
Volume 11, issue 7
November 2009
ISSN 1389-9341
ELSEVIER
Forest Policy and Economics
A companion journal to Forest Ecology and Management

Forest Policy and Economics 11 (2009) 498–507

Contents lists available at ScienceDirect

Forest Policy and Economics

journal homepage: www.elsevier.com/locate/forpol

Participation and compensation claims in voluntary forest conservation: A case of privately owned forests in Finland

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ARTICLE INFO

Article history:
Received 4 January 2008
Received in revised form 14 April 2009
Accepted 29 May 2009

Keywords:
Biodiversity
Forest conservation
Voluntary agreements
Cost-efficiency

ABSTRACT

A new market-based voluntary programme aimed at preserving forest habitats on private land has been implemented in Finland. This scheme is based on conservation by fixed-term agreements between forest owners and a governmental authority. In this study we examine the characteristics of forest owners and their properties that indicate the owners' willingness to participate in the programme. In addition, we analyse factors affecting the real compensation claims. The study uses a dual set of data from the pilot project, i.e. one data set supplied by the authority and another collected from the owners involved in the project. The results suggest that to increase the participation rate, information on the conservation project should be targeted in particular to the forest owners who either emphasize financial investment as a motive for forest ownership, have positive attitudes toward nature protection, or own large amounts of forest property. Additionally, owners' positive environmental preferences would decrease and high harvesting value and high ecological quality of a preserved forest stand would increase compensation claims. The voluntary programme could not, however, circumvent owners' strategic behaviour with respect to the claims.

1. Introduction

There has been a growing interest in using voluntary agreements (VAs) and compensation payments for nature conservation on private land as they may provide many desirable outcomes. VAs with compensation payments may reduce perverse incentives that can occur under a mandatory approach (Langpap and Wu, 2004). If landowners, for example, cannot get compensation for the taking of a site, they have a strong incentive to decrease the preservation value of their land. Moreover, to be sure about the preservation value the government needs to make expensive inventories on private land. Without compensation, owners may prohibit inventories that would lead to the taking of a site. (Polasky and Doremus, 1998, see also Innes et al., 1998; Innes, 2001; Shogren et al., 2001.) Furthermore, VAs are considered more readily accepted by landowners, and by the society in general, than traditional mandatory approaches such as compulsory purchase (see e.g. Horne et al., 2004).

Moreover, VAs are suggested to be more efficient than mandatory policies due to the lower transaction and opportunity costs. Transaction costs may be lower because of reduced reliance on formal legal procedures and reduced conflict. Lower opportunity costs may occur because VAs are generally thought to provide more flexibility in determining the means by which a target level of conservation would be met (Segerson and Miceli, 1998). In particular, the latter costs may be lower if the conservation-minded landowners can be revealed and persuaded to make agreements in the voluntary regime (Smith and Shogren, 2002; Michael, 2003).

Historically, voluntary approaches have been used in several fields, but perhaps most notably they have been used in agriculture to reduce pollution in soil conservation and other erosion control programmes such as the US Conservation Reserve Program (see, e.g., Segerson and Miceli, 1998). In Austria, VAs are used to protect forests for biodiversity maintenance (Frank and Müller, 2003).

A new market-based voluntary programme, hereafter termed the Trading in Natural Values (TNV), to preserve forest habitats on private land was tested in 2003–2007 in Finland. Non-industrial private owners possess over 14 million hectares of forests, which is about 53% of the total forestry land in Finland. These forests are primarily used for timber production. At the same time, intensive forestry for timber production is the most important reason for species endangerment in Fennoscandia (Esseen et al., 1997; Rassi et al., 2001). Most of the non-industrial private forests are located in southern Finland, where strictly protected areas cover only about 2.2% of the total land area (Horne et al., 2006, p. 16). In Finland as a whole, protected areas account for about 11.2% of the total land area (Horne et al., 2006). Most of these areas are located, however, in the northern and eastern part of the country, especially in Lapland,

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doi:10.1016/j.forpol.2009.05.007

where the climate is more artic and the soil more barren. For these reasons the biodiversity is not very rich there. Thus, there is an urgent need to extend the conservation network to the southern part of the country (Hanski, 2000). It is likely that a mandatory approach, such as land taking, would spawn intense resistance from disgruntled landowners. Therefore, a voluntary programme seems quite an attractive policy tool for conserving biodiversity in these circumstances.

TNV is based on fixed-term agreements between landowners and a governmental authority. According to these contracts, the forest owners conserve their lands for biodiversity and receive compensation, i.e. a rental payment. The aim of TNV is to create markets for biodiversity services in a manner that enjoys broad acceptance in society and in particular among forest owners. Thus, not only is TNV politically feasible, it may also be cost effective.

Several theoretical studies have analysed the effectiveness of using VAs in nature conservation (Stranlund, 1995; Polasky and Doremus, 1998; Segerson and Miceli, 1998; Wu and Babcock, 1999; Innes, 2000; Smith and Shogren, 2002; Langpap and Wu, 2004). In general, they have found that the efficiency of VAs depends on many factors such as the background threat of regulation, contract scheme, supporting public services, deadweight losses of government expenditures, number of participants in the programme, cost advantage offered by VAs, and allocation of bargaining power.

The empirical literature considering efficiency of VAs can be divided into two groups. The first group of research examines the efficiency of VAs using comparative policy analysis. For example, Smith (1995) used the mechanism design theory to characterize the properties of a least-cost conservation reserve programme. Similarly, Whitby and Saunders (1996) compared two management agreements used in the U.K., including designation as Sites of Special Scientific Interest (SSSI) and Environmentally Sensitive Areas (ESAs), in terms of cost effectiveness. Using a data set from a survey, Siikamäki and Layton (2007) assessed the potential cost effectiveness of incentive payment programmes relative to traditional top-down regulatory programmes for biological conservation. Using data from the TNV pilot programme, Juutinen et al. (2008) analysed whether it is more efficient to buy or lease the conservation areas from the viewpoint of an environmental authority. These studies showed that the use of a single pricing rule compared with nonlinear price schedules in conservation programmes results in too generous payments to landowners. In addition, an incentive-based policy could be more efficient than a traditional top-town policy. The realization of potential benefits of VAs depends, however, on the way the policy is implemented in practice.

