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Economic, Pro-social and Pro-environmental Factors Influencing Participation in an Incentive-based Conservation Program in Bolivia

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1. Introduction

Payments for Environmental Services (PES)[1] have been widely advocated as an efficient and effective socio-economic and institutional instrument to preserve and improve the provision of ecosystem services (Engel & Palmer, 2008; Wunder et al., 2008) and have been widely implemented around the world, including in tropical forest regions (Ezzine-de-Blas et al., 2016; Grima et al., 2016).

One key but insufficiently explored critique of PES is that relying on extrinsic, often monetary, motivations for the targeted behaviour may undermine intrinsic motivations, potentially jeopardizing the long-term effectiveness of the intervention. Social psychology describes this as "motivation crowding", in which external incentives can either lead to the reinforcement ("crowding-in") of intrinsic motivations, or their replacement ("crowding-out") by extrinsic motivations (Moros et al., 2019; Benabou & Tirole, 2003; Bowles & Polonia-Reyes, 2012; Rode *et al.,* 2015; Neuteleers & Engelen, 2015; Frey & Oberholzer-Gee, 1997). Intrinsic motivations correspond to the inherent satisfaction that the activity brings, resulting from a combined set of psychological *moderators* including autonomy, personal development and a sense of social and environmental belonging. Extrinsic motivations correspond to the instrumental value derived from the activity, i.e. the motivation to perform an activity to achieve a separable result that can be material, monetary or non-material benefits, such as social recognition (Ryan & Deci, 2000; Ezzine-de-Blas et al., 2019).

Anticipating the risks of ineffectiveness or inefficiency that can derive from the crowding out of intrinsic motivations requires further exploring the links between incentive-based conservation and pre-existing and post-intervention motivations and behaviours (Vatn, 2010; Muradian et al., 2010; Moros et al., 2019; Levine et al., 2015; Rode et al., 2015; Ezzine-de-Blas et al., 2019). Embracing the multidimensionality of the motivations and barriers influencing participation into PES is also key to identify which ones can be used to improve the uptake of the program.

Studies analysing the factors affecting participation in PES schemes have highlighted the importance of economic factors (such as the size of farm, access to alternative source of incomes, and ownership of land title) and access to information or knowledge, which represent barriers to entry, affecting the ability and eligibility to participate and transaction and opportunity costs (Bremer et al., 2014; Pagiola et al., 2005). Participants in Costa Rica's national PES program tended to have more land-intensive and larger farms and farm incomes, were better educated, had more income from and were

proportionately more reliant on off-farm incomes, and had greater access to information about the program (Zbinden & Lee 2005). Similarly, in Ecuador's SocioPáramo program, land tenure requirements, legal or biophysical land-use restrictions, and a need for pre-existing social, human, and financial capital favored the participation of wealthier landowners with lower opportunity costs and access to alternative livelihood incomes (Bremer et al., 2014). Using a contingent valuation methodology, Seroa da Mottaa & Arigoni Ortiz (2018) found that opportunity costs, inertia to changes in production modes, fear of additional monitoring, and level of understanding of the program influenced farmers' decision to join a PES program in the Paraíba do Sul River basin in Brazil. Several studies have shown that pro-environmental factors had a positive effect on participation, such as the value placed on ecosystem services (Bremer et al., 2014; Bottazzi et al., 2018; García-Amado et al., 2013; Hayes, 2012), environmental knowledge or awareness (Seroa da Mottaa & Arigoni Ortiz, 2018) or moral values (Van Hecken & Bastianensen, 2010). A few studies have investigated the role of pro-social factors in triggering participation, such as Bremer et al. (2014), who found a positive influence of social capital in the form of social networks with institutions and of community organization, which facilitated awareness of the program and completion of entry requirements for community and smallholder participants in Ecuador's SocioPáramo PES program. Chen (2012) found that social norms, through social interactions before decision-making, increased re-enrollment of land in a Chinese PES program.

Grillos (2017) found that social embeddedness, including participation in community work and in the communal decision-making institution, and time of residence in community, increased participation in a Bolivian in-kind incentive-based program. In contrast, Bottazzi et al. (2018), studying the same program, found that pro-social motivations were the least cited reasons cited by participants and did not have a significant effect on the decision to participate. In this article, we study Watershared, the same program that was evaluated by Grillos (2017) and Bottazzi et al. (2018). The explicit strategy of Watershared – unlike the traditional PES programs that focus on economic incentives – is to build on pro-social and pro-environmental motivations to foster participation, in particular through social embeddedness and instrumental value of water-related ecosystem services.

We make three contributions to the current literature. First, we propose a theoretical framework that builds on the combination of three perspectives on environmental decision-making or behaviour, namely utility maximization, collective action, and environmentally responsible behaviour, to identify the economic, pro-social and pro-environmental factors that explain participation in the program. Second, using econometric models and controlling for conventional economic factors, we quantify the separate impact of these three types of factors on the decision to participate but also on

the size of the land that participants decide to enroll. Third, we study how heterogeneity in the agreement – in terms of the importance of the land for water services, conservation commitments and amount of compensation – interact with households' characteristics to explain participation in the most restrictive and rewarding agreement type. We use data from a comprehensive pre-intervention survey of 424 households in order to estimate econometric models explaining (i) the probability of participation in the program, (ii) the intensity of participation, measured as the area allocated in the agreement, and (iii) the modality of participation, measured as the probability of participation in the different types of agreements.

Our analysis shows that all three groups of factors contain variables that significantly influence the probability and intensity of participation, with a stronger influence of economic and pro-social characteristics, while pro-environmental factors influence more strongly the participation to more restrictive agreements. In particular, we find that richer households, with property titles, more forested land, more agricultural tools and access to off-farm incomes were more likely to sign a Watershared Agreement and commit a large part of their farm to the program, presumably because they face less barriers to entry. In addition, pro-social factors (related to a deeper or older integration into social networks, a greater compliance to social norms of reciprocity, a weaker trust in public institutions) and pro-environmental factors (such as awareness of environmental problems, knowledge about potential solutions to solve them and perception of the gains associated with the conservation of ecosystem services) can influence both the likelihood and the intensity of participation in the program. Finally, feeling individual responsibility for environmental issues and having difficulty in performing pro-environmental options seems to increase participation into more restrictive agreements.

The paper is organized as follows: Section 2 presents a theoretical framework for the analysis of the determinants of households' participation in PES. Section 3 presents the content and the specificities of the program under study. Section 4 provides the materials and methods. Section 5 presents the results, which are discussed in Section 6.

2. Theoretical foundations to understand participation in incentive-based conservation

Three main streams of literature can help to understand the decision made by rural households to voluntarily participate in an in-kind incentive-based conservation program. First, classical economic theory describes a rational agent which makes decisions in order to maximise utility. Second, theories of collective actions problems describe environmental management decisions as situations in which altruistic individuals may renounce short-term individual benefits in order to

generate long-term societal benefits. Third, social and environmental psychology describes pro-environmental or conservation-friendly behaviours using psycho-social factors related to values, attitudes, beliefs, norms, needs and knowledge, among many others.

In classical economic theory, conditional economic incentives are conceptualised assuming that conservation decisions are made by balancing economic reward from the participation to the program and opportunity costs – foregone income due to restrictions if participating to the program – and maximizing the economic utility of the households' productive activities. De Janvry & Sadoulet (2006) have modelled rural household behaviour under market failure conditions, which are frequent in developing countries and correspond to the conditions of our study area. They present a conceptual framework that makes it possible to model the behaviour of rural households – as agricultural productive units – in the form of maximizing a series of utilities.

In contrast, building on the collective action literature, participation in incentive-based conservation can also be framed as a contribution to collective action and environmental stewardship, as part of an altruistic or socially responsible behaviour (Crilly, Schneider & Zollo, 2008). In this theoretical approach, environmental problems are rooted in problems of collective action, i.e., a social dilemma in which individual benefits must be sacrificed to generate a societal or common benefit. Isolated individuals lack sufficient incentives or capacity to act alone, while collective action building on pro-social behaviours has the potential to address the problem (Ostrom et al., 1998). Under this perspective, participation in incentive-based conservation can be considered as a case of collective action where households decide to cooperate and commit themselves to the protection of their environment for the benefit of downstream communities or society at large, while an economic incentive can help to reduce this individual cost-benefit dilemma (Muradian, 2013).

Ostrom's collective action theory shows that *trust* (individuals' expectations about others' behaviours), *reciprocity* (norms that individuals learn from socialization and life experiences) and *reputation* (identities that individuals create and that project their intentions and norms), which are causally linked, are conditions that support collective action. These social phenomena drive *cooperation*, which in turn determines the net benefits generated by the use of the common resource for a given group (Ostrom, 1998). *Social capital*, defined as "the attributes of individuals and of their relationships that strengthen their ability to solve collective action problems" (Ostrom & Ahn, 2009) or "the norms and networks within a civil society that invoke cooperative behaviours in various governance actors" (Putnam, 1994) also plays a key role in environmental policy issues and for understanding collective action for the environment (e.g., Pretty & Ward, 2001;

Pretty, 2003; Selman, 2001; Jones et al., 2009a, 2009b, 2011). Social capital is generally articulated in four components: *social trust*, *institutional trust*, compliance with *social norms*[2] and participation in *social networks* (Bourdieu, 1986; Woolcock & Narayan, 2000; Bowles & Gintis, 2002; Jones, 2010; Jin, 2013).

Thirdly, participants in incentive-based conservation commit to "environmentally responsible behaviours", or "pro-environmental behaviours", theorized in social and environmental psychology as individual behaviours that are consciously carried out to have a positive impact on the environment and its protection (Stern, 2000). Bamberg & Möser (2007) proposes a framework that identifies a number of psycho-social variables that are consistently associated with pro-environmental behaviour. They show that pro-environmental behaviour is mainly mediated by the *intention* to act pro-environmentally, which itself is influenced by three other factors: *attitudes* (the perceived positive and negative personal consequences that result from choosing this pro-environmental option compared to other options), *perceived behavioural control* (the perceived difficulty of performing the pro-environmental option compared to other options) and *moral norms* (the perceived moral obligation for performing the pro-environmental option). These three factors are strongly influenced by four other interacting psycho-social constructs: *problem awareness* and *internal attribution* (cognitive factors), feelings of *guilt* (emotional factors) and *social norms* (social factors) (Bamberg & Möser, 2007).

Other works have explored ways to integrate these different perspectives. Ezzine-de-Blas et al., (2019) drew on the Self-Determination Theory (Ryan & Deci, 2000) and others to propose an additional relevant conceptual framework for understanding the motivations to participate into an incentive-based conservation program. It describes how external incentives' design and features could increase or decrease intrinsic motivations versus extrinsic motivations and consequently improve the performance of the desired conservation behaviour (either participation in the program, or the efficiency of the targeted behaviour and the compliance to the program), by supporting moderators of psycho-social needs and well-being: *competence* through recognition of skills and personal development, *autonomy* through inclusive design, *social relatedness* through reciprocity, distributive and procedural equity and group or community inclusion and *environmental relatedness* through feeling of belonging, well-being and awareness of healthy environment.

