

Environmental effectiveness, Economic effectiveness and Equity - a case study of Payments for Environmental Services (PES) in Hojancha, Costa Rica

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Forest plantations in Hojanca, Costa Rica (Foto: Signe V. Rugtveit)

Preface

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Abstract

Payments for Environmental services (PES) has been considered a cost-effective instrument to deal with negative externalities such as CO₂ emissions and loss of biodiversity, in addition to providing co-benefits such as poverty reduction. Costa Rica has been considered a success among developing countries for regaining forest cover after high deforestation trends in the 1960s and 1970s and the PSA ('Pagos Por Servicios Ambientales') program implemented in 1996, has been partly credited for this. However, the program, like many PES schemes, have also being criticized for low environmental effectiveness due to lack of additionality (i.e. the forest would have been preserved anyway; without payments), high transaction- and compliance costs, and the obstacles to participate that smallholders face.

This thesis evaluates PES schemes in the canton of Hojancha in Costa Rica with respect to environmental effectiveness, economic effectiveness and equity. Evaluating two contract types, forest protection and reforestation (timber plantations), the results seem to support the general critic of the country's PSA program. Reforestation seems to provide most of the additionality (additional forest cover/environmental effectiveness). However, high participation costs appear to be an issue lowering cost-effectiveness, especially compliance costs for reforestation participants, and impeding participation for many potential participants. Also, the PSA applicants are characterized by having large properties, which supports the notion of smallholders being less likely to participate in the PSA program. There are, however, also other issues that need to be considered when evaluating the success of this PES scheme; including the Forest Law which prohibits forest clearing, leading to low additionality; and the question of whether timber plantations provide actual environmental services.

Sammendrag

Betaling for økosystemtjenester (PES) har vært sett på som et kostnadseffektivt virkemiddel for å håndtere negative eksterne effekter som CO₂-utslipp og tap av biodiversitet, i tillegg til å bidra til andre fordeler, som fattigdomsreduksjon. Costa Rica har vært sett på som en suksess blant utviklingsland for å gjenvinne skogdekke etter å ha hatt høy avskogingsrate i 1960 og 70-årene, og PSA (Pagos Por Servicios Ambientales) programmet som ble innført i 1996 har delvis fått æren for dette. Programmet er likevel, slik som mange PES programmer blitt kritisert for lav miljøeffektivitet som en følge av mangel på addisjonalitet (dvs. at skogen ville blitt bevart i alle fall, uten betaling), høye transaksjons- og gjennomføringskostnader, og for hindringer for å delta som små landeiere møter på.

Denne oppgaven evaluerer PES programmet i kommunen Hojancha i Costa Rica med hensyn på miljøeffektivitet, økonomisk effektivitet og likhet. Etter å ha evaluert to kontrakttyper, skogbevaring og gjenskoging (tømmerplantasjer), ser resultatene ut til å vise at de støtter den generelle kritikken av landets PSA program. Gjenskoging ser ut til å sørge for det meste som er av addisjonalitet (tillegg i skogdekket/miljøeffektivitet). Uansett ser høye deltakelseskostnader ut til å være noe som reduserer kostnadseffektiviteten, spesielt gjennomføringskostnader for deltakerne i gjenskoging, og hindrer deltakelse for mange potensielle deltakere. I tillegg er et kjennetegn ved PSA-søkerne at de ser ut til å ha større eiendommer, noe som støtter antakelsen om at det er mindre sannsynlighet for at små landeiere deltar i PSA programmet. Det er likevel andre ting som må tas med i betraktning ved en evaluering av graden av suksess for dette PES programmet, som inkluderer skogloven fra 1996 som forbyr hogst av skog, noe som fører til lav addisjonalitet; i tillegg til spørsmålet om tømmerplantasjer fører til faktiske miljø/økosystemtjenester.

Summary

The negative environmental effects caused by deforestation, have the last decades received increased attention, and various policies have been developed in order to deal with the challenges and negative externalities in terms of CO₂ emissions and loss of biodiversity. Payments for Environmental Services (PES) is an instrument believed to be cost-effective compared to traditional command-and-control measures. Costa Rica implemented their PES program 'Pagos Por Servicios Ambientales' (PSA) in 1996 and has been considered a pioneer and success as a developing country dealing with its deforestation problems in the 1960s and 70s. Four contract modalities exist today, including two of them on forest protection and reforestation (timber plantations). The program has been criticized for low environmental effectiveness, hence low opportunity cost of land among especially protection participants, leading to low additionality, especially; high transaction- and compliance costs for participants leading to lower cost-effectiveness, and that participants often are larger landowners, better educated etc.

I have performed a case study in the canton of Hojancha and surrounding areas in Costa Rica, evaluating environmental effectiveness, economic effectiveness and equity. Concerning environmental effectiveness (in terms of forest cover), I have looked at opportunity cost factors of land for participants vs. non-participants and for protection participants vs. reforestation participants. Regarding environmental effectiveness, I have calculated transaction- and compliance costs to find out how large part of the payments they represent in addition to looking at factors concerning landowners not participating in PSA. I have also looked at the opportunity costs of land for contract applicants vs. recipients concerning cost-effectiveness. As to equity, I have studied factors affecting participation in PES.

Hojancha is one of the first places in the country where incentives for reforestation were introduced, and where the recovery of the landscape has been significant the past decades. Today, a large part of all contracts signed in this area are reforestation contracts, as compared to the rest of the country, where it represents only a small percentage.

The theory the study is based on is primarily the 'Public Private Benefits framework' by Pannel, D.J. (2008), stating that negative incentives (protection contracts) should be used in

cases with positive private net benefits, negative public net benefits and public net costs outweighing the private net benefits. In order for the incentives to work efficiently, the payments should thus not be provided unless there would be undertaken changes to land use in the absence of them. The opposite applies to positive incentives (reforestation), which should only be used in cases with negative private net benefits and private net costs should not outweigh public net benefits. When it comes to transaction- and compliance costs, or “learning costs”, these are important as there in the presence of such costs may be need for increasing payments to make it privately profitable for landowners to enjoy the program. Landholders that in the end might have resulted with positive private net benefits may be prevented from entering the program.

I performed a household survey, interviewing 207 farmers, including 31 protection participants, 32 in reforestation, and 135 non-participants who had never had a PSA contract. For opportunity cost factors and differences between participants/non-participants and protection/reforestation contracts, I performed a logistic regression for binary response. As to transaction- and compliance costs, appliance costs and establishment- (plantation), maintenance- and other similar costs were calculated and the percentage was compared to the payment levels of the respective contract type. I also had data on self-reported alternative land-uses in case of not receiving payments, main uses of payments, reasons for not participating among the non-participants, and main issues that should be improved to the program according to participants.

Regarding the results; as to the environmental effectiveness, there was found little evidence of less opportunity costs of land for participants than for non-participants. As to differences between protection and reforestation contract land, there was found a few significant variables. However, the results were supported by the self-reported land-use alternatives in the absence of payments stated by the landholders, in addition to the main uses of the payments. This indicated higher opportunity costs of land for reforestation participants than protection participants, thus higher additionality, and in addition that reforestation payments seem to appear as a subsidy for timber production. There are however, critics concerning what kind of environmental services the reforestation contract actually provide, due to the issue that for example some tree species are very nutrient demanding in addition to the trees being permitted to harvest after 15 years.

When it comes to the cost-effectiveness issue, transaction- and compliance costs, the transaction costs (appliance costs) do not appear to be very high among participants, but compliance costs, especially for reforestation participants, appear to be substantial relative to the payment level. There is however high variation in the data. In addition, there are most likely costs that are not included in the calculation. Regarding non-participants, transaction- and compliance costs of PSA and low payment level appear to be a key factor that many landholders do not apply. These costs thus appear to be high and prevent several landholders from participation and hence also likely to prevent cost-effectiveness. Regarding the opportunity cost and cost-effectiveness related to applicants and recipients, there did not seem to be much difference. There does hence not seem to be any specific selection when it comes to landowners with lower opportunity costs.

As to the equity perspective, several variables turned out to be significant, even though not all with the expected sign. However, it gives some indications that there are certain characteristics typical to participants also in the case study area, but it may be that the presence of intermediary plays a role to some extent. Data on reasons that non-participants give for not applying and opinions from participants on what should be improved support the hypotheses of high transaction costs and low payments being a major obstacle.

The results from Hojanca and the surrounding areas seem to support many of the general critics of PES, such as lack of environmental and economic effectiveness. The canton is as mentioned a particular place, and there has been a considerable development and improvement in forest cover and these things need to be taken into consideration for designing such a program.

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Abbreviations

CAF – Forest Credit Certificate

CAFA – Forest Credit Certificate in Advance

CPB – Forest Protection Certificate

ES – Environmental Service

FONAFIFO – The National Forest Financing Fund

GEF – Global Environmental Facility

GIS – Geographical Information System

MAG – Ministry of Agriculture

MINAET – Ministry of Environment and Energy

PES – Payments for Environmental Services

PSA – Pagos Por Servicios Ambientales

SAF – Sistemas Agro Forestales (The agroforestry modality)

SINAC – National System of Conservation Areas (Sistema Nacional de Áreas de Conservación)

TC – Transaction Costs

WTA – Willingness to Accept

WTP – Willingness to Pay

1 Introduction

1.1 Background

During the last decades, the attention toward greenhouse gas emissions, biodiversity loss and other negative effects on the environment as a result of deforestation, has been increasing. Deforestation and forest degradation is said to account for 20% of the total CO₂ emissions globally (e.g. Angelsen 2008, Burgess et al, 2011).

There has been developed various policies aiming to deal with the problems of deforestation and the negative externalities they impose on society. The international society has spent, and continues to spend, millions of dollars to try to deal with these problems. In this regard, Payments for Environmental Services (PES) is considered, depending on land-use and conservation values, to be a more cost-effective environmental policy instrument to correct for negative externalities (such as loss of biodiversity and CO₂ emissions), than traditional command-and-control instruments, such as land-use restrictions, that have been the dominating conservation approach (e.g. Ferraro and Kiss. 2002, Engel et al. 2009).

PES is considered to become effective, cost-efficient and equitable instruments for the implementation of REDD+ (Reducing Emissions from Deforestation and Forest Degradation) on the national and local level (Wunder, 2009). REDD+ is a mechanism that intends to create a financial value for the carbon that is stored in forests, and is supposed to offer incentives to developing countries “to reduce emissions from forested lands and invest in low-carbon paths to sustainable development” (UN-REDD, 2012). The program now also includes conservation, sustainable management of forests and enhancement of forest carbon stocks” (ibid.).

Thus, PES in general is related to REDD+ as it is a market-based approach, working as a direct way of recognising the values and positive externalities that ecosystem services represent. It creates a voluntary system in which landowners receive payments as an economic incentive for providing environmental services. Environmental/ecosystem services can be defined as:

“the beneficial outcomes, for the natural environment or people resulting from ecosystem functions. Ecosystem functions are the physical, chemical and biological processes or attributes that occur within ecosystems such as wetlands, forests or estuaries. These contribute to the self-maintenance of an ecosystem”
(Zandersen et al 2009, p.23).

PES differs from targeted subsidies in that it implies conditionality, meaning that the service delivery must be secured, which depends on a well functioning monitoring and sanctioning system.

Latin America is a region that has experienced high deforestation rates the last few decades, and Costa Rica is one of the countries experiencing high deforestation rates, especially in the 1960s and 70s. It holds a very high level of biodiversity, high density of species (e.g. Sanchez-Azofeifa, 2001). However, Costa Rica has been considered a pioneer and a success story among development countries when it comes to handling its deforestation problems. In 1996/1997, the country implemented its PSA (‘Pagos por Servicios Ambientales’) program, a government-led PES program paying private landowners for providing environmental services, and the program has partly been credited for the low deforestation rates that the Costa Rica experiences today.

However, there have been several critics of the country’s PSA program when it comes to lack of efficiency/effectiveness especially, which include:

- i) Lack of additionality or lack of environmental effectiveness, implies that there is none or little increase in environmental services (or in this case forest cover), compared to a predefined baseline, or in the absence of payments. The additionality of PSA in Costa Rica has been questionable, and it is claimed that the country’s success is based on the previously implemented measures, such as reforestation incentives (Sanchez-Azofeifa et al. 2007, Pagiola. 2008). Many landowners participating in the program are claimed to have low or negative opportunity cost of their land, and combined with the ban of forest clearing in Costa Rica, the Forest Law from 1996, the landowners seem in many cases to

have protected their forests in any case (Pagiola. 2008, Wünscher et al. 2006). Reforestation therefore appears as the primary cause of ‘real’ land-use change in Costa Rica. The country does not have additionality as an explicit target for the PSA program. Its focus is rather to compensate landowners for the environmental services their forests or plantations provide (hence, instead of providing payments to the farmers to increase environmental services (i.e. through forest protection) relative to a baseline, the farmers receive payments for the value of the environmental services their forests etc. already provide). This can be seen in connection with the Forest Law from 1996.

- ii) The second problem is related to cost-effectiveness – high transaction and contract implementation costs in addition to low opportunity costs. These include costs related to the application process for a contract and the costs involved with fulfilling the contract requirements. The transaction- and compliance costs will from the farmers’ perspective affect whether they will decide to apply for a PSA contract, (assuming they will participate as long as they find it privately profitable) or not. The level of transaction costs in the PSA program have been criticized for being high, and a result of a complicated application procedure, and in that way also being a significant impediment for poorer landholders to participate (Pagiola 2005, 2008).

When it comes to the equity question, poverty reduction is not an explicit target in Costa Rica’s PSA program, but with the right design, such programs are considered instruments that may contribute to this in addition to environmental services (Pagiola, 2005). Larger landholders are for example found to be more likely to have a contract than smaller ones and off-farm income in addition to have higher education (Zbinden and Lee, 2005).

The case study area selected for this study is the canton of Hojancha and surrounding areas, located in the province of Guanacaste, northwest at the Pacific coast of Costa Rica. This is an area that experienced high levels of deforestation, but which has recovered substantially the forest cover over the years, and was one of the places in the country where forest incentives were first implemented and remain highly prevalent. It is also an area where reforestation is a widespread activity and there are many PSA participants in both forest protection and in

reforestation contracts compared to elsewhere in the country, making it an interesting area to explore the mentioned challenges to PES programs and to look at how cost-effectiveness issues can be addressed.

1.2 Problem statement and hypotheses

Main problem statement:

To evaluate Costa Rica's PSA program in Hojancha not working appropriately with respect to:

- i) Environmental effectiveness (opportunity cost of land)
- ii) Economic effectiveness (cost-effectiveness)
- iii) Equity perspective

Environmental effectiveness (additionality)

As mentioned, additionality implies to increase the level of environmental services (conserved forest or planted trees in this case), and this will often depend on the farmers' opportunity cost of land. In order to be able to say something about this, I will be looking at opportunity cost factors of land, such as biophysical characteristics of the farm area, whether there has been offer to sell the farm, farm size, number of cattle, and compare participants and non-participants. As reforestation participants are assumed to have higher opportunity cost of land than protection participants, this issue is also addressed. The number of cattle is included as a factor since this traditionally has been the main economic activity in the case study area and often considered the most relevant land-use.

1. Do PSA participants have lower opportunity costs of land than non-participants (do the incentives cause positive public net benefits)?

H. 1: a. Forest protection participants have less cattle/livestock than non-participants.

b. Reforestation participants have less cattle/livestock than non-participants.

H. 2: a. Forest protection participants are more likely to have less favourable biophysical conditions (poor soils and steep slope) than non-participants.

- H. 3: a. Forest protection participants are less likely to have been offered to sell their property than non-participants.
- H. 4: a. Forest protection participants are more likely to have larger properties and/or several parcels than non-participants
b. Reforestation participants are more likely to have larger properties and/or several farms/parcels than non-participants
- H. 5: a. Forest protection participants are more likely to have off-farm income and/or a second occupation than non-participants.
b. Reforestation participants are more likely to have off-farm income and/or a second occupation than non-participants.
- H. 6: a. Forest protection participants are more likely to have more difficult access to their farm than non-participants.

2. Do reforestation participants have higher opportunity cost of land than forest protection participants (do the positive incentives create higher public net benefits than the negative incentives)?

- H. 7: Reforestation participants have higher opportunity cost of land than protection participants (same opportunity cost factors as in H.1-H.6.).
- H. 8: Forest protection participants would express they would have kept the forest in any case (would not have cleared the forest even if they did not receive payment).
- H. 9: Reforestation participants would express that they would have reforested the area in any case (even if they did not receive payment).

Cost-effectiveness.

Cost-effectiveness with respect to PES implies low participation costs per unit environmental service. Hence, low total opportunity cost and transaction cost per hectare conserved or hectare reforested. In a program with a restricted budget and many applicants, there is a need for targeting concerning who the receivers of the contracts are. It is therefore a point to look at who receive contracts vs. who are those applying, whether there are differences in opportunity costs of land between these.

As to the transaction- and compliance costs, these are as mentioned, an important issue when it comes to whether a PES contract is attractive or not, also which type of policy that should be used in order for a program to be as cost-effective as possible. If the transaction costs represent too large a part of the payments, this obviously keep many landowners from applying for a PES contract, as well as creating too large costs overall. The 'establishment costs' are considered separately since they are of high importance to whether a farmer will consider a reforestation contract, and there are not given any payments in advance. These costs are hence compared to the first payment of the reforestation contract.

3. Are transaction- and compliance costs too high compared to payment level in order to make landowners decide to undertake the desired land-use change, and are opportunity cost of land lower among recipients than applicants?

H. 10: The transaction costs and compliance costs combined represent more than 30% (*Rodriguez, 2008*) of the PES payment received.

H. 11: The plantation establishment costs are less than the first payment in the contract for reforestation (50% of the total).

H. 12: The transaction- and compliance costs related to the reforestation contract are higher than those costs related to the forest protection contract, (relative to the PES-payment received).

H. 13: There are not lower opportunity costs among the contract receivers than the contract applicants (there is a lack of targeting when it comes to opportunity cost of land).

Equity perspective

In order to be able to say something about whether there are certain farmer characteristics dominating among PSA participants in the case study area, I have looked at factors that are assumed to be positively related to PSA participation (farm size, previous participation in forest incentive programs, distance to public offices, education level, off-farm income, second occupation, whether they live at the farm or not).

4. Are there specific characteristics of PSA participants, and which factors affect participation in the canton of Hojancha (and surrounding areas)?

- H. 14: Landowners with larger properties are more likely to participate than smaller.
- H. 15: Landowners that have participated in similar incentive programs (before 1997) are more likely to apply/participate in PSA than others
- H. 16: Landowners living closer to public offices (MAG, FONAFIFO) are more likely to apply/participate
- H. 17: Higher educated landowners are more likely to apply/participate than others
- H. 18: Landowners with off-farm income or second occupation are more likely to apply/participate than farmers without.
- H. 19: Landowners living at the farm in question are less likely to be participants than farmers living elsewhere.

1.3 Outline of the thesis

In the second chapter, I will look at the case study site, and give a brief introduction to the country Costa Rica and then insight into the specific area of Hojancha, in which the case study took place. In the second part of the chapter, i will introduce the Costa Rican PSA program and the structures it was built on.

In chapter 3, I will give a literature review of the topics involved in the thesis; additionality, transaction costs and the equity perspective.

In the forth chapter, there will be presented the theory behind PES, with the factors necessary for the system to work, and I will look at two frameworks that are useful for analysing cost-effectiveness/efficiency of PES programs.

In chapter 5, the methodology used for the thesis will be presented, with description of the data collection, calculation of transaction costs and econometric and statistical methods.

Chapter 6 consists of the results found and discussion, and finally chapter 7 will present the conclusions. Chapter 8 will give recommendations based on my findings, and in chapter 9 there will contain the list of references. Finally there will be appendixes, including the questionnaire used for the household survey.

2 Case study site and Costa Rica's PSA program

In this chapter, I will first introduce briefly Costa Rica and the province of Guanacaste, and then I will introduce the canton of Hojancha, which was the place the case study was conducted. In the second part of the chapter, I will present Costa Rica's PSA program and the different contract modalities that exist and the requirements for being able to receive a PSA contract. Finally, I will give a background on the financing of the program and the previous program structures that the current program is based on.

2.1 Costa Rica

Costa Rica is a quite small country in Central America with coastline to both the Pacific Ocean and the Atlantic Ocean. It has a population of approximately 4,5 million (2010) and covers an area of 51,100km², and the national capital is San José (Britannica, 2012).

It is a stable country compared to its neighbouring countries and the national army was abolished in 1948. Costa Rica has a developing economy with one of the highest GNP per capita in Central America (Britannica 2012) and is at the top of the 'Happy Planet Index', which involves human well being and environmental impact, taking environmental sustainability into account (Nef, 2009).

Costa Rica has with time received a reputation for being a "green country" with much concern for the environment, and intends to become carbon neutral by 2021 (UNEP, 2012). It has developed an extended national park system and a well-established tourism industry, which has attracted foreign investment, and made the country's economy shift from being agriculture-based to being dominated by services and technology by the late 20th century (Britannica, 2012).



Figure 2.1 Map of Costa Rica and its provinces. The province of Guanacaste and the canton of Hojancha are outlined. http://www.mapasdecostarica.info/atlascantonal/atlas_cantonal.htm



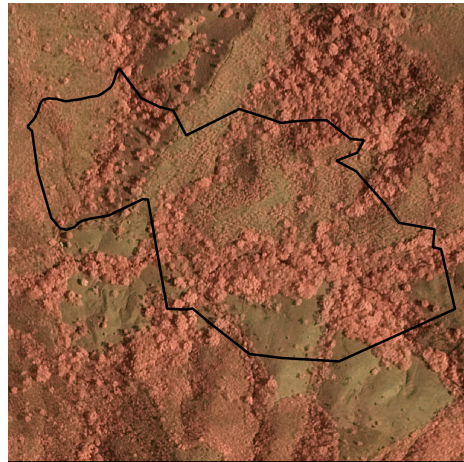
Figure 2.2 Map over the province of Guanacaste and its cantons. Hojancha is canton number 11. <http://www.mapasdecostarica.info/atlascantonal/guan.htm>

2.2 Guanacaste

The province of Guanacaste, in which the case study took place, was previously dominated by the agricultural sector. Today, there is still much livestock production, but the province has developed as one of the most attractive provinces of the country when it comes to the country's tourism sector, in addition to a great urban development. Still, it remains among the provinces with highest poverty and unemployment rates. The economic crisis hit tourism and real estate activities hard, and when the construction industry crashed in 2009, Guanacaste experienced the highest impact (Britannica. 2012, Costa Rica Guides. 2012).



Picture from 1998



Picture from 2005 (infrared), with increased forest cover

Figure 2.3 Satellite images of changes in forest cover of one of the properties in Hojancha participating in reforestation (performed at Norwegian Institute for Nature Research (NINA), 2012)

2.3 Hojancha

The main area for the case study was the canton of Hojancha. As the fieldwork went on, it turned out to be a need to expand the case study area to parts of the neighbouring cantons Nandayure and Nicoya. Since Hojancha and its experiences were the main objectives and most of the farmers interviewed for the study are located close to the border, I will keep focusing on the canton of Hojancha in the description of the area.

Hojancha is a little canton located in the province of Guanacaste, at the western coast, at the North Pacific of Costa Rica and makes up part of the ‘Tempisque Conservation Area’. It is located at the mountainous foothills of the Nicoya peninsula, the altitude ranging from 0 to 830 meters above sea level, and limits to the east and south with the canton of Nandayure and to the Pacific Ocean and to the west and the north with the canton of Nicoya. Hojancha consists of 26,140 hectares and is made up of 4 districts: Hojancha, Monte Romo, Huacas and Puerto Carrillo. Matambú, which is the only indigenous reserve in the Guanacaste province, is also located in Hojancha (Isaza et al., 2007).

Hojancha and the surrounding areas went through a great transformation of landscape in the 1960s and 1970s, as the majority of the forest cover was deforested. It was a result of clearing forest for pastures for livestock production, which continues to be the main economic income source in the area today. With intensified livestock production, the soil was degraded, and together with a meat crisis in the 1970s in which meat prices decreased substantially, labour

sources decreased and 57% of the population migrated. The product capacity was limited further by the climate conditions at the time with little precipitation and high temperatures in addition to decreasing water supplies. Together, these conditions led to the need to undertaking measures for the environmental and social problems in the region (Isaza et al. 2007, Morales. 2012).

Hojancha is a canton that has been highly influenced by measures introduced to deal with the deforestation challenges during the last decades. It was actually the first place in the country to implement CAFA (Forest Credit Certificate in Advance), which were incentives for encouraging reforestation and facilitated participation of small farmers through organizations. Today, a significant amount of the area is involved in the PSA program. On the country level, mostly forest protection participants comprise the PSA program. In Hojancha and the neighbouring areas, however, the long history with reforestation incentives and initially with large deforested areas, degradation and abandonment after the livestock crisis, the reforestation modality continues to be important and comprises a large part of all PSA contracts in the area today.

Today, the main production activities are livestock production, agriculture and timber production. 80% of the economically active population work in the primary sector (livestock production, reforestation, agriculture, beekeeping, plant production), 5% work in the secondary sector (sawmills, coffee mills, furniture shops etc.) and 10% work in the tertiary sector (cafeterias, shops, stores etc.), and the remaining working populations work within professional activities (lawyers, teachers, engineers etc.) (Isaza et al. 2007).