The second group of research investigates landowners' participation in conservation incentive programmes. For example, Lynch and Lovell (2003) analysed factors influencing owners' participation in programmes concerning agricultural lands and Langpap (2004) concerning forest lands. Our contribution falls into this category. However, in contrast to the previous studies, we analyse factors affecting the real compensation claims. This is an important issue because the efficiency of TNV depends strongly on the level of the compensation. For comparative purposes with former studies such as Lynch and Lovell (2003) and Langpap (2004), we also analyse the characteristics that are typical of landowners willing to participate in TNV. Operating voluntary programmes effectively depends on understanding what motivates a landowner to participate. This information can be used to target and market these programmes more effectively to the right segments of forest owners. This study uses dual sets of data from a real TNV pilot project, i.e. one data set supplied by the authority running the programme and another collected from the owners involved in the project.

Note that there is an overlap between the forest owners included in the two analyses. In the first step, in the model related to participation into TNV, some of the owners did not enter into an agreement while others did. In the second step, in the model related to compensation, we only analyse the latter group. The owners that have signed a TNV contract are not a random sample of forest owners that initially expressed their willingness to participate, and this may bias compensation claims. In order to take this problem into account we combine the two analyses by using the Heckman Two-Step estimation method (Heckman, 1979). Thus, although the model related to participation is interesting per se for comparative reasons with earlier research, this estimation method is a way to take into account the sample selection problem of the model related to compensation.

The results may prove useful in considering the most effective implementation strategy in countries that are planning to apply incentive-based programmes for nature preservation on privately owned land, such as TNV in Finland. After this small scale pilot phase, it has been decided to implement the scheme based on VAs in Finland as a permanent programme and expand it to the southern and western part of the country (Government Resolution, 2008), where private non-industrial ownership dominates the land markets.

The paper is organized as follows. We first describe the Finnish nature conservation framework, the market for VAs, and the pilot project regarding TNV that has been conducted in Finland. Then, in Section 3 we present an analytical framework. In Section 4, we describe data sets, variables and econometric models and in Section 5 we present the corresponding empirical results. Finally, we discuss our findings in Section 6 and present conclusions in Section 7.

2. Description of the pilot project of Trading in Natural Values

2.1. General market description

In this section we give a description of TNV showing how the process between a forest owner and the governmental authority running this programme starts and continues, ending in an agreement or non-agreement with respect to protection of a forest area. We describe the process as a market where forest owners offer their forest plots or stands for protection to the authority, which chooses the enrolled stands and pays the agreed compensation to the landowners (Gustafsson and Nummi, 2004). To present an overview of the pilot project at hand we start the discussion by considering the factors that affect demand and supply of biodiversity services in the context of the contractual mechanism.

Assume the aim of forest owners is to maximize the net benefits from their land (Hartman, 1976). These benefits include both commercial and subjective values as forests provide a myriad of products and services. Many of these products and services, such as biodiversity, do not have a market price. However, landowners' emphasis on non-timber objectives does not exclude timber production (Karppinen, 2000), which is the dominant purpose of forest use in Finland. Thus, forest owners either use their stands for timber production or offer them to the project. Each stand has different ecological characteristics and timber production possibilities. We assume, just like Smith and Shogren (2002) for example, that the aim of the authority is to maximize net social benefits of conservation. The authority can pay different amounts of compensation to each landowner willing to protect his or her forests.

The most important factor affecting the demand and supply in this market are the ecological characteristics of the potential conservation target. First, the stand must fulfil the specific ecological criteria before it can be accepted as a target for conservation (Kriteerityöryhmä, 2003), because all types of forests do not need protection or are not ecologically valuable enough to deserve protection. Second, the agency is willing to pay more for higher quality stands than for lower quality stands. The interpretation of quality depends, however, on the more specific local goals of conservation.

The supply of biodiversity services and the compensation claims of the forest owners depend on several factors. One important factor is the timber production possibility of the particular stand. This affects the magnitude of monetary losses incurred by the forest owners due to protection of the stand, i.e., the opportunity cost of forsaking the possibility to harvest their own forest stands and sell timber for money. These losses depend also on the wood market, which determines timber prices. However, the goals and preferences of a forest owner affect the compensation claim, too. In practice, the forest management decisions are made and the goals for timber production are set at the forest holding level, not at the stand level. Therefore, the timber production possibilities of a given stand cannot solely determine the losses incurred from its protection. Finally, the compensation claim depends on a forest owner's preferences with respect to nature conservation. Environmentally minded landowners are those who value biodiversity services highly and potentially require lower compensation than landowners who highly value timber production associated with monetary benefits.

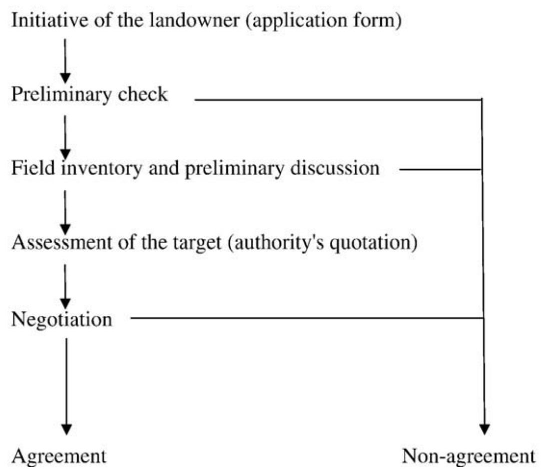

Fig. 1. Phases of the voluntary conservation process in the Finnish pilot project.

