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

by Gracia Maria, Marcela Ibañez, Meike Wollni, and Miriam Vorlaufer

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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 2016; Engel, Pagiola, and Wunder 2008). Due to the high cost of implementing command and control measures and weak institutions in developing countries, this policy instrument is regarded as being more effective than command and control instruments (Le Velly and Dutilly 2016; Narloch, Pascual, and Drucker 2012; Pagiola, Arcenas, and Platais 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; Börner et al. 2017; Adhikari and Agrawal 2013). 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; DeFries 2017). However, one concern that remains is how to bundle small individual contracts into one larger agreement to have a complete landscape coverage and to reduce transaction cost (Kerr, Vardhan, and Jindal 2014; Ramirez-Reyes et al. 2018). Individual payments do not explicitly promote the coordination among suppliers to conserve, contiguous land parcels and hence potentially result in low 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, Vardhan, and Jindal 2014; Dickman, Macdonald, and Macdonald 2011).

However, uncertainty on whether the threshold can be trespassed and the possibility for free-riding behavior might decrease the effectiveness of collective schemes compared to an individual payment scheme. For example, Narloch et al (2012) identified that collective incentives affect positively conservation outcomes but its effect was undermined due to free-ridding behavior.

Social norms are understood as key when implementing payment for environmental services (Clements et al. 2010; Grima et al. 2016; Midler et al. 2015; Muradian et al. 2010; Narloch, Pascual, and Drucker 2012). Pretty (2003) argues that where there is a strong social norm, individuals have confidence to invest in pro-social activities, knowing that others will do so too. Middler et.al. (2015) identified that collective incentives have a positive effect on conservation only when social ties are strong.

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 PES schemes and disentangle heterogeneous effects of individual and collective schemes. In addition, we explore to what extend the behavior of others, or the unwritten social norms, help to enhance conservation under under individual and collective incentive schemes.

As case study, we focus on Indonesia which 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 (Sloan, Edwards, and Laurance 2012; Carlson et al. 2012). It is estimated that 53 percent of the total area planted with oil palm in Indonesia is the result of deforestation since 1989 (Vijay et al. 2016). In response, the Government of Indonesia has started more than 60 REDD+ (Reducing Emissions from Deforestation and Forest Degradation) activities, being one of them the provision of monetary incentives to reduce land conversion and promote sustainable forest management (FCPF 2018). In this regard, this study provides insights on farmers' response to different PES schemes to foster environmentally friendly behavior associated with the cultivation of rubber agroforestry.

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 experimentally 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 a significant proportion of the endowment of land (40 percent) is devoted to rubber agroforestry. As expected farmers with high endowments invest a significantly larger fraction of their land endowments (52 percent) compared to low endowed individuals (45 percent) 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 on the average.

There are many studies analyzing the effect of PES but relatively few studies exploring the response to individual and collective PES schemes. Midler et al. (2015) analyze collective and individual types of PES schemes with and without communication. Supporting the importance of social norms, they find that collective incentive promotes conservation only when social ties are strong (number of family members in the same session) or when communication was allowed. More recently, Kaczan et al (2017) showed that collective incentives increase the time contribution for conservation practices. We contribute to the literature by explicitly considering how heterogeneity in land endowments and the interaction of monetary incentives with network behavior affects farmer’s pro-environmental behavior under PES schemes.

There is limited literature concerning land use heterogeneity providing recommendations for the design of payments for environmental services. In terms of PES geographical focus, 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). With regards to response to incentives considering land heterogeneity, Vorlaufer et al. (2017) show that farmers with low land endowment (poor) reacted more strongly to PES than farmers with high endowment (rich). In the same line, 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). Yet, these studies do not compare different PES schemes.

This paper also contributes to the literature studying the how social norms affect the effectiveness of PES. Barr et al (2012) study the role of trust, group membership and networks 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. 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.

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 norms and network, 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. Conceptual framework

We consider the individual decision on land use. Each individual i has e_i 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_i 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 $(e_i - r_i)$. 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. We assume that low-endowed individuals are less productive in rubber-agroforestry than high-endowed individuals and set $\gamma_L < \gamma_H$ ..

