Evaluating Nature Conservation: The Case of Meadow Birds in The Netherlands

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Abstract

Healthy growth towards sustainability requires evaluation methods that incorporate ecological and economic effects. Evaluating ecological effects in monetary terms would permit the use of Cost-Benefit Analysis. Major methodological difficulties hamper use of this approach. In this paper an alternative evaluation method is used. The method consists of a Multicriteria Analysis (MCA), in which the different aspects of nature conservation projects can be evaluated in their own terms. The net result of the monetarised effects is part of a CBA that is integrated as one of the criteria. This framework is applied to a major, publicly financed nature conservation project in the Netherlands. The project is based on a fixed budget and a fixed area in which nature can be produced using different methods. In this project, apart from analysing the net results, besides the net results of a CBA, only one other criterion is analysed: the production of nature. In this way, the concept is reduced to a straightforward analysis of the performance (cost-effectiveness) of the different methods used to produce natural environment.

Keywords: *cost-benefit analysis; multicriteria analysis; biodiversity; nature conservation; project evaluation; the Netherlands*

Introduction

Evaluating sustainability

Government and business worldwide are striving for more sustainable growth. The measurement of progress towards sustainability, and evaluating policies and projects in a context of sustainability are major topics. Because the concept of sustainable development is broad and there are many different interpretations of it, measurement and evaluation are taking different forms and there is much debate on methodological issues. This article will focus on the evaluation of biodiversity policies in the heavily urbanised Netherlands. It will present a new methodology, which combines the expertise of economists and ecologists, and touch upon the debate on methodologies for valuation of the environment.

Biodiversity policies in the Netherlands

Since the beginning of the century, the amount of natural area in the Netherlands has declined dramatically and what is left has been severely fragmented; the biodiversity of fauna and flora has decreased nationally and regionally (OECD, 1995). The Dutch govern-

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ment has decided to stop the processes that have caused this, and to reverse the effects, reaching a more sustainable conservation of nature and landscape. Its policies are set out in the National Nature Policy Plan (LNV, 1990), the main goal of which is to create a national ecological network by means of creating three types of zones: core areas, natural development areas and ecological corridors. Implementation of the national ecological network is planned to take some 30 years, up until the year 2020.

The central aim of the national ecological network is to increase the amount of biodiversity in the Netherlands. This aim is envisaged as being achieved by means of different methods: increasing different types of natural environment can achieve a comparable increase in biodiversity, at different costs. The increase or conservation of a certain type of natural environment can be achieved using various methods of nature management, such as professional upgrading of existing conservation areas, development of new areas, or nature-oriented farming. The aim of this article is to show the results of a method to evaluate the cost-effectiveness of the different methods. Two different concepts of cost will be analysed: social costs and costs for governments (public funds). It will be shown that the method can be applied at a global or macro level (increase of global biodiversity in the Netherlands as a whole), but also at a more specific level (increase in biodiversity for specific species).

Evaluation methods

Cost-Benefit Analysis

Cost-Benefit Analysis (CBA) is a straightforward evaluation method used for investment plans, and is very popular amongst economists. It can, in principle, be applied to any allocation of resources in the economy. Its theoretical foundation is in welfare economics. The net benefits, which are seen as being the contribution made to welfare, are determined by weighting up the costs of a project against its benefits. The main criterion for evaluation is economic efficiency. One strong advantage that CBA has is that it is one- dimensional: results and sub-results are expressed in monetary terms. The outcomes of different projects or policies can easily be compared. Furthermore, if CBA is applied properly, double counting does not occur. But although CBA has a strong tradition in demonstrating the non-market effects on, for instance, consumers (see Mishan, 1977), applying it to projects with important environmental effects has proved to be rather complicated. The major complications hampering the effective application of CBA seem to be, firstly, how to evaluate environmental goods and services, and secondly the lack of knowledge about ecological effects due the complexity of the ecosystem (Hanley, 1992; Faucheux and O'Connor, 1998, p. 6).

