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Taking into account opportunity costs when assessing costs of biodiversity and ecosystem action

Final report

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Executive Summary

Given the challenges associated with halting the loss of biodiversity and the breath of sectors relevant to achieving this goal, an increase in financial resources is crucial to enabling the successful protection of biodiversity and ecosystems. Within Europe, however, a gap exists between the quantity of funds designated by the EU for conservation purposes and the achievement of the subsequent targeted actions, largely as a result of limited data on the costs of conservation. Making the implicit costs of conservation explicit via the identification and inclusion of opportunity costs in estimates could help address this incoherence. This cost category reflects the *foregone economic benefits from alternative activities or uses of a resource on a particular site*.

Producing an accurate estimate of opportunity costs and the total cost of biodiversity and ecosystem related action within the EU has the potential to reduce the careless use of often undervalued natural resources by providing a stronger evidence base on the real costs and benefits of biodiversity, thereby enabling more informed decision-making and increased efficiency in distributing of available financial resources. Existing estimates on these costs have mostly been made at a regional level and have usually not addressed the total costs of action at an EU level. Moreover, there is a great variability in the cost types and categories used in the studies, hampering the comparability of the results. **This project aims to address this inadequacy and adopt a comprehensive approach to produce a first broad estimate of the total economic costs of EU biodiversity and ecosystem policy.**

To this aim, this report focuses on ten policy areas comprising the core aspects of biodiversity and ecosystem conservation within the EU, namely: Natura 2000, national (terrestrial) protected areas, species conservation, conservation and restoration of high nature value farmland, conservation and restoration of forest areas, wider environmental policy measures positively affecting biodiversity, EU strategy to combat invasive alien species and EU research on biodiversity. Additionally, the report looks at the opportunity costs arising from foregone development opportunities, a cross-cutting and multi-sectoral cost category.

These areas are explored in an extensive literature review, utilizing existing reports, studies and research activities on associated costs. After identifying the various cost types and methodologies applied to calculate these costs, a synthesis and overall estimation of opportunity costs involved in biodiversity and ecosystem policies within the EU is presented. Finally, given the policy areas found to be lacking data, recommendations for a future methodology for estimating opportunity costs in biodiversity policies are presented alongside a typology of biodiversity costs.

Overview of costs incurred in selected areas of EU biodiversity policy

Data availability between the selected areas of EU biodiversity policy varied greatly. While concrete measures of costs could be identified for Natura 2000, agri-environmental measures and forest conservation (to some extent), data and figures were limited or very general for the marine environment and species programmes. For some Member States, especially the UK, detailed cost estimates were available across a variety of areas of biodiversity action. However, throughout these estimates, opportunity costs were found to be rarely reported as such. While they were perhaps reflected in financial transactions (e.g. through compensation payments, management agreements including payment for income foregone, or land purchases), they were generally left out of overall cost estimates. This holds particularly true in cases without compensation payments. The results of the

assessment including the significance of opportunity costs and the extent to which quantified estimates could be made are summarized below.

Executive Summary Table 1: Synthesis of costs incurred in EU biodiversity policy

Policy	Estimated Annual Costs (€m)	Estimated Opportunity Costs (€m)	Share of opportunity costs over total (%)
A. Natura 2000 Network	5,772	2,069	35.8
B. National Protected Areas	1,280	459	35.9
C. High Natural Value Farming	4,370	3,390	71.7
D. High Natural Value / Semi-natural Forestry	4,500+	4,500	n/a
E. Species Conservation	2,841	1,697	59.7
F. Marine Protected Areas	235	n/a	n/a
G. Biodiversity Research	648	n/a	n/a
H. Invasive Alien Species	193	Negative	n/a
I. Correction for Overlaps between above Estimates	-4722[1]	-3696	-
J. Total	**10,617**	**8,419**	**n/a**

Note: n/a = information not available

These estimates are illustrative and aim to demonstrate the broad scale of costs of conserving biodiversity and the significance of opportunity costs within these, acknowledging the high variance between Member States and even regions. **The combined cost of these different policy actions is roughly estimated at €10.6 billion per year. Within this, opportunity costs amount to approximately €8.4 billion**.

The overall costs of biodiversity conservation could be grouped into the following categories:

- Those resulting from *restrictions in land management* (€8.4 billion/year)
- Those resulting from the *use of scarce financial and human resources* that could be used for other purposes or developments (€2.3 billion/year)
- The unquantifiable costs of conserving biodiversity in the EU, including:
    - Loss of output as a result of *foregone development opportunities*
    - *Lost opportunity to a range of sectors*, such as fisheries and natural resource-based industries.

In addition, biodiversity conservation may give rise to 'opportunity benefits' by reducing the extent to which damage or over-exploitation of natural resources would result in reduced

[1] Based on following adjustments: N2K cost includes €2025m for agricultural land (assumed to be HNV) and €78m marine protected areas; national protected areas costs include estimated 35% HNV agriculture and 33% HNV forest; 50% of species costs estimated to overlap with other habitats; 50% of biodiversity research is assumed to be species related. Double counting of opportunity costs is estimated to be proportionate to that of overall costs.

output/income. Examples include long-term effects of fisheries conservation and control of invasive alien species. These benefits may exceed the opportunity costs of the policy, such that the 'net' opportunity cost of conserving biodiversity may be significantly smaller or even negative in the long-term.

Recommendations for estimating opportunity costs in biodiversity policies

Given the wide discrepancies in cost types and categories used in existing estimates of the costs of biodiversity action, a general cost typology was developed to enable the comparison of results from cost assessments based on different methodologies. The typology aims to deliver a clear categorisation of costs that could also serve as a model for an even broader application of the method beyond the project scope, and to allow for the integration of all relevant data from existing cost estimates.

Within this typology (see Executive Summary Table 2 below), **financial costs** are defined as real payments and expenditures for biodiversity actions (e.g. compensatory payments and management costs) that also include payments/expenditures for activities that are only indirectly associated with the action, but also have to be taken into account (e.g. administrative and transaction costs). In addition, opportunity costs that are internalised in existing expenditures, such as compensation payments and land purchases, belong to this category of costs.

Wider economic costs, on the other hand, include opportunity costs that have not been reflected in payments and therefore remain uncompensated. These include losses from foregone development opportunities, income foregone because of restrictions on the extraction of natural resources, and losses of socio-economic opportunities such as cohesion or job creation.

Executive Summary Table 2: A cost typology for biodiversity action

Cost category	Types of Costs	Examples
Financial Costs	**Costs of resources expended:** Costs of capital, labour, materials, energy Capital costs and recurrent management costs Administrative and transaction costs involving financial outlay	Labour and materials for fences around nature reserves Salaries and equipment of biodiversity researchers Materials, labour and equipment for construction of visitor centres Costs of developing and administering species action plans
	Costs that reflect opportunity costs: Payments to compensate for income foregone Compensation payments for foregone development/ exploitation rights Land purchase (reflecting income from land in alternative use)	Agri-environment payments to compensate for loss of cereals output from leaving fallow land for nesting birds Compensation payments to fishermen for establishment of marine nature reserve Cost of purchase of farmland to establish new wetland reserve

Wider Economic Costs	**Uncompensated opportunity costs:** Lost income from foregone development Loss of socio-economic opportunities Output restrictions on exploitation of natural resources	Loss of income from prevented commercial and industrial development Foregone opportunities for job creation and cohesion Loss of output of fisheries, wood, minerals, energy etc.

While this cost typology is foreseen to aid in the calculation of biodiversity actions across different policy areas, it must also be acknowledged that the cross-cutting nature of biodiversity conservation and the range of sectors involved evoke clear limitations for a comprehensive methodology. That being said, however, several considerations can help to ensure a maximization of coherency and usefulness in estimating costs. It is, for example, crucial to have explicit definitions that clarify the calculation methods utilised, actions and measures included, and extrapolations (if any) conducted to arrive at the given cost estimates. The degree to which the highlighted measures explicitly address biodiversity also warrants attention. Finally, opportunity costs for which no compensation is paid or for which estimates have not yet been established should also be acknowledged when discussing opportunity costs and creating cost assessment methodologies.

This report has been a first attempt to provide a comprehensive overview on costs for biodiversity and ecosystem actions in the European Union, a topic which had not been previously explored, and has lent significant contributions to the understanding of opportunity costs within the context of biodiversity policies. However, the definition of opportunity costs as a distinct consideration within cost calculations as well as their inclusion within EU and national biodiversity cost estimates warrant further development.

Table of Contents

Tables

Figures

1 Objectives and Approach

1.1 Background

The European Commission's mid-term assessment of progress on implementing the EU's Biodiversity Action Plan[2] acknowledges that the EU will fail to meet its target of halting the loss of biodiversity by 2010. This is confirmed by Habitats Directive Article 17 reports, which revealed that 50% of all species and up to 80% of habitat types deemed by the EU to be "of conservation interest" in Europe now have an "unfavourable conservation" status. The same is true for over 40% of European bird species. Although the mid-term assessment notes that some targeted measures to protect sites and threatened species have been a success, larger-scale and more comprehensive conservation actions are needed.

A key requirement underpinning biodiversity conservation is the protection of natural and semi-natural habitats and their associated species. This often conflicts with human development activities, which might lead to habitat loss and fragmentation and to intensification of land and sea use, possibly resulting in a further loss of biodiversity.

IEEP, MRAG and UNEP-WCMC recently carried out a review for DG Environment as part of the Biodiversity Knowledge Base contract (see Gantioler et al. 2009) on the reasons for the EU's failure to meet its biodiversity target. This review concluded that the EU has a relatively comprehensive legal and policy framework for the conservation of biodiversity. The main problem has therefore been a slow and incomplete implementation of the agreed upon actions, largely as a result of inadequate funding at a national level, an inadequate uptake of EU funds (see also Gantioler et al., 2010), and to some extent to Member States' weak enforcement of existing measures. Given the obstacles presented by under-investment in biodiversity actions as well as perceived conflicts with other policy goals (e.g. cohesion), a better understanding of *all* costs associated with biodiversity and ecosystem policy, including opportunity costs, would be helpful in addressing the challenges facing the EU in its work towards halting biodiversity loss. Various studies support this supposition (including Naidoo et al. 2006; Naidoo and Iwamura 2007; Balmford 2003), emphasising that a comprehensive and accurate assessment of various cost types across eco-regions or at area level is crucial for a cost-effective implementation of conservation actions. Opportunity costs comprise a central element of such cost considerations. This cost category reflects the perceived *foregone economic benefits from alternative activities or uses of a resource* on a particular site.

Opportunity costs can give rise to direct financial costs when they result in real payments and expenditures – for example where compensation is paid to those affected or where land is purchased for conservation purposes. However, there may also be wider economic costs (uncompensated societal costs). While compensation payments and land purchases can be helpful in representing internalised opportunity costs, uncompensated opportunity costs that

[2] Commission of the European Communities (2008): Communication COM(2008) 864 final, A Mid-term assessment of implementing the EC Biodiversity Action Plan, Brussels, 16.12.2008.

are not reflected in payments are much more difficult to estimate. As there are no accepted standards about which costs should be compensated or the most appropriate form for estimating appropriate amounts, estimates vary greatly. Thus, in practice, the perceived forgone benefits from the *most likely* alternative use are generally considered in cost estimates.

The relationship between biodiversity and ecosystem targeted actions and the resultant provisioning of ecosystem services adds an additional element of complexity to cost estimates. While the literature provides numerous methodological options for estimating some services (e.g. cultural benefits via willingness to pay[3]), provisioning and regulating services remain more abstract and difficult to quantify, particularly on a local level as their effects often extend beyond the geographic confines of the action in question. Such elements should, however, still be taken into consideration when calculating conservation (including opportunity) costs when possible.

Despite the complexities, however, the importance of establishing inclusive cost estimates remains. By informing and, if necessary, adjusting biodiversity policies and projects, such cost assessments would help to increase the efficiency of financing for conservation activities. They could, for instance, create new opportunities in moving conservation actions with equal biodiversity value to areas where opportunity costs (e.g. linked to land value) are lower, or on the other hand influence an increase in compensation payments in key biodiversity areas where opportunity costs are high. This latter impact could thus also increase the uptake of voluntary biodiversity actions by landowners.

Taking into account and compensating for the opportunity costs of resources often avoids their careless use. A focus on the inclusion of opportunity costs in assessments of total costs could also support assumptions that initiatives to sustain high levels of biodiversity are best implemented in low-intensity farming systems, not only at a national level but at international level (Kleijn et al. 2008). These assumptions are based on the fact that reducing the intensity of farming is more costly in intensive systems. Such systems have higher fixed costs for machinery, buildings and drainage, and higher compensation costs for reduced output and loss of income.

Furthermore, a clear understanding of all components of the costs of biodiversity action is needed if future policies aim to address the need for payments for ecosystems services (PES), in which case those who benefit from services compensate the regions and actors providing these ecosystem services. Such attempts have been proposed by many scientists (such as Naidoo et al. 2008 ; Layton 2009), however, a further design of payment schemes often fails because of the limited knowledge of the costs that accrue to those to be compensated.

[3] See e.g. Zander et al, 2010, exploring the trade-offs between development, culture and conservation for tropical river management in Australia via willingness to pay.

1.2 Objectives and scope of the study

This study aimed at estimating the costs of biodiversity action in the EU. Special consideration was given to opportunity costs, on the grounds that these are not covered substantially in the current literature. More specifically the aims of the project were the following:

- To identify the **types of costs** associated with biodiversity policy in the EU, including direct, indirect and opportunity costs
- To review the available literature to see if there are any **gaps in the cost analysis** – such as the opportunity costs of conversion to other uses, and to assess the extent of any gap
- To produce an estimate of the **total economic costs of biodiversity policy** (including opportunity costs) in the EU, namely:
    - **Financial costs:** real payments and expenditures for biodiversity actions (e.g. compensatory payments and management costs) that also include payments/expenditures for activities that are only associated with the action, but still have to be taken into account (e.g. administrative and transaction costs); also includes opportunity costs that are internalised in existing expenditures, such as compensation payments and land purchases; and
    - **Other economic costs**: opportunity costs that have not been reflected in payments and therefore remain uncompensated; includes losses from forgone development opportunities for different sectors (such as transport or tourism), income forgone because of restrictions on the extraction of natural resources (in fisheries or uncompensated restrictions on land use) and losses of socio-economic opportunities such as cohesion or job creation.
- To provide advice on how to systematically fill any such gap in the future and on the methodologies that can be used to address comprehensively all types of economic costs.

The project builds on previous and currently ongoing initiatives and projects, in particular the TEEB process and EU projects on the costs and benefits of Natura 2000 (Gantioler et al, 2010) and the benefits and costs of conserving biodiversity and ecosystem services globally (starting in parallel to this project). At the same time, results from the project, especially the cost typology, can directly feed in the work of these initiatives. It has to be noted that the focus of this project was on costs at EU level, while TEEB and other initiatives reflect on global level costs.

Reviewing studies that include estimates of opportunity costs of biodiversity action and drawing conclusions on total costs estimates and gaps that have to be filled in future analysis were the core topics of the project. There was therefore a different approach to the TEEB project which mainly concentrates on benefits from ecosystem services.

Opportunity costs are rarely considered in decision-making processes. The project examined from the literature which opportunity costs are easier to estimate and therefore are often tackled in respective studies and which opportunity costs are rather neglected due to

methodological difficulties. Moreover, driving factors that influence the volume of opportunity costs such as land productivity, infrastructure, natural value and property rights were analysed.

The report is structured as follows:

- Section 1 describes the objectives and the methodological approach of the study behind this report.
- Section 2 consists of synthesis chapters for all policies that were investigated in the literature review. The syntheses extract the most relevant information for the purposes of this study and present them in a standardised order in order to present a structured overview. The syntheses also form the basis for the overall cost estimate of biodiversity action on EU level.
- Section 3 presents a summary of the syntheses and an overall cost estimate for the EU. It further highlights information and data gaps found in the analysis and gives advice for a methodology for estimating the costs of EU biodiversity policies in the future. Section 3 ends with conclusions and policy recommendations.

1.3 Definition of biodiversity and ecosystem actions

In order to investigate the costs (and in particular opportunity costs) of biodiversity and ecosystem action, it is first necessary to define the overall programme of biodiversity related actions that give rise to costs. The focus for this study has been the EU Biodiversity Action Plan (BAP), which defines actions that are necessary to conserve and restore biodiversity and ecosystems, and thus their services, in the EU (and support conservation elsewhere). These measures include implementation of existing legal measures such as the Habitats and Birds Directives and the Water Framework Directive as well as non-binding measures (e.g. conservation management and habitat restoration through Axis 2 measures of the Rural Development Programmes), funding through regional and territorial development programme (e.g. Structural Funds) and control of invasive alien species.

The EU BAP, which accompanied the 2006 the European Commission Communication on 'Halting Biodiversity Loss by 2010 – and Beyond: Sustaining ecosystem services for human well-being' (COM (2006)216), describes a number of actions and outlines responsibilities of the EU institutions and Member States around four main policy areas. All of these measures give rise to costs (direct, indirect, opportunity) that can, in theory, be attributed in part or in whole to biodiversity conservation.

Under each policy area, measures are grouped around a range of targets. These are:

Policy Area 1: Biodiversity in the EU

1. To safeguard the EU's most important habitats and species
2. To conserve and restore biodiversity and ecosystem services in the wider EU countryside

3. To conserve and restore biodiversity and ecosystem services in the wider EU marine environment
4. To reinforce compatibility of regional and territorial development with biodiversity in the EU
5. To substantially reduce the impact on EU biodiversity of invasive alien species and alien genotypes

Policy Area 2: The EU and global biodiversity

6. To substantially strengthen effectiveness of international governance for biodiversity and ecosystem services
7. To strengthen support for biodiversity and ecosystem services in external assistance
8. To substantially reduce the impact of international trade on global biodiversity and ecosystem services

Policy Area 3: Biodiversity and climate change

9. To support biodiversity adaptation to climate change

Policy Area 4: The knowledge base

10. To substantially strengthen the knowledge base for conservation and sustainable use of biodiversity in the EU and globally

As the EU BAP describes more than 150 actions, this study focused on a subset of measures that were considered particularly relevant, grouping actions where appropriate.

First of all, as the objective of the study was to estimate the total economic costs of biodiversity policy in the EU, we focused only on those actions aimed at conserving biodiversity within the EU, rather than on the actions taking place on a global level.

Secondly, the analysis focused on a subset of key measures related to Natura 2000 (where a large share of the information on costs were expected to be found) and, more broadly, on actions referring to the conservation of biodiversity in the wider countryside, in the marine environment, related to regional and territorial development as well as invasive alien species. These refer, for example, to the requirements under the Bird and Habitats Directives, measures under Axis 2 of the Rural Development Programmes of the European Agricultural Fund for Rural Development (EAFRD), and other national and EU policies.

Initiatives under the Water Framework Directive (WFD), the National Emissions Ceiling Directive, and other EU directives were considered more challenging to assess given the difficulty in identifying which share of costs would be attributable to biodiversity and ecosystem actions and which would relate to other legislative objectives. Although these have been covered in the analysis, they are addressed in a more aggregated and less detailed way.

This approach allowed us to identify a subset of 23 actions which built on the BAP actions and targets and other relevant national and EU legislation. These in turn have been grouped into 9 macro-categories that aimed to reflect key EU biodiversity and ecosystem policies, namely:

- Natura 2000 - completion, implementation and management;
- Conservation and restoration of national protected areas;
- Species protection;
- Conservation and restoration of High Nature Value Farmland;
- Conservation and restoration of forests managed for biodiversity, including HNV forests;
- Conservation and restoration of biodiversity in the marine environment;
- Wider environmental policy measures positively affecting biodiversity (including water policy and pollution control)
- Invasive alien species; and
- Biodiversity research.

By employing this approach, key biodiversity and ecosystem actions could be addressed, while at the same time reducing the level of complexity and ensuring more flexibility in the analysis. The study also tried to account for possible overlaps between these categories as well as gaps within the cost estimates which may have arisen from excluded actions. Nevertheless, the clear identification of the selected categories ensures a more transparent methodology and easier usage within future cost calculations. An overview of the categories used and the actions they include is provided in table 1.

Table 1 Selected categories and actions extracted from the Biodiversity Action Plan (BAP)

Categories	Actions
Category A Natura 2000 - completion, implementation and management	**ACTION A1: Finalise the Natura 2000 network**
	ACTION A2: Achieve favourable conservation status
	Action A3: Strengthen coherence, connectivity and resilience of the Natura 2000 network
Category B Conservation and restoration of national protected areas	**Action B1: Management activities undertaken to maintain conservation status:** Establish and implement management priorities and necessary conservation measures to maintain conservation status.
	Action B2: Management Activities undertaken to restore conservation status: Establish and implement management priorities and necessary restoration measures for SACs and SPAs.
	Action B3: Strengthen coherence, connectivity and resilience of the network of protected areas
Category C Species protection	**ACTION C1: Implement existing species action or management plans for species under threat and implement additional species action or management plans for a wider range of species under threat**
	Action C2: Identify and fill critical gaps in EU ex-situ (zoo, botanic gardens, etc.) conservation programmes for wild

	species, in line with best practice
	Action C3: Implement a system of strict protection of animal species according to Article 12 and 16 of the Habitats Directive
Category D: Conservation and restoration of High Nature Value Farmland and forest area	**Action D1: Apply good agricultural and environmental condition**
	Action D2: Agri-environment measures and forest environment measures
	Action D3: Agriculture genetic resources
	Action D4: Implement sustainable forest management (SFM) according to Helsinki MCPFE resolution on SFM and measures required by Vienna MCPFE resolution on forest biodiversity
Category E: Conservation and restoration of biodiversity in the marine environment	**Action E1: Marine strategy: Introduce and implement fisheries management measures**
	Action E2: Ensure that fisheries resources are within safe biological (sustainable) limits and adjust fishing capacity
	Action E3: Take concerted EU action to combat illegal, unreported and unregulated fishing
	Action E1: Measures to achieve favourable conservation status of not commercially exploited species and habitats
Category F: Wider environmental policy measures positively affecting biodiversity	**Action F1: Invasive Alien Species**
	Action F2: Impact Assessment
	Action F3: Implement measures to achieve good ecological status of freshwaters
	Action F4: Reducing principal pollutant pressures
	Action F5: Measures for the conservation and restoration of green infrastructure for spatial planning
	Action F6: Other wider environmental measures (Water Framework Directive, pollution control measures, Thematic Strategy for Soil Protection, regional and territorial development strategies)

1.4 Methodological approach

The study followed a step-by-step approach to get as close as possible to an estimate of EU costs of biodiversity action. These steps include:

Review and analysis of existing reports, studies, and research activities on the costs related to EU biodiversity actions

The principal aim of the literature review was to gain a comprehensive overview of estimates of the costs of biodiversity action based on relevant available literature and studies. The

analysis provided information on the parameters which drive the level of these costs and identify variations between geographic regions and regional scales. Another important objective was the identification of the extent to which opportunity costs are considered in the literature. In order to approach existing literature in a comprehensive manner, specific thematic fields were distinguished based on the definition of relevant biodiversity and ecosystem actions (see section 1.3) and represented by the chapters under section 2. General descriptions and concrete estimates of costs were searched separately, with efforts made to identify and correct for overlaps between these fields (e.g. for agri-environmental measures and Natura 2000). The primary focus in the search for data was clear figures on opportunity costs for biodiversity and ecosystem actions within overall cost estimates. If these figures could not be found, general statements on the nature and current consideration of opportunity costs in the literature were sought and extracted. Moreover, current data gaps were described for the different thematic fields.

These steps describe a bottom-up approach that enables the project team to gain a clear understanding of opportunity costs for biodiversity actions and their determining factors in different contexts. Moreover, the literature review provides for an overview of the current knowledge and available figures of opportunity costs, but also on data gaps that need to be filled in order to generate cost estimates for biodiversity action at EU level. The full literature review can be found at the end of the report.

Identification of different cost types and methodologies applied to calculate the costs

Based on the information gained from the literature review, different cost categories and cost types were distinguished. Starting with a rough understanding of direct, indirect and opportunity costs for biodiversity actions, available cost estimates in the different sections were examined in terms of the cost types that were used. The cost types found in the different estimates were compiled in a cost typology that can be seen as both a comprehensive overview of costs incurred and as a tool for future analyses (see table 2 below).

Table 2 A cost typology for biodiversity action

Cost category	Types of Costs	Examples
Financial Costs	**Costs of resources expended*:** Costs of capital, labour, materials, energy Capital costs and recurrent management costs Administrative and transaction costs involving financial outlay	Labour and materials for fences around nature reserves Salaries and equipment of biodiversity researchers Materials, labour and equipment for construction of visitor centres Costs of developing and administering species action plans
	Costs that reflect opportunity costs: Payments to compensate for income foregone Compensation payments for foregone	Agri-environment payments to compensate for loss of cereals output from leaving fallow land for nesting birds

	development/ exploitation rights Land purchase (reflecting income from land in alternative use)	Compensation payments to fishermen for establishment of marine nature reserve Cost of purchase of farmland to establish new wetland reserve
Wider Economic Costs	**<u>Uncompensated opportunity costs:</u>** Lost income from foregone development Loss of socio-economic opportunities Output restrictions on exploitation of natural resources	Loss of income from prevented commercial and industrial development Foregone opportunities for job creation and cohesion Loss of output of fisheries, wood, minerals, energy etc.

*Note that all activities using scarce resources have opportunity costs in the sense that those resources have alternative uses; however, activities placing direct restrictions on the use of land and natural resources have additional and more direct opportunity costs.

This cost typology aimed at highlighting the nature and significance of opportunity costs within overall cost estimates, showing the relationships between opportunity costs and both financial costs (real payments and expenditures for biodiversity actions) and wider economic costs (societal costs not reflected in payments). Dividing between different cost types allowed for a structured and comprehensive approach towards overall cost estimates for biodiversity actions in the EU.

Moreover, methodologies applied for calculating costs were compared between the different sections in order to get a clear picture of heterogeneity within cost estimates and determine if results are reliable (see chapter 3.2). Examining the methodologies also allowed for recommendations to be made about how cost estimates can be streamlined in the future to get a more comprehensive picture of EU biodiversity costs.

Synthesis and overall estimation of opportunity costs of actions to conserve biodiversity in the EU context

The literature review informed a synthesis of the costs of different policies to conserve biodiversity, and of the opportunity costs of biodiversity conservation. For each of the key policy areas, the synthesis identified:

- The key actions required to address the EU Biodiversity Action Plan
- The types of costs involved, including financial costs and wider economic costs (including opportunity costs), and the nature and significance of these costs
- The key quantitative estimates available of costs at MS and EU level
- The approach adopted in assessing overall levels of costs and opportunity costs at EU level
- An overall assessment of costs, and as far as possible opportunity costs, at the EU level
- A review of the key methodological issues encountered and identification of gaps and further research needs.

The degree to which a detailed assessment of costs and opportunity costs was possible varied between the different policy areas and actions, depending on the quality of existing cost evidence. For most areas, it was possible to provide an overall quantitative estimate of the costs of biodiversity action, based either on existing EU assessments or by extrapolating from national estimates, especially from countries such as the UK where cost information is available for different biodiversity actions.

Based on the analysis of these estimates, quantitative assessments of the extent of opportunity costs within overall cost estimates were made. In addition, a wider, more qualitative or semi-quantitative assessment of the overall extent of opportunity costs at the EU level was given, drawing on available examples in as far as possible.

Gap analysis of cost estimates

The analysis identified numerous examples where insufficient data are available. For some policies, available evidence did not permit an overall estimate of opportunity costs to be made. For each policy, an assessment is provided of the degree to which it has been possible to identify and quantify overall costs and opportunity costs, and identify where there are significant data gaps that would benefit from future research.

2 Overview of Costs Incurred in selected categories of the EU Biodiversity Action Plan (BAP)

This chapter represents a synthesis of the review and analysis of costs incurred in different policy fields that are relevant in the context of EU biodiversity action. Before dealing with the different policies, the cross-cutting issue of forgone development opportunities from biodiversity conservation action as special category of opportunity costs is discussed (see chapter 2.1). Such forgone development opportunities occur in almost all policies/actions outlined in the subsequent chapters.

The structure of the policies sections follows the BAP categories presented in chapter 1.3, elaborating for each category the costs incurred and available estimates for the EU. For practical reasons category D was split into two, dealing with HNV farmland and the conservation of forests in two separate chapters. In addition to the BAP categories, costs for biodiversity research are highlighted in chapter 2.9 followed by a general discussion on foregone developments derived from opportunity costs of biodiversity action (chapter 2.1). Each subchapter on the BAP categories is divided in the following sections stressing respective issues:

Overview of the policy

- Overall aims and objectives
- Types of activity involved
- Scale of activity involved (e.g. area, number of projects etc) across EU

Types of costs

- Qualitative assessment of the costs resulting from policy action – referring to cost typology and identifying different types of financial and economic costs
- Qualitative assessment of opportunity costs – what types of opportunity costs and the nature and extent of these?

Overview of available cost estimates

- What types of evidence are available?
- Extent of EU, national, regional cost estimates
- Degree to which costs can be quantified
- Degree to which opportunity costs can be quantified

Methodology for overall cost assessment

- Proposed method for assessing overall costs of biodiversity action
- Proposed method for assessing opportunity costs of biodiversity action

Assessment of costs at EU level

- Overall costs
- Opportunity costs

Gaps and methodological issues

- Degree to which overall costs are understood and can be quantified
- Degree to which opportunity costs are understood and can be quantified
- Robustness, completeness, reliability of estimates made
- Key data gaps
- Key methodological issues and challenges

2.1 Foregone development opportunities

Introduction

Development-related opportunity costs incurred as a result of biodiversity and ecosystem conservation policy are primarily evoked by restrictions on acceptable uses of and conversion opportunities for natural areas. While no concrete categorisation exists to date regarding the degree of or variance among such foregone opportunities, influencing factors have been cited as: the level of restriction[4] and, when a project has been devised, if it is rejected, modified or delayed (see e.g. Eppink and Wätzold, 2009). Additional aspects affecting the level of opportunity costs can also serve as indicators of the significance of foregone development opportunities, such as land productivity, infrastructure, distance from an urban centre, market price, value of adjacent areas and profitability (Mathur and Sachdeva, 2003; Lovell and Sunding, 2001).

A unique consideration regarding foregone development opportunities is the time aspect of the imposed restrictions. By limiting acceptable future developments, the current market value of a property will be affected (Lovell and Sunding, 2001; Adler, 2008). This can create a perverse incentive for landowners to develop immediately instead of deferring the decision to develop until later, thereby avoiding the risk that restrictions may be imposed at a later time (Adler, 2008).

Within the European Union, foregone development opportunities may occur within a diverse range of sectors. Land use and marine and coastal management restrictions are especially relevant for agriculture, forestry, fisheries, rural and urban cohesion (e.g. road construction, train routes), spatial planning, renewable energies (e.g. biogas, wind, hydro) and tourism (e.g. regarding access and infrastructure). Constraints placed on these sectors are generally rationalised when an area is found to contain high levels of biodiversity and/or is designated as a protected area. Yet, several development-focused policies relating to these sectors may encounter situations in which their goals, e.g. those of the EU's cohesion policy, come into conflict with conservation objectives. A relevant European example is the development-related opportunity costs arising from restrictions on Natura 2000 sites (see Box 1 below). For this reason, in general, coordination among policies and between countries to find an optimal level of coherence taking different goals into account and come to well-balanced decisions is necessary.

Box 1 Examples of development-related opportunity costs of Natura 2000

Establishing the Natura 2000 network is at the core of the Habitat and Birds Directives. These two directives provide a process for evaluating potential adverse effects on

[4] Restrictions can range from absolute denial of land use to strong restrictions allowing only a select few practices to low restrictions on common practices.

nature conservation from infrastructure development and other human activities. In the best case, alternative locations or development options are identified. However where these are not feasible, the Directives also enable mitigation or compensation measures to be identified to mitigate any negative impacts as far as possible.

Despite this 'resolution' mechanism, there have been cases where development has been entirely restricted or denied due to excessive environmental impacts that could not be resolved. For instance, the Commission delivered a negative opinion on the development of a new industrial and commercial area near Siegen in North-Rhine Westphalia, Germany due to unjustified adverse effects of the project on one of the 29 proposed Natura 2000 sites nearby.[5] In Scotland, plans by Lewis Wind power for a 181-turbine wind farm at Barvas Moor on the Isle of Lewis, Scotland were refused in 2008 due to the serious impact the development would have on the Lewis Peatlands Special Protection Area.[6] However, in 2010 the Scottish Government approved planning for a wind farm in Muaithebhal, 40 miles south west of the rejected Lewis Wind Farm, which lies partly in the Lewis Harris and North Uist National Scenic Area.[7] The application was approved by reducing the original plan from 51 to 39 turbines, and by imposing other conditions to protect the natural environment (e.g. requiring an ongoing 1% contribution of the turnover to the Muaitheabhal Community Wind Farm Trust to enhance the ecological and cultural heritage resource of the Eisgein Estate). The development will create roughly 150 construction jobs, and will source local materials and labour where possible.[8] Further examples of foregone or restricted development due to Natura 2000 designation are given in the table below.

Table 3 Examples of restriction to future land use or development due to the assessment of plans and projects on Natura 2000 sites[9]

Sector	Limitation	Reference (e.g. Natura 2000 site)
Transport	Ban on road development in NATURA 2000 area/ Different trace of road avoiding NATURA 2000 area	Rospuda Valley (Poland), Krasn gorge (Bulgaria); Monte el Pardo (Spain); Naardermeer (The Netherlands), Buzau river (Romania); Lech Valley(Austria); Strait of Gibraltar (Spain); Santona marshes(Spain)
	Restrictions to port expansion	Rotterdam (Netherlands), Liverpool (UK); Estuary (UK); Bristol (UK); Antwerp (Belgium);

[5] http://www.ens-newswire.com/ens/apr2003/2003-04-28-02.html

[6] http://www.scotland.gov.uk/News/Releases/2008/04/21102611

[7] http://www.viewsofscotland.org/snp_conference/LewisSurveys-01Nov07-MedRes.pdf

[8] http://www.thescottishfarmer.co.uk/news/this-weeks-news/lewis-windfarm-approved-1.998938

[9] http://ec.europa.eu/environment/nature/natura2000/management/docs/report%20LOT3_Task%201-European_review.pdf

		Göteburg (Sweden)
	Restrictions to dredging of shipping lanes and/or deposition of sediments resulting from dredging activities	Humber estuary (UK); Dragaggi (Italy)
	Restriction to airport expansion	Finland Pomponrahka Expansion of Turku airport on adjacent bog
Tourism	Rejected expansion of tourist facilities (hotels, campsites, ski-slopes, gold courses)	Zakopane (Poland); Beskidy (Poland); Mount Olympus (Greece); Wendler & Jessel, 2004; Netherlands country study; Wörschacher Moos (Austria); Geuldal (Netherlands)
Urban / industrial expansion	No construction allowed	Santona marshes (Spain)
Agriculture	Restrictions to expansion of business/change in type of business	Overijssel / Peelvenen regions (Netherlands)
Fishery	Ban on certain fishery techniques	Waddensea (The Netherlands)
	Ban on fish farming	Santona marshes (Spain)
Energy	No construction of windmills	Lewis Wind Farm (UK); Volovja reber (Slovenia)
	No construction of solar panels	Karts region (Slovenia)
	Construction of dams for hydro-electric power	Potential future disputes on various rivers in Slovenia

In a speech by Stavros Dimas, the EU Commissioner noted that Natura 2000 "quite intentionally puts limits on unconstrained developments that damage nature". However, from more than 25,000 Natura 2000 sites across the EU, only 20 cases a year require compensation measures. He therefore concludes that "it is hard to make a serious case that 20 cases per year - spread across 25,000 sites - represent an excessive obstacle to the overall development of the European economy".[10] It should be noted, however, that a larger and unknown number of sites might be developed were they not protected by Natura 2000 designations – thus the true extent of the opportunity costs arising from the network is difficult to estimate.

