Can payments-for-ecosystem-services change social norms? Experimental evidence on motivational crowding from Costa Rican oil palm smallholders

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Abstract

Exposure to economic incentives such as payments for ecosystem services (PES) can change intrinsic motivations to act pro-environmentally. These so-called crowding effects of PES have been shown to affect pro-environmental behavior (PEB) of PES-beneficiaries. It is, however, unclear if social norms towards PEB are also susceptible to motivational crowding effects in PES and how these changes could influence peer behavior. We design and implement a modified dictator game with Costa Rican oil palm smallholders to test, if crowding effects influence social norms and if these social norms affect PEB of non-beneficiaries. Our results show that crowding effects in PES can change social norms towards PEB and that social norms affect PEB of non-beneficiaries.

Introduction

Payments for ecosystem services (PES) schemes have become a common policy instrument to incentivize conservation or pro-environmental behavior (PEB) of landowners, or -users. However, exposure to economic incentives such as PES can change intrinsic motivations to act pro-environmentally (Bowles and Polanía-Reyes 2012; Rode et al. 2015; Ezzine-de-Blas et al.

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2019). These changes are called "crowding-effects" and have important implications for long-term PEB among PES recipients. Furthermore, studies have shown that social norms and peer communication can affect PEB of individuals (Allcott 2011; Schultz et al. 2015; Kastner and Stern 2015; Farrow et al. 2017). It is, however, unclear if social norms and peer communication are also susceptible to motivational crowding effects in PES and how these changes could influence behavior of non-PES-beneficiaries. This paper explores if crowding effects of PES can spillover to non-PES-beneficiaries in a framed lab-in-the-field experiment among oil palm smallholders in Costa Rica. To do so, we first check how susceptible perceived social norms of PES-beneficiaries are to motivational crowding effects (RQ1) and then test to what extent perceived social norms influence non-PES-beneficiaries PEB (RQ2).

PES programs reward providers of ecosystem services (ES) with payments. However, these are usually limited in scope and time. Ergo only some providers of ES will receive payments and even those will not receive it for the whole duration of ES provision. While it has been shown that PES programs can increase desirable outcomes (e.g., forest conservation) during the payment period[1], different studies are now assessing how these payments affect intrinsic motivations and thus long-term behavior of PES recipients after payments end. Evidence of both positive and negative crowding effects in PES is mounting in experimental settings[2] but little is known about long-term consequences of implemented PES schemes on PEB in both receiver and non-receiver populations (for some notable exceptions see Vorlaufer et al. 2023; Calle 2020; Pagiola et al. 2016). Given the budgetary limitations of PES programs, long-term changes in behavior could outweigh benefits derived during the payment period – both positively and negatively. As data on crowding effects in actual PES schemes is rare, most research stems from lab-in-the-field experiments like ours. Here, observed crowding-effects

[1] See Börner et al. (2017) for an overview on the effectiveness of PES schemes during the payment period.
[2] See Akers and Yasué (2019) or Rode et al. (2015) for overviews of the empirical evidence on crowding effects in PES.

after economic incentives are removed need to serve as proxies for potential long-term changes to behavior. However, we don't know how accurately these measured effects can represent long-term behavioral changes in a real PES scheme. From experimental data, it is difficult to argue how long these effects will actually last, if they fade over time or remain robust. Measuring changes in perceived social norms induced by motivational crowding effects may provide a more accurate picture of long-term behavior. As crowding effects in PES are induced by changes to intrinsic motivations, we assume that these changes to intrinsic motivation will also reflect in changes to perceived social norms. Additionally, perceived social norms of PES-beneficiaries are likely communicated to non-PES-beneficiaries and could therefore influence their PEB as well.

Our research contributes to the theoretical understanding of motivational crowding in PES and peer influence on PEB. To our knowledge, we are the first to test how motivational crowding effects of PES-beneficiaries could spill over to non-beneficiaries by changing perceived social norms in a framed lab-in-the-field experiment. This adds to the general understanding of potential long-term motivational crowding effects in PES and social norms in PEB. Furthermore, we help to close the gap between the literature on crowding effects in PES and studies examining peer influence on individual PEB. In a practical application, our results can help to inform policy makers about the potential for PES applications in the oil palm sector, as well as potential long-term implications of the program and spill-overs to non-PES-beneficiaries.

The data for this study was collected as part of a household survey among Costa Rican oil palm smallholders in the Puntarenas province between November 2022 and January 2023. Participants played a modified version of a dictator game, where they had to decide how much of an initial endowment would be donated to a local NGO. The decision was framed as a selection between oil palm monoculture and mixed, biodiverse systems on a fictional oil palm

plantation. We assigned participants randomly into five treatment groups. Two groups (treatment & control) were designed to capture crowding-effects in PES by playing three stages (pre-policy, policy & post-policy) where implementing mixed systems was economically incentivized in the policy stage for the treatment group. These groups were also asked to select between two normative statements (sustainable & conventional) before and after the experiment to be sent to other farmers in order to see, if the PES treatment affects selected messages. The sustainable normative statement highlighted the need for oil palm smallholders to implement mixed systems, while the conventional normative statement recommended to focus on oil palm cultivation. The remaining three groups (2 treatments, 1 control) were designed to see, if messages from other farmers influence individual PEB. One group received a sustainable normative statement before starting the experiment, one received the conventional normative statement and the control group received no statement. The statement was framed as a message from another farmer who participated in the experiment. These three groups only played one stage of the game with no policy interventions.

Our results show that receiving PES leads to a crowding-in effect of PEB. Participants in the PES policy treatment act more pro-environmentally in stage 3 (post-policy) relative to stage 1 (pre-policy) compared to the control group. Furthermore, we find that the effect on perceived social norms (selected normative statements) is aligned to this crowding-in effect of PEB. Participants in the PES policy treatment are more likely to change from a conventional normative statement at the beginning of the experiment to a sustainable normative statement after finishing the experiment, compared to the control group. These findings show that receiving PES can not only have crowding effects on behavior but also on perceived social norms. This has important implications for the long-term effect of PES schemes. We also find evidence that participants which received the conventional normative statements before playing the game altered their behavior. This effect increases significantly when interacting it with

participants perceptions of biodiversity enrichment in oil palm plantations. However, we find no effect in the treatment group which received the sustainable normative statement.

The rest of this paper is structured as follows: In the following section, we provide a theoretical framework for the connection of economic incentives such as PES, individual PEB and social norms towards PEB. We continue with an explanation of the general data collection, the experiment and our empirical framework. We then present the results of our analysis and close the paper by discussing implications for research and policy.

Theoretical framework

Motivational crowding in PES

Changes in intrinsic motivation induced by economic incentives are referred to as motivational crowding effects. Self-determination theory (SDT, Ryan and Deci 2000) posits that an individual's motivation to act in a certain way lies on a continuum of self-determination between being extrinsically and intrinsically motivated. Ryan and Deci (2000) define intrinsic and extrinsic motivations as follows:

"[…] extrinsic motivation refers to the performance of an activity in order to attain some separable outcome and, thus, contrasts with intrinsic motivation, which refers to doing an activity for the inherent satisfaction of the activity itself."

The concept of motivational crowding in PES refers to a situation where the economic incentive offered by PES substitutes or complements intrinsic motivations and thus shifts the individual's motivation towards a new state along the self-determination-continuum. Two scenarios are theoretically possible:

Crowding-In: The economic incentive complements intrinsic motivations. PES receiver's motivation to act pro-environmentally shifts towards a more intrinsically motivated state on the

self-determination-continuum. They maintain a higher provision of ES compared to pre-PES after the payment ends.

Crowding-Out: The economic incentive substitutes intrinsic motivations. PES receiver's motivation to act pro-environmentally shifts towards a more extrinsically motivated state on the self-determination-continuum. They reduce the provision of ES below pre-PES levels after the payment ends.

