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Environmental motivations in an ongoing PES program in the Colombian Amazon

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Abstract

Payments for Ecosystem Services (PES) are often regarded as incentive-based environmental policy programs that can potentially “crowd out” participants’ intrinsic conservation motivations. However, conservation motivations may also coexist and reinforce each other under certain program designs, implementation practices and household contexts. In contrast to studies focusing on post-program persistence, this article examines motivational dynamics while incentives are active. We study whether reported intrinsic and extrinsic motivations move in opposite directions or coexist among households enrolled in Colombia’s Amazon Forest Incentive Program (IFA) in a high-deforestation risk region during the study period. Using two-wave panel survey data (2022–2023) from 144 program participants and 43 eligible non-participants of an ongoing program, we relate within-household changes in motivations to three exposure measures: participation status, the number of payments received, and the share of PES payments relative to household income. Participation was associated with stronger guilt-related motivation, while a higher payment-to-income share (payment salience) was associated with stronger intrinsic motivations linked to self-image, identity, and moral responsibility. The number of payments received showed weak and inconsistent associations with intrinsic motivations. Higher payment salience was also associated with greater recognition of payments as a conservation incentive without evidence of displacement of intrinsic motivations over the study period, supporting a coexistence

interpretation rather than a simple trade-off. Overall, the results highlight associations between payment salience, structural context, and motivational dynamics.

Keywords

Payments for ecosystem services, motivational crowding, pro-environmental motivations, design of payments.

Highlights

- We investigate how PES design and implementation relate to conservation motivations in a short period.
- Disaggregated motivation measures reveal crowding-in of moral and identity-related motivations under salient payments.
- Larger payment-to-income ratios are associated with stronger intrinsic conservation motivations.
- Intrinsic and extrinsic motivations can coexist in PES, with payment salience influencing their dynamics.

1. Introduction

Payments for Ecosystem Services (PES) are widely used policy instruments to promote conservation by compensating landholders for providing ecosystem services such as forest cover, carbon sequestration, and watershed protection. Since their expansion in the late 1990s, PES programs have been implemented across diverse institutional and ecological contexts, particularly in Latin America, with substantial variation in contract duration, payment structures, targeting strategies, and governance arrangements.

Evidence of the environmental effectiveness of PES remains mixed. While some programs have achieved modest conservation gains, particularly in areas facing high land-use pressure (Charoud et al., 2024; Costedoat et al., 2015; Jayachandran et al., 2017), others showed limited impacts or low additionality relative to program costs (Alix-Garcia et al., 2012; Aspelund & Russo, 2025; Robalino et al., 2008; Robalino & Pfaff, 2013; Saint-Cyr et al., 2023). This heterogeneity has been attributed in part to differences in program design and implementation, including conditionality, monitoring, targeting, and payment structures (Wunder et al., 2018). Systematic and qualitative reviews of PES social outcomes also reflect

mixed outcomes in terms of poverty alleviation, income, material wellbeing, local governance, or justice considerations, with some studies noting largely neutral or positive outcomes for some PES programs, and other studies documenting mostly negative outcomes (Corbera & Izquierdo-Tort, 2023).

A growing body of scholarship has raised concerns about the possibility of PES foreclosing participants' pro-environmental motivations. Studies have hypothesized or shown that monetary incentives may crowd out intrinsic motivations to conserve, potentially undermining conservation behaviors once payments are introduced or over time (Ezzine-de-Blas et al., 2019; Grillos et al., 2019; Lliso et al., 2020; Moros et al., 2019; Rode et al., 2015; Wunder et al., 2020). These concerns draw on foundational work on motivational crowding and the "hidden costs" of incentives (Frey, 1993, 1994; Titmuss, 1970), which can erode social norms and other-regarding preferences that support collective conservation (Bowles, 2008; Cárdenas et al., 2000).

The interaction between monetary incentives and intrinsic motivations is theoretically ambiguous and empirically underexplored. Incentives may crowd out, crowd in, or interact synergistically with intrinsic motivations depending on program design and context (Ezzine-de-Blas et al., 2019). Yet, most empirical studies examine PES impacts at a single point in time or after program completion, and few explicitly analyze how payment design characteristics, such as payment frequency and saliency, shape motivational dynamics during program implementation. This paper makes two contributions. First, we study motivational crowding effects within an ongoing PES program, allowing us to observe how intrinsic and extrinsic motivations evolve while payments are actively being delivered. Second, we examine how payment design features, particularly the frequency of payments and their saliency relative to household income, are associated with disaggregated intrinsic and extrinsic motivational responses. In our empirical approach, these payment characteristics capture variation in the PES design, while motivational responses are measured through self-reported intrinsic and extrinsic motivations derived from a survey grounded in Self-Determination Theory (SDT). This allows us to link variation in incentive design to changes in specific motivational dimensions during program implementation. By focusing on this relationship within an ongoing PES program in Colombia's northern Amazon, we advance our understanding on

motivational crowding in the context of PES.

2. Driving factors for motivational crowding in PES settings

2.1 Conceptualizing motivational crowding in PES

We distinguish between motivational crowding, which refers to changes in the level or composition of intrinsic and extrinsic motivations due to the introduction of an external incentive, and behavioral crowding, which refers to changes in observable behavior attributable to motivational shifts beyond the direct incentive effect (Table 1). Motivational crowding has been widely studied in psychology, especially within the tradition of SDT and related work on educational and work motivation (Amabile, 1993; Deci, 1971, 1975; Deci et al., 1999; Lepper et al., 1973; Ryan & Deci, 2000). In parallel, the discussion of behavioral crowding is rooted in economics and behavioral economics (Fehr & List, 2004), with empirical work showing how external rules or incentives can erode pro-social behaviors (Gneezy & Rustichini, 2000a), and cooperation for the provision of a public good (e.g. Cárdenas, et al., (2000). In the particular context of PES, the need to disentangle motivations from behaviors has been emphasized, recently, by Ezzine-de-Blas et al., (2019); Moros et al., (2019) and Vorlaufer et al., (2025).

In terms of operationalization, a clear distinction has been proposed: while behavioral crowding is most cleanly assessed after incentives end, motivational crowding can be measured during PES implementation through changes in self-reported motivations. Importantly, coexistence or complementarity between intrinsic and extrinsic motivations is theoretically possible during the payment period (Ezzine-de-Blas et al., 2019; Festré & Garrouste, 2015; Moros et al., 2019; Vorlaufer et al., 2025).

Table 1. Types of crowding and its typical operationalization.

Type of Crowding	Definition	While the incentive is being delivered (e.g. during PES implementation)	Once the incentive is interrupted (e.g. after PES concludes)

Motivational	A change in the level or composition of motivational orientations (e.g., more autonomous/intrinsic vs more controlled/extrinsic motives) triggered by the presence or framing of an external incentive.	Can be observed as changes in self-reported motivations while payments are active (e.g., shifts in identity, moral responsibility, guilt, or increased recognition of payments as an incentive). Coexistence/complementarity is possible (extrinsic recognition rises without a decline in autonomous motives).	Can be observed as persistence (or reversal) of motivational orientations after payments end (e.g., autonomous motives remain lower/higher than pre-program or counterfactual), ideally measured with post-program surveys.
Behavioral	A change in observable behavior attributable to motivational shifts induced by incentives (beyond the direct price/incentive effect). Often discussed as whether behavior is lower/higher than an appropriate counterfactual once incentives are removed.	Hard to identify because observed behavior reflects the net effect of (i) the incentive and (ii) any motivational change; behavioral crowding during payments is only detectable if motivational effects are strong enough to offset the incentive.	Assessed by comparing behavior after incentives end to a pre-program baseline or counterfactual (e.g., persistence of conservation, or rebound/backsliding). This is the classic setting to test behavioral crowding-out/in.

Source: Authors, based on Ezzine-de-Blas et al., (2019); Festré & Garrouste, (2015); Moros et al., (2019); Vorlaufer et al., (2025).

Prior empirical research in PES has focused mainly on behavioral crowding. This literature indicates PES programs are more likely to exert a negative influence on conservation behaviors when framed in ways that commodify nature, erode social relations, or undervalue local people's ecological knowledge (Ezzine-de-Blas et al., 2019; Rode et al., 2015). Conversely, several complementary design and implementation features have also been shown to support behavioral crowding out. These include participatory rule-setting and flexibility in resource-use regulations (Akers & Yasué, 2019), culturally attuned program framing (Lliso et al., 2020; Maca-Millán et al., 2021), and fostering dialogue within

participating communities (Andersson et al., 2018). Additionally, incorporating non-monetary incentives or collective benefits (Agrawal et al., 2015; Kaczan et al., 2017; Moros et al., 2019), offering complementary support such as technical assistance or environmental education (Garbach et al., 2012; Jones et al., 2018), and ensuring the equitable distribution of program benefits (Ezzine-de-Blas et al., 2019) have likewise been identified as mechanisms that may reinforce conservation behaviors.

Empirical evidence on motivational and behavioral crowding in PES scholarship documents cases of crowding-in, crowding-out, and null effects (Grillos et al., 2019; Kerr et al., 2012; Vorlauffer et al., 2023, 2025). However, much of this evidence focuses on post-program persistence or behavioral outcomes, implicitly treating crowding as something that materializes only after incentives are withdrawn. This can be explained by the fact that identifying behavioral crowding during implementation is inherently difficult because observed behavior reflects the combined influence of incentives and motivational change (Vorlauffer et al., 2025).

In this paper, we focus on motivational crowding while the incentive is being delivered. We do not explore behavioral crowding because we lack data on conservation behaviors over time from participating and non-participating individuals.

2.2 Payment structure as a driver of motivational dynamics

PES payment structures vary widely across programs, including differences in payment mode, amount, differentiation, duration, and contract length (Adhikari & Boag, 2013; Engel, 2016). These features are typically determined by local operators, such as NGOs or regional environmental authorities, who adapt the payment mechanisms to suit local contexts, preferences, and administrative constraints. However, these features may also shape motivational dynamics by influencing how incentives are perceived and interpreted by program participants. Two recent global reviews on PES and motivations report either no systematic relationship between payments and motivational or behavioral crowding, or a higher incidence of crowding-in rather than crowding-out (Akers & Yasué, 2019; Huang et al., 2024; Vorlauffer et al., 2025). Although these reviews differ in their selection criteria and

method of analysis, they suggest that crowding-in is just as possible as crowding-out, depending on the specificities of each case study. Importantly, they also identify inconclusive results on the effect of program design issues such as the type of payments (in-kind or monetary), often depending on methodological elements such as sample size and framing of the studies.

Psychological theory challenges the assumption that extrinsic incentives necessarily undermine intrinsic motivation. Certain types of extrinsic motivators can combine synergistically with intrinsic motivations, particularly when incentives are perceived as supportive or informational rather than controlling (Amabile, 1993). Beyond a simple trade-off, incentives may interact with other motivational drivers in complementary ways, producing synergy rather than displacement, as shown in evidence on policy mixes combining incentives and nudges (Drews et al., 2020). Importantly for PES, recent work based on semi-structured interviews, documents that monetary incentives can be embedded within a “fabric” of plural values in which instrumental motives co-occur with relational and intrinsic motivations such as stewardship (“with or without payment I conserve”), suggesting complementarity rather than a strict trade-off (Arias-Arévalo et al., 2025). Experimental evidence also indicates that how PES are framed (e.g., instrumental vs relational value frames) can shape motivational responses, in ways that are consistent with the absence of systematic crowding out and with the coexistence of motivational drivers (Lliso et al., 2022).

Payment magnitude and differentiation play a central role in how incentives are perceived. Uniform payments that ignore heterogeneity in opportunity costs among providers may undermine intrinsic motivations by generating perceptions of unfairness or misalignment between effort and reward (Ezzine-de-Blas et al., 2019). At the same time, the relationship between payment magnitude and motivation is not monotonic (Gneezy & Rustichini, 2000b). This means that while very low incentives may discourage participation or crowd-out intrinsic motivation, appropriately structured payments can enhance program legitimacy and perceived fairness when they better reflect the environmental benefits delivered. Evidence from PES auctions shows that payment rules which more closely approximate providers’ costs – such as uniform-price mechanisms that reduce strategic bidding – can improve value for

money while also fostering perceptions of procedural fairness among participants (Balmford et al., 2023). More broadly, natural-capital approaches argue for aligning payments with the social value of ecosystem service outcomes rather than uniform activity-based rates, as benefit-reflective pricing can substantially increase efficiency and policy effectiveness (Day et al., 2024). From this perspective, higher payments are not inherently unproductive for motivation; rather, their motivational implications may depend on whether payment levels and structures are perceived as proportional to both opportunity costs and the environmental benefits delivered, as well as their perceived fairness.

