COST-BENEFIT ANALYSIS OF THE DUTCH NATURE CONSERVATION POLICY: DIRECT, INDIRECT EFFECTS AND TRANSACTION COSTS OF THE ECOLOGICAL MAIN STRUCTURE IN THE NETHERLANDS

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Abstract- **The scattering of nature areas in the Netherlands and the increased demand for nature lead to a governmental project in 1990 to complete a network of nature favouring areas, the ecological main structure, in 2018. The financial and economic costs and benefits of this project were analysed. Targets for purchasing of agricultural land and conversion into nature were adjusted several times as the land price doubled between 1995 and 2000. The purchasing rate still has to double, which will probably drive up the land price even further. The alternative is long-term contracts with farmers or private landowners for nature conservation.**

Keywords- cost-benefit analysis; transaction costs, land market
JEL classification- G18 Government Policy and Regulation

I INTRODUCTION

In 1990 the Dutch government started a nation-wide project for developing a network of nature favouring areas. This network is called the ecological main structure (EMS), which has the purpose of safeguarding the biodiversity and therewith the value of nature in the Netherlands. This ecological network, which should be completed by 2018, covers about 15% of rural area in the Netherlands. Although the Netherlands is a small country, it has nationally important biodiversity 'hotspots' that require protection. Protection of biodiversity is considered important to society because biodiversity constitute the 'web of life' providing services needed to maintain health and the flexibility for sustaining humankind into the future. Metaphorically speaking, the EMS is the flagship of the most important nature conservation programme of the Netherlands.

Given that the Netherlands is determined to develop a complete system of reserved or protected areas for the protection of biodiversity, a number of questions can be addressed. For example, since the policy involves the purchase of significant amounts of land, the question arises how land markets will be affected. Moreover, the Dutch government can and does use various institutional arrangements for managing the conservation of nature. These management schemes or institutional arrangements, including agri-environmental schemes (AES) as an important case, not only differ in terms of compensations or costs, but also involve different transaction costs. There the question arises what are the economic, financial, and transaction costs associated with these different management options.

The main aim of this paper is to analyse the economic and financial costs using a cost-benefit approach, including transaction costs of the different institutional arrangements used for the implementation of EMS. Especially attention is paid to the cost savings that can be obtained by adjusting the mix of institutional arrangements (in-house production, clubs such as nature conservation organisations and contracts with private landowners or farmers for nature conservation). Since some arrangements involve the purchase of significant amounts of land, the analysis will take into account an endogenized land market, an issue often ignored in other conservation studies (Armsworth et al, 2006).

Cost-benefit analysis (CBA) provides a consistent analytical framework to compare the economic and financial impacts of different institutional arrangements for various nature conservation policies. However, in its standard setting CBA usually does not include transaction costs. A contribution of this paper is that it comes up with a more comprehensive analysis, which both conceptually and empirically includes transaction costs. Little work has yet been done on the comparison of costs across different types of conservation procurement schemes, although anecdotal evidence

suggests transaction costs can be significant. Falconer and Saunders (2002: 58) focus on this issue by comparing different AES. Here we will look to the following different institutional arrangements: (1) in-house production by the government (purchasing and converting agricultural land in nature and management by government agencies); (2) purchasing and converting agricultural land in nature and management by nature conservation organisations; (3) nature management by private persons; (4) nature management by farmers rural development policies (AES).

The structure of the paper is as follows. Section 2 discusses the methodology used, with a particular focus on incorporating transaction costs into CBA analysis. Section 3 provides a description of the EMS, the original target levels and recently made adjustments. Section 4 discusses the endogenization of land prices in the simulation model. Section 5 identifies the costs, benefits and transaction costs. The simulation results are presented in Section 6 Finally, the paper closes with conclusions and recommendations (Section 7).