3. An in-kind incentive-based forest and water conservation program in Bolivia

Forests have an important role to play in climate change adaptation/mitigation and the regulation of local and global water flows and temperature (Ellison et al., 2017). In particular, Andean natural ecosystems and cloud montane forests are very

important for local and regional water provision (Célleri and Feyen, 2009, Bonnesoeur et al., 2019). These ecosystems also provide other services, such as controlling water erosion and floods and stabilizing soils against landslides in steep terrain (Bathurst et al., 2010; Guns & Vanacker, 2013). However, deforestation related to livestock grazing and conversion to pastures among other causes, increases erosion and landslides risks by reducing slope stability (Guns & Vanacker, 2013). For example, in the high Andes of Ecuador, converting natural forests to agricultural lands has led to high loss of the capacity of the landscape to deliver many ecosystem services, including on-site protection against water erosion and off-site water yield provision and erosion regulation (Balthazar et al., 2015). From 2001 to 2017, Bolivia lost 7% of its tree cover, representing 4.53 Mha and 374 Mt of CO_2 emissions (Global Forest Watch, 2018).

To mitigate such problems, Fundación Natura Bolivia ("Natura"), a local NGO, has for 15 years been implementing an incentive-based conservation program, Reciprocal Watershared Agreements ("Acuerdos Recíprocos por el Agua"). In these agreements, the upstream rural farming households (water service providers), whose land use practices influence the provision of water services agree to conserve part of their forests and their water sources in order to provide clean and sufficient water to downstream urban dwellers (water service users), in exchange for material compensations. These compensations are paid by 1) the downstream municipal government – drawing from the redistribution of the national budget linked to the decentralisation of environmental management responsibilities, 2) the public water service cooperative operating in the municipality – by adding an additional percentage onto members' monthly water bills, and 3) Natura – from international donors and private organisations. Together, these contributors create a new institution, a "Local Water Fund". Watershared aims to avoid some of the previously described pitfalls of traditional PES programs, (Wunder, 2006; Farley & Costanza, 2010; Cranford & Mourato, 2011; García-Amado et al., 2013), by building on economic motivations through direct in-kind compensations as well as on other supportive and intrinsic motivations, with the expressed aim of reducing the risk of crowding-out and the cost of the program (Asquith et al., 2016)[3].

Firstly, Watershared uses in-kind compensations proportional to the area put into conservation to support farmers to improve their local production systems, to reduce their detrimental impacts on forest and water resources (Wiik et al., 2019). These compensations include equipment related to irrigation (pipes, water pumps, etc.), fruticulture (fruit trees, fertilizers, etc.), beekeeping (hives, beekeeper suit, gloves, etc.) and improved livestock management (barbed wire, water troughs, fodder seeds, etc.). Some compensations improve household living conditions (e.g., water pipe, roof sheets, and water tanks). In order to reduce the risk of the economic incentives inhibiting intrinsic motivations, materials are not allocated according to a household's opportunity cost. These compensations are thus low and not intended to motivate

potential participants by maximizing their utility. Rather, these materials are intended to materialize a form of social recognition (Wiik et al., 2020).

Secondly, Watershared also relies on social norms in several ways (Grillos et al., 2019). Technicians present Watershared to communities as a form of ancestral reciprocal work ("Ayni") towards the mother earth. Ayni is a traditional unpaid exchange of agricultural labour that takes place between two people or households that still exists in Bolivia. Other forms of ancestral reciprocal work in the region are "Minga" and "Faena" which consist of regular collective work on community infrastructure and rotational collective work in which several families come together to help one another. The social norm of reciprocity is also specifically referred to in the program name, "Reciprocal Watershared Agreements".

Other ways in which the program mobilises social norms is through social marketing, such as by using reputation as a motivation to participate. By publicly distributing the compensations and framing them as rewards to the households that have signed and respected their agreements in front of members of their communities, and sometimes of other communities[4], implementors highlight the social importance of households that contribute to the protection of forest and water sources and to the well-being of their communities and downstream households. Moreover, the fact that downstream users contribute to the funding of the compensations through their water bills, also intends to show to upstream communities that downstream users value and recognize the environmental services they provide (a point that is often repeated by technicians when offering Watershared). The distribution of the compensations is often organized in places of high social significance – e. g. the municipality square or at popular agricultural fairs. These rewards are given directly and individually to each household, accompanied with a diploma and a photograph, with the aim of creating both a sense of personal commitment and of social pride and reputation.

Finally, the entire program is designed to build on pro-environmental motivations. When Watershared is offered to communities, it is prefaced by an environmental education session[5] discussing the water cycle, i.e., how forest cover influences soil protection, structure and retention, and in turn water infiltration and purification of water, runoff and erosion, and how evapotranspiration from vegetation influences rainfall. As landslides, floods, as well as droughts, are common and increasingly frequent phenomena in the region, this information is expected to be a motivation for participation. The program also uses a productivist and utilitarian discourse, publicly calling forests "water factories", to discuss the link between forests and water quantity and quality. Watershared and forest protection are presented as an effective way to ensure clean and abundant water supply for both upstream and downstream households.

In this study, we focus on a set of Watershared agreements that were implemented in 2015, for three years, in two municipalities in the Bolivian Chaco, Monteagudo and Villa Vaca Guzman (Figure 1). Each household could enroll different parts of their forests in three different types of agreements, with different levels of compensation depending on the importance of the forest for water services and assumed conservation commitments (Table 1). Type 1 agreements had the greatest potential additionality, as they required actual changes in management to exclude cows from riparian forests, which often necessitated the installation of barbed wire. To enter into an agreement, a household needed to meet certain requirements, i.e., to own forested land *de jure* (with a property title) or *de facto* (through a document from the communal authority acknowledging traditional ownership of the land for a certain number of years), and, for Type 1 and 2 agreements, to have a water source or stream surrounded by forest on its property.

< Table 1 here >

Annual field monitoring of presence of cattle, timber extraction or forest clearance in parcels under Type 1 or Type 2 evaluates compliance (Asquith, 2016; Fundación Natura Bolivia, 2017). Type 3 agreements are monitored remotely, and only points that are suspected of being deforested are subject to field visits. In cases of incompliance, the compensation packages received by the household – or their equivalent value – must be returned back to its community.

4. Materials and Methods

Study area

The study area (Figure 1) is located in the transition zone of the inter-Andean valleys, between the Altiplano in the east and the Chaco plains in the west, within the Tucumano-Boliviano Bosque and Chaco Serrano ecoregions (Ibisch et al., 2003). Geomorphologically, it is composed of a series of incised and parallel valleys, extending from north to south, with altitudes varying between approximately 1000 meters for valleys and 1700 meters for peaks. The climate is characterized by a mild and dry season from May to October and a hot and rainy season from November to April.

< Figure 1 here >

Farmers cultivate in the humid flat valley bottoms, rich in sediment and silt. Most of the slopes are steep with shallow or rocky soils, unfavourable for agriculture, and are mainly occupied by forest, sometimes degraded by extensive livestock

grazing. Some forest patches are being progressively deforested due to the extension of agriculture and grassland pastures for semi-intensive livestock farming.

Farmers live in small communities, legally represented by a Basic Territorial Organisation (*Organización Territorial de Base* - OTB). These OTBs constitute a key rural institution with their own authority and "executive board", composed of several members who are elected each year by community vote. Members meet monthly to organize community work related to the maintenance and creation of common projects and infrastructure, resolve potential conflicts, and define communal land repartition and forest clearing authorizations. Land tenure systems are characterized by a mix of private and collective land. Traditionally, free grazing in the collective area was allowed, as well as clearing the forest for creating new fields in areas accepted by the OTB. Through several episodes of agrarian reforms (1952, 1996, 2006), some households acquired private property land titles for the land they used to cultivate under customary tenure. In 2014, some households held private property while others – generally poorer or latecomers – did not have private property and either rented land from private owners or had requested permission to clear some of the communal land to cultivate. Some households with private lands cleared part of for permanent grassland for their own livestock while also maintaining their access to the communal area for all community members' livestock.

Survey data and sample

This study uses a comprehensive face-to-face household survey that was conducted by Natura in 22 communities of the municipalities of Monteagudo and Villa Vaca Guzman in Southern Bolivia, as a baseline before initiating the program. In each community, an average of 21 households was surveyed in 2014, one year before Natura offered to each household of these communities to participate in the Watershared program. The survey included three set of questions: questions related to economic variables such as household demographics, assets, activities, land-use, expenses and income; questions related to perceptions about the institutional, social and environmental context; and questions aimed at understanding social and environmental values and motivations.

Households were composed on average by four members. They practiced a combination of sedentary slash-and-burn subsistence with cash crop agriculture, with little or no mechanization, mainly growing corn, groundnuts, beans, peppers and potatoes. Households had on average 47.4 ha (±6.6) of forest, 2.9 ha (±0.5) of grassland, 4.1 ha (±0.3) of crops. They grow on average 3.2 ha (±0.2) of maize, 0.4 ha (±0.1) of groundnuts, 0.3 ha (±0.1) of beans, 0.1 ha (±0.02) of peppers and

0.02 ha (±0.01) of potatoes. Only 3.2 % had a tractor and 22.8% a plough. They also had an average of 16 cows (±2), 9 pigs (±1), and 26 hens (±6).

The study area covers 727,500 ha, from which 27,500 ha were enrolled in conservation, through 293 individual Watershared agreements signed by 178 households (each household can sign several agreements on different plots) (Figure 1). Due to spelling inaccuracies and to the incompleteness of the baseline survey, only 79 from the 178 households in the list of contract-holders could be matched with households in the baseline survey, representing a total enrolled area of 15,000 ha (Frame C of Figure 1). Households in the baseline survey that were not part of the list of contract-holders were designated as non-signatories. Our dataset thus includes 79 households who signed a Watershared agreement and 391 households who did not.

Selection of variables

We selected a number of variables that are referred to the rational choice model (De Janvry & Sadoulet, 2006), collective action theory (Ostrom, 1998), social capital elements (Jin, 2013), environmentally-responsible behaviour model (Bamberg & Moser, 2007) and the expanded self-determination theory under external incentives (Ezzine-de-Blas et al., 2019). We created composite variables by aggregating variables with similar meanings – e.g., we grouped the variables of participation in the three types of traditional collective work into a single variable and we grouped the perceptions of forest ecosystem services into provisioning, regulating and cultural services. In order to avoid collinearity, we conducted bivariate association tests for each pair of variables to discard pro-social and pro-environmental variables that were highly correlated with each other or with economic variables. We only kept one variable for each pair of variables with significant (p-value <0.05) and strong associations (correlation, eta or Cramer's $V > 0.30$).

