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How much does it cost to include a marginal rural area as a Natura 2000 site? Social costs and expenditures for compensation schemes

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Abstract

Following the identification of sites of community importance (SCI) under the habitats directive (43/92 EEC), managing authorities are designing conservation plans to maintain and/or enhance the natural values of the sites. This paper presents both an estimate of the costs associated with the implementation of the management plan and an estimate of the compensation payments that will be established. This allows us to know whether including this area in Natura 2000 is profitable from an economic perspective and managing authorities to budget sufficient resources for implementing conservation plans. The paper ends with some considerations regarding the global cost of Natura 2000 network in Europe.

Key words: cost-benefit analysis, compensatory payments, Natura 2000 network, marginal agricultural areas.

Resumen

¿Cuánto cuesta incluir áreas marginales en la red Natura 2000? Coste social y gasto en programas compensatorios

En el marco de la directiva hábitats (92/43 CEE) y como continuación a la declaración de los lugares de importancia comunitarios (LIC), las administraciones responsables están diseñando planes de gestión que aseguren la conservación de los valores ambientales de estos lugares. Este trabajo presenta una estimación tanto de los costes derivados de la puesta en marcha de un plan de gestión en un LIC, así como de los derivados del establecimiento de los pagos compensatorios que podrían llegar a establecerse. Esta aproximación permite analizar la rentabilidad económica de incluir un determinado lugar en la red Natura 2000 y a las autoridades responsables de su gestión el disponer de una estimación del coste de la puesta en marcha de los planes de conservación. El trabajo finaliza con algunas consideraciones relativas al coste total de la puesta en marcha de la red Natura 2000 en Europa.

Palabras clave: análisis coste-beneficio, pagos compensatorios, áreas agrícolas marginales.

Introduction

The implementation of Directives 79/409/EEC (OJ, 1979) and 92/43/EC (OJ, 1992) (better known as birds and habitats directives) in the EU is increasing areas devoted to nature protection by a factor of 10 and has the final objective of reaching the target of 15% of all surface under some form of protection or other. The latest figures available show that on October 2004 over 450,000 km^2 had been proposed by member states for their inclusion in Natura 2000 network, close to the proposed target regarding percetange of the Union`s total surface. For one member state the Commission has already evaluated their proposal as complete while for the remaining 14 proposals are deemed as substantial but still incomplete (Barometer Natura-2000). Thus, the target seems feasible to achieve, although protection of all areas will not necessarily be under the classic figures of parks with its legislative developments and might only be implemented through site-specific management plans.

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The implementation of Natura 2000 network is running behind schedule[1] and although it foresaw the designation of special areas of conservation (SACs) by 2000 the only lists approved by the Commission up to date are those of the Macaronesian and Alpine biogeographical regions which are restricted to a limited area of the Union and count for approximately 7% of all the proposed sites of community importance (SCI) and 15% of the total proposed surface[2]. Once all the network had been agreed between the member states and the Commission an initial four year period was envisaged for the declaration of SCI as SAC.

In order to assure conservation in SACs, management plans should be designed and implemented. Currently, the Government of Navarra is a leading stakeholder in Spain for the process of developing a common methodology for the design of these plans based on the logical framework matrix (García Fernández-Velilla, 2003). This design includes identifying conservation objectives and specific measures for achieving those objectives. Any measure included in a nature management plan will mean a modification of land uses and economic activities. Some agents will benefit from these measures while others will see their current activities restricted or banned.

This study has two main objectives. First, a preliminar cost-benefit analysis (CBA)[3] is undertaken in order to see whether the decision of including an area in the list of SCI is efficient. The analysis is focused on the costs of the implementation of the management plan, while the benefits are taken from a previous study. A second objective derives from the fact that the management authority in Spain considers that in order to assure a smooth implementation of these plans, some compensations must be given to those economic agents that see their activities disrupted. Thus, a second analysis is undertaken to estimate the minimum amount of the compensatory payments including in this payment two different concepts: revenue loss and incentive.

Thus, this paper provides a bottom-up approach estimate of the costs that both society and the administrative authority should bear in order to implement the management plan designed by the Government of Navarra (Spain) for a SCI named «Peñadil, Montecillo and Monterrey» (Natura 2000 code ES2200042). The rest of the paper is structured as follows: first, we review the theoretical foundations of cost and benefit estimation for nature protection as well as other case studies carried out in Spain and other member states. Second, we present a brief description of the characteristics of the SCI and its management plan. Third, we estimate the costs and benefits of this management plan to see whether it is efficient to include this area in the Natura 2000 network using a CBA framework. Fourth, we present the estimates for the minimum compensatory payments that should be implemented to compensate income losses suffered by affected agents. The paper ends with some considerations regarding the global cost of Natura 2000 network in Europe, conclusions and recommendations for further research.

Background

Following Lierdeman (1996), there are two established methods for calculating costs arising from the long-term management of Natura 2000 sites. These are the «top-down» and the «bottom-up» approaches. «Top-down» estimates are based on predicted costs for a small sample of sites which are extrapolated to all Natura 2000 sites. This provides a broad but acceptable estimate of management costs for the whole Natura 2000 network over a given period of time. Bottom-up estimates rely on individual studies for each SCI and the overall cost is calculated by adding up all these studies.

Our study is mainly a bottom-up approach. We estimate costs based in the implementation of management plans designed by the Department of the Environment of the Government of Navarra. The design of the management plan implies selecting a series of conservation objectives which are reached by the implementation of individual measures. These measures will imply restrictions, changes and/or bans on natural resources uses in the area. Depending on

[1] For a more detailed description of the implementation of Natura 2000 please refer to the EC homepage on Natura 2000 http://europa.eu.int/comm/environment/nature/natura.htm.

