If Possible, Incentivize Individuals Not Groups: Evidence from Lab-in-the-Field Experiments on Forest Conservation in Rural Uganda

Tsegaye Gatiso, Björn Vollan, Ruppert Vimal, Hjalmar S Kühl

Conservation Letters
A journal of the Society for Conservation Biology
Open Access

LETTER

If Possible, Incentivize Individuals Not Groups: Evidence from Lab-in-the-Field Experiments on Forest Conservation in Rural Uganda

Tsegaye T. Gatiso[1,2], Björn Vollan[3], Ruppert Vimal[1,2], & Hjalmar S. Kühl[1,2]

[1] German Centre for Integrative Biodiversity Research (iDiv), Halle-Jena- Leipzig, Germany,
[2] Max Planck Institute for Evolutionary Anthropology, Department of Primatology, Leipzig, Germany,
[3] Philipps-Universität Marburg, School of Business and Economics, Marburg, Germany

Keywords
Payments for ecosystem services; incentives for conservation; cooperation; leadership; framed field experiments; Uganda.

Correspondence
Tsegaye T. Gatiso, Max Planck Institute for Evolutionary Anthropology Deutscher Platz 6 04103 Leipzig, Germany.
E-mail: tsegaye_gatiso@eva.mpg.de

Received
14 November 2016
Accepted
15 June 2017

Editor
Krister Andersson

doi: 10.1111/conl.12387

Abstract

Payment for ecosystem services has become one of the most important conservation policy options worldwide. In developing countries, however, payments are often targeted toward communities instead of individuals. Nonetheless, there is little evidence for the effectiveness of different payment schemes in promoting proconservation behavior. We compare three payment schemes (community-based payments [CBP], equality-based individual payments [EBIP], and performance-based individual payments [PBIP]) using dynamic behavioral experiments with 450 participants in 34 Ugandan villages. We further assess the interplay of the payment schemes with stylized local organizations including communication, leadership, and external advice. We find that PBIP lead to better conservation outcomes than EBIP and CBP. Furthermore, PBIP outperform CBP under all tested conditions. Thus, our results provide important insights for the design of future incentive-based conservation interventions, and we underscore how our novel and low-cost approach can be used to increase the effectiveness of conservation policies.

Introduction

Large-scale land conversion and overexploitation of natural resources have resulted in considerable loss of biodiversity and reduction of ecosystem services (MEA 2005). Mankind urgently has to develop environmental policies that provide the legal framework for achieving the sustainable use of natural resources.

In the past, command and control policies have been the dominant approach for natural resource conservation. Since the 1970s, however, conservation policies moved toward more participatory approaches, especially in developing countries (Charnley & Poe 2007). Moreover, very recently, payment for ecosystem services (PES) became a viable conservation tool (Schomers & Matzdorf 2013).

In developing countries, the dominance of community-based payments (CBP) continues, despite evidence for its success being mixed (Ferraro & Kiss 2002; Travers *et al.* 2011; Narloch *et al.* 2012; Salk *et al.* 2016).[1] In Africa, owing to the structure of smallholder agriculture, unclear property rights, and the history of community-based natural resource management programs, incentive schemes have targeted groups of users instead of individuals (Namirembe *et al.* 2014).

In CBP schemes, protected area (PA)-related benefits are managed by a community council and are used for the provision of community projects, such as building schools. However, community projects may fail to address individual heterogeneities within a community (Sommerville *et al.* 2010). Individuals who contribute more to conservation may benefit equally compared to people who undermine conservation.[2] Therefore, the failure to account for these heterogeneities may be perceived as unfair, and thereby undermine long-term conservation success.[3]

In order to eliminate the unequal benefits from community projects, conservation-related benefits could be paid out equally to all community members (equality-based individual payments [EBIP]). However, the only way to eliminate the inherent free-rider problem in the distribution of the benefits would be to make the individual conservation efforts congruent to the individual benefits from conservation (Ostrom 2000). Payments to individuals is the standard practice in most PES schemes in industrialized countries where farmers have individual property rights (Wunder *et al.* 2008). Nonetheless, performance-based individual payments (PBIP) are not a panacea. The implementation of the PBIP schemes may be impeded by high transaction costs, inequitable land tenure, poor legislation, and the lack of robust monitoring (Milne & Niesten 2009; Wunder 2013).

In Africa, PBIP schemes are rarely implemented. "Trees for Global Benefit Initiative-Uganda" (Mwayafu & Kimbowa 2011) is one such project. The initiative incentivizes farmers to plant indigenous trees on their farms by covering tree establishment costs. A second example is a PES project in Uganda that pays private forest-owning farmers based on the number of hectares of forest they retain (Jayachandran *et al.* 2016). The project was implemented on private and communal land around forest reserves, where clearing of forests for cash crops is the main threat to wildlife living in the reserves (Jayachandran *et al.* 2016). The objectives of these two projects include conserving biodiversity and providing a corridor for the wildlife in the surrounding forest reserves and PAs. A third example is the PES project integrated to Nyungwe National Park in Rwanda, which primarily pays target households based on the opportunity cost they incur in terms of lost access to forest resources from the PA (Gross-Camp *et al.* 2012). Although the project pays an equal amount to all target households, the amount of payments were estimated based on individual households' lost access of resources from the PA. Moreover, this project uses a combination of mechanisms (such as providing goats, seedlings, community projects, etc.) to pay for the conservation effort. The project was reported to be effective in generating additional conservation outcomes, and improving the attitude of the villagers toward the park and its management (Martin *et al.* 2014). These examples suggest that PBIP schemes in some form could be promising options for conservation interventions to complement the common practice of CBP schemes in Africa.

