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Abstract: The adoption of sustainable land-use systems (SLUS) remains low among smallholder farmers in Sub-Saharan Africa, mainly due to immediate costs and risks outweighing short-term benefits. This study examines how different payments for environmental services (PES) mechanisms can incentivize SLUS adoption among smallholder farmers in Zimbabwe, assuming a critical mass adoption would enhance environmental services. Using a framed lab-in-the-field experiment with 588 farmers, we modeled SLUS adoption as a threshold public good game and compared three PES mechanisms: individual payments unconditional on reaching an adoption threshold, collective payments conditional on reaching adoption threshold, and a combined approach incorporating both payment types. We also investigated policy framing effects on adoption decisions and explored prosocial and risk preferences' role in decision-making. Results show only the combined payment scheme successfully achieved the SLUS adoption threshold. When the same payment structure was implemented without explicit explanation of the additional payment, contributions dropped to control group levels, highlighting policy framing's crucial role. Social preferences and risk attitudes showed minimal correlation with adoption decisions, although farmers exhibiting other-regarding preferences in the dictator game contributed more to the threshold public good game. These findings advance our understanding of PES design by demonstrating that combining individual and collective payments can overcome coordination challenges in SLUS adoption, while emphasizing clear communication in program implementation.

Keywords: Payment for ecosystem services, Sustainable land-use systems, Threshold public goods game, Collective action, Smallholder agriculture, Lab-in-the-field

JEL Codes: C93, Q15, Q57, O13, D70

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1 Introduction

Global agriculture faces unprecedented challenges from biodiversity loss to extreme climate events. These challenges are particularly pressing in Sub-Saharan Africa (SSA), where environmental degradation threatens already fragile livelihoods. While transitioning towards sustainable land-use systems (SLUS) could help adapt to and mitigate these challenges, their adoption remains low among smallholder farmers despite decades of promotion by governments and NGOs (Arslan et al. 2022). The primary barrier is that transitioning to SLUS can involve immediate additional costs and risks for farmers along with reduced private gains at least in the short term (Karlan et al. 2014; Nyanghura et al. 2024; Wong et al. 2020). At the same time, SLUS generate environmental services (ES) at both farm and landscape levels. While some services like enhanced soil fertility provide direct benefits to individual farmers (private goods), others like improved water quality benefit society as a whole (public goods). Farmers are usually not remunerated for the production of these public goods and paying them for these services would be a fair recognition of the services furnished while helping them adopt more sustainable practices. This creates a social dilemma: individual farmers bear the costs of their pro-environmental behavior through SLUS adoption, while many of the benefits are shared collectively.

Payments for environmental services (PES) are flexible policy tools that can help overcome these barriers by aligning farmers' economic incentives with social and environmental sustainability objectives. By compensating farmers for the public goods they generate, PES programs can address the imbalance between private costs and public benefits. These programs consist of direct payments to ES providers (*e.g.* farmers) conditional on implementing SLUS and can bevoluntary (Engel 2016; Jones et al. 2020; Wunder et al. 2020). However, the conventional version of PES is at the individual's scale, meaning that the payment is dependent on the individual decision of adoption. Such PES fall short of providing certain ES services that are at landscape level (Rudolf et al. 2022) such as improved water quality or enhanced pest management (Pretty & Ward 2001), as these services only emerge when the adoption of SLUS reaches a critical threshold across the landscape (Limbach et al. 2023). This individualistic design also imposes significant contractual burdens and raises important questions on benefit sharing mechanisms. To tackle theses issues, PES can be adapted so that the payment is made when a collective level of SLUS adoption or ES generation is reached (Piñeiro et al. 2020).

PES based on a collective threshold of adoption create contractual inter-dependencies among participants that necessitate coordination (Barnaud et al. 2018). Such schemes have traditionally been implemented primarily to reduce transaction costs and facilitate monitoring. Beyond the enhancement of ES, collective threshold PES facilitate additional forms of cooperation: participants can engage in collective initiatives such as bulk purchasing, group investment, and resource-sharing arrangements (Nourani et al. 2021). These groups can also serve as platforms for knowledge sharing and innovation in agricultural practices (Bodin 2017; Wynne-Jones et al. 2020). Recent research explores how payment design could promote coordination for ES generation (Kaczan et al. 2019; Kerr et al. 2014; Kotchen & Segerson 2019; Segerson 2022). However, the empirical evidence on which design features effectively promote coordination remains limited (Gatiso et al. 2018). The main objective of this paper is to identify payment systems that incentivize farmers to coordinate in their adoption of SLUS.

To represent the dilemma farmers face when choosing between private and public returns, we use a threshold public goods game (TPGG) (Maca-Millán et al. 2021; Midler et al. 2015; Narloch et al. 2012). Using a field experiment with smallholder farmers in Zimbabwe, this study tests the effectiveness of three payment systems in promoting coordination toward pro-environmental behavior. SLUS adoption is analogous to contributing to the public good (the environment), and the threshold represents the minimum area that should be under SLUS to generate ES (from now on, we will only discuss contributions). The game was framed as a land-use decision problem, where each farmer decided how much of their land to allocate to SLUS.

First, we test the effectiveness of a *collective payment* in incentivizing farmers to reach the collective threshold. This payment is triggered by the attainment of the collective threshold, and is proportional to the aggregated contributions. While this payment makes the attainment of the threshold more attractive to farmers, it does not reduce the strategic uncertainty inherent to public goods games, where farmers must make decisions without knowing whether others will contribute sufficiently to reach the threshold. Second, we introduce an *individual payment* that is unconditional on threshold attainment and proportional to the farmers' own contribution level. This payment weakens the social dilemma, as it reduces farmers' potential losses when the threshold is not reached. Finally, we test a payment system that combines both the individual and collective payments, called *combined payment*. This combination increases the likelihood of achieving the threshold, while simultaneously managing individual risks. The **first objective** of this study is to determine the payment system that can best incentivize smallholder farmers to reach the threshold.

Our **second objective** is to identify the role of social and risk preferences on contribution levels. Trust in group members can reduce perceived strategic uncertainty and encourage participation as well as willingness to contribute to the public good (Ansink et al. 2017; Kim et al. 2022). Reciprocal behavior can motivate cooperative behavior as individuals respond to the contributions of others with their own, thus creating a positive feedback loop that supports collective action (Ostrom 1998). Altruism and, more broadly, other-regarding preferences also influence public good provisions as individuals may contribute on the basis that they care about others' welfare and derive utility from improving collective outcomes (M. Blanco et al. 2011; Fehr & Schmidt 1999; Fischbacher & Gächter 2010). Finally, risk attitudes play a decisive role as for instance, risk averse individuals may be less willing to take the risk of contributing compared to risk tolerant individuals (Kocher et al. 2015; Teyssier 2012).

Our **third objective** is to examine how framing may affect contributions levels. In the first three experimental treatments, payments tied to contributions were explicitly presented during the experimental sessions (i.e., farmers knew they would receive a 'bonus' for contributing to the public good). To understand the role of framing, we thus added a fourth treatment where the combined payment was implemented with *no explicit mention of an additional payment for contributing* (named the no-policy-framing treatment).[1] This contributes to the debate on the influence of framing on behavior by providing empirical evidence on whether the way incentives are communicated influences farmers' willingness to contribute to the public good (Benabou & Tirole 2003; Ferré et al. 2023; Levin et al. 1998; Tversky & Kahneman 1981). This is particularly relevant for the design of PES programs, where the effectiveness of incentives may depend not only on their structure but also on how they are presented to and perceived by farmers (Ropret Homar & Knežević Cvelbar 2021).

The findings advance our understanding of PES design and SLUS adoption through three key insights. First, only the combined payment successfully achieves the threshold, providing experimental evidence that combining individual and collective payments can overcome coordination challenges. Second, policy framing is critical in driving adoption - when the explicit explanation of the incentive structure was removed, while maintaining the same payoffs as the combined payment, the contributions were comparable to those of the control group. This highlights the importance of clear communication in PES design. Third, while our analysis reveals minimal correlation between most socio-demographic characteristics and contributions, we found that farmers with other-regarding preferences in the dictator game contributed more in the TPGG, and both household size and secondary education posi-

[1]Due to budget and time constraints, we tested this salience effect only with the combined payment mechanism.

tively correlated with adoption. These results are robust to alternative analytical choices, as demonstrated through our systematic multiverse analysis, which offers a methodological template for future field-based experimental studies.

The remainder of the paper is organized as follows. Section 2 discusses the choices of terminology. Section 3 describes the study context and motivation. Section 4 details the theoretical foundations of our game, experimental design, and empirical strategy. Section 5 presents our empirical findings. Section 6 discusses our findings and provides policy implications. Section 7 concludes and provide suggestions for future research.

2 A note on terminology

In the literature examining PES designed to incentivize coordinated adoption of SLUS and collective action, there is no unified terminology. This section clarifies the various design aspects that may result in the use of the term 'collective' or synonyms. The collective dimension typically refers to either payment conditionality or payment magnitude. Payment conditionality describes whether the payment is contingent on group performance, often measured by a threshold of SLUS adoption. Payment magnitude refers to how the payment size is determined—whether it is proportional to group performance or individual performance (Segerson 2022). Some studies use the term 'collective' to refer to either or both of these aspects.

In Table 1 we summarize the design aspects that can qualify a PES as collective and propose a framework for interpreting the different types of PES. The literature presents various comparisons between these elements, often using similar terminology for different designs. Hayes et al. 2019; Kerr et al. 2014 define collective PES schemes as those contingent upon the group's collective fulfillment of contract conditions.

Kerr et al. (2014) defines collective PES as arrangements where "group members must work together to agree upon the conditions of the arrangement they will jointly enter and then monitor each other and enforce the terms of the agreement." More recent literature primarily uses "collective" to indicate that payment is contingent upon the group's collective fulfillment of contract conditions (*e.g.,* Hayes et al. 2019; Rodriguez et al. 2019). However, another strand of research compares "collective" and "individual" payments based on how payments are calculated: proportional to individual or group adoption (e.g., Gatiso et al. 2018; Midler et al. 2015; Moros, Vélez, Quintero, et al. 2023). In this case, payments depend on meeting a collective threshold, thus both mechanisms qualify as "collective PES" under the aforementioned definition. Segerson (2022), unifies the concepts of conditionality and magnitude under the term "group incentive schemes," where payments are both triggered by and proportional to group performance rather than individual contributions. Beyond payment magnitude and conditionality, the collective dimension may also refer to payment recipients and distribution methods among group members (E. Blanco et al. 2021; V. T. H. Nguyen et al. 2022). Furthermore, thresholds can take various forms and become more complex when designed to ensure spatial coordination among land users (C. Nguyen et al. 2022; Rudolf et al. 2022).

Table 1: PES Nomenclature

Magnitude of payments	**Conditionality** Unconditional on threshold of adoption	 Conditional on threshold of adoption
Proportional to the individual level adoption	Individual unconditional payment	Individual conditional payment
Proportional to the collective level adoption or divided equally	Collective unconditional payment	Collective conditional payment
Fixed amount	Fixed unconditional payment	Fixed conditional payment

Note: This table presents the literature's various conceptualizations of 'collective PES'. For instance, the individual unconditional payment refers to the scenario where the payment is contingent upon a threshold of adoption, but the size of the payment is proportional to the individual adoption level. The types of payments examined in this paper are indicated in grey.

These examples do not represent an exhaustive list of all instances where the term "collective" is applied to PES design, but they offer readers an overview of how terminology varies across the literature. This diversity in terminology makes it challenging not only to discern which specific design features authors are referring to when discussing collective PES, but also to effectively compare results across studies.

This paper examines three payment schemes: individual unconditional payments (hereafter "individual payments"), collective conditional payments (hereafter "collective payments"), and a combination of both approaches (hereafter "combined payments"). Such a comparison, to our knowledge, has not been previously investigated.

3 Study Context

The focus on smallholder farmers in Sub-Saharan Africa (SSA), particularly in Zimbabwe, is justified by several factors. Firstly, in SSA, 80% of farms are smaller than 2 hectares and cover approximately 40% of SSA's total farmland (Lowder et al. 2016). To generate landscape-level benefits, it is crucial that smallholders coordinate in their adoption of SLUS. Secondly, most smallholder farms operate under customary law, presenting an interesting interplay of individual and collective dimensions. Zimbabwe exemplifies this dynamic where 42% of land is under such customary law, called communal land (ZimStat 2019) and inhabited by smallholder farmers.

Our research was conducted in Murehwa district, located 75 kilometers northeast of Harare in Zimbabwe's Mashonaland East province (17°43'S and 31°39'E; 1300 meters above sea level). The district, predominantly under communal land tenure, receives annual rainfall of 750-1000 millimeters between November and April (Rufino et al. 2011). These rainfall patterns combined with good soils availability (FAO 2006) make the area suitable for crop production. Smallholder agriculture in Murehwa is characterized by mixed crop-livestock production systems, with maize as the primary crop. A recent farm typology in the district revealed economic disparities: 46% of surveyed farmers were severely resource-constrained, earning USD 100 per capita annually, 29% were economically vulnerable without alternative income sources, 15% maintained moderate stability through off-farm activities, and 10% were well-resourced, earning USD 617 per capita annually (Manyanga et al. 2023).

Smallholder farmers in Murehwa represent a typical case of agriculture with large yield gaps (Affholder et al. 2013; Dzanku et al. 2015), where ecological intensification is needed—that is, adopting practices that increase yield to combat food insecurity and poverty, while remaining environmentally sustainable (Tittonell et al. 2009).[2] Farmers could benefit from coordinating their adoption for multiple reasons. For instance, while the use of inorganic fertilizers can enhance yields of maize and is necessary in the context of smallholder farming in Murewha (Falconnier et al. 2023; Michelson et al. 2023; Vanlauwe et al. 2014), overuse can harm soil and water quality. Coordinated efforts to manage fertilizer application could help maintain environmental sustainability. Similarly, adopting pest management strategies collectively would ensure more effective control, as pests can be better managed across larger areas rather than isolated farms. The case of sorghum, a drought-resistant crop, offers a compelling example. If only a few farmers grow sorghum, their crops are likely to be over attacked by birds, leading to significant losses. But, if many farmers adopt sorghum simultaneously, bird eating would be distributed, reducing damage to any single plot. Coordination is also crucial for controlled roaming of livestock and thus allow farmers to keep their soil covered with maize residues (mulching) all year around, thus providing numerous ES (Ranaivoson

[2] This aligns with the concept of "sustainable intensification" (Pretty, Toulmin, et al. 2011), which emphasizes improving agricultural productivity without compromising ES.

et al. 2017).

