The influence of positive incentives on the perception of use values of forest conservation: the case of a payment for environmental services program in Cambodia

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Abstract
In contexts of close interlinkages between poverty and biodiversity conservation, high dependency on the use of biodiversity for livelihoods might constitute a motivation to enforce conservation practices. Besides, changes in the institutional framework can lead to mutually reinforcing social and environmental consequences. We conceptualize motivation crowding as an illustration of such effect in the sense that the implementation of Payments for Environmental Service (PES) would either strengthen or undermine at least partially intrinsic motivations to conserve. This paper explores the effect of a PES scheme in Cambodia on the perception of use values of forest conservation. This scheme aims at halting slash-and-burn practices by providing a mix of in-kind and in-cash benefits to forest communities. We conducted a household survey with project participants (N=205) and non-participants (N=120) and find three significant results. First, the program emphasized externally regulated values i.e. linked to market demand (ER) and reduced the prevalence of values with a higher degree of autonomy i.e. closely linked to key subsistence goals (ID). Second, increased exposure to PES and its benefits changed the decision-situation frame regarding forest use by emphasizing "segregation" between livelihoods and forest use, and the role of forest resources in contributing to family income. Third, this switch may have implications for scheme effectiveness in the long run, as ER individuals reported that they would break conservation rules significantly more than other people if the payment stopped.

1 Introduction

Rapid biodiversity loss and extreme poverty seem to be intimately related and are emphasized in low-income countries with a large portion of their territory considered as a biodiversity hotspot. Interdependencies are reported to occur for different reasons including the strong dependence of poor rural people on limited natural resources, shared vulnerabilities to natural and human-made shocks, and the failure of social, political an economic institutions to regulate human behaviors due to corruption, lack of qualified human resources, etc. (Barrett, Travis, et Dasgupta 2011). In such context, changes in the institutional framework, such as the implementation of a PES scheme, can lead to mutually reinforcing social and environmental consequences.

Payments for Environmental Services (PES) have become popular tools for biodiversity conservation, not only because they are considered as an efficient solution to environmental problems (Ferraro et Kiss 2002; Engel, Pagiola, et Wunder 2008) but also because they can lead to co-benefits in terms of poverty reduction and contribute diversifying financing sources for conservation policies (Ferraro 2011). PES was first defined as "*a voluntary transaction where a well-defined ES (or a land-use likely to secure that service) is being 'bought' by a (minimum one) ES buyer from a (minimum one) ES provider if and only if the ES provider secures ES provision*" (Wunder 2005). This definition and the efficiency promise further rely on neoclassical assumptions about human behavior i.e. rational choice as maximization of self-preferences, stable preferences independent from the institutional context.

However, a number of scholars oppose the neoclassical approach to human rationality and argue that there are risks that PES leads to unintended and mutually reinforcing social and environmental effects. Firstly, they consider human beings as multi-rational, their behaviors being influenced by different types of preferences or motivations (Vatn 2005). In this regard, they further borrowed

from social psychologists the distinction between intrinsic motivations, "*which refers to doing something because it is inherently interesting or enjoyable* and extrinsic motivations, *which refers to doing something because it leads to a separable outcome"* (Ryan et Deci 2000). These scholars further define different types of extrinsic motives, according to their level of autonomy i.e. how externally imposed versus internally integrated the separable outcome is, that is *external regulation*, *introjected regulation*, *identification* and *integrated regulation*[1]. Secondly, they argue that the type of motivation that is emphasized in a given decision situation depends on the institutional context as preferences are state-dependent (Bowles et Polanía-Reyes 2012). Thirdly, they argue that economic incentives do not simply operate as pure *"external regulations"* that only modify the costs and benefits of the target activity but also affect other types of motivations that involve some degree of *autonomy* (Bowles and Polanía-Reyes 2012). Within this conceptual framework, motivation crowding arises because economic incentives – a concept that encompasses both environmental taxes and positive incentives such as PES – do not only operate as an *"external regulation"* that modifies the costs and benefits of the target activity but might also complement (crowding in) or undermine (crowding out) the other types of motivations that involve some degree of *autonomy* and support conservation (Bowles and Polanía-Reyes 2012). This effect is believed to have effectiveness implications as it might "*under certain conditions, outweigh the stimulating effect of monetary incentives and reduce the propensity to engage in the desired activity*"(Rode, Gómez-Baggethun, and Krause 2013), and it can remain invisible in the short run and occur only once payments stop (Bowles et Polanía-Reyes 2012).

A rising number of empirical studies have provided evidence for motivation crowding applied to economic incentives for biodiversity conservation and have helped to highlight a variety of factors and mechanisms that affect the extent and the sign of the motivation crowding effect. For example, some authors suggest that crowding out is more likely in situations where intrinsic motives or social norms guide target behaviors (Muradian et al. 2013; Wunder 2013). In addition, the way that the meaning of payments is individually perceived seems in some cases to explain motivation crowding, as they induce mechanisms such as control aversion or adverse reaction to perceived bad intentions from the PES administrators (Muradian et al. 2013). Alternatively, "the focus on economic reasoning can be such that it changes mindsets and values" of beneficiaries (Rode, Gómez-Baggethun, et Krause 2013). However, results from empirical studies are often inconclusive due to a number of methodological limitations (Rode, Gómez-Baggethun, and Krause 2013). Firstly, there is generally a lack of adequate baseline information about the nature of preexisting pro-nature motivations. Secondly, these studies are hardly comparable because they focus on various specific motivations, rarely provide explicit clues about the underlying psychological mechanisms and are implemented in different social contexts (with different local norms). Thirdly, they generally fail to provide statistically significant results and, at the same time, to isolate the PES effect on motivations, and so to discard alternative explanations.
Finally, empirical studies and theoretical debates around motivation crowding applied to economic incentives and PES in particular have largely focused on a very narrow type of motivation, namely

[1] External regulations: "such behaviors are performed to satisfy an external demand or obtain an externally imposed reward contingency". Introjected regulation: "type of internal regulation that is still quite controlling because people perform such actions with the feeling of pressure in order to avoid guilt or anxiety". Identification: "the person has identified with the personal importance of a behavior (life goal) and has thus accepted its regulation as his or her own". Integrated regulation: "integration occurs when identified regulations have been fully assimilated to the self".

social preferences such as altruism, reciprocity or guilt (Cardenas 2004; Rodriguez-Sickert, Guzmán, and Cárdenas 2008) or on pure intrinsic motives such as respect for wild animals (Rico García-Amado, Ruiz Pérez, and Barrasa García 2013). However, we also expect the perception of forest use values to be instrumental in supporting conservation, particularly when PES recipients are poor and vulnerable. Indeed, a number of empirical studies show that, under these conditions, use values support people's key life goals including daily small cash-generation but also food security, shelter and health (Bawa and Gadjil 1997). We postulate that the integration between key life goals, forest use values and policy design represents a motive to conserve (Ezzine-de-Blas et al., this issue). In other words, the perception of use values reflects a type of autonomous extrinsic motivation to conserve forest that Ryan and Deci (2000) call "*identification*".

