Supplementary Online Material (SOM)

The supplementary appendix includes further data analysis (Appendix A), and the experimental protocol (Appendix B).

Appendix A

A1. Study sites and participant characteristics

We conducted 90 experimental sessions with 450 participants randomly selected from 34 villages (2-4 sessions in each village) adjacent to three protected areas namely Kibale National Park, Queen Elizabeth National Park and Bwindi National Park. Though there are some peculiarities in the benefit sharing mechanism of the three protected areas considered in our study, benefits are mainly offered in terms of community projects. In only a few cases benefits are offered at individual or household level. We intentionally chose Uganda for the experiments to capture the behavioural responses of local communities in developing countries towards different incentive schemes. Given that some of the incentive schemes in our treatment are already implemented in Uganda, it makes it easier for the locals to understand our treatments very easily, which enhances the external validity of our results.

The two major religions followed by the participants are protestant (47.1%) and catholic (35.1%); which together account for almost 82%. Muslim accounts for 12.7% and others account for 5.1%. A slight majority of participants (51%) reported that they faced damage by wildlife from protected areas in the previous 12 months from the date of our experiment. Most of the respondents from around Queen Elizabeth National park (70%) complained that they faced damage by wildlife from the park, while 47% and 30% of participants from Kibale and Bwindi national parks respectively complained that they faced damage by wildlife in the 12 months preceding the date of the

experiment. Most of the participants (85%) consider that the government and tourists are main beneficiaries of national parks in Uganda, while only 15% perceive that everybody benefits from the protection of the parks. Only 35% of the participants are willing to contribute to stopping deforestation in their community, majority of whom are from around Kibale national park.

A2. The design of the experiment

The experiments are implemented in two games of ten rounds each. The first game of ten rounds (baseline game) is played with three different instructions depending on the type of treatment (i.e. incentive schemes) with which the groups play the forest extraction game. Then the second game follows for another ten rounds where we randomly introduce different institutional scenarios (communication, communication with leadership, and communication with local leadership and external advice).

Sessions were held in a community building of each location by the same research team. To implement the experiment, a group of five participants is invited to a room in their respective village centre. Instructions were read out loud, and we illustrated the process of making harvest decision during the instruction by showing corresponding posters. We administered three practice rounds (without providing feedback on individual decisions). After making sure that they understood the experiment by asking "test questions", they go out of the room one by one to make their harvest decisions by communicating their harvest decisions to the assistant waiting outside the room. Then after recording the harvest levels of all the participants for that particular round, the assistant comes into the room and informs the total number of trees harvested by the group. The total harvest minus the regrown amount is removed from a board visualizing the common plot. We had a board in the room in front of the participants with a harvest decision table where the

assistants write the harvest decisions of all participates at the end of each round. The harvest decisions on the board are written only with the participants' id number. Consequently, participants were not able to associate the harvest decisions to individual participants in their group, except their understanding of how members of their groups are harvesting. All participants only know their own ID number which enables them to compare their own harvest with the harvest of other members of their group. Before they make their harvest decision for the subsequent rounds, the number of trees they have as a group and the maximum number of trees they are allowed to harvest individually (see Table A1) are communicated to the group members in public. This approach enabled the participants even with a low education background to participate effectively in the experiment.

All participants permanently live within 10 km from conservation areas. To reduce the likelihood of collusion and contagion, we conducted all the experiments in a village on the same day.The survey at the end of the experiment shows that almost 95% of the participants understood the experiment very well.

Table A1: The maximum number of trees allowed to harvest in each round

The number of trees at the beginning of the round	Maximum number of trees each participant is allowed to harvest
Greater than or equal to 50	10
45-49	9
40-44	8
35-39	7
30-34	6
25-29	5
20-24	4

15-19	3
10-14	2
5-9	1
0-4	0 (game ends)

Payoff functions and commons dilemma by treatment in Game I

1. **Community-based Payments (CBP)**

In each round the earnings of an individual participant is calculated according to the following payoff function:

$$\pi_{it} = 100x_{it} \tag{1}$$

Where π_{it} is the payoff of individual i in period t

As individuals do not get paid in private for the donations to the public good (i.e. school), the incentive part does not formally appear in the payoff function of individual participants. Thus, the individual payoff function at the end of the game is defined only in terms of harvest over time and is given as:

$$\pi_i = \sum_{t=0}^{T} \pi_{it} = \sum_{t=0}^{T} 100x_{it} \tag{2}$$

Where π_i is the payoff of individual i at the end of the game.

The group pay-off function under this scenario is given as:

$$\pi_g = \sum_{t=0}^{T} \pi_{gt} = \sum_{t=0}^{T} 100X_t + [100 * 2Y_T] \tag{3}$$

Where $\pi_{gt} = \sum_{i=1}^{n} \pi_{it}$ and Y_T is the end stock, obtained through forward induction, and is given as:

$$Y_T = (1 + g)^{T-1}Y_0 - \sum_{t=1}^{T}(1 + g)^{T-t} X_t \qquad (4)$$

Where g is the re-growth rate at which the forest at the end of round t grows for the next round $(t + 1)$; Y_0 is the initial stock of trees with which the groups start playing the game and

$$X_t = \sum_{i=1}^{n} x_{it}.$$

Under the community project-based incentive scheme the harvest decisions are hypothesized to be influenced by both individual benefit-maximization motive and concern for the public good (i.e. community school in our setup). Our prediction from equations 4 and 5 is that selfish individuals always harvest the maximum allowed $(x_{max,t})$, while cooperative individuals harvest zero and contribute the maximum to their community school.

2. **Equality-based individual payments (EBIP)**

In each round the earnings of an individual participant is calculated according to the following payoff function:

$$\pi_{it} = 100 x_{it} \qquad (5)$$

At the end of the game individuals are paid according to the following payoff function: [1]

$$\pi_i = \sum_{t=0}^{T} \pi_{it} + [100 * \left(\frac{2Y_T}{n}\right) = \sum_{t=0}^{T} 100 x_{it} + [100 * (\frac{2Y_T}{n})] \qquad (6)$$

Note that the payoff function in equation 6 (after substituting equation 4 into 6) is composed of two parts. The first part constitutes the individual gain from their harvest, which monotonically increases with the harvest level, and the second part stands for the cost of harvest which directly

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[1] We assumed that the value of the trees at the end of the games is equal to the amount of trees over the rounds; i.e. in our setup the price of trees remains the same over time.

depends on the level of harvest and inversely depends on the availability of the resource in the stock. And the group pay-off function is given as:

$$\pi_g = \sum_{t=0}^{T} \pi_{gt} + [100 * 2Y_T] = \sum_{t=0}^{T} 100X_t + [100 * 2Y_T] \tag{7}$$

Where $\pi_{gt} = \sum_{i=1}^{n} \pi_{it}$

Under equality-based incentive scheme, individuals could be considered as selfish or cooperative based on their harvest behaviour throughout the game. We expect free riders to harvest the maximum allowed in all rounds and contribute nothing to the stock remaining at the end of the game, while cooperative individuals harvest less or nothing, and contribute more to the end stock.

3. Performance-based individual payments (PBIP)

The individual pay-off function under this treatment is given as:

$$\pi_i = 100 \sum_{t=0}^{T} x_{it} + 100 * \frac{\sum_{t=0}^{T}(x_{max,t} - x_{it})}{\sum_{t=0}^{T} \sum_{i=1}^{n}(x_{max,t} - x_{it})} (2Y_T) \tag{8}$$

The group pay-off function is given as:

$$\pi_g = \sum_{t=0}^{T} 100X_t + [100 * 2Y_T] \tag{9}$$

Where $\pi_{gt} = \sum_{i=1}^{n} \pi_{it}$

Based on the payoff functions for the three treatments, we compute the commons dilemma in our experiment. Individual gains depend on own decisions and the decisions of others. The influence of own decision works through round level harvests made by individuals privately, while the influence of other group members' decisions comes through a reduction in the size of the stock in

the subsequent rounds. In addition, in the case of PBIP and EBIP, others' decisions also affect the own gain through the end stock.

The stock over the round continuously declines with an increase in group harvest. Therefore, individuals in our experiment have to cooperate and coordinate their actions to earn the maximum as a group from the games. If all members of a group do not cooperate, those who cooperate earn lower and those who defect earn higher (see Table A2). To avoid the risk of earning low, rational individuals always tend to harvest the maximum and contribute less to the group welfare/gain as they expect others to do the same. This tendency is higher in the case of CBP scheme followed by EBIP scheme. In the PBIP scheme, participants may tend to restrict their harvest in order to get a larger share of the benefits at the end of the game. Nonetheless, as they are not sure of what their co-members would do in the game, they are more likely to harvest whatever they get in a round as being selfish still earns better than being cooperative. Therefore, in all the cases selfish participants tend to harvest the maximum allowed.