When it comes to land tenancy, in 1994, 76% of the land was in private hands, 9% under lease and 15% had mixed tenancy. The properties are in general medium and small size. 84% of the farms are up to 50 hectares in size and the rest (16%) are larger than 50 hectares (ICES 2001 in Isaza et al. 2007).

In 2002, forestry represented the main productive activity, generating 30% of the canton's income (the number based on the sale from the sawmill that processes and commercializes 90% of the timber in the canton). The forestry sector in Hojancha began in the 1980s, with the establishment of forest plantations, and more general planting of trees at the properties, for

'living fences' ('cercas vivas'). This turned out to be the main alternative for recovery of degraded areas and generation of income to the community, which continues today. An important factor that has facilitated forestry activity in the canton, is the development of activities related to production and use of forest resources such as recollection and sale of seeds, 'viveros', technical assistance, industrialization and commercialization (Isaza et al. 2007)

According to Isaza et al. (2007), there are several conditions that have led to the successful recovery of the landscape in Hojancha. Political aspects, such as forest legislation and the space given for the commercialization of seeds etc., which have generated an added value to the forest is one of the points. Another is the mentioned compensation mechanisms for conservation, such as like the previous forest incentives and later the PSA program. Access to credit is also mentioned as an important factor. Larger and better control of forest fires in addition to the emerging ecotourism sector is also stressed as an important reason for the recovery in the period 1986-2000 (Morales, 2012).

One of the institutions that appear to have substantial importance in Hojancha related to facilitate participation in the various programs throughout the years, is the Agricultural Center of Hojancha ('Centro Agrícola Cantonal de Hojancha'), CACH (the neighbouring cantons also have similar offices). These centres exist in various parts of the country, and Hojancha is one of the places where it has long experience of serving farmers and landowners by for example facilitating applications and providing information. The Agricultural Centres are farmer organizations, private, non-profit, legal entities with certain characteristics:

- a) Consist of individual persons or enterprises
- b) Their objectives are to promote participation of farmers/producers and to improve farming, agroforestry, fisheries, and conservation of natural resources by the local population. In addition they should promote appropriate training, credit, technology transfer and other benefits that contribute to the improvement of productive activities
- c) They should ensure members free membership, voluntary retirement and other basic rights

(MAG, 1999)

See Appendix A for development of the forestry law and effects in Hojancha.

2.4 Costa Rica's PSA program

2.4.1 'Pagos Por Servicios Ambientales', PSA

The Costa Rican PSA program 'Pagos por Servicios Ambientales' is a government-led PES program that pays private landowners for providing environmental services. The current design uses forest cover as a proxy for ecosystem or environmental services (Daniels et al. 2010). The program is established to compensate forest landowners for the value the forest, either natural forest or planted, on their land provide, and aims to integrate lands outside the already protected areas.

Costa Rica experienced in the 1960s and 1970s one of the highest deforestation rates in the world, reducing the country's forest cover radically, mainly as a result of agricultural expansion. Costa Rica was the first developing country to implement a large-scale PES program, and this has been given part of the credit for the positive trend over the last decades, related to low deforestation rates. In the early 2000s, the country achieved negative net deforestation (Daniels et al, 2010) and Costa Rica has been considered a showcase for other countries in the region (Pagiola, 2008). The Peninsula of Nicoya, which is the region of the case study area, is one of the areas that has had the most positive development regarding regaining forest cover (Morales, 2012).

The program was established in its current form in 1996 (Pagiola, 2008, Sanchez-Azofeifa et al. 2007) and came short time after the Forest Law No. 7575 from 1996 was implemented. This law recognized four kinds of environmental services that forest ecosystems provide: 1) mitigation of greenhouse gas emissions, 2) hydrological services (including provision of water for human consumption, irrigation and energy production), 3) provision of scenic beauty for recreation and ecotourism, and 4) biodiversity conservation. Furthermore, four types of contracts or land use modalities are available: 'forest protection' (protection of existing forest), 'reforestation' (through timber plantations), 'natural forest regeneration', and 'agroforestry systems' (Pagiola, 2008).

2.4.2 The contract modalities

Forest protection modality

The forest protection/conservation contract has on the country level been the far most popular contract since the implementation of the program. In 2008, more than 89% of the area contracted for PSA were forest protection contracts (Daniels et al. 2010), and 95% of the contracted areas at the end of 2005, were forest protection contracts (Pagiola 2008). The forest protection contract is also referred to as the ‘forest conservation contract’ and implies that no forest clearing is allowed at all (even though it with the current legislation, which prohibits forest clearing, is still allowed to harvest up to 40% of standing timber above a certain diameter (Pagiola, 2008). Being a forest protection participant implies that one has to make sure to prevent forest fires and prevent livestock to enter the forest, prevent hunting etc. Often the landowners will need to fence in the forest (FONAFIFO, 2009).

The contract is given for minimum 2ha of forest (max 300ha) over a period of 5 years, where the payment is distributed equally over the 5-year period. It can be renewed after the 5 years, but this is not guaranteed. The PES-related restriction becomes written into the land title, thus if the owner decides to sell the property, the restriction transfers to the new owner (this also goes for the other contract types). Private landowners living inside nationally protected areas, but who have not been compensated for their lands are eligible for the forest protection contract as well (ibid.).

Reforestation modality

When it comes to the reforestation contract, this represents 5% of the total area contracted in the country (4% at the end of 2005) (Pagiola, 2008), and was initially intended to promote production of commercial timber plantations. Now, it is supposed to pay the landowners for the environmental services provided by the plantations. Still, many areas, including the case study area, timber production is an important income source driving the interest for reforestation. Not all areas are eligible for forest plantations, for example areas in where the terrain consists of steep slopes and riparian zones (Pagiola, 2008). A reforestation contracts requires a minimum of 1 ha planted (max 300ha) (FONAFIFO, 2009). The reforestation contract also implies a payment distributed over a 5-year period, but with the difference that 50% of the total is paid the first year (in order to provide funds for the establishment phase), 20% in the second, 15% in the third, 10% in the fourth, and 5% in the fifth year. In the

reforestation contract, they commit themselves to preserve the plantation for 15 years and are then permitted to harvest the wood (ibid.).

Agroforestry modality

The agroforestry contract was implemented in 2003, and pays the farmers per tree planted (mostly native species and often used for “living fences” (‘cercas vivas’)), with a minimum of 350 trees. This contract does also last for 5 years, but the payments are paid over three years; 65% the first year, 20% the second year, and the last 15% the third year (FONAFIFO 2011a). The participation rate in this contract type is expanding, in 2010 there was in total contracted over 530000 trees (see table 2.1).

Natural regeneration modality

The natural regeneration contract came in 2006, when it became separated from the reforestation contract (FONAFIFO, 2011b), and it aims to recover pasture areas etc. that were deforested before 31.12.1989 (MINAET, 2011). It has the same payment structure as the conservation contract. The forest regeneration contract creates an incentive for letting forest grow, and aims for being qualified for a forest protection contract in the future. But once letting the forest regenerate, one is not permitted to clear it later on, hence creating competing incentives. The possibility of getting a renewal of the contract is also an important factor for the decision of applying for this program.

Table 2.1 Number of hectares (or trees in the case of agroforestry) in the different PSA modalities and total number of contracts in PSA Costa Rica from 1998 to 2010 (FONAFIFO 2011b)

	Forest Protection	Reforestation	Natural Regeneration	Agroforestry	Number of contracts
1998	47,804	4,173			597
1999	55,776	3,156			622
2000	26,583	2,457			271
2001	20,629	3,281			287
2002	21,819	1086			279
2003	65,405	3155		97,381	672
2004	71,081	1557		412,558	760
2005	53,493	3602		513,684	755
2006	19,972	4586,70	279,30	380,398	619
2007	60,567	5070,90	755,10	541,531	1180
2008	66,474	4083,30	1660	656,295	1103
2009	52,017	4017,50	1500,20	370,187	796
2010	59,644	4185,40	1274,60	536,839	1111

Table 2.2 Number of contracts (valid), hectares and trees in different contract modalities in the canton of Hojancha in 2012 (FONAFIFO, 2012)

	Number of contracts	Number of hectares	Number of trees
Reforestation	78	1665,30	
Forest protection	31	1094,30	
Agroforestry	8		8350
Other version of the contracts	22	440,50	

Application requirements

In order to apply for PSA, there are certain basic requirements that need to be fulfilled, but to some landowners it appears troublesome and too time-consuming to comply with. Figure 2.4 shows the initial requirements.

Requirements:

Pre-application (to one of the regional offices of FONAFIFO):

Individual landholders:

- *Copy of id-card ('cédula')*
- *Copy of cadastral map ('plano catastrado')*
- *Copy of the legal document of the farm ('escritura')*

Enterprises:

- *Copy of legal certification of the enterprise ('personería jurídica').*
- *Copy of the document of identification of the enterprise ('cédula jurídica')*
- *Copy of identification of the legal representative ('cédula')*

There must be a separate application for each modality if applying for more than one.

When pre-application approved by FONAFIFO for farms in the public register (the following often performed assisted by an intermediary):

- *Contract with a Forest Official ('regente forestal')*
- *Sustainable forest management plan (prepared by a licensed Forest Official, including information on e.g. topography, soils, climate, drainage, current land-use, plans for preventing forest fires, illegal hunting and harvesting etc. if forest protection contract (or plan for reforestation/plantations or agroforestry if that is the contract).*

For farms in 'possession' (under these conditions only forest protection can be applied for):

- *Legal declaration about the right of possession for more than 15 years. Or in the case of being within a protected wildlife area, prove the right of possession 10 years before the creation.*
- *Authentic selling card ('carta de venta') by an attorney*
- *Determination of the farm area through one of the following option:*
 - *Cadastral map*
 - *Topography*

Figure 2.4 Requirements for what landowners need in order to apply for PSA (FONAFIFO, 2009)

2.4.3 Administration, FONAFIFO and previous incentive programs

In the beginning of the program, it was the national conservation area system (Sistema Nacional de áreas de Conservación, SINAC), and NGOs, such as FUNDECOR, which administered these contracts. From 2003, the task was handed over to FONAFIFO, and eight regional offices were established in order to handle applications, sign contracts and perform monitoring (Pagiola, 2008).

The National Fund for Forest Financing ('Fondo Nacional de Financiamiento Forestal'), FONAFIFO, was established together with the Forestry Law from 1996. FONAFIFO is a semi-autonomous agency with independent legal status and administers today the PSA program. FONAFIFO's governing board consists of representatives from Ministry of Environment and Energy (MINAE), Ministry of Agriculture (MAG) and the National Banking system, in addition to representatives from the private forest sector. FONAFIFO is thus quite autonomous when it comes to decisions and managing of funds, but it still has to deal with certain governmental restrictions, making the work more difficult, for example that the budget must be approved by the Ministry of Finance. Payment levels are also set by executive degree (Pagiola, 2008).

Prior to the establishment of the PSA program and the Forest Law, there were several initiatives, which the PSA program was based on. It started in the 1970s with a concern over less timber supply, and it was initiated incentives for planting of timber plantations. In the beginning, this was performed through income tax credits. In 1986, the Forest Credit Certificate ('Certificado de Abono Forestal'), CAF, was created. This facilitated participation and thus led to increased participation. Several variants of this credit were introduced over the coming years. A very significant one was the Forest Protection Certificate ('Certificado para la protección del Bosque'), CPB, which was introduced in 1995, giving support for forest conservation, and led to a broader focus, which had so far been to promote reforestation (Daniels et al. 2010, Pagiola, 2008).

Thus, there was already a system and institutions in place when the PSA program was implemented. The Forest Law was based on these existing structures, but compared to the previous system, two major changes appeared. The first involved justification for 'reforestation payments', implying that what as previously viewed as support for timber

production, was now to be understood as support for providing environmental services. The second change involved the financing source. It was previously financed from the government budget, but from now on the financing came from an earmarked tax and payments from beneficiaries (ibid.). Today, most of the financing for PSA comes from a fossil fuel sales tax, and FONAFIFO is allocated 3,5%, which represents about US\$10 million a year. The rest of the funds come from different grants, for example from the Global Environmental Facility (GEF) through the so-called Ecomarkets Project (e.g. Sanchez-Azofeifa et al. 2007).

When it comes to the monitoring and enforcement of the contracts and the participating farms, these are first and foremost carried out by the agencies responsible for the contracts with the landowners, such as the Agricultural Centers and the forest officials ('regentes'). There are made visits to the farms at least once a year. FONAFIFO performs a sampling of approximately 10% of all projects annually, SINAC 5%, and the rest is carried out by the forest officials, often in connection with the intermediaries (e.g. Centro Agrícola) if they are not hired directly by the farmer (Sánchez, 2012). In addition, FONAFIFO has established a monitoring system with GIS (Geographic Information Systems) and databases in order to verify that the requirements of the contract are fulfilled. If it turns out that the participants do not comply, they will not receive further payments, and the forest officials may lose their license if they report compliance if it turns out that it is not the case (Pagiola, 2008). Leakage, in this case the issue of moving deforestation from the area under contract to another parcel/farm, does not seem to be a major concern in Costa Rica. There is no specific contract condition addressing this issue, but they would equally be affected by the ban on forest clearing, hence this is not considered a serious risk (ibid.).

3 Literature review

In this section, I will go through the major literature related to the topic. First I will go into the topic of additionality, then cost-effectiveness and transaction costs, and finally literature related to PES the equity question.

3.1 Additionality

Even though additionality (environmental effectiveness) is not an explicit aim for the Costa Rican PSA, it has emerged as an external requirement as a result of the increased amounts of money spent globally on these issues and this leading to an increased focus on how these funds are spent and what positive environmental effect they in reality have (Daniels et al. 2010). Costa Rica's PSA program has been criticized for lack of targeting and the use of undifferentiated payments. However, the program has taken many of these issues into account over the years, and there has been made several improvements to it, such as creating a list of priority areas (see appendix B).

Studies investigating the impact of the forest protection PSA contract, have in general found that there is higher forest cover among PSA participants than non-participants, even though the effect appears limited (Zbinden and Lee. 2005, Sierra and Russmann. 2006). Other researchers have not found much difference in land-use change between participants and non-participants in forest protection (Sánchez-Azofeifa et al. 2007, Pfaff et al. 2008, Robalino et al. 2008).

The farmers' opportunity cost of land is highly related to additionality. For example Wunder (2005, 2006), stresses the importance of seeking landholders with the higher opportunity costs who might be a more credible threat to conservation. Farmers that have mostly forests on their land and unfavourable conditions for crop cultivation and livestock production/agriculture (previously the major cause of deforestation (Daniels et al, 2010), are for example less likely to change land-use on their properties. Livestock production has traditionally been the main opportunity cost of land in this area, and if the farm has little favourable conditions for this kind of land use, the actual threat to forest, hence the chance that the forest might be cleared.

which give indications that “agricultural land is abandoned by landholders who use the payments as capital to engage in other (often urban) productive activities and forest cover is maintained or let increase” (ibid. p.139). They state that “because the existing forest area would not have changed without the payments, any additional gain would be from the new forest growing in previous agricultural and charral areas” (ibid. p.139), hence pointing to the relevance of the natural regeneration contract modality, which may have more potential to create addtionality. Sierra and Russmann (2006) also claim that including more landholders that are already involved in non-forest land use will make it possible to increase PES addtionality as it will limit agricultural expansion in addition to providing a diversification of farm income, by producing land rent from the provision of ecosystem services and not only agriculture. Two of the conditions important for the level of efficiency of PES are “whether forest cover would be lower without the payments” and “whether any additional gain in forest cover is temporary or permanent” (ibid. p. 139).

Arriagada et al (2009) find that one of the main reasons for participating in PES according to farmers in a study in the Sarapiquí region in Costa Rica is “lack of more profitable land use alternatives (e.g. poor soil quality, high slope)” (ibid. p. 355). Other important reasons appear to be the restrictions on forest management (Forestry Law 7575 prohibiting forest clearing), and that cattle farming/livestock production is less profitable, influencing the decisions to rather plant trees instead. This indicates a low opportunity cost of land to many farmers. In general they found that those with high opportunity cost of participation and significant off-farm income were less likely to participate.

Concerning land characteristics, Sánchez-Azofeifa et al (2007) find that the variable ‘slope’ (the amount of the land area that has steep slope) is negatively associated with deforestation. Zbinden and Lee (2005) find that landowners with a higher level of marginal lands at their farms are “more likely to participate in reforestation given the lower opportunity cost of land” (ibid. p.262). Hence, variables such as the extent to which the farmer perceives land degradation and steepness at their farm, are assumed to be positively related to participation in reforestation. They also claim that “an owner of steep forestland is more likely to participate in forest protection rather than forest management, since harvesting timber on steep slopes presumably increases the costs of timber harvesting” (ibid. p.262).

The Costa Rican PSA program has been very popular among landowners, and there are much more applicants than available contracts and financing. There are many applicants on waiting lists, willing to accept a contract at the current prices, which indicates that to many applicants and current participants, the opportunity cost of land is not very high (the lands may not be very productive or relevant for agriculture or such activities), and that larger area could be included in the program for the same budget (Pagiola, 2008). Wünscher et al. (2006, 2008) look at opportunity costs and transaction costs at the Nicoya peninsula of Costa Rica and find that, given a fixed budget, spatial targeting of the payments according to opportunity- and transaction costs have the potential of substantially increasing the efficiency/effectiveness of the program, indicating that additionality may be increased by targeting areas where opportunity costs of land are higher.

According to Daniels et al (2010), reforestation contracts are more likely to bring about additionality. However, as mentioned previously, this contract modality is on the country level not very widespread.

3.2 Cost-effectiveness and transaction costs

Ferraro and Kiss (2002) and Ferraro and Simpson (2002) state that direct payments to landowners can be a more cost-effective way to promote conservation targets than traditional command-and-control measures such as restrictions on land use. There are, however, challenges related to the issue of transaction costs as well as compliance costs when it comes to implementing such conservation systems, especially in low-income countries (Ferraro and Simpson, 2002), as these costs may appear to be higher than the costs would be under conventional command-and-control systems. These may appear due to insecure property rights, as markets may not be functioning well.

PES programs (together with other market-based instruments such as environmental taxes and tradable permits) are considered more cost-effective than command-and-control regulation because the market-based instruments are more flexible when it comes to e.g. levels of benefits of forests and the cost of conserving forest. PES may thus make it easier to target the forests with higher value and lower cost (Engel et al. 2008).

Developing countries are considered to have more challenges, as there may often be weak 23

governance, high transaction costs and informational problems may create problems for efficiency/effectiveness, appropriate monitoring and enforcement (ibid.).

Wünscher et al. (2006, 2008), as mentioned earlier, have in a study of the PSA program at the Nicoya Peninsula in Costa Rica, found that the PSA program has the potential of increasing efficiency, also when it comes to transaction costs, as more targeting of participants would lead to lower transaction costs in total. When considering the amount of transaction costs to the farmers, they base this on the maximum of 18% in administration cost of the payment received from FONAFIFO that is charged by the intermediary often performing the work between the landowner and FONAFIFO, and do not consider other transaction costs besides this. They therefore state that the per hectare transaction cost does not decrease with increasing contract size. When it comes to compliance costs for the forest protection contract, their survey data find that the average cost for conservation obligations (compliance costs) and activities are a little less than 3US\$/ha. And by calculating 18% administration cost to be 7.20US\$ (2006), they estimate that transaction costs and conservation costs together, come to a cost of approximately 10US\$/ha, which represents 15,6% of the PSA payment per hectare.

Rodriguez (2008) evaluates the transaction costs of the landowners and the intermediaries (between the landowners and FONAFIFO), with respect to agroforestry systems contract (SAF) in two areas in Costa Rica. She compares two types of agroforestry contracts, FONAFIFO's PSA contract and another project, ESIMSE, and separates the costs for the landowner/PSA participant into fixed costs and variable costs. She finds that, beside the 18% administration costs for the intermediary, for a SAF contract of 1642 trees, compliance costs/expenses to comply with requirements reached approximately 26\$US, representing approximately 1,6% of the payment amount received. There are however variable costs involved as well, related to things such as transport, opportunity costs of working time and costs for correcting legal documents, e.g. correction of the identity card 'cédula' in case of errors. For one landholder with one trip to the regional FONAFIFO office, transport there, one trip to the local Agricultural Center, half a working day there and costs related to correction of the identity card, she estimates 78US\$ for one contract, or 5% of the total amount of payments received. Of the total – variable and fixed costs, these represent approximately 30% of the total amount received.

Rodriguez (2008) stresses that it is difficult to estimate representative transaction costs for all landowners since there are always variable transaction costs that depend on the landowner characteristics and factors such as distance from his/her farm to the office/intermediary/FONAFIFO, type of transport used etc. In addition, problems with errors in documents and documents that do not match vary a lot from landowner to landowner.

Arriagada et al (2009) find that low payments and high maintenance costs seem to be the main motives for an eligible farmer to decide not to participate. To many, the costs outweigh the benefits from the contract payments, which turn out to be insufficient. Various landowners expressed that there were high costs associated with technical assistance. Eligibility problems, for example concerning property rights also appears to be a problem to many for participating.

3.3 Poverty and equity/fairness perspective

PES is often considered to be able to reach several objectives besides providing ecosystem services, and work indirectly, but also criticized for not achieving much results (Ferraro and Kiss, 2002). However, the inclusion of poor farmers is considered to provide possibilities for these farmers by increasing cash flows, and diversifying sources of income/provide off-farm employment opportunities such as tourism and added value (ibid., Ferraro and Simpson, 2002).

According to Zbinden and Lee (2005) and Miranda et al. (2003), who have conducted studies of PES in Costa Rica of participation factors and household characteristics, larger and more well-off landowners tend to have a higher participation rate than smaller landowners with lower income, in addition to characteristics such as education level, and whether they live at their farms or more urban areas (non-participants tend to more often live at the farms), and more often devote family labour to the farm activities in comparison to participants (Zbinden and Lee, 2005).

Arriagada et al. (2009) state that off-farm income is an important factor that leads farmers in their study not to participate in PSA. The time needed for application and maintaining the forest, as required by the contract appears to be critical for many farmers. The opportunity cost of participation is hence quite influential to the decision for many farmers. Several

farmers express they because of little time seldom go and see their farms. Non-participants living on their farm appeared to often spend most of the day outside the farm and therefore did not have time for the contract requirements.

Costa Rica's PSA program is not designed to work as a poverty reduction program, but is claimed to have the potential of reaching such objectives (Pagiola et al. 2005). Areas with many poor farmers are often located in areas with high levels of environmental services, such as biodiversity and in upper watersheds (ibid., Wünscher et al, 2006), PES programs are therefore considered able to reduce poverty in such areas. However, Muradian et al. (2010), (and Pagiola (2005)) stress the point that distribution issues should be viewed separately from the efficiency question, as the involved agents in such programs are important for its legitimacy.

Rød (2010), studying PES in indigenous communities in Costa Rica, finds that when it comes to socio-economic objectives, the PSA program in such a community has been beneficial for the participants' income opportunities and livelihoods strategies, and that they have given the participants new opportunities and improved their farm and family/household conditions. However, the program has also seemed to create large differences between participants and non-participants in the PSA program in the area, and it appears to be problematic to various landholders to apply for PSA, to that the design of the PSA program does not fit well with the governance structures of many indigenous territories.

As mentioned, Sierra and Russmann (2006) stress the issue of focusing on landowners already engaged in agriculture to improve additionality. Such farmers with a major part of the property involved in agriculture or livestock production are usually often smaller farmers, suggesting that the possibility to increase additionality is greater for this group (ibid.). Even though 'low social index' is included in the list of FONAFIFO's priority areas (see Appendix B), they may still find the payment too low relative to the income from the current farm activities, or as a result of uncertainty for the future.

Pagiola et al. (2005) stress the importance of transaction costs as a possible impediment for poor to participate in PSA. The design of the program is important, and should address problems such as insecure tenure or lack of titles, access to credit and technical assistance.

The application process is considered tiresome for many potential applicants who may consider the application procedure too much work for too little money. According to Pagiola et al. (2005), strong local organizations such as community groups or NGOs play an important role in that regard.

In the beginning of the program, there were considerable requirements the PSA applicants needed to fulfil in order to be eligible. For example, the applicants needed proof of having paid local taxes and not having any debt to the national health system (Miranda et al, 2003). Since then, the amount of requirements have been reduced substantially, and even though much of the previous requirements now may be checked automatically through databases, there still remains much paperwork that are perceived as troublesome in time and costs and not worth the effort.

Earlier, there existed a system of collective contracts ('contratos globales') in order to reduce the impediments that transaction costs may imply for poorer landowners. This implied that small farmers joined the PSA program together instead of individually, and thereby spreading the transaction costs over all the farmers joining the contract (FONAFIFO, 2000, Chomitz et al. 1998 in Zbinden and Lee, 2005). However, it led to problems if one of the participants in such a contract if one of the members did not comply with the requirements, and the payments would stop to the entire group. This was also the reason that the collective contracts came to a stop in the case study area Hojanca, where all of the contracts signed before 2002 were made collectively through the Agricultural Center. Today, in comparison, the application procedure is considered a much more complicated and costly procedure.