II METHODOLOGY

A consistent analytical framework for nature conservation decision making is essential. Cost-benefit analysis (CBA) provides such a framework, by projecting a stream of costs and benefits associated with different policy decisions. The costs and benefits are expressed in monetary terms and made comparable by transforming them in present values. In a more detailed analysis distributional issues (over persons and space), risk attitudes, and non-market valuations can be incorporated. The aim of our methodology is to provide a transparent framework in which different policy options can be compared on common economic criteria, usually net present monetary value.

Economic efficiency is at the core of CBA, with a policy increasing economic efficiency if the sum of benefits to those who gain exceed the sum of costs to those who lose (Kaldor-Hicks compensation principle; Jongeneel and Koning, 1996). Implicit in this framework is that government intervention should be only undertaken if the total benefits of the intervention or policy change exceed its total costs. Advantages of the CBA approach are its ability to aggregate impacts from various sources into one monetary measure of net benefits, its provision of a transparent overview of the economic implications of a policy (therewith providing an instrument to improve accountability), its provision of consistent framework for data collection, and the identification of gaps in knowledge and uncertainties (Kopp, 1997). The method has also some drawbacks. A considerable amount of information is required, which can be hard to collect or recover (e.g. valuation of non-market goods and measurement of non-exchange values). Moreover, focusing on one single criterion, economic efficiency, may be too narrow for applications aimed at achieving nature conservation targets (benefits are more difficult to measure and to value than costs, besides quantity issues quality issues play an important role).

As mentioned before, the standard CBA-approach does not account for transaction costs. However, different policies imply different transaction costs of enacting, implementing, organizing and monitoring. The omission of transaction costs may therefore result in the design and implementation of sub-optimal institutional arrangement (cf. Falconer and Saunders, 2002: 158). Public and private transaction costs must be analysed in relation to the policy objective and in the context of their achievement. Well-designed and implemented administrative activities, organizational procedures, etc. may be crucial for the success of nature conservation policies. Recognizing that transaction costs might have a productive function, however, at the same time these costs should be taken into account if decisions are to be made to maximise economic efficiency in resource allocation (Falconer et al., 2001: 99). Yet, hardly anybody has so far made a comprehensive attempt to include these into the analysis of nature conservation policies. In this paper an attempt is made to explicitly include the transaction costs into the analysis. Moreover, within CBA often a small project-assumption is made, which justifies treating prices as fixed. However, nature conservation policies might affect the land market, which creates a need for endogenizing the land market.

With respect to transaction costs a distinction can be made to the supply side of nature conservation practices on land and the demand side. Transaction costs can be included in a demand and supply framework (cf. Bovenberg, 2002: 535). With respect to the supply side we suppose that farmers or other private landowners offer nature conservation on a contract-basis and the government demands for such contracts. The contract is the transaction or co-ordination mechanism. If by concluding a contract the farmers impose a private transaction cost of x on themselves, it is efficient to conclude such a contract only if the gains from participating ($d - s$) exceed these transaction costs (see

Figure 1, supply side). In the absence of transaction costs the market equilibrium is given by E, and the associated transactions are given by q_E. The impact of non-zero transaction costs is that they lead to a provision shortage of the good. With transaction costs the equilibrium quantity is q_T rather than q_E .All points in between q_T and q_E yield a positive gross surplus, which is however not sufficient to cover the transaction costs. At the margin q_T the gross surplus $p^d - p^s$ exactly offsets the transaction costs. The transaction costs can thus be measured analogous to a tax distortion, with the total transaction costs amounting rectangle ABCD in Figure 1. Besides this rectangle, the economic or efficiency costs also include the Harberger triangle BCE, which represents the loss of surplus due to transactions that are crowded out by the implicit tax wedge *x*. It is also possible to redraw the supply curve (see dotted line in Figure 1, panel a) including the transaction costs. This supply curve then expresses supply as a function of the price, corrected for the transaction costs.