In this paper, we provide empirical evidence for the effect that a positive incentive scheme for biodiversity conservation has on motivations that are associated with the perception of use values of conservation, in project-specific case study. In the first section, we describe our case study, a PES scheme for biodiversity conservation implemented in Cambodia by Conservation international (CI). In the second section, we introduce our methodology, which is based on a household survey with project participants and a control group of non-participants. In the third section, we evaluate the net impact of the scheme on motivations. In the fourth section, we endeavor to better ascertain what aspects of the PES scheme induced these motivation changes. In the fifth section, we look at the effectiveness implications of such motivation changes. The sixth section is dedicated to the discussion, where we further discuss the validity of our method and results, the validity of the tested hypotheses regarding the underlying mechanisms leading to changes in motivations, and the potential implications of these results for the effectiveness of the scheme.

In particular, we find that the scheme had a significant impact on undermining forest conservation use values associated with subsistence goals and emphasized those associated with economic goals. We also show that this effect is mostly linked to the level of benefits received from the scheme and more specifically to the way the payments and CI's conservation message were shaped. Our results also suggest that this switch can have implications for scheme effectiveness in the long run, as economically motivated individuals –whose numbers might increase following program implementation- reported that they would break conservation rules significantly more than other groups if the payment stopped.

2 Case study description and methods

2.1 Case study description: the conservation agreements

The Conservation Agreement (CA) is the main tool of CI's international Conservation Stewardship Program, which aimed at "*making biodiversity conservation a viable choice for local resource users*" (Conservation International 2007). It is strongly inspired from the PES rhetoric (Sarah Milne 2009): it provides communities with "*tangible benefits*" in exchange for the compliance with a number of conservation rules that lead to "*the effective conservation of high priority areas and species*" (Conservation International 2007). Since 2005, 51 agreements have been signed in 14 countries.

In Cambodia, the CA model has been implemented since 2006 in the Cardamom Mountains. This landscape, located in South-West Cambodia (see map in figure 1), is home to the largest remaining

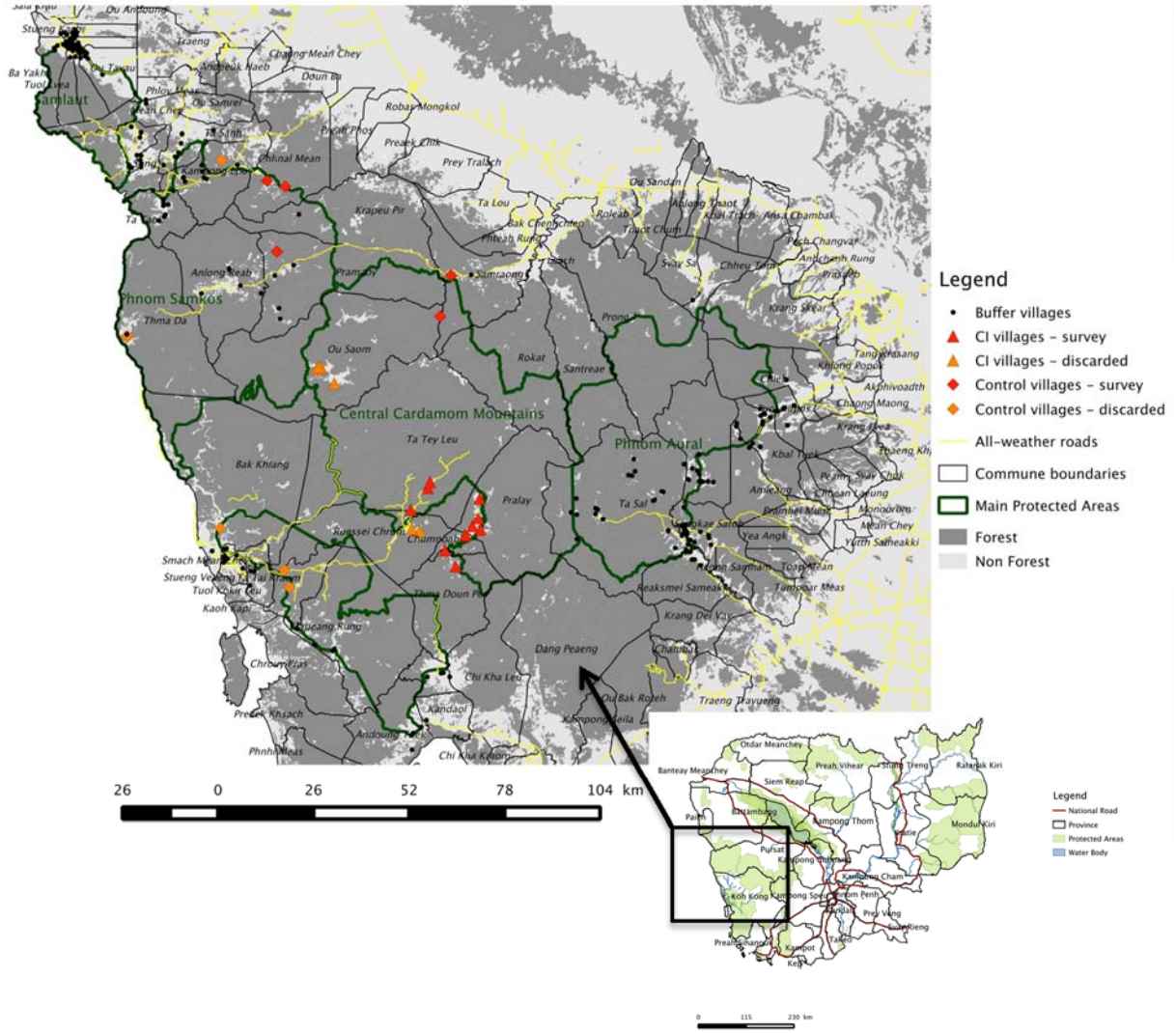
continuous forest in mainland Southeast Asia and are widely recognized as being of global conservation importance (Killen 2012; Daltry and Momberg 2000). However, this it has undergone increasing pressure and ecosystem loss and degradation since the early 2000's. Two mains types of deforestation and degradation can be distinguished, planned and unplanned. The former corresponds to logging concessions in dam reservoirs or Economic Land Concessions for agricultural investment granted by the government. The latter corresponds to illegal expansion of agricultural land for small-scale commercial and subsistence agriculture, illegal selective logging of luxury wood and poaching of wildlife for sale by local farmers, migrants and even outsiders. Illegal extraction of forest products and deforestation are made possible because the enforcement of formal laws is weak – including in particular land tenure, which was poorly clarified locally until the last land titling campaign in 2012 – so that access to and the use of NRs are governed locally by informal institutions led by powerful individuals or organizations (Schweithelm and Chanthy 2004, Clements et al. 2010). It is also exacerbated by the development of access roads built by investment companies.