4 Theoretical framework

In this chapter I will first introduce the economic theory behind the idea of Payments for Environmental Services, and the necessary conditions for PES by Wunder (2008) and others making up the basis for the following frameworks. Next, I will present two frameworks, one for analysing the efficiency of PES programs by Pagiola (2005), and a framework by Pannell, D.J. (2008), which focuses on how to choose the most efficient policy mechanism for different projects based on public and private net benefits.

4.1 Definition of PES

A widely recognized definition of PES:

1. a *voluntary* transaction where
2. a *well-defined* environmental service (ES) or a land-use likely to secure that ES
3. is being "bought" by minimum one ES *buyer*
4. from minimum one ES *provider*
5. if, and only if, the ES provider continuously secures ES provision (*conditionality*)
(Wunder, 2005)

The PES concept is based on the theory that providers of environmental services (resource managers) should be compensated for the costs that are implied for providing these services. In contrast to the common 'polluter-pays-principle', PES in effect works as a "bribe" to stop or to reduce an economic harmful activity (Engel et al, 2008).

Ideally, PES should work as a correction to market failure and be applied when there is an undersupply of a positive externality (e.g. biodiversity, watershed services, carbon sequestration and landscape aesthetics), and not only benefit the landowner (e.g. by improving on-farm soil quality) (Zandersen et al. 2009).

"Socially optimal provision (like other externalities) of an environmental service is the point at which the marginal cost to a landowner (or several cooperative owners) of providing that service (or the management activities giving rise to that service) equals the beneficiaries' willingness to pay (WTP) for that marginal change" (ibid. p.34).

4.2 Necessary conditions for PES

Economic preconditions:

In general, when deciding whether or not to enter a PES contract, a farmer or individual faces the question of which land use is the most profitable, for example whether to rather convert the area to cropland or pasture. The payment must by definition thus be greater than the opportunity cost, the option value, in addition to future options (Wunder. 2008, Engel et al. 2008).

There exist different interests between the natural resource manager and those demanding the environmental services, and the payment must needed for the provision of the service(s). PES can only work if the willingness to pay (WTP) for an environmental service is larger than the willingness to accept compensation (WTA) and transaction costs (TC) combined. Hence, $WTP > WTA + TC$. This implies that in the cases there TCs are very high, PES will not work, and if the gap between WTP and WTA is small, the TCs cannot be high if PES is to work. Many buyers and sellers will often lead to very high TCs. Local conditions play an important part here (Wunder. 2008, Zandersen et al. 2009).

As mentioned previously, PES tries to put the Coase theorem into practice, which implies to overcome a negative externality through bargaining between the affected parties (Coase, 1960 in Engel et al. 2008), implying that transaction costs are low and well-defined property rights (ibid.).

Institutional preconditions

For the seller, it is important to know that the buyer will stay to the deal, and the buyer needs confidence that the seller really will provide the service they are paid for (e.g. forest protection for biodiversity). This relates to the ‘conditionality’ term, which distinguishes PES from targeted subsidies, and is critical to the definition of PES. For payments to be conditional, it must be possible to verify the existence of the environmental service, and ensure additionality, to measure the additional environmental services provided to a predefined baseline. The ideal would be to pay for the services directly on the basis of the environmental service provided, but such output-based payments are often not possible, since there are many environmental services the land users cannot observe. Thus, most PES programs base payments on the adoption of particular land uses, thus ‘input-based’. Such

programs are often made on a ‘per-hectare’ basis, or e.g. number of trees planted (Zandersen et al. 2009) such as the Costa Rican PSA program.

The concept of leakage (or spillage) also relates to this, and refers to the displacement of environmentally damaging practices to outside of the (geographical) PES area (Roberson and Wunder, 2005 in Pagiola, 2005). A landowner may for example receive payments to protect primary forest in one area he/she possesses and rather deforest somewhere else within his/her property/ies.

Informational Preconditions:

PES is quite information-intensive, which tends to lead to high transaction costs. They are also often quite large in the initial phase compared to the operational phase, or the rest of the period where the compliance of requirements takes place (Wunder, 2008). In general for PSA programs, high transaction costs may be a problem in PES programs due to high numbers and different kinds of environmental buyers and sellers, and complex environmental services. I will come back to a definition of transaction cost later in the chapter and a particular definition for this study in the methodology chapter.

Cultural Preconditions:

This implies that should be no strong intrinsic values on the environmental services involved. In the case of such intrinsic values, monetary payments may undermine the intentions of PES, and in some cases lead to outcomes to the contrary of the intended. This depends on local cultural traditions and conditions.

4.3 Pagiola's framework

Pagiola (2005) provides a framework for how to analyse the effectiveness of PES programs. The aim of PES is to make privately unprofitable, but socially desirable practices become profitable to individual land users, and hence lead landowners to adopt them. This is illustrated in case A in Figure 1 below.

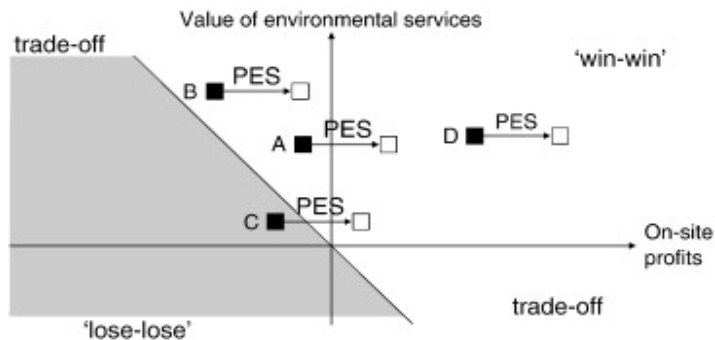


Figure 4.1. Framework for how to analyze effectiveness of PES (Pagiola, 2005)

The horizontal axis in the figure above (Figure 1) shows land users' net private profitability of land uses. The vertical axis shows the net value of the environmental services generated to others. Practices that belong to the top-right quadrant create a win-win situation as it generates both profits to land users and generating positive externalities. Practices that belong to the bottom-left quadrant create a lose-lose situation.

In the top-left quadrant, the practices are unprofitable to land users but generate positive externalities, which are the land-use practices aimed for by PES programs. The bottom-right quadrant involves privately profitable practices, but which generate negative externalities to society.

Pagiola identifies 3 types of inefficiencies a PES program can suffer from:

Case B: The case where the payments offered are insufficient to lead landholders to adopt socially desirable land uses (leading socially undesirable land uses to continue).

Case C: Including the adoption of socially undesirable land uses, that supply environmental services, but at a cost that is higher than the environmental service.

Case D: Paying for adoption of practices that would have been adopted anyway.

I will look first and foremost at problems related to case B and D for being the most relevant in my case study to address with my data from the case study area.

Case B concerns social inefficiency, leading social welfare to be smaller than what it otherwise might have been. We have here the issue that opportunity costs and transaction costs (participation costs) should be low. Costa Rica has been criticised for suffering from such inefficiencies by having a relatively low, undifferentiated and untargeted payment in the PSA program (Pagiola, 2005). (And case C). Case B is related to transaction costs and compliance costs involved in PES programs, since these costs will influence whether a contract will be privately profitable for the farmer or not, and in general affect the cost-effectiveness of the program. These costs are for the Costa Rican program criticized for being high, and compliance costs especially, related to the reforestation contract for the establishment of plantations etc. are assumed to be high, and the PES payment may not be sufficient to cover the expenses to make the landowner undertake the desired land-use change (or refrain to do so in the case of protection contracts).

Case D regards environmental effectiveness, hence the issue of additionality and relates to the problem of “money for nothing”, providing payments for actions or non-actions that the landowners would have performed also in the absence of payments (Pagiola, 2005; Pagiola et al. 2008). This is criticized for being a major issue in Costa Rica and I address it by looking at opportunity factors of land to see whether one may say that participants have lower opportunity cost than non-participants, and whether reforestation participants have higher opportunity cost of land than forest protection participants. In order to achieve cost-effectiveness, the opportunity cost should be low, but low opportunity cost may lead to lack of additionality. Hence, these two issues need to be considered together.

4.4 Pannell's 'Public Private Benefits' framework

The 'Public Private Benefits' framework developed by Pannell, D.J. (2008) is designed to work as a guide for how to choose the right policy mechanism under different circumstances, in order to achieve efficient resource conservation on private lands. While Pagiola (2005)'s framework seems to suggest that PES is relevant under all combinations of public private benefits, Pannell (2008) shows that the decisions of policy mechanism should depend on the relative levels of i) private (or internal) net benefits, and ii) public (or external) net benefits.

'Private net benefits': Benefits minus costs accruing to the private land manager as a result of the proposed changes in land management. They exclude transfers, which are part of the policy intervention, so that one can compare landholder behaviour with and without the intervention. In principle, private benefits are broader than financial benefits, and include the broad range of factors that influence the relative advantage of the new land use option (as perceived by the landholders) such as riskiness, complexity, social considerations, personal attitude to the environment, and farming system impacts of the land-use practice (Kabií and Horwitz, 2006 in Pannell, D.J. 2008)

'Public net benefits': Benefits minus costs accruing to everyone other than the private land manager. They exclude any costs borne by the environmental manager in the process in intervening to encourage the change in land management. This will allow us to compare the benefits of an intervention with its costs.
(Pannell, D.J. 2008)

In order for environmental managers to choose the right policy mechanism for the different contexts, Pannell identifies 5 categories of policy mechanisms:

1. Positive incentives: Financial or regulatory instruments intended to encourage land-use change (e.g. command-and-control, pollution taxes, subsidies). In context of PES programs, payments to promote reforestation belong to this category, as the payments are intended to change land-use in order to provide environmental services.
2. Negative incentives: Financial or regulatory instruments (as above) that are intended to make landholders not to change their land management in particular ways. When it comes to PES programs, conservation payments is such a negative incentive,

provided in order to prevent clearing of forests that are important for biodiversity etc., using tools such as command-and-control regulation, environmental taxes, or potentially subsidies as a reward for not changing land-use.

3. Extension: Implies for example education, technology transfer and communications. Rather than giving payments of grants to landholders, extension is a relatively cheap policy instrument that helps landholders to learn about available land management practices, including practices that environmental managers would like to see adapted.
4. Technology development: “Development of improved land management options, such as through strategic R&D, participatory R&D with landholders, provision of infrastructure to support a new management option”.
5. No action
(Pannell, 2008)

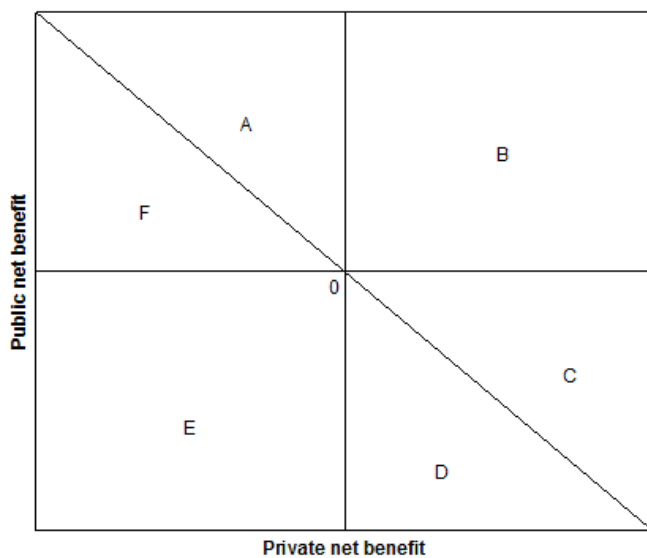


Figure 4.2. The sample space for potential projects, involving specific changes in land management in specific locations, depending on private and public net benefits. (Pannell, 2008)

Figure 4.2 shows the sample space for possible projects with various levels of public and private net benefits. Any potential project for analysis would correspond to one point on the graph. Hence, there may be any combination of positive or negative net benefits of a project. From the figure, we see that the projects that generate net positive benefits are the projects belonging to the areas A, B and C.

In area A, public net benefits outweigh private net costs. Private net benefits are not sufficient to make landowners choose to perform land-use changes, hence incentives would be needed to achieve the desired land-use. In area C, private net benefits outweigh public net costs. It may for example be (very) profitable for a landowner to convert pastures into a forestry plantation, but this may for example result in adverse effects to downstream water users into a waterway, which are of such importance that the on-site benefits may not be large enough. In area B, there are positive net benefits for both landholders and the public.

When outlining the rules for the initial guide for choosing among the different policy mechanisms, it is assumed that landholders will adopt all practices giving private net benefits. B, C and D are hence the areas giving private net benefits to the landholders, provided that they are able to learn about those practices. We first assume learning costs to be zero (Pannell, 2008).

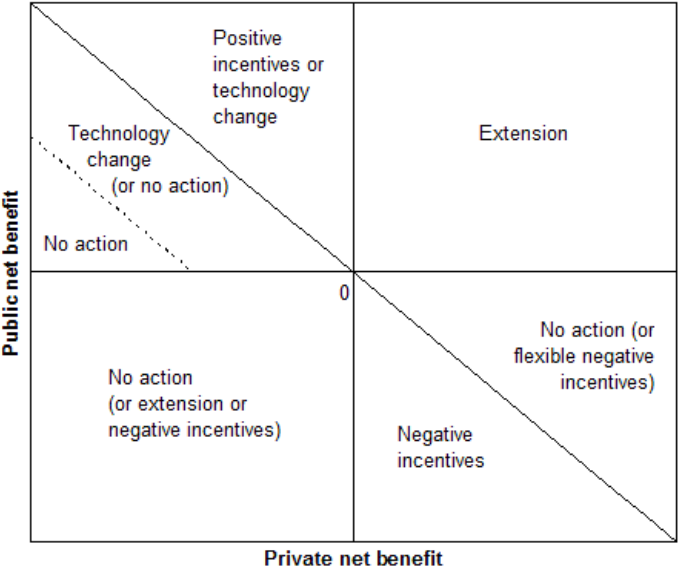


Figure 4.3. Suggested classes of policy tools for different levels of public and private benefits. (Pannell, 2008)

When to use which policy mechanism?

The two policy mechanisms I will address with my data are positive and negative incentives, as these are associated with the two contract types I am studying in the case study area, reforestation and forest protection respectively.

Positive incentives

Pannell (2008) states that positive incentives for land-use change are not recommended unless public net benefits of change are positive (hence, should not be given for area C, D and E), nor if private net costs outweigh public net benefits (hence, should not be given for F). By not considering transaction- or compliance costs in this part, we are here considering the situations in which e.g. reforestation is a cost-effective and appropriate instrument with social efficiency. The use of positive incentives is therefore limited to area A. Using positive incentives for area C, D and E would lead to lack of social efficiency/cost-effectiveness due to lack of public net benefits and for F the private net costs are too high. When it comes to area B, we have the environmental effectiveness issue, as landholders in this case would be adopting the land-use changes even without the incentives. This would cause lack of additionality, thus “money for nothing”. Extension is rather recommended for projects in this area.

Negative incentives

Negative incentives, in my case study, referring to payments for forest protection are assigned to area D in figure 4-3. In order for these incentives to be appropriate, there must be overall benefits from preventing the land-use changes that the private landholders would like to adopt. Incentives must be needed to discourage the specific land-use (Pannell, 2008):

- The projects must generate negative public net benefits, hence there must be negative externalities associated with the land use, in my case deforestation.
- The projects must generate private net benefits. Landholders must thus be likely to adopt the other land-use practice unless they are prevented from doing so. In the case of forest protection, there must therefore be a clear risk that landholders will clear forest unless they are paid not to do it. Otherwise, there will also in this case be waste of money and lack of environmental effectiveness/additionality.
- Public net costs outweigh the private net benefits. The positive externalities must hence be high enough (e.g. biodiversity in case of natural forests) to outweigh the private benefits.

I will hence be addressing the issue of additionality by looking at the protection participants’ opportunity cost of land (factors that are assumed to be related) compared to non-participants, in order to give any indications of these problems in the case study area, whether there really

is a great risk for deforestation.

It is recommended “no action” for area C and E. In area C, private net benefits outweigh public net costs. Only instruments that are relatively flexible negative incentives (e.g. a pollution tax) are recommended in the case of uncertainty whether private net benefits are sufficient to outweigh public net costs. In area E, public net benefits and private net benefits are both negative (landholders must accurately perceive this for being the case). In this case it is thus not necessary to introduce any incentives not other action since it would be unlikely that anyone would adopt adverse practices. All cases should be weighted up against the alternative of no action (Pannell, 2008).

Including ‘learning costs’

Pannell (2008)’s definition of learning costs says that these costs are to include all factors in the transition from the current management to the new management system. It involves transaction costs, hereby costs for obtaining and analysing information about the new practice, the presence or absence of social networks supporting learning, and constraints on financial equity that is required for up-front costs of the land-use change.

In my case study, I will be addressing the importance of the costs to the landowner when participating in PES/PSA, as these costs are criticised for being too high for many landholders compared to the payment levels. Pannell’s definition of learning costs includes both transaction costs (which are associated with applicants costs in a PSA program), and compliance costs/other costs that can be related to especially the reforestation (plantation) contract in Costa Rica/the case study area. This contract type requires quite some information for plantation establishment, and financial equity in order to be able to undertake the land-use change (up-front costs).

As Pannell (2008) mentions, when there are positive learning costs, the payment/incentive could result too little to make landowners decide to undertake land-use change (or refrain from it) even if the adoption of it ultimately would yield positive private net benefits. The costs for the landowners are therefore a key issue I address with my data, what the level of transaction- and compliance costs are for current participants, and whether these costs are important obstacles for non-participants.

When it comes to the size of the incentives to be implemented, the rule says that these should be just large enough for the landowners to decide to adopt the practice. Larger payments than that would (assuming a fixed budget), lead to lower capacity of the program to achieve the desired environmental outcomes.

Cost-effectiveness of such a program hence depends on the transaction- and compliance costs involved in the program. The payment may therefore in some cases need to be increased in order to cover these “learning costs”.

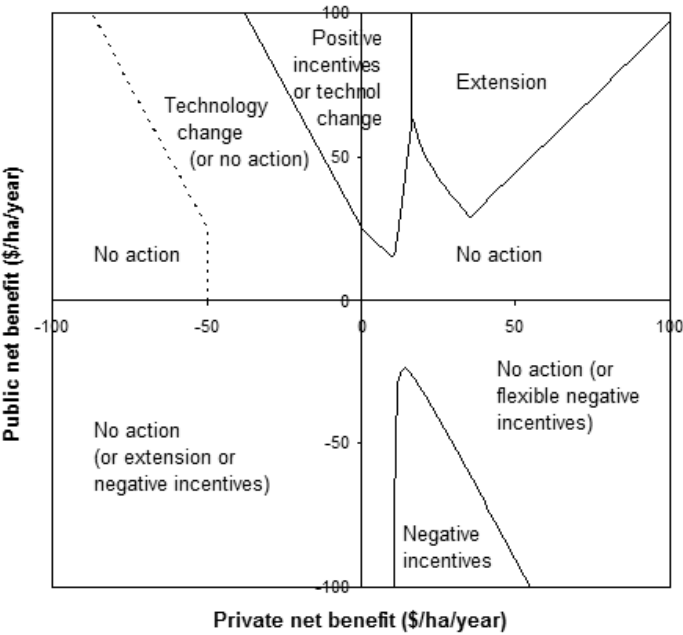


Figure 4.4. Efficient policy mechanisms for encouraging land use on private land, refined to account for lags to adoption and learning costs, and assuming that managers require benefit-cost-ratio ≥ 2.0 . (Pannell, 2008)

The resulting figure over (figure 4.4) shows figure 4.3, but in which the incentives are adjusted, in order to account for learning costs and lags in adoption in the absence of incentives¹. From the figure, we see that the areas, for which positive or negative incentives are the appropriate measures, are reduced, and there are more areas in which there rather should be taken ”no action”. Hence, with positive learning/transaction costs, fewer projects will lead to total net benefits and cost effectiveness, which is important to take into account in the design of PES schemes.

¹ Based on the assumption that monitoring and enforcement costs are 2,50\$/ha

5 Methodology and data collection

In this chapter, I will first go through how the process of the data collection. Next, I will go into the transaction cost part, where I will give a definition of transaction costs and compliance costs used for the thesis and the way in which the calculation has been performed for this study. Then, I will go into the econometric and statistical methods used, and finally, I will look at some issues with respect to validity of the analysis.

5.1 Data

5.1.1 Data sources used in the study

For this thesis I have used both quantitative and qualitative data sources; the quantitative part being the main basis for the results and are obtained through a household survey. The qualitative data are mainly used as a supplement and for supporting the design of the survey, and are collected through semi-structured interviews with public officials and other relevant institutions, in addition to statistics at the FONAFIFO web page. All data are collected through a fieldwork in Costa Rica in 2011.

5.1.2 Household survey – data collection and sampling

The quantitative part, representing the main basis for my results is made up of a household survey of farmers conducted by assistants and myself between March 21st and May 21st, 2011. During the period, my assistants and I conducted in-person interviews with the selected farmers in their homes.

In order to perform analyses to find differences between PSA participants and non-participants, we looked for both landholders that had or had had contracts, and landholders that had not had a PSA contract. Of those not having a contract, we found some farmers that had applied for one but not received, and many that had never applied for a contract. The information from both these two last groups gave interesting information on reasons that landholders cannot enter or do not wish to enter this program. Since the case study area Hojancha is an area where half of the contracts signed are reforestation contracts, the focus was put equally on the two contract modalities. Hence, we intended to find equal amount of participating respondents for each of the two modalities.

In total we ended up with 207 respondents/households. Out of these, 122 had never applied for a PSA contract, 13 had applied but not received a contract, 1 had also been rejected but received contract previously, and 3 were on waiting lists. Hence, 69 of the respondents had a contract of had had one since the program started in 1997.

If the respondents had both a forest protection and a reforestation contract (or more), this was noted, but the follow-up questions were related to one of the contract types, the most relevant, being the most recent of them, but to have lasted for at least one period (5 years).

Since many of the landowners that are receiving PSA contracts in the region of the case study area are enterprises, we intended to include these and compare them as a separate group (participants/non-participants). As this would turn out very complicated and require much effort, I decided to leave them out of the survey. However, as the survey went on, it appeared that quite many of the family farms were enterprises, and it was common that friends had made enterprises out of several farms. Hence, very many respondents would have to be left out if these were not to be included. I therefore decided to include them, and the respondents are therefore a mix of single owners and owners whose farm is an enterprise they have together with either family and/or others. But all of the respondents are among those making decisions related to management on behalf of the farm(s).

Selection of 'participants'

The list of farmers from which we selected the 'participants', was a list from FONAFIFO over PSA participants in the canton, as well as lists of farmers who had applied for a contract, but who had not received one. The Agricultural Centre also provided us with lists of PSA participants. For the selection process, we started out with a list of 62 participants, involved in forest protection, reforestation, or both. There were a few of the respondents who had both contract types, who were asked about only one of the contract types.

Selection of 'non-participants'

The non-participants were selected from the FONAFIFO list of farmers who had applied for a contract, but not received one, in addition to lists provided by the local office of CATIE and MAG (local agricultural office). From the list of farmers having applied for a contract but not

received one, several of these had previously had a contract, and these were excluded since we were looking for farmers that had not had a contract previously either. For this group we ended up with 12 farmers, which should ideally have been more since it would have permitted us to get a better perception of differences between farmers that had applied for a contract and not received, and farmers that had received one or more contracts.

In general, we looked for farmers who had at least some amount of either forest or forest plantations, preferable more than 2ha, since that is the limit of FONAFIFO for applying for a forest protection contract. It also turned out that some farmers on the lists did have a contract, and some of them had sold their farm and did not any longer have the farm in question, and some farmers only had pasture area, and were therefore not included in the survey. We also made sure that for every area where we selected some participants, we would have some non-participants as well.

In general, almost all of the farmers that were asked to participate in the survey, accepted. However, as the survey went on we realised that several of the farmers on the lists we had of participants, were difficult to reach since several of them did not live in the region, but only had their farm there. As it would require very much time to get hold of these, they were not included in the survey, which shortened the list. When it comes to the non-participants, as mentioned, many of the farmers on the lists, were not used for the survey for mentioned reasons, and some of them could not be found. It therefore became necessary to look for new areas to find more respondents. We found lists of more farmers at the local Ministry of Agriculture (MAG) in the neighbouring canton, Nandayure. Since this is a much larger canton, and we wished to stay close to Hojancha both because of practical reasons and because many of the farmers living close to the border of Hojancha have connections to Hojancha, either through family or by having their farm in Hojancha. We also went to the second neighbouring canton, Nicoya, where we received new names of farmers in that canton from the canton's MAG office. To find non-participants, we asked the respondents we had names and numbers for and in that way found new respondents. Also Nicoya is a large canton, and we stayed mostly to the areas closest to the Hojancha border, on the route south towards the ocean from the canton centre (the town of Nicoya).

5.1.3 Semi-structured interviews/qualitative part

The qualitative part consists of semi-structured interviews with persons in relevant institutions, such as the national forest agency, FONAFIFO, located in the capital of San José, in addition to local officers in the region in which the survey was conducted, and the local Agricultural Center ('Centro Agrícola') in Hojanca. In order to improve the questionnaire for the household survey, I also talked to officers in the local ministry of agriculture, MAG, prior to beginning the household survey in order to get more information on the program in the specific area. In addition, I conducted some semi-structured interviews with a few farmers in order to try out the draft of the questionnaire for the household survey, but also to obtain wider opinions of the program on behalf of the farmers and a broader understanding of the program.

