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Can differences in benefits affect group investment into irrigation projects? Experimental Evidence from Northern Ghana

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Abstract

Particularly in sub-Saharan Africa, agriculture is predominantly rain-fed and, therefore, prone to unstable weather conditions and less productive than in other regions of the world. Increasing the efficiency and sustainability of farmer groups and cooperatives is of primary importance to many policy makers in developing countries. Experimental studies have suggested that the privileged person in a group would voluntarily provide the public good in social dilemma situations, while those with lower benefits would free-ride. Using a framed lab-in-the-field experiment complemented by a detailed household survey in rural Ghana, we examine how asymmetries in benefits and real wealth levels impact farmers' behavior and group outcomes. We find that efficiency concerns (i.e. higher group returns) outweigh inequality concerns. Thus, the implication is that higher group benefits and heterogeneous within-group benefits reduce strategic uncertainty and enhance cooperation in agricultural settings of subsistence farmers. Finally, aside from the group-level effects, we show that farmers with smaller potential benefits and those who live in poor households contribute even more than the resource rich. The results indicate that, as much as interventions are aimed at saving the poor, the poor contribute much to save themselves. These results remain robust, controlling for a long list of covariates including socioeconomic characteristics, loss aversion and inequality aversion. The results overall have implications for structuring farmer groups and the provision and maintenance of both public goods and common-pool resources in poor countries.

Keywords: Asymmetric benefits, lab-in-the-field experiments, group financing, farmer cooperatives, development financing, irrigation in Sub-Saharan Africa, Ghana
JEL classification: C93, D31, D63, O13, Q15, Q2

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Introduction

Fostering economic growth and reducing poverty is closely linked to agricultural development in sub-Saharan Africa. There are two growth strategies that are usually adopted to achieve this aim: extensification and/or intensification of agriculture. While the former strategy expands cultivated land, the latter strategy induces a technological transformation to more efficient and effective input practices. The most recent increases in crop production in the region have been due to land expansion (Deininger et al., 2011). However, maintaining this strategy will be difficult to meet the food demands of the ever growing population. Besides increasing agricultural output, solutions have to be climate friendly and sustainable. Irrigation and improved planting methods (proper use of agrochemicals and improved seeds) have been canvassed as a possible coping strategy for climate change and the resultant increase in drought periods (IPCC, 2014). Recent studies have demonstrated the huge impact of access to irrigation on farmers' income, irrespective of crop choice (Chambers, 1976; Karlberg et al., 2015), and directly alleviating poverty (Hussain and Wijerathna, 2004).

Irrigation systems are usually costly and have a complex construction and, therefore, cannot be installed easily by individuals. Farmer groups and cooperatives are often purchasers and users of these systems which have usually been designed and built by construction companies and financed by international donors (see for example in Ghana: GIDA (2015)). These projects interconnect with the debate as to whether agricultural success can be better achieved in the traditional family farm model (subsistence farmers), farmer organizations (cooperatives or farmer groups) or larger farming systems (contract farming) (Pollak, 1985; Barham and Chitemi, 2009; Fischer and Quaim 2014; Collier and Dercon, 2014). This discussion is spurred by collective action theory (Holcombe and Ostrom, 1993; Ostrom and Gardener, 1993; Ostrom, 2002) in agriculture, showing that institutions and groups can be structured in a way which can foster cooperative behavior, and that the cooperative model could indeed be an alternative to private ownership. There is evidence that farmer group participation positively impacts on farmers' agricultural outcomes, for example the self-reported market situation (Barham and Chitemi, 2009; Hellin et al., 2009; Markelova et al., 2009), the price achieved per kilogram of yield, the innovative character of input factors used and planting processes stimulated (Fischer and Qaim, 2014). Little is known so far about how farmer groups should be composed to act most effectively. Fischer and Qaim (2014) provide some evidence towards the attributes that make participation in farmer groups more likely and show that wealth, access to land and credit are important determinates of group participation. But how do

personal traits of farmers, personal expectations, experiences and profit orientation influence farmer group participation, engagement and success?

Evidence from non-agricultural settings has shown that within-group inequality impacts group outcomes and cooperation (Olson, 1965; Sandler 1992; Cardenas, 2003; Glöckner et al., 2011). Evidence from experimental studies suggests that, in a group setting, whenever some individuals have the dominant strategy to contribute, overall contributions to the group are low (Glöckner et al., 2011). Theoretical models based on fairness and reciprocity norms in principle predict such behavior (Knez and Camerer, 1995). The main thrust of the argument is that the asymmetric nature of privileged groups – that is, a group with at least one privileged individual – may cause conflicting perceptions of fairness and reciprocity norms (Knez and Camerer, 1995). Additionally, experimental studies testing the effect of the 'degree of privilege' – marginal per capita rate of return (MPCR) for the privileged of either smaller (weakly dominant) or greater than one (strictly dominant) – on cooperation, find that other group members are less inclined to cooperate if cooperation is strictly dominant for the privileged person (Glöckner et al., 2011).

Our study is one of the first to examine the impact of heterogeneous benefits on farmer group performance in developing countries. From experimental studies on collective action and the literature on the impact of farmer groups on farmers' outcomes, we derive the following research question: How do farmer groups have to be set up to ensure that contributions to the provision of public goods (a natural resource, market access, etc.) are high enough to sustain the system? The paper explores how asymmetries in benefits can impact the likelihood of cooperation with other group members. This hypothesis is tested against the case in which farmers have the same benefits from cooperation.

We contribute to the existing literature in a number of important ways. With regards to endowment heterogeneity, we neglect the effect of endowment on cooperation. A number of studies have shown that endowment differences have little impact on cooperation (Buckley and Croson, 2006; Cardenas, 2003). We examine how heterogeneous benefits impact individuals and group behavior instead of analyzing the impact of individual heterogeneous endowments on the provision of the public good (Buckley and Croson, 2006; Isaac and Walker, 1988; Kachelmeier and Shehata, 1997; Cardenas, 2003). In our case, the potential benefits for individuals in a group are different. While differences in potential benefits stem from a random allocation of land ownership, financial endowment is the same for all individuals.

In addition, this study broadens the scope of research on the impact of asymmetric benefits on behavior because we examine the asymmetric benefits from group cooperation and wealth in a lab-in-the-field setting in sub-Saharan African. The majority of the aforementioned studies, such as the study by Glöckner et al. (2011) and Reuben and Riedl (2011), examine the impact of differential benefits using student subject pools (with the exception of Cardenas, 2003).[1] We enhance these findings and their external validity by examining people outside the university, particularly farmers in an irrigation provision setting. In developing countries and especially in sub-Saharan Africa, group cooperation and group investment is paramount to overcome a number of credit market imperfections preventing the poor (usually farmers) from making large investments on their own. Farmers in rural areas of developing countries are constantly involved in activities that require cooperation and group-investment decisions that impact their daily lives.

To address our research question, we use a threshold public good game. The game and its setting are designed to mimic the situation of farmer groups in an irrigation scheme whereby below a certain threshold (i.e. investments towards irrigation), farmers lose their investment and their produce. In the experimental setting, all participants have the same endowment (i.e. - a value of GHC 5) but are free to decide how much to invest in a group account and how much to keep for themselves knowing very well that other members of the group will benefit more or less. Implicit in our design, the overall group benefits are higher for some groups but inequality within the group is also high whilst for some other groups there is perfect equality and overall group benefits are relatively lower. Making use of participant data collected in a household survey, we further test how personal attitudes and socioeconomic conditions impact individual cooperation decisions in the lab-in-the-field experimental setting.