[2] Own calculations using data from COM(2001)3998 and COM(2003)497 for sites and surface in the Macaronesian and Alpine regions and Barometer Natura as on 16/10/2003 for overall sites and surface.

[3] Cost benefit analysis is a well know economic tool used to evaluate public policies and projects. Presenting its main characteristics is outside the scope of this paper but interested readers are referred to Brent (1996) and de Rus (2001) for a thorough review of its theory and practice.

whether the substitute activities generate higher or lower economic revenues, we will identify a benefit or a cost respectively.

Regardless of the approach selected, the costs and benefits we want to estimate need to be defined. A first classification of the costs and benefits associated to the implementation of management plans would be related to the agent which bears the cost (Barberán *et al*., 2004a). Under this classification, we could distinguish two groups: costs borne by the managing authority and costs borne by other agents[4]. Costs borne by the managing authority include: *i)* identification and designation costs (*i.e*. scientific research, management plan drafting, etc.) and *ii)* management costs (both current expenses and investments). These costs should be considered without taxes and/or subsidies in order to know the exact cost that the management of a SAC will mean.

Several estimates have been carried out in Europe regarding the extent of these costs. In Spain, Pérez y Pérez *et al.* (1998) estimated that the direct cost of managing 1 ha of the existing protected areas at that time was 85.2 euros (1997 constant prices)[5]. This study included a revision of the actual expenditure of managing authorities in Spain for a representative sample of protected areas grouped by habitat type. More recently, Prada *et al.* (2001) have followed the same approach to estimate the management and some indirect costs for a particular national park in Galicia (Spain). Their results, part of a wider cost-benefit study with special emphasis on the benefit side, showed that these costs for the 1993-1997 period amount to 935 euros ha^{-1} at 1998 constant prices. The divergence between this estimate and the average reported by Pérez y Pérez *et al.* (1998) is caused both by the wider concept of cost used and by the relatively small size of the studied area (434 ha) and the importance of protection related to size decreasing marginal costs.

Stones *et al*. (1999) have estimated an average management cost of 80 euros per ha obtained from a Delphi consultation to UK and European organisations[6]. Extending this cost to the whole network adjusting for national differences results in an overall annual figure of 2,500 million euros per year.

The last study related to direct cost estimation is that provided by TERRA (2000). This study estimated the management and investment costs of all sites proposed for the Macaronesian biogeographical region using a bottom-up approach (thus estimating the cost for each single site) and reached an overall figure of 68.8 million euros per year during the first five years of implementation.

On the other hand, costs borne by other agents relate more to the economic impact of management plans on economic activity. The approach to estimate these costs cannot be a top-down one as each single protected area will have different uses and protection measures. Limiting fertiliser use will probably have a lower impact on areas where soil quality is higher than in areas where soil quality is low. In order to protect some areas it will be necessary to promote uses that have lower revenues than the existing ones while in other areas it will promote using land currently abandoned and thus increasing revenue opportunities.

Studies applying this approach have been undertaken lately to assist the European Commission to estimate the overall cost of the implementation of Natura 2000 and how this cost could be financed. Case studies have been conducted to our knowledge for a protected river area in Denmark (Dubgaard *et al.*, 2002) and for a rural area with substantive development perspectives in Spain (Barberán *et al.*, 2004b). The main conclusion that can be derived from these studies is that costs depend significantly on the type of conservation measures that will be implemented and of the economic activities currently undertaken in the area. Thus, the Danish case provides examples where fish farming is restricted and land use reallocations needed. The Spanish case is focused more on theoretical considerations related to cost estimates and the effect of opportunity costs related to imposing limitations to wind energy developments and irrigation plans.

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[4] This classification may change if the managing authority decides to compensate some or all costs borne by other agents. In the theoretical approach we assume that this is not the case and that the managing authority only budgets actions that have to be undertaken directly either through direct provision or trough subcontracting.

[5] The global cost of nature protection for the 3.2 million ha protected in Spain at that time meant 327.5 million euros. If this figure is updated both in terms of inflation and protected area (Europarc-España, 2002) the overall cost of nature protection in Spain for 2002 would raise to 383.2 million euros (94.7 euros ha-1 and 4.05 million ha protected). This estimate would not take into account possible increases per ha costs due to better management practices.

[6] This figure is similar in order of magnitude to the direct cost of managing protected areas included in NATURA 2000 directly managed by the Royal Society for the Protection of Birds in the UK (70 euros).

In order to estimate this type of costs several issues have to be taken into account. First, subsidies should be excluded as the value of those that can be obtained in other areas in the region (using the same resource for other areas). Second, the role of potential activities needs to be clearly defined as management plans can affect not only current uses but limit those potential activities, and costs can vary significantly. Last, compensation rights need to be identified; this will affect whether the cost can be defined as a direct cost and an expenditure paid by the managing authority (if the agent has the property right for the current use) or as an indirect cost borne by an economic agent and not causing expenditure (if the agent does not have the property right for the current use).

A third alternative approach, based neither on direct costs or costs borne by other agents, has been undertaken by Soliño (2003). In order to estimate the expenditure needed to implement conservation plans in rural areas where forestry is the main economic activity he conducted a Delphi analysis to 26 managers of community owned forests. His results, which do not measure revenue loss but demand for compensation, show that programmes to improve habitat quality in that area range from 180 to 225 euros yr^{-1} for a period of time that exceeds the 6-yr considered in our management plan (close to 35-yr). Additionally, in order to undertake investment to create new forests compensation ranging from 2,524 to 3,500 euros ha^{-1} was demanded too. This figure can be considered an estimate of the minimum expenditure needed to implement successfully (*i.e.* with enrolment of private owners) this type of forestry conservation policies but has no identifiable direct relationship with any cost concept.