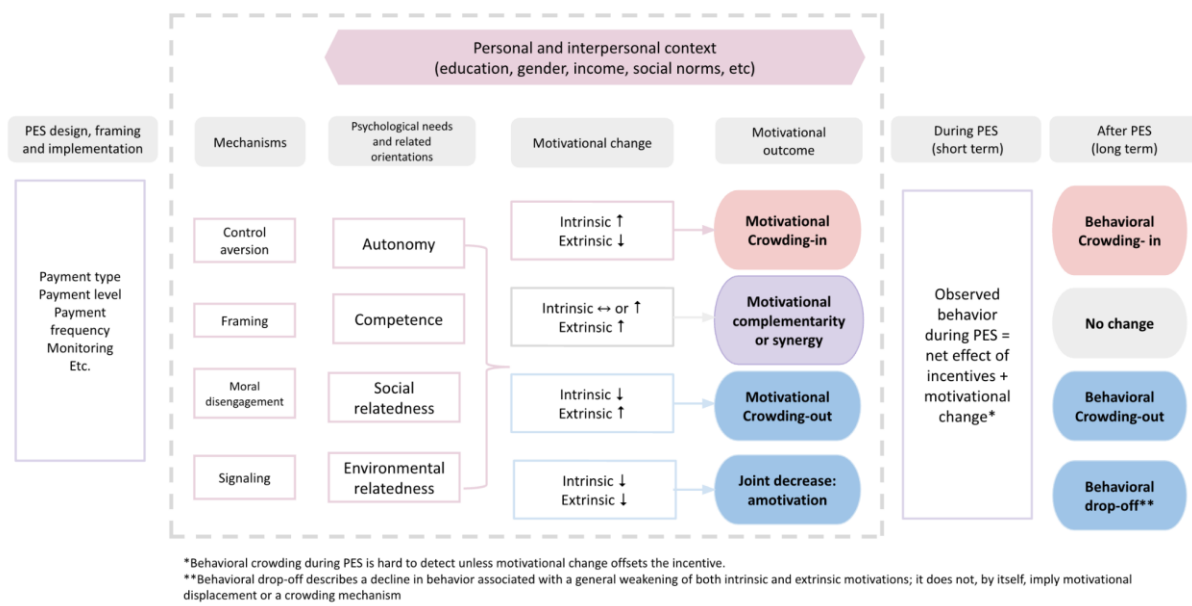
2.3 Theoretical framework and mechanisms

Our theoretical framework, in Figure 1, builds on Self-Determination Theory (Ryan & Deci, 2000) and its application in PES (Ezzine-de-Blas et al., 2019). It is structured around three main components: first, PES design, framing, and implementation—including payment type, level, and frequency, as well as monitoring and other implementation features—interact with personal and interpersonal factors (e.g., education, gender, income, and social norms); second, these features influence motivational dynamics through a set of psychological needs emphasized by SDT (autonomy, competence, and social relatedness), as well as broader relational orientations relevant to conservation settings (including environmental relatedness), and through several mechanisms identified in the crowding literature; third, motivational change during the payment period can translate into different “motivational trajectories”: shifts toward more autonomous motives (motivational crowding-in), shifts toward more controlled motives (motivational crowding-out), or stable coexistence/complementarity between autonomous and controlled motives. Behavioral crowding in the long term is then the observed result of motivational shifts due to the introduction and/or removal of an incentive.

Based on this framework, and the ongoing nature of the PES program we study, we operationalize motivational crowding as within-household changes in self-reported intrinsic and extrinsic motivations during program participation. We use land-use change outcomes as supplementary evidence, while recognizing that they cannot, on their own, disentangle incentive effects from motivational shifts during implementation. Building on previous

research (Bowles, 2008; Bowles & Polania-Reyes, 2012), we also identify four mechanisms through which incentives may influence motivations: signaling (“bad news” or recognition), framing (market versus civic interpretations of the situation), control aversion (the experience of external control undermining autonomy), and moral disengagement (rationalizing behavior in ways that weaken moral responsibility). In a PES context, these mechanisms may operate in opposite directions: payments and monitoring can be perceived as controlling or distrustful (making crowding-out more plausible), but they can also be perceived as recognition and support for valued stewardship (supporting coexistence or crowding-in), especially when the program aligns with local values and fosters legitimacy and fairness.

Figure 1. Theoretical framework: trajectories of motivational and behavioral crowding



Source: Authors, based on SDT theory, Bowles & Polanía-Reyes (2012), Ezzine-de-Blas et al. (2018) and Lliso et al. (2022).

To bring this framework into an empirical setting, we focus on payment design features as observable dimensions of the PES scheme, and on self-reported measures as indicators of intrinsic and extrinsic motivational orientations. By relating variation in these features to changes in specific motivational items along the SDT continuum, we assess whether different incentive configurations are associated with patterns consistent with crowding-out, crowding-in, or motivational coexistence. Specifically, we assess whether variation in

payment design features is associated with changes in intrinsic and extrinsic motivations in a longitudinally and contextually rich setting, testing whether:

H1: A higher number of payments and greater salience relative to household income are associated with stronger extrinsic motivations.

H2: Greater payment exposure is associated with a reduction in intrinsic motivations (motivational crowding-out), or alternatively with stable coexistence between intrinsic and extrinsic motivations during the payment period.

3. Case study and methods

3.1. Colombia's REDD+ strategy

Colombia is one of the most biodiverse countries in the world, with vast tropical forests. The country has over 60 million hectares (ha) of natural forests, covering 52.6% of its continental territory (MinAmbiente, 2018). About 25.5 million ha of land are under the ownership of ethnic (indigenous and afro-Colombian) and peasant communities, mainly in the Amazon, Pacific, and Orinoco regions. These communities have played a key role in forest conservation, protecting these areas from deforestation and degradation (Vélez et al., 2020).

As part of the provisions of the United Nations Framework Convention on Climate Change (UNFCCC), Colombia began its preparation process in 2009 to prepare the National Strategy for Reducing Emissions from Deforestation and Forest Degradation (REDD+), with support from various international cooperation organizations and programs and currently known as the “Bosques, Territorios de Vida” strategy.

3.1.1 Visión Amazonía

In July 2016, the program “Visión Amazonía” was launched in the context of Colombia's national REDD+ strategy for early movers. With support from Norway, the United Kingdom, and Germany, 85 million dollars were granted for a period of five years (until 2021) to promote activities aimed at reducing carbon emissions across Colombia's Amazon departments and their respective deforestation frontiers. Continued financial support for “Visión Amazonía” was conditional upon yearly verified reductions in deforestation through payment-by-results contracts. These reductions were assessed by comparing the average annual forest loss in the Colombian Amazon during the period 2016–2021 with the average

annual forest loss during 2000–2012, which was 82.833 ha (Vision Amazonía, 2019). In 2016, for example, forest loss in the Colombian Amazon amounted to 56.952 ha, around 26.000 ha less than the baseline, and the Colombian government received payments for the corresponding avoided emission reductions. In contrast, the average forest loss in 2017 almost doubled the baseline figure, resulting in the suspension of payments.

Regardless of the level of payments annually disbursed or not by international donors, “Visión Amazonía” has become a cornerstone of Colombia’s environmental policy, seeking to reduce deforestation in the Colombian Amazon by halting the advancement of the agricultural frontier and incentivizing the value of standing forests and other associated production systems, such as agroforestry and silvopastoral schemes. The program targets landowners, rural and indigenous communities along or beyond the agriculture-forest frontier in the departments of Putumayo, Caquetá, Meta, Guaviare, Vichada, Vaupés, Guainía, and Amazonas. These are departments where deforestation is progressing apace. For example, in Guaviare where this research has been conducted, around 8% of tree cover, i.e. about 425 thousand ha, were lost between 2001 and 2023 (Global Forest Watch, 2024). The program has five implementation pillars: 1) the promotion of sustainable forest management practices and community-based conservation, where the Amazon Forest Incentive of concern for this research is inserted; 2) the enhanced collaboration between the ministries of Agriculture, Mining, and Environment; 3) the establishment of sustainable value chains for non-timber products; 4) the strengthening of land rights and well-being of indigenous communities, and 5) the reinforcement of the country’s remote-sensing forest and carbon monitoring system and the national forestry inventory for the Amazon region.

3.1.2. The Amazon Forest Incentive

As noted above, the Amazon Forest Incentive (in Spanish, *Incentivo Forestal Amazónico*, hereafter IFA) is part of “Visión Amazonía” pillar 1 and is aimed at promoting forest management and conservation through the provision of a voluntary, yet conditional forest conservation incentive. IFA also involves the development of a land management plan that clarifies property boundaries and land uses. As of 2021, it had targeted 517 families located along the active deforestation arc of the department, representing a total conservation goal of 45.000 ha of primary forest.

Payments under the IFA are not indexed to the number of hectares enrolled. Instead, compensation follows a flat, tiered schedule based on the share of forest cover relative to the total size of the participant's landholding: 2.4 million COP per year for participants whose enrolled forests represent 30% to 59% of their landholding area, 3.0 million COP for those who enroll 60% to 74%, and 3.6 million COP for those who enroll more than 75%. As a result, properties of different absolute sizes can receive the same payment level if they fall within the same forest-cover bracket. Payments average 200,000–300,000 COP per month (USD 40–60 in 2023), corresponding to about 25% of the legal monthly minimum wage, and are delivered quarterly via bank transfer. Contracts are renewed annually for up to three years, contingent on compliance and funding availability.

Enrollment in IFA occurs on an ongoing basis. While the rules governing eligibility, payment levels, and conditionality are uniform across participants, households can enter the program at different points in time. This design choice reflects the program's objective of maximizing flexibility and inclusion in a remote, high-deforestation-risk context, where security conditions, administrative constraints, and household readiness vary substantially. Consequently, when we observe participants in our survey sample, there is meaningful variation in the total number of payments received, even though all participants face the same payment structure once enrolled. This variation is therefore a direct outcome of the program's adaptive enrollment design rather than differential treatment rules. Program compliance is monitored through weekly satellite-based early deforestation alerts issued by the National Institute of Hydrology, Meteorology, and Environmental Studies (IDEAM), complemented by field visits when feasible. Implementation challenges - including the presence of armed groups, mistrust, and administrative constraints - have resulted in some variability in contract duration, with an average observed duration of 2.09 years ($SD = 0.4$).

IFA's payment structure has some key differences with respect to other major public forest conservation payment programs in Latin America, including Mexico, Costa Rica, or Ecuador's PES programs (Arriagada et al., 2015; Hayes et al., 2015; Izquierdo-Tort et al., 2025). IFA has a flat, tiered payment structure based on the proportion of forest cover relative to total landholding area, rather than a per-hectare payment. IFA also relies on shorter, annually

renewed contracts and monthly payments, contrasting with the longer contract durations and less frequent payments in Mexico and Costa Rica (five-year contracts with annual payments) and Ecuador (20-year contracts with bi-annual payments).

3.2. Data collection in Guaviare

This research was conducted in the department of Guaviare. By 2024, Guaviare was among the top three departments with the highest deforestation rates in Colombia. Over the past twenty-five years, an accumulated 314.000 ha of primary humid forest have been lost according to Global Forest Watch. In Guaviare, land tenure is organized in privately managed land holdings (*fincas*), often informally occupied by families composed of migrants from other parts of the country. Most of the land holdings in these family units are dedicated to a mix of productive uses, including pasture for livestock, primary or secondary forest, and crops. Large-scale deforestation in Guaviare is driven by road construction (i.e. 37 km of illegal roads were built in 2000 to connect two municipalities), land grabbing, illegal crops, and monocultures. Small-scale deforestation is due to the advancement of the agricultural frontier mainly for the establishment of cash crops and pastures for cattle ranching (Botero, 2020).

We administered a household survey among 144 program participants and a randomly selected set of 43 comparable control individuals who complied with the eligibility requirements for the program and were located in the same area of Guaviare where IFA was being rolled out. Data collection was conducted in the local language (Spanish), over two waves, the first in January 2022 and the second in January 2023, yielding a total of 201 individuals, of whom 187 were successfully re-interviewed in both waves.

Because the IFA was already underway when fieldwork began, we lacked baseline (pre-program) information. This restricts our ability to identify causal program impacts or to distinguish program-induced changes from pre-existing differences between participants and non-participants. In addition, the voluntary nature of participation in the IFA may have introduced selection bias, as individuals with different underlying motivations were more likely to enroll. For these reasons, our results are interpreted as associations rather than

causal effects, and the analysis focuses on documenting how program participation and payment design characteristics are related to changes in self-reported motivations over time.

To account for confounding factors, we collected detailed sociodemographic, livelihood, and land-use information for both treated and eligible non-treated individuals and compared these groups using time-invariant and slow-moving characteristics (see Appendix A). Program participants were, on average, slightly older and had fewer household members, including fewer members working on the farm. Since these characteristics may influence both participation decisions and motivational trajectories, we included them as control variables in our regression analyses. However, these adjustments cannot fully eliminate selection bias concerns, and we thus interpret findings with appropriate caution.

The survey included questions on sociodemographic, livelihood strategies, and land-use characteristics; reasons for participating in the PES program; and different motivation-related statements about forest conservation (see Appendix B for the full survey questionnaire). Motivation variables were constructed following SDT, distinguishing extrinsic motivations related to external rewards or sanctions from intrinsic motivations connected to interest, enjoyment, or personal value.

Table 2. Motivational dimensions, SDT classification, and corresponding survey items

Motivational dimension	SDT classification	Survey statement
Self-image	Intrinsic	I see myself as someone who does not clear the forests
Identity	Intrinsic	I enjoy it when I take care of the forest
Personal normative	Intrinsic	Cutting down forest is not right
Guilt	Intrinsic	I feel guilty if I clear the forest
Payments	Extrinsic	I would take care of the forest only if I am paid to do so
Fines	Extrinsic	I do not cut the forest because of fear of fines
Conditionality	Extrinsic	I take care of forests only if others do so as well
Family	Extrinsic	My family would be upset if I clear the forest

Normative	Extrinsic	I would be criticized by my neighbors if I clear the forests
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To clarify the relationship between motivational measures used in the analysis, Table 2 maps each survey item to its corresponding motivational dimension and SDT classification. Individual Likert-scale items are analyzed separately to capture heterogeneity across motivational dimensions (e.g., self-image, identity, guilt), while composite indices aggregate these items into broader intrinsic and extrinsic motivation measures. The indices thus provide a summary measure of motivational orientation, whereas the item-level variables allow us to examine which specific motivational components are associated with variation in payment design.

3.3. Empirical Strategy

To account for potential interdependence across motivational measures, we developed two indices: an intrinsic motivation index and an extrinsic motivation index. Both indices assume equal weighting of their component items, and higher values indicate stronger agreement with the corresponding motivational orientation. All motivation items are measured on a four-point Likert scale (*1=Strongly disagree, 2=Somewhat disagree, 3=Somewhat agree, 4=Strongly agree*).

The intrinsic motivation index was developed using all items corresponding to self-image, identity, personal normative beliefs, and guilt (See Table 2). These items capture self-driven reasons for conservation, such as personal values, interest, enjoyment, and perceptions of importance, and reflect motivations that arise internally rather than from external influences. Each item is equally weighted, and the index is calculated as the normalized sum of responses divided by 16, with higher values indicating stronger intrinsic motivation. A maximum score corresponds to selecting “strongly agree” for all intrinsic motivation statements. The extrinsic motivation index was constructed analogously using the five statements, including motivations related to payments, sanctions, and external expectations. These items reflect motivations driven by external incentives or pressures, such as financial rewards, social sanctions, or compliance expectations. As with the intrinsic index, all items receive equal weight and are normalized such that higher values indicate stronger reliance on external

motivators for forest conservation. Together, these indices provide summary measures of overall motivational orientation.

