Social capital and conservation under collective and individual incentive schemes: a framed field experiment in Indonesia

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In this study, we explore the effects of payments for environmental services on land use decisions among farmers living in Jambi province in Indonesia. Using a framed field experiment we compare land use decisions in a baseline with no payment with two alternative payments for environmental services (PES): an individual incentive scheme, where each participant receives a flat rate payment for each experimental land unit conserved, and a collective incentive scheme that offers individual payments only if an aggregate pre-determined conservation threshold is passed by the group. We find that individual and collective PES are equally effective on the average to increase environmentally friendly behavior associated with the cultivation of rubber agroforestry. Yet we find that whereas individual incentives work equally well for small and large farmers, collective incentives only work for large farmers. In addition, collective incentives generate an increase in conservation even at low payment levels whereas individual incentives only work when payments are high. Participants with a larger social network cultivating oil palm invest a lower share of their endowment in conservation. These findings highlight how land heterogeneity and social capital influence the success of a PES scheme.

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Keywords: social capital, payment for environmental services, agroforestry, incentives for conservation

1. Introduction

Over the last two decades, payments for environmental services (PES) have become a common environmental policy instrument to promote conservation (Le Velly and Dutilly, 2016). PES are defined as a voluntary transaction where a buyer buys a well-defined ecosystem service from a service provider if and only if the provider secures its provision (Engel et al. 2008). Due to the voluntary nature of the transaction, this policy instrument is regarded as being more effective than command and control instruments (Le Velly and Dutilly, 2016; Narloch et al., 2012; Pagiola et al., 2005; Porras and International Institute for Environment and Development., 2010; Wunder and Borner, 2011).

Recent systematic reviews suggest that PES reduce deforestation rates, although the effect is relatively modest (Samii et al., 2014). Experimental evidence supports this finding; e.g., offering payments to forest owners in Uganda for not cutting down their trees led to decreased deforestation rates (Jayachandran et al., 2017). However, one concern that remains is that the functional value of a reserve for biodiversity conservation usually depends on its spatial configuration (Poiani et al., 2000). Individual payments do not explicitly promote the coordination among suppliers to conserve, e.g., contiguous land parcels, potentially resulting in lower ecological services. An alternative to overcome this problem is to use a collective incentive scheme, where individual service providers receive a payment only if a minimum level of conservation is achieved at the group level (Kerr et al., 2014; Dickman et al., 2011). However, in collective schemes uncertainty on whether the threshold can be trespassed and the possibility for free-riding behavior might decrease the effectiveness of this instrument compared to an individual payment scheme.

In this paper, we investigate the effectiveness of individual versus collective payment schemes in promoting conservation using a framed field experiment. We assess the response to two payment levels (low and high) and disentangle heterogeneous effects of individual and collective schemes.

As case study, we consider the Jambi province of Indonesia. Indonesia has the third largest area of tropical rainforest in the world after the Amazon and Congo Basins (Fitzherbert et al., 2008). Despite its reputation as a global biodiversity hotspot, the country is also known as one of the top three greenhouse gas emitters from deforestation worldwide, partly due to the expansion of oil palm cultivation (“REDDX | Countries,” n.d.; Sloan et al., 2012). It is estimated that 53% of the total area planted with oil palm in Indonesia is the result of deforestation since 1989 (Vijay et al., 2016). In response, Indonesia is a focus country under the UNFCC for forest conservation and REDD+ development activities. Against this background, this study provides insights on the effects of different PES schemes to promote sustainable land use.

Our framed field experiment is based on Vorlaufer et al. (2017). Participants decide how to allocate their endowment of land between two alternative products commonly grown in the region: rubber agroforestry and oil palm plantations. Replicating actual trade-offs in the land allocation decisions, we set the experiment such that cultivation in oil palm yields higher returns than the cultivation of rubber agroforestry. Yet, to capture the effects that rubber agroforestry generates on the environment (e.g., soil conservation, biodiversity habitat, etc.), we allow positive externalities to the cultivation of rubber agroforestry. To examine how heterogeneity in endowments and in returns affects conservation decisions, we vary the endowment of land that individuals in a group receive. Two individuals are low endowed and receive 5 units of land and one individual is high endowed and receives 10 units. We extended this experiment to include a between subject design, where participants took identical land allocation decisions but under an alternative incentive schemes. The incentive was framed as Payment for Environmental Services aiming to foster environmentally friendly behavior associated with the cultivation of rubber agroforestry. We vary two characteristics of the scheme. We implemented either an individual or collective incentive scheme and under each scheme we offered a low and a high incentive. Under the individual scheme, participants received the payment individually for each unit of endowment individually allocated to conservation. In the collective incentive scheme, participants received the incentive based on their individual allocation, but only once the total number of land units allocated to the conservation of rubber agroforestry at the group level reached a minimum threshold level.

We find that a significant proportion of the land, 40% of the endowment on the average, is devoted to rubber agroforestry. As expected farmers with high endowments invest a significantly larger fraction of their land endowments (52%) compared to low endowed individuals (45%) under individual schemes. We find that PES are effective at promoting conservation. However, the elasticity of supply is relatively low. A one percent increase in the payments leads to a 0.02 percent increase in the area conserved. Comparing individual and collective incentives, we find that they are equally effective at promoting conservation. Yet, we find that whereas low endowed individuals respond both to individual and collective incentives, high-endowed individuals only respond to collective incentives. We contribute to the literature by explicitly considering how heterogeneity in land endowments affects the effectiveness of PES.