5.1.4 The questionnaire

The questionnaire was split into several parts. The first consisted of information about the farm (the most important economically in case they possessed various), length of possession, size of farm, different land-uses of the farm, whether they possessed other farms/parcels as well, about the access to the farm in dry and rainy season, water sources at the farm, documents they possessed of their farm, distance to the nearest forest/agricultural offices, number of cattle and percentage of poor soil and steepness (biophysical characteristics).

The second part was about PSA, whether they had received any kind of forestry incentive earlier, if they had ever applied, if they had received a contract, and if yes, what kind of contract, and if they had not applied for a contract, for what reason. Then the questions were split into type of contract for those who had been/were participants. The first section here was general information about the contract(s) they had/had had and how they perceived the process/program, what the payments they received mainly were spent on, what they thought should be improved etc. in addition to what land-uses the farm would have if they were not participating in PSA.

The next section was related to costs related to application process and costs implied with the contract requirements, split into sections for each type of contract. There was also a section for those who had applied for a contract but not received, with questions about the contract(s) applied for and the costs and possible costs involved. The last part of the questionnaire was

dedicated to questions about socio-economic issues.

As a help to design the questionnaire, I based it on two surveys previously conducted in Costa Rica. One of them was conducted by Rodrigo Arrigada, who performed a household study in Costa Rica in 2005 (Arrigada, 2008), and the other was done by Tobias Wünscher, at the Nicoya peninsula in Costa Rica in 2005 (Wünscher et al. 2006, 2008). Many of the questions, especially in Arrigada's questionnaire were relevant for my study and gave me an idea of how to build it up. These questionnaires were also very useful as the questions were adapted to the local conditions, also by already being in Spanish, which helped me to get them well formulated and in such a way to make the respondents understand well the questions.

The questionnaire was, as mentioned, tested at the first visit to the case study area on a couple of farmers, and we found that several of the questions needed to be formulated differently, changed or skipped.

5.2 Transaction- and compliance costs

Based on the information retrieved from the household survey, concerning participation costs, I calculated the transaction- and compliance costs the farmers had had with their respective PSA contracts, in order to get information on the amount of transaction costs and compliance costs related to the payments the landowners receive. In this section I will define these costs and explain the costs that were used in the calculation for the study. I will in the end explain the different interpretations I have made of maintenance costs and establishment costs for the results section.

5.2.1 Definition of transaction- and compliance costs

For estimating costs related to an economic instrument such as PES, it is natural to distinguish between 'transaction costs' and 'compliance costs', which may also be referred to as 'implementation costs'.

In the case of PES, **transaction costs** include the costs that are associated with the application process in order to be included in the program. This relates to legislation and institutions, and what concerns seeking, gathering and exchanging information, making decisions, and

contracting. In addition, they include monitoring and enforcement of the contract requirements (first and foremost related to intermediaries and authorities).

Compliance costs or implementation costs are, in relation to the two PES contracts in Costa Rica, associated with fulfilment of the contract requirements, such as putting up fences to make sure cattle do not enter the forest, areas, creating firebreaks etc. The costs concerning the protection contract are related to refraining from the undesired practices. In the case of reforestation contracts, these costs imply establishment of plantation(s) and the costs related to the maintenance of these plantations.

Both transaction costs and the implementation- or compliance costs for the landowners may be divided into different groups – material and immaterial costs. The material costs to the farmer would normally imply expenses for things such as making copies of the required documents of the farm, transport etc. in addition to a potential correction of documents containing errors, which implies additional costs. The immaterial costs refer to the farmers' opportunity costs of time, the income they are missing by performing the work related to the application procedures, attending meetings with forest officials, or related to implementation/maintenance.

When I next will be describing the transaction costs and implementation costs from my study further, I divide both transaction costs and implementation costs into material and immaterial costs.

5.2.2 Transaction- and compliance costs to landholder

Transaction costs

The transaction costs to the landowner are those costs related to the application procedure. In the survey, in the section related to the application, I included questions concerning the time spent for this procedure, related to visits to the necessary offices/forest officials, making copies etc. In the survey, I focused mainly on the time spent, since many of the landowners participated quite some years ago, and it would be easier to remember as well.

- Material costs: When it comes to the application process, the specific material costs I asked for were possible costs related to the need for an attorney in the case of

problems with documents, and other likely costs, e.g. for topographer in order to create new cadastral map of the farm (one of the requirements) etc. In the calculation of these costs, when used to compare per hectare costs, the possible costs for topographer were divided on the number of hectares (assumed to be variable) and the other costs were assumed fixed.

- Immaterial costs: These costs relate, as mentioned, to the opportunity costs of the farmer, the time he/she spent for things such as meetings with forest officials, intermediaries, paperwork etc. In order to calculate the value of the time spent by the farmers for these things, as well as for the implementation/compliance phase, I have tried to find the value (shadow price) of an average working hour for the specific farmer involved. I have assumed average working hours during a month to be 140 hours (7hrs/day, 5 days/week, 4 weeks/month). I have then used the information obtained from the household survey about the monthly consume by the family and divided this on average monthly working hours (concerning the monthly consume of the family, it should be mentioned that the survey question consisted of alternatives with intervals, and that for the calculation, the median of the interval is used as the specific number). I have hence assumed monthly consume to be the same as monthly income, which of course may not be the case due to savings or earnings of other family members apart from the respondent interviewed. I asked for monthly consume instead of income since farmers may be more reluctant to give up information on income than consumption, and generally, these two numbers are quite close.
- Material/immaterial costs: Most of the landowners interviewed, applied through an intermediary, which in the case study area are the Agricultural Centres ('Centro Agrícola'). This implies that the intermediary takes care of most of the administrative procedures, and works as the intermediary between FONAFIFO and the landowners applying for a PSA contract. According to the Forestry Law 7575², the intermediaries are allowed to charge up to 18% of the payments received from FONAFIFO for the work as the intermediary for PSA contracts. Since there are very few of the farmers interviewed that applied directly to FONAFIFO (which is the other option), I have excluded these respondents when making the analysis. The 18% administration costs

² <http://www.elaw.org/system/files/Ley+Forestal+CR.pdf>

are hence assumed to be fixed and are added to the transaction cost part in the final aggregation.

Compliance/implementation/establishment costs

Since I included two types of contracts, the forest protection- and the reforestation contract, there are of course different types of costs involved when it comes to 'compliance' costs, so I have calculated these separately.

As to the forest protection contract, the costs are related to the whole contract period, since the costs will be quite spread over the period (also reflected in the equal payment amount given over the 5-year period). When it comes to the reforestation contract, the payments are given out differently, with the majority of the payments given in the first year, indicating that most of the expenses are related to this first year. These costs related to the establishment of the plantations may be substantial. I have hence separated these costs from those that relate to maintenance over the rest of the period in order to be able to distinguish between the two.

- Material costs: The material costs for the **forest protection** contract refer partly to the preparation for the contract period, in relation to the contract requirements involving putting up fences to protect the forest for entering livestock, put up signs and create firebreaks. There are as well maintenance costs involved, for maintenance of fences and signs. I did not include a question concerning of specific material costs related to these issues, but some farmers gave this information during the survey. However, since I did not originally have questions about these costs, and thus only received this information from some of the farmers, I decided not to include them in the analysis and only kept the time costs/labour costs (as the results might have become misleading otherwise).

When it comes to the **reforestation contract**, the material costs naturally relate to the specific costs in relation to the establishment of the plantation(s) – transport and purchase of tree-plants, equipment etc. Neither for this contract did I include questions about this, but rather focused on time involved. As to the maintenance costs, the farmers were asked about costs per year. I have thus aggregated these costs over the 5-year period (less if they had not completed the contract period yet for the first cost

interpretation). Separation between the ‘preparation’ phase and the ‘maintenance’ period should also have been done with the protection contract in order to obtain more accurate cost information.

- Immaterial costs: The value of one working hour was calculated the same way as described under the transaction cost section. The time costs here are related to the time spent by the farmer for the associated activities, preparation, plantation establishment, and maintenance.
- Material/immaterial costs: Many of the farmers appeared to have hired labour for the implementation/compliance cost part of the contract. This question was hence quickly included in the survey. Some farmers gave this information in expenses for labour per day, other in per hour payment and number of days spent for the work in total. In these cases, it is assumed a working day of 6 hours since this number appeared to be the usual amount of working hours for this type of work for the calculation. If specific payments were not given, it was assumed US\$2 per hour and US\$12 per day (2010-value).

When it comes to calculation of the percentages (the costs as a percentage of the payment received from FONAFIFO), I have looked up the level of payments for the relevant years (1998-2010) and when having all values in dollars, the 2010-value (inflation) was calculated through the consumer price index for this type of calculation (Banco Central, 2011).

Uncertainties of the data

There may be several uncertainties related to the cost calculations due to possible misunderstandings with the questions, which might have been better designed to obtain more accurate information. It was probably not given a sufficient specification of time frame for the costs, as many of the farmers/landholders have or have had several contracts and/or renewed contracts. This issue was not taken into account when designing the survey and not considered enough when performing it. This effect is probably smaller for the information related to protection contracts, since these contracts are often renewed, and there are less costs related to renewed contracts than new contracts. In general, however, the calculation has been directed to one contract period, the last fulfilled. If the contract was signed few years before the

interview (thus not yet a completed contract), the costs have been modified, comparing with other similar contracts/landholders. In the cases where the landholder had two contracts signed close in time (e.g. one year), it could be assumed that the costs were related to both of them.

It is particularly difficult to obtain accurate estimates of the maintenance costs of reforestation contracts, as it implies to ask for the costs/time related to each year of the contract, as this varies according to the growth level of the trees and how much work/maintenance that is necessary in different periods. In addition, there had been a long time for many of the landowners since they entered the program, and did therefore often have difficulties with remembering exactly the time and costs involved. Some of them gave time information in weeks, for example, hence sometimes making accurate estimation of time costs challenging. When it comes to transaction costs, it is important to keep in mind that before 2002, all contracts were group contracts ('contratos globales'), which had a great significance of the level of transaction costs where these costs were spread over the whole group rather than each one having to make all the procedures him/herself.

5.2.3 Interpretations of compliance costs for the reforestation contract

Due to uncertainties of how best to understand the costs related to maintenance and establishment for the reforestation contract, I have made 4 interpretations of the maintenance costs, and 2 different interpretations of the establishment costs.

Maintenance

- The first interpretation at 129% includes all observations providing transaction cost information and multiplying the given per year maintenance cost for the plantation with the number of years the contract had been in force.
- For interpretation 2, I have removed one observation related to the maintenance costs, which I consider an outlier and substantially affecting the mean percentage.
- Interpretation 3 implies removing 3 observations related to the establishment costs that imply over US\$1000 per hectare in establishment, which I consider unlikely.
- In interpretation 4, the maintenance costs are not multiplied by the number of years the contract has been in force as in interpretation 1. This is because the results from interpretation 1 may seem unlikely high, and is likely to contain some kind of error. 48

The question in the survey related to the level of these costs was intended to be maintenance costs per year, hence these costs were originally summed up by 5 years, but there are very high variances in these numbers, so many of the farmers may have given the total sum for all contract period, 5 years. Hence, here those contracts that have not passed the whole period have been corrected for according to how many years they have had a contract and hence had maintenance costs (assuming the information given by the farmers was for the entire period and not for each year).

Establishment

- The first interpretation in which all observations are included show that based on my results, the total establishment costs represent a percentage of 62% of the first PSA payment of the reforestation contract (50% of the total).
- The second interpretation is obtained by removing the 3 extreme values which represent establishment costs of more than US\$1000 per hectare).

5.3 Econometric and statistical methods

In order to say something about the basis for additionality of participants compared to non-participants, characteristics of participants vs. non-participants, in addition to characteristics of the farmers related to the level of transaction costs, there was used econometric methods, first and foremost the logistic model for binary response, and the OLS estimation method related to the transaction costs vs. possible associated variables.

In general, many of the variables were correlated, which in the case they had been run together may have led to reducing the significance of the variables. The variables with more than 0,35 correlation were therefore run separately.

Several of the variables have been redefined and converted to dummy variables in order to get more accurate results.

5.3.1 The multiple regression model

The multiple regression model and the estimation method Ordinary Least Squares (OLS) are central when it comes to predicting the marginal effect of a dependent variable on an independent variable, holding all other variables constant.

Some assumptions that are needed to obtain the Best Linear Unbiased Estimator (BLUE), which is the estimator with the smallest variance (Gauss-Markov). The assumptions for Gauss Markov theorem are: Linearity in parameters, random sampling, no perfect collinearity, zero conditional mean, homoscedasticity and normality. Potential problems of heteroskedasticity are accounted for by using heteroskedasticity-robust standard errors (Wooldridge, 2009).

OLS and transaction costs

In order to find out which factors/characteristics of the landowners that might affect the level of transaction costs (application costs), OLS regressions were applied. These results are supposed to supplement the equity part. The independent variable (y) is the level of transaction costs per hectare, and the dependent variables are the characteristics assumed to affect the landowner's level of transaction costs. The variables included are: whether the landowner has earlier received incentives (prior to the PSA program); the distance to public offices (MINAET, FONAFIFO), type of document possessed by the landholder, monthly consume of the family (proxy for income), education level, and the number of contracts they have/have had.

5.3.2 Probability models – binary response models

The logit model

The logit model is a discrete choice model for binary response where the response probability is the logit function evaluated at a linear function of the explanatory variables.

A binary dependent variable is an example of a limited dependent variable, which is a variable for which the value is somehow restricted. It implies that the variable may contain two values, zero and one (Wooldridge, 2009).

In this study, I have used the logit model for three purposes:

1. The first is in order to find out whether PSA participants have lower opportunity costs of land than non-participants. I have therefore run regressions with independent

variable ($y=1$) for applicants and ($y=0$) for non-applicants in addition to similar regression in which ($y=1$) for participants and ($y=0$) for non-participant. I run regressions for both applicants and participants since it is interesting to see whether there are differences when it comes to the opportunity cost factors between these two independent variables, even though most of the applicants receive contract in the case study area. I will be looking at the differences between these regressions also to see whether one may say anything concerning the targeting of payments, hence differences in characteristics between the applicant group and the contract recipient group. If there is no difference between the two groups, it may indicate little if any targeting of the PSA funds, and that there is a potential for increasing cost-effectiveness of the program. Since I assume differences in opportunity costs of land between forest protection participants and reforestation participants, there are made separate regressions for these. When running these regressions, I am using the following opportunity cost factors of land: biophysical characteristics of the land (percentage of amount of poor soils and steep slope of the farm), number of cattle, whether the farmers have a second occupation, off-farm income, the level of access to the farm during rainy season; and whether the landowner has been offered to sell the farm during the last 10 years.

2. The second issue I will use the logit-model for, regards opportunity cost factors of land related to the type of contract the farmer has. In this case, ($y=1$) implies a forest protection contract, and ($y=0$) a reforestation contract. I am hence looking for whether it is more likely to have a reforestation contract than forest protection contract if the opportunity cost of land appears higher. The same variables are used above.
3. The third concerns the equity issue, for which I will look at variables that are assumed related to whether farmers participate in PSA or not. It concerns the response probability for participating in PSA with certain characteristics. The dependent variable will be ($y=1$) for participant (forest protection or reforestation), and ($y=0$) for non-participant. The variables included in this analysis are: number of hectares, number of more farms (additional), distance from farm to MAG office, distance to FONAFIFO regional office, level of education, whether the farmer has a second occupation, the level of off-farm income, whether the landowner has previously

received forest incentives (e.g. CAF), and whether they live on the farm or not. I have also run regressions with the same independent variables, but in which the dependent variable is ($y=1$) applicant and ($y=0$) non-applicant.

5.4 Validity considerations

I will in this section look at some factors that should be considered in relation to validity of the results of the study.

Selection

As mentioned earlier in the chapter, it was difficult to perform a random selection of respondents since the case study area is a small canton and it ended up with mostly including those landholders that were possible get hold of. It is also important to take into account that for example many participants in PSA in the case study area did not live in the area and were not included in the survey due to limited time. These are probably quite wealthy landowners and the inclusion of these would have made the result more representative for the population.

Measuring of variables

There could probably have been better ways of measuring some of the variables more accurately, and questions that should have been made clearer. This especially goes for the participation cost part, also mentioned earlier, which ended up with very high variations. Some data was lacking as well. Measuring opportunity cost of time of the landholders is a particular issue that has large implications and could have been done differently by focusing on the specific landholder, in order to obtain more specific individual opportunity costs.

Applicability to other settings

It would be difficult to apply findings from this analysis to other settings and situations, as Hojanca is a quite particular place and has a different setting than many other areas concerning deforestation with respect to the historical trends in this area.

6 Results and discussion

In this chapter, I will first go through the results and hypotheses. I will first look at the environmental effectiveness part and the hypotheses regarding opportunity cost of land and the differences related to these and the type of contract. Next, I will look at the cost-effectiveness part concerning transaction- and compliance costs related to the landowner and opportunity costs. Finally, I will go through the hypotheses and result that relate to the equity part and participatory factors, and in the last part of the chapter I will have a discussion section.

Table 6.1 Explication and description of variables used in the regressions in the chapter

Variable name	Description of variable	Type of measure	Average/ no of obs.	Min value	Max value	Standard deviation
Number of hectares	Continuous, number of hectares at the farm in question	Hectares	57,7	2,5	787	87,58
Number of more farms	Continuous, number of farms/parcels besides the farm in question	Number of farms or parcels	0,7	0	6	0,9
Cattle in 2011	Continuous, average number of adult cattle (>1 year) in 2011	Number of cattle	25	0	400	38,2
Poor soils	Continuous, percentage of poor soils (not appropriate for agriculture) at the farm in question	Percentage	10,9	0	100	20,2
Steep slope	Continuous, percentage of farm in question that contains steep slope (not appropriate for agriculture)	Percentage	34,3	0	100	25,7
Off-farm income 2011	Continuous, percentage of family's total income that does not come from the farm in question in 2011	Percentage	47,1	0	100	40,5
Access rainy season	Dummy variable 1=Accessible by car, 0=Accessible by either motorcycle, horse or by foot	Mean of transport	1=139 0=68			
Second occupation	Dummy variable 1=Has a second occupation, 0=Does not have a second occupation		1=83 0=124			
Distance MAG	Continuous, distance in minutes from farm in question to closest MAG office	Minutes	29,7	2	120	18,6
Distance FONFAFIFO	Continuous, distance in minutes from farm in question to closest FONAFIFO office	Minutes	59,1	5	180	32,8

Live at farm	Dummy variable, whether the landowner lives at the farm in question or not		1=73 0=133
Participant CAF	Dummy variable 1=landowner has received any forest incentives (CAF or similar) before 1997 0 =not received		1=65 0=142
Ever applied	Dummy variable 1= has ever applied for a PSA contract between 1997 and 2011, 0=has never applied for a PSA contract		1= 85 0=122
Received contract	Dummy variable, 1=has received a PSA contract between 1998 and 2011, 0=has not received a PSA contract between 1998 and 2011		1=71 0=13
Education	Dummy variable, 1=has higher completed education than secondary school, 0=has lower education than secondary school	Level of completed education	1=29 0=178
Offer to sell	Dummy variable, 1=has been offered to sell the farm in question during the last 10 years, 0=not received offer		1=108 0=99

Many of the variables were correlated. They are therefore run separately in the regressions (see Appendix C).

6.1 Environmental effectiveness and opportunity cost of land

In this section, I will first go through the first hypotheses; H.1-H.6 related to opportunity cost of land. I have been using two different dependent variables for the regressions here, *ever_applied* and *received_contract* (see table 6.1). The results from both these dependent variables are applied since they are assumed to be different and it is interesting to see whether there is any difference, and in that case, which differences there are.

I will analyse the difference in opportunity factors between PSA participants and non-participants using regressions with both the dependent variables, separately for the contract types and finally also with the two groups pooled. Next, I will analyse the differences between protection participants and reforestation participants.

I will start by looking at H.1.a-H.6.a (related to the forest protection contract) and then go through the same hypotheses (with respect to the reforestation contract, where some of the

hypotheses from the protection part are excluded as they are not logic with respect to the reforestation contract). Next, I will go through hypotheses H.7.- H.9. by first looking at the regressions relating to opportunity cost factors of land with respect to type of contract, and then the results from what the participants themselves expressed would be the alternative use of the land. I have also added tables concerning the main uses of the payment the participants receive, as reported by the landowners.

6.1.1 Forest protection – opportunity cost of land

Table 6.2 *Opportunity cost factors for forest protection contract with dependent variable ever applied*

Opportunity cost factors	Regression 1	Regression 2	Regression 3	Regression 4
H.4. Number of other farms	0,305 (1,24)	0,297 (1,28)	0,262 (1,10)	0,197 (0,86)
H.6. Access rainy season	-0,957*** (-2,40)	-0,975*** (-2,41)	-1,004*** (-2,48)	-0,781*** (-2,01)
H.1. Cattle in 2011	-0,003 (-0,52)			
H.2. Poor soils	0,004 (0,48)	0,005 (0,50)	0,005 (1,73)	
H.2. Steep slope	0,008 (0,97)	0,008 (1,01)	0,008 (0,99)	0,010 (1,32)
H.5. Off-farm income in 2011	-0,003 (-0,54)		-0,002 (-0,49)	-0,003 (-0,61)
H.5. Second occupation		-0,151 (-0,37)		
H.3. Offer to sell farm	0,194 (0,49)	0,119 (0,29)	0,084 (0,21)	0,052 (0,14)
H.4 Number of hectares		0,004** (1,74)	0,004**(1,73)	0,004** (1,86)
Constant	-0,975	-1,334	-1,206	-1,199
Wald Chi2	10,21	12,88	13,05	11,50
Prob > Chi2	0,1770	0,0750	0,0708	0,0742
Pseudo R2	0,0593	0,0746	0,0759	0,0622
N	154	155	154	161

The numbers in the parentheses are the z-values. * = significant at 15%³ level ** = significant at 10% level, *** = significant at 5% level, and **** = significant at 1% level.

³ I choose to use 15% significance level as well, since the sample is quite small.

Table 6.3 Opportunity cost factors for forest protection contract with dependent variable *received contract*

Opportunity cost factors	Regression 1	Regression 2	Regression 3
H.4. Number of other farms	0,309 (0,55)	0,679 (1,00)	0,584 (0,86)
H.6. Access rainy season	0,319 (0,34)	-0,876 (-0,89)	-1,273 (-1,21)
H.1. Cattle in 2011	-0,017 (-1,05)		
H.2. Poor soils	0,036 (1,20)	0,039 (1,22)	0,037 (1,13)
H.2. Steep slope	-0,010 (-0,61)	-0,009 (-0,58)	-0,007 (-0,47)
H.5. Off-farm income in 2011	-0,0001 (-0,01)		-0,010 (-0,85)
H.5. Second occupation		0,735 (0,73)	
H.3. Offer to sell farm	-0,238 (-0,26)	-0,656 (-0,63)	-0,633 (-0,61)
H.4. Number of hectares		0,021 (1,57)*	0,028 (1,84)**
Constant	1,561	-0,083	0,489
Wald Chi2	3,06	6,90	7,10
Prob > Chi2	0,8791	0,4396	0,4189
Pseudo R2	0,0783	0,1764	0,1814
N	38	38	38

The numbers in the parentheses are the z-values. * = significant at 15% level ** = significant at 10% level, *** = significant at 5% level, and **** = significant at 1% level.

H. 1a: Forest protection participants are less likely to have cattle/livestock than non-participants

The variable *cattle in 2011* is not significant in either table 6.2 (*ever_applied*) or table 6.3 (*received_contract*). As to the opportunity cost issue, we would expect a negative relationship between the number of cattle and whether they would like to apply for/participate in PSA, since, if there are few or no cattle at the farm, we assume the farm area to be less valuable or useful for agriculture than if there were more cattle. However, the survey question related to the number of cattle at the farm was referring to the year 2011. The data for some of the farmers may therefore be somewhat inaccurate, as I included participants from the year 1998 to 2011, and some landowners may have acquired (more) cattle after the contract was finished. Farmers may also still have many cattle even though they are participants if they possess of several farms.

H. 2a: Forest protection participants are more likely to have less favourable biophysical conditions (poor soils and steep slope) than non-participants.

Since soil quality and steepness of the land are characteristics affecting the opportunity cost of land, hence alternative land uses. We expect a positive relationship between the variables *poor soils/steep slope* and application/participation in PSA. Less favourable biophysical conditions of the farm would most likely make it more attractive to apply for a PSA contract since such areas may not be very useful for other purposes such as agriculture. According to Zbinden and Lee (2005), farms with relatively degraded area in their study, were more likely to participate in PSA. Also according to Arriagada et al. (2009), farmers with unfavourable biophysical conditions are more likely to apply for PSA due to lack of other alternative land uses. In my study, however, none of these two variables are significant in any of the regressions. It may be that many non-participants with unfavourable biophysical conditions do not wish to apply/participate because they find costs too high as well.

H. 3a: Forest protection participants are less likely to have been offered to sell their property than non-participants.

As there is an increasing interest by foreigners to buy real estate in this part of the country especially, we expected the variable *offer to sell farm* to be negatively related to application/participation in PSA, since an offer to sell would indicate that the farm has more value and that the farmer would be more likely to wish to sell the farm than participating in PSA. The variable is however, not significant in any of the regressions in table 6.2 or 6.3. An explication of the lack of significance here may be that many of the farmers do not wish to sell due to being family farms and if they do not have any other properties they would often prefer to keep the farm they have.