To the best of our knowledge, we are the first to use a lab-in-the-field experiment to explicitly examine how asymmetries in benefits impact cooperation in farmer groups in a developing country context. The majority of studies that have examined the impact of farmer group structure analyze how the leadership and leadership selection impacts group performance using observational data. The existing literature is constrained in its ability to test other interesting factors that could impact group outcomes. Our approach, however, is very appropriate and unique in terms of using lab-in the-field experiments to complement existing

[1] As argued by List (2011), inviting participants as varied as chief executive officers, farmers, traders and other trading outfits, as well as politicians into the laboratory and augmenting with 'framing' helps to overcome the concerns associated using student subjects.

research on the topic. Furthermore, even though existing studies (such as Glöckner et al., 2011) examine the impact of the 'degree of privilege' (i.e. marginal per capita returns (MPCR) less or greater than one for the privileged person) on cooperation, we are the first to examine the impact of the 'degree of inequality' on cooperative behavior, and particularly the cooperative behavior of the resource poor.

We find that having a privileged member in a group in a developing country context serves as a good coordination device that can help to reduce strategic uncertainty. Specifically, we find that contributions are higher in asymmetric groups compared to groups with similar potential benefits. Beneficiaries with smaller profits in groups with at least one privileged farmer contribute more than beneficiaries in a group without a privileged farmer. This suggests that, contrary to earlier findings, the less privileged who are also poor in profits, nevertheless, also care about their outcomes. Loss aversion additionally explains the farmer's behavior. The results also show that efficiency concerns outweigh inequality concerns.[2] Thus, people are relatively more likely to cooperate when the benefits to the group are high. Interestingly, we find that the poor push more for cooperation. Using the individual external data, we find that personal wealth decreases the propensity to cooperate, confirming earlier results by Cardenas (2003) from villages in Columbia. Lastly, we find in this setting with farmers that the beneficiaries with smaller benefits in extremely unequal groups contribute even more than the beneficiaries with larger profits in the same group. Overall, the implication is that the presence of a 'privileged' person in farmer groups reduces strategic uncertainty and enhances cooperation in rural Africa, where household livelihoods are at stake.

Overall, our study has implications for the design of sustainable group irrigation schemes in developing countries that are usually expensive. The results show that in designing and sustaining irrigation schemes in developing countries, it may be necessary to have high potential beneficiaries in groups. A proper understanding of the culture, the external individual characteristics and group dynamics are important before rolling out large interventions such as irrigation for farmers in developing countries. This is important for the continuous contributions of group members towards the maintenance and sustainability of the project once the developing partner has left.

The reminder of the paper is structured as follows. Section 2 briefly presents the farming group and agricultural development context. In section 3, a simple theoretical framework which

[2] In this setting we are not able to separate efficiency and inequality concerns.

highlights differential benefits and cooperation is presented. Section 4 presents the experimental design and the implementation process adopted in the field. Section 5 presents the descriptive results whilst section 6 presents the empirical results of the study. Section 7 concludes.

A simple theoretical framework

This section offers a simple theoretical framework that highlights the effect of inequality among the poor on cooperative behavior.

Consider a village or an economy with three agents: a poor agent *p*, and two rich agents *r*. In each year (or round or production cycle) each participant is given an endowment of cash or time, ω. Each participant in each year is free to decide how much of his endowment to contribute towards maintaining the group irrigation system and how much to invest in his own farm business. Aside from the endowment ω, the poor has an endowment of land or land under cultivation L^p , and the rich has an endowment L^r, where $L^p < L^r$. In this setting the potential benefit of maintaining the irrigation system for group use is higher for farmers with more land. The implicit assumption here is that land cannot easily be liquidated by persons with more land due to improper land titles in Ghana (Goldstein and Udry, 2008). Thus, the rich cannot use the land as collateral to finance large investments such as the provision of irrigation systems. In such a village, participants L^r and L^p both benefits from cooperation; but the potential benefits are different. The preferences for cooperation by the poor and rich are represented by (assuming well-behaved utility functions):

$$U^p = U\,(\,L^p, I^p\,) \tag{1}$$

$$U^r = U\,(\,L^r, I^r\,) \tag{2}$$

where I indicates a person's inequality aversion,[3] with $U_i \equiv \partial U/\,\partial \mathrm{L} > 0$, and $U_i \equiv \partial U/\,\partial I < 0$ indicating that a person's utility from cooperation is increasing in land under cultivation and decreasing in inequality aversion. We can show that $U_{LI} \equiv \partial^2 U/\;\partial L_i\,\partial I_i \leq 0$, indicating that a person's marginal disutility of inequality aversion decreases with land holdings.

[3] Recent models that augment the standard utility framework show that individuals care not only about their income/consumption but also about income/consumption inequality (Alesina and Giulino, 2009).

Individuals maximize utility from cooperation subject to liquidity constraints. Each village consists of n=3 persons in our setting and each person has an endowment of cash of ω for each year. Farming is the main activity for all individuals in the village. Since below a certain level of water availability crops will not grow and farmers would lose their investment towards maintenance of the irrigation system, we set a threshold provision level of ħ, that requires the investment of all three persons in the village. In our experiment, an endowment of GHC[4] 5 is provided per farmer and GHC 12 is set as the threshold. The marginal return from investing is 0.5 for L^p and 1.5 for L^r.

The sub-game perfect equilibrium can be described as:

a) If L^p , then cooperate. It is not difficult to see that those with L^p should contribute all endowments. Considering the parameters used in the study, individuals with L^p upon reaching the threshold receive 0.5* GHC 12.
b) If L^p and inequality averse, then zero cooperation. An individual is inequity averse if he dislikes outcomes that are perceived as inequitable (Fehr and Schmidt, 1999). Any contribution by individuals L^r that is less than GHC 2 will surely lead to non-provision.
c) If L^r, then cooperate (full cooperation) i.e. contribution of all endowments. Cooperation is socially optimal for all individuals in the village.
d) If L^r and inequality averse, then ambiguous. We do not have clear priors on what the exact directional impact will be in a developing country context. A number of studies have shown high preferences for redistribution in US and European samples (Alesina and Giuliano, 2009; Olivera, 2015). Theories based on other-regarding preferences suggest that people who dislike inequitable outcomes suffer from both disadvantageous inequity and advantageous inequity i.e. utility losses due to disadvantageous and advantageous inequity (see Fehr and Schmidt, 1999).[5] Even though the inequity averse suffer potential losses in utility, it is not very clear if they will indeed act to bridge this gap or if it is just a form of 'cheap feelings'. One could argue that since contributions that are less than GHC 2 will surely lead to non-provision, with a little disaffection for inequality the prior expectation could point more to zero contributions.

[4] At the time of the experiment GHC 3.5 = US$ 1
[5] However, utility loss from a disadvantageous situation is greater.

Experimental design and implementation

Experiments took place in March 2015 in schools and community centers in the four villages of the Mamprugu Moaduri District in the Northern Region in Ghana. All farmers participating in the experiment have the possibility to receive access to irrigation land later on because an irrigation project will be located in between the four villages. At the time of the experiment, farmers were not aware that everybody will have the possibility to qualify for access to irrigated land through participation in a certain amount of sessions of a Farmer Field Schools and that access to irrigation will be given on a group level.

We invited a total of 270 farmers and 264 attended the sessions. Farmers were randomly selected across four villages in the Mamprugu Moaduri District in the Northern Region of Ghana. The northern part of Ghana is an area that experiences long spells of dry periods which negatively affect production, making only one harvest possible. As a result, poverty is endemic compared to other parts of the country. Aside from the experimental data, we also have the advantage of having detailed background information on the participants and the household based on an extensive household questionnaire stratified on farming households. All farmers in the experiment were also part of a large scale household survey. The four villages and its members were chosen for the experiment because of the imminent access to irrigation in farmer groups.