In this paper we use a bottom-up approach to estimate a combination of the first two cost concepts (direct cost and cost borne by other agents) and move towards shedding some light on two relevant policy issues: whether the protection of this particular Natura 2000 SCI passes a cost benefit test and how much will it cost to implement the conservation plan for this SCI to the managing authority.

For the first issue, we take into account the costs for society (considering society at the regional level) that each measure will imply, while for the second one we will refer to the minimum compensatory payment that the managing authority should implement to maintain a constant income in the region once the plan is in place considering the current property rights design.

The case study SCI and its management plan

The «Montes del Peñadil, el Montecillo and Monterrey» SCI is located in southeastern Navarra and is included in the Mediterranean biogeographical region. This area has a total surface of 2,922 ha and priority and interest habitats account for 13% of the total surface[7]. It is the most southern gypsum area in Navarra and also the one with the most continental climate, due to its distance to the sea, and with the highest temperature variation. This SCI has two well-defined areas: one with brushwood typical from gypsum areas and the other with brush-wood from arid areas. Nevertheless, more than 50% of the total area is under agricultural use mainly for cereals. Both brushwood on gypsum and brushwood on arid areas are interest habitats under the 49/92/EC Directive (OJ, 1992). In those areas where soil is deeper, rosemary (*Rosmarinus officinalis* L.) formations appear and where rosemary is not present the area is occupied by pastures of high ecological value also included as priority habitat.

The area is home of many bird species mainly steppe birds such as *Chersophilus duponti, Tetrax tetrax, Circus pygargus* and *Falco naumanni*. It also hosts some protected mammals such as *Myotis myotis* and reptiles such as *Mauremys leporsa*. All of them are included in Annex I or II of birds or habitats directive (OJ, 1979 and 1992), thus their habitats must be protected. As far as plants are concerned, two species that rely on the presence of gypsum soils for their survival are located here, *Gypsophila hispanica* and *Astragalus clusii*. Both are endemisms of the Iberian Peninsula.

The management plan designed by the managing authority (Department of the Environment in the Regional Government of Navarra) includes measures to protect four main key elements (habitats, flora, fauna and landscape) with five final objectives. Table 1 summarises the objectives and measures of the management plan. As it can be seen, most of the management measures relate to direct expenditure by the regional government to undertake studies to improve

[7] More information on the SCI location and images can be found at the following internet address http://www.navarra.es/nr/navarra/asp/redirect.asp?sUrl=%2Fappsext%2FLics%2F&f=True [10 March, 2004].

Table 1. Key elements of the management plant

Key element	Final objective	Description
Habitat	Maintain surface and quality of key habitats	— Inventory of habitats — Design management plan — Develop management instruments for environmental appraisal of future actions in the SCI — Minimize impacts from mining activity
Habitat	Design and implement a forestry management plan which will increase the surface of key habitats	— Increase environmental quality of gorges — Increase the quality of forest areas
Steppe landscape	Develop a sustainable agriculture and livestock management system	— Improve the management of agricultural area as fauna refuge and feeding ground — Increase livestock grazing in the area
Flora	Maintain current populations of Astragalus clusii, Narcissus dubius and Lichen	— Inventory of the flora distribution in the SCI — Design of flora conservation plans
Fauna	Maintain current populations of key fauna	— Inventory and monitoring of fauna presence in the SCI

Source: DOTMAV (2002a).

knowledge regarding the natural characteristics of the site. Nevertheless, several measures, especially those related to changes in agriculture and livestock uses and the limitation of mining activities, will impose costs on other agents that need to be evaluated.

In the following sections we will analyse individually those measures that will have direct impact on production and/or income and describe them more detailed.

The first step in order to know the possible costs of protection is to have a general overview of the socio-economic characteristics of the influence area so income and income structure can be analysed. The SCI is located in a rural municipality of Navarra (Ablitas) close to Navarra's second main town (Tudela, 35,000 inhabitants).

The SCI covers 34% of the total surface of this municipality and generates only 4% of its total agricultural production. One hundred per cent of the total arable land is non-irrigated while in the surrounding area over 35% is irrigated. Over 50% of the SCI´s total arable land is idle due both to set-aside (9.7%) and fallow lands (40.6%). This percentage is significantly higher than the average in the surrounding area (29.5%), even if only non-irrigated land is considered (41.2%). Average yields in the SCI area amount for barely 10% of the average in the area. Sixteen per cent of all farmers use land located in the SCI although none has land only located in the SCI. Thus we can conclude that this SCI is located in extremely marginal agricultural land. Distribution of total area among crops is shown in Table 2.

Livestock production is the other main use in SCI area. The SCI land is used as pasture by ovine livestock. Over 5,000 sheep are kept in the municipality although the tendency is to produce in an intensive manner and abandon free grazing. Free grazing is needed together with agricultural production in order to develop a sustainable land use model.