Table A2. Commons dilemma in our experiment

			Own decision			
			Cooperate	Selfish	Cooperate	Selfish
			Gain in UGX		End stock	
Others' decision	EBIP	Cooperate	[10931.8, 10931.8]	[13,028.8, 4556.8]	236	76.42
		Selfish	[1500, 5700]	[3600, 3600]	0	0
	PBIP	Cooperate	[10931.8, 10931.8]	[11,500, 5321]	236	76.2
		Selfish	[0, 5700]	[3600, 3600]	0	0
	CBP	Cooperate for public good provision	[1500, 1500]	[11,500, 1500]	236[‡]	76.42 [†]
		Selfish	[1500, 5700]	[3600, 3600]	0	0

The numbers in the parentheses are earnings in UGX, including the appearance fee; [†] In this case UGX 15284 would be donated to a community school; [‡] In this case UGX 47200 would be donated to a community school;

In the first round, a self-interested individual independent of the treatment (CBP scheme, PBIP or EBIP) harvests 10 trees, which is the maximum allowed in the first round. Harvesting of 10 trees, by each of the five individuals, results in a group's total harvest of 50 trees leaving only 50 of the initial 100 trees. However, after re-growth, in the second round the groups have 55 trees on their forest plot. Then, selfish individuals again harvest 10 trees each in the second round. This leaves only 5 trees on their plots. As we assume that the resource stock needs a minimum of 10 standing trees to re-grow, the forest in the second round does not regenerate. Thus, the group has only 5 trees to make individual harvest decisions subject to the maximum limit of 1 tree each (as defined in Table A1) for the next round. The users again realize the maximum harvest, i.e. 1 tree each, and then the resource is exhausted after the third round. Following the selfish prediction we obtain identical earnings for all the three treatments (individual earnings of UGX 3416 and group earnings of UGX 18205).

Table A3: Cooperative and selfish predictions by treatments

	Harvest level	End stock	Individual gain (in UGX)	Group gain (in UGx)	Efficiency (%)
Cooperative prediction					
CBP	0	236	1500	6000 (plus 47200 school contribution)	100
PBIP	0	236	10932	53200	100
EBIP	0	236	10932	53200	100
Selfish prediction					
CBP	10	0	3600	18000	30
PBIP	10	0	3600	18000	30
EBIP	10	0	3600	18000	30

The cooperative equilibrium is obtained with a harvest level that maximizes the group gain. Throughout the game individuals from all the three treatment groups should not harvest anything but leave the commons to regrow from round to round. Consequently, at the end of the game (10th round), all the groups conserve 234 trees and doubling it leads to 468 trees. In community project treatment, groups contribute the maximum of 47200 UGX to the community school and individuals get the appearance fee of UGX 1500 each. In the case of both PBIP and EBIP, individuals receive UGX 9360 on top of the appearance fee of UGX 1500. Further, the selfish and cooperative decisions are reflected in the sustainability of the commons. As shown in Figure A1, under selfish prediction the resource collapses in the third round while under cooperative prediction the resource keeps growing and at the end of the game the groups would have the maximum number of trees on their common plot. In the second game, as we made no modification to the basic game and mode of payment (or payoff function) predictions remain the same.
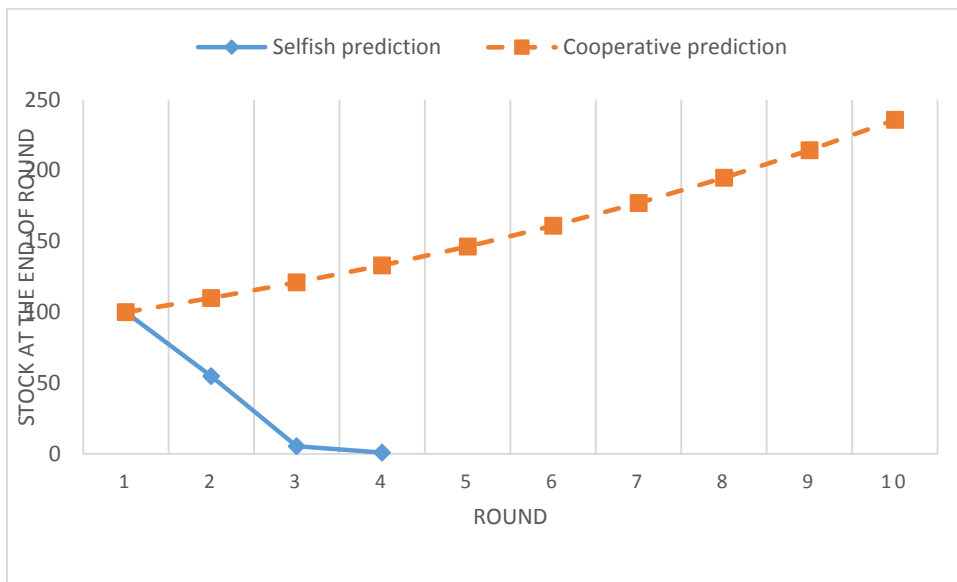

Figure A1: Predicted commons stock over rounds

In our experiments, at the end of the two games, participants are privately paid their earnings from one of the two games, which was determined by throwing a coin. On average, participants from

CBP earned UGX 1800, which is equivalent to 70-80% of the daily rural wage in Uganda. Participants from EBIP and PBIP earned, on average, UGX 6034 and UGX 7036[2] respectively. Sessions with CBP, on average, contributed, UGX 12840 to a school in their community.

A3. Statistical analysis

To investigate the effectiveness of different incentive schemes and institutions, we use multilevel mixed effect linear regression models. The dependent variable in almost all of the models is the harvest rate (as % of maximum allowed). Mixed effects models are used to account for the clustering of observations at village, session and individual level, and hence the usual assumption of independence of observations may not hold. The likelihood ratio test suggests that linear regression models without random effects are rejected in all the cases. Further, statistical tests show that random intercept and slop models are superior to only random intercept models (see Table A4). Tough we report only results from the multilevel-mixed effect linear regression models, we also cross-checked the robustness of our results using mixed effect logit regression, and found out that our results are consistent (seeTable A6). For descriptive statistics we mainly used non-parametric test (Mann-Whitney test) and in some cases t-test at group and individual level. We used the software packages Stata 10.1 (StataCorp, 2007) and R 3.2.2 (R Core Team, 2015) to estimate our models.

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[2] In all cases individual earnings include the appearance fee of UGX 1500.

Table A4: Likelihood ratio tests comparing only intercept random effects, and intercept and slop random effect models

Table 1		Likelihood ratio test	
		χ^2	p
	Model 1	250.89	0.000
	Model 2	447.63	0.000
	Model 3	75.10	0.000
	Model 4	138.72	0.000
	Model 5	187.57	0.000

A4. Results

On average participants in our experiment harvested 17% of the maximum allowed harvest. This is noticeably lower than other studies that used the same frame (see Janssen et al. 2013; Handberg &Angelesen (2015), Gatiso et al. (2015). For example, in Janssen et al. (2013) first round harvest rate was about 80% of the maximum allowed. The average harvest rates in Handberg &Angelesen (2015), Gatiso et al. (2015) were 45% and 38% respectively. Though the comparison of these results should be made cautiously, they suggest that conservation payments, in general, are viable policy tools for conservation, and may not necessarily be prone to crowding-out effects (Rode et al. 2015). One-way AVOVA analysis shows that there is a significant difference in the harvest decision of individuals from the three treatment groups (incentive schemes) in the first round (df=449; F=39.82; P=0.000) as well as throughout the game (df=4499; F=305.21; P=0.000). Participants are more cooperative when the incentives are offered based on their performance than equality concerns, which still is better than community projects. The difference in the level of cooperation across the three treatments is clearly reflected in the sustainability of their common stock over time. There is a clear difference in the round-end stock over the rounds by the three treatments, though the initial stock in all the tree treatments is the same (100 trees). When

participants take part in community project treatment the stock level is lower in all rounds compared to groups with individual level incentives. While groups with community projects, on average, conserve only 64 trees at the end of the first game, those from PBIP and EBIP conserve 109 and 135 trees respectively[3]. Thus, they managed to increase the stock compared to the start of the game. Further, stock level for groups with equality-based individual incentives is lower than the performance-based individual incentives throughout the game. Statistical tests using one-way ANOVA also show that there is statistically significant difference among the amount of end stocks conserved by the groups under the three treatments (df=89; F=183.2; P=0.000).