2.2. Implementation of the pilot project of Trading in Natural Values

The history of protected-area establishment in many global regions including Fennoscandia has been based on top-down management and conservation programmes, where conservation authorities have prioritised and established a network of conservation areas largely on state-owned land. This has resulted in a situation where a majority of the protected areas are located at high elevations and high latitudes, or in remote sites with low economic value (Virkkala 1996; Stokland 1997). Protected-area networks in more productive regions of Fennoscandia appear to be inadequate, and there is an imminent need to protect more productive sites, particularly forests (Hanski, 2000; Angelstam and Andersson, 2001). As a consequence of the bias towards land with low productivity, areas of high priority for nature conservation tend to be located on unprotected private land (Knight, 1999).

A new type of conservation policy, *Forest Biodiversity Programme for Southern Finland* (METSO), was implemented for testing in 2002–2007. This programme was based on voluntary participation by forest owners and mainly used fixed-term contracts. The new policies included *Trading in Natural Values* (TNV) (Gustafsson, 2008). An evaluation of the ecological, social and economic effects of the METSO programme was completed in the end of 2006 (Horne et al. 2006). Subsequently, the Finnish government has issued a resolution on the second phase of METSO from 2008 to 2016 (Government Resolution, 2008) where the emphasis is on enlarging the existing network of conservation by voluntary agreements, e.g. TNV, with private forest owners.

As a part of the METSO programme, the principal idea of TNV is based on landowners' initiative to protect their own forest (Fig. 1). The process starts when a landowner offers his or her land to the programme by submitting a specific application form to the authority, the regional Forest Centre. The form includes a description of the ecological characteristics of the offered conservation target, which can include several stands. Landowners are also expected to submit a compensation claim at the beginning of the negotiations. In the pilot project the contracts are in force for a limited period lasting 10 years. Compensation payments are made in one lump sum at the beginning of the contract period and they are exempt from taxes.

In the next phase of TNV the authority checks the application form and makes a preliminary assessment whether the offered target is eligible to be a potential target for conservation or not. If it seems that the quality of the offered target is high enough, the nature value expert from the Forest Centre makes an inventory in the forest and checks if the forest fulfils the biological criteria of nature protection (Kriteerityöryhmä, 2003). Otherwise the authority informs the landowner that the offered target is not worth protecting and there will be no agreement.

After the field inventory, if the authority still considers the target good enough for conservation, it calculates the compensation value of the target using a certain valuation mechanism (see Appendix A), which includes prices for different ecological characteristics evaluated by the authority. It includes also a capitalized value for the loss of delayed harvesting calculated by using a 1% interest rate for the value of the forest and expected decay of wood. Thus the authority has good knowledge of the timber production possibilities of the target due to the field inventory.

Finally, the authority and the landowner negotiate about the amount of compensation and the required protection activities. In most cases the protection means that no silvicultural activities are carried out in the forest but in some cases careful cuttings and treatment can be allowed. It should be noted that there is no explicit background threat for the landowners. They are free to withdraw from the agreement process at any time and after 10 years the forest owner can freely decide on the use of the forest. The negotiations can be interpreted as a competitive bidding process, because several landowners are offering their forests to the programme simultaneously and the authority can pay each landowner different amounts of compensation. Moreover, the authority works under a given budget constraint and therefore it is likely that all potential targets will not be included in the programme.

The competition among landowners may not, however, be effective in practice. In particular, the authority reveals the estimated compensation value in the negotiation process to landowners, which may give some landowners an opportunity to inflate their claims above their true opportunity costs. In addition, in the negotiation process contracts are allocated by using subjective expert judgements, not by using predetermined strict rules like in an auction mechanism, for example (Stoneham et al., 2003). Expert judgements may be exposed to some irrelevant factors, and therefore, they may not always be consistent.

3. Analytical framework

Following a model developed by Lynch and Lovell (2003) and modified by Langpap (2004), the analytical framework of the paper conceptualizes a forest owner's decision to participate in a voluntary programme for environmental preservation such as TNV. The forest owners' utility with respect to participation is determined by two options. On the one hand, they can choose not to participate in TNV and harvest their forest at the optimal time denoted by T_1. On the other hand, they can choose to participate in the voluntary programme, which lasts until time T_2, and refrain from harvesting during that period, and then harvest at T_2. We assume that $T_2 \geq T_1$.

Different forest owners may obtain different levels of utility from the net revenue of harvesting their forest at the optimal time, from preserving a part of their forest from cutting, from compensation they receive from a preservation programme, and from non-timber income. Let q denote the decision variable so that if $q = 1$, the landowner participates in the TNV programme, and if $q = 0$, the landowner does not participate. Then the forest owner i chooses q to maximize his or her utility V_i, given by:

$$V_i = \max_q (1-q)\left[\int_{t=0}^{T_1} U_i(S_i(\mathbf{x}_i,t),W_i(\mathbf{x}_i,t))e^{-\rho t}dt + \int_{T_1}^{\infty} U_i(W_i(\mathbf{x}_i,t),rR_i(\mathbf{x}_i))e^{-\rho t}dt\right] + q\left[\int_{t=0}^{T_2} U_i(S_i(\mathbf{x}_i,t),W_i(\mathbf{x}_i,t),I_i(\mathbf{x}_i,t))e^{-\rho t}dt + \int_{T_2}^{\infty} U_i(W_i(\mathbf{x}_i,t),rR_i(\mathbf{x}_i))e^{-\rho t}dt\right] \quad (1)$$

where $U_i(\cdot)$ denotes owner's i utility function; $\mathbf{x}_i$ is the vector of demographic and property characteristics for forest owner i; $R_i(\mathbf{x}_i)$ represents the net revenues from harvesting at T_1; $S_i(\mathbf{x}_i,t)$ is the amenity value of preserving the land as forest at time t; $I_i(\mathbf{x}_i,t)$ is the value of the compensation payment received from participating in TNV at time t; $W_i(\mathbf{x}_i,t)$ is the non-timber income at time t; r is the discount rate, and ρ is the forest owner's rate of time preference.