The influence area has 2,311 inhabitants (1999) and this has increased 2.7% since 1991. Thirteen per cent of total employment is related to agriculture while 34%

Table 2. Arable land uses in the SCI (year 2001)

Crop	Area (ha)	Yield (t ha^{-1})	Production (t)
Wheat	241.5	0.9	217.4
Durum wheat	133.0	0.8	106.4
Barley	276.3	1.5	408.9
Fallow land	681.4	N.a.	
Set aside	161.5	N.a.	
Oilseed rape	0.4	0.0	0.0
Vetch	93.5	0.0	0.0
Pastures	47.9	N.a.	
Non cultivated	0.5	N.a.	
Almond trees	11.8	0.7	7.7
Forest	29.2	N.a.	
Total	1,676.9	N.a.	

Source: CAP-DP application forms. N.a.: not applicable.

is related to industry. These percentages are higher than the region's average. Moreover, the high importance of industry is related to employment outside the municipality, as many of these workers are commuters to neighbouring municipalities. The only industrial activity directly linked with the natural resources that exist in the SCI is a gypsum quarry. This quarry employs 11 persons and has expectations (and mining rights) to expand its current quarry into the SCI.

Does the designation and conservation of the SCI pass a benefit cost analysis?

As mentioned before, to answer this question we have to consider the cost that implementing the management plan will pose to society and compare it with the benefits. We have identified ten individual measures that will imply costs not borne by the managing authority. Costs borne by the managing authority have been identified, taxes excluded, by the Department of the Environment of the Regional Government and for the six year period that the management plan will be in place. Considering a 5% discount rate, their total value at year zero amounts to 2.4 million euros. Over 88% of the total cost is related to investments in the improvement of gorges (heavily eroded) and livestock related infrastructures for easing extensification of current livestock management practices (roads, paths and stables).

Estimating the costs of individual measures we have only considered income lost due to value of agricultural production net of common agricultural policy direct payments (CAP-DP). It is assumed that if production is cut, direct payments will be reallocated to other areas in Navarra which are currently dedicated to other crops. Thus, although it will surely be a cost to the local economy, considering the region as a whole the impact will be zero. When other sectors are involved, costs have been estimated trying to exclude subsidies.

We have grouped the different measures according to their impact. Thus we can identify two major groups: those restricting uses and those changing practices. Table 3 presents these two groups.

Table 3. Measures grouped according to effects

Measure group	Measure
Use restriction	— Establish a non harvested periphery area (3 m) in 50% of all cereal surface in 80% of all farms — Implement permanent set-aside in areas with more than 10% brae — Limit area in which gypsum extraction is permitted
Practice change	— Hay left non-harvested in 80% of fields — 5% of surface in 80% of all parcels changed from cereals to legumes — Organic farming practices in all farms — Change in pesticide and seed use from current use to AAA/AAB products in 80% of all fields — Change in fallow land management system (no spring tillage) — Limit livestock pasture in areas with high erosion — Establish an alternative extraction route for trucks from the quarry to the production plant.

Source: DOTMAV (2002a) and own calculations. AAA: toxic level classification: compatible with mammals, birds and fish species. AAB: toxic level classification: compatible with mammals and birds species, relatively not too dangerous for fish species.

Two alternative approaches have been used to value its cost for each single measure: *i)* market value of the production lost, calculated using surfaces and yields provided by the Department of Agriculture or *ii)* additional production costs associated to the new practice when compared to common practices currently followed. Next we present the basic assumptions made to estimate the cost of each single measure and the total cost estimated.

In order to leave the three-meter periphery area in the cereal arable land we have considered the average size of each individual plot existing in the SCI by crop and assumed that all plots are squared. Comparing the total arable land between the non-periphery area scenario and that of the periphery scenario we can estimate the % of production loss[8]. Areas have been obtained from CAP DP application forms provided by the CAP managing authority. Yields

[8] Considering that the average plot is 1 ha and that the plot has a squared shape we are considering a 100 m side square. If the periphery band is 3 m the plot that will actually be harvested will be a 94 m side square. The difference in surface (10,000-8,836 m^2) multiplied by the production yields will be the production loss.

are the average yields for the area in 2001. The average yield loss is 11.7% (the average plot has a size of 0.98 ha). Considering the value of production for each cereal crop currently being cultivated (wheat, durum wheat and barley) and the relative surface of each one the average cost[9] is 17.8 euros ha^{-1}.

The measure's goal is to implement this periphery area in 50% of all cereals surface in 80% of all farms. Considering that all farms have the same surface distribution as the average the goal would be to implement this management practice in 260.3 ha. The global cost thus associated to this measure is 4,644.3 euros per year. As some of the area in the SCI is under organic farming (Regulation 2092/91/EC; OJ, 1991) we have also considered the loss associated if some of the area left idle is already under this production scheme. As the exact figures for production and price variation for organic farming in the area are unknown we have considered, using data from nation-wide surveys (Michelsen *et al.,* 1999; DG Agriculture, 2000; Soler, 2002), a price increase of 25% and a production reduction of 10%. Thus the cost for each hectare would raise to 20.1 euros.

Implementing permanent set-aside in areas with brae higher than 10% will imply reducing production in the eastern side of the SCI where higher brae is located. According to the same source as before average production per ha in this area amounts to 122.5 euros. As the total surface that wants to be tackled with this measure is unknown to estimate the total cost of the measure, upon consultation with the managing authority, 10 ha have been considered as a successful implementation of this measure, thus the total cost of this measure amounts to 1,225.4 euros per year.

In order to limit the area where gypsum extraction is carried out an extension requested by the mining company HORPASA had to be assessed. In Spain, mining concessions are granted for 100 years and for areas of several km^2. Once the mining concession has been granted each mining activity has also to be approved. An additional 20.9 ha have been requested by HORPASA for mining activity and due to the environmental impact in the SCI only 13.1 ha have been approved. Additionally, the extraction road has to be diverted to minimize the noise pollution to birds.

