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Voluntary agreements in protecting privately owned forests in Finland — To buy or to lease?

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Abstract

A voluntary conservation approach may reveal environmentally minded landowners who are willing to protect their lands with a compensation that is lower than the market price based compensation. Consequently, voluntary conservation programs may induce lower costs than traditional obligatory programs, such as a land taking. We compared the costs accrued from land purchasing with those from temporal land leasing. The costs included both direct costs, such as fees of land acquisition and compensation payments in land leasing, and transaction costs. We used a data set from a Finnish pilot program called Trading in Natural Values (TNV). In this new practice landowners and the authority that represents the Finnish government sign a fixed-term contract. According to these contracts the forest owners produce biodiversity services on their lands and receive a compensation payment. We developed a framework where land purchasing and leasing can be treated equivalently in terms of duration of time, so that their costs can be compared consistently. Land purchasing and leasing yielded quite similar cost levels. This indicates that the competitive bidding process in TNV has not worked properly.

Keywords: Biodiversity; Forest conservation; Cost-efficiency

1. Introduction

Protecting privately owned forests for biodiversity involves many challenges. For example, traditional obligatory approaches, such as government compulsory acquisition of land, have met with intense resistance from displeased land owners (e.g., Wätzold and Schwerdtner, 2005). In particular, mandatory approaches do not provide incentives to landowners to produce biodiversity services on their lands. In contrast, at worst they may generate perverse incentives that might compel landowners to manage their land in a way that harms biodiversity maintenance (Innes et al., 1998; Polasky and Doremus, 1998). More typically, perhaps, the landowners may be reluctant to reveal information on valuable environmental characteristics of their property to environmental administrators and they may forbid on-site inspections of their land. Land purchasing is also very expensive as the landowners must be fairly compensated. Typically, the compensation is based on the market price. These obstacles have called for new voluntary approaches to protect privately owned properties for biodiversity.

Several arguments for voluntary approaches in nature conservation have been proposed in the literature (see Segerson and Miceli, 1998, and references therein). By virtue of being voluntary they have a broad acceptance in society, which may reduce expensive conflicts between various interested parties and promote positive attitudes toward environmental protection. If designed properly, a voluntary program gives motivation to landowners to produce biodiversity services and to co-operate with environmental managers (Smith and Shogren, 2002). This is likely to reduce the opportunity and transaction costs of nature conservation compared with mandatory conservation. In particular a voluntary approach may reveal environmentally minded landowners who are willing to protect their lands with a compensation that is lower than the market price based compensation (Michael, 2003). A limited government budget may also work in favour of voluntary approaches as they can be implemented in a setting, such as a land leasing, which typically requires less funds than land purchasing in the beginning of the conservation program.

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In line with these arguments the Finnish government has started new voluntary pilot programs to protect privately owned forests in southern Finland, where less than 2% of the forest land is currently protected and the existing conservation area network have attested inadequate (Virkkala, 1996). One of these new approaches is called Trading in Natural Values (TNV). In this new practice landowners and the authority that represents the Finnish government sign a fixed-term contract. According to these contracts the forest owners produce biodiversity services in their lands and receive a compensation payment. In other words, the government temporarily leases the forest land from the landowner for biodiversity conservation. The aim of TNV is to create markets for biodiversity in a manner that has a broad acceptance in society and in particularly among forest owners. Thus, not only is TNV politically feasible, it may also be cost-effective.

There exists an extensive body of literature concerning the efficiency of voluntary agreements (VAs) in nature conservation. For example, Stranlund (1995) compared the use of a voluntary compliance regime with a mandatory regime in the context of recycling and concluded that whether the latter dominates the former depends on the characteristics of the public effort aimed at lowering of the cost of compliance (see also Wu and Babcock, 1999 who extended and generalized Stranlund's model to examine which program is more efficient at controlling nonpoint pollution in an agricultural setting). Segerson and Miceli (1998) developed a model of the interaction between a regulator and a polluter to examine whether the resulting agreement is the likely outcome of that interaction and whether it will result in adequate environmental protection. They found that the overall environmental impact of VA depends on several factors, including the allocation of bargaining power, the magnitude of the background threat, and the social cost of funds. Smith and Shogren (2002) examined optimal incentive schemes under asymmetric information and found that the outcome depends on the design of the mechanism used. Langpap and Wu (2004) analyzed when VAs are likely to arise and what level of conservation they generate in the presence of uncertainty about future conservation benefits and irreversibility of habitat loss and species extinction. Their results suggested that the likelihood of an agreement and the resulting conservation levels depend on the background threat of regulation, the cost advantage offered by VA, and the availability of assurances regarding future regulation. The main conclusion from these studies is that the efficiency of VAs depends on several context-specific factors and therefore it is difficult to generalize these results. This calls for empirical analysis to validate the theoretical findings.