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 utility function U_i is given by:

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

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

Taking as given the investment decisions of others, r_j, the marginal incentive to invest in rubber agroforestry is:

$$\frac{dU_{ik}}{dr_{iK}} = -1 + \gamma_K + 2\mathrm{c_i}(e_{ik} - r_{iK})$$

Because the marginal return from oil palm is higher than from rubber agroforestry, the model predicts that an individual who does not care about conservation will allocate all the endowment to oil palm instead of rubber agroforestry ($r_i^* = 0$). Alternatively, for an individual who cares sufficiently about conservation such that $\frac{dU_{ik}}{dr_{iK}} = 0$ we will have an interior solution where the investment in rubber agroforestry is:

$$r_{iK} = \frac{2c_i e_{iK} + \gamma_K - 1}{2c_i} \tag{2}$$

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 is larger 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. In addition, conditional on positive investments, PES increases the amount of endowment that individuals invest in agroforestry. For individuals who care about the environment, $\left(\frac{dU_{ik}}{dr_{iK}} = 0\right)$, the marginal effect of an increase in PES is:

$$\frac{\mathrm{d}r_{iK}}{\mathrm{dPES}_K} = \frac{1}{2c_i} \tag{4}$$

Hence, the model predicts that the response to the incentive is independent on the endowment of land.

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 her conservation decisions. In this case, $\sum_{i=1}^{n} r_{iK} \geq T$ individual's utility is given by Equation **Error! Reference source not found.**. 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 marginal effect of PES for individuals who do cultivate rubber agroforestry concerns is:

$$\frac{\mathrm{d}r_{iK}}{\mathrm{dPES}_K} = \frac{p_i}{2c_i} \tag{4}$$

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. The effect of PES is independent of endowment of land.

H3. Conservation behavior is dependent on the individual's expected investment of network members. As more network members cultivate rubber agroforestry, more land is allocated to rubber agroforestry under collective incentives but not under individual incentives.

3. 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 (Waltert, Mardiastuti, and Mühlenberg 2004). 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 (Engel, Pagiola, and Wunder 2008; Muradian et al. 2010; Muradian 2013; Börner et al. 2017). 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, Widayati, and Vincent 2004) and therefore generates positive environmental effects (i.e. improved water quality, increased soil fertility and higher biodiversity).

Indonesia has implemented PES instruments to promote the provision of water and carbon sequestration services in the Bungo watershed and Lake Singkarak (Adhikari and Agrawal 2013). Farmers who protect upper watersheds and avoid planned deforestation or increase tree planting have benefited from these schemes (Kerr, Vardhan, and Jindal 2014; Lapeyre, Pirard, and Leimona 2015; Suich et al. 2017). Under this scheme, the community leaders certify compliance with conservation goals. The success of the mechanisms has been associated with increased coordination by publically agreeing expected behavior. Furthermore, social sanctions for not compliance are expected to foster compliance (Coleman 1987).

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, which guaranteed compliance at the individual level. The Social Forestry Program was considered a success because most farmers did not have land security and the option of having a provisional land right was incentive enough to protect the watershed; in addition, farmers had the possibility to extend this land right permit for a 25-year period after the first five years. Nowadays, land rights have been granted for longer period (25 years) and are no longer an in-kind incentive.

The result of this study are particularly relevant as the Indonesian Government has started more than 60 REDD+ (Reducing Emissions from Deforestation and Forest Degradation) activities, being one of them the provision of monetary incentives to reduce land conversion and promote sustainable forest management (FCPF 2018). In our study area, the Jambi province, these incentives are yet to be implemented.

To the best of our knowledge there are no studies that analyze the conservation outcomes of collective schemes under different payment levels and therefore this study provides insights on farmers' response to different PES schemes to foster environmentally friendly behavior associated with the cultivation of rubber agroforestry.

4. Experimental design and procedure

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 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 (Table 1). 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 two different types of PES, individual and collective, and implemented two different payment sets. 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 and participants 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)	Total	
			PES_L	PES_H	PES_L	PES_H		Participants (N=246)	Groups (N=82)
Individual Incentive	$e_L = 5$	$\gamma_L = 0.5$	0.05	0.25	0.1	0.3	0.2	88	22
	$e_H = 10$	$\gamma_H = 0.6$	0.05	0.25	0.1	0.3	0.2	44	22
Collective incentive	$e_L = 5$	$\gamma_L = 0.5$	0.05	0.25	0.1	0.3	0.2	76	18
	$e_H = 10$	$\gamma_H = 0.6$	0.05	0.25	0.1	0.3	0.2	38	20

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 and to illustrate 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 and communication was not allowed throughout the session.