Our experiment is designed to have two treatment and one control group during five periods in which the 'common pool resource' *water for irrigating* the fields is provided to a group of three farmers[6]. The two different treatments and the control are classified as follows: SSS (Small-Small-Small) refers to the control group with every group member having the same benefit as other members of the group, i.e. perfect equality group. LSS (Large-Small-Small) refers to a group with one person having a large benefit and two persons having small benefits. LLS (Large-Large-Small) refers to a group with two members having large benefits in the group and one member having a small benefit, i.e. inequality in benefits is highest in this group. Table 1 presents the experimental treatments. The definition of small or large benefits was made by referring farmers to the situation of owning land. For demonstrative purposes, two quadratic surfaces of different size were shown on a 100 × 70 cm flipchart sheet. One surface was larger in size than the other one without making a reference to proportions or quantification of

[6] We used a group of three instead of four to be able to collect more information similar to Charness and Villeval (2009).

differences in size. Thus, large and small reflect the subjective perception of benefits of a large or small piece of land for each individual.

Because six invited farmers did not show up, we have 29 groups in two of the treatments and 30 groups in the third treatment. Table 1 presents the experimental treatments as well as the number of groups across the three treatments.

Table 1 Experimental Treatments

Treatments	Groups	Subjects
SSS	29	87
LSS	29	87
LLS	30	90
Total	88	264

Once the farmers arrived at the venue of the experiment, they were made to sit on separate tables and were informed not to communicate with other participants. They were also asked to switch off their cell phones. At the beginning of each session of the different treatments, farmers were randomly and anonymously assigned to groups of three and to the allocation of small or large land beneficiary. In total nine sessions (three sessions per treatment) were implemented with 27/30 persons per session. The groups remained constant throughout the rounds of the experiment (partner's protocol). The identity of other members in the three-person group was not known to the participants, and as such individuals could not attribute contributions to specific persons in the session.

Instructions of the experiment were read out to the participants in their local language Mampruli (see Appendix A for an example of the instructions in English).[7] At the beginning of each round, participants were given the same amount of endowment worth GHC 5 represented by five tokens in form of seeds. It was explained in the introduction that each group has a common group account for a project in irrigation farming. The group only benefitted from the group account if the accumulated amount in their account was GHC 12 or beyond. If the group did not reach the threshold, all funds in the group account were lost. Farmers who did not contribute did not lose anything, but kept the total GHC 5 for themselves. Each group member had to decide independently how much to put into the group account and how much to keep in his/her own pocket. After each round the experimental assistants collected envelopes containing each individual's contribution. The amount farmers contributed was counted and envelops were

[7] The experiment was translated from English into Mampruli and then back into English to make sure the instructions are correct.

redistributed for the next round. Participants were informed whether the group met the threshold of GHC 12 with a green sticker in their envelope. A yellow sticker was used to indicate that the group did not meet the threshold. This procedure was repeated for a total of five rounds in each of the experimental sessions. The marginal per capita return (MPCR) from contributing was 0.5 of the threshold for farmers assigned to have a small benefit and 1.5 of the threshold for farmers in the group with a large benefit. The average earnings in the experiment was approximately GHC 9, which is higher than the minimum wage of GHC 6 per day set by the Ghanaian government at the time of the experiment (http://www.ghana.gov.gh).[8]

Subjects' payoff is given by:

$$\pi_i = 5 - c_i + \gamma_i \sum_{i=1}^{3} c_j \quad (3)$$

where c_i denotes person i's contribution to the public good, and γ_i denotes person i's MPCR from the public good. At the end of the last round, one round was randomly selected for payment. This was achieved by asking one of the participants to randomly select one of the 5 rounds for payment. Afterwards, a post-experimental questionnaire was administered to capture attitudes relating to risk, inequality aversion, trust etc., see Appendix B.

As noted by Cadsby and Maynes (1999), for the standard threshold public goods game there are many possible pure strategy Nash equilibria, but two are symmetric. The first is the standard non – cooperative solution where contributions are zero for all participants. Thus, for participants of the SSS group the dominate strategy for all is zero contribution (strong free-riding). The second symmetric pure strategy Nash equilibrium will be participants contributing an equal share of the threshold ($c_i = Threshold/N$), where N is the total number of people in the group. In the case of differential benefits, there also exists an additional symmetric equilibrium for people with large benefits from cooperation by contributing all endowments to the public good.

Using a student population, Glöckner et al. (2011) observed that the presence of a privileged player with an MPCR of less than one incentivizes contributions by the other players; but when the privileged player had an MPCR larger than one, other players contributed less. Contrary to this prediction, they also find that the privileged players contribute less than their

[8] The minimum wage as at 2016 is GHC 7 per day.

full endowment. As Cardenas (2003) has well noted, the poor, who have lower assets and lower potential benefits, may even show larger stakes in cooperation than the rich, and as such contribute more. This is because the rich might have more alternatives outside of group cooperation. Adding to all these studies, we argue that in a field setting (with resource poor subsistence farmers), an MPCR of larger than one should not negatively impact cooperation.

Descriptive Statistics

Table 2 reports the sample means (column 1) for the pooled data and the means for the different treatment groups i.e. LLS (column 2) and LSS (column 3), and the control group SSS (column 4). The last column shows the difference in means between the LLS and LSS compared to SSS.[9] None of the differences in any of the variables are statistically significant, and thus shows that the sample is balanced across the treatments for all individual and household characteristics. Specifically, personal and household characteristics such as the participants' age, gender, wealth, and household size are not statistically different between the participants of the different treatments. Furthermore, the variables measuring risk, loss and inequality aversion and the trust measure are balanced between groups (see Appendix B for the questionnaire and Appendix C for the coding of variables).

Table 2 Summary statistics on participants' characteristics

	(1) Pooled sample	(2) Group LLS	(3) Group LSS	(4) Group SSS	(5) Difference
Age of participant	43.21	43.36	44.19	42.01	-1.469
	(0.943)	(1.630)	(1.612)	(1.667)	(0.75)
Age at first marriage	25.76	25.53	25.54	26.21	0.762
	(0.404)	(0.666)	(0.689)	(0.745)	(0.89)
Participant female	0.0658	0.0822	0.0625	0.0533	-0.0210
	(0.0165)	(0.0324)	(0.0272)	(0.0261)	(0.52)
Participant ever attended school	0.215	0.123	0.325	0.187	-0.0247
	(0.0273)	(0.0387)	(0.0527)	(0.0453)	(0.45)
Size of the Household	7.640	8.205	7.388	7.360	-0.198
	(0.240)	(0.450)	(0.411)	(0.384)	(0.412)
Participant is member of a civil society organization	0.162	0.0959	0.212	0.173	0.00253
	(0.0245)	(0.0347)	(0.0460)	(0.0440)	(0.005)
Person who is fully prepared to take risks or do you try to avoid taking risks?	3.215	3.027	3.263	3.347	0.169
	(0.0653)	(0.0872)	(0.118)	(0.127)	(1.30)
What fraction of the GHC 4000 would you invest in the business?(in GHC)	2,186	2,014	2,253	2,284	92.67
	(52.59)	(62.43)	(93.41)	(107.6)	(0.90)
Loss aversion	0.684	0.822	0.637	0.600	-0.0964
	(0.0309)	(0.0451)	(0.0541)	(0.0569)	(1.62)
Inequality aversion	3.864	3.822	4.050	3.707	-0.208
	(0.0704)	(0.124)	(0.118)	(0.123)	(1.52)

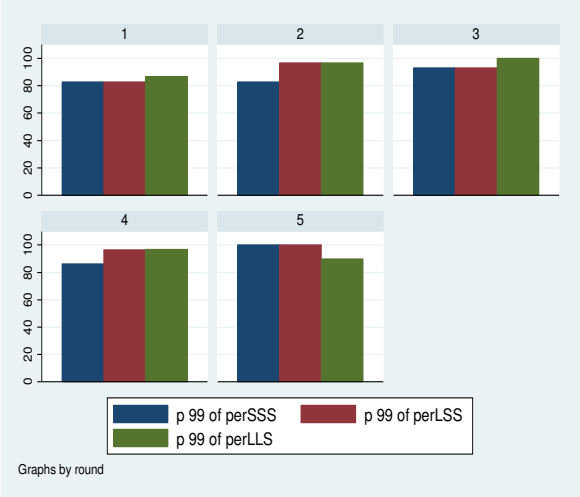
[9] Individual comparisons between the LLS and SSS, and between LSS and SSS are similar to comparison between LLS and LSS to SSS.