We examine the efficiency of VAs focusing on the Finnish pilot program of TNV. More precisely, we investigate whether it would have been cheaper to buy the forests conserved in TNV than to use fixed term contracts for biodiversity conservation from the viewpoint of an environmental regulator. For that purpose we develop a framework where land acquisition and leasing are equivalent in terms of the duration of time so that their costs can be compared consistently. Typically, land acquisition is thought to secure biodiversity persistence at a site ad infinitum and VA for a certain fixed period. We assume that the regulator aims at permanent conservation and the VAs can be renewed after the contract period ends. Our data includes the actual compensation payments and the transaction costs of TNV. The purchase prices for land acquisition are assessed using detailed field inventory data on stand characteristics with an adding-value method that is commonly used in Finland in practice. The transaction costs of land acquisition are derived from actual costs of Finnish conservation programs during 1997–2003.

We contribute to the literature by examining the cost-effectiveness of voluntary agreements in forest conservation for biodiversity. As far as we know there are only a few empirical studies related to this issue. Smith (1995) uses the mechanism design theory to characterize the properties of a least-cost conservation reserve program and estimates that farmers were paid far too much when using a single pricing rule compared with nonlinear price schedules in the Conservation Reserve Program, a subtitle of the Conservation Title (Title 12) of the Food Security Act of 1985, in the USA (see also Nickerson and Lynch, 2003). Similarly, Whitby and Saunders (1996) compare 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. Crucially, compensation for proprietors in SSSI is individually negotiated on each farm whilst in ESAs it is predetermined at flat rates for each area. The conclusion is that SSSI are more cost-effective than ESAs. These two studies consider, however, agricultural land that differs quite a lot from forest land, where the harvesting rotations are clearly longer than in agricultural land. Therefore, it is much more difficult to assess the private profit functions and biodiversity benefits in implementing a conservation program for forest land than for agricultural land. Siikamäki and Layton (in press) examine the potential cost-effectiveness of incentive payment programs relative to traditional top-down regulatory programs for biological conservation in forest land. The conclusion is that the incentive payment programs may be considerably more cost-effective than traditional top-down regulatory programs (see also Juutinen et al., 2004). Siikamäki's and Layton's study is based, however, on survey data, not actual contracts. One limitation of all the above-mentioned studies is that they do not take into consideration the transaction costs of different conservation policies.

2. Trading in Natural Values (TNV)

In October 2002, the Finnish government made a decision to implement the Forest Biodiversity Programme for Southern Finland 2003–2007 (METSO), including pilot programs to test new voluntary means for landowners to increase the biodiversity of forests in Southern Finland (Government decision, 2002). TNV is one part of this action programme aiming to create markets for biodiversity in forests. The pilot project for TNV started in May 2003 in the Satakunta region in Western Finland and it will continue until 2007. After the assessment of the pilot project, a decision will be made regarding whether TNV will become a permanent policy mechanism.

In the government decision TNV is defined as follows:

> Trading in natural values is a procedure whereby a landowner or his authorized representative enters into an agreement to maintain or improve specified natural values of his forest and in return receives a regular payment from the 'buyer' of these natural values, for example, the state or a forest conservation foundation. The agreement may define specific areas within which the owner is required to maintain a rare species or specific elements essential to biodiversity (e.g. dead and decaying trees). The environmental and forestry authorities will consider proposals based on the criteria explained in action 3. Agreements will be made based on the needs of sellers and buyers, and they may be in force for a limited period or until further notice. When an agreement ends, the area concerned can then be used as the landowner sees fit.

The South-West Finland Forestry Centre operates as the environmental regulator in the pilot project. Regional Forestry Centres are supervised by the Ministry of Agriculture and Forestry. Note that in the traditional Finnish conservation programs the environmental regulator has been a regional Environmental Centre, which is supervised by the Ministry of the Environment.

The implementation of TNV can be described as follows (Fig. 1). The pilot project is based on landowners' initiatives. Forest owners can freely contact the regional Forest Centre if they think their forests have ecological value. The process starts when a landowner offers his or her land to the program by submitting a specific declaration form to the regional Forest Centre. The form includes a description of the ecological characteristics of the offered conservation target, which can include several stands.

Next the regulator checks the declaration form and assesses preliminarily whether the offered target is valuable enough for conservation or not. The process ceases if the preliminary assessment is not positive and there will be no agreement. If it seems that the quality of the offered target is high enough, the nature value expert from the Forest Centre makes a survey of the forest to check if the forest fulfils the biological criteria of nature protection.

After the field inventory, if the regulator still considers the target good enough for conservation, the conservation value of the target is calculated by using a certain valuation mechanism (Gustafsson and Nummi, 2004a). This value includes prices for different ecological characteristics (e.g. large broadleaved trees and pines, dead or burned trees, threatened species, luxurious vegetation, natural water conditions, distance to existing nature protection areas, size of the area, and landscape values). It includes also costs of delayed harvesting calculated by using a 1% interest rate for the value of standing timber. Thus the regulator has a good knowledge of the timber production possibilities of the target due to the field inventory. The regulator will use the conservation value as a guideline in the negotiations to compare different targets and offers.