Ezzine-de-Blas et al. (2019) provide a conceptual framework for motivation crowding in PES based on the Self-Determination-Theory (SDT). They posit that any PES scheme will induce changes to long-term behavior through interactions with internal moderators (psychological dimensions) of PES receivers. Four main moderators are defined: Autonomy, Competence, Social Relatedness and Environmental Relatedness. In a crowding-in scenario, the increased short-term performance (induced by the PES) will be maintained after the PES ends, if the design of the scheme is positively aligned to these moderators. In a crowding-out scenario, the misalignment of PES design and internal moderators will reduce the long-term performance of a desirable outcome to pre-PES levels or below once the PES scheme ends. The main idea behind these pathways is that individuals act within a self-determination continuum of intrinsic and extrinsic motivations. When internal needs (moderators) are met, intrinsic motivation increases while extrinsic motivation decreases. If unmet, extrinsic motivation increases and intrinsic motivation decreases. In the latter situation, ES provision will be more dependent on extrinsic motivations and thus ES provision likely decreases to pre-PES levels or below after payments end.

For our study this framework will help to deepen the analysis of our findings. We can proxy some of the moderators outlined above, using data from a survey the experiment participants completed and thus elicit treatment effects more clearly within the treatment groups.

Social norms and PEB

As social norms are a central component of our analysis, we first need to define what we consider social norms to be in the context of our study. Here, we follow Nyborg et al. (2016) in their definition that social norms are "[…] a predominant behavioral pattern within a group, supported by a shared understanding of acceptable actions and sustained through social interactions within that group". Social norms are commonly separated into descriptive and injunctive norms. The differentiation between the two being, that descriptive norms refer to observed behavior while injunctive norms refer to approved behavior. Or what people think others do versus what they think others approve of (Farrow et al. 2017).

Some studies use information about an individual's behavior compared to the descriptive social norm as a treatment to elicit effects on PEB (see, e.g., Allcott 2011; Schultz et al. 2015). Others have shown that recommendations or other forms of communication from peers can influence investments in reducing energy consumption (Kastner and Stern 2015). We posit that recommendations regarding PEB to peers can be used as a proxy for injunctive social norms. Although recommendations during our experiment were anonymous, these messages are the only input participants receive about what behavior is approved by others. The benefit of using recommendations as a proxy for injunctive social norms is that it allows for a controlled, individual experimental setting where other confounding social influences are minimized.

Connecting motivational crowding in PES and social norms

Our theoretical framework is based on the work of Ryan and Deci (2000) as well as Bowles and Polanía-Reyes (2012). We use the self-determination-continuum proposed by Ryan and Deci (2000) to depict crowding effects in PES. We complement this with Bowles and Polanía-Reyes (2012), who describe how incentives can alter cultural learning through changes in the perceived fraction of civics (or individuals engaging in a socially desirable behavior). They also add a mechanism of cultural evolution where individuals not engaging in the socially desirable

behavior will start engaging in said behavior due to forces of conformism (Bowles and Polanía-Reyes 2012).

Figure 1 - *Theoretical framework* displays our theoretical framework. The upper path of the figure replicates crowding effects in PES according to SDT. Economic incentives can shift the self-determination-continuum between extrinsic and intrinsic motivations and thus crowd-in or crowd-out intrinsic motivations to act pro-environmentally. This can affect pro-environmental behavior as well as perceived social norms. In the lower part of our framework, we show how economic incentives can affect both perceived descriptive and perceived injunctive social norms of the receiver population. Descriptive social norms are colored in grey, as we do not measure them during our experiment. We assume that exposure to PES can change perceived injunctive social norms and therefore pro-environmental behavior. Additionally, perceived injunctive social norms of PES recipients – if communicated – can also change perceived injunctive social norms of non-recipients and thus their pro-environmental behavior.

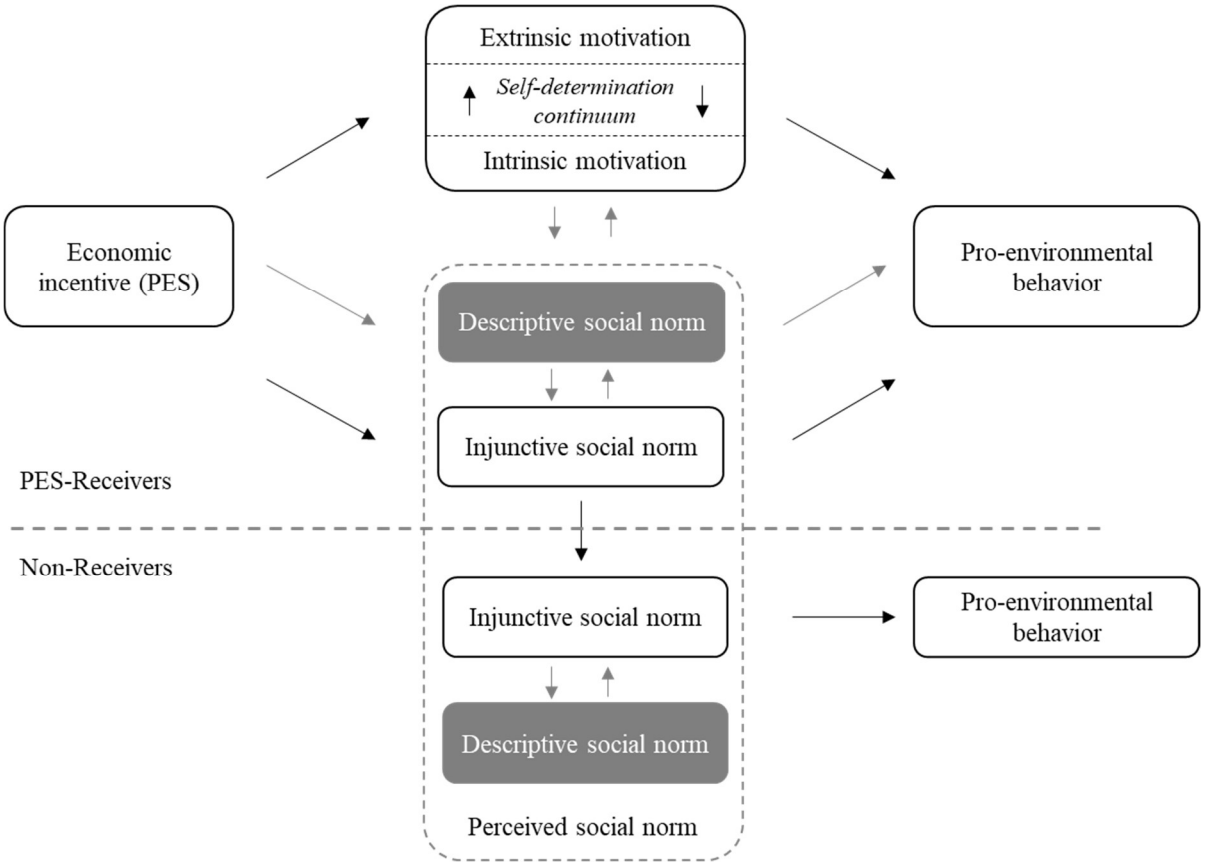

Figure 1 - Theoretical framework

Data & Methodology

Study site selection

Oil palm cultivation is driven mainly by countries such as Indonesia and Malaysia, jointly producing around 83% globally (USDA 2023). Especially Indonesia's oil palm sector has gained a lot of research attention in the last decade. Adopting oil palm cultivation has had many socio-economic benefits for smallholders in Indonesia, despite the ecological cost (Qaim et al. 2020). In order to minimize further environmental degradation and improve ecosystem functions on existing plantations, diversification in crops or through native trees could be crucial. Here, PES could provide a viable tool for policy makers, especially if it is geared towards environmental perceptions of smallholders (Romero et al. 2019; Rudolf et al. 2022).

We chose to complement this research by looking at Costa Rica for two main reasons: First, oil palm is becoming an increasingly important crop in the region. Latin America is one of the fastest growing production regions of palm oil, having almost doubled its cultivation area throughout the last decade. In Costa Rica, oil palms are the second largest agricultural crop in terms of production area (MAG 2022). And second, Costa Rica has made significant progress in combining agricultural production and strict environmental protection laws in the past three decades (OECD 2017). Doing so, it provides an interesting case study of what palm oil production in the region or globally could become once further expansion of plantation is made impossible by environmental protection laws. Furthermore, Costa Rica is one of the few countries in the world with a national PES scheme in place. While it is focused on forest conservation and reforestation so far, advances have been made to include agroforestry schemes (FONAFIFO 2018). Any insights into long-term effects of exposure to PES among oil palm smallholders could thus be crucial for the further development of these policies in Costa Rica.