There has been much discussion on valuation of the environment (Pethig, 1994; Dabbert et al., 1998; O'Connor and Spash, 1999). Several approaches to making valuations of non-marketed environmental goods have been developed. These include the hedonic price method, the travel approach, the averting behaviour method and contingent valuation (see Hanley, Spash and Walker, 1995; Hoevenagel, 1994a en 1994b). The heroic attempt by Costanza et al. (1997) to value the worlds' environmental goods and services (at $ 33 billion per year) and the discussion surrounding it, brought the complex issue of valuation of the environment into the scientific arena (Ecological Economics, 1998). There were a limited number of positive comments, and these stressed either the political character of the article, the value of the attempt in itself or the signal function such figures may have. Most comments stress the enormous methodological difficulties, leading to either overestimation, underestimation or the irrelevance of any estimation, but, in any case, largely invalidating the results of the attempt. Much of the critique is aimed at the use of the Contingent Valuation Method (CVM), and the difficulties of transferring values estimated at lower geographical levels and in specific contexts to higher geographical levels and different contexts. All in all, there are many problems connected with the monetarisation of biodiversity.

In relation to our approach, the comment by Toman (1998) is interesting. He states that 'cost-benefit analysis and economic valuation are not informationally rich enough to determine policy choices'. It is important to find ways of 'laying out the economic and non-economic information in a way that facilitates both informed decision making and accountability'. This is a plea for supplementing (among other things) 'economic information with information on the physical consequences (in space and time)'. Various kinds of sensitivity analysis and multicriteria analytic techniques can be used (Toman, 1999, p. 66).

This article can be seen as an attempt to supplement such an approach. When evaluating the cost-effectiveness of different methods, which are directed at achieving the same goal, there is no decisive reason for viewing the increase of biodiversity in monetary terms, as long as the degree of biodiversity can be measured in quantitative terms. In this article, a methodology will be described which will present changes in biodiversity in a way that facilitates informed decision-making.

Multicriteria Analysis

When making a comparison between the costs involved and the increase in bioversity, both measured in their own terms, one enters in fact the field of Multicriteria Analysis (MCA) (Clímaco, 1997). MCA belongs to the class of non-monetary evaluation methods. In MCA, the performance of a project in its aspects or dimensions is compared with the objective(s) of the decision-maker(s) or social welfare at large. The major advantage of this method is that it can handle a set of different criteria, even when they are qualitative, such as the intangible effects of environmental projects. The different effects of an environmental project (such as costs, equity and air pollution) can be analysed in their own terms (Nijkamp and Van Delft, 1977; Zimmerman and Gutsche, 1991, p. 20).

In Multicriteria Decision Making (MCDM) a distinction is sometimes made between approaches that focus on *decision-making* and approaches that focus on *decision aid* (Bana e Costa and Pirlot, 1997). Multicriteria Decision Making often requires strong restrictions on the structure of the decision-makers' preferences (weights and values), the behavioural realism of which is not often addressed (Korhonen and Wallenius, 1997). These problems are mostly related to the decision-making approach. According to Bana e Costa and Pirlot, more attention should be given to the decision aid approach. This would lead to much more attention being given to structuring and framing as a fundamental phase in decision-making. In a decision aid approach, MCA is 'designed to facilitate decision-making by constructing a set of keys which might enable the actors to go forward' (Bana e Costa and Pirlot, 1997, p. 565). Understandability of the criteria to the decision-maker is very important in acquiring valid weights (Wenstøp et al. 1997). Simplicity and the related issue of the possibility of communicating the results of the analysis are prerequisites for an effective use of MCA (Bana e Costa and Pirlot, 1997, p. 564-565).