Finally, the regulator and the landowner will negotiate about the compensation payment 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 carefully designed cuttings and treatment can be allowed. It should be noted that there is no explicit background threat for the landowner. He or she is free to withdraw from the process at any time and after ten years the forest owner can freely decide on the use of the forest according to the situation prevailing at that time. The negotiations can be interpreted as a competitive bid process, because several landowners are offering their forests to the program simultaneously and the regulator can pay different amounts to each land owner. Moreover, the regulator works under a given budget constraint and therefore it is likely that not all potential targets will be included into the program. Landowners are expected to submit an asking price at the beginning of the negotiations. In the pilot program the contracts are in force for a limited period lasting 10 years. Compensation payments are paid in one lump sum at the beginning of the contract period and they are exempt from taxes.

During the first two years over 150 forest owners with over 1400 ha have contacted the Forest Centre. Contracts have been made with 62 landowners covering 552 ha. Some forest owners have made several contracts, thus the total number of contracts is 66. Naturally, the given annual budget of 400,000 euros restricts the number of contracts. Also many of the offered targets did not fill the biological criteria. The annual payment to

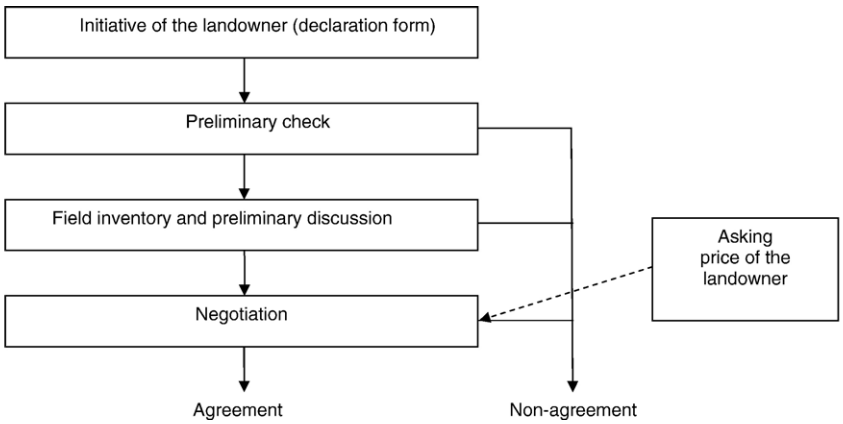

Fig. 1. Phases of the voluntary conservation process in the Finnish pilot project.

landowners has varied from 20 to 300 €/ha. The average annual payments were 170 €/ha and 160 €/ha in years 2003 and 2004, respectively.

3. Theoretical framework

We assess the cost-effectiveness of voluntary agreements by comparing their performance to the traditional government acquisition of land. In this section we develop a framework to investigate whether it is more efficient for the environmental regulator to buy a given area for biodiversity conservation than to lease it for a fixed period.

Land purchases and leasing contracts for biodiversity conservation typically have different time scales. The former is thought to retain biodiversity permanently, but the latter only for some fixed period. However, they can be treated as having an equivalent time scale by assuming, for example, that the government aims toward permanent conservation and the leasing contract can be renewed after the contract period ends. Thus, treating the stand in question as exogenously determined and assuming endless renewing of the contract, the land ownership and leasing yield the same level of biodiversity benefits (Stranlund, 1995; Wu and Babcock, 1999), and therefore, we can focus on the costs of these policies.

Consider an environmental regulator who wants to conserve permanently a forest stand for biodiversity. For that purpose the regulator has two means, a land purchase or a leasing contract. Denote the choice variable by x. If the regulator chooses to purchase the land, the choice variable gets a value of 1, otherwise it gets a value of 0. The aim of the environmental regulator is to minimize conservation costs. The land purchase causes costs due to a fee, but it includes also transaction costs related to real estate deal, such as a stamp-duty, surveyor's fee, and administration costs. We denote the land purchase prices and the transaction costs of land acquisition by V and T^A, respectively. The land leasing for the fixed period generates costs due to the annual leasing payments, P, and transaction costs, T^L. The latter includes the administration costs related to the contracting, but not the costs related to the real estate deal indicating that $T^A \geq T^L$. The real interest rate is denoted by r and the contract period in leasing by t.

Formally, the social regulator chooses to

$$\min_x \left[x\left(V+T^A\right) + (1-x)\frac{\sum_{i=1}^{t} P_i e^{-ri} + T^L}{1-e^{-rt}} \right].$$

Accordingly, the leasing approach is the best solution if

$$V + T^A > \frac{\sum_{i=1}^{t} P_i e^{-ri} + T^L}{1-e^{-rt}}. \tag{1}$$

The left-hand side of inequality (1) includes the costs of government acquisition of land. The right-hand side includes the costs of land leasing. In the numerator, the annual payments of the first contract period are discounted with the given interest rate and summed to achieve the present value. The denominator indicates that the contracts are infinitely renewed with t year intervals.

Notice that the inequality (1) reflects a case where there are no management or maintenance costs, because these cost items are very difficult to estimate. One would expect that the State owning would come with some management costs in practice. Similarly, however, land leasing would cause some management costs as the regulator has to control that landowners are adhering to the agreements. Thus, the management costs would affect to the cost comparison only marginally.