Our results contradict with Travers et al. (2011) and Salk et al. (2016). For example, there are five major differences between our study and Travers et al. (2011). First, their experimental games were static while ours were dynamic. Second, in their study payments were made at the end of each round, while in our case it takes ten rounds to calculate the payoff. Third, in their individual payments treatment, incentives (bonus as they call it) are provided based on pure chance. Thus, the uncertainty in the probabilistic nature of the individual incentive provision may undermine the effectiveness of individual payments to reduce extraction rates. Fourth, the setup of the communal payment in their experiment is different from that in our experiment. In their study, if the group extracts less than a threshold set by the experimenters (e.g. 20 fish) then all the participants of the group get equal amount of bonus, which resembles equality based individual payment in our experiment. In our study the community based payment is in terms of "real" community projects (e.g. school) which are widely implemented in Uganda as a mechanism to distribute conservation

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[3] In all the three cases the end stock was significantly lower than the amount predicted under cooperative equilibrium (community project: t=-24.104, p=0,000; equality based: t=-21.76; p=0.000 and performance based: t=-23.67; p=0.000). On the other hand, the end stock under the three treatments is significantly higher than the selfish prediction (t=21.44; p=0.000; t=45.97; p=0.000; t=115.41; p=0.000 respectively).

related benefits to local communities. Fifth, as their experiments were conducted in Cambodia and ours is in Uganda, the culture and the social context could be different (see Hofstede, 2001) and may lead to behavioral differences, which bolsters the importance of context specific studies. Similarly, in Salk et al. (2016) individual payments are made at each round, while in our case the payments were made only at the end of the game. Moreover, in the group payments treatment all players of the group will get equal amount if the entire group meets the required threshold (e.g. cultivating less than 24 patches of land).

Table A5: Comparison of harvest rates between the two games by treatments

		Harvest rate		% change[†]	t-values[‡]	p-values	n
		Game 1	Game 2				
	Communication	23.00	20.00	-13.04	3.92	0.0001	800
	CEL	23.00	15.00	-34.78	3.92	0.0000	600
	CELA	23.00	17.00	-26.09	5.80	0.0000	600
CBP	Repetition	20.00	19.00	-5.00	0.51	0.6070	500
	Communication	16.00	13.00	-18.75	3.24	0.0013	800
	CEL	17.00	13.00	-23.53	3.3800	0.0008	600
	CELA	18.00	15.00	-16.67	3.0500	0.0023	800
EBIP	Repetition	16.00	17.00	6.25	-0.23	0.8145	800
	Communication alone	14.00	11.00	-21.43	3.63	0.0003	1200
	CEL	13.00	10.00	-23.08	4.13	0.0000	1000
	CELA	14.00	10.00	-28.57	4.02	0.0000	700
PBIP	Repetition	14.00	17.00	21.43	-3.98	0.0001	600

[†]This shows the percentage change in game II compared to game I. [‡‡] Compares the harvest rate in game II with that of game I.

In the second game the harvest rate declines in all institutional treatments, with the most decline being in the case of leadership accompanied by communication (29%) followed by leadership with communication and outside information (28%) and the least being in the case of only communication (13%). Participants are as cooperative in the second game as they were in the first game when we introduce no institutional treatments. One way-ANOVA test shows that there is a significant difference in the change in harvest behavior following the introduction of the three institutional treatments and the control group (repeating the baseline scenario) (df=449; F=34.60; p=0.000). Further our results show that participants are more cooperative when we introduce leadership with communication compared to communication alone (see Appendix A Figure A4). Nonetheless, there is no statistically significant difference in the harvest behavior of participants when we add external advice on top of communication and leadership.

Interestingly, the role of local leadership is more pronounced when it is applied to the community project incentive scheme (34% reduction) compared to individual level incentive schemes. On the other hand communication alone is less effective in the case community project; only 13% reduction as opposed to 19% and 21% respectively in the case of equity-based and performance-based individual level incentive schemes. Under community project and equity-based incentive schemes, there is no significant difference between the harvest behavior in the first and second game when there is no institutional treatment. When the incentives are provided based on the performance of the participants throughout the game, if we don't introduce any institutional change such as communication or leadership or outside advice, repetition significantly deters cooperation.

Table A6: Mixed effect logit regression baseline game

	Dependent variable: Harvest rate (% of the maximum allowed)
Treatments: Incentive schemes	
EBIP	-0.299***
	(-4.07)
PBIP	-0.603***
	(-7.64)
Reference category: CBP	
Control variables	

Round	0.148***
	(8.14)
First round HR	0.0228
	(1.67)
Previous round others mean HR	-0.0134***
	(-3.33)
End of game	0.0345
	(0.73)
National Park 1 (Kibale=1)	-0.108
	(-1.33)
National Park 2 (Queen Elizabeth=1)	0.308**
	(2.99)
National Park 3 (Bwindi: reference category)	
Gender (male=1)	-0.0238
	(-0.74)
Age (in years)	0.00125
	(1.17)
Education level (years of school)	-0.00276
	(-0.58)
Willing to donate to stop deforestation? (yes=1)	-0.333***
	(-6.69)
Constant	-2.431***
	(-14.66)
N	40500

In the case of Multilevel mixed effect logit regression (model 1) the dependent variable is the probability of harvesting a tree in each round. For example, in the first round an individual has the possibility to harvest up to 10 trees as the maximum allowed to harvest is 10. The dependent variable, therefore, is the probability of harvesting the first tree, second tree, third tree and so on. If individual i harvests 10 trees in the first round, then the dependent variables takes 10 yes's. On the other hand, if the harvest level is 5 trees, the dependent variable for individual i is 5 yes's and 5 no's. We assume that the order in which the trees are harvested doesn't matter. The results show that our findings are consistent across the models; strongly supporting that the effect of the design of the incentive scheme on the harvest rate of the participants is robust, and is not influenced by the type model we employ.

Table A7: Mixed effect linear regression results across national parks

	Model (1) KNP	Model (2) QENP	Model (3) BNP
Treatments: Incentive schemes			
EBIP	-4.907***	-4.367***	-4.871***
	(-2.68)	(-3.70)	(-4.41)
PBIP	-8.149***	-5.967***	-10.75***
	(-4.16)	(-5.34)	(-7.74)
CBP (reference)			
Round	3.745***	-1.452*	-4.008***
	(4.81)	(-1.80)	(-4.75)
Round squared	-0.316***	0.487***	0.395***
	(-4.64)	(6.90)	(5.76)
First round harvest rate	0.0538*	-0.0276	0.00424
	(1.95)	(-0.79)	(0.09)
Previous round others' harvest rate	-0.154***	0.0551	-0.0238
	(-4.33)	(1.28)	(-0.54)
Last round (yes=1)	13.89***	17.47***	5.118***
	(9.18)	(11.12)	(3.35)
Gender (1=male)	-0.807	-0.480	0.107
	(-1.04)	(-0.67)	(0.16)
Age (in years)	0.0146	0.0213	0.0198
	(0.59)	(0.96)	(0.79)
Education level (years of school)	0.139	-0.0596	-0.187
	(1.27)	(-0.53)	(-1.84)
Number of school children	-0.634**	-0.0848	0.104
	(-2.64)	(-0.46)	(0.52)
Willing to donate to stop deforestation? (1=yes)	-4.366***	-2.174**	-1.061
	(-3.68)	(-2.00)	(-1.14)
Sessions with village chairperson	-1.010	-0.309	0.345

(yes=1)

	(-0.68)	(-0.36)	(0.32)
Constant	10.29***	14.56***	28.45***
	(3.49)	(5.42)	(8.55)
N	1530	1485	1035

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

As shown in Table A7 the result that PBIP outperform the other two types of payment schemes holds across the PAs tested.

Table A8: Mixed effect linear regression with Helmert comparison

	Dependent variable: Harvest rate (% maximum allowed)
Treatments: Incentive packages	
CBP vs Individual Payments[†]	6.369***
	(7.69)
EBIP vs PBIP	2.998***
	(3.58)
Control variables	
Round	0.0428
	(0.08)
Round Squared	0.160***
	(3.79)
First round HR	0.0343
	(1.79)
Previous round others mean HR	-0.0812***
	(-3.37)
End of game	0.151
	(0.16)
National Park 1 (Kibale=1)	-0.741
	(-0.69)
National Park 2 (Queen Elizabeth=1)	1.042
	(0.98)
National Park 3 (Bwindi: reference category)	
Gender (male=1)	-0.198
	(-0.46)
Age (in years)	0.0147
	(1.04)
Education level (years of school)	-0.0286
	(-0.45)
Number of school children	-0.167

			(-1.43)	
Willing to donate to stop deforestation? (yes=1)			-3.096***	
			(-5.01)	
Sessions with village chairperson (yes=1)			-0.588	
			(-0.80)	
Constant			8.486***	
			(4.13)	
N			4050	

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.05$; †Individual incentives include PBIP and EBIP.

The coefficient of "CBP vs Individual incentives" shows the mean harvest ratio under CBP minus the mean harvest ration under individual incentive schemes, and it suggests that the difference and statistically significant. Participants harvest more under community project than individual incentive schemes. Similarly, the coefficient of "EBIP vs PBIP" implies that individuals are more cooperative under performance based incentives than equity based incentives.