The CA were implemented as an "add-on" to the preexisting command-and-control approach: it aims at supporting the enforcement of the Forest Law amongst local communities. The first consequence is that it is located inside and in the buffer zone of one of the 13 protected areas (PA) of the Greater Cardamoms Landscape, the Central Cardamoms Protected Forest (CCPF). CI started the project with 2 communes[2] in 2006 and then expanded it up to 6 communes in 2009 before dropping two communes in 2011 and 2012 (see map of the Greater Cardamoms Landscape in figure 1). At their maximum extent, the CA covered most villages located within a 5 km buffer of this particular PA that CI co-manages with the Forestry Administration i.e. 17 out of 23 villages, for about 920 households.

[2] Administrative division of Cambodia: Cambodia is composed of 25 provinces. Each of them is divided into districts. The subdivision of districts is a commune, which is in turn composed of several villages.

Figure 1:

Map of the larger Cardamom landscape with the target and discarded control and treated villages of the survey.



The second consequence is that the conservation rules stipulated in the CA contracts are aligned with some articles of the Forest Law. More specifically, the scheme aims to support local communities to give up a number of illegal activities, such as clearing of new plots in pristine forest for swidden agriculture, poaching and logging for commercial purposes and, on the other hand, to adopt alternative livelihood strategies to generate cash and produce food. It includes in particular the rehabilitation of abandoned rice fields, and the rotation of upland agriculture on existing swidden fields. The third consequence is that the rules attached to the CA are not only enforced through positive incentives but also through law enforcement activities (patrolling, arresting, confiscating, etc.).

Overall, there is an attempt to modify the preexisting relationship between people and forest and agricultural systems. Indeed, since local people started returning to this area in 1997 after the end of the civil war, they have rapidly developed subsistence livelihood strategies that are also highly dependent on forest services. In particular, the main livelihood activity is rice production for home

consumption. Rice production was mainly conducted through extensive slash-and-burn systems that people favored instead of rehabilitating their former lowland rice fields, which had remained abandoned for more than twenty years. Forest also played a key role in supporting people's basic needs such as nutrition, health and shelter through the collection of timber for house building and firewood, forest vegetables, fruits, animals and mushrooms for food, plants as traditional medicine. Finally, at that time access to the market was very difficult so that middlemen were buying only high-value forest products, such as luxury wood, wildlife but also some Non-Timber Forest Products (NTFPs), such as resin.

CA scheme relies on a mix of positive individual and collective, in-cash and in-kind incentives, whose monetary values add up to the overall benefit package. The total value of this package was originally estimated so that it equals the opportunity costs of communities to give up the target illegal activities, which in turn were calculated based on a socio-economic survey where individual farmers were reporting their intention to engage in these activities the following year (Niesten et Zurita, s. d.). Until 2011, each commune received between 8,000 and 21,000 USD per year. From 2011 onwards, CI reduced the size of the benefit package due to a financial shortage, so that it now ranges from 1,700 to 8,200 USD. Benefits are threefold, namely collective in-cash incentives (salary for contractual teachers in local schools, repair of local schools), individual in-cash incentives (salary for community patrollers), individual in-kind incentives (financial support to community mechanical mules and buffalo banks).

CI signs a contract with the commune council and sanctions are also enforced at the commune level meaning that if one farmer breaks a rule in a given village, the benefits for all the villages composing the commune would be cut. The distribution of communal payments to individual households is organized through local institutions that were created by CI and thus rely to a large extent on collective decisions. For example, CI set up community-based natural management communities, which are mainly in charge of making decisions regarding the distribution of benefits, including patrolling and buffalo-bank shifts while communal mechanical mules are managed within smaller user groups. Previous scientific work reveals that this system tends to reinforce local power asymmetries and income inequalities (Sarah Milne 2009; S. Milne and Adams 2012).

2.2 Methods: sample selection

The main objective of this study was to isolate the net impact of the CA program on the type of motivations driving forest conservation. As we expected changes in motivations to occur only in the long run, we assessed the impact on communes that had been continuously participating in the conservation agreements since 2007 (4 communes and 11 villages – see map in figure 1 and list of villages in appendix 1). We thus decided to discard two communes that had participated in the program for a shorter period of time.

In addition, estimating net impact meant defining a robust counterfactual in order to be able to establish what would have happened without the project, a methodological requirement especially tricky in conservation projects where participating communities have some endogenous unique characteristics (Ferraro 2009; Miteva, Pattanayak, and Ferraro 2012). The risk of biased selection of counterfactual is particularly high in our case for two reasons. The conservation agreement program is located in remote, highly forested areas, and villages with a low population density so

that we expected the individual preexisting characteristics affecting motivations to be different from many other human settlements in the Cardamoms Greater Landscape that did not receive the program (risk of selection bias). In addition, the Cardamoms Mountains have undergone drastic changes since the CAs were first implemented (see previous section), and these threats on ecosystems are both unevenly distributed and believed potentially to affect motivations (risk of contemporaneous factor bias)[3].

In order to select robust counterfactuals that take into account these potential biases, we rely on quasi-experimental design and more specifically on matching statistical tools. The purpose of matching is to select two groups – one treated and one control – with similar distributions for observable cofounding variables that are believed to influence the probability of being selected in the program and of being correlated with the outcome (motivations to conserve in our case). We preferred the nearest neighbor propensity score matching to covariate matching because this statistical method better balanced covariates in our database. This method calculates a " *propensity score for each unit (e.g. village or household), which represents the probability of receiving the program based on observable characteristics and then, the nearest neighbor request matches each intervention unit to the control unit with the closest propensity score"* (Jagger et al. 2015). Impact is obtained by comparing the difference in outcomes between the intervention and similar comparison group.