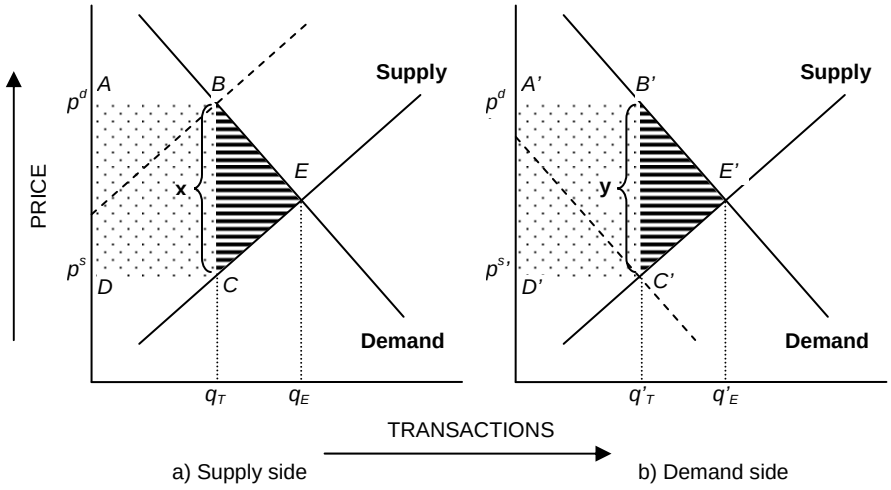

Figure 1. Demand and supply of contracts and transaction costs (Source: Bovenberg (2002: 535) adapted)

With respect to the demand side a similar reasoning can be made (see Figure 1, demand side). Here the public transaction costs can be thought of as the organizational costs (overhead, contract design, bargaining cost) and costs of bureaucracy involved in generating the demand for nature conservation. Often it can be represented by a mark-up on the (labour) inputs used in the governance structure for realising nature conservation. These public transaction costs *y* can be simply modelled as a wedge between $p^{d'} - p^{s'}$, in a way analogous as was done at the supply side. Likewise on the supply side, also here the demand curve can be redrawn to include the transaction costs. Similar as with respect to the supply side, also with respect to the demand side the presence of non-zero transaction costs imply the demand to be underestimated. The public transaction cost amount A'B'C'D' and the efficiency costs are equal to A'B'C'.

Summarizing, transaction costs can thus be incorporated into the CBA framework in an analogous way as price distortions (e.g. Zerbe and Bellas, 2006). In that case, instead of market prices, shadow prices have to be used, which correct the market value for its deviation from the social value.

The process of creating nature within the EMS can be distinguished in different phases, such as for example policy design, the purchase of land and the conversion of the purchased land into nature, or the reliance on contracting out and involvement of third parties in he management of nature. In general the coordinating and connecting of different phases involves transaction costs[1]. Based on the different phases in nature creation and the way of contracting out by the government (cf. Hart et al, 1997: 1127-1161) the following institutional arrangements are distinguished: (1) in-house production by the government (purchasing and converting agricultural land into nature and management by government agencies); (2) purchasing and converting land into nature by the government and management by private nature conservation organisations (NCOs); (3) nature management by private persons; (4) nature management by farmers.

III DESCRIPTION OF THE ECOLOGICAL MAIN STRUCTURE

Since the 1960s of the last century there is growing attention among the people and in politics for restructuring and conservation of nature areas. In the 1980s the Dutch government started to develop new nature areas by purchasing agricultural land and converting it to different types of nature. According to the island theory of McArthur and Wilson (1963), the

[1] Part of what we call transaction costs is labeled in Peirce et al (2006, 76) as regulatory and compliance costs.