Table A9: Mixed effect linear regression: The effect of organizational treatments on payment schemes

	Model (1) Communication	(2) CEL	(3) CELA
Treatments: Incentive schemes			
EBIP	-6.546**	1.624	-3.383
	(-2.67)	(1.43)	(-1.05)
PBIP	-8.724***	-0.807**	-5.138**
	(-3.64)	(-2.18)	(-1.98)
CBP (reference)			
Round	-5.434***	-0.787	-7.604***
	(-4.03)	(-0.53)	(-5.11)
Round squared	0.202***	0.0392	0.279***
	(4.57)	(0.81)	(5.81)
First round harvest rate	0.0270	0.141***	0.0204

	(1.05)	(4.18)	(0.84)
Previous round others' harvest rate	-0.113***	-0.101**	0.0607
	(-3.08)	(-2.19)	(1.21)
Last round (yes=1)	-2.901**	3.747**	-2.197
	(-2.31)	(2.74)	(-1.61)
National Park 1 (Kibale=1)	-1.516	-0.789	-2.758
	(-0.55)	(-0.32)	(-0.80)
National Park 2 (Queen Elizabeth=1)	-1.802	-0.467	5.275
	(-0.63)	(-0.21)	(1.42)
National Park 3 (Bwindi: reference)			
Gender (1=male)	0.0834	-0.796	-0.425
	(0.14)	(-1.12)	(-0.65)
Age (in years)	0.00106	0.0272	0.0151
	(0.06)	(1.24)	(0.57)
Education level (years of school)	-0.0805	0.00993	-0.00263
	(-0.93)	(0.10)	(-0.03)
Number of school children	0.0405	0.0122	-0.258
	(0.25)	(0.07)	(-1.32)
Willing to donate to stop deforestation? (1=yes)	-0.475	-5.307***	0.769
	(-0.56)	(-4.52)	(0.54)
Sessions with village chairperson (yes=1)	0.240	0.499	-4.864*
	(0.10)	(0.31)	(-1.71)
Constant	55.63***	13.47	66.96***
	(5.25)	(1.15)	(5.39)
N	1400	1100	1050

Z statistics in parentheses, $^{*} p < 0.1$, $^{**} p < 0.05$, $^{***} p < 0.01$

Our results suggest that that performance-based PES could be incorporated into national parks management as is common practice in community forestry and agroforestry. For example, park related benefits and incentives could be conditioned on the likelihood of tracking wildlife on the farms of villagers or the damage caused by wildlife. Moreover, park related incentives could be

offered as cash payments to the villagers living around the parks based on environmental services they offer on their own farm (e.g. planting trees) so that they reduce their dependence on forest resources from protected areas.

Table A10: Mixed effect linear regression (accounting for the dynamic nature of the game)

	Model (2) Round beginning stock as explanatory variable	Model (3) Maximum allowed as explanatory variable
Treatments: Incentive schemes		
EBIP	-7.096***	-4.803***
	(-3.61)	(-5.77)
PBIP	-7.674***	-7.714***
	(-3.82)	(-8.73)
Control Group: CBP		
Control variables		
Round	-3.666***	0.103
	(-5.57)	(0.20)
Round squared	0.303***	0.154***
	(7.62)	(3.63)
First round harvest rate	0.0471**	0.0398**
	(2.52)	(2.10)
Previous round other harvest rate	-0.0913***	-0.0881***
	(-4.09)	(-3.67)

Last round (yes=1)	1.791**	-0.205
	(2.04)	(-0.22)
National Park 1 (Kibale=1)	-2.517	-0.609
	(-1.19)	(-0.56)
National Park 2 (Queen Elizabeth=1)	-14.59***	1.476
	(-6.76)	(1.39)
National Park 3 (Bwindi: reference category)		
Gender (1=male)	-0.168	-0.196
	(-0.40)	(-0.46)
Age (in years)	0.0109	0.0108
	(0.79)	(0.77)
Education level (years of school)	-0.0269	-0.0323
	(-0.44)	(-0.51)
Number of school children	-0.262**	-0.176
	(-2.30)	(-1.52)
Willing to donate to stop deforestation? (1=yes)	-1.593**	-3.106***
	(-2.50)	(-5.14)
Sessions with village chairperson (yes=1)	0.649	-0.548
	(0.43)	(-0.81)
Round beginning stock	0.695***	
	(22.84)	
Maximum allowed		-3.555***

		(-3.94)
Constant	-40.31***	50.54***
	(-11.35)	(5.50)
N	4050	4050

t statistics in parentheses; * $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$

Samsple communication excerpt for communication in the second game.

1. In this round nobody has to harvest because our forest is declining very fast. If we conserve more we will benefit from the regrowth rate of the forest.

2. Now let some of us harvest and some us conserve. If all of us harvest at the same time our forest will collapse soon. It is the same with the forest around us. If everybody harvests the forest will be gone and we will have no rainfall.

3. Let us make sure that our conservation effort is so high that we benefit from conservation. You can take example of our park. If you destroy it you will be destroying the home for birds, wild animals, butterflies and other important animals.

4. Let the rest of us who didn't harvest in the previous round harvest little, and then we wait for two more rounds so that our stock increases and our payment gets higher.

Appendix B

B1: EXPERIMENTAL PROTOCOL: Community project-based incentive schemes

First of all, we would like to thank you for accepting our invitation, and for coming to participate in this experiment.

In this experiment today, you can earn a considerable amount of money that you are permitted to keep and take home. You must understand that this is not our private money but given to us by our research institute based in Germany. If you listen to the following instructions carefully, you can,

depending on your decisions and the decisions of the other participants in your group, earn a considerable amount of money. This, therefore, requires you to follow the instructions very attentively. The objective of the experiment is to generate data for our research project. It does not have any political objective; neither religious objectives. We are interested in your decision during the experiment. However, there is no "right" or "wrong" answer.

During the experiment, we will not speak in terms of Ugandan Shillings (UGX), but in terms of trees. Hence, your entire earnings will be calculated in trees. At the end of the experiment, the total amount of trees you have earned will be converted to UGX at the rate of 1 tree = 100 UGX. You will be paid 1500 UGX for just participating in the experiment (as an appearance fee) plus the additional earnings that you have kept during the experiment. The experiment is composed of two games; each with 10 rounds. You can earn money in each round depending on the number of trees you decide to harvest. Your total earning finally paid out is the amount of money earned in either of the two games; which will be determined by tossing a coin. Your earnings will be paid out to you in private such that nobody will know your decisions in the experiment.

Some important remarks before we can start:

a) The experiment will take about two hours, including waiting time. If you find that this experiment is something that you do not wish to participate in for any reason, **or you already know that you will not be able to stay for the two hours,** please let us know immediately so that we can replace you with somebody else.

b) You are not allowed to communicate with each other throughout the game unless you are told to do so. Your harvest decisions are private and hence nobody should make any attempt to know the harvest decisions of others.

c) **It is very important that you understand the game**. Therefore we will check your understanding by asking each of you questions about the procedures of the game. If you do not understand the rules you may always ask the assistants to explain them again. **But if you cannot answer the questions after explaining them, we might have to exclude you from the experiment.**

d) If you have questions, always raise your hand and wait until the assistant comes to you. Then you can ask your question and the assistant will answer it in private. You are not allowed to

talk to other participants during the experiment unless you are told to do so. You are not allowed to leave the room without permission.

Before we start explaining the procedures to be followed in the experiment, you will pick a number from the basket that comes to you, and remember that this number will be your identification number throughout the experiment.

(The participants will be made to pick their identification number).

Game I (Baseline Game): This is the first part of the experiment.

In this experiment, you are making decisions about the management of a forest from which you and four other people can extract trees. Your common plot of forest is represented by the board in front of you (the assistant shows the board). You can earn money by extracting trees from the common plot. Moreover, you will contribute to a school in your community by conserving your common plot. We will pay a school in your community on your behalf the double of the number of trees your group conserves at the end of the game. For example, if your group manages to conserve 75 trees at the end of the game, we will give 150 trees (which is equal to UGX 15000) as your contribution to the school in your community. The more trees you and the other four participants in your group extract, the smaller the size of the forest becomes and the less you will be able to harvest in the remaining rounds. In addition, the number of trees you conserve at the end of the game, and hence, your contribution to the school in your community will be smaller.

Depending on the number of trees remaining in each round some forest will regrow. We will now explain step-by-step the components of the forest game that will determine your final earnings and contribution to the school in your community:

- Harvest
- Regrowth
- Conserved forest after round 10.

Harvest

Every tree harvested generates private income to you. At the beginning of each round, you will be informed of the number of trees available for harvest (size of the forest) and the maximum number

of trees you will be allowed to harvest. Then, in each round, you will individually decide how much trees to take away.

As your forest plot has 100 trees at the beginning of the experiment (as you can see on the board with 100 trees), each of you will be allowed to harvest maximum of 10 trees in the first round, and this will stay the same in the subsequent rounds till the forest size declines to less than 50 trees. However, starting from the round at the beginning of which the available stock is less than 50 trees, the maximum number of trees to be harvested would be less than 10 as shown in Table 1 below. The rounds in this game are supposed to imply different tree harvesting seasons.