In total 30 experimental sessions were carried out, 16 with the individual incentive scheme and 14 with the collective incentive scheme. Each experimental session had between 2 and

3 groups, with a total of 246 participants and 82 groups from which 44 groups participated in the individual incentive scheme and 38 in the collective incentive scheme. On average, participants earned 86,347 Rp, which is equivalent to one to two daily wages in the research area. A post experimental questionnaire was applied to gather information concerning individual socio-economic characteristics, perception of fairness towards the payment, reasons behind their decision on planting oil palm and rubber agroforestry, number of family members that participated in the same session, 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.

In addition, as illustrated in Equation **Error! Reference source not found.** the subjective probability, p_i, that individual assigns depends on the individual's experience on how much community members invest in rubber agroforestry. In order to capture individual's experience on how much its community invest in rubber agroforestry, a socioeconomic survey including questions with regard to social norms and network was performed. The survey applied the random matching within sample technique (Maertens and Barrett, 2013), where 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. Based on Conley and Udry (2001) and Maertens and Barrett (2013), we include questions such as: 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?. 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.

5. 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:

$$Y_{it} = \beta_0 + \beta_T T_i + \beta_{PES} PES_{it} + \beta_{TxPES}(T_i \: x \: PES_{it}) + X_i{}'\beta + S_i{}'\beta + u_i + v_{it} \tag{5}$$

Where, Y_{it} 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 norm and network variables, while u_i stands for the idiosyncratic error term and v_{it} is the residual. With regards to $S_i{}'$ we include the characteristics of the farmer's network with regards to the aggregate level of environmental connectedness from his/her network, number of people from his/her network that cultivates rubber agroforestry and number of people from his/her network that cultivates oil palm. In addition we consider how much weight a farmer gives to act like others and to comply with the social norm. We expect that farmers refer to their social network to derive predictions on how their group members will behave and what the social norm is; for example, a farmer with a larger network cultivating oil palm is expected to invest less in rubber agroforestry under the collective incentive scheme (Hypothesis 3) while it should not affect investment under the individual PES.

To disentangle heterogeneous effects by land-endowment we define as dependent variable the individual share of the total endowment allocated to rubber agroforestry. Thus, the model we estimate is the following:

$$Y_i = \beta_0 + \beta_{PES}PES_i + \beta_{KxES}(K_i \, x \, PES_{it}) + X_i{}'\beta + S_i{}'\beta + u_i + v_{it} \qquad (6)$$

Where, Y is the conservation outcome by participant i. *K* is a dummy that takes value equal to one if the individual was endowed with ten hectares and zero otherwise, *PES* is the value of the incentive that was offered to participants (0.05, 0.10, 0.25, 0.30). Our coefficients of interest are β_{ES} and β_{KxPES} which compare the response of low and high endowed individuals to PES, respectively. Our hypothesis is that β_{PES} will be positive. The model predicts that β_{KxPES} will be not significantly different from zero, indicating that low and high endowed individuals react similarly to PES. The vectors X and S represent socioeconomic characteristics and social norm and network variables, while u_i stands for the idiosyncratic error term and v_{it} is the residual.

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.

6. Results

6.1 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 size of the farm. Farmers are on average 43.78 years old with successful completion of elementary school (six years of education) but have not finalized secondary school (Table 2). 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 percent of the participants have as main occupation agriculture.