Data collection

We collected the data for this study between November 2022 and January 2023 in the Puntarenas province of Costa Rica. Oil palm production in Costa Rica is focused on three regions: The central pacific (Pacifico Central), the southern pacific (Pacifico Sur) and, to a smaller extent, Limón. In 2017, around 99% of the total oil palm area in Costa Rica was situated along the pacific coast with 32% in the central pacific and 67% in the southern pacific regions (MAG 2017). The Puntarenas province encompasses both the central and southern pacific region. We used a census database to randomly select oil palm cultivating smallholders (less than 25 hectares of oil palm) as participants in the survey as well as the experiment. As the central pacific region features more large-scale plantations operated by companies or large cooperatives, the majority of our sample is situated in the southern pacific region (see Figure 1). In total 355 oil palm smallholders participated in the experiment.

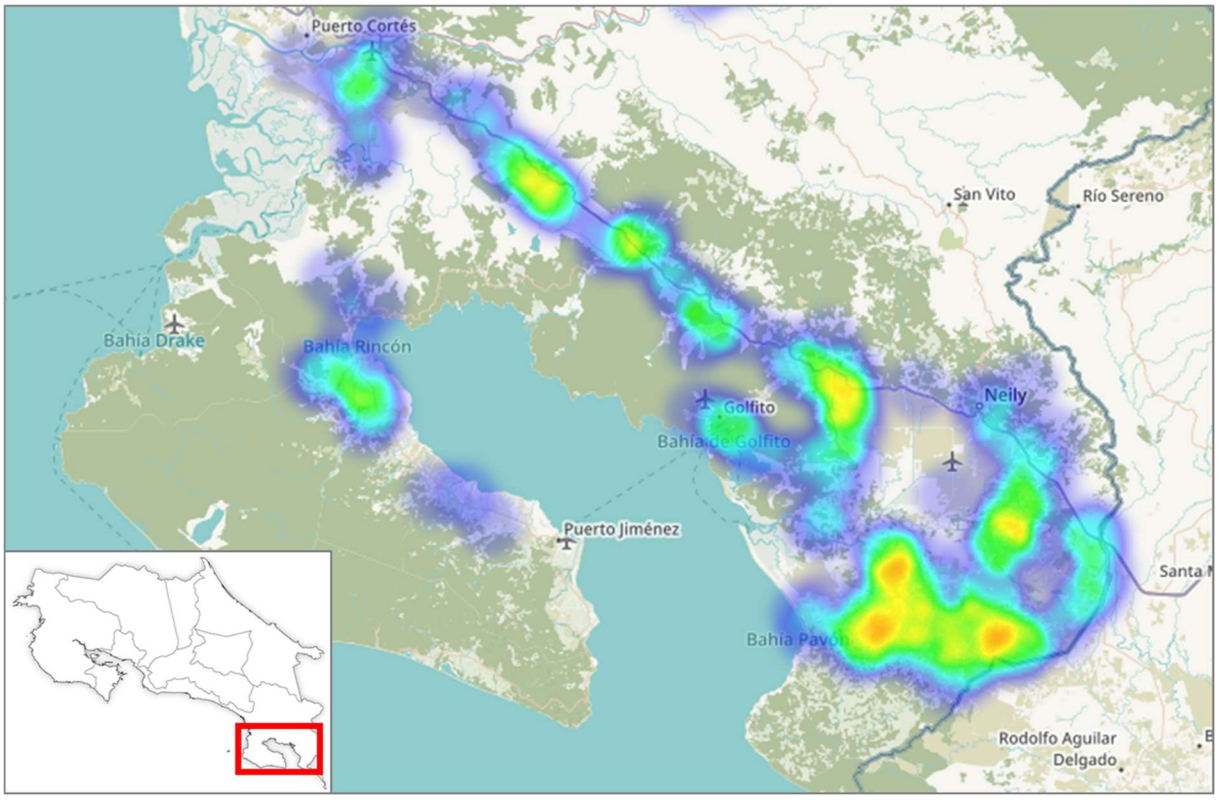

Figure 2 - Map of sampling region (heatmap indicates interviews conducted)

Experimental setting[3]

The experiment was conducted as part of a household survey on tablets with individual farmers. All decisions were made anonymously[4]. Following studies such as Kaczan et al. (2019), we use a modified dictator game to assess crowding effects in PES. All participants were presented with a baseline situation where they inherited an oil palm plantation next to their current plantation. The plantation is divided into five plots, each already cultivated with oil palm. As mixed systems are – on average – less profitable than cultivating monoculture oil palm, each plot was assigned a value indicating the difference in profitability between monoculture oil palm and the mixed system. The values varied between plots and rounds but were the same for each participant (i.e. the value for plot 1 in round 1 was the same across participants). We added

[3] Our experimental set-up was well as the research questions and hypotheses were published on AsPredicted.org and can be accessed through the following link: https://aspredicted.org/blind.php?x=5ZP_FJ9

[4] To ensure the anonymity of participants' decisions, all choices during the experiment were made by participants on the tablet without any interference from the enumerators. Enumerators only provided a thorough explanation and practice round before the start of the experiment and when additional explanations were required (e.g., before the PES round). If the participant could not handle the tablet for some reason, the experiment was not conducted as it was impossible to make her decisions anonymously in this context.

this feature to avoid repetitive decision-making of participants out of convenience. All values always added to the total initial endowment of 7.000 CRC (~12 USD). We chose this amount as it reflects an average daily wage for Also someone working on an oil palm plantation in Costa Rica. By implementing a mixed system on one plot, farmers would waive the additional profitability and thus donate it to the NGO "*Osa Conservación*". This was framed as a positive externality, arguing that mixed systems show higher levels of biodiversity and ecosystem functioning compared to monoculture oil palm plantations. Appendix 2 provides an example of a farmer's decision in the baseline setting.

The final payout for each farmer was a random selection from every round the farmer played. This was also explained to the farmers at the beginning of the experiment. To make sure that all payouts and donations were also anonymous, the maximum possible amount (9.500 CRC for the PES-Sender group; 7.000 CRC for all other groups) was given to the participant before starting the experiment together with a donation box. The payout round was picked randomly by the program and displayed to the participant who was then asked to put the donation amount in the box and keep the rest as a payout.

Treatment groups & research hypotheses

In order to assess crowding effects in PES and changes in social norms, we assigned participants randomly[5] to one of five treatments (see figure 3).

[5] We stratified treatments on the canton level (sub-districts of the province of Puntarenas) to make sure that cantons are not over- or under-represented in treatments.