Table 1.Targets for EMS nature policy

Type of terrain	Total surface	Purchasing, conversion, delivery	Agricultural nature conservation	Private nature conservation
	Surface in ha			
Existing nature terrain	455,000			
Reserves and nature development	150,000	112,000	5,000	34,000
Agricultural areas with nature value within the EMS	90,000		90,000	
Robust connections zones	27,000	16, 000	1,500	4,000
Robust connections zones 2nd round			1,500	4,000
Existing wetland nature	3,500			
To be purchased wetland nature	3,000	3,000		
TOTAL	**728,500**	**131,000**	**98,000**	**42,000**

Source: Bredenoord et al. (2004:18)

number of species increases if different populations of the same species that were separated by each other by scattering of nature, make contact again. Based on this theory the scattered nature areas should be expanded and connected in a network of areas where flora and fauna have priority. The Netherlands created such a network, known as the Ecological Main Structure (EMS). The EMS was introduced in 1990 in the Nature Policy Plan ("Natuurbeleidsplan") of the Dutch Ministry of Agriculture, Nature and Food quality. The programme of buying agricultural land and converting in nature is to be finished in 2018. The EMS exists of:

- Existing nature areas, nature reserves and nature development areas, robust connections areas and wetland nature;
- Agricultural areas with possibilities for agricultural nature preservation (nature management agreements areas).
- Large water surfaces (e.g. the coastal zone of the North Sea, the IJsselmeer and the Waddenzee).

In 1990 we had about 450 thousand ha of nature area. The Netherlands has a total area of about 3.5 million ha of land of which about 60% is used for agriculture; and 13 % of the area was nature. The target of the nature policy plan (LNV, 1990) was to add 275 thousand ha of nature for the EMS in the year 2018, i.e. an increase of the nature area to about 20 %. Part of this is to be realised by purchasing agricultural land and converting it into nature. In the original plan about 50 thousand ha agricultural land for nature development and 100 thousand ha agricultural land for nature reserves were planned to purchase. Besides it 100 thousand ha agricultural land were destinated for agricultural nature management (Bredenoord et al., 2004: 52). Later on purchasing agricultural land for realising robust nature connections zones and wetland nature were added to this plan, both together about 20,000 ha. Table 1 gives an overview of the total area involved.

However, the initial plans had to deal with time inconsistency of the government. In the government coalition agreement of 1998 the target area for new nature of 150,000 ha was reduced by 19,000 ha to 131,000 ha. Instead of purchasing the 19,000 thousand ha, the government targets for long term nature conservation contracts with private landowners were increased. The remaining 131,000 ha still would have to be purchased. Of this, about 62,000 ha of land, which is (to be) converted into nature for the EMS, has already been purchased (Bredenoord et al., 2004: 52). The government coalitions of Balkenende I (2002) and II (2003) brought into a further policy change. The government would like to buy less land and making more use of nature conservation by private landowners and farmers (AES). It means again a shift in the institutional arrangements for realising new nature. The latest target for number of hectares to be purchased for new nature in the EMS is 112,000 ha. In Table 1 this is indicated as reserves and nature development. Because of the cut in the target for purchasing, the target for private nature conservation in the EMS was increased in 2003 to 42,000 ha, to be completed in 2018. Private landowners, who participate in a contract for private nature management receive on average a compensation of € 1,700 per ha per year during 30 years (or a single compensation of € 27,500 per ha) for the devaluation of their land value. Besides, they get a one-off compensation for developing their agricultural land in nature or forest and an yearly compensation for nature management.

IV LAND MARKET: ENDOGENOUS PURCHASING PRICE OF LAND

Figure 2 illustrates the pattern of land purchases during the recent past, as well as the specified targets and their revisions. As Figure 2 shows, even with the adjusted targets the annual amount of land purchases should be significantly increased, as compared to the historical pattern. Given the scarcity of land in the Netherlands it is unlikely that these increased land purchases will have no impact at (future) land prices, and therefore land price was made endogenous in the analysis.