H. 4a: Forest protection participants are more likely to have larger property and/or several parcels than non-participants

We expect farm size and number of parcels to be positively related to the decision to apply/participate for PSA protection, since more area available could be assumed to make landowners decide to spend/let some of the area be used for other purposes, such as

agriculture. Zbinden and Lee (2005) find that farm area is positively related to PSA participation. In my study, the variable *hectares* is significant in both table 6.2 at 10% level, and at 10% and 15% in table 6.3 (*received_contract*), in all with positive sign, suggesting that the hypothesis cannot be rejected. *Number of other farms* is however, not significant in any of the regressions.

H. 5a: Forest protection participants are more likely to have off-farm income/a second occupation than non-participants.

According to Zbinden and Lee (2005), more off-farm income increased the probability of participating in PSA. Arriagada et al (2009) rather found that most of the non-participants had off-farm income, and that off-farm income seemed to make landowners not to participate in PSA. It would be likely to expect off-farm to be positively related to participation due to this indicating less opportunity cost of the farmland. On the other hand, it is also likely to believe that farmers applying for/participating in PSA are in need for the extra income, and poorer farmers may therefore be expected to seek for extra income by applying for PSA. But also, if they are working off-farm, which is often the case, they will have little time for their own farm and for complying with requirements (maintenance) (Arriagada et al. 2009). The relationship between the variable *off-farm income in 2011* and ever applying for PSA/participating may be expected to have either positive or negative sign. The variable *second occupation* is a dummy variable for whether the respondent has a second occupation or not. As this variable only refers to the respondent and not other family members as well, the variable *off-farm income* may be more accurate to use for this purpose. However, none of the two variables are significant in any of the regressions, however. It must be noted that the survey question is related to off-farm income in 2011, and not necessarily to the time they had PSA contract. The data may therefore be somewhat inaccurate. It would probably have been better to ask for this percentage for the year the landowners entered the (first) PSA contract (in case of participation). On the other hand, it might have been difficult for several of the landowners entering the program quite some time ago to remember the exact number.

H. 6a: Forest protection participants are more likely to have more difficult access to their farm than non-participants.

We expect forest protection applicants/participants to have poorer access to their farms than non-participants, since we understand poor access (only reached by foot or horse) as a sign of low opportunity cost of the land. More difficult access makes it more difficult to have cattle on the area and use it for other purposes that would require transport. Sierra and Russmann (2006) also state that farmers with more difficult access to markets, thus higher transportation costs would give less incentives to clear forest for agriculture. The variable *access in rainy season* is significant at 5% level with the dependent variable *ever_applied*, with a negative sign, which is what we expect. The hypothesis can hence not be rejected.

There are not many significant variables in table 6.2 and 6.3, only two for *ever_applied* and one for *received_contract*. This does not give many indications of lower opportunity costs among participants (counting only with protection contract). It should be noted that most of the PSA applicants in the case study receive(d) contract. Out of 85 applicants, 13 did not receive contract.

6.1.2 Reforestation – opportunity cost of land

In this part, I will go through the same hypotheses as for the protection contract over, but this time related to the reforestation contract.

Table 6.4 Opportunity cost factors for reforestation contract with dependent variable *ever_applied*

Opportunity cost factors	Regression 1	Regression 2	Regression 3	Regression 4
H.4. Number of other farms	0,692 (2,88)****	0,485 (2,36)***	0,459 (2,19)***	0,655 (2,78)****
H.6. Access rainy season	0,328 (0,72)	0,282 (0,65)	0,245 (0,56)	0,233 (0,53)
H.1. Cattle in 2011	-0,022 (-2,41)**			-0,020 (-2,32)***
H.2. Poor soils	0,004 (0,44)	0,0009 (0,08)	0,001 (0,14)	
H.2 Steep slope	-0,002 (-0,03)	-0,0002 (-0,03)	-0,001 (-0,14)	0,004 (0,05)
H.5.Off-farm income in 2011	-0,005 (-0,98)		-0,002 (-0,47)	-0,005 (-1,02)
H.5. Second occupation		0,019 (0,49)		

H.3. Offer to sell farm	-0,008 (-0,02)	0,022 (0,05)	0,027 (0,07)	-0,061 (-0,16)
H.4 Number of hectares		0,0008 (0,40)	0,0007 (0,36)	
Constant	-1,224	-1,840	-1,565	-1,091
Wald Chi2	14,76	7,18	6,92	13,76
Prob > Chi2	0,0392	0,4099	0,4373	0,0325
Pseudo R2	0,0857	0,0416	0,0402	0,0779
N	154	155	154	158

The numbers in the parentheses are the z-values. * = significant at 15% level ** = significant at 10% level, *** = significant at 5% level, and **** = significant at 1% level.

Table 6.5 Opportunity cost factors for reforestation contract with dependent variable received_contract

Opportunity cost factors	Regression 1	Regression 2	Regression 3	Regression 4
H.4. Number of other farms	0,464 (0,65)	0,593 (0,63)	0,811(0,78)	0,433 (0,64)
H.6. Access rainy season	2,048 (1,35)	1,591 (1,16)	1,448 (1,05)	1,662 (1,18)
H.1. Cattle in 2011	0,089 (1,34)			0,089 (1,31)
H.2. Poor soils	-0,014 (-0,46)	-0,003 (-0,10)	-0,009 (-0,31)	
H.2. Steep slope	-0,040 (-1,82)***	-0,030 (-1,48)*	-0,027 (-1,40)	-0,040 (-1,83)***
H.5. Off-farm income in 2011	-0,018 (-1,37)		-0,021 (-1,36)	-0,021 (-1,56)*
H.5. Second occupation		-1,615 (-1,29)		
H.3. Offer to sell farm	-0,171 (-0,12)	-0,230 (-0,16)	-0,560 (-0,39)	-0,105 (-0,08)
H.4. Number of hectares		0,054 (1,40)	0,040 (1,29)	
Constant	1,517	0,475	1,241	1,810
Wald Chi2	10,03	9,92	10,16	9,59
Prob > Chi2	0,1868	0,1929	0,1797	0,1430
Pseudo R2	0,3026	0,2994	0,3065	0,2864
N	38	38	38	39

The numbers in the parentheses are the z-values. * = significant at 15% level ** = significant at 10% level, *** = significant at 5% level, and **** = significant at 1% level.

H. 1b: Reforestation participants are less likely to have cattle/livestock than non-participants

Also for the reforestation contract, we expect the applicants/participants to have fewer cattle than non-participants. However, we might assume that the farm is more relevant for livestock production (as compared to protection participants) since landowners, if they are able to, often quit cattle farming or sell some of the livestock in order to establish timber plantations. From table 6.4, we see that the variable *cattle in 2011* is significant at 5% and 10% significance

level for *ever_applied*. The sign is negative, thus indicating that less cattle gives larger probability of participating in reforestation, which is as expected. The hypothesis can thus not be rejected.

H. 2b: Reforestation participants are more likely to have less favourable biophysical conditions (poor soils and steep slope) than non-participants.

We expect PSA participants in general to have lower opportunity cost of land than non-participants, but we assume that soil quality and inclination of the land to be considerably better for reforestation participants than for protection participants. The variables *poor soils* and *steep slope* are not significant in table 6.3, but *steep slope* is significant at 5% and 15% significance level in table 6.4 (*received_contract*). However, it shows negative sign, which is contrary to what we expect, as we originally assume a positive relationship here. But as mentioned, the land cannot have too much inclination in order to establish a plantation, so it is not very surprising that the results do not show the expected results for PSA participants here.

H. 4b: Reforestation participants are more likely to have larger property and/or several parcels than non-participants

We expect the reforestation participants to be more likely to have more (available) area or several land areas (parcels) than non-participants, as we assume them to have less opportunity cost of land than non-participants. Farmers with larger properties and/or several parcels may have the possibility of planting/establishing plantations at some of the area/one of the parcels. Hence, they do not depend on all the farm area, and have something to spare for other activities. We hence expect the variables *hectares* and *number of other farms* to have a positive sign. *Number of other farms* is in table 6.4 (*received_contract*) significant at 1% and 5% significance level, with expected positive sign. The hypothesis can therefore not be rejected.

H. 5b: Reforestation participants are more likely to have off-farm income/a second occupation than non-participants.

As mentioned under the previous section for protection contract, there can be two different expected outcomes for the variable *off-farm income 2011*. It may be that farmers apply for PSA in order to obtain some more income (diversifying their income) or they may not depend that much on their farm, hence find it easier to include it in PSA to get some extra income. When it comes to the reforestation contract, it is a bit different, since there are substantial investment costs related to establishing a plantation. In fact, off-farm income may be needed in order to be able to establish the plantation as there are no payments given in advance. However, this is an issue I will come back to under the transaction cost/compliance cost section. In table 6.4 (*received_contract*), the variable off-farm income 2011 is significant at 15% level. It has a negative sign, indicating that more off-farm income reduces the probability of participating in PSA reforestation. As mentioned previously, Arriagada et al (2009) also found this, focusing on forest protection participants. Reforestation participants should be expected to be more in need for off-farm income, but from this it might seem that they may be able to undertake the investment even with little off-farm income. It should again be noted that there might have been changes to the level of off-farm income from they entered the contract and until 2011, which is the year asked for in the survey. The variable *second occupation* is not significant in either of the tables.

In table 6.6 and 6.7 under, I have pooled the protection and reforestation participants in order to obtain a higher observation number, and find out whether there may appear more significant variables this way. Even though we expect some of the variables to show different results with respect to contract type, it could be worth to check out. Table 6.6 refers to the dependent variable *ever_applied*, and table 6.7 to *received_contract*.

Table 6.6 Opportunity cost factors with both contract types with dependent variable ever_applied

Opportunity cost factors	Regression 1	Regression 2	Regression 3	Regression 4
H.4. Number of other farms	0,429 (2,34)***	0,392 (2,18)***	0,354 (1,93)**	0,354 (1,93)**
H.6. Access rainy season	-0,321 (-0,99)	-0,305 (-0,96)	-0,352 (-1,10)	-0,353 (-1,11)
H.1. Cattle in 2011	-0,008 (-1,51)*			
H.2. Poor soils	0,004 (0,50)	0,003 (0,38)	0,003 (0,40)	
H.2. Steep slope	0,004 (0,68)	0,004 (0,67)	0,004 (0,65)	0,004 (0,66)
H.5. Off-farm income in 2011	-0,004 (-1,12)		-0,003 (-0,83)	-0,003 (-0,83)
H.5. Second occupation		-0,128 (-0,42)		
H.3. Offer to sell farm	0,054 (0,18)	0,0002 (-0,00)	-0,020 (-0,06)	
H.4. Number of hectares		0,002 (1,21)	0,002 (1,20)	0,002 (1,21)
Constant	-0,276	-0,709	-1,532	-0,541
Wald Chi2	11,35	9,67	10,07	10,07
Prob > Chi2	0,1242	0,2081	0,1846	0,1219
Pseudo R2	0,0428	0,0363	0,0380	0,0380
N	196	197	196	196

The numbers in the parentheses are the z-values. * = significant at 15% level ** = significant at 10% level, *** = significant at 5% level, and **** = significant at 1% level.

Table 6.7 Opportunity cost factors with both contract types with dependent variable received_contract

Opportunity cost factors	Regression 1	Regression 2	Regression 3	Regression 4
H.4. Number of other farms	0,340 (0,89)	0,635 (1,31)	0,677 (1,23)	0,384 (0,84)
H.6. Access rainy season	0,124 (0,40)	0,154 (0,50)	0,269 (0,82)	-0,303 (-0,44)
H.1. Cattle in 2011	-0,005 (-0,39)			
H.2. Poor soils	0,012 (0,65)	0,012 (0,69)	0,014 (0,75)	
H.2. Steep slope	-0,019 (-1,59)*	-0,020 (-1,68)**	-0,020 (-1,64)**	-0,017 (-1,45)*
H.5. Off-farm income in 2011	-0,011 (-1,38)		-0,014 (-1,60)*	-0,014 (-1,63)*
H.5. Second occupation		-0,107 (-0,16)		
H.3. Offer to sell farm	0,134 (0,20)	-0,401 (-0,55)	-0,405 (-0,55)	
H.4. Number of hectares		0,154 (1,73)**	0,020 (1,87)**	0,017 (1,72)**

Constant	2,412	0,899	1,280	2,181
Wald Chi2	7,30	9,57	12,29	10,92
Prob > Chi2	0,3980	0,2142	0,0916	0,0530
Pseudo R2	0,1929	0,1348	0,1730	0,1501
N	80	80	80	85

The numbers in the parentheses are the z-values. * = significant at 15% level ** = significant at 10% level, *** = significant at 5% level, and **** = significant at 1% level.

Tables 6.6 and 6.7 shows that pooling the protection and reforestation participant result in the same significant variables as in the separate regressions (6.2-6.5), with exception of *access in rainy season*, which does not appear significant in table 6.6 nor table 6.7. It hence results that more observations did not give more significant variables.

Table 6.8 Opportunity cost factors of land, summary table of tables 1-4.

	Forest protection contract	Forest protection contract	Reforestation contract	Reforestation contract	
Hypotheses	Ever_applied	Received_contract	Ever_applied	Received_contract	Can reject hypothesis?
H.1. Cattle			-		No
H.2. Poor soils					
H.2 Steep slope				-	No
H.3 Offer to sell farm					
H.4. Hectares	+	+			No
H.4 More farms			+		No
H.5. Off-farm income				-	?
H.5 Second occupation					
H.6 Access rainy season	-				No

The table shows which variables of the hypotheses that resulted significant for the different regression types related to opportunity cost factors, and with which sign they had.

From the summary of tables of opportunity cost factors of land in table 6.8, we see that overall, there are few significant variables. Even though the variables are significant, there does not seem to be enough evidence to claim that participants have lower opportunity cost of land than non-participants.

6.1.3 Opportunity cost of land – type of contract

In this section I will look at the differences in the opportunity cost factors between farms related to the two contract types forest protection and reforestation. I will first look at hypothesis H.7, by studying regressions with opportunity cost factors of land with respect to type of contract. Then I will go through H.8. and H.9 by looking at tables regarding farmers' self-reported alternative land uses and what the farmers said were the main uses of the PSA payments they received.

H. 7: Reforestation participants have higher opportunity cost of land than protection participants (same factors as under protection contract).

Table 6.9 Opportunity cost factors related to the type of contract, regressions 1-7

Opportunity cost factors	Regression 1	Regression 2	Regression 3	Regression 4
Number of other farms	-0,343 (-1,19)	-0,329 (-1,11)	-0,445 (-1,40)	-0,426 (-1,38)
Access rainy season	-1,846 (-2,63)****	-1,776 (-2,57)***	-1,908 (-2,66)****	-1,848 (-2,61)****
Cattle in 2011	0,016 (1,18)	0,014 (1,04)	0,016 (1,16)	
Poor soils	-0,003 (-0,16)	-0,002 (-0,10)	-0,002 (-0,11)	0,005 (0,28)
Steep slope	0,028 (1,94)**	0,027 (1,90)**	0,031 (2,03)***	0,028 (1,86)**
Off-farm income in 2011		-0,002 (-0,22)	-0,004 (-0,45)	
Second occupation	-0,532 (-0,85)			-0,478 (-0,77)
Offer to sell farm			0,737 (1,08)	0,641 (0,94)
Number of hectares				0,001 (0,45)
Constant	0,346	0,176	-0,129	0,162
Wald Chi2	13,85	13,16	14,39	13,84
Prob > Chi2	0,0313	0,0406	0,0447	0,0541
Pseudo R2	0,1729	0,1642	0,1796	0,1727
N	58	58	58	58

The numbers in the parentheses are the z-values. * = significant at 15% level ** = significant at 10% level, *** = significant at 5% level, and **** = significant at 1% level.

Opportunity cost factors	Regression 5	Regression 6	Regression 7
Number of other farms	-0,432 (-1,53)*	-0,412 (-1,48)*	-0,413 (-1,48)*
Access rainy season	-1,359 (-2,13)***	-1,375 (-2,16)***	-1,332 (-2,08)***
Cattle in 2011		0,012 (0,98)	
Poor soils			
Steep slope	0,028 (2,13)***	0,028 (2,23)***	0,029 (2,29)***
Off-farm income in 2011			
Second occupation	-0,244 (-0,43)	-0,325 (-0,57)	-0,255 (-0,45)
Offer to sell farm	0,606 (0,98)	0,699 (1,14)	0,667 (1,10)
Number of hectares	0,001 (0,50)		
Constant	-0,071	-0,231	-0,067
Wald Chi2	11,49	12,18	11,22
Prob > Chi2	0,0313	0,0580	0,0472
Pseudo R2	0,0745	0,1395	0,1285
N	63	63	63

- We expect the variable *number of farms* to be positively related to participation in forest protection, hence that protection participants are more likely to have more farms than reforestation participants. In table 6.9, we find that this variable is significant at 15% level, with negative sign. This is hence the opposite of what we expected. However, it may indicate that reforestation participants need more area than protection participants (or that they more often have more parcels) in order to participate.
- The variable *access rainy season* is expected to have a negative relationship to forest protection participation, hence that reforestation farms are assumed to have better access (by car) than farms involved in conservation. This, first and foremost because when it comes to reforestation, one needs better access to the farm than protection participants do. Reforestation participants have plantations that they are allowed to harvest after 15 years, and they therefore depend on good access in order to facilitate harvesting and transport to markets. In tables 6.9 we find the variable significant at 5% and 1% level, with negative sign, which is what we expected.
- We expected the variable *cattle 2011* to be negatively related to protection participation, hence that it was a greater probability for reforestation participants having more cattle than protection participants. This variable is however, not significant in any of the regressions in table 6.9.

- Reforestation participants are assumed to have better biophysical conditions of their farms than protection participants. We thus assume a positive relationship for both *steep slope* and *poor soils* related to participation in forest protection as compared to reforestation. That is because reforestation participants in order to establish plantations need biophysically favourable conditions on the land (like an agricultural crop). We find that the variable *steep slope* is significant at 5% and 10% level in tables 6.9. and with positive signs, which is as expected.
- The variable *off-farm income* can be expected to have either of the signs, as mentioned previously. However, when considering differences between protection and reforestation participants, the reforestation participants can be assumed to be more in need for off-farm income in order to participate than protection participants (as previously mentioned). This variable however, is not significant in any of the regressions.
- *Second occupation* would also be expected to have either sign for the same reasons as for *off-farm income 2011* over. This variable is not significant in any of the regressions either.
- We expect *offer to sell farm* to be negatively related to protection participation, since we expect reforestation participants in general to be offered to sell their farm than protection participants. This variable is, however, not significant in any of the regressions in the table 6.9. As mentioned previously, there may be several reasons for that the variable is not significant.

Out of the regressions in table 6.9., there are hence two significant variables showing expected sign.

H. 8: Forest protection participants would report they would not have cleared the forest even in the absence of payment.

This hypothesis is also related to the issue of opportunity cost of land and hence additionality, and concerns what the PSA participants themselves think when it comes to what they would have used their land for if they were not participating (the alternative use of the area). Table 6.10 and 6.11 give an indication of the most likely alternative uses for PSA participants in Hojancha if they had not been participating.

Table 6.10 The percentages of the self-reported area in PSA contract that would be used for the different purposes if not participating in PSA protection

FOREST PROTECTION	
Percentage that would stay forest	Percentage of forest protection participants
0 %	15% (5)
13-99 ⁴ %	20% (7)
100 %	65% (22)
Percentage used for sustainable management	
0 %	91% (31)
12-13 ⁵ %	6% (2)
100 %	3% (1)
Percentage conversion to pastures	
0 %	85% (29)
42-65 ⁶ %	9% (3)
100 %	6% (2)
Percentage conversion to plantations	
0 %	94% (32)
5 %	3% (1)
50 %	3% (1)
Percentage conversion to agricultural crops	
0 %	94% (32)
5 %	3% (1)
22 %	3% (1)

⁴ 7 observations ranging from 13-99,70%

⁵ 12,70 and 13,50

⁶ 3 observations from 42,30 and 65,20%

Percentage that would be sold ⁷	
0 %	94% (32)
100 %	6% (2)

Table 6.10 relates to the protection participants and their alternative use of the land they conserve(d) in the PSA program. There are 6 different alternatives, and the first column shows the percentages of the different alternative uses of land the area would have been used for. The second column consists of the percentage of the protection participants that gave the specific number in the first column (in some cases the numbers are aggregated), with the number of observations in parenthesis. The percentages are calculated from the survey question in which I asked for the number of hectares (of the contract) that would be used for the different purposes in the absence of PSA. The number of respondents is not very high, but the numbers still give a quite clear indication of the trends.

Looking at table 6.10, we find that 65% of the forest protection participants say they would have let all the area (100%) that they included in PSA protection contract, stay forest even if they had not received payments for it. An additional 20% say they would let part of the area (13%-99%) stay forest. Hence, it seems that the majority of the protection participants in the case study area would have conserved the forest at their land even in the absence of PSA payments, indicating a low level of additionality of the forest protection contract. However, it is important to keep in mind that the Costa Rican Forest Law from 1996 prohibits forest clearing, and even though the survey question related to these tables intended to specify the alternative use even in the absence of the Forest Law, farmers are now used to a system in which land-use change of natural and regenerated forest is not allowed, and may have difficulties of picturing the situation in which they are able to clear forest and use it for other purposes, for example pastures for livestock production. In general, farmers in Costa Rica comply with the law to a large extent.

Based on the data in table 6.10, hypothesis H.8 cannot be rejected.

⁷ This alternative was not initially included in the questionnaire, but included afterwards as several farmers informed that they would have sold the farm if not participating in PSA. 69

H. 9: Reforestation participants would report that they would have reforested the area even in the absence of payment.

For this hypothesis we have table 6.11, regarding the alternative land uses of the PSA area, as told by the reforestation participants.

Table 6.11 *The percentages of the self-reported area in PSA contract that would be used for the different purposes if not participating in PSA reforestation*

REFORESTATION	
Percentage that would be plantations	Percentage of reforestation participants
0 %	79% (22)
50 %	3% (1)
100 %	18% (5)
Percentage that would be agricultural crops	Percentage of reforestation participants
0 %	93% (26)
100 %	7% (2)
Percentage that would stay pastures	Percentage of reforestation participants
0 %	39% (11)
50 %	4% (1)
100 %	57% (16)
Percentage left for regeneration/not used	Percentage of reforestation participants
100 %	14% (4)
0 %	86% (24)

In table 6.11, we see that, compared to the forest protection participants, the results differ quite a lot from table 6. 79% of the reforestation participants express that they would not have planted anything if they had not received PSA. 18% say they would have planted all the area they have planted in the contract even in the absence of the payments. This indicates that also some reforestation participants would have planted even in the absence of payments, but compared to table 6 and protection participants, it suggests that the PSA payments are more important for the reforestation participants. Opportunity cost of land therefore seems to be higher for reforestation participants, and thus also probably higher possibility additionality

for reforestation contracts than for protection. The results in table 6.10 and 6.11 therefore support the hypothesis of higher additionality (in terms of forest cover) among reforestation participants than protection participants.

6.1.4 More on additionality and opportunity cost of land

In this section, I will look further at the additionality issue. I will look at tables over the main uses of payments for protection participants and reforestation participants in order to obtain a wider perspective of opportunity cost.

Main uses of payments

Table 6.12 Main uses of PSA payments for forest protection participants

Main uses of payment – protection contract	Percentage of respondents	Number of respondents
Investment in the farm/maintenance	35%	12
Subsistence/consume	29%	10
Investment in farm&subsistence/consume	29%	10
Subsistence/consume&fencing of PSA area	3%	1
Investment in farm&expenses for lawyer/topographer	3%	1

Table 6.13 Main uses of PSA payments for reforestation participants

Main uses of payment – reforestation contract	Percentage of respondents	Number of respondents
For savings	3%	1
Investment in the farm	80%	24
Investment in other economic activities outside the farm	3%	1
Subsistence/consume	3%	1
Investment in farm&subsistence/consume	10%	3

From the tables 6.12 and 6.13 we see that there are some differences regarding what the PSA participants primarily spend the payments they receive on, related to the type of contract they have. It seems that the reforestation participants to a larger extent use the payments for investment at the farm than protection participants. 80% of the reforestation participants say

they spend/spent most of the payment for this purpose. We may therefore assume that the payments for reforestation contract are used mostly for plantation establishment and maintenance expenses/costs.

Sierra and Russmann (2006) found that many of the PSA participants spend the payments they receive for economic activities outside the farm, which may indicate that the farmers used the payments in order to switch from agricultural activities to more urban activities. It could also be interpreted as the farmers not really being in need for the payments, hence little opportunity cost of land (indicating little additionality). Their study was related to forest protection participants; however, comparing to my study in Hojanca, only 3% of the farmers (1 reforestation participant) chose this alternative. One of the reasons for this may be that the survey question many times was asked without giving the alternatives, and instead just asked for the main uses of the payment. Another thing is that many farmers often possess of/administer several farms, and they may therefore have had difficulties with distinguishing between the different farms when choosing the alternative “investment at the farm”. The question may have been interpreted as investment at whichever of the farms they possess, and the alternative “economic activities at other farms” may not have been clear and to be separated from the farm in question. It may also be the case that payments that are used for family consumption, and other family funds are than used for other activities outside the farm instead.