Cost-Benefit Analysis and Multicriteria Analysis

Nijkamp and Van Delft (1977) and Van Pelt et al. (1990) have suggested using a combination of both methods to minimise their disadvantages. In the kind of combination they suggest, some elements of CBA are included in an MCA framework. In our view, reducing the relevance of weighing by minimising the amount of criteria is a way the required simplicity and understandability of MCA to the decision-maker can be achieved. CBA should be used for effects that are, or can easily be monetarised (for the treatment of monetary and non-monetary values in MCA-literature: Edwards and Newman, 1982). Ultimately this involves taking a modest and realistic view of the role that the outcomes of applying CBA and MCA can have on decision making. If one acknowledges the limited role and the limited possibilities of any evaluation method, issue then becomes limited to the supply of meaningful figures on some important aspects rather than attempting complete quantification or valuation of all relevant aspects.

With regard to the Netherlands' National Nature Policy Plan, we have followed the approach of combining CBA and MCA. The evaluation focuses on two important criteria:

1. Economic effects - measured in monetary terms as the net result of the CBA;
2. Effects on nature (biodiversity) - measured in scale points (MCA).

For policy reasons, the effect on the government's budget will also be analysed[1]. Since this effect shows a substantial overlap with the economic effect, public funding is not incorporated in the MCA, but treated as a possible constraint in the implementation of the project as such.

Project description

The central objective of the National Nature Policy Plan (LNV, 1990) is the realisation of a so-called 'Ecological Network'. This plan is directed at the conservation of existing nature areas, and the realisation of connecting corridors between existing nature areas. The most remarkable and also the expensive element, however, is the *creation* of new nature conservation areas on land which, up until now, has been in agricultural use.

Over a period of thirty years, some 150,000 hectares of agricultural land are planned to be taken out of agricultural production, while another 100,000 hectares will be assigned to nature-oriented farming. These 250,000 hectares amount to 12.5 % of the total agricultural area of the Netherlands. A certain part of this area is, from an agricultural productivity point of view, more or less wasteland, but other parts are good, or even highly productive agricultural land. The physical productivity of the land, which will be taken out of production, is approximately 90% of the average productivity of agricultural land in the Netherlands (see Sijtsma and Strijker, 1995, section 6.2).

The description of the plan does not contain an overview of the types and size of natural areas to be created. This is a major complication in making an analysis of the effects. The geographical distribution is indicated in the plan, but only globally. To solve this problem, a nation-wide survey among local experts from nature management institutions was held. Given their knowledge of policy priorities, budgetary constraints, local soil and water conditions and existing nature conservation areas they were asked to indicate the acreage of the types of natural environment that will most probably be realised. For this survey, an existing typology of 132 types of natural environment was used (LNV, 1995). These types of natural environment were intended to represent all types of natural environment within the Dutch ecosystem. This existing typology for nature areas (of which 92 proved relevant to this project) did not include agricultural land. In this project, the existing typology has been extended to include agricultural land. This procedure has led to an additional 39 types of 'agricultural nature' being defined: 26 for nature-oriented farming and 13 for intensively used agricultural land for conventional purposes. To summarise, the categories on which the Ecological Network is based entails a shift from 13 types of agricultural land used for conventional farming to, on the one hand, 26 types of nature-oriented farming, and on the other hand, 92 types of nature areas.

The government will pay for a large share of the financial costs of the project. These costs as such are not included into the social cost-benefit diagram, because they are not necessarily costs to society, as they include to a large extent 'transfers'. This is one reason for treating public costs strictly separately. The costs to the public budget consist of two elements:

(1) costs connected with buying land, and the concomitant costs of turning agricultural land into natural environment,

(2) ongoing management costs (subsidies for farmers working under restrictions) and the costs of nature management in reserves.

The total nominal cost to the public budget will be NGL 11,153 million, or NGL 223 million annually. This amount is not spread equally over time. The maximum (in the year 2020) is NGL 375 million.