It is sometimes argued that the EU too readily allows developments that have

[10] http://www.europa-eu-un.org/articles/en/article_7828_en.htm

excessively adverse impacts on Natura 2000 sites, for example by approving a railway in Sweden, a coal mine expansion in Germany, and the expansion of the Rotterdam Harbour in the Netherlands on the basis of "overriding public interest" and the lack of feasible alternatives regardless of the adverse affects on Natura 2000 sites (although compensation measures were proposed).[11]

It is clear that there are conflicts between development and conservation, although the extent of this conflict is debateable. Most recently, environmentalists have called on the EU to take action against 'wild capitalism' which is leading to the 'vandalism' of protected natural habitats in Bulgaria. In a petition, the Bulgarian Society for the Protection of Birds has documented sixteen cases where entrepreneurs have violated Natura 2000 obligations by constructing tourist resorts, golf courses and ski slopes, wind farms, hydro-power plants and by undertaking sand and gravel extraction, and intensive wood production in Bulgaria's protected areas.[12]

Nonetheless, there are clear cases where conflict management has led to acceptable resolutions. For instance, in the Wadden Sea of the Netherlands, there have been long standing conflicts between nature organisations and fishermen on the use of the area for catching mussel seed using techniques which were considered to be causing too much damage to the ecosystem. An agreement was eventually reached to phase out current fishing techniques while new ones are developed. Thus the current technique to catch mussel seed using a 'boomkor' has been allowed until 2020, while the fishermen's federation invests instead in catchment installations float or are suspended in the water and on which the young mussels will attach themselves, thus catching mussel seed without causing disturbance of the seabed. Although the conflict with regard to mussel seed fishing has been resolved, cockle fisheries have been totally banned as part of Natura 2000 site restrictions.[13]

The following section will provide an overview of available costs estimates for this category of opportunity costs, approaching the topic from a sectoral perspective. Subsequently, considerations relevant to the effects of development restrictions within the context of biodiversity policies on a local versus regional and national scale will be presented, including data availability considerations.

Overview of available cost estimates

An analysis of foregone development opportunities from biodiversity and ecosystem action is only possible if specific sectors, scales and locations are taken into account as costs vary considerably both in spatial terms and with changing conditions. In principle, however, conceptual extrapolations are indeed possible and form the basis of the following analysis.

Some conservation schemes, such as Natura 2000, already recognise the foregone development aspect of conservation. In this case, an estimated 5% of its total expenditures are used to compensate relinquished development rights (see table 30 in Annex A for a

[11] http://www.ens-newswire.com/ens/apr2003/2003-04-28-02.html

[12] http://www.birdlife.org/eu/pdfs/Nature_Directives_material/Portfolio_texts%20_final.pdf; http://www.euractiv.com/en/climate-environment/wild-capitalism-destroying-habitats-bulgaria-news-497105

[13] http://ec.europa.eu/environment/nature/natura2000/management/docs/report%20LOT3_Task%201-European_review.pdf

detailed breakdown of Natura 2000 costs). Considerations within this cost category include the effects on land prices of neighbouring areas and restrictions for the transport, tourism and construction sectors as well as mining and extraction activities (European Commission, 2004). Foregone development opportunities within these sectors arise either from restrictions regarding land conversion allowances (e.g. for mining and biomass production) or acceptable usages (e.g. for wind farms and transport infrastructure).

Within the areas of **agriculture and forestry**, foregone development opportunities often arise as a result of maintaining current habitats and practices complementary to biodiversity conservation goals. The loss of such opportunities results from forfeiting all future streams of income associated with conversion of the property (Chomitz, 2005). Development restrictions altering future land uses for agriculture and farmland can theoretically be reflected in market values and thus measured via changes in the market prices of the given land area (Lovell and Sunding, 2001).

In the case of restrictions on the application of environmentally damaging technologies or on expansions of agricultural areas, for example, the potential for yield and production increases may be reduced and, accordingly, future job creation may be affected. While less extensive organic agriculture offers the potential for long-term job creation and the maintenance of said jobs due to high labour requirements and sustainable practices, expanded large scale operations may create fewer jobs in the long run due to the lower input requirements obtained by using time saving technologies and unsustainable practices.

While agri-environmental measures do not currently compensate or mention foregone development considerations outright, payments in the form of compensation are being made for income forgone from restrictions on agricultural practices in an effort to prevent conversion to intensive agriculture or habitat abandonment. Although these payments may primarily target goals other than biodiversity conservation (e.g. reducing pollution or the overuse of water resources), they can still be considered a proxy for this cost type as prevented conversion regardless of the reason has the potential to result in foregone development costs. However, the relevance to biodiversity and ecosystems as such must be more clearly identified when calculating targeted cost estimates. These impacts and the subsequent opportunities foregone also require more research as they are highly variable depending on the type of production and associated labour inputs. For the purposes of this report, the proportion of payments addressing foregone income was estimated, focusing on those most relevant to biodiversity.

Forest conservation literature addresses the costs of foregone alternate land uses more explicitly than in the case of agriculture, including e.g. parking lots, industrial facilities, urban development, or conversion to agricultural or grazing land. Although concrete cost estimates have yet to be determined, several methods for calculation have been proposed. Assuming that the opportunity costs for development take account of “all economic outputs foregone or precluded by maintaining land under forest cover”, the amounts that could be earned from the individual alternative forms of land utilization would be the possible foregone development opportunity costs Mathur and Sachdeva, 2003); when including this amount in cost calculations, however, either a single alternative use or the sum of several compatible uses may be selected. More specifically, the market prices of comparable land could be used as a measure of the highest valued alternative use of a forested area, provided that all of the values of alternative uses are sufficiently reflected in such land prices, which is not always the case.

Spatial planning is one sector that is particularly affected by conservation-based land use restrictions, both in terms of urban considerations as well as the maintenance of agricultural land. Incurred costs have the potential to extend to development plans for industrial, housing, infrastructural or recreational purposes given the scarce nature of land as a resource and the preclusion of using the land for alternate purposes. Species or habitat

considerations may be responsible for rejecting, modifying or delaying planned projects (Eppink and Wätzold, 2009).

Eppink and Wätzold (2009) explored this phenomenon in Mannheim, Germany, focusing on development restrictions aimed at protecting the local hamster population. Four highlighted projects were found to be impacted by such measures, resulting in the size of residential area and a parking lot being reduced, a building project being delayed by a year and an area of agricultural land being turned into a nature reserve. Given the lack of a visible exchange of financial resources illustrating these modifications, the hidden costs of the incurred foregone development were examined and estimated at between approx. €20 and €38 million Euro for the studied Mannheim region (Eppink and Wätzold, 2009).

Within the context of increasing **cohesion** via expanded transport networks, construction projects for roads, airports and ports are also impacted by the aforementioned conservation-induced restrictions. European Cohesion Policy aims to enhance accessibility and promote "balanced and harmonious development" to reduce regional inequalities imposed by geographic remoteness (Samecki, 2009). While this policy and Natura 2000 both emphasise the sustainability aspect of development, their primary objectives (development and conservation, respectively) can be in opposition. Thus, a compatibility assessment of foreseen development projects is required by Article 6(3) of the Habitats Directive as part of Natura 2000 in order to uphold envisioned environmental standards.[14] Such requirements are sometimes responsible for delays in project execution or adjustments in development plans, having resultant impacts on European connectivity.

In Rospuda River Valley in Poland, for example, the construction of a highway intended to connect the Czech Republic, Poland and Finland has been put on hold due to its violation of environmental restrictions. Although the project has been ongoing for the past 10 years, entrance into the EU by Poland in 2004 activated new laws enforcing designated European protected areas. According to the Royal Society for the Protection of Birds (RSPB), planned construction would damage a protected peat bog and threaten lynx, wolf and greater spotted eagle populations, among others.[15] Conditions set out by the Habitats and Birds Directives outline the needed requirements for resuming of construction; until these standards are met, delays or a complete rejection of the project jeopardize Poland's opportunity to improve trade via this freeway with its neighbours.

A similar situation revolving around the construction of the 'Port of Granadilla' on the Spanish island of Tenerife is also currently being debated. Foreseen threats to 53 bird species reliant upon an area protected by the Habitats Directive provided the justification for stopping this port's construction in early 2009.[16] The ruling stated that "the significant negative economic impacts" of the injunction could not "outweigh the risk of damage to the environment".[17] Estimates predict that, if constructed, the port would have created 2000 construction jobs, 10000 skilled positions jobs and 300 innovative enterprises.[18] Additionally,

[14] This article outlines the necessary aspects of an Environmental Impact Assessment needing to be conducted and approved before beginning construction (EC: Financing Natura 2000).

[15] http://www.spiegel.de/international/0,1518,468629,00.html

[16] http://secret-tenerife.blogspot.com/2009/03/up-to-50000-say-no-to-granadilla-port.html

[17] http://www.endseurope.com/20833

[18] http://www.gobcan.es/noticias/index.jsp?module=1&page=nota.htm&id=133161

the port would have expanded Tenerife's connections abroad and improved the chance to be integrated into the global maritime transport networks.[19]

Cases like these, in which Natura 2000 or other environmental standards prevent the construction of transport-related infrastructure, can work against cohesion goals. Consequently, economic development may be hindered in inaccessible (rural) locations, placing those areas at a comparative disadvantage and presenting the loss of significant development opportunities. Greater coherence between environmental, cohesion and development policies and funds should be addressed in order to minimise and more evenly distribute such foregone opportunities.

The **renewable energy sector** provides another interesting example of costs incurred from foregone development opportunities. Restrictions on the acceptable usages of land can be seen through, for example, the construction of onshore wind farms. Alternatively, restrictions on allowed conversions of select areas come into effect in the case of e.g. efforts to expand Europe's bioenergy potential.

Scotland's planned construction of what would have been one of Europe's largest onshore wind farms with 181 turbines on the Lewis Peatlands Special Protection Area (SPA) was rejected, despite producing subsequent proposals incorporating 'environmentally friendly' modifications. The ground for rejection was the potential "significant adverse impacts" it would have posed to rare and endangered birds living in the area in which the SPA was originally designated (Royal Society for the Protection of Birds, 2007). More quantitatively, foregone development opportunities can be illustrated by the estimated 400 jobs and £6 (€6.86) million annual contribution (in the form of rental payments) that the wind farm would have made to the Island of Lewis' economy.[20]

Another quite illustrative example of how restrictions on land use could reduce the potential economic development of renewable energies is provided by a study from the EEA, produced in 2006. The study estimated the biomass potential for bioenergy that can be produced in the EU without harming the environment, taking objectives for biodiversity protection and other considerations into account. Restrictive criteria for avoiding additional environmental pressure from biomass production from agriculture are as follows (see EEA, 2006):

- At least 30% of the agricultural land in most Member States is dedicated to 'environmentally-oriented farming' in 2030 (defined as HNV-farmland or organic farming).
- 3% of the currently intensively cultivated agricultural land is set aside for establishing ecological compensation areas in intensive farming areas.
- Extensively cultivated agricultural areas (e.g. grassland or olive groves or 'dehesas') are maintained.
- Bioenergy crops with low environmental pressures are used.

According to the study, the environmentally compatible primary biomass potential from agriculture could reach up to 142 million tonnes oil-equivalents (MtOE) by 2030, compared to 47 MtOE in 2010. Unfortunately, the study does not include figures on how much biomass could be supplied *without* taking the aforementioned restraining factors into account but, for example, the almost 6 million ha of released permanent grassland (as well as parts of the olive grove and 'dehesa' areas) were assumed to be excluded from dedicated bioenergy

[19] http://www.tenerifecaptialbusiness.info/porque/proyectos.asp?leng=eng

[20] http://www.guardian.co.uk/environment/2008/apr/22/windpower.greenpolitics

production in 2030. Subsequently, regions dominated by such types of land use would not benefit from future European bioenergy developments. Other regions endowed with highly productive agricultural land might face constraints in making additional land available for biomass production due to the assumed 'set-aside' obligation. This example demonstrates that European targets for biodiversity[21] can restrain the development of a sector whose growth is actually needed to achieve the objectives of other EU environmental policies, i.e. the target of achieving 20% renewables by 2020, in this case.

Finally, the **non-energy extractive industry** (NEEI) is regularly faced with restrictions regarding acceptable extraction practices and site selection. Decisions on these aspects must be in accordance with established biodiversity protection measures. Regarding designated Natura 2000 areas, extractive activities need to be conducted in such a way as to not compromise the ecological quality of the selected sites. (European Commission, 2004) These conditions frequently inflict local opportunity costs in terms of evoking time delays and mandating alternative, satisfactory methods of extraction. Large scale inequalities resulting from foregone development opportunities are also incurred due to the non-uniform allocation of mineral resources across Europe (European Commission, 2010) and the differing acceptance rates for extraction activities depending on the level of biodiversity present in and protected area status of the commercially viable site.

Conclusions

The sectoral overview of foregone development opportunities presented in this chapter aims to introduce both the conceptual aspects of such opportunity costs as well as practical examples from within Europe. However, estimates of the aggregated effects of conservation-induced restrictions are not possible on an EU-wide scale. This is partly a result of limited data availability (particularly regarding quantitative assessments) and large outstanding gaps in the literature. More importantly, however, site level estimates cannot be aggregated at the EU scale because of problems of additionality. Even where opportunity costs can be measured at a local level, regional or national assessments are problematic because it is difficult to assess the net effect on overall development levels at these scales. While conservation of biodiversity and ecosystems may restrict development locally, this development will often be able to take place in a more suitable location elsewhere, such that the overall opportunity cost regionally or nationally is less than the sum of opportunity costs arising at individual sites. However, several trends within this cost category have been discovered and are presented below.

In contrast to the often individual nature of the opportunity costs outlined throughout this paper, the effects of development restrictions and resulting foregone opportunities can also affect regional and macro-level economies. Although such biodiversity based restrictions are generally applied on a more localised scale, the implications have the potential to shape opportunities on a regional, national or even EU-wide scale. This important spatial dimension subsequently impacts the distribution of associated economic costs and benefits.

Examples have been cited in which development restrictions are induced in an effort to protect biodiversity and their habitats, thus also helping to protect the services provided by the targeted ecosystems. These limits can generate opportunity costs at a local level, such as in the case of the executed building restrictions in Mannheim, Germany to protect the hamster population or the rejected wind farm development on the Island of Lewis in Scotland. The geographically specialised nature of these land use restrictions may prompt the planning system to shift the development to an alternative area with fewer or less severe

[21] It should be noted that the targets represented by the aforementioned criteria likely represent the minimum requirements to achieve a halt in the decline of biodiversity on EU agricultural land.

controls or, alternatively, an area deemed more suitable for development in terms of creating fewer threats to biodiversity. While this trend would result in decreased or perhaps eliminated opportunity costs at a regional or national level (assuming the new sites were also economically viable for the development purpose[22]), such variability could motivate a 'race to the bottom'. By lowering restrictions, an area could choose to sacrifice biodiversity objectives in an effort to attract economic actors and development activities. Furthermore, if no suitable sites can be found within a nation or even within Europe due to high restrictions, industry companies, e.g., could leave the continent and relocate sites to countries outside of the EU prioritizing biodiversity to a lesser degree.

On the other hand, certain sectors or development projects do not have the possibility to simply relocate their planned activities; in these cases, biodiversity conservation has the potential to produce regional or national opportunity costs. This point is emphasised by the unequal distribution between regions with high biodiversity value and those able to maintain a more concentrated focus on economic development. Two examples within the area of cohesion were outlined, illustrating the national costs incurred as a result of local infrastructural restrictions (i.e. freeway construction in Poland and the building of a port in Spain). Implications for access to trade and connectivity arise in these cases and, as alternative sites within the countries are not possible, national growth and development opportunities are ultimately restricted. Moreover, land use regulations are invariably focused on underdeveloped parcels, as opposed to those that have already been developed. (Adler, 2008) This characteristic causes an accentuated imbalance in the overall level of development in more versus less developed countries in addition to those having higher or lower levels of biodiversity.

Table 4 Types of opportunity costs incurred due to conservation restrictions

Scenario	Opportunity costs (OC)	Examples
Development takes place at an alternative, equally suitable site	Local OC due to loss of output and employment No opportunity cost at regional/national level	General commercial or industrial developments.
Development takes place at another site that is less economically attractive	Local OC due to loss of output and employment Opportunity cost at regional/national/EU level equivalent to marginal change in output, employment and utility compared to original site	Tourism development shifted from attractive coastal or wetland location to less attractive site. Development may be kept on a smaller scale as a result. May apply to wide range of developments where location specific factors are important.
Development takes place at another site, affecting development costs	Local OC due to loss of output and employment Wider opportunity costs	Commercial, industrial or residential developments faced with additional costs due to increased difficulty of access or higher costs of water supply

[22] In cases in which development is forced to take place on a 'second best' site in terms of economic considerations, the opportunity cost would be equivalent to the marginal benefit foregone as compared to the original, preferred site (see Table 4).

	equivalent to extra development costs to sector or industry concerned	or other infrastructure.
Development does not take place as no suitable alternative site exists	OC at local, regional and possibly national and EU level due to reduced overall level of development (scale of effect depends on specificity of site needs)	Tidal barrage across an estuary for which only a few suitable sites are available – conservation has the effect of reducing overall level of development. Development of wind energy restricted by a shortage of suitable sites without conservation designations or restrictions.
Development of strategically important site for transport or cohesion is prevented	OC at local, regional, national and potentially EU level due to prevented cohesion benefits and reduced or eliminated access to trade and transport	New port development or major national/EU transport link.

As becomes evident by this review, further research is needed within the area of foregone development opportunities. Replacing effects and national level implications for development, particularly regarding cohesion aspects, are of central importance when considering conservation policy. There is a risk that biodiversity protection as a whole may not improve if negative environmental impacts are simply shifted to other areas, unless of course the relocation takes place in a more suitable, less sensitive area presenting fewer risks to biodiversity. Again, however, great variances between the outlined sectors exist, often preventing the feasibility of such location shifts. This unique consideration of development highlights the need for a coordinated EU-wide approach to conservation. Furthermore, additional quantitative studies examining this type of opportunity cost are necessary within the outlined sectors, also reviewing the larger scale effects incurred via local restrictions. Included within this research should be substantiated estimates of the aggregated effects of foregone development opportunities on a European scale, both generally as well as for individual sectors.

It should be noted that this chapter only stressed the costs incurred in foregone development opportunities imposed by biodiversity action. For future research and to avoid a narrow approach to the topic that could lead to an erroneous perception of biodiversity protection, benefits arising from conservation actions must also be taken into account. Such a comparison, which automatically leads to a cost-benefit analysis, needs to deal with different levels of quantification that can be conducted and differentiate between those benefiting from a development and those incurring most of the negative consequences as a result of such restrictions. Moreover, costs and benefits have to be evaluated across different time scales when designing policies in order to avoid the prioritization of short-term benefits for few actors at the expense of long-term benefits for the wider public or, alternatively, lower short-term costs leading to higher costs in the future.

2.2 Natura 2000 (Category A)

Overview of the policy

Natura 2000 is the centrepiece of EU nature and biodiversity policy, and is a network of special sites designated under the EU Birds and Habitats Directives. The network currently comprises more than 25,000 sites, and accounts for more than 17% of the EU land area.

Member States are required to protect Natura 2000 sites and promote their management in order to achieve favourable conservation status.

Implementation of the network typically involves a wide range of activities to support the designation of sites and their ongoing protection and management. These actions include survey, research and monitoring work; management planning; consultation and communications; the development of infrastructure for visitors and for site management; the restoration, re-creation and management of habitats; advisory and training activities the purchase of land at certain sites; and the implementation and administration of management agreements.

Types of costs

Implementation of the Natura 2000 network gives rise to a range of financial and economic costs.

The **financial costs** of the network have been assessed through a recent study for DG Environment, which categorised them as follows:

One-off costs associated with the establishment of the network, including:

- Management costs - finalisation of sites (scientific studies, administration, consultation etc), management planning (preparing management plans, establishing management bodies, consultations etc.)
- Investment costs - land purchase, one-off payments of compensation for development rights, and infrastructure costs (both to support conservation work and for public access/interpretation)

Recurrent costs associated with ongoing management activities to maintain or improve sites, including:

- Management planning - running costs of management bodies, review of management plans, and public communication.
- Habitat management and monitoring - conservation management measures; implementation of management schemes and agreements; compensation for rights foregone and loss of income; monitoring and surveillance; maintenance of infrastructure; risk management (fire prevention and control, flooding etc).

Most of these costs are incurred by the public sector, which is responsible for ensuring the protection and management of the network for the public good. However, much of the network is privately owned and these costs therefore include management agreements with private owners and managers of land and associated compensation and incentive payments.

The **opportunity costs** of the network include:

- **Foregone development opportunities** – the protection of sites may prevent their use for built development, including housing, industrial, commercial, energy, tourism and infrastructure developments. This may reduce economic output and/or lead to a wider loss of social benefits;

- **Foregone opportunities for land use change** – Natura 2000 status reduces opportunities to "improve" or convert land for intensive agriculture and forestry, and may therefore reduce the output of land management;
- **Foregone output through constraints on land management/land use practices** – management of sites may reduce output by constraining farming and forestry practices (e.g. through reduced stocking rates, chemical application, timber harvesting etc.).

These opportunity costs are reflected in the financial costs of the network to some extent. For example:

- **Purchase of land** is most likely to take place in situations where there are conflicting pressures and development options. The price should reflect the returns that can be expected from that land in alternative uses;
- **Payment of compensation** for foregone development rights or ongoing management constraints is designed to offset the opportunity costs of managing the land for nature. Providing compensation payments reflect the income foregone from not changing the use of the site, they should be a good reflection of opportunity costs;
- **Management agreements** normally involve payments to land owners/managers, which are likely to reflect the costs incurred and income foregone resulting from the prescribed management practices. The income foregone element should reflect the opportunity costs of alternative land management practices. Expenditure on management agreements is not estimated separately but forms an important element of the recurrent cost of habitat management.

Overview of available cost estimates

The costs of the Natura 2000 network have been estimated through a study by IEEP, GHK and Ecologic for DG Environment[23]. Based on a questionnaire survey of Member States, this study has made an overall estimate of the financial costs of implementing the Natura 2000 network. The results are based on data provided by 25 Member States (all except Finland and Romania) which are extrapolated to provide overall estimates for the EU27.

The cost estimates are based on financial resource needs over the period 2010 to 2015 and focus on the costs to the public sector, rather than providing an overall assessment of the economic costs of the network. Therefore any costs incurred by the private sector and for which compensation is not paid are largely excluded. Opportunity costs are therefore included only to the extent to which they result in the payment of compensation or management agreements, or involve the purchase of land.

The figures represent the best estimate of the financial resources required in each of the Member States to implement and manage the network so as to achieve favourable conservation status. The EU has committed itself to co-funding the network so part of the overall cost will be met through EU financial instruments.

[23] IEEP, Ecologic and GHK (2010) Costs and Socio-Economic Benefits associated with the Natura 2000 Network. Draft report to DG Environment.

Although not all MS provided detailed breakdowns of cost estimates, based on the returns provided it is possible to make overall estimates at the EU level according to the cost categories used by the questionnaire. While opportunity costs are not separately identified in the analysis, it is possible to provide an assessment of the portion of the cost estimates that relate to opportunity costs with reference to the categories above (land purchase, compensation payments and management agreements). Examples of identified financial costs of the network which relate to opportunity costs are given in Box 1.

Box 2 Examples of the Opportunity Costs of Natura 2000

Bulgaria – compensation is paid under the Water Framework Directive for owners of agricultural land and forest land with water bodies in Natura 2000 areas. This involves one-off payment of €12.5m to compensate landowners for restrictions imposed.

Cyprus – figures are dominated by estimated one-off costs of €750m for purchase of 25,000 hectares of land by the authorities. This figure applies to both existing and newly designated Natura 2000 sites.

Czech Republic – figures include annual compensation payments of CZK 120 million (€4.5m) as compensation for damage caused by species in Natura 2000 sites, as well as CZK 410 million (€15.5m) for payments under agri-environment agreements.

France – the main cost is that of management schemes, estimated at €328m annually; land purchase is estimated at €300k per year; no compensation is paid for foregone development rights.

Greece – costs include one-off cost of €45.7m, for purchase of wetland, cultivated, pasture and forest land and recurrent costs of €5.0m annually for agri-, aqua- and forest environment measures; no compensation for foregone development is paid.

Hungary – costs include €20m for purchase of privatised agricultural land, wooded steppes and hardwood galley forests whose conservation objectives cannot be reconciled with existing management. Agri-environment payments amount to €111m annually and include schemes targeted at species, such as great bustard, red-footed falcon, cranes and geese, with average payments of €237/ha to cover income foregone and costs incurred. No compensation is envisaged for loss of development rights.

Latvia – one off costs of LVL 112 million for purchase of 50,000 hectares of land and LVL 190 million for compensation payments(based on the implementation of the national law of the rights of landowners to the compensation for the restriction of economic activity in the protected areas and micro-reserves, 2006). Compensation relates mainly to 95,000 ha of forestry land and varies with age of stand, size of plot and foregone timber income. Recurrent costs of LVL 4.7m f(€6.6m) or compensation payments and LVL2.6m for management agreements.

The main opportunity costs which cannot be quantified are those relating to foregone development opportunities or changes in land use where compensation is not paid. These costs are likely to be very variable and site specific. Extrapolation or aggregation from the site level is problematic, because of problems of additionality. For example, it is possible that development that is not permitted on a Natura 2000 site will take place instead somewhere else nationally or in the EU, and therefore it is incorrect to scale up site specific estimates of opportunity costs. It is, however, possible to make a more qualitative assessment of the

extent to which Natura 2000 imposes opportunity costs at the regional, national and EU levels by constraining development opportunities (see section 2.1 on foregone development for more information on this type of opportunity cost).

Methodology for overall cost assessment

The IEEP et al study provides an overall assessment of the costs of the Natura 2000 network at the EU level.

The extent of opportunity costs within these estimates has been assessed by examining the different types of costs included in each of the categories in the overall cost typology. From this:

- The costs of land purchase are taken as an estimate of the capitalised value of foregone net income from relevant sites in alternative uses. These alternative uses – and hence the price of land – vary from one site to another. Land with development potential commands higher prices than land suitable only for agriculture and forestry. In this sense, land purchase costs can be expected to reflect the opportunity costs of protecting different sites, providing they are based on accurate estimates of land prices;
- Payments of compensation (either one-off compensation for loss of development rights or recurrent payments of compensation) are taken as estimates of the income from alternative uses of the relevant sites;
- Income foregone from habitat management has been estimated by identifying habitat management costs and estimating income foregone at 70% of these. This ratio was taken from the review of income foregone within agri-environment payments in the literature review, which covered a wide range of payments across 6 Member States (see Section 2.5 and Annexes A and B);
- Other costs (management planning, management bodies, infrastructure, surveillance and monitoring, scientific studies) are assumed not to include opportunity costs.

A brief qualitative assessment is provided as to the likely extent of additional opportunity costs for which compensation is not paid, and which are not included in the quantitative estimates.

Assessment of costs at EU level

Overall estimates of the costs of implementing the Natura 2000 network, and the extent of opportunity costs within them, are given in Table 5.

Table 5 Estimated costs of Natura 2000 Network and extent of opportunity costs (EU27)

Type of cost	Total (M Euro)	Opp costs (%)	Opp Costs (M Euro)
One-off costs (management)			
Scientific studies, administration, consultation etc	71	0%	-
Preparing management plans, establishing management bodies, consultation etc	149	0%	-
Habitat inventories	100	0%	-
Establishing management bodies	6	0%	-
Subtotal: One-off costs management	***325***		
Land purchase	***506***	***100%***	***506***
One-off costs (infrastructure)			
One-off (i.e. not regular annual) payment of compensation for development rights.	130	100%	130
Infrastructure needed for the improvement / restoration of habitat or species	681	0%	-
Infrastructure for public access, interpretation works, observatories and kiosks, etc (contributing to conservation)	220	0%	-
Other	31	0%	-
Subtotal: Infrastructure	***1,062***		
Recurrent Costs (management planning)			
Running costs of management bodies	654	0%	-
Review of management plans	59	0%	-
Public communication	61	0%	-
Subtotal: management planning	***774***		
Recurrent Costs (habitat management and monitoring)			
Conservation management measures– maintenance and improvement of habitats' favourable conservation status	643	70%	450
Conservation management measures– maintenance and improvement of species' favourable conservation status	186	70%	130
Implementation of management schemes and agreements with owners and managers of land or water for following certain prescriptions	1,028	70%	719

Provision of services; compensation for rights foregone and loss of income; developing acceptability 'liaison' with neighbours	269	50%	134
Monitoring	199	0%	-
Maintenance of facilities for public access to and use of the sites, interpretation works, observatories and kiosks etc.	131	0%	-
Risk management (fire prevention and control, flooding etc)	518	0%	-
Surveillance of the sites	132	0%	-
Subtotal: Habitat management and Monitoring	***3,106***		
Sub-total: Recurrent Costs	***3,880***		***1,434***
Subtotal: One-off costs	***1,892***		***636***
Total Costs	**5,772**		**2,069**

The financial costs of implementing the Natura 2000 network are €5.8 billion per annum between 2008 and 2014. These include estimated opportunity costs of €2.1 billion, which are reflected in land purchase costs of €506m, one off compensation payments of 130m, annual compensation payments of €134m and estimated income foregone associated with habitat management of €1300m.

Interviews with Member States as part of the Natura 2000 costs and benefits study revealed that these costs are expected to increase in future for a wide range of reasons, including further extension of the network, increased levels of management activity to achieve favourable conservation status, further work to designate and manage marine sites, planned increases in staffing, increasing pressures such as climate change and land abandonment, and cost inflation.

Gaps and methodological issues

Because the costs of implementing the Natura 2000 network have been subject to a recent, dedicated and detailed study, this is the area of biodiversity action for which costs are best understood and for which the most detailed and reliable quantitative assessment can be made. This, however, is not without methodological challenges, and the IEEP et al study concluded that the wide variations in cost estimates between Member States is likely to reflect variations in strategic approach and estimation methodologies as much as real differences in unit costs.

Overall, it is likely that the cost estimates are conservative and that the full costs of achieving favourable conservation status across the network as a whole would be higher.

The IEEP et al study focused on the financial resources required to implement the network and did not attempt to assess opportunity costs. However, it is likely that a large proportion of these costs are reflected in transactions with landowners (such as management agreements and compensation payments) and therefore included within the cost estimates.

Estimates of the extent of opportunity costs within different cost lines have been made, based on certain assumptions. Further, more detailed work to understand the extent of opportunity costs within overall cost estimates, and to test these assumptions, would be beneficial.

The true extent of opportunity costs for which no compensation is paid is not known. However, examples are given where Natura 2000 has prevented development taking place. In most of these examples protection of the site is likely to have displaced development to more appropriate locations. Overall, it is likely that the net reduction in economic development at EU level as a result of Natura 2000 is likely to be small, although further work to assess this would be desirable.

A more detailed understanding of opportunity costs and the extent to which they are reflected in financial transactions could be obtained through a survey of individual sites to assess the effect of designation in constraining output and development opportunities and the degree to which land owners/managers are compensated for this through management agreements and/or payments.

2.3 National (terrestrial) protected areas (Category B)

Overview of the policy

The term 'protected area' is used to describe a wide range of both terrestrial and marine designations.[24] These areas differ significantly with respect to: the degree of legal protection, restrictions on activities, governance structure and management approach. The IUCN classifies protected areas according to six categories of management objectives (see Table 6) (Dudley, 2008). This typology has become the internationally recognised system of categorising protected areas and enables a comparison of protected areas between countries around the world. This section focuses on terrestrial protected areas whereas marine sites are considered in section 2.7.

A recent report on protected areas (EEA, 2010) revealed that the EU currently has over 50,000 protected areas[25], more than any other continent. This resource provides a mechanism for approaching threats to biodiversity and valued habitats from site development, construction of infrastructure, and the impacts of agriculture (EEA, 2010). The sites vary enormously in size, ranging from a single tree to over 2 million hectares (ha). In total, European protected areas cover 77 million hectares.

Outside of the Natura 2000 network, Member States have developed a diverse set of designations that differ in their combinations of protected area categories. Some Member States already had extensive protected areas in place before the Natura 2000 network was implemented (such as Estonia, Latvia and Germany); in others, however, the current protected area network relies predominately on Natura 2000 (such as Ireland or Denmark),

24 The IUCN defines a protected area as a "clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values" (Dudley, 2008).

25 See CDDA MS Access database, downloadable from http://www.eea.europa.eu/data-and-maps/data/nationally-designated-areas-national-cdda-4

with a very limited number of nationally protected sites (see Figure 1). Table 7 provide details about the size area of the area land in each Member States designated as Natura 2000 sites, but not nationally, and the overlap between Natura 2000 and nationally designated protected areas. Over a third of the Natura 2000 sites are also designated nationally (Table 7) and thus, the cost types described in section 2.2 will have been influenced by those facing nationally designated sites. However, over half of the nationally designated areas in Member States do not fall under Natura 2000 designation (approximately 42.3 million ha). Table 6 identifies the terrestrial areas (outside of Natura 2000) that are subject to the strongest level of protection (IUCN Categories I-IV) and that may give rise to opportunity costs. It is these sites that are the focus of this section.

Table 6 Internationally recognised system of protected area categories

IUCN Category	Description
Ia – Strict nature protection	Strictly protected areas set aside to protect biodiversity and also possibly geological/ geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. These areas serve as vital reference areas for scientific research and monitoring.
Ib Willderness protection	Usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.
II Ecosystem protection and recreation	Large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.
III Protection of natural monument or feature	Areas set aside to protect a specific natural monument and their associated biodiversity and habitats. They are often quite small areas and often have high visitor value; e.g. a geological feature such as a cave or living features such as an ancient grove.
IV Protection of habitats and species	Protected areas that aim to protect particular species or habitats and management reflects this priority. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats.
V Protection of landscapes or seascapes	An area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value. The principle aim is to '*protect and sustain important landscapes/seascapes and the associated nature conservation and other values created by interactions with humans through traditional management practices*.'
VI	Protected areas, often large, with most of the area in a natural condition,

Protection and sustainable resource use	where a proportion is under sustainable natural resource management. Low-level non-industrial use of natural resources compatible with nature conservation is seen not only as a main aim of the area but as a *means* to achieve nature conservation, together and in synergy with other actions such as protection.

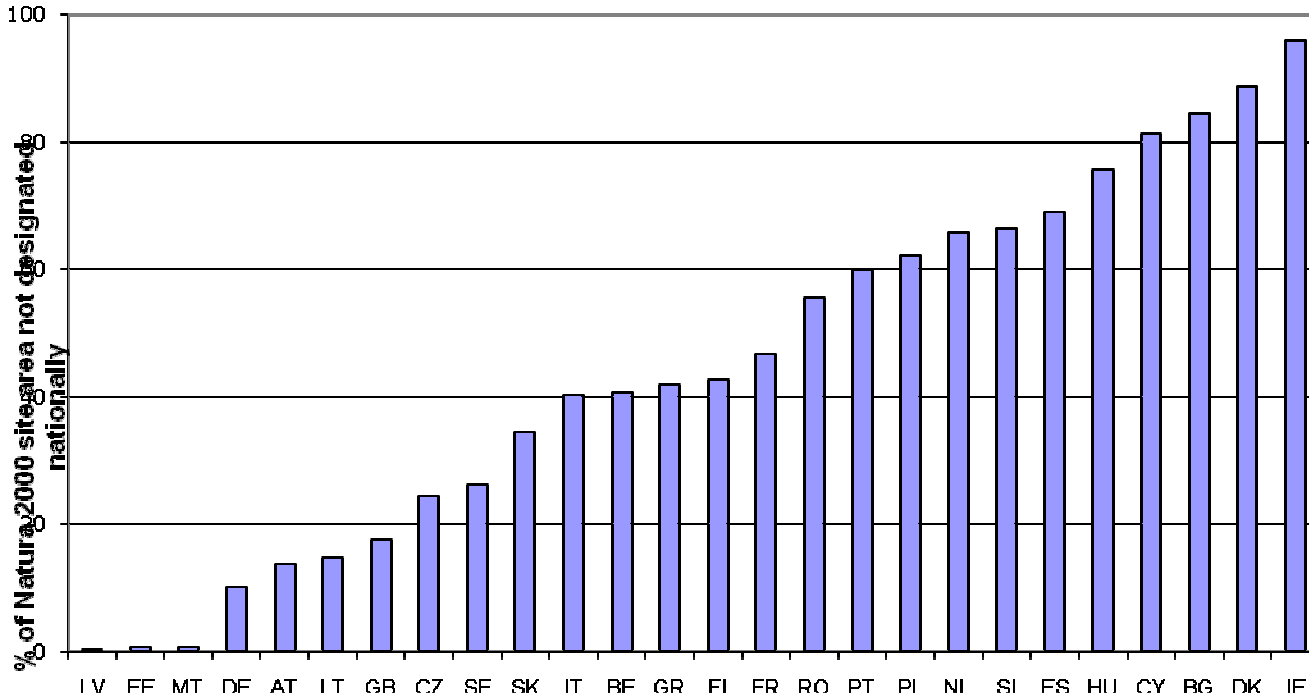


Figure 1 Percentage of Natura 2000 site area not previously designated nationally as protected areas

Source: European Topic Centre on Biological Diversity (ETC/BD), 2009.