When the forest owner's behaviour is consistent with a well-defined utility function, the forest owner will choose to participate in the voluntary conservation programme if:

$$\left[\int_{t=0}^{T_1} U_i(S_i(\mathbf{x}_i,t),W_i(\mathbf{x}_i,t))e^{-\rho t}dt + \int_{T_1}^{\infty} U_i(W_i(\mathbf{x}_i,t),rR_i(\mathbf{x}_i))e^{-\rho t}dt\right] < \left[\int_{t=0}^{T_2} U_i(S_i(\mathbf{x}_i,t),W_i(\mathbf{x}_i,t),I_i(\mathbf{x}_i,t))e^{-\rho t}dt + \int_{T_2}^{\infty} U_i(W_i(\mathbf{x}_i,t),rR_i(\mathbf{x}_i))e^{-\rho t}dt\right]$$

meaning that the forest owner will participate in TNV if the utility of participating in the programme, receiving the compensation, benefiting from environmental values of preserved forest, and harvesting after the contract period exceeds the utility of not participating and harvesting at an optimal time.

The above framework presented by Lynch and Lovell (2003) and Langpap (2004) can be modified for defining the landowner's compensation claim, C_i, as follows:

$$C_i \geq \left[\int_{t=0}^{T_1} U_i(S_i(\mathbf{x}_i,t),W_i(\mathbf{x}_i,t))e^{-\rho t}dt + \int_{T_1}^{\infty} U_i(W_i(\mathbf{x}_i,t),rR_i(\mathbf{x}_i))e^{-\rho t}dt\right] - \left[\int_{t=0}^{T_2} U_i(S_i(\mathbf{x}_i,t),W_i(\mathbf{x}_i,t))e^{-\rho t}dt + \int_{T_2}^{\infty} U_i(W_i(\mathbf{x}_i,t),rR_i(\mathbf{x}_i))e^{-\rho t}dt\right] \quad (2)$$

According to Eq. (2) delaying the harvesting from T_1 to T_2 decreases the landowner's utility as we assumed that $T_2 \geq T_1$. The landowner will claim compensation which is equal to or higher than the utility loss.

The landowner's preferences play a crucial role in determining the value of non-consumptive benefits from standing trees in a forest (Karppinen, 2000; Horne et al., 2004). Preferences may be environmentally friendly and the benefits from $S_i(\mathbf{x}_i,t)$ in Eq. (2) very high so that a forest owner would not need any or only a small amount of compensation for preserving his or her own forest stand. (The optimal harvesting period is longer when a forest owner also values non-timber benefits from a stand compared with a pure optimal timber management period provided that non-timber benefits increase with stand age (Hartman, 1976).) In the opposite extreme case he or she may not value the environment at all and may not get any benefits from the preserved forest. In this case the owner would claim compensation for preservation that covers all losses from timber production (see also Innes et al., 1998). If the environmental policy authority could identify the types of preferences of the forest owners, it could find the most environmentally friendly owners. Combining this information with a data set on ecologically valuable forest plots, the authority would be able to make an optimal combination of preservation areas and a socially efficient solution of environmental protection.

There is, however, a problem of asymmetric information between the authority and the forest owners in voluntary preservation of private forests because the authority does not know the owners' preferences. Moreover, forest owners do not have an incentive to tell the truth about their preferences to the authority (Latacz-Lohman and Van der Hamsvoort, 1997). Instead of bargaining truthfully, forest owners with environmentally friendly attitudes may have an incentive to behave strategically and indicate untrue preferences in order to get money for preservation although they would be willing to preserve the stand without any compensation. Therefore, the compensation claim may be larger than the utility loss in Eq. (2).

A solution to the problem of asymmetric information may be found if a competitive bidding process could be developed for voluntary preservation including bargaining in which several forest owners simultaneously offer their forest plots for preservation. In this kind of scheme the owners compete for agreements with each other and take into account their own preferences for environmental quality and other motives, realizing that too high a compensation claim may not result in an agreement. This is a market of VAs where owners with strong environmental preferences or those who are not intending to harvest a valuable stand in a contract period for some other reason may claim smaller compensation and will conclude an agreement in place of owners with weak environmental preferences or those who wish to maximize timber production.

4. Data sets, variables and econometric models

4.1. Data sets

In this section we describe the data sets, variables and econometric models estimated in the empirical analysis of the study. Our data includes information from TNV covering the years 2003–2004. In this period, a total of 104 forest owners have offered their land for preservation. The forests offered include 119 stands covering 679 ha. In 2003 agreements were made with 30 owners on 47 stands (254 ha) and in 2004 with 35 owners on 43 stands (243 ha). The forest owners who offered their land to TNV but did not reach agreements were 29 persons with 29 stands (183 ha).

We have two sources of information. First, we have directly received a data set from TNV compiled by the regional Forest Centre during the first 2 years of the pilot project. This data set consists of information on all 119 stands offered to the project including the following variables: the year when a stand was submitted or agreement made (2003 or 2004), result of negotiations (agreement or non-agreement), surface area of a stand (ha), compensation claimed (€/ha/a) by those owners who made agreements, forest value (harvesting value of standing forest; €/ha), stand age (years), and the authority's estimate of the ecological value of a stand (points) (for more information, see Appendix A).[1] Some of the stands included in TNV were recently burnt, located on barren soil or had for some other reason a poor value as a standing forest. These 35 stands were excluded from the following analyses leaving 84 observations in the data set.

The second source of information is a survey that was directed to all – not to a sample – of the forest owners in the Satakunta region who have offered their stands to TNV in 2003 and 2004 (Juutinen et al., 2005). In November 2004 a questionnaire was sent to 137 forest owners consisting of 61 owners who made an agreement and of 76 owners who offered their stands but did not reach an agreement. In total we received 89 acceptable responses, the response rate being 65%. The owners with an agreement returned 50 questionnaires (response rate 82%) and those without an agreement 39 questionnaires (51%).