We use a novel approach of economic experiments to test the effectiveness of three incentive schemes (CBP, EBIP, and PBIP) for natural resource conservation in and around PAs. Under CBP, the payments are made in terms of contribution to a public good (community school), while under EBIP and PBIP, the payments are distributed based on either an equal share or individuals' relative effort to conservation. There is mixed evidence in the literature on how best to incentivize groups to solve social dilemma and contribute more to the group gain. While some studies show that incentives paid equally result in free-riding behavior and lower effort, others argue that incentives paid equally may increase effort through peer pressure (Kandel & Lazear 1992; Gneezy *et al.* 2011). The other strand of empirical evidence suggests that performance-based rewards lead to higher performance than rewards distributed equally (Sinclair 2003). There is also a mixed evidence on whether cash or in-kind payments motivate people more (Ariely *et al.* 2009), calling for further empirical investigations. Thus, our study contributes to an unresolved question in PES, by comparing the effectiveness of three payment schemes (CBP, EBIP, and PBIP) for biodiversity conservation in and around PAs.

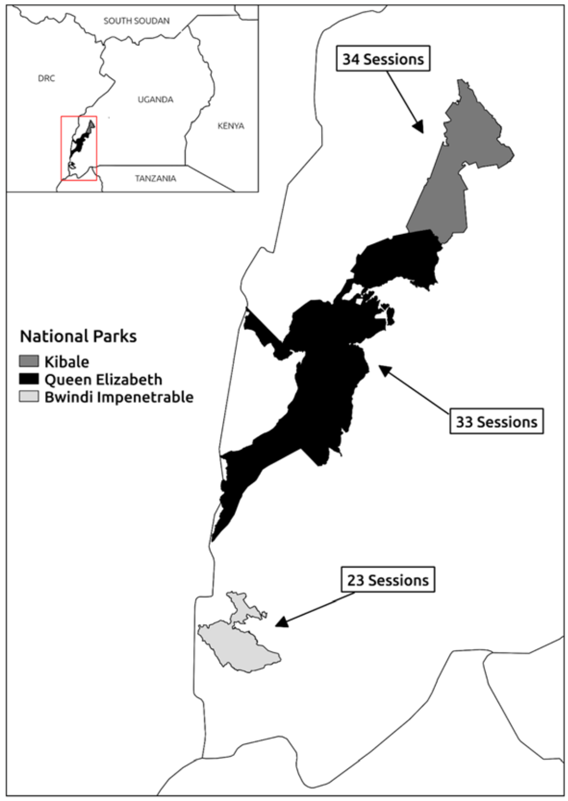

Figure 1 Map of the study sites.

Study area

The study was conducted in Uganda with communities living on the fringes of three PAs, recognized for their high biodiversity and ape habitat (Sandbrook & Roe 2010): Kibale National Park (KNP), Queen Elizabeth National Park (QENP), and Bwindi Impenetrable National Park (BNP) (Figure 1). The sites were chosen with the intention of incentivizing local communities to reduce their pressure on PAs, which is the major cause of deforestation and biodiversity loss in Africa (USAID 2011).The local communities benefit through 20% of the park entrance fees. The fund obtained from the PAs is mainly used for community projects (Manyindo & Makumbi 2005). Most of our participants are from communities where these projects are implemented, and most of them are aware of such projects. However, only a few of the participants are part of the PES projects implemented in some parts of Uganda.

Methods

To operationalize the inherent social dilemma that undermines the success of communities to effectively conserve natural resources inside and around PAs (Hardin 1968), we implemented dynamic common-pool resource experiments.[4] In order to increase familiarity with the task, and hence, enhance the external validity of our experimental results (Lusk *et al.* 2006), we framed the experiments as a decision of a group of individuals to harvest timber from a collectively managed forest. Our experimental setup follows the initial work by Janssen *et al.* (2013); which was later modified by Gatiso *et al.* (2015) and Handberg & Angelsen (2015), where groups of five participants independently and anonymously appropriate timber resources from a jointly owned forest. Each group starts with a "forest" of 100 trees. Every harvested tree is worth 100 Ugandan shillings (UGX) to the harvester.[5] The experiments are conducted in two games of 10 rounds each. The forest remaining at the end of a round regenerates with 10% to the next round. To ensure feasible harvest rates throughout the experiment, the maximum harvest level in each round is defined as

$$x_{it} \leq x_{max,t} = \begin{cases} 10 & if\ Y_t \geq 50 \\ \frac{Y_t}{n}, & if\ Y_t < 50 \end{cases} \quad (1)$$

where x_{it} is individual *i's* harvest in round t; $x_{max,t}$ is the maximum number of trees participants are individually allowed to harvest in round t; n is the number of participants in a group ($n = 5$ in our case) and Y_t is the stock size at the beginning of round t.[6]

We test three payment schemes to distribute any conserved forest after round 10

CBP: The number of trees remaining at the end of round 10 are doubled and its monetary equivalent is donated to a primary school in the community.[7]

EBIP: The number of trees that remain at the end of round 10 are doubled and distributed equally to all group members.

PBIP: The number of trees that remain at the end of round 10 are doubled and distributed to each member depending on individual conservation effort.[8]

At the beginning of the game, we assigned the participants into the three payment schemes randomly, and we explained how their earnings from the games are going to be calculated (see supplementary online material [SOM] for details). But in all the sessions the payments were made at the end of the experiment.[9] Communication was not allowed in the first game.