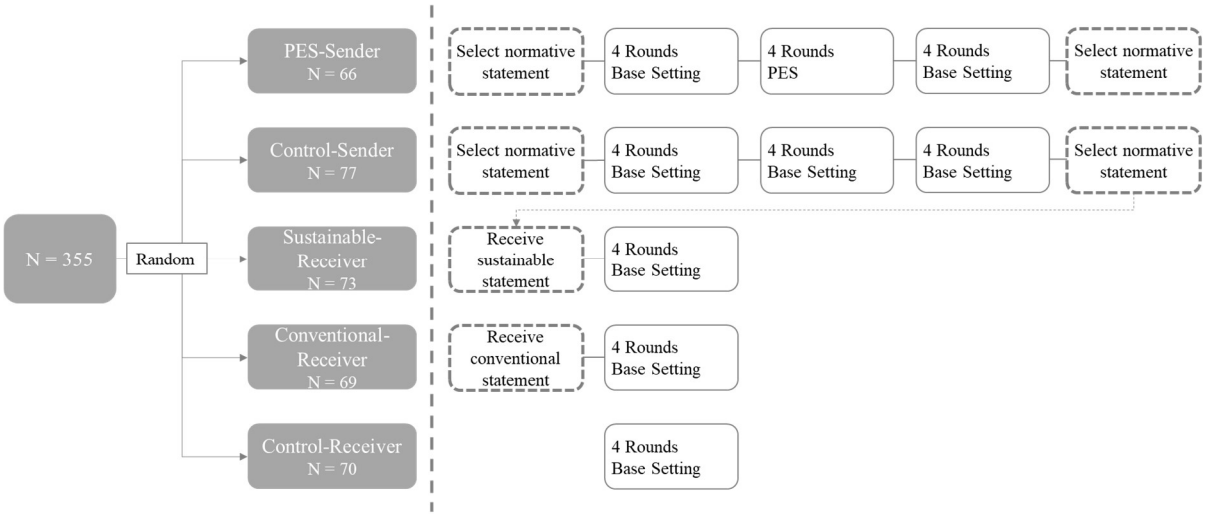

Figure 3 – Experimental procedure for different treatment groups

(1) PES-Sender <> (2) Control-Sender

In the *PES-Sender* treatment, farmers first played four rounds of the baseline setting. Before the beginning of the fifth round, farmers were offered a PES scheme where they received an economic incentive of 500 CRC[6] per plot switched to a mixed system. After four rounds including the PES incentive the budget to finance the PES scheme was depleted and participants played another four rounds of the baseline setting, for a total of 12 rounds over the course of the experiment. Additionally, participants were asked before the first round and after the twelfth and final round to select a message to be sent to another farmer as well as a recommendation on how many plots to convert to a mixed system. The messages were binary and either recommended the implementation of mixed systems (positive) or a focus on monoculture oil palm (negative). For the recommendation, farmers could choose from zero to five plots. Similarly, participants in the *Control-Sender* group were also asked to select a message as well as a recommendation before and after the first and final rounds, respectively. However, participants in this group played all 12 rounds under the baseline setting without any incentive.

[6] We chose 500 CRC as an incentive amount as it does not fully cover the opportunity cost of switching to a mixed system. This is in-line with most PES schemes where they do not cover the full cost of adaptation.

We test the following hypotheses for the treatments in these groups:

H1.1 – Crowding effects on PEB*:* The difference in the average amount of plots with mixed systems between stage 1 (pre-policy) and stage 3 (post-policy) will be larger in the *PES-Sender group,* compared to the *Control-Sender* group.

H1.2 – Crowding effects on injunctive social norms*:* Participants are more likely to change their initial recommendation in the *PES-Sender* group than in the *Control-Sender* group.

H1.3 – Correlation between crowding effects: The direction of the crowding effect on PEB will be aligned with the crowding effect on social norms. I.e., a change from a positive message to a negative message will be aligned with a reduction in the average amount of plots with mixed systems in phase III relative to phase I, and vice versa.

(3) Sustainable-Receiver | (4) Conventional-Receiver <> (5) Control-Receiver:

In the "Sustainable-Receiver" and "Conventional-Receiver" groups we aim to compare the effects of receiving a message from another farmer on the choices in the experiment. To do so, participants in these groups received either the positive message ("Sustainable-Receiver") or the negative message ("Conventional-Receiver"), which groups (1) and (2) could choose between. The message was read to participants before starting the experiment but after the instruction and practice round. They then played four rounds of the base setting with no further treatments.

The "Control-Receiver" group played four rounds without any messages being received and no further treatments.

We test the following hypothesis for the treatments in these groups:

H2 – Effect of injunctive social norms on behavior of non-recipients: *Compared to the Control-Receiver group, participants in the Sustainable-Receiver (Conventional Receiver) group will convert more (less) plots to mixed systems on average.*

Empirical Framework

PES treatment effect & Crowding effect in PES

Before testing our hypotheses, we first check for the PES treatment effect, if the PES treatment induces a crowding effect and what direction the effect has (crowding-out vs. crowding-in). The panel structure of our data allows us to use a difference-in-difference Tobit model comparing the "PES-Sender" and "Control-Sender" groups.

(1) $\text{Plots} = \alpha + \beta_1 * \text{policy} + \beta_2 * \text{post-policy} + \beta_3 * \text{treatment} + \beta_4 * \text{policy} * \text{treatment} + \beta_5 * \text{post-policy} * \text{treatment} + \varepsilon$

(2) $\text{Donation} = \alpha + \beta_1 * \text{policy} + \beta_2 * \text{post-policy} + \beta_3 * \text{treatment} + \beta_4 * \text{policy} * \text{treatment} + \beta_5 * \text{post-policy} * \text{treatment} + \varepsilon$

We will use both the number of plots converted to mixed systems as well as the average amount donated as outcome variables and the phases (policy & post-policy), the treatment ("PES-Sender" group) as well as their interactions (policy * treatment; post-policy * treatment) as independent variables. Doing so, we can estimate PES effectiveness (policy * treatment) and the extent of the crowding effect (post-policy * treatment). We use a random effects model here, assuming that our randomization procedure was successful and none of the individual specific effects are correlated with the treatments.

(3) $\text{ChangedMessage} = \alpha + \beta_1 * \text{treatment} + \varepsilon$

Second, we will assess how susceptible injunctive social norms are to these crowding effects in PES. Here we will compare changes in the messages and recommendations selected by participants in the "PES-Sender" group to the "Control-Sender" group using a Fisher's exact t-test (two-sided; alpha = 0.05). We complement this analysis by running a Probit regression on the changes in messages. We consider changes in messages as a dummy variable (1 if message

was changed; 0 if message was not changed). See Table 1 - Summary of variables usedfor the details on all variables used in these equations.

Effect of peer recommendations/ social norms on behavior of non-recipients

(4) $Plots = \alpha + \beta_1 * \text{sustainable-message} + \beta_2 * \text{conventional-message} + \varepsilon$

(5) $Donation = \alpha + \beta_1 * \text{sustainable-message} + \beta_2 * \text{conventional-message} + \varepsilon$

Finally, we will analyze if the messages sent by the "PES-Sender" and "Control-Sender" groups have an effect on the behavior of the "Sustainable-Receiver" and "Conventional-Receiver" groups. To do so, we employ a one-sided, non-parametric Mann-Whitney-U-test (alpha = 0.05) with the number of plots as well as average donation of both treatments versus the control group. We also run two Tobit regression models on the number of plots with mixed systems and the donated amount. Both models include the treatment group as an independent dummy variable and the control group as a control (see Table 1 for definition of variables).

Name	**Type**	**Description**
Number of plots	Discrete (censored at 0 and 5)	Number of plots converted to mixed systems per round in the experiment
Amount donated	Discrete (censored at 0 and 7.000)	Total amount donated per round in CRC
Changed message	Dummy	1 if a participant changed from a negative to a positive message / recommendation after the experiment 0 if the participant did not change the message
PES-Sender	Dummy	1 if a participant was part of the "PES-Sender" group 0 if a participant was part of the "Control-Sender" group
Policy	Dummy	1 for all rounds where the PES incentive was active (rounds 5-8) 0 for all rounds where the PES incentive was inactive (rounds 1-4 and 9-12)
Post-Policy	Dummy	1 for rounds 9-12 0 for rounds 1-8
Sustainable-Receiver	Dummy	1 if a participant was part of the "Sustainable-Receiver" group

		0 if a participant was part of the "Conventional-Receiver" or "Base-Control" group
Negative Receiver	Dummy	1 if a participant was part of the "Conventional-Receiver" group 0 if a participant was part of the "Sustainable-Receiver" or "Base-Control" group

Table 1 - Summary of variables used

The role of intrinsic motivations on decisions during the experiment

As intrinsic motivations are likely to drive behavior during the experiment in general as well as changes induced by treatments, we introduce another explanatory variable to our estimations. During the survey, participants were asked about their opinions about the effectiveness of different strategies to improve biodiversity and ecosystem functions on oil palm plantations. We provided them with three options: (1) Incorporate native trees to the plantation; (2) Reduce the usage of chemicals; (3) Start intercropping oil palm with other crops. For each option, participants provided a likert-scale answer from 1 = strongly disagree to 5 = strongly agree. While Option (2) does not require changes to the plantation, both options (1) and (3) reflect the setting of our experiment where farmers introduce a mixed system. We simply add the answers to both of these questions to a new indicator (ranging from 1-10) to incorporate the participants perceptions about the effectiveness of biodiversity enrichment in oil palm plantations. As participants did not know what the experiment would cover at this point of the survey, their answer cannot be influenced by decision during the experiment. In our further analysis, we refer to this measure as "Agroforestry Perceptions".