Kackzan et.al. (2017) showed that collective incentives increase the time contribution for conservation practices from participants; Middler et.al. (2015) identified that collective incentives have a positive effect only when social ties are strong. Narloch et.al. (2012) identified that collective schemes are less (cost effective) when compared to individual rewards because they might undermine pro-social norms. Nonetheless, Narloch et. al. (2012) recommends evaluating social norms that are of relevance for the success of formal institutions such as PES, as collective incentives might enhance bonding and linking social capital.

The paper is structured as follows: Section two provides background and context in terms of previous PES in Indonesia and the importance of the region. In Section three, we present the literature review on the empirical evidence about social capital, PES and environmental outcomes. Section four presents the theoretical framework of the investment game; followed by section five, where details of the empirical data are presented. In Section six, we present descriptive statistics followed by the econometric results. Finally, in Section seven, we discussed the implications of the findings at the policy level with regards to natural resources management initiatives in Indonesia and the design of PES in general.

2. Background

Indonesia spreads over more than 18,000 islands; with around 60% of the territory being located in tropical rainforest. Due to the high levels of endemic species and rich biodiversity, this country is of worldwide environmental importance. Oil palm plantations cover approximately 8 million hectares in Indonesia and it is expected that they will reach about 13 million hectares by 2020 (Cacho et al., 2014). The establishment of oil palm and timber plantations have now become the main drivers of deforestation in Indonesia (Cacho et al., 2014; Koh and Wilcove, 2008). The increasing world demand for crude palm oil and the national policies on biofuels requiring either ethanol or palm-oil biodiesel in the fuel mix suggest that expansion of oil palm plantations will continue (Dillon et al., 2008). Much of the production in Indonesia comes from large-scale plantations, however, independent smallholders are increasing their share and may dominate production in the future.

PES are regarded as a promising policy instrument to foster conservation and promote alternative agroforestry systems such as rubber agroforest. Rubber agroforest represents a traditional, extensive management system, which is established by inter-planting rubber trees with native fruit and timber trees. Rubber agroforest can rapidly develop a vegetation structure close to that of secondary forest of similar age (Ekadinata et al., 2004) and therefore generates positive environmental effects (i.e. improved water quality, increased soil fertility and higher biodiversity).

Indonesia has used PES for more than a decade to promote the provision of water and carbon sequestration services in the Bungo watershed and Lake Singkarak in Indonesia. Farmers who protect upper watersheds and avoid planned deforestation or increase tree planting have benefited from this scheme (Kerr et al., 2014; Lapeyre et al., 2015; Suich et al., 2017). In a systematic revision of PES in Indonesia, Suich et al. (2017) found that those PES related to avoid deforestation are paying for inputs to halt deforestation (i.e. seedlings) but these are not being directly associated with an specific target of tons of carbon dioxide equivalent sequestration and therefore it is not possible to measure whether these projects have been successful in achieving conservation outcomes. There are no agricultural PES Implemented in our area of study.

Generally, PES related to land use change have provided individual incentives but require some type of organization at the community/village level. Kerr et al (2014) examined the "Hutan Kamasyarakatan (HKm) Social Forestry Program", which offered an in-kind individual incentive (probationary land right) in exchange for watershed protection. Participation was on a voluntary basis but required individuals to be part of an organized group; this group was responsible for assuring compliance at the individual level. Most farmers did not have land security and this probationary land right was successful for watershed protection because farmers had the motivation that the land right could be extended for a 25-year period after the first five years. Adhikari and Agrawal (2013) found that individual schemes are positively influence by local organizations and informal institutions. Leaders of the community monitor compliance of the associated farmers, the established social norm was that everybody should respect and implement what was agreed with government in order to keep the probationary land right as a group. Coleman (1987) refers to this obedience to the norm because the sanctions (external and internal) are sufficiently great and certain to make disobedience less immediately attractive than obedience. The role of the social norms, in terms of expressing that no compliance with the agreement was wrong and the fact that it was internalized trough socialization in the group, helped increase participation and adoption of conservation measures and reduced transaction costs in the Bungo watershed and Lake Singkarak PES in Indonesia. There are no studies that analyze the conservation outcomes of collective schemes under different payment levels and therefore the present study will provide insights on the relative effectiveness of individual vs collective PES schemes at promoting extension of rubber agroforestry. This is of special importance since there is uncertainty about the response and behavior towards cash incentives as land rights have been already granted for longer period (25 years) and are no longer available as in-kind incentives.

3. PES, social capital and environmental outcomes: empirical evidence

Social capital, social norms and social networks among others have been identified as key aspects when implementing payment for environmental services (Clements et al., 2010; Grima et al., 2016; Midler et al., 2015; Muradian et al., 2010b; Narloch et al., 2012). Pretty (2003) argues that where social capital is high, individuals have confidence to invest in pro-social activities, knowing that others will do so too. In this paper, we understand individual incentives as a direct arrangement of payment in exchange for environmental services at the individual level. Collective schemes are understood as an arrangement where a specific set of conditions is laid out at the group level in order to receive the incentive. Based on these definitions, we reviewed studies on behavioral economics that examine the relation between PES and social capital. With regards to collective schemes, Kaczan et.al. (2017) found that collective schemes with conditionality on additionality raised collective contributions, showing a positive effect of group coordination mechanism and group participation in contract design on contributions. Midler et al. (2015) test four types of PES schemes: collective reward, communication and collective reward, individual reward and communication only. For the collective treatment they specified a minimum threshold in order to receive the PES incentive, they found that collective incentives had a positive effect on conservation when social ties were strong or when communication was allowed, but without communication it did not have any significant effect. The measurement of social capital was through social ties specifically by the number of family members in the same session, which had a positive effect when interacted with the collective treatment. Narloch et. al. (2012) identified that collective incentives affect positively conservation outcomes but its effect was undermined due to free-ridding behavior.