After finishing the first game, all group members stayed together, and started the second game with a new forest plot of 100 trees and the same payment schemes they had in the first game. During the second game, participants had one of three organizational treatments and a control scenario randomly assigned to them (Table 1). These organizational treatments are:[10]

Communication: The participants are allowed to discuss issues of their interest for 5 minutes at the beginning of the second game, and for 3 minutes before each subsequent round.

Communication with elected leadership (CEL): In addition to communication, each group chooses a leader from the group members through majority vote before they start the second game.[11]

Communication with elected leadership and external advice (CELA): In addition to communication and elected leadership, at the beginning of the second game, research assistants provided noncoercive advice that the necessary harvest level required to maximize the group gain is zero.

We conducted 90 experimental sessions with 450 participants randomly selected from 34 villages of rural Uganda (Figure 1). For our analysis, we used descriptive statistics and multilevel mixed effect linear regression models (Hamilton 2012).[12] The dependent variable in our regression models is the harvest ratio (i.e., individual harvest divided by the maximum allowed).

Results

Characteristics of the participants

Almost 55% of the participants were men, with a mean age of 41 years and mean education level of 5 years. Fifty-one percent of participants reported that they had faced damage by wildlife from PAs in the 12 months preceding our experiment (QENP: 70%; KNP: 47%; BNP: 30%). Moreover, the majority of our sample respondents (63%) are dissatisfied with the existing benefit sharing mechanism of the PAs.

Table 1 The treatments and the number of sessions with the treatments in the two games

First game[a]		
PBIP (35 sessions)	EBIP (30 sessions)	CBP (25 sessions)
• Pay per harvest • End trees doubled AND distributed to participants based on their conservation effort	• Pay per harvest • End trees doubled AND divided equally	• Pay per harvest • End trees doubled AND contributed to a public good (primary school in the community)
Second game[a]		
Repeat the first game (6 sessions) Communication (12 sessions) CEL (10 sessions) CELA (7 sessions)	Repeat the first game (8 sessions) Communication (8 sessions) CEL (6 sessions) CELA (8 sessions)	Repeat the first game (5 sessions) Communication (8 sessions) CEL (6 sessions) CELA (6 sessions)

[a]Though the uneven distribution of the groups across the treatments is the result of the randomization process, in some cases it is aggravated by dropouts in some villages.

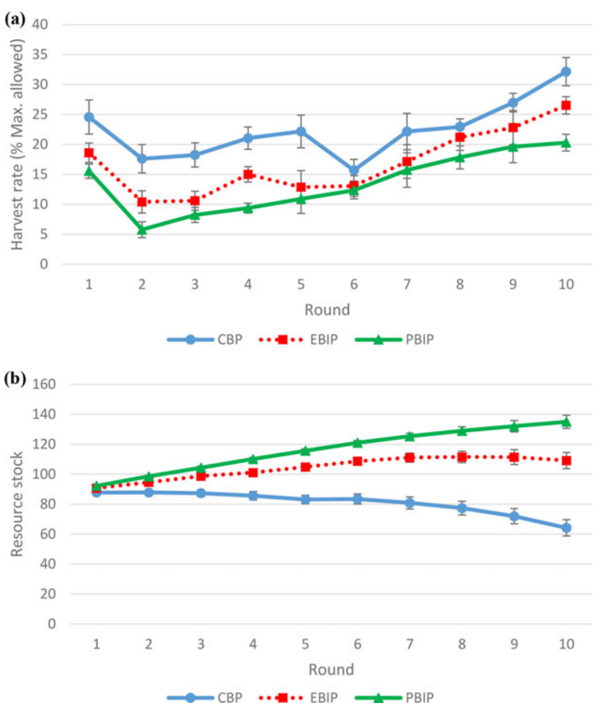

Figure 2 Average harvest rate (% of maximum allowed) and round-end stock by payment schemes in Game I.

Experimental results

In our experiment, participants started the first round of the game by harvesting, on average, 19% of the maximum allowed. Harvest ratio differed significantly by treatments already in the first round as well as throughout the game (Figure 2a).[13] Participants with CBP were less cooperative and had high harvest rate in the first game (22%) compared to those with individual payments (n = 90; z = 12.132; $P < 0.001$). On average, participants with EBIP harvested 17%, whereas those with PBIP harvested only 14% in the first game (n = 65; z = 6.293; $P < 0.001$).

The difference in harvest rate across the three treatments is clearly reflected in the sustainability of the resource managed in the experiment (Figure 2b). While groups with CBP, on average, conserved only 64 trees, those from EBIP and PBIP conserved 109 and 135 trees, respectively (one-way ANOVA: df = 89; F = 183.2; $P <$ 0.001).

In the second game, the harvest rate declined with all organizational treatments compared to the first game (Figure 3a). Moreover, there was a significant difference in the harvest behavior following the three organizational treatments compared to the control group in the second game (one-way ANOVA: df = 449; F = 34.60; $P < 0.001$). There are interesting differences in the organizational treatments depending on the underlying payment scheme. With PBIP, all organizational treatments significantly improved conservation compared to the control group. With the CBP, CEL led to a significant reduction in harvest rate compared to the control group (n = 125; z = -3.756, $P < 0.001$), while communication alone (n = 125; z = 1.167; $P > 0.1$) and CELA (n = 125, z = -1.584, $P > 0.1$) did not (also Figure 3b and Table A5).