Trust	3.772	3.863	3.813	3.640	-0.176
	(0.0684)	(0.114)	(0.122)	(0.118)	(1.31)
Wealth index[10]	0.167	0.160	0.186	0.156	-0.00410
	(0.00786)	(0.0103)	(0.0177)	(0.0105)	(0.0165)

Note: Difference is computed as the regression coefficient on SSS dummy and represents the average difference between individuals in SSS and the heterogeneous groups pooled together. Individual paired differences are qualitatively similar. Standard errors in parenthesis.

Figure 1 and Table 3 show the distribution of success rates, i.e. provision of the common pool resource, by treatment and round of the experiment. Overall the average success rate was 92 percent, with groups in SSS having the lowest rate of 89 percent and LSS having the highest rate of 94 percent. As this is a field experiment and not a laboratory experiment with students, we do not doubt these numbers.

Figure 1 Percentage Success across Rounds



Because the failure rates, indicating non-provision of the public good, are very small (or success rates are high), we perform a categorical analysis on the differences in success using the Fisher's exact test.[11] This is an alternative test to the chi-square test. Similar results are obtained with the Wilcoxon rank-sum test.[12] We observe that the over 90 percent success rate in treatments with privileged farmers (pooling LSS and LLS on one side), is significantly higher than the 89 percent success rate observed for the control group with no privileged farmer (SSS) (*Fisher's exact test = 0.087, Pearson* X^2 *= 0.069).* However, comparing the success rates

[10] The wealth measure is an asset index constructed from 20 assets including livestock, water and sanitation facilities, housing conditions, furniture items, jewelry, productive tools, TV, radio, bicycle, motorbike, car, cell phones and personal computers. A principal component analysis is applied to construct the index as frequently done since Filmer and Pritchett (2001). The first principal component is used as the asset index because it has the largest variance and therefore describes most of the variation in the data. The index is standardized to a range from zero to one. The wealth index serves as a proxy for income or the socio-economic status of households.

[11] When the sample size is very small in any cell (expected value<5), Fisher's exact test is used as an alternative to the chi-square test.

[12] Note that as a robustness check we use the Wilcoxon rank-sum test instead of the Wilcoxon signed-ranks test due to the unmatched data i.e. one more additional group in the LLS treatment

between each treatment and the control group masks this result (*Fisher's exact test = 0.209, Pearson* X^2 *= 0.143 comparing LSS and SSS; Fisher's exact test = 0.145, Pearson* X^2 *= 0.121 comparing LLS and SSS*). For a one-sided test, we find significantly higher success rates for LLS compared to SSS (*one-sided Fisher's exact test = 0.089*).

Table 3 Success by Round

	Round					
Treatment	1	2	3	4	5	Total
SSS	24 (83%)	24 (83%)	27(93%)	25(86%)	29 (100%)	129 (89%)
LSS	24(83%)	28 (97%)	28 (87%)	28 (97%)	28 (87%)	136 (94%)
LLS	26 (87%)	29 (97%)	30 (100)	29 (97%)	27 (90%)	141 (93%)

We now turn our attention to the actual contribution behavior by subjects across the three treatments. Figure 2 shows the evolution of contributions across the five rounds and across the three treatments. The average contributions are higher in groups with at least one privileged person. For example, we find that whilst members in privileged groups (LSS and LLS pooled) contribute approximately 92 percent of their initial endowment, average percent contribution in groups without a privileged participant is approximately 88 percent (Wilcoxon rank sum test, *p-value* = 0.000, two-sided). Thus, the effect of a privileged participant on group contributions is strong and significantly increases contributions.

We also find that, when there are two privileged participants, group members on average contribute 92 percent of their endowment. With one privileged participant, average group contribution is 91 percent. The difference in contributions between the treatment with two and one privileged member is not significant (Wilcoxon rank sum test, *p-value* = 0.5330). However, average group contributions are higher and significant when comparing LLS vs. SSS or LSS vs. SSS (Wilcoxon rank sum test, *p-value* = 0.000 and *p-value* = 0.003, two-sided respectively). Our data shows that contributions tend to be more stable the more privileged subjects there are in a group.[13]

[13] Marwell and Ames (1979 p.g. 1348 - 1352) examining a treatment with "high" and "low" interest persons (i.e., small, unequal-interest groups) and validating Model 2 of their paper using a student sample, reports that small, unequal interest groups (SUE) invest more than any other group invalidating their initial model. Our results using smallholder resource-poor farmers in the field support the findings of Marwell and Ames (1979).

Figure 2 Mean Contribution by Round

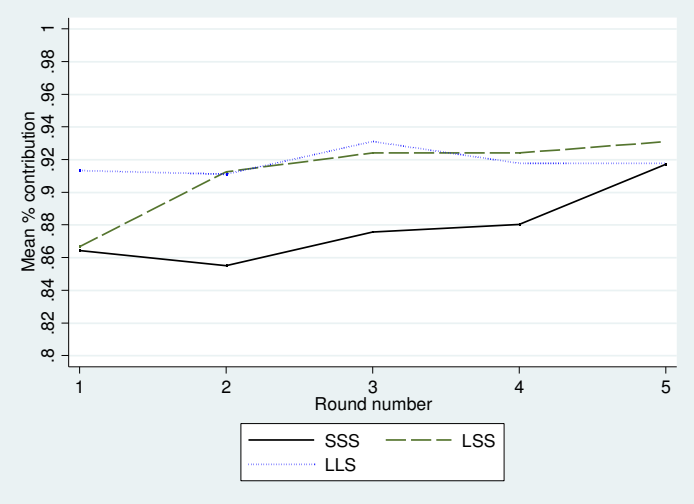
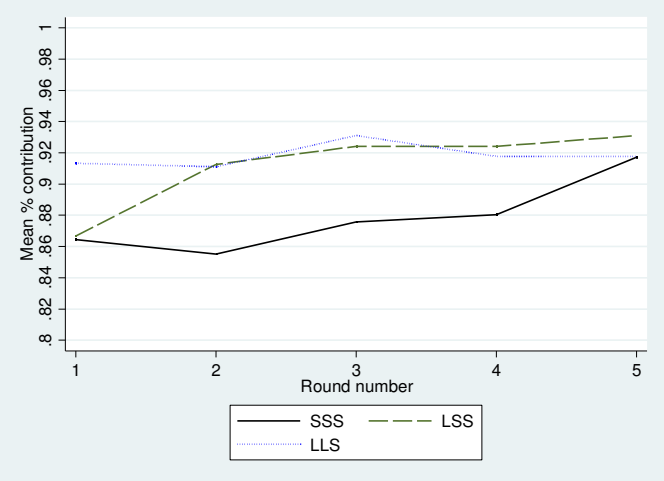


