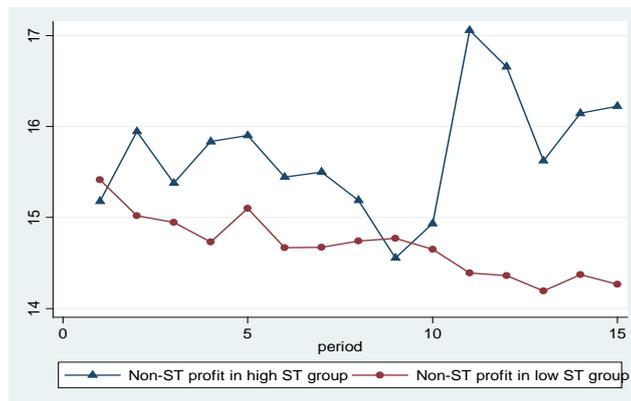
Figure 11: Non-ST Profit in High and Low Proportion Groups

A similar pattern of contribution is seen for female 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 12-15.
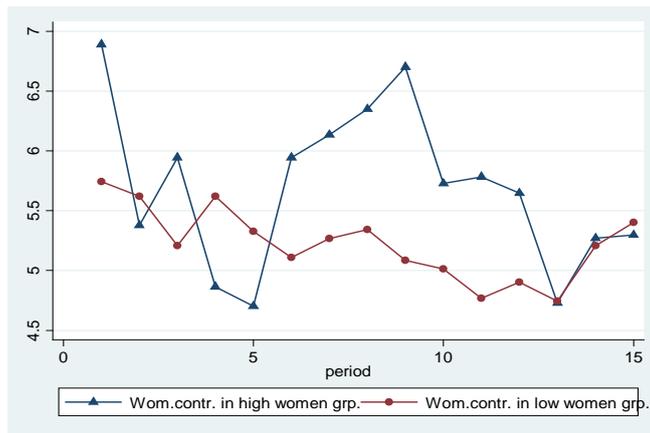
Figure 12: Women's Contr. in High and Low Proportion Groups
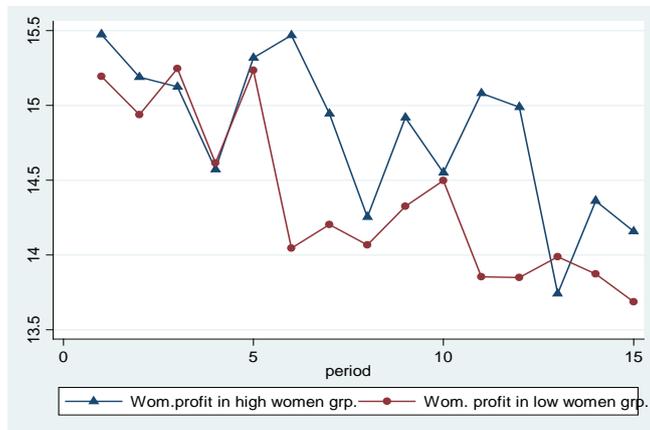
Figure 13: Women's Profit in High and Low Proportion Groups
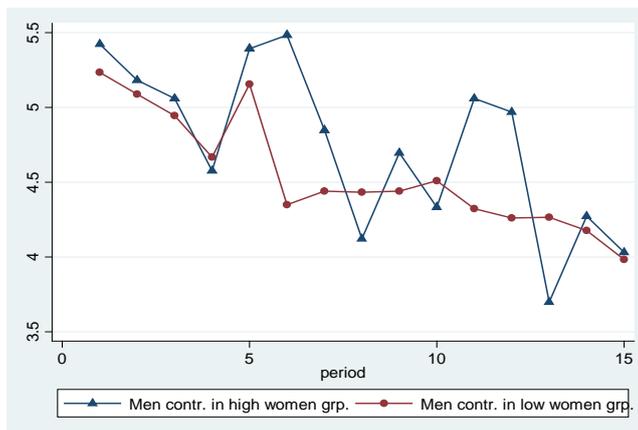
Figure 14: Men's Contr. in High and Low Proportion Groups
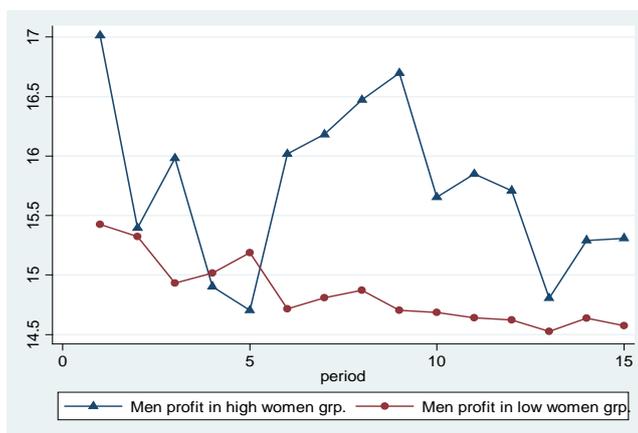
Figure 15: Men's Profit in High and Low Proportion Groups