Beyond environmental benefits, collaboration can address economic challenges. Farmers in Murehwa face limited access to affordable inputs and markets for their produce. By coordinating their efforts, they could reduce costs and strengthen their bargaining power. Cooperation could facilitate knowledge sharing, enabling farmers to learn from each other's experiences about what works best in Murehwa's context. While not exhaustive, these examples underscore the importance of widespread adoption of SLUS in the context of Murehwa, both for enhancing ES and overcoming economic constraints. These considerations form the foundation of our study's design.

4 Data and Methodology

We assessed the efficiency of different payments in encouraging farmers to achieve an adoption threshold using a modified threshold public good game (TPGG). This game simulates scenarios where insufficient adoption of SLUS fails to yield the desired collective benefits. Below the adoption threshold, individual efforts yield only individual benefits and no benefits for the community. However, once the threshold is reached, collective benefits arise, enabling farmers to share the rewards of their collective actions. This setup effectively demonstrates the importance of cooperation among farmers, showing that isolated actions are insufficient, but coordinated efforts can overcome costs and generate substantial gains (Deutchman et al. 2022).

4.1 The threshold public good game: theoretical framework

In this section, we present a descriptive overview of the theoretical framework underlying our game and payment mechanisms. The TPGG is adapted from Narloch et al. 2012 and Midler et al. 2015. Our game differs from theirs as the individual payment presented below is *not conditional* on reaching the threshold. The formal model and mathematical proofs are provided in Appendix E.

a. Baseline settings

Consider an n-player public good game with a collective contribution threshold T, which is required for the collective marginal return of the public good, λ. The unique feature of this game is that if the threshold is not met, individual marginal returns from the public good (β) are still available to the players. This sets the game apart from standard threshold public good games where no money-back is guaranteed (*e.g.* Bchir & Willinger 2013; Cadsby & Maynes 1999; Croson & Marks 2000). Individual contributions x_i are constrained by the player's endowment w_i. If an individual anticipates a contribution of X_{-i} from the other players, its individual payoff functions is as follows:

$$\pi_i = \begin{cases} \alpha(w_i - x_i) + \beta x_i + \lambda(x_i + X_{-i}) & \text{if } X \geq T, \\ \alpha(w_i - x_i) + \beta x_i & \text{if } X < T \end{cases} \tag{1}$$

where $X = x_i + X_{-i}$ is the total contribution to the public good.

Considering α to be the returns to the private good, we can normalize it to 1, and let β and λ be positive constants. Additionally, suppose the threshold T is set below W, the total of individual endowments, making it possible to reach the threshold through cooperative effort.

b. Individual payment (ρ)

This payment is based solely on individual contributions and independent of other group members' contributions. Even if the threshold is not reached, subjects are still rewarded for contributing to the public good. This payment reduces the dependence of individual payoffs on the collective outcome and thus the risks associated with others' decision. In other words, the individual payment weakens the social dilemma.

$$\pi_i = \begin{cases} (w_i - x_i) + (\beta + \boldsymbol{\rho}) x_i + \lambda(x_i + X_{-i}) & \text{if } X \geq T, \\ (w_i - x_i) + (\beta + \boldsymbol{\rho}) x_i & \text{if } X < T \end{cases} \tag{2}$$

c. Collective payment (κ)

To incentivize collective action, we test a mechanism where an additional payment is contingent upon the group reaching the threshold and is proportional to the group's aggregated contributions. The collective payment is designed to highlight the importance of cooperation among subjects and to enhance the perceived value of collective action. Payoffs increase significantly when subjects cooperate to achieve the threshold. The payoff function is defined as follows:

$$\pi_i = \begin{cases} (w_i - x_i) + \beta x_i + (\lambda + \boldsymbol{\kappa})(x_i + X_{-i}) & \text{if } X \geq T, \\ (w_i - x_i) + \beta x_i & \text{if } X < T \end{cases} \tag{3}$$

d. Combined payment ($\rho + \kappa$)

Finally, we consider a payment system that integrates both individual and collective payments. This mechanism enhances the value of cooperation while simultaneously reducing the risks associated with contributing. This treatment aims to examine the additivity and potential interaction effects of both payment types. The payoff function is then:

$$\pi_i = \begin{cases} (w_i - x_i) + (\beta + \boldsymbol{\rho})x_i + (\lambda + \boldsymbol{\kappa})(x_i + X_{-i}) & \text{if } X \geq T, \\ (w_i - x_i) + (\beta + \boldsymbol{\rho})x_i & \text{if } X < T \end{cases} \tag{4}$$

4.2 Parameters and framing

The TPGG was framed to mimic an agricultural context, with participants randomly assigned to groups of four, each receiving an endowment of four plots ($w_i = 4$), for a total of 16 plots per group. Participants had to choose the number of plots x_i where they adopted the cropping system B, contributing to the public good. As a result $w_i - x_i$ represented the remaining number of plots allocated to cropping system A, reflecting conventional practices and not generating the public good.

While choosing system B incurred a 60% reduction in individual returns, it generated collective benefits when at least 8 plots per group ($T = 8$) were under this system, providing an additional return of $0.2(x_i + X_{-i})$. This settings represented the baseline. We set $\kappa = 0.11$ and $\rho = 0.21$. The baseline and each of the three payments was tested in an separate treatment group (in-between design). In treatment groups, subjects were informed that there was a 'bonus', individual and/or collective, depending on the number of plots that they put in cropping system B and if the threshold was reached (see instructions in Appendix G).

An additional treatment examined the effect of policy framing by implementing the combined payment payoffs structure without any bonus framing. Essentially, the setup was the same as the baseline, but with the combined payment's payoffs.[3] Figure 1 presents an excerpt of the instructions given to subjects. In the combined payment treatment group, subjects were presented the base payment (Figure 1a, column 3 and 4), and then explicitly showed that contributing to cropping system B would result in a bonus (Figure 1b column 5). In the no-policy-framing treatment, the level of information presented to subjects was the same as for the baseline (Figure 1c, column 5). Finally, to improve comprehension and realism, all payoffs functions were multiplied by 100. Table 2 presents the parametrized payoff functions.

[3]Ideally, we would have tested each treatment with and without bonus framing, but doing so would have required a significant increase in sample size, which was not feasible due to time and budget constraints.

Table 2: Payoff functions with parameters

Payment type	Payoff function	Equation
Baseline	$\begin{cases} 100(4-x_i)+40x_i+20(x_i+X_{-i}) & \text{if } X \geq 8, \\ 100(4-x_i)+40x_i & \text{if } X < 8 \end{cases}$	1
Individual payment	$\begin{cases} 100(4-x_i)+61x_i+20(x_i+X_{-i}) & \text{if } X \geq 8, \\ 100(4-x_i)+61x_i & \text{if } X < 8 \end{cases}$	2
Collective payment	$\begin{cases} 100(4-x_i)+40x_i+31(x_i+X_{-i}) & \text{if } X \geq 8, \\ 100(4-x_i)+40x_i & \text{if } X < 8 \end{cases}$	3
(No-policy-framing) Combined payment	$\begin{cases} 100(4-x_i)+61x_i+31(x_i+X_{-i}) & \text{if } X \geq 8, \\ 100(4-x_i)+61x_i & \text{if } X < 8 \end{cases}$	4

Note: The parameters are $\alpha = 1$, $\beta = 0.4$, $w_i = 4$, $\lambda = 0.2$, $\rho = 0.21$ and $\kappa = 0.11$. x_i corresponds to the number of plots the subject puts under cropping system B. $(4 - x_i)$ corresponds to the number of plots under cropping system A. X is the total number of plots the group puts under cropping system B.

No mention of SLUS nor environmental aspects were included during the experimental sessions. Farmers in the region may have prior exposure to SLUS-related campaigns, which could influence their perceptions positively or negatively. Including these topics risked to unevenly biasing participants' answers, notably if they associated these practices with specific organization or existing public policy. Additionally, addressing environmental concerns would require questions on pro-environmental preferences. Given the session's nearly three-hour length, adding more content was unreasonable. This framing ensured a more controlled environment and that farmers' decisions were driven by economic and pro-social preferences.

4.3 Equilibria

The non-cooperative Nash equilibrium is $x_i = 0$ for all groups members. At equilibrium, no plots are contributed to cropping system B under any treatment. The Pareto optimum is 4, meaning that all players should contribute all their plots. We define the coordination equilibrium such that the threshold T is reached for a given vector of contributions $x = (x_1, x_2, x_3, x_4)$ for players $i = 1, 2, 3, 4$ with all individual contributions being interchangeable.

To compute this equilibrium, we analyze how many plots an individual is willing to contribute based on the expected contributions of the group. Appendix F.2 presents the contribution vectors that qualify as coordination equilibria for each treatment. Without any intervention, we observe that only a contribution of 2 plots is viable, as no individual is willing to bear additional effort.

The payments systems, however, expand the range of viable strategies. Under individual payments, players are willing to contribute 3 plots to enable the group to meet the threshold. With collective or combined treatments, players are further incentivized to contribute 4 plots. While these policies do not alter the equilibrium itself or the fundamental incentives to cooperate, they make it more feasible for players to accept larger contributions and greater effort.

4.4 Measuring pro-social preferences and risk attitudes

To capture the effect of subjects' pro-social preferences and risk attitudes on contribution levels, we implemented complementary experimental tasks. We used a Dictator Game (DG) (Forsythe et al. 1994) to measure altruism. In our version, both players were equally endowed with USD 4 (rather than only player 1) to disentangle altruism from inequality aversion. We used a Trust Game (TG) (Berg et al. 1995) to measure trust and reciprocity. Both games were implemented using strategy methods. To measure risk attitudes, we implemented the "Bomb" Risk Elicitation Task (BRET) (Crosetto & Filippin 2013). The instructions of these complementary experimental tasks are included in the Appendix G. At the end of the session, a questionnaire was administered to the participants. It included self-reported trust questions, such as those developed by Dohmen et al. (2012). Additionally, we gathered subjects' socio-demographic information. Notably, questions related to farming areas, agricultural practices, and sources of income were included.

4.5 Sampling

The survey was conducted in three wards within the Murehwa district of Zimbabwe. For each ward, we selected five villages based on their varying distances to the tarmac road, which served as a proxy for market access. Two experimental sessions were conducted per village – one in the morning and one in the afternoon – with treatments randomly assigned to each session. Each session included between 16 and 20 participants from the same village, and every treatment was implemented twice in each ward. Table 3 presents the distribution of subjects across wards and treatments. To recruit participants, we relied on extension officers to inform the community about a survey being conducted on specific dates. To prevent large crowds on the day of the experiment, no details about the survey's nature were shared in advance. Participation was entirely voluntary.

Table 3: Number of subjects per Ward and treatment

	Ward 4	Ward 26	Ward 28	Total number of subjects
Baseline	40	36	40	116
Collective payment	36	40	40	116
Combined payment	40	40	40	120
Individual payment	40	40	40	120
No-policy-framing combined payment	40	36	40	116
Total number of subjects	196	192	200	588

Note: This table summarizes the distribution of participants across wards and treatments. In three of the sessions, we had only 16 participants instead of the intended 20.

4.6 Experimental sessions

The survey was administered with pen and paper by three enumerators in Shona (local language): one leader explaining the games following a script and two assistants helping subjects answer questions - important in case of low literacy levels in English. Subjects played one treatment over 8 rounds (in-between design), with groups randomly and anonymously assigned (subjects knew the three other members were from the same session but did not know whom exactly). Group composition remained the same for all rounds. Between rounds, answering sheets (see Appendix G) were collected from each player. We used Excel to compute the total number of plots in cropping system B within each group, determine if the threshold was reached, and calculate individual payoffs. The sheets were then returned to subjects. Communication between participants was prohibited during sessions. Each experimental session lasted approximately 3 hours.

Games were played using tokens, and subjects where informed of the equivalence with USD at the beginning of each game. For the TPGG, USD 1 was equal to 10 tokens, and for the three other experimental tasks USD 1 was equal to 1 token. Each game was assigned a color: the TPGG was the 'yellow game', the DG was the 'blue game', the TG was the 'green game' and the BRET was the 'red game.' Once all games were played and before we distributed the socio-demographic questionnaire, subjects would pick someone from the session to randomly select a colored bottle cap from a hat to determine the game to be paid. For the TPGG, if selected, we computed the average of all rounds for each player and rounded it to the next interger. For the DG and TG, as we implemented strategy method, subjects were randomly assigned the role of P1 or P2 and paid according to their attributed role.

Figure 1: Tables given to subjects to present individual returns to cropping systems A and B

Plots in cropping system A	Plots in Cropping system B	Gains for plots in cropping system **A**	Gains for plots in cropping system **B**	Total **individual gains**
4	0	400	0	400
3	1	300	40	340
2	2	200	80	280
1	3	100	120	220
0	4	0	160	160

(a) Baseline

Plots in cropping system A	Plots in Cropping system B	Gains for plots in cropping system **A**	Gains for plots in cropping system **B**	**Individual bonus** for plots under cropping system **B**	Total **individual gains**
4	0	400	0	0	400
3	1	300	40	1 x 21 = **21**	361
2	2	200	80	2 x 21 = **42**	322
1	3	100	120	3 x 21 = **63**	283
0	4	0	160	4 x 21 = **84**	244

(b) Policy framing combined payment

Plots in cropping system A	Plots in Cropping system B	Gains for plots in cropping system **A**	Gains for plots in cropping system **B**	Total **individual gains**
4	0	400	0	400
3	1	300	61	361
2	2	200	122	322
1	3	100	183	283
0	4	0	244	244

(c) No-policy-framing combined payment

Note: This figure presents an excerpt of the instructions provided to subjects. In the table given to participants in the no-policy-framing treatment, while the individual payoffs remain identical to those in the combined payment group, the explanations provided are the same as those given to subjects in the baseline. The additional payment is thus explicit only in the combined payment group. The table for collective returns were similarly presented, see Appendix G.