Figure 3 presents the average contribution only for "the poorer" type S subjects across the three treatments. Even though type S players in groups with one privileged subject (LSS) and the type S in equal groups (SSS) tend to start off almost at the same level in terms of contributions, types S players in LSS tend to learn to cooperate more rapidly than subjects in the SSS group. Thus, over the 5 rounds, average contributions by type S players in groups with one privileged participant are significantly higher than that of groups without a privileged participant (Wilcoxon rank sum test, *p-value* = 0.01, two-sided). Specifically, whilst types S players in groups with one privileged subject contribute an average of 91 percent of their endowment, players in groups without a privileged subject contribute an average of 88 percent. We find that type S players in LLS even contribute significantly more than type S players in the other treatments (Wilcoxon rank sum test, *p-value* = 0.000 for treatment LLS vs. SSS and *p-value* = 0.004 for treatment LLS vs. LSS, two-sided). The data shows that for people in resource-poor settings, even when contributions are strictly dominant for higher beneficiaries, they are still willing to contribute. Having extra money (an extra Ghana Cedi) irrespective of how small it is, could mean a lot to the poor.

We now turn our attention to within treatment comparisons between people with smaller benefits and those with larger benefits. Interestingly, comparing within treatments, we find that contributions by S's are greater than contributions by L's in the LLS treatment (Wilcoxon rank sum test, *p-value* = 0.006, two-sided). We interpret this as the effect of a person's action being pivotal, which creates the extra burden for the person who, in a village context, does not want to be blamed as being responsible for the breakdown of cooperation. We find nearly similar contributions by S's and L's in the treatment LSS (Wilcoxon rank sum test, *p-value* = 0.5754,

two-sided). Thus, in the lab-in-the-field experiment with resource-poor farmers, the person who perceives to receive lower personal benefits will over-invest to prevent the burden of being responsible for the breakdown of the cooperation.

Figure 3 Mean Contribution by Round (Small Beneficiaries)



Empirical Results

We start the empirical analysis by estimating a random-effects Tobit model to identify the determinants of investing in the common-pool irrigation system (similar to Charness and Villeval, 2009). The random-effects Tobit regression analysis is a panel data method which allows us to account for each participant's decision during the five rounds and both, the left and right censoring of the contribution data (GHC 0 and GHC 5). The fundamental advantage of panel data analysis over a cross-sectional analysis is that the former allows for greater flexibility in modeling differences in repeated behavior across individuals (Greene, 2010). To examine the investment behavior of resource-poor subsistent farmers in the presence of inequality in potential benefits, we use the following basic regression specification:

$$Invest_{it} = \alpha_i + \beta tLSS_i + \beta tLLS_i + X'_{it}\beta + \varepsilon_{it} \qquad (4)$$

where $Invest_{it}$ represents the amount contributed by participant i in round t. The main variables of interest are $tLSS$ and $tLLS$ which measure the respective treatment into which participant i is assigned.[14] To control for the possible heterogeneity of participants we always estimate the model with a set of control variables, accounting for individuals' and households' socioeconomic characteristics. We also include controls for whether or not the group was successful in the previous round, and also the individual's contribution in the previous round.

[14] The omitted treatment category is SSS.

Additionally, we included behavioral controls examining specifically the impact of trust, loss and inequality aversion. In a latter estimation, we also include the real wealth level of households (using an asset index) to account for differences in external wealth, which possibly impacts how participants will value the potential earnings in the experiments. Controlling for real wealth, we are also able to examine how relative external wealth itself impacts overall cooperation among resource-poor farmers in Ghana.

Since participating farmers are randomly assigned to sessions and treatment status, and because all the household and behavioral measures are well-balanced across treatments (as reported by the balancing test in Table 2), we expect the disturbance term in Equation (4) to be uncorrelated with our independent variable. In addition, we have accounted for a set of household and behavioral measures – including lagged experimental outcomes such as lagged success of the group, and lagged contributions – and as such deal with any possible omitted variables that may impact investments. In case there are any omitted variables, we do not expect them to be correlated with the included variables because of the random assignment into groups. Finally, we also control for possible time trends in investment including the round number.

Table 4 presents the results for the investment behavior of the resource-poor facing inequality in potential benefits. The estimation is done based on the pooled data from all the sessions. Results in column (1) are shown without behavioral controls whereas in column (2) controls for the behavioral measures trust, loss and inequality aversion are included. Overall, the results of the multivariate analysis generally confirm the non-parametric test results. Table 4, column (2) indicates that in groups with a privileged farmer, individuals contribute GHC 0.531 to GHC 0.687 (LSS and LLS, respectively) more than in groups without a privileged farmer. The effect is much stronger in the LLS group, where more than half of the group members have high potential benefits from investing. Thus, in this case we reject the alternate hypothesis that contributions in homogenous groups are higher than heterogeneous groups, in favor of the alternate that contributions are higher when there is at least one privileged farmer in the group.

Including behavioral measures in the model, column (2) shows that loss aversion is an important determinant of investment. Farmers who are loss averse tend to contribute less.[15]

[15] The measure is a dummy variable that reflects the willingness to invest GHC 4000 in a lottery with 50 percent probability of loss and a chance to double one's investment. Farmers who are willing to invest less than GHC 2000 are classified as loss averse (see Appendix B, Question 2).

Inequality aversion seems not to impact cooperation among resource-poor farmers, confirming results obtained from the experimental manipulation of inequality[16]. We also do not find that trust *per se* impacts cooperation[17]. In a nutshell, the biggest behavioral driver of investments by resource-poor famers is loss aversion. We argue that having a privileged farmer reduces the perceived likelihood of loss compared to having no privileged farmer.

Household characteristics seem in general not to be very important drivers of group investment, however we find a significant and positive effect for household size.

Table 4 Levels of contributions in farmer groups – Tobit model[18]

	(1) Participants' contribution	(2) Participants' contribution
Age of participant	-0.002	-0.002
	(0.008)	(0.008)
Participant female	-0.034	-0.013
	(0.394)	(0.396)
Participant attended school	-0.292	-0.299
	(0.304)	(0.302)
Size of the Household	0.062*	0.057*
	(0.035)	(0.035)
Participant is member of a civil society organization	0.058	0.020
	(0.350)	(0.347)
Not successful in previous round	-0.229	-0.219
	(0.192)	(0.192)
Contribution in previous round	-0.034	-0.033
	(0.062)	(0.062)
Round number	0.138***	0.138***
	(0.031)	(0.031)
tLSS	0.535*	0.531*
	(0.300)	(0.298)
tLLS	0.596**	0.687**
	(0.298)	(0.300)
Loss aversion		-0.564**
		(0.274)
Inequality aversion		-0.039
		(0.116)
Trust		0.054
		(0.123)
Constant	4.968***	1.119***
	(0.543)	(0.046)

[16] Variable coded as Likert scale ranging from 1 to 6, Question 3a) in Appendix B.
[17] Variable coded as Likert scale ranging from 1 to 6, Question 3c) in Appendix B.
[18] To examine the robustness of our results we also perform the same regressions using OLS with robust standard errors clustered at the group level. See Appendix D Table 4A.

Observations	1,319	1,319
Number of ID	264	264

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Estimations are random-effects Tobit models controlling for both right and left censuring of the observations.