Table 7 The overlap between Natura 2000 and nationally designated protected areas (terrestrial and marine)

Country name	Area Natura 2000 (ha)	Area CDDA* (ha)	Overlap (area of CDDA within N2K (ha))	CDDA area minus overlap	Natura 2000 area minus overlap
Austria	1,232,075	2,265,295	870,201	1,395,094	361,874
Belgium	422,594	431,796	125,968	305,828	296,626
Bulgaria	3,860,626	616,586	518,978	97,608	3,341,648
Cyprus	105,385	20,348	17,806	2,543	87,579
Czech Republic	1,048,378	1,249,781	647,065	602,715	401,312
Denmark	1,671,744	199,676	113,126	86,550	1,558,617
Estonia	1,466,308	2,293,661	1,451,199	842,462	15,109
Finland	5,574,964	3,278,460	3,135,841	142,619	2,439,123
France	10,321,574	9,009,922	2,412,404	6,597,518	7,909,170
Germany	7,192,908	21,764,040	4,735,030	17,029,010	2,457,878
Greece	3,395,389	3,105,164	1,158,635	1,946,528	2,236,754
Hungary	1,968,266	499,150	412,316	86,834	1,555,950
Ireland	1,399,968	60,362	8,132	52,230	1,391,836
Italy	6,182,118	5,550,881	2,433,681	3,117,200	3,748,438
Latvia	769,579	1,287,642	766,340	521,303	3,240
Lithuania	806,866	987,510	635,986	351,525	170,880
Malta	5,034	13,178	4,946	8,231	88
Netherlands	1,123,887	454,315	248,291	206,024	875,596
Poland	6,297,654	2,825,545	1,650,377	1,175,168	4,647,277
Portugal	2,098,584	925,108	710,151	214,957	1,388,434
Romania	4,422,700	2,217,878	1,657,195	560,683	2,765,505
Slovakia	1,414,087	1,229,932	771,497	458,434	642,589
Slovenia	720,527	267,026	196,008	71,018	524,519
Spain	14,253,061	4,492,947	4,227,786	265,161	10,025,275
Sweden	6,498,792	5,427,542	4,573,363	854,179	1,925,429
United Kingdom	3,413,532	7,164,295	1,898,741	5,265,554	1,514,792
Total	87,666,602	77,638,039	35,381,064	42,256,975	52,285,537

Source: European Topic Centre on Biological Diversity (ETC/BD), 2009

*CDDA – Common Database on nationally Designated Areas

Table 8 The terrestrial area of Natura 2000 and nationally designated protected areas (CDDA) (categories I – IV)

Country name	Area Natura 2000 minus CDDA (ha)	Area CDDA (minus Natura 2000 and IUCN Cat V, VI, NA)
Austria	986,531	387,185
Belgium	321,737	323,078
Bulgaria	3,492,763	297,200
Cyprus	82,956	19,467
Czech Republic	909,523	162,569
Denmark	287,879	98,193
Estonia	65,154	369,487
Finland	3,811,443	1,107,300
France	6,268,538	660,686
Germany	3,787,863	1,379,344
Greece	1,859,851	2,062,323
Hungary	1,807,528	184,239
Ireland	771,943	58,331
Italy	3,770,046	2,431,935
Latvia	155,713	580,997
Lithuania	322,131	501,552
Malta	64	5,966
Netherlands	344,416	440,229
Poland	5,351,664	295,644
Portugal	1,776,592	144,946
Romania	3,616,400	680,627
Slovakia	1,082,684	360,313
Slovenia	622,870	99,724
Spain	12,463,602	1,027,795
Sweden	1,763,239	4,366,820
United Kingdom	474,201	2,187,653
Total	56,197,330	20,233,603

Source: European Topic Centre on Biological Diversity (ETC/BD), 2009

Types of costs

The financial and economic costs associated with nationally designated protected areas are similar to those of the Natura 2000 network (see section 2.2). The nature of the costs varies, however, according to the different categories of protection (Table 7). For example, Categories I and II are mostly unmodified natural areas where the ecological processes are broadly functioning and intact. In these cases, the intervention required is minimal and is actually discouraged as it is generally the natural processes themselves that are the focus of the designation. Thus, the direct costs for species and habitat management are likely to be low and more focused on actions to prevent disturbance from humans (e.g. poaching) (Table 9). For these sites, the main costs are the opportunity costs, arising from restrictions to development (e.g. for settlement or agriculture) and/or on extractive activities (such as mining or hunting). Category IV areas, on the other hand, often include fragments of an ecosystem that are unlikely to be self-sustaining and will thus require regular and active management interventions to ensure the survival of the targeted species or habitat (Dudley, 2008). The opportunity costs of maintaining these areas can often be estimated by referring to financial investments in land purchases and/or management agreements as proxies for foregone development opportunities (Table 9).

As was also observed with marine protected areas, the size of terrestrial sites has an important influence on costs. Morling (*pers. comm.*), examining the costs of managing RSPB management sites in the UK, demonstrated that size was the predominant factor influencing costs, as the relative importance of fixed costs for a site were reduced with increased area. The influence of size on costs was more important than habitat type, with significantly lower costs incurred per hectare for larger sites. This is significant as IUCN Category I and II protected areas should be of a sufficient size to maintain the ecological functions and processes that native species and communities require to survive in the long-term. Category III and IV protected areas are typically much smaller (Dudley, 2008), and fixed costs per site are likely to be high and focussed on visitor access and habitat/species management, respectively (see Table 9).

Table 9 Likely predominant cost types per IUCN protected area category

IUCN Category	Cost typology	Potential types of costs
I Strict nature/ wilderness protection	Financial: recurrent	prevention of human interference species and habitat monitoring scientific research
	Wider economic: opportunity costs	foregone opportunities for development and land use change constraints on land management practices
II Ecosystem protection and recreation	Financial: recurrent	promoting understanding and education management to protect and maintain special natural features activities focused on conserving cultural heritage development management (consents and reviews)
	one-off	development of tourist facilities
	Wider economic: opportunity costs	foregone opportunities for development and land use change constraints on land management practices
III Protection of natural monument or feature	Financial: recurrent	management to protect and maintain special natural features
	one-off	development of tourist facilities
IV Protection of habitats and species	Financial: recurrent	active management to maintain target species or natural/semi-natural ecosystems active management of culturally-defined ecosystems development management (consents and reviews)
	one-off	land purchase infrastructure for restoration of habitats/species
V Protection of land & sea-scapes	Wider economic: Economic: opportunity costs	restrictions on development that interfere with landscapes restrictions on land use change that interfere with landscapes
VI Protection & sustainable resource use	Wider economic: Economic: opportunity costs	extraction of natural resources limited to sustainable levels restriction on large-scale industrial harvests limited restrictions on development activities

Table 10 The areas of the different IUCN categories within the EU

IUCN category	I	II	III	IV	V	VI	N/A
Area (ha)	4,972,003	7,224,958	210,061	11,883,196	46,026,437	3,438,683	3,438,683
No.	4,001	287	4,258	28,245	11,242	1,895	1,895
Minimum (ha)	0	1	0	0	0	0	0
Maximum (ha)	554,675	441,500	18,078	2,557,258	578,848	294,536	294,536

Source: European Topic Centre on Biological Diversity (ETC/BD), 2009

Overview of available cost estimates

An assessment of the costs of nationally designated areas is not readily obtainable and, although the data may exist at a Member State level, such figures are rarely published. However, some data is available relating to the UK, both with regard to Sites of Special Scientific Interest (SSSI, the principal national nature conservation designation) and national parks.

The costs of management of England's 4,000 SSSIs have been estimated by Defra at approximately €116.7 million in 2009/10. More than 80% of this cost relates to land management, through incentives to land managers and direct expenditures by government. The remainder is accounted for by the costs of advocacy, providing advice, programme and project management, and regulatory costs. This equates to approximately €112/ha per year. The costs of management of the 1,000 SSSIs in Wales have been estimated at a further €11.4 million per annum[26].

The above cost estimates include an element of income foregone, through land management incentives. In addition, SSSIs, by protecting designated sites from development, are likely to impose additional opportunity costs through foregone economic opportunities, which are not included in the cost estimates. It is debateable whether these represent net opportunity costs at the national level or whether they merely displace development to more suitable sites (see section on foregone development 2.1 for further information).

The annual costs of operating of five National Parks in the UK that are not designated as Natura 2000 are presented below (Table 11). The costs show an apparent trend of decreasing per area as the overall size of the park increases. A further break-down of the types of expenditure by four of the parks is shown in Figure 2.

[26] These amounts have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010.

Table 11 The annual cost (EUR/ha) of five UK national parks not designated as Natura 2000

National Park	Area (ha)	Net Operating Expenditure (£)	Net Operation Expenditure (€[27])	Expenditure per hectare (£/ha)	Expenditure per hectare (€/ha)
Loch Lomond	186,500	6,904,248	7,892,179	37	42
Northumberland	104,947	3,398,633	3,885,104	32	37
Dartmoor	95,338	5,113,000	5,844,479	54	61
Exmoor	69,280	4,519,184	5,165,710	65	74
Pembrokeshire Coast	58,431	5,109,000	5,840,050	87	100
Average expenditure per ha (total area/total expenditure)				**49**	**56**

Source: National parks' annual accounts28,29,30, 31

The spread of the expenditures show that the largest expenditure of the parks[32] overall was promoting understanding and education at almost €12,5/ha, followed by the ongoing costs of paying rangers, upkeep of estates and managing volunteers at €11,8/ha. Natural environment conservation work was the third largest expenditure at almost €9,1/ha.

Figure 2 Comparison of annual expenditure in four UK National Parks

[27] These amounts have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010.

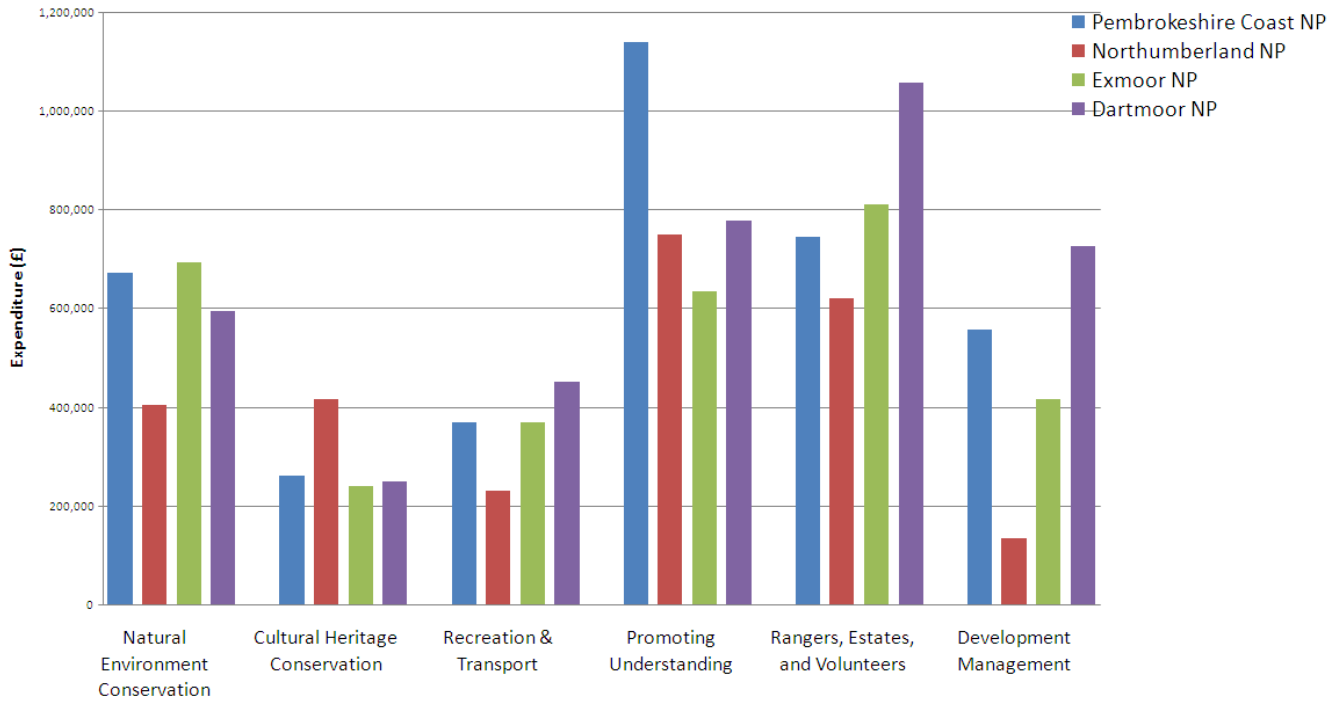
[28] http://www.exmoor-nationalpark.gov.uk/200809_annual_accounts_pdf.pdf; http://www.exmoor-nationalpark.gov.uk/filex_01.pdf

[29] http://www.lochlomond-trossachs.org/images/stories/Looking%20After/PDF/publication%20pdfs/NP_AR10_Annual_final_low.pdf

[30] http://www.pcnpa.org.uk/website/default.asp?SID=195&SkinID=5

[31] http://www.northumberlandnationalpark.org.uk/statementofaccounts0809.pdf

[32] Northumberland, Dartmoor, Exmoor, and Perbrokeshire Coast. Loch Lomond was excluded for the purpose of this exercise as it classified expenditures differently.



Methodology for overall cost assessment

The preferred methodology for assessing the costs of protected areas at an EU-scale would be to follow that carried out for Natura 2000 areas (IEEP et al., 2010), where the information on each cost type was gathered directly from the Member States. While not feasible within the scope of the current project, this method may also find a scarcity of information on protected areas outside the Natura 2000 network. For the latter, Member States are required by the EU to have management plans and, therefore, have more information relating to costs. This EU requirement does not apply to protected areas outside of Natura 2000; data are thus collected at the discretion of Member States alone.

In the absence of such data, a broad estimate of the costs of protected areas can be made by extrapolating from the Natura 2000 estimates, on the basis that there are an estimated 20.2 million hectares of protected areas (IUCN categories I-IV) in the EU outside of the Natura 2000 network. The costs of managing Natura 2000 sites average €63/ha/yr, of which €23/ha/yr are opportunity costs. The latter are estimated financial costs relating to land purchases, compensation payments and the income foregone element of land management schemes - details are given in the section on Natura 2000.

Assessment of costs at EU level

Based on an extrapolation of the estimated costs of the Natura 2000 network, it is estimated that the financial costs of managing nationally protected areas outside the network amount to an additional €1,280 million annually. Of this, opportunity costs total an estimated €459 million annually. As for Natura 2000, there are additional uncompensated opportunity costs relating to foregone development opportunities. No overall estimates are available for the latter, and, although examples are available at the local level, these cannot be aggregated across sites.

It is important to note that national protected areas are often less focused on biodiversity than the Natura 2000 network. While they do play a role in the conservation of biodiversity,

sites outside the Natura 2000 network often have other objectives, too, such as landscape conservation.

Gaps and methodological issues

This review has found that evidence on the costs of national protected areas in the EU is very limited. Extrapolations have been made from evidence of the costs of Natura 2000, for which cost issues are likely to be similar. However, more evidence relating specifically to the costs of conservation of biodiversity in protected areas outside the network, and the associated opportunity costs, would be beneficial.

2.4 Species conservation (Category C)

Overview of the policy

The EU Biodiversity Action Plan established a target of having:

No priority species in worsening conservation status by 2010; majority of priority species in, or moving towards, favourable conservation status by 2013.

The plan notes that actions to achieve this target are needed at both the EU and MS level. Central to achieving the target is the development and implementation of species action plans at the EU level and in its Member States. In addition, the plan calls for a scientific review of species listed in annexes of nature directives, ensuring that all species of Community interest are sufficiently represented in the Natura 2000 network where appropriate. Another action is to identify and fill critical gaps in EU ex-situ conservation programmes for wild species (in zoos, botanic gardens, etc.).

Species action plans provide a framework for assessing the needs of particular species and implementing a programme of action to secure favourable conservation status. Typically they set out a programme of action which may include scientific research, monitoring, site protection and management, species protection, policy and advisory measures.

These actions, in addition to the protection and management of habitats, are designed to ensure that each species achieves favourable conservation status. It is important to understand the degree to which the costs of species conservation are additional to habitat based measures (such as Natura 2000, national designations, measures for HNV farming and forestry), particularly as species conservation is a significant objective of the habitat measures.

At the EU level, species action plans have been published for 49 threatened bird species[33]. The plans set out the threats facing each species, conservation objectives, and actions to be implemented (which may include policy and legislation, site and habitat protection and management, monitoring and research, or public information and training). The costs of these plans have not been assessed.

[33] http://ec.europa.eu/environment/nature/conservation/wildbirds/action_plans/index_en.htm

Some Member States have also developed their own species action programmes. The most comprehensive of these appears to be in the UK, where 1150 species have been highlighted as priorities for conservation actions under the UK Biodiversity Action Plan. This list was revised and expanded in 2007. All species listed on the original BAP priority list were allocated an action plan, published between 1995-1999, though detailed plans have yet to be produced for the species added to the priority list in the 2007 review. There were 393 original species action plans, with 382 covering individual species and 11 covering groups of species[34]. Each SAP set out actions for the species concerned under six headings: Policy and legislation; Site safeguard and management; Species management and protection; Advisory; Research and monitoring; and Communications and publicity. The costs of the SAPs were assessed and revised estimates of costs were made in 2006 and 2010.

Types of costs

Species conservation programmes give rise to a range of financial and wider economic (opportunity) costs.

Financial costs are often borne largely by the public sector, though NGOs and businesses may also make significant contributions. Examples of such costs include:

- Policy and legislation – including policy studies and advocacy work, both relating to conservation policies and targeted at wider policy drivers and funding instruments;
- Site safeguard and management – including the work required to designate particular sites of importance for the species, to protect them from potentially damaging developments or land management practices, and to implement management practices designed to achieve favourable conservation status;
- Species management and protection – including actions to protect the species from disturbance, threatening activities or illegal persecution, ex-situ conservation measures, and reintroduction programmes;
- Advice – including provision of advice to farmers, land managers and other interests, and associated costs of publications and communications;
- Research and monitoring – including the costs of conducting research into species' status and needs, conducting surveys and monitoring trends in populations;
- Communications and publicity – the costs of raising public awareness of species and conservation issues, including human resources and publications.

The opportunity costs of species conservation include the income and output foregone from:

- Protecting sites from development or changes in land management;
- Limiting land management activities on particular sites (e.g. late cutting or harvesting to protect nest sites, leaving particular areas uncultivated or unsprayed);
- Limiting harvesting of particular species (such as fish and edible plants); and

[34] http://www.ukbap.org.uk/species.aspx

- Damage to agriculture, forestry and fisheries as a result of restrictions on species control measures.

Examples of these costs might include:

- Lost opportunities for development through the protection of a site designated to protect a rare species of wild flower;
- Reduced fisheries output resulting from measures to limit harvesting of cod and other target species;
- The lost agricultural output from ceasing farming operations on an area of land used by breeding stone curlews or great bustards;
- The loss of yield of hay or silage resulting from late cutting of a meadow occupied by nesting corncrakes;
- The reduction in agricultural output caused by damage through grazing by protected geese; and
- The loss of livestock resulting from the protection of predators such as wolf and lynx.

The main opportunity costs of conservation therefore result from actions for site safeguard and management. In addition, for certain species which may cause damage to economic interests (such as predators and wild geese), species protection and management measures may result in foregone income. The costs relating to sites overlap with those for protected areas (see section 2.3), high nature value farming (see 2.5) and forestry (see 2.6).

Costs associated with species conservation legislation vary depending on the specific requirements and existing systems that Member States have in place[35]. For instance, the cost of implementing the Wild Birds Directive depends on the extent of existing systems for the classification, protection and management of sites, the monitoring of sites and species, and the occurrence in the territory concerned of habitats and species to be protected. The establishment of special areas of protection include capital expenditures that may include compensation payments or the purchasing of sites.

Overview of available cost estimates

In the UK, the costs of implementing Species Action Plans have been assessed by GHK (2006, 2010). The costs of achieving SAP targets include:

- The costs of actions for **individual species**, which include specific research, advisory, monitoring, site and species protection measures. These costs were estimated by examining in detail the costs of implementing a sample of SAPs and extrapolating from that sample to the list of priority species as a whole.
- The costs of achieving targets to reverse the decline of **widespread species** – such as farmland birds - which require habitat management measures at the landscape scale, through agri-environment and woodland management schemes.

[35] Regional Environmental Center for Central and Eastern Europe (REC) (2007) Handbook on the Implementation of EC Environmental Legislation: Section 6 Nature Protection Legislation. Available from: http://ec.europa.eu/environment/enlarg/handbook/handbook.htm

These costs were estimated through the use of an ecological model to estimate the area over which sympathetic management practices would be needed in order to meet species targets, and measuring the costs of this activity based on current payment rates for land management schemes.

The latest estimates are that the average cost of delivering each individual Species Action Plan is €260,490 per year for vertebrates, €49,285 per year for invertebrates and €29,274 per year for plants. Extrapolated across all species for which SAPs were estimated to be required, this gave an annual cost estimate of €53,7 million for the delivery of conservation measures for individual species (see Table 12 below)[36].

Table 12 SAP Costs Estimate – Individual Species, UK

	Annual cost estimate (2009 prices, €k)[37]	% of total
Vertebrates	28,612	53%
Invertebrates	14,436	27%
Plants	11,020	20%
All SAPs	**54,068**	**100%**

It is estimated that vertebrates account for just more than half of the revised total (53%), with invertebrates accounting for 27% and plants 20%.

An estimated breakdown of these costs by type of action is given in Table 13.

Table 13 Breakdown of costs by type of action of species protection

Activity	Estimated Cost (€m[18])	% of total	Significance of opportunity costs
Policy and legislation	1.03	2%	May give rise to opportunity costs if they impact on economic activity. Not included in these cost estimates.
Site safeguard and management	4.12	8%	Significant opportunity costs by protecting sites from development; largely not included in these estimates.
Species protection and management	12.7	23%	Income foregone from protection and management of sites. This is a small element of cost estimates (<10% of estimated costs)

[36] These amounts have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010.

[37] These amounts have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010.

Advice	7.2	13%	No significant opportunity costs
Research and monitoring	23.33	43%	No significant opportunity costs
Communications and publicity	1.14	2%	No significant opportunity costs
Administration	4.7	9%	No significant opportunity costs
Total	**54.1**	**100%**	

Opportunity costs account for only a very small proportion of the estimated costs of actions for individual species, with compensation for income foregone estimated to account for less than 1% of the measured costs. The largest element of costs is for research and monitoring work, which has no significant opportunity costs. However, species protection may give rise to additional, unmeasured opportunity costs by preventing development and/or land use change on designated sites – these are part of the opportunity costs of Natura 2000 sites and protected areas (see above).

The costs of meeting targets for widespread countryside species in the UK are estimated at £274 million (€313 million) per year[38] between 2011 and 2020. According to the ecological model employed, achieving targets for widespread species depends on securing a positive management of land through "entry level" agri-environment schemes (across 37.5% of total landscape area), "higher level" schemes (across 6.5% of total landscape area) and woodland management schemes (across 4% of total landscape area), largely in the lowland areas of the UK.

The estimated costs of widespread species entirely comprise habitat management measures across the wider landscape and have a significant element of opportunity costs, as a large element of the costs of the schemes is accounted for by payments for income foregone. Based on a review of UK agri-environment payment rates, it is estimated that income foregone accounts for 70% of these costs.

Table 14 Costs of UK Species Action Plans

	Estimated cost (€m)[39]	Estimated opportunity costs within these estimates	Notes
Individual species measures	54	Insignificant	Protection of individual species has significant wider opportunity costs not included in these estimates, where it prevents development or land use change on designated sites. See sections on Natura 2000

[38] These amounts have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010.

[39] Idem.

			and national protected areas.
Habitat management for widespread species at landscape scale	313	220	Estimate based on income foregone accounting for 70% of land management payment. This is additional to costs of habitat action plans/protected areas, but there is significant overlap with costs of HNV farming
Total	**367**	**220**	

Box 3 Examples of costs of species protection measures in the EU

Great bustard: In Villafáfila Lagoons Reserve, Castilla y León, Spain incentive payments are made for different types of contracts for: increasing the area of fallow and pastures on the holding and improving their condition for great bustards (Type 1 and 2); establishing long-term set-aside (Type 3); and re-introducing or maintaining alfalfa cultivation or maintaining threatened crop varieties (type 4). In 2000, the number of type 1 and 2 contracts covered a total area of 215.000 ha in Castilla y Leon (close to the 13 % of potential area), at a total cost of 21.4 Mio. €. In the same year, the number of type 3 and 4 contracts covered 4.465 ha and a total cost of 0.94 Mio. €. By 2004 some 64.6% of cultivated land in the Lagoons Reserve area was participating in agri-environment measures.

Large Blue Butterfly: In Lithuania, the Grassland Management scheme which benefits this species attracts an annual payment of 809 LTL per ha (234 € per ha).

Common hamster: In France, a scheme requiring at least three years of alfalfa on a field during a five year period attracts a payment of 309 €/ha/year; having at least three years of winter cereals on a field during a five year period attracts a payment of 169 €/ha/year. In the Netherlands, four different schemes offer annual payments of up to 2300 €/ha. In Flanders, Belgium, creating buffer strips with alfalfa pays 600 €/ha/year while creating unharvested buffer strips with cereals pays 415 €/ha/year.

Ortolan bunting: In Lower Saxony, Germany, farmers have committed themselves to reducing the sowing density of their crops and abstaining from using sprinklers, herbicides or fertilisers on their fields. The compensations paid range from 510 €/ha for cereals, 1600 €/ha for potatoes ad 1200 €/ha for sugar beet (pilot study). Based on this pilot study a new agri-environment measure was introduced into Lower Saxony's RDP for bird conservation on arable land: the present subsidy for this is between 320-615 €/ha.

Opportunity costs are likely to be significant in each of the above examples, with income foregone likely to represent a significant proportion of the agri-environment payment in each case.

Basking shark: The UK Biodiversity Action Plan includes a Species Action Plan for the basking shark. The opportunity costs of protecting the basking shark are largely driven by demands from China, specifically given the rising market for sharks' fin soup. One basking shark can yield 90kg of fin, with dried shark's fins costing up to US$600-700 per kg. This makes the basking shark a very profitable fisheries target, whose exploitation is restricted by the protection afforded by the SAP.

Two illustrative and useful examples of (opportunity) cost estimates are provided in the following box.

Box 4. Examples of (opportunity) cost estimates for species protection in the EU

Eppink and Wätzold (2009): Hidden costs of the Habitats Directive: Hamster conservation in Germany:

This paper argues that, as well as giving rise to financial costs, through expenditures on conservation management and payments to landowners for species protection measures, nature conservation also has hidden costs which result from rejecting, modifying and delaying development projects.

These costs are investigated through a case study of conservation of the common hamster in Baden-Württemberg, Germany. In the area of Mannheim, conservation of this threatened species (as required by the Habitats Directive) has conflicted with proposed developments, resulting in restrictions on the development of a new car park, and reductions and delays in residential and commercial developments at three sites.

The authors estimate these costs, discounted over a 10 year period, as follows:

- Conservation management costs (including costs of fencing, monitoring, staff costs) - €769,101 - €924,881;
- Payments to landowners (largely compensating for opportunity costs of land management) - € 214,453 - €263,647;
- Costs of modifying and delaying development projects - €19,587,867 - €38,294,573. The range of cost estimates depends on the choice of discount rates as well as the estimates of development values employed;
- Total conservation costs - €20,571,421 - €39,483,101.

In this case opportunity costs of protecting designated sites represent a very large proportion of the overall costs of conservation, and hidden opportunity costs are large relative to financial costs. However, the hidden costs are measured only in terms of the lost income from the particular sites affected – it is not clear whether overall levels of development in the area are reduced or whether development takes place instead on other sites not protected for hamsters. The opportunity costs result from protection of Natura 2000 sites of importance for the species.

MacMillan et al. (2004): Costs of wild goose conservation in Scotland[40]

The authors estimated the value of damage caused by wild geese grazing agricultural crops in two areas of Scotland, Islay (Barnacle and Greenland White-fronted Geese) and Strathbeg (Pink-footed Geese). Grazing by geese, especially in areas where goose numbers are highly concentrated, can cause damage to spring-sown cereals and grass, delay turn-out of stock, and can cause problems with soil puddling and compaction. These effects result mainly in yield losses or losses of winter grazing (income foregone) as well as additional costs such as for reseeding grass. While these costs are essentially damage costs, conservation of wild geese gives rise to opportunity costs in the sense that it restricts agricultural output and incomes.

On Islay, total costs were estimated to average €13,154 per farm, equivalent to €82 per hectare or €14.8 per goose per annum, amounting to €640,562 across the island as a whole (for 1999/2000). A 10% increase in endangered geese numbers would increase damage costs by €1,167 per farm, and for the island as a whole by €48,759.

In Strathbeg, costs were estimated at an average of €6,634 per farm, or €25 per productive hectare; costs for the whole area were estimated at €250,505 (for 1999/2000).

Using a choice experiment to estimate willingness to pay for goose conservation, it was estimated that the benefits greatly exceed the costs of wild goose conservation. As farmers suffer the brunt of the costs for goose conservation, compensation is paid through management agreements. However, if crop damage continues to increase as the goose population expands, there is some concern that the costs to government of such compensation schemes may become excessive.

[40] These amounts have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010.

Methodology for overall cost assessment

The only comprehensive data available for the costs of species conservation relate to the UK. An illustrative estimate of the costs of species conservation at EU level can be gained from extrapolating from these national estimates.

The UK currently accounts for 13% of the GDP of the EU27. If it is assumed that the costs of species conservation account for a similar proportion of GDP across the EU27, the costs of species conservation at EU level will be roughly 7.5 times as high as those in the UK. This estimate should be seen as illustrative only - in reality, we would expect species conservation costs to vary between Member States according to a variety of factors such as differences in conservation status, management requirements and variations in unit costs.

Assessment of costs at EU level

Based on the method outlined above, the total cost of species conservation across the EU27 could amount to €2.8 billion per annum. The majority of this estimate relates to the cost of habitat management for widespread species at the landscape scale outside protected areas, a large proportion of which is accounted for by income foregone through land management schemes. However, there is likely to be significant overlap between this figure and the costs of biodiversity conservation in HNV farming and forestry systems.

Table 15 Illustrative Estimate of Costs of Species Conservation at the EU Level

	Estimated cost (€m)	Estimated opportunity costs within these estimates
Individual species measures	475.8	Insignificant
Habitat management for widespread species at landscape scale	2773.9	1941
Total	**3249.7**	**1941**

Protection of species has significant wider opportunity costs that are not included in these estimates, especially regarding restrictions on development opportunities at the local level (see sections on foregone development opportunities, Natura 2000 and national protected areas).

Gaps and methodological issues

Data on the financial and opportunity costs of species conservation across the EU are highly fragmented. As a result, the above analysis of costs at EU level is highly speculative. Nevertheless, it is possible to demonstrate the different types of financial and opportunity costs that may be incurred in different circumstances and their likely nature and scale.

A more detailed and accurate assessment would depend on more information being available about:

- The actions required to protect species in different member states;
- The costs of species action plans;
- The nature and size of opportunity costs associated with different species action plans; and
- The significance of as yet unquantified opportunity costs – particularly those relating to foregone development opportunities – and the extent to which these limit overall levels of opportunity at different scales (local, regional, national and EU).

2.5 Conservation and restoration of High Nature Value Farmland (Category D)

Overview of the policy

The link between low-intensity production and farmland biodiversity has long been recognised and is captured in the concept of High Nature Value (HNV) farming (Anderson *et al.,* 1993; Baldock *et al.,* 1993; Beaufoy *et al.* 1994; Bignal and McCracken, 2000). HNV farmland is characterised by a combination of low intensity land use, the presence and/or use of semi-natural vegetation and a diverse land cover and land use (Redman 2009). These characteristics have enabled three types of HNV farmland to be characterised, namely:

1) farmland with a high proportion of semi-natural vegetation,

2) farmland with a mosaic of low intensity agriculture and natural and structural elements such as field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers *etc.* and

3) farmland supporting rare species or a high proportion of European or world populations (Paracchini *et al.* 2008).

Within the EU, HNV farmland is most strongly represented in southern and eastern Europe and in some specific areas of north west Europe, such as parts of Scotland.

Within the EU, the main policy vehicle for enhancing biodiversity on farmland (outside designated areas) is the Common Agricultural Policy. The European Commission first established its commitment to supporting HNV farming in its 1998 EU Biodiversity Strategy[41], and more recently included the concept specifically within its Community Strategic Guidelines[42] on Rural Development (2006). These latter clearly state that: "*resources devoted to Axis 2 should contribute to three EU-level priority areas: biodiversity and the preservation and development of high nature value farming and traditional agricultural landscape"*.

[41] COM (1998) 42 Final communication of the European Commission to the Council and to the Parliament on a European Community Biodiversity Strategy

[42] EC Council Decision 144/2006 on Community strategic guidelines for rural development (programming period 2007 to 2013)

The agri-environment measure (214) under Axis 2 of the EAFRD[43] is the main measure that can support biodiversity management on HNV farmland. The extent to which this measure is actually targeted at HNV farmland, however, varies significantly between Member States (EEA 2009). Measures 211 and 212 (support for mountain or less favoured area) of Axis 2 can also provide support for HNV farming, since a significant proportion of HNV farmland occurs in such areas, but these measures are directed at supporting farming in challenging environmental conditions, rather than at supporting the biodiversity of the area (although biodiversity may benefit indirectly from such support). A number of measures under Axes 1 and 3 of the EAFRD can also provide support for HNV farming (Redman 2009), but again these tend to be directed towards the farm business rather than the biodiversity element of HNV farmland. They are therefore, not considered further in this analysis, since there is considerable uncertainty over how much of the payments under these measures can be attributed to support for biodiversity and how much to support for the farming business.

Types of costs

HNV farming incurs a number of costs, but many are not relevant to biodiversity management (Table 16). Within a productive HNV farming system, the costs of biodiversity action are hidden within the recurrent farm costs; and where the farm is both productive and profitable, the cost to society of biodiversity management on HNV farmland will be small, since, by definition HNV farming delivers direct benefits to biodiversity. The societal costs of biodiversity management emerge when the farming system is no longer profitable, and land abandonment or conversion to another land use is more cost-effective. For example, the opportunity cost of cereal production that is compatible with the conservation of birds in the steppe or pseudosteppe lands of southern Navarra in Spain, has been calculated as an income foregone of approximately €36 per hectare compared with conventional cereal production (Annex B). Similarly, maintenance of hill farming in the UK and the public goods associated with it (namely biodiversity, landscape, amenity, cultural heritage, carbon storage, water quality and management) is heavily dependent on public support which is estimated to contribute up to 45 per cent of total output for hill farms in the South West of England (Turner *et al.* 2008). Without this support, such farms would not be economically viable and the public goods and the public benefits that they provide would be lost.

Costs of supporting biodiversity management on HNV farmland can be assessed from the payments given for implementing agri-environment actions on HNV land. These payments include an element of income foregone (representing the opportunity cost of more profitable foregone agricultural land management or production activities), of additional costs for management required for biodiversity enhancement and of transaction costs (e.g. cost of advice for drawing up site management plans). The size of each element may be indicated in a Member State's Rural Development Plan or may sometimes be available from the Member State institutions responsible for determining agri-environment payments. An analysis of these payments and of the scale on which they are implemented on HNV farmland within each Member State can be used to estimate both the total cost and opportunity cost of managing biodiversity on HNV farmland.

[43] Council Regulation No. 1698/2005 (as amended) on support for rural development by the European Agricultural Fund for Rural Development (EAFRD)

It should be noted that, while agri-environment payments are based on costs incurred and income foregone, they do not necessarily reflect the true costs and income foregone of all farmers. Typically payments are based on averages, with individual farms experiencing higher or lower costs. The rate of payment set may diverge from these averages, depending on the level of uptake being targeted. Therefore agri-environment payments should be seen as a proxy for the costs of specific land management within a region, for a specific type of farms, rather than a precise estimate at farm level.

Where the calculations used to set agri-environment payments are available, these can be used to assess the levels of opportunity costs (i.e. the income foregone element) within agri-environment payments.

It should be noted that where HNV farmland is included under national or international protected area designations or national planning legislation, opportunity costs may arise with respect to restrictions on development or conversion of the land to other uses *e.g.* conversion to forestry, intensive agriculture, game sports, touristic development, wind, water or solar power generation, etc. The significance of such opportunity costs is discussed in the section 2.1 on forgone development and is not examined further here.