Results

Descriptive statistics & randomization checks

Statistic	N	Mean	Std. Dev.	Min	Max
Age	352	55.92	13.34	16	89
Education (Highest degree obtained; 0-8)	352	2.4	1.5	0	8
Gender (1 = female; 2 = male)	352	1.7	0.4	1	2
Size of land owned (hectares)	355	17.5	28.4	0.5	300
Size of oil palm plots (hectares)	355	12.1	19.2	0.5	220
Size of forest owned (hectares)	355	2.4	9.1	0	81
Agroforestry perceptions	355	6.9	2.9	1	10

Table 2 – Socio-demographic statistics of participants

In Table 2, we report descriptive statistics of key variables that could potentially influence decisions during the experiment. In order to check if our randomization was successful, we run five probit models on the treatment groups with these statistics as independent variables. Appendix 1 reports the results of our randomization checks.

Following these results, we incorporate the size of the land owned and the size of the oil palm plots as controls to our regressions for the PES-Sender and Control-Sender group. For the analysis of the Sustainable- and Conventional-Receiver groups we add the size of the land owned, the size of the forest, the size of the oil palm plots as well as the agroforestry perceptions as controls. Furthermore we add the Canton as a control, as we stratified the randomization at this level.

PES treatment

The PES treatment showed a clear effect on behavior in the PES-Sender group (see figure 4). In the PES-Sender group, participants donated approximately 1.9 plots or 2570CRC on average during the baseline phase. Compared to the Control-Sender group at 2.4 plots or 3257CRC, this is significantly less. To make sure that both the treatment and control group played the game in

a comparable fashion, we compared the slopes of both donations and plots between the PES-Sender and Control-Sender group and found no significant differences. The results of this test are provided in Appendix 3.

During the PES treatment, PES-Sender donations increased to 2.4 plots or 3315CRC while Control-Sender slightly decreased to 2.2 plots or 3027 on average. After the PES treatment, PES-Senders kept a relatively high level of donations at 2.3 plots or 3175CRC. While this is still significantly different from the baseline phase, Control-Sender participants also slightly increased donations to 2.3 plots or 3111CRC.

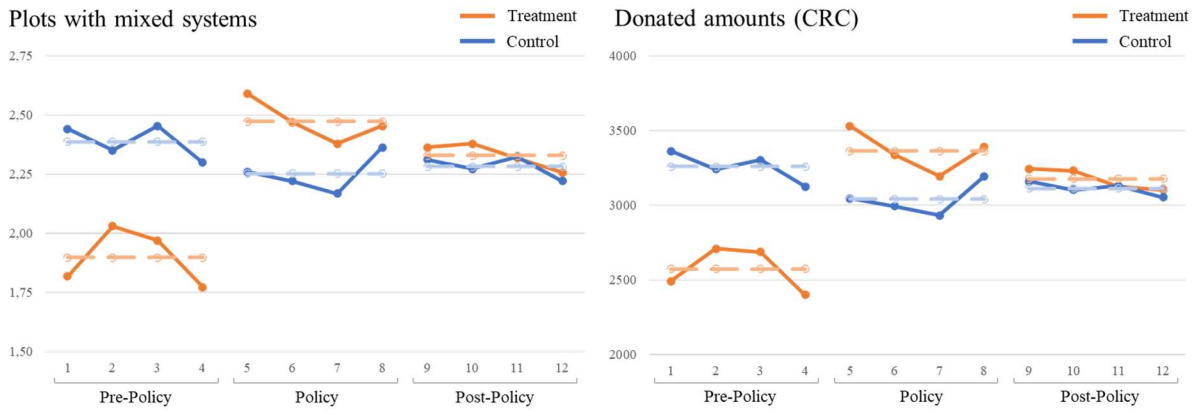

Figure 4 - Results of PES treatment

These results seem to confirm a crowding-in effect of the PES treatment. Participants in the PES-Sender group acted more pro-environmentally after PES relative to the baseline compared to the Control-Sender group which showed a slightly decreased pro-environmental behavior in the third phase compared to the baseline.

Table 3 shows the results of our Tobit model estimations. We estimated two different models each for both plots and donated amounts as outcome variables in order to compare effect sizes when introducing controls. Models (1) and (3) show the estimates without any controls. As expected from the basic results, the PES-Sender group has a significantly lower baseline for both plots converted to mixed systems as well as the donated amounts. The PES treatment phase induced a significant positive effect on both plots and donations. This effect is consistent across

model specifications with the controls active. The Tobit model also shows a significant crowding-in effect. Even after the PES treatment ended, participants in the PES-Sender group still converted around 1.1 more plots or donated approximately 1600CRC more compared to the control group.

Introducing different controls generally does not alter our main treatment variables significantly but reduce the negative impact of the PES-Sender dummy slightly. The controls themselves show statistical significance in some model specifications but effect sizes are negligible.

Tobit Model Results

	Dependent variable:			
	# of Plots		Amount donated	
	(1)	(2)	(3)	(4)
PES-Sender	-1.1***	-1.0***	-1,549.9***	-1,351.8***
	(0.3)	(0.3)	(470.4)	(475.9)
Policy	-0.3	-0.3	-471.5	-473.6
	(0.3)	(0.3)	(439.7)	(437.0)
Post-Policy	-0.3	-0.3	-416.9	-422.0
	(0.3)	(0.3)	(435.2)	(432.2)
PES-Sender x Policy	1.4***	1.4***	2,037.9***	2,038.1***
	(0.5)	(0.5)	(660.3)	(657.2)
PES-Sender x Post-Policy	1.1**	1.1**	1,594.7**	1,599.2**
	(0.5)	(0.5)	(652.3)	(649.3)
Constant	2.5***	2.1***	3,366.9***	2,831.9***
	(0.2)	(0.2)	(311.4)	(343.8)
Controls	NO	YES	NO	YES
Observations	1,716	1,716	1,716	1,716
Log Likelihood	-3,078.9	-3,067.3	-9,030.6	-9,018.8
Akaike Inf. Crit.	6,171.9	6,152.7	18,075.2	18,055.5
Bayesian Inf. Crit.	6,210.0	6,201.7	18,113.3	18,104.5
Note:				*p<0.1; **p<0.05; ***p<0.01

Table 3 - Tobit Model Results of PES Treatment

Crowding Effects in Social Norms

In the second part of our analysis, we want to check if the crowding effects we find in the behavior during the experiment also translate to social norms. Both PES-Sender and Control-Sender group participants were asked to select a message to be sent to another farmer

participating in the experiment before starting and after ending their experiment. The positive message recommended to implement mixed systems while the negative message said to focus on cultivating oil palm. In the PES-Sender group, 40 out of the 66 participants (~61%) chose the positive message before starting the experiment. After finishing the experiment, 49 participants chose the positive message (~74%). Of those 49 participants choosing the positive message, 39 had chosen the same message before the experiment and 10 persons changed from a negative to a positive message. One person switched from a positive to a negative message. In the Control-Sender group, 50 of the 75 participants chose the positive message (66%), which aligns with the higher pro-environmental behavior and agroforestry perceptions in that group. However, only four people switched from a negative to a positive message in this group (see Figure 5). This value is significantly different from the PES-Sender group at a p-value of 0,053 (Fisher's exact t-test). This finding shows, that crowding effects in PES can influence social norms and that the direction of the effects on pro-environmental behavior and social norms are aligned.