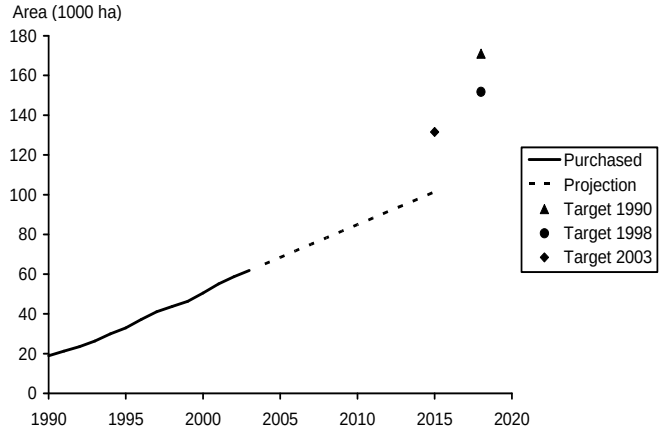

Figure 2. Land purchases for nature

Purchased area between 1990 and 2003 (full line), projected area at current purchasing rate between 2004 and 2015 (dotted line), target for purchasing in 1990, and targets adjusted in 1998 and 2003

Different studies about the land market indicate the effect of government purchases on the land price. The purchasing of land for the EMS is a substantial part of the total purchasing of land by the government. The purchasing rate needs to double almost, compared to the average between 1991 and 2003, from 3300 to about 6000 ha per year between 2004 and 2015 in order to reach the target. This will cause an increased demand for land on the market. Moreover, in the past relatively cheap land was purchased, which means that there is less land available for purchasing in the lower price classes.

In order to trace the effects of land purchasing by the government for the EMS, an econometric analysis was done. The land price was estimated as a function of a price index of agricultural products, the purchasing of land for the EMS and the delayed land price. Different specifications were used, among which the use of variables in levels and growth rates. We also looked at real and nominal variables (correction for inflation with price index consumption). We selected the equation that explained the explosive price developments in the second half of the nineties of the last century.

The effect of prices for agricultural products appeared to be little and mostly not significant. Other studies mentioned that the land price developments cannot be explained within the agricultural sector alone. This is being confirmed by our analysis and therefore the price developments in agriculture are being taken into account separately. Based on this empirical analysis the following simplified land price relation was used:

$$p_{l,t} = 0.8 \cdot p_{l,t-1} + 0.27 \cdot g_{EMS,t}$$

where p is the land price and g is the purchasing of land for the EMS (both variables are measured in percentage change; other variables suppressed; R^2 0.49; estimation period 1991-2003). This relation was used for making the land price endogenous.

V IDENTIFICATION OF COSTS, BENEFITS AND TRANSACTION COSTS

The EMS is a complicated programme. In this case study we estimate the costs and benefits as detailed as possible. Table 2 provides an illustrative overview of the (main) elements taken into account in the economic cost benefit analysis. Note that part of the costs associated with nature provision are transaction costs, which are included in entries like C, E, G and I. An important reason to conserve nature is for their non-marketable benefits, which are due to lack of reliable valuation data not explicitly accounted for in this analysis. Whereas for the economic cost benefit analysis the government expenditure on land purchases is considered as a transfer, and therefore cancels out (Innes et al, 1998: 37). In the financial analysis, which focuses here on the government budget perspective, this expenditure will be taken into account. The allocation loss is related to the deadweight or efficiency losses associated with government intervention (e.g. the triangles in Figure 1). Here this mainly consists of the social costs of public funds (Innes et al, 1998, 39-40; Jongeneel, 2000).

Table 3 summarizes the components of public transaction costs for nature conservation in the Netherlands. Following Falconer et al. (2001: 87) we distinguish 3 main categories of transaction costs: (1) information (e.g. surveying of designated areas and designing the prescriptions); (2) contracting (e.g. promotion of contracts and administrating contracts); (3) policy evaluation (e.g. enforcement of compliance and environmental monitoring). These costs can be

fixed at the scheme or program level, or vary with the number of participants. Falconer et al (2001: 97) emphasized the existence of administrative economies of size related to scheme participation. Generally it is the case that the lower the rate of change in participation over time, the lower the transaction costs. Similarly, the less frequent new agreements need to be established the lower are the transaction costs. Designating areas and designing prescriptions are fixed at the level of the scheme whereas monitoring varies with the level of participants.