In addition to the indices, we analyze changes in individual motivation items. This dual approach reflects the theoretical premise that different motivational dimensions may be correlated but not fully substitutable, and that incentives may be associated with specific components of motivation even when aggregate indices exhibit limited variation. By combining index-based and item-level analyses, we aim to capture both overall motivational orientations and heterogeneity across specific motivational dimensions, without relying solely on composite measures.

The main outcomes of interest are changes in intrinsic and extrinsic motivations between the two survey waves (2022-2023), measured both through changes in the respective indices and through changes in individual motivation items. These outcomes are analyzed in relation to program participation and to key features of the payment design (the total number of payments received, and the share of payments relative to the household income), while controlling for individual and household characteristics.

Participation in the IFA program is interpreted as exposure to both financial and non-financial components of the intervention. These include the monthly incentive payments, technical assistance for sustainable timber and non-timber production, environmental education activities, and support for strengthening community-based forest governance and local social networks. At the same time, because participation is voluntary, observed differences between participants and non-participants may also reflect selection effects, whereby households with different underlying motivations or characteristics are more likely to enroll in the program.

Changes in motivation outcomes are modeled as a function of program participation, payment design characteristics, and sociodemographic controls. For motivational indices, we estimate linear regression models with village-level clustered standard errors to account for spatial correlation across the 17 sampled communities. For individual motivation items, which are ordinal, we estimate ordered logit models, also clustered at the village level. These

specifications allow us to examine how program participation and payment design characteristics are associated with shifts in specific intrinsic and extrinsic motivations, while recognizing the limitations of our observational study design.

The intrinsic distribution index has limited variation over the study period, with an average change of 0.01 (standard deviation = 0.06) between 2022 and 2023 (see Appendix C). This limited variance constrains statistical power but does not undermine the relevance of index-based analysis, as indices provide a theoretically grounded summary of motivational orientations. At the same time, greater heterogeneity is observed at the item level, reinforcing the value of examining individual motivational dimensions alongside aggregate measures.

Given the number of item-level outcomes examined, p-values for item-level analyses are adjusted for multiple hypothesis testing using the Benjamini-Hochberg false discovery rate procedure. Adjustments are applied within outcome families to reduce the risk of false discoveries while preserving statistical power. All results are interpreted cautiously in light of the modest variation in self-reported motivational measures.

On average, program participants received five payments during the study period, corresponding roughly to half of their reported annual household income. Respondents were predominantly male, with an average age in their early fifties, primary education attainment, and long-term residence in their communities. Households averaged three members, typically with two individuals engaged in farming. About half of the respondents reported owning land, with around 50% of land under forest cover, 20% used in pasture, and the remainder either idle or used for other purposes (see Appendix D for full descriptive statistics).

To explore heterogeneity in motivational associations, we estimate interaction models that allow payment design effects to vary by landholding size, defined using observed landholding area measured at the time of the second survey wave (2023). In the absence of pre-program baseline data and given the slow-moving nature of this variable, landholdings size is interpreted as a contemporaneous structural constraint reflecting differences in land-use flexibility and opportunity costs, rather than as a causal determinant. These heterogeneity

analyses are explicitly exploratory and are interpreted descriptively as conditional associations rather than as causal moderation effects; accordingly, they are not adjusted for multiple hypothesis testing.

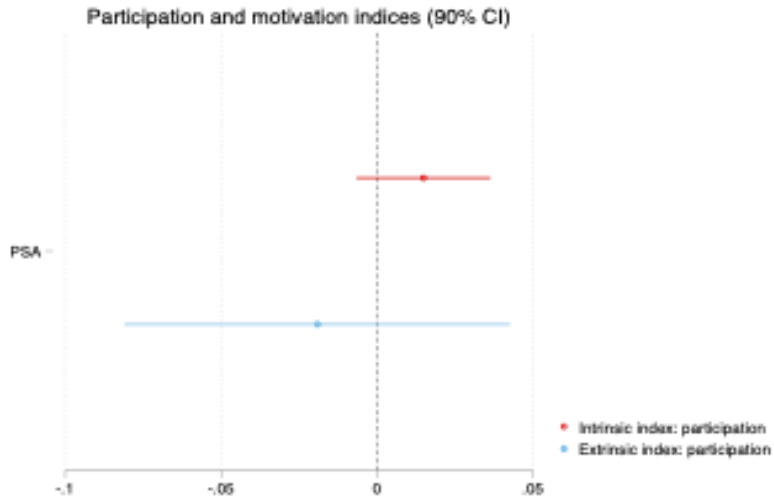
Overall, this empirical strategy allows us to document patterns consistent with motivational crowding associated with payment design features during program implementation, while maintaining transparency about data limitations and avoiding causal overreach.

4. Results

We begin by examining changes in aggregate indices of intrinsic and extrinsic motivations between 2022 and 2023. Across all specifications, we found no statistically significant association between PES participation and changes in either the intrinsic or extrinsic motivation indices. Similarly, among participants, neither of the two program design characteristics considered in this study - the total number of payments received, nor the mean share of household income derived from PES payments - was associated with detectable changes in the aggregate indices. These results are illustrated in Figure 2, which presents coefficient estimates and 90% confidence intervals for participation and payment design variables.

The absence of detectable associations at the index level indicates a high degree of overall motivational stability over the study period, which is not surprising given the short-time span across survey waves. Given the limited within-person variation in the indices and the short program evaluation period, we treat these aggregate results as descriptive rather than as primary outcomes. Full regression results for the intrinsic and extrinsic motivation indices are reported in Appendix E, where they serve to contextualize the item-level analyses that follow.

Figure 2. Crowding effects of PES on intrinsic and extrinsic motivation indices (90% CI)



4.1. PES participation and changes in intrinsic motivation variables

To assess whether aggregate stability masks variation across specific motivational dimensions, we next examine intrinsic motivation variables individually. Figure 3 and Table 3 present ordered logit estimates of the association between PES participation and changes in four intrinsic motivations: self-image, identity, personal normative beliefs (“cutting forests is wrong”), and guilt.

Figure 3. Crowding effects of PES on different items of intrinsic motivations (90% CI)

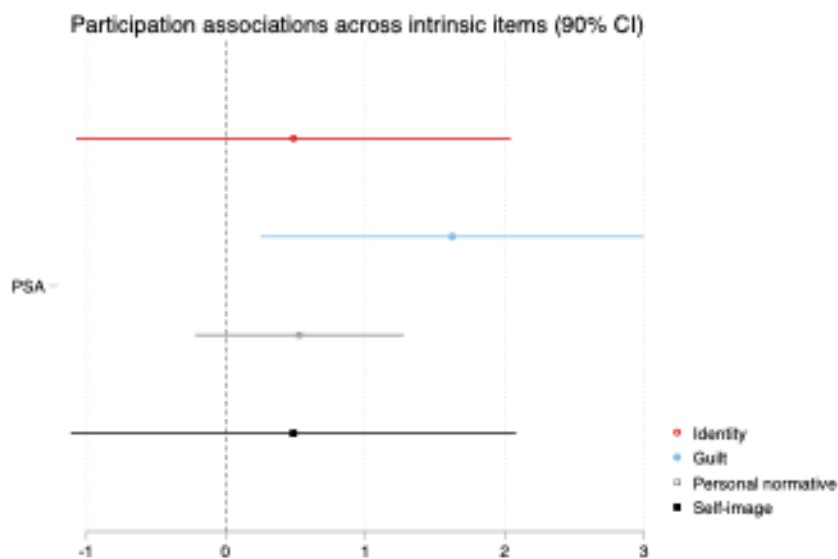


Table 3. Participation and change in intrinsic motivations

Outcome: Change in Motivations (2022- 2023)	(1) Selfimage	(2) Identity	(3) PersNormative	(4) Guilt
PSA participation	0.485 (0.971)	0.485 (0.947)	0.528 (0.454)	1.624* (0.835)
Owns land	1.471** (0.672)	1.657** (0.812)	2.511** (1.003)	-0.737 (0.774)
Gender: male	-0.058 (0.586)	-1.348** (0.673)	-0.801** (0.408)	-0.144 (0.565)
Age	0.002 (0.030)	-0.068*** (0.024)	-0.034* (0.018)	-0.046*** (0.018)
Primary education	0.978 (0.811)	0.913 (0.674)	1.950*** (0.669)	0.639* (0.337)
Secondary education	2.413*** (0.658)	0.016 (1.653)	0.026 (0.604)	-0.060 (0.705)
Technical education	-1.866 (1.778)	-4.339*** (1.345)	-1.782 (1.281)	-1.144 (2.077)
College	-0.058 (0.759)	-2.061* (1.086)	-0.137 (0.667)	1.034 (1.302)
Labor on farm	-0.024 (0.252)	0.095 (0.562)	-0.048 (0.232)	0.350 (0.323)
Household size	0.042 (0.267)	-0.174 (0.235)	0.110 (0.212)	-0.305 (0.197)
Observations	187	187	187	187
McFadden's Pseudo R2	0.092	0.139	0.096	0.076
Log likelihood	-46.814	-40.505	-89.930	-75.121
BH q(psa)	0.617	0.617	0.490	0.207

Robust village-clustered standard errors in parentheses

Ordered logit. Descriptive associations; not causal.

For ordered logit models we report McFadden's pseudo R²

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

Program participation exhibited heterogeneous associations across intrinsic motivation items (Table 3; Figure 3). Using unadjusted p-values, participation was positively associated with changes in guilt-related motivation, with an estimated increase of approximately 1.6 log-odds units and marginal statistical significance at the 10% level. However, this association does not remain statistically significant after adjusting for multiple hypothesis testing using the Benjamini-Hochberg procedure. No statistically significant associations – either before or

after adjustment – were observed between participation and changes in self-image, identity-based motivation, or personal normative beliefs, although estimated coefficients for these outcomes were generally positive and small in magnitude.

These results suggest that PES participation may be associated with heightened moral salience around forest loss, as reflected in guilt, rather than with broad-based shifts in identity or normative beliefs over the study period, but this pattern should be interpreted as exploratory rather than confirmatory. Importantly, this participation-related association emerged even in the absence of changes in the aggregate intrinsic motivation index, underscoring the value of item-level analysis for understanding how motivations are configured during program participation.

Across models, several control variables exhibited systematic associations with changes in intrinsic motivations. Land ownership was positively associated with increases in self-image, identity, and personal normative motivations, with coefficients ranging from approximately 1.5 to 2.5 log-odds units and statistical significance at the 5% level or better. This pattern suggests that landowners experienced stronger reinforcement of identity- and norm-based motivations to conserve forest relative to non-owners over the study period.

In contrast, gender differences are evident for identity-based and personal normative motivations: men display significantly lower increases in agreement with statements reflecting conservation identity and the belief that forest clearing is wrong, with coefficients of roughly -1.3 and -0.8 log-odds units, respectively. Age was also negatively associated with changes in several intrinsic motivations, particularly identity, personal normative beliefs, and guilt, indicating smaller increases - or modest declines - in these motivations among older respondents. Educational attainment showed heterogeneous patterns: primary education was positively associated with changes in personal normative motivation and guilt, while secondary education was strongly associated with increases in self-image motivation. Conversely, technical education was negatively associated with identity-based motivation, suggesting weaker internalization of conservation identity among respondents with technical training. Other controls, including labor participation on the farm and household size, did not display consistent or statistically significant associations across intrinsic motivation outcomes.

4.2 Program design characteristics and intrinsic motivations among participants

We next examined how variation in program design characteristics among participants was associated with changes in intrinsic motivations. To avoid conflating participation with exposure to payments, these analyses restrict the sample to PES participants only and focus on two dimensions of payment design: the total number of payments received over the study period and the mean share of household income derived from PES payments.

Results are presented in Table 4 and Figure 4. Table 4 reports the estimated associations between the core program design characteristics and changes in intrinsic motivation variables, while the full set of model estimates, including all control variables, is reported in Appendix F. The mean share of household income derived from PES payments was positively associated with several intrinsic motivation variables. Specifically, a higher income share was associated with statistically significant increases in self-image and identity-based motivation using unadjusted p-values, with estimated magnitudes ranging from approximately 0.4 to 0.6 log-odds units. After adjusting for multiple hypothesis testing, the association with self-image remained statistically significant at the 10% false discovery rate, while associations with identity and guilt should be interpreted as exploratory. No statistically significant association was observed between payment income share and changes in personal normative beliefs.