The above-mentioned figures could be treated as a separate criterion in a Multicriteria Analysis. Here, the burden to the government is treated as a restriction: the question is whether the amount is reasonable in relation to the budget of the government. The annual average of NGL 223 million will be 6.7% of the total budget of the Ministry of Agriculture, Nature Conservation and Fisheries, while the maximum (in 2020) will be 12.1%. Compared to the total state budget, it is 0.1%. Politically, these last figures are much more interesting than the figure of NGL 11 billion or its net present value.

Evaluation of Nature

The complete biodiversity of the Netherlands is estimated to consist of some 36,000 species. There is a full biological description of roughly 2600 of these. Starting from this subset, IKC Natuurbeheer (a branch of the Ministry of Agriculture, Nature Conservation and Fisheries) has selected a group of so-called target species. Target species are quality parameters for the complete biodiversity of the Netherlands. Target species have been selected from the 2600 subset on the basis of three criteria:

- Rarity: when the occurrence of a species transgresses the limit of occurring in less than 5% of the Dutch area, it is called an R-species,

- Trend in occurrence: when the number of a species has halved in the period 1950-1990, it is called a T-species,

- International importance: when the environment (natural environment or otherwise) in the Netherlands is of major importance for the survival of a species, it is called an I-species.

Species are target species when they meet at least two of these criteria, that is, when they are IT, IR, TR or ITR species. On this basis, 657 target species can be discerned. A small number of these target species is not relevant for our research project (e.g. marine life). The remaining number of relevant species is 564 (out of the 2600 which were mentioned before).

For all 131 types of natural environment (92 plus 26 plus 13, see above), the species that potentially occur there, or have a strong preference for that type of nature have been charted. For a large part, this charting was based on existing material (LNV, 1995); for the agricultural types of nature and land in conventional agricultural use, the charting was done within the project.

This work resulted in a database charting 131 types of natural environment, the number of hectares of different types of natural environment, the agricultural land to be brought into the Ecological Network, the number of target species per hectare in the different types of nature (in the event of this structure not being realised, the number of target species per hectare in the agricultural land), an indicator for the degree of preference of the species for that type of nature, and the species' score on the R, T and I scale (see Appendix 1).

Each type of relevant natural environment has been given a nature rating. The purpose of this was to calculate an indicator for the total value of all types of natural environment. The nature rating of a specific type of nature or agricultural land will depend on the number of target species that occur potentially within it. It is assumed that the nature rating will increase in proportion to the number of hectares. Although different indicators were developed within the research project, only one will be elaborated on here (the most complete one).

The indicator for the value of nature of a certain type of natural or agricultural land (131 in total) is composed of three elements:

1. The number of hectares comprising that type of nature;
2. The number of species that potentially occur in that type of nature. Species with a strong preference for that type of nature are given an extra weight in terms of a factor 2;
3. The ecological value of the species. An index developed by the Dutch Centre for Agriculture and the Environment (CLM, 1995) is used to calculate the ecological value of a species. The ecological value in this index is based on the previously mentioned criteria of rarity, trend and international importance. The structure of the CLM-index is followed in this project (for the details see Appendix 1). It is furthermore assumed that the nature value of a certain type of natural environment will increase proportionally with an increase in its area[2].

The equation for the value of nature as developed in Appendix 1 is applied to the total amount of agricultural land and nature area in the Netherlands, in both the situation before the creation of the Ecological Network and the situation after implementation of it. Adding together the results for the 131 types of nature yields the result for the Netherlands as a whole. Dividing the result by the total acreage of agriculture and nature produces the results per hectare.

In creating the Ecological Network, two types of methods, each containing two components will be used:

Nature conservation areas:
- *Upgrading*: upgrading agricultural land with existing relatively high nature values,
- *Nature development*: creating nature reservations on conventional agricultural land that has little or no initial nature value.

Nature-oriented farming:
- *Stringent conditions*: continuation of agricultural use with important, subsidised limitations for nature purposes,
- *Light conditions*: continuation of agricultural use with minor, subsidised limitations for nature purposes.