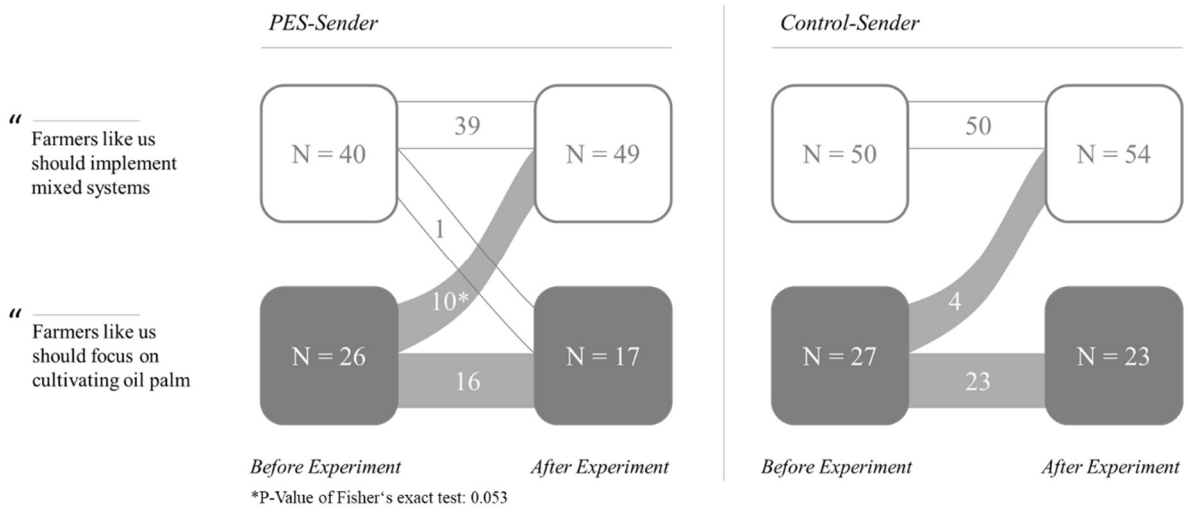

Figure 5 - Selected messages in PES-Sender and Control-Sender groups

A probit model with the change in message as an outcome variable and the treatment ("PES-Sender") as an independent variable confirms these findings (see table 4). The PES treatment

has a significant positive effect on the probability to change a message from negative to positive.

Probit Model Results

	Dependent variable:
	Change in message
PES-Sender	0.60**
	(0.30)
Constant	-1.63***
	(0.24)
Observations	143
Log Likelihood	-43.80
Akaike Inf. Crit.	91.59
Note:	*p<0.1; **p<0.05; ***p<0.01

Table 4 - Probit model results for changes in messages selected

Effect of injunctive social norms on behavior of non-PES-recipients

In the final part of our analysis, we check if injunctive social norms also affect behavior of non-PES-recipients. To do so, participants in the Sustainable-Receiver and Conventional-Receiver groups received either the sustainable or conventional message before starting the experiment. In Figure 6, we show the basic results of these groups. While the Conventional-Receiver participants seem to donate less on average compared to the control group, no clear effect of the sustainable message is visible.

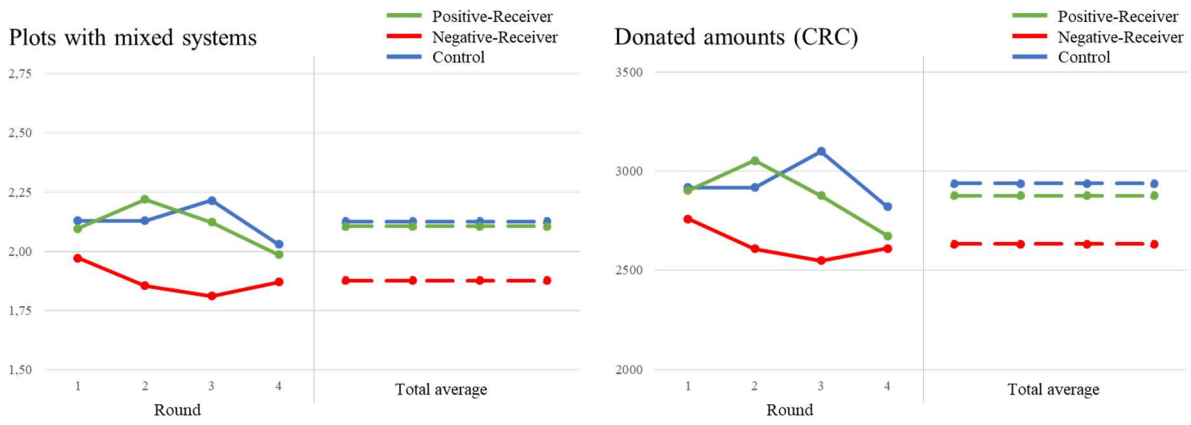

Figure 6 - Results of message treatment

To understand these effects better, we run another difference-in-difference Tobit model for the Sustainable-Receiver and Conventional-Receiver treatment groups. We use a similar approach as before where we run three different model specifications, introducing different controls to see how they change our coefficients. As was already evident from the basic results, the negative message has a significant negative effect on PEB during the experiment. This is true across model specifications. However, the sustainable message does not have a significant effect on behavior without adding controls. When adding controls, the effect of the message is negative and significant but changes to a positive, non-significant effect when we interact the sustainable message with agroforestry perceptions.

Adding controls to the models does not significantly alter the size or statistical power of the conventional-receiver treatment. However, when we interact the agroforestry perceptions with each of the treatments, the effect of the negative treatment increases in size from a negative effect of 0.6/0.7 plots or 838/962CRC to 2.2 plots or 2858CRC and the interaction effect is positive at 0.2 plots or 263CRC. This means that for those people with a score of 0 on the agroforestry perceptions, the negative message reduces the average number of plots converted by 2.2. For those with at least a score of 1 on the agroforestry perceptions, each unit increase in the perceptions reduces this negative effect by 0.2, meaning the higher their perceptions of agroforestry enrichment, the smaller the effect of the conventional message.

Receivers of the sustainable message do not seem to alter their behavior significantly compared to the control group. However, when we introduce the interaction of the sustainable message and agroforestry perceptions, the coefficient does become positive – albeit not significant at 10% level. The interaction coefficient is non-significant as well and negative at 0.1 plots or 206CRC. This pattern would mean that the sustainable message has a small positive effect on those participants with a score of 0 on the agroforestry perceptions. For those participants with at least a score of 1, the effect of the message decreases with each additional point on the

agroforestry perceptions. The fact that these findings are not statistically significant could be explained by the generally high levels of biodiversity perceptions in our population and no room to show "additional" PEB over converting all of the plots.

Tobit Model Results

	Dependent variable:					
	# of Plots			Amount donated		
	(1)	(2)	(3)	(4)	(5)	(6)
Sustainable-Receiver	-0.1	-0.5*	0.5	-123.2	-759.4*	937.0
	(0.3)	(0.3)	(0.8)	(421.7)	(404.7)	(1,138.0)
Conventional-Receiver	-0.6**	-0.7**	-2.2***	-838.2**	-962.3**	-2,858.3**
	(0.3)	(0.3)	(0.8)	(412.8)	(400.5)	(1,132.0)
Agroforestry Perceptions		0.3***	0.3***		446.9***	426.4***
		(0.04)	(0.1)		(61.6)	(101.6)
Sustainable-Receiver x Agroforestry Percep.			-0.1			-206.2
			(0.1)			(140.4)
Conventional-Receiver x Agroforestry-Percep.			0.2**			263.3*
			(0.1)			(146.5)
logSigma	1.2***	1.1***	1.1***	8.4***	8.4***	8.4***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Constant	2.0***	-0.5	-0.3	2,723.7***	-790.3	-655.9
	(0.2)	(0.4)	(0.6)	(309.8)	(553.7)	(795.9)
Controls	NO	YES	YES	NO	YES	YES
Observations	848	848	848	848	848	848
Log Likelihood	-1,535.6	-1,496.2	-1,491.5	-4,726.7	-4,686.8	-4,682.1
Akaike Inf. Crit.	3,079.2	3,008.4	3,002.9	9,461.3	9,389.6	9,384.1
Bayesian Inf. Crit.	3,098.2	3,046.4	3,050.4	9,480.3	9,427.6	9,431.6
Note:						*p<0.1; **p<0.05; ***p<0.01