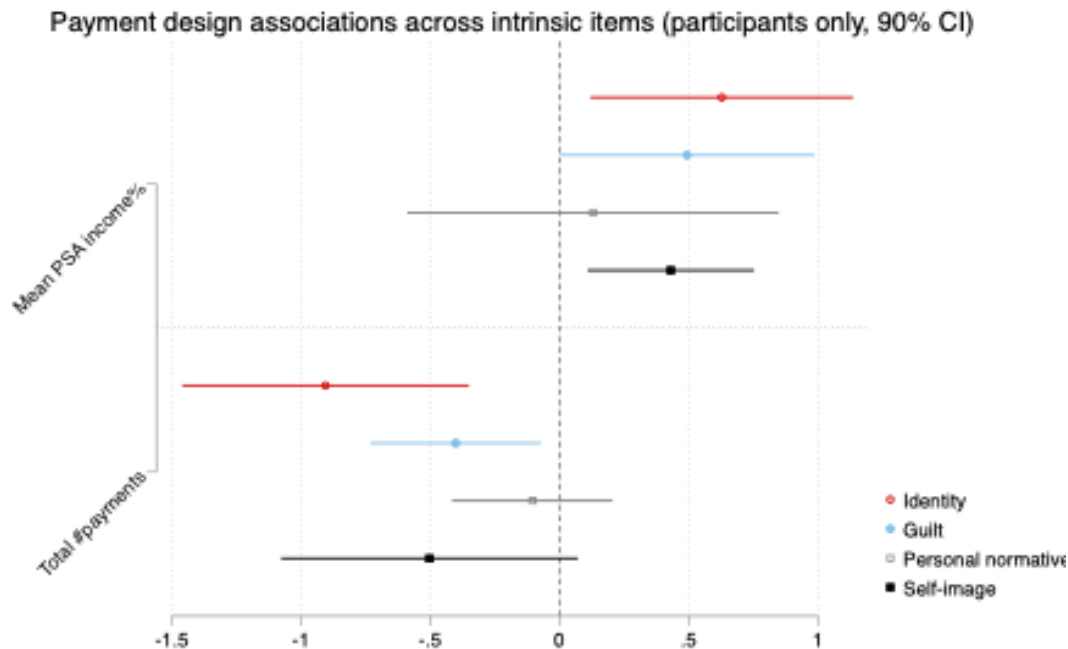
Table 4. Program design elements and intrinsic motivation

Outcome:	(1)	(2)	(3)	(4)
Change in Motivations (2022-2023)	Selfimage	Identity	PersNormative	Guilt
Total #PES received	-0.503 (0.349)	-0.905*** (0.338)	-0.105 (0.189)	-0.402** (0.201)
Mean payments income share(%)	0.431** (0.196)	0.628** (0.309)	0.130 (0.437)	0.494* (0.300)
Observations	144	144	144	144
Pseudo R2	0.124	0.317	0.091	0.121
BH q(mean payments share)	0.084	0.084	0.767	0.133
BH q(total#PES)	0.029	0.199	0.577	0.091

Robust village-clustered standard errors in parentheses

Ordered logit Descriptive associations; not causal.
 For ordered logit models we report McFadden's pseudo R^2
 *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Figure 4. Payment design characteristics and intrinsic motivation



In contrast, the total number of payments received showed a different pattern. A higher number of payments was associated with statistically significant decreases in identity-based motivation and guilt using unadjusted p-values. Each additional payment was associated with a reduction of roughly 0.9 log-odds units in identity-based motivation and approximately 0.4 log-odds units in guilt. After adjustment for multiple testing, the negative association with self-image remains statistically significant, while the associations with identity and guilt do not. Associations with self-image and personal normative beliefs were negative but not statistically significant.

These results highlight the importance of distinguishing between different dimensions of payment design. Payment salience relative to household livelihoods showed more robust associations with certain intrinsic motivations than payment frequency, although several item-level relationships should be interpreted as exploratory. While greater payment

salience, as measured by the share of household income derived from PES, was associated with stronger internalized motivations related to self-image, identity, and guilt, a higher frequency of payments was associated with weaker internal moral framing for some intrinsic motivations. These patterns suggest that how payments are experienced relative to household livelihoods may matter more for intrinsic motivations than the cumulative number of transfers received.

4.3 Heterogeneity in intrinsic motivations by property size

As an exploratory exercise, we examined whether associations between payment design characteristics and intrinsic motivations differ by landholding size, reflecting potential differences in land-use flexibility. Households were classified into smaller landholdings (≤ 80 hectares) and larger landholdings (> 80 hectares)- below and above average landholding size- reflecting potential differences in flexibility in allocating land to conservation. Consistent with the empirical strategy outlined in Section 3, these heterogeneity results are interpreted descriptively and are not adjusted for multiple hypothesis testing.

Results from interaction models are reported in Appendix G. Overall, limited heterogeneity by landholding size is observed across intrinsic motivation measures. The only dimension for which a differential pattern emerges is self-image motivation. For households with smaller landholding size (below the mean), a higher share of household income derived from PES payments was positively associated with self-image motivation. For households with larger landholding size, the interaction between payment income share and property size was negative and statistically significant, indicating that the positive association observed for smaller properties was attenuated or reversed among larger landholders.

No statistically significant heterogeneity by landholding size was observed for guilt, identity-based motivation, or personal normative beliefs. These results suggest that property size plays a limited role in moderating the relationship between payment salience and intrinsic motivations, with the exception of self-image motivation. This limited heterogeneity is consistent with the design of the program and the context in which it was implemented. Eligibility requires that at least 30% of the property's area be covered by primary forest, or alternatively that a minimum of 10 hectares of primary forest be maintained. Importantly,

payments are not indexed to the number of hectares enrolled. Instead, as noted earlier, compensation follows a flat schedule determined by the share of forest cover on the property (30–59%, 60–74%, and >75%), rather than by absolute landholding size. As a result, landholdings of different sizes can receive the same payment level if they fall within the same forest-cover bracket, which limits the scope for strategic land allocation by larger landholders and helps explain the weak heterogeneity by landholding size observed in the results.

Table 5. Heterogeneous effects by landholding size

Outcome:	(1)	(2)	(3)	(4)
Change in Motivations (2022-2023)	Selfimage	Identity	PersNormative	Guilt
Total #PES received	-0.278 (0.311)	-0.592** (0.279)	-0.137 (0.203)	-0.279 (0.210)
Large landholding (above mean)	1.908*** (0.455)	1.109 (1.216)	1.227 (0.810)	0.291 (0.858)
Large landholding * Mean payments income share (%)	-1.393** (0.313)	1.895 (4.246)	-0.782 (0.520)	0.167 (0.421)
Observations	143	143	143	143
Pseudo R2	0.179	0.352	0.112	0.120

4.4. The case of extrinsic motivations

Finally, we examined extrinsic motivations to contextualize the intrinsic results and to characterize how external motivators coexist with internal motivations during PES participation. Given the focus of this paper on intrinsic motivations and payment design, these results are presented more concisely, with full details reported in Appendix H.

At the aggregate level, neither PES participation nor the two program design characteristics - the total number of payments received and the mean share of household income from PES payments - were significantly associated with changes in the extrinsic motivation index. At the item level, most extrinsic motivations, including those related to fines, conditionality, family expectations, and social norms, showed no statistically significant associations with participation or payment design.

The only exception concerns explicit recognition of payments as a motivation for conservation. Among participants, a higher mean share of household income derived from PES payments was associated with a statistically significant increase in agreement with the statement that payments motivate forest conservation. A one percentage point increase in payment income share corresponded to an increase of approximately 0.4 log-odds units in agreement with this statement. This indicates that greater payment salience reinforces acknowledgment of financial incentives as a motivation, without systematically displacing intrinsic motivations.

Overall, the results point to substantial motivational stability at the aggregate level alongside meaningful variation across specific motivational dimensions. PES participation was associated with increased guilt-related motivation, while program design characteristics, particularly the mean share of household income derived from payments, were associated with stronger self-image and identity-based motivations among participants. At the same time, a higher number of payments was associated with weaker internal moral framing for some intrinsic motivations. Extrinsic motivations responded primarily through payments as a motivator. As with intrinsic motivations, item-level associations for extrinsic motivations are interpreted descriptively, and none are statistically significant after adjustment for multiple hypothesis testing.

5. Discussion

In this study we examined how participation in an ongoing PES program and key payment design features are associated with motivational crowding in forest conservation in the Amazonian department of Guaviare in Colombia. Specifically, we analyzed how the total number of payments received (frequency) and the share of those payments relative to household income (salience) – two features of the institutional design of the program – are associated with changes in self-reported intrinsic and extrinsic motivations, as captured through Likert-based measures grounded in Self-Determination Theory.

Our findings indicate that how payments are designed and delivered matters for motivational dynamics, at least as much as whether payments are provided. In particular, the analysis

highlights the importance of distinguishing between payment frequency and payment salience when examining how incentives relate to different components of intrinsic motivation. While the observational nature of the data limits our ability to infer causality, the patterns documented here provide systematic evidence on how variation in payment design is associated with specific motivational dimensions and with the coexistence of intrinsic and extrinsic motivational crowding during program participation.

First, we have shown that aggregate motivational stability can coexist with meaningful changes in particular motivational items. The absence of detectable change in the intrinsic motivation index contrasts with clear item-level shifts, underscoring the limits of index-based approaches for studying motivational crowding. This finding is analytically important: motivational crowding need not manifest as uniform shifts across all intrinsic components (Moros et al. 2019; Vorlaufer et al. 2023, Blanco et al. 2023). Instead, PES programs, depending on their framing and implementation, may selectively activate moral or identity-related dimensions while leaving others unchanged. Studies relying exclusively on composite indices risk overlooking these mechanisms.

Second, the association between program participation and increased guilt-related motivation for forest conservation points to moral salience as a plausible channel of crowding-in. We found that participation in the IFA program was associated with higher guilt-related motivation (“I feel guilty if I clear the forest”), relative to non-participants. However, because participation in the IFA was voluntary, this association could partly reflect a selection effect rather than a treatment effect since households with stronger latent moral or pro-conservation orientations may have been more likely to enroll, so the observed difference in guilt-related motivation may capture pre-existing dispositions in addition to any change induced by program participation. We therefore interpret this association as suggestive evidence consistent with crowding-in rather than as a causal estimate. Unlike identity transformation or norm internalization, guilt reflects heightened moral awareness tied to specific commitments. In the study context, formal conservation agreements and conditional obligations may operate less by redefining who participants are, and more by intensifying how morally consequential forest clearing becomes. This distinction helps reconcile mixed

findings in the PES literature, where strong identity shifts -which may take longer time to change- are often absent but moral framing effects persist (Bowles, 2008; Rode et al., 2015).

Third, we have also shown that the total number of payments received by participants showed weak and inconsistent associations with intrinsic motivations and did not provide evidence of systematic crowding-in or crowding-out. In some specifications, the direction of the association between payment frequency and identity- or self-image-based motivations was negative, although imprecisely estimated. The total number of payments is often emphasized in implementation debates (Ezzine-de-Blas et al., 2019; Hayes et al., 2022; Huang et al., 2024; Murayama et al., 2010), but our study showed little systematic relationship with intrinsic motivations, with weakened symbolic recognition when payments were fragmented (or repeated). Hayes et al. (2022) for instance, shows behavioral responses under loss and uncertain compensations, a situation that is not uncommon in Latin American PES implementation. If the total number of payments varies across participants as a result of heterogeneous or discontinuous implementation, then we could expect different motivational and behavioral responses among participants during the program. This was one of the premises of our research design. However, we could not provide consistent evidence in this regard. In contrast, payment salience, measured as the share of household income derived from PES, is consistently associated with stronger self-image, identity, and guilt-related motivations. This pattern supports a motivational alignment interpretation in line with early experiments by Gneezy and Rusticchini (2000): when payments are economically meaningful, they may be perceived as recognition rather than control, facilitating internalization rather than crowding-out.

The extrinsic motivation results further refine this interpretation. Payment salience strengthens explicit acknowledgment of payments as a conservation motive without expanding compliance-oriented motivations related to sanctions, social pressure, or conditionality. Within the theoretical bounds we set out in Section 2, this pattern is consistent with intrinsic and extrinsic motives coexisting rather than substituting during the study period. Coexistence is one of several configurations the broader literature documents, alongside crowding-out, null effects, and motivational spillovers to non-participants whose communities are affected by program presence (Akers & Yasué, 2019; Arias-Arévalo et al.,

2025; Chapman et al., 2020; Huang et al., 2024; Vorlauffer et al., 2025). Our design observes motivational change during implementation rather than post-program persistence, and is not constructed to detect spillover effects on non-enrolled community members; therefore, the patterns we report speak to one slice of these dynamics and should not be interpreted as evidence of longer-term behavioral change or post-program motivational persistence. Consistent with SDT, when economically meaningful transfers are perceived as recognition of conservation effort rather than as control over it, they may be more compatible with autonomy- and competence-supporting conditions (Ryan and Deci, 2000). Under such conditions, increased acknowledgement of payments need not be associated with the erosion of internalized motives. This carries a direct implication for PES design. The way a program communicates its transfers – as compensation for an environmental service rendered, or as acknowledgement of ongoing or historical forest conservation effort – is likely to engage distinct motivational channels, a distinction Chapman et al. (2020) argue has substantive consequences both for how participants experience the program and for how it is legitimized within the surrounding community. In IFA, our salience results are consistent with the latter framing being available to participants when payments are economically meaningful, although our data do not allow us to test the framing channel directly.

Our exploratory heterogeneity analyses also indicate that these patterns are broadly similar across participants, with only limited variation by landholding size. The association between payment salience and self-image motivation appears somewhat stronger among households with smaller landholdings, but this difference should be interpreted cautiously. Given the design of the program - where eligibility depends on forest-cover thresholds and payments are determined by forest-cover ratios rather than by the total placed under conservation – the scope for land-use strategizing by larger landholders is constrained. Consequently, land holding size is unlikely to be a primary driver of motivational differences in this context, which in turn suggests that payment design features play a more central role in shaping motivational responses than landholding size per se.

Finally, supplementary land-use analyses (Appendix I) serve as a behavioral consistency check rather than a test of impact. The absence of adverse land-use responses, coupled with modest positive associations between participation and forest cover, is consistent with expectations

under motivational crowding-in. These patterns align with existing evaluations of IFA's impact on avoided deforestation which document modest and heterogeneous conservation effects (Charoud et al., forthcoming; Ministerio de Ambiente y Desarrollo Sostenible, 2025). While not causal, our research suggests that the motivational dynamics observed are compatible with conservation-oriented behavior and do not appear to generate perverse short-term responses. When focusing on payment design among participants, neither the total number of payments received, nor the share of household income derived from PES payments exhibited robust associations with forest or pasture change over this short time horizon. Taken together, these patterns imply that the observed crowding-in of intrinsic motivations linked to program participation, and payment salience is directionally consistent with forest-conserving behavior, without evidence of compensatory deforestation or expansion of pasture during the study period. These findings align with other studies documenting modest and context-dependent conservation impacts of PES programs (Börner et al., 2020; Charoud et al., 2024; Costedoat et al., 2015; Pfaff et al., 2008).

Several limitations warrant emphasis. First, motivations are self-reported and cannot be externally validated through observed behavior. The distinction between motivational and behavioral crowding is central to the interpretation of our results. While our findings speak to changes in self-reported motivations during program implementation, they do not provide evidence on behavioral crowding or post-program persistence, which remain important areas for research. Second, the absence of baseline motivational data limits our ability to attribute changes solely to program participation or payment design. Third, the short time-span between survey waves constrains our ability to assess post-program motivational persistence, which remains a central concern in the motivational crowding literature. Fourth, IFA's one-year contracts and flat rate payment structure, which differs from the longer-term contracts and per hectare payments common in other large-scale PES programs limits the generalizability of our findings to other contexts.