The purchase price for government acquisition of land can be determined using the Faustmann model (Faustmann, 1849). Regarding biodiversity conservation it is typical, however, that the conservation target is an old-growth stand. The presence of the initial stand implies that the rotation problem can most conveniently be studied in two phases (Johansson and Löfgren, 1985, p. 86). First, the landowner decides upon the use of the initial stand. Then, from that point onwards the choice reduces to a conventional steady-state choice of rotation age. However, to solve the problem of initial harvest, we first have to consider the bare land management.

In the steady-state, the landowner continues with bare land, plants trees and clear-cuts so as to maximize the present value from future harvest revenue over an infinite cycle of rotations.

$$W = \left\{pe^{-rT}f(T) - S\right\}\left(1-e^{-rT}\right)^{-1} \tag{2}$$

where W denotes the benefits from the forest management, p timber stumpage price, r real interest rate, T the harvesting age, $f(T)$ is the timber growth or production function giving the commercial cubic meters of timber as a function of stand age, and S is silvicultural costs.

The optimal steady state rotation, T^*, and the maximum benefits from the forest management, W^*, can be defined from Eq. (2) by assuming that the forest owner chooses the optimal harvesting time so as to maximize the net harvest revenue. Accordingly, a forest stand shall be harvested when the rate of change of its timber value with respect to time is equal to the interest on the value of the standing forest plus interest on the value of the bare forest land (see Faustmann, 1849, for the details).

Consider now the initial stand of age A, and denote the forest growth function by $f(T^0)$, where T^0 denotes the age of the original stand at the first harvest. The initial choice of rotation age is given in Eq. (3), where W^0 denotes the benefits from forest management of an initial stand. The difference T^0-A indicates how long the landowner will wait for the first harvesting time. The maximum benefits from future rotations, W^*, are taken as given. We can also interpret W^* as the value of bare land.

$$W^0 = pe^{-r\left(T^0-A\right)}f\left(T^0\right) + e^{-r\left(T^0-A\right)}W^* \tag{3}$$

The maximization of Eq. (3) with respect to the harvesting age, T^0, shows that the age at which the marginal benefit from a small delay (MBD) in the harvest equals the marginal opportunity cost of delay (MOC) defines an optimum (Strang, 1983).

Given the initial stand, it is possible, however, that the first order condition is never met (Strang, 1983). In this case the optimal rotation age is shorter than the current age, $T^{0*} < A$, suggesting that the immediate cut is the best option. The initial age exceeds the optimal rotation age for timber management, for example, if the landowner values also the other services and products provided by the forest than timber and these benefits are increasing with the rotation age (Hartman, 1976). However, the purchase price for land acquisition is determined due to the commercial timber production not due to non-timber goods as these are typically public goods. This is true particularly in the Nordic countries where the right of public access to both public and private land (i.e. non-disruptive use such as hiking, wildlife viewing and berry picking) is a key convention of property rights. Accordingly, the purchase price is determined by $V = W^0(T^{0*})$ if $T^{0*} > A$, and by $V = W^0(A)$ if $T^{0*} < A$.

4. Data and methods

Our data included detailed information on 59 stands conserved in TNV in the years 2003 and 2004. The total area of these stands was 300 ha and the number of contracts was 42. The contracts for these stands forbid all silvicultural activities. Some TNV contracts, which we excluded from our data, presumed measures to improve the natural values of stands. The payments with respect to these stands include wages for the landowner's work to improve the natural values, and therefore, these payments are not comparable to land purchases. Also we did not include stands that did not fulfill the biological criteria for TNV. A few of these stands were accepted into the TNV program according to the wishes of landowners as the stands were located near some high quality stands. The payments concerning these stands were minor. The database included information on habitat type as well as volume and age of living trees.

To estimate the costs of land leasing, we used information on the actual payments of the stands. We also had detailed information on the actual transaction costs of TNV, but these costs were associated to all the protected stands in TNV. Therefore, we divided the total transaction costs by the number of TNV contracts (66) to obtain unit costs, and then, multiplied the unit value by the number of contracts included in our database. The nominal costs were transformed to 2003 prices by using consumer price index. Table 1 presents the original cost figures for TNV.

To estimate the costs of land ownership, we used detailed field inventory data on stand characteristics and the additive-value method (Oksanen-Peltola, 1994). The inventory data was provided by the regional Forest Centre. The regulator used the same data in the assessment of the conservation value (see Section 2). In practice, one needs to use a forest growth simulator, for example, to estimate the forest value (Eqs. (2) and (3)). In Finland regional Forest Centres and Environmental Centres often use pre-calculated tables for this purpose. In this additive-value method, the value of the standing timber and the land are estimated separately. The valuation of standing timber is based on the detailed stand characteristic and relevant timber prices. If the forest is not at cutting age yet, the value is calculated by multiplying the value of standing timber by the coefficient of expected yield derived from the pre-calculated tables. The tables include several coefficients of expected yield classified according to the forest age, geographic location, and habitat type. Similarly, the land values are classified in the given tables according to different habitat types and geographic locations. The additive-value method includes also a correction coefficient used to reduce the forest value as the value of standing timber and land value do not take into account administration costs and forest taxes, for example. Determining the value for the correction coefficient is nevertheless a subjective matter. Therefore, we calculated the forest values using several alternative correction coefficients. The correction coefficient typically varies between 10–30% in the regional Forest Centres and Environmental Centres. The timber and land prices used are presented in Tables 2 and 3. They are the same as the regional Forest Centre has used.