Table 5 - Tobit Model Results of Message Treatment

Discussion

Our findings hold some interesting points for the discussion on motivational crowding in PES and the long-term viability of economic incentives to induce PEB. First, our results add to existing evidence that monetary incentives do not necessarily crowd-out intrinsic motivation but can have a positive long-term effect on PEB (crowding-in). In our experiment, participants receiving a PES treatment maintained higher levels of pro-environmental behavior after the incentive ended, compared to before the treatment. This effect was stable across model

specifications, even when controlling for intrinsic motivations. This confirms findings from other field-experiments, that economic incentives can complement intrinsic motivations rather than substituting them (Bowles and Polanía-Reyes 2012). This also follows what Ezzine-de-Blas et al. (2019) have posited in their framework for evaluating PES schemes. When the PES outcome aligns with internal moderators they complement one another and short-term increased performances are maintained in the long-term. While our PES scheme was relatively simple and does not allow us to control for alignment with all potential moderators, we do check for environmental relatedness of the participants or how much they believe in the benefit of the outcome. This indicator which we call agroforestry perceptions affects PEB during the experiment significantly and consistently across our models. It also does not take away effect size or statistical power from our treatments, which allows us to argue that the crowding-in effect we observe is in-fact induced by the PES treatment.

One shortcoming of our findings is that we cannot entirely explain why participants in the PES-Sender group donated significantly less in the baseline round. Even when we control for the differences in agroforestry perceptions and other socio-economics, being assigned to the PES-Sender group still has a significant negative effect on PEB during the experiment. Despite this, the PES treatment induced a significant positive effect both during policy and post-policy across our model specifications. We can therefore argue that even though some unobserved variable influenced PEB in the PES-Sender group, we still show a significant crowding-in effect induced by the PES treatment.

Additionally, we now show that crowding effects in PES can change social norms. Participants in the PES-Sender group changed their message from a negative to a positive one significantly more often than those in the Control-Sender group. This means that next to affecting intrinsic motivations, PES can change how PES-beneficiaries would like their peers to act. As this effect is in-line with the crowding-in effect of PES on PEB, these findings provide further

confirmation of the changes economic incentives can induce in individual and collective intrinsic motivations & norms.

The last part of our analysis assessed the question if these changes in social norms could affect behavior of non-PES-recipients. Our results suggest that injunctive norms (peer messages in our case) are more effective in inducing non-desirable behavior in peers than in inducing desirable outcomes, especially if these align with existing agroforestry perceptions. Given that agroforestry perceptions were relatively high in our sample (average 6.9 of 10), this may have made a potential effect of a positive message too difficult to detect.

Conclusion

PES schemes are a commonly proposed policy tool to induce conservation, reforestation or diversification among land-owners. As these schemes are naturally limited in scope or time, interactions of economic incentives like PES with intrinsic motivations to conserve, reforest or diversify are important to assess potential long-term implications. In an adapted version of a dictator game, we found that Costa Rican oil palm smallholders act more pro-environmentally during the PES treatment compared to a control group and maintain higher levels of pro-environmental after the PES treatment ends. This crowding-in effect of PES means that the economic incentive did not substitute intrinsic motivations to act pro-environmentally but complemented them instead.

Farmers of the PES treatment also changed their perceived social norms in line with this crowding-in effect. They were more likely to change to a pro-environmental recommendation compared to those participants who did not receive the PES treatment. This shows that changes in intrinsic motivations induced by economic incentives can also spill-over to peers.

While the positive effect (crowding-in) of changes in social norms did not translate into more pro-environmental behavior of non-recipients, we did find that a negative message does alter behavior of peers. This can provide an argument for PES as a double-edged sword. Our sample displayed a high level of pro-environmental perceptions which are known to drive PEB. One could argue that in a populace with less pro-environmental norms, crowding-out effects of PES could be observed as well. If the effects we find in our sample would also translate to a crowding-out scenario, these could also change social norms in a negative way and thus further exacerbate non-desirable outcomes in the non-receiver population. It shows that while often an effective policy instrument, economic incentives for PEB require a firm understanding of environmental perceptions, beliefs and norms in the targeted population to ensure the desired outcomes and avoid negative long-term consequences.

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Appendix

Appendix 1 – Example of base setting

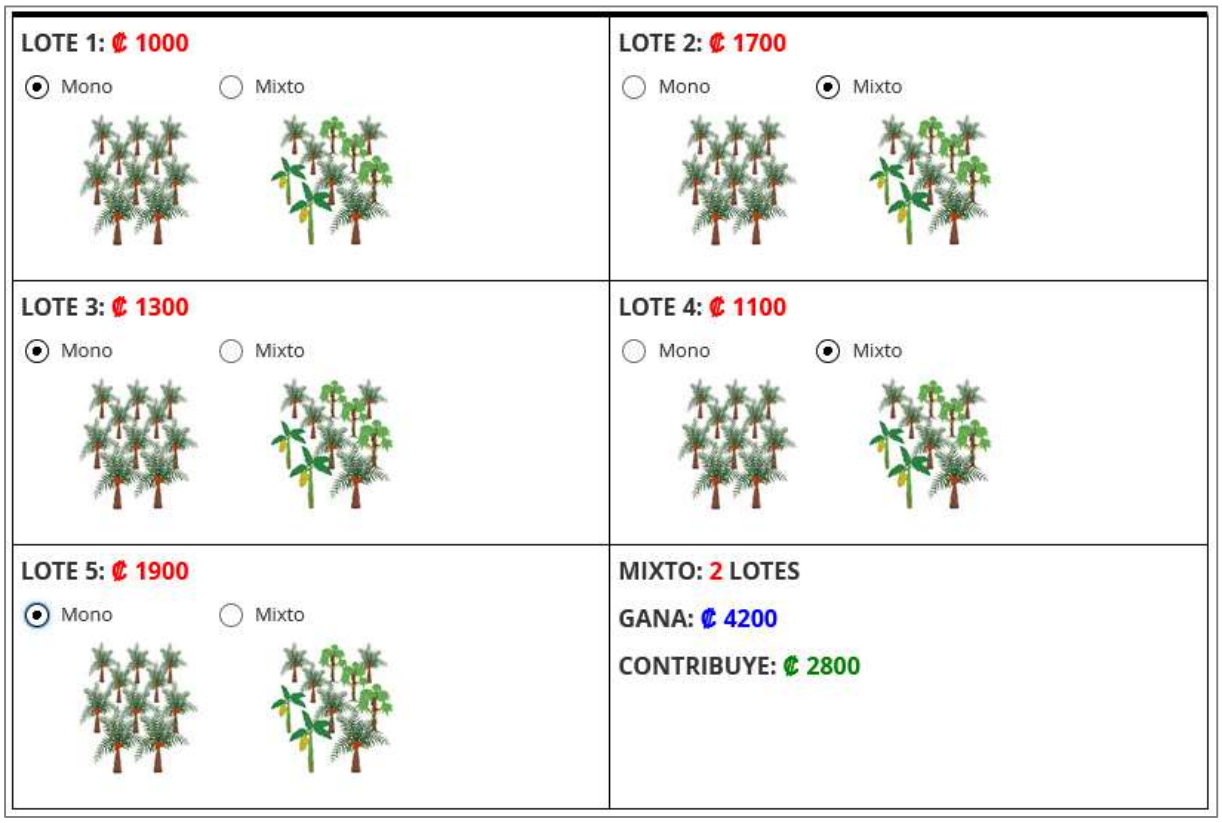

Figure 7 - Base setting of experiment

Figure 6 displays an example of the baseline setting where plots 1, 3 and 5 are kept as monoculture (i.e., the farmer receives the respective difference in profitability) while plots 2 and 4 are changed to a mixed system. The total payout for the farmer in this round would be [1.000 CRC + 1.300 CRC + 1.900 CRC] = 4.200 CRC and he donates [1.700 CRC + 1.100 CRC] = 2.800 CRC.