4.7 Econometric model

We focus on individual contributions, as our objective is to elucidate the factors influencing subjects' contribution, such as the effects of treatment, pro-social preferences, risk attitude, and socio-demographic variables.

a. Mixed effect model

The clustered structure of the data required a model to account for correlation between observations. Two types of correlation exists in the data. One at the subject's level: each subject i contributed for 8 periods, and it is reasonable to assume that i's contribution in t is correlated with their contribution in $t-1$. Another one at the experimental group level: assuming that i and $j \neq i$ belong to the same group, there is likely a correlation between the contributions of subject i and subject j across all periods (except for period 1). To account for these unobservable characteristics, we thus implemented a mixed-effects model with random intercepts at the level of the subject and the experimental group (Andersson et al. 2018; Singmann & Kellen 2019).[4]

Mixed-effects model allows to also include fixed effects. The fixed effects included in our models are round and enumerators effects, the pro-social measures from the DG and TG, the BRET in its continuous form as well as socio-demographic variables. All the variables included in the regression analysis are presented in Appendix A.

The functional form of our mixed effects model is specified as follows:

$$Y_{ijt} = X_{ijt}\beta + \alpha_i + \gamma_j + \epsilon_{ijt} \quad (5)$$

where Y_{ijt} represents the contribution of subject i in group j at time t. X_{ijt} is a vector of fixed effects. α_i and γ_j are random intercepts at the subject and group level respectively, with $\alpha_i \sim N(0, \sigma_\alpha^2)$ and $\gamma_j \sim N(0, \sigma_\gamma^2)$. The error term ϵ_{ijt} follows a normal distribution $N(0, \sigma_\epsilon^2)$.

b. Robustness checks: multiverse analysis

To test the robustness of our results, we conducted a multiverse analysis. Given the numerous analytical decisions we faced—particularly regarding covariate inclusion/exclusion and model specification—this approach allowed us to systematically explore all reasonable combinations

[4]Ordinary least squares estimation is not appropriate because the assumption of independent and identically distributed (iid) observations is violated due to the presence of repeated measures (Singmann & Kellen 2019)

and verify that our findings were not dependent on a specific model choice. The remainder of this section introduces the conceptual background of the multiverse approach, while the specific analytical pathways we considered are detailed in the results section.

When analyzing data, researchers face numerous analytical decisions from data cleaning to which results to present. These choices, referred to as "researchers degree of freedom", include variables coding and transformation, missing values and outliers handling and econometric model selection (to only cite a few). Throughout the analytical process, researchers make decisions that ultimately influence statistical results (Götz et al. 2024; Simonsohn et al. 2020; Steegen et al. 2016).

Each path of analytical choices is called a "universe," and the collection of all possible model specifications that can address a research question constitutes a "multiverse." This concept is particularly relevant in academic contexts where results are typically considered intellectually significant only when meeting a statistical significance threshold of $\alpha = 0.05$. This environment can incentivize researchers to selectively report models showing statistical significance (Brodeur et al. 2020; Simmons et al. 2011; Steegen et al. 2016). The multiverse approach represents a movement toward greater transparency in research by explicitly acknowledging and examining the range of reasonable analytical decisions. For a more comprehensive overview of this approach and its emergence, we refer the reader to (Götz et al. 2024).

5 Results

5.1 Descriptive Statistics

The sample consists of 61% women and the average age was 47 years-old. The average farm size of subjects was 1.7 hectares. A detailed overview of the socio-demographic characteristics can be found in Table B.1 in Appendix B. To assess differences in socio-demographic characteristics between treatment groups, we conducted statistical tests (F-test or Chi-square depending on the variable), presented in Table B.2 in Appendix B, focusing specifically on the same comparisons as done in our regression analysis.

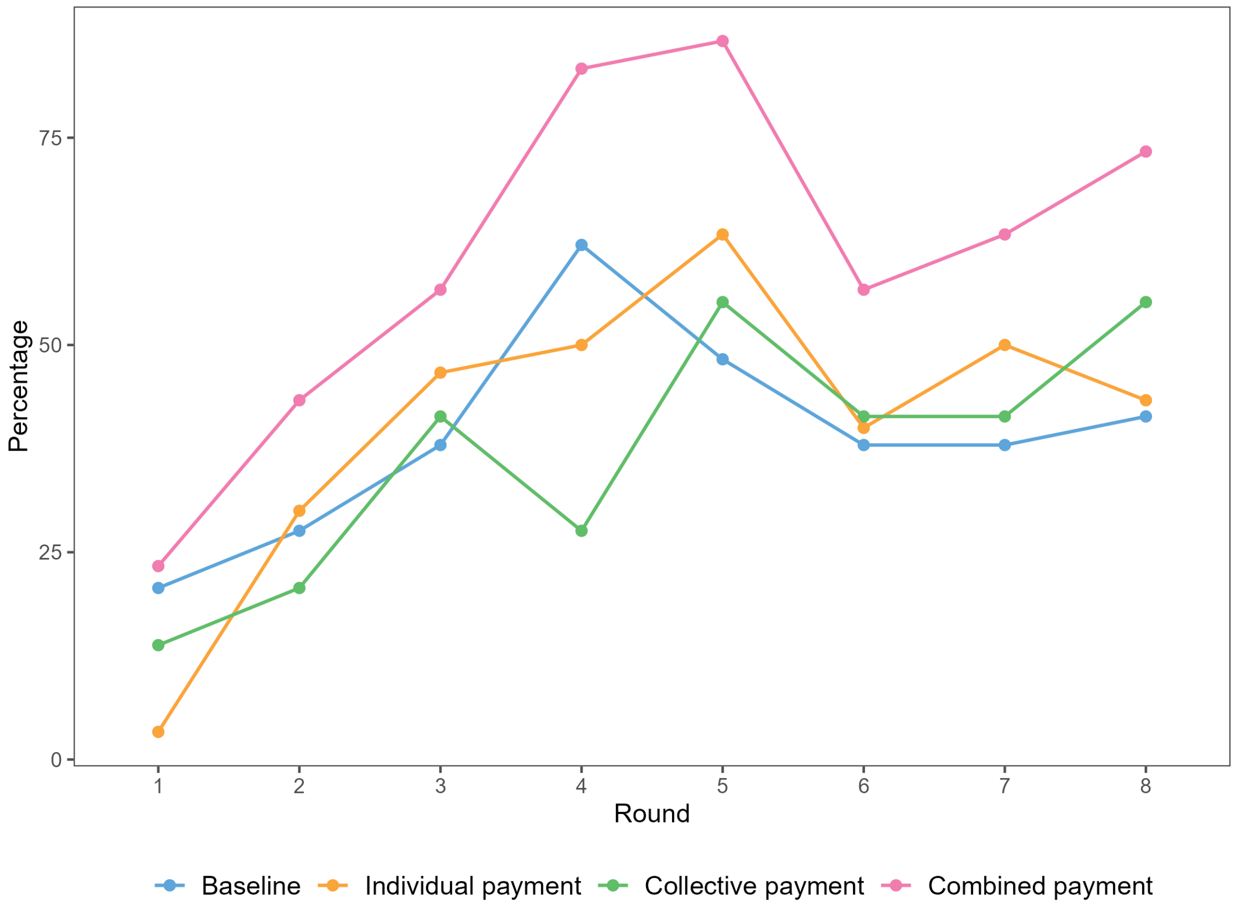
The treatment groups show minimal differences compared to the baseline group, with a few exceptions. Statistically significant differences exist between treatment groups in terms of age and household size. For instance, households in the baseline group are larger by 0.6 members on average compared to households in the collective payment or no-policy-framing treatment group. Regarding age, subjects in the baseline group were 45 years-old on average, while in the collective payment group it averaged 50 years. Although these differences are statistically significant, the differences in magnitude are relatively small. Two additional differences merit attention: first, a higher proportion of subjects in the baseline group had at least a secondary education compared to subjects in the collective payment group; second, more individuals in individual payment group report having off-farm work compared to the baseline group. To account for potential impacts of the socio-demographic differences between treatment groups, we included these variables as covariates in our regression analysis.

5.2 Treatment effects with policy framing

This section examines treatment effects on contributions when the payment system is salient by comparing the baseline with the other treatments where the payment is explicit. Figure 2 shows that experimental groups in the combined payment treatment reached the threshold 61% of the time on average, whereas other treatments ranged between 37-41%. Mean contributions per round and treatment presented in Table 4 show consistently higher contributions in the combined payment. We compared the mean contributions between treatments using Wilcoxon tests (Table 5), which confirmed these results as only the difference between baseline and the combined payment was statistically significant, with combined payment's mean over all rounds staying just above threshold.

A notable pattern emerges around round 5 as contributions dropped in round 6 across all treatments. This dip can be attributed to strategic behavior after groups initially learned to reach the threshold. Once groups achieved success through round 5, some individuals may have attempted to free-ride by reducing their contributions while probably hoping others would maintain higher contribution. Although in the combined payment treatment group also experiences some decline after round 5, more experimental groups remained above the threshold. This indicates that the combined payment treatment effectively maintains threshold-level participation while reducing strategic free-riding.

Figure 2: Percentage of Groups Reaching the Threshold



Note: This graph illustrates the percentage of groups that reached the threshold for each treatment in each round. The threshold is met when a group collectively contributes at least 8 plots to cropping system B.

Table 4: Mean Contributions by Round and Treatment

Round	Baseline	Individual payment	Collective payment	Combined payment
1	4.55	3.13	4.38	4.77
2	5.55	6.40	5.83	6.70
3	6.90	7.13	7.07	8.10
4	7.48	8.03	7.00	9.37
5	7.83	8.37	7.66	10.23
6	6.97	6.43	7.72	8.40
7	6.45	7.73	7.14	8.07
8	6.55	6.97	7.66	8.93

Note: This table presents the mean contribution per treatment and per round.

Table 5: Testing difference in contribution

Comparison	Mean contribution baseline	Mean contribution treatment	p-value	Sig.
Baseline vs. Individual payment	6.53	6.78	0.503	
Baseline vs. Collective payment	6.53	6.81	0.425	
Baseline vs. Combined payment	6.53	8.07	<0.001	**

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Wilcoxon tests were performed to test the difference in contributions between treatment groups where the payment system is explicit. The threshold is met when a group collectively contributes at least 8 plots to cropping system B.

Table 6 presents mixed effects regression results with mean-centered continuous covariates. The intercept represents the average contribution for control group subjects with average characteristics. The combined payment treatment shows a consistent effect across all specifications: participants contribute approximately 0.374 more plots compared to other treatments. The contributions in the individual and collective payments groups are not statistically different from the control groups.

Model 3 reveals several significant relationships between contributions and subjects behavioral and socio-demographic characteristics. Subjects that contributed more in the first round without knowing other group members contributions show a willingness to cooperate (unconditional cooperators) (Midler et al. 2015; Narloch et al. 2012). Each additional plot contributed in the first round of TPGG corresponds to 0.26 higher average contributions throughout the game ($p<0.001$). Players who sent more as Player 1 in the Dictator Game contributed an additional 0.092 plots ($p = 0.019$). These two findings suggests that intrinsic

Table 6: Treatment effect on individual contribution decision

	Dependent variable:		
	Contribution to PG		
	(1)	(2)	(3)
Individual payment	0.051	0.152	0.158
	(0.128)	(0.108)	(0.110)
Collective payment	0.012	0.038	0.088
	(0.130)	(0.110)	(0.114)
Combined payment	0.382**	0.379***	0.374***
	(0.120)	(0.101)	(0.104)
TPPG: Contribution first round		0.263***	0.257***
		(0.034)	(0.034)
DG: Sent by P1		0.099*	0.092*
		(0.039)	(0.039)
DG: First order belief		−0.036	−0.033
		(0.034)	(0.034)
TG: Trust		0.004	−0.0001
		(0.042)	(0.042)
TG: Reciprocity		0.085	0.079
		(0.041)	(0.041)
Risk BRET		−0.046	−0.035
		(0.034)	(0.035)
Age			0.015
			(0.041)
Size of household			0.068*
			(0.034)
Number of cattle			0.007
			(0.034)
Size of farm (acres)			−0.010
			(0.033)
Female			−0.064
			(0.075)
Head of household			−0.011
			(0.087)
Married			0.019
			(0.079)
Have at least secondary education			0.187*
			(0.081)
Remittances less than 100 USD			0.110
			(0.158)
Off-farm			−0.010
			(0.069)
Intercept	1.001***	0.958***	0.731***
	(0.121)	(0.107)	(0.212)
Rounds dummies	*Yes*	*Yes*	*Yes*
Enumerators dummies	*Yes*	*Yes*	*Yes*
Observations	3,776	3,768	3,760
Log Likelihood	-6,481.083	-6,440.685	-6,441.018

Notes: *p<0.05; **p<0.01; ***p<0.001. Two missing values in the dataset: one for age and one for BRET. All continuous variables were mean-centered. Sample means of continuous variables: TPPG Contribution (first round) = 1.1, Dictator Game sent by P1 = 1.4, Dictator Game first order belief = 2.1, Trust Game trust = 1.6, Reciprocity = 1.3, Risk (BRET) = 13, Age = 48, Farm size = 2.1 acres, Household size = 5.7 members. Observations from the no-policy-framing combined payment treatment are excluded. Estimates from linear mixed effects model with random effects for subject and experimental group.

motivations influence contributions. In our context, contributions seem to be motivated more by altruism than by trust and reciprocity (although the coefficient for reciprocity is close to the 5% threshold with p = 0.054). The analysis also shows socioeconomic factors matter: larger households contribute more, with each additional member associated with a 0.069 plot increase (p = 0.0456). Education also plays a role - participants with at least secondary education contribute 0.379 more plots compared to those with primary or no education (p = 0.0212).

5.3 The role of policy framing

We examine the role of policy framing by comparing contributions between two treatments: the policy framing and no-policy-framing payment treatments, which share identical payoff functions but differ in information presentation. The mean contributions in the no-policy-framing treatment reached 6.4 plots, similar to the control group at 6.53 plots (p = 0.492) (Table 7). Subjects in the policy framing treatment achieved significantly higher contributions at 8.07 plots compared to T4 ($p < 0.001$). This indicates that explicitly showing the additional payments drives contributions and that increased payoffs are not sufficient to increase contributions. Regression analyses with our full set of covariates confirm these findings (Table C.1, Appendix C). The policy framing treatment maintains its positive and significant effect ($p < 0.01$ in Model 3), while the no-policy framing shows no significant impact.