With regards to individual PES schemes, Handberg and Angelsen (2016) test three different payment levels, showing that low payment level had no effect while medium and high payment levels have a positive effect. The experiment also consider the role of a close network, as a form of social capital, controlling for Family and/or close friends in the same session showing no effect on harvest rates. Midler et.al. (2015) explore the effect of an individual scheme, showing an increase in conservation level and no effect of social ties.
Barr et al. (2012) test three forms of social capital (trust, group membership and presence within a reciprocal fishing dependency network) in an individual incentive scheme. They

found that trust and group membership positively reinforce individual participation while the presence within a reciprocal fishing dependency network reduces the likelihood of participation (Barr et al., 2011). Similarly, Chen et. al. (2009) found that farmer's intention to re-enroll in the Grain-to-Green Program in China decreased if they observed reconversion to non-green technologies among their neighbors.

There is limited literature concerning land use heterogeneity in the context of payments for environmental services. Eloy (2012) performed an analysis of land use heterogeneity in agricultural frontiers in the Amazonia, showing that PES policies should focus on remote areas, where the initial stage of deforestation usually takes place, where the agro ecosystem fertility and agro biodiversity are already high and where farmers are younger and poorer (Eloy et al., 2012). Vorlaufer et al. (2017) show that farmers with low land endowment (poor) reacted more strongly to PES than farmers with high endowment (rich). Keser (2014) found that when there are strong asymmetries in endowment, high endowed (rich) participants contribute significantly lower percentage than low-endowed (poor) participants (Keser et al., 2014). This study builds on Narloch et.al. (2012), and answers the gap identified in their study with regards to disentangling the effect of varying payment levels under collective and individual incentives schemes in order to compare their effectiveness. In addition, we carefully assess the influence of social norms, networks and goes in more depth by analyzing heterogeneous effects in response to individual and collective schemes.

4. Conceptual framework

In this study, the decision to plant rubber agroforestry instead of oil palm cultivation is represented as an investment decision. Each individual has e units of land which we refer to as hectares. Their task is to decide how to allocate the endowment between oil palm and rubber agroforestry. We denote r the number of units that are invested in rubber agroforestry and consider that the land that is not invested in rubber agroforestry is invested in oil palm $(e_{ik} - r_i)$. Acknowledging the existence of multiple types of individuals as a core principle of modeling collective behavior (Ostrom, 2007), we consider that producers are heterogeneous in terms of size of available land. Therefore, we have low-endowed individuals, L, with e_L units of land and high endowed individuals, H, with e_H units of land.
Consistent with the fact that the cultivation of rubber agroforestry generates positive environmental effects (i.e. host lowland biodiversity, carbon storage, improve water quality, among others) we consider that each unit invested in rubber agroforestry generates a positive externality, β, to the members of the group. In addition, consistent with the fact that rubber agroforestry has lower economic returns than oil palm (Djanibekov and Villamor,

2017), we set the marginal return generated by each hectare of oil palm to 1, while the marginal return from one hectare of rubber agroforestry is set to γ<1. We further allow different marginal returns for low and high-endowed individuals, $\gamma_L < \gamma_H$, representing the situation where low-endowed individuals are less productive in rubber-agroforestry than high-endowed individuals.

To account for the possibility that individuals internalize the cost that cultivating oil palm generates to nature, similar to Ibanez and Martinsson (2010) we assume that individuals disutility from cultivating oil palm is M= $c_i(e_{ik} - r_{iK})^2$ Where c_i denotes a parameter that measures the importance that individual i gives to conservation. For an individual who does not care about conservation, $c_i = 0$. Whereas for an individual who gives importance to the environment $c_i > 0$.

The individual's U, utility function is given by:

$$U_{Ki} = e_{ik} - r_{iK} + \gamma_K r_{iK} + \beta \sum_{j=1}^{n=2} r_j - c_i(e_{ik} - r_{iK})^2 \quad (1)$$

where $K = \{L, H\}$.

Because the marginal return from oil palm is higher than from rubber agroforestry (1>γ), the model predicts that an individual who does not care about conservation will allocate all the endowment to oil palm instead of rubber agroforestry ($r_i^* = 0$). For an individual who cares about conservation, the investment in rubber agroforestry is:

$$r_{iK} = \frac{2c_i e_{iK} + \gamma_K - 1}{2c_i} \quad (2)$$

Hence, the units of land in rubber agroforestry will increase as individuals give more importance to the environment, have more land endowments and have higher marginal return from cultivating rubber agroforestry. From this condition, we derive our first hypothesis:

H1. The proportion of land invested in rubber agroforestry increases for high-endowed individuals compared to low endowed individuals.