Groups with elected leadership in addition to communication and external advice (i.e. CEL and CELA) were significantly more cooperative than those without leadership (i.e., communication alone; n = 90; z = 4.08; P < 0.001). Nonetheless, external advice on top of CEL did not improve cooperation. Interestingly, there were "real" village chairpersons in 32 sessions (74.4%), and in 24 (75%) of them they were re-elected as group leaders emphasizing their legitimacy and importance in the local context. This may help explain both the significant difference from communication alone and the insignificant result for additional external advice.[14]

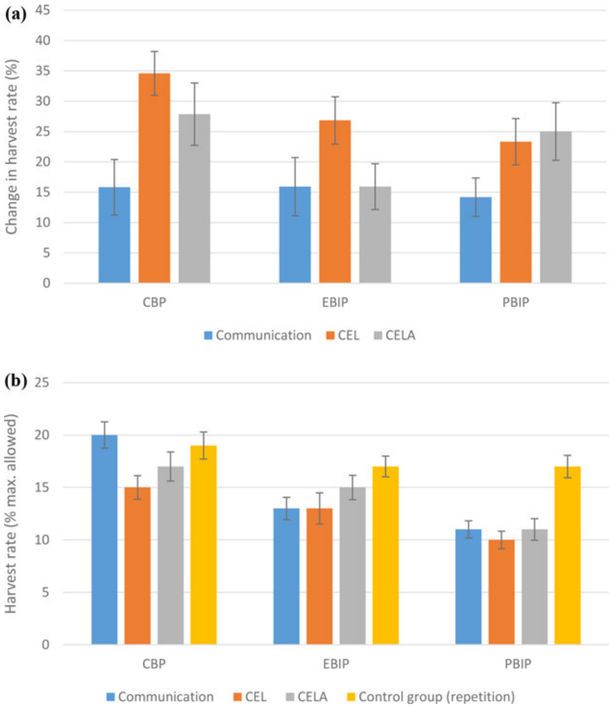

Figure 3 Change in harvest rate between Games I & II and harvest rate in Game II by payment schemes and institutions.

The above findings are also corroborated by regression analysis (Table 2). The results show that participants were significantly less cooperative under CBP than both individual-level payments (Model 2), and these results hold across the three PAs (Table A7). We also found that PBIP are more effective in reducing the harvest rate compared to EBIP (Table A8).[15] We expected that participates with children in the community school would be more willing to sacrifice their personal benefit from the games as their benefits from school contributions are higher, and the expectation holds. The number of school-age children in the household of the participants significantly influences their harvest rate in CBP treatment (Model 3), but not under other payment schemes (Models 4 & 5). Such plausible results increase the external validity of our experiments.

Overall participants in the second game were again more cooperative under individual incentive schemes than under CBP (Model 2). Moreover, all organizational treatments significantly increased cooperative behavior compared to the control group (Model 2) and the results from the descriptive analysis hold.[16] Under all institutional treatments, PBIP schemes are the most effective compared to other payment schemes. Interestingly, the difference between EBIP and CBP disappears when we introduce CEL, suggesting that elected leadership with communication could enhance the effectiveness of CBP (Table A9).[17]

Discussion

Comparing three alternative incentive-based interventions for conservation, we find that individual payments lead to better conservation outcomes than CBP. Particularly, PBIP schemes are more effective in promoting conservation than both CBP and EBIP. Arguably, the main reason for the effectiveness of PBIP in our experiment is its ability to circumvent the inexorable social dilemma in CBP and EBIP. PBIP reduces the tendency to free-ride on the efforts of others by making the incentives congruent to conservation-related efforts. This is in line with the important contribution of Elinor Ostrom, emphasizing the need for congruence between the costs incurred and the benefits received from collective action (Ostrom 2000).[18]

Our study corroborates the findings from Western Uganda by Jayachandran *et al.* (2016), who found that PBIP schemes improve the effectiveness of conservation interventions in Uganda. Our findings are also in accordance with Ferraro & Simpson (2002), Narloch *et al.* (2012), and Martin *et al.* (2014). Nonetheless, our results contradict findings of Travers *et al.* (2011) and Salk *et al.* (2016) in Cambodia and Lao. While there are several notable differences in the implementation of the studies, such as the way the payments were implemented, the level of anonymity and communication (see SOM A4 for details), we believe that the cultural and sociopolitical context of the study areas might also explain the divergent findings.

We admit that the implementation of PBIP schemes around PAs in Africa may be challenged by high administrative costs and lack of clear property rights (Wunder 2013). For instance, in Uganda only 15-20% of the land is legally registered (USAID 2010), which might lead to higher PES-related transaction costs. However, informal tenure or collective ownership may not impede the full potential for PBIP (Locatelli *et al.* 2014). Some studies also suggest that PBIP may be no more costly than other forms of payments (Ferraro & Kiss 2002) or sometimes even less costly (Ferraro & Simpson 2002).