The results of the random matching within sample technique showed that farmers on the average know four people that cultivate rubber agroforestry and six people that cultivate oil palm; 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 2. 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	0.51
Sex (=1 if female)	0.06	0.24	0.05	0.08	0.48
Education (=years of schooling)	7.70	3.73	7.65	7.75	0.48
Size of the farm (has)	3.84	6.00	3.21	4.65	0.47
Area of oil palm cultivated by the participant (*has*)	2.35	3.46	1.98	2.78	0.46
Area of rubber agroforestry cultivated by the participant (*has*)	0.33	1.91	0.31	0.34	0.48
Main occupation (=1 if it is agriculture else 0)	0.86	0.35	0.88	0.82	0.53
Individual environmental perception	0.81	0.39	0.83	0.79	0.52
Family members in the same session	1.03	1.68	1.20	0.83	0.55
People known by name in the same session	7.24	1.50	7.53	6.91	0.00
People with whom the participant speaks at least once per month in the same session	3.80	2.54	4.08	3.53	0.33
Social rubber agroforestry network	4.47	3.13	4.41	4.52	0.82
Social oil palm network	6.83	2.02	6.81	6.88	0.76
Environmental connectedness of the network	5.53	1.01	5.49	5.59	0.59
Stated commitment to comply and be consistent with the social norm (=1 if yes)	0.70	0.45	0.73	0.68	0.53

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

In addition, we observed high environmental connectedness of the network (5.53 out of 7) and around 70 percent of the participants stated that they have and will behave to comply and be consistent with the social norm.

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. There are initial differences in the share allocated to conservation among payment sets for individual payments (Wilcoxon rank-sum test, p<0.10). 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 baseline (no incentive), 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, 0.05 and 0.10, the share increases by 4.5 percent and high incentives, 0.25 and 0.30, the share increases by 6.5 percent compared to the average of the baseline respectively.

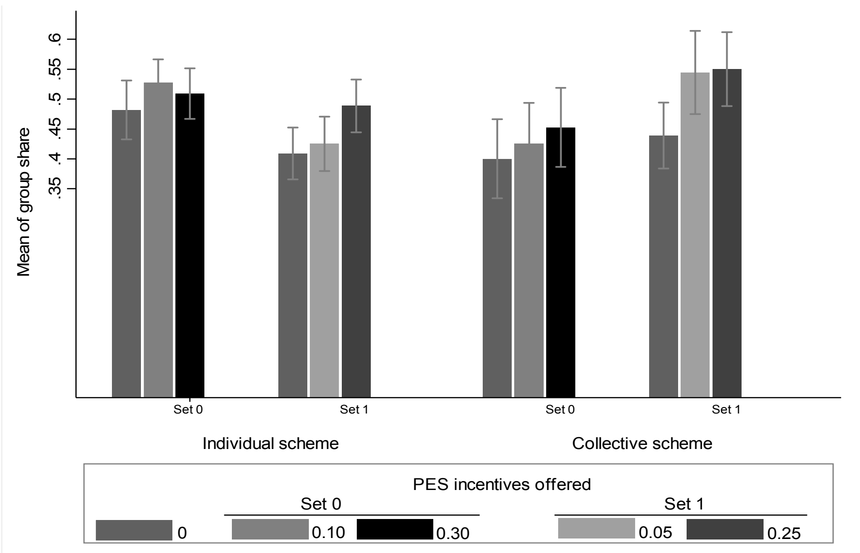

Figure 1. Mean group share allocated to conservation

6.1.1 Collective versus 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 equation 8 for the pooled sample controlling for session dummies with clustered standard errors at the session level (Table 3). We find that when there are no incentives 45 percent of endowment is invested in rubber agroforestry. This indicates that participant have high concerns for the environment, asigning a high moral cost from investing in oil palm. PES has a positive although small effect on conservation.

Table 3. Random effects GLS estimation for share of land conserved at the group level

	(1) Group share of land conserved	
	Coef.	S.E.
PES Incentive	0.002*	0.001
Treatment (=1 if collective)	-0.013	0.056
Collective * PES incentive	0.000	0.001
Constant	0.453***	0.028
N	246	
chi2	8.494	
P	0.037	
Linear combination		
PES Incentive + Collective*PES incentive	0.002**	0.0010

Note: 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 percentual points under individual incentives and by 0.23 percentual points 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. This unexpected result could indicate that individual asign a high probability or receive the incentive under collective incentive, or that they expect that the other participants would invest sufficiently in rubber agroforestry to receive the PES.

6.1.2 Heterogeneous effects

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, Pascual, and Drucker 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 4). For this purpose, we estimate equation 9 separately by individual and collective scheme and interacted endowment level with the PES incentive (model 2 and 3).