The difference between 20.9 ha and 13.1 ha of mining concession means that activity will be stopped in 30 years instead of in 80 years, thus the cost is the value of production between years 31 and 80. Yearly production amounts to 50,000 t of gypsum with an average market price of 52.7 euros t^{-1} (COAATG, 2003). Discounting this value to year cero with a 10% discount rate[10] we obtain an overall cost of 1.5 million euros.

Additionally, due to the new extraction road an extra 2-km have to be driven to transport gypsum to the production plant. Cost per km, as given by the mining company, is 0.1 euros t^{-1} km^{-1} and extraction of raw material amounts to 83,333 t yr^{-1}. The additional cost of this measure is then 18,030.4 euros yr^{-1} and considering a 10% discount rate this value for the 6-yr management plan amounts for 78,526.9 euros.

The value of non-harvested hay in the area is zero as the technical production sheets (DAGA, 2001) show that for this region of Navarra there is no hay component in the total agricultural production of cereals. Thus this measure will have no cost in the region.

Changing production from cereals to legumes will increase the amount of feed for wild animals. The management plan's objective is to reach 5% of legume for 80% of all farms. Current yields for legumes in the area amount to zero (there is no harvest due to the small growth of the plant) while average production per ha for

[9] As mentioned by an external reviewer, total cost of this measure could also include other concepts such as a new use rate for fixed capital in affected agricultural holdings. With the available data this concept cannot be estimated and thus this cost can only be considered as a lower-bound estimate of the total cost.

[10] Discount rates are used to compare monetary values in different periods of time. A detailed description of this concept and its implications for CBA can be found in Lázaro and Barberán (2001) and Azqueta (2002). In this study we use three different discount rates for different benefit or cost concepts. For public investments this concept should reflect rate at which society is willing to substitute actual consumption with future consumption, interest rates for long-term public debt is the adecuate concept to be considered. Actually this rate is close to 5% in the European Union and this figure has been used for all public expenditure items. For private decissions this concept should reflect the opportunity costs of money (average benefit rate) for enterprises. We distinguish two scenarios, for items related to agricultural activity the average benefit rate considered has been 5% while for items related to non-agricutural activities this rate has been considered as 10%. The third rate considered is for public benefits related to nature protection. In this case the preferences of future generations and a precaution principle need to be included and thus a lower rate is used to reflect them. In our case a 2% discount rate is used to aggregate conservation benefits related to the SCI.

cereals, as mentioned before is 152.0 euros. Changing land use from cereals to legumes provides some benefits for future harvests as legumes fix high quantities of nitrogen in the soil. According to the Department of Agriculture of the Government of Navarra, production can increase up to 15% the following year once the rotation has been implemented. Thus the cost must be adjusted by this factor. A 15% increase in yields means an extra 22.8 euros ha^{-1} in year x + 1. Discounting this value at 5% and subtracting it to the production lost we obtain a net cost of 129.6 euros.

The measure's objective is 5% of 80% of all annual crops, which in the area means 23.8 ha. Thus the total cost per year of this measure amounts to 3,089.1 euros.

Estimating the cost of changing production habits from conventional farming to organic farming introduces a high level of uncertainty. As mentioned before, yield and price variation are not uniform among areas and products. We have assumed a 10% production loss and a 25% price increase once organic farming is established. For the first three years of transition towards organic farming, as the product cannot be sold as organic, price is assumed to remain constant and production reduced by 20% as practices are still new to the farmer. Thus during years 1 to 3 there will be a loss for farmers while during years 4 to 6 farmers will be better off. Table 4 presents these results for the four main crops that can be changed to organic farming.

The average cost taking into account relative surfaces is 39.3 euros ha^{-1} that should be paid during year zero. The goal of implementing the measure would be 584.4 ha under production once taken into account the additional fallow land due to other measures, thus the total cost amounts to 22,990.3 euros in year zero.

The previous measure takes into account the implementation of another measure as organic farming already takes care for limiting the use of pesticides and herbicides. Thus the cost of implementing that measure would already be included in the cost of change of use towards organic farming.

Modifying the fallow land management limiting Spring tillage will imply a higher competence among crops and weeds the following year, as the growth of weeds has not been stopped with the Spring tillage. The exact impact on the following harvest is unknown but we can estimate the additional cost needed in year x + 1 to eliminate those weeds and prevent the negative effect on the harvest. According to the extension service consulted, there are two options: to carry out an additional tillage prior to sowing or to apply additional herbicides. As an objective in the management plan is to limit herbicide use, we assume that the only feasible option is to carry out an additional tillage. Cost per ha of an additional tillage have been estimated at 36.1 euros ha^{-1}.

The objective is to apply this management practice in 80% of all fallow lands. Thus success would be obtained if 545.1 ha of fallow land avoid spring tillage. The total cost per year would amount to 19,655.9 euros.

The final measure is to limit livestock pasture in over eroded areas. This would mean that some of the animals currently grazing in the SCI would have their feed limited. Nevertheless, as nearly all other management measures are designed to increase the fodder value of land this limitation would be offset by the increase in feed available to livestock. Thus the cost of this measure is zero.

To sum up, the total cost of these measures for the six-year live of the management plan, considered at year zero with a 5% discount rate except in the case of the compensation for reduction in mining activity and extra costs for the new extraction route which uses a 10% discount rate is reflected in Table 5.