Table 7: Comparison of Average Contributions Between Treatment Groups With and Without Policy Framing

Comparison	Mean contributions baseline or policy framing treatment	Mean contributions no-policy-framing treatment	p-value	Sig.
Baseline vs. No-policy-framing treatment	6.53	6.4	0.492	
Policy framing vs. No-policy-framing treatment	8.07	6.4	0.000	***

Note: * $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$. Wilcoxon tests were performed to compare contributions between the baseline group and no-policy-framing combined payment treatment, and between policy framing combined payment treatment and no-policy-framing combined payment treatment.

5.4 Robustness Checks of the Results

We conducted a multiverse analysis to test the robustness of our results. We focus on the treatments where the policy framing was included.[5] Our objective was to demonstrate that

[5]The specification curve examining the effect of policy framing is available in Appendix D.

the results in Table 6 are not specification-dependent. Table 8 presents an overview of all the analytical choices we considered. These include the coding of certain variables such as reciprocity, education, and remittances; the inclusion or exclusion of covariates in our model; and the random effect structure. The options we selected as our preferred specification are indicated in bold in Table 8. For computational efficiency, we grouped related indicators. With this version of the multiverse, the number of specifications is 1,296.

Regarding model selection, various models have been employed in the literature for similar data structure, with OLS, tobit, and ordered probit being the most frequently utilized (Midler et al. 2015; Moros, Vélez, & Corbera 2019; Narloch et al. 2012; Rudolf et al. 2022). However, we posit that the most appropriate modeling approach is either a linear or Poisson (to account for the count nature of the data) mixed-effect model, which allows for the consideration of the panel structure of the data and thus the dependence between observations. Poisson mixed-effect models often face convergence issues (Wood 2011). Thus, despite attempts to incorporate them into our multiverse analysis, many specifications did not converge. Therefore, we only used the linear mixed-effect model in our multiverse analysis but for completeness, the Poisson regressions with covariates are included in Appendix C.

Table 8: Specification Choices for Multiverse Analysis

Measure	Analytical options
	Variable Coding
Reciprocity	1. Number of tokens sent back for each amount received 2. Mean return across all received amounts by Player 2 3. **Mean proportion returned relative to Player 1's sent amount**
Education	1. Original categorical levels 2. Binary: No formal education 3. **Binary: Secondary education or higher**
Remittances	1. Four-level factor (none to >USD 500) 2. **Binary: Less than USD 100**
	Covariate Selection
Pro-social and Economic Preferences	1. None 2. Self-reported trust measures only 3. **Game-derived measures only** (trust, risk, other-regarding preferences) 4. All measures combined
Demographics	1. None 2. Basic demographics (education, gender, age) 3. **Full set** (education, age, female, household size, cattle owned, farm size, household head status, marital status, remittances, off-farm income)
TPPG: Contribution first round	1. Excluded 2. **Included**
Round Fixed Effects	1. **Included**
Enumerator Fixed Effects	1. **Included**
	Model Structure
Random Effects	1. Subject-level only 2. Experimental group-level only 3. **Both subject and group levels**

Notes: Specifications in **bold** correspond to model 3 in Table 6. For computational efficiency, related indicators for pro-social preferences, risk attitudes, and demographics are grouped together.

A key dimension of multiverse analysis is that researchers must include all reasonable specifications, meaning all specifications that make sense both intuitively and econometrically.

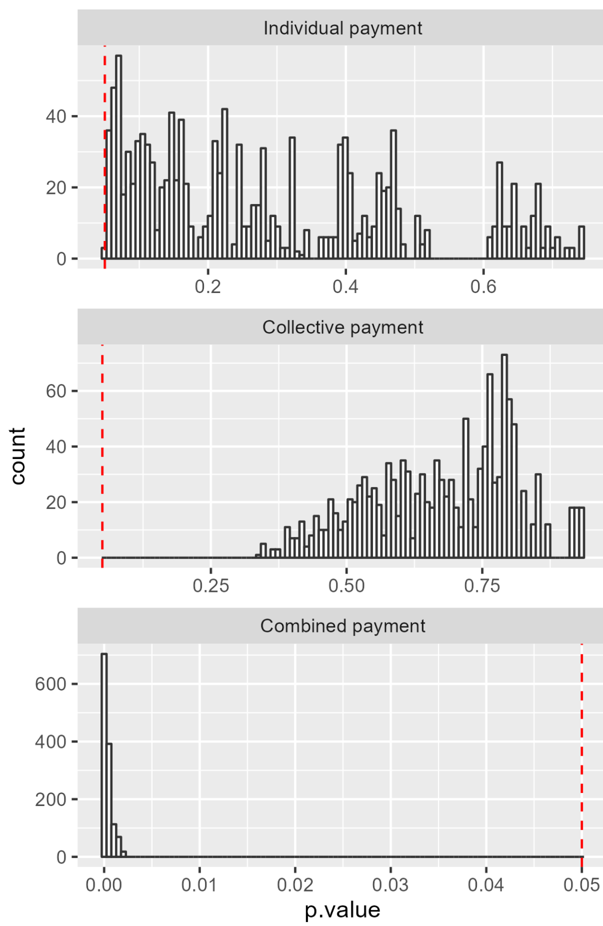
This principle informed our decision to exclude village fixed effects from both our preferred specification and the multiverse analysis. While we initially considered incorporating village fixed effects due to potential differences in local contexts, these village-level characteristics are likely already accounted for by our subject and experimental group random effects structure. The inclusion of village fixed effects could potentially introduce multicollinearity, which may inflate standard errors or reduce degrees of freedom through the addition of numerous dummy variables. Most crucially, with only 40 subjects per village, village fixed effects would restrict comparisons to very limited subsamples, potentially compromising our ability to detect treatment effects without adding explanatory power.

Figure 3: Specification curve

Note: The upper panel presents the estimated effect of the combined payment on the TPGG contribution, with dots colored to indicate if the estimates are statistically significant. The bottom panel displays the tested specification, including dummies for enumerator and round effects. To clarify the specification curve, we excluded some specifications, retaining the most significant (lowest 5% p-values), the least significant (highest 5% p-values), and a random 10% of specifications within this range.

Figure 3 presents the specification curve for the combined payment treatment, as developed by Simonsohn et al. (2015). The top panel displays the effect size and statistical significance (p-value < 0.05), while the lower panel shows the corresponding specifications. The specification curve indicates that the coefficient for the combined payment is always statistically significant at the 5% level. Figure 4 illustrates how the statistical significance of each treatment effect changes across the different analytical choices (*i.e.*, universes) considered in the multiverse analysis. The histograms indicate that both individual and collective payment treatments consistently yield non-significant results across model specifications, whereas the combined payment treatment remains statistically significant across virtually all universes, reflecting high robustness.

Figure 4: P-values histograms



Note: Distribution of p-values for each treatment across universes. The dashed line indicates p = 0.05.

6 Discussion

This study examined the effects of various payment types—individual, collective, or a combined—on group members contributions to the public good. The public good contribution was an analogy for the adoption of sustainable land-use systems (SLUS), operating under the assumption that SLUS adoption would result in a decrease in private gains but generate landscape-level environmental services (ES) if a certain adoption threshold was reached. The results indicate that only subjects in the combined payment treatment increased their contributions sufficiently to reach this threshold. In settings where resources are limited, expecting farmers to bear the full risk of cooperation is likely to lead to failure—as illustrated by the lack of effect in the collective payment treatment. Combined payment schemes offer a promising alternative: the individual component provides a safety net by reducing losses if the threshold is not reached, while the collective component incentivizes coordination toward landscape-level benefits. Implementing such combined schemes, particularly during the early stages of PES programs, may be especially beneficial, as this period is critical for building trust among participants and ultimately promote pro-environmental behavior. Once trust has been established, programs may gain more flexibility to adjust payment structures.

Our results also highlight the role of policy framing. Indeed, removing the explanation of the payment though the 'bonus' lens resulted in contributions similar to the ones in the baseline. This suggests that the way monetary incentives are presented can significantly influence behavior, regardless of the actual payoff. This could be resulting from an anchoring effect and a positive-frame effect (Andreoni 1995; Furnham & Boo 2011; Levin et al. 1998; Tversky & Kahneman 1974). When the payment is salient, subjects evaluate increases against the baseline payment. Without policy framing, this reference point disappears, and thus the contribution decision feels less rewarding. Additionally, the use of the word 'bonus' created a positive frame that could have been more motivating than a neutral framing. Although to confirm this latter aspect it would require additional testing using more neutral framing. This finding implies that the presentation of the PES to farmers should be carefully thought of as it can influence participation. It can also be beneficial to develop tools where farmers can compare their current earnings with what they would earn by participating in the PES.

This study presents evidence that altruism and unconditional cooperation were significant factors in contributions to the public good. The findings suggest that, in addition to monetary motivations, subjects were also influenced by intrinsic non-monetary motivations, since payments did not appear to be the sole driver of contributions. One critical aspect that our experimental design did not address is the interaction between payment mechanisms and intrinsic motivations and whether monetary incentives could crowd-in or crowd-out intrinsic motivations (Lapeyre et al. 2015). The existing literature presents heterogeneous findings, with some studies reporting a crowding-in of motivations, while others observe a crowding-out of motivation (Rode et al. 2015). Finally, we found no correlation between measured risk attitudes and contribution levels, similarly to Kocher et al. (2015). One explanation could be that our risk measurement task was too decontextualized from the agricultural setting. While farmers engaged enthusiastically with the BRET task, their behavior may reflect the perception of the task as a game rather than a proxy for real-world decision-making under risk, potentially limiting its external validity in this context.

Our experimental design present a few limitations. First, we did not allow for communication among subjects. It can be argued that in real life, if the payments were to be implemented, farmers would be able to communicate with one another to coordinate. We contend that this is true if the group is small; however, if the group is larger, it would be more challenging for each member to communicate. Not including communication allowed us to ensure that we have a treatment that is effective even if communication is not possible. From an experimental perspective, it also allowed us to avoid confounding effects, where pre-existing relationships would have influenced contribution levels. Second, we did not include any environmental dimension. While we justify this choice in Section 4, it is important to note that pro-environmental preferences (or the lack thereof) could influence adoption of SLUS (*e.g.,* Cao et al. 2022; Maca-Millán et al. 2021). However, it is reasonable to consider that it should influence the effectiveness of the PES.

Field experiments are a cost-effective way to understand decision-making processes prior to policy implementation and to allow for more design to be considered before testing in real-world contexts where financial and social costs are greater (Moros, Vélez, Quintero, et al. 2023). However, real-world implementation necessitates the consideration of several technical and practical factors not addressed in this study, which could challenge our results. First, the 50% threshold for plots under SLUS may not accurately reflect ES production, and adjusting this threshold could impact contribution levels (Kotchen & Segerson 2019; Moros, Vélez, Quintero, et al. 2023; Rodriguez et al. 2019; Tambunlertchai & Pongkijvorasin 2020). Second, some ES require spatial connectivity between plots under SLUS to materialize, which can be incorporated through an agglomeration bonus or payment (Rudolf et al. 2022). The temporal gap between initial investment in SLUS and the receipt of PES funds can burden smallholders, although this could be mitigated by structuring payments as conditional credit (Cranford & Mourato 2014). Another aspect to consider is to whom the payment would be made: the individual or the group? One practical advantage of collective PES is that it reduces transaction and monitoring costs by having a single contract for a group of farmers. While this factor was not included in our design, it is a key aspect because collective payment may result in elite capture (Hayes et al. 2019; Kerr et al. 2014). Although these aspects were not included in our design, we believe our results can inform PES design in the context of SLUS adoption in developing countries. These considerations also highlight the need for future research to better understand benefit-sharing mechanisms within collective arrangements.

7 Conclusion

This study had three objectives: (1) to compare the effectiveness in increasing adoption of sustainable land-use systems (SLUS) of an individual payment, a collective payment and a combined payment, (2) to identify the role of pro-social preferences and risk attitude on contributions and to (3) to evaluate the role of policy framing on contributions. Using a framed lab-in-the-field experiment, we show that only the combination of a collective conditional payment with an individual unconditional payment was effective in increasing adoption of SLUS, reaching the threshold, and ensuring the generation of collective benefits. We also show that pro-social motivations, such as altruism and unconditional cooperation, positively influenced adoption decisions. Finally, we show that policy framing was key in reaching the threshold, as the absence of explicit mention of the payment system resulted in contributions similar to those in the control group.

Future research should examine whether the combined payment remains effective when the threshold is set higher, requiring greater coordination among farmers. It should also test the full range of individual and collective payment designs outlined in Table 1 to better understand which mechanisms work best in different contexts. Finally, an important next step is to explore how these experimental results can be translated into real-world policy and practice.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work the author(s) used Claude in order to improve readability and English language quality. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

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Appendix A Variables included in analysis

Table A.1: Description of variables

Variable name	**Type of variable**	**Description**	**Experimental task or questionnaire**	**Included in regression**
Treatment	Categorical	Variable indicating if the subject was in T0, T1, T2, T3 or T4.	TPGG	Yes
TPGG: Contribution first round	Integer from 0 to 4	Number of plots that the subject put under cropping system B during the first round.	TPGG	Yes
DG: Sent by P1	Integer from 0 to 4	Amount sent by Player 1 to Player 2	DG	Yes
DG: first order belief	Integer from 0 to 4	Amount expected by Player 2	DG	Yes
TG: Trust	Integer from 0 to 4	Amount sent by Player 1 to Player 2	TG	Yes
TG: Reciprocity	Continuous	We first computed the proportion returned by Player 2 relative to the amount sent by Player 1 for each possible sending scenario (1-4 tokens), then we calculated the mean of the four proportions. Values equal to 1 reflect Player 2 returning exactly what was sent, values above 1 indicate returning more than sent, and values below 1 indicate returning less than sent.	TG	Yes
Risk BRET	Integer 1 to 25	Number of boxes collected	BRET	Yes
Trust family	Categorical	Trust in "your family". =1 Trust completely; =2 Trust somewhat; =3 Do not trust very much; =4 Do not trust at all	Questionnaire	No
Trust neighborhood	Categorical	Trust in "your neighborhood". Same levels as for trust family.	Questionnaire	No
Trust friends	Categorical	Trust in "people you know personally". Same levels as for trust family.	Questionnaire	No
Trust strangers	Categorical	Trust in "people you meet for the first time". Same levels as for trust family.	Questionnaire	No
Age	Continuous	Age of subject	Questionnaire	Yes
Size of household	Continuous	Number of household members	Questionnaire	Yes
Number of cattle	Continuous	Number of cattle at time of survey	Questionnaire	Yes
Size of farm (acres)	Continuous	Size of farm in acres	Questionnaire	Yes
Female	Dummy	1 if female, 0 if male	Questionnaire	Yes
Head of household	Dummy	1 if head of household, 0 otherwise	Questionnaire	Yes
Married	Dummy	1 if married, 0 otherwise	Questionnaire	Yes
Attended at least high-school	Dummy	1 if went to high-school and/or university, 0 otherwise	Questionnaire	Yes
Remittances less than USD100	Dummy	1 if subject or household member received between 0 and USD 100 remittances in the past 12 months, 0 otherwise	Questionnaire	Yes
Off-farm	Dummy	1 if subject or household member had off-farm income in the past 12 months, 0 otherwise	Questionnaire	Yes

Note: This table presents the variables included in the analysis. TPGG = threshold public good game; DG = Dictator game; TG: Trust game; BRET: Bomb risk elicitation task.

