Equity vs. Conservation: Can Payments for Environmental Services (PES) achieve both?

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Abstract

This paper investigates the trade-off between equity and conservation outcomes of two alternative Payment for Environmental Services (PES) schemes, using the results of a framed field experiment (public good game). Particularly, we investigate two alternative PES schemes under endowment heterogeneity and heterogeneity in the opportunity costs of conservation. We test an equal PES scheme, where a fixed flat rate per conserved hectare is paid and an unequal PES scheme, which compensates according to the opportunity costs of conservation. Main findings indicate that the introduction of an unequal PES scheme does not necessarily come at the cost of conservation. Furthermore, the results show that an unequal PES may function as a redistribution instrument by realigning earnings towards the low-endowed subjects.

Keywords: Public good game, Endowment heterogeneity, Productivity heterogeneity, Payments for Environmental Services (PES), Equity

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1. Introduction

Payments for Environmental Services (PES) are an incentive-based policy instrument that aim to realign the private and social benefits, resulting from decisions that affect the environment (Jack et al., 2008; Engel et al. 2008). Although this instrument is increasingly proposed as a cost-effective instrument to promote conservation, critics argue that PES are regressive as they privilege large-scale farmers who have lower opportunity costs of conservation. Hence, it has been proposed that PES should be used as a redistributive instrument. This paper investigates the potential of using PES as multi-purpose instrument to promote conservation and redistribution. We study if the use of PES as a redistributive instrument compromises conservation goals.

To investigate the effect of PES schemes on conservation and equity outcomes we conducted a framed field experiment in Indonesia with farmers who live in areas that are prone to be transformed into oil palm plantations in detriment of forests. Our experimental design is based on a public good game with heterogeneous subjects. Participants, who differ in terms of the endowment – land units-, decide how to allocate the endowment between oil palm and rubber agroforestry. Rubber agroforestry brings lower private returns than oil palm. At the same time rubber agroforestry also generates positive externalities (higher biodiversity, water availability, soil fertility). These positive externalities can be thus considered as a public good, to which each subject can contribute by adopting rubber agroforestry. Pagiola et al. (2005) show that the desire of the poor to participate in a PES scheme, in our case similar to the ability to participate and actual participation[1], is often restricted by higher opportunity costs of conservation. In the design we hence assume that opportunity costs of conservation (relative return of rubber agroforestry) are higher for low-endowed subjects (small farmers). Our design compares PES schemes that use equal payments versus a scheme that uses unequal PES. In the equal payment scheme the conservation funds are equally distributed among the participants (per unit of land conserved), irrespective of the opportunity costs of conservation. However, in the unequal payment scheme the level of payment is determined by the cost of conservation. Hence smaller farmers receive higher payments, while the total funds provided for conservation are kept constant.

Scholars pay increasingly attention to social dimensions of PES such as distributional and procedural justice (Pagiola et al., 2005; Narloch et al., 2013; Pascual et al., 2010). PES literature shows that justice/fairness considerations of PES scheme partly determine the social and political legitimacy of a program (Narloch et al., 2013; Corbera et al,. 2007; Landell-Mills, 2002; Corbera and Pascual, 2012, Muradian et al., 2013), since formal institutions such as PES are embedded in complex social systems interacting with social norms (Cardenas and Carpenter, 2008; Pascual et al., 2010). In the PES literature, fairness is often associated with the pro-poor targeting of a PES scheme[2]. In this context, the transfer of payments itself has been identified as major contributor to poverty reduction in PES programs (Pagiola et al., 2005). A key question is hence to which extent the poor have access to PES programs (Pagiola et al., 2010; Zbinden and Lee, 2005, Jindal et al., 2013, Narloch et al., 2013). Several case studies investigate equity implications of PES schemes: Sommerville et al. (2010) highlight the lack of adequate benefits accruing to those members with high agricultural

[1] Since insecure property rights, ability to meet investments costs, technical constraints are neglected in our study, which determine, according to Pagiola et al. (2005) the step from the ability to participate to the actual participation.