Since there was no relevant household database available at landscape level before the program started, we decided to conduct a two-step matching. As a first step, we selected a group of control villages in the broader Cardamoms Landscape with the most similar preexisting observable characteristics that we believed influenced the assignment of the CA placement and accounted for a number of contemporaneous changes that may have affected the local motivations to conserve[4]. We used R version 3.0.2 and the Matchit package (Ho et al. 2011) to perform nearest neighbor propensity score matching (PSM) with replacement (table with variables and results of the PSM in appendix 2a). The outcome was a group of 11 control villages from which we selected 5 to implement the household survey[5].

We carried out the same household survey in the five control villages (N=120, sampling intensity = 20%) and in the sub-sample of CI target villages (N=205, sampling intensity = 40%), based on random sampling organized by village.

We further controlled for potential remaining bias associated with differences in preexisting personal characteristics and exposure to contemporaneous contextual changes at the individual

[3] It is worth noting that we expected the other main bias associated with impact evaluation studies, the risk of spillover, to be very small in our case study as CI target villages are very remote (located at least 10 km away from any other village that did not sign a CA contract).

[4] Covariates at the village level include: forest cover in 2006, population increase 2006-2011, population density 2006, accessibility to secondary roads, area of fertile soils, area with a slope below 7%, net deforestation 2002-2006, location within a 5km buffer of a protected area which receive financial and technical support from an international NGO, location outside any kind of active economic land concession.

[5] We discarded 6 of them for logistics and safety reasons – there are landmines in some of the villages and some other village were very far from the others (located on the western side of the mountain) so that it would have been too costly to organize the logistics (and also ecosystems and livelihoods are different, more connected to the sea)

level that might affect the motivation outcome[6]. To this end, we used a number of fixed variables (i.e. which were not influenced by the project) collected through our survey to perform a nearest neighbor propensity-score-matching test with a caliper of 0.2 and no replacement[7]. The matching gave us two groups of 97 participants and 97 non-participants (table with variables and results of the PSM in appendix 2b).

Overall, we obtained two separate databases: the first was a database compiling data for matched individuals only (N=194) and is analyzed in section 4.2 to estimate the impact of the conservation agreement program on motivations. The second was a database that encompassed data for all individuals interviewed in the CI target villages (N=205) and which was used in sections 4.2 and 4.3 to identify factors that influence motivation types and assess the links between motivation types and reported behaviors.

2.3 Methods: elicitation method for motivations

Another methodological challenge was to design an appropriate elicitation question to capture the individual motivations to conserve. In order to select the central question, we designed different options based on review of questions used in similar studies (Sarah Milne 2009; Rico García-Amado, Ruiz Pérez, and Barrasa García 2013; Fisher 2012). These questions were: (1) Why do you think it is important to conserve the forest and what is inside? (2) What are the benefits of living near the forest? (3) What are the benefits that you derive from forest conservation? We then tested these different options during an exploratory mission and ended up selecting option 3 because it proved to be the one that led to the broadest range of answers[8] that did not compromise on the elicitation of use values, which was the central topic of this study, and that remained connected to personal motivation.

In order to account for the relative importance of each benefit for a given individual, we also asked them to rank the top three benefits out of all the ones they listed ("Which ones are the most important?"). We then attributed a weighted score to each of the top three benefits of each respondent. This score was primarily based on the position in the ranking: 3 points were allocated to the first motive, 2 to the second and 1 to the third. We also weighted these basic scores as follows: if the respondent quoted only one benefit, the basic score was multiplied by three; if two, each score was multiplied by two; and if three or more, by one. A dominant type of motive was determined for each individual based on the motivation class that obtained the highest sum of weighted scores.

Finally, we classified the respondents' responses following the typology of Ryan and Deci (2000) based on the level of autonomy of each motivation type.

2.4 Methods: self-reporting of behaviors

We also asked respondents to report on three behaviors that corresponded to the three key conservation rules stipulated in conservation agreement contracts: the clearing of new forest plots,

[6] Covariates at the individual include: age, education level, year of settlement, reported percentage of land that received a land title

[7] Because there were fewer control units than treated units and matching without replacement, not all treated units received a match and we asked the software to match them in random order.

[8] We found strong bias towards non-use value with option 1 and strong bias towards use values with option 2

the collection of luxury wood and the poaching of wildlife for sale. We asked participants how many years they had conducted these behaviors within the last 8 years (i.e. since the CAs started) and whether they would carry out any of these target activities if CI stopped the payment program. For these behavioral data, we relied on self-reporting but also on recall and scenario questions. A number of biases are associated with the use of such data collection methods, such as desirability bias, potential information falsification and false recall (Sommerville et al. 2010). The risk for information falsification is particularly high since we focused on illegal behaviors. In order to mitigate this risk, we conducted several preparatory missions, which happened to be very useful to build trust with local communities, to make sure we were actually perceived as students (all enumerators were fourth-year Bachelor students from the Royal University of Agriculture of Cambodia) and not as conservationists. In addition, we did not ask respondents their names and did our sampling based on the village map (sampled the houses) so that they did not feel they could be reported to the authorities or tracked (less reason to hide).

2.5 Explanatory variables

We also asked different types of closed-ended questions, including 4-point Likert scales for perception questions, in order to create a number of cofounding and explanatory variables that we expected might affect motivation to conserve. We asked respondents to report for the benefits they received from the program, the number of attendances at CA meetings but also to share their perception about the PES scheme and managers (perception of fairness, scoring of CA managers' work, level of pressure perceived from the enforcement of rules). We also collected data about basic descriptive (age, special position, education, ethnicity) and livelihood characteristics (household demography, settlement year, access to land, reliance on NTFP) of respondents. Finally, we asked how they perceived conservation norms were enforced in the surrounding forests and how many percent of their land received a land paper during the last land titling campaign.

3 Results

3.1 Perception of forest conservation values

The values of forest conservation quoted by respondents are diverse and cover a broad range of the value types of the Total Economic Value approach (Pascual et al. 2010): we obtained 10 categories that correspond to direct-use values, indirect-use values and non-use values (table 1). In both control and treated groups, the most quoted values are related to climate regulation for agriculture (regular rainfall, no flood or drought events), timber for house construction and NTFPs for sale. Overall, direct-use values are the most frequent. These results reflect the fact that people's livelihoods are based on subsistence strategies that are closely dependent on forest use.