Next, focusing on the sub-sample of our data of only small beneficiaries, we explore whether participants with smaller benefits in heterogeneous benefit groups (LSS and LLS) differ in their contributions from those in the homogenous groups (SSS). We approach this by comparing only participants with small benefits in the study. Table 5 presents the multivariate regression results to show that small beneficiaries in LLS contribute significantly more than small beneficiaries in SSS or LSS treatments. These regressions again confirm the results from the non-parametric tests (see also Figure 3): The higher contributions observed in LLS are not solely driven by the large beneficiaries in LLS. Our data from the lab-in-the-field experiment suggest that having more privileged subject(s) reduces strategic uncertainty about contributions and enhances cooperation.

Furthermore, under this specification with small beneficiaries across treatments, the variable household size is observed to be marginally significant. Thus, participants from larger households with relatively small profits contribute more to sustain cooperation. With regard to the behavioral measures, again loss aversion seems to be the most important behavioral factor influencing farmers' contributions to the common pool resource.

Table 5 Contributions by Small Beneficiaries – Tobit Model[19]

	(1) Participants' contribution	(2) Participants' contribution
Age of participant	-0.006	-0.004
	(0.010)	(0.010)
Participant female	-0.119	0.038
	(0.464)	(0.473)
Participant attended school	0.008	0.004
	(0.361)	(0.357)
Size of the Household	0.077*	0.075*
	(0.041)	(0.041)
Participant is member of a civil society organization	0.050	-0.022
	(0.414)	(0.409)
Not successful in previous round	-0.240	-0.215
	(0.234)	(0.233)
Contribution in previous round	-0.054	-0.050

[19] Again we ran the same model using OLS, see Appendix D Table 5A.

	(0.076)	(0.076)
Round number	0.169***	0.169***
	(0.039)	(0.039)
tLSS	0.486	0.481
	(0.323)	(0.319)
tLLS	1.089***	1.101***
	(0.419)	(0.416)
Loss aversion		-0.546*
		(0.310)
Inequality aversion		0.041
		(0.137)
Trust		0.100
		(0.137)
Constant	4.924***	4.679***
	(0.149)	(0.926)
Observations	874	874
Number of ID	175	175

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Estimations are random-effects Tobit models controlling for both right and left censuring of the observations.

Sensitivity analysis

As an additional control we introduce a wealth asset index to see whether real wealth affects decisions in the experiment. The underlying premise of this model is that peoples' external wealth is actually what is driving their cooperative behavior or contributions, and not the heterogeneity in potential benefits within their group. The wealth indicator on its own also helps us to examine how relative wealth in resource-poor settings in sub-Saharan Africa impacts cooperation. Table 6 shows that real external wealth in resource-poor settings in sub-Saharan Africa negatively impacts group cooperation even though the level of wealth and standard deviation of wealth in these villages is small. The results as shown by the coefficients of the treatment dummies are observed to be robust whether we control for external wealth or not (see for comparison Table 4). The coefficient on the wealth measure is negative and significant. In addition, the results are robust for the subsample of small beneficiaries, see Table 6 column 3 and 4 compared to the estimation without the wealth measure in Table 5. The overall implication here is that relatively wealthy participants from resource-poor settings are less likely to contribute towards the public good. Relatively wealthier households in resource-poor communities will be less likely to give contributions relative to the poor because they have more private alternatives, even in these constrained settings. This is an important finding for group composition and management of common-pool resources in a developing country. Our findings confirm results from Columbian villages by Cardenas (2003) which show that wealthy households are less cooperative in a negative group externality setting or framing, in this case

the decision not to over extract resources from a forest. We show that, in the case of a positive group externality - here investing in a common good (irrigation) - wealth also reduces cooperation. Thus, wealth, whether in a positive or a negative externality setting, reduces cooperation in developing countries.

Even after properly controlling for external wealth, we still see that the significant effect of privileged farmers on group investment behaviors is robust. The results show that even though in former studies in non-field and non-developing country contexts, having a privileged person with a MCPR greater than one does not incentivize group cooperation, we show that the opposite is required to reduce strategic uncertainty about cooperation in developing country settings. Thus, inequality concerns do not matter as much to people when their livelihoods are at stake. Poorer households are much more interested in making a little extra money to support their families than focusing on higher benefits accrued to neighbors. Overall, the effect of heterogeneous benefits is robust in the face of negative wealth effects on cooperation. On the one hand, whilst wealth decreases cooperation, differences in potential benefits enhance cooperation. This result shows the complexities involved in designing farmer organizations and farmer groups in developing countries. Even though these complexities exist, we show that the effect of heterogeneous benefits is not outweighed by the negative effect of wealth.

Table 6 Levels of contributions in farmer groups including wealth index – Tobit model[20]

	(1) Participants' contribution *Full sample*	(2) Participants' contribution *Full sample*	(3) Participants' contribution *Small Beneficiaries*	(4) Participants' contribution *Small Beneficiaries*
Age of participant	-0.002	-0.002	-0.007	-0.006
	(0.008)	(0.008)	(0.010)	(0.010)
Participant female	-0.080	-0.087	-0.076	0.022
	(0.389)	(0.391)	(0.451)	(0.462)
Participant attended school	-0.075	-0.077	0.282	0.266
	(0.303)	(0.303)	(0.362)	(0.361)
Size of the Household	0.115***	0.110***	0.142***	0.136***
	(0.038)	(0.038)	(0.046)	(0.045)
Participant is member of a civil society organization	0.118	0.080	0.136	0.069
	(0.343)	(0.340)	(0.405)	(0.401)
Not successful in previous round	-0.214	-0.206	-0.222	-0.201
	(0.192)	(0.192)	(0.233)	(0.233)
Contribution in previous round	-0.029	-0.028	-0.050	-0.047
	(0.062)	(0.062)	(0.076)	(0.076)
Round number	0.134***	0.134***	0.164***	0.164***

[20] Again we also run the same model using OLS, see Appendix D Table 6a

	(0.031)	(0.031)	(0.039)	(0.039)
tLSS	0.579**	0.583**	0.597*	0.590*
	(0.294)	(0.293)	(0.318)	(0.316)
tLLS	0.536*	0.631**	1.026**	1.057***
	(0.291)	(0.294)	(0.405)	(0.405)
Loss aversion		-0.509*		-0.485
		(0.268)		(0.302)
Inequality aversion		-0.057		0.035
		(0.114)		(0.135)
Trust		0.017		0.046
		(0.121)		(0.135)
Wealth index	-3.604***	-3.457***	-3.444***	-3.218***
	(1.048)	(1.044)	(1.126)	(1.124)
Constant	5.093***	5.598***	4.998***	4.951***
	(0.535)	(0.813)	(0.618)	(0.913)
Observations	1,309	1,309	869	869
Number of ID	262	262	174	174

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Estimations are random-effects Tobit models controlling for both right and left censuring of the observations.

Conclusion

Making farmer groups sustainable is of utmost importance for the overarching goal of reducing rural poverty, enhancing agricultural transformation and achieving food security, especially in sub-Saharan Africa. Irrigation can serve as additional input in the production process to achieve higher yields. Studies that investigate the impact of irrigation schemes on farmer productivity have shown that there are huge positive benefits for farmers. However, many irrigation systems in Africa face serious breakdowns or work far below capacity. Ostrom (2002) shows that self-governed farmer groups managing irrigation can be successful. But the question still remains as to how farmer groups and organizations should be structured to be successful. Thus, in this paper we investigate how groups of farmers participating in an irrigation project should be composed to make provision of the common pool resource irrigation more effective. Furthermore, due to credit market imperfections, many smallholder farmers cannot purchase these productivity enhancing irrigation facilities on their own and, therefore, the existence of farmer groups in small villages in developing countries are important in the poverty alleviation process.