Table 2 displays the selected variables, their coding or unit, their theoretical relevance and expected effect on participation. Economic variables include age and education of the head of the household, variables linked to productive capital such as agricultural tools, labour force, animals, available land, land use distribution and ownership and variables linked to other sources of income or liquidity. Pro-social factors that could promote collective action for the environment or that could increase intrinsic motivation through social relatedness include variables related to integration into social networks and the community, social norms of reciprocity and cooperation, social and institutional trust, altruistic or egalitarian versus liberal moral norms. Pro-environmental factors that could promote pro-environmental behaviours or increase intrinsic motivations through environmental relatedness, autonomy or competence include variables related to

perceived benefit or loss generated by conservation, environmental social or moral norms, perceived responsibility towards environmental problems, awareness of environmental problem, knowledge of behavioural options and perceived behavioural control or sense of competence related to environmental issues.

< Table 2 here >

Econometric models

We estimated three econometric models to assess the effect of the variables mentioned above on i) the likelihood to participate in the program, ii) the intensity of participation in the program, and iii) the likelihood to opt for the most stringent contract. In each case, we first built a standard economic model (De Janvry and Sadoulet, 2006) that we gradually enriched with pro-social and pro-environmental variables to determine the best-fit complete model, including all economic determinants and the set of most significant and robust pro-social and pro-environmental determinants. We controlled for community-specific effects, using dummy variables. Using the economic variables as control variables allowed us to verify that the added pro-social and pro-environmental variables explained an additional part of the variance unexplained by the economic variables.

We first studied the determinants of participation in the program by estimating a maximum-likelihood logit model, where the probability for a farmer to sign a Watershared agreement is (Equation 1):

$$(1)\ Pr(P = 1) = F(\beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_n x_n) = F(\beta_0 + \beta X)$$

where $F(z) = \frac{e^z}{1+e^z}$ is the cumulative logistic distribution. The dependent variable P is a dummy that takes the value of one if the household participated in a Watershared agreement (whatever the type of agreement chosen) and zero elsewhere. β_0 is a constant term, $X = (x_1, x_2, \dots, x_n)$ is the vector of economic, pro-social and pro-environmental covariates for a household and $\beta = (\beta_1, \beta_2, \dots, \beta_n)$ is the related vector of coefficients.

We then looked at participation intensity, measured as the surface S enrolled into a Watershared agreement.[6] We estimated a Tobit model where the dependent variable S is the number of hectares enrolled in the program and S^* is a latent variable. We use Tobit, a special case of censored-normal regression, because S is censored at zero (Equation 2):

$$(1)\ S = \begin{cases} S^* if S^* > 0 \\ 0\ if S^* \leq 0 \end{cases} \text{and } S^* = \beta X$$

Finally, we estimated a multinomial logit model to study the determinants of households' decision to participate in the most stringent type of agreements. We created an unordered categorical variable H, that can take three values:

$$(1)\ Pr(H = 1) = \frac{e^{X\beta^{(1)}}}{e^{X\beta^{(1)}} + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}}$$

$$(2)\ Pr(H = 2) = \frac{e^{X\beta^{(2)}}}{e^{X\beta^{(1)}} + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}}$$

$$(3)\ Pr(H = 3) = \frac{e^{X\beta^{(3)}}}{e^{X\beta^{(1)}} + e^{X\beta^{(2)}} + e^{X\beta^{(3)}}}$$

where the outcome 1 refers to those households who participated in at least one Type 1 agreement (Equation 3), which have the greatest potential additionality; outcome 2 refers to those households who participated in a Type 2 or Type 3 agreement (Equation 4); outcome 3 refers to those that did not participate in any agreement (Equation 5). We estimated the set of coefficients $\beta^{(1)}$,$\beta^{(2)}$, and $\beta^{(3)}$, corresponding to each outcomes using the maximum-likelihood estimator. In practice, we perform the econometric analysis using *R Software* (R Core Team, 2018) and the following R-packages: *heplots* (Fox et al., 2018), *maxLik* (Henningsen & Toomet, 2011), *censReg* (Henningsen, 2017), *ggplot2* (Wickham, 2009) and *nnet* (Venables & Ripley, 2002).

5. Results

Overall, our results show that all three groups of factors include variables that significantly influence the probability and the intensity of participation, with a strong influence of economic and pro-social characteristics, while pro-environmental factors influence more strongly the participation to more stringent agreements.

Probability of participation in the program and area enrolled

Table 3 presents both the results of the logistic model of participation (model 1), as well as the results of the Tobit model (model 2). Figures 2 and 3 give a graphic representation of these results.

< Table 3 here >

Main results suggest that economic factors had an important influence on the decision to participate and the area enrolled. Firstly, we found that the households that had a greater proportion of forest on their land had a greater probability to enter Watershared and dedicate a greater area to conservation. To support this result, we also estimated an alternative model

where we included the area of forestland in hectares instead of the proportion of forestland as a determinant of participation (Appendix 1). We did not find any significant influence of the area of forested land on the probability of participation (the odds ratio almost equals one in the Logit model). However, we found that for each additional hectare of forestland, the households contributed on average 0.6 ha more to conservation effort (see the Tobit model).

Results presented in Table 3 do not highlight the importance of forest ownership in participation in Watershared. However, estimating an alternative model, where we replaced the forest ownership variable with a dummy variable taking on the value of one for households that own forests they do not use because the land is not suitable for other purposes, and zero for households who do not have any unexploited forests, we found that households, who did not use their forests because they considered them unsuitable for agriculture, enrolled an average of 150 additional hectares in the program (Appendix 2).

< Figure 2 here >

Main results further show that households having more means of production in the form of agricultural tools were also more likely to participate and dedicate a greater area to conservation. Households that had no other sources of income apart from agriculture were also less likely to participate and allocated fewer hectares to conservation.

The pro-social factors influencing participation include variables about integration into the community and into its social networks, as well as reciprocal interactions and trust in institutions. Being a member of a breeders' association strongly influences the probability of participation and area enrolled in the program. A household that was part of a livestock association was about 8.5 times more likely to participate, and put about 210 hectares more under conservation.

Families who had been part of the community since at least the generation of their grandparents were about 10 times more likely to participate, and on average put 340 ha supplementary under conservation. Reciprocity also strongly influenced the probability of participation and area enrolled. Households that participated in at least one form of collective agricultural work (Minga, Faena or Ayni) were more likely to participate in Watershared and on average contributed an additional 160 hectares to conservation. Similarly, the number of days of community work dedicated to water management had a statistically significant (though small) positive impact on the probability of participation and on the area under conservation. For each additional day of collective work in water management, we expect to see about a 12%

increase in the odds of participating in the program, and 17 additional hectares under conservation. Finally, institutional trust had a significant and negative impact on the probability of participation and on the area enrolled in the program.

< Figure 3 here >

Regarding pro-environmental factors, we found that household heads who stated that forest provide them with climate and water cycle regulation services were about twice more likely than others to participate and committed an average of 100 ha more to conservation. Surprisingly, the cultural service of landscape beauty had a stronger positive influence on participation than the perception of the water and climate regulation services, although the natural beauty of landscape was not an argument used by Natura when offering to participate in the program. In contrast, households citing provisioning services provided by forests (e.g. fuelwood, timber, bushmeat, non-timber forest products and fodder) were about three times less likely to participate.

Knowledge about the environment, in terms of how it works, the threats it faces and the possible solutions, appeared to be another important psychosocial determinant of participation in the program. Households who believed that they knew how their community could protect the environment were three times more likely to participate in the program and contributed an average of 120 ha more to conservation. The variable related to awareness about water or environmental problems was not included in our final models as it had no significant influence on participation and did not improve the model fit. However, households that requested support from visiting institutions for the management of water or the environment participated more in all types of agreement and committed more land to conservation

Some variables that were expected to influence participation finally had no significant impacts in the various model specifications tested. It was for example the case of the idea that it is up to the government to implement laws that determine what people can do with their land to protect the environment. Also, personal pro-environmental moral norms - prioritizing environmental protection as a value to transmit to their children among other values- had a negative influence on the probability of participation, contrary to our assumptions.

Finally, we ran additional set of robustness analyses using alternative regression models (Heckman or Hurdle models). The results are displayed in Appendix 3 and 4. In both cases, we obtain estimates that resemble those that we have for the participation equation using the logit regression, while we do not get anything significant for the result equation (contrary to what we get using the Tobit regression). This suggests that strong claims can be made with respect to what determines

participation, while conclusions on what determines area enrolment are less robust and would probably benefit from further analysis with a larger sample.

Decision to participate in most stringent agreements (Type 1)

Table 4 presents the results of the multinomial logistic model. This model takes as reference the households that did not participate in any agreement. The odds ratios displayed in column 1 refer to households that have participated in at least one Type 1 agreement (compared to those that have not participated in any agreement). The odds ratios in column 2 refer to those households who participated in Type 2 or Type 3 agreements (compared to those that did not participate in any agreement).

Beyond the variables already mentioned in the previous results that make it possible to distinguish households participating in any agreements and area enrolled without distinction of the different types, some other factors, mainly pro-environmental ones, precisely differentiate households that participate in Type 1 agreements. Households that participated in at least one agreement of Type 1 generally had knowledge about what their community could do to protect the environment, wanted support for managing environmental or water problems but agreed that damaging the environment is somehow necessary to improve their standard of living. They also generally disagreed that if their neighbours did nothing for the environment, they should do nothing either. In addition, the recognition that forests provide a beautiful view (cultural ecosystem service) was the variable with the greatest positive effect on participation into Type 1 agreements.

Regarding economic factors, not having access to other income-generating activities strongly decreased the probability of participation into Type 1 agreement. We did not detect an effect from the number of cows owned by households. This result appears counter-intuitive since, as Type 1 agreements demand farmers to exclude cattle from the surface under the agreement, a larger number of cows could provide negative incentives to participate to such an agreement. However, this variable was strongly correlated to the total land area (Pearson correlation = 0.538***) and the proportion of forested land (Pearson correlation = 0.331***). When removing these variables, the variable *number of cows* become significantly positive, suggesting that it reflects a higher participation of richer households.

Regarding pro-social variables, we found that those households who believe that people in one's own community cooperate to solve common problems (stronger perception of cooperation norms within community) had opted for Type 1 agreements more often than other ones.

< Table 4 here >

6. Discussion

The advantage of wealthier households owning large forests

Overall, the economic factors seem to have operated mainly as a mix of barriers and incentives that favoured better-off people, having property titles, owning more forested land, more means of production in the form of agricultural tools and access to off-farm income-generating activities. Grillos (2017) and Bremer et al., (2014) also found similar evidence.

The poorest households, who own a smaller area of forest, had a lower probability of participating in the program, while the richest households were able to enroll a higher forest area in the program and so received the greatest compensation. Access to off-farm income-generating activities also increased the possibility of dedicating land to conservation.