Besides, these values are characterized by different levels of autonomy and can be classified according to three types of motivations following to Ryan and Deci's typology (see table 1):

- *External regulation (ER)*: protection is reported to be important in order to satisfy an external demand such as for landscape beauty or leisure (ecotourism) and the selling of forest products such as timber, non-timber forest products and wildlife.
- *Identification (ID)*: these values are linked to key life subsistence needs such as family food security, shelter and health. They encompass both consumptive use of forest products (food, construction timber) and regulation services for subsistence agriculture and quality of life (soil fertility, local climate regulation).

- *Intrinsic motives (INTR)*: inherent satisfaction to know that these resources will be available for future generations or the satisfaction derived from knowing that wildlife exists (protection of habitat).

Confirming the above results, ID motives are the most frequently quoted in both groups. These results also suggest that although elicited values are dominantly self-regarding (both ER and ID motives), some of them, the most closely linked to subsistence goals (ID motives) might involve some degrees of autonomy. We will keep the motivation classification for the rest of the paper.

Table 1

Attitudes towards the benefits of conservation and typology of benefits. Frequency analysis of benefits

Benefit	**Control**		**Treated**		**Classification TEV**			**Classification Ryan and Deci (2000)**		
	N	***%***	***N***	***%***	**Types**	**Control**	**Treated**	**Types**	**Control**	**Treated**
NTFPs	45	13%	115	20%	Direct-use value	48%	53%	EXTERNAL REGULATION	19%	27%
Luxury wood	16	5%	8	1%						
Wildlife hunting	4	1%	13	2%						
Ecotourism	1	0%	21	4%						
Food & medicine	21	6%	21	4%						
Timber for housing	79	23%	127	22%						
Soil fertility	29	8%	69	12%	Indirect-use value	31%	36%	IDENTIFICATION	68%	62%
Climate regulation	106	31%	137	24%						
Next generation	25	7%	42	7%	Non-use value	13%	11%	INTRINSIC	13%	11%
Wildlife habitat	20	6%	22	4%						

3.2 Impact of the Conservation Agreements on motivations

Matching allowed us to improve the reconstruction of two groups of treated and control individuals with similar preexisting characteristics and who had been evenly affected by contemporaneous factors. In this framework, we assessed the impact of the CA program on the perception of conservation values by directly comparing the average outcomes of these two groups. More specifically, we used a Mann Whitney U test[9] to assess whether the individual sums of weighted scores for each type of motive were significantly different between the two matched groups (results are in table 2).

Table 2

Impact of the conservation agreement program on motivations to conserve, classified by type of motivation. Mann Whitney U test for each motivation score between matched control (participant) and treated (non-participant) groups of households.

	Mean Control	***Mean Treated***	**Mann Whitney U test**
INTR	0.74	0.74	W = 4736, p-value = 0.9223
ER	0.74	1.81	W = 3344.5, p-value = 0.0001812***
ID	5.75	4.80	W = 5480.5, p-value =0.04397 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

We find that the scores for ER motives were significantly higher and scores for ID motives were significantly lower in the treated group when compared to the control group. On the other hand, we did not find any significant difference for INTR motives between matched participants and non-participants.

Overall, our results suggest that the CA emphasized economic motives and undermined subsistence motives.

3.3 What aspects of PES matter?

This section aims at identifying what mechanisms have influenced the differences in motivations betwenn control and treated groups. To this aim, we assess which aspects of the payment scheme influenced the probability to be ER-motivated, the overrepresented motive[10].

The level of individual benefits received from the scheme seems to be instrumental in explaining differences in motivations between ER and non-ER individuals. More specifically, the level of benefits was significantly higher amongst ER-motivated people when compared to the other two groups (Mann Whitney U test in table 3a). In addition, benefits received from the scheme

[9]Non-parametric test that assess whether the population mean rank of two groups differ. This is an efficient alternative to Student's t-tests in case data are not normally distributed and variances are not equal.

[10] We created a binary variable according to whether respondents had dominant economic motives (the overrepresented motive) or not (encompassing the two underrepresented motives, subsistence and social).

significantly positively influenced the log odds of being economically motivated (backward/forward stepwise logistic regression in table 3b). It is worth stressing that this variable encompassed the individual in-cash benefits linked to the participation in community patrolling (money perceived) and the monetary value of in-kind benefits that aim at inducing the abandonment of slash-and-burn systems (borrowing the community mechanical mule and juvenile buffaloes received from the buffalo bank).

In addition, none of the variables intended to capture the perception of the message conveyed by the scheme and the perception of the PES management practices happened to be significant. The level of benefits was the only significant variable that was directly linked to the payment scheme and the perception of scheme management did not seem to explain differences in motivations. These extra variables were aimed at potentially revealing mechanisms such as disappointment linked to bad news regarding the CA managers' intentions (e.g. lack of distributive fairness) or control aversion (due to high enforcement pressure associated with the CAs).

Finally, the results also suggested that the broader institutional context might also significantly influence motivations. Indeed, ER-motivated people had a smaller share of their upland fields that received a land title and also perceived higher levels of threats on surrounding natural resources.

Table 3

Statistical tests on the socio-economic, PES-related and context-related explanatory variables for the binary variable "dominant ER motive" (dependent variable): (a) Mann Whitney U test and (b) logit forward/backward stepwise regression model.

(a) Mann Whitney U test

Explanatory variable	**Mean Non-ER**	**Mean ER**	**Mann Whitney U test results**
average_age	40.38	40.81	W = 3248.5, p-value = 0.9536
average_grade	2.17	1.93	W = 3481, p-value = 0.508
average_settle_year	1998.9	1999.4	W = 3365.5, p-value = 0.7651
NTFP_revenue_Riels[11]	5201168	6070581	W = 2722, p-value = 0.08557 .
total_land_Ha	8.02	8.77	W = 2936.5, p-value = 0.3107
Benefits_Riels	616447	1043954	W = 2255, p-value = 0.001925 **
average_mark	68.32	66.31	W = 3351.5, p-value = 0.5728
Pressure_likert	0.91	0.9	W = 3299, p-value = 0.9252
average_fairness_likert	2.45	2.33	W = 3873.5, p-value = 0.05678 .
nb_meeting_conservation	4.81	4.98	W = 3193, p-value = 0.8185
impact_norm_likert	2.14	2.56	W = 2175.5, p-value = 0.0007848 ***
land_tenure_percent	54.39	30.23	W = 3978.5, p-value = 0.01309 *