Appendix 2 – Randomization check results

	Dependent variable:		
	PES-Sender	Sustainable-Receiver	Conventional-Receiver
Age	0.017	-0.002	0.005
	(0.015)	(0.014)	(0.015)
Education	-0.102	-0.024	0.030
	(0.129)	(0.122)	(0.121)
Gender	-0.167	-0.108	0.487
	(0.411)	(0.414)	(0.382)
Size of land owned	0.065**	0.077**	-0.014
	(0.031)	(0.037)	(0.028)
Size of forest owned	-0.049	-0.166**	0.021
	(0.041)	(0.077)	(0.041)
Size of oil palm plots	-0.177***	-0.093**	0.035
	(0.057)	(0.047)	(0.035)
Agroforestry Perceptions	-0.068	0.174**	0.004
	(0.061)	(0.069)	(0.062)
Constant	0.654	-0.797	-1.431
	(1.179)	(1.182)	(1.216)
Observations	141	141	138
Log Likelihood	-87.339	-91.084	-93.499
Akaike Inf. Crit.	190.677	198.167	202.998
Note:			*p<0.1; **p<0.05; ***p<0.01

Appendix 3 – Comparison of slopes between treatments and control

PES-Sender vs. Control-Sender

	Dependent variable:		
	Plots		
	Pre-Policy	Policy	Post-Policy
PES-Sender	-1.183	1.177	0.223
	(0.770)	(1.900)	(3.223)
Round	-0.065	0.019	-0.057
	(0.186)	(0.194)	(0.205)
PES-Sender*Round	0.043	-0.130	-0.018
	(0.282)	(0.287)	(0.306)
logSigma	1.254***	1.272***	1.344***
	(0.045)	(0.045)	(0.047)
Constant	2.631***	2.042	2.771
	(0.505)	(1.290)	(2.169)
Observations	572	572	572
Log Likelihood	-1,023.003	-1,035.509	-1,019.232
Akaike Inf. Crit.	2,056.006	2,081.018	2,048.463
Bayesian Inf. Crit.	2,077.751	2,102.764	2,070.209
Note:	*p<0.1; **p<0.05; ***p<0.01		

	Dependent variable:		
	Payout		
	Pre-Policy	Policy	Post-Policy
PES-Sender	-1,701.312	1,536.505	405.267
	(1,083.411)	(2,684.418)	(4,547.806)
Round	-110.744	23.206	-72.292
	(261.175)	(275.188)	(290.062)
PES-Sender*Round	75.938	-161.748	-34.221
	(395.937)	(405.868)	(431.201)
logSigma	8.502***	8.526***	8.597***
	(0.045)	(0.046)	(0.048)
Constant	3,638.731***	2,746.664	3,697.690
	(709.132)	(1,825.186)	(3,062.257)
Observations	572	572	572
Log Likelihood	-3,037.411	-3,065.986	-2,925.945
Akaike Inf. Crit.	6,084.822	6,141.971	5,861.890
Bayesian Inf. Crit.	6,106.567	6,163.717	5,883.636
Note:	*p<0.1; **p<0.05; ***p<0.01		

Sustainable-Receiver & Conventional-Receiver vs. Control

	Dependent variable:	
	Plots	Donation
Sustainable-Receiver	0.093	215.365
	(0.635)	(904.660)
Round	-0.028	-18.504
	(0.170)	(242.010)
Sustainable-Receiver*Round	-0.059	-132.938
	(0.232)	(330.274)
logSigma	1.077***	8.336***
	(0.040)	(0.041)
Constant	2.061***	2,791.304***
	(0.470)	(669.279)
Observations	572	572
Log Likelihood	-1,058.377	-3,401.679
Akaike Inf. Crit.	2,126.754	6,813.359
Bayesian Inf. Crit.	2,148.500	6,835.105
Note:	*p<0.1; **p<0.05; ***p<0.01	

	Dependent variable:	
	Plots	Donation
Conventional-Receiver	-0.613	-753.510
	(0.732)	(1,036.448)
Round	-0.028	-17.445
	(0.202)	(285.665)
Conventional-Receiver*Round	-0.009	-38.583
	(0.268)	(378.803)
logSigma	1.193***	8.447***
	(0.044)	(0.045)
Constant	2.044***	2,761.954***
	(0.558)	(790.078)
Observations	556	556
Log Likelihood	-998.820	-3,043.739
Akaike Inf. Crit.	2,007.641	6,097.479
Bayesian Inf. Crit.	2,029.245	6,119.083
Note:	*p<0.1; **p<0.05; ***p<0.01	

Appendix 4 – Full Regression table for PES Treatment

Tobit Model Results

	Dependent variable:			
	# of Plots		Amount donated	
	(1)	(2)	(3)	(4)
PES-Sender	-1.1***	-1.0***	-1,549.9***	-1,351.8***
	(0.3)	(0.3)	(470.4)	(475.9)
Policy	-0.3	-0.3	-471.5	-473.6
	(0.3)	(0.3)	(439.7)	(437.0)
Post-Policy	-0.3	-0.3	-416.9	-422.0
	(0.3)	(0.3)	(435.2)	(432.2)
PES-Sender x Policy	1.4***	1.4***	2,037.9***	2,038.1***
	(0.5)	(0.5)	(660.3)	(657.2)
PES-Sender x Post-Policy	1.1**	1.1**	1,594.7**	1,599.2**
	(0.5)	(0.5)	(652.3)	(649.3)
Size of land owned		0.003		6.0
		(0.01)		(8.5)
Size of oil palm owned		0.02*		32.6*
		(0.01)		(18.5)
Constant	2.5***	2.1***	3,366.9***	2,831.9***
	(0.2)	(0.2)	(311.4)	(343.8)
Observations	1,716	1,716	1,716	1,716
Log Likelihood	-3,078.9	-3,067.3	-9,030.6	-9,018.8
Akaike Inf. Crit.	6,171.9	6,152.7	18,075.2	18,055.5
Bayesian Inf. Crit.	6,210.0	6,201.7	18,113.3	18,104.5
Note:				*p<0.1; **p<0.05; ***p<0.01

Appendix 5 - Full regression table for receiver treatments

Tobit Model Results

	Dependent variable:					
	# of Plots			Amount donated		
	(1)	(2)	(3)	(4)	(5)	(6)
Sustainable-Receiver	-0.1	-0.5*	0.5	-123.2	-759.4*	937.0
	(0.3)	(0.3)	(0.8)	(421.7)	(404.7)	(1,138.0)
Conventional-Receiver	-0.6**	-0.7**	-2.2***	-838.2**	-962.3**	-2,858.3**
	(0.3)	(0.3)	(0.8)	(412.8)	(400.5)	(1,132.0)
Size of land owned		0.1***	0.1***		87.5***	85.5***
		(0.02)	(0.02)		(25.1)	(26.7)
Size of oil palm owned		-0.05**	-0.05*		-67.1**	-64.8*
		(0.02)	(0.02)		(32.2)	(33.8)
Size of forest owned		-0.1**	-0.1*		-89.9**	-83.5*
		(0.03)	(0.03)		(41.8)	(45.6)
Agroforestry Perceptions		0.3***	0.3***		446.9***	426.4***
		(0.04)	(0.1)		(61.6)	(101.6)
Sustainable-Receiver x Agroforestry Percep.			-0.1			-206.2
			(0.1)			(140.4)
Conventional-Receiver x Agroforestry-Percep.			0.2**			263.3*
			(0.1)			(146.5)
logSigma	1.2***	1.1***	1.1***	8.4***	8.4***	8.4***
	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)
Constant	2.0***	-0.5	-0.3	2,723.7***	-790.3	-655.9
	(0.2)	(0.4)	(0.6)	(309.8)	(553.7)	(795.9)
Controls	NO	YES	YES	NO	YES	YES
Observations	848	848	848	848	848	848
Log Likelihood	-1,535.6	-1,496.2	-1,491.5	-4,726.7	-4,686.8	-4,682.1
Akaike Inf. Crit.	3,079.2	3,008.4	3,002.9	9,461.3	9,389.6	9,384.1
Bayesian Inf. Crit.	3,098.2	3,046.4	3,050.4	9,480.3	9,427.6	9,431.6
Note:						*p<0.1; **p<0.05; ***p<0.01