An additional consideration relates to the context in which the data were collected. Fieldwork for this study was conducted in a region of the Colombian Amazon characterized by long-standing insecurity and exposure to armed violence, including an "armed strike" during the second wave of data collection, conditions that posed significant challenges for the

completion of the research. These constraints limited the scope and frequency of data gathering but also underscore the value of the empirical evidence assembled here.

Future research combining longitudinal designs, behavioral measures, quasi-experimental designs (e.g., difference-indifferences, instrumental variables, or regression discontinuity approaches), and experimental approaches would help clarify how motivational configurations evolve beyond program implementation and whether contemporaneous crowding-in translates into sustained conservation behavior. These should be built on robust, mixed, methods that are able to capture the complexity of motivational shifts and improve the design of policies and programs aimed at influencing conservation behavior in complex and uncertain contexts. The combination of surveys with in-depth interviews can shed more light on why people participate (or not) in PES programs, and which feelings, emotions and responsibilities related to forest conservation become reinforced or emerge as a result.

6. Conclusion

We have examined how participation in an ongoing PES program and its payment design characteristics are associated with motivational dynamics in forest conservation, focusing on a high-deforestation-risk context in the department of Guaviare, Colombia. By distinguishing between program participation and specific features of payment design – namely, the total number of payments received and the share of payments relative to household income- we have provided novel evidence on how financial incentives relate to changes in intrinsic and extrinsic conservation motivations while incentives are still active. Rather than assessing post-program persistence, we have shed light on the interaction between financial incentives and pro-environmental motivations in a real-world PES setting.

Specifically, this study contributes to ongoing discussions of motivational crowding in PES programs by shifting attention from whether incentives crowd motivations in or out to how features of payment design may relate to patterns of motivational complementarity. Our findings suggest that motivational responses are not monolithic and are not readily captured through aggregate indices alone. Instead, the results indicate that variation in payment salience, and program framing, jointly relate to how intrinsic and extrinsic motivations coexist during program participation. Because our study is observational and the patterns

documented here cannot be interpreted as causal effects, we frame our conclusions in associational terms. PES participation was associated with heightened moral salience without clear evidence of broad identity shifts, and economically meaningful payments appeared to coexist with intrinsic motivations rather than displacing them. These findings contribute to a growing body of evidence that questions unequivocal crowding-out narratives and underscores the conditional nature of motivational responses to environmental incentives.

Importantly, the motivational patterns we have documented are consistent with observed land-use outcomes and with independent impact evaluations of the same program. While causal inference remains limited, the observed associations between motivational crowding-in and stable or modestly improved forest outcomes are consistent with theoretical predictions that stronger internal motivations for conservation translate into conservation-aligned behavior. The absence of compensatory deforestation or pasture expansion during the study period suggests that short-term motivational alignment is compatible with, and potentially supportive of, forest conservation outcomes.

More broadly, we have also illustrated the value of examining motivational processes in high-risk, data-constrained settings where experimental or survey-based empirical designs are often infeasible. By documenting how motivations respond to PES design under real-world conditions, we have provided practical insights for policymakers seeking to design incentive programs that support, rather than erode, internal conservation motives. Future research combining longer time horizons, behavioral measures, and mixed methods will be essential for assessing whether motivational crowding-in translates into durable post-program conservation behavior.

Declaration of generative AI and AI-assisted technologies in the writing process

During the preparation of this work, the author(s) used ChatGPT in order to enhance the readability and clarity of the text, improving coherence. After using this tool/service, the author(s) reviewed and edited the content as needed and take(s) full responsibility for the content of the publication.

References

- Adhikari, B., & Boag, G. (2013). Designing payments for ecosystem services schemes: Some considerations. *Current Opinion in Environmental Sustainability, Terrestrial Systems*, 5(1), 72–77. <https://doi.org/10.1016/j.cosust.2012.11.001>
- Akers, J. F., & Yasué, M. (2019). Motivational Crowding in Payments for Ecosystem Service Schemes: A Global Systematic Review. *Conservation and Society*, 17(4), 377. https://doi.org/10.4103/cs.cs_18_90
- Alix-Garcia, J. M., Shapiro, E. N., & Sims, K. R. (2012). Forest conservation and slippage: Evidence from Mexico's national payments for ecosystem services program. *Land Economics*, 88(4), 613–638.
- Amabile, T. M. (1993). Motivational synergy: Toward new conceptualizations of intrinsic and extrinsic motivation in the workplace. *Human Resource Management Review*, 3(3), 185–201. [https://doi.org/10.1016/1053-4822\(93\)90012-S](https://doi.org/10.1016/1053-4822(93)90012-S)
- Arias-Arévalo, P., Pacheco-Valdés, N., & García-Lozano, A. (2025). “With or without payment I conserve”: The fabric of intrinsic, instrumental and relational values in payments for ecosystem services. *Journal of Environmental Management*, 387, 125744. <https://doi.org/10.1016/j.jenvman.2025.125744>
- Arriagada, R. A., Sills, E. O., Ferraro, P. J., & Pattanayak, S. K. (2015). Do Payments Pay Off? Evidence from Participation in Costa Rica's PES Program. *PLOS ONE*, 10(7), e0131544. <https://doi.org/10.1371/journal.pone.0131544>

- Aspelund, K. M., & Russo, A. (2025). Additionality and Asymmetric Information in Environmental Markets: Evidence from Conservation Auctions. *Working Paper Ag.Econ Search*. <https://doi.org/https://doi.org/10.22004/AG.ECON.361138>
- Balmford, B., Collins, J., Day, B., Lindsay, L., & Peacock, J. (2023). Pricing rules for PES auctions: Evidence from a natural experiment. *Journal of Environmental Economics and Management*, 122, 102889. <https://doi.org/10.1016/j.jeem.2023.102889>
- Börner, J., Schulz, D., Wunder, S., & Pfaff, A. (2020). *The effectiveness of forest conservation policies and programs*. 12(1), 45–64.
- Botero, R. (2020). *Disminuye la velocidad de la deforestación, pero se agota la Reserva Forestal de la Amazonia*. Revista Colombia Amazónica. En Conservación y Desarrollo - FCDS.
- Bowles, S. (2008). Policies Designed for Self-Interested Citizens May Undermine “The Moral Sentiments”: Evidence from Economic Experiments. *Science*, 320(5883), 1605–1609. <https://doi.org/10.1126/science.1152110>
- Cardenas, J. C., Stranlund, J., & Willis, C. (2000). Local Environmental Control and Institutional Crowding-Out. *World Development*, 28(10), 1719–1733. [https://doi.org/10.1016/S0305-750X\(00\)00055-3](https://doi.org/10.1016/S0305-750X(00)00055-3)
- Chapman, M., Satterfield, T., Wittman, H., & Chan, K. M. A. (2020). A payment by any other name: Is Costa Rica’s PES a payment for services or a support for stewards? *World Development*, 129, 104900. <https://doi.org/10.1016/j.worlddev.2020.104900>
- Charoud, H., Corbera, E., Moros, L., Costedoat, S., & Izquierdo-Tort, S. (forthcoming). Incentives are effective but insufficient to halt smallholder deforestation in the Colombian Amazon. *PLOS ONE*.

- Charoud, H., Costedoat, S., Izquierdo-Tort, S., Moros, L., Villamayor-Tomás, S., Castillo-Santiago, M. Á., Wunder, S., & Corbera, E. (2024). Author correction: Sustained participation in a Payments for Ecosystem Services program reduces deforestation in a Mexican agricultural frontier. *Scientific Reports*, 14(1), 1648. <https://doi.org/10.1038/s41598-024-52284-0>
- Corbera, E., & Izquierdo-Tort, S. (2023). Payments for Ecosystem Services. In *Edward Elgar Encyclopaedia of Ecological Economics* (pp. 406-411.). Ramos-Martín, J. and Padilla, E. (Eds).
- Costedoat, S., Corbera, E., Ezzine-de-Blas, D., Honey-Rosés, J., Baylis, K., & Castillo-Santiago, M. A. (2015). How Effective Are Biodiversity Conservation Payments in Mexico? *PLOS ONE*, 10(3), e0119881. <https://doi.org/10.1371/journal.pone.0119881>
- Day, B., Mancini, M., Bateman, I., Binner, A., Cho, F., Gol, A., Ferguson-Gow, H., Fezzi, C., Lee, C., Liuzzo, L., Lovett, A., Owen, N., Pearson, R., & Smith, G. (2024). Natural capital approaches for the optimal design of policies for nature recovery. *Philosophical Transactions of the Royal Society B*, 379. <https://doi.org/10.1098/rstb.2022.0327>
- Deci, E. L. (1971). *Effects of externally mediated rewards on intrinsic motivation*. 18(1)(105.).
- Deci, E. L. (1975). *Intrinsic Motivation*. Plenum Press. <https://doi.org/https://doi.org/10.1007/978-1-4613-4446-9>
- Deci, E. L., Koestner, R., & Ryan, R. M. (1999). *A meta-analytic review of experiments examining the effects of extrinsic rewards on intrinsic motivation*. 125(6)(627.).
- Drews, S., Exadaktylos, F., & van den Bergh, J. C. J. M. (2020). Assessing synergy of incentives and nudges in the energy policy mix. *Energy Policy*, 144, 111605. <https://doi.org/10.1016/j.enpol.2020.111605>

- Engel, S. (2016). The devil in the detail: A practical guide on designing payments for environmental services. *International Review of Environmental and Resource Economics*, 9(1–2), 131–177.
- Ezzine-de-Blas, D., Corbera, E., & Lapeyre, R. (2019). Payments for Environmental Services and Motivation Crowding: Towards a Conceptual Framework. *Ecological Economics*, 156, 434–443. <https://doi.org/10.1016/j.ecolecon.2018.07.026>
- Fehr, E., & List, J. A. (2004). *The hidden costs and returns of incentives—Trust and trustworthiness among CEOs*. 2(5), 743–771.
- Festré, A., & Garrouste, P. (2015). Theory and Evidence in Psychology and Economics About Motivation Crowding Out: A Possible Convergence? *Journal of Economic Surveys*, 29(2), 339–356. <https://doi.org/10.1111/joes.12059>
- Frey, B. S. (1993). Motivation as a limit to pricing. *Journal of Economic Psychology*, 14(4), 635–664. [https://doi.org/10.1016/0167-4870\(93\)90014-C](https://doi.org/10.1016/0167-4870(93)90014-C)
- Frey, B. S. (1994). How Intrinsic Motivation is Crowded out and in. *Rationality and Society*, 6(3), 334–352. <https://doi.org/10.1177/1043463194006003004>
- Gneezy, U., & Rustichini, A. (2000a). *A fine is a price*. 29(1), 1–17.
- Gneezy, U., & Rustichini, A. (2000b). Pay Enough or Don't Pay at All*. *The Quarterly Journal of Economics*, 115(3), 791–810. <https://doi.org/10.1162/003355300554917>
- Grillos, T., Bottazzi, P., Crespo, D., Asquith, N., & Jones, J. P. G. (2019). In-kind conservation payments crowd in environmental values and increase support for government intervention: A randomized trial in Bolivia. *Ecological Economics*, 166, 106404. <https://doi.org/10.1016/j.ecolecon.2019.106404>

- Hayes, T., Murtinho, F., & Wolff, H. (2015). An institutional analysis of Payment for Environmental Services on collectively managed lands in Ecuador. *Ecological Economics*, 118, 81–89. <https://doi.org/10.1016/j.ecolecon.2015.07.017>
- Hayes, T., Murtinho, F., Wolff, H., López-Sandoval, M. F., & Salazar, J. (2022). Effectiveness of payment for ecosystem services after loss and uncertainty of compensation. *Nature Sustainability*, 5(1), 81–88. <https://doi.org/10.1038/s41893-021-00804-5>
- Huang, Y., Zhang, X., Sheng, X., Wang, Y., & Leung, K. M. Y. (2024). The impact of payment for ecosystem service schemes on participants' motivation: A global assessment. *Ecosystem Services*, 65, 101595. <https://doi.org/10.1016/j.ecoser.2024.101595>
- Izquierdo-Tort, S., Alatorre, A., Shapiro-Garza, E., Corbera, E., Deschamps-Lomelí, J., Ávila-Foucat, V. S., Carabias, J., Dupras, J., Kolinjivadi, V., Nuñez, J. M., Perevochtchikova, M., Sims, K., & Van Hecken, G. (2025). Payments for ecosystem services in Mexico: Two decades of progress and challenges between research and practice. *Ecosystem Services*, 73, 101720. <https://doi.org/10.1016/j.ecoser.2025.101720>
- Jayachandran, S., de Laat, J., Lambin, E. F., Stanton, C. Y., Audy, R., & Thomas, N. E. (2017). Cash for carbon: A randomized trial of payments for ecosystem services to reduce deforestation. *Science*, 357(6348), 267–273. <https://doi.org/10.1126/science.aan0568>
- Kerr, J., Vardhan, M., & Jindal, R. (2012). Prosocial behavior and incentives: Evidence from field experiments in rural Mexico and Tanzania. *Ecological Economics*, 73, 220–227. <https://doi.org/10.1016/j.ecolecon.2011.10.031>
- Lepper, M. R., Greene, D., & Nisbett, R. E. (1973). *Undermining children's intrinsic interest with extrinsic reward: A test of the "overjustification" hypothesis*. 28(1)(129.).