Similar to what we observe for ST, women on average contribute 5.69 per period when they are in the high proportion groups as compared to a contribution of 5.22 in low proportion groups. This difference is significant using both a t-test (two-tailed p-value = 0.0014) as well as a non-parametric Wilcoxon test (two-tailed 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 significantly (t-test p-value = 0.000, Wilcoxon p-value = 0.000) higher profits in groups with a higher proportion of women but the difference between their profits in high proportion groups vis-à-vis lower proportion groups (14.8 and 14.4 respectively) is not as much as for men. These results are in the same direction as Bohnet and Greig (2009) who find that gender heterogeneity in groups reduces the contribution of women to the public good. An interesting observation from this analysis is that though pro-sociality with one's own demographic type may partially explain the high contribution of women and STs, there is also an intrinsic tendency of these groups to give more to the common pool. This is seen by the fact that women in low proportion groups contribute more (x = 5.22) than men averagely contribute (x= 4.58). The difference is significant using a two-tailed t-test with a p-value of 0.000. Similarly ST in low proportion groups contribute significantly more (x = 5.14) than non-ST averagely contribute (x =4.69).This difference is significant using a one-tailed t-test with a p-value of 0.027.

Observation 7: Cooperation increases with age.

The average age of our sample is 36, and the population looks well distributed and representative. From the table below it is 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. In an earlier study, List (2004) obtains a positive relationship between social preferences and age in field experiments on the linear public goods game and the prisoner's dilemma. It is interesting to note that up to the age of 60 average individual contribution increases and then falls.

Table 7: Average Individual Contribution to the Common Pool According to Age

Age Ranges	No. of Individuals	Mean(x)
Age<50	316	4.76
Age $\geq$ 50	74	5.06
Age<20	40	4.32
[19, 30)	105	4.67
[30, 40)	97	4.92
[40, 50)	74	4.91
[50, 60)	43	5.4
[60, 70)	26	4.5
[70, 80]	5	4.65

4.1 Regression Analysis

We present in table 9 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 and robust standard errors.Clustering procedures allow heteroskedasticity between and within clusters, as well as autocorrelation within clusters. Wooldridge (2003) reviews some issues in the use of clustering for panel effects. Table 8 specifies the variables used in the regression analysis.

Table 8: Description of Variables Used in the Regression Analysis

Variable	Brief Description
Individual Contribution	Dependent: Takes a value between 0 and 10
Age	In years
Female	Takes the value 1 if female, 0 otherwise
Scheduled Caste (SC)	Takes the value 1 if Scheduled Caste (SC), 0 otherwise
Scheduled Tribe (ST)	Takes the value 1 if Scheduled Tribe (ST), 0 otherwise
Farmer	Takes the value 1 if occupation is farming, 0 otherwise
Lagged Total Contribution	Sum of all individual contribution in the last period, varies between 0 and 100.
Period 6	Takes the value 1 for the 6th period, 0 otherwise
Period 11	Takes the value 1 for the 11th period, 0 otherwise
High Income	Takes the value 1 is high (>Rs. 200,000 per annum), 0 otherwise
Literate	Takes the value 1 if literate, 0 otherwise

The regression equation is given as:

Individual Contribution $= \beta_0 + \beta_1$Age $+ \beta_2$Female $+ \beta_3$Scheduled caste $+ \beta_4$Scheduled tribe $+ \beta_5$Farmer $+ \beta_6$Lagged total contribution $+ \beta_7$Period 6 $+ \beta_8$Period 11 $+ \beta_9$ High income $+ \beta_{10}$Literate. $\qquad(2)$

Table 9 shows that the variables age, gender, the ST indicator, the indicator variable for literate participants (literate) and the first lags of average contribution are all significant at the 1 percent level.[13] The adjusted R^2 indicates that the covariates together explain 14 percent of the variation in the dependent variable. Women invest more than men; ST participants invest more than the scheduled castes and upper caste participants.[14] Given that we control for women's investment with the female dummy, the difference in contribution between ST and other participants is driven by the behaviour of men. Age in years though significant at the 5 percent level, leads to only a marginal increase (Rs 0.02) in contribution controlling for other variables. 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 percent level.

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[13]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 percent level. These are not reported above.