When it comes to the protection contract, 30% of the farmers say they spend most of the payments for subsistence/consume, which may suggest that protection participants are poorer than reforestation participants by having to spend a larger part of the payments they receive on consume. But it may also indicate that these farmers do not have to spend very much of the payments on contract requirements and rather spend it on other things.

However, there seems to be a quite substantial difference when it comes to the difference in choices between the two contract types. Reforestation participants appear to need more of the payments for the farm (although it may be the case that some farmers also here have mixed up this alternative with other activities, and spent some or more of the payments for activities at other farms). Anyway, plantation establishment is usually considered an investment at the farm. It may be difficult to draw strict conclusions of the additionality question from tables

6.12 and 6.13, but they seem to strengthen the hypothesis that a larger part of the payment that reforestation participants receive go to fulfilling contract requirements than it does for protection participants, hence that reforestation participants are more in need for the payments than protection participants. It may hence indicate a lower opportunity cost for the protection participants than for reforestation participants.

6.2 Cost-effectiveness

In this section, I will first look at hypothesis H.10 and H.11 regarding transaction- and compliance costs. Then I will analyse hypothesis H.12., by comparing the differences in results in opportunity costs of land with respect to contract applicants and contract recipients.

6.2.1 Transaction- and compliance costs

In this part, I will go through the hypotheses H.10-H.12, which are related to the amount of transaction costs and compliance costs that the PSA participants have/have had in relation to their contract(s) as a percentage of the payments they receive(d). The tables that follow under show percentages of transaction costs (appliance costs) and compliance costs related to corresponding contract type. The first table, table 6.14 regards the forest protection contract, and consists of percentages of application- and compliance costs, and the two added, and finally, included the 18% administrative costs charged by the intermediary. Since most of the farmers apply through an intermediary, the few landowners (8 in total) that applied directly to FONAFIFO were excluded when calculating these costs.

Table 6.15, 6.16, 6.17 and 6.18 relate to the reforestation contract. The calculation of these costs and the presentation is somewhat more complicated due to separated establishment costs and maintenance costs, having to create several interpretations of the numbers since I found the numbers to appear quite uncertain and the numbers of costs given by the farmers were varying a lot.

Table 6.15 shows application/transaction costs (same numbers as for protection contract in table 6.14, since I assumed application costs not to differ substantially between protection and reforestation participants), and the results for the separate establishment and maintenance

costs. Table 6.16 gives the different interpretations of the total compliance costs (establishment and maintenance costs combined) for reforestation contract. Table 6.17 shows the percentage of total transaction (application)- and compliance costs for reforestation contract, and table 6.18 shows the same numbers as table 6.17, but in which 18% administrative costs charged by intermediary is added to the percentages. The payment level is in the calculation therefore deducted by the 18% charged by the intermediary.

Table 6.14 Transaction- and compliance costs for forest protection contract

	Percentage of the PSA payment	St.dev	Min	Max	Number of observations
Application costs⁸	1,3%	2,192	0,04	13	51
Compliance costs	4,3%	3,361	0,11	12	27
Application+compliance costs	6,2%	5,220	0,32	20	27
Application+compliance costs (incl. 18% adm.costs⁹)	24 %	5,220	18,3	38	27

Table 6.15 Application costs, establishment costs and maintenance costs separated for reforestation contract

	Percentage of the PSA payment	St.dev	Min	Max	Number of obs
Application costs¹⁰	1,3%	2,192	0,04	13	51
<i>Establishment costs (compliance costs)</i>					
Interpretation 1	31%	36,94	2,1	125	23
Interpretation 2¹¹	19%	18,23	2,1	84	20

⁸ Both contract types included

⁹ Paid to intermediary for facilitating application process

¹⁰ Same as footnote 7

¹¹ Removed obs. 109, 125 and 149 due to outliers (over 1000US\$ in establishment costs per hectare).

Maintenance costs (compliance costs)					
Interpretation 1	69%	98,85	1,3	437	20
Interpretation 2¹²	55%	51,43	3,2	185	19
Interpretation 3¹³	17%	22,13	0,7	87	20

Table 6.16 Establishment costs and maintenance costs combined for reforestation contract

	Percentage of the PSA payment	St.dev.	Min	Max	N
Establishment and maintenance costs (total compliance costs)					
Interpretation 1	103%	123,13	5,5	535	20
Interpretation 2¹⁴	85%	72,86	5,5	263	19
Interpretation 3¹⁵	69%	54,20	5,5	219	17
Interpretation 4¹⁶	51%	52,29	2,7	186	20

Table 6.17 Transaction- and compliance costs combined for reforestation contract

	Percentage of the PSA payment	St.dev.	Min	Max	N
Total reforestation costs (application/TCs&compliance costs)					
Interpretation 1	111%	125,41	6,8	537	19
Interpretation 2¹⁷	91%	74,32	6,8	274	18
Interpretation 3¹⁸	73%	55,79	6,8	221	16
Interpretation 4¹⁹	54%	54,83	4,1	188	19

¹² Removed obs. 125 due to unlikely high number for maintenance costs (outlier)

¹³ Maintenance costs not multiplied by 5 years (or the number of years the contract had been in force). See methodology chapter, section 5.2.3

¹⁴ Removed obs. 125 due to unlikely high number for maintenance costs (outlier)

¹⁵ Removed obs. 108, 125 and 149 due to very high establishment costs (more than 1000US\$)

¹⁶ Maintenance costs adjusted as explained under footnote 13

¹⁷ Same as footnote 12

¹⁸ Same as footnote 11

¹⁹ Maintenance costs adjusted as explained under footnote 13

Table 6.18 Total transaction- and compliance costs for reforestation contract

<i>Total transaction and compliance costs (included 18% adm.) as a percentage of the total payment received (whole period) for reforestation contract.</i>	Percentage of the PSA payment	St.dev.	Min	Max	N
Interpretation 1	129%	125,41	25	555	19
Interpretation 2²⁰	109%	74,32	25	292	18
Interpretation 3²¹	91%	55,79	25	239	16
Interpretation 4²²	72%	54,83	22	206	19

H. 10: The transaction costs and compliance costs (combined) represent more than 30% of the PES payment received.

When it comes to the transaction- and compliance costs related to the **forest protection contract**, we see from table 10 that including the 18% administration costs, the percentage reaches 24% when calculating the expenses of 27 PSA protection participants. It does not exceed the 30% calculated by Rodriguez (2008), but my numbers do not include specific material costs, such as the fixed costs related to fencing the contract area, and signs. In some cases the area may already be fenced, but in most cases not. The percentage could therefore in reality be significantly higher. Another issue related to Rodriguez’s (2008) calculation, is that she operated with a fixed opportunity cost of time for the farmer, US\$2 per hour. In reality, this opportunity cost may be quite a bit higher, depending on the farmer. As there were great economic differences between the farmers that were interviewed in my survey, and many of them had second occupations and off-farm income, it was natural to assume different opportunity costs of time among them. This was therefore calculated based on the total family consume, even though this may not be very accurate, as the monthly family consume level may consist of more than the farmer in question’s income. My calculation is mainly based on the opportunity cost of time of the farmers and the costs related to hiring labour for fulfilling the requirements of the contract.

²⁰ Same as footnote 8

²¹ Same as footnote 9

²² Maintenance costs adjusted as explained under footnote 13

As to the total percentages for the **reforestation contract**, we have table 6.18, which shows the total transaction- and compliance cost for reforestation participants, ranging from 72% to 129% with the different interpretations. There are several interpretations of the compliance costs for the reforestation contract due to uncertainties in how to interpret right the numbers and inaccuracies when the survey was conducted (see section 5.2.2). Also because the costs for maintenance vary a lot from year to year according to the varying needs for maintenance etc., it may be a better option to interpret the numbers in different ways.

Even though a reforestation contract implies higher costs than a protection contract, the payment amount given to the farmers is higher as well. When calculating these numbers, material costs for establishment (purchasing of plants, transport, equipment etc.) were not included as I did not have this question in the survey from the beginning. The actual numbers are therefore most likely higher, and we may at least conclude that the costs exceed 30%²³. However, there is a low observation number, which makes the results more uncertain, and also uncertainty when it comes to actual opportunity cost of time of the farmer, as we have used monthly family consume when finding the value of a working hour (same as when calculating cost for the forest protection contract).

It should also be noted that for the transaction costs (the application costs), also participants entering the program between 1998 and 2002 are included, for which the circumstances were somewhat different. All contracts made until 2002 were in the case study area group contracts; the application costs were thus spread over all participants in the contract, and there were therefore less costs for each of them. 15 of the total contracts included in my calculations were signed before 2002.

A point to mention is that there is not the same number of observations for establishment costs and maintenance cost. This is because I did not receive all information from all the farmers, so for some farmers I only obtained establishment costs, and other only maintenance costs. So when calculating both together, some of the observations had to be removed since they would not have been representative with lack of information.

²³ Even though the reforestation contract implies more costs than the forest protection contract, the payments for the reforestation contracts are higher; hence one will assume the percentage of costs of the payment not to differ too much from that for the protection contract. The percentage 30% from Rodriguez (2008) was based on an agroforestry contract, which implies planting as well (but native species mostly). It should hence be possible to compare these numbers. 77

Table 6.19 Establishment cost as a percentage of the first payment of reforestation contract

The establishment costs as a percentage of the first payment	Percentage	St.dev	Min	Max	Number of obs
Interpretation 1	62%	63,88	4,1	249	23
	37%	36,47	4,1	167	20
Interpretation 2²⁴					

H. 11: The plantation establishment costs are less than the first payment in the contract for reforestation (50% of the total).

This hypothesis is related to the issue that the establishment costs for plantations associated with the reforestation contract are claimed to be too high for many farmers relative to the initial payment they receive, which is supposed to cover these costs. Since for the reforestation contract, 50% of the total payments are given the first year of the contract in order to help cover the expenses for the establishment of the plantation(s), it is interesting to look at how much these costs represent of the first payment of the contract. As there is not given any payments in advance, many farmers have expressed that they would need a larger payment in advance in order to be able to establish a plantation. As the plantation will not generate incomes until it is harvested at least 15 years ahead, many farmers find this difficult, as there may not be any income sources in the meantime (between the contract and the time of harvesting). This indicates that payments given for this contract, to many farmers may be too little to overcome their opportunity costs, while farmers with more resources and area available can afford the investment (supported by results for reforestation contract from regressions in table 6.4).

From table 6.19 we have two interpretations of the amount of establishment costs related to the first payment of a reforestation contract. The first interpretation in which all observations are included show that based on my results, the total establishment costs represent a percentage of 62% of the first PSA payment of the reforestation contract (50% of the total). If we remove the 3 extreme values (see section 5.2.3), we get the second percentage, interpretation 2 of 37%. Neither of these numbers exceeds the first payment amount, but fixed

²⁴ Removed obs. 109, 125 and 149 due to unlikely high establishment costs.

material costs for expenses such as plants, transport, equipment etc. are not included. The percentage may therefore also here be substantially higher. The level of establishment costs also depends a lot from place to place, accesses to the farm etc., so it may be substantially higher costs for farmers living in more remote areas. However, with the numbers obtained in the study, though the observation number is quite low, the hypothesis cannot be rejected.

H. 12: The transaction- and compliance costs related to the reforestation contract are higher than those costs related to the forest protection contract, (relative to the PES-payment received).

From table 6.14 (the last row where all costs are included) and table 6.18, we see that the percentages related to the reforestation contract (relative to the payment amount the farmers receive) are substantially higher than for protection contract participants. There are, as mentioned, uncertainties to the numbers, but to both contract types the same type of costs are not included. The numbers should therefore be comparable. We see that the transaction (application) costs seem to be relatively low, hence the large differences result from the compliance costs. As mentioned earlier, the payments to reforestation participants are higher than for forest protection, since investment costs are higher. Hence, the costs for reforestation contracts appear to be substantial in comparison. However, in the case study area there is a large timber industry and to many landowners, the reforestation/plantation contract is viewed as an investment to be profitable in 15 years when they are permitted to harvest and sell the wood. One may therefore assume that the reason that many farmers are interested in the reforestation contract is the aspect of future gains of the timber, and that they otherwise might probably not been applying for this contract type.

6.2.2 Cost-effectiveness and opportunity cost of land

When it comes to cost-effectiveness, one aims for low opportunity costs as well as transaction costs. By comparing the regressions of opportunity cost factors of land, we may draw some conclusions regarding differences between applicants and the receivers of PSA, and it might be possible to say something about the targeting by FONAFIFO when distributing the payments. When analysing H.13, I will first look at the part related to forest protection contract and then the part related to the reforestation contract.

H. 13: There are not lower opportunity costs among the contract receivers than the contract applicants (there is a lack of targeting when it comes to opportunity cost of land).

As to the forest protection contract and the regressions in table 6.2 (dependent variable is *ever_applied*), comparing the results to table 6.3 (*received_contract*), the results appear quite similar with respect to significant variables. The variable *hectares* is significant in both regression types, but there is one more significant variable in table 6.2 than table 6.3, which is *access rainy season*. Hence, out of these results there does not appear to be much difference between applicants and recipients of forest protection contract, but there are few significant variables, and one may first and foremost conclude based on the specific variables.

When it comes to the reforestation contract, it seems like from the results that there are greater differences between applicants and participants here than for the forest protection applicants and participants. The two variables that are significant for the applicants, *number of other farms* and *cattle in 2011*, are not the same as those that are significant for reforestation participants, which turned out to be *steep slope*.

Out from these results, they appear quite similar for the protection-regressions and different to some extent for reforestation, but they do not give sufficient result to conclude that opportunity costs among contract receivers are less than for applicants. Hence, there does not seem to be targeting when it comes to the recipients of PSA based on the case study data, and therefore some lack of cost-effectiveness due to this. As I will come back to, there is however in the interest to have high opportunity costs when it comes to additionality. The hypothesis can however, not be rejected.

6.3 Equity

In this section, I will go through logit-regressions related to factors that are assumed to affect the decision of farmers whether to participate in PSA or not and I will give results on whether the level of transaction (application) costs are affected by certain factors assumed to affect these. In the end I will present results from questions regarding reasons for not to participate and things that according to participate should be improved in the program.

6.3.1 Factors affecting participation

In this part, I will look at regressions with factors assumed to affect landholders' decisions in whether to apply for/participate in PSA. I will therefore look at the dependent variable *ever_applied* in relation to the hypotheses H.14.-H.19., in order to say something about characteristics of the PES participants in the case study area. In these regressions, participants refer to both participants in forest protection and reforestation.

Table 6.20 Factors affecting participation with dependent variable *ever_applied*, regressions 1-8

Participatory factors	Regression 1	Regression 2	Regression 3	Regression 4
H.14. Number of hectares	0,002 (0,91)	0,004 (1,47)*	0,002 (1,26)	0,002 (1,11)
H.14. Number of more farms	0,269 (1,52)*	0,256 (1,42)	0,305 (1,73)**	0,269 (1,53)*
H.16. Distance to MAG office	0,022 (2,63)****			
H.16. Distance to FONAFIFO office			0,012 (2,45)***	
H.17. Education level	-1,151 (-0,33)	-0,557 (-1,23)	-0,123 (-0,27)	-0,477 (-1,07)
H.18. Off-farm income in 2011	-0,003 (-0,93)	-0,004 (-1,08)	-0,003 (-0,92)	-0,003 (-0,82)
H.18. Second occupation				
H.15. Participant CAF or similar	0,453 (1,40)	0,453 (1,39)		0,456 (1,44)*
H.19. Live at farm		-0,462 (-1,37)*		
Constant	-1,284	-0,462	-1,223	-0,607
Wald Chi2	18,18	14,63	14,68	10,76
Prob > Chi2	0,0058	0,0233	0,0118	0,0563
Pseudo R2	0,0651	0,0526	0,0528	0,0385
N	206	205	205	206

Participatory factors	Regression 5	Regression 6	Regression 7	Regression 8
H.14. Number of hectares	0,002 (1,08)	0,005 (1,76)**	0,002 (1,06)	0,002 (1,18)
H.14. Number of more farms	0,317 (1,81)**	0,324 (1,84)**	0,288 (1,62)*	0,330 (1,91)**
H.16. Distance to MAG office				0,022 (2,65)****
H.16. Distance to FONAFIFO office	0,011 (2,33)***		0,012 (2,55)***	
H.17. Education level	-0,233 (-0,50)	-0,550 (-1,22)		-0,162 (-0,35)
H.18. Off-farm income in 2011			-0,004 (-0,95)	
H.18. Second occupation	0,038 (0,12)	-0,065 (-0,22)		0,016 (0,05)
H.15. Participant CAF or similar	0,403 (1,25)			
H.19. Live at farm		-0,377 (-1,22)		
Constant	-1,475	-0,608	-1,326	-1,382
Wald Chi2	15,72	11,90	15,99	15,65
Prob > Chi2	0,0153	0,0363	0,0069	0,0079
Pseudo R2	0,0563	0,0426	0,0575	0,0558
N	206	206	205	207

The numbers in the parentheses are the z-values. * = significant at 15% level ** = significant at 10% level, *** = significant at 5% level, and **** = significant at 1% level.

H. 14: Landowners with larger properties are more likely to participate than smaller.

We expect a positive relationship between the variable hectares and application in PSA. As mentioned in section 6.1, it is suggested by Zbinden and Lee (2005) and Miranda et al. (2003) that larger landholders (hence assumed to be wealthier), are more likely to participate in PSA. We find the variable hectares to be significant at 10% and 15% significance level with positive sign, as expected. From the results it thus seems that farmers with larger properties are more likely to apply than non-participants, hence the hypothesis cannot be rejected.

H. 15: Landholders that have participated in similar incentive programs (before 1997) are more likely to apply/participate in PSA than others

We expect a positive relationship between the variable *participant CAF* and participation in PSA, since participation in previous incentive programmes is assumed to bring about more information and knowledge of such programmes, and thus facilitating participation for PSA. The variable is significant at 15% level in table 6.20. Hypothesis H.15 can therefore not be rejected.

H. 16: Landowners closer to public offices (MAG, FONAFIFO) are more likely to apply/participate than landowners farther away from these offices

We would expect a negative relationship between the variables related to distance to (forestry) public offices and participation in PSA, due to proximity to these offices probably making the application process somewhat easier. This variable expresses the distance from the farm in question in minutes to the closest office of the kind as reported by the farmer and according to the mean of transport he/she normally uses. In table 6.20, both these variables are significant; *distance to MAG office* at 1% level and *distance to FONAFIFO office* at 5% significance level. However, the variables have positive sign, which is opposite to the expected. This may be related to the existence of the intermediary ‘Centro Agrícola’, spreading information about the program and facilitates application, and also visiting farmers to encourage them to apply as well. Perhaps the most important issue is that the variable is related to the distance of the farm and not necessarily the place in which the farmer lives. In many cases, the farmer lives in the centre of the canton, close to public offices, but has the farm out in the district. This would mean that farmers who had farms far from the centre were systematically more likely to live in the town. It could make sense as if the farm is close to the town, one would live at the farm, and if the farm is far from the centre one would live where there is available place in the centre. Arriagada et al. (2009) find that many farmers not living on their farms often find it costly in terms of opportunity costs to participate since they rarely visit their farms.

H. 17: Higher educated landowners are more likely to apply/participate than others

The variable *education* is expected to be positively related to PSA participation, as more education is assumed to facilitate the process for the farmers, perhaps first and foremost concerning plantation establishment. Miranda et al. (2003) and Zbinden and Lee (2005) found that participants were more likely to have more education than non-participants. However, in table 6.20, the variable is not significant in any of the regressions. It might be the case that the agricultural centres ('Centro Agrícola') are facilitating application and participation for many participants and that education level therefore is not that much of importance.

H. 18: Landowners with relatively more off-farm income or landowners with a second occupation are more likely to apply/participate than farmers without.

This hypothesis is in reality the same as hypothesis H.5., related to opportunity cost of land. Here, the regressions are not separated for conservation farmers and reforestation farmers. We expect off-farm income to be positively related to participation. According to Zbinden and Lee (2005), off-farm income is among other things often associated with more information and wider networks. As mentioned earlier under the discussion of opportunity factors, this variable may have two different outcomes, since one may also expect that the farmers without off-farm income are to be considered poor and hence are in need of an extra income, and therefore are likely to apply for/participate in PSA. Arriagada et al (2009) mention that most of the farmers in their study have off-farm income (work outside the farm), often at other farms, and do not have much time for their own farms, which often lead them not to participate in PSA. However, I expected a positive relationship here, especially thinking of the reforestation contract (since this off-farm income often would be necessary for farmers to establish plantations). However, neither the variable off-farm income nor *second occupation*, are significant in any of the regressions in table 6.20.

H.19: Landowners living at the farm in question are less likely to be participants than farmers living elsewhere.

We expect the variable *live at farm* to be negatively related to participation in PSA, since we assume that landholders living outside the farms to be more wealthy than farmers living at

their farm, who probably depend more on their farm for a living. This variable is significant at 15% level in table 6.20, with negative sign, which is what we expected. This is also what Zbinen and Lee (2005) found. Arriagada et al. (2009), however, as noted under H.16 find that many landowners not living at their farms rarely visit their properties and hence do not find it worth with respect to opportunity cost of time to participate/enter the program. Hypothesis H.19. can however, not be rejected.

Table 6.21 Factors affecting participation, summary table for tables 19a and 19b, participatory factors

Hypotheses	Ever_applied	Can reject hypothesis?²⁵
H.14. Number of hectares	+	No
H.15. Previous incentive programs	+	No
H.16. Distance MAG	+	Yes
H.16. Distance FONAFIFO	+	Yes
H.17. Education level		?
H.18. Off-farm income		?
H.18. Second occupation		?
H.19. Live at farm	-	No

From the hypotheses related to participation factors in the summary table above, we see that there are some significant variables, and several of the hypotheses cannot be rejected. The results hence indicate that there seem to be certain characteristics typical to applicants/participants of PSA in the case study area. On the other hand, some variables appear with sign opposite of what expected, hence it may suggest that there are circumstances in the case study area different from other places, as could be expected since Hojancha differs from many other places. The intermediary ‘Centro Agrícola) may be an institution with importance for facilitating participation for some farmers.

²⁵ For those variables I have rejected hypotheses in the presence of significant variable, 85 this is due to opposite expected sign of the variables.

6.3.2 Transaction costs and factors affecting these and participation

I have run OLS-regressions (see appendix D) for variables that are assumed to affect the level of transaction cost, (the dependent variable of application costs). The independent variables were several of those associated with factors affecting participation; property size, participation CAF, distance to MAG/FONAFIFO, education level, documents (dummy of whether the landowner has 'escritura' and 'plano' or not), the number of contracts they have/had in total. Larger property, previous participation, higher education, documents and having several contracts are all expected to lead to lower transaction costs (per hectare). Having the two documents in place is assumed to make costs lower since they would have a less troublesome application process. Higher education is assumed to be related to more knowledge and hence less need for searching for information. Less distance to forest/agricultural offices is expected to lead to lower transaction costs as it longer distances can be assumed to cause more costs and make the process more troublesome.

It turned out that only two variables were significant. *Documents* showed positive sign, and *distance FONAFIFO* gave negative sign, which for both variables is contrary of the expected result. When it comes to *documents*, it should be noted that it is not sufficient to only have the two documents in question, but they also need to match (show the same number of hectares etc.), hence despite having the documents it may lead to extra costs for the landowners.

There are hence few results from these regressions, indicating no tendencies. There are probably weaknesses in the data as well, as there should have been more accurate questions concerning the transaction costs in order to include all costs the landholders had.

6.3.3 More on participation

In this section, I will present results regarding reasons for not participating among landholders, in addition to opinions among participants concerning whether they received the payments in the time they were supposed to, and what they think should be improved or changed in the program of their respective contract modality. The results will be discussed under in the discussion section.

Table 6.22 Reasons farmers gave for not wanting a contract or not wanting to apply again among landholders

Reason for not participating/applying	Percentage of respondents	Number of respondents
Little payment	23%	31
Complicated process/much restrictions/requirements/costs & paperwork	18%	24
Do not think they are eligible (legal issues, size of area, quality of soil for reforestation)	22%	29
Would rather like to sell the property (too little payment)	9%	12
Lack of knowledge of the program or knowledge of how to apply	18%	24
Need the forest for the livestock & access to the water sources	4%	5
Do not want any restrictions/obligations/commitments of the farm	4%	5
Would rather like to plant native trees (instead of Teak)	2%	3
Sum	100%	133

Looking at table 6.22, we see the main reasons for why farmers who have never applied (or not interested in applying again in the case of previous participation) were not interested in applying for PSA. There were given many different answers for this question, and there are therefore made groups out of all the answers and the original alternatives.

The second and third row (“complicated process/much restrictions/requirements, costs and paperwork” and “do not think they are eligible”, respectively) are the most obvious alternatives when it comes to transaction costs being an obstacle (may imply much costs to become eligible). But also the fifth row, “lack of knowledge” can be added to the issue of transaction costs. These three groups summed up represent 58% of the respondents. That indicates that transaction costs are a primary reason for farmers not being willing to apply. For this question, it must be noted that it was not separated between the two PSA contract types, for which the compliance costs especially may have larger implications for reforestation participants.

23% of the farmers express that “little payment” is the main reason for not applying and 9% say they would not apply because they would rather like to sell the property.