Previous studies have warned that PES may exclude poor households because of eligibility requirements such as access to land and formal property rights, higher relative transaction costs and initial investments to adopt new pro-environmental practices, and higher opportunity cost - income lost from agriculture and other forest-resource-use activities (Landell-Mills & Porras, 2002; Wunder, 2008; Lee & Mahanty, 2009; Zbinden & Lee, 2005; Pagiola et al., 2005; Grieg-Gran et al., 2005). Forests are a crucial source of income and income diversification in tropical developing countries (Vedeld et al., 2007; Wunder, Angelsen, & Belcher, 2014) and a financial safety net for the poorest in times of scarcity or emergency (Angelsen and Wunder, 2003; Cavendish, 2003). This increases the relative opportunity cost for poorer households to participate in restrictive conservation agreements, potentially outweighing the value of the compensation.

Our results also underline the importance of owning unused forests with a low opportunity cost in the decision to participate and to enroll a large area to conservation in the program. In both the Logistic and the Tobit models, the variable that referred to the ownership of unused and low opportunity cost forests had a large, positive and significant coefficient. This result suggests that the probability of participating is not dependent on simply owning a forest, but owning a forest that is not exploited because it is not suitable for agriculture. In a Watershared program to the north of our

study site, 39% of Type 1 agreements and 14% of Type 2 and 3 agreements were actually additional, i.e., agreements were respected, the enrolled land was suitable for agriculture or grazing and the owner would have used it in the absence of the program (Bottazzi et al., 2018). Although we are not able to estimate the additionality of the agreements in this study, our results suggest that, similar to other incentive-based conservation programs (Börner et al., 2017), the program may have enrolled farmers owning a large area of eligible land with a low opportunity cost, or land that they would not have used anyway (Pattanayak et al., 2010; Sánchez-Azofeifa et al., 2007; Arriagada et al., 2009; Figueroa et al., 2016).

The commitment of socially-engaged and long-established households

Several pro-social variables - integration into social and reciprocal networks as well as seniority - appeared to have a significant effect on participation and intensity of participation in the program, which suggests that the Watershared program succeeded in building on pro-social motivations to encourage participation. These results differ from those of Bottazzi et al. (2018) who studied the self-reported motivations of Watershared participants after their decision to participate. In their analysis, pro-social motivations were the least cited reasons for entering into the program and did not have a statistically significant effect on the decision to participate. When pro-social attitudes were measured before households' decision to participate as in our study, pro-social factors did influence the participation, with effects as strong (in magnitude) as some economic variables.

The positive influence of farmers' integration into social and reciprocal networks may operate by increasing the altruistic pro-social motivations for participation. Such network integration could also increase the access to information about projects (existence about the project and how to enter in it) (Bremer et al., 2014) or about environmental problems, and therefore contribute to a greater environmental awareness (Cramb, 2005; Wakefield et al., 2006). The generation (or seniority) effect underlined in our analysis may be because people who have lived longer in a community are more integrated into social networks and have more pro-social motivations to enter the program. It may also reflect that they are more emotionally bound to their environment and community and are more motivated to take care of it. This feeling of belonging, also called a "sense of place" in the literature, refers to feelings of identity, attachment and dependence to specific places (Jorgensen & Stedman 2001; Stedman 2002) and is related to pro-environmental concerns and behaviours regarding these places (Terry et al., 1999; Clayton, 2003; van der Werff et al., 2013; Stedman, 2002; Noorgaard, 2011; Fraser et al., 2009) especially if they are threatened (Manzo & Devine-Wright, 2013; Clayton & Opotow, 2003; Kim & Kaplan, 2004). This feeling develops through direct experiences with the physical environment (Proshansky et al., 1983),

intimate episodes (Tuan 1977), the duration of residence in a place, or cultural or ancestral bonds with a place (Hay 1998). In the literature, it has been shown to be stronger for people who have grown up in a place or have lived longer there (Terry et al., 1999; Clayton, 2003; van der Werff et al., 2013; Stedman, 2002; Noorgaard, 2011; Fraser et al., 2009).

The counter-intuitive effect of trust in institutions

We detected a statistically significant negative effect of trust in institutions and NGOs on households' decision to participate and enrol large areas in the program, which was contrary to our hypotheses. In several previous studies, institutional trust had a positive influence on pro-environmental behaviour and on participation in conservation programs (Groothuis & Miller, 1997; Petts, 1998; Beierle & Cayford, 2002; Jones et al., 2009a). Indeed, people who trust institutions were more confident that they will receive the payment offered and did not fear expropriation of their land (Miranda et al., 2003; Southgate & Wunder, 2009). In our case, it is possible that the lack of trust in institutions and NGOs could encourage individuals to address such institutional failures by committing themselves to pro-environmental actions. This would be in line with the higher participation we observe in our data among households who think that the decisions made by their community are unfair. This poses a dilemma. On the one hand, a lack of trust in institutions may incentivize households to engage with new programs. On the other hand, a lack of social capital may reduce the capacity of communities to address common problems of collective action in the long term and thus affect the success of conservation interventions (Cranford & Mourato, 2011). Reconciling these two dynamics might prove challenging in contexts where farmers seem not to believe in local institutions and communal decisions, and because pro-social motivations related to social capital can be subject to crowding-out by economic incentives (Rode et al., 2015).

The influence of environmental consciousness

In line with our assumptions derived from Bamberg's & Möser's (2007) pro-environmental factors and the Self-Determination Theory (Ezzine-de-Blas et al., 2019), we found that some pro-environmental motivations positively influenced households' decision to participate and the intensity of participation. In contrast, Grillos (2017), studying Watershared in Bolivia's Santa Cruz valleys, found no significant influence of pro-environmental motivation when controlling for social and material factors.

Households who valued the regulating and cultural ecosystem services provided by forest participated with higher probability and intensity. This positive influence of the perception of water ecosystem services is in line with Bremer et

al., (2014) and Bottazzi et al., (2018) who showed that the perception of water services provided by conserving the forest – a utilitarian pro-environmental motivation – was one of the main motivations for entering incentive-based conservation programs. On the contrary, households that valued provisioning ecosystem services such as fodder, non-timber forest products, timber, firewood and bushmeat participated less. Indeed, given that the agreements specified that landowners were not allowed to extract plants and natural fertilizers (dead leaves and humus), hunt animals or cut trees for commercial uses, households that valued more highly these provisioning services might consider that engaging in a conservation agreement would represent a loss of benefits. This suggests that the households can well perceive and evaluate the implications on ecosystem services of their decision to participate in an agreement (Meyfroidt, 2013). The importance of farmers' cognition of ecosystem services – i.e. their knowledge about and evaluation of ecosystem services – in their conservation decisions has been shown in other contexts, such as the French Alps (Lamarque et al., 2014).

We found that households who allocated the greatest area to the agreements were aware of environmental problems, had the perception that they have knowledge about what can be done to protect the environment and would like the situation to change. Moreover, they prioritized this problem among others – they would specifically request support for water and environmental management if NGOs offered them the opportunity to do so. Participants in the most stringent agreements felt a greater individual responsibility to act (they stated they would not do the same as their neighbours if the latter did nothing for the environment). However, they may also have a low perceived competence (SDT of Ryan & Deci, 2000, expanded by Ezzine-de-Blas et al., 2019) or a low perception of behavioural control (Bamberg & Möser, 2007) to act more pro-environmentally, since they believed that improving their standard of living was necessarily linked to degrading the environment.

Both concepts derive from the concept of self-efficacy (Bandura, 1982) defined as "the belief in one's capabilities to organize and execute courses of action required to produce given attainments" (Bandura, 2003), which mediates the link between attitudes or intentions and behaviors (Bandura 2003; Armitage & Conner 2001). According to this concept, low self-efficacy belief hinders actions in a related domain, which means that actors who believe that they do not have control over their behaviour or the capacity to change it will act less pro-environmentally or will have fewer incentives to do so.

In addition to being correlated with knowledge (Meinhold & Malkus, 2005), self-efficacy is normally positively associated with engagement in pro-environmental behaviours (Spence et al., 2011; Hines et al., 1987) and has a mediating role between knowledge and engagement in pro-environmental behaviour (Bamberg & Möser, 2007). Our results show

the contrary: households with knowledge about environmental problems and solutions but low self-efficacy are more likely to enter into more restrictive conservation agreements. Our assumption is that the program, which compensates households that give up the benefit of deforestation by offering ways of developing without degrading the forest, could precisely appeal to these individuals by increasing their perceived behavioural control and competence by learning about (and how to implement) development alternatives and receiving materials to do it.

Further research

Future investigation could use structural equation modelling (SEM) (Kaplan, 2008) to gain a deeper understanding of the motivations to participation by exploring the psychological mechanisms that underlie the psycho-social constructs studied in this analysis and the associated environmental behaviours. Further clarifying the motivations leading to deforestation could also contribute to improve our understanding of potential gaps between conservation decisions and actual land-use behaviours, and to identify the most effective motivational drivers of conservation (Kollmuss & Agyeman, 2002). Land-use practices such as deforestation are influenced by a broad range of processes and factors embedded in a larger structural, historical, social, cultural, institutional, economic and technical context. Future research would thus benefit from combining the psycho-social approach used in this study with the broader and less individual-centred sociological literature on practices and habits related to the environment (Shove, 2010, 2012). More generally, a combination of qualitative and quantitative research is likely to better inform our understanding of the mechanisms by which households decide to participate in conservation programs. This understanding is of crucial importance for being able to implement conservation interventions or policies that truly succeed in changing the dynamics at work behind environmental behaviours in the long term.

7. Conclusions

The effectiveness of incentive-based programs for conservation depends on how they interact with multiple motivations of the participants, in order to have a sufficient participation rate, to avoid the crowding out of intrinsic motivations, and to generate desired pro-environmental behaviours that will sustain on the long term. In this article, we studied an in-kind incentive-based conservation program that mixes material incentives with pro-social motivations based on reciprocity and pro-environmental motivations related to forest ecosystem services. Drawing on three perspectives of the scientific literature on pro-environmental decisions, we have identified a number of determinants, which include economic factors,

pro-social factors likely to promote collective action and social capital, and pro-environmental factors likely to trigger engagement in environmentally responsible behaviour. We found that those levers are likely to influence the probability to participate voluntarily in the program, the area engaged into the program and the probability to enroll in the most restrictive agreements.

Our results are in line with the literature suggesting that motivations related to incentive-based conservation do not come only and directly from economic incentives (Bottazzi et al., 2018; Grillos, 2017; Figueroa et al., 2016; Rode et al., 2015; Hayes, 2012). Although economic incentives and barriers favoured the probability of participation of better-off households with property titles, more forested land, more agricultural tools and access to alternative income, and the intensity of their participation, we found that pro-social factors, related to a deeper or older integration into social networks, greater compliance to social norms of reciprocity and weaker institutional trust, play a role at least as important.