The transaction costs of land acquisition via land purchases were derived from actual costs of Finnish conservation programs during 1997–2003 (Ministry of the Environment, 2004, unpublished data). The transaction costs consisted of the surveyor's fee and other miscellaneous costs (Table 4). The latter included costs related to the purchase of required materials (e.g. maps and air photos) and assessment of services, for example. These data included all types of habitats, not only forests. Moreover, it included several types of land acquisition, such as donations and purchases at a mutually agreed price, or through expropriation, which allows the government to force the sale at a fair market price. It was not possible to separate the transaction costs according to the habitat or acquisition types. The nominal costs were deflated into 2003 prices by using the consumer price index.

Table 1
Costs occurred in the pilot project of trading in natural values, current prices (€)

Cost item	2003	2004	Total
Payments to landowners	388,395	395,972	784,367
Salaries (site inspection, negotiations, etc.)	53,842	67,626	121,468
Travel and material costs	8428	7119	15,547
Other costs	18,426	19,126	37,552
Total	469,091	489,834	958,934

Sources: Gustafsson and Nummi, 2004a,b.

Table 2
Stumpage prices, €/m^3

Tree species	Saw timber	Pulpwood
Pine	47.10	15.00
Spruce	43.80	23.80
Birch	37.90	13.50
Other	33.60	13.50

Table 3
Land values

Habitat type	€/ha
Grovelike	639
Fresh	404
Dryish	336
Dry	269

Table 4
The actual transaction costs (euros at 2003 prices) and the number of estates of Finnish nature conservation programs during 1997–2003

	1997	1998	1999	2000	2001	2002	2003
Surveyor's fee	246,810	318,947	409,331	445,230	514,848	697,740	756,339
Other miscellaneous costs	343,778	422,074	490,300	312,967	404,893	412,504	619,356
Total	590,588	741,021	899,631	758,197	919,741	1,110,244	1,375,695
Number of estates	762	1080	1288	1180	978	1018	919

Source: Ministry of the Environment, 2004, unpublished data.

The unit transaction costs were attained by dividing the absolute cost with the number of estates that has been obtained (Table 4). Although the unit costs have been rising during the period 1997–2003, it is not justified to use only the latest single year observation, because there may be occasional fluctuations in yearly figures. We opted to calculate the average unit cost using only information on the years 2001–2003. To link the unit costs to our data we assumed that the transaction cost per estate is equal to the transaction cost per contract.

The original data on transaction costs of government acquisition of land did not include the costs occurred in the regional Environmental Centres to perform the on-site inspections and contract negotiations, for example. It is difficult to estimate these costs, because the regional Environmental Centres have many other duties in addition to land acquisition for conserving biodiversity. Therefore, we assumed that the total transaction costs of a land purchase are equal to the sum of the surveyor's fee, the other miscellaneous costs, and the transaction costs of land leasing as the latter include costs related to land inspections and contract negotiations (Table 1). There is no reason to assume that these costs would differ between regional Forest Centres and Environmental Centres.

5. Results

5.1. Costs comparison

The costs of land leasing include the annual payments to landowners and transaction costs. Recall that the annual payments are paid in advance at the beginning of the TNV contract period. The total payments at current prices for 10-year protection of the particular stands were 528,034 euros and the unit payment was on average 1760 €/ha. The total transaction costs were 110,975 euros, respectively. The unit transaction costs were 2642 €/contract. On average a contract covered 7.3 ha.

These costs aimed at permanent conservation are born for 10-year intervals as contracts are renewed, and therefore the total costs of permanent land leasing depend on the selected interest rate (Table 5). The lower the interest rate, the higher the total costs when contracts are continuously renewed for the given interval.

The costs of land purchase include purchase fees and transaction costs. Purchase fees are based on timber and land values. The estimates for these values were 2,040,677 and 144,210 euros. The timber and land values per hectare were on average 6802 €/ha and 481 €/ha, respectively. Transaction costs also include two components: 1) surveyor's fees and other miscellaneous costs; 2) costs of site inspection and contract negotiations. The values for these cost items were 49,392 and 110,975 euros. Recall that the latter is equal to the transaction costs of land leasing. Moreover, purchase fees depend on the selected correction coefficient as clarified in previous section. Table 6 describes the total costs of land purchases.

Finally, we compare the cost estimates to reveal whether land purchasing or leasing is the cheaper option for the regulator (see Eq. (1)). We summarize these results in Fig. 2, which depicts the costs of conservation for leasing as a function of the interest rate. Moreover, it includes the cost of land purchases according to alternative correction coefficients.