Table 2: Illustrative scheme of social costs and benefits associated with nature policy

Costs		**Benefits**	
Lost production associated with previous land use (agriculture) (opportunity costs of land)	A	Non-marketable benefits of nature areas	B
Costs associated with planning and transformation into nature	C	Marketable benefits nature production	D
Maintenance and preservation costs (operational costs)	E	Net production created by production factors freed from their previous use in agriculture	F
Lost non-marketable benefits associated with previous land-use	G	Net contribution from EU funding	H
Costs associated with nature management by third parties (agriculture, forest-owners)	I	Allocation losses	AL
Total	S	Total	S

In this paper only public transaction costs are explicitly accounted for. They are mainly based on primary sources, in our case interviews among experts, and secondary sources such as reports of the Ministry of Agriculture, Nature, and Food Quality (LNV 2004a; 2004b), and Hilhorst et al. (2003).

Table 3. The public transaction costs per hectare per year for different institutional arrangements

Activity	Institutional arrangements			
	In-house production (State Forest Service)	Nature Monuments and Provincial Landscapes	Private nature management	Agricultural nature management
Purchase of land	1774	1774	170*	-
Converting land	318	318	318	-
Managing nature	76	12	27	70

* Actually land is not purchased but owners get a compensation when the value of their land decreases as a consequence of converting it from agricultural land into nature.

Table 3 shows that the public transaction costs per hectare differ over institutional arrangements.
Remarkable are the high public transaction costs for purchasing and converting agricultural land in nature. An important reason for this is the involvement of different government agencies which results in a chain of principal/agent relationships. Table 3 makes clear that the transaction costs for all the phases of nature preservation for the institutional arrangement 'in-house production by the government' are higher or at least equal to the other institutional arrangements. However, the transaction costs for the institutional arrangement 'in-house production by the government' only consists of public transaction costs, while the other institutional arrangements also have to deal with private transaction costs.
It must be pointed out that the average transaction size (measured in hectare of land) within each institutional arrangements is different. This implies e.g. that although the contracts for agricultural nature management and private nature management are for a large part comparable, the transaction costs per hectare for private nature management are lower due to the larger contract size (15 hectare versus to 5 hectare for agricultural nature conservation).(Furthermore, in comparison to contracts with other parties, the institutional arrangement between the Ministry of Agriculture, Nature and Food Quality and the State Forest Service concerns a much larger area because it is an arrangement on the aggregated level. The costs in Table 3 are assumed to be yearly costs, which are assumed to grow with 2% per year.

VI RESULTS

Results for four different scenario's are presented (see Table 4). The baseline is the scenario where it is being assumed that the actual targets as initially planned will be reached. Scenario A is similar to scenario, but now it includes the impact of public transaction costs. Scenario B assumes the government purchases 3300 hectares of land per year until 2015. This follows the past trend and was the average amount of land that was purchased between 1991 and 2003. An amount of only 98,000 ha of land will be purchased. In scenario C there will be more private and agricultural nature conservation in such a way as to achieve a similar total hectare target as was

initially planned. Two thirds goes to private and one thirds to agricultural nature conservation. More specifically, the target for becomes 64,000 ha private nature conservation ha and 109,000 ha agricultural nature conservation.

Table 4. Results of the different scenarios *)

Description / scenario	Baseline	A	B	C
Target number of hectares (1000 ha)				
Hectares to purchase for the EMS	131000	131000	98000	98000
Hectares for private nature management	42000	42000	42000	64000
Hectares for agricultural nature management	98000	98000	98000	109000
Land market (€/ha)				
Expenditure for purchasing of land	3484	3669	2327	2327
Average price of land	60929	60929	50339	50339
Compensation paid to landowners for value land	287	333	333	503
Net present values CBA (million €)				
Total economic costs	3798	3978	3210	3498
Total financial burden	5589	6031	4478	4813
Total transaction costs	0	442	386	423
Percentage share		7.3	8.6	8.7

*) The discount rate used was 4%, whereas the time horizon was the thirty year period 1990-2020.