Table B1: The maximum number of trees allowed to harvest in each round

The number of trees at the beginning of the round	Maximum number of trees each participant is allowed to harvest
50-100	10
45-49	9
40-44	8
35-39	7
30-34	6
25-29	5
20-24	4
15-19	3
10-14	2
5-9	1
0-4	0 (game over)

[The assistant will explain this in local language by using visual aid. To visualize standing trees at the beginning of every round, we use small trees with stickers attached to the board in front of the participants, where a tree on the board represents a standing tree on the hypothetical common plot. At the beginning of the experiment, the pieces will be arranged in 10 rows and 10 columns.

For example, if you decide to harvest 4 trees, and the other four participants harvest 3 trees, 8 trees, 2 trees and 5 trees each, the total harvest will be 4+3+8+2+5=22.

Regrowth

The forest available in one round will regenerate naturally at the growth rate of 10% for the next round. For instance, this implies that if your group harvests 22 trees, as in the example we just used, the common plot will have 78 trees (100-22=78). Thus, there will be 7 additional trees for the next round. Similarly, if you have 52 trees at the beginning of a certain round, you can have 5 additional trees for the next round due to the natural growth rate. The natural growth rate will be calculated as shown in the following table. The simple rule is that your forest will regrow by as much as your current trees and deleting the last digit.

Table B2: The stock size at the end of a round and the regrown amount for the next round

The number of trees at the end of a round	Regrown trees for the next round
230-239	23
220-229	22
210-219	21
200-209	20
190-199	19
180-189	18
170-179	17
160-169	16
150-159	15
140-149	14
130-139	13
120-129	12

110-119	11
100-109	10
90-99	9
80-89	8
70-79	7
60-69	6
50-59	5
40-49	4
30-39	3
20-29	2
10-19	1
0-9	0

As shown in the table there will not be any growth for the stock size less than 10 trees. So, the more trees you and the other four participants in your group leave in the forest, the more the forest can regrow and the more trees you will have for the subsequent rounds to harvest.

[In this part we now explain the regrowth by adding new trees depending on the number of trees remaining on the plot after all participants made their individual decisions.]

Conservation effort

In addition to your earnings from the privately harvested trees, you will be able to contribute for a school in your community by conserving your common plot. We will pay a school in your community on your behalf the double of the number of trees your group conserves at the end of the game. For example, if the number of trees that remain on your common forest plot at the end of the game is 20 trees, we will donate UGX 400 (200*2*20) as your contribution to the school in your community. The 20 trees are doubled to 40 trees with a value of 4000 UGX. If you have 150 trees left these will be doubled to 300 trees and converted to 30000 UGX. Trees harvested during the game have the same value (conversion to UGX) as trees left until the end of round 10.

At the end of the game the amount of trees you have will be translated into Ugandan Shilling. Every tree you have is worth 100 UGX. Your earnings comprise:

- The amount of trees you harvest in all rounds plus
- The appearance fee of 1500 UGX.

Moreover, the double of trees standing at the end of the game will be contributed to the school in your community on your behalf.

Putting things together and playing the game

At the beginning of every round you will be informed about the size of the forest in your plot as a group and the maximum number of trees you will be allowed to harvest individually. Then you will make your harvest decisions privately. To make your decisions, you will go out of the room one by one so that nobody will see your decision. You will communicate your decision to the assistant waiting for you outside the room. In a given round, after all members made their decision, we will announce the group harvest. We will visualize this in front of you on the board. Then we will show you the amount of trees that regrow on your common plot as a group and the maximum number of trees each of you is allowed to take individually for the next round. This process continues until round 10 or until the number of trees remaining on the common plot is less than 5.

For example, let's assume that at the beginning of the third round your group has 40 trees and you harvest 3 trees and others harvest 4, 2, 4 and 2. It means that your group as a whole harvests 15 (3+4+2+4+2=15) trees, leaving 25 (40-15) standing trees on your forest plot. Due to the natural growth rate, the 25 standing trees will add 3 more trees for the 4th round. Hence you will have 28 (25+3) standing trees at the beginning of the next round. Thus, from Table A1 we know that the maximum number of trees you will be allowed to take away in the 4th round will be 5 as the number of standing trees is between 25 and 29.

Example for the last round:

[If 20 trees are remaining after round 10 then each of you will get 4 trees (i.e. 20/5=4). And trees harvested have the same values as trees left until the end of round 10.]

[Continue with more examples]

In this game you decide privately and no one else in the group will know how many trees you harvest. Neither will you know how much a particular person in your group harvests. You will

only know the sum of trees that all 5 players of your group harvest at the end of a round, which will be communicated in public.

At the end of the game the amount of trees you have will be translated into Ugandan Shillings. Every tree you have is worth 100 UGX. Your earnings comprise:

- the amount of trees you harvest in all rounds (translated to UGX) plus
- the appearance fee of 1500 UGX

[Has everybody understood the game? Please ask questions].

Now you will play the game for three rounds to practice the procedures we explained to you. But the decisions in these three rounds will not be included in your final payment.

Before we start the practice, if you have any problem in understanding the game or any other problem, please raise your hand and ask us.

(Practice of the game continues)

To make sure that you have understood the game we ask you some questions.

(Pre-designed questions will be asked in private).

To keep the track of the amounts harvested by each participant we use the following table. Whenever a participant decides, his harvest level will be recorded in the following harvest decision table by the assistant.

Harvest decisions of the participants

| Rounds of the game | Natural Re-growth | Size of the forest at the beginning of the round | Individual Harvest | | | | | Total group harvest | Total forest at the end of the round |
			1	2	3	4	5		
Practice	-	100							

Practice									
Practice									
1	-	100							
2									
3									
4									
5									
6									
7									
8									
9									
10									

Note: 1 tree is equal to 100 UGX.

Second game

The second game will be played with either of the four scenarios.

i) Communication alone

[We start this game by putting the chairs in a circle.]

As in the first ten rounds, you and all other group members will make private harvest decisions. The forest size will again start with 100 trees. However, the difference in this game is that you can discuss whatever you want with your group members according to the following principles. Before the first round, you can discuss for a maximum of 5 minutes about the game. There is no limitation on the type of things to be discussed. Starting from the second round, nevertheless, you will discuss only for a maximum of three minutes. But remember that the harvest decisions are still private. To make your harvest decisions you will go out of the room as it was in the first game. The maximum allowed, the regrowth rate and other procedures will remain the same as in the first game.

Ask: Did everybody understand the rule?

Note that we will pay you the amount of money you obtained from either of the games (either baseline or second game). To decide which of the two earnings to compensate, we toss a coin and pay the earnings from the first game if we observe the side of a coin with a monetary value or pay the earnings from the second game otherwise.

ii) Communication with a traditional leader

[We start this game by putting the chairs in a circle.]

As in the first ten rounds, you and all other group members will make private harvest decisions. The forest size will again start with 100 trees. Before we proceed with the game for the next 10 rounds you will be able to make some changes in the procedures. The first change is that in this game you can discuss whatever you want with your group members according to the following principles. Before, the first round you can discuss for 5 minutes. There is no limitation on the type of things to be discussed. Starting from the second round you will discuss only for three minutes. But remember that the harvest decisions are still private. You are not allowed to tell other group members about your harvest decision. To make your harvest decisions you will go out of the room as it was in the first game. The maximum allowed, the regrowth rate and other procedures will remain the same as in the first game.

The second change is that in this game you will elect a leader from your group and he/she will chair the discussions of your group. You will choose a leader by writing the name of your favorite person from your group to be the leader of the group for the next ten rounds on the cards we distribute (the assistant shows the cards) to you. You are not allowed to talk to others about your vote. It is your private choice of the person whom you want to be the leader of your group. The person that gets at least 3 votes will be the leader of the group in the next game. On the other hand, if you don't want to vote for any of the persons from your group, you can also abstain from voting by returning a blank card and your vote will not be counted. In the case of no clear majority, we will go for the next round vote between the two members of your group who get the top number of votes and the one who gets a majority vote in the second poll will be the leader.

[Collect the cards, count the votes and announce leader]

Then the leader will chair the discussion.

iii) Communication with outside advice

(The instructions will be read by the assistant representing external authority)

As in the first ten rounds, you and all other members will make your harvest decisions. The forest size will again start with 100 trees. You will play the new game as you played in the first game but with some modifications. Now you will be allowed to communicate with your group members but for a limited time before you make decisions in each round. Before your harvest decisions in the first round, you will discuss all issues of your interest for a maximum of five minutes. In the subsequent rounds, however, you will discuss for a maximum of 3 minutes. But remember that the harvest decisions are still private. To make your harvest decisions you will go out of the room as it was in the first game. The maximum allowed, the regrowth rate and other procedures will remain the same as in the first game.