- Lliso, B., Arias-Arévalo, P., Maca-Millán, S., Engel, S., & Pascual, U. (2022). Motivational crowding effects in payments for ecosystem services: Exploring the role of instrumental and relational values. *People and Nature*, 4(2), 312–329.
<https://doi.org/10.1002/pan3.10280>
- Lliso, B., Pascual, U., Engel, S., & Mariel, P. (2020). Payments for ecosystem services or collective stewardship of Mother Earth? Applying deliberative valuation in an indigenous community in Colombia. *Ecological Economics*, 169, 106499.
<https://doi.org/10.1016/j.ecolecon.2019.106499>
- Ministerio de Ambiente y Desarrollo Sostenible. (2025). *Evaluación ex post de impacto de la implementación de los instrumentos de incentivos del Programa REM Colombia I – Visión Amazonía y evaluación ex ante y recomendaciones para REM Colombia II – Visión Amazonía (Informe final de evaluación)*.
- Moros, L., Vélez, M. A., & Corbera, E. (2019). Payments for Ecosystem Services and Motivational Crowding in Colombia's Amazon Piedmont. *Ecological Economics*, 156, 468–488. <https://doi.org/10.1016/j.ecolecon.2017.11.032>
- Murayama, K., Matsumoto, M., Izuma, K., & Matsumoto, K. (2010). Neural basis of the undermining effect of monetary reward on intrinsic motivation. *Proceedings of the National Academy of Sciences of the United States of America*, 107(49), 20911–20916. <https://doi.org/10.1073/pnas.1013305107>
- Pfaff, A., Robalino, & Sanchez-Azofeifa, G. A. (2008). Payments for environmental services: Empirical analysis for Costa Rica. *Terry Sanford Institute of Public Policy, Duke University, Durham, NC, USA*, 404–424.
- Robalino, J., & Pfaff, A. (2013). Ecopayments and deforestation in Costa Rica: A nationwide analysis of PSA's initial years. *Land Economics*, 89(3), 432–448.

- Robalino, J., Pfaff, A., Sanchez-Azofeifa, G. A., Alpízar, F., León, C., & Rodríguez, C. M. (2008). *Deforestation Impacts of Environmental Services Payments: Costa Rica's PSA Program 2000-2005*. Discussion Paper Series, Environment for Development.
- Rode, J., Gómez-Baggethun, E., & Krause, T. (2015). Motivation crowding by economic incentives in conservation policy: A review of the empirical evidence. *Ecological Economics*, 117, 270–282. <https://doi.org/10.1016/j.ecolecon.2014.11.019>
- Ryan, R. M., & Deci, E. L. (2000). Self-determination theory and the facilitation of intrinsic motivation, social development, and well-being. *American Psychologist*, 55(1), 68.
- Saint-Cyr, L. D. F., Védrine, L., Legras, S., Le Gallo, J., & Bellassen, V. (2023). Drivers of PES effectiveness: Some evidence from a quantitative meta-analysis. *Ecological Economics*, 210, 107856. <https://doi.org/10.1016/j.ecolecon.2023.107856>
- Titmuss, R. (1970). *The gift relationship: From human blood to social policy*. Allen & Unwin.
- Vélez, M. A., Robalino, J., Cardenas, J. C., Paz, A., & Pacay, E. (2020). Is collective titling enough to protect forests? Evidence from Afro-descendant communities in the Colombian Pacific region. *World Development*, 128, 104837. <https://doi.org/10.1016/j.worlddev.2019.104837>
- Vision Amazonía. (2019). *Infografía Registro Reducción Emisiones*. Ministerio de Medio Ambiente. https://visionamazonia.minambiente.gov.co/content/uploads/2019/08/infografia_registro_reduccion_emisiones.pdf
- Vorlaufer, T., Engel, S., de Laat, J., & Vollan, B. (2023). Payments for ecosystem services did not crowd out pro-environmental behavior: Long-term experimental evidence from Uganda. *Proceedings of the National Academy of Sciences*, 120(18), e2215465120. <https://doi.org/10.1073/pnas.2215465120>

- Vorlauffer, T., Steimanis, I., & Plassenberg, J. (2025). Payment for ecosystem services and crowding of conservation behavior: A meta-analysis of lab-in-the-field experiments. *Ecosystem Services*, 74, 101750. <https://doi.org/10.1016/j.ecoser.2025.101750>
- Wunder, S., Börner, J., Ezzine-de-Blas, D., Feder, S., & Pagiola, S. (2020). Payments for Environmental Services: Past Performance and Pending Potentials. *Annual Review of Resource Economics*, 12(Volume 12, 2020), 209–234. <https://doi.org/10.1146/annurev-resource-100518-094206>
- Wunder, S., Brouwer, R., Engel, S., Ezzine-de-Blas, D., Muradian, R., Pascual, U., & Pinto, R. (2018). From principles to practice in paying for nature's services. *Nature Sustainability*, 1(3), 145–150. <https://doi.org/10.1038/s41893-018-0036-x>

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The Authors have nothing to declare.

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Appendix

Appendix A. Balance table

Table A1. Balance table with time-invariant and slow-variant variables

	Control			Treatment			Diff
	n	mean	sd	n	mean	sd	
Years in village	46	24.09	12.66	141	27.26	15.12	3.343
Owns land	95	0.68	0.47	278	0.65	0.48	-0.026
Age	46	50.09	11.66	141	53.56	15.36	4.390*
Education	96	5.40	3.02	278	5.46	3.87	-0.194
Household size	96	3.19	1.58	278	2.85	1.56	-0.325*
Labor on farm	96	1.96	1.18	278	1.70	1.05	-0.287**
Belongs to association	96	0.41	0.49	278	0.33	0.47	-0.059

Appendix B. Survey Questionnaire in Spanish

Datos de identificación de la encuesta

Lugar (vereda en la que está ubicado su predio):

Datos básicos del encuestado y de su familia

¿Usted hace parte actualmente del programa de PSA de Visión Amazonía? (Si/No)

¿Desde cuándo hace parte del programa de PSA de Visión Amazonía?

¿Cuántos pagos ha recibido hasta el momento?

- Ninguno/Un pago/Dos pagos
- Tres pagos/Cuatro pagos/Cinco pagos
- Más de cinco pagos

Si usted actualmente NO hace parte del programa de PSA de Visión Amazonía, ¿fue parte del programa alguna vez? Si/No

¿En qué año hizo parte del programa?

¿A qué destina (o destinó, si fue beneficiario en el pasado) el pago del PSA? Indique por favor todo lo que ha pagado con dinero del PSA.

Si no ha sido NUNCA ha sido parte del programa PSA de Visión Amazonía, ¿lo solicitó alguna vez, pero le fue DENEGADO participar? Si/No

Por favor indique el año en que se le denegó participar.

Si usted participa actualmente en el programa de PSA, o participó en el pasado, quiero preguntarle por las razones por las que quiso participar. ¿Me puede mencionar las razones que usted considera importantes?

Si usted participaba previamente en PSA pero actualmente ya NO participa, quiero preguntarle por las razones por las que quiso participar. ¿Me puede mencionar las razones que usted considera importantes?

Si NUNCA ha participado en PSA pero SI ha solicitado participar, ¿por qué ESTABA INTERESADO en participar? Explique las razones que considere importantes.

Si NUNCA ha participado en PSA pero SI ha solicitado participar, ¿por qué NO PUDO participar? Comente las razones que considere importantes.

Si usted NUNCA ha participado en PSA y NUNCA ha solicitado participar ¿Por qué no ha participado? Diga las razones más importantes.

Independientemente de que usted participe o no participe en PSA, ¿por qué cree que otros miembros de su vereda han participado en el PSA de Visión Amazonía? Explique las razones que considere importantes.

Durante la encuesta, le voy a ir leyendo unas frases y le voy a pedir que me diga qué tan de acuerdo está usted con estas frases usando una escala de 1 a 4 donde 1 es NO estoy de acuerdo, 2 es estoy un POCO de acuerdo, 3 es Estoy de acuerdo y 4 es estoy MUY de acuerdo.

- Me siento bien cuando cuido el bosque
- Mi familia se molestaría conmigo si tumbo el bosque
- Tengo miedo a las multas que me puede poner la autoridad ambiental si tumbo el bosque

Comportamiento de conservación

¿Usted o alguien de su hogar ha tumbado bosque en su predio? Sí/No

¿Cuántas hectáreas ha tumbado aproximadamente?

El bosque que tumbó...

- Era bosque que NO estaba en el programa de PSA en el momento que se tumbó
- Era bosque que SÍ estaba en el programa de PSA en el momento que se tumbó
- Otra: ¿Cuál?

¿Por qué tumbó el bosque? (Por favor explíquenos sus razones abiertamente, con al menos una o dos frases por motivo, y no se preocupe si se alarga):

¿Cree usted que en su comunidad son más las personas que tumban el bosque que las que lo cuidan? (Si/No)

Le voy a pedir de nuevo que me diga qué tan de acuerdo está con las siguientes frases

- Soy de las personas que cuidan el bosque
- El pago del PSA es una motivación importante para que yo cuide el bosque
- Tumar el bosque está mal

Características sociodemográficas y medios de vida

Género del encuestado/a

Edad

¿Cuál es el último año que cursó?

Ninguno 1o primaria 2o primaria 3o primaria 4o primaria 5o primaria 6o primaria 1o secundaria 2o secundaria 3o secundaria 1o bachillerato 2o bachillerato 3o bachillerato Grado técnico completo Grado técnico Incompleto Grado universitario completo Grado universitario Incompleto Posgrado

¿Cuántas personas viven en su casa, incluyéndolo a usted?

¿Cuántas de éstas son adultas (i.e. mayores de 18 años), incluyéndolo a usted?

¿Cuántas personas de su hogar generan ingresos, incluyéndolo a usted?

¿Alguien de su hogar además de usted ha participado o intentado participar en PSA? Si/No

¿Cómo se llama dicha persona?

¿Cuál es su relación con dicha persona?

¿Cuál es el tamaño conjunto de sus predios? En hectáreas

Le voy a preguntar sobre las actividades agropecuarias y forestales que lleva a cabo en su predio a día de hoy. Empecemos. ¿Tiene...

- Maíz, frijol y yuca (Si/No)
 - Número de hectáreas
- Palma de aceite (Si/No)
 - Número de hectáreas
- Caña (Si/No)
 - Número de hectáreas
- Ganado y pastos (Si/No)
 - Número de hectáreas
- Rastrojo (Si/No)
 - Número de hectáreas
- Bosque nativo (Si/No)
 - Número de hectáreas
- Otros cultivos:

Si usted tiene bosque en su predio, le voy a dar ejemplos de actividades y le voy a pedir que me diga si usted las realiza (Marque las opciones que se ajusten a su caso)

- Extraer árboles para madera
- Extraer leña de árboles caídos
- Extraer productos no maderables (e.g., hongos, plantas medicinales)
- Pastoreo de animales
- Ecoturismo
- Cultivos de sombra
- Hay investigadores que vienen a su bosque a hacer investigación
- No hago nada con el bosque que tengo en mi predio

Una última vez le voy a pedir que me diga qué piensa sobre las siguientes frases:

- Me siento culpable si tumbo el bosque
- Las personas más cercanas a mí en mi comunidad se molestarían conmigo si tumbo el bosque
- No veo qué puedo ganar cuidando el bosque
- Que la gente más importante para mí cuide el bosque es importante para que yo lo cuide

Ingreso y actividades económicas

En el último mes, ¿cuál fue el ingreso de su hogar, contando todo lo que aportan al mismo sus miembros adultos? En pesos colombianos (COP)

En el último año ¿cuál fue el ingreso de su hogar, contando todo lo que aportan al mismo sus miembros adultos? En pesos colombianos (COP)

¿Cuáles fueron las DOS principales fuentes de ingreso del hogar durante el último año? (Marque todas las relevantes)

- Venta de cultivos
- Venta de ganado
- Venta de productos forestales y no maderables
- Jornales
- Apoyos del gobierno
- Turismo
- Otra

A continuación, le pediré que me indique cuáles de los siguientes apoyos del gobierno recibe su hogar actualmente:

- No recibo ningún apoyo
- Familias en Acción
- Subsidio de vivienda
- Jóvenes construyendo el futuro

Redes sociales y organización comunitaria

¿Es usted, o ha sido alguna vez autoridad en su comunidad? (E.g., presidente de la Junta de Acción Comunal, secretario o tesorero de la comunidad) (Si/No)

¿Por cuántos años ha ocupado alguno de estos cargos durante toda su vida?

¿Es usted miembro de alguna organización social, grupo de trabajo, o asociación productiva? (Si/No)

¿A qué organizaciones, grupos de trabajo, y/o asociaciones productivas pertenece? (Indíquelas)

¿Usted hace parte de algún otro programa de pagos por servicios ambientales diferente al de Visión Amazonía? Esta pregunta se hace porque en Guaviare está el programa de Acuerdos de Conservación Caminemos de la ONF (Si/No)

¿Cómo se llama el programa?

Appendix C. Index distribution

Figure C1. Intrinsic index distribution

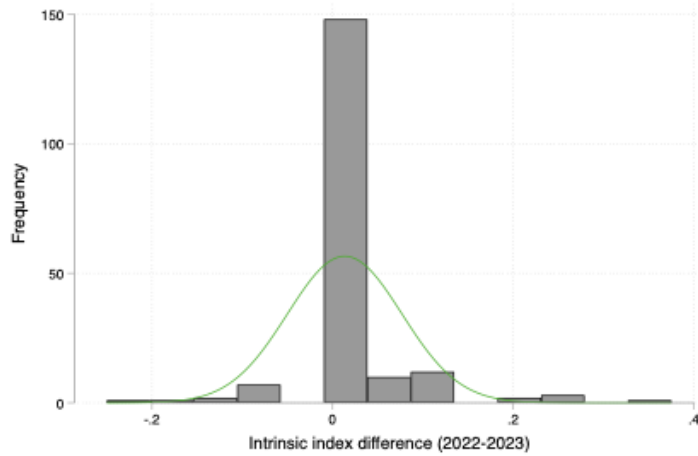


Figure C1 displays the distribution of intrinsic index differences from 2022 to 2023. The histogram reveals a pattern that approximates a normal distribution, with most observations concentrated around zero. The overlaid density curve suggests a symmetric shape, with a peak at zero and a gradual tapering of values on both sides. This indicates that, on average, intrinsic index differences remained relatively stable over the observed period, with variations distributed fairly evenly around the mean.