Finally, we found that pro-environmental factors such as awareness of environmental problems, greater knowledge about solutions and a positive evaluation of ecosystem services provided by forest conservation may influence positively the probability to participate and the intensity of participation, while greater individual responsibility and weaker perceived behavioural control increased the participation into more stringent and more rewarding agreements.

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Tables

Table 1.Types of Watershared Agreements

Type	1	2	3
Type of land	Riparian forest within 100 meters of a stream or water source	Riparian forest within 100 meters of a stream or water source	Primary and secondary forest or shrub land
Commitments	- No land-use change (no cultivation, no slash-and-burn, no road opening) - No cutting of trees for commercial exploitation (cutting for personal use permitted) - Livestock prohibited	- No land-use change (no cultivation, no slash-and-burn, no road opening) - No cutting of trees for commercial exploitation (cutting for personal use permitted) - Landowners commit to gradually reducing livestock numbers	- No land-use change (no cultivation, no slash-and-burn, no road opening) - No cutting of trees for commercial exploitation (cutting for personal use permitted)
Value of compensation	$100 worth of in-kind compensation at the time of signing + in-kind compensation equivalent to 10 $/ha/year	In-kind compensation equivalent to 5$/ha/year	In-kind compensation equivalent to 3$/ha/year

Table 2. Variable meaning, unit, theoretical significance within and expected sense of their effect on participation in the Watershared program. The table does not include some variables that were initially selected for their theoretical relevance but were not used in the models as they did not improve models' performance.

	Variable meaning (and unit/coding)	Link with theoretical concept	Expected effect
Economic factors	Number of members (number)	Labour force	+
	Age of the head of the household (years)	Human capital	±
	Head of the household went to primary school (1=Yes, 0=No)	Human capital	+
	Head of the household went to secondary school (1=Yes, 0=No)	Human capital	+
	Total land area (ha)	Land capital	+
	Proportion of forested land (% of land area)	Land capital + Anticipated size of incentives	+
	Proportion of grassland (% of land area)	Land capital	-
	Superficies of forested land (ha)	Land capital	+
	Superficies of grassland (ha)	Land capital	+
	Superficies of cultivated land (ha)	Land capital	+
	Owns forested land (1=Yes, 0=No)	Land capital + Requisite for entry	+
	Maintained forested land because it was unsuitable for other purposes (1=Yes, 0=No)	Land capital + Requisite for entry + Opportunity cost	+
	Owns cultivated land (1=Yes, 0=No)	Land capital	+
	Number of cows (number)	Assets – Animals	±
	Owns at least one plough (1=Yes, 0=No)	Assets – Tools	+
	Owns at least one tractor (1=Yes, 0=No)	Assets – Tools	+

	Has a credit with a bank, or a credit union, or a government fund (1=Yes, 0=No)	Source of income	+
	Has no other income-generating activities (1=Yes, 0=No)	Source of income	-
Pro-social factors	Is an authority/was an authority/is a member of an OTB (1=Yes, 0=No)	Integration into social networks - Social relatedness/involvement	+
	Frequency of OTB meetings (number of meetings)	Integration into social networks - Social relatedness /involvement	+
	Is an authority/was an authority/is a member of a breeders' association (1=Yes, 0=No)	Integration into social networks - Social relatedness /involvement	+
	His an authority/was an authority/is a member of a water cooperative (1=Yes, 0=No)	Integration into social networks - Social relatedness /involvement	+
	Participates in collective work (Minga, Faena, Ayni) (1=Yes, 0=No)	Compliance with social norms of reciprocity – Social relatedness	+
	Number of days of community work devoted to water management (number)	Compliance with social norms of reciprocity - Social relatedness	+
	Lives in the community since their generation (1=Yes, 0=No)	Integration into social networks - Social and environmental relatedness	+
	Lives in the community since the generation of their parents (1=Yes, 0=No)	Integration into social networks - Social and environmental relatedness	+
	Lives in the community since the generation of their grandparents (1=Yes, 0=No)	Integration into social networks - Social and environmental relatedness	+
	Trusts institutions and NGOs (1=Yes, 0=No)	Institutional trust - Social relatedness	+
	Agrees that "People in his community work together to solve common problems" (1=Yes, 0=No)	Social norms of cooperation – Social trust - Social relatedness	+
	Thinks that decisions made by his-her community are fair (1=Yes, 0=No)	Social trust - Social relatedness	+
Pro-environmental factors	Agrees that "to improve living conditions, it is necessary to damage the environment." (1=Yes, 0=No)	Perceived behavioural control - Competence - Perceived loss from conservation decreasing attitudes	-
	Agrees that "if his-her neighbours do nothing for the environment, he-she should do nothing either." (1=Yes, 0=No)	Individual responsibility	-
	Is in favour of the imposition of forest standards by the government (1=Yes, 0=No)	Problem awareness	+
	Has ideas about what his-her community can do to protect the environment (1=Yes, 0=No)	Knowledge of behavioural options - Competence	+
	Thinks that the forest provides fodder, non-timber forest products, timber, firewood and bush meat (1=Yes, 0=No)	Perceived loss in ecosystem services from conservation decreasing attitudes- Environmental relatedness	±
	Thinks that the forest brings rain, maintains water quality, maintains water quantity, stabilizes the climate (1=Yes, 0=No)	Perceived benefit in ecosystem services from conservation increasing attitudes - Environmental relatedness	+
	Thinks that the forest brings a nice view (1=Yes, 0=No)	Perceived benefit in ecosystem services from conservation increasing attitudes - Environmental relatedness	+
	Environmental protection is an important value that he wants to teach his-her children (1=Yes, 0=No)	Pro-environmental moral norm	+
	Wants support for water and/or environmental management (1=Yes, 0=No)	Problem awareness – Priorities	+
	Thinks that the destruction of the environment is a major challenge for his-her community (1=Yes, 0=No)	Problem awareness	+

Table 3. Summary of Logistic model of the probability of participation in Watershared and the censored Tobit model for the area enrolled in ARAs. Variables that were not included in one of the model are indicated by "n.i." ("not included"). Estimates include community dummies for each community, that are not displayed in this table in order to save space. The code for the p-value is p<0.01 (***) – p<0.05 (**) – p<0.1 (*) – p<0.15 (.)

	Model 1 (Logit)	Model 2 (Tobit)
Dependant variable	Participate (1=Yes, 0=No)	Total area under agreement (ha)

	Covariates	Unit/Code	Odds ratio	p	95% CI	Coef	p	95% CI
	Intercept		0.01	**	[0; 0.39]	-834.43	***	[-1075.4; -308.3]
Economic factors	Number of members	(number)	1.05		[0.87; 1.28]	-2.95		[-23; 17.1]
	Age of the head of the household	(years)	0.98		[0.95; 1.01]	-1.91		[-5.2; 1.4]
	Head of the household went to primary school	(1=Yes, 0=No)	1.50		[0.39; 6.45]	76.23		[-68; 220.4]
	Head of the household went to secondary school	(1=Yes, 0=No)	0.95		[0.18; 5.35]	-4.74		[-181.9; 172.4]
	Total land area	(ha)	1.00		[1; 1]	0.37	**	[0; 0.7]
	Proportion of forested land	(% of land area)	17.00	***	[3.14; 119.74]	305.43	***	[121.4; 489.5]
	Proportion of grassland	(% of land area)	12.71	.	[0.43; 341.07]	297.89	*	[-49.5; 645.3]
	Owns forested land	(1=Yes, 0=No)	1.93	.	[0.82; 4.53]	57.80		[-30.3; 145.9]
	Owns cultivated land	(1=Yes, 0=No)	3.02	*	[1; 10.21]	77.24		[-37.6; 192]
	Number of cows	(number)	0.99	.	[0.97; 1]	-1.07		[-2.8; 0.7]
	Owns at least one plough	(1=Yes, 0=No)	2.64	**	[1.02; 6.98]	87.85	*	[-7.6; 183.3]
	Owns at least one tractor	(1=Yes, 0=No)	9.00	**	[1.48; 53.48]	268.71	***	[90.4; 447]
	Has a credit with a bank, or a credit union, or a government fund.	(1=Yes, 0=No)	1.47		[0.56; 3.81]	-42.01		[-141.5; 57.4]
	Has no other income-generating activities	(1=Yes, 0=No)	0.44	*	[0.18; 1.04]	-83.54	*	[-172.1; 5.1]
Pro-social factors	Is an authority/was an authority/is a member of a breeders' association	(1=Yes, 0=No)	8.42	***	[2.55; 29.47]	209.50	***	[82.9; 336.1]
	Participates in collective work (Minga, Faena, Ayni)	(1=Yes, 0=No)	4.01	***	[1.68; 9.99]	155.86	***	[64.6; 247.1]
	Number of days of community work devoted to water management	(number)	1.12	*	[0.99; 1.26]	16.60	***	[4.8; 28.4]
	Lives in the community since the generation of their parents	(1=Yes, 0=No)	1.67		[0.71; 4]	88.04	*	[-0.1; 176.2]
	Lives in the community since the generation of their grandparents	(1=Yes, 0=No)	9.51	**	[0.95; 89.05]	341.89	***	[115.8; 568]
	Trusts institutions and NGOs	(1=Yes, 0=No)	0.21	***	[0.09; 0.48]	-142.55	***	[-226.7; -58.4]
	Thinks that decisions made by his-her community are fair	(1=Yes, 0=No)	0.30	.	[0.07; 1.3]	-117.31	.	[-263.6; 29]
Pro-environmental factors	Knows how his-her community can protect the environment	(1=Yes, 0=No)	3.66	*	[1; 16.49]	122.91	.	[-26.1; 271.9]
	Thinks that the forest provides fodder, non-timber forest products, timber, firewood and bushmeat	(1=Yes, 0=No)	0.33	**	[0.11; 1.01]	n.i.	n.i.	n.i.
	Thinks that the forest brings rain, maintains water quality, maintains water quantity, stabilizes the climate	(1=Yes, 0=No)	2.19	*	[0.99; 5.02]	108.51	**	[23.1; 193.9]
	Thinks that the forest brings a nice view	(1=Yes, 0=No)	5.40	*	[0.79; 33.5]	n.i.	n.i.	n.i.
	Environmental protection is an important value that he wants to teach his-her children	(1=Yes, 0=No)	0.39	**	[0.16; 0.89]	-67.51	.	[-152.4; 17.4]
	Wants support for water and environmental management	(1=Yes, 0=No)	2.70	**	[1.08; 6.9]	109.76	**	[16.6; 202.9]
		AIC	325.29			1225.01		
		Mc Fadden R^2	0.45			0.17		

Sample size: 424 households including 74 that participated in Watershared.