From the survey (see above) we know the total acreage, and the foreseen acreage per type of nature for these four methods. This allows for the calculation of the value of nature per method. Table 1 summarises the results.

Further research showed that the differences in value of nature per hectare between the four methods are not very sensitive to moderate changes in the listing of target species or in the definition of the indicator. Simple counting of species, omitting the other elements of the formula, showed that, per hectare of the Ecological Network, there are three times as many species compared to the number of species on ordinary agricultural land. The more sophisticated formula, which is applied here, yields roughly the same figures.

Table 1. Nature Scores within the Ecological Network

Method	Nature score	
	Score (absolute)	Index (ordinary agricultural land = 1.0)
With Ecological Network	4423	4.9
Without Ecological Network (using conventional farming methods)	902	1.0
Different policy methods within the Ecological Network		
EN conservation areas	6294	7.0
Upgraded	6088	6.7
Nature development	6759	7.5
Nature-oriented farming	1737	1.9
Stringent conditions	2133	2.4
Light conditions	1342	1.5

Source: IKC Natuurbeheer; CLM; Own Calculations

On the basis of these figures, an estimation in quantitative terms can be made of the total national increase in nature values due to the realisation of the Ecological Network. A total increase in nature values of 18% (or in general terms 15-20%) is estimated for the Netherlands as a whole (table 3 shows the results of four different policy methods).

Costs and Economic benefits

Five questions are crucial in the evaluation of the economic effects of withdrawal of agricultural land for nature purposes:

(1) Which agricultural land will be withdrawn, and what types of production take place there?

(2) What is the level of agricultural productivity of that land?

Which agricultural activities will shift to other regions, and which will be terminated? Which activities will change considerably (from intensive farming to nature-friendly farming)?

What are the costs of maintaining nature conservation areas, and what are the costs of converting agricultural land into nature?

Will there be any positive economic benefits?

Question (1) To find out the exact location of the acreage to be withdrawn and the actual production which takes place on those lands, a connection has been made between the Agricultural Census and the plan description of the Ecological Network. Specifications have been taken from the results of the previously mentioned survey at the lowest administrative level (the level of communities). The assumption made is that for each region (a combination of provinces and soil types), the agricultural production structure of the land to be withdrawn will be identical to the agricultural structure of communities which completely, or almost completely coincide with the indicative map of the Ecological Network. This procedure yields a list of hectares producing various crops.

Question (2) The next question deals with the productivity of the acreage that is to be withdrawn. Two methods were applied: (1) actual prices paid for land bought for nature development, (2) figures on productivity from the survey study. Both yield the same result: the agricultural productivity of the land that will be withdrawn is approximately 90% of the Dutch average.

Question (3) If land is withdrawn from agricultural use, it is not a foregone conclusion that the production furnished by that land will be terminated. High-yielding activities will most probably be moved to regions outside the Ecological Network, expelling lower-yielding activities there. On the basis of Gross Standard Margins per activity and a number of restrictions (the decrease in the national acreage of a crop is limited to 50% of the 1990 acreage, soil quality restrictions etc.), it can be calculated which activities will shift to regions outside the Ecological Network, and which activities will permanently lose acreage. The difference in productivity that was mentioned earlier is taken into account. The annual net loss of agricultural production is thus estimated at NGL 380 million: 1.0% of the value of Dutch agricultural production. This production value results in a loss, in terms of value added, of NGL 143 million. Based on input-output calculations (LEI-DLO, 1995), and taking into account the specific input-output structure of the relevant crops, NGL 172 million should be added for effects on upstream and downstream industries. The total loss will certainly be higher because during the period of planning, there will be stagnation in the development of production. In addition, with the shift of production to other regions, transaction costs will be involved. These effects are estimated to be 50% of the initial loss. Including agribusiness, this results in a total loss, in terms of value added, of NGL 479 million annually.