The basic decision problem is extended to investigate the effectiveness of different institutional designs of PES. The first design that we consider is one in which PES are offered to each individual. For each unit of land invested in rubber agroforestry, participants receive γ_K+ *PES.* Individual's utility is:

$$U_{Ki} = e_{ik} - r_{iK} + (\gamma_K + \mathrm{PES_K})r_{iK} + \beta \sum_{j=1}^{n=2} r_j - c_i(e_{ik} - r_{iK})^2 \tag{3}$$

As shown in Vorlaufer et al. (2017) an individual payment is predicted to increase the likelihood that an individual invests in rubber agroforestry. The net utility from investing in rubber agroforestry compared with not investing is:

$$U_{Ki}(r_{iK} > 0) - U_{Ki}(r_{iK} = 0) = (\gamma_K + \mathrm{PES_K} - 1)r_{iK} \tag{4}$$

In addition, PES increases the amount of endowment that individuals invest in agroforestry. For individuals who care about the environment, the marginal effect of an increase in PES is:

$$\frac{\mathrm{d}r_{iK}}{\mathrm{dPES}_K} = \frac{1}{2c_i} \tag{5}$$

The second design considers a collective incentive. Under this scheme, n community members receive a payment PES conditional on achieving a specified target level of conservation. If the total area conversed by the community is larger than a pre-specified threshold T ($\sum_{i=1}^{n} r_{iK} \geq T$) the individual i receives the incentive independently on conservation decisions. In this case, $\sum_{i=1}^{n} r_{iK} \geq T$ individual's utility is given by Equation(4). If the threshold is not reached, no community member receives the payment. In this case individual’s utility is given by Equation (1). Participants expected utility of investing in rubber agroforestry depends on the subjective probability, p_i, that individual assigns that the group reaches the threshold level. We assume that individuals have rational expectations and that the expected probability depends on individual's experience on how much community members invest in rubber agroforestry.

It is straightforward to show that compared with the individual incentive, collective incentives have a lower effect on the likelihood that individuals invest in rubber agroforestry and the amount of land that is devoted to rubber agroforestry. The net utility from investing in rubber agroforestry compared with not investing is:

$$U_{Ki}(r_{iK} > 0) - U_{Ki}(r_{iK} = 0) = (\gamma_K + \mathrm{p_{iK}}\mathrm{PES_K} - 1)r_{iK} \quad (6)$$

while the marginal effect of PES for individuals who have environmental concerns is:

$$\frac{\mathrm{d}r_{iK}}{\mathrm{dPES}_K} = \frac{p}{2c_i} \quad (7)$$

Based on this extension of the basic model we derive the following hypotheses:

H2: Under collective incentives the effect of PES on conservation would be lower than under individual incentives.

H3. Conservation behavior is dependent on the individual's network behavior, showing a significant effect on land allocated to rubber agroforestry under collective incentives but not under individual incentives.

5. Experimental design and procedures

The experimental design aims at testing the effectiveness of different institutional designs of PES to foster conservation decisions. We formed random and anonymous groups of three participants (n=3). Two participants in the group were randomly assigned to receive an endowment e_L= 5 and one participant received e_H = 10. The participants' task was then to decide how to allocate their endowment between oil palm and rubber agroforestry. The scenarios reproduce the investment decision presented in the theoretical model ($\gamma_L < \gamma_H < 1$). Considering the estimates by Feintrenie et al. (2010) of rubber agroforestry and oil palm productivity in Jambi province, we set the marginal return of rubber agroforestry of low-endowed participants to $\gamma_L = 0.5$, and for high-endowed participants to $\gamma_H = 0.6$.

Participants were explained about the positive externalities of rubber agroforestry and how this system contributes to habitat for biodiversity, carbon sequestration. In our experiment, we emphasize that by their decision on allocating hectares to rubber agroforestry they will be benefiting their group members. Assigning a value to the externality is challenging due to the complex relationships between land management, biodiversity and fluctuations in ecological services, (Pascual and Perrings, 2007). As far as we are aware, there is no economic valuation of the effects of rubber agroforestry on the environment. For the experiment, we let each experimental unit of land cultivated with rubber agroforestry generate a value of β=0.2.

In the experiment we use a between-within subject design that varies the type of incentive scheme and the payment level across two payment sets. In the within subject design, each participant was presented with three decisions that vary the value of the incentive. In the first decision the incentive is set to zero (baseline without PES). The second and third decisions correspond to either a low or a high incentive depending on the order randomly pre-determined for the session. In the between subject design, we tested to different types of PES, individual and collective, and implemented two different payment sets (see Table 1). While under the individual incentive scheme, participants received a flat-rate payment for each experimental land unit allocated to rubber agroforestry, under the collective scheme, payment is conditional on the achievement of an aggregate conservation threshold. We set the threshold level at *T=7*, corresponding to 35% of the aggregate land endowment at group level. Table 1 presents an overview of the parameters used in the experiment.

Table 1. Parameters used in the experiment by treatment and endowment status

Treatments	Endowment (e)	Marginal per capita return (γ)	PES Set 1		PES Set 2		Positive externalities (β)
			PES_L	PES_H	PES_L	PES_H	
Individual Incentive scheme	$e_L = 5$	$\gamma_L = 0.5$	0.05	0.25	0.1	0.3	0.2
	$e_H = 10$	$\gamma_H = 0.6$	0.05	0.25	0.1	0.3	0.2
Collective incentive scheme	$e_L = 5$	$\gamma_L = 0.5$	0.05	0.25	0.1	0.3	0.2
	$e_H = 10$	$\gamma_H = 0.6$	0.05	0.25	0.1	0.3	0.2

The experiment was implemented from November 2012 until March 2013. The participants were randomly invited to participate in the experiment based on a village census. At the start of the session, the instructions of the game were read aloud to the participants, followed by several examples. To improve understanding of the rules of the game, we worked with visualizations. To illustrate the investment decisions, participants were presented with pictures from oil palm and rubber agroforestry systems. The endowment with experimental land units was represented by color stickers. After completion of two practice rounds, the actual experiment was carried out. Participants did not receive feedback on investment decisions of other group members.