We have calculated that if you want to increase your number of trees as much as possible as a group, nobody should harvest anything from the common plot. You have to let the trees regrow over time. Thereby you can make most money as a group. But if all of your group members do not act accordingly, you will not achieve the highest amount of trees in your common plot.

Thank you for your time!

iv)   **Repeat the baseline game.**

The resource stock again starts from 100 trees, and all the rules remain the same

B2: EXPERIMENTAL PROTOCOL: Equality-based incentive scheme

First of all, we would like to thank you for accepting our invitation, and for coming to participate in this experiment.

In this experiment, today you can earn a considerable amount of money that you are permitted to keep and take home. You must understand that this is not our private money but given to us by our research institute based in Germany. If you listen to the following instructions carefully, you can, depending on your decisions and the decisions of the other participants in your group, earn a considerable amount of money. This, therefore, requires you to follow the instructions very

attentively. The objective of the experiment is to generate data for our research project. It does not have any political objective; neither religious objectives. We are interested in your decision during the experiment. However, there is no "right" or "wrong" answer.

During the experiment, we will not speak in terms of Ugandan Shillings (UGX), but in terms of trees. Hence, your entire earnings will be calculated in trees. At the end of the experiment, the total amount of trees you have earned will be converted to UGX at the rate of 1 tree = 100 UGX. You will be paid 1500 UGX for just participating in the experiment (as an appearance fee) plus the additional earnings that you have kept during the experiment. The experiment is composed of two games; each with 10 rounds. You can earn money in each round depending on the number of trees you decide to harvest. Your total earning finally paid out is the amount of money earned in either of the two games; which will be determined by tossing a coin. Your earnings will be paid out to you in private such that nobody will know your decisions in the experiment.

Some important remarks before we can start:

1. The experiment will take about two hours, including waiting time. If you find that this experiment is something that you do not wish to participate in for any reason, **or you already know that you will not be able to stay for the two hours,** please let us know immediately so that we can replace you with somebody else.
2. You are not allowed to communicate with each other throughout the game unless you are told to do so. Your harvest decisions are private and hence nobody should make any attempt to know the harvest decisions of others.
3. **It is very important that you understand the game**. Therefore we will check your understanding by asking each of you questions about the procedures of the game. If you do not understand the rules you may always ask the assistants to explain them again. **But if you cannot answer the questions after explaining them, we might have to exclude you from the experiment.**
4. If you have questions, always raise your hand and wait until the assistant comes to you. Then you can ask your question and the assistant will answer it in private. You are not allowed to talk to other participants during the experiment unless you are told to do so. You are not allowed to leave the room without permission.

Before we start explaining the procedures to be followed in the experiment, you will pick a number from the basket that comes to you, and remember that this number will be your identification number throughout the experiment.

(The participants will be made to pick their identification number).

Game I (Baseline Game): This is the first part of the experiment.

In this experiment, you are making decisions about the management of a forest from which you and four other people can extract trees. Your common plot of forest is represented by the board in front of you (the assistant shows the board). You can earn money by extracting trees but the more trees you and the other four participants in your group extract, the smaller the size of the forest becomes and the less you will be able to harvest in the remaining rounds. In addition to your earnings from the individual harvest in each round, you will get a share from the number of trees that remain standing at the end of the game doubled and equally distributed among the group members. For example, if you as a group manage to conserve 75 trees at the end of the game, it will be doubled and become 150 trees and then equally distributed to all group members. Each of you gets 30 trees (2*75/5=30). Nonetheless, if you harvest more trees in each round, you will have a small number of trees that remain standing at the end of the game and your share from the conserved amount will be small. For example, if the number of trees that remain standing at the end of the game is only 5 trees, you will get only 2 trees (2*5/5=2) individually as a share from the end stock.

We will now explain step-by-step the components of the forest game that will determine your final earnings:

- Harvest
- Regrowth
- Conserved forest after round 10.

Harvest

Every tree harvested generates private income to you. At the beginning of each round, you will be informed of the number of trees available for harvest (size of the forest) and the maximum number

of trees you will be allowed to harvest. Then, in each round, you will individually decide how much trees to take away.

As your forest plot has 100 trees at the beginning of the experiment (as you can see on the board with 100 trees), each of you will be allowed to harvest maximum of 10 trees in the first round, and this will stay the same in the subsequent rounds till the forest size declines to less than 50 trees. However, starting from the round at the beginning of which the available stock is less than 50 trees, the maximum number of trees to be harvested would be less than 10 as shown in Table B1 below. The rounds in this game are supposed to imply different tree harvesting seasons.

Table B1: The maximum number of trees allowed to harvest in each round

The number of trees at the beginning of the round	Maximum number of trees each participant is allowed to harvest
50-100	10
45-49	9
40-44	8
35-39	7
30-34	6
25-29	5
20-24	4
15-19	3
10-14	2
5-9	1
0-4	0 (game over)

[The assistant will explain this in local language by using visual aid. To visualize standing trees at the beginning of every round, we use small trees with stickers attached to the board in front of the participants, where a tree on the board represents a standing tree on the hypothetical common plot. At the beginning of the experiment, the pieces will be arranged in 10 rows and 10 columns.

For example, if you decide to harvest 4 trees, and the other four participants harvest 3 trees, 8 trees, 2 trees and 5 trees each, the total harvest will be 4+3+8+2+5=22.

Regrowth

The forest available in one round will regenerate naturally at the growth rate of 10% for the next round. For instance, this implies that if your group harvests 22 trees, as in the example we just used, the common plot will have 78 trees (100-22=78). Thus, there will be 7 additional trees for the next round. Similarly, if you have 52 trees at the beginning of a certain round, you can have 5 additional trees for the next round due to the natural growth rate. The natural growth rate will be calculated as shown in the following table.

Table B2: The stock size at the end of a round and the regrown amount for the next round

The number of trees at the end of a round	Regrown trees for the next round
230-239	23
220-229	22
210-219	21
200-209	20
190-199	19
180-189	18
170-179	17
160-169	16
150-159	15
140-149	14
130-139	13
120-129	12
110-119	11

100-109	10
90-99	9
80-89	8
70-79	7
60-69	6
50-59	5
40-49	4
30-39	3
20-29	2
10-19	1
0-9	0

As shown in the table there will not be any growth for the stock size less than 10 trees. So, the more trees you and the other four participants in your group leave in the forest, the more the forest can regrow and the more trees you will have for the subsequent rounds to harvest.

[In this part we now explain the regrowth by adding new trees depending on the number of trees remaining on the plot after all participants made their individual decisions.]

Conservation effort

In addition to your earnings from the privately harvested trees, you will get a share from the number of trees that remain standing at the end of the game **doubled** and equally distributed among the group members. For example, if 20 trees are remaining after round 10, then each of you will get 8 trees (i.e. 2*20/5=8). This means that the 20 trees are doubled to 40 and divided equally among all participants. If you have 150 trees left these will be doubled to 300 trees and divided equally. Thus, each of you will get 60 trees. Trees harvested during the game have the same value (conversion to UGX) as trees left until the end of round 10.

At the end of the game the amount of trees you have will be translated into Ugandan Shillings. Every tree you have is worth 100 UGX. Your earnings comprise:

- the amount of trees you harvest in all rounds (changed into UGX) plus

- One fifth of the number of trees standing at the end of round 10.

- the appearance fee of 1500 UGX

[Has everybody understood the game? Please ask questions].

Now you will play the game for three rounds to practice the procedures we explained to you. But the decisions in these three rounds will not be included in your final payment.

Before we start the practice, if you have any problem in understanding the game or any other problem, please raise your hand and ask us.

(Practice of the game continues)

To make sure that you have understood the game we ask you some questions.

(Pre-designed questions will be asked in private).

Putting things together and playing the game

At the beginning of every round you will be informed about the size of the forest in your plot as a group and the maximum number of trees you will be allowed to harvest individually. Then you will make your harvest decisions privately. To make your decisions, you will go out of the room one by one so that nobody will see your decision. You will communicate your decision to the assistant waiting for you outside the room. In a given round, after all members made their decision, we will announce the group harvest. We will visualize this in front of you on the board. Then we will show you the amount of trees that regrow on your common plot as a group and the maximum number of trees each of you is allowed to take individually for the next round. This process continues until round 10 or until the number of trees remaining on the common plot is less than 5.

For example, let's assume that at the beginning of the third round your group has 40 trees and you harvest 3 trees and others harvest 4, 2, 4 and 2. It means that your group as a whole harvests 15 (3+4+2+4+2=15) trees, leaving 25 (40-15) standing trees on your forest plot. Due to the natural growth rate, the 25 standing trees will add 3 more trees for the 4th round. Hence you will have 28 (25+3) standing trees at the beginning of the next round. Thus, from Table A1 we know that the maximum number of trees you will be allowed to take away in the 4th round will be 5 as the number of standing trees is between 25 and 29.

Example for the last round:

[If 20 trees are remaining after round 10 then each of you will get 4 trees (i.e. 20/5=4). And trees harvested have the same values as trees left until the end of round 10.]