[2] When considering the impact of PES on poverty, both the effect among program participants and indirect effects on non-participants through labor, food crops and other markets must be investigated (see Zilberman et al., 2008).

opportunity costs in a community-based PES scheme in Menabe, Madagascar. Corbera et al. (2007) show that the introduction of the Carbon Sequestration Service Program in Mexico reinforces existing power structures, inequities and vulnerabilities. This paper contributes to this literature providing empirical evidence on the potential impacts of PES on conservation and equity.

Challenging the economic foundation of PES, Kosoy et al. (2007) show empirically that the amount of compensation is below the opportunity costs of providing conservation. Their findings indicate that less tangible factors than the incentives provided by PES schemes affect conservation decisions. The effects of intangible factors on conservation behavior is shaped by informal institutions of the culture or social group, irrespective whether these factors are associated with the nature of the PES scheme (e.g. implicit fairness criterion[3]) or the ecosystem service (Corbera et al., 2007). Here, especially for disentangling these intangible factors the usefulness of case studies and survey data may be limited. Hence, working with controlled environments can improve our understanding of the underlying assumptions and incentives that drive behavioral response to policy interventions, such as the implementation of certain PES mechanisms (Ehmke and Shrogen, 2008). Additional real-world complexity can be added into the experimental design in a controlled way to identify conditions that might cause the failure of policy interventions.

To the best of our knowledge only a very limited number of studies investigate PES schemes using framed field experiment in a developing country context. The majority of these framed field experiments investigate the role of PES-like schemes on cooperation between resource users (see Vollan[4], 2008; Travers[5] et al., 2011). Narloch et al. (2012) highlight to which degree alternative reward systems (individual vs. collective) interact with social norms, resulting result in crowding-in or -out effects. Their analysis is based on a public good experiment, introducing homogenous and heterogeneous population with regard to endowment. Only Narloch et al. (2013) investigate the distributional outcome of three alternative payment[6] rules that differ in terms of how to allocate payments to the ranked bid offers. They applied an agro biodiversity conservation auction in Bolivia and Peru (see Jindal et al., 2013). The paper shows that both conservation and distributional outcomes are highly sensitive to the payment rules chosen.

The next section briefly outlines the field context in which the framed field experiment was carried out, before describing the design, setting and implementation of the public good experiment in the subsequent sections. The econometric results are presented in Section 5. We start with the analysis of the alternative payment schemes on conservation behavior at group level, before investigating the conservation behavior by farm size, allowing us to make conclusions on equity considerations with respect to conservation behavior and earning effects. The paper concludes with discussing the main findings and their implications.

[3] Fairness is a social construct, resulting in manifold fairness criteria (Pascual et al,. 2010; Konow, 2003) .

[4] He emphasizes that the nature of the external intervention (controlling vs. supporting external intervention) affects the crowding-out of the intervention that aim to reduce overgrazing in Namibia and South Africa, using a common pool resource game.

[5] They highlight the role of institutional arrangements on common pool resource extraction in Cambodia, using a common pool resource game.

[6] They tested discriminatory rules, where a) the level of payments is selected according to the conservation costs; b) a uniform rule, where each selected group would receive the same payment per hectare and c) a conditional payment rule where each group was paid the payment level requested per hectare.

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2. Background

During the last decade oil palm cultivation increased rapidly in Indonesia; the oil palm area almost doubled from 4.2. Mio. ha in 2000 to around 8 Mio. ha in 2010, which account for 46% of world's crude oil palm production (Obidzinski et al., 2012). In 2010, 66% of the plantation area is found on Sumatra, 30% in Kalimantan and 3% in Sulawesi (PWC, 2012).
The UN reports that the establishment of oil palm plantation causes significant losses in forest area, where the majority of endemic plant species (Fritzherbst, 2008) are located (Unep, 2011). Among the countries which face significant losses in forested land between 1990-2005, Indonesia ranks second with regard to the absolute decline in forested area (280,000 km2) (World Trade Organization, 2010).
The experiment was carried out in Jambi Province located on the island of Sumatra. The province is one of the provinces with the fastest and most complete transformation of tropical lowland rainforest into rubber or oil palm plantations worldwide (Laumonier et al., 2010). The transformation of lowland rainforest systems into mainly oil palm plantations has been identified as a major factor in the significant biodiversity loss (Danielsen et al., 2009; Wilcove and Koh, 2010). Since primary lowland rainforest has been almost totally converted into monocultures, rubber agroforestry systems is the most extensive forest-like vegetation type in Jambi Province.
Rubber agroforestry is an extensive smallholder cultivation system that combines the cultivation of a perennial crop, such as rubber, with useful other plants, such as timber and fruits trees building/handicraft and medical plants. Beukema et al. (2007) show that rubber agroforestry systems incorporate high levels of bird and plant species richness and are more similar to neighboring forests than to oil palm monocultures. Ecological functions of the forest as water flow regulation and soil protection can be preserved by rubber agroforestry systems (Feintrenie and Levang, 2009). Despite the environmental benefits of rubber agroforestry, oil palm and rubber monocultures are preferred due to their higher direct profitability (Feintrenie et al., 2010).