Table 16 Cost of biodiversity action in HNV farming systems

Cost category	Cost sub-types	Occurrence within HNV farming system	Applies mainly to farm production or biodiversity management
Financial costs	Investment/capital costs	Land purchase/rent Capital equipment Site/habitat restoration	Farm production Farm production Farm production and biodiversity management
	Transfer payment costs	Not relevant	
	Site management costs	Management planning and , implementation Labour and materials for land management	Farm production Farm production
	Administrative costs	Staff costs Site monitoring Financial management including farm support payment applications	Farm production Farm production and biodiversity management Farm production and biodiversity management
	Transaction costs	Generally not	

		relevant at farm level	
Costs that reflect opportunity costs	Income foregone	Revenue loss due to extensification can be compensated for by agri-environment payments	Farm production and biodiversity management
Economic costs	Wider economic costs	Foregone development opportunities if HNV land strictly protected	
	Environmental costs	Not relevant	

Overview of available cost estimates

There are no EU-wide studies of the cost of biodiversity action on HNV farmland. Several studies have highlighted the low economic viability of many HNV farming systems and their often strong dependence on the CAP, especially on the LFA and agri-environment measures for economic support (Osterburg *et al.,* 2008; Redman 2009). A recent review of CAP expenditure with respect to support for biodiversity on HNV farmland (EEA 2009), concluded that CAP funding still tended to be concentrated on the most productive agricultural land with relatively little being spent on HNV farmland (EEA 2009). The study also demonstrated that across different Member States, actions under the agri-environment measure were inconsistently targeted at HNV farmland; the most precise targeting being evident for New Member States such as Czech Republic Bulgaria and Romania (Redman 2009).However, even in these countries, support for HNV farmland from agri-environment measures may be lower than anticipated due to eligibility limits set for minimum farm size and lack of knowledge concerning the availability of support for HNV farmland (Redman 2009).

Nevertheless the targeting of agri-environment actions at HNV farmland in some countries, and at specific habitat types commonly found on HNV farmland does permit a preliminary analysis of the total cost and opportunity cost of management for biodiversity on HNV farmland to be made for some Member States. The countries, agri-environment actions and payments included in this analysis are listed in Table 17.

Table 17 Agri-environment payments (€/ha) for HNV farmland habitat or species actions and % income foregone for the six Member States included in the analysis

Country	Habitats or species action	Agri-environment payment (range)	Income foregone as % of payment
Austria	Grasslands	23 – 464	48 – 100
Austria	Arable land	19 – 331	42 – 100

Bulgaria	Grassland	97 or 155	100 or 63
Bulgaria	Birds on arable land	20 – 102	100
Czech Republic	Grassland	76 – 175	21 – 97
Czech Republic	Birds on grassland	215 or 236	99 or 90
Poland	Grassland	128	Random variable
Poland	Endangered birds outside Natura 2000	141 – 307	Random variable
Romania	Grassland	124 or 182	100 or 68
UK(England)	Grassland, heathland, moorland & saltmarsh	36 – 338	39 - 100

Methodology for overall cost assessment

To provide a complete assessment of the overall costs of managing biodiversity on HNV farmland under the agri-environment measure (214), the following information would be needed for each of the 27 EU Member States:

- the agri-environment actions targeted at HNV farmland in each Member State
- the total payment given for each targeted action and the proportion of that payment representing farmers' income foregone, and
- the uptake of each action (in hectares (ha)) on HNV farmland in each Member State.

For the purpose of this study, we have provided an assessment based on data from six Member States: Austria, Bulgaria, Czech Republic, UK(England), Poland and Romania were used (Table 15). A more extensive assessment was not possible within the resources of this study and with the data available from Member States; therefore, this approach should be rather seen as an initial assessment, which could be potentially strengthened and expanded to more Member States in future research.

For the Member States/regions considered here, the agri-environment actions likely to be adopted on HNV farmland could be identified with confidence, together with the target area for each action[44] and the estimated total area of HNV farmland present (from Paracchini *et al.* 2008). Information on the actual uptake by farmers of each action was not available to this study and the total costs and opportunity costs for these payments were based on the target area specified for each agri-environment action (or group of actions) in the Rural Development Plans for each Member State. The full methodology is described in Box 13 of Annex A.

[44] No appropriate Target Area could be identified for the relevant agri-environment actions for Poland. Therefore the value was generated using a uniformly distributed random variable as described in Assumption 2.

For the remaining 20 Member States (Malta was not included in this analysis as no data are available on HNV Farmland), it was not possible to determine one or more of the following: i) to identify the agri-environment actions that might be focused specifically at HNV farmland or habitats that typically occur on HNV farmland; ii) to determine the proportion of the agri-environment payment that was attributable to income foregone or iii) to determine the target area for the specific agri-environment action.

To achieve a preliminary EU-wide estimate that included all 26 Member States for which HNV farmland area data were available (Paracchini *et al.* 2008) the following assumptions were made:

- Assumption 1: The EU-wide mean total cost per hectare and EU-wide mean opportunity cost per hectare is the same for each EU Member State. The EU wide mean per hectare values are estimated from data on the per hectare agri-environment payments given for HNV farmland habitat or species actions undertaken in Austria, Bulgaria, Czech Republic, UK (England), Poland and Romania. The within and between country variation in the size of these payments is indicated in Table 16. These data were considered as representative of the costs incurred across all EU Member States since per hectare agri-environment payments are constrained by the Rural Development Regulation to remain with a specified limit.
- Assumption 2: The proportionate area (*PA*) of total HNV farmland used to calculate the target area for each Member State, is a uniformly distributed variable. The limits of the distribution of *PA* are 0.08[45] to 0.70. These values are the limits of the distribution of proportionate areas identified for Austria, Bulgaria, Czech Republic, UK (England) and Romania. The distribution identified for these five countries/regions was assumed to be representative for all Member States. The uniform (rather than a normal) distribution is assumed since the decision on target area for these agri-environment actions is a political one by each Member State and is not made with reference to any specific quantified goal established centrally by the EU.

Using country cost estimates and proportionate target areas derived from these two assumptions, together with estimates of the total area of HNV farmland present in each Member State (listed in EEA 2009 and derived from Paracchini *et al.* 2008), an EU-wide estimate of the distribution of the total cost and opportunity cost associated with biodiversity action applied under the agri-environment measure to HNV farmland could be calculated. To get a reliable distribution, the analysis was repeated 100,000 times to give a mean and variance value for the overall EU-wide total cost and opportunity cost for biodiversity action on HNV farmland under the agri-environment measure. These values are given in section 3.1 below and details of the methodology are discussed further in Annex A.

Assessment of costs at EU level

[45] The figure drops to 0.08 because this is the proportion of HNV land that is targeted within a particular country for a particular agri-environment action. Specifically the figure of 0.08 relates to agri-environment action on Bulgarian grassland. It is the product of the Target Area for grassland, specified within the Bulgarian RDP, divided by the total area of HNV land available in Bulgaria (from EEA 2009). This gives a figure of 0.08 as the proportionate area of HNV farmland in Bulgaria that is targeted for agri-environment grassland payments.

Estimates of the mean total cost and mean opportunity costs for six Member States, where agri-environment actions appropriate to HNV farmland could be identified, are shown in Table 18together with their respective standard deviations.

Table 18 Estimates of the costs of biodiversity action on HNV farmland under the agri-environment measure for six Member States using the target area specified by each country in its Rural Development Programme.

Estimates are based on 100,000 simulations[46].

Country	Target area (ha) specified for (HNV relevant) AE action and estimated total HNV area (ha)	Mean Total Cost (€M) and per hectare cost in (€/ha)(€)	Standard Deviation (S.D.) of Total Cost (€M) and per hectare cost in (€/ha)(€)	Mean Opportunity Cost (€M) and per hectare cost in (€/ha)()	Standard Deviation (S.D.) of Opportunity Cost (€M) and per hectare cost in (€/ha)(€)
Austria	0.39 M	1.07 M 272.8/ha	6.21 M 15.9/ha	77.3 M 197.5/ha	3.60 M 9.2/ha
Bulgaria	2.45 M	44.4 M 180.4/ha	5.6M 21.8/ha	38.6M 151.7/ha	2.87 M 8.2/ha
Czech Republic	0.55 M*	113M 165.9/ha	9.28 M 13.7/ha	85.0 M 125.2/ha	4.45 M 6.6/ha
UK(England)	2.51M	128M 174.1/ha	13.4M 18.2/ha	87.0 M 113.9/ha	10.5M 14.3/ha
Poland	0.68 M	97.5M 238.3/ha	5.00M 12.2/ha	80.9M 197.8/ha	5.14M 12.6/ha
Romania	1.04M	223 M 153.0/ha	20.1 M 13.8/ha	181 M 123.9/ha	0.083 M 0.1/ha

M= million

[46] A distribution of total and opportunity cost estimates was generated for each country, from which an overall mean value, variance and standard deviation for these country specific costs could be estimate. Each distribution was constructed from 100,000 estimates of cost for each country. Each estimate of total cost was obtained by assigning a random weighting to each agri-environment payment, reflecting the likelihood of the payment being applied to the target area. This was done because each country has a range of payment values (see Annex A for details on the methodology).

Table 17 reveals significant variation in the mean total costs across the six countries, ranging from €44.4 million for Bulgaria to €223 million for Romania. This variation arises from two parameters: i) the size of the per hectare agri-environment payments specified by each Member State (Table 16) and ii) the size of the target area specified for (HNV relevant) agri-environment actions by each Member State (Table 17). The same parameters account for a similar variation observed in the estimates of mean opportunity cost (Table 17).

Of the six countries studied here, Romania has the smallest mean total cost per hectare at 153 €/ha (Table 17), reflecting just two relatively low payments for agri-environment action compared to the other countries (Table 16). However, Romania has the largest target area (1.46 million ha) for agri-environment action relevant to HNV farmland; and it is the size of this target area that pushes up the estimated mean total cost to €223 million.

By comparison, Austria has the largest mean total cost per hectare at 273 €/ha (Table 17), reflecting relatively large per hectare payments for agri-environment action (Table 16), but its target area for agri-environment action on HNV farmland is small at 0.39 million ha (Table 17). Thus its overall mean total cost of €10.7 million falls in the middle of the range of estimated mean total costs (Table 17).

The per hectare (€/ha) values for mean total cost and mean opportunity cost for each country (Table 17) were used to estimate an overall mean total cost and mean opportunity cost of 169.21 €/ha and 130 €/ha respectively. These values (and their standard deviations of 13.96 and 8.90 €/ha respectively) were applied to the HNV target areas estimated for each EU Member State (see Annex A and B), the latter being determined by total area of HNV farmland present in each country (EEA 2009). From this approach, an EU-wide value for the total cost and opportunity cost of biodiversity action on HNV farmland under the agri-environment measure is estimated as $€4.37\times10^9$ (S.D. 2.64×10^8) and $€3.35\times10^9$ (S.D. 2.31×10^8). In considering these values, it should be remembered that they are based on an estimated target area of HNV farmland to which the agri-environment actions listed in Table 15 are applied. This estimated target area is expected to be larger than the current uptake by farmers of these agri-environment actions. The values are thus an over-estimate of the current total cost and opportunity cost of biodiversity action on HNV farmland but provide an indication of the scale of the costs that might be expected if the planned target area for these agri-environment actions was met and applied to HNV farmland.

Gaps and methodological issues

This analysis has focused on an assessment of the total costs and opportunity costs associated with biodiversity management on HNV farmland under the agri-environment measure (214) of the EAFRD Regulation. The estimates do not include any opportunity costs arising from foregone development, access or land use restriction imposed by biodiversity management requirements for HNV farmland.

The analysis uses data from six Member States where agri-environment actions can be identified clearly for HNV farmland. The costs for these six Member States can be established with certainty since robust payment and area data are available for each and thus enable the full range of the distribution of costs associated with the different agri-environment actions available to be identified

There is no reason to suppose that the distribution of payment values and target areas for these 20 MS will differ significantly from the data distributions identified for the six MS. The per hectare value of agri-environment payments is constrained by the Commission and hence the parameters of the distribution of payment values for all Member States will be

similar. Likewise, the distribution of PA values (the proportionate area of HNV farmland targeted for each agri-environment action) for the six Member States was included a wide range of values and such a range would be expected for the remaining 20 States.

The analysis has assumed that a single EU-wide unit cost (mean value in Euros/ha) can be applied to all Member States. This is clearly an over-simplification as the unit cost will vary with the standard of living for each country. However, given that the EU-wide cost is the sum of costs for 26 individual countries, large unit costs in some countries will be cancelled out by low unit costs in others. Thus the use of a single value for the EU-wide cost may be expected to yield a reasonably accurate estimate. As noted throughout, the cost estimates were made with respect to the target areas for each agri-environment action. A more accurate estimate could be obtained by using actual uptake data, and would have the advantage of enabling a direct comparison between the estimated value and the observed cost. Such a comparison was beyond the scope of this study and hence would be an area for further work.

2.6 Conservation and restoration of forest areas (Category D)

Overview of the policy

The EU Biodiversity Action Plan establishes the following target:

Member States have optimised use of opportunities under agricultural, rural development and forest policy to benefit biodiversity 2007-2013.

Actions to achieve this target include definition of high-nature-value forest areas threatened with loss of biodiversity (with particular attention to extensive forest/woodland systems at risk of intensification or abandonment, or already abandoned), and design and implementation of measures to maintain and/or restore conservation status. The need for co-funding through rural development programmes and less favoured areas measures is identified.

The EU's forests are of variable value for biodiversity, comprising areas of natural and semi-natural woodland of high nature value, as well as lower nature value plantation woodlands, often comprised of non-native species. According to IEEP (2007)[47]:

High Nature Value forests are all natural forests and those semi-natural forests in Europe where the management (historical or present) supports a high diversity of native species and habitats, and/or those forests which support the presence of species of European, and/or national, and/or regional conservation concern.

No agreed estimate of the overall extent of HNV forest is available at the EU level. HNV forest is a subset of the overall EU forest area. Natura 2000 sites and national protected areas are likely to account for a proportion of the HNV forest area. However, from available statistics, it is estimated that:

- The total EU forest area amounts to 176 million hectares, 42% of the overall land area of the EU27 in 2005. 59% of this area is in private ownership and 41% in public ownership[48].

[47] IEEP (2007) Study on HNV Indicators For Evaluation. http://ec.europa.eu/agriculture/analysis/external/evaluation/short_sum.pdf

- Of this, approximately 85% is 'semi-natural'[49], totalling around 150 million hectares, displaying some characteristics of natural ecosystems, with different levels of naturalness and biodiversity.
- Approximately 25% of forests are excluded from wood harvesting, largely to protect their importance for biodiversity; this amounts to roughly 44 million hectares in the EU[50]
- Forests account for approximately 46% of the Natura 2000 area, with an estimated 40 million hectares of forested land in Natura 2000 sites.
- Forests that are 'undisturbed by man' are the most valuable forest type in terms of storing biodiversity and have a high conservation value. However, only 5% of forests in the EEA region (9 million hectares) are classified as 'undisturbed by man', more than half of which is to be found in Sweden.[51] In most European countries, the share of forests considered 'undisturbed' is low, ranging from 0 to 1%. These types of forest are mostly located in remote or inaccessible areas dominated by extreme climatic or topographic conditions.[52]

Although the absolute area of forests in the EU is increasing, the environmental quality is often in decline. The rise in forested areas also hides the fact that some of the forests which are most valuable for biodiversity are still threatened to be replaced by intensively managed semi-natural forests or plantations. Most EU forests are managed in a way that takes little account of general biodiversity concerns and gives priority to sustainable timber yield. A clear priority for the protection of biodiversity, therefore, is finding appropriate forest management systems that take biodiversity concerns into account.[53]

In the UK, the Biodiversity Action Plan estimates the extent of native woodland nationally at 1,058,721 hectares, of which ancient semi-natural woodland amounts to 403,400 hectares. These figures represent 37% and 14% respectively of the total UK woodland area of 2,829,000 hectares. Natura 2000 sites in the UK contain 842,000 hectares of forest, suggesting that the network covers most HNV forest land.

High Nature Value Forests require protection from development or land use change, and need varying levels of management to maintain their structure, enhance their biodiversity value, and prevent abandonment.

The different forestry measures under the current rural development programme (2007 to 2013) include:

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[48] Eurostat (2007) Forestry Statistics – 2007 Edition.

[49] MCPFE (2007) State of Europe's Forests 2007 – The MCPFE Report on Sustainable Forest Management in Europe.

[50] EEA (2008) European forests – ecosystem conditions and sustainable use. EEA Report No.3/2008.

[51] EEA (2008) European forests – ecosystem conditions and sustainable use. EEA Report No.3/2008.

[52] MCPFE (2007) State of Europe's Forests 2007 – The MCPFE Report on Sustainable Forest Management in Europe.

[53] European Commission (2003) Natura 2000 and Forests – 'Challenges and Opportunities'. Interpretation guide.

- 221 - Afforestation of agricultural land - Support for establishment of new forests will involve more than 127 000 land owners and covers 650 000 ha of forests.
- 224 – Natura 2000 payments for forests – this measure is included in 15 of the 88 RDPs. 60 000 private forest owner and 400 000 ha Natura 2000 forest will receive support.
- 225 – forest environment payments: 28 programmes include this measure, which is expected to support 75 000 forest holdings and 2 million hectares of forest.
- 227 – non-productive investments. This is the most widely used measure for forestry in rural development programmes, covering 71 programmes and 120 000 forest owners. It is likely to overlap with other programmes[54].

Types of costs

The costs of forest conservation include:

- Capital costs – for restoration or re-creation of forested habitats
- Ongoing maintenance and management costs
- Other costs – surveys, monitoring, research and advisory measures
- Administrative costs, such as for achieving certification.

The costs of forest operations include the labour, machinery, equipment and materials required for planting, removal of trees and other vegetation, conversion of plantations, preparation of areas for natural regeneration, coppicing and pollarding of trees, control of pests, fencing, creation of fire breaks and restoration of habitats and features.

The opportunity costs of forest conservation include:

- losses due to reduced output of timber or other forest products, which may result from use of less productive native species, delayed or forgone harvesting of whole forests or certain areas, removal of non-native species, and protection of old trees or dead wood
- income forgone for alternative uses (e.g. a parking lot or industrial facility, conversion to agricultural land, urban development),

In a global literature review of forest costs and benefits, Mullan and Kontoleon (2008) noted that the most significant costs of conserving forest biodiversity are often the opportunity costs of retaining land in a more-or-less natural state, rather than using it intensively or converting it to some use that is incompatible with biodiversity conservation (e.g. a parking lot or industrial facility). Forest land may be converted to agriculture, used for urban development, or managed in order to increase the output of timber or another valuable forest product. In all of these cases, some components of biodiversity may be lost, but other benefits would be obtained. The benefits may include food or cash income for farmers, employment opportunities for local households, or profit for timber companies. If these opportunities are not accounted for, the costs of losing biodiversity, or the benefits of conserving it, would be overstated.

[54] European Commission (2009) Report on implementation of forestry measures under the rural development regulation 1698/2005 for the period 2007-2013, March 2009.

Kniivila and Saastamoinen (2002) observed that the protection of natural forests gives rise to opportunity costs in lost timber harvesting. These opportunity costs are highest if the management regime prevents the extraction of timber. If, instead of strict protection, some forestry activities are allowed, the opportunity cost is the net decrease in the value of wood production. As well as foregone income, these opportunity costs may lead to a loss of employment and wages and hence foregone opportunities for rural development, which may be significant in more remote rural areas with few development opportunities.

Overview of available cost estimates

The costs and benefits of Natura 2000 study estimates the average cost of forested sites at 37 euro per hectare, compared to 63 euro per hectare for the network as a whole. This estimate includes both the one-off costs of implementing the network and the annual costs of its management. The total cost of forested areas in the Natura 2000 network is estimated at €1.5 billion annually.

In the UK, the costs of implementing Habitat Action Plans for native woodlands are estimated at €102 million per annum between 2005 and 2010, rising to €133 million per annum between 2015 and 2020. The increase in costs results from an increase in the area brought under sympathetic management over time. Averaged across the overall area of native woodland, this amounts to €96 - €126 per hectare per year. These costs include annual management costs (42%), restoration costs (18%), costs of forest expansion (24%), administrative/central costs (12%) and other costs (research, monitoring, and advice etc – 5%)[55].

There is a significant element of opportunity costs within the costs of forest expansion. Approximately 50% of the estimated expansion costs over the 2005 to 2020 period are capital costs of forest creation, with the remaining 50% relating to the costs of annual payments to land managers. A large proportion of the latter payments relates to income foregone from agriculture or other land uses. Annual maintenance costs also include an element of income foregone resulting from reductions in yield from conservation management practices. In addition, the conservation of most forests is likely to give rise to some opportunity costs if the forested land has alternative uses for development, farming or other purposes – these uncompensated opportunity costs are not included in the BAP cost estimates.

In Finland, Kniivila and Saastamoinen (2002) estimated that 10% of the land area is strictly protected for nature conservation; however, protected forests are concentrated in the north of the country and in less productive forestry areas. The authors estimated that if commercial forestry operations were allowed on 20,000 hectares of protected areas in Ilomantsi, Eastern Finland, this could lead to a sustained increase in timber production of 25,000 m^3 per year, producing net revenues of 4.7 million FIM (€0.8m) per year and generating 5.7 to 6.3 new jobs. Thus the opportunity cost of protecting the forest is equivalent to 235 FIM (€39) per hectare per year, and 0.3 jobs per 1000 hectares.

Box 5 Global Evidence of Opportunity Costs of Conserving Biodiversity

[55] These amounts have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010

Mullan and Kontoleon (2008) reviewed global evidence of the opportunity costs of conserving forest biodiversity. They found that the opportunity costs of tropical forests vary according to potential alternative land uses, but are generally less than US$100 per hectare per year, and in many cases below US$5 per hectare per year.

Case studies from developed countries suggest significantly higher opportunity costs of conserving forest biodiversity, although this varies depending on local land scarcity and potential alternative uses. In European countries, high land values result in large estimates of opportunity costs. Siikamaki and Layton (2006) surveyed non-industrial private forest land owners in Finland to elicit their willingness to accept compensation (WTA) for biodiversity improving management practices, and report median WTA of US$738 per forest site.

In less densely populated developed countries, the opportunity costs of conservation are lower. Shaik et al (2007) found that farmers in parts of Canada were willing to accept US$12/ha/year, on average, to convert to agroforestry, while Sinden (2004) estimated the opportunity costs to farmers in Australia of not converting native vegetation to farmland at US$4-7/ha/year, depending on how much land they would be likely to convert in the absence of restrictions.

At a global level, Lewandrowski et al (1999) estimate the reduction in GDP that would result if 5% or 15% of land was retired from production and devoted to conservation. The results are for ecosystems but suggest similar values to the individual case studies for forest land. Average opportunity costs at a global level are estimated at US$85/ha/year for 5% of land, rising to US$90/ha/year if 15% of land was withdrawn from production. At a regional level, the authors estimate opportunity costs at around US$30/ha/year in Australia, New Zealand, Canada, and most of the developing world, and US$100-200/ha/year in Southeast Asia and the USA. Estimated opportunity costs were significantly higher in Europe, at US$1200/ha/year, and reached over US$6000/ha/year in Japan. The analysis took account only of foregone crop, livestock and forestry output from setting aside currently productive land for nature, and not the market value of any ecosystem services that might result.

Costs and Expenditures under EAFRD

The EAFRD regulation[56] prescribes which types of costs can be covered by compensation payments and sets minimum and maximum payment rates. Payments can be made as follows:

Forest environment payments (measure 225) - payments of 40€/ha - 200€/ha[57] for 5 to 7 years, covering additional costs and income foregone.

First afforestation of agricultural land (measure 221):

- Establishment costs - one-off payments for soil preparation, stabilisation and drainage; cost of seedlings; labour costs; transport costs; and sometimes early

[56] Council of the European Union (2005): Council Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development.

[57] Increased in exceptional cases taking account of specific circumstances to be justified in the RDPs.

year's management; normally range between 50 and 3200 EUR/ha, depending on which components of the above are included.

- Maintenance costs: Annual premium per ha over 5 years for recurring costs of weed control, protection against browsing and grazing, prevention of soil erosion, fire prevention equipment and training, other material costs, labour costs.
- Income foregone: annual premium per ha over 15 years (maximum 700€/ha/yr for farmers and 150€/ha/yr for other natural persons or private-law bodies).

Opportunity costs are reflected in income foregone. For most rural development programmes, calculations of income foregone are not publicly available; however, for some it is apparent that actual rates of payment are often set below calculated income foregone.

A review of rural development programmes reveals varying approaches to estimation of income foregone for forest environment payments:

- Income foregone calculated in comparison with a mean yearly contribution margin in similar conditions and with the same forest stand. (DE – Bavaria, see box 2)
- The income foregone equals the annual interest rate for long-term deposits that could be received in case of selling the wood after allowed final forest felling or allowed clear-cutting. (LT)[58]
- Opportunity costs are presented in terms of the lost revenue associated with felling timber before its optimum harvesting date. (UK)
- Income foregone for increased share of deciduous trees which reduce the felling premium. (CZ)

Box 6 Income foregone in Forest Environment Payments, Bavaria

Details of calculation of forest environment payments are available for Bavaria (DE)[59]. The compensation payments are based on the calculation of income foregone for foresters by implementing voluntary and contractually agreed measures of nature, habitat and species protection[60].

- Conservation and improvement of coppice shoot woods: Opportunity cost is calculated based on the difference in margin compared to a tall tree forest. The compensation payment is set almost equivalent to computed income foregone at between 40 and 70 EUR/ha.
- Conservation and establishment of less dense forest structures: compensation is from 40 to 200 EUR/ha/y, in line with estimated reductions in forest yield, depending on the type

[58] Rural Development Programme for Lithuania, 2007 – 2013, September 19, 2007. last retrieved 23.06.10 at www.zum.lt/min/failai/RDP_2007-2013_2007_09_19_EK.pdf

[59] "Bayerisches Vertragsnaturschutzprogramm Wald", Chapter 5.3.2.2.5, Status Feb. 2010, last retrieved 23.06.10 at http://www.stmelf.bayern.de/agrarpolitik/programme/eler/24245/linkurl_0_13_0_9.pdf

[60] In the case of Bavaria the forest environment payments are targeted at forests in areas of specific ecological value or in protected areas. These payments are thus not applicable to any forest in Bavaria.

of tree and the percentage decrease of density of the forest (from 30% to more than 75%)

- Conservation of old and habitat-trees (minimum 6%): the premium is calculated based on the income, interest and value loss. The income foregone for 3 habitat trees and 3 old trees on 1 ha amounts to 84 EUR/ha, thus the value of the premium is 80 EUR/ha.
- Dead wood (minimum 7% per ha of a minimum size of 0.4m x 3m): The calculated income foregone amounts to 43 EUR/ha to 74 EUR/ha for 7-20 pieces.
- Conservation of beaver habitats (strips of up to 20m width along beaver habitats): The premium of 155 EUR/ha is based on lost margin due to constraints on the exploitation of riparian forest and by allowing flooding by beaver activity.
- Forest area set-aside from exploitation (in natural old and decaying forests): The premium is calculated based on the income foregone for varying types of trees with low or medium growth (42 -83 EUR/ha).

Factors affecting estimation of opportunity costs for afforestation on agricultural land (221) include:

- Former land use (grassland or arable land)
- Beneficiary of the payment (farmer or other forest owner): payments to farmers are typically based on regional gross margins, while those for others can be based on the market value of land.
- The motivation (i.e. incentive needed) of the person engaging in a new voluntary activity.
- The time until the new forest generates income (which may be longer for forests of importance for biodiversity).
- The time that has been released by the new activity (e.g. forestry instead of agriculture) to spend on other economic activities.
- Reduced income because of some of management restrictions: e.g. reduced felling premium because of higher share of deciduous trees

The approximate EU 27 planned expenditure for the selected measures (221, 225 and 227) in the 2007-2013 programming period (out of the total EAFRD budget of 91 billion EUR) is as follows[61]:

- First afforestation (221 & 223): 2.4 billion EUR and 360 million EUR respectively (2.6% and 0.4% of total expenditure)
- Forest environment payments (225): 260 million EUR (0.3% of total expenditure)
- Non-productive investments (227): 800 million EUR (0.9% of total expenditure)

[61] DG AGRI, 2009, Rural development in the European Union, statistical and economic information, Report 2009.

Some regions in the EU, especially central and northern Europe, are dominated by intensive land use, so that nature conservation competes strongly with other land-uses, leaving little room for semi-natural or natural areas. Consequently, in these areas there is a tendency to establish protected areas that are small to medium-sized where the protection of these sites is based largely on purchasing land or the rights to use in order to manage it for conservation purposes. In other areas, such as the southern and eastern European regions, the predominance of extensive farming and forestry systems on high nature value land allow the integration of nature conservation and rural development.[62]

In general, forestry in Europe has more often followed this latter, integrative strategy. This is largely why so many forest areas are considered 'semi-natural'. This makes the need for habitat restoration less apparent than in the case of other habitats where economic use has significantly altered landscape features and biodiversity levels.[63] Combined with the fact that 'undisturbed' forests, which are of the greatest value to nature conservation, are often located in remote or inaccessible areas dominated by extreme conditions, the opportunity costs associated with combining conservation with the forest's other management purposes are therefore often not as great as in the case of other habitats.

In fact, some examples illustrate that multi-functional forest management can actually enhance the biodiversity and ecological value of European forests (see Box 7). However, in the case of especially rare or valuable habitats, the setting aside of land exclusively for nature conservation purposes should be considered. The opportunity costs of restricting the use of these areas will vary depending on where the sites are located. Currently, 'old growth' and 'virgin' forest areas are limited to small pockets in managed complexes or regions with very specific conditions. The degree to which conservation of these areas can be reconciled with a degree of human interference depends on their regenerative capacity.[64] In the case of very low growth rates, no intervention might therefore be the only option, which can mean high opportunity costs of conserving these areas.

Where the opportunity costs of conserving forest areas are high, these can be offset by financial compensation schemes. For instance, in the Walloon Region of Belgium, all Natura 2000 sites are exempted from inheritance tax and from property tax in order to compensate private owners of protected sites for the loss of property value that has sometimes been associated with Natura 2000 designation. The German state of Nordrhein Westphalia associates Natura 2000 designation with compensations for economic losses in relation to the maintenance of well-defined levels of decaying trees and deadwood, as well as the transformation of conifer stands into indigenous broadleaved forest.[65]

Box 7 Economic benefits of conservation-based forestry

The administration of forests of Lower Saxony in Germany is implementing a comprehensive production and nature protection strategy for 'close-to- nature forestry' called 'LÖWE' (long-term ecological forest development). Since its introduction, costs for planting and harvesting

[62] European Commission (2003) Natura 2000 and Forests – 'Challenges and Opportunities'. Interpretation guide.

[63] *ibid.*

[64] *ibid.*

[65] *ibid.*

per cubic metre have been drastically reduced through the use of natural processes such as the natural regeneration of forests. The strategy also involved measures that are essential for the change to ecological forest management, including, for instance, ensuring adequately low numbers of deer per hectare to encourage the natural regeneration of the forests without the need for expensive fencing,

Although economic considerations were not originally included in the principles of the LÖWE programme, they have since been derived from them. Profits have increased, for example, from the objectives of girth limit felling. In the eight years of its implementation, the LÖWE programme has led to a significant reduction in expenditure and a corresponding increase in income in the state forests of the area.

The LÖWE programme illustrates that ecologically based forestry can, under certain conditions, be the most economically viable form of management.

Source: European Commission (2003) Natura 2000 and Forests – 'Challenges and Opportunities'. Interpretation guide.

Methodology for overall cost assessment

The overall costs of management of the estimated 40 million hectares of forest in the Natura 2000 network are estimated at €1.5 billion annually (an average of €37 per hectare per year). A significant but unquantified proportion of these costs are opportunity costs relating to income foregone from conservation friendly forest management practices.

While no overall estimate of "high natural value forests" is available at the EU level, it is estimated that the overall area of semi-natural forest extends to around 150 million hectares.

Available data from studies of opportunity costs and from rural development schemes suggest that conservation management of semi-natural forests incurs average opportunity costs of at least €40 per hectare per year. This figure can be used to give a conservative estimate of the opportunity costs of biodiversity conservation in EU forests.

In addition, the conservation of forests incurs some additional opportunity costs by restricting opportunities for development (see section 2.1 on foregone development opportunities). Expansion of the EU forest area through conversion of land in other uses such as agriculture incurs significant additional opportunity costs.

Assessment of costs at EU level

Based on the above analysis, a rough but conservative estimate is that the management of the EU's semi-natural forests for biodiversity would incur annual opportunity costs in the order of €6 billion per annum. Of this approximately €1.5 billion relates to the Natura 2000 network and €4.5 billion to forests outside Natura 2000 sites.

This estimate excludes opportunity costs from forest expansion and from foregone development.

Gaps and methodological issues

The above assessment is somewhat speculative, but indicates the possible scale of opportunity costs associated with biodiversity conservation in the EU's forests.

A more detailed and accurate assessment would benefit from further analysis of:

- The area of high natural value forest in the EU and its management requirements;

- The unit costs of forest management, including opportunity costs;
- The degree to which costs vary across the EU and the factors behind these variances; and
- The opportunity costs associated with forest expansion and foregone development.

2.7 Conservation and restoration of biodiversity in the marine environment (Category E)

Overview of the policy

Marine protected areas (MPAs) are currently the main tool for maintaining and managing marine biodiversity and ecosystem services (Adams *et al.* 2010). The establishment of a global network of MPAs by 2012 is a key requirement of the Marine Strategy Framework Directive ((2008/56/EC)[66](MSFD). The MSFD also places a requirement on Member States to assess the current environmental status of their marine waters, to define a condition of Good Environmental Status for their marine waters and to establish targets, indicators and monitoring programmes to determine progress towards this condition (see Box 15 in Annex A Marine Environment for further information). Whilst the establishment and achievement of Good Environmental Status for marine waters is likely to give rise to additional costs and opportunity costs, progress towards this goal is still in an early phase, establishing standards and assessment criteria (see Box 15), and thus no further consideration of potential costs associated with the achievement of this broad goal is given here. Instead the section focuses on the costs and opportunity costs that may be associated with the establishment and running of MPAs which have been operational for some time now and which are currently the main instrument for the protection of marine habitats and species.

MPAs are now being implemented by a wide number of institutions and governments worldwide to address a range of problems from fish stock depletion to habitat degradation. In 2003, it was estimated that worldwide there were 4,116 MPAs containing coastal and marine elements (WWF, 2004).

The implementation of MPAs in the European Union (EU) is driven by a number of international, EU and national obligations and initiatives to which the EU and its Member States are committed. These include:

- the World Summit on Sustainable Development (WSSD) and the Convention on Biological Diversity (CBD) targets to establish representative networks of MPAs by 2012;
- the OSPAR agreement to work with HELCOM and the European Community, to identify the first set of Marine Protected Areas (MPAs) by 2006 and complete by 2010 a joint network of well-managed marine protected areas that will be ecologically coherent with the NATURA 2000 network;

[66] See: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF

- EU Council Directive 92/43/EEC on the Conservation of Natural Habitats and of Wild Fauna and Flora (the habitats Directive) (1992) which requires the establishment of Special Areas of Conservation (SACs); and
- EU Council Directive 79/409/EEC on the Conservation of Wild Birds (the birds Directive) (1979) that requires designation of Special Protection Areas (SPAs).

Despite these international and regional political commitments, a legal basis that is over twenty five years old and strong support of environmental NGOs, progress on implementation of MPAs in the EU remains slow. As they can play a role in *inter alia* fisheries management and conservation, the poor implementation record is particularly striking when the EU is faltering in meeting its broader targets in two key areas (e.g. restoring stocks to maximum sustainable yield (MSY) levels by 2015 and halting the loss of biodiversity by 2010) (Lutchman, 2007). Data on site designation contains so many limitations that drawing meaningful conclusions on extent of area designation becomes impossible[67].

Types of costs

The financial cost of an MPA includes the initial, typically short-term investments in establishment as well as the recurrent costs of maintenance (including administration, management and enforcement) incurred over the long-term. Compared to terrestrial protected areas, there can be more costs since additional equipment is needed such as boat moorings, diving equipment etc (MPA News 2008) and the costs of enforcement may be large depending on the size of the MPA.

The total economic cost incurred in establishing and running an MPA is the sum of standard operational type costs such as:

- Start-up costs,
- Management costs,
- Direct operating costs,
- Costs for building social and political capital and capacities,
- Monitoring and enforcement costs, and
- General governing costs
  (*e.g.* Balmford *et al..*, 2004; Charles and Wilson, 2009; Greenville and MacAulay, 2007; Rudd 2007)

As well as socio-economic costs arising from opportunity costs associated with different stakeholder groups. With respect to MPA establishment, it is evident that opportunity costs are more influential in determining site/area selection in the marine environment than in the terrestrial one where site use is more clearly defined by property rights (Ban and Klein 2009). Similarly, the balance of costs may differ from those for terrestrial protected areas, involving greater start-up /establishment costs in capital items for example survey boats, research costs and transaction costs arising from discussions with and lobbying from different stakeholders (McCrea-Strub *et al.* 2010), but lower recurrent costs, as management

[67] Numerous sites have been designated according to both the Birds and the Habitats Directives, either in their totality or partially. The data on numbers of sites and area coverage may therefore not necessarily add up. http://europa.eu.int/comm/environment/nature/nature_conservation/useful_info/barometer/index_en.htm

of the marine environment will rather focus on monitoring and restricting the use of the MPA rather than on the physical management of the habitat frequently required on terrestrial protected area sites (Naidoo *et al.* 2006).