The survey includes questions about forest owners' attitudes on protection of forests and nature in general, aims of forest ownership, acceptability of different protection measures and their attributes, and importance of different viewpoints in protection of nature values. In addition, forest owners were asked about the TNV protection policy itself and its application in practice, about the factors affecting compensation claims, and about assessments of future use of the offered target.

Our data are exceptional in the sense that they are based on a real societal pilot project. The organizer of TNV directly delivered us the basic data consisting of information that was produced during the course of making lawfully binding agreements between forest owners and the governmental authority. Furthermore, the survey we conducted is not a pure opinion poll of a sample but rather an inquiry directed to all those owners who were involved in the project during the first 2 years. Therefore, the analysis based on these data provides more realistic results than earlier studies based on survey data and hypothetical contracts with potentially several types of biases (e.g. Siikamäki and Layton, 2007).

The data, however, have some weaknesses that may affect our findings. The fact that TNV is a first pilot project in the country means that the owners who participated in the scheme on their own initiative during the first 2 years were probably not at all ordinary forest owners but rather a self-selected group. According to the survey results reported by Juutinen et al. (2005) the TNV participants own relative large forest estates and are very active in forestry having a sufficient knowledge base and education to assess potentially valuable stands and participate in new activities, like TNV. Thus, the data may not represent owners in general and may not have the variation a random sample would have.

Despite the fact that we examined the whole population, i.e. all the owners who were involved into the project, the other problem with our data is that the number of observations is rather low. The reason for this is that we are dependent on the number of the forest owners participating in the project. The number of the participants is not very large because the annual budget of the project was limited.

In order to carry out the empirical estimations we merge the data sets obtained from the two sources. In the estimations of the two models, i.e. the model related to participation (hereafter the Participation Model) and the model related to compensation (the Compensation Model), the data set is not, however, identical. In estimation of the latter model we can use only the part of the observation units (i.e. the forest owners) who made a TNV agreement. The simple reason for this is that we do not have information on compensation claims from owners without an agreement, because in many cases ecological values were so low that the agreement process ended before the claim was even submitted (see Fig. 1). In the former model we, of course, use a data set including observations from both owners who achieved an agreement and those who did not.

4.2. Variables and econometric models

We construct two econometric models, one for each research topic (i.e. the Participation Model and the Compensation Model), with seven regressors classified into five sets of variables (Table 1). We chose these independent variables according to economic theory and results based on earlier related studies.

The dependent variable of the Participation Model (PARTICIP) describes the forest owner's decision on whether to participate in TNV or not. Thus, we define PARTICIP = 0 if the forest owner does not want to participate and PARTICIP = 1 if he or she does. The dependent variable of the Compensation Model (COMPCLAIM) is a continuous variable corresponding to the compensation claimed by forest owners for voluntary temporary conservation. In both models

Table 1
Variable description of empirical models.

Variable	Description	Mean	Std. dev.
Dependent variables			
Participation Model			
PARTICIP	Whether a forest owner participates in TNV or not; binary variable: 0 = no, 1 = yes.	0.63	0.49
Compensation Model			
COMCLAIM	Compensation claimed by forest owners for voluntary temporary conservation (€/ha/a); continuous variable.	205.30	75.82
Independent variables			
Property characteristics			
lnFORAREA	Natural logarithm of total area of a forest estate (ha); continuous variable.	133.36	450.24
FORVALUE	Harvesting value of a forest plot (€/ha); continuous variable.	5721.92	2937.53
ECONVALUE	Authority's estimate of ecological value of a stand (points); continuous variable.	109.82	33.88
Forest owner's aims for forest management			
INVEST	Importance of financial investment as a motive for forest ownership; a Likert scale from 1 (not important at all) to 5 (very important)	2.99	1.38
Implementation of the voluntary conservation programme			
TNVORG	How competently TNV has been organized; a Likert scale from 1 (not important at all) to 5 (very important)	4.61	0.88
Environmental preferences of a forest owner			
ENVPREF	Forest owners' attitudes in nature protection; an additive variable combining information from four questions revealing opinions about given statements concerning “preservation and reproduction of species enjoyable for myself”, “preservation of a forest as a natural state for my own recreational use”, “preservation of biodiversity”, and “all species have the right to live”; for each statement a Likert scale from 1 (not important at all) to 5 (very important). Thus, the potential range of this variable is 4–20.	16.01	3.27
Demographic characteristics of a forest owner			
FOREDUC	Education including a degree on forest management or forest sciences; binary variable: 0 = no, 1 = yes.	0.16	0.37

[1] The authority measured the determinants of conservation value in monetary terms (€/ha/a) but in this study we interpret the determinants related to the ecological characteristics of a stand as points of ecological value. The prices for different ecological characteristics were evaluated by the authority, i.e. they are not market prices but they reflect how important the determinants are for conservation according to the authority. Therefore, it is justified to interpret the monetary values as points as well.

the value of the dependent variable depends on characteristics of the forest owner and of his or her forest.

We explain the variation of the dependent variables of both models partly with the same independent variables. The first set of explanatory variables describes *property characteristics* which may play a role in the determination of a landowner's participation and compensation claim. The first variable in this set, lnFORAREA, describes the natural logarithm of the amount of forested area owned by the respondent.[2] A large forest holding is more likely to include ecologically valuable areas than a small one. Furthermore, respondents owning large forested areas may be better able to absorb opportunity costs of conserving a part of their property. Thus, in the Participation Model the coefficient of lnFORAREA should have a positive sign but in the Compensation Model a negative sign.

The next explanatory variable, FORVALUE, consists of the harvesting value of the standing forest of the preserved plot indicating the potential revenues of the landowner. The forest owner will incur economic losses from temporary conservation if the value of forest growth is smaller than the return from other alternative investments. Typically, a conservation target is mature or old-growth forest having a low growth rate. Thus, we may assume a priori that the higher the forest value, the greater the compensation claimed by a forest owner. This variable, however, cannot be used as a regressor in the Participation Model since we do not have enough observations on FORVALUE for owners who did not make an agreement.