Our results also show that democratically elected leadership with communication may improve the effectiveness of CBP (cf. Gutiérrez *et al.* 2011). This implies that in situations where PBIP are prohibitively costly, the effectiveness of conservation interventions could be enhanced by encouraging the local communities to participate in decision making and election of leadership in addition to CBP. The positive effect of elected leadership in our experiment may be due to the presence of democracy in the election process (Sutter *et al.* 2010) or the additional

Table 2 Multilevel mixed effect regression results: between-subject and within-subject effects of incentive schemes and institutional treatments

	Dependent variable: harvest rate (as % of the maximum allowed)[a]					
	Model (1) Game I Between subjects (Full sample)	Model (2) Game II Between subjects (Full sample)	Model (3) Game II Between subjects (Community project only)	Model (4) Game II Between subjects (Equity-based incentive scheme only)	Model (5) Game II Between subjects (performance-based incentive scheme only)	Model (6) Games I & II Within subjects effect
Treatments: incentive schemes						
EBIP	−5.263***	−3.720***				−4.316***
	(−5.91)	(−3.12)				(−4.38)
PBIP	−8.117***	−5.266***				−6.728***
	(−8.60)	(−4.25)				(−6.62)
Control group: CBP						
Treatments: institutions						
Communication		−3.094**	−1.627	−3.263**	−7.382***	−2.490***
		(−2.37)	(−0.92)	(−2.07)	(−7.60)	(−6.29)
CEL		−4.389***	−6.854***	−2.875	−5.191***	−4.412***
		(−2.99)	(−2.90)	(−1.28)	(−5.99)	(−9.91)
CELA		−3.065**	−3.227	−2.160	−5.530***	−3.222***
		(−2.06)	(−1.21)	(−1.11)	(−4.40)	(−7.08)
Control group: repetition						1.594***
						(3.34)
Control variables						
Round	0.0435	−4.141***	−7.143***	−5.769***	−0.980	−1.016***
	(0.08)	(−5.61)	(−4.81)	(−4.46)	(−0.94)	(−3.25)
Round squared	0.160***	0.163***	0.239***	0.218***	0.0623*	0.213***
	(3.79)	(6.88)	(4.89)	(5.17)	(1.84)	(9.69)
First round Harvest rate	0.0430**	0.0589***	0.0279	0.0763**	0.118***	0.0480***
	(2.25)	(4.12)	(1.30)	(2.23)	(3.98)	(3.84)
Previous round Other harvest rate	−0.0882***	−0.0778***	−0.134***	−0.00555	0.0458	−0.0832***
	(−3.67)	(−3.55)	(−3.65)	(−0.15)	(0.98)	(−5.03)

Continued

Table 2 Continued

	Dependent variable: harvest rate (as % of the maximum allowed)[a]					
	Model (1) Game I Between subjects (Full sample)	Model (2) Game II Between subjects (Full sample)	Model (3) Game II Between subjects (Community project only)	Model (4) Game II Between subjects (Equity-based incentive scheme only)	Model (5) Game II Between subjects (performance-based incentive scheme only)	Model (6) Games I & II Within subjects effect
Last round (yes = 1)	0.151	−0.405	−1.390	−0.760	0.603	−0.686
	(0.16)	(−0.60)	(−1.00)	(−0.63)	(0.63)	(−1.20)
National Park 1 (Kibale = 1)	−0.609	−2.322	1.229	−1.530	−4.154**	−1.765
	(−0.55)	(−1.47)	(0.39)	(−0.71)	(−2.56)	(−1.41)
National Park 2 (Queen Elizabeth = 1)	1.182	−0.0346	1.260	−5.180**	1.147	0.343
	(1.10)	(−0.02)	(0.36)	(−2.31)	(0.75)	(0.28)
National Park 3 (Bwindi: reference category)						
Gender (1 = male)	−0.189	−0.209	−0.0949	0.194	−0.643	−0.209
	(−0.44)	(−0.65)	(−0.14)	(0.31)	(−1.34)	(−0.74)
Age (in years)	0.0118	0.00689	0.000479	0.00496	0.00699	0.00858
	(0.83)	(0.65)	(0.02)	(0.23)	(0.46)	(0.93)
Education level (years of school)	−0.0296	−0.0321	−0.0928	0.0228	0.0297	−0.0319
	(−0.47)	(−0.68)	(−0.90)	(0.25)	(0.44)	(−0.78)
Number of school children	−0.185	−0.116	−0.405*	−0.270	−0.0668	−0.172**
	(−1.58)	(−1.32)	(−1.81)	(−1.49)	(−0.59)	(−2.24)
Willing to donate to stop deforestation? (1 = yes)	−2.871***	−0.850	1.238	−4.514***	−0.0359	−1.569***
	(−4.67)	(−1.75)	(0.94)	(−4.47)	(−0.06)	(−3.72)
Sessions with village chairperson (yes = 1)	−0.522	−0.730	−3.458	0.672	0.619	−0.481
	(−0.72)	(−0.67)	(−1.04)	(0.35)	(0.87)	(−0.60)
Constant	15.35***	14.84***	17.44***	24.24***	15.33*	19.05***
	(7.62)	(7.24)	(6.14)	(5.36)	(1.87)	(11.62)
N	4,050	4,500	1,250	1,500	1,750	8,550

z-statistics in parentheses. *$P < 0.1$, **$P < 0.05$, ***$P < 0.01$.

[a]Similar results are obtained by using harvest level as a dependent variable (see supplementary online material).

legitimacy from traditional authority as village leaders (Weber 1968). We are not arguing that leadership always leads to better outcomes as it may also lead to corruption and elite capture (e.g., Bardhan & Mookherjee 2000). Nonetheless, as the elected leaders became more cooperative after their election, there was no indication of strong elite capture in our study (e.g., Grossman & Baldassarri 2012; Gatiso & Vollan 2016).

Our approach is novel from both methodological and policy perspectives. Methodologically, our study provides empirical support for using economic experiments in ex ante evaluation of conservation policies.[19] Nonetheless, ensuring external validity of experimental results might be the major challenge, and requires an all-out effort to overcome by using experienced participants and framing experiments to the local context.