The identification of opportunity costs for MPAs has tended to focus on short-term (albeit large) costs to fishers and may include:

- Net decrease in fishing offtake (Balmford *et al.*, 2004; Charles and Wilson, 2009)
- Loss of access rights (Charles and Wilson, 2009; Greenville and MacAulay, 2007)
    - Displacement and relocation resulting in extra travel costs (e.g. fuel usage, crew employment) and less time available for fishing
- Higher capital costs from investing in new fishing equipment (Greenville and MacAulay, 2007)

In the medium to long-term there are likely to be other costs which include:

- Crowding externalities in new fishing locations (Charles and Wilson, 2009; Sanchirico, 2000)
- Loss of 'way of life' (Jones, 2009) and 'attachment to place' (Charles and Wilson, 2009).

However, stakeholders in other sectors may also be affected, particularly oil and gas (see Table 20below), recreation and telecommunications. Moreover the significance of the opportunity cost will vary within any one stakeholder group; thus inshore fishermen in the UK were considered to be especially vulnerable to the establishment of MPAs (Jones 2009). The issue of opportunity costs for the fishing industry may be seen as a short-term cost since enhancing the sustainable management of the fishery will confer a long-term benefit on the industry (Cullis-Suzuki and Pauly 2009). Further discussion of these different types of costs is given in the Annex C at the end of this report.

A recent study by McCrea Strub et al. (2010) emphasizes that while the recurrent costs of managing marine protected areas (MPAs) have been documented and estimated for a number of tropical and some temperate regions, there has been virtually no attempt to quantify the cost of establishing MPAs in the first place.

Overview of available cost estimates

One of the first attempts to estimate the costs of establishing a network of MPAs was made by Balmford (2004) using a survey of over 500 individuals involved in running MPAs worldwide. Although the study started with 83 MPAs, the data for 16 well managed areas were used in the final estimations. The study found that recurrent annual expenditure on the MPAs sampled, expressed in $ per km^2, ranged from $0 to $28 million per km^2 per year (median, $775 per km^2 per year; all costs are given in U.S. dollars($) for the year 2000). The WSSD commitment to establishing national MPA networks by 2012 sets no targets for the number, size or coverage of MPAs, but the Worlds Park Congress calls for strictly protected marine reserves covering 20–30% of habitats by 2012. Using various models, Balmford estimated that a global MPA network covering 20–30% of the seas and costing $5–19 billion per year to run would require an increase in present areal and financial investment in marine conservation of around two orders of magnitude. The return on such an investment would be substantial. Apart from the direct financial gain from potentially increased catches, the MPA system modelled by Balmford estimated an increase in the sustainability of a global marine

fish catch currently worth $70–80 billion annually. In addition there is the potential to deliver unseen marine ecosystem services with a gross value of roughly $4.5–6.7 trillion each year.

Cullis-Suzuki and Pauly (2010) applied the model used by Balmford to estimate the annual maintenance cost of the current global network of MPAs, and ranked the maritime countries of the world according to their financial investment in MPAs. The running costs of MPAs were evaluated using information from three sources (Balmford *et al.*, 2004): MPA details (e.g. total area protected for number of staff); income from MPAs (e.g. sources of income and visitor fees) and spending (e.g. wages for wardens). Building on the work done by Balmford and despite the caveats associated with the inadequacy of the data and coverage, the results of this study provide additional information on costs. Their estimate was that it would cost $25-37 billion annually to protect 20-30% of the global oceans. This value is higher than the estimate of cost by Balmford *et al.* (2004) of $5-19 billion.

The work by Balmford *et al* (2004) and by Cullis-Suzuki and Pauly (2010) provides the most comprehensive assessment of the total annual running cost for a global network of MPAs. Both studies concluded that MPA area was a key predictor of cost and that the per unit area cost of an MPA was inversely related to its area. Thus the unit cost in $ per km^2 of running a small MPA is larger than the unit cost of running a large MPA.

Both studies also noted that the costs for MPAs in developed countries were five to six times greater than for developing countries. The difference reflects variation in Gross Domestic Product (GDP) per capita of the different countries. Cullis-Suzuki and Pauly (2010) used per capita GDP as a correction factor for estimates of MPA cost for different countries and additionally corrected these estimates to take account of differences in the size of the Exclusive Economic Zone (EEZ) for each country. The resulting parameter, termed the "Investment to Marine Protected Areas" index (MPA_{inv}) and expressed as a percentage value, can be used to evaluate the economic performance of a country's running costs for MPAs relative to the value of its fisheries catches (Cullis-Suzuki and Pauly, 2010). An MPA_{inv} index of 10 percent or more was considered indicative of countries with the most advanced management of marine protected areas.

Twelve EU Member States were included in the study by Cullis-Suzuki and Pauly (2010), which assessed the running costs for MPAs in the 53 countries that jointly contribute 95% of the global marine fisheries catch. The estimated total running costs for these Member States are shown in Table 19. The values (Table 19) should be viewed with caution as no data on MPA area or fisheries catch are included in the paper; thus costs and economic performance cannot be easily related to the size of the MPA network in each country or to the country's contribution to the EU wide fishing industry.

Table 19 Estimates of the running costs for MPAs in 12 EU Member States for the year 2000 and their MPAinv Index

Rank	EU Member State	MPA cost* (x10^3 US$)	MPA_{inv} Index*
1	Sweden	30,046	15.0
2	Germany	12,610	12.3
4	Denmark	21,100	8.6
5	United Kingdom	70,685	5.8

9	Italy	19,258	3.6
10	Netherlands	4,335	3.2
12	Spain	13,780	2.7
16	Poland	980	1.9
17	France	8,616	1.8
21	Portugal	2,602	1.1
25	Latvia	216	0.8
33	Ireland	1,971	0.5

Source: Cullis-Suzuki and Pauly, 2010

** MPA costs are in 103.US$, MPAinv in %. Rankings based on MPAinv Index in relation to the 53 countries that contribute to 95% of global marine fisheries. An MPAinv index value of 10 or more is indicative of advanced management of MPA.*

The figures indicate a total annual running cost of $186 million across these 12 member states (US$ at 2000 prices) which, given their size and coastal location, are likely to account for a large proportion of the EU total.

Further cost estimates are available for the UK (Box 8) and a comprehensive analysis of the costs of marine conservation has been undertaken for the network of Marine Conservation Zones (MCZs) proposed by the UK Government for English and UK territorial waters (Defra 2010). This analysis is focused on extending the network of protected seas around England by 71,000 km^2. The costs considered for this study included:

- the costs associated with developing and implementing a network of MCZs, estimated as a Total one-off cost of €9.8 – 10.5 million and an Annual Cost of €3.1M. The latter giving a discounted Total Cost (discount rate of 3.5%) of €55.1 – 55.8M over a 20 year period;
- the costs associated with enforcing general offence and byelaws to reduce damage and maintain protection of the MCZs, estimated as a Total one-off cost of €0.007M and an Annual Cost of €0.7 - 1.14M or a discounted total running cost of €9.9 – 16.7M for a 20 year period.

This study also included an assessment of the additional costs to marine developers of implementing MCZs in England (ABPmer *et al.* 2007). The study used a combination of three network scenarios and two different management regimes ('highly-restricted' and 'maintenance of conservation status') to estimate the costs across a wide range of sectors (Table 2). The costs considered by this study included opportunity costs such as restrictions on development and extraction of resources (oil and aggregates) and additional costs of extra cabling to avoid protected areas. However, unit costs varied between each cost element (e.g. £/tonne, £/km, £/km^2, £/licence) and were not calculated for a specific site or area. Consequently it was not possible to separate out opportunity costs from additional costs in the analysis. The study suggested that the Total Cost might range from €503M - €1.37Bn discounted for a period of 20 years. Over 90% of this cost was predicted as being borne by the Oil and Gas and Fisheries sectors. Annual cost estimates were not provided

due to uncertainties in the timing of specific events and /or costs (ABPmer *et al.* 2007), although a range of €25 - € 69.7M has been presented in Defra (2010).[68]

Box 8 Estimates of costs for UK marine protected area

'*The DEFRA Marine Bill consultation document (2006) suggested that it would cost approximately £195,000 (€223,052.7) to establish a marine protected area site and approximately £95,000 (€108,666.7)in annual running costs thereafter. In their advice on Coastal and Marine National Parks (2006), Scottish Natural Heritage (SNH) published figures from two Scottish land based national parks; in 2004-2005 the Loch Lomond and Trossachs National Park employed 110.8 full-time staff and the total running costs were £6,840,000 (€782,400.2) whilst the Cairngorm National Park employs 45 full time staff and its total running costs were £3,360,000 (€3,843,370). SNH advised that the running costs associated with a coastal and marine park would be higher because of greater research, survey, monitoring and equipment costs together with the creation of a dedicated marine ranger service with the appropriate equipment they would require for enforcement of the park's rules. The Royal Commission on Environmental Pollution (2004) calculated that the cost per unit area of conserving the North Sea would be approximately £25-35 (€29-40) /km per year or £240-370 (€274-423) /km per year in the Irish Sea compared with £2450 (€2802) /km for National Parks in England and Wales. The large difference in costs between the North and Irish Sea was attributable to the prediction that marine protected areas in the Irish Sea would be smaller and more fragmented*.' (Feilen,2006).

Table 20 Estimated cost to industry of the establishment and implementation of Marine Conservation Zones (MCZs) in English territorial and UK offshore waters

Sector	Range of total discounted costs (£M) (Discount rate 3.5% over 20 years)
Aggregates	7.9 – 27.9 (€ 9 -31.9)
Telecommunications	5.2 – 17.1 (€5.9 – 19.6)
Power cables	2.6 – 5.1 (€3 – 5.8)
Offshore wind energy	8.8 – 34.6 (€10 – 39.6)
Wave energy	0.1 (€0.11)
Tidal energy	0.5 – 1.5 (0.6 – 1.7)€
Oil and Gas	257.0 – 794.3 (€294 – 908.5)
Fisheries	157.1 – 346.6 (€180 -396.4)

[68] These amounts have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010

Total – all sectors	**440 – 1230** (€503.3 – 1407)

Source: ABPmer, RPA and Brooke, J. (2007)

Methodology for overall cost assessment

The inverse relationship between MPA area and cost identified by Balmford *et al.* (2004) and confirmed by Cullis-Suzuki and Pauly (2010) could be used to estimate the overall cost of an EU network of MPAs. Such a calculation would need to be undertaken for each MPA separately and the individual values then summed to establish the total cost of the network. A calculation based solely on the total summed area of the MPA network would not provide a correct estimate (Cullis-Suzuki and Pauly, 2010). However, it has not been possible within the scope of this study to determine either the total area of the EU MPA network or the areas for individual MPAs within different Member States. Data from the Defra study on MCZs in England suggests a unit cost in £ / km^2 of approximately £138 (€158) / km^2. This figure includes both the one-off and recurrent costs of developing and implementing a network of MCZs (Defra 2010). However, even if the data were known, it would not be appropriate to apply this figure to the full EU MPA network since the scale and nature of costs vary significantly between countries and sites within countries (see Box 8).

The study of Cullis-Suzuki and Pauly (2010) does not include any element of the costs of establishing MPAs. These latter costs have been studied by McCrea-Stubb *et al.* (2010) who identified MPA size and time spent in the establishment of the MPA as the two key predictors of MPA establishment costs. As in the Balmford *et al.* (2004) study, the unit costs($ per km^2) for establishing MPAs were inversely related to the area of individual MPAs (McCrea-Stubb *et al.* 2010).

Assessment of costs at EU level

At present there are no published assessments of the costs of establishing or maintaining MPAs at the EU-wide scale. In theory it would be possible to apply the approach of Cullis-Suzuki and Pauly (2010) using data on the individual areas of MPAs within the EU network. The approach does not, however, permit for the calculation of opportunity costs *per se.,*although it does provide an assessment of the relative value of MPA running costs.

The closest available estimate is that provided by Cullis-Suczuki which estimates combined costs of MPAs across 12 EU Member States at $186 million (US$, 2000). This is equivalent to €235 million in 2010 prices; these 12 MS account for a large proportion of the EU's marine area. However, these figures need to be interpreted with caution as it is not clear what area they refer to, how they have been calculated or what costs are included. These figures do not include opportunity costs for running MPAs, since the authors argue that MPAs generally enhance fisheries; and thus short-term losses in income foregone from a restriction in fishing, are offset by long-term gains in the sustainability of the fish stock. Thus, with respect to the fishing industry at least, the significance of income foregone from the establishment of MPAs is subject to debate. Where long term opportunity benefits outweigh short term opportunity costs, it is argued that opportunity costs of MPAs may be negative over time.

The significance of opportunity costs for the fishing industry is also made more uncertain by the variable levels of protection that can apply to MPAs - varying from no fishing permitted to a multi-use conservation area (Ban and Klein 2009). Opportunity Costs will, however, occur for other sectors, notably oil and gas (ABPmer *et al.* 2007).

Gaps and methodological issues

Uncertainty about MPAs across the EU and their current state of implementation means that an overall quantitative assessment of the EU MPA network is not currently possible. However, an indicative assessment of total annual running cost and the value of MPAs in some EU Member States are given by Cullis-Suzuki and Pauly (2010), indicating a total annual running cost of $186 million across 12 MS analysed (i.e about €200 million at 2000 values[69]). These countries account for a large proportion of the EU total MPAs, and therefore this figure arguably provides a useful order of magnitude. However, it should be taken with caution as it does not include any data on MPA area or fishery catch, nor on the cost of establishing the MPAs. The running costs for MPAs appears to be lower than the recurrent costs for terrestrial Natura 2000 areas, accounting for about €3,880 million (see section 2.2 above) - although this is clearly an approximation and also the figures refer to different years.

2.8 Wider environmental policy measures positively affecting biodiversity (Category F)

Overview of the policy

As well as particular actions for sites and species, the conservation of biodiversity in the EU depends on addressing wider environmental pressures and opportunities which impact on these sites and species. These include:

- Impacts on the water environment (including through pollution, abstraction and flood risk management);
- Impacts of land management on soil biodiversity;
- Climate change mitigation and adaptation; and
- Planning and development policies, including EIA and SEA.

Measures to address these issues are important for the conservation of biodiversity, but have wider benefits to society. Therefore, their costs are not attributable solely to biodiversity.

The EU BAP contains the following targets:

- *Risks to soil biodiversity in EU substantially reduced by 2013*, by identifying geographical risk areas and implementing measures to minimise soil sealing, sustain soil organic matter and prevent soil erosion through the Thematic Strategy for Soil Protection.
- *Substantial progress made towards 'good ecological status' of freshwaters by 2010 and further substantial progress made by 2013,* by implementing requirements of Water Framework Directive (operational monitoring programmes, River Basin Management Plans and River Basin District Programmes of Measures).

[69] At average 2000 annual exchange rate of 1.08 based on http://www.oanda.com/currency/historical-rates/

- *Principal pollutant pressures on terrestrial, freshwater and marine biodiversity substantially reduced by 2010*, and again by 2013, by:
    - Strengthening implementation of relevant Directives, notably on Integrated Pollution Prevention and Control, Large Combustion Plants, Waste Incineration, Urban Waste Water Treatment.
    - Significantly reducing airborne eutrophicating and acidifying pollution of terrestrial and freshwater ecosystems in line with Thematic Strategy on Air Quality
    - Significantly reducing pollution from agricultural sources (notably pesticides, nitrates) through measures in line with Thematic Strategy on the Sustainable Use of Pesticides, pesticides and biocides legislation, Nitrates Directive
    - Significantly reducing exposure, of terrestrial and freshwater ecosystems to toxic chemicals through measures in line with EU chemicals legislation including REACH
- *Flood risk management plans in place and designed in such a way as to prevent and minimise biodiversity loss and optimise biodiversity gains*, by 2015, by assessing the risks and benefits of flooding for biodiversity as part of the preliminary flood risk assessment for each river basin under the WFD, and ensuring flood risk management plans optimise benefits for biodiversity, by allowing necessary freshwater input to wetland and floodplain habitats, and creating where possible and appropriate additional wetland and floodplain habitats which enhance capacity for flood water retention.
- *Regional and territorial development benefiting biodiversity, and negative impacts on biodiversity prevented or where unavoidable, adequately compensated for, from 2006 onwards.* This includes ensuring that SEAs and EIAs take full account of biodiversity (to address potential impacts of Structural and Cohesion Funds, Trans-European Networks and national/regional development plans); allocation of funding from Structural and Cohesion Funds to projects that directly or indirectly benefit biodiversity; implementing policies and measures in line with Thematic Strategy for Urban Environment to prevent urban sprawl; implementing CBD Guidelines on Sustainable Tourism; and developing and implementing spatial and programmatic plans that support the coherence of the Natura 2000 network and maintain/restore the ecological quality of wider landscape.

This section examines evidence of the costs of these various measures, and the significance of opportunity costs. It relies largely on evidence from existing studies and impact assessments of different EU policies. As a result, the evidence is variable and the degree to which evidence of opportunity costs is available differs between policy areas.

Types of costs

The main types of costs resulting from these different areas of activity are summarised as follows:

Soil Management

The key costs of the Thematic Strategy for Soil Protection include:

- The financial costs of survey, monitoring and research work to improve knowledge of soil management issues (including the management of soil biodiversity) at EU and MS level;
- The financial costs of developing and implementing legislation, including the Soil Framework Directive and national legislation, and of integrating soil management concerns into other legislation;
- Administrative costs of developing and implementing national soil remediation strategies;
- Costs of commissioning a soil status report when a site on which potentially polluting activity has taken place is traded;
- Costs of developing and implementing soil management plans;
- Financial costs of soil management, at Member State level, including remediation of contaminated sites, establishing buffer strips, management of field boundaries, maintenance of terraces, conservation tillage.
- The opportunity costs resulting from soil management practices, such as reduced agricultural output from restrictions on cultivation practices or conversion of arable land to pasture or forestry.

In addition there are expected to be substantial benefits from reduced damage costs, as existing poor soil management practices, resulting in erosion, compaction, loss of nutrients and contamination impose costs on society (e.g. water treatment) and lead to lost agricultural and forestry output. Many of the benefits of the policy can be seen as opportunity benefits – for example by enabling development of contaminated sites and by enhancing opportunities to increase agricultural and forestry output.

Water and Flood Risk Management

Relevant costs of the Water Framework Directive include:

- Administrative costs: running costs of local water agencies, staff costs, developing river basin management plans etc
- Financial costs: land purchases to restore floodplains and/or wetlands to their natural state
- Transaction costs: monitoring water bodies regarding progress on achieving good water status
- Yearly maintenance costs: upkeep of floodplain areas and buffer strips through mowing etc.
- Opportunity costs: income foregone for land taken in order to re-meander streams or plant buffer strips, or from reduced output as a result of changes in land management practices.

Some regional impact assessments of the implementation of the Water Framework Directive provide more detailed figures and comparisons of costs incurred by various possible implementation scenarios and thus also a breakdown of costs per measure. The impact assessment of the River Basin Management Plan for Scotland River Basin District provides insights in the types of costs that are considered for several restoration measures (see Table

21 below). They show that in this case mainly one-off investment costs and studies and recurring monitoring and awareness raising activities are considered.

Floodplains and wetland habitats are threatened in Europe due to competing land uses. As such, if a floodplain area or wetland is restored to its natural conditions and natural river flows, competing land uses will be affected and opportunity costs arise. For example, in the Netherlands and elsewhere in Europe floodplains have historically been used for agricultural purposes. Should the use of the land by farmers be prevented or restrictions in management practices introduced in order to allow natural flooding or river restoration to improve biodiversity, farmers incur opportunity costs in the form of income foregone. Opportunity cost can also arise when farmers have to switch to extensive agriculture or to provide land for re-naturation. These costs may be compensated through payments to farmers or by buying land. Furthermore, if more space for rivers is needed in order to allow for flooding, housing developments may not be allowed or people may be asked to relocate.

One of the possible reasons why opportunity costs do not seem to be included in cost and impact assessments of the implementation of WFD measures is that the directive is very much oriented along the polluter pays principle: the target of improved ecological status is stated and the polluter must comply with the Directive. Seeing that there is no specific financial mechanism in place for the WFD, the burden of the costs is distributed across polluting sectors. Financial costs of compliance (direct costs) are thus the usual cost types taken in account.

In addition, many of the measures that Member States intend to implement at river basin level are tied to other legislation. Specifically, measures are often linked to national or regional rural development programmes. Since the Water Framework Directive does not have an individual budget for the realisation of measures, many of the measures foreseen will be financed through other Community policies, most notably through the CAP. As such, many of the costs incurred to implement measures to achieve good water status are similar to those presented on agri-environment and high nature value farming and Natura 2000 management.

Pollution Control

The key costs of pollution control include:

- Public administrative costs – including the time and resources required to issue guidance, provide advice, conduct consultations, complete inspections and deal with non-compliance.
- Private administrative costs – including the costs to businesses of record keeping, reporting, correspondence and hosting inspections.
- Compliance costs – including the costs of investment in new capital equipment and associated ongoing expenditures on operation and maintenance, and costs of monitoring, training.
- Opportunity costs – where pollution control reduces economic output by preventing particular activities or restricts productivity by constraining production processes.

Examples of opportunity costs can include:

- Reduced crop yields as a result of limits on fertiliser applications, in compliance with the Nitrates Directive
- Inability to expand output or to obtain necessary permits to open a plant in a particular location, as a result of quantitative limits on emissions
- Effects on output as a result of bans on particular products or processes. In most cases alternatives will be available and there may be no net loss of output.

In general, compliance costs are easily identified where a single technological solution is available. Aside from the additional (marginal) costs associated with installation to existing production processes, the wider operation may often be largely unaffected. However, compliance can also involve changes to processes, including re-engineering production or operations. It is more difficult in these cases to determine the cost of compliance. Opportunity costs associated with compliance with pollution control legislation do arise in the (rare) cases where regulation prevents a business from expanding (e.g. because of permit limits), instead of requiring technological solutions.

More widely, there may be reductions in output and profits may where environmental legislation leads to marginal changes in economic parameters, which can negatively affect market opportunities and employment where compliance costs are passed on to product prices. These effects may be at least partially compensated for by increases in other economic activities, such that there overall economic effects need to be examined using macro-economic models. There is evidence that costs in adjusting to new legislation may b reduced over time as a result of innovation and structural change.[70]

Regional and Territorial Development

The costs of addressing the impacts of regional and territorial development on biodiversity include:

- The time and resources required to incorporate biodiversity considerations into EIAs, SEAs, and spatial, programmatic and strategic plans. As well as extra work in completing these documents and the studies that underpin them, may require new survey and research work to be commissioned to enhance understanding of potential biodiversity impacts;
- The costs of issuing guidance on biodiversity considerations within the development process and with regard to particular sectors such as tourism;
- Ongoing costs of taking account of biodiversity in the planning and development process, including the time of planning officers and developers;
- The opportunity costs associated with foregone development opportunities, where biodiversity considerations prevent development taking place or restrict the scale, nature or location of development and hence potentially the benefits that it delivers.

[70] Institute for Environmental Studies (IVM) (2006) Ex-post estimates of costs to business of EU environmental legislation. Available from: http://ec.europa.eu/environment/enveco/ex_post/pdf/costs.pdf

Overview of available cost estimates

Soil Management

The costs of the EU Thematic Strategy on Soil Management are assessed in an Impact Assessment[71]. Costs for the EU25 include:

- Targeted monitoring to identify risk areas - < €2 million per year;
- Establishing an inventory of contaminated sites - preliminary survey, €51 million per year for five years, followed by more detailed inventory costing up to €240 million yearly over 25 years.

The most significant costs will be incurred at the Member State level. These are dependent on the national plans and the soil management practices proposed at MS level. Various examples of costs are given in the Annex. Examples of measures to combat soil erosion and loss of organic matter include:

- Conversion of arable land to forest - €288/ha (discounted and annualised), including investment cost of 88 and income foregone of 200/ha/yr;
- Conversion of arable land to pasture - €154/ha (discounted and annualised), including investment cost of 14 and income foregone of 140/ha/yr;
- Terraces - €12,000/ha capital cost of construction; €200/ha/yr annual maintenance;
- Buffer strips – 230/ha/yr (annualised) including establishment (60), maintenance (150), loss of revenue (20)
- Residue management (44/ha/yr), conservation tillage (59/ha/yr) and cover crop (57/yr), total 160/ha/yr.

The IA predicts that these costs are likely to be outweighed by the benefits of improved soil management. Total annual costs of soil degradation in the EU25 are estimated at up to €38 billion, including:

- erosion: €0.7 – 14.0 billion
- organic matter decline: €3.4 – 5.6 billion
- salinisation: €158 – 321 million
- landslides: up to €1.2 billion per event
- contamination: €2.4 – 17.3 billion.

It is estimated (speculatively) that measures to address problems of soil erosion and loss of organic matter could generate net additional off-site benefits of €8.6 billion annually across the EU25, compared to net costs of €4.1 billion. The total gross costs of these measures are estimated at €9.1 billion, yielding on site benefits of €5.0 billion, giving a net cost to the land manager of €4.1 billion. It was estimated that these measures would require total additional expenditures of €2.3 billion (in addition to current expenditures of €1.8 billion under the agri-environment programme). The figures suggest that opportunity costs account for only a

[71] European Commission (2006) Impact Assessment of the Thematic Strategy on Soil Protection {COM(2006)231 final}

small proportion (approximately 6%) of gross costs – although the income foregone from some practices (conversion of arable land) is substantial, these are assumed to be required on only a relatively small area.

Remediation of contaminated sites is estimated to require additional expenditure of 20 billion, with annual costs of €0.67 billion over 30 years or €0.4 billion over 50 years. These are remediation costs rather than opportunity costs. This is estimated to yield annual benefits of €7.7 billion.

Water and Flood Risk Management

No overall estimates are available of the cost of implementing the Water Framework Directive. However, some examples of relevant costs are given in the following tables.

Table 21 Estimated cost of restoration measures in the Impact Assessment of the River Basin Management Plan for Scotland River Basin District

Type of measure	Types of costs	Estimated cost (exchange rate Sept. 2010)
Fish passages and fish migration	investment costs – one off: building fish passages, remediation of abandoned works: Management costs: studies for fish passages	2001 k EUR 83 k EUR
Species specific measures: removal and control of IAS	Management/administrative costs – yearly : monitoring, early warning Management costs - one-off: risk assessments Investment costs one-off: systems to regulate and prevent spread of species Administrative costs – yearly: sectoral involvement, awareness raising, supporting material	59 k EUR/ y 6-17 k EUR 117 k EUR 146 k EUR/y
Removing fish barriers	Investment cost – one off	Unit cost: 234k EUR
Catchment restoration	Investment cost – one off	Unit cost: 1289k EUR
Land claims for restoration	Investment cost – one off	47k/ha EUR

Table 22 Cost and financing information for re-naturation of streams

Measure	MS & RB	Costs estimates

Re-meandering of small streams	FR - Loire	364,92 million€
	FR - Rhine-Meuse	80 million €
	FR - Sambre-Meuse	11 million €
	LV – Daugava	28,460 €
	LV – Gauja	71,144 €
	LV – Venta	71,144 €

Table 23 Cost and financing information for removal of migration barriers

Measure improved	MS & RB	Cost & source of financing
Removal of migration barriers	CZ– Odra	167 million€
	SE - North-Baltic	4.8 million € per year
	SE - South-Baltic	4.8 million € per year
	SLO - Adriatic Sea	
	SLO– Danube	640€/meter

Source: Dworak, et al, 2010

Cost estimates for implementing re-naturation measures are in general only available at the regional and local level and refer to the overall cost for implementing the measure. The overall costs for implementing the measure are, however, not often broken down.

The above estimates largely relate to the financial costs of investments and management actions needed for the restoration of the aquatic environment, and do not appear to include significant opportunity costs. However, floodplain restoration projects also give rise to significant opportunity costs by taking land from other productive uses such as agriculture (Box 9). Agricultural income foregone is reflected in recorded costs of land acquisition and management agreements.

Box 9 River system Project Ruwer, Germany

Example 1: River System Project Ruwer, Germany

The main objective of the project was the conservation and development of the river Ruwer and its tributaries including the floodplains as a near-natural water and floodplain landscape. Along the entire watercourse pipe passages, thresholds, weirs and creekfalls were reconstructed in a way that fish and other aquatic fauna can migrate freely. Straightened sections were renaturalized. As a result, the rivers had space for natural development. This increases the habitat diversity of the creeks significantly and reduces further pollution.

The measures are taken within the framework of land acquisition, management contracts and exchange of land. In total, land acquisition provided for the natural development and succession of 50 km of riparian buffers. The total costs of the measure of **6.8 million Euros over 10 years** were paid by the Federal Government.

Source: Factsheet on WFD Implementation, River System Project Ruwer. Grüne Liga. http://www.wrrl-info.de/site.php4?navione=steckbriefe&navitwo=&content=steckbriefe (accessed 08 Sep 2010)

Box 10 Floodplain Program of North Rhine-Westphalia, Germany

Example 2: Floodplain Program of North Rhine-Westphalia, Germany

The Floodplain Program was launched with the goal of restoring the large water bodies and floodplains in North Rhine-Westphalia to their near-natural state in order to allow flood dynamics as natural as possible. Rivers and their floodplains, from source to river mouth, should be developed ecologically and major water bodies should be linked with their floodplains as a state-wide biotope network. Furthermore, the Floodplain Program has the goal of preventing further anthropogenic development of the floodplains, and thus protects it as a habitat.

Amongst others local measures include tree planting, purchase of floodplains and buffer strips and extensification of the purchased land, and creation of alluvial forests. In total, the cost for the Floodplain Program amounted to approximately **10-20 million Euros per year from 1995 to 2004** coming from the state, federal and EU level.

Source: Factsheet on WFD Implementation, North Rhine-Westphalia Floodplain Program, Grüne Liga. http://www.wrrlinfo.de/site.php4?navione=steckbriefe&navitwo=&content=steckbriefe (accessed 08 Sep 2010)

Wetland restoration on privately owned agricultural land is often funded through rural development schemes, which provide compensation for income foregone. Figures from a case study in Sweden (Holen, 2009) show that establishment costs are between 2943 € and 49 057 € (average of 15 698 €) per hectare depending on the location of the wetland and that the establishment compensation varies between 9811 € and 19 623 € per hectare. Additional management compensation is 294 € per hectare for basic compensation and 78 € for additional compensation for mowing and pasture. The compensation approach considers income foregone and the alternative value of the land.

Pollution Control

In 2007 the European Commission adopted a Proposal for a Directive on industrial emissions, which recasts seven existing Directives (including the IPPC Directive, the Large Combustion Plants Directive, the Waste Incineration Directive, the Solvents Emissions Directive and 3 Directives on Titanium Dioxide) into a single clear and coherent legislative instrument[72].

The proposal calls for extending the scope of the IPCC (e.g. including 20-50MW combustion installations), which would incur administrative costs of €37m/year, €19m/year of which about would fall on operators. Additionally, more specific provisions on compliance and environmental improvements would also lead to an administrative burden of €40m/year, 65%

[72] http://ec.europa.eu/environment/air/pollutants/stationary/ippc/proposal.htm

of which would be borne by Member State authorities. Other specific costs related to controlling industrial emissions include:[73]

- Developing BREFs (reference documents giving guidance on Best Available Technologies) has cost between €150 and 300 million between 1997 and 2007 in administration for the Commission, Member States and other stakeholders.
- Inspection of IPPC installations (assuming an average inspection frequency of 3 days of inspection time per installation per year) costs roughly €80 million per year for competent authorities.
- The option of lowering the threshold of the IPPC Directive for combustion installations from 50 MW to 20 MW would result in additional annual overall costs (including compliance and administrative costs) of between €291 and €989 million per year, depending on various scenarios and the stringency of emission limits.
- The expected costs of introduction of a soil monitoring requirement will likely cost between €5,000 and €10,000 per site, including the selection of sites and baseline investigations.
- Compliance costs vary significantly according to the site and the size of the installation. For instance, the average overall annual costs of five pig farms in the UK were estimated cost £4,699 (€5375), whilst four broiler units averaged overall annual costs of £3,868 (€4424).
- Annual costs for the implementation of Best Available Technology under the IPPC Directive on Large Combustion Plants for the EU27 are estimated to be between €2.1 and €6.5 billion per year in 2020.
- Reductions in unnecessary administrative burdens under the new Directive would outweigh additional administrative costs, yielding annual cost savings of €105-255 million.

The Commission has also published a Thematic Strategy on Air Pollution, whose implementation is expected to entail additional costs amounting to €7.1 billion per year (compared to annual health benefits of €42 billion; environmental benefits were not quantified), representing 0.05% of the EU25 GDP in 2020. The cost estimates are based on expenditures on pollution abatement (investments and operating costs) and opportunity costs do not appear to be significant. The estimates include costs of reducing pollution from large combustion plant, so there is some overlap with those summarised above.[74]

Regarding the Nitrates Directive, costs of implementation vary significantly across Member states, from €6 to €236 per hectare affected (averaging €75 per hectare per year for areas where measures are required), due to differences in industry structure, livestock intensity,

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[73] Commission Staff Working Document – Accompanying document to the proposal for a Directive of the European Parliament and of the Council on industrial emissions (integrated pollution prevention and control) (recast) Impact Assessment (SEC (2007) 162). Available from: http://ec.europa.eu/environment/air/pollutants/stationary/ippc/pdf/recast/ia_en.pdf

[74] Commission Staff Working Paper. Annex to the Communication on Thematic Strategy on Air Pollution and the Directive on Ambient Air Quality and Cleaner Air for Euopre – Impact Assessment (SEC(2005)1133). Available from: http://ec.europa.eu/environment/archives/cafe/pdf/ia_report_en050921_final.pdf

historical rates of fertiliser application and the vulnerability of soils[75]. Total costs to farmers in the EU15 were estimated (on an ex ante basis, at 1997/98 prices) to amount to €635 million per year (equivalent to €819 million at 2010 prices). The costs included in these figures vary according to the methodology applied at the MS level and include, to varying extents, the costs of investment in manure storage facilities at the farm, costs of transporting manure off the farm, yield effects due to a limitation of fertiliser and offsetting savings due to a more rational application of fertiliser (in some cases) and costs of administration at the farm. Where yield effects are included, there is clearly an element of opportunity costs. Although no overall estimate is given as to the overall significance of these yield effects, the data presented suggest that they represent only a small proportion of the estimated costs – i.e. most of the cost estimates relate to costs incurred rather than income foregone.

Lastly, in the case of the Thematic Strategy on Sustainable Use of Pesticides, farmers face costs of around €250 million in expenses for training, €130 million for maintenance and inspection of sprayers, between €2 and €4.5 million extra costs for purchasing certified new equipment, and €2 million for detailed record keeping and reporting. The costs of extra work involved in applying Integrated Pest Management, and associated advisory services, are estimated to amount to €340 million. In the case of authorities, additional costs are mostly related to the collection of data on pesticides sale and use, in the order of €9 million per year. Most significantly, cost savings to farmers of between €770 and €1100 million will result in an equivalent reduction in turnover for the plant protection product (PPP) industry and supply chain, which will also incur additional costs of €40 to 80 million for setting up container management schemes.[76] None of these costs appear to involve opportunity costs.

Although the costs of controlling pollution in the EU can therefore be significant, the benefits are thought to far outweigh these. For instance, although the PPP industry will be negatively affected by the Thematic Strategy on Sustainable Use of Pesticides, any job losses in the PPP chain will be more than compensated by new jobs in other industry and service sectors (with a net positive balance of 3,000 jobs).[77]

It is also worth noting that costs of pollution control are often over-estimated *ex-ante*, in many cases as much as twice the actual costs. In some cases they can be much more.[78] For instance, AEA Technology found that the ex-ante costs of the UK National Air Quality

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[75] Kuik, O. (2006) Ex ante and ex post costs of implementing the Nitrates Directive: Case study Case study in the framework of the project 'Ex post estimates of costs to business of EU environmental policies'. Available from: http://ec.europa.eu/environment/enveco/ex_post/pdf/nitrates.pdf

[76] Commission Staff Working Paper. Accompanying the Proposal for a Directive of the European Parliament and of the Council establishing a framework for Community action to achieve a sustainable use of pesticides – Impact Assessment of the Thematic Strategy of the Sustainable Use of Pesticides (SEC(2006)894). Available from: http://ec.europa.eu/environment/ppps/pdf/sec_2006_0894.pdf

[77] Commission Staff Working Paper. Accompanying the Proposal for a Directive of the European Parliament and of the Council establishing a framework for Community action to achieve a sustainable use of pesticides – Impact Assessment of the Thematic Strategy of the Sustainable Use of Pesticides (SEC(2006)894). Available from: http://ec.europa.eu/environment/ppps/pdf/sec_2006_0894.pdf

[78] Institute for Environmental Studies (IVM) (2006) Ex-post estimates of costs to business of EU environmental legislation. Available from: http://ec.europa.eu/environment/enveco/ex_post/pdf/costs.pdf

Strategy were overestimated by up to a factor of 5 (comparing the *ex-ante* estimate of £16-23 (€18-26) billion with the *ex-post* cost estimate of €3 billion for the period 1990 to 2001).[79]

Most of the costs identified above relate to the direct financial costs of required activities, and opportunity costs are insignificant in most cases. The only significant opportunity costs appear to relate to the case of the Nitrates Directive, but even here they appear to amount to only a very small proportion of the available cost estimates.