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

(b) Logit regression model

	Coefficients	**Estimate Std. Error**	**z value**	**Pr(>|z|)**
(Intercept)	-2.946e+00	0.7307	-4.032	5.53e-05 ***
Benefits_Riels	3.937E-07	1.838E-07	2.142	0.03221 *
Impact_norm_likert	0.6658	0.2533	2.629	0.00857 **
Land_tenure_percent	-5.625e-03	0.003973	-1.416	0.15682

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

3.4 Environmental effectiveness

In order to assess whether the impact of the scheme on both ID and ER motives had implications both in terms of short term and long term environmental effectiveness, we compared the level of reported rule-breaking behaviors between two groups of participants, one with dominant ER motives and the other with both ID and INTR dominant motives. We focus on two types of

[11] 1 USD is equal to about 4000 Cambodian Riels

behaviors, i.e. the opening up of new upland fields in pristine forest on the one hand, and wildlife poaching or luxury wood logging for sale on the other hand because they illustrate the two main economic-drive behaviors. We also looked at two different periods of time, i.e. while the scheme was running (number of years they broke conservation rules over the past 8 years) and if the payments stopped (binary variable that reflected whether they would break conservation rules for sure, or not, next year).

We find three main results. First, we do not find any significant differences between the ER-motivated group and the other two motivation groups (INTR and ID) in terms of rule compliance while the scheme was still running (results of the Mann Whitney U test in table 4.a). Second, having dominant ER motives significantly explain the odds of breaking rules related to illegal trade of forest products, i.e. luxury wood logging and wildlife poaching for sale, if payments stopped (results of the Pearson's Chi Square test in table 4.a and the logit forward/backward regression in table 4.b). Third, being ER-motivated does not significantly explain the probability of opening up new upland fields if payments stopped. Overall, while being ER-motivated does not seem to influence rule-breaking behaviors as long as the scheme is still running, the results showed that these same people reported that they would break some of the conservation rules (participation in illegal trades) significantly more than the other two groups if the scheme stopped.

It is also worth noting that the logit model shows that the socio-economic characteristics of households (age, level of income from NTFPs and year of settlement) and the level of land tenure security also significantly influenced the odds of complying with conservation rules if the payment stopped. This result suggests that the motivation effect on behaviors might be mitigated by other personal and contextual characteristics.

Table 4

Compliance with conservation rules (participation in illegal trade such as wildlife poaching and luxury wood logging, opening up of illegal upland plots) per type of motivation type (binary variable ER) during CA implementation and if the CA stopped. (a) Mann Whitney U test for the non-compliance with conservation rules (number of years they broke the rules since the CAs started) between economic and non-economic participants. Chi-squared test for the non-compliance with conservation rules (binary variable: intention to break the rule or not) between ER and non-ER participants. (b) Logit forward/backward stepwise regression model of explanatory variables for the compliance with conservation rules (dependent variables: binary variables, participation in illegal trades and opening up of illegal upland plots if payments stopped).

(a) Chi-squared test and Mann Whitney U test

Behavior	During				After				
	Non-ER	ER	Mann Whitney U test	Illegal acts	Non-ER		ER		Pearson's Chi-squared test
	Mean nb years	Mean nb years			N	%	N	%	
Participation in illegal trades	2.26	2.65	W = 2992.5, p-value = 0.3427	NO	128	84.2	27	62.8	X-squared = 9.4316, df = 1, p-value = 0.002133 **
				YES	24	15.8	16	37.2	
Opening up of illegal upland plots	0.71	1.18	W = 2943, p-value = 0.1592	NO	141	92.8	26	83.7	X-squared = 3.2708, df = 1, p-value = 0.07052 .
				YES	11	7.2	7	16.3	

(b) Logit regression

		Coefficients	Estimate Std. Error	z value	Pr(>|z|)
Participation in illegal trades	(Intercept)	-1.99E+02	8.19E+01	-2.427	0.01521 *
	NTFP_REVENUE	2.20E-08	1.44E-08	1.524	0.1276
	PERCENT_CHAMKAR_TITLE	-9.68E-03	4.40E-03	-2.202	0.02768 *
	MONEY_bin[T.1]	1.17E+00	4.27E-01	2.739	0.00616 **
	AVERAGE_AGE	-3.98E-02	1.68E-02	-2.375	0.01756 *
	AVERAGE_SETTLE	9.94E-02	4.09E-02	2.431	0.01504 *

	(Intercept)	0.67737	0.92822	0.73	0.46554
Opening up of illegal upland plots	PERCENT_CHAMKAR_TITLE	-0.03444	0.01319	-2.611	0.00904 **
	AVERAGE_AGE	-0.06179	0.02632	-2.348	0.01888 *

4 Discussion

4.1 Is motivation crowding-out happening?

Our study concluded that the CA emphasized the perception of economic motivations and undermined subsistence-based motivations to conserve. However, jumping to the conclusion that the scheme led to some kind of motivation crowding requires further discussion.

The type of motivation change we evidenced is consistent, although it takes a different form, with what has been dealt with in the literature on motivation crowding applied to economic incentives for biodiversity conservation. On the one hand, scholars have generally emphasized the negative effect of economic incentives on other types of motives such as social preferences (guilt, reciprocity, etc.) and "genuine" intrinsic preferences (respect of wild animals)(Cardenas 2004; Rodriguez-Sickert, Guzmán, and Cárdenas 2008; Rico García-Amado, Ruiz Pérez, and Barrasa García 2013). In our case, the CA seem to have eroded values associated with *identification* motives. If we refer to the taxonomy of motivations (Ryan et Deci 2000) as well as the definition of motivation crowding (Frey and Jegen 2001), we argue that the effect we found can be conceptualized as some kind of motivation crowding because these motives are associated with high levels of autonomy (higher than most social motives). On the other hand, the emphasis on ER motives is generally directly associated with the payment scheme, i.e. the money received from the scheme. In our case, ER motives are associated with other market signals for forest commodities and amenities. This result might be linked to the characteristic of the scheme: an asset-building project in which the importance of the monetary incentive is limited.