From a policy perspective, our study highlights that individual-level payments could lead to better conservation outcomes than CBP, especially when payments account for individual contributions to conservation. Thus, to conserve biodiversity by integrating the landscapes around PAs into conservation strategies, we think the use of PBIP, when possible, would enhance the effectiveness of the conservation interventions. This could be done through: (1) Payments to private forest owners around PAs based on the hectares of forest they own (e.g., Jayachandran *et al.* 2016), given that 70% of Uganda's forest is on privately owned and customary land (NEMA 2008), engaging private forest owners through PBIP will solve part of the complex problem of biodiversity conservation in and around PAs; (2) Payments to small-holder farmers to engage in agroforestry and planting trees at the edge of their farms (e.g., Mwayafu & Kimbowa 2011);[20] (3) Payments could be offered in terms of opportunity cost to local villagers due to the presence of PAs (e.g., Gross-Camp *et al.* 2012);[21] and (4) Allowing the target communities to endogenously decide on who made the largest effort or sacrifice for conservation (Engel 2016). Accordingly, local communities would reach binding agreements to distribute the payments based on individual contributions to conservation (going further than the nonbinding agreement of "cheap talk" under the communication treatment in our experiment). In summary, the approaches we suggest here are not mutually exclusive, and we believe that by using one or more of these approaches, the PES implementing agencies could effectively integrate the PAs to the landscapes around them, and effectively conserve biodiversity in and around PAs.

Acknowledgments

We gratefully acknowledge the financial support obtained for the study from the Robert Bosch Foundation. Our gratitude also goes to Uganda Wildlife Authority, Uganda National Council for Science and Technology, and the Government of Uganda for granting us the permission to conduct the study. We would also like to thank Esther Blanco and Sergio Marrocoli for their constructive comments, and Ugandan team of research assistants for their support in the field.

Endnote

1. While Ferraro & Kiss (2002) and Narloch *et al.* (2012) argue for direct individual payments, Travers *et al.* (2011) and Salk *et al.* (2016) report that group payments work well given that participants could communicate with each other.
2. For instance, school projects may be less attractive to households living on the fringes of conservation areas who need more family labor to protect their crops and livestock from predation (Archabald & Naughton-Treves 2002) or to households with fewer school-age children.
3. A growing body of research in behavioral economics has documented that people are averse toward inequality and cooperate if the fairness concerns are met (Fehr & Schmidt 1999).
4. We used common-pool resource experiments for four main reasons. First, we think that PAs are public goods (Gross-Camp *et al.* 2012) where everybody has to contribute to their conservation, and effective conservation depends on the ability to mobilize collective action (Bulte *et al.* 2008). Second, in some of our study sites, local communities have legal rights to access resources from the PAs (e.g., QENP). Third, enforcements of park regulations are never perfect, which makes them de facto open access resources. Fourth, most importantly, considerable part of forest in Uganda is on communal lands, which also involves obvious commons dilemma.
5. At the time of the experiment, the exchange rate was \$1 = 2,700 UGX.
6. Stock at the beginning of round t is given as: $Y_t = Y_{t-1} - \sum_{i=1}^{n} x_{it-1} + g(Y_{t-1} - \sum_{i=1}^{n} x_{it-1})$, where g is the regrowth rate at which the forest at the end of round $t-1$ grows for round t.
7. In communities with more than one primary school, the groups decide to which primary school they want to donate through majority vote, and the value of the double of the end stock goes to the chosen school. Given the institutional setup of conservation-related benefit sharing in our study sites, this treatment can be interpreted as the status quo conservation method.
8. The group member with the highest harvest, and hence with the lowest contribution to conservation, receives the lowest share. The individual share is calculated as the ratio of the sum of unharvested trees of individual i $[\sum_{t=0}^{T}(x_{max,t} - x_{it})]$ to the sum of unharvested trees of

the whole group over the 10 rounds $[\sum_{t=0}^{T}\sum_{i=1}^{n}(x_{max,t}-x_{it})]$, i.e., $Individual\ Share = \frac{\sum_{t=0}^{T}(x_{max,t}-x_{it})}{\sum_{t=0}^{T}\sum_{i=1}^{n}(x_{max,t}-x_{it})}$.