The direct costs of land purchasing and leasing are at a similar level when the interest rate is about between 3–4% (Fig. 2a). The direct costs of land purchases are lower than the direct costs of land leasing when the interest rate is less than 3%. The opposite holds when the interest rate is higher than 4%. Land leasing causes higher transaction costs than land purchases due to the contract renewal (Fig. 2b). Because the costs depend on the interest rate (land leasing) and the selected correction coefficient (land purchasing), it is not straightforward to say which one of the means is cheaper in terms of total costs (Fig. 2c). In general it seems that land purchasing and leasing result in quite similar cost levels. However, if the interest rate is less than 3%, then land purchasing is clearly cheaper than land leasing. Also, if the interest rate is more than 5%, then land leasing is certainly the preferred option for the regulator.

Table 5
Costs of permanent land leasing, at 2003 prices (€)

Interest rate	Payments	Transaction costs	Total costs
1%	5,548,754	1,166,158	6,714,913
2%	2,912,981	612,209	3,525,189
3%	2,037,311	428,173	2,465,484
4%	1,601,656	336,613	1,938,269
5%	1,341,995	282,041	1,624,036

Table 6
Total costs of land purchase, at 2003 prices (€)

Correction coefficient	Purchase fees	Surveyor's fees etc.	Site inspection etc.	Total
10%	1,966,399	49,392	110,975	2,126,765
15%	1,857,154	49,392	110,975	2,017,521
20%	1,747,910	49,392	110,975	1,908,277
25%	1,638,666	49,392	110,975	1,799,032

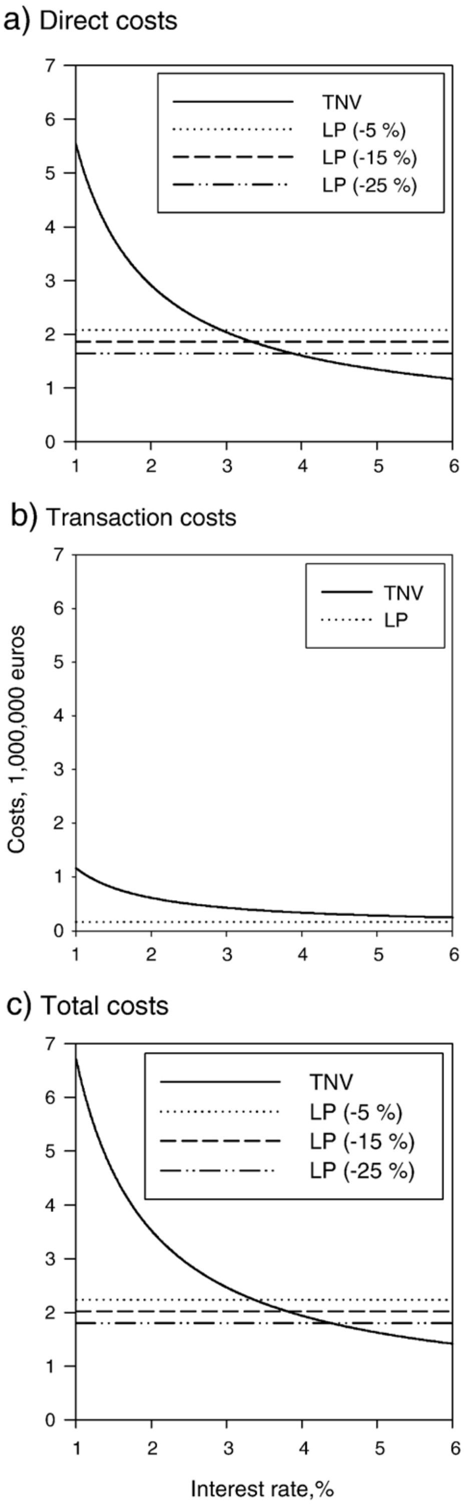

Fig. 2. Cost comparison of land purchasing (LP) and leasing (TNV = Trading in Natural Values) under permanent conservation. The correction coefficient used in estimation of purchase fee is showed in parentheses.

5.2. Conservation under a fixed budget constraint

While land purchasing and leasing seem to result in similar cost levels in the long run, there may be significant temporal differences between these alternatives in practice. Temporal differences arise due to the fixed budget constraint as the regulator has typically limited funds for conservation available. For example, in Finland the annual budget for government land acquisition has varied between 25–50 million euros during 1996–2003. In recent years the budget has been about 25 million euros/year.

According to the previous section, the land purchase price is 6189 €/ha (with 15% correction coefficient) and the transaction costs of land purchases are 523 €/ha. The compensation for land leasing can either be paid in the beginning of the 10-year contract or annually during the contract period. The payments for land leasing are 1760 €/ha, when the compensation for the 10-year period is paid at the beginning of the contract period. Alternatively, if the compensation is paid annually during the contract period, the payments for land leasing are about 209 €/ha/year. Landowners will prefer payments paid today to payments paid in future, and therefore they would require larger annual payments. The total present value of these annual payments is the same as the lump sum payment (1760 €/ha) with a 4% interest rate for a 10-year contract. The transaction costs of land leasing are 362 €/ha. We assume that the annual budget for conservation is 25 million euros. We can now estimate how the total conservation area increases with time using alternative methods (TNV vs. land acquisition) with the given budget (Fig. 3).