Appendix D. Descriptive Statistics

Table D1: Descriptive Statistics (N = 374)

Variables	Mean/Prop.	SD	Min.	Max.
Intrinsic motivation index change	.01	.06	-.25	.38
Share payments of income (mean %)	.47	.87	0.0	7.72
Total # payments	4.06	2.66	0.0	10
I feel good when I take care of the forest	3.96	.22	2.0	4.00
I am the type of person who takes care of the forest	3.97	.18	2.0	4.00
Cutting the forest is wrong	3.92	.31	1.0	4.00
I feel guilty if I deforest	3.94	.27	2.0	4.00
Taking care of the forest is worth it	2.55	1.48	1.0	4.00

Years in village	26.48	14.59	2.0	57.00
Owns land	0.66	0.47	0.0	1.0
% Forest land	0.53	0.29	0.0	1.38
Gender=men	0.72	0.45	0.0	1.0
Age	53.21	14.57	21	87.00
Education	5.44	3.67	0.0	14.00
Household size	2.94	1.57	1.00	12.00
Associated	0.35	0.48	0.0	1.0
Has cleared forest in the past year	0.31	0.46	0.0	1.0
Area (ha) cleared in the past year	13.44	21.07	0.0	150
Labor on farm (# family members)	1.77	1.09	0.0	7.0
% Pasture land	0.27	.27	0.0	1.52
% Forest land	0.53	.29	0.0	1.38
% Idle land	0.14	.22	0.0	2.50
Livestock quantity	18.44	31.37	0.0	280
Income per month (thousand)	825.8	806.8	0.0	8,500

Appendix E. Index effects and PES participation

Table E1. Index Effects with Intrinsic and Extrinsic Motivators

Outcome:	(1)	(2)	(3)	(4)
Change in Indices (2022-2023)	Intrinsic index	Intrinsic index	Extrinsic index	Extrinsic index
IFA participation	0.015 (0.012)		0.015 (0.035)	
Mean payments share (%)		0.007 (0.006)		0.002 (0.012)
Total #PES received		-0.007 (0.005)		0.002 (0.007)
Owns land	0.022	0.013	0.053	0.039

	(0.017)	(0.019)	(0.033)	(0.038)
Gender: male	-0.008	0.004	-0.022	-0.024
	(0.009)	(0.012)	(0.016)	(0.024)
Age	-0.001*	-0.000	-0.000	0.001
	(0.000)	(0.000)	(0.001)	(0.001)
Primary education	0.020**	0.028*	0.024	0.028
	(0.009)	(0.015)	(0.037)	(0.039)
Secondary education	0.011	0.024	0.033	0.037
	(0.013)	(0.016)	(0.036)	(0.041)
Technical education	-0.030	0.021	0.040	0.073
	(0.037)	(0.036)	(0.078)	(0.076)
College	-0.000	0.023	0.128	0.143
	(0.021)	(0.029)	(0.097)	(0.105)
Labor on farm	0.002	0.008	-0.026**	-0.012
	(0.004)	(0.005)	(0.009)	(0.012)
Household size	-0.001	-0.000	-0.008	-0.006
	(0.005)	(0.004)	(0.007)	(0.007)
Cons	0.016	0.018	0.157	0.063
	(0.040)	(0.036)	(0.109)	(0.11)
Observations	187	144	187	144
R2	0.047	0.096	0.087	0.074

Standard errors in parentheses

OLS with village-clustered SEs; descriptive association only.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Appendix F. Full table program design elements and intrinsic motivations

Outcome:	(1)	(2)	(3)	(4)
Change in Motivations (2022-2023)	Selfimage	Identity	PersNormative	Guilt
Total #PES received	-0.503 (0.349)	-0.905*** (0.338)	-0.105 (0.189)	-0.402** (0.201)
Mean payments income share(%)	0.431** (0.196)	0.628** (0.309)	0.130 (0.437)	0.494* (0.300)
Owns land	1.044 (0.814)	15.841*** (3.474)	2.743** (1.197)	-1.609* (0.954)
Gender: male	0.482 (0.820)	-0.245 (1.321)	-0.494 (0.540)	0.446 (1.016)
Age	0.004 (0.029)	-0.059* (0.033)	-0.019* (0.011)	-0.033 (0.024)
Primary education	0.978	15.446***	2.419**	1.402**

	(0.919)	(2.079)	(1.174)	(0.704)
Secondary education	2.138**	15.266***	1.586	0.550
	(0.865)	(1.910)	(1.150)	(0.863)
Technical education	0.551	-2.128	-0.507	1.769
	(1.285)	(2.723)	(2.013)	(1.775)
College	0.623	-0.085	0.665	2.687
	(0.878)	(2.191)	(0.978)	(2.082)
Labor on farm	0.071	0.252	0.218	0.688
	(0.388)	(0.524)	(0.341)	(0.445)
Household size	0.038	-0.366	0.191	-0.267
	(0.298)	(0.471)	(0.262)	(0.338)
Observations	144	144	144	144
Pseudo R2	0.124	0.317	0.091	0.121

Robust standard errors in parentheses

Ordered logit; village-clustered SEs. Descriptive associations; not causal.

For ordered logit models we report McFadden's pseudo R²

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

Appendix G. Full table heterogeneous effects for intrinsic motivations

Table G1. Heterogeneity by landholding size: payment salience and intrinsic motivations (participants only)

	(1) diff_identity	(2) diff_guilt	(3) diff_persnorma tive	(4) diff_selfimage
Mean payments income share	-1.295 (4.388)	0.427 (0.351)	0.295 (0.353)	0.724*** (0.225)
Big landholding (above mean)	1.109 (1.216)	0.291 (0.858)	1.227 (0.810)	1.908*** (0.455)
Big landholding # Mean payments income share	1.895 (4.246)	0.167 (0.421)	-0.782 (0.520)	-1.393*** (0.313)
Tot #payments	-0.592** (0.279)	-0.279 (0.210)	-0.137 (0.203)	-0.278 (0.311)
Owns land	15.723*** (2.240)	-1.438 (0.998)	2.976** (1.174)	1.685 (1.077)
Gender: male	-0.656 (1.829)	0.392 (1.122)	-0.609 (0.582)	-0.076 (0.786)
Age	-0.094 (0.058)	-0.042* (0.024)	-0.023* (0.012)	-0.026 (0.040)
Primary education	12.407*** (1.806)	1.202* (0.704)	2.403** (1.200)	1.162 (1.141)
Secondary education	12.038*** (2.353)	0.331 (0.831)	1.646 (1.069)	2.120** (0.859)
Technical education	-3.934 (2.834)	1.446 (1.802)	-0.615 (2.120)	-0.097 (1.552)
College	-3.183 (3.491)	2.263 (2.242)	0.525 (0.973)	-0.261 (1.236)

Labor on farm	0.462 (0.371)	0.682 (0.488)	0.159 (0.304)	0.102 (0.431)
Household size	-0.363* (0.219)	-0.238 (0.357)	0.201 (0.271)	0.131 (0.348)
Observations	143	143	143	143
Pseudo R2	0.352	0.120	0.112	0.179

Standard errors in parentheses

Ordered logit; village-clustered SEs. Interaction between payment income share and landholding size. Descriptive.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure G1. Heterogeneity by landholding size



Appendix H. Extrinsic motivations

This appendix reports the full set of results for extrinsic motivation outcomes, complementing the main text analysis of intrinsic motivations. The purpose of this appendix is to document how PES participation and payment design characteristics are associated with changes in extrinsic motivations, and to assess whether these associations vary by landholding size. All estimated are descriptive and based on ordered logit models with village-clustered standard errors.

H.1. PES participation and changes in extrinsic motivation items

Table H.1 reports associations between PES participation and changes in individual extrinsic motivation items, including motivations related to payments, fines, conditionality, family expectations, and social norms. Across most outcomes, PES participation was not statistically significantly associated with changes in extrinsic motivations. Coefficient estimates were

generally small in magnitude and imprecisely estimated, suggesting limited differentiation between participants and non-participants in how extrinsic motivations evolved over the study period.

For motivations related to conditionality and family expectations, land ownership was positively associated with agreement that program rules and family considerations motivate forest conservation. Specifically, landowners showed significantly higher agreement with conditionality-based motivation and significantly lower agreement with family-based motivation. Education variables were also strongly associated with some extrinsic motivations, particularly fines: individuals with technical or college education reported substantially higher agreement with fines as a motivating factor.

Age and household size showed statistically significant associations in some models, although magnitudes were modest. Larger households were consistently associated with lower agreement with family and norm-based motivations, while older individuals report slightly higher agreement with fines as a motivating factor. Figure H.1 visually summarizes these participation associations using the extrinsic motivation index and confirms the absence of statistically meaningful aggregate effects.

Table H.1 Participation and change in extrinsic motivations (items)

	(1) diff_paymen t	(2) diff_fines	(3) diff_conditio nality	(4) diff_family	(5) diff_normati ve
IFA participation	0.571 (0.681)	-0.850 (0.741)	0.306 (0.238)	-0.316 (0.577)	-0.578 (0.371)
Owns land	-0.410 (0.885)	-0.949 (1.150)	2.063*** (0.800)	-0.960* (0.534)	-0.219 (0.642)
Gender: male	0.221 (0.352)	0.254 (0.439)	-0.236 (0.312)	-0.319 (0.289)	-0.389 (0.449)
age	-0.004 (0.019)	0.031* (0.018)	-0.010 (0.012)	-0.008 (0.013)	-0.004 (0.014)
Primary education	0.234 (0.338)	0.978** (0.403)	0.478 (1.069)	-0.600 (1.058)	0.846 (0.871)
Secondary education	0.476	1.353**	0.219	-1.238	0.889

	(0.762)	(0.552)	(0.992)	(0.947)	(1.025)
Technical education	0.402	3.221***	-0.543	-0.121	0.915
	(0.863)	(0.894)	(1.339)	(1.795)	(1.289)
College	1.331	3.132*	-0.174	0.272	2.508***
	(1.516)	(1.689)	(1.286)	(2.315)	(0.855)
Labor on farm	-0.142	-0.283	-0.489***	0.044	0.068
	(0.238)	(0.258)	(0.106)	(0.205)	(0.200)
hh_size	-0.046	0.014	0.148	-0.249**	-0.403***
	(0.145)	(0.153)	(0.128)	(0.117)	(0.105)
Observations	187	187	187	187	187
Pseudo R2	0.016	0.054	0.035	0.027	0.041

Standard errors in parentheses

Ordered logit; village-clustered SEs. Descriptive.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure H.1 Program participation and extrinsic motivations index

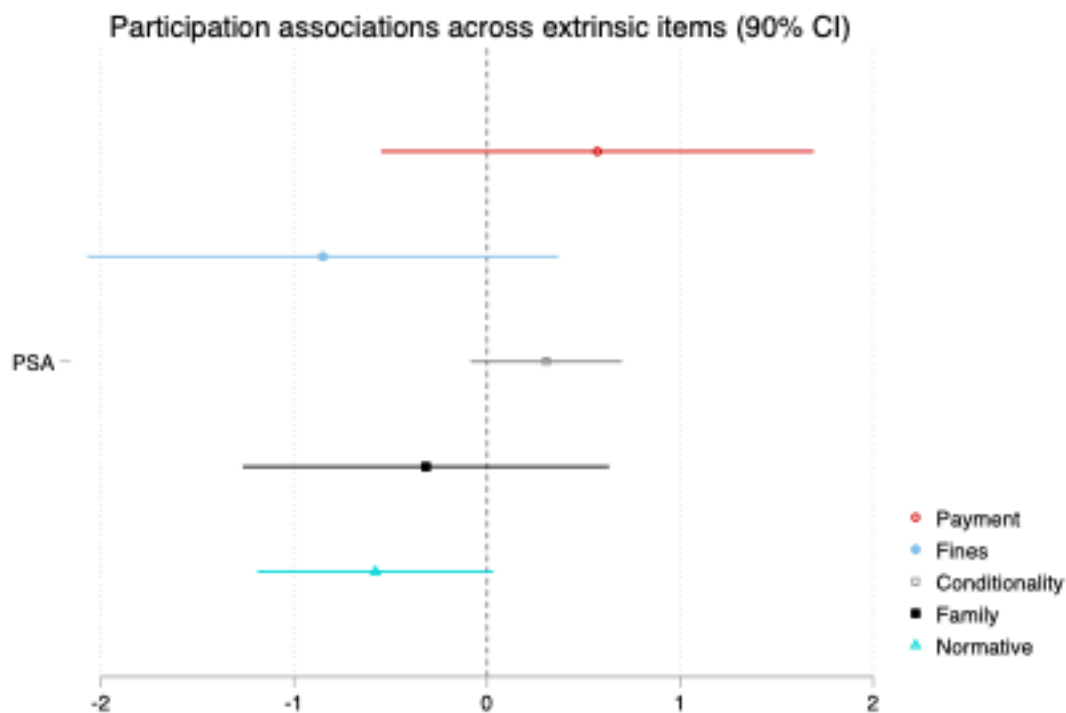


Table H.2 focuses on program participants only and examines how payment design characteristics (the total number of payments received, and the mean share of household

income derived from PES payments) were associated with changes in extrinsic motivation items. Consistent with the results reported in the main text, the total number of payments received was not significantly associated with changes in any extrinsic motivation outcome.

In contrast, the mean share of household income derived from PES payments was positively and statistically significantly associated with agreement that payments motivate forest conservation. A one-percentage-point increase in payment income share was associated with an increase of approximately 0.49 log-odds units in agreement with this statement, significant at the 1 percent level. This infinding indicates that greater payment salience reinforces explicit acknowledgement of financial incentives as a motivation for conservation. No statistically significant associations were observed between payment income share and extrinsic motivations related to fines, conditionality, family expectations, or social norms. This pattern suggests that while higher payment salience strengthens recognitions of payments as a motivating factor, it does not appear to crowd out or amplify other external pressures or sanctions. Figure H.2 summarizes these findings.