3. Experimental Design

The decision to conserve rubber agroforestry can be represented as a public good game. Rubber agroforestry cultivation generates positive environmental effects, such as improved water quality, larger bird diversity and decreased soil erosion (Beukema et al., 2007). Yet, rubber agroforestry is less profitable than oil palm (Feintrenie et al., 2010). This situation leads to a social dilemma in which individually producers have an incentive to plant oil palm, while the community would be better off with rubber agroforestry and its indirect conservation benefits (in the following this activity will be simplified as conservation). To represent this dilemma, [7]we used a modified public good game in which we consider that producers are heterogeneous in terms of the size of their farm and the opportunity cost that they face to conserve (marginal return of conservation). Farmers where randomly matched into groups of three farmers. Two participants in the group are endowed with five units of land (e=5) and one participant is endowed with ten units of land (e =10). Participants have to decide how many land units they want to allocate to oil palm (x) cultivation and how many land units they want to allocate to rubber agroforestry. All land units need to be allocated, hence the number of units allocated to rubber agroforestry are (e-x). Private returns for rubber agroforestry are lower than for oil palm. In the experiment, each unit of land allocated to oil palm yields a return of 1, while each land unit allocated to rubber agroforestry gives a

[7]Instructions are available upon request

return a, (with a < 1). The relative profit of rubber agroforestry is based on the findings of Feintrenie et al. (2010), who compare the profitability of oil palm monoculture, rubber monoculture and rubber agroforestry in Jambi Province. Yet, in order to represent the differences in opportunity cost that large and small producers face, we allow the returns for rubber agroforestry to differ for participants with small and large endowments. For each unit of land allocated to agroforestry farmers with 5 land units earn 0.3, while farmers with 10 land units earn 0.4. This reflects the common characteristic that resource users with limited endowment often bear significantly higher relative opportunity costs to allocate scarce resources to conservation, when limited endowments need to be used for private purpose (Narloch et al., 2013).

The cultivation of rubber agroforestry relative to oil palm cultivation is associated with public conservation benefits per land unit that affect the community. Hence, for each unit of land allocated to rubber agroforestry in the group, the income of each group member increases by b. We explained participants that rubber agroforestry has a positive environmental effects that translates into higher payments for all group members.

Each participant took 4 decisions. In Decisions 1 and 4 farmers do not receive any payment for environmental services (PES). In Decision 2 and 3 payments for environmental services for the cultivation of rubber agroforestry were introduced, leading to an increase in the relative profit of rubber agroforestry (a + PES). The scheme was framed as Payments for Environmental Services (PES) that aims to foster environmentally friendly behavior associated with the planting of rubber agroforestry. Each participant decides on the allocation of land units in three consecutive rounds each with different payment levels of PES (no payment, low payment, high payment). Yet, to account for order effects we vary the order in which high and low payments were offered (low-high and high-low). In Decision 4 we removed the PES scheme.

We are interested in testing whether the use of PES as a redistributive tool comes at the cost of lower conservation outcomes. We compare an equal PES in which participants with e=5 and e=10 receive the same amount of incentive for conservation (per ha) with an unequal PES scheme, where the payment differs according to the opportunity costs of conservation. Under the latter scheme low-endowed subjects receive a higher compensation (per ha) than high-endowed subjects. To compare the cost-effectiveness of different levels of PES, we introduced different levels of payments as depicted in Table 1 (Set 1 and Set 2). The average payment per unit conserved (av.PES) is kept constant across the two alternative PES schemes. Set 1 and 2 differ in terms of the relative profit of rubber agroforestry (a+PES) in the decisions, where PES are offered.