[Continue with more examples]

In this game you decide privately and no one else in the group will know how many trees you harvest. Neither will you know how much a particular person in your group harvests. You will only know the sum of trees that all 5 players of your group harvest at the end of a round, which will be communicated in public.

[Has everybody understood the game? Please ask questions].

Now you will play the game for three rounds to practice the procedures we explained to you. But the decisions in these three rounds will not be included in your final payment.

Before we start the practice, if you have any problem in understanding the game or any other problem, please raise your hand and ask us.

(Practice of the game continues)

To make sure that you have understood the game we ask you some questions.

(Pre-designed questions will be asked in private).

To keep the track of the amounts harvested by each participant we use the following table. Whenever a participant decides, his harvest level will be recorded in the following harvest decision table by the assistant.

Harvest decisions of the participants

		Size of the forest at the	Individual Harvest						Total forest
			1	2	3	4	5		

Rounds of the game	Natural Re-growth	beginning of the round						Total group harvest	at the end of the round
Practice	-	100							
Practice									
Practice									
1	-	100							
2									
3									
4									
5									
6									
7									
8									
9									
10									

Note: 1 tree is equal to 100 UGX.

Second game

The second game will be played with either of the four scenarios)

i) Communication alone

[We start this game by putting the chairs in a circle.]

As in the first ten rounds, you and all other group members will make private harvest decisions. The forest size will again start with 100 trees. However, the difference in this game is that you can discuss whatever you want with your group members according to the following principles. Before the first round, you can discuss for maximum of 5 minutes about the game. There is no limitation on the type of things to be discussed. Starting from the second round, nevertheless, you will discuss

only for a maximum of three minutes. But remember that the harvest decisions are still private. To make your harvest decisions you will go out of the room as it was in the first game. The maximum allowed, the regrowth rate and other procedures will remain the same as in the first game.

Ask: Did everybody understand the rule?

Note that we will pay you the amount of money you obtained from either of the games (either baseline or second game). To decide which of the two earnings to compensate, we toss a coin and pay the earnings from the first game if we observe the side of a coin with a monetary value or pay the earnings from the second game otherwise.

ii)   **Communication with a traditional leader**

[We start this game by putting the chairs in a circle.]

As in the first ten rounds, you and all other group members will make private harvest decisions. The forest size will again start with 100 trees. Before we proceed with the game for the next 10 rounds you will be able to make some changes in the procedures. The first change is that in this game you can discuss whatever you want with your group members according to the following principles. Before, the first round you can discuss for 5 minutes. There is no limitation on the type of things to be discussed. Starting from the second round you will discuss only for three minutes. But remember that the harvest decisions are still private. You are not allowed to tell other group members about your harvest decision. To make your harvest decisions you will go out of the room as it was in the first game. The maximum allowed, the regrowth rate and other procedures will remain the same as in the first game.

The second change is that in this game you will elect a leader from your group and he/she will chair the discussions of your group. You will choose a leader by writing the name of your favorite person from your group to be the leader of the group for the next ten rounds on the cards we distribute (the assistant shows the cards) to you. You are not allowed to talk to others about your vote. It is your private choice of the person whom you want to be the leader of your group. The person that gets at least 3 votes will be the leader of the group in the next game. On the other hand, if you don't want to vote for any of the persons from your group, you can also abstain from voting by returning a blank card and your vote will not be counted. In case of no clear majority we will go for the next round vote between the two members of your group who get the top number of votes and the one who gets majority vote in the second poll will be the leader.

[Collect the cards, count the votes and announce leader]

Then the leader will chair the discussion.

iii) Communication with outside authority

[We start this game by putting the chairs in a circle.]

(The instructions will be read by the assistant representing external authority)

As in the first ten rounds, you and all other members will make your harvest decisions. The forest size will again start with 100 trees. You will play the new game as you played in the first game but with some modifications. Now you will be allowed to communicate with your group members but for only limited time before you make decisions in each round. Before your harvest decisions in the first round you will discuss all issues of your interest for maximum of five minutes. In the subsequent rounds, however, you will discuss for maximum of 3 minutes. But remember that the harvest decisions are still private. To make your harvest decisions you will go out of the room as it was in the first game. The maximum allowed, the regrowth rate and other procedures will remain the same as in the first game.

We have calculated that if you want to increase your number of trees as much as possible as a group, nobody should harvest anything from the common plot. You have to let the trees regrow over time. Thereby you can make most money as a group. But if all of your group members do not act accordingly, you will not achieve the highest amount of trees in your common plot.

Thank you for your time!

iv) Repeat the baseline game.

The resource stock again starts from 100 trees, and all the rules remain the same

B3: EXPERIMENTAL PROTOCOL: Performance-based Individual payment scheme

First of all, we would like to thank you for accepting our invitation, and for coming to participate in this experiment.

In this experiment, today you can earn a considerable amount of money that you are permitted to keep and take home. You must understand that this is not our private money but given to us by our research institute based in Germany. If you listen to the following instructions carefully, you can, depending on your decisions and the decisions of the other participants in your group, earn a considerable amount of money. This, therefore, requires you to follow the instructions very attentively. The objective of the experiment is to generate data for our research project. It does not have any political objective; neither religious objectives. We are interested in your decision during the experiment. However, there is no "right" or "wrong" answer.

During the experiment we will not speak in terms of Ugandan Shillings (UGX), but in terms of trees. Hence, your entire earnings will be calculated in trees. At the end of the experiment the total amount of trees you have earned will be converted to UGX at the rate of 1 tree = 100 UGX. You will be paid 1500 UGX for just participating in the experiment (as an appearance fee) plus the additional earnings that you have kept during the experiment. The experiment is composed of two games; each with 10 rounds. You can earn money in each round depending on the amount of trees you decide to harvest. Your total earning finally paid out is the amount of money earned in either of the two games; which will be determined by tossing a coin. Your earnings will be paid out to you in private such that nobody will know your decisions in the experiment.

Some important remarks before we can start:

1. The experiment will take about two hours, including waiting time. If you find that this experiment is something that you do not wish to participate in for any reason, **or you already know that you will not be able to stay for the two hours,** please let us know immediately so that we can replace you with somebody else.
2. You are not allowed to communicate with each other throughout the game unless you are told to do so. Your harvest decisions are private and hence nobody should make any attempt to know the harvest decisions of others.
3. **It is very important that you understand the game**. Therefore we will check your understanding by asking each of you questions about the procedures of the game. If you do not understand the rules you may always ask the assistants to explain them again. **But if you cannot answer the questions after explaining them, we might have to exclude you from the experiment.**

4. If you have questions, always raise your hand and wait until the assistant comes to you. Then you can ask your question and the assistant will answer it in private. You are not allowed to talk to other participants during the experiment unless you are told to do so. You are not allowed to leave the room without permission.

Before we start explaining the procedures to be followed in the experiment, you will pick a number from the basket that comes to you, and remember that this number will be your identification number throughout the experiment.

(The participants will be made to pick their identification number).

Game I (Baseline Game): This is the first part of the experiment.

In this experiment, you are making decisions about the management of a forest from which you and four other people can extract trees. Your common plot of forest is represented by the board in front of you (the assistant shows the board). You can earn money by extracting trees and by having some trees left at the end of round 10. Depending on the number of trees remaining in each round some forest will regrow. We will now explain step-by-step the components of the forest game that will determine your final earnings:

- Harvest
- Regrowth
- Conserved forest after round 10.

Harvest

Every tree harvested generates private income to you. At the beginning of each round you will be informed of the number of trees available for harvest (size of the forest) and the maximum number of trees you will be allowed to harvest. Then, in each round you will individually decide how much trees to take away.

As your forest plot has 100 trees at the beginning of the experiment (as you can see on the board with 100 trees), each of you will be allowed to harvest maximum of 10 trees in the first round, and this will stay the same in the subsequent rounds till the forest size declines to less than 50 trees. However, starting from the round at the beginning of which the available stock is less than 50

trees, the maximum number of trees to be harvested would be less than 10 as shown in Table 1 below. The rounds in this game are supposed to imply different tree harvesting seasons.

Table 1: The maximum number of trees allowed to harvest in each round

The number of trees at the beginning of the round	Maximum number of trees each participant is allowed to harvest
50-100	10
45-49	9
40-44	8
35-39	7
30-34	6
25-29	5
20-24	4
15-19	3
10-14	2
5-9	1
0-4	0 (game over)

[The assistant will explain this in local language by using visual aid. To visualize standing trees at the beginning of every round, we use small trees with stickers attached to the board in front of the participants, where a tree on the board represents a standing tree on the hypothetical common plot. At the beginning of the experiment, the pieces will be arranged in 10 rows and 10 columns. Here we first explain simply how to calculate total group harvest from individual harvest as well as the implication of the maximum allowed harvest]

For example, if you decide to harvest 4 trees, and the other four participants harvest 3 trees, 8 trees, 2 trees and 5 trees each, the total harvest will be 4+3+8+2+5=22.