Regional and Territorial Development

No estimates are available specifically relating to the costs of incorporating biodiversity considerations into regional and territorial development plans. However, overall estimates are available of the costs of implementing obligations under the Thematic Strategy on the Urban Environment, and in implementing the EIA directive.

The total costs for the EU25 of implementing obligations under the Thematic Strategy on the Urban Environment mainly relate to the costs of developing and implementing thematic plans and management systems designed to improve the integrated management of the urban environment. These one-off costs are estimated in an impact assessment[80] as follows:

- Environmental management plans €24.71 million – €106.59 million
- Sustainable urban transport plan €92.89 million – €168.18 million
- Management system:
    - Establishment cost €49.68 million – €90.77 million
    - Operation cost €20.74 million – €38.09 million

The estimates were made by estimating the average cost of each of the above measures and aggregating these across the EU's 462 largest urban areas. It is however likely that the cost in practice will be significantly lower since many authorities already have elements of the necessary plans and systems in place. The voluntary measures contained in the Strategy are not foreseen to impose any additional costs. However, measures for obligations such as the establishment of environmental management plans, sustainable urban transport plans and management systems would incur costs to public authorities but would not give rise to direct costs for business or industry. Indirectly, some of the measures included in such plans may incur costs to business and individuals, for instance in the case of road pricing.

No opportunity costs are included in the above estimates, although it is likely that measures imposed by the urban authorities themselves would give rise to opportunity costs, for example by limiting development of green spaces. On the other hand, urban environmental

[79] AEA Technology, 2005. Referenced in: Commission Staff Working Paper. Annex to the Communication on Thematic Strategy on Air Pollution and the Directive on Ambient Air Quality and Cleaner Air for Euopre – Impact Assessment (SEC(2005)1133). Available from: http://ec.europa.eu/environment/archives/cafe/pdf/ia_report_en050921_final.pdf

[80] Commission Staff Working document. Annex to the Communication from the Commission to the Council and the European Parliament on the Thematic Strategy on the Urban Environment: Impact Assessment (SEC(2006)16). Available from: http://ec.europa.eu/environment/urban/pdf/sec_2006_16_en.pdf

problems such as traffic congestion, neglect of the built environment and poor air quality give rise to significant opportunity costs, which the strategy is attempting to address.

There is much evidence regarding the costs of Environmental Impact Assessments (EIAs) and the requirements of the EIA Directive. Several studies have so far found similar results, with the cost of an EIA typically amounting to 0.1 - 0.3% of the total development cost.[81] The approximate average cost per EIA is thought to be €50,000. The overall direct costs of undertaking EIAs in 5 MS (France, Germany, Netherlands, Spain and the UK) were estimated at €417m annually in 2007.[82] The additional costs to a project as a result of the Directive however are likely to be smaller, as some environmental studies would have been conducted regardless of EIA requirements, given the need to demonstrate an acceptable project as the basis of development consent.[83] However, one significant consequence of the EIA procedure is the indirect costs to developers associated with delays to the overall development consent procedure. The costs of delays are likely to be the most important with regard to opportunity cost, given the impact on developers in terms of capital costs and revenues foregone.[84]

Opportunity costs may also arise in the case of foregone development, if the results of an EIA lead to the abortion of a development project. However, examples of this are few and far between. Rather than a project being cancelled, the project's design is more often altered to mitigate any adverse environmental effects in order for the project to be deemed acceptable and in accordance with wider development consent regulations. To the extent that particular impacts and hence mitigation might not have been identified without the EIA, then mitigation might be claimed as a cost of the EIA.[85] Nonetheless, there have been cases where proposed projects have been blocked because of a failure to properly prepare an acceptable EIA. Furthermore, where a project needs to be significantly modified in scale, nature or location, this may give rise to opportunity costs, by limiting the benefits that the development is able to yield.

While biodiversity will inevitably place restrictions on development opportunities, well-designed planning policies and the provision of appropriate guidance should help to ensure that biodiversity is taken into account at an early stage of the development process, thereby reducing the costs involved.

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[81] e.g. Report from the Commission on the application and effectiveness of the EIA Directive (COM2009)378 final) (Available from: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2009:0378:FIN:EN:PDF); Oosterhuis F. (2007) Costs and benefits of the EIA Directive. Final report for DG Environment under specific agreement no. 07010401/2006/447175/FRA/G1. Available from: http://ec.europa.eu/environment/eia/pdf/Costs%20and%20benefits%20of%20the%20EIA%20Directive.pdf; GHK (2008) Evaluation of the EU Legislation – Directive 85/337/EEC (Available from: http://ec.europa.eu/environment/eia/pdf/Evaluation%20of%20EIA.pdf.

[82] GHK (2008) Evaluation of the EU Legislation – Directive 85/337/EEC (Available from: http://ec.europa.eu/environment/eia/pdf/Evaluation%20of%20EIA.pdf.

[83] *ibid.*

[84] Oosterhuis F. (2007) Costs and benefits of the EIA Directive. Final report for DG Environment under specific agreement no. 07010401/2006/447175/FRA/G1. Available from: http://ec.europa.eu/environment/eia/pdf/Costs%20and%20benefits%20of%20the%20EIA%20Directive.pdf;

[85] GHK (2008) Evaluation of the EU Legislation – Directive 85/337/EEC (Available from: http://ec.europa.eu/environment/eia/pdf/Evaluation%20of%20EIA.pdf

Administrative costs associated with the EIA Directive are hard to determine, given their entanglement with other planning and development requirements as EIAs take place in parallel with other administrative procedures for the same project.[86]

Methodology for overall cost assessment

The costs of different environmental policy measures can be estimated as follows:

- Soil Management – estimates of costs are available in the Impact Assessment of the EU thematic strategy for soil management. Opportunity costs can be estimated from estimates of income foregone in these figures;
- Water Framework Directive – no overall estimates of the costs of the Directive are available;
- Pollution Control – cost estimates are available from various Impact Assessments
- Regional and Territorial Development – costs of EIAs at EU level can be estimated by extrapolating from available estimates in MS, above. The costs of EIAs undertaken in France, Germany, Netherlands, Spain and the UK have been estimated at €417 million annually; these five countries together account for 64% of the EU27 GDP; an estimate for the EU27 can therefore be gained by multiplying by 1.56, giving an estimated annual total of €650 million.

The analysis therefore relies largely on existing Impact Assessments of these various measures. This provides evidence of the types and overall scale of the costs involved. However, there are significant limitations in this approach. The available Impact Assessments vary in their scope and focus. In general there is greater emphasis on the direct financial costs of the policies concerned (including the administrative costs) than on the wider costs, including the opportunity costs. Our analysis examines where opportunity costs are likely to form part of the available estimates. However, the Impact Assessments rarely consider uncompensated opportunity costs resulting from constraints on development.

Assessment of costs at EU level

A summary of available cost estimates is given in Table 24.

Table 24 Estimated Costs at EU Level of Wider Environmental Policy Measures Affecting Biodiversity

	Estimated Annual Cost (EU, € M)	Estimated Opportunity Costs within these estimates (€ M)	Significance of unquantified opportunity costs
Soil Management: Measures to address soil	4,100 (net on-site costs)	568	Insignificant as effects on changes in land use and

[86] Oosterhuis F. (2007) Costs and benefits of the EIA Directive. Final report for DG Environment under specific agreement no. 07010401/2006/447175/FRA/G1. Available from: http://ec.europa.eu/environment/eia/pdf/Costs%20and%20benefits%20of%20the%20EIA%20Directive.pdf;

erosion and loss of organic matter			management are included
Water and Flood Management	n/a	Significant, through management agreements, land purchase and compensation payments	Potentially significant, as a result of changes in wider land use and land management
Pollution control: **BAT for large combustion plant**	2,100 to 6,500	0	Not significant as compared to direct compliance costs, though regulations may sometimes restrict development.
Thematic strategy on air pollution	7100	0	Not significant as compared to direct compliance costs, though regulations may sometimes restrict development. Includes costs for large combustion plant
Nitrates directive	819	Small proportion of the estimated costs; most costs estimated to relate to actions required	Not significant though potentially under-estimated
Thematic Strategy on Sustainable Use of Pesticides	794	0	Not considered to be significant by the IA, though reduced pesticide use may reduce yields
Regional and Territorial Development: **EIA Directive**	650	0	Figures are for costs of EIAs only. Planning and development policies likely to give rise to significant opportunity costs through foregone or modified development.

Soil management – the total cost of measures to address problems of soil erosion and loss of organic matter across the EU have been (speculatively) estimated at €4.1 billion annually, requiring estimated additional expenditures of €2.3 billion on top of current expenditures of €1.8 billion under the agri-environment programme. The gross costs of these measures, before taking account of on-farm benefits, are put at €9.1 billion. Opportunity costs – relating to the income foregone from converting arable land to forestry, grassland or buffer strips – are estimated to account for only a small proportion (approximately 6%) of these costs. It is estimated that these measures will bring substantial net benefits through enhanced land productivity and reduced treatment costs. While these measures should benefit soil biodiversity, this is only one of the objectives, and not accounted for in the benefits estimates, such that only a small proportion of the estimated costs could be attributed to biodiversity.

Pollution control – various estimates are available for the costs of pollution control measures at EU level. These costs largely relate to the financial costs of investments in pollution control, and associated operating, monitoring, administration and training costs. Little evidence of the opportunity costs of these measures is available. In most cases they are not thought to be significant although it is possible that pollution control regulations can have the effect in preventing or constraining development in particular locations. The cost estimates do include some opportunity costs, as in the case of the Nitrates Directive where changes in land management practices involve compensation for income foregone. While these various pollution control measures have benefits for biodiversity, this is generally not a core objective, and it would therefore be misleading to attribute the costs identified to the conservation of biodiversity.

Regional and Territorial Development – Ensuring that development safeguards biodiversity interests incurs significant costs related to planning, administration, management and information, as well as potentially significant opportunity costs by restricting development opportunities. The costs of undertaking EIAs are estimated at €650 million annually – taking full account of biodiversity conservation issues may have some influence on the level of these costs. The opportunity costs of foregone development are difficult to quantify – they are likely to be greatest at the local level.

Gaps and methodological issues

A wide range of environmental policies affect biodiversity. It is clear that the costs of these different policies are substantial, but that they deliver a wide range of benefits as well as contributing to biodiversity conservation. Opportunity costs appear to be only a small proportion of the overall costs of most of these measures, though are relevant in some cases, particularly for policies which restrict land management practices in some way.

The costs of some of the relevant policies are well understood, though there are significant gaps in relation to others, notably the Water Framework Directive, which is one of the more significant policies from a biodiversity perspective. As a result the analysis above is illustrative rather than comprehensive.

While further work to improve estimates of these various costs would be desirable, given the breadth of the subject area and the often indirect linkages to biodiversity, there would be greatest benefit in focusing attention on those areas where biodiversity impacts are greatest and opportunity costs are likely to be significant, such as in the case of floodplain management under the Water Framework Directive.

2.9 EU Strategy to combat Invasive Alien Species (Category F)

Overview of the policy

In 2006, EU institutions committed to develop an EU strategy to substantially reduce the impacts of Invasive Alien Species (IAS) and alien genotypes and to establish an early warning system[87]. Building on this commitment, in 2008 the Communication Towards an EU Strategy on Invasive Species outlined possible policy options for further consideration[88] and in 2009, the Environment Council[89] called for an effective Strategy on Invasive Alien Species (IAS) to fill existing gaps at EU level and establish a comprehensive EU IAS framework in a proportionate and cost-effective manner, based on strategic cooperation at EU and Member State (MS) level. According to the Council, this framework should:

- cover i) prevention, including trade-related aspects, and information exchange, ii) early detection, warning and rapid response, including prevention of spread and eradication, iii) monitoring, control and long-term containment, and iv) restoration of biodiversity affected by IAS as far as feasible (§33);
- take into account the biogeographic approach and the specific circumstances of islands and ultra-peripheral regions (§34); and
- provide for the establishment and maintenance of a comprehensive inventory of IAS and common standards for risk assessment processes (§35).

The Council also stressed the need for the Commission and MS to:

- jointly develop an appropriate information system for early warning and rapid response and improve cooperation on biosecurity and control measures within and beyond the EU (§37);
- integrate IAS considerations into relevant EU and national policies, in particular trade, agricultural, forestry, aquaculture, transport and tourism policies, with a view to preventing the threats caused by IAS (§38);
- address unintentional introductions of IAS, particularly in marine ecosystems (§39); and
- note the importance of adequate financing for all aspects of IAS activities and increase public and sectoral awareness, responsibility and education, and ensuring public participation and involvement (§40).

Types of costs

Ongoing studies concerning the development and implementation of the EU strategy to combat invasive alien species suggest that this would give rise to a range of financial and wider economic costs (Shine *et al.* 2010). However, it should be noted that since the EU and Member states are already taking action on IAS only some of the estimated costs would be incremental, i.e. new, costs resulting from the implementation of the EU Strategy. Furthermore, Shine *et al.* (2010) estimate that the costs of policy inaction on IAS in the EU

[87] Communication on Halting the Loss of Biodiversity by 2010 and Beyond (COM(2006)216) and Action Plan (SEC(2006)621).

[88] EC Communication "Towards an EU Strategy on Invasive Species". Brussels, 3.12.2008 (COM (2008) 789)

[89] Council Conclusions on a mid-term assessment of implementing the EU Biodiversity Action Plan and Towards an EU Strategy on Invasive Alien Species (2953rd Environment Council meeting, 25 June 2009).

are likely to be much higher than costs of policy action on IAS (i.e. implementation of the EU Strategy).

The **financial costs** of the Strategy have been assessed through a recent study for DG Environment (Shine *et al.* 2010), and categorised as follows:

One-off costs associated with the implementation of an EU Strategy to combat invasive alien species, including:

- Direct investment including setting up EU information and early warning system, IAS risk assessment and measures for IAS pathway control

Recurrent costs associated with monitoring and IAS management activities, including:

- Recurrent Direct Administrative Costs - management of key IAS pathways, monitoring programmes, policy development, administration and coordination, stakeholder engagement and communications
- Recurrent direct management cost - Contingency planning for rapid response actions, control, management and restoration
- Recurrent direct investment cost – Research
- Recurrent compliance costs - costs of compliance and enforcement to private actors (e.g. via permits and fees),

Most of these costs are likely to be incurred by the public sector which is responsible for taking appropriate action to ensure that invasive alien species do not spread further across Europe. However, depending on the decisions taken on the implementation of different Strategy measures some costs (e.g. risk assessments and permits for the introduction of alien species) can be recovered from relevant private stakeholders via fees. These costs could include, for example, costs of impact assessment and permits for import and export of alien species, According to Shine et al. (2010), the costs to private actors linked to compliance with IAS permit and inspection procedures might range from hundreds of thousands of Euros to several million Euros per year for each Member State, depending on the general level of ambition of the IAS regime and the agreed arrangements for cost recovery at the national level.

The **opportunity costs** resulting from the implementation of the Strategy to combat IAS could include:

- Recurrent Economic opportunity costs – income foregone due to restrictions on the use of non-native species for production and/or trade; income diverted to the development and enforcement of voluntary codes and best practices for IAS.

In general, there are few cost elements that fit "pure opportunity cost" criteria and at present there are no data to indicate the opportunity cost, in terms of Income Foregone of restricting the use, import or export of non-native species. The following scenarios may, however, be envisaged as giving rise to opportunity costs to private actors:

- In agriculture: restrictions on the introduction of new crop types to facilitate adaptation to climate change or to provide new crops or biofuel resources; restrictions on the use of non-native species or varieties or genes from non-native plants to enhance crop resistance to environmental stresses such as drought, salinity, mineral or nutrient deficient soils; restriction on the introduction of non-native species as a biological control agent to reduce or control crop pests.

- In forestry: restrictions on the planting of non-native species to enhance production or on the introduction of non-native biological control agents
- Restrictions on commercial production of non-native species due to potential damage caused by accidental releases (an example of such damage is the release of American mink (*Mustela vison)* from fur farms)
- In fisheries: restrictions on the introduction of new species to enhance production. Such a potential trade-off between economic benefits and ecological costs may be illustrated by the introduction of the common carp (Cyprinus carpio), one of the most widely introduced species in inland water ecosystems. While native species have suffered in lakes and rivers where this species has been introduced, in 2002, over 2.8 million tons of common carp were produced through aquaculture, providing important revenues in particular in developing countries. (CBD, 2004).
- Another example is the Rapana (Rapana venosa), an invasive seasnail in the Black Sea, predator for some other species such as the Black mussel, which now forms the basis for a significant fishery, in particular in Bulgaria where the exploitation of the snail has largely developed (FAO, 2003)
- In horticulture, aquaria and the pet trade: restrictions on the trading of non-native species that may out-compete native species if released accidentally into the wild, or harbour pests or diseases that are damaging to native species. Restricting sales of exotic species has direct economic implications for the pet trade. In Italy, the import ban, required under Wildlife Trade Regulations, on Red-eared sliders (Trachemys scripta elegans), a semi-aquatic turtle which has become invasive in European water bodies led to seizure of about 23,000 specimens with an economic value of 296,000 EUR between 1999-2000 (Fiori and Avanzo, 2002) The extent to which this can clearly be categorised as an opportunity cost is however questionable since most invasive pet species can arguably be substituted with non invasive pet species. In the case of the game bird industry, a study commissioned by Defra in 2005 indicated that 35 million non-native birds (mainly pheasant and partridge) were released into the UK per year providing a total revenue of approximately 400 million EUR (without taking account of benefits to hotels, restaurants etc. which support the game industry) (DEFRA, 2005).

Whilst these examples illustrate a range of possible situations where eradicating IAS or imposing restrictions on IAS introduction may give rise to opportunity costs, very limited data or well documented cases currently exist to indicate the size or the scale of the costs incurred. In a number of cases the opportunity costs caused by a ban on a certain species could be offset by focusing commercial activities (eg horticultural and pet trade) on other, non-invasive species. However, no studies are available that would assess the possibilities for and economic implications of replacing commercially used, potentially invasive non-native species with a 'safer' alternative.

Private actors may also undertake a number of voluntary actions, such as developing sector specific codes of conduct or guidance for best practice on IAS. Although these voluntary actions could be supported by public funding (e.g. a mix of national, EU and/or private funding) the cost for the development and implementation of voluntary codes of conduct and best practices can be expected to be borne primarily by the private sector. For example, trade associations of the sectors likely to be affected by the costs of invasive alien species, such as agriculture and forestry, might decide to launch awareness campaigns and disseminate information among their members to support the coordinated effort to combat

IAS. Such communications may come at the expense of information campaigns on other issues relevant to the actors in these sectors, thus resulting in an opportunity cost.

The main parameter influencing, firstly, the level of these costs and, secondly, the distribution of overall costs between EU and Member States appears to be the level of ambition with which the EU Strategy and combating IAS in general will be approached in practice and the extent to which synergies between actions at MS and EU level are exploited (in particular with regard to the possibility of setting up a pan-European information gathering and early warning system).

Despite the financial costs and opportunity costs described in this section, it needs to be stressed that the costs of not controlling IAS – through lost output and opportunities in e.g. agriculture, forestry, fishery, are estimated to be significantly higher than the costs of action (Kettunen et al, 2008), thus clearly resulting in substantial opportunity benefits of action.

Overview of cost estimates

The scale of annual costs of the Implementation of a European Strategy to combat IAS have been estimated through a study led by IEEP (Shine et al, 2010). The cost estimates presented in table 24, based on the scale / level of costs for IAS measures, are taken from this study. The figures do not include any estimates of income foregone due to opportunity costs: the cost estimates in the table are costs of policy action on IAS, meaning the direct costs associated with the implementation of specific measures (e.g. staff costs, costs of establishing early warning and monitoring systems, and costs of required risk analysis and other assessments etc)**.**

Table 25 Estimated key annual costs of EU action on IAS i.e. implementing the EU Strategy (including costs at EU-level and Member State level for EU-27)

Type of cost	Level of costs	New cost vs. existing cost	Estimated scale of costs / year for EU policy action **Note: see sections 6.2 - 6.11 for more detailed information on how the ranges have been estimated.**	Possible scale of costs / year at the EU level. inc. EU & national (EU-27)		Comment re: calculation
				Level of investment - low	Level of EU investment - high	
EU-level information and early warning system	EU	**NEW**	300 000 EUR - 6 million EUR / year	300,000	6,000,000	See Genovesi et al. (2010)
National information and early warning systems (to support the EU-level)	Member State (EU-27)	Depends on MS, existing in several MS	Low EU level investment: 122 000 EUR / MS / year (i.e. average level of current investment) High EU level investment: 26 000 EUR / MS / year (i.e. estimated investment to complement comprehensive EU IEWS system)	3,000,000	702,000	Low EU investment foreseen to require higher level of MS investment. EU27: 27 x 122 000 = ~3 million EUR / year Highlevel of EU investment foreseen to require lower level of EU investment: EU27 = 27 x 26 000 EUR = 702 000 EUR / year
National 'on-the-ground' monitoring schemes	Member State (EU-27)	**Largely NEW** for high investment EXISTING for low investment	260 000 - 1.3 million EUR (one-off) year / MS for 1 to 5 IAS	7,000,000	35,000,000	EU27: 27 x 260 000 = ~7 million - 27 x 1.3 = 35 million EUR / year
EU-level risk assessment panel	EU	**NEW**	1 million EUR / year	1,000,000	1,000,000	
National risk assessment frameworks (e.g. coordination & conducting species-specific RAs)	Member State (EU-27)	**Largely NEW** for high investment EXITSING for low investment But RA frameworks already existing in some MS	10 800 - 225 000 EUR / year / MS for existing / minimum level RA systems Upto 500 000 EUR / year / MS for comprehensive system to support EU IEWS	3,000,000	13,500,000	Minimum level = average of given range EU27: 27 x 117 900 = ~3 million EUR / year - 27 x 500 000 = ~13.5 million EUR / year

Species-specific risk assessments	EU and Member State (EU-27)	**NEW for EU level**	42 000 EUR / risk assessment (of which 15 000 EUR costs of expert workshop, rest staff costs) Total costs of ~22 – 50 million EUR for 515 – 1200 assessments, respectively. Total costs of ~7.7 - 18 million EUR for 515 – 1200 assessments (respectively) when excluding staff costs	2,200,000	1,800,000	Annual costs estimated assuming spread of total costs over 10 year period. For the 'high' investment option, staff costs have been left out as assumed to be largely covered under a comprehensive bodies for IAS risk assessment and/or policy coordination.
Eramework for marine pathways risks assessments	EU and Member State (EU-27)	**Lergely NEW**	Not possible to estimate annual / total figure	N/A	N/A	
Intentional introductions: administration of an EU-level framework for non-native species trade / movement	EU	**Largely NEW** (apart from aquaculture)	115 000 EUR / year	115,000	Assumed to be largely covered under a comprehensive body for IAS policy coordination (below)	
Intentional introductions: administration of permitting framework & costs of inspection by Member State	Member State (EU-27)		60 000 - 1 125 000 EUR / year / MS for running a permitting system of 1.5 - 15 fulltime staff, with around < 100 – max 60 000 permits issued / year) plus 100 000 EUR / year for inspection / MS = 160 000 EUR / year / MS - 1 225 000 EUR / year / MS	4,000,000	33,000,000	EU27: 27 x 160 000 = ~4 million EUR / year - 27 x 1 225 000 = ~33 million EUR / year
Unintentional introductions: administration of an EU-level framework for preventing unintentional introductions of IAS	EU	**NEW** for IAS that non-pests / diseases	115 000 EUR / year	115,000	Assumed to be largely covered under a comprehensive body for IAS policy	

Unintentional introductions: administration of permitting framework & inspection duties by Member State	Member State (EU-27)		203 000 EUR / year / MS	5.5	coordination (below)	EU27 = 27 x 203 000 = ~5.5 million EUR
Unintentional introductions: inspection effort by Member State	Member State (EU-27)		500 000 EUR - 2.5 million EUR / year / MS, based on 1/5 - equal costs to plant health regime	13,500,000	62,500,000	EU27: 27 x 500 000 = 13.5 million - 27 x 2,5 million = 62.5 million EUR
Unintentional marine & other pathway introductions	EU and Member State (EU-27)	**Largely NEW**	Not possible to estimate an annual figure	N/A	N/A	
Contingency for rapid reaction: administration	EU	**NEW** for IAS that non-pests / diseases	16 000 EUR / year	16,000	Assumed to be largely covered under a comprehensive body for IAS policy coordination (below)	
	Member State (EU-27)		1200 EUR / year / MS	32,400		EU27: 27 x 1200 = 32 400 EUR
Budget for contingency actions on IAS	EU		1 - 3 million EUR / year, based on actual EU spending on solidarity funding under the EU Plant Health Regime	1,000,000	3,000,000	
	Member State (EU-27)		50 000 / 100 000 EUR - 5 - 14 million EUR / total event / MS, based on existing costs	Not possible to determine as varies greatly according to investment / objectives		
Management / control: EU level action plans	EU	**NEW**	20 000 - 50 000 EUR (total) / action plan (average 35 000 EUR / action plan) 70 000 - 350 000 EUR / action plan for 2 to 10 species	17,500	87,500	Annual costs estimated assuming total costs take place in 4 years time, i.e. 70 000 / 4 = 17 500 and 350 000 / 4 = 87 700 EUR / year

Management / control: MS level action plans	Member State (EU-27)	EXISTING	3900 EUR - 33 000 EUR / management plan / species (total / one-off)	Not possible to determine as varies greatly according to investment / objectives		
Management / control of IAS of EU concern	EU and Member State (EU-27)	**Largely NEW** for high level of investment EXISTING for low level of investment	3 - 12 million EUR / year inc. EU and MS contributions	3,000,000	12,000,000	
Restoration	EU and Member State (EU-27)	EXISTING	100 000 EUR - 2 million EUR / year	Not possible to determine as varies greatly according to investment / objectives		
IAS policy development & coordination	EU	EXISTING re: low level of investment **Largely NEW** re: dedicated bodies for IAS policy	75 000 - 550 000 EUR / year, for one fulltime staff and dedicated body ~7 staff members, respectively	75,000	550,000	
	Member State (EU-27)		40 000 - 650 000 / year / MS for one fulltime staff and dedicated body ~7 staff members, respectively	1,000,000	18,000,000	High level estimate rather high, as based on information from Sweden. Required investment likely to be much less for several Member States. EU27: 27 x 40 000 = ~1 million EUR - 27 x 650 000 = ~18 million EUR
Development of national strategies (for MS that do not yet have them)	Member State (EU-27)	Largely EXISTING	130 000 - 1.5 million EUR (total) / MS	Not possible to determine as varies greatly according MS approach / MS remaining without national IAS plan		
Policy assessment & support	EU	EXISTING	100 000 - 120 000 EUR (total) / study	33,000	100,000	Annual costs estimated assuming one study / three years - one study / year with an average costs of ~100 000 EUR (total). I.e. for 'low' level of investment 100 000 / 3 = 33 000 EUR / year
	Member State (EU-27)	EXISTING	10 000 / 120 000 EUR (total) / study	460,000	1,400,000	Annual costs estimated assuming one study / year, with an average costs of ~50 000 EUR (total). I.e. for 'low' level of investment 50 000 / 3 = 17 000 EUR / year

						EU27: 27 x 17 000 EUR = ~460 000 EUR - 27 x 50 000 = ~1.4 million EUR
Stakeholder engagement	EU	**Largely NEW** for high level of investment	100 000 EUR - 530 000 EUR / year	100,000	530,000	
	Member State (EU-27)	Largely EXISTING for low level of investment	less than 800 EUR - 150 000 EUR / year / Member State	21,600	4,000,000	EU27: 27 x 800 = 21 600 EUR - 27 x 150 000 = ~4 million EUR / year
Research	EU and Member State (EU-27)	**Largely NEW** for high level of investment	3.5 million - 10.5 million EUR / year	3.5	10.5	
	Member State (EU-27)	Largely EXISTING for low level of investment	60 000 EUR - 700 000 EUR (total) / Member State.	Not possible to determine as varies greatly according MS approach / MS remaining without national IAS plan		
TOTAL				**39,985,509**	**193,169,511**	

Source: Shine et al. (2010)

Methodology for overall cost assessment

The costs discussed in this section relate mostly to direct costs and do not include opportunity costs of IAS. Shine *et al* (2010) first identified the key measures / actions required to implement the Strategy components. The assessment of possible costs associated with implementation was then developed based on existing information on the costs of these IAS measures / actions, both within and outside the EU. In addition, the most applicable examples of costs from parallel policy areas (e.g. the EU frameworks for plant health and wildlife trade) were chosen in several cases to illustrate the possible costs of different IAS measures in the EU context. Shine et al (2010) provide a suggestive range of costs to illustrate different levels of ambition in implementing the identified measures. Finally, it should be noted that the costs were estimated as total (not additional) costs related to the implementation of the EU Strategy i.e. some of the cost elements relate to already existing national and EU actions.

For the EU-wide information and early warning system (IEWS), the authors based their evidence on the estimates calculated and published in the EEA report (Genovesi et al. 2010), integrated with additional data and information collected through a questionnaire circulated among national representatives of the NOBANIS network. The questionnaire aimed at developing a detailed breakdown of the estimated level and distribution of incremental costs of administrative measures required for IEWS implementation.

In order to calculate the opportunity costs of combating invasive alien species, further data would be needed on the income derived from the current / potential future use of potentially invasive alien species in a number of sectors (e.g. agriculture, forestry, horticulture). Such data is not currently available. Without such data, providing even an indicative estimate of the opportunity cost of combating invasive alien species is impossible. These opportunity costs are therefore not reflected in the cost estimate provided in **Error! Reference source not found.**, which primarily reflects the financial costs related to carrying out and complying with specific measures foreseen in the Strategy (e.g. implementation costs to public authorities). Opportunity costs (i.e. possible economic opportunities foregone due to more stringent restrictions) arising to private actors would therefore have to be added to this estimate to provide a full picture of the overall costs to the economy caused by restrictions on the use of and trade in alien species. However, the level of costs due to opportunities foregone is unlikely to be very high as it can be expected that restrictions on introduction of alien species will be the exception rather than the rule and that even in the cases of a ban on important/use substitutes to alien species can be found (see also below). Hence, even if the full extent of opportunities costs could be factored in, substantial opportunity benefits of action would still prevail.

Assessment of costs at EU level

Shine et al (2010) stress the difficulty of providing a comprehensive total estimate of the costs of implementing the EU Strategy given the different timescales within which IAS measures can/are foreseen to be taken up and the different possible levels of ambition in implementing these measures. The authors do however provide a very indicative assessment suggesting that the possible scale of total costs for EU policy action on IAS could be around 40 million – 190 million EUR / year, ranging from low to and high level of investment, respectively.

This estimate does not encompass an estimate of opportunity costs that might occur to economic sectors as a consequence of limited use of / trade in alien species. Providing a comprehensive estimate for opportunity costs does not appear possible at this stage. It must be pointed out, however, that opportunity costs might certainly arise for a number of sectors who will see restrictions imposed on the kind of species they are allowed to import, sell and/or cultivate. Furthermore, as indicated in Section 2 restrictions on IAS might also result in higher costs to private operators if they are required to bear the costs of carrying out risk assessments prior to importing and using non-native species. This can be expected to be of relevance primarily for the pet trade, horticultural, agricultural and forestry sectors. The opportunity cost of restrictions on alien species might further increase with climate change, which might result in a higher interest in / demand for non-native species in the forestry, agricultural (e.g. biofuels) and horticultural sectors.

From a qualitative perspective, the scale of opportunity costs arising from possible limitations on alien species is not likely to be highly significant. The first reason for this is that in a majority of cases, the introduction and use of alien species will remain possible as long as the risk that these become invasive has been proven to be low. Second, where restrictions are placed on the use and trade of certain alien species alternatives/substitutes may be found. As a result, the opportunity benefits of action (i.e. avoided damage caused by IAS to these sectors) are likely to be significantly higher than the opportunity costs. Kettunen et al. (2008) have estimated that the costs of damage (e.g. to agriculture, fisheries and aquaculture, forestry and health sectors) over the past 20 years amounts to around 9.6 billion EUR / year. This estimate makes it clear that costs of policy action on IAS, including potential opportunity costs, are likely to be smaller than the cost of damage caused by policy inaction.

Gaps and methodological issues

Regarding the extent to which overall costs are understood and can be quantified, Shine *et al*. (2010) stress that there are significant gaps in the available documented data on the costs of IAS measures. For example, the costs for Member States are often estimated based on extrapolating information from a few individual Member States. Thus, estimated costs of measures / actions to implement the key EU Strategy components presented in **Error! Reference source not found.** above should be treated as initial / rough estimations of the level / scale of costs associated with such implementation.

Although a range of examples provided earlier in this section suggest that, in a limited number of cases, opportunity costs may arise from restrictions on IAS introduction and trade or the eradication of an IAS, the calculation of opportunity costs is made impossible by the absence of reliable data on the dependence of a number of sectors on the use and exploitation of (potentially invasive) alien species. Also, the substitutability of those invasive non-native species with native species is likely to be possible in many cases. The transition process to replace a commercially used, potentially invasive non-native species by a non-invasive (native) species may also result in some costs but these are equally difficult to estimate. There currently is no information available on the possibilities for and economic implications of replacing commercially used, potentially invasive non-native species with 'safer' alternatives. Hence income potentially lost by private actors through the implementation and enforcement of a European Strategy to combat IAS cannot be estimated in a reliable way. It is however important to recognise that costs to private actors do not only include the cost of compliance and enforcement but could also arise from restrictions placed on introducing and trading specified non-native species in the EU. Information on the overall level of trade and/or use of non-native species in the EU would help estimate the possible

scale of opportunity costs associated with this aspect of Strategy implementation (eg list of key species and level of trade) (Shine et al., 2010).

2.10 EU Research on biodiversity

Overview of the policy

Scientific research plays a key role in providing the knowledge required to guide EU biodiversity policy. Objective 10 of the EU Biodiversity Action Plan is:

To substantially strengthen the knowledge base for conservation and sustainable use of biodiversity, in the EU and globally.

The Plan establishes a target that:

Research findings on biodiversity and ecosystem services have substantially advanced our ability to ensure conservation and sustainable use by 2010 and again by 2013.

Actions outlined in the BAP include strengthening the contribution that research makes to policy development; enhancing research on the status, trends and distribution of habitats and species; enhancing research on pressures, prevention and mitigation options; developing and applying tools to enhance the effectiveness of policy instruments; establishing a European Research Area for biodiversity; and establishing common data standards and quality assurance procedures to ensure interoperability of EU and national databases and inventories.

While some of these actions overlap with the need for research to conserve particular sites and species, others are more cross-cutting and based on the recognition that effective conservation of biodiversity needs to be underpinned by a more general programme of research to enhance knowledge of biodiversity trends, pressures, needs and policy options.

Research is undertaken at both the EU level (to guide the delivery of EU biodiversity policy) and within the Member States, as part of national biodiversity action plans.

At the EU level, funding for biodiversity research is covered primarily by the research Framework Programmes (FP). The Seventh Framework Programme (FP7) began in 2007 and is scheduled to run until 2013, and its available funding is expected to rise quite steeply towards the end of its budget period. The EU, through the Framework Programmes, FP5, FP6 and FP7, has funded a variety of relevant research projects, covering risks and pressures on biodiversity, the impacts of biodiversity loss on particular ecosystems and species, conservation strategies, and the development of knowledge networks (IEEP 2009).

BiodivERsA, an ERA-Net project funded by FP6 and Member States, has built a network of 19 research-funding institutions across 13 European countries to provide support for research and research training in biodiversity.

At the national level, a review by the European Commission (2008) found that at least 14 Member States have a dedicated national or sub-national programme that supports biodiversity research (Belgium, Bulgaria, Cyprus, Czech Republic, Finland, France,

Germany, Hungary, Ireland, Luxembourg, Netherlands, Spain, Sweden, UK), 7 Member States do not have programmes (Austria, Denmark, Estonia, Greece, Latvia, Lithuania, Romania) and for 6 this is unknown (Italy, Malta, Poland, Portugal, Slovakia, Slovenia).

Types of costs

The main costs of biodiversity research are the financial costs of undertaking research projects, which include the costs of staff, equipment and materials used, and associated office costs, expenses and overheads.

Staff costs are a significant component of all research projects. Certain types of research also involve the use of expensive equipment – this is particularly the case for research into marine biodiversity.

Research does not incur significant opportunity costs, apart from those relating to the alternative uses of the financial resources deployed.

Overview of available cost estimates

As the costs of research are mostly financial, they are relatively easily measured.