The figure mentioned above applies only to the acreage which will be withdrawn completely (143,535 ha). For land that will remain agriculturally productive, albeit with restrictions, subsidised or otherwise, on the usage, the loss in value added is estimated separately. Including agriculture-oriented business, that loss will be NGL 80 million annually. However, not all calculated costs will be full costs to society because after a period of time, a certain part of the factors of production will be used again. A procedure developed by Oskam (1994) is followed here. In this procedure it is assumed that in agriculture, 25% of the value added is connected with the production factor land, and 75% with labour and capital. For these latter factors, it is assumed that 50% will be used again after 1 year, increasing to 100% after 10 years. Land will be permanently withdrawn. For the factors of production in agriculture-oriented business, it is assumed that 75% will be in use again after 1 year, increasing to 100% after 5 years.

Question (4) The effort involved in maintaining the nature reserve areas is a substantial cost item. The annual costs per hectare are calculated at NGL 800, based on the records of public and private authorities in this field. The final item that has to be incorporated into a proper cost-benefit analysis is the cost involved in the physical conversion of agricultural land into nature. On the basis of figures from the Ministry of Agriculture, Nature Conservation and Fisheries, and also from private institutes, it is calculated that the total costs will be NGL 570 million.

Question (5) Apart from an increase in biodiversity, in principle, a project like the Ecological Network also yields other benefits. Four elements can be mentioned. The Network probably has a positive influence on the quality of the landscape. There will also be gains in terms of a decrease in agricultural pollution. We did not estimate these gains here: they are treated as provisional items. There may also be economic gains in terms of additional recreational activities connected with the increase of natural environment. On the national level, these gains will be small, because on that level, an increase in international tourism in the Netherlands should only be counted (additional international tourists coming to the Netherlands, or Dutch citizens who otherwise would go abroad and who now will stay in the Netherlands). Here, this item is estimated to be zero. On a lower scale, the impact of additional recreation may be significant, because than intra-national changes should be included. In the case of nature conservation for meadow birds (see section V) the impact will be small, because areas for meadow birds are not very attractive from a recreational point of view. The last positive element is production from nature: wood etc. In the circumstances created by the Ecological Network, this production is estimated to be zero.

The different elements can now be combined in a cost-benefit diagram. Table 2 gives the social net present values of costs and benefits over a period of fifty years. For discounting, we used a real discount rate of 4 percent annually.

Table 2. CBA for the Ecological Network (net present values)

COSTS	NGL **million**	**BENEFITS**	NGL **million**
Physical change	313	Valuation of landscape beauty	
		Capacity for clean water production	P.M.
Maintenance of conservation areas	1230	Recreation	
		Production from nature	P.M.
Maintenance costs of			0
nature-oriented farming[1]	954		0
Agricultural production loss due to establishment of conservation areas (including agribusiness)	866		
Total Costs	3363	Total Benefits	0
Net Costs (without minor p.m. items)	3363		

[1] Measured as the compensation cost for 'agricultural production loss'

Cost-effectiveness

Now two elements are left: the net result of the cost-benefit analysis, and the increase in biodiversity (value of nature). This implies that the results for the two criteria can be compared directly, without introducing explicit weights. The result of the comparison is an indicator for the cost-efficiency of the project.

Table 3 shows that in the Ecological Network, 243,535 ha. of agricultural land will be converted into nature, or remain agricultural, but under nature-oriented restrictions (management prescriptions). The total amount of the value of nature in the Netherlands will then increase by roughly 18%. The net present value of the social costs connected to the project will be NGL 3.4 billion.

Results on the social costs and the increase in value of nature are not only available for the Ecological Network as a whole, but also for the four previously mentioned methods (Upgrading, Nature development, Stringent conditions, Light conditions). The most striking result is that withdrawal of agricultural land is, on this global level, relatively expensive (71% of the social costs), but it also yields a steep increase in nature (90% of the total increase in value of nature). Per percentile increase in the value of nature, it is thus relatively cheaper to completely withdraw from agriculture than to continue under subsidised restrictions. Light condition restrictions, in particular, are relatively expensive in the sense that this method will generate 3% of the total increase in nature value, at 9% of the total social cost.