Using land leasing with a lump-sum payment in the beginning of the contract period the regulator is faster able to establish new conservation areas than in land purchasing. However, after 10 years when the first contract period ends, the size of the conservation network will not increase anymore as all the funds available are needed for renewing the contracts in land leasing. Thus, in land purchasing the conservation level will ultimately be higher than in land leasing, but it may take a longer time to achieve the targeted conservation level when the annual budget is fixed. As the targeted conservation level is achieved, the land purchasing ends and there are no costs

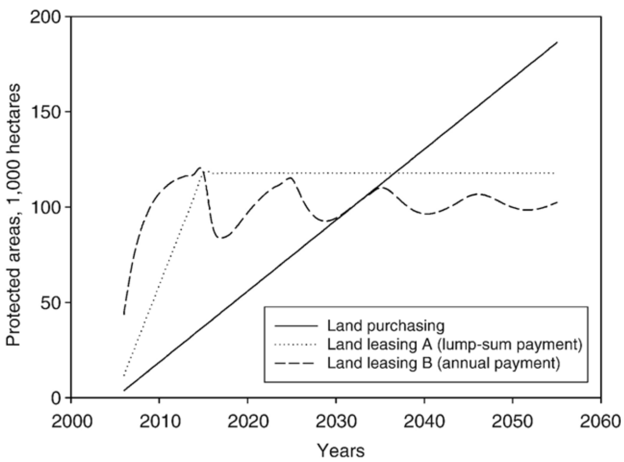

Fig. 3. Protected areas as a function of years in land purchasing (with 15% correction coefficient) and leasing with a 25-million-euro annual budget constraint. Land leasing A describes a practice in which the payment for 10-year conservation is paid as a lump sum at the beginning of contract period while in Land leasing B the payment is paid annually during the contract period.

anymore as our illustration does not include maintenance costs. In contrast, the leasing mechanism may not achieve the targeted conservation level if the annual budget is not high enough. Moreover, land leasing incurs costs ad infinitum, because the contracts have to be renewed in order to maintain the targeted conservation level.

Using annual payments instead of lump-sum payments in the beginning of the contract period may yield a larger conservation network in the short run, but the advantage is only temporal. In the long run annual payments would result in a lower conservation level than lump sum payments. Using annual payments causes fluctuations in the conservation in terms of the size of the conservation network when the annual budget is fixed. The fluctuation reduces as renewing of the leasing contracts continues and the market stabilizes.

In southern Finland forests are largely privately owned, and only about 2% of the forest land is protected. The estimates of the incremental size of conservation areas in southern Finland needed to stop further species endangerment and extinctions is under continuous debate, but it seems that the magnitude is in the order of 0.5–1.1 million hectares, i.e. the protected areas should cover about 5–10% of forest land. (Angelstam and Anderson, 2001; Rassi et al., 2001; Hanski, 2003). To achieve this conservation target using land leasing with a lump-sum payment the annual budget should be about 100–250 million euros. With a 100-million-euro annual budget, for example, it would take about 35 years to protect 500 thousand hectares using land purchases. Thus regarding the situation in southern Finland, it seems that the budget should be larger than the current annual 25-million-euro budget to achieve an acceptable conservation level within a reasonable time frame.

6. Discussion and conclusions

Our cost comparison showed that in the long run TNV results in cost level approximately equal to land purchase at the 3–5% interest level. It has been argued that VAs would provide a cost advantage compared to the mandatory approaches, because they have lower compliance and transaction costs (Langpap and Wu, 2004). In TNV the transaction costs per contract are lower than in land purchases, because the latter includes costs such as the surveyor's fee which are not occurring in land leasing. However, land purchasing is a one time event but in land leasing the contracts have to be renewed for permanent conservation. Therefore, in the long run the present value of total transaction costs is greater in land leasing than in land purchasing.

The compliance costs could be lower in TNV than in land purchasing, because TNV may reveal environmentally minded landowners who are willing to protect their lands with compensation that does not fully cover the market-based losses caused by conservation (Michael, 2003). Juutinen et al. (2005) showed that environmental issues have been important for the participants of TNV. According to our results, however, TNV yields similar cost levels as land purchasing. Thus, it seems that the environmental preferences have not resulted in particularly low compensation demands in TNV. Instead landowners have likely acted strategically to get larger payments by not revealing their true preferences as Smith and Shogren (2002) showed using theoretical analysis. This indicates that the market in TNV has not been sufficiently competitive.

TNV is organized by regional Forest Centres. Typically, these authorities act as government officials in serving forest owners, but in TNV they should act more like brokers to create competitive markets for natural values. Traditional mandatory forest conservation has reduced landowners' trust in the government officials in Finland (see Wätzold and Schwerdtner, 2005). Forest Centres have not been involved in the previous nature conservation programs. Therefore, landowners may trust them and participate more eagerly in a voluntary program organized via Forest Centres than in a program organized via Environmental Centres, for instance (Horne, 2006). In the long run, however, it may be inefficient to organize the markets for natural values via the Forest Centres (or by any other governmental body) because the markets are unlikely to be competitive. In the United States, for example, privately owned foundations have been used for this purpose. The same idea has also been proposed in Finland, but so far the attempts to establish such a foundation have failed.