Adding these figures to the total cost borne by the managing authority gives an overall cost for the six-year management plan of 4.12 million euros for the whole period. The mean annual cost per hectare would be 234.8 euros. To investigate the total cost of implementing Natura 2000 network in Navarra we could use this figure as an average cost for the whole

Table 4. Cost and benefits of transition to organic farming (euros ha^{-1})

Crop	Year 1	Year 2	Year 3	Year 4	Year 5	Year 6	Total
Wheat	–24.9	–24.9	–24.9	15.6	15.6	15.6	–31.2
Durum wheat	–22.3	–22.3	–22.3	13.9	13.9	13.9	–27.9
Barley	–39.2	–39.2	–39.2	24.58	24.5	24.5	–49.1
Almonds	–84.5	–84.5	–84.5	52.2	52.2	52.2	–107.3

Source: Own calculations using CAP-DP application forms and surface and yield data from DAGA (2001). Totals have been estimated with a 5% discount rate.

Table 5. Costs of individual measures per ha and total cost for 6-yr considered at year 0 (5% discount rate for all activities except for those related to mining which use a 10% discount rate)

Measure	Total cost at year 0 (euros)	Annual cost ha^{-1} (euros)
Establishment of a non harvested periphery area (3 m) in 50% of all cereal surface in 80% of all farms	23,573.0	17.8
Implement permanent set-aside in areas with more than 10% brae	6,219.8	122.5
Limit area in which gypsum extraction is permitted	1,490,000.0	N.a.
Hay left non-harvested in 80% of fields	—	—
5% of surface in 80% of all parcels changed from cereals to legumes	15,679.2	129.6
Organic farming practices in all farms	22,990.3	39.3*
Change in pesticide and seed use from current use to AAA / AAB products in 80% of all fields	—	—
Change in fallow land management system (no spring tillage)	99,767.1	36.1
Limit livestock pasture in areas with high erosion	—	—
Establish an alternative extraction route for trucks from the quarry to the production plant	78,526.9	N.a.
Total	1,736,756.3	

Source: Own calculations. N.a.: not applicable. —: no cost.* Total cost at year zero estimated using a 5% discount rate as after a 3-yr transition period this measure provides net benefits to farmers (see Table 4). AAA: toxic level classification: compatible with mammals, birds and fish species. AAB: toxic level classification: compatible with mammals and birds species, relatively not too dangerous for fish species.

network. This assumption is rather strong as the 42 SCI proposed varied both in current land uses and in the measures included in management plans but we could consider this estimation as a medium one as low profitability of agriculture in the area is compensated by the presence of important non-farming costs associated with mining activity. If we extrapolate this figure as an average management cost for all Natura 2000 sites in Navarra the global cost for the network (104,000 ha) would be close to 25 million euros yr^{-1}.

On the other hand, benefits must also be considered from a social point of view. The implementation of the management plan will improve the quality of fauna and flora that might mean better market values for hunting permits. Erosion could be limited and, therefore, restoration cost in the future will disappear, flood risks will be reduced due to better water retention, existence value will increase due to higher quality of habitats and higher fauna presence, recreational possibilities will be enhanced due to better infrastructures and widespread knowledge of the area, etc. A specific study should be designed to assess the extent to which these benefits would be realised and the most suitable method used to estimate the individual components of total benefits (direct or indirect methods, revealed or stated preference methods, etc.). An example of how this should be conducted can be found in Dubgaard *et al.* (2002). Alternatively if benefits for similar areas have been estimated before, a benefit transfer approach can be used. In the above-mentioned study, some of the benefits (mainly existence benefits) have been transferred from existing studies.

There is a wide range of benefit estimates available in Spain to date (Barreiro and Pérez y Pérez, 1999; Vázquez, 2000) and even some benefit transfer functions have been developed for use and non-use values (Del Saz *et al.*, 1998; Prada *et al.*, 2001). Unfortunately our study area does not share common characteristics with the existing studies (both for institutional arrangements, scenic quality and recreational demand) and the data needed to implement the available benefit transfer functions are not available so we cannot undertake a reasonable benefit transfer exercise as the one conducted by Dubgaard *et al.* (2002). Thus we have opted to include the figures estimated by Tragsatec (1998), which has attempted to estimate the total economic value of biodiversity in Navarra using both use and non use values and then has allocated those benefits to individual areas using

a geographical information system (GIS) based application[11].

The overall benefits have been grouped in four main categories: *i)* recreational use, *ii)* landscape, *iii)* carbon sequestration and *iv)* existence value. The first three are related to use values while the last one could be considered as non-use value. Each category has been estimated using a different valuation technique. Recreational use has been estimated using the travel cost method, landscape and non-use has been estimated using the contingent valuation method and carbon sequestration using the production function method (defensive costs)[12]. Values were estimated for Navarra as a whole and later assigned to each area depending on natural characteristics of each area. Results for the area covered by this SCI are presented in Table 6.

The total benefits for the 6-yr period using a 2% discount rate amount to 274,900 euros. As it can be seen, the benefit cost ratio is slightly over 6.5%, that is, benefits only amount for 6% of total cost of conservation. The conclusion would be that under the hypothesis considered in this study, conservation of the SCI is not profitable for society as designed in the management plan.

Several considerations must be made to this assertion though. Only two cost items of all measures included in the management plan amount for over 80% of total cost: compensation of mining rights to HORPASA and investments in agriculture and livestock related infrastructures. Compensating mining rights is a property rights issue. According to the Spanish Mining Law (BOE, 1973), all mining concessions are considered of national interest. Thus the mining right prevails upon the conservation right. If the establishment of Natura 2000 network was considered also of national interest this payment will no longer be a cost. Investments have been designed as a compensating measure for local farmers. They expect that, sooner or later, a land consolidation scheme would be carried out in the area and that the management plan prevents the implementation of the consolidation scheme. Thus, this measure is not a conservation measure and could be excluded from the cost benefit analysis. If these two items were eliminated, the benefit cost ratio would be close to 31%.