EU expenditures on biodiversity research under the Framework Programmes have totalled as follows:

- FP5 (1998 to 2002) - € 136 078 000 for biodiversity projects
- FP6 (2002 to 2006) - € 78 608 847 for biodiversity projects focusing on ecosystems from a total budget of €769 Million for Global Change and Ecosystems
- FP7 (2007 to 2013) - € 29.6 Million had been spent on biodiversity projects by 2009, out of a €1.9 Billion budget for environmental research funding.

The figures indicate an average annual expenditure of **€24 million** by the EU over the period 1998 to 2006. These expenditures were co-funded by Member States.

The FP6 funded BiodivERsA (ERA-Net in Biodiversity research) project received EU funding of € 2.8 million, with funding by Member States of € 20 million.

In the UK BAP costings, the costs of research required to deliver the BAP are estimated at £14 (€16) million per annum between 2010 and 2015, including:

- £5.0 (€5.7) million for Habitat Action plans, just less than 1% of the annual HAP costs of £516 (€590) million;
- £9 (€10.2) million per annum for species, 19% of estimated annual costs of action for individual species of £47 (€53.8) million.

Research conducted by BiodivERsA found 84 major national agencies throughout Europe which fund biodiversity research. In some countries, regional organisations were also found to fund biodiversity research in addition to national efforts. The total figure for biodiversity research that came out of this research was roughly €600 million, however this significantly underestimates the research on biodiversity that is conducted in the EU, as figures could only be obtained for 16 countries (information was missing completely for 8), whilst many research organisations which were known to fund biodiversity related research did report on their annual funding in sufficient detail to be able to extricate figures for biodiversity. Although the figures below therefore give some indication of the level of funding available for biodiversity research across different Member States, the picture is by no means complete

given the lack of data for many countries and their agencies. On average, however, the results of the survey found that research per financing agency varied between €100,000 and €250 million, with a median value of roughly €2 million.[90]

Table 26 Annual funding for biodiversity research

Country / Organisation	Annual funding for biodiversity research (€ million)
Estonia	
Estonian Science Foundation	€2.8
Ministry of Education and Research	€2
Estonian Science Foundation	€0.6
Estonian Ministry of Agriculture	€0.1
Environmental Investment Centre	€0.1
National Agency of Research	€ 8.6
France	
Institut Français de la Biodiversité	€1.2
Ministry of Ecology and Sustainable Development	€2
Bureau des Resources Génétiques	€1
Germany	
The Federal Ministry of Education and Research and the German Research Foundation	€16
Deutsche Forschungsgemeinschaft	€10
Hungary	
National Office for Research and Technology	€2.2
Hungarian Scientific Research Fund – OTKA	€0.1
Ireland	
The Environmental Protection Agency	€1.5
National Parks and Wildlife Service, Department of Environment, Heritage and Local Government	€4

[90] BiodivERsA (2006) Compendium of Biodiversity Research Funding Agencies in Europe. Available from: http://www.eurobiodiversa.org/

Italy	
Ministero delle Politiche Agricole e Forestali	€1.4
Agenzia Servizi Settore Agroalimentare Marche	€ 0.0015
The Netherlands	
Netherlands organisation for scientific research (NWO)	€15
Norway	
The Research Council of Norway (RCN)	€4
Portugal	
The science and technology foundation - Fundação para a Ciência e Tecnologia – FCT	€5
Spain	
The Ministry of education and science - Ministerio de Educación y Ciencia – MEC	€250
Ministerio de Medio Ambiente (Ministry of the Environment) – MMA	€200
Sweden	
The Swedish Research Council for Environment, Agricultural Sciences and Spatial planning (Formas)	€7
The Swedish Environmental Protection Agency – SEPA	€2
The Swedish Research Council (VR): The Council for Natural and Engineering Sciences (CNES) Ecology and Systematics	 € 5.5 €4
The Foundation for Strategic Environmental Research (MISTRA)	€2.3
Swedish Species Information Centre	€1.8
United Kingdom	
Natural Environment Research Council (NERC)	€53.6
Total	**€604**

Methodology for overall cost assessment

The best estimate of the total costs of biodiversity research can be made by summing the available estimates at the EU and Member State levels. Although these are the best

available estimates of biodiversity research expenditures in the EU, they are likely to be underestimates as they exclude the activities of some Member States and organisations.

It is important to note that there is some overlap between research and other identified costs of biodiversity conservation, particularly those relating to species. This needs to be accounted for when aggregating different aspects of biodiversity costs.

Research is not estimated to incur significant opportunity costs.

Assessment of costs at EU level

The best estimates of current annual costs of biodiversity research across the EU are:

EU level - €24 million;

MS level - €604 million

Total - €628 million.

Biodiversity research is not estimated to give rise to any significant opportunity costs, except to the extent that the financial resources expended have alternative uses.

Gaps and methodological issues

The costs of biodiversity research are relatively well understood, and, while not comprehensive, the above estimates are believed to provide a reasonable assessment of current expenditures. Improving the estimates would require a further and more detailed examination of the expenditures by different research organisations in the Member States. Opportunity costs are believed to be insignificant compared to other areas of biodiversity action.

3 Analysis and conclusions

3.1 Estimating overall costs and opportunity costs of biodiversity action at EU level

3.1.1 Brief summary on available cost estimates

Section 2 has shown that cost estimates for biodiversity actions rarely report on opportunity costs as a category as such. Most cost estimates focus on the direct financial costs of actions - opportunity costs may therefore appear within other cost categories, where they are reflected in financial transactions, for example through compensation payments, management agreements that include payment for income foregone, or land purchase. Often, however, opportunity costs are left out of overall cost estimates, particularly where no compensation is paid. However, for almost all thematic fields, evidence was found that, in recent years, more attention has been paid to opportunity costs as an important measure to determine economic costs and to improve the effectiveness and efficiency of conservation activities.

Assessment of opportunity costs takes different forms in the literature, such as:

- Purely qualitative evidence of the likely existence, nature and possible significance of opportunity costs;
- Semi-quantified evidence of the extent to which opportunity costs are already incorporated into existing cost estimates (e.g. the extent to which Natura 2000 cost estimates incorporate compensation for income foregone)
- Partial estimates for particular Member States, sectors, habitats, policies or actions, from which it may be possible to extrapolate;
- Unit cost data, expressed, for example, per hectare, per site, per unit output etc;
- More complete estimates for particular programmes of biodiversity action (e.g. management of Natura 2000 network).

The data availability varied strongly between the different topics. While concrete measures of costs (and partially also opportunity costs) could be found for Natura 2000, for agri-environmental measures and to some extent also for forest conservation (at least for rural development programmes), data and figures were limited or only of very general nature for the marine environment and the species programmes. For the latter only individual case studies could be found which offered an understanding of where opportunity costs might occur, but did not give a detailed picture of opportunity costs across Member States. Where EU wide estimates were not available, it has sometimes been necessary to extrapolate from national estimates. For some Member States, especially the UK, detailed cost estimates were available across a variety of areas of biodiversity action, although again the focus was

on financial costs generated by implementation and opportunity costs are rarely separately identified.

The following section summarises the results of the assessment of the costs of different areas of biodiversity policy action, the significance of opportunity costs and the extent to which quantified estimates can be made. It should be noted that the estimates are often of an illustrative nature and aim to demonstrate the broad scale of costs and opportunity costs in each case. Challenges remain, mainly in the areas where data is limited. Additional case studies could help to get a broader view on costs incurred and might lead to some general results that can be transferred to other regions or to other conditions. While data of cost estimates is limited, information on methodologies to assess opportunity costs of biodiversity action could be found for almost all thematic areas. Section 3.2 draws conclusions about the types of opportunity costs and methods for assessing them in the future.

3.1.2 Synthesis of cost incurred in EU biodiversity policies

Section 2 presented syntheses of the costs and opportunity costs of different aspects of EU Biodiversity Policy. These are summarised in Table 27.

Table 27 Summary of Costs of Different Aspects of EU Biodiversity Policy

Policy Area	Estimated Annual Costs (€m)	Estimated Opportunity Costs within Annual Costs (€m)	Notes
Natura 2000 Network	5,772	2,069	Opportunity costs relate to land management schemes, compensation payments and land purchase costs – excludes foregone development opportunities which can be significant (at least locally) as well as some other opportunity costs (e.g. loss of fisheries income)
National Protected Areas (outside Natura 2000 areas)	1,280	459	Estimates are additional to Natura 2000 and based on Natura 2000 costs
High Natural Value	4,370	3,390	Estimates of income foregone from agri-environment measures. This includes

Farming			some overlap with Natura 2000 and nationally protected areas; a correction for double counting is given at the bottom of the table and details are provided in the footnote.
High Natural Value / Semi-natural Forestry	4,500+	4,500	Estimates of loss of productivity from range of forest management practices. Figures are for forests outside Natura 2000, but overlap with national protected areas. Note that no estimate of additional costs other than opportunity costs has been made.
Species Conservation	2,841	1,697	Opportunity costs largely relate to income foregone from constraints on land management. Large degree of overlap with HNV farming and forestry.
Marine Protected Areas	235	-	Significant opportunity costs for a variety of sectors such as oil and gas and fisheries. For fisheries long term opportunity benefits may outweigh short term costs.
Biodiversity Research	648	-	Research is assumed not to have opportunity costs except to the extent that human and financial resources expended have alternative uses. Some overlap with species conservation because estimated species costs include species research.
Invasive Alien Species	193	Negative	Control and preventative measures have opportunity costs but these are likely to be outweighed by opportunity benefits from control of IAS. There is likely to be a small level of overlap between IAS costs, species protection costs, Natura 2000 and protected areas costs.
Correction for Overlaps between	-4722[91]	-3696	

[91] Based on following adjustments: N2K cost includes €2025m for agricultural land (assumed to be HNV) and €78m marine protected areas; national protected areas costs include estimated 35% HNV agriculture and 33% HNV forest; 50% of species costs estimated to overlap with other habitats; 50% of biodiversity research is assumed to be species related. Double counting of opportunity costs is estimated to be proportionate to that of overall costs.

above Estimates			
Total	10, 617	8,419	

The cost estimates are illustrative and aim to demonstrate the broad scale of costs of conserving biodiversity and the significance of opportunity costs within these. The combined cost of these different policy actions is roughly estimated at €10.6 billion per year. Within this, opportunity costs amount to approximately €8.4 billion, or 79%.

The estimated opportunity costs largely comprise the income foregone from reduced agricultural and forestry output from managing land for the benefit of biodiversity. The remaining costs (€2.2 billion) are largely the financial costs of actions in each of the policy areas. It could be noted that these also have opportunity costs in the sense that the financial and human resources employed have alternative uses.

Biodiversity conservation also gives rise to opportunity costs by restricting opportunities for development, which are not quantified in the above estimates. It should be noted that these are often localised and difficult to aggregate, since, while biodiversity conservation might prevent development of a particular site, in most cases that development is likely to take place elsewhere instead. Therefore the net impact of biodiversity conservation in restricting development at the EU level might be rather small, although replacing effects on international level might play a role (see section 2.1).

There are also other opportunity costs for which it has not been possible to quantify, such as:

- Loss of fisheries output through protection of MPAs and marine N2000 sites;
- Loss of agricultural and forestry output due to damage from protected species;
- Loss of economic opportunity caused by restriction of trade and exploitation of invasive alien species (or potentially invasive alien species).

It should be noted that some of the policy actions identified for the analysis in this study are highly focused on biodiversity conservation (e.g. Natura 2000, species conservation) while others (e.g. HNV farming and forestry) have a slightly broader focus while still retaining biodiversity as a key objective.

In addition, the costs of broader environmental policies that contribute to biodiversity conservation among a range of environmental objectives have also been reviewed. This review identified a set of wider policies with a combined cost in the order of €15.5 and 20 billion per annum, of which opportunity costs could only be assessed qualitatively. This review found that, while the overall costs of these wider environmental policies is substantial, the opportunity costs are generally less significant than for more biodiversity focused policies, particularly as most of these policies place fewer restrictions on land use and fulfil a wider range of purposes apart from mere biodiversity conservation.

In summary, therefore, the analysis has been able to distinguish between the following types of opportunity costs relating to biodiversity conservation:

- The opportunity costs resulting from restrictions in land management – these are estimated at €8.4 billion per annum;

- The opportunity costs resulting from the use of scarce financial and human resources that could be used in for other purposes/developments– these are the other costs incurred in conserving biodiversity and are estimated at €2.3 billion per annum;
- The other, unquantifiable costs of conserving biodiversity in the EU, include:
    - The loss of output as a result of foregone development opportunities. This can impose significant opportunity costs at local level although the aggregate costs at EU level are significantly less than this.
    - The lost opportunity to a range of sectors such as fisheries and natural resource based industries.

In addition, biodiversity conservation can give rise to 'opportunity benefits' by reducing the extent to which damage or over-exploitation of natural resources would result in reduced output/income. Examples include long-term effects of fisheries conservation and control of invasive alien species. These benefits may exceed the opportunity costs of the policy, such that the opportunity cost of conserving biodiversity may be negative in the long-term.

3.2 Recommendations for a future methodology for estimating opportunity costs in biodiversity policies

3.2.1 Analysing cost types and their relevance for biodiversity actions

To date, estimates of the costs of biodiversity action have mostly been made at national and regional level, while a comprehensive analysis of the total costs of biodiversity action for the whole EU is still missing. Moreover, there is a great variability of cost types and categories used in the studies, which often hampers the comparability of the study results.

For a better understanding of costs for biodiversity actions and in order make results from cost assessments based on different methodologies comparable, a general cost typology was developed as a result of cost types identified in the different policy fields (see section 2).

This cost typology aims at

- delivering a clear categorisation of costs that could also serve as a model for an even broader application beyond the project scope; and
- allowing for the integration of all relevant data from existing cost estimates.

It has been shown that in some cases, opportunity costs (which are mostly the foregone benefits from alternative activities on a particular site) are the biggest part of conservation costs. However, the analysis has also shown that agricultural payments for compensating foregone incomes can only serve as a first proxy to estimate the opportunity costs as regional and context specifics are only considered to a certain extent and other opportunity costs might occur.

In this cost typology, **financial costs** are defined as real payments and expenditures for biodiversity actions (e.g. compensatory payments and management costs) that also include payments/expenditures for activities that are only associated with the action, but also have to be taken into account (e.g. administrative and transaction costs). In addition, opportunity

costs that are internalised in existing expenditures, such as compensation payments and land purchases, belong to the category of financial costs.

Wider economic (non-financial) **costs** include opportunity costs that have not been reflected in payments and therefore remain uncompensated. These include losses from forgone development opportunities (for different sectors such as transport or tourism), income forgone because of restrictions on the extraction of natural resources (in fisheries or uncompensated restrictions on land use) and losses of socio-economic opportunities such as cohesion or job creation.

The classification leaves enough flexibility to link the costs to different actors and contexts. Hence, each cost category could be further divided into:

1) one-off vs. recurrent (annual) costs,

2) public vs. private costs, and

3) primary activity vs. dependent activities.

Table 28 A cost typology for biodiversity action

Cost category	Types of Costs	Examples
Financial Costs	Costs of resources expended*: Costs of capital, labour, materials, energy Capital costs and recurrent management costs Administrative and transaction costs involving financial outlay	 Labour and materials for fences around nature reserves Salaries and equipment of biodiversity researchers Materials, labour and equipment for construction of visitor centres Costs of developing and administering species action plans
	Costs that reflect opportunity costs: Payments to compensate for income foregone Compensation payments for foregone development/ exploitation rights Land purchase (reflecting income from land in alternative use)	 Agri-environment payments to compensate for loss of cereals output from leaving fallow land for nesting birds Compensation payments to fishermen for establishment of marine nature reserve Cost of purchase of farmland to establish new wetland reserve
Wider Economic Costs	Uncompensated opportunity costs: Lost income from foregone development	 Loss of income from prevented commercial and industrial

	Loss of socio-economic opportunities Output restrictions on exploitation of natural resources	development Foregone opportunities for job creation and cohesion Loss of output of fisheries, wood, minerals, energy etc.

*Note that all activities using scarce resources have opportunity costs in the sense that those resources have alternative uses; however, activities placing direct restrictions on the use of land and natural resources have additional and more direct opportunity costs.

3.2.2 Calculating costs of biodiversity action across different policy areas

Due to the cross-cutting nature of biodiversity conservation and the range of sectors and fields affected by related actions, a diverse set of methodologies for assessing associated costs have been utilised to date. That being said, however, policy makers see a need to get a better picture of overall costs of biodiversity actions which in fact requires a more consistent assessment methodology on a more collective level.

However, the different policies analysed in this study as well as the need for rough and rather speculative cost estimates (partly based on extrapolation) highlight clear limitations for such a comprehensive methodology. For example, regional and contextual factors resulting in variations in unit costs across the Member States (e.g. different living standards) should be underscored in order to avoid inaccurate overgeneralisations at EU level (as found in the analysis for HNV farmland). Marine conservation also illustrates this point; as costs are inversely related to the size of the protected area, assessments must be conducted on a case by case basis and would be erroneous if projected from one exemplar onto a European scale. In other words, the study showed clear obstacles of scaling-up exercises, mainly by neglecting varying factors that highly influence cost estimates. However, in other contexts, generalisation and scaling-up from results gained in different cases can be easier as great variances between regions are less significant, such as for costs of protected areas.

In general, it is crucial to have explicit definitions that clarify the calculation methods utilised, actions and measures included and extrapolations (if any) conducted in order to arrive at the given cost estimates. Without an understanding of the background of these items, the variations between the opportunity costs incurred by Member States cannot be fully understood and the attained numbers will not be comparable. Clear expressions of the activities included in assessments will also reduce the likelihood of encountering overlaps between sectors and subsequently double-counting cost estimates (e.g. between species protection and forestry/HNV farming measures).

The degree to which the highlighted measures explicitly address biodiversity also warrants attention in cost estimate methodologies. Similarly, the degree of ambition of such efforts in implementing the identified measures needs to be recognized, as this will affect the costs involved (e.g. the complete removal of invasive species vs. a reduction; no-catch vs. multi-use marine protected areas) and whether costs can be solely assigned to biodiversity policy or partly to other policy areas.

Finally, opportunity costs for which no compensation is paid or for which estimates have not yet been established should also be acknowledged when discussing opportunity costs and creating assessment methodologies. This consideration is particularly relevant in terms of opportunity costs associated with foregone development or restrictions on access or land use. As previously mentioned, the idea of 'double-counting' is particularly relevant in this cost category, as many restrictions are compensated or included in other cost categories. Furthermore, while an initial assessment of foregone development costs has been presented in this paper, additional studies will be necessary in order to more concretely quantify such costs in the various relevant sectors and to integrate the findings into a more general European approximation of the costs of biodiversity conservation.

Recommendations for conducting future cost assessments

Among the presented methodologies, that of the Natura 2000 Network was recognisably the most developed, inclusive and accurate in providing both general as well as opportunity cost figures. This was largely due to the European requirement for information from the Member States and the resulting high availability of data.[92] The United Kingdom serves as an additional example in which thorough assessments were conducted, producing valuable cost information for the various areas of biodiversity conservation.

Given that a lack of information necessitates extrapolation processes in order to move from the given level of data to that which is desired, the collection techniques used for Natura 2000 and the United Kingdom could be useful models for future cost estimation efforts. Evidence of opportunity costs could be collected through local surveys to collect evidence of the effect of Natura 2000 designations on forestry outputs and on development opportunities, as well as the degree to which land owners and managers were compensated for such opportunity costs through management agreements and/or payments. Given the shortage of evidence of opportunity costs, any new research on the issue would be informative, particularly if surveys covered different Member States facing different conservation and development pressures. The UK's experience in conducting dedicated cost assessments of key areas of biodiversity policy (including a full assessment of the costs of implementing the national Biodiversity Action Plan as well as estimates of the costs of national protected area policy) could complement the Natura 2000 technique and serve as a useful starting point in the development of a set of guidelines on 'best practice' for calculating conservation costs.

The cost typology developed and presented in this paper (see Table 28) could form the basis for categorising and collecting evidence of the costs of biodiversity conservation activities. Questionnaires could be distributed to those individuals or groups in each Member State responsible for gathering data on conservation related costs, acting as a tool to increase the awareness and comprehension of the important issue of opportunity costs. Although a detailed investigation of the range of costs involved in all of the different methods and actions aiming to conserve biodiversity would be demanding,, more focused guidelines addressing the various areas (as outlined in the BAP and throughout this paper) could prove useful in efforts to establish a European biodiversity conservation cost assessment. Such an

[92] For protected areas outside of the N2000 network, for example, the lack of a European requirement to produce management plans (and consequently to delineate costs) results in only select Member States producing cost figures.

assessment would need to take account of the overlaps between different categories of conservation action. These guidelines would be consistent across the Member States and would assist in producing more comprehensive, standardised and accessible data. If needed, such guidelines will have to be adjusted in terms of local and site specific variations or between different contexts.

Just to give an illustrative example from the synthesis:

To provide a complete assessment of the overall costs of managing biodiversity on HNV farmland under the agri-environment measure (214) and other rural development measures, the following information would be needed for each of the 27 EU Member States:

- the agri-environment actions targeting HNV farmland in each Member State,
- the total payment given for each targeted action under agri-environmental measures and the proportion of that payment representing farmers' income foregone,
- interactions with other relevant policy measures, such as the Natural Handicap (LFA) and Natura 2000 related measures, and
- the uptake of each action (in hectares (ha)) on HNV farmland in each Member State.

Although this report has contributed significantly to the understanding of opportunity costs in biodiversity policies, definition and distinction from other costs can be developed further. The overall aim would be to reach a common understanding of what can be counted as opportunity costs and should be taken into account in overall cost assessments.

3.3 Conclusions

This report has been a first attempt to provide a comprehensive overview on costs for biodiversity and ecosystem actions in the European Union, a topic which had not been previously explored. Because of the lack of existing data, the assessment has been exploratory and in places somewhat speculative; the results should therefore be regarded as indicative.

The combined cost of different policy actions selected from the EU Biodiversity Action Plan is roughly estimated at €10.6 billion per year. Within this, opportunity costs amount to approximately €8.4 billion, or 79%. While the actual figure of €10.6 billion might be highly underestimated due to data limitations and the omission of certain actions included under the umbrella of biodiversity and ecosystem conservation, the percentage share of opportunity costs over total costs can be seen as the most interesting result of this report. However, it has to be noted that this share of opportunity costs can highly vary among regions and even Member States, as outlined in the various sections on different policies in this report.

The key costs by policy identified in the study are summarised below. Although some of these results can only provide an order of magnitude due to gaps in the existing data, they are a useful first overall estimate and enable the different policy costs to be placed in context.

Table 29 Overview of Costs of Different Aspects of EU Biodiversity Policy

Policy	Estimated Annual Costs (€m)	Estimated Opportunity Costs (€m)	Share of opportunity costs over total (%)
K. Natura 2000 Network	5,772	2,069	35.8
L. National Protected Areas	1,280	459	35.9
M. High Natural Value Farming	4,370	3,390	71.7
N. High Natural Value / Semi-natural Forestry	4,500+*	4,500	n/a
O. Species Conservation	2,841	1,697	59.7
P. Marine Protected Areas	235	n/a	n/a
Q. Biodiversity Research	648	n/a	n/a
R. Invasive Alien Species	332	Negative	n/a
S. Correction for overlaps between above Estimates	-4722[93]	-3696	-
T. Total	**10,617+**	**8,419**	**n/a**

*Note: only the opportunity costs were estimated for this cost category.

n/a = not available

We can conclude from this that compensation for opportunity costs represents a high proportion of the overall financial costs of biodiversity conservation in the EU. Such costs are a particularly important component of payments to land managers. In addition, there are significant but unmeasurable opportunity costs relating to constraints on development for which no compensation is paid. This category is particularly relevant when estimating costs related to biodiversity action as development restrictions are a cross-cutting concept and affect a wide range of sectors and non-biodiversity specific EU policies.

In order to get a better idea of the extent of EU expenditures for biodiversity, it can be interesting to put the calculated sum in the context of the overall EU budget. In the period from 2007-2013, for example, the budget allocated to regional policy amounts to around €348 billion, comprising €278 billion for the Structural Funds and €70 billion for the Cohesion Fund. This represents 35% of the Community budget and is the second largest budget item. Broken down to annual values, the Structural Funds would account for approximately €40 billion and the Cohesion Fund for €10 billion.

Given the magnitude of costs associated with biodiversity conservation, the limited funds available and the breath of needs competing for financing, two central considerations arise: the efficiency in distributing available financial resources and coherency in EU spending. Adequately addressing these areas is central to carrying out necessary actions for halting the loss of biodiversity. By identifying the sectors and sources of opportunity costs, sufficient incentives/compensation measures can be established in order to maximize cooperation and

[93] Based on following adjustments: N2K cost includes €2025m for agricultural land (assumed to be HNV) and €78m marine protected areas; national protected areas costs include estimated 35% HNV agriculture and 33% HNV forest; 50% of species costs estimated to overlap with other habitats; 50% of biodiversity research is assumed to be species related. Double counting of opportunity costs is estimated to be proportionate to that of overall costs.

policy success. Additionally, given restraints on available financial resources, areas deemed the most crucial to biodiversity and ecosystem conservation goals and, when possible, having the lowest associated opportunity costs can be targeted, especially in the case of development projects.

It must also be acknowledged, however, that certain cases will prove exceptions to this ideal. In scenarios in which resources deemed necessary for the public good are only obtainable in certain areas (e.g. rare minerals), restrictions on extraction or land use may be ignored despite society's willingness to pay for the high opportunity costs. Such exceptions are, for example, considered under Article 6.4 of Natura 2000 for projects with "no alternative solutions [...] considered to be of overriding public interest".

Regarding the obtained figures, a high share of opportunity costs in overall costs essentially means that numerous actors and stakeholders are compensated for restrictions imposed by biodiversity and ecosystem conservation policies, for example by protected areas limiting land use practices. Further opportunity costs arise from uncompensated costs and could not be estimated here as these figures are highly subjective depending on the underlying perspectives. As such costs aim to quantify foregone benefits, interpretations of possible alternative uses or the value of these options are difficult to measure and thus vary greatly. Consequently, effort needs to be invested in assessing these costs and providing financial resources to adequately compensate affected actors as well as prioritize the areas in which restrictions should be applied.

Relevant stakeholders should also be informed not only about the costs (restrictions) evoked by biodiversity and ecosystem policies, but also about the numerous benefits of such efforts, an aspect not addressed in this report. Information campaigns outlining the local benefits provided by the conservation of specific sites and the rationale behind restrictive actions should be utilized when possible, particularly regarding ecosystem services and their relevance to people's daily practices. Recreational benefits as well as less easily quantified concepts like air and climate regulation, water purification, waste management, conservation of genetic resources, etc can also be highlighted. Improving the knowledge of these benefits could contribute to an increased acceptance of conservation actions and possibly instil a sense of stewardship in the public's mind, thereby helping to ensure the long-term successful conservation of biodiversity and natural resources.

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4 References

ABPmer, RPA and Brooke, J. (2007). Cost impact of marine biodiversity policies on business – The Marine Bill. Report for DEFRA, Natural Environment Science Division, Bristol.

Adams, VM; Mills, M; Jupiter SD; Pressey, RL (2010). Marine opportunity costs: a method for calculating opportunity costs to multiple stakeholder groups. Wildlife Conservation Society - Fiji Technical Report no. 01/10. Suva, Fiji, 34 pp.

Adler, JH (2008). Money or nothing: The adverse environmental consequences of uncompensated land use controls. Boston College Law Review: 49 B.C.L. Rev 301.

Alban F., Appéré G. & Boncoeur J., 2008. Economic Analysis of Marine Protected Areas.A Literature Review. EMPAFISH Project, Booklet nº 3. Editum 51 pp.

Anderson, E., Baldock, D., Bennett, H., Beaufoy, G., Bignal, E., Brouwer, F., Elbersen, B., Eiden, G., Godeschalk, F., Jones, G., McCracken, D.I., Nieuwenhuizen, W., van Eupen, M., Hennekens, S., and Zervas, G. (2003) Developing a high nature value indicator. Report for the Euopean Environment Agency, Copenhagen

Angulo-Valdes, JA and Hatcher, BG (2010). A new typology of benefits derived from marine protected areas. Marine Policy, Volume 34, pp. 635–644.

Baldock, D., Beaufoy, G., Bennett, G. and Clark, J. (1993) Nature conservation and new directions in the Common Agricultural Policy. IEEP, London.

Balmford, A., Gaston, K.J., Blyth, S. et al. (2003): Global variation in terrestrial conservation costs,conservation benefits, and unmet conservation needs, PNAS, vol. 100, no. 3, pp.1046–1050, February 4, 2003.

Balmford, A; Gravestock, P; Hocklez, N; McClean, CJ; Roberts, CM (2004). The worldwide costs of marine protected areas. PNAS, Volume 101, No. 26: 9694-9697. http://www.pnas.org/content/101/26/9694.full.pdf+html.

Ban, NC and Klein, CJ (2009).Spatial socioeconomic data as a cost in systematic marine conservation planning. Conservation Letters, Volume 2, pp. 206-215.

Bauer, D. S. Swallow, P. Paton (2008): Cost-effective species conservation in exurban communities: A spatial analysis Resource and Energy Economics, Volume 32, Issue 2, Pages 180-202

Beaufoy, G., Beaufoy, G. and Clark, J. (1994). The nature of farming: low intensity farming systems in nine European countries. IEEP, London

Beaumont, NJ; Austen, MC; Mangi, SC; Townsend, M (1998).Economic valuation for the conservation of marine biodiversity. Marine Pollution Bulletin, Volume 56, pp. 386-396.

Beaumont, NJ; Austen, MC; Atkins, JP; Burdon, D; Degraer, S; Dentinho, TP; Derous, S; Holm, P; Horton, T; van Ierland, E; Marboe, AH; Starkey, DJ; Townsend, M; Zarzycki, T (2007). Identification, definition and quantification of goods and services provided by marine biodiversity: Implications for the ecosystem approach. Marine Pollution Bulletin, Volume 54, pp. 253–265.

Becker, Nir, Yael Choresh, Ofer Bahat, Moshe Inbar (2009): Economic analysis of feeding stations as a means to preserve an endangered species: The case of Griffon Vulture (Gyps fulvus) in Israel. Journal for Nature Conservation, Volume 17, Issue 4, December 2009, Pages 199-211

Bignal, E.M. and McCracken, D.I. (2000) The nature conservation value of European traditional farming. Environmental Reviews, 8, 149-171

BiodivERsA (2010): http://www.eurobiodiversa.org/ Last accessed 11.05.2010.

Boman, M. (1995): Estimating costs and genetic benefits of various sizes of predator populations: The case of bear, wolf, wolverine and lynx in Sweden. Journal of Environmental Management, Volume 43, Issue 4, April 1995, Pages 349-357

Bräuer, I. (2006): Restoring ecosystem services by reintroducing a keystone species – case study on the cost and benefits of beaver reintroduction in Germany. Case Study published in "Value of biodiversity. Documenting EU examples where biodiversity loss has led to the loss of ecosystem services (Annex 9). DG Environment. Final report

Brenner, J; Jimenez, JA; Sarda, R; Garola, A (2010). An assessment of the non-market value of the ecosystem services provided by the Catalan coastal zone, Spain. Ocean & Coastal Management, Volume 53, pp. 27-38.

Carter, DW (2003). Protected areas in marine resources management: another look at the economics and research issues. Ocean & Coastal Management, Volume 46, pp. 439-456.

CBD (2004) The Ecological and socio-economic Impacts of Invasive Alien Species on inland water ecosystems. Available at: www.cbd.int/doc/ref/alien/ias-inland-waters-en.pdf [Accessed 2 March 2011).

CCW (2006) Sites of Special Scientific Interest (SSSIs) in Wales.Current state of knowledge. Report for April 2005 to March 2006. Countryside Council for Wales.

Charles, A and Wilson, L (2009).Human dimensions of Marine Protected Areas. ICES Journal of Marine Sciences, Volume 66, pp. 6-15.

Chomitz, KM; Alger, K; Thomas, TS; Orlando, H; Nova, PV (2005). Opportunity costs of conservation in a biodiversity hotspot: the case of southern Bahia. Environment and Development Economics, Volume 10: 293-312.

COM - European Commission (2003): How species conservation can be supported through rural development programmes. Good practice examples. Orbicon (DK), Ecosystems (BE), Atecma (ES) and Écosphère (FR)

COM - European Commission (2008): Commission Staff Working Document, Accompanying document to the, Communication from the Commission to the Council, The European Parliament,

The European Economic and Social Committee and the Committee of the Regions, A Mid-Term Assessment of Implementing the EC Biodiversity Action Plan, SEC (2008) 3044. http://ec.europa.eu/environment/nature/biodiversity/comm2006/pdf/consolidated_profile.pdf Last accessed 11.05.2010.

COM - European Commission (2009a): Ex-Post Evaluation of Projects and Activities Financed under the LIFE Programme. Final Report. Part 4: Part 4: Thematic analysis – Nature

COM - European Commission (2009b): Ex-Post Evaluation of Projects and Activities Financed under the LIFE Programme. Final Report. Part 6: Conclusions and Recommendations

COM - European Commission: The European Biodiversity Action Plan – State of Play and prospects after 2010, DG Env Presentation from 18.03.2009. http://www.google.com/url?sa=t&source=web&ct=res&cd=4&ved=0CB8QFjAD&url=http%3A%2F%2Fwww.ies.be%2Ffiles%2Frepo%2Fteller.ppt&rct=j&q=European+biodiversity+campaign+-+state+of+play&ei=RxzpS4vgIsylONrV-KsL&usg=AFQjCNF09fP97r6n6CLFYTW9sbxxigcgZw

COM - European Commission (2010): Healthcheck for Europe's protected nature. 28 pages

COM - European Commission (2006): Communication from the Commission, Halting the Loss of Biodiversity by 2010 – and Beyond, Sustaining ecosystem services for human well-being, COM (2006) 216 final http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=COM:2006:0216:FIN:EN:PDF

Costello, C. & Polasky, S. (2004).Dynamic reserve site selection.Res. Energy Econ,Volume26, pp. 157–-174.

Cubbage, F; Richter, D; Thompson, M; Moore, S: Edeburn, J; Chesnutt, M; Cox, J; Boyette, W. Forest Certfication Costs and Benefits (2003). The Experience of the Southern Center for Sustainable Forests.I n: Proceedings, Society of American Foresters Annual Convention, 2002. Bethesda, MD. pp. 236-242.

Cullis-Suzuki,S. and Pauly, D. 2010. Marine Protected Area Costs as 'Beneficial' Fisheries Subsidies: A global evaluation. Coastal Management 38(2), 113 -121.

Department for Environment, Food and Rural Affairs (Defra). (2005) *The UK game bird industry – a short study*. Available at: www.defra.gov.uk/foodfarm/food/industry/sectors/eggspoultry/documents/gamebirdindustry-study.pdf [Accessed 1 April 2010.

Defra (2010) Marine and Coastal Access Act 2009 Impact Assessment. Final – Royal Assent.http://www.defra.gov.uk

Diversitas (2010): http://www.diversitas-international.org/ Last accessed 11.05.2010.

Drechsler, M. & Wätzold, F. (2003).Species conservation in the face of political uncertainty.UFZ discussion papers 4/2003, Leipzig.

Drechsler, M., Wätzold, F., Johst, K., Bergmann, H., Settele, J. (2007) A model-based approach for designing cost-effective compensation payments for conservation of endangered species in real landscapes. Biological Conservation, 140, 174-186.

Dudley, N. (ed.), 2008. Guidelines for Applying Protected Area Management Categories. IUCN, Gland,

Durst, PB; McKenzie, PJ; Brown, CL; Appanah, S (2006).Challenges facing certification and eco-labeling of forest products in developing countries.International Forestry Review, Volume8(2).

EEA (2006): How much bionenergy can be produced without harming the environment? EEA Report No 7/2006.

EEA (2009).Distribution and targeting of the CAP budget from a biodiversity perspective EEA Technical Report No. 12/2009.

EEA (2010) 10 Messages for 2010 – Protected Areas. EEA, Copenhagen, Denmark. Available at: www.eea.europa.eu/publications/10-messages-for-2010 [Accessed September 2010].

Eppink, F. V., Wätzold, F. (2009): Shedding light on the hidden costs of the Habitats Directive: the case of hamster conservation in Germany. Biodivers.Conserv. 18 (4), 795-810

European Commission (2004).Communication from the Commission on Financing Natura 2000, Extended Impact Assessment. {COM(2004)431 final}. Brussels, Belgium 15.7.2004.

European Commission (2006): Communication from the Commission, Halting the Loss of Biodiversity by 2010 – and Beyond, Sustaining ecosystem services for human well-being, COM (2006) 216 final.

European Commission (2006). "Towards a Future Maritime Policy for the Union: A European Vision for the Oceans and Seas," SEC (2006) 689, p. 2, online at http://ec.europa.eu/maritimeaffairs/pdf/COMM_NATIVE_COM_2006_0275_5_EN_ACTE2%20.pdf.