In total 30 experimental sessions were carried out, 14 with the collective incentive scheme and 16 with the individual incentive scheme. Each experimental session had between 2 and 3 groups. On average, participants earned 86,347 Rp, which is equivalent to one to two daily wages in the research area.

Table 2 summarizes the number of participants by treatment, payment sets and endowment status.

Table 2. Number of participants by PES scheme, payment set and endowment status.

	Individual incentive	Collective incentive

	Groups	Participants	e=5	e=10	Groups	Participants	e=5	e=10
PES Set 1 (0.5, 0.25)	22	66	44	22	18	54	36	18
PES Set 2 (0.10, 0.30)	22	66	44	22	20	60	40	20
Total	44	132	88	44	38	104	76	38

6. Data

6.1 Experimental data

The responses from the experiment were recorded after each decision; the enumerators collected each of the cards where the participants decided how much of their endowment was for oil palm and for rubber agroforestry. In total we have three responses per each individual, therefore in the analysis we consider the panel data structure.

6.2 Socioeconomic data

A socioeconomic survey was conducted to gather information about the characteristics of the people living in each of the four villages where the experiments were implemented. The socioeconomic survey provided information about the main activities in each of the villages, level of education, and participation in local organizations.

6.3 Social network data

The socioeconomic survey included questions with regard to the farmer's social network using the random matching within sample technique (Maertens and Barrett, 2013). Each farmer was matched with nine randomly drawn individuals from the sample in each village and, for each match, we elicit details of the relationship between the farmer and the match, including do you know farmer X?, when did you last talk with X?, in a normal month, how often do you talk to X?, Does X plant oil palm, rubber monoculture or rubber agroforest? and how many hectares does X cultivate? (Conley and Udry, 2001; Maertens and Barrett, 2013). Since the matching was random, these measures give us an indication of the farmer's social connectedness within the community and his perceptions regarding the cultivation activities of his social network members. We use the responses to these questions to capture the subjective probability that the farmer attaches to other community members investing in rubber agroforestry.

From this section of the survey the following variables were estimated and used in the model:

- *Social oil palm network:* we create this variable by adding the number of people that the participant knew from the nine that were randomly asked in the socioeconomic survey. cultivate oil palm.
- *Environmental connectedness of the network:* is estimated as the average environmental connectedness of the people that the participants in the experiment knew from the nine that were randomly asked in the socioeconomic survey. This ranges from 1-7, the higher the more connected is the individual with the environment.
- Education of the network: is the average years of education of the people that the participants in the experiment knew from the nine that were randomly asked in the socioeconomic survey.

In addition, we captured several social capital variables through a post-experimental survey. These variables relate to social ties among the participants of the same experimental session, and include the number of family members that participated in the same session, the number of participants in the same session known by name, and the number of participants in the same session with whom the participant has interacted in the last month.

7. Estimation approach

In order to analyze the effect of individual and collective schemes on conservation behavior, we define as dependent variable the share of the total endowment allocated to rubber agroforestry. Thus, the model we estimate is the following:

$$Y_{it} = \beta_0 + \beta_T T_i + \beta_{PES} PES_{it} + \beta_{TxPES} (T_i \, x \, PES_{it}) + X_i^{'} \beta + S_i^{'} \beta + u_i + v_{it} \quad (8)$$

Where, Y is the conservation outcome by participant i in decision t. *T* is a dummy that takes value equal to one if the collective scheme was implemented and zero otherwise, PES is the value of the incentive that was offered to participants (0.05, 0.10, 0.25, 0.30). Our coefficient of interest is β_{TxPES}. Our hypothesis is that this coefficient is negative indicating that participants respond less to the collective than to the individual incentive. The vectors X and S represent socioeconomic characteristics and social capital variables, while u_i stands for the idiosyncratic error term and v_{it} is the residual. With regards to social capital variables, the characteristics of the network are not those from the group members but from the network data collected from the survey, we expect that farmers refer to their social network to derive predictions on how their group members will behave.

To account for the panel structure of the data, we estimate a Generalized Least squares (GLS) random effects model. Although our dependent variable ranges between 0 and 1, it is distributed normally justifying the use of this model.

8. Results

8.1 Descriptive statistics

From the total sample of farmers, 54% were assigned to the individual incentive scheme and 46% to the collective incentive scheme. The socioeconomic characteristics of the participants in the study are comparable across villages. The balance across sample for individual and collective treatment shows no significant differences with regards to age, education and migration background. Farmers are on average 43.78 years old with successful completion of elementary school (6 years of education) but have not finalized secondary school (Table 3). With regards to migration, 49% have migrated to the Jambi province. Participants of the two treatments do not differ in terms of area of oil palm cultivated and the size of the farm. The crop that is cultivated more commonly by the participants is oil palm, followed by rubber and small portion with rubber agroforestry. On average 86% of the participants have as main occupation agriculture.

Regarding social capital variables, 53% of the farmers belong to a farmer organization. The results of the random matching within sample technique showed that farmers on the average know six people out of nine; the level of education of the network is on average 7.45 years of schooling. In general, the network has the same pattern of cultivation, being oil palm the predominant crop, followed by rubber and in small proportion jungle rubber.