Table 3. The Ecological Network (EN) and its component parts, and the results for the two MCA criteria

	Hectares	Criterion 1: Nature value	Criterion 2: Social costs (result CBA)
Ecological Network (total effect)	**243,535**	**18%**	**f 3.4 bn (NPV)**
EN TOTAL (%)	100%	100%	100%
EN conservation areas	**59%**	**90%**	**71%**
Upgrading	41%	60%	45%
Nature development	18%	30%	26%
Nature-oriented farming	**41%**	**10%**	**29%**
Stringent conditions	21%	7%	20%
Light conditions	21%	3%	9%

From nature in general to meadow birds

The foregoing remarks do not imply that nature-oriented farming is always less cost-effective than complete withdrawal. The measurement of the effect on nature is a broad measure that includes seven taxonomic groups. If the policy aim is to sustain nature in general, it is appropriate to use the cost-effectiveness calculation. However, nature policy often has other targets or sub-targets. Often nature policies aim specifically at the conservation of birds. Therefore, specific attention will now be paid to the costs and benefits in relation to conservation measures for meadow birds.

In the Netherlands, 28 meadow birds are generally accepted as occurring, and these are divided into 14 primary and 14 secondary species. Of the primary species, five belong to our list of target species, and of the secondary species, eight[3] (Beintema, 1995).

In the Dutch nature conservation policy, eight geographical areas are described as being core areas for meadow birds (den Boer, 1995). Two of these areas are analysed here: clay areas in central Groningen and lowland peat areas in the province of North Holland. For both areas, types of natural environment that are relevant for meadow birds are selected. These types of natural environment include, for instance, nature-friendly farming (stringent and light conditions), peat-swamps, and traditional hay land. For each of these types of nature, the social costs (present value per hectare, NGL, 50 years), connected with the change in landuse from intensively agricultural use into the designated type of nature, are calculated (fully comparable with the foregoing calculations for the Ecological Network). The increase in biodiversity (points per hectare) stemming from meadow birds is also calculated for the types of natural environment in the selected areas. This gives us the social costs per unit of biodiversity. The results are given in Tables 4 and 5, where the different types of nature are ranked according tot the increase in costs per unit of biodiversity per hectare.

Table 4. Cost indicators for nature conservation measures for meadow birds in the clay areas of central Groningen when intensively used grass or arable land is turned into nature

Target nature types	Additional target species*	Additional score points*	Government outlays/ha (present value) NGL	Government outlays/point NGL	Social costs/ha NGL	social costs/point NGL
Grassland stringent conditions**	+7	+643	13,120	20.40	13,120	20.40
Grassland rich in herbs***	+2	+682	16,783	24.61	28,739	42.14
Grassland light conditions**	+2	+124	5,960	48.06	5,660	48.06
Arable land stringent conditions**	+2	+195	13,120	67.28	13,120	75.44
Lowland peat***	+6	+305	16,783	55.03	28,739	94.23

* *Grassland in normal intensive use yields 7 target species (262 points), arable land yields 3 target species (138 points)*
** *Nature-oriented farming*
*** *Nature conservation area*

Table 5. Cost indication of nature conservation measures for meadow birds in lowland peat areas of North Holland when intensively used grass or arable land is turned into nature

Target nature types	Additional target species*	Additional score points*	Government outlays/ha (present value) NGL	Government outlays/point NGL	Social costs/ha NGL	Social costs/point NGL
Grassy marshes***	+5	+1532	16,783	10.96	28,739	18.76
Grassland stringent conditions**	+6	+547	13,120	23.99	13,120	23.99
Reed lands and scrubs***	-1	+647	16,783	25.94	28,739	44.42
Grassland rich in herbs***	+1	+556	16,783	30.19	28,739	51.69
Grassland light conditions**	+1	+45	5,960	132.44	5,960	132.44