Table 1: Relative profit of rubber agroforestry with PES (a+PES) by PES scheme, endowment status and payment level

PES scheme	*Equal PES scheme*		*Unequal PES scheme*	
Set 1	*e=5*	*e=10*	*e=5*	*e=10*
Decision 1 and 4	0.3	0.4	0.3	0.4
Decision 2 and 3	0.35	0.45	0.4	0.4
Decision 3 and 2	0.55	0.65	0.6	0.6
Set 2				
Decision 1 and 4	0.3	0.4	0.3	0.4
Decision 2 and 3	0.4	0.5	0.45	0.45
Decision 3 and 2	0.6	0.7	0.65	0.65

In summary, each participants *i* faces the following pay-off function in round t.

$$\pi_i = x_i + (a + PES)\ \ (e \ \ - x_i) + b \sum_{i=1}^{n} (e \ \ - x_i) \qquad (1)$$

where, *e* is the endowment, x_i is the endowment allocated to oil palm production, *a* is the profit of rubber agroforestry, *PES*, is the PES payment for rubber agroforestry, *b* is the positive externality generated from rubber agroforestry. The social optimum, where the group total benefit is maximized, is reached when all group members allocate all of their land to rubber agroforestry. By contrast, the optimal individual decision is to invest all the endowment in oil palm.

4. Experimental Procedures

The experiment was carried out between November 2012 and March 2013. The experiment was conducted in Batanghari district (Jambi Province) in four villages; two autochthonous villages (Pulau Betung, Kameo) and two trans-migrant villages (Bukit Harapan, Bukit Sari). In each village, each treatment was played in four sessions corresponding to two sets of payment levels. To control for order effects each set of payment level was played twice (once in reversed order). Each session consists of 3 groups (9 participants). Based on a village census, the household heads of oil palm and/or rubber cultivating families were invited.

All treatments were exogenously given. Decisions were made anonymously and between decisions participants did not receive feed-back on their own earning or group contribution. Throughout the sessions, information on group-membership was not provided to participants. Hence, the composition of their group was unknown to the participants. Communication between the participants was not allowed during all stages of the experiments. The experimental session consists of four different stages. First the instructions of the game were read aloud to the participants, followed by several examples. In a second step, two practice rounds were played. After completion of the practice rounds, the actual experiment was carried out consisting of four rounds of decisions. Once participants had completed the decisions of the experiment, one round was randomly drawn and 10% of the earning gained in this round was paid out to the farmers. All subjects were paid privately using checks made payable for them in their local shops. Game participants earned between 30.000 and 120.000 Rp. (average daily wage is around 50.000 Rp.). At the end of the game a brief post-experimental questionnaire was completed, incorporating questions related to the game, participants demographics and farming activities. Table 2 summarizes the number of participants according to the PES scheme and the payment set.

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

	Equal PES			*Unequal PES*		
	No. of farmers with e=5	No. of farmers with e=10	No. of groups	No. of farmers with e=5	No. of farmers with e=10	No. of groups
Set 1	46	24	24	48	24	24
Set 2	48	24	24	48	24	24

5. Econometric Results

In a first step, to answer the question, whether a PES scheme that aims to compensate low-endowed farmers for their higher opportunity costs of conservation comes at the cost of overall conservation, we apply a random effect model. Here we use the percentage share of endowment allocated to conservation area at group level as the dependent variable. The results are depicted in Table 3. On the right-hand-side of the model, we include a variable for an unequal PES scheme and one for the average relative profit of rubber agroforestry (a+PES) at group level. In addition, we include an interaction term between unequal PES scheme and the average relative profit of rubber agroforestry to test whether the elasticity of supply of conservation area differs between the alternative PES schemes.

Table 3: Random effect model estimation of group conservation; dependent variable: the percentage share of endowment allocated to rubber agroforestry

	Coefficient	Standard error
Unequal PES scheme (0/1)	.0113	.0720
Av. relative profit of rubber agroforestry	.2291***	.0719
Unequal PES scheme (0/1)* av. relative profit of rubber agroforestry	-.0252	.0977
_constant	.3071***	.0524

N =93; Wald chi2(3)=19.63; Prob>chi2=.0002 Note: *p<0.10, **p< 0.05, ***p<0.01; We also estimated random effect models that include session dummies and socioeconomic variables. Results do not change significantly.