Table 3. Summary Statistics and balance check

Variables	Mean	S.D.	**Balance across sample[1]**		
			Individual Treatment (Mean)	Collective Treatment (Mean)	p-value
Age	43.79	11.01	43.73	43.88	.514
Sex (=1 if female)	.060	.239	.046	.078	.484
Education (=years of schooling)	7.697	3.734	7.651	7.754	.479
Size of the farm (has)	3.842	6.002	3.210	4.650	..471
Area of oil palm cultivated by the participant (*has)*	2.345	3.460	1.982	2.783	.463
Area of rubber agroforestry cultivated by the participant (*has)*	.326	1.908	.314	.340	.479
Main occupation (=1 if it is agriculture else 0)	.857	.350	.883	.823	.530
Family members that participated in the same experiment	1.03	1675	1.20	.833	.546
People known by name that participated in the same experiment	7.24	1.500	7.53	6.91	0.000***
People that participated in the same experiment with whom the participant speaks at least once per month	3.80	2.543	4.075	3.526	.3259
Social rubber agroforestry network	4.47	3.133	4.41	4.52	.816
Social oil palm network	6.83	2.018	6.81	6.878	.76
Environmental connectedness of the network	5.53	1.007	5.489	5.585	.586

[1] Two-sample Wilcoxon rank-sum (Mann-Whitney) test. S.D. stands for Standard Deviation

The response from the participants in the experiment at the group level is displayed in Figure 1. The figure shows the mean share allocated to conservation at the group level by treatment and payment set. The lines represent the confidence intervals. We observe that for individual payments, there are initial differences in the share allocated to conservation among payment sets. This suggests that in the econometric analysis we need to control for payment set. We also find that the share conserved increases with higher PES. Figure 1 shows that at no incentive level, on average 40 to 48 percent of the land is invested in conservation. The share increases when participants are offered a PES, at low incentives, 5 and 10%, the share increases by 4.5% and high incentives, 25% and 30%, the share increases by 6.5% compared to baseline respectively.

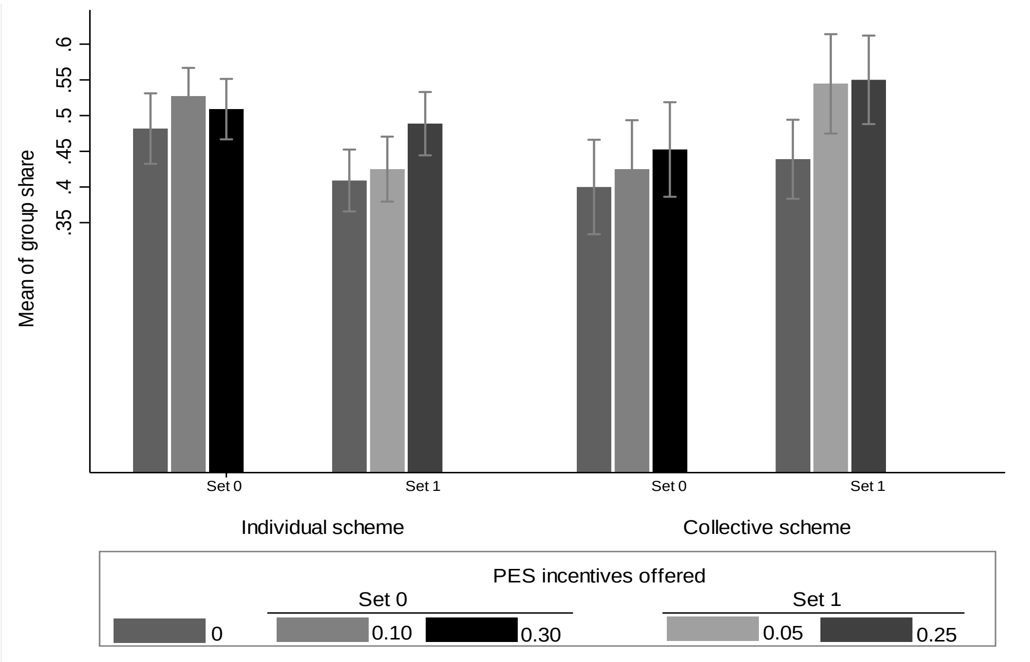

Figure 1. Mean group share allocated to conservation

We further describe the data at the individual level disentangling the response by endowment. Table 4 presents the results by individual and collective scheme, comparing the share conserved of low and high-endowed participants at different payment levels. We find that conservation increases with PES for both types of participants.

Table 4. Descriptive statistics of the individual share allocated for conservation by endowment

	Individual scheme					Collective scheme				
	e=5		e=10		t-test value[1]	e=5		e=10		t-test value[1]
	Mean	S.D	Mean	S.D.		Mean	S.D	Mean	S.D	
No incentive	.406	.308	.484	.265	-1.41*	.463	.368	.373	.339	n.s.
5%	.422	.286	.427	.274	n.s.	.522	.383	.566	.353	n.s.
10%	.422	.314	.631	.054	-2.70**	.51	.384	.34	.358	1.65*
25%	.531	.322	.445	.275	n.s.	.516	.392	.583	.374	n.s.
30%	.436	.348	.581	.285	-1.69*	.5	.397	.405	.342	n.s.

[1] Two-sample t test. S.D. stands for Standard Deviation. n.s. stands for not significant.