Table H.2 Payment design and change in extrinsic motivations (participants only)

	(1) diff_paymen t	(2) diff_fines	(3) diff_conditio nality	(4) diff_family	(5) diff_normati ve
Tot. #payments	-0.077 (0.197)	0.026 (0.193)	-0.001 (0.074)	-0.100 (0.199)	0.050 (0.141)
Mean payments income share	0.490*** (0.180)	0.047 (0.298)	-0.122 (0.148)	-0.041 (0.258)	0.161 (0.260)
Owens land	-1.248 (1.419)	-1.514 (1.472)	2.003** (0.812)	-1.369* (0.828)	-0.346 (0.741)
Gender: male	0.595 (0.535)	0.166 (0.848)	-0.245 (0.320)	0.023 (0.434)	-0.459 (0.578)
Age	0.024 (0.021)	0.051** (0.026)	-0.006 (0.016)	0.004 (0.021)	-0.001 (0.017)
Primary education	0.953** (0.480)	1.902*** (0.407)	0.285 (1.421)	-0.862 (1.074)	0.969 (1.179)

Secondary education	1.827** (0.912)	2.198*** (0.429)	-0.019 (1.340)	-1.456 (1.079)	0.872 (1.277)
Technical education	2.609** (1.127)	4.609*** (1.425)	-0.006 (1.516)	-0.133 (2.289)	1.058 (1.731)
College	3.250** (1.640)	4.367** (2.190)	-0.158 (1.652)	0.413 (2.593)	2.547** (1.075)
Labor on farm	0.344 (0.301)	0.023 (0.259)	-0.418*** (0.140)	0.111 (0.271)	0.201 (0.302)
Household size	-0.124 (0.215)	0.088 (0.172)	0.077 (0.140)	-0.235 (0.191)	-0.331*** (0.112)
Observations	144	144	144	144	144
Pseudo R2	0.063	0.066	0.026	0.035	0.037

Standard errors in parentheses

Ordered logit; village-clustered SEs. Program design characteristics: payment income share and total number of payments.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure H.2. Payment design elements and extrinsic motivations

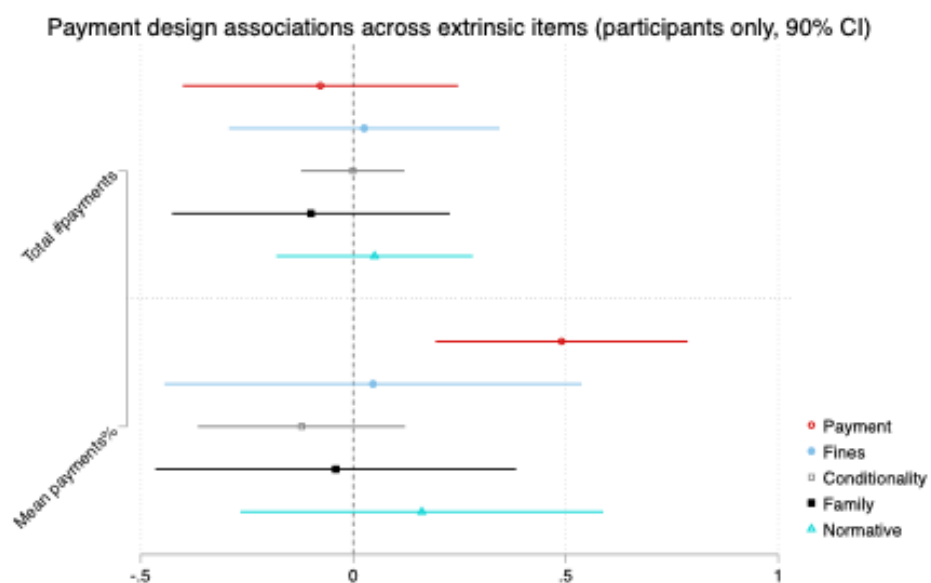


Table H.3 and Figure H.3 summarize the moderation of landholding size on the associations between payment design characteristics and extrinsic motivations. Interaction models between payment income share and a binary indicator for large landholdings (>80 ha) reveal limited evidence of systematic heterogeneity. For most extrinsic motivation items, neither the interaction term nor the main effect of landholding size was statistically significant.

One partial exception was observed for social normative motivation, where larger landholding size was weakly associated with higher agreement that social norms motivate forest conservation. However, this effect does not interact significantly with payment income share, indicating that differences across landholding sizes were not driven by differential payment salience. Across all outcomes, the interaction between landholding size and payment income share was imprecisely estimated and statistically insignificant.

Table H.3 Heterogeneity by landholding size (extrinsic motivations, participants only)

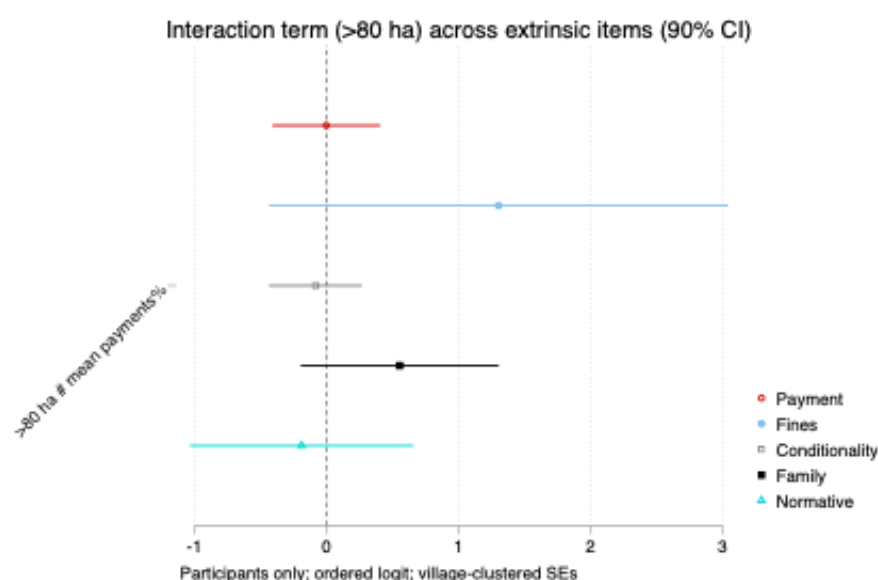
	(1) diff_paymen t	(2) diff_fines	(3) diff_conditio nality	(4) diff_family	(5) diff_normati ve
Mean payments income share	0.537*** (0.199)	-0.399 (0.279)	-0.095 (0.148)	-0.197 (0.200)	0.215 (0.268)
Above average landholding	-0.044 (0.691)	-1.838 (1.376)	-0.057 (0.488)	-0.433 (0.614)	0.902* (0.492)
Above average landholding #mean payments share	-0.003 (0.248)	1.302 (1.056)	-0.084 (0.214)	0.553 (0.455)	-0.190 (0.514)
Tot. #payments	0.041 (0.185)	0.278 (0.226)	-0.006 (0.092)	-0.004 (0.202)	0.088 (0.143)
N	143	143	143	143	143

Standard errors in parentheses

Ordered logit; village-clustered SEs. Descriptive interaction.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure H.3 Association of payment characteristics and extrinsic motivations by landholding size



Appendix I. Program effects on land use changes

We present here supplementary analyses examining associations between PES participation, payment design characteristics, and short-term land-use changes between 2022 and 2023. Using household-level OLS models with village-clustered standard errors, we analyze changes in forest and pasture cover for all households and for participants only. These analyses are intended to provide contextual evidence alongside the motivational results and are descriptive in nature. Given data limitations and the short time horizon, the models are not designed to identify causal effects on deforestation or reforestation.

Table I.1 and Figure I.1 report associations between PES participation and changes in forest and pasture cover for all households in the analytic sample. Participation in the PES program was positively associated with changes in forest cover, with participants exhibiting, on average, greater increases in forest cover relative to non-participants. The estimated coefficient is statistically significant at the 5% level. In contrast, no statistically significant association was observed between participation and changes in pasture cover.

Among control variables, higher levels of technical education were positively associated with forest cover change, while most other covariates showed no statistically significant

relationships with either land-use outcome. Overall explanatory power remains modest, consistent with the short time horizon and the descriptive nature of the analysis.

Table I.1 Participation and land-use change (2022,2023, descriptive)

	(1)	(2)
Outcome: change 2022-2023	Forest cover ha.	Pasture cover ha.
1.psa2	0.103** (0.040)	-0.021 (0.056)
Owns land	0.001 (0.038)	-0.014 (0.045)
Gender: male	-0.040 (0.024)	-0.007 (0.035)
age	-0.002 (0.001)	-0.000 (0.002)
Primary education	0.070 (0.061)	-0.006 (0.064)
Secondary education	0.049 (0.057)	-0.043 (0.083)
Technical education	0.225*** (0.076)	-0.065 (0.108)
College	0.073 (0.119)	0.000 (0.089)
Labor on farm	-0.022 (0.025)	-0.005 (0.009)
hh_size	-0.012 (0.017)	0.004 (0.012)
_cons	0.093 (0.087)	0.038 (0.184)
Observations	184	186
R-squared	0.115	0.009

Standard errors in parentheses

OLS with village-clustered SEs. All households. Descriptive associations; not causal.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure I.1 Program participation and land-use change

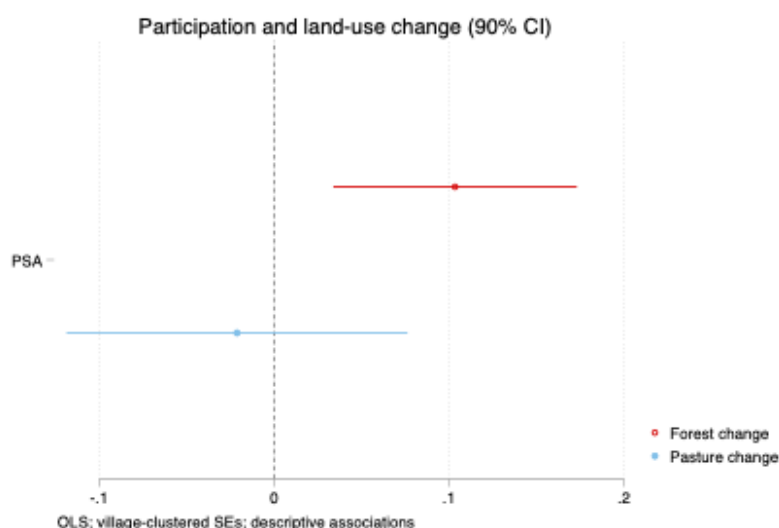


Table I.2 and Figure I.2 examine associations between payment design characteristics and land-use change among PES participants only. Neither the total number of payments received nor the share of household income derived from PES payments was significantly associated with changes in forest or pasture cover. Estimated coefficients are small in magnitude and statistically insignificant across both outcomes.

As in the participation models, selected control variables, such as technical education, show positive associations with forest cover change, while no systematic patterns emerge for pasture dynamics. These findings suggest that, within the study period, variation in payment design is not strongly linked to observable land-use shifts.

Table I.2 Payment design and land-use change (2022, 2023, participants only, descriptive)

	(1)	(2)
Outcome: change 2022-2023	Forest cover ha.	Pasture cover ha.
Tot. #payments	0.022 (0.014)	0.013 (0.013)
Mean payments income share	-0.023 (0.015)	-0.007 (0.013)
Owns land	0.013 (0.048)	-0.049 (0.037)

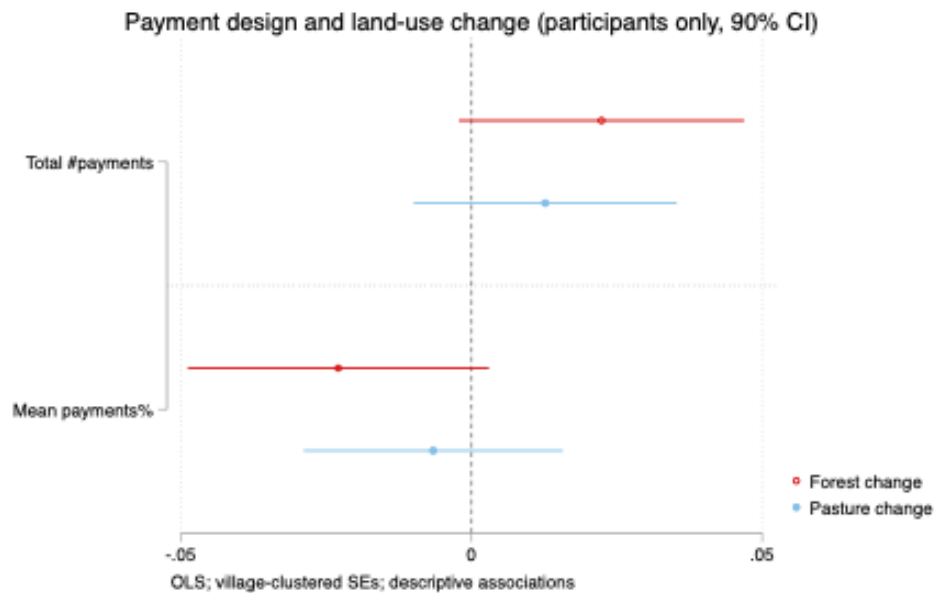
Gender: male	-0.054* (0.028)	-0.011 (0.042)
age	-0.001 (0.002)	0.000 (0.002)
Primary education	0.055 (0.072)	0.024 (0.045)
Secondary education	-0.002 (0.054)	-0.008 (0.057)
Technical education	0.228* (0.111)	0.018 (0.063)
College	0.033 (0.111)	0.048 (0.052)
labor_onfarm	-0.011 (0.025)	0.000 (0.010)
hh_size	-0.011 (0.023)	-0.006 (0.012)
_cons	0.081 (0.157)	-0.045 (0.166)
Observations	141	143
R-squared	0.118	0.018

Standard errors in parentheses

OLS with village-clustered SEs. Participants only. Program design: total number of payments and payment income share. Descriptive associations; not causal.

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

Figure I.2 Payment characteristics and land-use change



Taken together, the land-use results indicate that while PES participation is associated with modest increases in forest cover, variation in payment design does not exhibit robust associations with deforestation or pasture expansion. These findings reinforce the interpretation that the motivational effects documented in the main analysis are not accompanied by short-term adverse land-use outcomes.