Appendix B Descriptive statistics

B.1 Full Sample

Table B.1: Full sample descriptive statistics

Variable	N	Mean/Proportion	s.d.	Min	Pctl. 25	Pctl. 75	Max
Age	587	47	15	16	36	57	100
Size household	588	5.6	2	1	4	7	14
Number of cattle	588	1.4	2.4	0	0	2.2	16
Size farm (acres)	588	4.2	8	0.5	2	5	120
Gender	588						
... Women		61%					
... Men		39%					
Head of household	588						
... Yes		28%					
... No		72%					
Married	588						
... Yes		72%					
... No		28%					
Education	588						
... Yes		70%					
... No		30%					
Remittances < USD 100	588						
... Yes		72%					
... No		28%					
Off-farm	588						
... Yes		54%					
... No		46%					

B.2 Balancing tests for treatment effects

Table B.2: Balancing tests

	Baseline			Ind. payment				Coll. payment				Comb. payment				No-policy-framing				
Variable	N	Mean	s.d.	N	Mean	s.d.	Test Bas. vs. Ind.	N	Mean	s.d.	Test Bas. vs. Coll.	N	Mean	s.d.	Test Bas. vs. Comb.	N	Mean	s.d.	Test Bas. vs. No-pol.	Test Comb. vs. No-pol.
Age	116	45	13	119	48	16	F=2.879*	116	50	16	F=7.45***	120	47	13	F=0.867	116	47	16	F=0.629	F=0.003
Size household	116	5.8	1.8	120	5.7	2.1	F=0.223	116	5.2	1.8	F=6.491**	120	5.8	2.3	F=0	116	5.2	2	F=6.991***	F=5.666**
Number of cattle	116	1.4	2.5	120	1.6	2.3	F=0.147	116	1.2	1.9	F=0.742	120	1.1	1.9	F=1.168	116	1.7	3.1	F=0.686	F=3.425*
Size farm (acres)	116	3.6	2.1	120	5.4	13	F=1.996	116	4.7	11	F=1.076	120	3.6	2.7	F=0.041	116	3.4	2.2	F=1.056	F=0.486
Gender	116			120			X2=1.878	116			X2=2.551	120			X2=1.68	116			X2=0.292	X2=3.898**
... Women		64%			54%				53%				72%				59%			
... Men		36%			46%				47%				28%				41%			
Head of household	116			120			X2=0.089	116			X2=0.905	120			X2=3.232*	116			X2=2.475	X2=0.006
... Yes		25%			22%				19%				37%				35%			
... No		75%			78%				81%				63%				65%			
Married	116			120			X2=0.019	116			X2=1.657	120			X2=0	116			X2=0.087	X2=0.093
... Yes		74%			72%				66%				74%				72%			
... No		26%			28%				34%				26%				28%			
Education	116			120			X2=0.931	116			X2=6.809***	120			X2=0.024	116			X2=0.858	X2=0.401
... Yes		73%			67%				56%				75%				79%			
... No		27%			33%				44%				25%				21%			
Remittances ¡ USD 100	116			120			X2=0.718	116			X2=1.9	120			X2=3.151*	116			X2=0.05	X2=4.852**
... Yes		91%			95%				97%				98%				90%			
... No		9%			5%				3%				2%				10%			
Off-farm	116			120			X2=4.272**	116			X2=0.069	120			X2=0.265	116			X2=0.017	X2=0.062
... Yes		49%			63%				52%				53%				51%			
... No		51%			37%				48%				47%				49%			

Note: *** p < 0.01, ** p < 0.05, * p < 0.01 ; Paired comparisons, each treatment was compared to the baseline and the combined payment treatment group was compared to the no-policy-framing treatment group.

Appendix C Regressions

Table C.1: Policy framing effect on individual contribution decision

	Dependent variable:		
	Contribution to PGG		
	(1b)	(2b)	(3b)
Combined payment *with* policy framing	0.382**	0.386***	0.357**
	(0.136)	(0.109)	(0.111)
Combined payment *without* policy framing	−0.055	0.005	0.012
	(0.139)	(0.111)	(0.114)
TPPG: Contribution first round		0.329***	0.333***
		(0.039)	(0.040)
DG: Sent by P1		0.127**	0.131*
		(0.044)	(0.044)
DG: First order belief		−0.044	−0.040
		(0.038)	(0.039)
TG: Trust		0.070	0.055
		(0.045)	(0.046)
TG: Reciprocity		0.043	0.055
		(0.044)	(0.045)
Risk BRET		−0.024	−0.025
		(0.039)	(0.040)
Age			0.058
			(0.048)
Size of household			0.062
			(0.039)
Number of cattle			0.041
			(0.040)
Size of farm (acres)			0.009
			(0.041)
Female			0.082
			(0.090)
Head of household			0.066
			(0.095)
Married			0.002
			(0.087)
Attended at least high school			0.109
			(0.102)
Remittances less than 100 USD			0.100
			(0.153)
Off-farm			0.029
			(0.079)
Intercept	1.051***	0.968***	0.693***
	(0.140)	(0.119)	(0.222)
Rounds dummies	*Yes*	*Yes*	*Yes*
Enumerators dummies	*Yes*	*Yes*	*Yes*
Observations	2,816	2,808	2,808
Log Likelihood	-4,823.366	-4,776.396	-4,790.450

Notes: *p<0.1; **p<0.05; ***p<0.01. Only observations from T0, T3 and T4 groups are included. All continuous variables were mean-centered. Sample means of continuous variables: TPPG Contribution (first round) = 1.1, Dictator Game sent by P1 = 1.4, Dictator Game first order belief = 2.1, Trust Game trust = 1.6, Reciprocity = 1.3, Risk (BRET) = 13, Age = 46, Farm size = 2 acres, Household size = 5.6 members. Observations from T4 are excluded. Estimates from linear mixed effects model with random effects for subject and experimental group.

Table C.2: Treatment effect on individual contribution decision (Poisson)

	Dependent variable:		
	Contribution to PGG		
	(1)	(2)	(3)
T1: Individual payment	0.034	0.091	0.095
	(0.079)	(0.067)	(0.068)
T2: Collective payment	0.011	0.027	0.064
	(0.081)	(0.068)	(0.070)
T3: Mixed payment	0.206***	0.203***	0.200***
	(0.074)	(0.062)	(0.064)
TPPG: Contribution first round		0.146***	0.141***
		(0.021)	(0.021)
DG: Sent by P1		0.064**	0.058**
		(0.025)	(0.025)
DG: First order belief		−0.022	−0.020
		(0.021)	(0.021)
TG: Trust		0.005	0.003
		(0.026)	(0.026)
TG: Reciprocity		0.061**	0.056**
		(0.026)	(0.026)
Risk BRET		−0.026	−0.017
		(0.022)	(0.022)
Age			0.002
			(0.025)
Size of household			0.037*
			(0.021)
Number of cattle			0.008
			(0.021)
Size of farm (acres)			−0.010
			(0.022)
Female			−0.034
			(0.046)
Head of household			−0.004
			(0.054)
Married			0.027
			(0.049)
Attended at least high school			0.126**
			(0.051)
Remittances less than 100 USD			0.082
			(0.099)
Off-farm			0.002
			(0.043)
Intercept	−0.056	−0.082	−0.263*
	(0.080)	(0.072)	(0.137)
Rounds dummies	*Yes*	*Yes*	*Yes*
Enumerators dummies	*Yes*	*Yes*	*Yes*
Observations	3,776	3,768	3,760
Log Likelihood	-6,229.452	-6,175.682	-6,159.885

Notes: *p<0.05; **p<0.01; ***p<0.001. Two missing values in the dataset: one for age and one for BRET. All continuous variables were mean-centered. Sample means of continuous variables: TPPG Contribution (first round) = 1.1, Dictator Game sent by P1 = 1.4, Dictator Game first order belief = 2.1, Trust Game trust = 1.6, Reciprocity = 1.3, Risk (BRET) = 13, Age = 48, Farm size = 2.1 acres, Household size = 5.7 members. Observations from the no-policy-framing treatment are excluded. Estimates from Poisson mixed effects model with random effects for subject and experimental group.

Table C.3: Policy framing effect on individual contribution decision (Poisson)

	Dependent variable:		
	Contribution to PGG		
	(1)	(2)	(3)
Combined payment *with* policy framing	0.205*	0.211***	0.191*
	(0.092)	(0.074)	(0.075)
Combined payment *without* policy framing	−0.053	−0.022	−0.017
	(0.095)	(0.077)	(0.078)
TPPG: Contribution first round		0.181***	0.182***
		(0.025)	(0.025)
DG: Sent by P1		0.083***	0.084***
		(0.029)	(0.029)
DG: First order belief		−0.029	−0.028
		(0.026)	(0.026)
TG: Trust		0.056*	0.047
		(0.030)	(0.030)
TG: Reciprocity		0.035	0.043
		(0.029)	(0.030)
Risk BRET		−0.021	−0.017
		(0.026)	(0.026)
Age			0.023
			(0.032)
Size of household			0.029
			(0.025)
Number of cattle			0.025
			(0.026)
Size of farm (acres)			0.010
			(0.027)
Female			0.065
			(0.058)
Head of household			0.040
			(0.062)
Married			0.026
			(0.057)
Attended at least high school			0.081
			(0.067)
Remittances less than 100 USD			0.088
			(0.103)
Off-farm			0.028
			(0.052)
Intercept	−0.026	−0.078	−0.310*
	(0.098)	(0.086)	(0.152)
Rounds dummies	*Yes*	*Yes*	*Yes*
Enumerators dummies	*Yes*	*Yes*	*Yes*
Observations	2,816	2,808	2,808
Log Likelihood	-4,617.889	-4,561.440	-4,557.720

Notes: *p<0.05; **p<0.01; ***p<0.001. One missing value from the BRET game. All continuous variables were mean-centered. Sample means of continuous variables: TPPG Contribution (first round) = 1.1, Dictator Game sent by P1 = 1.4, Dictator Game first order belief = 2.1, Trust Game trust = 1.6, Reciprocity = 1.3, Risk (BRET) = 13, Age = 46, Farm size = 2 acres, Household size = 5.6 members. Observations from the individual and collective payment treatment groups are excluded. Estimates from Poisson mixed effects model with random effects for subject and experimental group.

Appendix D Specification curve for policy framing effect

Figure 5: Specification curve - Policy framing effect

Note: The upper panel presents the estimated effect of the combined payment on the TPGG contribution, with dots colored to indicate if the estimates are statistically significant. The bottom panel displays the tested specification, including dummies for enumerator and round effects. To clarify the specification curve, we excluded some specifications, retaining the most significant (lowest 5% p-values), the least significant (highest 5% p-values), and a random 10% of specifications within this range.

Appendix E Model and Equilibriums

E.1 Baseline

Consider a n-player Public good game with a collective threshold of contribution T as a necessary condition for the marginal return of the public good λ. The specificity of this game is that, if the threshold is not reached, individual returns β from the public good are still available for the players. It distinguishes this game from the standard Threshold public good games with no money-back guaranteed (*e.g.* Bchir & Willinger 2013; Croson & Marks 2000; Isaac et al. 1989). The individual contributions x_i are constrained by an individual endowment w_i. The payoff functions are described as follows:

$$\pi_i = \begin{cases} \alpha(w_i - x_i) + \beta x_i + \lambda(x_i + X_{-i}) & \text{if } X \geq T, \\ \alpha(w_i - x_i) + \beta x_i & \text{if } X < T \end{cases}$$

For consistency with the model of Midler et al. 2015, our model can be described as follows:

$$\pi_i = \begin{cases} P_{i,A}X_{i,A} + P_{i,B}X_{i,B} + B(X_{i,B} + \sum_{j\neq i}^{n} X_{j,B}) & \text{if } \sum_{i=1}^{n} X_{i,B} \geq T, \\ P_{i,A}X_{i,A} + P_{i,B}X_{i,B} & \text{if } \sum_{i=1}^{n} X_{i,B} < T \end{cases}$$

with $P_{i,A}$ and $P_{i,B}$ corresponding respectively to the payoffs of player i for cultivating one land unit of variety A and variety B. We denote these private marginal per capita return (MPCR), α and β. Since players allocate their endowment w_i between these two activities, we denote x_i the allocation in variety B and $w_i - x_i$ the allocation in variety A. The public MPCR B when T is reached is denoted as λ.

Consider we normalize $\alpha = 1$ and β and γ are positive constants. Consider that T the threshold is lower than W the sum of individual endowments to make the threshold reachable by cooperation.

$$\pi_i = \begin{cases} (w_i - x_i) + \beta x_i + \lambda(x_i + X_{-i}) & \text{if } X \geq T, \\ (w_i - x_i) + \beta x_i & \text{if } X < T \end{cases}$$

Proposition 1. *If $\beta + n\lambda < 1$ then $x_i^* = 0$ and there is neither collective nor individual interest to invest in the public good.*

Proof. If every player i contributes w_i, then $\sum_{i=1}^{n} x_i = \sum_{i=1}^{n} w_i = W$. The sum of the payoff functions can be written $\Pi = (W - X) + \beta X + n\lambda X$ which is greater than the sum of payoff functions of every player i contributing $x_i = 0$ only if $(W-X)+\beta X+n\lambda X > X \Leftrightarrow \beta+n\lambda > 1$.