The third variable, ECOLVALUE, describes the ecological quality of the considered conservation target estimated by the authority (see Appendix A for illustration; Gustafsson and Nummi, 2004). In a competitive market this variable should not be statistically significant in the Compensation Model, because forest owners' compensation claims should depend on losses caused by conservation of the land. Moreover, compensation claims reflect forest owners' preferences, which determine how they value these losses. However, if the market is not competitive, then forest owners may behave strategically asking for high compensation for protecting ecologically high quality land. Amongst forest owners, it is commonly known that the authority is willing to pay more for high quality land than low quality land. In this case we can expect the sign of this variable to be positive in the Compensation Model. Also this variable cannot be used as a regressor in the Participation Model since we do not have enough observations on ECOLVALUE for owners with no agreement.

The second set of independent variables is related to the *forest owner's aims for forest management*. The only variable in this set is INVEST or importance of financial investment as a motive for forest ownership. It is measured with a five category ordinal Likert scale from "not important at all" to "very important".[3] It is likely that those owners, who consider this motive more important, emphasize financial gains of forestry and claim higher compensation than others. Thus in the Compensation Model this coefficient should have a positive sign. In the Participation Model it is a priori unclear what would be the sign of the coefficient of this variable. Those who see monetary compensation as a good way to earn money from their forest may be more eager to participate in TNV whereas those who think that protection would decrease their flow of income may refrain from participation. It is, however, also possible that active owners are not mistrustful of this new income source either.

There are several ways to *implement a voluntary conservation programme* and participation in TNV and the amount of compensation claims may depend on how satisfied the forest owners are with this implementation. In the third set we have one variable, TNVORG, describing experiences the owner has had regarding the competence of the authority in organizing TNV assessed with a Likert scale from "very bad" to "very good". We can expect that those forest owners who are more satisfied would participate more often in the programme than the others. It is, however, a priori unclear what would be the sign of the coefficient of this variable in the Compensation Model.

The only variable of the next set of explanatory variables, *environmental preferences of a forest owner*, is ENVPREF describing forest owners' attitudes towards different aspects of nature protection. It is an indexed variable additively combining information from four questions where forest owners reveal their opinions about the given statements in a Likert scale from "not important at all" to "very important" (more detailed, see Table 1). This kind of additive procedure should increase the explanatory power of the variable. In the Participation Model the coefficient of ENVPREF should have a positive sign, i.e. more positive environmental preferences should increase the probability of making a contract, and in the Compensation Model a negative sign, i.e. more positive preferences should decrease a compensation claim.

The final set of independent variables measure *demographic characteristics of a forest owner* that may have an effect on participation in TNV and determination of a forest owner's compensation claim. For that purpose we use a variable including information on whether respondents' education includes a degree in forest management or forest sciences (FOREDUC). It is a binary variable indicating either that forest owners who have a degree in forest management or forest sciences may be better able to understand the benefits of conservation and therefore require lower compensation. They may also be more easily able to identify ecologically valuable areas on their property. In the Participation Model, however, FOREDUC cannot be used as an explanatory variable since we have only one observation of a forest owner who has this education and who did not make an agreement. Summary statistics of the variables are presented in Table 1.

The estimation of the Participation Model was carried out using the Probit model. The independent variables of this model were tested for heteroskedasticity carrying out the Lagrange Multiplier test using the artificial regression method described by Davidson and MacKinnon (1993). The estimation of the Compensation Model was performed using the Ordinary Least Squares (OLS) method for explaining the compensation claims of those owners who made an agreement within TNV. Using the Ramsey RESET test we evaluated the misspecification of both models, i.e. whether we omitted any important variables from the estimation, for example.

The dependency between observations of the two analyses and the censored dependent variable created by the sample selection problem of the Compensation Model causes a violation of the assumption of zero correlation between independent variables and the error term in OLS regression. In order to solve this problem we combine the two analyses by using the Heckman Two-Step estimation method, which estimates a bias correction term in the Probit model and uses it as an additional regressor in the OLS model (Heckman, 1979). However, the error terms in the second step are non-normal and heteroskedastic (see Heij et al., 2004, pp. 504–505). Therefore we will use White heteroskedasticity-consistent standard errors and covariance while presenting the estimation results (White, 1980).

5. Results

5.1. Participation

The parameter estimates of the Participation Model are presented in Table 2. The null hypothesis of homoskedasticity was accepted for

[2] The reason we use a logarithmic transformation of forested area is that the dependence between participation and the size of a forest holding may not be linear. When forest area increases over some relatively large amount, its marginal increase may not have an effect on forest owners' willingness to participate in TNV.

[3] In the models, we use explanatory variables assessed with a Likert scale (i.e. variables INVEST, TNVORG and ENVPREF) like continuous variables, i.e. as they were measured with an ordinal scale with identical distances. This is, of course, not true for all respondents. A more accurate way would be to create an indicator or dummy variable for each of the levels. This would, however, increase the number of regressors too much in relation to our small data set.

Table 2
Parameter estimates of a binary Probit model for explaining forest owners' participation into a voluntary conservation programme.

Variable	Coefficient	Standard error	Chi-square	Pr>ChiSq
Intercept	−7.6641	2.0827	13.54	0.0002
lnFORAREA	0.4776	0.1705	7.84	0.0051
INVEST	0.7675	0.1827	17.64	<0.0001
TNVORG	0.3577	0.2016	3.15	0.0760
ENVPREF	0.1543	0.0691	4.98	0.0256
Included obs.	71			
Criteria for assessing goodness of fit				
Criterion	DF	Value	Value/DF	
Deviance	66	60.2137	0.9123	
Pearson Chi-square	66	63.3972	0.9606	
Log likelihood		−30.1069		

all the variables included in the estimation. The Ramsey RESET test suggests that the model is adequate ($\chi^2=2.00$, $p=0.3670$). The hit rate (i.e. count R^2) of the model is about 83% with a 0.5 cut-off value of success. The results suggest that forest owners' participation in TNV is positively and significantly correlated with the total area of a forest estate (lnFORAREA), importance of financial investment as a motive for forest ownership (INVEST), and forest owners' attitudes toward nature protection (ENVPREF). The level of competence of organizing TNV (TNVORG) is also positively correlated but the p-value is slightly larger than 0.05, i.e. the customary limit of statistical significance.[4]