There are several important aspects that should be considered when generalizing our findings. First, conservation requires information about the biological characteristics of candidate stands. In land leasing this information can be collected during the negotiation process, but in land purchasing the regulator has to collect the required information. Assessing the biological characteristics of stands is possible in countries having public access to private land, at least in principle. In countries, which does not have public access rights (e.g. the United States), land leasing may be a very effective mean to provide the needed information. Moreover, there are good databases on stand characteristic available for conservation planning in Finland, which greatly reduces transaction costs. This may not be the case in many other countries thus making land purchasing relatively more expensive. Also, there are a lot of forest owners in Finland, which helps to create competitive markets for natural value trading. If the number of forest owners is low, regulator must likely pay market price based compensations to forest owners, which increases the costs of land leasing. Market price based compensations are used, for example, in the Austrian Natural Forest Reserves Program (Frank and Müller, 2003). It is important to notice also that there is a great deal of transparency in TNV: it is clearly described how the regulator values different components of natural features and the regulator reports on yearly basis the performance of the project including prices paid to (anonymous) landowners (e.g. Gustafsson and Nummi, 2004a). It is impossible to create competitive markets for natural value trading if the required information is not readily available.

In the cost comparison we assumed that all the given areas can be bought simultaneously. In practice, however, environmental regulators have budget constraints which limit the number of areas that can be conserved annually. Consequently land leasing and purchasing have different temporal effects as their costs differ, and therefore, the time dimension should be taken into account in the cost comparison. In this case, however, one needs a more specific description of natural values and how these would be affected by the aging of forests.

Usually, conservation benefits are a positive function of forest age, and old-growth stands are valued the highest. Some specific features may, however, be reduced with the ageing of the forests, such as the proportion of deciduous trees in boreal forests. If these characteristics have been the target of the conservation, the flow of conservation benefits may decrease with the ageing of the stand. Therefore, the purchase option typically results in temporally increasing conservation benefits due the aging of the purchased stands, but in some cases the flow of conservation benefits may be reduced. In the latter case, the leasing option would allow more flexibility than land purchasing by swapping to alternative forest stands after the end of the leasing period, thus keeping the flow of conservation benefits more or less constant.

Characteristics that are important for biodiversity in forest ecosystems include a wide variety structural features some of which require long periods of time to develop (such as snags or over-mature large trees) while others are more ephemeral (such as recently died or burnt trees). This invokes an important question about the optimal length of contract period in land leasing. It is likely so that variation in contract lengths is needed to effectively encompass this natural variation in structural features. Dominance of short contracts, as was the case in the Finnish TNV program, may result in spatially and temporally dynamic network of protected sites that is inefficient in conserving forest biodiversity. Thus, temporary contracts must be accompanied by more permanent reserves, e.g. via land purchase. The optimal length of contract periods and optimal combination of land leasing and purchasing are interesting research topics for future work.

Another important constraint in our study is that the protected stands in land leasing and purchasing were same in the cost comparison so that the two policies provided equal biodiversity benefits. One should notice that in TNV stand are initially offered by forest owners and negotiated between both partners. Also, in land purchasing it is possible that the regulator searches actively for the best targets for conservation in countries having a public access to private land. Therefore, the conserved areas in land purchasing and TNV could be different and provide different biodiversity benefits in practice. In that case the cost comparison becomes more complex, however, because commensurable measures of the both policies in terms of biodiversity benefits and opportunity costs are more difficult to obtain.

We assumed that the contracts in land leasing will be renewed after the contract period ends. However, in practice it is uncertain whether the land owners will continue the contracts. In the United States temporal contracts have been used since 1985 in the Conservation Reserve Program to reduce agricultural pollution indicating that new contracts can be agreed upon without failing to meet the conservation targets. Regarding forest biodiversity, however, it may be more difficult to find new targets to replace the original targets as the forests may be unique and biodiversity values on a stand after clear-cutting may require a century to develop. Anyway, according to a survey study many participants in TNV are willing to continue their contract after it ends (Juutinen et al., 2005).

Temporal contracts are flexible for forest owners, but they are flexible also for the regulator. For example, it is difficult to precisely assess the biodiversity benefits of given targets and there still is a lack of knowledge regarding many aspects of biodiversity. In land leasing, the regulator can reconsider the biodiversity value of a given target after the contract period ends. Similarly, land leasing is flexible from viewpoint of policy change, e.g. if the priorities in biodiversity protection become redirected in the future. Thus, flexibility may be an important feature of conservation policy, and therefore, it may be rational to pay more for temporal leasing contracts than permanent ownership. Flexibility can also reduce costs of conservation, because land leasing allows different types of contracts depending on the problem at hand. For example, in certain habitats it may be reasonable to allow some harvesting and lease mainly dead or very old trees. Leasing only limited property rights is likely cheaper than leasing all property rights. Finally, we would like to emphasize that in practice land leasing and purchasing are not mutually exclusive. On the contrary, they should be used together to capture their best features for efficient and acceptable conservation.

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