The results depicted in Table 3 show that with an increase in the relative profit of rubber agroforestry under an equal PES scheme the percentage share endowment allocated to conservation area significantly increases. It can be interpreted as the elasticity of supply of rubber agroforestry, i.e. with a 1% increase in the relative profit of rubber agroforestry, the share of conserved area increases by 0.2%. The estimates with respect to the interaction term emphasize that the introduction of an unequal PES scheme does not significantly change the elasticity of supply of rubber agroforestry. Hence, results may suggest that the introduction of an unequal PES scheme, which accounts for differences in the opportunity costs of conservation, does not necessarily come at the cost of conservation area at group level.

Furthermore, we investigate the equity implications of the two alternative PES schemes. In a first step, we address the question whether the high-endowed or the low-endowed farmers conserves more in terms of the proportion of their individual endowment. In a second step, we investigate the earning effects of the alternative PES schemes by endowment status. Table 4 depicts the estimates of random effects models with the percentage share of individual endowment allocated to rubber agroforestry area as the dependent variable. We include the relative profit of rubber agroforestry (a+PES) and a dummy variable for the endowment status. Again we consider an interaction term between relative profit of rubber agroforestry and the endowment status. Model 1 depicts the results for the equal PES scheme. Model 2 shows the estimates for the unequal PES scheme.

Table 4: Random effect estimation for participants by PES scheme; dependent variable: percentage share of individual endowment allocated to rubber agroforestry

	Model 1 *Equal PES scheme*		*Model 2* *Unequal PES scheme*	
	Coefficient	Standard error	Coefficient	Standard error
High-endowed farmer (0/1)	13.235	10.455	-12.544	11.583
Relative profit of rubber agroforestry	32.452***	8.291	22.033***	6.9969
Relative profit of rubber agroforestry * high-endowed farmer (0/1)	-16.617	14.215	1.442	15.479
_constant	24.181***	5.605	37.636***	5.400
N	138		140	
Wald chi2(3)	18.33		16.23	
Prob>chi2	.0004		.00010	

Note: *p<0.10, **p< 0.05, ***p<0.01; We also estimated random effect models that include session dummies and socioeconomic variables. Results do not change significantly.

The results of model 1 and 2 show that an increase in the relative profit of rubber agroforestry significantly increases the percentage share of endowment allocated to conservation area of low-endowed farmers under both PES schemes. However, the elasticity of supply does not significantly differ between high-endowed and low-endowed farmers under both PES schemes, indicating that we cannot derive equity implications with respect to the share individual endowment contributed to rubber agroforestry. To make conclusions on equity implications of the PES schemes or answer the question whether an unequal PES scheme may function as a redistribution instrument, we investigate the earning effects of the PES schemes by endowment status. Therefore, in a first step, we estimate two random effect models. In model 1 the average earning per ha (at group level) without externality is used as the dependent variable. In model 2 we consider the externality. Results are depicted in Table 5.

Table 5: Random effect estimation; dependent variable: Average earning per ha with and without externality.

	Model 1 *Without externality*		*Model 2* *With externality*	
	Coefficient	Standard error	Coefficient	Standard error
Unequal PES scheme (0/1)	-4331.32	2935.06	-3512.35	6280.99
Average profit of rubber agroforestry	36768.02***	3028.83	63457.14***	6550.09
Average profit of rubber agroforestry* Unequal PES (0/1)	4951.97	4115.24	-1843.64	8883.88
_constant	60760.25***	2139.30	96473.01***	4584.04
N	91			91
Waldchi2(3)	372.06			212.63
Prob>chi2	.0000			.0000

Note: *p<0.10, **p< 0.05, ***p<0.01; We also estimated random effect models that include session dummies and socioeconomic variables. Results do not change significantly.

Both models show that an increase in the average relative profit of rubber agroforestry leads to an increase in the average earning per ha, indicating a positive earning effect due to the introduction of the PES scheme. This earning effect does not significantly differ between the PES schemes. To make conclusions on the distributional outcome, we again estimate random effect models with the percentage share of individual earnings among total group earnings as the dependent variable. Models are separated by endowment status. Results are depicted in Table 6.