Table 6.23 Percentages of whether the protection participants received the payments in time agreed upon

Received payment in time?	Percentage of respondents	Number of respondents
Yes	51%	17
No	49%	16

Table 6.23 and 6.25 show that approximately half of all the participants say they did not receive the PSA payments in the time agreed upon from FONAFIFO. This is of importance especially regarding the reforestation contract since one needs payments in time in order to be able to start the establishment of the plantation.

Table 6.24 The opinion of the farmers in protection contract of what should be improved or changed in the program

What should be improved in PSA Protection	Percentage of respondents	Number of respondents
Requirements of eligibility and costs related to application process	13%	4
Payment level (or that intermediaries should charge less for administration)	47%	14
Level and punctuality of payments	13%	4
Punctuality of payments	10%	3
Should be more information, capacitation etc.	3%	1
Should be possible to extract/take out dead wood	3%	1
No need for improvements or changes	10%	3
Sum	100%	30

Table 6.24 and 6.26 show which things the participants think should be changed improved in the PSA program, and for protection participants it appears that payment level and punctuality of payments are the main issues the landholders are not satisfied with. For reforestation, the results show that also here, payment level and punctuality of payments are main things they think should be improved, but also information is an important factor there is lack of for these landowners. 29% mention information among the most important things. This shows that

many farmers would like to have more knowledge on technical matters and issues concerning plantations and maintenance probably. This is probably something that prevents many landholders from applying as well, since this knowledge is required and seemingly not very much available.

Table 6.25 Percentages of whether the reforestation participants received the payments in time agreed upon

Received payment in time?	Percentage of respondents	Number of respondents
Yes	45%	13
No	55%	16

Table 6.26 The opinion of the farmers in reforestation contract of what should be improved or changed in the program

What should be improved in PSA Reforestation	Percentage of respondents	Number of respondents
Requirements of eligibility/complicated process	7%	2
Payment level (or that intermediaries should charge less for administration)	21%	6
Punctuality of payments, should be given in advance and/or for a longer period	7%	2
Punctuality and punctuality of payments	11%	3
More counselling, information on plantations (commercialization etc.)	7%	2
Costs of application and more information	4%	1
Requirements, payment level and payments should be given in advance	11%	3
Punctuality of payments and more information	7%	2
More information and should give payment in advance	11%	3
Does not know	14%	4
Sum	100%	28

6.4 Discussion section

6.4.1 Negative and positive incentives and opportunity cost of land

According to Pagiola (2005)'s theoretical framework, we have seen that reforestation participants seem to be more in need for payments in order for it to become privately profitable to undertake the desired land-use change (establish plantations) than for protection participants. We may hence assume that for many protection participants, the practices may have been adopted anyway, as compared to reforestation. Considering Pannell (2008)'s framework, negative incentives such as conservation payments for forest protection are to be used only if there is a need to discourage landholders from undertaking certain land-use changes. Landholders should hence be likely to adopt the other land-use practice unless they are prevented from doing so. There should also be overall benefits from preventing such land-use changes; hence public net costs should outweigh private net benefits for these incentives to become appropriate (Pannell, 2008). The problem with the Costa Rican forest protection modality seems to be that the private net benefits in reality are not very high. The opportunity cost of land may thus be quite low for these landowners. The previously mentioned Forest Law from 1996, prohibiting forest clearing may have an important role here, especially when it comes to the larger landowners with large areas of forest. Thus, considering the environmental effectiveness and the additionality-question, such incentives may therefore in principle not be necessary in order to achieve the desired environmental outcome, such as biodiversity. The negative incentives may in fact here have little effect on the landowners' decision of land-use and which to choose. Looking at Pannell (2008)'s figures in section 4.4, we would in this case be outside the limit where these incentives are recommended. When it comes to the question of alternative land-uses and what landowners would use the land for in absence of PES payments, this could be addressed by an impact evaluation with interpretation of land cover in a matched control group without PES.

As to the positive incentives, these are according to Pannell (2008) intended to encourage a specific land-use change, which in the case of the Costa Rican PSA program relate to the reforestation/plantation contract. According to the theory, they should be used when the positive net benefit is positive and the private net benefit is negative. There thus appears a need to make it privately profitable to the landowners (private net benefits) to undertake the change that will provide increased environmental services. As claimed by e.g. Daniels et al. (2010) and as results from this study indicate, these positive incentives seem to provide more 90

effect in terms of additionality, as they seem to have higher opportunity costs of land. This indicates that the landowners in most cases would not have reforested in the absence of payments. On the other hand, there is an issue concerning the value and permanence of the environmental services provided, given that the contract lasts for 15 years. After this period, the landowners are permitted to harvest the plantations and sell off the timber. As to the value of environmental services, the Teak, which is the most common and valuable tree species used for plantations in this area is known for being very demanding of e.g. soils and nutrients (e.g. Tropical Forestry and Timberland News, 2012). Hence, the environmental service value in the long run should probably be considered more, in relation to that the focus after PSA was introduced in 1996/97 changed from supporting timber production to a focus on environmental/ecosystem services. It seems that to many, it is still works as a support for timber production.

6.4.2 Transaction- and compliance costs

From the results of the percentages of transaction- and compliance costs, we found that for participants, especially the costs related to the reforestation contract turned out to be high. The appliance costs (transaction costs) did not seem to be very large. However, the costs are probably, as mentioned under the hypotheses section, higher due to lack of including some types of costs. In the Pagiola model from the theory part, we find that one of the inefficiency problems relate to the payment being insufficient to make landholders adopt the socially desirable land uses. This is also said by Pannell, who included both the typical transaction costs for the application process and compliance cost, including up-front costs and the costs involved with fulfilling the requirements in the definition of the costs. He claims that these costs may make it necessary to increase the payments in order to cover these costs and lead to private net benefit, which is necessary in order to choose to enter the program. From the results of this study, it seems that to many landholders, the transaction- and compliance costs turn out to be a main obstacle to apply/participate. For the landowners participating, it has in the literature been suggested that larger and more wealthy and more educated landowners are more likely to participate than smaller, less educated landowners etc. It may hence be assumed that these farmers are more able to take the costs as they have more information, perhaps easier access to credit etc. And if they are larger landholders, they will also probably have lower transaction costs per hectare, facilitating access for the larger landholders. However, from my regression results there are some indications but few that give evidence

on specific characteristics of participants. Concerning transaction costs, they did not give any significant variables with expected signs. These “participation results” may indicate that the intermediaries (‘Centro Agricola’) play an important role in the case study area, but especially the transaction cost data are not very strong, there may hence be uncertainties related to the results.

Anyway, by looking at the reasons that non-participants give for not wishing a PSA contract, we find that transaction- and compliance costs represent a major reason to not apply, even though there are differences between protection participants and reforestation participants regarding this. The opinions among already participants may also say something about the obstacles for non-participants. Many of the participants stress that the main things that should be changed or improved by the program are larger payments and less complicated appliance process/less requirements. Punctuality of payments is also an important factor that many farmers complain about. Approximately half of the protection participants and less than half of the reforestation participants said they received the payment at the time they were supposed to. This is especially an issue for landowners wishing to establish plantations and who besides often some payment in advance at least would need the payment to arrive in time. Information is another issue that is particularly important for potential reforestation participants, as there normally is needed counselling and technical assistance, as many do not have experience of plantations. The costs hence appear as an important obstacle for many landowners and making the program less cost-efficient.

Concerning reforestation again, which as mentioned often is considered an investment for the future, the participation constraint is one issue, but there are also uncertainties regarding future market prices for timber. The farmers may hence result worse off even though they are participating voluntarily (Pagiola, 2008).

6.4.3 Opportunity cost and smallholders

If we go back to the issue of opportunity cost and additionality, we have the contradictions between the interests of low opportunity costs (of land) for cost-effectiveness, but which may cause little additionality for the previously mentioned reasons. Some of the literature (e.g. Sierra and Russmann, 2006) state that including landholders already involved in agriculture, which are often small landholders, may lead to a higher level of additionality (in terms of

forest cover). Wünscher et al. (2006, 2008) point to the need for targeting of PSA in order to achieve additionality. It hence appears that smaller landholders may play an important role in this regard. Here, participation constraints come in since opportunity costs may be higher and hence the payment may not be high enough to cover the transaction- and compliance costs of the landholder. From table 6.22, there are 4% saying they will not participate because the livestock needs access to the forest. This indicates that the payment is not sufficient for these farmers to abandon the cattle farming (Sierra and Russmann, 2006 state that PSA lead landholders to quit agriculture), or making them want to do so. Sierra and Russmann (2006) also suggest that profitability often is too low to make PSA be a real option for many landholders. As many have cattle and many say payments is too little, one may assume this reason to apply for several landholders. Miranda et al (2003) also mention that the farmers cannot reduce the grazing area without being adversely affected as in the protection contract, the livestock is not permitted to graze or seek shelter or enter the water in the forest. There is also uncertainty related to this contract, as one is not guaranteed a renewal of the contract. An automatically renewal of contracts if requirements have been fulfilled, as suggested by Miranda et al (2003), would probably cause more certainty for landholders and permanence of environmental services as well. The inclusion of many small landholders must however be viewed in relation to the increased transaction costs by intermediaries as a result of this.

6.4.4 Change in deforestation trends

However, although agricultural expansion used to be the main reason for deforestation trends in the past decades, it needs to be taken into account that the profitability of this sector has fallen. The pressure on forests for conversion to pasture land, especially in the marginal lands is thus reduced as well and in general it does no longer appear to be the main reason for land-use change of forest in many parts of the country, but not at least in the case study area around Hojanca (e.g. Morales, 2012). This can be related to the economic development Costa Rica has undergone during the last decades, with a substantial increase in the tourist sector and thereby and increased interest from foreigners to purchase real estate (Daniels et al, 2010), especially in the coastal areas of the country. With legal documents in place, purchase and sale of properties in Costa Rica is quite straightforward procedure, except in indigenous territories that have their own rules and regulations. In these areas, landholders are often not permitted to sell nor participate in PSA without the consent the rest of the community. In the case study area, however, many landowners have taken advantage of the foreign interest, but 93

as an effect of the world economic crisis from 2008, Costa Rica has experienced less interest from foreigners in buying properties the last years. Even though the variable related to offer to sell the farm did not result significant in the regressions, several landholders in Hojancha (and surrounding areas) expect the conditions to improve sooner or later, and await an offer until then. Foreign interest should therefore be taken into account as an increasingly important opportunity cost to landowners facing the option of whether to apply for a PSA contract, especially in the most attractive areas.

Sierra and Russmann (2006) mention that the contract modality “natural regeneration” might be the most effective in terms of providing more environmental services. Since the Forest Law for the most part prevents forest clearing, this contract (which is not yet very widespread in the country) should receive more focus. However, once trunks of emerging trees in a secondary forest area reach 10cm in diameter, they are protected by the law, so it would probably be a need for automatic renewal of contracts in order to provide an extra incentive for the landowners who currently are in need of the area to cover the opportunity cost.

It should also be noted that there seems to be a widespread environmental consciousness among the population in general in Costa Rica. The country is often considered a ‘green country’ and known for managing well the natural resources of the country, and have therefore obtained a good reputation in this regard. Many landowners express the importance of keeping forest for protection of water sources on their farm. It may also be related to making the farm more attractive for potential buyers.

7 Conclusions

The objective of this study has been to evaluate the challenges of the Costa Rican PSA program at three areas; environmental effectiveness in terms of forest cover (additionality), cost-effectiveness and equity, through a case study in the canton of Hojanca and surrounding areas in Costa Rica, with respect to the two contract modalities forest protection and reforestation (plantations).

The environmental effectiveness (additionality) issue was studied by investigating opportunity cost factors of land of participants vs. non-participants to see whether participants have less opportunity costs, and by comparing opportunity cost of land of protection participants vs. reforestation participants.

- I found little evidence of less opportunity cost of land for participants than non-participants. There were a few significant variables, for forest protection: property size and access to farm, and for reforestation: number of cattle, number of farms, steepness at the farm and off-farm income.
- When it comes to differences between protection and reforestation participants with respect to opportunity cost factors, the regressions also here show a few significant variables (with expected signs), but confirm important factors; that access to farm is better and steepness at the farm is less for reforestation participants. However, data of self-reported land use alternatives in case of not participating, support the findings that reforestation participants have higher opportunity cost of land than protection participants and hence seem to have higher additionality than participants.
- However, the fact that Costa Rica prohibited forest clearing in 1996 with the Forest Law, and the current trends with less pressure on forest for pastures as cattle farming is less profitable, have important implications for the threat to forests today. Negative incentives such as conservation payments do hence not seem to be very effective. Positive incentives such as reforestation incentives show more effect, but the results indicate that the payments work as subsidies for timber production. It should be taken into account that there may be adverse long-term effects since plantations often are quite demanding of soil qualities.

As to the cost-effectiveness of the program, the main part was related to the farmers' transaction- and compliance costs and their role in impeding cost-effectiveness. I compared the level of transaction- and compliance costs to the payment amount they received for both contract types separated. I also looked at reasons for non-participants not to apply for a contract and that participants think should be improved. The second part concerned opportunity cost factors, in order to see whether recipients of PES had lower opportunity costs than applicants, regarding targeting.

- Based on calculations of transaction- and compliance costs in the case study area, these costs do not seem to be very high for protection participants, but the percentage appear to be substantially higher for reforestation participants. The level of compliance costs especially seems to be the major problem.
- When it comes to non-participants, transaction- and compliance costs and low payment level seem to be a key factor for not applying/participating, and the payment level seems to be too low for many farmers to cover their participation costs.
- Even though the numbers show high variation, there are probably several costs that are not included and it seems that transaction- and compliance costs prevent cost-effectiveness to some extent in the case study area.
- As to the opportunity costs between applicants and receivers, there did not appear to be any targeting from the case study data.

When it comes to the equity perspective, I have studied factors that are assumed to affect participation in order to find out whether participants have certain characteristics, as suggested by literature, such as mainly larger landholders participating.

- Number of hectares and participation in previous incentive programs were positively related to participation in PSA, as expected.
- The variable for whether the landholder lives at the farm or not was negatively related to participation, also as expected
- Distance to public offices of agriculture and forestry MAG and FONAFIFO were negatively related to participation, which was contrary to the expected, but may be a result of many farmers not living at their farm and often close to the centers.
- Some of the variables hence indicate that there are certain characteristics that are typical to participation in the case study area as well.

Overall, it seems that some of the results from the case study support the general critics to the PSA program in Costa Rica and other PES programs in general. One is reforestation providing more additionality than forest protection. High participation costs seem to have large implications especially for reforestation participants and lead to less cost-effectiveness. Hojancha is particular for being a pioneer in providing reforestation incentives and for currently having a high amount of farmers involved in the reforestation contract and timber production, and has had a great recovery of the landscape since the introduction of the first incentives in the 1980s. The results from the case study can therefore not easily be generalized to other places, but may give some implications.

8 Recommendations

8.1 Improvements in methodology

- An impact evaluation with interpretation of land cover in a matched control group would evaluate additionality and alternative land uses in absence of PSA in a more accurate way
- Opportunity cost of time is an important variable that could be better observed by focusing more specifically on the individual landholders. It is important to take into account that there are large differences in the opportunity cost of time among landowners in order to do such analyses of participation in PES schemes.

8.2 Policy recommendations

- From the results in the thesis it seems that payment levels are not high enough for many, probably smaller landholders, especially when it comes to the reforestation contract modality. An increase in payment and easier access to credit/payment in advance would probably facilitate access for many landholders.
- As to additionality and the fact that reforestation participants are those contributing most to increased forest cover, it should probably be a larger focus on natural regeneration and increased payments to encourage landholders to choose this land-use. It would, however, most likely be necessary with automatically renewal of contracts for this to be attractive to abandon other land-uses in favour of regeneration as farmers with opportunity costs related to the farm would need some security for the future.

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Appendix A Development of the Forestry Law and effects in Hojancha

- Forestry Law No. 4465 of 1969: creation of the ‘Dirección General Forestal’ and the forest incentives and they start the reforestation on national level as one of the main strategies for the restoration of degraded lands.
- Law of creation of the Agricultural Centers (‘Centros Agrícolas Cantonales’) No. 7932 of 1975: Creation of the Agricultural Center, an organization of producers/farmers which are supposed to promote and facilitate the direct participation of the population in the development of the canton and thereby creates CACH (Agricultural Center in Hojancha).
- Law of creation of the national office of seeds No. 6289 of 1978: grants to the National Office of Seeds the responsibility of control and promotion the use of seeds with a higher quality. Also supports and assists techniques to the ‘seed activities’ in the canton.
- Forest Law No. 7032 of 1986: Creation of CAF, and CAFA, which facilitated the access of small and medium producers and to organizations.
- Forest Law No. 7174 of 1990: Creation of CPB, which gave incentives to activities of protection. They also widened the option of cultivating, managing and conserving the forest.
- Forest Law No. 7575 of 1996: Creation of the PSA Program. Regulated the prohibition of land use change.

(Isaza et al, 2007)

Appendix B Priority areas

1. Reforestation projects:

Priority areas for this contract type are the areas without forest in the sites that have a high productive potential for forest plantation development.

- a) For the reforestation projects with species found in closure degrees and threatened species or in danger of extinction (Decrete N°25663-MINAE and decree N°25700-MINAE), the whole country is considered priority area.
- b) For reforestation projects established in protected areas according to the article 22 of Forestry Law N°7575, the whole country is considered priority area.
- c) Sites in where there is a high potential of block plantation giving especial priority to the projects utilizing improved genetic material and to the projects that use seeds certified by the National bureau of Seeds.
- d) One may include areas in which there has been undertaken projects of reforestation financed by incentives and that have complied with the approved management plans and the period of validity.
- e) Reforestation projects with forest industry integration

2. Forest protection projects

The priority areas that are set for all forest protection projects are those established by the executive decree according to N°35762-MINAET of December 4, 2009, or others that have been decided in agreements or special provisions. For implementing these priorities to the applications, the following valorisation matrix will determine the punctuation they will reach once they are evaluated.

N° of criteria	Priorities for the Protection modality	Points for prioritation
1	Forests at farms located in the ‘vacios’ of conservation in private lands inside the Protected Areas (ASP); forests at farms located in the gaps of conservation in private lands inside biological corridors, forests protecting water resources (ASADA; AYA, municipality), or FONAFIFO or of MINAET, where it is stated the importance of protecting forest; forests of the indigenous territories of the country.	80
2	Forests at farms located in ‘vacios’ of conservation at private lands outside ASP and the biological corridors; forests at private farms inside ASP and outside ”gaps of conservation”; forests at private farms located inside the Protected Areas and that have not yet been bought or expropriated by the state.	75
3	Forests at private farms inside biological corridors and outside the ‘vacios’ of conservation.	70

4	Forests that have contracts in the PSA modality Forest Management and that present an application for the forest protection modality, and that complies with the other requirements established in the Procedure Manual for Payments for Environmental Services and the contract ends the same year in which the new application is presented	65
5	Forests outside any of the mentioned priorities over	60

I	Forests for forest protection at estates complying with the requirements mentioned previously, where there has been signed payments for environmental service contracts previously, as long as they comply with the other requirements established in the Procedure Manual for PSA and the new contract begins the day after the expiration of the previous contract.	5 additional points
II	Forests at farms located in districts with IDS less than 40% according what determined by MIDEPLAN (2007).	5 additional points
III	Forests in whichever of the previous priorities, with an application for PSA for areas less than 50 hectares	10 additional points
IV	For applications not approved the previous year, that apply again, and complying with the requirements	5 additional points

In case that the number of points between to or more applications result equal, these should be processed by giving priority according to the order of presentation/application. Those applications that after the matrix above has been used, obtain a number of points equal or more than 100, these should be sent immediately to approval, those with less points will wait for the qualification of the total amount of applications received and they will be processed until the budget is used of the agreed number of points obtained.

(MINAET, 2011)

Appendix C Correlation matrixes

	more_f~s	acc_ra~2	cat~2011	poor_s~s	steep_~e	off~2011	second~c	offer_~l	hectares
more_farms	1.0000								
acc_rainys~2	-0.0473	1.0000							
cattle_2011	0.2098	0.0138	1.0000						
poor_soils	-0.0576	-0.0329	0.0287	1.0000					
steep_slope	-0.0490	-0.1299	-0.0452	0.2919	1.0000				
offfarm_2011	-0.2237	-0.0633	-0.1960	0.0646	-0.0138	1.0000			
second_occ	-0.0347	0.0099	-0.0869	-0.0271	-0.0761	0.4032	1.0000		
offer_sell	0.0347	0.0717	0.0267	-0.1335	-0.1036	-0.0011	0.0749	1.0000	
hectares	0.1092	0.0463	0.3728	-0.0259	0.0656	-0.0514	-0.0050	0.1782	1.0000

```
. corr hectares distance_MAG distance_FONAFIFO participantCAF education2 offfarm_2011 second_occ
(obs=205)
```

	hectares	distan~G	distan~0	partic~F	educat~2	off~2011	second~c
hectares	1.0000						
distance_MAG	0.0916	1.0000					
distance_F~0	0.0362	0.7933	1.0000				
participan~F	0.1970	0.0274	0.0760	1.0000			
education2	-0.0045	-0.2612	-0.2746	0.0543	1.0000		
offfarm_2011	-0.0535	-0.0239	-0.0091	-0.0453	0.1594	1.0000	
second_occ	0.0070	-0.0964	-0.1300	0.0428	0.1829	0.3713	1.0000

```
. corr fam_consume2 documents2 education2 participantCAF received_intime distance_MAG distance_FONAFIFO cont
> racts
(obs=31)
```

	fam_co~2	docume~2	educat~2	partic~F	receiv~e	distan~G	distan~0	contra~s
fam_consume2	1.0000							
documents2	-0.0142	1.0000						
education2	0.8483	0.0479	1.0000					
participan~F	0.3958	-0.2297	0.3304	1.0000				
received_i~e	0.0234	0.1768	0.0085	0.0256	1.0000			
distance_MAG	-0.3369	-0.0287	-0.3792	-0.0873	-0.3895	1.0000		
distance_F~0	-0.3638	-0.1605	-0.3876	-0.0478	-0.4953	0.8256	1.0000	
contracts	-0.2402	-0.3283	-0.2418	-0.0116	-0.4529	0.2569	0.4260	1.0000

Appendix D OLS regressions

OLS-regressions of factors of participation in relation to the level of transaction costs.

Transaction costs	Regression 1	Regression 2	Regression 3	Regression 4
Documents of farm	22,488 (1,97)**	17,559 (1,02)	11,571 (0,80)	26,859 (2,44)***
Distance to MAG office	-0,573(-1,04)		-0,289 (-0,67)	
Distance to FONAFIFO office				-0,591 (-2,31)***
Education level			68,574 (0,95)	
Number of contracts	0,797 (0,06)	-3,288 (-0,22)		
Hectares		0,041 (0,46)		-0,009 (-0,16)
Participant CAF		-9,147 (-0,42)	-25,785 (-1,27)	
Constant	62,415	53,822	77,698	87,28
F-value	1,64	1,61	2,05	2,93
Prob > F	0,1927	0,1903	0,0115	0,0428
R-squared	0,0320	0,0129	0,0669	0,0737
R-squared adjusted				
N	48	48	53	53

The numbers in the parentheses are the t-values. * = significant at 15% level ** = significant at 10% level, *** = significant at 5% level, and **** = significant at 1% level.

Appendix E The questionnaire for the survey

Questionnaire about effectiveness and participation costs in PSA

Survey number: _____

GPS coordinates: _____

_____ (most important farm)

Register number of the farm: _____

Interviewer: _____

Date: _____

Time of initiation: _____ Time of finalization: _____ Duration: ____ min

Buenos días/tardes. I am a student at the Norwegian University of Life Sciences (UMB). I am carrying out a survey in Hojanca in order to make a study which will be part of my final thesis of a M.Sc. degree in Economics. This investigation is done in collaboration with CATIE (Tropical Agricultural Research and Higher Education Center) in Turrialba, Cartago.

The objective of this survey is to investigate the factors that affect the effectiveness of the modalities forest protection and reforestation and participation costs in the PSA (Pagos Por Servicios Ambientales) in the area of Hojanca. To do this, are we going to interview approximately 200 landowners – participants and non-participants of the program in order to compare the mentioned issues.

Participation in the survey is voluntary and you have the opportunity to withdraw whenever you like without further explanation. In the case of withdrawal, all information provided will be anonymized. The desired information for this study will be treated confidentially and will not be utilized for other purposes. The information will be analyzed in group form, hence, we will not refer to individual answers from a specific landowner. All information will be anonymized when the project is finalized.

The duration of the survey is 30-45 minutos. All questions of the survey refer to year 2010 or 1998. In the survey there will be used the word “finca” (farm) for all type of property (terrain, property etc.)

In case of any question, you may call me at the number xxxx-xxxx or send an e-mail to signe.rugtveit@student.umb.no. You may also contact my contact person in CATIE, Muhammad Ibrahim at number xxxx-xxxx.

I confirm to have understood the objective of the survey and give my permission to carry out the survey:

Signature:

Thank you very much for your collaboration.