Results from model 2 show that in the absence of PES, individuals with high endowment of land invest a larger proportion of the endowent in rubber agroforestry. Yet, the results of model 3, indicate the opposite. Therefore we reject Hypothesis 1, stating that individuals with larger endowments invest a larger proportion of land in conservation.

Model 2 indicate that payments significantly increased conservation among low endowed participants. Yet the elasticity is relatively small and a one percent increase in PES increases the endowment invested in rubber agroforestry in only 0.3 percentual points ($p<0.1$). In contrast, among high endowed participants the effect, given by the linear combination of coefficients is in fact not significantly different from zero ($p>0.10$) as predicted by the model.

Under the collective scheme, PES significantly increases conservation among low endowed participants, although the size of the effect is small. A one percent increase in PES increases land conserve in only 0.1 percentual points ($p<0.05$). The effect of PES on land conservation from high endowed participants is slightly larger (0.3 percentual points, $p<0.10$). Thus, the results indicate that the two types of PES schemes have the same effect on participants with different land endowments.

Table 4. Random effect GLS estimation of individual share of land allocated to rubber agroforestry

Variables	(2) Individual scheme		(3) Collective Scheme		(4) Individual scheme		(5) Collective Scheme	
	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.	Coef.	S.E.
Endowment *(=1 if 10has)*	0.110*	0.059	-0.119*	0.075	0.091	0.057	-0.082	0.074
PES Incentive	0.003*	0.002	0.001*	0.001				
High-endowed X PES incentive	-0.002	0.002	0.003	0.002				
Level of PES								
Low (0.05-0.1)					0.027	0.021	0.066***	0.021
High (0.25-0.30)					0.066**	0.029	0.076***	0.020
Constant	0.352**	0.145	0.329	0.234	0.356**	0.147	0.285	0.236
N	382		306		382		306	382
chi2	49.92		30.007		27.274		34.228	27.274
P	0.000		0.001		0.002		0.000	0.002

Note: All models control for age, sex, education, land tenure, family members, people known by name and people with whom the participant speak in the last month in the same session. Standard errors are clustered at the session level. * p<0.1, ** p<0.05, *** p<0.01

To analyze if the effectiveness of the two schemes is conditional on whether high or low incentives are offered[1] we aggregate the average share of land from the two lower (0.05 and 0.1) and from the two higher (0.25 and 0.30) discrete PES offered. 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 individual share of land allocated to rubber agroforestry by 6.1 percentual points

[1] As mentioned in the experimental procedure, we offer four discretional PES levels 0.05, 0.1, 0.25, 0.30.

compared to the baseline. This means that although conservation levels can be achieved with individual schemes higher payment levels are required to motivate the farmer to engage in the scheme.

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 percentual points. High incentives also have a significant and positive effect under the collective scheme, although the size of the effect (6.8 percentual points) 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.

6.1.3 PES interaction with social norm and network characteristics

Social interactions are critical within collective processes (Kaczan et al. 2017), in this regard we analyze the effect of the participants' network characteristics and the stated disposition to act according to the social norm and their interaction with the incentives. Table 5 shows that characteristics related to the participant's social network have a significant influence on the conservation behavior mainly under the collective scheme, supporting Hypothesis 3. Individual characteristics are more prominent when PES area offered under individual schemes.

Under the collective scheme, we observed the size of the social agroforestry network and the environmental perception of the network having a positive effect, increasing the share of land conserved by 24 and 6 percentual points respectively. In addition, we observe the negative effect of having a large oil palm network and a high compliance with the norm, implying that an additional person in the social oil palm network of the participant reduces the share of land allocated to rubber agroforest by 4 percentual points and the more willing a participant is to comply with what the social norm establishes, his contribution is reduced by 16 percentual points. This negative effect 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) in real life, individuals consider the behavior of others to predict the probability of conservation from the group members.