Table 6. SCI benefits according to Tragsatec (1998)

Value	Category	Annual rent value (euros)	Annual rent value (euros ha^{-1})
Use	Recreation	0	0
	Landscape	8,354.01	2.86
	Carbon sequestration	405.52	0.14
Non use	Existence	40,325.22	13.80
Total		49,084.75	16.80

Source: Tragsatec (1998).

Considering the benefit side, only non-use annual rent for 6-yr has been considered as a benefit. The implementation of the management plan assures preserving the area so not only the rent, but also the existence value should be included as benefit. If we consider as benefits the total value of the area[13], the benefit cost ratio raises to 301% excluding the above-mentioned costs. Another issue that should be pointed out is that with the implementation of the management plan the quality of this natural resource would improve and thus its existence value should increase. Moreover, recreational use of the area which has been estimated as zero is severely underestimated as there are some visitors which benefit now from the use value and this number will increase in the future as the area will be promoted as part of the Natura 2000 network.

In conclusion, considering the *status quo*, preservation of the SCI under the current management plan does not pass a benefit cost analysis. If the plan is modified (*i.e.* exclusion of the mining area and reduction of investments) or the current legal system modified (consideration of Natura 2000 of national interest) the situation could be reversed.

How much will the SCI protection cost to the managing auhority?

Once we have analysed whether the decision to protect this individual SCI passes a benefit cost

[11] The accuracy of the estimation conducted in this study can be subject to scrutiny. The approach followed to allocate total value to each area probably underestimates the benefits of marginal areas where prominent species are not present but we consider that the figure can allow us to obtain a first impression of the cost benefit ratio of this management plan. The optimal alternative would be to carry out a specific benefit estimate for this particular SCI but this was outside the scope of the present study.

[12] Providing details of each of the individual applications of the methods is beyond the scope of this paper. Nevertheless, limitations to the applications will be mentioned later on to justify the low value obtained for the benefits.

[13] Total value is considered in this study as the capitalisation of 50 years rent with a 2% discount rate.

analysis, the next policy relevant issue is how much will the implementation of the management plan cost to the managing authority in terms of actual (budget) expenditure. For this, we will assume that the policy interest is to compensate total income loss to all affected agriculture and livestock related agents. On the other hand, compensation to industrial and mining activities are not considered by the managing authority.

Regarding costs directly borne by the managing authority the difference between cost and expenditure will only be the value added tax. The average rate in Spain is 16% so total expenditure considered at year zero amounts to 2.76 million euros.

The main difference is that, for all other measures, the concept to be considered is not production value (net of subsidies) but net margin[14]. In this value for agricultural production we include CAP direct payments as their loss, when applicable, will be an income loss for farmers although at the regional level it has not been considered as a cost.

Additionally an incentive for adoption will also be considered ranging from 0% to 20% depending on the degree of effort needed by farmers to change habits as estimated by the managing authority. In the cases where land use is promoted we have assumed that costs are homogenous among crops (due to data unavailability) and thus the only difference between cost and expenditure will be due to the incentive.

The assumptions made for each measure are the same as those made for the cost estimate and data on net margins is provided by DAGA (2001). Table 7 resumes the total expenditure for the 6-yr management plan discounting payments at 5% discount rate except for compensations for limitation to mining activities which are evaluated using a 10% discount rate.

As it can be seen, expenditure is relatively smaller particularly for costs not borne by the managing authority. Total expenditure is 3.0 million euros for the 6-yr management plan at year zero constant euros. This means 171 euros ha^{-1} yr^{-1} during the 6-yr period for which the management plan is designed. This figure doubles previous estimates mentioned above. This can be a result of a stricter management plan or of the inclusion of compensation payments not considered in those studies. With the information available we cannot estimate which percentage of the total difference is caused by each of those two possible causes. Of course this figure can vary depending on the extent to which the managing authority decides to compensate costs, the managing authority has

Table 7. Expenditure for the implementation of the 6-yr management plan considered at year zero (5% discount rate for all activities except for those related to mining which use a 10% discount rate)

Measure	Incentive (%)	Expenditure
Establishment of a non harvested periphery area (3 m) in 50% of all cereal surface in 80% of all farms	10	4,664.4
Implement permanent set-aside in areas with more than 10% brae	10	7,146.6
Limit area in which gypsum extraction is permitted	0	—
Hay left non-harvested in 80% of fields	0	—
5% of surface in 80% of all parcels changed from cereals to legumes	0	13,546.8
Organic farming practices in all farms	10	
Change in pesticide and seed use from current use to AAA/AAB products in 80% of all fields	20	25,289.3 —
Change in fallow land management system (no spring tillage)	20	119,721.0
Limit livestock pasture in areas with high erosion	10	—
Establish an alternative extraction route for trucks from the quarry to the production plant	0	78,526.9
Total	N.a.	248,895.0

Source: Own calculations. N.a.: not applicable. —: no expenditure. AAA: toxic level classification: compatible with mammals, birds and fish species. AAB: toxic level classification: compatible with mammals and birds species, relatively not too dangerous for fish species.