Table 6: Random effect model by endowment status: dependent variable: the percentage share of individual earnings among total group earnings

	Model 1/2 *Low endowed farmers (e=5)*		*Model 3/4* *High-endowed farmers (e=10)*	
	Without ext.	*With ext.*	*Without ext.*	*With ext.*
	Coefficient	Coefficient	Coefficient	Coefficient
Unequal PES scheme (0/1)	-.0355***	-.0276***	.0712***	.0662***
	(.010)	(.0100)	(.0232)	(.0246)
Relative profit of rubber agroforestry	-.0149	-.0113	.0295	.0232
	(.011)	(-.0276)	(.0188)	(.0214)
Relative profit of rubber agroforestry* Unequal PES	.0468***	.0325**	-.1087***	-.0760**
	(.0146)	(.0143)	(.0293)	(.0326)
_constant	.2577***	.2913***	.5030***	.4211***
	(.0075)	(.0075)	(.0156)	(.0167)
N	183	180	94	91
Waldchi2(3)	15.58	8.80	14.89	7.67
Prob>chi2	.0014	.0320	.0019	.0533

Note: *p<0.10, **p< 0.05, ***p<0.01; We also estimated random effect models that include session dummies and socioeconomic variables. Results do not change significantly.

Model 1 and 2, which show the results for low-endowed farmers, emphasize that under the unequal PES the percentage share of group earnings (without and with externality) generated by low-endowed subjects significantly increases with increasing PES level. In contrast, the percentage share of total earnings generated by high-endowed subjects significantly decreases with increasing PES level. In the decisions, where no PES are paid the percentage share of earnings generated by low-endowed subjects is significantly lower under the unequal PES than under the equal PES scheme. Vice versa, the percentage share of earnings generated by high-endowed subjects is significantly higher under the unequal PES than under the equal PES scheme. These results suggest, that the unequal PES scheme may function as a redistribution instrument, indicated by an increase in the percentage share of earnings generated by low-endowed with increasing unequal PES level.

6. Discussion and Conclusion

In the PES literature, the maximization of the cost-effectiveness (i.e. maximizing the conservation area with given limited conservation funds) plays a central role. Hence, many programs target large land-holders who can provide conservation services at least-cost. These outcomes are often perceived as unfair as small-scale land-users seldom benefit under such PES schemes. A growing consensus hence emphasizes social equity aspects of PES in order to guarantee the political and social legitimacy of a PES scheme. We address the gap in the current literature by approaching the question whether redistribution towards low-endowed farmers - in terms of access to PES programs and earning - compromises cost efficiency in terms of conserved land. More precisely, we investigate the effect of two alternative PES schemes on conservation and equity considerations under endowment and productivity heterogeneity (differences in opportunity costs of conservation). At the group level, the introduction of a PES scheme, implying an increase in the relative profitability of rubber agroforestry significantly increases the share of conserved land. Yet, the type of PES scheme under which these payments are introduced does not significantly affect the aggregated conservation outcomes. Hence the introduction of an unequal PES scheme does not come at the cost of efficiency in terms of aggregated conserved land. Considering the earning effects of the introduction of the alternative PES schemes, we find that the increase in the average earning (with externality) per ha induced by the PES is not significantly different under unequal PES scheme than under equal PES scheme. We can conclude that the introduction of an unequal PES scheme does not sacrifice in terms of a reduced overall earning effect. In a second step, we investigate whether an unequal PES scheme can be implemented as a redistributive instrument. With respect to the conservation behavior, we find that the elasticity of supply of rubber agroforestry does not significantly change with the introduction of an unequal vs. an equal PES scheme. Considering the distribution of the earning effects, we show that the increase in the percentage share of earning generated by low-endowed farmers induced by the introduction of an unequal PES scheme is significantly higher than under an equal PES scheme. In contrast, with the introduction of an unequal PES scheme the increase in the percentage share of earning hold by high-endowed farmers decreases compared to an equal PES scheme. It implies that the introduction of an unequal PES scheme can function as a multi-purpose instrument that realigns income towards low-endowed farmers.

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