* *Grassland in normal intensive use yields 7 target species (262 points), arable land yields 3 target species (138 points)*
** *Nature-oriented farming*
*** *Nature conservation areas*

From table 4 (clay areas of central Groningen) it can be concluded that, in contrast to the general findings about the cost-effectiveness of different ways of maintenance in the Ecological Network, in the case of meadow bird biodiversity some types of nature-friendly farming (especially grass, stringent conditions) are more cost-effective than nature development or upgrading by establishing nature reserves.

In the lowland peat area of North Holland (table 5) the situation is different. There the creation of nature reserves (especially traditional hay lands) is the most cost-effective measure. In that area nature friendly farming, under light conditions appears to be a useless method since it yields no more nature than intensive agricultural use does. The costs per hectare are low, but the results, in terms of increase in biodiversity stemming from meadow birds, are zero.

Conclusions

This article shows that in determining the cost-effectiveness of different methods for nature conservation, it is not necessary to monetarise the value of nature. When a direct quantification of the effect on nature (or biodiversity), and the costs involved are analysed in the context of Multicriteria Analysis, the result is a trade-off between increase in biodiversity and social costs. It also shows that a relatively simple method for measuring the change in nature values yields useful insights in the cost-effectiveness of different techniques for nature conservation and creation. Reliable data on the effects on nature values are, at least in the Netherlands, sufficiently readily available for this kind of policy evaluation. The results shed new light on the cost-effectiveness of subsidised nature-oriented farming, compared to the full withdrawal of agricultural land from production. It appears that the results can differ considerably, depending on the goal of the nature conservation project: biodiversity at large, or biodiversity in terms of meadow birds. The method applied appears to be a helpful tool for selecting ways of nature conservation which are cost-effective.

Notes

1 It is arguable whether this is a separate criterion or not. In any case this criterion has a different status to the others.

2 Because the systematic categorisation of types of nature also includes some indication of maximum or minimum size, this proportional increase and decrease has “natural” limitations.

3 Primary species: Anas clypeata, Anas querquedula, Limosa limosa, Gallinago gallinago, Philimachus pugnax,. Secundary species: Perdix perdix, Crex crex, Saxicola rubetra, Recurvirostra avocetta, Sterna hirundo, Chlidonias niger, Saxicola torquata, Miliaria calandra.

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Appendix 1: A synthetic index for the value of nature

The species rarity rating is obtained by dividing the Netherlands into 1677 grids, each of 25 square kilometres. The degree of rarity, R, is defined as 1677 divided by the number of grids in which the species actually occurs. The trend value, T, is defined as the change in percentage in the size of the population of that species between 1940 and 1990. The international importance, I, of the Dutch population of the species is a dummy variable with value of 1.5 or 1, depending on whether the species matches the condition that the Netherlands are central in its area of occurrence or not.

Because multiplication of the values for R, T and I leads to a scale ranging from 1 to approximately 250,000 in which relatively few species score highly, the results have been rescaled logarithmically to the range of 0 to 100. The resulting formula for the ecological value of a species, j (EV_j) is then:

$$EV_j = 18.5 * {}^{10}\log(R_j * T_j * I_j) \quad (1)$$

$$NV_i = \sum_{j=1}^{s_t} P_{ij} * EV_j \quad (2)$$

The value of the nature (the biodiversity), NV, within an existing or created hectare of a certain type of nature, i, can then be written as:
with:

- NV_i the nature value of the different types of natural environment
- i the different types of nature (131 in all)
- j the different number of species occurring in that type of nature (subset from the total of 564 in all)
- P degree of preference of species, j, in nature type, i (dummy variable: 1 or 2);

It is furthermore assumed that the nature value of a certain type of nature will increase proportionally with an increase in its area.