Our paper suggests that the structure of farmer groups in developing countries can indeed have an implication for small investments into, and the sustainability of, the common-pool. Although a number of studies with student populations have found that heterogeneity in benefits hinders cooperation, we find that heterogeneity in potential benefits among resource-poor farmers promotes cooperation and therefore supports Marwell and Ames (1979) model on

unequal groups. To be more precise, heterogeneous benefits among resource-poor individuals are likely to incentivize cooperation by reducing strategic uncertainty about poor farmers' small investments. Thus, not only are the higher beneficiaries incentivized but also the relatively lower beneficiaries. Since resource-poor farmers' livelihoods are at stake and there is the urgency to support their households, having higher potential beneficiaries in the group rather reduces strategic uncertainty. A farmer with a smaller benefit from cooperation and therefore lower revenues in a group will still contribute if there are farmers in the group who have a larger benefit and the likelihood of losing his/her investment is low. In a group where all resource-poor farmers have the same potential benefits and equally (low) revenues, cooperation is lower. We also show that contrary to other studies with student subjects, in very unequal groups in a developing country context, the smaller beneficiary contributes even more. We interpret this as the effect of being pivotal and the associated fear or aversion of being tagged as the person responsible for the breakdown of cooperation in the field. This is very important in reality, because reputation in a local village in developing country settings carries economic value.

The external validity of our results is also increased because we have a field experiment and we can control for various personal and household characteristics. We further show that wealth is an important determinant of contribution to a common pool resource as irrigation for farmer groups. The real world richer people are less likely to invest in public goods. Even after properly controlling for wealth, we continue to see that potential group benefits from investing is important. For practitioners, this can mean that if irrigation projects are to be sustainable and the provision of water as a common good is to be lasting, then farmers need to have considerable benefits and there is a need to have participants with different potential benefits from investments. Equal benefits for all could cause project failure or negatively impact on the potential of the project. In practice, if farmers grow different types of crops (e.g. rice which requires a lot of water or maize which requires relatively lower quantities of water) or at least grow them in different proportions, then group cooperation to sustain the public good will be higher.

Obviously, this is the first attempt to see how heterogeneity in benefits impacts group investment and cooperation outcomes in the field. Even though we do not assign actual irrigation facilities to farmers, our experimental evidence offers some insights which will help understand how farmer group structure impacts group outcomes and facilitates the design of farmer irrigation systems in developing countries. Very few studies examine how farmer groups

should be designed due to an absence of observable data. We contribute to this scanty literature using experiments in the field.

Overall, the research has implications for the design of famer groups in developing countries. The results indicate that there is a huge requirement for policy makers and project implementers to have background information on participants and information on the social and cultural settings to better develop sustainable strategies in developing countries. The results point towards a farmer group design that allows for rich and poor people together in one group to guarantee contribution to the common pool resource. Excluding high potential beneficiaries in a developing country context may not be wise as they incentivize group cooperation and minimize project uncertainty. A further implication of this study is that reducing farmers' loss aversion (possibly through providing a safety net) could be beneficial for enhancing group cooperation. This latter point might be crucial in involving poorer households. Inequity aversion has less impact on resource-poor farmers in a developing country context and thus makes it possible to design farmer groups in which not everybody must be equal.

Appendix

Appendix A. Experimental Instructions LSS (English version[21])

Hello and welcome to our workshop. Before we start we will explain what you have to do in this workshop. This workshop is about making decisions. The instructions are simple and you can earn some money in this workshop. This money will be paid to you in cash at the end of the workshop. How much money you will earn will depend on your own decisions. In total you have five rounds of decision making and in the end we will randomly select one of the rounds for payment in cash. Which round will be paid will be decided by drawing one of these five cards (SHOW CARDS).

Please notice: Talking to others is not allowed during the workshop. All the decisions that are made are anonymously, that is, no other participant is informed about your decisions or the decision of others. If you have any questions, please raise your hand and we will come and help you. The payment is anonymously too, that is no participant gets to know how much money you earned.

I will now explain the rules of the workshop:

In this workshop you will be randomly assigned to a group with two other people. As the workshop is anonymous, you do not know who these two people are. This means that you will not know who is in your group, nor will the other members know who you are. You will interact with the same two people for the whole five rounds in the workshop.

There are two types of people in your group: one person has a larger land and two persons have a smaller land in this workshop. We will randomly assign who in the group has the larger land (L) and the smaller land (S). You will know yourself whether you have a larger or a smaller land. You will draw a piece of paper out of a box which indicates whether you have L land or S land in the workshop (SHOW DRAWING ON POSTER).

In the beginning of each round each group members receives 5 GHS. In each group, you have a common group account for a project in irrigation farming. Each group member has to decide independently how much to put into the group account and how much to keep in his/her own pocket.

[21] These instructions are an example of the instructions given to the participants. The instructions were adjusted for LLS and SSS respectively. Each instruction was translated into the local language Mampruli and read out in Mampruli before the first round started.

The group only benefit from the group account if the amount is 12 GHS or beyond. If the group does not reach the total amount of GHC 12 then everybody will lose their contribution. Those who do not contribute do not lose anything, but will keep the total GHC 5 for themselves.

If there are at least GHC 12 or more in the group account, everybody benefits from the group account. However, how much benefit you get from the group account depends on the size of your land. So the one person with the larger land gets the threshold which is GHC 12 plus an additional half (ILLUSTRATION 12+6=18). The two persons with the smaller lands get half of the threshold of GHC 12 in return from the account (ILLUSTRATION 12:2=6). If the threshold of GHC 12 is not reached, nobody in your group gets a payoff but only keeps what remains in his/her personal pocket.

Let's demonstrate with these examples:

Scenario 1: For example, assuming you are the person with a larger land and you decided to contribute GHC 4 to the account in your group. If the total amount of the group account at the end of the round is 7 GHS, this means that the other persons in your group altogether contributed GHC 3. The threshold of GHC 12 is not reached, and therefore nobody in your group gets a payoff but only keeps what remains in his/her personal pocket. Any amount contributed in this case is lost, i.e. the GHC 4 contributed to the account in this case is lost.

Scenario 2: For example, assuming you are the person with a larger land and you decided to contribute GHC 4 to the account in your group. If the amount of the group account at the end of the round is GHC 13, this means that the other persons in your group altogether contributed GHC 9. The threshold of GHC 12 is reached, and therefore everybody in your group gets a payoff according to land size and keeps what remains in his/her personal pocket. If you are a person with a larger land you get the threshold which is GHC 12 plus a half (ILLUSTRATION 12+6=18). So, the total amount of money you get is 1+18.

Scenario 3: For example, assuming you are one of the persons with a smaller land and you decided to contribute GHC 3 to the account in your group. If the amount of the group account at the end of the round is GHC 13, this means that the other persons in your group altogether contributed GHC 10. The threshold of GHC 12 is reached, and therefore everybody in your group gets a payoff according to land size and keeps what remains in his/her personal pocket. If you are a person with a smaller land you get half of the threshold which is GHC 6 (ILLUSTRATION 12:2=6). So, the total amount of money you get is 2+6

Now we want to ask you to go through some examples:

Large land:

1. For example, assuming you have a larger land and you contributed all your GHC 5 to the account in your group. The group did reach the threshold of GHC 12, how much money do you get in the workshop?

Answer checked on a piece of paper and should be 18.

Small land:

2. For example, assuming you have a smaller land and you contributed all your GHC 5 to the account in your group. The group did reach the threshold of GHC 12, how much money do you get in the workshop?

Answer checked on a piece of paper and should be 6.

3. For example, assuming you have a smaller land and you contributed all your GHC 5 to the account in your group. The group did not reach the threshold of GHC 12, how much money do you get in the workshop?

Answer checked on a piece of paper and should be 0.