Landpurchases and landmarket

As regards the land purchase, Table 4 shows that the reduced land purchases in scenarios B and C imply that the average price per hectare the government has to pay is 50339€/ha, which is €10590/ha less (-17%) as compared to the baseline. As a consequence of this the net present value of the expenditures on land purchases are reduced by nearly 40 percent. These results emphasize the need to take the impacts of government purchases on the land market equilibrium into account.

If the target is not reached and the purchasing rate is equal to the average purchasing rate between 1991 and 2003 (scenario B), the financial burden will be much lower (-26%) than in case the initial target is reached (see scenario A). This is mainly due to the relatively small amount of land that is purchased and the lower land price increase. The economic costs are also considerably lower. This is mainly due to the decreased spending of tax money, as a consequence of which the excess burden also diminishes. Also the transaction costs (involved in land purchases) are lower.

Transaction costs

Table 5 shows a further decomposition of costs into the financial costs, the public transaction costs and the increase of financial costs due to the transaction costs of the used institutional arrangements within baseline scenario A. As Table 5 shows the institutional arrangement *in-house production* has the highest public transaction costs. This can be explained by the relative large number of transactions: buying agriculture land, converting the land in nature, the delivery of land to SFS, and nature management and the numbers of hectares. These transactions imply the involvement of different government agencies which results in a chain of principal/agent relationships. The transaction costs in 1) and 2) differ from 3) and 4) because agricultural land is not purchased and converted in nature.

Table 5. The total financial costs and the transaction costs of the four institutional arrangements within Scenario A (million €)

Institutional arrangement	Total financial cost	Public transaction costs	Increase in financial costs due to transaction cost (%)
1) In-house production: SFS (purchasing land, converting land and managing nature)	2310	162	7.0
2) NCOs (purchasing land, converting land and managing nature)	2264	119	5.2
3)Private nature conservation (converting land and managing nature)	504	63	12.5
4) Agricultural nature management (AES)	511	97	19.1
Total	5589	442	7.9

Increased reliance on private sector including agriculture

In Scenario C the government by contracting out relies more on private and agricultural nature management to achieve its nature policy targets. Here, the financial costs are 4,813 million euros, i.e. 19% lower than those in scenario A. Substitution of different types of nature management can be an option for the government, especially if this gives the possibility to cut the amount of land to be purchased. However, the substitution between different types of management should guarantee that the quality of the nature is the same.

VII CONCLUSIONS

The total net economic costs of the EMS are 3,978 billion euro (see scenario A). This is 14,651 euro per hectare (present value) or about €250 per hectare per annum. So the societal valuation of the EMS should be at least €250 per hectare per year for the benefits to outweigh the costs. Of this costs public transaction costs amount 4.7% (present value €687/ha, or €11.8 per hectare per annum). The financial burden for the government of the EMS is 6,031 billion euro (including public transaction costs) or €22,214 per hectare. Relative to scenario A scenario C (with the reduced in-house production completely being compensated by increase private and agricultural nature management) saves the government €1,219 million (net financial burden) and also reduces the net economic cost with €480 million (-17%). This is mainly due to the lower excess burden because of the lower amount of necessary public means in scenario C. Assuming the quality of nature will be equal in scenario A and C, scenario C is more efficient in reaching the same.

Adding public transaction costs into the CBA leads to higher financial and economic costs (+€442 million or +7.9%). Transaction costs represent significant amounts and therefore need to be taken into account in CBAs of nature policy. Moreover, if nature policies include large scale land purchases the land market need to be endogenized for otherwise contracting out alternatives will get an unfair treatment.

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