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

Table 9: Determinants of Individual Contribution

	Estimation 1		Estimation 2		Estimation 3	
No. of Obs.	390		360		320	
Adjusted R²	0.13		0.14		0.12	
Variable	Coefficient	(Std. Err.)	Coefficient	(Std. Err.)	Coefficient	(Std. Err.)
Age	0.02***	(0.005)	0.01**	(0.005)	0.01***	(0.005)
Female	0.74***	(0.15)	0.65***	(0.15)	0.64***	(0.16)
Scheduled Caste	-0.01	(0.17)	0.09	(0.18)	-0.07	(0.18)
Scheduled Tribe	0.46**	(0.18)	0.44**	(0.18)	0.36**	(0.18)
Farmer	-0.10	(0.18)	-0.06	(0.20)	-0.05	(0.17)
Lagged Total Contribution	0.06***	(0.004)	0.06***	(0.004)	0.06***	(0.004)
Period 6	-0.23*	(0.14)	0.26*	(0.14)	0.28*	(0.16)
Period 11	-0.09	(0.16)	-0.19	(0.16)	-0.21	(0.18)
High Income	-	-	0.19	(0.16)	0.14	(0.16)
Literate	-	-	-	-	0.58**	(0.27)
Constant	1.09***	(0.32)	1.07***	(0.33)	0.71	(0.45)

Note 1: Least squares, robust standard errors clustered by individual. '***', '**', '*' = Significant at the 1, 5, 10 percent respectively.

Note 2: We run three different models, one of which uses all the covariates (Estimation 3). Estimation 2 omits the variable Income and estimation 1 omits Income and Literacy. Since we don't have literacy and income data for some villages, estimation 2 has 450 less observations and estimation 3 has 1050 less observations than estimation 1.

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) and Croson et al. (2005) use lagged total contribution in the same way we do and obtain the same reciprocity result, 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.

5   Conclusion

We run a field experiment using a linear Voluntary Contributions Mechanism (VCM) game with face-to-face communication and a subject pool comprising villagers from the Gori-Ganga basin in the Kumaon region of Uttarakhand in India. Our experiment uses a large group size and static repetition. The former is uncommon among laboratory VCM experiments and the latter is uncommon among field experiments. The pattern of contribution in our study differs somewhat from laboratory experiments using similar designs such as Isaac and Walker (1988b) and Bochet et al. (2006) and Bochet and Putterman (2009). Specifically, even with a relatively low marginal per capita return and a group size of 10, we find an average contribution rate to the common pool that starts around 55 percent which diminishes only slightly at the end of the session to around 45 percent. *Thus our subject pool on average contributes close to half their endowment even in the very last period of a finitely repeated one-shot VCM game.* 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. As we randomize among different demographics we do not create experimental groups that have just women, tribals, educated people or senior citizens. In our mixed demographic groups women on average contribute more to the public good. Scheduled tribe (ST) men contribute more than men from the scheduled caste (SC) and upper caste. Some of this high contribution is driven by women and scheduled tribe participants who contribute significantly higher amounts when they are in groups with more than half of their own type. However even after controlling for group composition we find that these demographic groups contribute higher than average amounts to the public good. Broadly our results parallel those from the peasant societies explored by Andersen et al. (2008) where the higher contribution of Khasi men drives the difference in contribution to the public good between the tribal and the Hindu society. Face-to-face communication is not seen to increase average individual contribution. We conjecture that a high group size and a low marginal return on the public good may make it difficult for subjects to coordinate group contributions to the level of efficiency seen in laboratory studies on the VCM.

Differential rates of contribution among different demographic groups for certain public goods may help develop policies that reflect the development goals that are relevant to these groups. The constitution of India in its 73rd amendment (1992) has allowed for reservation of posts in gram panchayats (village councils) for women, scheduled castes and scheduled tribes in a bid to empower these groups in terms of community decision making. Chattopadhyay and Duflo (2003, 2004) analyse a natural experiment that compares the level of public good provision at the village level in two districts, Rajasthan and West Bengal and find that the level of provision of certain types of public goods was higher in areas where the post of pradhan (head of the council) was reserved. Differential provision arises from the preferences of women or scheduled castes/tribes (SC/ST) that are a higher priority in a reserved gram panchayat.[15] Given that these groups have been traditionally disadvantaged in rural India, reservation could thus help empower them by supplying public goods that are more relevant to their needs. An artefactual game like ours highlights this demographic heterogeneity and subsequent field research could help frame contexts that allow us to study more sharply, the nature and extent of the differential provision of public goods.

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[15]As the Government of India randomly performed the reservation of posts, there were negligible differences between reserved and unreserved gram panchayats on average, using a large sample.

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Appendix

A   Instructions 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 a bridge or a school). 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 or a school). 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   Pictures from the Sessions

Picture 1: Instructions, Natural Gender Grouping

Picture 2: Individual Decision Rounds

Pictures 3 and 4: Communication Rounds, Exclusion of Women