Table 5. Random effect GLS estimation of individual share of land allocated to rubber agroforestry

Variables	(6) Individual		(7) Collective	
	Coef.	S.E.	Coef.	S.E
PES incentive	-0.00536	0.004	0.00483	0.006

Variables	(6) Individual		(7) Collective	
	Coef.	S.E.	Coef.	S.E
Endowment (=1 if 10 hectares)	0.10839*	0.096	-0.04136	0.122
Individual characteristics				
Individual environmental perception	0.10671***	0.039	-0.05551	0.058
Jungle rubber cultivated by the participant	0.01904***	0.007	0.03780***	0.015
Social network characteristics				
Social Agroforestry network	0.19523	0.197	0.24918***	0.073
Compliance with the social norm (normative social influence)	-0.09740	0.078	-0.16948***	0.046
Environmental perception of the network	-0.01207	0.023	0.06471*	0.038
Social Oil palm network	-0.02568**	0.011	-0.04563**	0.019
Interactions				
PES * Social Agroforestry network	-0.00467***	0.001	0.00968***	0.002
PES * Social Oil palm network	-0.00062	0.001	-0.00017	0.000
PES* Compliance with the social norm (Normative social influence)	0.00252	0.002	-0.00120	0.002
PES *Environmental perception of the network	0.00186**	0.001	-0.00017	0.001
Constant	0.52212**	0.235	0.54140	0.429

Note: All models control for age, sex, education, land tenure, family members, people known by name and people with whom the participant speak in the last month in the same session. Standard errors are clustered at the session level. * p<0.1, ** p<0.05, *** p<0.01

Considering that economic incentives for conservation influence moral motivations for conservation through their interaction with social preferences (Liu et al. 2014). We consider the interaction of the PES incentive with the social network characteristics. We find that in the collective scheme once the incentive is offered having a network that cultivate agroforestry positively influences conservation behavior and slightly increases land allocated to agroforestry by 0.9 percentual points; this effect is inverse under the individual incentive where the land allocated to conservation is reduced in 0.4 percentual points.

Individual environmental perception plays an important role under the individual scheme increasing the land allocated to conservation by 10%, under the collective scheme there is not effect. Once the incentive is offered, we observe a small positive and significant effect of environmental connectedness of the network under the individual scheme, 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 the environment.

7. Conclusions

Payment for Environmental Services is an instrument that provides incentives for conservation. We analyze the effectiveness of individual and collective incentives and find

that both types of schemes are effective at increasing conservation, though the impact is relatively small. A one percent increase in PES increases conservation in only 2 percentual points or three percent of the investment.
Our findings contribute to the discussion in terms of individual versus collective PES schemes, specifically showing that collective schemes can be as effective as individual schemes.. The results indicate that collective schemes can be more cost-effective because it achieves conservation outcome at lower incentive payments and 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, their contribution is slightly larger under the individual scheme (0.3%) compared to the collective scheme (0.1%). In areas where transaction costs are not so high and the prevalence is small patches from small farmers, individual schemes could achieve higher conservation outcomes; while in critical areas with large farmers collective schemes might be more suitable.

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. The analysis of the social network characteristics and its interaction with PES incentives highlights the fact that the adequacy and efficiency of a specific scheme partly depends on the social norms and network characteristics of the area. In contexts where farmers are highly committed to what his close network does as a whole, such as the case of our study area where the social norm is the cultivation of oil palm, higher monetary incentives are required to compensate the opportunity costs forgone for a crop such as oil palm.

The positive and significant effect of the social agroforestry network opens a door of opportunities and strategies to promote pro-conservation behavior. Acknowledging that financial resources are not always available to fully compensate farmers for not cultivating oil palm, strategies based on the social context could complement the monetary incentives, promoting good reputation, engaging with productive associations to encourage their members to become more environmentally friendly can stimulate change in behavior. This understanding is important in order to provide policymakers with key aspects when designing PES, especially the messaging that monetary incentives are not a single solution for such a complex problem, and that a holistic approach in defining strategies that contemplates not only monetary aspects but also key features from the close social network of the farmer can achieve a higher impact.

This study highlights how endowment heterogeneity and social network can affect the success of PES schemes. Further research could analyze higher levels of PES under both schemes, providing insights into the discussion of appropriateness of monetary incentives aiming at reducing cultivation of high profitable crops. In addition, analysis comparing monetary vs social incentives and the long-term effect could provide insights on which strategies are more efficient, considering limited resources to finance monetary incentives.

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