8.2 Econometric results

8.2.1 Collective vs individual scheme

To test the effect of individual and collective schemes on conservation behavior we analyze the proportion of total endowment allocated to rubber agroforestry at the group level (Group share). We estimate model 8 controlling for session dummies. Standard errors are clustered at the session level. Table 5, presents the results of estimating equation 8 for the pooled sample. We find that when there are no incentives 57% of endowment is invested in rubber agroforestry. PES has a positive although small effect on conservation.

Table 5. Random effects GLS estimation

	(1) Group share of land conserved	
	Coef.	S.E.
PES Incentive	0.0017*	0.0009
Treatment (=1 if collective)	-0.033	0.0860
Collective * PES incentive	0.0006	0.0014
Constant	0.5759***	.1191
N	246	
chi2	13.50	
p	0.096	
Linear combination		
PES Incentive + Collective*PES incentive	0.0023**	0.0010

Note: Control for the number of family members, number of people known by name and number of people with whom members of the group have spoken in the last month showing no significant influence. Standard errors are clustered at the session level.
* p<0.1, ** p<0.05, *** p<0.01

A one percent increase in incentives increases investments in rubber agroforestry by 0.17% under individual incentives and by 0.23% under collective incentives. Yet, as indicated by the coefficient on the interaction term, this difference is not statistically significant. Hence we reject H2 stating that the elasticity of supply to PES is lower under collective than under individual incentive schemes.

8.2.2 Heterogeneous effects by land endowment

There has been little attention to asymmetry in endowment in the experiments when analyzing individual or collective PES schemes. The opportunity costs of allocating scarce resources to conservation are often significant for resource users with limited endowments (Narloch et al., 2012), as is the case for our low-endowed participants. In this study, we test whether conservation behavior under individual and collective schemes differs by endowment level (Table 6). For this purpose, we estimate equation 8 separately by endowment level (models 2 and 3) and also we estimate equation 8 separately for the individual and the collective scheme and interact the proportion of land endowment invested in rubber agroforestry at the individual level with endowment level (model 4 and 5). Results from model 2 and 4, show that under the individual scheme payments significantly increase conservation among low endowed participants (0.003*, SD. 0.001, p<0.1).

Table 6. Random effect GLS estimation of individual share of land allocated to rubber agroforestry

	By Endowment				By PES scheme			
	(2) Low-endowed participants e=5		(3) High- endowed participants e=10		(4) Individual scheme		(5) Collective Scheme	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
PES Incentive	0.003*	0.001	0.001	0.001	0.003*	0.001	0.001**	0.001
Treatment (=1 if collective)	0.111	0.078	-0.101	0.117				
Collective * PES incentive	-0.002	0.002	0.004	0.002				
Endowment (=1 if 10has)					0.100*	0.059	-0.088*	0.053
High Endowed * PES incentive					-0.002	0.002	0.002	0.002
Constant	0.381***	0.049	0.581***	0.056	0.486***	0.151	0.494***	0.109
N	492		246		394		342	
chi2	10.413		13.757		7,574		13,839	
p	0.064		0.017		0.271		0.031	
Linear combinations								
PES Incentive + Collective*PES incentive	0.001*	0.0006	0.0045**	0.0021				
Pes+ PES*High Endowed					0.0008	0.0009	0.0033*	0.00194

Note: All models control for the number of family members, number of people known by name and number of people with whom members of the group have spoken in the last month showing no significant influence. Standard errors are clustered at the session level.

* p<0.1, ** p<0.05, *** p<0.01

In contrast, among high endowed participants the effect is significantly smaller, and in fact not significantly different from zero (0.008, S.D.0.0009, p>0.10). Under the collective scheme, the introduction of PES significantly increases conservation among low endowed participants, although the size of the effect is small (0.001*, S.D. 0.0062, p<0.10). In comparison model 3 and five shows that the effect on high endowed participants is significantly larger (0.0045*, S.D.0.0021, p<0.05). Thus, the results indicate that the two types of PES schemes have heterogeneous effects on participants with different land endowments. While low endowed participants are relatively more responsive to individual incentives, high endowed participants only significantly increased conservation in response to collective incentives. These results are robust with and without the control variables. This is of high importance for the design of PES schemes because it can explain why PES schemes do not lead to the desired outcomes.

Given that in the experimental treatments we have offered four discrete levels of incentives that were presented in two sets, we test to what extent the effectiveness of the two different

PES schemes is conditional on whether high or low incentives are offered[1]. Table 7 shows the results of the random effect GLS analyzing the individual share allocated to conservation under individual (model 6) and collective (model 7) schemes. The results indicate that under the individual scheme low incentives were not sufficient to alter the farmer's behavior in comparison with the baseline (no incentive scenario). However, high incentives increase the share of land allocated to rubber agroforest by 6.1% compared to the baseline.

Table 7. Random effect GLS estimation of individual share of land allocated to rubber agroforestry under high and low incentives by PES scheme

Individual share	(6) Individual scheme		(7) Collective scheme	
	Coef.	S.D.	Coef.	S.D.
Low PES	.026	.020	.060***	.022
High PES	0.061**	.025	.068***	.023
Endowment (=1 if 10has)	.078*	.047	-.059	0.065
Constant				
N	396		342	
chi2	8.529		12.793	
p	0.036		0.046	

Note: * p<0.1, ** p<0.05, *** p<0.01

In contrast, low incentives under the collective scheme have a positive and significant influence on conservation behavior increasing the share of land allocated to rubber agroforestry by 6.0%. High incentives also have a significant and positive effect under the collective scheme, although the size of the effect (6.8%) is not much larger than with low incentives. Thus, as regards cost-effectiveness, collective incentives may offer the opportunity to achieve similar conservation outcomes at lower cost.