Now we start the actual decisions.

You will receive 10 seeds in a small black plastic. These 10 seeds you receive at the beginning of each period indicate your GHC 5, i.e. each seed is 50 Peswa.

Now you draw an envelope from this box. The envelope you draw will determine whether you have a large land or a small land. If you find L you have a large land and if you find S you have a small land (SHOW DRAWING ON POSTER).

Please put your contribution to the group account in the envelope provided. You will receive information whether your group reached the threshold in the inside of the envelope. This will be indicated by stickers in green and yellow.

GREEN=threshold is reached and you get returns from the group account

YELLOW= threshold is not reached and you do not get returns from the group account. You lost your contribution to the group account.

Now we start the first round. We will now ask you to make your contribution. Please put your contribution to the group account into the envelope provided. After you made your decision we will collect the envelope.

Appendix B. Questionnaire on behavioral aspects

		Code	Name
Q1	**Household ID**		
Q2	**PERSON ID**		
Q3	**Community**		

1. Are you generally a person who is fully prepared to take risks or do you try to avoid taking risk?

1	2	3	4	5	6

2. Imagine you had just won GHC 4000 in a lottery and you can invest this money in a business. It is equally likely that the business goes well or not. If it goes well you can double the amount invested after one year. If it does not go well you will lose half the amount you invested.

What fraction of the GHC 4000 would you invest in the business?

GHC ☐

3. How much do you agree/disagree with the following statements?

(a) Other people should not own or have a lot more than me

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

(b) Other people should not own or have a lot less than me

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

(c) I generally trust people.

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

(d) I generally trust people in the village.

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

(e) I generally trust people in the farmer group.

Strongly Disagree	Disagree	Slightly Disagree	Slightly Agree	Agree	Strongly Agree
1	2	3	4	5	6

4a) How much did you expect the person (s) with the larger land to give from the beginning?

GHS

4b) How much did you expect the person (s) with the smaller lands to give from the beginning?

GHS

Appendix C. List and coding of variables

Variable name	Coding
Age of participant	Age in years
Participant female	1=Female 0=Male
Participant attended school	1=Yes 0=No
Size of the Household	Number of household members
Participant is member civil society organization	1=Yes 0=No
Not successful in previous round	1=Yes 0=No
Contribution in previous round	GHC 0 to GHC 5
Round number	1 to 5
tLSS	1 in LSS treatment, 0 otherwise
tLLS	1 in LLS treatment, 0 otherwise
Loss aversion	Imagine you had just won 4000 GHC in a lottery and you can invest this money in a business. It is equally likely that the business goes well or not. If it goes well you can double the amount invested after one year. If it does not go well you will lose half the amount you invested. What fraction of the 4000 GHS would you invest in the business? 1= if <= GHC2000 ; 0 if >2000
Inequality aversion	Other people should not own or have a lot more than me Scale: 1=Strongly Disagree to 6=Strongly agree
Trust	I generally trust people. Scale: 1=Strongly Disagree to 6=Strongly agree

Appendix D. Replication Tobit regressions applying OLS

Table 4a Levels of contributions in farmer groups – OLS model

	(1) Participants' contribution	(2) Participants' contribution
Age of participant	-0.001	-0.001
	(0.003)	(0.003)
Participant female	0.044	0.062
	(0.116)	(0.120)
Participant attended school	-0.121	-0.136
	(0.109)	(0.107)
Size of the Household	0.023**	0.021**
	(0.010)	(0.009)
Participant is member of a civil society organization	-0.018	-0.029
	(0.138)	(0.136)
Not successful in previous round	-0.104	-0.101
	(0.080)	(0.080)
Contribution in previous round	-0.017	-0.016
	(0.017)	(0.016)
Round number	0.044***	0.044***
	(0.013)	(0.013)
tLSS	0.180**	0.182**
	(0.092)	(0.092)
tLLS	0.170*	0.199**
	(0.096)	(0.098)
Risk/loss aversion		-0.199**
		(0.082)
Inequality aversion		-0.017
		(0.031)
Trust		0.045
		(0.044)
Constant	4.246***	4.300***
	(0.176)	(0.250)
Observations	1,319	1,319
Number of ID	264	264

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Estimations are random effect linear models with robust standard errors clustered on the group.

Table 5a Contributions by Small Beneficiaries – OLS Model

	(1) Participants' contribution	(2) Participants' contribution
Age of participant	-0.002	-0.002
	(0.004)	(0.003)
Participant female	-0.032	0.031
	(0.148)	(0.159)
Participant attended school	-0.005	-0.011
	(0.130)	(0.128)
Size of the Household	0.028***	0.028***
	(0.011)	(0.011)
Participant is member of a civil society organization	-0.011	-0.034
	(0.162)	(0.162)
Not successful in previous round	-0.076	-0.067
	(0.077)	(0.076)
Contribution in previous round	-0.020	-0.019
	(0.022)	(0.022)
Round number	0.057***	0.057***
	(0.014)	(0.015)
tLSS	0.150	0.152
	(0.104)	(0.104)
tLLS	0.393***	0.398***
	(0.089)	(0.092)
Loss aversion		-0.204**
		(0.099)
Inequality aversion		0.020
		(0.038)
Trust		0.050
		(0.048)
Constant	4.210***	4.063***
	(0.209)	(0.311)
Observations	874	874
Number of ID	175	175

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Estimations are random effect linear models with robust standard errors clustered on the group.

Table 6a Levels of contributions in farmer groups including wealth index – OLS Model

	(1)	(2)	(3)	(4)
	Participants' contribution	Participants' contribution	Participants' contribution	Participants' contribution
	Full sample	*Full sample*	*Small Beneficiaries*	*Small Beneficiaries*
Age of participant	-0.001	-0.002	-0.003	-0.003
	(0.003)	(0.003)	(0.004)	(0.003)
Participant female	0.031	0.041	-0.023	0.024
	(0.103)	(0.109)	(0.118)	(0.134)
Dummy for attended school	-0.054	-0.069	0.088	0.076
	(0.105)	(0.103)	(0.127)	(0.123)
Size of the Household	0.043***	0.039***	0.054***	0.052***
	(0.010)	(0.010)	(0.013)	(0.013)
Participant is member of a civil society organization	0.009	-0.003	0.029	0.005
	(0.133)	(0.132)	(0.150)	(0.151)
Not successful in previous round	-0.099	-0.097	-0.069	-0.062
	(0.079)	(0.080)	(0.074)	(0.074)
Contribution in previous round	-0.016	-0.015	-0.020	-0.019
	(0.017)	(0.017)	(0.022)	(0.022)
Round number	0.044***	0.044***	0.056***	0.056***
	(0.013)	(0.013)	(0.015)	(0.015)
tLSS	0.192**	0.194**	0.185*	0.183*
	(0.087)	(0.088)	(0.102)	(0.102)
tLLS	0.152	0.181*	0.382***	0.391***
	(0.093)	(0.095)	(0.090)	(0.092)
Loss aversion		-0.183**		-0.184**
		(0.080)		(0.093)
Inequality aversion		-0.020		0.021
		(0.032)		(0.039)
Trust		0.035		0.032
		(0.045)		(0.047)
Wealth index	-1.254***	-1.174***	-1.312***	-1.205***
	(0.315)	(0.339)	(0.303)	(0.341)
Constant	4.298***	4.383***	4.247***	4.151***
	(0.180)	(0.264)	(0.211)	(0.322)
Observations	1,309	1,309	869	869
Number of ID	262	262	174	174

Note: * $p<0.1$; ** $p<0.05$; *** $p<0.01$. Estimations are random effect linear models with robust standard errors clustered on the group.