Moreover, our research design to estimate the impact of the CA on motivations to conserve relies on strong assumptions that are to be discussed. Indeed, one inherent assumption to matching is that "*Matching assumes that similarity in observable characteristics translates into similarity in unobservable characteristics correlated with the outcome and the policy assignment*" (Miteva, Pattanayak, et Ferraro 2012). However, it is not always the case because of missing data related to important cofounding variables (political, institutional preexisting socio-economic characteristics). For this reason, the preferred method to compare outcomes and estimate impacts is to combine matching with a before-after-control-intervention comparison (BACI). However, in our particular case, we did not have access to motivation data at landscape level prior to project implementation so that we had to rely on a with–without comparison of outcomes. We mitigated the risk of hidden bias by selecting our control variables based on an accurate qualitative understanding of local dynamics of the placement of the CAs and changes affecting behaviors and motivations. Having access to baseline data on motivations or at least preexisting data on a broader range cofounding variables at landscape level would have been critical to improve the accuracy of our results.

4.2 The CA changes the behavior of people towards the forest

Frame shifting is a concept that is sometimes used to explain motivation crowding. It refers to situations where the payment scheme provides new information about the decision situation framing the target behaviors, which subsequently alter the underlying motives. In some cases, "*the focus on economic reasoning can be such that it changes mindsets and values*" of beneficiaries (Rode, Gómez-Baggethun, et Krause 2013). We argue that this concept provides a consistent interpretation of the mechanism underlying motivation changes we evidenced.

On the one hand, we show that the changes in motivations are consistent with the project's philosophy and the way it intends to modify people's use and relationship with the forest. We argue that the CA provided two kinds of new information about the use of forest. First, the CA strategy is based on a land-sparing approach, which promotes a shift in people's livelihoods so that they rely less on forest use for subsistence (van Noordwijk et al. 2012). In practice, the main three rules attached to the CAs require people to stop a number of forest-related activities and agricultural practices: shifting cultivation or opening up of new fields, poaching and selective logging for commercial purposes. In addition, CI promotes a number of alternative livelihoods that are less closely connected to the forest, such as lowland rice cultivation and permanent or shorter-rotation upland fields (usually used for cash crops and relying less on forest for soil fertility renewal). Second, CI seems to have contributed to framing the use and conservation of forests in terms of "cash generation" and so probably reinforced the monetary framework. Community patrolling is clearly perceived as a supplementary source of income and CI is regarded as an employer and these sentiments *"can jeopardize the notion of community participation, significantly ownership, and eventually affecting the effectiveness and sustainability of a project*" (CI review of the CAs). The project also promotes the collection of NTFPs, which main purpose is to generate income and also introduce ideas such as a well-preserved forest would be suitable for ecotourism - which can in turn generate employment and benefits for local communities.

On the other hand, we showed that the level of benefits received at the individual level is the only variable that significantly explains the motivation change, and more specifically becoming ER-motivated. The interpretation of this result is twofold. First, in some cases, the project mechanically modified people's livelihoods through the provision of in-kind incentives. For example, people who cultivate lowland rice (more than 0.25 Ha) received significantly more benefits, including in particular access to agricultural equipment. However, it seems that these changes remain marginal. For example, CI reports that the number of people growing lowland rice rose in the early years of implementation, falling thereafter so that people still rely to a large extent on shifting cultivation. In addition, ecotourism has not really occurred yet. Thus, changes in motivations may have also been induced through the messages delivered by project staffs during the project implementation. These messages may have been interpreted as indicating the socially desirable behavior to be followed.

4.3 Implications for long term forest and biodiversity conservation programs

Motivation crowding effect might remain hidden while payments are still running because the effect on the costs and benefits of the target activity might overweight or complement the effect of changes on motivations (Bowles et Polanía-Reyes 2012). Our results seem to confirm this assumption. Indeed, ER-motivated people do not break conservation rules significantly more than

other motivation groups when payments are still running. We postulate that access to payments modifies the relative utility of target activities (forest protection and restoration of lowland rice fields vs. extraction of forest products and opening of new land) so that complying with conservation rules may become more worthwhile than conducting illegal activities. This is a complex issue that deserves further research and should not only take into account the costs and benefits of target activities but also the influence of different types of risk aversion on decisions (e.g. being caught while conducting illegal activities, falling sick or being injured while working in the forest, having crops destroyed by wildlife, etc.).

Rather, our results suggest that changes in the perception of forest conservation values' might have implications for the long-term effectiveness of the program. This takes the form of an increased level of ER-motivated people reporting lower levels of future compliance for some conservation rules – extraction of illegal products- as compared to the other two motivation groups in a scenario where the program would come to an end.

We argue that ER-motives are more receptive to external regulations that take the form of economic or price signals, which rarely integrate environmental concerns in the Cambodian context (ecotourism has not really occurred yet). In the absence of benefits from the CAs, they would thus be more prone to respond to such signals as middlemen offering a high price for luxury wood or wildlife, because they value conservation only if it provides them with more economic benefits. Besides, ER-motives also follow a "maximizing logic" so that they tend to have higher extraction levels.

ID-motivated people do not tend to open up significantly more upland plots for subsistence-rice production, although slash-and-burn systems are also the most efficient way to produce rice (higher yields, low labor requirements). We argue that ID-motives, even is self-regarding, are associated with a "satisfying logic": ID-motivated people probably expect that their basic needs in rice for family consumption will be satisfied. Besides, the fact that ID-motives are also more autonomous might also explain this result. Indeed, these people value benefits of forest that are more integrated with their livelihoods and that rely on a standing and healthy forest, which constitutes the basis for self-interest for sustainable management of the resource (Ostrom et al. 1999). This result might be linked to existing debates around the link between poverty and conservation (Barrett, Travis, et Dasgupta 2011).

5 Conclusion

In this paper, we have shown that the conservation agreement program, which is one type of Payment for Ecosystem Services scheme, had a significant effect on the participants' individual perception of the use values of forest conservation. Indeed, it highlighted values linked to the generation of cash and that are driven by market demand, and undermined values linked to subsistence goals, such as family food security, health and shelter. We argue that in the context of poor forest dwellers, the perception of use value is closely linked to motivations to conserve, as these values are generally intimately linked to a number of key life goals. We further link this result to the literature on motivation crowding because it consists in emphasizing externally regulated motives (ER) and reducing motives with a higher degree of autonomy (with strong identification through key life goals, ID). This aspect has rarely been discussed in the literature on economic

incentives, which has generally focused on pro-social motives, such as guilt or reciprocity and genuine intrinsic motivations (the love of nature).