Regrowth

The forest available in one round will regenerate naturally at the growth rate of 10% for the next round. For instance, this implies that if your group harvests 22 trees, as in the example we just

used, the common plot will have 78 trees (100-22=78). Thus, there will be 7 additional trees for the next round. Similarly, if you have 52 trees at the beginning of a certain round, you can have 5 additional trees for the next round due to the natural growth rate. The natural growth rate will be calculated as shown in the following table. The simple rule is that your forest will regrow by as much as your current trees and deleting the last digit.

Table 2: The stock size at the end of a round and the regrown amount for the next round

The number of trees at the end of a round	Regrown trees for the next round
230-239	23
220-229	22
210-219	21
200-209	20
190-199	19
180-189	18
170-179	17
160-169	16
150-159	15
140-149	14
130-139	13
120-129	12
110-119	11
100-109	10
90-99	9
80-89	8
70-79	7
60-69	6
50-59	5
40-49	4

30-39	3
20-29	2
10-19	1
0-9	0

As shown in the table there will not be any growth for the stock size less than 10 trees. So, the more trees you and the other four participants in your group leave in the forest, the more the forest can regrow and the more trees you will have for the subsequent rounds to harvest.

[In this part we now explain the regrowth by adding new trees depending on the number of trees remaining on the plot after all participants made their individual decisions.]

Conservation effort

In addition to your earnings from the privately harvested trees over the game, you will get a share from the amount of trees that remain standing at the end of the game after being doubled. But your share will depend on your harvest over the 10 rounds in a reverse order. The person with the highest harvest and hence, with the lowest contribution for conservation will get the lowest share and the one with the lowest harvest (with the highest contribution for conservation) will get the highest share from the double of the end stock. For example, if 36 trees remain after round 10, then after doubling it becomes 72 trees (i.e. 2*36=72). Suppose you harvested 20 tress over the game and other participants from your group harvested in the following order: 13, 26, 24 and 49 trees respectively. Further, assume that the sum of the maximum allowed over the 10 rounds is 97. This means that though you were allowed to take 97 trees, you decided to take only 20 trees over the 10 rounds and contributed the remaining 77 trees for conservation. Then your contribution for conservation will be 97-20=77. The contribution of others will be 84 trees (97-13), 71 (97-26), 73 trees (97-25) and 48 trees (97-49) respectively. Consequently, your share from the end stock will be 22% $\left[\frac{77}{77+84+71+73+48}\right]$ of the double of the end stock, which equals 16 trees (0.22*72). The share of others will be 24%, 20%, 21% and 14% of the double of the end stock respectively. In summary, the smaller your harvest and the more your contribution to the end stock, the larger will be your share from the end stock. Trees harvested during the game have the same value (conversion to UGX) as trees left until the end of round 10.

Putting things together and playing the game

At the beginning of every round you will be informed about the size of the forest in your plot as a group and the maximum number of trees you will be allowed to harvest individually. Then you will make your harvest decisions privately. To make your decisions, you will go out of the room one by one so that nobody will see your decision. You will communicate your decision to the assistant waiting for you outside the room. In a given round, after all members made their decision, we will announce the group harvest. We will visualize this in front of you on the board. Then we will show you the amount of trees that regrow on your common plot as a group and the maximum number of trees each of you is allowed to take individually for the next round. This process continues until round 10 or until the number of trees remaining on the common plot is less than 5.

For example, let's assume that at the beginning of the third round your group has 40 trees and you harvest 3 trees and others harvest 4, 2, 4 and 2. It means that your group as a whole harvests 15 (3+4+2+4+2=15) trees, leaving 25 (40-15) standing trees on your forest plot. Due to the natural growth rate, the 25 standing trees will add 3 more trees for the 4th round. Hence you will have 28 (25+3) standing trees at the beginning of the next round. Thus, from Table A1 we know that the maximum number of trees you will be allowed to take away in the 4th round will be 5 as the number of standing trees is between 25 and 29.

Example for the last round:

[Continue with more examples]

In this game you decide privately and no one else in the group will know how many trees you harvest. Neither will you know how much a particular person in your group harvests. You will only know the sum of trees that all 5 players of your group harvest at the end of a round, which will be communicated in public.

At the end of the game the amount of trees you have will be translated into Ugandan Shillings. Every tree you have is worth 100 UGX. Your earnings comprise:

- the amount of trees you harvest in all rounds (translated to UGX) plus

- Your share from trees standing at the end of the game depending on your contribution to the end stock.

- the appearance fee of 1500 UGX

[Has everybody understood the game? Please ask questions].

Now you will play the game for three rounds to practice the procedures we explained to you. But the decisions in these three rounds will not be included in your final payment.

Before we start the practice, if you have any problem in understanding the game or any other problem, please raise your hand and ask us.

(Practice of the game continues)

To make sure that you have understood the game we ask you some questions.

(Pre-designed questions will be asked in private).

To keep the track of the amounts harvested by each participant we use the following table. Whenever a participant decides, his harvest level will be recorded in the following harvest decision table by the assistant.

Harvest decisions of the participants

Rounds of the game	Natural Re-growth	Size of the forest at the beginning of the round	Individual Harvest					Total group harvest	Total forest at the end of the round
			1	2	3	4	5		
Practice	-	100							
Practice									
Practice									
1	-	100							

2									
3									
4									
5									
6									
7									
8									
9									
10									

Note: 1 tree is equal to 100 UGX.

Second game

The second game was played with either of the four scenarios)

i)   Communication alone
[We start this game by putting the chairs in a circle.]

As in the first ten rounds, you and all other group members will make private harvest decisions. The forest size will again start with 100 trees. However, the difference in this game is that you can discuss whatever you want with your group members according to the following principles. Before the first round, you can discuss for maximum of 5 minutes about the game. There is no limitation on the type of things to be discussed. Starting from the second round, nevertheless, you will discuss only for a maximum of three minutes. But remember that the harvest decisions are still private. To make your harvest decisions you will go out of the room as it was in the first game. The maximum allowed, the regrowth rate and other procedures will remain the same as in the first game.

Ask: Did everybody understand the rule?

Note that we will pay you the amount of money you obtained from either of the games (either baseline or second game). To decide which of the two earnings to compensate, we toss a coin and

pay the earnings from the first game if we observe the side of a coin with a monetary value or pay the earnings from the second game otherwise.

ii)   **Communication with a traditional leader**

[We start this game by putting the chairs in a circle.]

As in the first ten rounds, you and all other group members will make private harvest decisions. The forest size will again start with 100 trees. Before we proceed with the game for the next 10 rounds you will be able to make some changes in the procedures. The first change is that in this game you can discuss whatever you want with your group members according to the following principles. Before, the first round you can discuss for 5 minutes. There is no limitation on the type of things to be discussed. Starting from the second round you will discuss only for three minutes. But remember that the harvest decisions are still private. You are not allowed to tell other group members about your harvest decision. To make your harvest decisions you will go out of the room as it was in the first game. The maximum allowed, the regrowth rate and other procedures will remain the same as in the first game.

The second change is that in this game you will elect a leader from your group and he/she will chair the discussions of your group. You will choose a leader by writing the name of your favorite person from your group to be the leader of the group for the next ten rounds on the cards we distribute (the assistant shows the cards) to you. You are not allowed to talk to others about your vote. It is your private choice of the person whom you want to be the leader of your group. The person that gets at least 3 votes will be the leader of the group in the next game. On the other hand, if you don't want to vote for any of the persons from your group, you can also abstain from voting by returning a blank card and your vote will not be counted. In case of no clear majority we will go for the next round vote between the two members of your group who get the top number of votes and the one who gets majority vote in the second poll will be the leader.

[Collect the cards, count the votes and announce leader]

Then the leader will chair the discussion.

iii)   **External advice with communication and traditional leader**

[We start this game by putting the chairs in a circle.]

(The instructions representing external advice were read by the assistant)

As in the first ten rounds, you and all other members will make your harvest decisions. The forest size will again start with 100 trees. You will play the new game as you played in the first game but with some modifications. Now you will be allowed to communicate with your group members but for only limited time before you make decisions in each round. Before your harvest decisions in the first round you will discuss all issues of your interest for maximum of five minutes. In the subsequent rounds, however, you will discuss for maximum of 3 minutes. But remember that the harvest decisions are still private. To make your harvest decisions you will go out of the room as it was in the first game. The maximum allowed, the regrowth rate and other procedures will remain the same as in the first game.

We have calculated that if you want to increase your number of trees as much as possible as a group, nobody should harvest anything from the common plot. You have to let the trees regrow over time. Thereby you can make most money as a group. But if all of your group members do not act accordingly, you will not achieve the highest amount of trees in your common plot.

Thank you for your time!

iv)   **Repeat the baseline game.**

The resource stock again starts from 100 trees, and all the rules remain the same