If every player j contribute $x_j = 0$, then the sum of contributions is $\sum_{j=1}^{n} x_j = 0$, then player i payoff becomes $\pi_i = w_i - x_i + \beta x_i = w_i + (\beta - 1)x_i < w_i$. If $\beta < 1$, then $x_i^* = 0$ is a

Nash equilibrium. This holds even if $w_i > T$ and that i can reach the threshold alone since $\pi_i = w_i - x_i + \beta x_i + \alpha x_i = w_i + (\beta + \alpha - 1)x_i < w_i$ □

Proposition 2. *If $\beta > 1$ then $x_i^* = w_i$ and there is no social dilemma.*

Proof. If every player $j \neq i$ contributes 0, then $\sum_{j=1}^{n} x_j = 0$. If player i contributes any positive amount $x_i > 0$, then her payoff becomes $\pi_i = w_i - x_i + \beta x_i = w_i + (\beta - 1)$. We exclude cases in which a player could by himself reach the threshold with $w_i < T$. If $\beta > 1$, then $x_i^* = w_i$ is a Nash equilibrium. Considering that players are symmetric, then the collective contribution is $X = W$. This is true for any $\beta > 1$ whether or not $W > T$. For $W > T$ this is true only if $\beta > 1$ and $\lambda > 1 - \beta$, which is true by assumption with λ a positive constant. □

Proposition 3. *If $\beta < 1$ and $\beta + n\lambda > 1$ then $X^* = \sum_{i=1}^{n} x_i^* = 0$ is a Nash equilibrium (Safe option).*

Proof. If every player $j \neq i$ contributes 0, then $\sum_{j=1}^{n} x_j = 0$ and the threshold T is not reached. If player i contributes any positive amount $x_i > 0$, then her payoff becomes $\pi_i = w_i - x_i + \beta x_i = w_i + (\beta - 1)x_i < w_i$. If $\beta < 1$, then $x_i^* = 0$ is a Nash equilibrium. □

Proposition 4. *If $\beta < 1$ and $\beta + n\lambda > 1$ then $X^* = \sum_{i=1}^{n} x_i^* = W = \sum_{i=1}^{n} w_i$ is the Pareto solution (Social optimal option).*

Proof. If the sum of contributions equals the sum of endowments W such that $X^* = \sum_{i=1}^{n} w_i^* = W$, any deviation denoted d from the maximum contribution X then leads to a change of collective profit function from $\Pi = (W - X) + \beta X + n\lambda X$ to $\Pi^D = (W - (X - d)) + \beta(X - d) + n\lambda(X - d)$. The inequality $\Pi > \Pi^D \Leftrightarrow 0 > d(1 - \beta - n\lambda)$ is true by assumption, since $\beta + n\lambda > 1$ is a necessary condition for the existence of a social dilemma. The demonstration for the case in which $T > W$ is superficial since we focus on cases in which the threshold is reachable. □

Proposition 5. *If $\beta < 1$ and $\beta + \lambda > 1$ then, if the threshold is reached, the social optimum $\hat{x}_i = w_i$ is a Nash equilibrium (Socially optimal option).*

Proof. If the sum of contributions equals the threshold such that $X^* = \sum_{i=1}^{n} x_i^* = T$, any negative deviation denoted d from the contribution x_i then leads to a change of profit function from $\pi_i = w_i - x_i + \beta x_i + \lambda(x_i + X_{-i})$ to $\pi_i = w_i - (x_i - d) + \beta(x_i - d)$. Consider the following inequality:

$$\begin{aligned}\pi_i > \pi_i^D &\Leftrightarrow w - x_i + \beta x_i + \lambda(x_i + X_{-i}) > w - (x_i - d_i) + \beta(x_i - d)\\ &\Leftrightarrow \lambda(x_i + X_{-i}) > (\beta - 1)d\end{aligned}$$

which is true by assumption, since $\beta < 1$ is a necessary condition for the existence of a social dilemma.

Moreover, any positive deviation denoted d from the contribution x_i then leads to a change of profit function from $\pi_i = w_i - x_i + \beta x_i + \lambda(x_i + X_{-i})$ to $\pi_i = (w_i - (x_i + d)) + \beta(x_i + d) + \lambda((x_i + d) + X_{-i})$. It implies $\Pi < \Pi^D \Leftrightarrow 0 < d(\beta + \lambda - 1)$ which is true only if $\beta + \lambda > 1$.

Accordingly, if the threshold T is reached and $\beta + \lambda > 1$, contributing $x_i^* = w_i$ is the best response. Then, under these conditions, the social optimum is a Nash equilibrium. □

Proposition 6. *If $\beta + \lambda < 1 < \beta + n\lambda$ then, if the threshold is reached, the threshold level contribution $X^* = T$ is also a Nash equilibrium (Coordination option).*

Proof. For the negative deviation, the proof is similar to Proposition 5: if the threshold is reached, it is not an equilibrium to contribute less than the current state. For the positive deviation, the inequality $\Pi > \Pi^D \Leftrightarrow 0 > d(\beta + \lambda - 1)$ is true if $\beta + \lambda < 1$. Then contributing more than the current state is not an equilibrium. Accordingly, not deviating from the threshold level $X = T$ is a Nash equilibrium if $\beta + \lambda < 1 < \beta + n\lambda$. □

E.2 With ρ a monetary nudge

If we consider ρx_i a monetary nudge given by the government following any positive contribution to the public good, the profit function is described as follows:

$$\pi_i = \begin{cases} (w_i - x_i) + \beta x_i + \rho x_i + \lambda(x_i + X_{-i}) & \text{if } X \geq T, \\ (w_i - x_i) + \beta x_i + \rho x_i & \text{if } X < T \end{cases}$$

According to the previous proofs, if $\beta + \rho > 1$ there is no more social dilemma. Conversely, if $\beta + \rho < 1$, the social dilemma remains. Then, to conserve the same setting than in the previous section, each β can be replaced by $\beta + \rho$.

Intuition: This particular subsidy is designed to encourage collective action. In the communities we engage with, there appears to be a lack of trust among individuals, complicating any efforts toward collective action. Hence, the monetary nudge is conceived as a subtle incentive, smaller in scale than the collective payment, to encourage participation without replacing the primary benefit of collaboration.

E.3 With κ a collective payment

If we consider κX a conditional payment given by the government when the threshold T is reached, the profit function is described as follows:

$$\pi_i = \begin{cases} w_i - x_i + \beta x_i + (\lambda + \kappa)(x_i + X_{-i}) & \text{if } X \geq T, \\ w_i - x_i + \beta x_i & \text{if } X < T \end{cases}$$

Proposition 7. *Implementing a collective payment κ:*

i. does not affect the Safe Nash equilibria $x_i^* = 0$ *and the Threshold Nash equilibria* $X^* = T$ *if* $\beta + \lambda + \kappa < 1 < \beta + n(\lambda + \kappa)$*,*

ii. shifts the Threshold Nash equilibria to the Social optimum $\hat{X} = W$ *if* $\beta + \lambda + \kappa > 1$*.*

Proof. i. Since adding κ the the inequalities $\beta + \lambda < 1 < \beta + n\lambda$, the proof is similar to the proof of Proposition 6. *ii.* Conversely, since adding κ to $\beta + \lambda$ make the inequality shifts from $\beta + \lambda < 1$ to $\beta + \lambda + \kappa > 1$, every player i deviates positively from $X = T$ leading to $X = W$ as shown in the proof of Proposition 5. □

Result 1. *In a setting corresponding to the Proposition 6, a collective reward given to everyone by the government when the threshold is reached shifts the threshold equilibrium to the socially optimal equilibrium if* $\kappa > 1 - (\beta + \lambda)$*. If the setting corresponds to the Proposition 5, it has no effect.*

Intuition: The objective is to promote collective action, so the majority of the payment will be contingent upon reaching the specified threshold.

E.4 With a monetary nudge (ρ) and a collective payment (κ)

Now let's consider a case where we bring both the monetary nudge and the collective payment together.

$$\pi_i = \begin{cases} (w_i - x_i) + \beta x_i + \rho x_i + (\lambda + \kappa)(x_i + X_{-i}) & \text{if } X \geq T, \\ (w_i - x_i) + \beta x_i + \rho x_i & \text{if } X < T \end{cases}$$

If $\beta + \rho < 1$ then the social dilemma remains. The introduction of κ leads to the same result than for section E.3. Nevertheless, to conserve the same setting than in the previous sections, each β has to be replaced by $\beta + \rho$.

Appendix F Setting

F.1 Parameters

The parameters used in our setting are $\alpha = 1$, $\beta = \frac{2}{5}$ and $\lambda = \frac{1}{5}$. Their setting respects:

- the Proposition 1 with $\beta + n\lambda = \frac{2}{5} + 4 * \frac{1}{5} = \frac{6}{5} > 1$,
- the Proposition 2 with $\beta = \frac{2}{5} < 1$,
- the Proposition 3 with $\beta < 1$ and $\beta + n\lambda > 1$ leading to the safe non-cooperative Nash equilibrium of $x_i^* = 0$,
- the Proposition 4 with $\beta < 1$ and $\beta + n\lambda > 1$ leading to a Social optimum of $\hat{X} = W$,
- the Proposition 6 with $\beta + \lambda = \frac{3}{5} < 1$ and $\beta + n\lambda > 1$ leading to the coordination Nash equilibrium of $X^* = T$ for any combination of x_i,

but not the Proposition 5 to have an interior solution corresponding to the threshold T.

In the Collective Reward treatment, $\kappa = 0.09$. Then, according to Proposition 7, since adding κ does not lead $\beta + \lambda + \kappa = 0.69$ to be greater than 1, the interior solution $X = T$ is conserved.

In the Individual Reward treatment, $\rho = 0.21$. Then, adding ρ such that $\beta + \rho = 0.61 < 1$ does not change the equilibria.

If both are introduced, then Propositions 1, 2, 3 and 4 are respected. And Propositions 6 and 7i. are still true since $\beta + \rho + \lambda + \kappa = 0.90 < 1$ maintaining the interior solution.

F.2 Equilibria

The following equilibria will be written as vectors of contributions $x = (x_1, x_2, x_3, x_4)$ for players $i = \{1, 2, 3, 4\}$ with all individual contributions being interchangeable. All following predictions are computed using the previous parameters.

Definition 1. *The non-cooperative Nash equilibrium $x_i^* = 0$ that we call the Safe solution is maintained in all treatments. We can write this solution as the following vector of contributions* $(0, 0, 0, 0)$.

Definition 2. *The Pareto optimum $\hat{X} = \sum_{i=1}^{n} w_i = W$ is also similar and is reached when the vector of contributions is* $(4, 4, 4, 4)$.

Definition 3. *We define the coordination equilibrium such that the threshold $X = T = 8$ is reached for a given vector of contribution.*

Without any mechanism and considering a threshold $T = 8$, since the setting implies an interior solution (Proposition 6), we have to study the vectors of contributions.

Prediction 1. *Without any mechanism and for a threshold $T = 8$, the vector of contributions*

$(2, 2, 2, 2)$ *is a coordination equilibrium.*

Proof. Consider T the threshold to be reached to shift the function, if the current state is $X_{-i} = T - k$, we compare $\pi_i(k, T-k) = w_i - k + \beta k + \lambda T$ to $\pi_i(0, T-k) = w_i$. Then $\pi_i(k, T-k) > \pi_i(0, T-k)$ only if $\frac{1-\beta}{\lambda} < \frac{T}{k}$.

Using this we can test for the vectors of contribution of the Threshold equilibrium. Consider $X_{-i} = 6$, then $k = 2$. According to the previous inequality, contribution $x_i = 2$ is an equilibrium if $\frac{1-\frac{2}{5}}{\frac{1}{5}} < \frac{8}{2} \Leftrightarrow 3 < 4$ which is true. But with $X_{-i} = 5$ and $k = 3$, it does not hold anymore since $3 > \frac{8}{3}$. According to these results, since players are symmetric, the only possible vector of contributions is $x = (2, 2, 2, 2)$. □

Prediction 2. *With the collective payment* κX *and for a threshold* $T = 8$*, all permutations of the vectors of contributions* $(0, 1, 3, 3)$*,* $(0, 2, 2, 3)$*,* $(1, 1, 1, 3)$*,* $(1, 2, 2, 2)$ *are coordination equilibria.*

Proof. The proof is similar to the previous one but by replacing λ by $\lambda + \kappa$ leading to the following inequality $\frac{1-\beta}{\lambda+\kappa} < \frac{T}{k}$ as the condition for reaching the threshold equilibrium from a current state of $X_i = T - k$.

If $X_{-i} = 7$ and $k = 1$, then $2.07 < 8$. If $X_{-i} = 6$ and $k = 2$, then $2.07 < \frac{8}{2}$. If $X_{-i} = 5$ and $k = 3$, then $2.07 < \frac{8}{3}$. But if $X_{-i} = 4$ and $k = 4$, then $2.07 > \frac{8}{4}$. □

Prediction 3. *With the monetary nudge* ρx_i *and for a threshold* $T = 8$*, all permutations of the vectors of contributions* $(0, 0, 3, 4)$*,* $(0, 1, 2, 4)$*,* $(1, 1, 1, 4)$*,* $(0, 1, 3, 3)$*,* $(0, 2, 2, 3)$*,* $(1, 1, 2, 3)$*,* $(1, 2, 2, 2)$ *are coordination equilibria.*

Proof. The proof is similar to the previous one but by replacing β by $\beta + \rho$ leading to the following inequality $\frac{1-(\beta+\rho)}{\lambda} < \frac{T}{k}$ as the condition for reaching the threshold equilibrium from a current state of $X_i = T - k$.

If $X_{-i} = 7$ and $k = 1$, then $1.95 < 8$. If $X_{-i} = 6$ and $k = 2$, then $1.95 < \frac{8}{2}$. If $X_{-i} = 5$ and $k = 3$, then $1.95 < \frac{8}{3}$. If $X_{-i} = 4$ and $k = 4$, then $1.95 < \frac{8}{4}$. But if $X_{-i} = 3$ and $k = 5$, then it is impossible since $k > w_i$. □

Prediction 4. *With both nudges* κX*,* ρx_i *and for a threshold* $T = 8$*, all permutations of the vectors of contributions* $(0, 0, 3, 4)$*,* $(0, 1, 2, 4)$*,* $(1, 1, 1, 4)$*,* $(0, 1, 3, 3)$*,* $(0, 2, 2, 3)$*,* $(1, 1, 2, 3)$*,* $(1, 2, 2, 2)$ *are coordination equilibria.*

Proof. The proof is similar to the previous one but by replacing β by $\beta + \rho$ leading to the following inequality $\frac{1-(\beta+\rho)}{\lambda+\kappa} < \frac{T}{k}$ as the condition for reaching the threshold equilibrium from a current state of $X_i = T - k$.