Table 4. Summary of the multinomial Logistic model of participation in the different types of Watershared. The reference level are the households that have not participated in any agreement (n=341). Estimates include community dummies for each community, but these are

not displayed in this table in order to save space. Two variables do not have enough variability to compute coefficients, which are thus coded as "n.a.". The code for the p-value is p<0.01 (***) – p<0.05 (**) – p<0.1 (*) – p<0.15 (.)

	Dependant variable		Participate in at least one Type 1 agreement		Participate in at least one agreement, but not Type 1	
	Covariates	Unit/Code	Odds ratio	p	Odds ratio	p
	Intercept		0.00	***	0.03	
Economic factors	Number of members	(number)	1.12		0.77	.
	Age of the head of the household	(years)	0.91	***	0.98	
	Head of the household went to primary school	(1=Yes, 0=No)	0.49		5.84	.
	Head of the household went to secondary school	(1=Yes, 0=No)	0.15		2.56	
	Total land area	(ha)	1.00		1.00	
	Proportion of forested land	(% of land area)	19.28	*	33.01	**
	Proportion of grassland	(% of land area)	13.43		15.08	
	Owns forested land	(1=Yes, 0=No)	1.34		6.33	**
	Owns cultivated land	(1=Yes, 0=No)	21.71	**	1.48	
	Number of cows	(number)	0.98		0.99	
	Owns at least one plough	(1=Yes, 0=No)	4.04	*	1.70	
	Owns at least one tractor	(1=Yes, 0=No)	20.29	**	40.85	***
	Has a credit with a bank, or a credit union, or a government fund.	(1=Yes, 0=No)	1.41		3.39	.
	Has no other income-generating activities	(1=Yes, 0=No)	0.10	**	0.87	
Pro-social factors	Is an authority/was an authority/is a member of an OTB	(1=Yes, 0=No)	n.a.	***	0.44	
	Is an authority/was an authority/is a member of a breeders' association	(1=Yes, 0=No)	8.66	**	33.92	***
	Is an authority/was an authority/is a member of a water cooperative	(1=Yes, 0=No)	1.46		0.08	***
	Participates in collective work (Minga, Faena, Ayni)	(1=Yes, 0=No)	6.83	***	5.34	**
	Number of days of community work devoted to water management	(number)	0.93		1.21	**
	Trusts institutions and NGOs	(1=Yes, 0=No)	0.07	***	0.24	**
	Agrees that "People in his community work together to solve common problems"	(1=Yes, 0=No)	4.91	*	0.34	
	Thinks that decisions made by his-her community are fair	(1=Yes, 0=No)	0.74		0.10	**
Pro-environmental factors	Agrees that "to improve living conditions, it is necessary to damage the environment."	(1=Yes, 0=No)	7.46	***	0.41	
	Agrees that "If your neighbours do nothing for the environment, you should do nothing either."	(1=Yes, 0=No)	0.20	*	2.09	
	Is in favour of the imposition of forest standards by the government	(1=Yes, 0=No)	n.a.	***	1.00	
	Knows how his-her community can protect the environment	(1=Yes, 0=No)	5.95	*	5.48	.
	Thinks that the forest provides fodder, non-timber forest products, timber, firewood and bush meat	(1=Yes, 0=No)	0.27		0.28	.
	Thinks that the forest brings rain, maintains water quality, maintains water quantity, stabilizes the climate	(1=Yes, 0=No)	2.54		3.42	*

	Thinks that the forest brings a nice view	(1=Yes, 0=No)	31.87	**	4.50
	Environmental protection is an important value that he wants to teach his-her children	(1=Yes, 0=No)	0.44		0.27 *
	Wants support for water and environmental management	(1=Yes, 0=No)	4.50	**	2.92 .
	Thinks that the destruction of the environment is a major challenge for his-her community	(1=Yes, 0=No)	0.28	.	2.32
		Residual Deviance	235.90		
		AIC	451.90		
		Mc Fadden R^2	0.55		

Sample size: 421 households including 34 that have participated in at least one Type 1 agreement and 37 that participated in ARAs of any type except Type 1

Figures

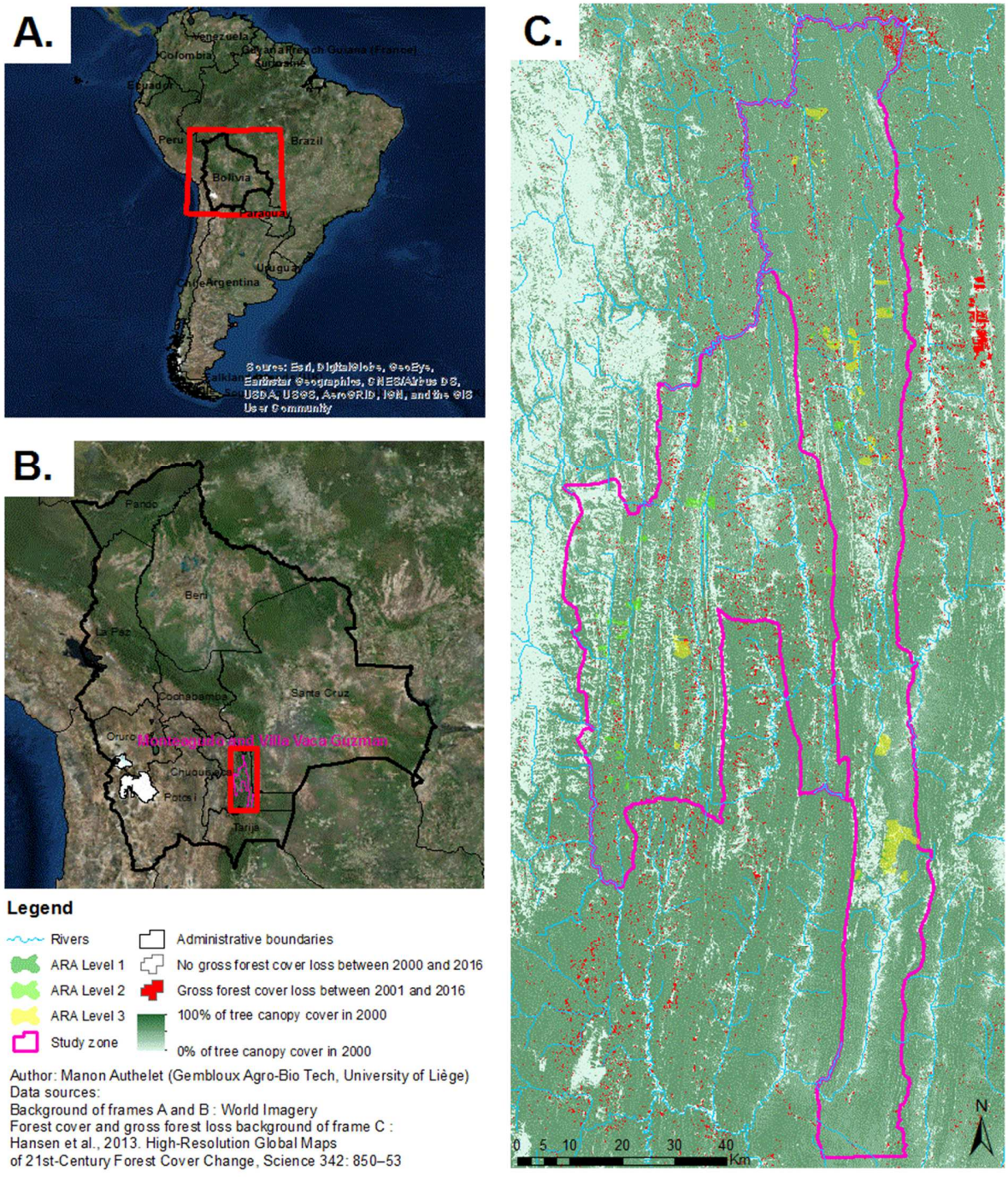

Figure 1. Map of the study area. Frame A: Location of Bolivia within South America. Frame B: Location of the departments of Bolivia and of the municipalities of Monteagudo and Villa Vaca Guzman within Chuquisaca department. Frame C: The green scale in the background represents tree canopy cover in 2000 (from Hansen et al., 2013). Cultivated valleys extending North-South have less forest cover and are thus lighter. The tree-covered pixels that have been lost between 2001 and 2016 are in red, representing 18,518 ha of gross tree cover loss. Individual plots under conservation agreements are represented by yellow to bright green polygons, according to the three types of agreement.

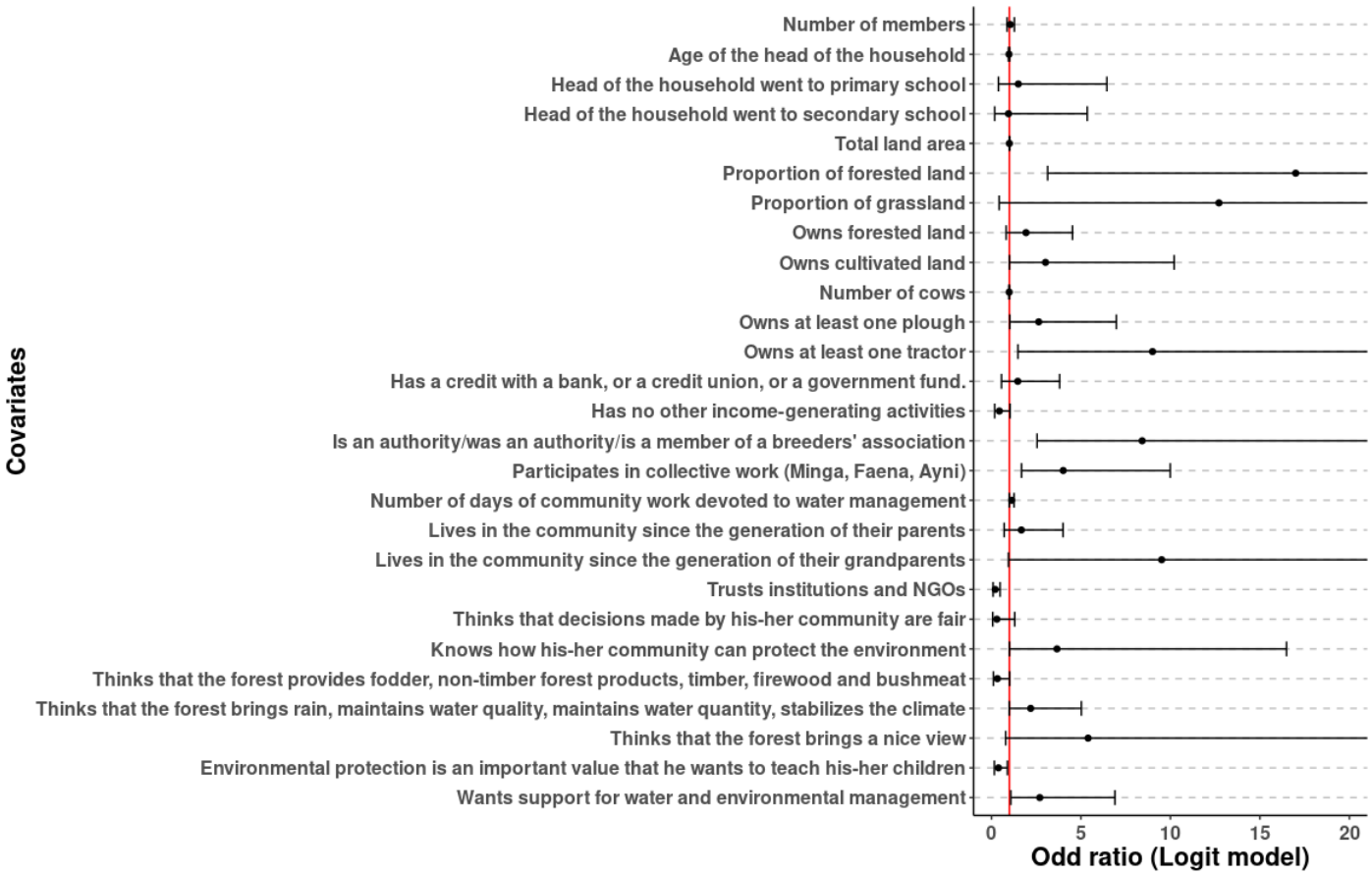

Figure 2. Determinants of participation in Watershared. Graphical representation of the coefficients of model 1 (Logit model)