9. A session stands for a group of participants playing the game for a specified number of rounds. In this article, groups and sessions are equivalent because every session only consisted of one group.
10. Repetition of the baseline game was done in 19 sessions. In this scenario, randomly selected groups play the same first game without any changes. Thus, communication is not allowed. The idea behind the organizational treatments is to enhance the validity of our results by allowing group members to coordinate with each other in various ways. Moreover, they enable us to capture the reality in Africa that most institutional setups take some of these institutional forms. In all cases, harvest decisions are still made simultaneously in private and anonymously including the decisions of the elected leader.
11. In case of tied preferences, another election is made between the two members with the top two votes. The winner of the election chairs the discussion of the group throughout the second game.
12. Mixed effects models are used to account for the clustering of observations at village, session, and individual level. We checked the robustness of the results with mixed effects logistic models (Table A6). We checked for the robustness of our results for different possibilities to account for the dynamic nature of our games but our major results remain the same in all the cases (Table A10).
13. Behavior in the first round is an important comparison unit as it is not yet affected by feedback from other's harvest and reflects an intrinsic motivation to cooperate or to conserve. In the first round, under EBIP, participants harvested, on average, 19%, whereas the harvest under PBIP was 16% (Mann-Whitney test: $n = 65$; $z = 5.48$; $P < 0.001$). The harvest rate in CBP was even higher with 25%, which is significantly different from the combined individual payment schemes ($n = 90$; $z = 8.24$; $P < 0.001$).
14. The harvest rate of democratically elected leaders was significantly lower than that of other members in the second game ($n = 450$; $z = 2.172$; $P < 0.05$), though they did not behave differently in the first game ($n = 450$; $z = 0.010$; $P > 0.1$). Yet, our study does not suggest that leadership is better than communication, rather it suggests that the positive effect of communication can be further increased by democratically electing a group leader.
15. These results are obtained from a similar regression but with Helmert coding, where we compare each level of a categorical variable to the mean of the subsequent levels.
16. In CBP schemes, communication alone does not have a significant effect on the cooperative behavior of the commons users (Model 3). Similarly, under CBP and EBIP schemes, the introduction of external advice (on top of communication and elected leadership) does not have significant impact (Models 3 & 4). When incentives are offered based on individual performance, however, all institutions have a statistically significant effect on cooperation (Model 5).
17. Participants become more cooperative and reduce their harvest rate under all institutional treatments in the second game compared to their respective behavior in the first game (Model 6).
18. This is also consistent with the behavioral economics literature that people care about fairness and inequality (Fehr & Schmidt, 1999). Violating such implicit contracts may lead to disengagement and crowding out of prosocial motivations.
19. Economic experiments offer a cost-effective approach to evaluate the implications of, for instance, specific components of incentive schemes (e.g., size, timing, and type of payments) to the effectiveness of the incentive-based conservation interventions before implementing them on a larger scale.
20. Assuming that PAs are public goods, it is possible that some farmers may engage in poaching and cutting trees from the parks though they are part of the PES, which may lead to commons dilemma. Therefore, communication plays a crucial role in enhancing cooperation and reducing such dilemma (e.g., Isaac & Walker 1988; del Pilar Moreno-Sánchez & Maldonado 2010).
21. The opportunity cost could also be estimated based on wildlife-related damage (real or potential) on the local community.

Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's web site:

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

Table A2: Commons dilemma in our experiment

Table A3: Cooperative and selfish predictions by treatments

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

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

Table A6: Mixed effect logit regression baseline game

Table A7: Mixed effect linear regression results across national parks

Table A8: Mixed effect linear regression with Helmert comparison

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

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

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

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

Figure A1: Predicted commons stock over rounds.

References

Archabald, K. & Naughton-Treves, L. (2002). Tourism revenue-sharing around national parks in Western Uganda: early efforts to identify and reward local communities. *Environ. Conserv.*, **28**(2), 135-149.

Ariely, D., Bracha, A. & Meier, S. (2009). Doing good or doing well? Image motivation and monetary incentives in behaving prosocially. *Am. Econ. Rev.*, **99**(1), 544-555.

Bardhan, P. & Mookherjee, D. (2000). Capture and governance at local and national levels. *Am. Econ. Rev.*, **90**(2), 1-6.

Bulte, E.H., Lipper, L., Stringer, R. & Zilberman, D. (2008). Payments for ecosystem services and poverty reduction: concepts, issues, and empirical perspectives. *Environ. Dev. Econ.*, **13**, 245-254.

Charnley, S. & Poe, M.R. (2007). Community forestry in theory and practice: where are we now? *Annu. Rev. Anthropol.*, **36**(1), 301-336.

del Pilar Moreno-Sánchez, R. & Maldonado, J.H. (2010). Evaluating the role of co-management in improving governance of marine protected areas: an experimental approach in the Colombian Caribbean. *Ecol. Econ.*, **69**(12), 2557-2567.

Engel, S. (2016). The devil in the detail: a practical guide on designing payments for environmental services. *Int. Rev. Environ. Resour. Econ.*, **9**, 131-177.

Fehr, E. & Schmidt, K.M. (1999). A theory of fairness, competition, and cooperation. *Q. J. Econ*, **114**(3), 817-868.

Ferraro, P.J. & Kiss, A. (2002). Direct payments to conserve biodiversity. *Science*, **298**(5599), 1718-1719.

Ferraro, P.J. & Simpson, R.D. (2002). The cost-effectiveness of conservation payments. *Land Econ.*, **78**(3), 339-353.

Gatiso, T.T. & Vollan, B. (2016). Democracy and cooperation in commons management: experimental evidence of representative and direct democracy from community forests in Ethiopia. *Environ. Dev. Econ.*, **22**(2), 110-132.

Gatiso, T.T., Vollan, B. & Nuppenau, E. (2015). Resource scarcity and democratic elections in commons dilemmas: an experiment on forest use in Ethiopia. *Ecol. Econ.*, **114**, 199-207.

Gneezy, U., Meier, S. & Rey-Biel, P. (2011). When and why incentives (don't) work to modify behavior. *J. Econ. Perspect.*, **25**(4), 191-210.

Gross-Camp, N.D., Martin, A., McGuire, S., Kebede, B. & Munyarukaza, J. (2012). Payments for ecosystem services in an African protected area: exploring issues of legitimacy, fairness, equity and effectiveness. *Oryx*, **46**(1), 24-33.

Grossman, G. & Baldassarri, D. (2012). The impact of elections on cooperation: evidence from a lab-in-the-field experiment in Uganda. *Am. J. Polit. Sci.*, **56**(4), 964-985.

Gutiérrez, N.L., Hilborn, R. & Defeo, O. (2011). Leadership, social capital and incentives promote successful fisheries. *Nature*, **470**(7334), 386-389.