If $X_{-i} = 7$ and $k = 1$, then $0.90 < 8$. If $X_{-i} = 6$ and $k = 2$, then $0.90 < \frac{8}{2}$. If $X_{-i} = 5$ and $k = 3$, then $0.90 < \frac{8}{3}$. If $X_{-i} = 4$ and $k = 4$, then $0.90 < \frac{8}{4}$. But if $X_{-i} = 3$ and $k = 5$, then it is impossible since $k > w_i$. $\square$

Appendix G Instructions

In this session you will play 4 games and answer survey questions. Each game is named according to a colour: the yellow game, the blue game, the green game and the red game. In these games you can win money: the amount of money that you will win depends on your choices and on the choices of other players. Only one game will be paid. When the games are finished, an “innocent hand” will pick a bottle cap from the pot. If the yellow bottle cap is chosen then the yellow game will be paid, if the blue bottle cap is chosen the blue game will be paid, if the green bottle cap is chosen the green game will be paid, if the red bottle cap is chosen the red game will be paid.

Your participation in this game is voluntary. You will receive a participation fee of 2 USD. If at any time you want to leave the game, you can do it with no problem. However, we will not be able reward your game performance. If you reach the end of this session, you will receive proof of participation that will contain the amount that we must pay to you. We will hand you over your earnings at the end of all the activity.

Welcome to the games. This study aims at investigating individual and group behavior in certain contexts. These games will be carried all across Murehwa district.

Yellow game

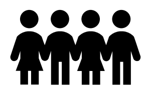
In this game you can earn money: **the amount that you will earn depends on your choices and on the choices of other players**. This game will be played over multiple rounds. You will earn the mean of your total gains for the 8 rounds.

From this point forward, we kindly ask you to refrain from communicating with one another and to keep electronic devices, such as phones, tablets etc., out of reach. We aim to keep your decisions private and confidential. Should you have any questions, whether presently or at any time during the session, please feel free to raise your hand. All questions will be addressed in private. If the question is of general interest, we may discuss it openly.

Game Instructions

1. In this game, there are two cropping systems.
   - **Cropping system A**: a cropping system that has higher individual benefits
   - **Cropping system B**: a cropping system where there are lower individual benefits but has benefits for the group. These benefits happen only if you agree with the other farmers in the group to implement this cropping system.

2. Each participant belongs to a **4-players group**. The group members are seated anywhere in the room. You don't know who they are, and they don't know who they're grouped with. **You will be in the same group for the all duration of the game**.

1 group = 

4 players

3. You are given **4 plots**. They are all of 1 acre each. Each person has 4 acres for a total of **16 acres in your group** (4 acres x 4 players = 16 acres).

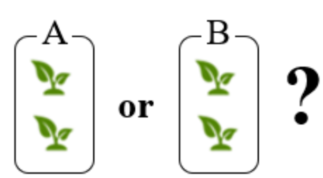
4 plots per player

= 4 acres per player

16 plots per group

= 16 acres per group

Your decision: Each participant must choose the use that they will assign to each of their 4 plots between cropping system A and cropping system B.



There is NO GOOD or BAD DECISION in this game. They are simply your **preferred** option.

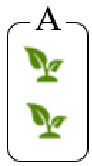
Your gains: you will receive individual gains that only depend on how you used the land, and you will receive collective gains that depend upon the group decisions of the 16 plots (4 plots for each player).

100 tokens = 1 USD

100 x  = 

BASELINE AND COLLECTIVE PAYMENT

Individual gains: you will receive 100 tokens for each plot under cropping system A and 40 tokens for each plot under cropping system B.

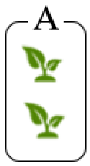


= 100 tokens 

= 40 tokens 

Plots in cropping system A 	Plots in Cropping system B 	Gains for plots in cropping system **A**	Gains for plots in cropping system **B**	Total **individual gains** 
4	0	400	0	400
3	1	300	40	340
2	2	200	80	280
1	3	100	120	220
0	4	0	160	160

Individual gains: you will receive 100 tokens for each plot under cropping system A and 40 tokens for each plot under cropping system B.



= 100 tokens

= 40 tokens

For every plot that you choose to put under cropping system B, **you earn an individual bonus of 21 tokens**. This bonus **depends only on your choices**, and not on the choices of the other members of the group. Your total individual earnings for each plot under cropping system B are thus:

= 40 + **21** = 61 tokens

Plots in cropping system A	Plots in Cropping system B	Gains for plots in cropping system **A**	Gains for plots in cropping system **B**	**Individual bonus** for plots under cropping system **B**	Total **individual gains**
4	0	400	0	0	400
3	1	300	40	1 x 21 = **21**	361
2	2	200	80	2 x 21 = **42**	322
1	3	100	120	3 x 21 = **63**	283
0	4	0	160	4 x 21 = **84**	244

Individual gains: you will receive 100 tokens for each plot under cropping system A and 61 tokens for each plot under cropping system B.

A = 100 tokens

B = 61 tokens

Plots in cropping system A	Plots in Cropping system B	Gains for plots in cropping system **A**	Gains for plots in cropping system **B**	Total **individual gains**
4	0	400	0	400
3	1	300	61	361
2	2	200	122	322
1	3	100	183	283
0	4	0	244	244

Collective gains: for your group to start receiving collective gains, at least **8 plots in total** need to be allocated by the group to cropping system B **(threshold)**. It means that if your group reaches together this goal, **then you get additional gains.** If your group contributes less than 8 plots, then you only earn the individual gains.

Total number of plots in cropping system B	My **Collective Gains**
0	0
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	160
9	180
10	200
11	220
12	240
13	260
14	280
15	300
16	320

Your **total gains** are computed as follow:

Individual gains + Collective gains

In cropping system A, you **earn more individually**.
In cropping system B, you **earn less individually** but there are **benefits for the community**.

Collective gains: for your group to start receiving collective gains, at least **8 plots in total** need to be allocated by the group to cropping system B **(threshold)**. It means that if your group reaches together this goal, **then you get additional gains.** If your group contributes less than 8 plots, then you only earn the individual gains.

Additionally, if the threshold of 8 plots is reached by your group, you get a **collective bonus of 11 tokens for each additional plot under cropping system B**.

Total number of plots in cropping system B	My **Collective Gains**	**My collective bonus**	**My total collective gains**
0	0	0	0
1	0	0	0
2	0	0	0
3	0	0	0
4	0	0	0
5	0	0	0
6	0	0	0
7	0	0	0
8	160	11 x 8 = **88**	248
9	180	11 x 9 = **99**	279
10	200	11 x 10 = **110**	310
11	220	11 x 11 = **121**	341
12	240	11 x 12 = **132**	372
13	260	11 x 13 = **143**	403
14	280	11 x 14 = **154**	434
15	300	11 x 15 = **165**	465
16	320	11 x 16 = **176**	496

Your **total gains** are computed as follow:

Individual gains + Total collective gains

In cropping system A, you **earn more individually**.
In cropping system B, you **earn less individually** but there are **benefits for the community**, and you get a **bonus for each plot you put in cropping system B if the threshold is reached**.

Collective gains: for your group to start receiving collective gains, at least **8 plots in total** need to be allocated by the group to cropping system B **(threshold)**. It means that if your group reaches together this goal, **then you get additional gains.** If your group contributes less than 8 plots, then you only earn the individual gains.

Total number of plots in cropping system B	My **Collective Gains**
0	0
1	0
2	0
3	0
4	0
5	0
6	0
7	0
8	248
9	279
10	310
11	341
12	372
13	403
14	434
15	465
16	496

Your **total gains** are computed as follow:

Individual gains + Collective gains

In cropping system A, you **earn more individually**.
In cropping system B, you **earn less individually** but there are **benefits for the community**.

Example 1:
You choose to put **3 plots under cropping system A** and **1 plot under cropping system B**.

For the plots in **cropping system A,** you earn: 100 x 3 = 300 tokens.

For the plots in **cropping system B,** you earn: 40 x 1 = 40 tokens.

Your **individual gains** are: 300 + 40 = 340 tokens.

The other 3 people in your group put 5 plots under cropping system B. So, the total number of plots under cropping system B is 5 + 1 = 6.
Your **collective gains** are 0 tokens.

Your **total gains** are thus:

340 + 0 = 340 tokens

Example 2:
You choose to put **0 plot under cropping system A** and **4 plots under cropping system B**.

For the plots in **cropping system A,** you earn: 100 x 0 = 0 tokens.

For the plots in **cropping system B,** you earn: 40 x 4 = 160 tokens.

Your **individual gains** are: 0 + 160 = 160 tokens.

The other 3 people in your group put 5 plots under cropping system B. So, the total number of plots under cropping system B is 4 + 5 = 9.
Your **collective gains** are 180 tokens.

Your total earnings are thus:

180 + 180 = 340 tokens.

Example 1:
You choose to put **4 plots under cropping system A** and **0 plot under cropping system B**.

For the plots in **cropping system A,** you earn: 100 x 4 = 400 tokens.

For the plots in **cropping system B,** you earn: 40 x 0 = 0 tokens.

Your **individual gains** are: 400 + 0 = 400 tokens.

The other 3 people in your group put 5 plots under cropping system B. So, the total number of plots under cropping system B is 5 + 0 = 5.
Your **collective gains** are 0 tokens.

Your **total gains** are thus:

400 + 0 = 400 tokens

Example 2:
You choose to put **0 plot under cropping system A** and **4 plots under cropping system B**.

For the plots in **cropping system A,** you earn: 100 x 0 = 0 tokens.

For the plots in **cropping system B,** you earn: 40 x 4 + 21 x 4 = 160 + 84 = 244 tokens.

Your **individual gains** are: 0 + 244 = 244 tokens.

The other 3 people in your group put 4 plots under cropping system B. So, the total number of plots under cropping system B is 4 + 4 = 4.
Your **collective gains** are 160 tokens.

Your total earnings are thus:

244+ 160 = 404 tokens.

Example 1:
You choose to put **4 plots under cropping system A** and **0 plot under cropping system B**.

For the plots in **cropping system A,** you earn: 100 x 4 = 400 tokens.

For the plots in **cropping system B,** you earn: 40 x 0 = 0 tokens.

Your **individual gains** are: 400 + 0 = 340 tokens.

The other 3 people in your group put 5 plots under cropping system B. So, the total number of plots under cropping system B is 5 + 0 = 5.
Your **collective gains** are 0 tokens.

Your **total gains** are thus:

400 + 0 = 400 tokens

Example 2:
You choose to put **0 plot under cropping system A** and **4 plots under cropping system B**.

For the plots in **cropping system A,** you earn: 100 x 0 = 0 tokens.

For the plots in **cropping system B,** you earn: 40 x 4 = 160 tokens.

Your **individual gains** are: 0 + 160 = 160 tokens.

The other 3 people in your group put 4 plots under cropping system B. So, the total number of plots under cropping system B is 4 + 4 = 8.

Your **collective gains** are: 160 +11 x 8 = 248 tokens.

Your total earnings are thus:

160 + 248 = 408 tokens.

Example 1:
You choose to put **4 plots under cropping system A** and **0 plot under cropping system B**.

For the plots in **cropping system A,** you earn: 100 x 4 = 400 tokens.

For the plots in **cropping system B,** you earn: 40 x 0 = 0 tokens.

Your **individual gains** are: 400 + 0 = 400 tokens.

The other 3 people in your group put 5 plots under cropping system B. So, the total number of plots under cropping system B is 5 + 0 = 5.
Your **collective gains** are 0 tokens.

Your **total gains** are thus:

400 + 0 = 400 tokens

Example 2:
You choose to put **0 plot under cropping system A** and **4 plots under cropping system B**.

For the plots in **cropping system A,** you earn: 100 x 0 = 0 tokens.

For the plots in **cropping system B,** you earn: 40 x 4 + 4 x 21= 244 tokens.

Your **individual gains** are: 0 + 244 = 244 tokens.

The other 3 people in your group put 4 plots under cropping system B. So, the total number of plots under cropping system B is 4 + 4 = 8.

Your total **collective gains** are: 160 + 11 x 8 = 248 tokens.

Your total earnings are thus:

244+ 248 = 492 tokens.

<u>Example 1:</u>
You choose to put **4 plots under cropping system A** and **0 plot under cropping system B**.

For the plots in **cropping system A,** you earn: 100 x 4 = 400 tokens.

For the plots in **cropping system B,** you earn: 61 x 0 = 0 tokens.

Your **individual gains** are: 400 + 0 = 400 tokens.

The other 3 people in your group put 5 plots under cropping system B. So, the total number of plots under cropping system B is 5 + 0 = 5.
Your **collective gains** are 0 tokens.

Your **total gains** are thus:

400 + 0 = 400 tokens

<u>Example 2:</u>
You choose to put **0 plot under cropping system A** and **4 plots under cropping system B**.

For the plots in **cropping system A,** you earn: 100 x 0 = 0 tokens.

For the plots in **cropping system B,** you earn: 61 x 4 = 244 tokens.

Your **individual gains** are: 0 + 244 = 244 tokens.

The other 3 people in your group put 4 plots under cropping system B. So, the total number of plots under cropping system B is 4 + 4 = 8.
Your **collective gains** are 248 tokens.

Your total earnings are thus:

244+ 248 = 492 tokens.

4. Rounds: You must **repeat** your plot allocation **8 times** (rounds). Remember, in each of these rounds, you will always belong to the same group of four people. After each round, you will know the number of plots under cropping system B by the entire group, and your total gains in that round.

You will receive an **answering sheet** with an identification number that allows us to record your responses without accessing your name. You can write your decision there. At the end of each round, an assistant will go through your desks collecting the decision form to calculate your and your groups earnings. You will receive the form with your gains for each round before deciding on the next round.

5. **Payment for your decisions**: if this game is selected, you will earn the mean of your total gains for the 8 rounds. The total gains will be round up. You will get the gains from the enumerators. Your gains will be anonymous.
6. Feel free to raise your hand if you have any questions. We will gladly answer them.