Questionnaire with average answers – some remarks:

For the continuous variables, the average of the given numbers is put after the question. For questions with alternatives, the total number of answers for the respective alternative is given. In the open questions, I have noted some of the answers. Note that in many cases the respondents gave other alternatives than those listed, in those cases I have mentioned some of them. There are also in several cases made new variables from these questions which are not given here. In addition, a couple of questions are removed from the original survey due to turning out not being relevant for the study. It resulted however, that there were more of the questions that would not be necessary for the analysis, that are kept in the survey.

1

a. Are you the owner of the farm?

- Yes: 194 → Are you the only owner of the farm or are there more owners?
 - Only owner: 72
 - More owners (co-owners): 98 → how many? Average: 4
- No: 13

b. Are you the person who principally manages and takes decisions affecting the farm?

- Yes: 207 → Which relation do you have with the owner(s)?
_____ **(only if he/she is not the owner)**
→ Who else takes decisions? _____
- No: 0 → which relation do you have to the farm? _____

c. From which year are you the owner? Average: 1989 (year)

d. Do you currently live at the farm?

- Yes: 73
For how many years have you lived at the farm? Average: 30 years
- No: 133
Where do you live? Note province, canton, district and locality

e. How did you obtain this farm?

- Inherited it: 75
- Bought it: 106
- Received it as a gift: 3
- Other (specify): 20 _____ *(Has been part of an association/enterprise or partly an association or part of the farm has been an association; partly bought and partly inherited; wife's inheritance)*

A. Information about the farm

2 Location of the main farm:

Province: Guanacaste
Canton: Hojancha, Nandayure, Nicoya
District: _____
Town/place: _____

3 How many hectares does the (main) farm consist of in total? 58 ha

4 How many hectares are there of:

- a. Natural/primary forest 12 ha
- b. Regeneration/secondary forest (<20 años)? 13 ha
- c. Forest plantations 8 ha
- Which is the most valuable species? Teak, Melina, Gallinazo, Pochote
- d. Agricultural crops 1 ha
- Which is the crop of highest value? Oranges, coffee
- e. Pastures 23 ha
- f. Fodder banks 0,2 ha

Natura/primary forest means: intact forest which has never been exploited, fragmented nor deliberately influenced/touched/influenced by human beings.

5 How many more farms do you possess/manage/have access to? 0,7

Interviewer: The following questions refer to the main farm/parcel or the one with mayor economic importance.

6 Are your farm accessible all year round or only in dry season?

- All year → Accessible with:
 - Car: 139
 - Motorcycle: 5
 - Horse: 55
 - Foot: 8

- Only in dry season → Accessible with:
 - Car: 177
 - Motorcycle: 8
 - Horse: 21
 - Foot: 1

7 Do there exist natural water sources (nacientes, streams, rivers, lakes or charco) at the farm?

- No: 5

- Yes → : 197
 - Nascent water ('naciente'): 92
 - Stream or river: 24
 - Lake or pool: 0
 - Both nascent water and stream or river: 86
- **Are the watersources protected by forest?**
 - Yes: 194
 - No: 2
 - Partly: 6

8 Is the forest fenced?

- Yes: 51
- No: 129
- Partly: 20

9 If you do not have natural/primary forest, go to question 10

Considering only the natural forest at your farm, do you think there at any moment has been harvested wood from this area, by yourself or previous owners, the last 50 years approximately?

- Yes: 106
- No: 49

"Wood" refers to wood of high quality for construction or industrial forestry products, not for fire wood or other uses.

10 Which documents do you possess of your farm (mark all alternatives that apply)

- 'Escritural notarial': 9
- 'Escritural notarial' and 'plano': 195
- 'Resolución del IDA': 1
- Posesion: 1
- 'Carta de venta privada': 0
- Right to using the farm: 0
- Other: 9

11 At what distance from the farm are the following offices located in travel time and which is the transport used?

Interviewer: We are looking for the distance by the road and the farm with PSA if it is a participant

- a. The closest agricultural office (MAG)
Office name: _____ distance: 30 hours travel time
Means of transport: _____
- b. The closest forestry office (MINAE)
Office name: _____ distance: 33 hours travel time
Means of transport: _____
- c. The closest FONAFIFO office

Office name: Nicoya distance: 59 hours travel time
Means of transport: _____

12 *If the farmer does not have cattle, go to question 14*

a. **How many adult cattle (>1 year) do you currently have at the farm?** 25

b. **How many adult cattle (>1 año) did you have in 1998?** 36

Interviewer: If the farmer does not remember for exactly this year, ask for thirteen years ago or ten years if it appears easier. Note how many years back in that case.

c. **Do you sell the cattle or derived products (milk, cheese, cream etc) that you produce?**

Does not sell (go to question 14): 16

Sells: 155

d. **In which place do you sell and how far from the farm by road is this place?**

Cattle: 138 Place: _____ km/travel time

Milk: 1 Place: _____ km/travel time

Subproducts: 0 Place: _____ km/travel time

Other or combination of previous alternatives: 21

14 **If by poor soils one understands soils that yields less than the average of the areas nearby, which percentage of your farm contains poor soils?** 11%

15 **If "steep slope" refers to soils/areas with too much steepness too work with crops, which percentage of your farm has steep slope?** 34%

16 **Have you participated in the program Certificados de Abono Forestal (CAF) or some other forest incentive program (before 1997)?**

No: 142

Yes: 65 When? From: 1989 (year) until: 1993 (year)

B. Pagos por Servicios Ambientales (PSA)

17

a. **Have you heard about the program "Pagos por Servicios Ambientales" (Payments for environmental services)?**

Yes: 203

No: 4 → Would you be interested in participating in PSA in the future?

Yes (go to section F, question 41): 3

No (go to section F, question 41): 0

b. **When did you hear about the PSA program for the first time?** 1997 (year)

c. **How did you hear about PSA the first time?** *__Through Centro Agrícola, media, neighbours/friends/people in town_____*

18 Have you ever applied for a PSA forest protection or reforestation?

- Yes: 85 → Did you receive contract?
 - Yes: 68
 - No: 13 (*go to question 27, section F*)
 - Other: 4
- No: 122 (*go to question 37, section G*)

19 When did you apply for PSA protection or reforestation the first time?

Interviewer: Note that we want to know the year en which the respondent applied included if the application was rejected. We are asking related to PSA protection or reforestation, not forest management or agroforestry.

Protection__2002____ (year)
Reforestation__2002____(year)

20 Have you had a PSA protection or reforestation contract after 1998 or do you currently have one?

- Yes: 68
 - **Have you had a protection/reforestation contract before 2006?**
 - Yes: 53 → **What kind of contract?**
 - Protection (*Ir a sección A, pregunta 22*)**
 - Reforestation (*Ir a sección B, pregunta 23*)**
 - No: 13
- No: 6

Go to section F (question 27)

C. PSA Participants protection contract

21 *For this question we want to obtain information about the landowners' PSA protection contract(s).*

- a. **How many hectares do you have/did you have under forest protection contract and how many do/did you have at other farms?**
- b. **From which year(s) was/were the contract(s)?**
- c. **How much did/do you receive per year/per ha?**

d. Which type of forest do you have under protection contract (primary or secondary)

	Forest protection (a)	Forest protection, other farms (a)	Ha (a)	Year (b)	¢/year/ha (c)	Type of forest (d)
1			35	2003		Primary:12, Secondary: 14 Both: 10
2			35	2007		Primary: 8, Secondary: 2 Both: 3
3			54	2010		Primary: 1, Secondary: 1 Both: 1

e. If you were not in the PSA program and there were no laws restricting the use of forest/land, what do you think you would have used the forest under protection contract for instead (how many hectares for which land-use)?

- 1) Would have kept the forest __32__ ha
- 2) Sustainable management of forest for wood __2__ ha
- 3) Would have converted the forest to pastures __3__ ha
- 4) Would have converted the area to forest plantation(s) __0,2__ ha
- 5) Would have converted the forest to crops __0,5__ ha
- 6) Other, specify: *Would have sold it* __1,5__ ha

f. What is the main use(s) of the payment you receive for the PSA protection contract?

Interviewer: One may have maximum two answers

- Savings: 0
- Investments at the farm: 12
- Investment in other economic activities outside the farm:
- Education: 0
- Subsistence (travels, health, food, clothing etc.): 5
- Other, specify: *_(combinations of the other alternatives): 12*

g. How satisfied are you with the PSA program forest protection?

- Satisfied: 29
- Insatisfied: 2
- No opinion: 3

h. Did you receive the FONAFIFO payment in the time agreed upon?

- Yes: 17
- No: 16 → How many days after the agreed time?
 - First payment: *__89__* days
 - Second payment: *__142__* days
 - Third payment: *__95__* days
 - Forth payment: *__89__* days
 - Fifth payment: *__159__* days

i. What do you think should be changed or improved in the PSA protection

program?

Interviewer: Do not read the alternatives, if the respondent gives various answers, ask for the two most important.

For example:

- Requirements of eligibility: 1
 - Application costs: 1
 - Payment level: 11
 - Payment punctuality: 3
 - The way in which compliance of the contract is monitored: 0
 - The way in which the disputes are resolved: 0
 - Others: *Combinations of alternatives above*: 14
-

j. Are you planning to apply for PSA protection or reforestation in the future?

Interviewer: the respondents may choose more than one alternative.

- No: 13
- Yes, new area: 23
- Yes, renew contract: 22
- Do not know: 8

(answers here are added for both the protection and reforestation contract)

Go to question 23 (section E)

D. PSA Participants reforestation

22

- a. Which species of forest plantation do you have/did you have (e.g. Teak)?
- b. In which year were the plantations planted?
- c. How many hectares were planted?
- d. With which density or trees per hectare was it planted?
- e. How much (how many trees or percentage) have been thinned?
- f. What will be or was the final cut (in "pulgadas")?
- g. How much do/did they pay you per ha/year?

Species (a)	ha (c)	Year of planting (b)	Density o no of trees (3x3,4x4) per ha (d)	Thinning (e)	Final cut in 'pulgadas' '(PMT) (f)
<i>Teak, Melina, Gallinazo, Pochote</i>	<i>12</i>	<i>2003</i>			
	<i>10</i>	<i>2006</i>			
	<i>14</i>	<i>2005</i>			

- h. If you were not in the PSA program and there were no laws restricting the use of forest/land, what do you think you would have used the land under reforestation contract for instead (how many hectares for which land-use)?

Forest plantation	__5__ ha
Agricultural crops	__1__ ha
Pastures	__7__ ha
Would not have used it	__0,4__ ha
Other, speciy: <u>Natural regeneration</u>	__5__ ha

k. **What is the main use(s) of the payment you receive for the PSA protection contract?**

Interviewer: One may have maximum two answers

- Savings: 1
- Investments at the farm: 24
- Investment in other economic activities outside the farm: 1
- Education: 0
- Subsistence (travels, health, food, clothing etc.):1
- Other, specify: Combinations of other alternatives: 3

l. **How satisfied are you with the PSA program forest protection?**

- Satisfied: 24
- Insatisfied: 4
- No opinion: 2

m. **Did you receive the FONAFIFO payment in the time agreed upon?**

- Yes: 13
- No: 16 → How many days after the agreed time?
 - o First payment: 175 days
 - o Second payment: 148 days
 - o Third payment: 109 days
 - o Forth payment: 113 days
 - o Fifth payment: 123 days

n. **What do you think should be changed or improved in the PSA protection program?**

Interviewer: Do not read the alternatives, if the respondent gives various answers, ask for the two most important.

For example:

- Requirements of eligibility: 1
- Application costs: 0
- Payment level: 6
- Payment punctuality: 1
- The way in which compliance of the contract is monitored: 0
- The way in which the disputes are resolved: 0
- Others: More information, more counselling, payments in advance, more flexibility and combinations of alternatives above: 20

o. **Are you planning to apply for PSA protection or reforestacion in the future?**

Interviewer: the respondents may choose more than one alternative.

- No: 13
- Yes, new area: 21

Do not know: 8

(answers here are added for both the protection and reforestation contract)

E. Participation costs

23 **FOREST PROTECTION –If not a participant in “forest protection, go to question 25**

a. **By which institution did you apply, and how much time have you spent for the application (fill out papers/forms, visits to offices, visits at the farms by regentes/intermediaries etc.)?**

- Directly to FONAFIFO/forest official: 3 __15hrs/3days__ hours or days
- Intermediary
 - Agricultural Center (CACH): 34 __3hrs/3days__ hours or days
 - NGO _____ hours or days
 - Other organization _____ hours or days
- Other disadvantages(e.g. topographer) , specify:
 e.g. lawyer, paperwork, counselling __3,5__ hours

b. **Have you had to consult an attorney for matters concerning tenancy or “escritura” or other things related to the PSA application?**

- No: 24
- Yes: 13 → How much did it cost you? *_26US\$_* In which year? 2004_____

c. **Have you had other costs related to the PSA application (forest officials, topographer etc.?)**

- No: 22
- Yes: 15 → Which: *_e.g. topographer, copies, forest officials_* _____
How much were the costs? *_329US\$_* In which year? *_2003_*

24

a. **In order to comply with the requirements for PSA protection, how many hours have you spent for the following:**

Interviewer: If the landowner hired labour for the preparation/maintenance, note how many days.

- i. Forest officials/intermediaries __5__ hours
- ii. Preparations/maintenance:
 - Do/maintain patrols* _____ hours (or days)
 - Do/maintain fences* _____ hours (or days)
 - Do/maintain signs* _____ hours (or days)
 - Total:** __166hrs/20days__ hours (or days)
- iii. Other, specify: _____ hours
- iv. Do/did you hire labour? Which percentage of the work was performed by hired labour? *_82_*%
 - How much do/did you pay per hour? __1,8 USD__

- b. **If you were not going to spend this time in any of the activities mentioned above, which would have been the alternative use of time?**

Interviewer: If it was hired labour only, the question is not necessary

_e.g the same as with PSA, cattle farming_____

25 REFORESTATION – if not participant in “reforestation”, go to question 40

- a. **By which institution did you apply, and how much time have you spent for the application (fill out papers/forms, visits to offices, visits at the farms by regentes/intermediaries etc.)?**

- Directly to FONAFIFO/forest official: 5 _____ *11 days* hours or days
 Intermediary
 ○ Agricultural Center (CACH): 24 _____ *4,5hrs, 2 days* hours or days
 ○ NGO _____ hours or days
 ○ Other organization _____ hours or days
 Other disadvantages(e.g. topographer) , specify:
 Forest officials _____ 1 day hours or days

- b. **Have you had to consult an attorney for matters concerning tenancy or “escritura” or other things related to the PSA application?**

- No: 24
 Yes: 5 → How much did it cost you? *60USD* ¢ In which year? *2002*

- c. **Have you had other costs related to the PSA application (forest officials, topographer etc.?)**

- No: 21
 Yes: 7 → Which: *Forest officials, topographer*
 How much were the costs? *171USD* ¢ In which year? *2004*

26

- a. **In order to comply with the requirements for PSA protection, how many hours have you spent for the following:**

Interviewer: If the landowner hired labour for the establishment/maintenance, note how many days(/year).

- i. Forest officials/Intermediaries _____ *24hrs* days/year
 ii. Establishment:
 Management plan _____ days
 Preparation of the land _____ days
 Purchase and transport of plants _____ days
 Planting _____ days
 “Rodajea”/”Chapea” _____ days
 Fertilization _____ days

Total establishment: 250hrs/31days days

iii. Maintenance:

Quemical control/herbicide/pesticide _____ days/year
Maintain patrols _____ days/year
Vigilance _____ days/year
Fences _____ days/year
Make/maintain signs _____ days/year
Total maintenance: 371hrs/25days days/year

iv. Other, specify: _____ hours

v. Did you hire labour? If yes, which percentage of the work was performed by hired labour? 70%

o How much was paid per hour? 2,1USD ¢

b. If you were not going to spend this time in any of the activities mentioned above, which would have been the alternative use of time?

Interviewer: If it was hired labour only, the question is not necessary

Cattle ranching, maintenance, plant with own resources

Go to question 40 (section H)

F. Non- participants (but who have applied for a PSA contract)

27 Why do you currently do not have a contract?

- Do not know the PSA system: 0
- Was rejected: 10
- Is at waiting list: 8
- Contract expired (go to question 43): 3
- Other, specify: 11 e.g. problems with application, has sold the farm, not agreement among the owners (go to question 43):

a. If "rejected", why do you think the contract was rejected?

Farm outside priority areas, legal problems, problems with requirements

28 FOREST PROTECTION – if not applied for a forest protection contract, go to question 40

For this question, we wish to obtain information about the contract(s) that the landowner has applied for and the alternative use of the farm/land

- a. For how many hectares did you apply, for this farm and for other farms?
- b. In what year did you apply?
- c. How much would they have paid you per ha per year?
- d. What type of forest did you wish to include in PSA protection (primary or secondary)?

Forest protection (a)	Forest protection, other farms (a)	Ha (a)	year (b)	¢/año/ha (c)	Type of forest(d)
		17,2	2009		Primary: 2, Secondary:6

29

- a. **By which institution did you apply, and how much time have you spent for the application (fill out papers/forms, visits to offices, visits at the farms by regentes/intermediaries, attorneys etc.)?**

- Directly to FONAFIFO/forest official: 1 _____ 4hrs _____ hours or days
- Intermediary
 - Agricultural Center (CACH): 9 _____ 3hrs, 2 days _____ hours or days
 - NGO _____ hours or days
 - Other organization _____ hours or days
- Other disadvantages(e.g. topographer) , specify: 0 _____ hours or days

- b. **Have you had to consult an attorney for matters concerning tenancy or "escritura" or other things related to the PSA application?**

- No: 10
- Yes: 0 → How much did it cost you? _____ ¢ In which year? _____

- c. **Have you had other costs related to the PSA application (forest officials, topographer etc.)?**

- No: 8
- Yes: 2 → Which: *Paperwork, topographer* _____
 How much were the costs? *55USD* _____ ¢ In which year? *2008* _____

32 If you had participated in PSA, how much time do you think you would have spent for the following in order to comply with the PSA requirements (not for the application):

Interviewer: If the landowner would hire labour for preparations/maintenance, note how many days.

- i. Forest officials/Intermediaries _____ days/year
- ii. Preparaciones/mantenimiento por rondas, cercas y rótulos _____ days/year
- Total: _____ 32 days/year
- iii. Other, specify: _____ days/year
- iv. Would you hire labour? How much would you pay per hour? 2,3USD _____ ¢

33 REFORESTATION – if not applied for PSA reforestation, go to question 40

- a. Which species of forest plantation did you apply for (e.g. Teak)?
- b. In which year did you apply?
- c. How many hectares did you apply for/intend to plant?
- d. With which density or trees per hectare did you plan to plant?
- e. How much (how many trees or percentage) have been thinned?
- f. What would have been the final cut (in “pulgadas”)?
- g. How much would they have paid you per ha/year?

Specie (a)	ha (c)	Year of application (b)	Density or how many trees (3x3,4x4) per ha (d)	Final cut in ‘pulgadas’ (PMT) (e)	¢/year/ha (f)
<i>Teak, Melina</i>	<i>7</i>	<i>2009</i>			

34

- a. **By which institution did you apply, and how much time have you spent for the application (fill out papers/forms, visits to offices, visits at the farms by regentes/intermediaries, attorneys etc.)?**

- Directly to FONAFIFO/forest official: 0 _____ hours or days
- Intermediary
 - o Agricultural Center (CACH): 5 4hrs, 1,5days hours or days
 - o NGO _____ hours or days
 - o Other organization _____ hours or days
- Other disadvantages(e.g. topographer) , specify: _____ hours or days

- b. **Have you had to consult an attorney for matters concerning tenancy or “escritura” or other things related to the PSA application?**

- No: 4

Yes: 0 → How much did it cost you? _____¢ In which year? _____

c. Have you had other costs related to the PSA application (forest officials, topographer etc.?)

No: 4

Yes: 0 → Which: _____
How much were the costs? _____¢ In which year? _____

35 If you had participated in PSA, how much time do you think you would have spent for the following in order to comply with the PSA requirements (not for the application):

Interviewer: If the landowner would hire labour for preparations/maintenance, note how many days.

i. Forest officials/Intermediaries _____ days/year

ii. Establishment (management plan, preparation of the land, purchase and transport of plants, planting, 'rodajea'/'chapea', fertilization)

Winter (rainy season): _____ days/year

Summer (dry season): _____ days/year

Total establecimiento: _____ *400hrs/50days* days/year

iii. Maintenance: (quimical control, maintenance patrols, fences, signs)

Winter (rainy season): _____ days/year

Summer (dry season): _____ days/year

Total mantenimiento: _____ *92hrs/1 day* days/days

iv. Other, especify: _____ hours

v. Would you hire labour? How much would you pay per hour? _____ *2USD* ¢

36 Are you planning to apply for PSA protection or reforestation in the future?

No: 3

Yes: 9

Do not know: 0

Go to question 40 (section H)

G. Non-participants (who never have applied for any PSA contract)

37 Why have you never applied for a PSA contract?

Do not know the program: 11

Do not know how to apply: 1

Too complicated process: 9

Does not trust state institutions or the intermediaries (or do not want them on their property): 0

The payment is less than what they may gain using the forest/land for something else:

14

- Do not have enough money for the application process:
- Do not believe themselves eligible for PSA
 - Not sufficient forest: 23
 - Not secure property: 3
 - Other legal issue
- Other, specify: 72 ___Cattle needs access to water, would rather like to sell the property, would not have used the area anyway, not agreement among owners, and combinations of alternatives above_____

If you received an offer for a PSA contract, would you accept it?

- Yes:** 46
- No:** 39 → **Why?**
 - Much paperwork: 7
 - High costs: 2
 - Little profitability: 5
 - Other, specify: 25 _Have little area, all owners need to agree, want the area for cattle farming, are retired, do not want any obligations, or combinations of alternatives_____

38 Thinking of the possible change of contract payments in the future; what would be the minimum payment you would accept for applying for a contract in the future?

- Forest protection: 82
The minimum payment you would accept? ___107USD_____¢/ha/year
- Reforestation: 13
The minimum payment you would accept? ___247USD_____¢/ha/year
- Agroforestry: 1
The minimum payment you would accept? _____¢/ha/year
- Do not know: 9

H.

39 Considering only natural/primary forest, and the case that one of your neighbours cuts trees at his/her farm without legal authorization; what do you consider would have happened?

Interviewer: Do not read the alternatives. The respondent might want to indicate more than one answer/alternative.

- Nothing (the law does not apply in the area): 29
- Would receive a warning: 7
- Would have to pay a little fee: 13
- Would have to pay a high fee: 35
- Would have to go to prison: 25

(The rest of the answers (92) are combinations of various alternatives in addition to "confiscation of equipment", "do society service", "must plant again".)

40 Do you have confidence in programs of statal institutions such as PSA of FONAFIFO?

- Very little: 10
- Little: 21
- Middle/normal: 117
- Much: 41
- Do not know: 18

41 Do you think the profitability of your property/land will increase, decrease or stay the same the next 15 years?

- Increase a little: 35
- Increase moderately: 76
- Increase much: 38
- Decrease a little: 9
- Decrease moderately: 4
- Decrease much: 0
- Will stay the same: 39

For what reason? *E.g. increased value of the timber or agricultural crops, because of economic crisis, decreasing prices of cattle*_____

I. Socio-economic information

42 Gender? *Interviewer: only note this question, do not ask*

- Masculine: 188
- Feminine: 19

43 What is your age? 55 year

44 What is your marital status? _____

45 How many persons live in your home (included yourself)?

- 2 men (more than 15 years old)
- 1,5 mujeres (more than 15 old)
- 0,5 children

Number of persons in total: 4

46 What is your highest completed education level (primary, secondary, technician, university)?

- Incomplete primary: 41
- Complete primary: 114
- Incomplete secondary: 14
- Complete secondary: 9
- Incomplete technician: 0
- Complete technician: 4
- Incomplete university: 5
- Complete university: 20

47 Which is your main occupation? *E.g. farmer, housewife, public official, retired, merchant*_____

48 Do you have a second occupation?

- Yes: 83 specify: _____
- No: 124

49

a. Are there incomes in the family that does originate from the farm (the farm with PSA contract if PSA participant)? Which percentage?

__47__ %

b. Which percentage did not originate from the farm in question in 1998? __42__%

Interviewer: If the respondent does not remember for this year, ask for 13 years ago or 10 years ago if it is easier. Note how many years.

50 Could you indicate on the following list, the total consume* per month in your home included all expenses of all persons living in the house?

*Consume includes all expenses that are not for the farm, for example food, clothing, school expenses (school, high school, university), expenses for the car, electrodomestics, reparations, medicins, doctor, medical insurances, gifts for friends or family, energy, telephone, water etc.

Total consume per month

- Less than 25 000 colones: 0
- 25 001 - 50 000 colones: 3
- 50 001 - 100 000 colones: 22
- 100 001 - 200 000 colones: 74
- 200 001 - 300 000 colones: 52
- 300 001 - 400 000 colones: 17
- 400 001 - 500 000 colones: 18
- 500 001 - 750 000 colones: 12
- 750 001 - 1 000 000 colones: 4
- More than 1 000 000 colones: 5

51 Thinking of the general living conditions of your family, comparing to 1998, do you think they are better, equal or worse now?

- Better: 104
- Equal: 45
- Worse now: 58

52 Have you been offered to sell your farm during the last 10 years?

- No: 99
- Yes: 108 → Year 2007

Type of buyer:

- Family: 0
- Other farmer: 19
- Enterprise: 7
- Turism purposes: 76

Offer per hectar (USD): 14405