The results are consistent with the findings from Handberg and Angelsen (2016) in a study in Tanzania of a PES to reduce forest harvest rates, identifying that low PES had no significant effect on the aggregate mean harvest rate under individual incentives. Although, conservation levels can be achieved with individual schemes higher payment levels are required to motivate the farmer to engage in the scheme.

8.2.3 Role of social capital

In order to study the effect of social capital (in the form of social norms and networks) on participants' conservation behavior, we control in the model for social capital variables specific to the game and include exogenous network variables as explained in section 5.4. Table 8, presents the results of the new estimated models incorporating social capital

[1] As mentioned in the experimental procedure, two sets were offered, we aggregate the average share of land from 0.05 and 0.1 as the response to low incentive and the average share of land from the 0.25 and 0.30 incentives as the response to high incentives.

variables. Essentially, we observe that social capital variables related to the participant's social network and group membership have a significant influence on the conservation behavior under the collective scheme and not under the individual scheme. This supports hypothesis 3.

Under the collective scheme, we observe a negative effect of the social oil palm network, implying that an additional person in the social oil palm network of the participant reduces the share of land allocated to rubber agroforest by 3%. In contrast, the environmental connectedness of the network, membership in a social local organization and the size of the social agroforestry network have a positive influence, increasing the share of land conserved by 7%, 25.9% and 2%, respectively. This implies that under collective schemes, farmers take their network preferences and characteristics into account when making land allocation decisions, because the other group members' decisions affect their payoffs.

Table 8. Random effect GLS estimation of individual share of land allocated to rubber agroforestry controlling for the effect of social capital variables

Individual share	(6) Individual scheme with control		(7) Collective scheme with control	
	Coef.	S.D.	Coef.	S.D.
Low PES	0.027	(0.022)	0.063**	(0.028)
High PES	0.066**	(0.027)	0.068***	(0.026)
Endowment (=1 if 10has)	0.095*	(0.050)	-0.022	(0.066)
Individual characteristics				
Land tenure (=1 if owned)	0.222**	(0.107)	0.164**	(0.076)
Age	-0.002	(0.003)	0.001	(0.004)
Education	-0.003	(0.008)	0.007	(0.012)
High individual environmental awareness (=1 if environmental awareness is >5)	0.106*	(0.054)	-0.058	(0.072)
Jungle rubber cultivated by the participant	0.022***	(0.005)	0.030	(0.031)
Social capital				
Membership in a social organization	0.100	(0.071)	0.202*	(0.117)
Membership in an oil palm cooperative	0.098	(0.057)	-0.096	(0.070)
Education of the network	0.024	(0.017)	0.026	(0.019)
Environmental perception of the network	0.015	(0.019)	0.070**	(0.032)
Social Agroforestry network	0.044	(0.194)	0.259**	(0.101)
Social Oil palm network	-0.015	(0.011)	-0.034**	(0.015)
Constant	0.077	(0.291)	-0.282	(0.379)
N	380		276	
chi2	75.877		405.617	
p	0.000		0.000	

Economic incentives for conservation influence moral motivations for conservation in complex ways through their interaction with social preferences (Liu et al., 2014). When deciding how much land to allocate to rubber agroforestry, participants were influenced by the amount of land under oil palm their network cultivated. The effect of the network reduced significantly the individual contribution under the collective scheme, which could be explain in two ways: 1) participants want to perform as the social norm in the area, which is the cultivation of oil palm and feel pressure to comply with the norm; and 2) individuals consider the behavior of other in real life to predict the probability that the members of the group will conserve. This results are in line with the finding from Barr et al. (2011), who show that the farmers who were dependent on a fishing network in Tanzania, were less likely to participate in a marine PES scheme.

In contrast, we observed a positive and significant effect of environmental connectedness of the network, meaning that when deciding to cultivate rubber agroforestry due to the positive environmental externalities, the participant's land investment decision takes into consideration that his network is conscious about environment and therefore would behave in a pro-environment way by allocating more land to rubber agroforestry, so he will behave in the same way.

9. Conclusions

Payment for Environmental Services is an instrument that provides incentives for conservation. Our findings have important implications for REDD focus countries, which is the most important arena for collective PES nowadays. The results show that collective schemes can be as effective as individual schemes, as we observed a positive and significant increase on conservation outcomes. Collective schemes can be more cost-effective because it achieves same conservation outcome at lower incentive payments. In addition, the results show that land heterogeneity matters, collective schemes may be especially suitable to engage large landowners, who may feel the moral pressure to contribute their share under such institutional arrangements. While smaller farmers respond to individual and collective incentives. It should be kept in mind, however, that the effectiveness of PES is highly place-specific and depends on the social norms prevalent in the communities. Social capital in the form of network shows a negative and significant influence of the share of land allocated to rubber agroforestry; while membership and environmental awareness of the network have a positive influence. This understanding is important in order to provide policymakers with key aspects when designing PES, so they can build up on existing social norms, provide economic incentives for conservation, and complement informal institutions. In the future more research is needed to asses which of the channels are explaining observed behavior. In particular, future work should measure expectations on others behavior and try to capture expected probability of receiving a payment under the collective incentive. This study highlights how endowment heterogeneity and social capital can compromise the success of a PES scheme. Future PES should focus and be tailor to the characteristics of the participants in terms of endowment, and should have a better understanding of the social norms of the context. Further research will be beneficial on understanding higher payment levels, and the interaction with already establish collective action mechanism.

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