THANK YOU SO MUCH FOR YOUR TIME AND PARTICIPATION!

 BASELINE

1. If you put **3 plots** under cropping system A and **1 plot** under cropping system B, and the other three group members puts another **5 plots** under cropping system B:
   a. How many plots are under cropping system B in total in your group? …….
   b. Is the threshold reached? …….
   c. What are your individual gains? …….
   d. What are your collective gains? …….
   e. What are your total gains? …….

2. If you put **0 plot** under cropping system A and **4 plots** under cropping system B, and the other three group members puts another **5 plots** under cropping system B:
   a. How many plots are under cropping system B in total in your group? …….
   b. Is the threshold reached? …….
   c. What are your individual gains? …….
   d. What are your collective gains? …….
   e. What are your total gains? …….

V0
Session: ______
ID:______

BASELINE

You only have to fill the grey columns.

Rounds	To be filled by respondent		To be filled by enumerators				
	Plots farming cropping system A	**Plots farming cropping system B**	**Individual gains**	**Threshold reached?**	**Contribution other three members** B	**Collective gains**	**Total gains**
1							
2							
3							
4							
5							
6							
7							
8							

INDIVIDUAL PAYMENT

1. If you put **4 plots** under cropping system A and **0 plot** under cropping system B, and the other three group members puts another **5 plots** under cropping system B:
    a. How many plots are under cropping system B in total in your group? …….
    b. Is the threshold reached? …….
    c. What are your individual gains? …….
    d. What are your collective gains? …….
    e. What are your total gains? …….

2. If you put **0 plot** under cropping system A and **4 plots** under cropping system B, and the other three group members puts another **4 plots** under cropping system B:
    a. How many plots are under cropping system B in total in your group? …….
    b. Is the threshold reached? …….
    c. What are your individual gains? …….
    d. What are your collective gains? …….
    e. What are your total gains? …….

V1
Session: ______
ID:______
You only have to fill the grey columns.

INDIVIDUAL PAYMENT

Rounds	To be filled by respondent		To be filled by enumerators					
	Plots farming cropping system A	Plots farming cropping system B	Individual gains	Individual bonus	Threshold reached?	Contribution other three members	Collective gains	Total gains
1								
2								
3								
4								
5								
6								
7								
8								

1. If you put **4 plots** under cropping system A and 0 **plot** under cropping system B, and the other three group members puts another **5 plots** under cropping system B:
   a. How many plots are under cropping system B in total in your group? …….
   b. Is the threshold reached? …….
   c. What are your individual gains? …….
   d. What are your collective gains? …….
   e. What are your total gains? …….

2. If you put **0 plot** under cropping system A and **4 plots** under cropping system B, and the other three group members puts another **4 plots** under cropping system B:
   a. How many plots are under cropping system B in total in your group? …….
   b. Is the threshold reached? …….
   c. What are your individual gains? …….
   d. What are your collective gains? …….
   e. What are your total gains? …….

V2

Session: ______

ID:______

You only have to fill the grey columns.

COLLECTIVE PAYMENT

Rounds	To be filled by respondent		To be filled by enumerators					
	Plots farming cropping system A	Plots farming cropping system B	Individual gains	Threshold reached?	Contribution other three members	Collective gains	Collective bonus	Total gains
1								
2								
3								
4								
5								
6								
7								
8								

Comprehension questions (V3)

1. If you put **4 plots** under cropping system A and **0 plot** under cropping system B, and the other three group members puts another **5 plots** under cropping system B:
   a. How many plots are under cropping system B in total in your group? …….
   b. Is the threshold reached? …….
   c. What are your individual gains? …….
   d. What are your collective gains? …….
   e. What are your total gains? …….

2. If you put **0 plot** under cropping system A and **4 plots** under cropping system B, and the other three group members puts another **4 plots** under cropping system B:
   a. How many plots are under cropping system B in total in your group? …….
   b. Is the threshold reached? …….
   c. What are your individual gains? …….
   d. What are your collective gains? …….
   e. What are your total gains? …….

V3
Session: ______
ID:______
You only have to fill the grey columns

COMBINED PAYMENT

Rounds	To be filled by respondent		To be filled by enumerators						
	Plots farming cropping system A	Plots farming cropping system B	Individual gains	Individual bonus	Threshold reached?	Contribution other three members	Collective gains	Collective bonus	Total gains
1									
2									
3									
4									
5									
6									
7									
8									

NO-POLICY-FRAMING

Comprehension questions (V4)

1. If you put **4 plots** under cropping system A and 0 **plot** under cropping system B, and the other three group members puts another **5 plots** under cropping system B:
    a. How many plots are under cropping system B in total in your group? …….
    b. Is the threshold reached? …….
    c. What are your individual gains? …….
    d. What are your collective gains? …….
    e. What are your total gains? …….

2. If you put **0 plot** under cropping system A and **4 plots** under cropping system B, and the other three group members puts another **4 plots** under cropping system B:
    a. How many plots are under cropping system B in total in your group? …….
    b. Is the threshold reached? …….
    c. What are your individual gains? …….
    d. What are your collective gains? …….
    e. What are your total gains? …….

V4
Session: ______
ID:______

NO-POLICY-FRAMING

You only have to fill the grey columns.

Rounds	**To be filled by respondent**		**To be filled by enumerators**				
	Plots farming cropping system A	**Plots farming cropping system B**	**Individual gains**	**Threshold reached?**	**Contribution other three members**	**Collective gains**	**Total gains**
1							
2							
3							
4							
5							
6							
7							
8							

Blue Game (Game 2)

In this game all gains are expressed in tokens.

1 token = 1 USD

For this game there are two possible roles: one role is called player 1 and the other role is called player 2. You don't know your role when you play the game. It means that you will have to answer questions for each role. Only after the game is finished you will eventually know what was your role. If this game is selected to be paid at the end of the session, we will put you randomly in a group of two players, where you will be either player 1 or player 2. Then the decision that each player has taken in his role will determine the gains of each one.

The game: For this game, both player 1 and player 2 will get 4 tokens from the experimenter. Player 1 can send any amount to player 2 between 0 tokens and 4 tokens. If player 1 sends tokens to player 2 the experimenter will multiply the amount sent by three.

Amount sent by player 1	**Amount received by player 2**
0	0
1	3
2	6
3	9
4	12

How much do you win in the blue game?

Player 1 wins 4 tokens minus the tokens sent to player 2.
Player 2 wins 4 tokens plus the tokens sent by player 1, the latter multiplied by three.

Example 1: player 1 sends 2 tokens
Player 1 wins: 4-2 = 2 tokens
Player 2 wins: 4 + 2x3 = 10 tokens

Example 2: player 1 sends 1 token
Player 1 wins: 4-1 = 3 tokens
Player 2 wins: 4 + 1x3 = 7 tokens

Session:
ID:

Blue Game (Game 2)

<u>**Decision:**</u>
If you are player 1:
Q1: how much do you send to player 2? *(choose only one box)*

☐	☐	☐	☐	☐
0	1	2	3	4

If you are player 2:
Q2: how much do you expect player 1 will send you (choose only one box)

☐	☐	☐	☐	☐
0	1	2	3	4

Green Game (game 3)

The settings are the same as the blue game. It is a two players game, player 1 and player 2. You don't know your role when you play the game. It means that you will have to answer questions for each role. Only after the game is finished you will eventually know what was your role. If this game is selected to be paid at the end of the session, we will put you in a group of two players. You will be either player 1 or player 2. Then the decision that each one has taken in his role will determine the gains of each one.

<u>The game:</u> For this game, both player 1 and player 2 will get 4 tokens from the experimenter. Player 1 can send any amount to player 2 between 0 tokens and 4 tokens. If player 1 sends tokens to player 2 the experimenter will multiply the amount sent by three.

If player 2 receives 3 tokens, 6 tokens, 9 tokens or 12 tokens, she can decide to return or not some tokens to player 1.

Amount sent by player 1	Amount received by player 2
0	0
1	3
2	6
3	9
4	12

<u>How much do you win in the green game?</u>
Player 1 wins 4 tokens minus the tokens sent to player 2 plus the tokens returned to her by player 2.

Player 2 wins 4 tokens plus the tokens sent by player 1, the latter multiplied by three, minus the tokens returned to player 1.

Example 1: player 1 sends 2 tokens and player 2 returns 4 tokens:
Player 1 wins: 4-2 + 4 = 6 tokens
Player 2 wins: 4 + 2x3 - 4 = 6 tokens

Example 2: player 1 sends 1 tokens and player 2 returns 2 tokens:
Player 1 wins: 4-1 + 2= 5 tokens
Player 2 wins: 4 + 1x3 - 2 = 5 tokens

Session:
ID:

Green Game (game 3)

If you are player 1:

Q3: how much do you send to player 2? *(choose only one box)*

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4

If you are player 2:

Q4: how much do you return to player 1?

a) If you receive 3 tokens? *(choose only one box)*

☐ 0 ☐ 1 ☐ 2 ☐ 3

b) If you receive 6 tokens? *(choose only one box)*

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6

c) If you receive 9 tokens? *(choose only one box)*

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9

d) If you receive 12 tokens? *(choose only one box)*

☐ 0 ☐ 1 ☐ 2 ☐ 3 ☐ 4 ☐ 5 ☐ 6 ☐ 7 ☐ 8 ☐ 9 ☐ 10 ☐ 11 ☐ 12

Red game (game 4)

In this game all gains are expressed in tokens.

1 token = 1 USD

If you have any questions or need help, please raise your hand. An experimenter will then come to your place and answer your questions in private.

On the sheet of paper that we gave to you, you see a table composed of 25 numbered boxes. Behind one of these boxes a time bomb is hidden; the remaining 24 boxes are empty. You do not know where the time bomb is. You only know that it can be in any place with equal probability. In other words, the bomb can be anywhere and you do not know.

Your task is to choose how many boxes to collect. Boxes are numbered from 1 to 25. You are asked to tick all the boxes that you wish to collect in numerical order.

At the end of the experiment, we will randomly determine the number of the box containing the time bomb by means of a bag containing 25 numbered pieces of paper. If you happen to have collected the box in which the time bomb is located - i.e., if the number of boxes that you ticked is greater than, or equal to, the drawn number - you will earn zero.

If the time bomb is located in a box that you did not collect - i.e., if your chosen number is smaller than the drawn number - **you will earn 1 token for each box you collected**.

Example 1

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

In grey are all the boxes you collected/ticked. In red is the location of the time bomb.
As the time bomb is **not** located in the boxes that you collected, you earn 8 x 1 token = 8 tokens.

Example 2

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

In grey are all the boxes collected/ticked. In red is the location of the time bomb.
As the time bomb is located in the boxes that you collected, you earn 0 tokens.

Comprehension question

1. Can you collect all 25 boxes?

Session:
ID: _______

Red Game - Answering sheet

Please tick the boxes that you wish to collect.

1	2	3	4	5
6	7	8	9	10
11	12	13	14	15
16	17	18	19	20
21	22	23	24	25

Session: _______
ID: ______

[Trust 1]

Generally speaking, would you say that most people can be trusted or that you need to be very careful in dealing with people?

1 Most people can be trusted

2 Need to be very careful

[Trust 2]

I would like to ask you how much you trust people from various groups. Could you tell me for each whether you trust people from this group completely, somewhat, not very much or not at all?

		Trust completely	Trust somewhat	Do not trust very much	Do not trust at all
Qa	Your family	☐	☐	☐	☐
Qb	Your neighborhood	☐	☐	☐	☐
Qc	People you know personally	☐	☐	☐	☐
Qd	People you meet for the first time	☐	☐	☐	☐

[Trust 3]

I assume that people have only the best intentions.

People **do not** only have the best intentions	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	People only have the best intentions
	0	1	2	3	4	5	6	7	8	9	10	

ID: _______________

1. What is your year of birth?

2. What gender do you identify as?

3. Please specify the village where you are currently living?

4. How many people lived and shared your meals in your household the last 3 months?

5. Do you consider yourself the head of your household? Yes / No

6. What is you level of study?

   a. No school

   b. Primary

   c. Secondary

   d. University

   e. Prefer not to say

7. What is your marital status?

    a. Single
    b. Married
    c. Divorced
    d. Widowed/widower
    e. Other
    f. Prefer not to say

8. How many minutes do you walk from your home to get to shops?

9. How many cattle heads do you own now?

10. What is the size in acres of your farm (including garden, fruit trees, fallows, grass areas, forested areas, etc.)?

11. In 2023, what is the area you used to grow crops (including garden, and fruit trees)

    a. Dry season: ________ acres
    b. Rainy season: _______ acres

12. In 2023, what is the land area in acres that you own but where you did not grow crops (fallow, opened grass area, forested area)?

13. In 2023, what are the crops that you cultivated?

a. Maize
b. Groundnut
c. Tobacco
d. Sorghum
e. Finger millet
f. Bambara nuts
g. Sugar beans
h. Fodder crop
i. Other 1: _____________
j. Other 2: _____________

14. What is the area cultivated for the followings (acres)?

a. Maize : ________________
b. Groundnuts : ________________
c. Intercrop maize with legumes : _________________

15. Over the past 12 months, did you sell some farm products (markets, collectors, etc.)?

a. Crop products: Yes / No
b. Animal products: Yes / No

16. Thinking of the last 12 months, how much you, or a member of your household receive remittances?

a. I / we never received remittances
b. I / we received less than USD 100
c. I / we received between USD 100 and USD 500
d. I / we received more than USD 500

17. Over the last 12 months, did you, or a member of your household, have any remunerated activity outside the farm (Employee, temporary jobs, bricks production, small shops etc.)? Yes / No

18. Can you rank your sources of income? 1 is the most important and 4 is the least important.

- ☐ Selling crops and vegetables
- ☐ Off-farm (Employee, temporary jobs, bricks production, small shops etc.)
- ☐ Remittances
- ☐ Selling livestock or products from livestock (egg, milk, meat, etc.)

19. Over the last 12 months, did you or other adults in your household ever cut the size of your meal or skip meals because there wasn't enough money for food? Yes / No

20. If yes, how often?
    a. Almost every month
    b. Some months but not every month
    c. Only 1 or 2 months

21. I would like to ask you about the groups or organizations, networks, associations to which you or any member of your household belong. These could be formally organized groups or just groups of people who get together regularly to do an activity or talk about things. Of how many such groups are you or any one in your household a member?