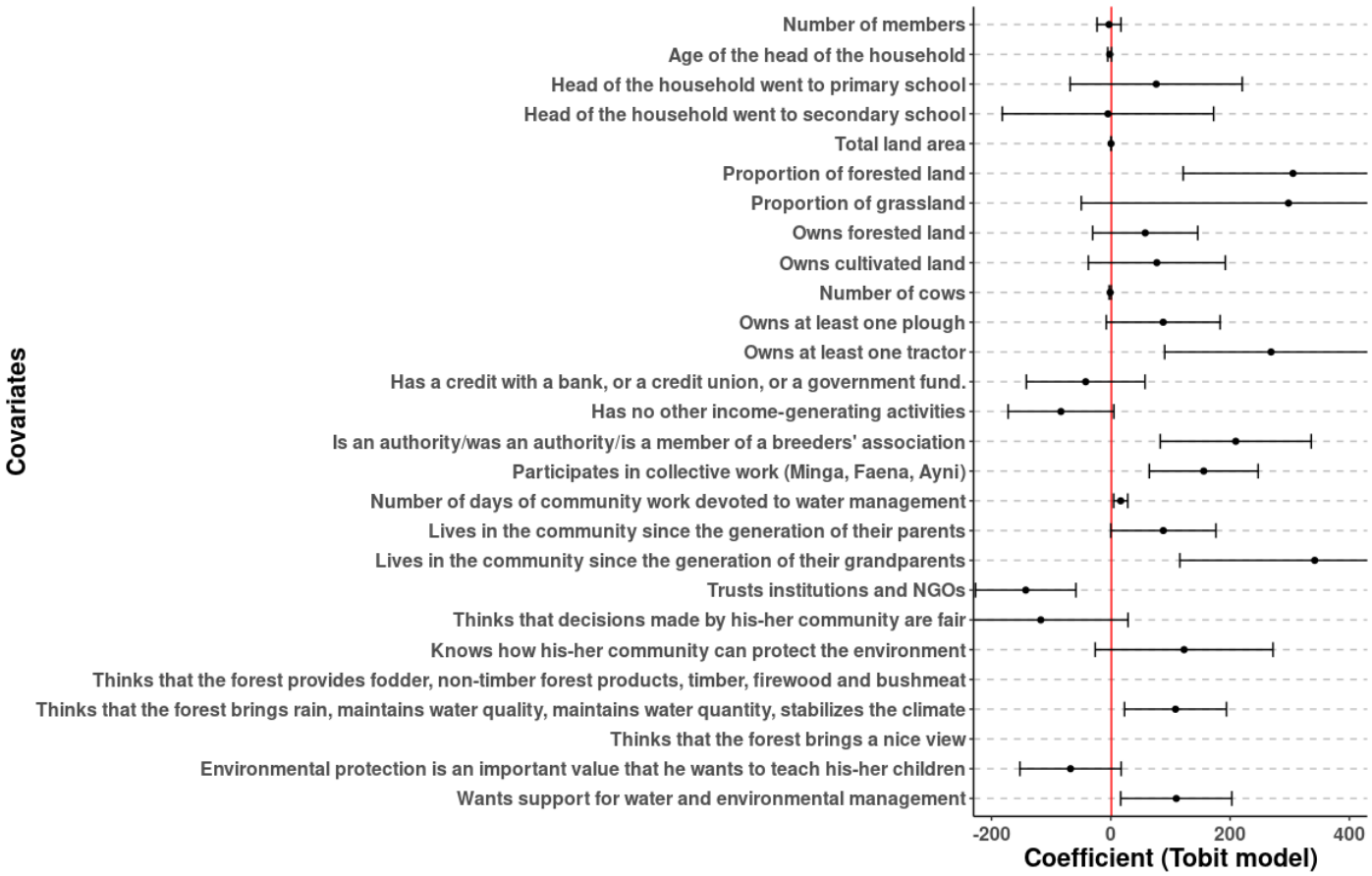

Figure 3. Determinants of the surface area engaged in Watershared. Graphical representation of the coefficients of model 2 (Tobit model)

Appendices

Appendix 1. Summary of the censored Tobit model for the area enrolled in Watershared, using values in hectares for land instead of proportional values. Estimates include community dummies for each community, but these are not displayed in this table in order to save space. The code for the p-value is p<0.01 (***) – p<0.05 (**) – p<0.1 (*) – p<0.15 (.)

	Type of statistical model		Tobit	
	Covariates	Unit/Code	Coef	p
	Intercept		-735.03	***
Economic factors	Number of members	(number)	0.19	
	Age of the head of the household	(years)	-1.84	
	Head of the household went to primary school	(1=Yes, 0=No)	109.76	.
	Head of the household went to secondary school	(1=Yes, 0=No)	48.35	
	Area of forested land	(ha)	0.63	***
	Area of grassland	(ha)	-1.26	
	Area of cultivated land	(ha)	-5.37	.
	Owns forested land	(1=Yes, 0=No)	97.94	**
	Owns cultivated land	(1=Yes, 0=No)	144.45	**
	Number of cows	(number)	-0.13	
	Owns at least one plough	(1=Yes, 0=No)	87.32	*
	Owns at least one tractor	(1=Yes, 0=No)	257.83	***
	Has a credit with a bank, or a credit union, or a government fund.	(1=Yes, 0=No)	-23.18	
	Has no other income-generating activities	(1=Yes, 0=No)	-106.48	**
Pro-social factors	Is an authority/was an authority/is a member of a breeders' association	(1=Yes, 0=No)	208.93	***
	Participates in collective work (Minga, Faena, Ayni)	(1=Yes, 0=No)	153.04	***
	Number of days of community work devoted to water management	(number)	14.72	**
	Lives in the community since the generation of their parents	(1=Yes, 0=No)	72.41	.
	Lives in the community since the generation of their grandparents	(1=Yes, 0=No)	324.93	***
	Trusts institutions and NGOs	(1=Yes, 0=No)	136.18	***
	Thinks that decisions made by his-her community are fair	(1=Yes, 0=No)	-83.77	
Pro-environmental factors	Knows how his-her community can protect the environment	(1=Yes, 0=No)	133.25	*
	Thinks that the forest brings rain, maintains water quality, maintains water quantity, stabilizes the climate	(1=Yes, 0=No)	91.32	**
	Environmental protection is an important value that he wants to teach his-her children	(1=Yes, 0=No)	-49.01	
	Wants support for water and environmental management	(1=Yes, 0=No)	96.89	**

AIC	1233.84	
Mc Fadden R^2	0.17	

Sample size: 424 households including 74 that participated in ARAs

Appendix 2. Summary of the censored Tobit model for the area enrolled in Watershared using the ownership of unsuitable forested land instead of the ownership of forest variable. Estimates include community dummies for each community, but these are not displayed in this table in order to save space. The code for the p-value is p<0.01 (***) – p<0.05 (**) – p<0.1 (*) – p<0.15 (.)

	Dependant variable		Total area under agreement (ha)	
	Type of statistical model		Tobit	
	Covariates	Unit/Code	Coef	p
	Intercept		-595.55	***
Economic factors	Number of members	(number)	-3.12	
	Age of the head of the household	(years)	-1.50	
	Head of the household went to primary school	(1=Yes, 0=No)	134.56	*
	Head of the household went to secondary school	(1=Yes, 0=No)	80.70	
	Area of forested land	(ha)	0.60	***
	Area of grassland	(ha)	-0.82	
	Area of cultivated land	(ha)	-5.22	.
	Maintained forested land because it was unsuitable for other purposes	(1=Yes, 0=No)	148.62	***
	Owns cultivated land	(1=Yes, 0=No)	149.63	***
	Number of cows	(number)	-0.53	
	Owns at least one plough	(1=Yes, 0=No)	70.99	.
	Owns at least one tractor	(1=Yes, 0=No)	275.11	***
	Has a credit with a bank, or a credit union, or a government fund.	(1=Yes, 0=No)	-37.81	
	Has no other income-generating activities	(1=Yes, 0=No)	-100.90	**
Pro-social factors	Is an authority/was an authority/is a member of a breeders' association	(1=Yes, 0=No)	211.73	***
	Participates in collective work (Minga, Faena, Ayni)	(1=Yes, 0=No)	152.98	***
	Number of days of community work devoted to water management	(number)	15.25	**
	Lives in the community since the generation of their parents	(1=Yes, 0=No)	81.11	*
	Lives in the community since the generation of their grandparents	(1=Yes, 0=No)	361.31	***
	Trusts institutions and NGOs	(1=Yes, 0=No)	-134.95	***
	Thinks that decisions made by his-her community are fair	(1=Yes, 0=No)	-80.44	

Pro-environmental factors	Knows how his-her community can protect the environment	(1=Yes, 0=No)	111.63	.
	Thinks that the forest brings rain, maintains water quality, maintains water quantity, stabilizes the climate	(1=Yes, 0=No)	88.40	**
	Environmental protection is an important value that he wants to teach his-her children	(1=Yes, 0=No)	-47.22	
	Wants support for water and environmental management	(1=Yes, 0=No)	90.15	*
		AIC	1216.95	
		Mc Fadden R^2	0.18	