The finding that ENVPREF has a positive sign is especially important because it indicates that owners who are more environmentally friendly are more likely to join the voluntary protection programme. Thus, identifying the owners with positive environmental preferences may increase the level of participation in TNV. The positive sign of INVEST has several alternative interpretations. One probable interpretation might be that this group is more open-minded to all possible ways to gain through their property and see TNV as a new possible source of income. This may also indicate that the compensation was relatively high compared with losses in timber harvesting revenues. Another explanation might be the relatively short duration of agreement periods. As forest ownership typically lasts longer than the agreement, it could be profitable for an owner to preserve a stand if he or she has not planned to cut it during the next 10 years or if the stand is still growing.

We find a positive and significant association between participation and the total area of a forest estate (lnFORAREA). Also TNVORG or respondents' impression how competently TNV has been organized does explain the participation in TNV in a positive manner, but the p-value is just outside of the usual significance level.

5.2. Compensation claims

Table 3 reports the coefficient estimates of the Compensation Model. The last regressor, IMILLS, is a bias correction term (also called the inverse Mills ratio or the hazard rate) estimated in the Probit model of the first phase of the Heckman Two-Step estimation method. The Ramsey RESET test suggests that the model is adequate (F-statistic 1.3724, $p=0.2503$). The estimation results suggest that the compensation claims of forest owners are positively and significantly correlated with the harvesting value of a forest plot to be preserved (FORVALUE) and with the authority's estimate of the ecological value of the stand (ECOLVALUE). The coefficient estimate of FOREDUC, i.e. whether the owners' education includes a degree on forest management or forest sciences, has a positive sign but the p-value is just outside of the 5% level of significance. On the other hand, compensation claims have a negative and significant correlation with positive environmental preferences of forest owners (ENVPREF).

The most noteworthy of these finding is that ENVPREF behaves according to a priori expectations having a negative coefficient. It means that the forest owners who are more environmentally friendly tend to claim smaller compensation than other owners. However, this does not necessarily mean that the market in this pilot project has worked efficiently leading to cost savings. Although claiming smaller compensations, the forest owners with positive attitudes towards the environment may behave strategically by hiding their real preferences.

The positive coefficient of ECOLVALUE suggests that this doubt may be true. According to this result, increasing the ecological value of a stand is associated with increased claims indicating that owners are willing to be compensated for ecological values, as well. It seems that knowing the authority's willingness to pay extra for more valuable stands induces the forest owners to behave strategically hiding their possible positive preferences regarding the environment and trying to maximize monetary benefits. This may be an indication of a problem of information asymmetry within the process meaning that the authority cannot recognize the environmentally friendly owners who would make an agreement at a cheaper rate. Therefore, the authority cannot totally avoid forest owners' strategic behaviour including higher compensation claims than their preferences would require. In this case, a voluntary conservation programme may not provide any costs savings compared with traditional conservation policies.

As expected FORVALUE has a positive and significant coefficient. This suggests that owners' claim more compensation for forests with higher harvesting value. The fact that TNVORG has a negative coefficient indicates that a well organized procedure for VAs may save public funds in forest protection. FOREDUC showed a positive effect on compensation claims suggesting that owners with a degree in forest management or forest sciences claim greater compensation. However, these two latter coefficients are not significant.

We also tested the significance of some other potential regressors. A bit surprisingly the coefficient of lnFORAREA did not get a significant estimate suggesting that the total area of the owner's forest estate does not have an effect on compensation claims. Similarly, FARMER has a non-significant coefficient indicating

Table 3
Parameter estimates of a linear regression model for explaining forest owners' compensation claims.

Variable	Coefficient	Standard error[a]	t value	Pr>| t |
Intercept	333.92	125.41	2.66	0.0123
FORVALUE	0.01088	0.004386	2.48	0.0189
ECOLVALUE	0.7720	0.2818	2.74	0.0103
TNVORG	−39.3290	23.6172	−1.67	0.1063
ENVPREF	−7.6178	3.6534	−2.09	0.0457
FOREDUC	38.7779	20.8973	1.86	0.0734
IMILLS	16.8970	34.5692	0.49	0.6285
R-square	0.4716			
Adjusted R-square	0.3659			
F value	4.46			
Pr>F	0.0024			
Included obs.	37			

[a]White heteroskedasticity-consistent standard errors (White 1980).

[4] Some variables whose p-value is slightly larger than 0.05 were included into the models, because these variables were also used in some previous studies.

that working as a farmer would not have an effect on compensation claims. Finally, INVEST or importance of financial investment as a motive for forest ownership did not have a significant coefficient in the Compensation Model. We left these variables out of the model.

6. Discussion

One of the main arguments for using VAs in nature conservation is that they are said to be more efficient than traditional mandatory approaches because they entice conservation-minded landowners to preserve their forests with lower compensation than average owners (Smith and Shogren, 2002; Michael, 2003; Juutinen et al., 2008). Our results support this argument to some extent. We found that the owners who have a more positive stance toward the environment claim smaller compensation than the others do. This suggests that the quasi-market created by using VAs could reveal the environmental preferences of forest owners and allocate contracts to those owners who are willing to make the deal with lower compensation.

However, we also found evidence of the strategic behaviour of forest owners. The ecological value of a stand increased compensation claims indicating that owners were raising their compensation claims above their true opportunity costs. When the problem of asymmetric information is absent, owners set their compensation claims according to the economic losses created by the protection. Thus, although TNV involves characteristics typical of competitive bidding, it seems that it has not worked properly to reduce landowners' information rents in practice (Juutinen et al., 2008). The performance of TNV could be improved, for example, by not revealing the authority's estimate on compensation value to landowners in negotiations (see Cason et al., 2003). It would also be worthwhile to consider moving from individually negotiated payments to an auction mechanism. The latter uses strict rules in contract allocation and is therefore a more transparent approach than the former. An auction mechanism requires, however, a large number of potential participants among other things (Latacz-Lohman and Schilizzi, 2005).