[14] Net margin is considered rather than net benefit because we consider that family labour, land rent and own capital interests in an agricultural context cannot be used for other uses than agricultural production due to the existing alternatives in the area.

decided not to compensate costs transferred to the mining company (moreover, if compensation was agreed data on the balance sheet of the company should be obtained) decreasing significantly the scope of compensation costs.

If we consider the average expenditure estimated for this SCI, the overall expenditure per year can be estimated for the total area covered by the 41 SCI that will be included in Natura 2000 in Navarra. This figure would exceed 17 million euros. This will mean nearly a 50% increase of the budget managed by the department in 2001 (36.6 million euros as mentioned in DOTMAV, 2002b).

It should also be mentioned that most of the arable land in the SCI is owned by the municipality which leases it to local farmers for an annual rent of 25.3 euros ha^{-1}. Land abandonment could be obtained at a much lower compensation expenditure if arrangements were made with the local municipality, this would not decrease the cost (agricultural output would still be decreased) but would decrease expenditure. Arrangements would be problematic though, due to political bargaining at the municipality level. Nevertheless, in this particular SCI as land abandonment is marginal (only 10 ha) the impact in total cost is reduced to approximately 1,200 euros per year.

Conclusions and further analysis

This paper presents an application of a bottom-up cost analysis to the designation of a SCI in Navarra. The context in which this area is located is of vital importance to understand the costs and benefits associated with it, both due to the marginal character of economic activity in this area and the low benefits associated to recreational use. Thus the rural character of many of the SCI included in Natura 2000 network affect both costs and benefits.

Our study has provided answers to the two questions put forward in the first section.

a) Protecting this Natura 2000 SCI under the current management plan does not pass a cost benefit analysis, costs exceed benefits. This conclusion must be carefully examined though. From the benefit side the estimate used is far from reliable and probably underestimates the potential benefits associated with the area both due to the methodology used in the Tragsatec (1998) study and to the fact that value will increase as the environmental quality of the area improves with the management plan. From the cost side, the exclusion of only two actions included in the management plan (which account for over 80% of total costs) would reverse this conclusion. The role for economic analysis when designing management plans is discussed below.

b) The total public expenditure needed to implement the management plan during the 6-yr period sums up to 2.93 million euros with an average of 167 euros ha^{-1} per year. This cost is substantially higher than previous estimations in Spain based only in direct costs and can exceed the current budget available for conservation practices. Financing this expenditure is discussed below.

Natura 2000 has been designed as a policy objective and is now being implemented based mainly on the biological and ecological characteristics of individual sites. Probably overall benefits will outcast costs although we are not aware of any single study trying to assess this benefit cost ratio. Substitution and complementary effects among services provided by each area will mean that benefit aggregation from individual benefit estimates will probably overestimate the real value of the network. Moreover, cost studies produced up to date either focus in particular sites (Dubgaard *et al.*, 2002; Barberán *et al.,* 2004b) or in management costs (Pérez y Pérez *et al.*, 1998; Stones *et al.*, 1998).

Once the decision of including a particular site in the network has been taken, there is room once more for economists to achieve an optimum management plan design. Conducting a benefit costs analysis for a single site can help to design economically efficient management plans for conservation. Conservation can be achieved at different levels and in some cases, marginal improvements in conservation can mean substantial increases in conservation costs. Economic analysis must be included since the beginning of the design of management plans to design the most efficient conservation strategy both from biological and economic points of view.

From a managerial point of view, cost benefit analysis must be supplemented with an expenditure analysis. Expenditure in compensation measures can vary significantly depending on the compensation strategy selected by the management authority. In this particular case, expenditure has been reduced by nearly 30% only by the fact that compensation of mining activities has been disregarded. This should not be confused with the fact that costs have been also reduced, costs can only be reduced if the property rights structure regarding natural resources is modified.

Funding sources for these compensation expenditures are still under consideration both at national and European levels. The conclusions of the working group on Natura 2000 funding (DG Environment, 2002) show that several options are still open and that although costs of Natura 2000 are high, their relative importance when compared to the overall figure of 75 billion euros available per year for co-funding from the different EU budgets, funds and financial instruments is limited. It should be mentioned here that part of the compensation payments needed in this area are caused by existing subsidies for agricultural production and that although the implementation of the common agricultural policy mid-term review (OJ, 2003) in Spain has still not been decided, cross-compliance requirements could include to some extent these measures thus reducing the overall cost and expenditure estimates.

In this study we have not considered potential activities that could be carried out in the SCI lands. In particular, wind energy developments could increase significantly the costs at the local and even regional level (this area is in the border of two regions) as this economic activity is limited due to the management plan and other environmental rules in Navarra. Other SCI potential uses can have a higher impact on overall costs, and designing management plans where both resource use (or development alternatives which provide an equivalent income to the area without using those resources) and conservation are allowed can require both expertise and imagination to allow achieving conservation at a reasonable cost.

To obtain an overall estimate of the costs and benefits of establishing Natura 2000 network, further individual analysis are needed. As conducting a study for each single site can mean a significant cost[15], an alternative approach would be the following. Sites should be classified according to habitat, region, management plan restrictions and socio-economic characteristics of the influence area. A representative sample should be selected and individual studies carried out identifying the key elements that affect total cost. Thus a cost transfer approach could be undertaken adjusting basic unit costs by coefficients estimated using the data from this sample of case studies (Bergstrom and De Civita, 1999; Rossi *et al*., 2004) and allowing to assess the economic rationale of individual management plans. An alternative option would be to include economic analysis in the terms of reference for the design of management plans, introducing a cost-effectiveness approach similar to that proposed by the water framework directive (OJ, 2000).

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