Our results also suggested that this effect deserves further attention because of its effectiveness implications. Indeed, respondents with dominant ER motives reported lower levels of compliance with key conservation rules, as compared to those reporting dominant ID motives. This is significant for practices that are directly linked to the generation of cash (poaching and logging of luxury wood) and only in the event that payments stopped. We suggest that ID-motivated people have more "intrinsic" reasons to conserve the resource sustainably as compared to ER-motivated people. The latter were more receptive to price signals, which rarely integrated environmental concerns in the Cambodian context (ecotourism had yet to really occur) while the former just needed to reach a minimum level of basic need satisfaction and valued a number of benefits that were integrated with their life goals and that were based on a standing and healthy forest.

In addition, we also showed that the level of benefits people received at individual level was the only aspect of the CA that significantly influenced these differences in motivations. We postulate that exposure to PES and its benefits changed the decision-situation frame regarding forest use by emphasizing "segregation" between livelihoods and forest use and the role of forest resources in contributing to family income. This eventually changed the preexisting relationship between people and the forest and in turn the perception of values of forest conservation.

Our research also allowed us to give thought to methodological challenges in measuring motivation crowding. Our research design was based on a with-without method, and used a matching method that enabled us to check for a number of biases and discard alternative explanations for observed changes in motivations. However, we also explained that missing data about preexisting socio-economic characteristics of households increased the risk of hidden bias associated with the distribution of different preexisting motivations in both the treated and control groups. Collection of baseline data, at least on cofounding variables and ideally directly on motivations, is key to improving the quality of such impact methods.

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8 Appendix

Appendix 1

List of treated and control villages. Treated villages encompass all villages where conservation agreements have been implemented. Control villages encompass the whole list of matched villages, obtained with propensity score matching. The last column shows whether a given village was discarded or not for the household survey.

	Province	District	Commune	Village	State / survey
Treated villages (CI)	Koh Kong	Thma Bang	Ta Tey Leu	Spean Kdar	YES
	Koh Kong	Thma Bang	Ta Tey Leu	Kandal	YES
	Koh Kong	Thma Bang	Ta Tey Leu	Trapeang Khnar	YES
	Koh Kong	Thma Bang	Pralay	Chamnar	YES
	Koh Kong	Thma Bang	Pralay	Pralay	YES
	Koh Kong	Thma Bang	Pralay	Samraong	YES
	Koh Kong	Thma Bang	Pralay	Toap Khley	YES
	Koh Kong	Thma Bang	Chumnoab	Chumnoab	YES
	Koh Kong	Thma Bang	Chumnoab	Chrak Ruessei	YES
	Koh Kong	Thma Bang	Thma Doun Pov	Kaoh	YES
	Koh Kong	Thma Bang	Thma Doun Pov	Preaek Svay	YES
	Koh Kong	Thma Bang	Ruessei Chrum	Trapeang Chheu Trav	NO
	Koh Kong	Thma Bang	Ruessei Chrum	Kokir Chrum	NO
	Pursat	Veal Veaeng	Ou Saom	Ou Saom	NO
	Pursat	Veal Veaeng	Ou Saom	Kandal	NO
	Pursat	Veal Veaeng	Ou Saom	Chhay Louk	NO
	Pursat	Veal Veaeng	Ou Saom	Kien Chongruk	NO
Control villages	Pursat	Veal Veaeng	Krapeu Pir	Krapeu Pir Leu	YES
	Pursat	Veal Veaeng	Krapeu Pir	Krapeu Pir Kraom	YES
	Pursat	Veal Veaeng	Pramaoy	Tumpor	YES
	Pursat	Phnum Kravanh	Samraong	Roveang	YES
	Pursat	Phnum Kravanh	Samraong	Mong Ry*	YES
	Battambang	Samlout	Kampong Lpov	Stueng Touch	NO
	Koh Kong	Kaoh Kong	Ta Tai Kraom	Kaoh Andaet	NO
	Koh Kong	Kaoh Kong	Ta Tai Kraom	Anlong Vak	NO
	Koh Kong	Mondol Seima	Pak Khlang	Kaoh Pao	NO
	Pursat	Veal Veaeng	Thma Da	Kandal	NO
	Pursat	Veal Veaeng	Thma Da	Sangkom Thmei	NO

* Administratively, Mong Ry is part of Roveang. However it is a separate significant human settlement which is located about 12 km away from Roveang

Appendix 2

Balancing statistics and tests for propensity score matching for (a) the matched and unmatched samples of villages and (b) the matched and unmatched samples of households. Statistics include the means of each group, the mean difference between control and treated groups for both the matched and unmatched data, and the percentage of balance improvement in mean difference between unmatched and matched samples.

(a) Village level: formula = Treat_CI~FC_2006+density_2006+access_JICA_2+slope+fertility_danida+pop_increase+net_deforest_2002_2006, method = "nearest"

Covariates	*Mean treated*		*Mean control*		*SD control*		*Mean difference*		*% balance improvement Mean Diff.*
	Unmatched	*Matched*	*Unmatched*	*Matched*	*Unmatched*	*Matched*	*Unmatched*	*Matched*	
Forest cover 2006 (Ha)	65889054	65889054	46625397	65662922	25695411	14289401	19263656	226132	99%
Population increase 2006-2011 (%)	144	144	149	149	113	52	-6	-5	4%
Population density 2006 (HH)	90	90	1665	129	1931	66	-1575	-38	98%
Accessibility to secondary road (min)	101	101	33	85	44	73	69	16	76%
Soil fertility (Ha)	11176030	11176030	29004473	5904922	34590511	19584412	-17828443	5271108	70%
Slope < 7% (Ha)	42180798	42180798	63450468	42239879	13485371	13785350	-21269669	-59080	100%
Net deforestation 2002-2006 (Ha)	-667877	-667877	-7195426	329123	10723674	5792315	6527549	-997000	85%

(b) Household: formula = - treat_CI ~ AVERAGE_AGE + AVERAGE_grade + AVERAGE_SETTLE + PERCENT_CHAMKAR_TITLE, data = villages_all, method = "nearest", discard = "both", caliper = 0.2

Covariates	*Mean treated*		*Mean Control*		*SD control*		*Mean Diff*		*% balance improvement mean diff.*
	Unmatched	*Matched*	*Unmatched*	*Matched*	*Unmatched*	*Matched*	*Unmatched*	*Matched*	
Age	40.48	39.52	39.19	39.61	12.32	12.01	1.29	0.51	92.41
Education	2.12	3.37	3.83	3.40	2.49	2.30	-1.71	0.34	97.89
Year_settlement	1999.05	2000.22	2000.45	2000.36	9.14	9.20	-1.40	0.77	90.46
percent_land_title	49.06	61.00	62.33	60.37	46.65	47.12	-13.27	1.09	95.26