With respect to participation, we found a similar result to Langpap (2004): conservation-minded forest owners are more willing to join a voluntary protection programme than others are. From a policy perspective, this suggests that advertisements and announcements of TNV should emphasize ecological arguments as a motive for participation. In contrast to Langpap (2004), our results showed that those forest owners who deem financial investment to be an important motive for forest ownership are more willing to participate than the rest of the owners. Related to effective targeting of VAs this raises an important question whether the arguments used in the marketing of these kinds of programmes so far are valid. Our results suggest that, along with ecological reasons, economic arguments, such as an opportunity for reasonable monetary compensation for conservation, should be used in advertising VAs to forest owners.

Although not statistically significant, the variable measuring respondents' impression of the competence of the TNV organization showed a positive coefficient in the Participation Model and a negative coefficient in the Compensation Model. These results may, however, emphasize that the organization of an incentive programme is important. For example, Horne (2006) found that landowners' participation in a voluntary conservation programme depends on the initiator of the contract. Thus, these results indicate that sufficient inputs for sound voluntary programmes including sufficient communication with potential clients, flexible co-operation with forest owners etc. may both encourage owners to make agreements and save remarkable amounts of public funds in forest protection in the long run.

A problem with our results is that the forest owners who offered their stands for TNV were more active in forest management than the average ones (Juutinen et al., 2005). The fact that we do not have information about those owners who did not want to be involved in TNV means that our results are less general. If we interpret this problem generally with respect to biodiversity protection policy, it would be important to activate the latter type of owners and make them participate in TNV in the future, especially now when the policy has expanded to the whole of southern Finland. Active forest owners, although carrying out cuttings and commercial forest management regularly, are often conscious about environmental protection and have knowledge to recognize a valuable habitat in their forest. The less active owners may live in cities far away from their woodlands working in jobs not related to forestry or agriculture, owning an inherited forest estate, and/or not being closely involved with forests and forest management. There is clearly an information gap between policy makers and these kinds of forest owners. If the policy makers wish to make them interested in VAs and participate in the conservation programme, communication between the parties has to be improved.

7. Conclusions

Our results support using voluntary agreements in nature conservation only with caution. Many Finnish forest owners have a negative attitude towards increasing the current conservation network in Finland (Karppinen, 2000; Horne et al., 2004). This is not a surprise as the previous mandatory policy has caused conflicts between landowners and the government (Wätzold and Schwerdtner, 2005). A voluntary mechanism may solve this conflict, but its participation rate depends on how well the programme is advertised and implemented in practice. The programme features, such as the length of the contract period and the type of authority (e.g. regional Forest Centre or regional Environmental Centre), must be acceptable to the forest owners (Horne, 2006). In addition, the level of compensation plays an important role in the programme, because many participants in the TNV pilot programme regarded financial investment as a motive for their forest ownership. The level of required compensation also depends on how the programme is organized. In particular, there are environmentally minded landowners who may protect their land with a low amount of compensation, but to achieve this outcome the programme must facilitate competition among landowners. In conservation contracting, the landowners will act strategically and try to raise their compensation claim above their true opportunity costs. In its current form the Finnish TNV programme may not provide any cost savings compared with the traditional conservation policy (Juutinen et al. 2008). We conclude that if compensation for temporary protection of forest land is high enough, it would be easy to find forest owners for VAs among those who emphasize either economic goals as a motive for forest ownership or have positive environmental preferences.

Acknowledgements

We thank Markku Rahiala and Eiichi Tomiura for their constructive and helpful comments and the Faculty of Economics, National University of Yokohama, Japan for a grant and facilities to work with this study. This article is part of the Biodiversity Research Programme in Finland (MOSSE). Funding from the Ministry of the Environment is gratefully acknowledged. In addition, this article is part of a postdoctoral research project “Forest conservation for biodiversity maintenance: cost-effective site selection and incentives for voluntary participation of private landowners” funded by the Academy of Finland.

Appendix A

Table A1
The determinants of the conservation value used by the authority of the TNV pilot programme.

Size classification	0–5 ha	5–10 ha	>10 ha				Ecological value
Stand size	0	10	20				*
Rent for VST[a]	0–100						
Degradation of timber quality	0–40						
Tree layers	0, 10, 20						*
Non-treatments	0–40						*
Volume classification	2–4 m^3/ha	5–9 m^3/ha	10–14 m^3/ha	15–19 m^3/ha	>19 m^3/ha		
Old aspens	10	25	35	45	50		*
Old deciduous trees	5	15	25	35	40		*
Old pine trees	5	10	15	20	25		*
Dead wood:							
– Standing, conifer	5	20	30	40	45		*
– Standing, deciduous	15	25	35	45	50		*
– Downed	10	20	30	40	45		*
Volume classification	2–9 m^3/ha	10–19 m^3/ha	20–29 m^3/ha	30–49 m^3/ha	50–100 m^3/ha	>100 m^3/ha	
Burned trees	25	35	45	60	80	100	*
Precious wood	20	30	40	50	70	100	*
Natural water conditions	0, 10, 20						*
Specific species	0, 10, 20						*
Distance to conserved areas	0, 10, 20						*
Landscape values	0, 10, 20						*
Others	0–40						*

The asterisks in the last column show the determinants taken into account when calculating an ecological value of a stand. The authority measured the determinants in monetary terms (€/ha/a) but in this study we interpret them as points of ecological value. The variable ECOLVALUE used in statistical analysis is determined as a sum of these points.
[a]VST = value of standing timber; rent = $(VST*e^{-0.01*10} - VST)*0.8/10$, where 0.8 = 1 − tax rate. Source: Gustafsson and Nummi (2004).

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