Hamilton, L.C. (2012). *Statistics with Stata* (12th ed.). Cengage Learning, Boston, MA.

Handberg, Ø.N. & Angelsen, A. (2015). Experimental tests of tropical forest conservation measures. *J. Econ. Behav. Organ.*, **118**, 346-359.

Hardin, G. (1968). The tragedy of the commons. *Science*, **162**(3859), 1243-1248.

Isaac, R.M. & Walker, J.M. (1988). Communication and free riding behavior: the voluntary contribution mechanism. *Econ. Inq.*, **26**(4), 585-608.

Janssen, M.A., Bousquet, F., Cardenas, J.-C., Castillo, D. & Worrapimphong, K. (2013). Breaking the elected rules in a field experiment on forestry resources. *Ecol. Econ.*, **90**, 132-139.

Jayachandran, S., de Laat, J., Lambin, E.F. & Stanton, C.Y. (2016). Cash for carbon: a randomized controlled trial of payments for ecosystem services to reduce deforestation. *NBER Working Paper No. 22378*.

Kandel, E. & Lazear, E.P. (1992). Peer pressure and partnerships. *J Polit. Econ.*, **100**(4), 801-817.

Locatelli, T., Binet, T., Kairo, J.G. *et al.* (2014). Turning the tide: how blue carbon and payments for ecosystem services (PES) might help save mangrove forests. *Ambio*, **43**(8), 981-995.

Lusk, J.L., Pruitt, J.R. & Norwood, B. (2006). External validity of a framed field experiment. *Econ. Lett.*, **93**, 285-290.

Manyindo, J. & Makumbi, I. (2005). *A review of the Uganda Wildlife Authority revenue sharing programme around Queen Elizabeth Protected Area*. Wildlife Series No. 4, Kampala, Uganda.

Martin, A., Gross-Camp, N., Kebede, B. & McGuire, S. (2014). Measuring effectiveness, efficiency and equity in an experimental payments for ecosystem services trial. *Global Environ. Chang.*, **28**, 216-226.

MEA (Millennium Ecosystem Assessment). (2005). *Ecosystems and human well-being: biodiversity synthesis*. Island Press, Washington, DC.

Milne, S. & Niesten, E. (2009). Direct payments for biodiversity conservation in developing countries: practical insights for design and implementation. *Oryx*, **43**(4), 530-541.

Mwayafu, B.D. & Kimbowa, R. (2011). *Benefit sharing in the Trees for Global Benefit (TGB) Initiative*. REDD-Net, Bushenyi District, Uganda.

Namirembe, S., Leimona, B., Van Noordwijk, M., Bernard, F. & Bacwayo, K.E. (2014). Co-investment paradigms as alternatives to payments for tree-based ecosystem services in Africa. *Curr. Opin. Env. Sust.*, **6**(1), 89-97.

Narloch, U., Pascual, U. & Drucker, A.G. (2012). Collective action dynamics under external rewards: experimental insights from Andean farming communities. *World Dev.*, **40**(10), 2096-2107.

NEMA (2008). *State of the environment report for Uganda: Sustainable Environment for Prosperity Report*. Uganda National Environment Management Authority, Kampala, Uganda.

Ostrom, E. (2000). Collective action and the evolution of social norms. *J. Econ. Perspect.*, **14**(3), 137-158.

Salk, C., Lopez, M.-C. & Wong, G. (2016). Simple incentives and group dependence for successful payments for ecosystem services programs: evidence from an experimental game in rural Lao PDR. *Conserv. Lett.*, **5**(0), 1-8.

Sandbrook, C. & Roe, D. (2010). *Linking conservation and poverty alleviation: the case of Great Apes. An overview of current policy and practice in Africa*. Arcus Foundation, London, UK.

Schomers, S. & Matzdorf, B. (2013). Payments for ecosystem services: a review and comparison of developing and industrialized countries. *Ecosyst. Serv.*, **6**, 16-30.

Sinclair, A.L. (2003). The effects of justice and cooperation on team effectiveness. *Small Gr. Res.*, **34**(1), 74-100.

Sommerville, M., Milner-Gulland, E.J., Rahajaharison, M. & Jones, J.P.G. (2010). Impact of a community-based payment for environmental services intervention on forest use in Menabe, Madagascar. *Conserv. Biol.*, **24**(6), 1488-1498.

Sutter, M., Haigner, S. & Kocher, M.G. (2010). Choosing the carrot or the stick? Endogenous institutional choice in social dilemma situations. *Rev. Econ. Stud.*, **77**(4), 1540-1566.

Travers, H., Clements, T., Keane, A. & Milner-Gulland, E.J. (2011). Incentives for cooperation: the effects of institutional controls on common pool resource extraction in Cambodia. *Ecol. Econ.*, **71**, 151-161.

USAID. (2010). *Uganda country profile: property rights and resource governance*. USAID, Kampala, Uganda.

USAID. (2011). *Uganda environmental threats and opportunities assessment (ETOA)*. USAID, Kampala, Uganda.

Weber, M. (1968). *Economy and society: parts I and II*. University of California Press, Berkeley, CA Final ETOA Report.

Wunder, S. (2013). When payments for environmental services will work for conservation. *Conserv. Lett.*, 230-237.

Wunder, S., Engel, S. & Pagiola, S. (2008). Taking stock: a comparative analysis of payments for environmental services programs in developed and developing countries. *Ecol. Econ.*, **65**(4), 834-852.