Sample size: 424 households including 74 that participated in ARAs

Appendix 3. Summary of the Heckman model

			Result equation			Selection equation		
	Dependant variable		Total area under agreement (ha)			Participate (1=Yes, 0=No)		
	Covariates	Unit/Code	Coef.	Std. Err.	95% CI	Coef.	Std. Err.	95% CI
Economic factors	Number of members	(number)	5.92	82,47	[-155.72; 167.56]	0.06	0.06	[-0.05; 0.18]
	Age of the head of the household	(years)	-7.36	12,84	[-32.52; 17.80]	-0.01	0.01	[-0.03; 0.01]
	Head of the household went to primary school	(1=Yes, 0=No)	182.82	485,85	[-769.44; 1135.07]	0.14	0.38	[-0.61; 0.90]
	Head of the household went to secondary school	(1=Yes, 0=No)	-72.58	702,03	[-1448.53; 1303.36]	-0.34	0.48	[-1.29; 0.60]
	Total land area	(ha)	-0.09	1,01	[-2.06; 1.89]	0.00	0.00	[0.00; 0.00]
	Proportion of forested land	(% of land area)	1081.81	1394,05	[-1650.47; 3814.09]	1.84	0.54	[0.79; 2.90]
	Proportion of grassland	(% of land area)	414.30	1408,26	[-2345.84; 3174.43]	0.97	0.96	[-0.91; 2.85]
	Owns forested land	(1=Yes, 0=No)	-5.74	761,61	[-1498.46; 1486.98]	0.14	0.56	[-0.96; 1.24]
	Owns cultivated land	(1=Yes, 0=No)	231.13	697,41	[-1135.78; 1598.04]	0.71	0.36	[0.00; 1.43]
	Number of cows	(number)	-0.11	2,10	[-4.23; 4.01]	0.00	0.00	[-0.01; 0.00]
	Owns at least one plough	(1=Yes, 0=No)	229.80	346,00	[-448.34; 907.95]	0.48	0.28	[-0.07; 1.02]
	Owns at least one tractor	(1=Yes, 0=No)	818.15	1033,85	[-1208.16; 2844.46]	1.35	0.49	[0.39; 2.32]
	Has a credit with a bank, or a credit union, or a government fund.	(1=Yes, 0=No)	-46.96	344,10	[-721.39; 627.47]	0.15	0.28	[-0.40; 0.70]
	Has no other income-generating activities	(1=Yes, 0=No)	-304.44	428,83	[-1144.92; 536.05]	-0.53	0.25	[-1.03; -0.04]
- social	Is an authority/was an authority/is a member of a breeders' association	(1=Yes, 0=No)	560.27	816,45	[-1039.94; 2160.49]	1.22	0.35	[0.53; 1.90]

	Participates in collective work (Minga, Faena, Ayni)	(1=Yes, 0=No)	340.65	598,04	[-831.48; 1512.78]	0.83	0.26	[0.33; 1.33]
	Number of days of community work devoted to water management	(number)	35.51	59,98	[-82.04; 153.07]	0.07	0.03	[0.00; 0.13]
	Lives in the community since the generation of their parents	(1=Yes, 0=No)	205.63	391,10	[-560.91; 972.17]	0.38	0.25	[-0.10; 0.86]
	Lives in the community since the generation of their grandparents	(1=Yes, 0=No)	935.13	1415,28	[-1838.77; 3709.03]	1.59	0.70	[0.22; 2.95]
	Trusts institutions and NGOs	(1=Yes, 0=No)	-309.85	558,96	[-1405.39; 785.69]	-0.91	0.25	[-1.39; -0.43]
	Thinks that decisions made by his-her community are fair	(1=Yes, 0=No)	-322.03	591,34	[-1481.03; 836.98]	-0.59	0.43	[-1.43; 0.25]
Pro-environmental factors	Knows how his-her community can protect the environment	(1=Yes, 0=No)	482.27	599,00	[-691.75; 1656.30]	0.68	0.39	[-0.08; 1.43]
	Thinks that the forest provides fodder, non-timber forest products, timber, firewood and bushmeat	(1=Yes, 0=No)	-235.13	481,40	[-1178.65; 708.40]	-0.50	0.33	[-1.16; 0.15]
	Thinks that the forest brings rain, maintains water quality, maintains water quantity, stabilizes the climate	(1=Yes, 0=No)	276.20	468,86	[-642.74; 1195.15]	0.53	0.24	[0.07; 0.99]
	Thinks that the forest brings a nice view	(1=Yes, 0=No)	490.53	855,51	[-1186.24; 2167.30]	1.22	0.52	[0.20; 2.23]
	Environmental protection is an important value that he wants to teach his-her children	(1=Yes, 0=No)	-114.32	424,25	[-945.83; 717.18]	-0.55	0.25	[-1.04; -0.07]
	Wants support for water and environmental management	(1=Yes, 0=No)	357.93	494,47	[-611.21; 1327.07]	0.56	0.26	[0.04; 1.08]

Notes: Nb of obs. is 413 (incl. 341 censored obs and 72 uncensored obs.) Dummy variables for villages are included in the model but are not displayed here for readability purposes.

Appendix 4. Summary of the Hurdle model

			Result equation			Selection equation		
	Dependant variable		Total area under agreement (ha)			Participate (1=Yes, 0=No)		
	Covariates	Unit/Code	Coef.	Std. Err.	95% CI	Coef.	Std. Err.	95% CI
Economic factors	Number of members	(number)	0,01	0,11	[-0.20; 0.22]	0,06	0,06	[-0.05; 0.18]
	Age of the head of the household	(years)	-0,01	0,01	[-0.04; 0.02]	-0,01	0,01	[-0.03; 0.01]
	Head of the household went to primary school	(1=Yes, 0=No)	2,38	0,69	[1.03; 3.73]	0,14	0,38	[-0.61; 0.90]
	Head of the household went to secondary school	(1=Yes, 0=No)	1,67	0,91	[-0.12; 3.46]	-0,34	0,48	[-1.29; 0.60]
	Total land area	(ha)	0,00	0,00	[0.00; 0.00]	0,00	0,00	[0.00; 0.00]
	Proportion of forested land	(% of land area)	1,15	0,90	[-0.62; 2.92]	1,84	0,54	[0.79; 2.90]
	Proportion of grassland	(% of land area)	-2,18	1,94	[-5.98; 1.63]	0,97	0,96	[-0.91; 2.85]
	Owns forested land	(1=Yes, 0=No)	-2,72	1,04	[-4.76; -0.69]	0,14	0,56	[-0.96; 1.24]

	Owns cultivated land	(1=Yes, 0=No)	-1,01	0,83	[-2.64; 0.62]	0,71	0,36	[0.00; 1.43]
	Number of cows	(number)	0,00	0,00	[0.00; 0.01]	0,00	0,00	[-0.01; 0.00]
	Owns at least one plough	(1=Yes, 0=No)	1,44	0,39	[0.68; 2.19]	0,48	0,28	[-0.07; 1.02]
	Owns at least one tractor	(1=Yes, 0=No)	0,98	0,66	[-0.32; 2.28]	1,35	0,49	[0.39; 2.32]
	Has a credit with a bank, or a credit union, or a government fund.	(1=Yes, 0=No)	-0,43	0,47	[-1.36; 0.50]	0,15	0,28	[-0.40; 0.70]
	Has no other income-generating activities	(1=Yes, 0=No)	-0,60	0,36	[-1.31; 0.10]	-0,53	0,25	[-1.03; -0.04]
Pro-social factors	Is an authority/was an authority/is a member of a breeders' association	(1=Yes, 0=No)	1,07	0,50	[0.09; 2.06]	1,22	0,35	[0.53; 1.90]
	Participates in collective work (Minga, Faena, Ayni)	(1=Yes, 0=No)	-0,95	0,40	[-1.73; -0.17]	0,83	0,26	[0.33; 1.33]
	Number of days of community work devoted to water management	(number)	-0,09	0,05	[-0.18; 0.01]	0,07	0,03	[0.00; 0.13]
	Lives in the community since the generation of their parents	(1=Yes, 0=No)	-0,18	0,39	[-0.95; 0.58]	0,38	0,25	[-0.10; 0.86]
	Lives in the community since the generation of their grandparents	(1=Yes, 0=No)	0,93	1,41	[-1.84; 3.70]	1,59	0,70	[0.22; 2.95]
	Trusts institutions and NGOs	(1=Yes, 0=No)	0,34	0,39	[-0.43; 1.10]	-0,91	0,25	[-1.39; -0.43]
	Thinks that decisions made by his-her community are fair	(1=Yes, 0=No)	0,48	0,63	[-0.75; 1.71]	-0,59	0,43	[-1.43; 0.25]
Pro-environmental factors	Knows how his-her community can protect the environment	(1=Yes, 0=No)	0,19	0,57	[-0.94; 1.31]	0,68	0,39	[-0.08; 1.43]
	Thinks that the forest provides fodder, non-timber forest products, timber, firewood and bushmeat	(1=Yes, 0=No)	0,99	0,46	[0.10; 1.89]	-0,50	0,33	[-1.16; 0.15]
	Thinks that the forest brings rain, maintains water quality, maintains water quantity, stabilizes the climate	(1=Yes, 0=No)	0,92	0,53	[-0.11; 1.95]	0,53	0,24	[0.07; 0.99]
	Thinks that the forest brings a nice view	(1=Yes, 0=No)	-0,60	0,76	[-2.10; 0.89]	1,22	0,52	[0.20; 2.23]
	Environmental protection is an important value that he wants to teach his-her children	(1=Yes, 0=No)	1,53	0,41	[0.73; 2.34]	-0,55	0,25	[-1.04; -0.07]
	Wants support for water and environmental management	(1=Yes, 0=No)	-0,34	0,36	[-1.05; 0.37]	0,56	0,26	[0.04; 1.08]

Notes: Nb of obs. is 413. Dummy variables for villages are included in the model but are not displayed here for readability purposes.

Endnotes

[1]A PES is a voluntary contractual transaction between suppliers of ES, playing a central role in the production or maintenance of these services and who incur its costs, and ES users (Wunder, 2015).

[2]Social norms are reflected in a shared, informal and implicit understanding of how to behave in regular social situations, encouraging people to act in ways that are compatible with the expectations of others (Fehr and Fischbacher, 2004; Thøgersen, 2006), because they may fear social sanctions if they violate social norms or because they may think that the most common behaviour is the most logical, efficient or appropriate one.

[3]Natura also argues that relying on other types of motivations is less costly because they don't have to pay the exact opportunity cost of conservation, nor calculate it through extensive studies (Asquith, 2016). Indeed, the monetary per hectare value of Watershared compensation packages is very low compared to most PES programs. Natura does not calculate the value of the services produced by upstream farmers' forests, meaning that Watershared agreements are fundamentally different from other market-based instruments for conservation such as PES.

[4]According to some beneficiaries Natura's relationships with communities are quite varied and the public distribution of compensations does not always happen in this idealized way.

[5]However, these collective environmental education sessions are short (about 15 minutes) and only take place once (when the Agreements are offered).

[6]Note that the variable used as a measure of the intensity of participation captures only one aspect of the effort made by the participant, since the nature of the land enrolled is not known.