European Commission (2008).The European Union's Biodiversity Action Plan: Halting the loss of biodiversity by 2010 – and beyond.

European Commission (2010). Natura 2000. European Commission Nature and Biodiversity Newsletter: Number 28.

European Commission (2010b) Biodiversity Knowledge Base - Assessment of the EU Biodiversity Action Plan as a tool for implementing biodiversity policy. Service contract nr 09/543261/B2.European Commission, Maritime Affairs FAQs (http://ec.europa.eu/maritimeaffairs/faq_en.html#q6)

European Council (2002). European Council Regulation (EC) No 2371/2002 of 20 December 2002 on the conservation and sustainable exploitation of fisheries resources under the Common Fisheries Policy.

FAO (2003) Enhancing or restoring the productivity of natural populations of shellfish and other marine invertebrate resources. FAO Fisheries Technical Paper 448, Available at: www.apfic.org/apfic_downloads/FAO_downloads/FAO_FTP_448.pdf [Accessed 2 March 2011.

Feilen, A. (2006) Marine Protected Areas. SPICe Briefing 06/110. Edinburgh: Scottish Parliament Information Centre. Available at: http://www.scottish.parliament.uk/business/research/briefings-06/SB06-110.pdf

Fifth Framework Programme (2010): http://cordis.europa.eu/fp5/src/budget.htmLast accessed, 11.05.2010.

Fiori, M. And C. Avanzo. 2002. Enforcement in Italy. Pages 69-74 in M. Anton, N. Dragffy, S. Pendry and T.R. Young, editors. Proceeding of the International Expert Workshop on the Enforcement of Wildlife Trade Controls in the EU. 5-6 November 2001, Frankfurt/Germany. TRAFFIC Europe, Brussels, Belgium and IUCN – The World Conservation Unoin, Gland, Switzerland and Cambridge, UK.

Fletcher, S (2007). Converting science to policy through stakeholder involvement: An analysis of the European Marine Strategy Directive. Marine Pollution Bulletin, Volume 54, pp. 1881–1886.

Forest Stewardship Council (FSC) (2009a). FSC impacts and outcomes – Extracts from FSC literature review 2009. FSC Report 2009.

Forest Stewardship Council (FSC). (2009b). Good practice guide to meeting FSC certification requirements for biodiversity and High Conservation Value Forests in Smalland Low Intensity Managed Forests.FSC Technical Series No. 2009 - T002.

Gantioler S., Rayment M., Bassi S., Kettunen M., McConville A., Landgrebe R., Gerdes H., ten Brink P. (2010) *Costs and Socio-Economic Benefits associated with the Natura 2000 Network*. Final report to the European Commission, DG Environment on Contract ENV.B.2/SER/2008/0038. Institute for European Environmental Policy / GHK / Ecologic, Brussels 2010.

Gantioler, S., Herkenrath, P., Mees, C. & Tucker, G. (project core team)(2009). European Commission Biodiversity Knowledge Base: Assessment of Reasons for 2010 Target Failure. (unpublished document for the Commission).

Genovesi P., Scalera R., Brunel, S., Solarz W. and Roy D. (2010) *Towards an Information and Early Warning System for invasive alien species (IAS) threatening biodiversity in Europe.*European Environment Agency, Tech. report 5/2010. 52 pp.

Goyert, W; Sagarin, R; Annala, J (2010).The promise and pitfalls of Marine Stewardship Council certification: Maine lobster as a case study. Marine Policy, Volume 34, pp. 1103 – 1109.

Greenville, J and Mac Aulay, TG (2007). A Bioeconomic Analysis of Protected Area use in Fisheries Management. Australian Journal of Agricultural and Resource Economics, Volume 51, pp. 403–424.

GSN Best Practice Competition (2009): Muck In4Life Campaign, http://www.google.com/url?sa=t&source=web&oi=more-results&ct=result&cd=1&ved=0CAQQxAEwAA&url=http%3A%2F%2Fec.europa.eu%2Fenvironment%2Fnetworks%2Fgreenspider%2Fdoc%2Fbp%2FGSN_BP%2520Muck%2520In4Life%2520UK.pdf&ei=SX7hS6OsM4eN_AbWlfTKAg&usg=AFQjCNF1LQ514z81R3z0Z_hgzBED_zNO_Q Last accessed 11.05.2010.

Gullison, RE (2003). Does forest certification conserve biodiversity? Oryx, Volume 37, No 2.

Hadjimichael, M; Edwards-Jones, G; Kaiser, MJ (2010). Distribution of the burden of fisheries regulations in Europe: The north/south divide. Marine Policy, Volume 34, pp. 795 – 802.

Hamaide, B. Charles S. ReVelle, Scott A. Malcolm (2006): Biological reserves, rare species and the trade-off between species abundance and species diversity. Ecological Economics, Volume 56, Issue 4, 1 April 2006, Pages 570-583

Holzkämper A, Seppelt R (2007): Evaluating cost-effectiveness of conservation management actions in an agricultural landscape on a regional scale. Biol Conserv 136:117–127

Hynes, Stephen and Nick Hanley (2009): The "Crex crex" lament: Estimating landowners willingness to pay for corncrake conservation on Irish farmland. Biological Conservation, Volume 142, Issue 1, January 2009, Pages 180-188

IEEP (2009): 'Biodiversity and the EU Budget', report commissioned by WWF. http://assets.panda.org/downloads/wwf_biodiversity_and_eu_budget.pdf Last accessed 11.05.2010.

IUCN (2007).Effects of marine biodiversity on ecosystem functioning. European Newsletter: Marine Biodiversity, Volume 13.

IUCN (2009).IUCN Resolution (4.045) on "Accelerating progress to establish marine protected areas and creating marine protected area networks". IUCN Resolution 4.045.

Jones PJS (2009).Equity, justice and power issues raised by no-take marine protected area proposals. Marine Policy, Volume 33(5), pp. 759-765.

Juda, L (2007). The European Union and Ocean Use Management: The Marine Strategy and the Maritime Policy. Ocean Development & International Law, Volume 38, pp. 259 – 282.

Kelleher, G. (1999) Guidelines for Marine Protected Areas.IUCN, Gland, Switzerland and Cambridge, UK.

Kettunen, M., Genovesi, P., Gollasch, S., Pagad, S., Starfinger, U. ten Brink, P. & Shine, C (2008) Technical support to EU strategy on invasive species (IAS) - Assessment of the impacts of IAS in Europe and the EU (final module report for the European Commission). Institute for European Environmental Policy (IEEP), Brussels, Belgium. 44 pp. + Annexes.

Kettunen, M.; Bassi, S.; Gantioler, S. and ten Brink, P. (2009) Assessing socio-economic benefits of Natura 2000 – a Toolkit for Practitioners (November 2009 Edition). Output of the European Commission project Financing Natura 2000: Cost estimate and benefits of Natura 2000. IEEP, Brussels, Belgium.

Kettunen, M., Baldock, D., Adelle, C., Cooper, T., Farmer, M. Hart, K., Torkler, P. (2009b). Biodiversity and the EU budget. Making the case for conserving biodiversity in the context of the EU Budget Review. WWF & Institute for European Environmental Policy (IEEP), London / Brussels.

Khalilian, S; Froese, R; Proelss, A; Requate, T (2010). Designed for failure: A critique of the Common Fisheries Policy of the European Union. Marine Policy, Article in Press, Corrected Proof.

Klein C; Chan, A; Kircher, L; Cundiff, A; Hrovat, Y; Scholz, A.; Kendall, BE; Airame, S (2008). Striking a balance between biodiversity conservation and socioeconomic viability in the design of marine protected areas. Conservation Biology doi:10.1111/j.1523-1739.2008.00896.x

Kleijn, D., Kohler, F., Báldi, A. et al (2008).On the relationship between farmland biodiversity and land-use intensity in Europe.Proceedings of the Royal Society B. doi:10.1098/rspb.2008.1509.

Kniivilä, M and Saastamoinen, O (2002). The Opportunity Costs of Forest Conservation in a Local Economy.Silva Fennica 36(4): 853–865.

Kvamsdal, SL and Sandal, LK (2008). The Premium of Marine Protected Areas: A Simple Valuation Model. Marine Resource Economics, Volume 23, pp. 171–197.

Layton,D.F., Siikamäki, J. (2009): Payments for Ecosystem Services Programs: Predicting Landowner Enrollment and Opportunity Cost Using a Beta-Binomial Model, (forthcoming) Environmental and Resource Economics, Springer, accepted 8 May 2009.

Lovell, S.J. and Sunding, D.L. (2001). Voluntary Development Restrictions and the Cost of Habitat Conservation. Real Estate Economics, Volume 29 (2): 191-206.

Lutchman, I, Brown, J. Kettunen, M. (2007). Review of EU legislation and implementation of marine protected areas (MPAs). IEEP: London.

MacMillan D, Hanley N, Daw M (2004): Costs and benefits of wild goose conservation in Scotland. BiolConserv 119:475–485

Marine Stewardship Council (2008).MSC environmental standard for sustainbable fishing. [Internet]. [Update 2008; cited 8 June 2010]; available from http://www.msc.org/about-us/standards/msc-environmental-standard.

Mathur, AS and Sachdeva, AS (2003).Towards an Economic Approach to Sustainable Forest Development.Perspective planning division, Planning Commission, Government of India. Working Paper Series, Paper No. 2/2003-PC.

McCrea-Strub, A., Zeller, D., Sumaila. U.R., Nelson, J., Balmford, A. and Pauly, D. (2010). Understanding the cost of establishing marine protected areas. Marine Policy. doi:10.1016/j.marpol.2010.07.001

Montgomery, C., Brown, G., Adams, D. (1994): The marginal cost of species preservation: the Northern Spotted Owl. Journal of Environmental Economics and Management 26 (2), 111–128.

MPA News. Volume 10. N0.1. What does an MPA cost? Considering the various costs of MPAs to stakeholders and management. July 2008.

Mullan, K and Kontoleon, A (2008).Output II – Benefits and costs of forest biodiversity: Economic theory and case study evidence.

Naidoo, R., Balmford, A., Ferraro, P.J. et al. (2006): Integrating economic costs into conservation planning, TRENDS in Ecology and Evolution, Vol.21 No.12, Elsevier Ltd., 2006.

Naidoo, R., Iwamura, T. (2007): Global-scale mapping of economic benefits from agricultural lands: Implications for conservation priorities, Biological conservation, No 140 (2007), pp. 40-49, Elsevier Ltd., 2007.

Naidoo, R., Balmford, A., Costanza, R., et al. (2008). Global mapping of ecosystem services and conservation priorities.Proceedings of the National Academy of Sciences. 105: 9495-9500.

Osterburg, B., Nitsch, H., Laggner, A. and Wagner, S. (2008) Analysis of policy measures for greenhouse gas abatement and compliance with the Convention on Biodiversity. Report produced under EU project SSPE-CT-2004-503604 'Impact of Environmental Agreements on the CAP'.

Pagiola, S., K. von Ritter, and J. Bishop(2004). Assessing the economicvalue of ecosystem conservation. Environment department papers, Paper 101. The World Bank, Washington, D.C.

Paracchini, M.L., Petersen, J-E., Hoogeveen, Y., Bamps, C., Burfield, I. and van Swaay, C. (2008) High Nature Value Farmland in Europe. An estimate of the distribution patterns on the basis of land cover and biodiversity data. European Commission Joint Research Centre, Institute for Environment and Sustainability. Office for Official Publications of the European Communities, Luxembourg.

Redman, M. (2009) The 'hidden values' of HNV farming. Report prepared for the WWF Danube-Carpathian programme, WWF.

Richartz, S. (2007). Putting the fish back into our seas - how marine reserves help bring back sea life. European Newsletter: Marine Biodiversity, Volume 13.

Royal Society for the Protection of Birds (2007). Objection of Lewis Wind Power revised application for 181 turbines on the Lewis Peatlands Special Protection Area. RSPB Scotland Briefing, February 2007.

Rudd, MA (2007). Evaluating the Economic Benefits of Marine Protected Areas (MPAs) in Canada. SWGC Environmental Valuation and Policy Laboratory, Memorial University.

Samecki, P (2009). Orientation Paper on Future Cohesion Policy. Presented at the '2nd Meeting of the High Level Group Reflecting on the Future of Cohesion Policy' in Brussels, Belgium, 3.12.2009.

Samonte-Tan, GB; White, AT; Tercer, MA; Diviva, J; Tabara, E; Caballes, C (2007). Economic Valuation of Coastal and Marine Resources: Bohol Marine Triangle. Coastal Management, Volume 35, pp. 319-338.

Sanchirico, JN (2000). Marine Protected Areas as Fishery Policy: A Discussion of Potential Costs and Benefits. Resources for the Future.

Sanchirrico, J.N., Cochran, K.A., Emerson, P.M. (2002). Marine Protected Areas: Economic and social implications. Discussion Paper 02-26. Washington D.C. Resources of the Future.

Seventh Framework Programme (2010): http://cordis.europa.eu/fp7/what_en.html Last accessed 11.05.2010.

Shine, C., Kettunen, M., Genovesi, P., Essl, F. Gollasch, S., Rabitsch, W., Scalera, R., Starfinger, U. and ten Brink, P. (2010). *Assessment to support continued development of the EU Strategy to combat invasive alien species*. Final Report for the European Commission. Institute for European Environmental Policy (IEEP), Brussels, Belgium.

Shogren, J.F., Tschirhart, J., Anderson, T., Whitenour, A., Beissinger, S., Brookshire, D., Brown, G., Coursey, D., Innes, R., Meyer, S., Polasky, S. (1999): Why economics matters for endangered species protection. Conservation Biology 13, 1257–1267

Sixth Framework Programme (2010): http://cordis.europa.eu/fp6/budget.htm Last accessed 11.05.2010.

Stewart, RR; Noyce, T; Possingham, HP (2003). Opportunity cost of ad hoc marine reserve design decisions: an example from South Australia. Mar Ecol Prog Ser, Volume 253, pp. 25–38.

Sunde, J and Isaacs, M (2008). Marine Conservation and Coastal Communities: Who Carries the Costs? A Study of Marine Protected Areas and Their Impact on Traditional Small-scale Fishing Communities in South Africa.

Switzerland. Available at: http://data.iucn.org/dbtwwpd/edocs/PAPS-016.pdf [Accessed September 2010].

Turrner, M., Robbins, K., Silcock, P. (2008) Hill farming systems in south west England: economic viability and the delivery of public goods. Department of Geography, University of Exeter, Rural Business Economics Report No 08/01

Ulbrich K.; Drechsler M.; Wätzold F.; Johst K.; Settele J., (2008). A software tool fordesigning cost-effective compensation payments for conservation measures. Environmental Modelling & Software 23, 122-123.

van Hoof, L and van Tatenhove, J (2009). EU marine policy on the move: The tension between fisheries and maritime policy. Marine Policy, Volume 33, pp. 726 – 732.

Wallmo, K and Edwards, S (2008). Estimating Non-market Values of Marine Protected Areas: A Latent Class Modeling Approach. Marine Resource Economics, Volume 23, pp. 301–323.

Wätzold, F., Lienhoop, N., Drechsler, M., Settele, J. (2008): Estimating optimal conservation in the context of agri-environmental schemes. Ecol.Econ. 68 (1-2), 295-305.

Wätzold, F., Schwerdtner, K., 2005. Why be wasteful when preserving a valuable resource? A review article on the costeffectiveness of European biodiversity conservation policy.Biological Conservation 123, 327–338.

Wilen, J and Abbott, J (2006). Estimates of the Maximum Potential Economic Impacts of Marine Protected Area Networks in the Central California Coast.

Winkel, G; Kaphengst, T; Herbert, S; Robaey, Z; Rosenkranz, L; Sotirov, M (2009). EU policy options for the protection of European forests against harmful impacts. As part of the tender: Implementation of the EU Forestry Strategy: "How to protect EU Forests against harmful impacts?" ENV.B.1/ETU/2008/0049: OJ 2008/S 112 – 149606.

Withana, S., Baldock, D., Farmer, A., Pallemaerts, M., Hjerp, P., Watkins, E., Armstrong, J., Medarova-Bergstrom, K., Gantioler, S. 2010. Strategic Orientations of EU Environmental Policy under the Sixth Environment Action Programme and Implications for the Future. Report for the IBGE-BIM, IEEP, London.

WWF 2004. Marine Protected Areas in the context of marine spatial planning – discussing the links. A report to WWF UK by Dr. Susan Gubbay.

Zander, K, Garnett, S, Straton, A (2010). Trade-offs between development, culture and conservation – willingness to pay for tropical river management among urban Australians. Journal of Environmental Management 91: 2519 – 2528.

Zander, K., Drucker, A.G., K. Holm-Müller (2009): Costing the conservation of animal genetic resources: The case of Borana cattle in Ethiopia and Kenya, presented at the Volume 73, Issue 4, February 2009, Journal of Arid Environments, Band 73 (2): 550-556

Annex A. Sources of synthesis: Literature review

Natura 2000

This section of the analysis focused on the policy actions under Category 1 “Natura 2000”, which includes actions for the finalisation of the sites, the achievement of favourable conservation status and the strengthening of the coherence, connectivity and resilience of the Natura 2000 network.

The Natura 2000 network is an EU-wide network of nature protection areas and represents a centrepiece of EU nature and biodiversity policy.

Its foundations lay on two main pillars of Europe’s legislation on nature conservation and biodiversity: Council Directive 79/409/EC on the conservation of wild birds (Birds Directive)[94] adopted in 1979 and Council Directive 92/43/EEC on the conservation of natural habitats and of wild fauna and flora (Habitats Directives)[95] adopted in 1992.These Directives establish two main approaches to deliver their overall conservation objectives (as defined in Article 2 of each Directive):

- the establishment, protection and management of a coherent network of areas designed to protect the habitats and species targeted by the Directives – the Natura 2000 Network (cf. Articles 3-6 of the Habitats Directive and Articles 3 and 4 of the Birds Directive)
- the establishment of a system of strict protection for animal and plant species covered by the Directives (cf. Articles 12-16 of the Habitats Directive and Articles 5-9 of the Birds Directive)

In addition, both Directives prescribe measures to be taken outside protected areas to ensure ecological coherence (Article 10 of Habitats Directive and Article 3 of Birds Directive).

The Natura 2000 network is comprised of Special Areas of Conservation (SAC) designated by Member States under the Habitats Directive, and Special Protection Areas (SPAs) under the Birds Directive. Its aim is to assure the long-term survival of Europe's most valuable and threatened species and habitats.

Natura 2000 is a key pillar of Communityaction for the conservation of biodiversity and it is central to achieving the commitment made at the 2001 European Council meeting in Gothenburg[96]to reverse the decline ofthe EU’s biodiversity by the year 2010. It is also

[94] Council Directive of 30 November 2009 on the conservation of wild birds. OJ 20/7, 26.1.2010

[95] Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora. OJ L 206, 22.7.1992,

[96] Presidency Conclusions of the Gothenburg European Council, 15 and 16 June 2001.

recognised as a key element of the EU Sustainable Development Strategy[97] and is developed in more detail in the Sixth Community Environment Action Programme (2002-2012)[98], which identifies nature and biodiversity as one of the four main priorities for action.Key actions identified in the Sixth EAP include implementation of the Community Biodiversity Strategy[99]and Action Plans[100] - developed in response to EC ratification of the Convention on Biological Diversity (CBD) in 1993 -, full implementation of the Habitat and Birds Directives and, in particular the establishment of the Natura 2000 network[101].

In 2009 the network consisted of over 25,000 sites covering over 17% of the EU's land surface[102]. A map of the distribution of sites across Europe (based on 2006 data) is provided below.

In addition to improving nature conservation efforts, this EU-wide ecological network of conservation areas also plays an important role in supporting the preservation of biodiversity and related ecosystem services, including provisioning, regulating, supporting and cultural services (as according to the 2005 Millennium Ecosystem Assessment, MEA), on a wider countryside and marine environment scale.

The variety of ecosystem services provided by Natura 2000 network (both directly and indirectly) is extensive. For example, Natura 2000 sites often preserve habitat types that provide important services, such as water purification/retention (wetlands), carbon storage (peat bogs) and erosion protection (forested mountain areas). The sites can also function as 'refuges' and breeding places for local biodiversity, e.g. pollinating insects, game animals and fish, helping maintain population levels at local and regional scales. In addition, Natura 2000 areas are known to provide a number of ecosystem services related to recreation, education and tourism. In several cases Natura sites are also recognised as an important part of local cultural heritage and identity.

Figure 3. Distribution of Natura 2000 sites across the EU25

[97] Communication from the Commission. A Sustainable Europe for a Better World: A European Union Strategy for Sustainable Development. COM(2001)264 final.

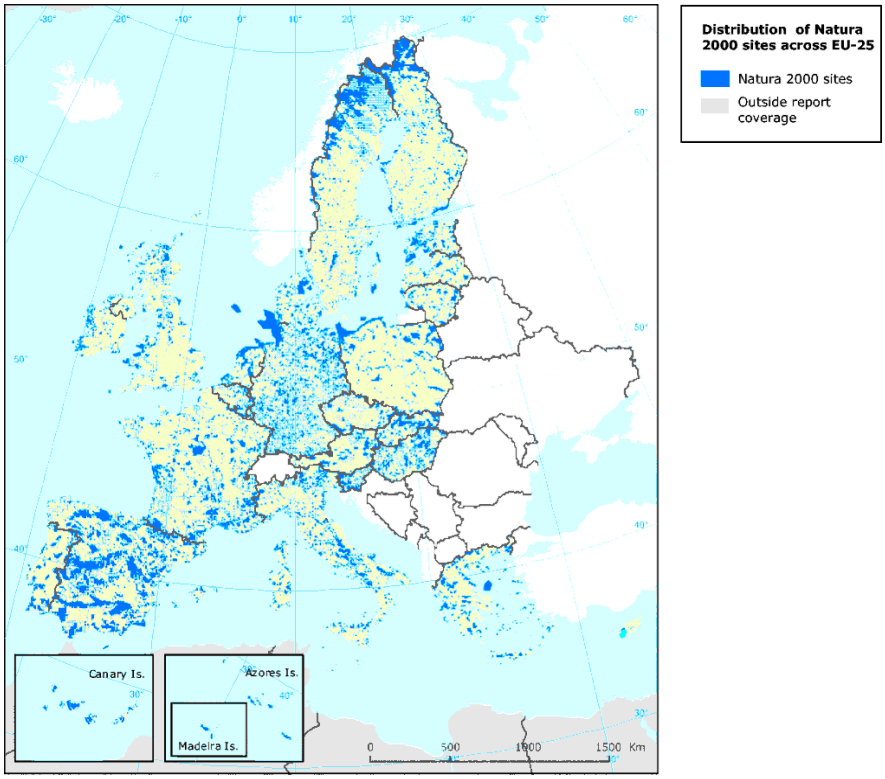
[98] Decision No 1600/2002/EC of the European Parliament and of the Council laying down the Sixth Community Environment Action Programme (OJ L 242, 10.9.2002, p.1).

[99] COM(1998) 42 final

[100] COM(2001)162 final Volumes I-V

[101] Article 6 §2(a) of Decision No 1600/2002/EC

[102] European Commission (2009): Natura 2000 - European Commission Nature and Biodiversity Newsletter. Number 27 • December 2009



Source: EEA-ETC/BD, December 2006. http://biodiversity.eionet.europa.eu/

The analysis on Natura 2000 related costs was based on information from two European Commission initiatives:

- the 2004 Communication 'Financing Natura 2000'[103] and
- the ongoing study 'Preparatory actions for Natura 2 Lot 1: The Economic and Social Benefits associated with the Natura 2000 Network'[104]

The two initiatives collected cost data on Natura 2000 through questionnaires compiled by EU Member States.

The 2004 Communication followed a report of the Article 8 Expert Working Group published in December 2002, which had provided initial cost estimates for EU-15 based on a questionnaire sent to Member States. Given issues about the reliability of these initial estimates, the Commission sent a second questionnaire to the Member States and Accession Countries in June 2003 to collect more detailed information ofestimated costs and financial needs of the Natura 2000 network. Responses were received from 9 old and 8 new MS. While some countries provided improved results, others were unable to provide additional data to what had been provided to the questionnaire of the Article 8 Working

[103] Communication from the Commission to the Council and the European Parliament 'Financing Natura 2000'. Brussels, 15.07.2004. COM(2004)431 final

[104] Gantioler S., Rayment M., Bassi S., Kettunen M., McConville A., Landgrebe R., Gerdes H., ten Brink P. *Costs and Socio-Economic Benefits associated with the Natura 2000 Network*. Final report to the European Commission, DG Environment on Contract ENV.B.2/SER/2008/0038. Institute for European Environmental Policy / GHK / Ecologic, Brussels 2010.

Group and asked this information to be used again, while others were unable to provide any information at all.

The cost information provided by the MS covered anticipated expenditure for managing and administering Natura 2000 sites. Most estimates were provisional (given that the network had not been finalised and there was little experience at the time of management and corresponding costs) and were based on the designation situation in 2003. Costs were categorised according to: Investment costs (Restorationprojects for habitats or species; Land purchase including compensation for development rights; Infrastructure for public access, interpretation, observatories etc); Management planning and administration (Preparation and review of management plans, strategies; Establishment and running costs of management bodies; Training; Education and visitor management); and Ongoing management actions and monitoring for different land-use categories.

A third round of questionnaires was circulated in 2008/2009 and the results are currently being assessed in the study 'Preparatory actions for Natura 2 Lot 1: The Economic and Social Benefits associated with the Natura 2000 Network', carried out by IEEP, GHK and Ecologic for DG Environment. Responses were received from 23 MS – the four non respondents at this date being Denmark, Finland, the Netherlands and Romania.

Compared to the previous questionnaire rounds, in the latest questionnaire costs were in many cases provided in a more disaggregated form, which allowed identifying an estimate for opportunity costs – at least for some MS. Furthermore, the information provided in the 2008/2009 questionnaire represents an update of the data provided in the previous rounds. Therefore the analysis for this study focused on this latest questionnaire.

Methodology: cost categories used

The 2008/2009 questionnaire provided an estimate of the costs expected for the completion of the Natura 2000 network, including site finalisation and the achievement of favourable conservation status. Standardised costs categories were used to allow comparability across countries.

First, costs were grouped into two broad categories: recurrent and one-off payments. These were in turn broken down into more detailed sub-categories. An overview of the cost categories and structure used in the questionnaire is shown in figure 3.

One-off costs were considered single payments incurred between October 2008 and the completion of the network. These were further distinguished into *one-off management costs* and *investment costs*.

Management costs included *costs for the finalisation of sites* (such as costs for scientific studies, administration, consultation etc) and *costs for management planning* (i.e. one-off costs for preparing management plans, establishing management bodies, consultations etc.)

Investment costs included *cost of land purchase*, *one-off payments of compensation for development rights*, infrastructure costs for the improvement/restoration of habitat and species and infrastructures costs contributing to conservation (egg for public access, interpretation works, observatories and kiosks, etc.)

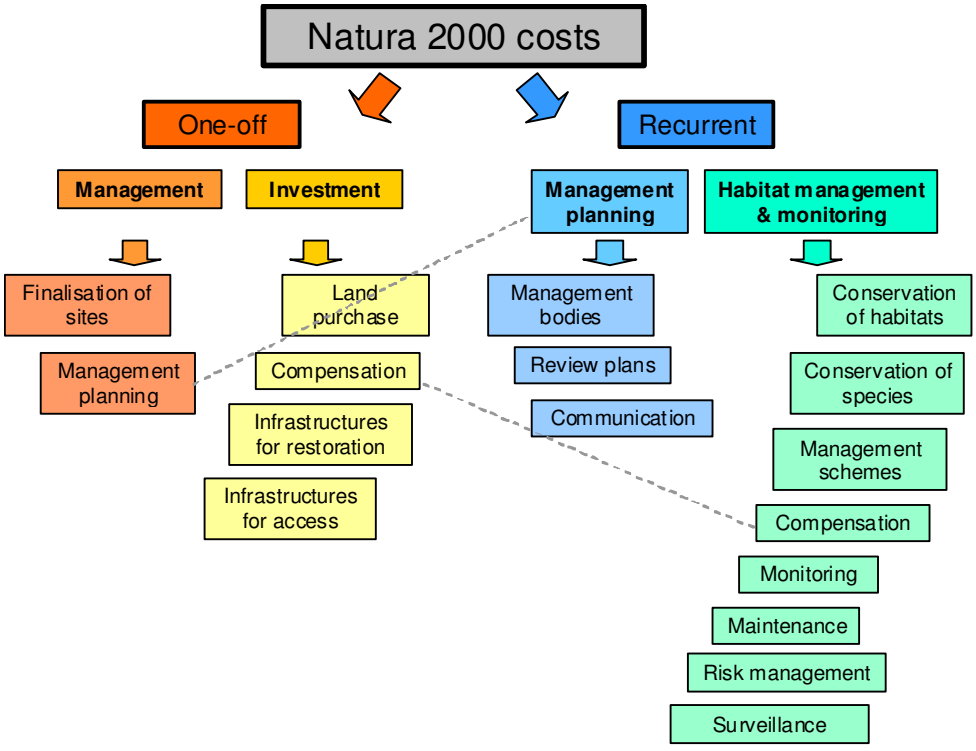
Recurrent costs were generally associated with the on-going management activities to maintain or improve sites. They were broken down into *costs for management planning* and *costs for habitat management and monitoring*.

Costs for Management planning included *running costs of management bodies*, *review of management plans*, and *public communication*.

Habitat management and monitoring costs included: *conservation management measures* (for maintenance and improvement of habitats' and species' favourable conservation status); *implementation of management schemes and agreements with owners and managers of land or water for following certain prescriptions; provision of services, compensation for rights foregone and loss of income and developing acceptability 'liaison' with neighbours; monitoring; maintenance of infrastructures*(for public access, interpretation works, observatories and kiosks); *risk management* (fire prevention and control, flooding etc); and*surveillance of the sites*.

The questionnaire also provided information on the expected ***costs of staff*** involved in Natura 2000.

Figure 4. Cost structure used in the study 'Preparatory actions for Natura 2000'



Source: Gantioler S., Rayment M., Bassi S., Kettunen M., McConville A., Landgrebe R., Gerdes H., ten Brink P. Costs and Socio-Economic Benefits associated with the Natura 2000 Network. Final report to the European Commission, DG Environment on Contract ENV.B.2/SER/2008/0038. Institute for European Environmental Policy / GHK / Ecologic, Brussels 2010.

In light of the cost categories used in the present study, the data provided through the questionnaire have been re-classified accordingly, whenever possible. They approach has been as follow:

Table 30. Cost re-classification

Study: Preparatory Actions for Natura 2000	This study
One-off management	*if aggregated – all under 'Planning' (site management costs)*
One-off costs for the finalisation of sites	Planning (site management costs)
One–off costs for management planning	Planning (site management costs)
Investment costs	*if aggregated – all under 'Infrastructure' (investment/capital cost)*
Land purchase	Land purchase (investment/capital cost)
Compensation for development rights	Compensation for development rights (opportunity cost)
Infrastructure for restoration	Infrastructure (investment/capital cost)
Infrastructures for public access etc	Infrastructure (investment/capital cost)
Costs for Management planning	*if aggregated – all under 'Planning' (site management costs)*
Running costs of management bodies	Running costs of management bodies (administrative costs)
Review of management plans	Planning (site management costs)
Public communication	Outreach and communication (administrative costs)
Habitat management and monitoring	*if aggregated: all under 'Management and monitoring' (site management costs)*
Conservation management - habitats	Management and monitoring (site management costs)
Conservation management - species	Management and monitoring (site management costs)
Management schemes	Management and monitoring (site management costs)
Compensation for loss of income	Compensation loss of income (Opportunity cost)
Monitoring	Management and monitoring (site management costs)
Maintenance of infrastructures	Management and monitoring (site management costs)
Risk management	Management and monitoring (site management costs)
Surveillance	Management and monitoring (site management costs)
Staff cost	Staff costs (administrative cost)

Cost overview

Although the 2008/2009 questionnaires provided a good overview of key costs for the completion of the Natura 2000 network, it should be noted that in some cases the costs categories have been interpreted differently by MS, making comparability sometimes difficult. The level of detail of the information provided also varied, with some countries providing information only for aggregated categories .egg. for 'habitat management a monitoring' as a broad category), while others were able to detail costs into more detailed categories (e.g. distinguishing between costs for conservation management measures, management

schemes and so on). This not always allowed distinguishing between opportunity costs and other costs.

Table 4 provides an overview of the total figures provided in the questionnaires by cost category, and their share over total costs.

Table 31. Overview of Natura 2000 costs for 23 MS

Cost category	Costs included	Total for all 23 MS (€)	% over total
Investment/ capital costs	• Land purchase • Infrastructure	907,336,871	18.51
Transfer payment costs		0	0.00
Site management costs	• Planning • Management and monitoring	3,030,783,618	61.83
Administrative costs	• Staff • Outreach • Running costs	621,866,817	12.69
Additional transaction costs		0	0.00
Opportunity costs	• Compensation for income foregone • Compensation for development rights	**341,503,594**	**6.97**
Economic costs		0	0.00
Environmental costs		0	0.00
TOTAL		***4,901,490,901***	100.00

Cost analysis

According to the estimates provided by the 23 MS, the total cost for Natura 2000 is estimated to be about € 4.9 billion per year. This figure is slightly higher that the results in the study "Preparatory actions for Natura 2000 as it includes staff costs – although it should be noted that some overlap between the data on staff cost and on running costs of management bodies is possible.

Considering some uncertainties in the methodologies used by MS for calculations, the fact that not all MS responded (the respondents cover about 85% of the network) and possible inaccuracies and data gaps in the country questionnaires, the total costs should not be seen as an exact figure, but it is considered useful to provide an order of magnitude for the costs of the network.

Table 5 provides a more detailed view of costs by each sub-category. The number of Member States that provided information on each category has been noted in the right hand side column.

Table 32. Natura 2000 costs detailed by sub-categories

Cost categories	Sub-categories	Total	%	# MS

	Land purchase	351,774,613	7.18	23
	Infrastructure	555,562,258	11.33	23
Total investment		***907,336,871***	**18.51**	
Transfer payment		**0**	0.00	0
	Planning	723,242,587	14.76	23
	Management and monitoring	2,307,541,030	47.08	23
Total site management		***3,030,783,618***	**61.83**	
	Staff	229,241,960	4.68	18
	Outreach	32,910,635	0.67	14
	Running costs	359,714,223	7.34	13
Total Administrative cost		***621,866,817***	**12.69**	
Transaction costs		**0**	**0.00**	0
	Compensation for income foregone	83,900,714	1.71	3
	Compensation for development rights	257,602,880	5.26	6
Total opportunity cost		***341,503,594***	**6.97**	
TOTAL COST		***4,901,490,901***	**100.00**	

High variability was found on the range of figures provided for each cost category (both total and per hectare), depending on several factors including the size of the country, the type of habitats (e.g. pristine forests are likely to require less management and hence less costs than some agriculture areas or than sites frequently visited by tourists), the existence and uptake of compensation measures (e.g. to farmers), and also the type of assumptions and methodology used by MS to estimate data. In addition, some countries based their estimates on 'desirable' costs for the ideal completion of the network, while others have rather based their analysis on actual costs or on financial resources available.

As for cost distribution between old and new MS, the study 'Preparatory actions for Natura 2000' highlights that about 80% of the identified costs are among the EU15 and 20% among the more recent entrants of the EU (although, as noted, coverage of both of these groups is incomplete). Per hectare costs tend also to be higher in the EU 15; these are substantially affected by differences in labour costs between Member States. In general, greater increases in future costs are expected in the new MS, in which the network is still very much under development, than in the EU15, where a significant proportion of one-off investments have been made and where the focus is shifting towards recurrent costs.[105]

The study also reveals very wide variations in different types of costs, including both one-off and recurrent costs. For example:

[105] Gantioler S., Rayment M., Bassi S., Kettunen M., McConville A., Landgrebe R., Gerdes H., ten Brink P. *Costs and Socio-Economic Benefits associated with the Natura 2000 Network*. Final report to the European Commission, DG Environment on Contract ENV.B.2/SER/2008/0038. Institute for European Environmental Policy / GHK / Ecologic, Brussels 2010.

- One-off management costs are relatively high in Malta, Belgium and the Czech Republic;
- Land purchase costs are extraordinarily high in Cyprus, Belgium, Latvia and Luxembourg
- Infrastructure costs are very high in Luxembourg and Malta (and fairly high in Latvia and Cyprus);
- Recurrent costs of management planning are estimated to be very high in Cyprus and Luxembourg;
- Habitat management costs are estimated to be high in Cyprus, Luxembourg, Malta and to a lesser extent Ireland.[106]

Overall, the biggest share of costs is represented by site management costs (about 62% of total costs), in particular management and monitoring costs, which covers alone about 47 per cent of total costs. This can be explained by the fact that in many MS – and especially in the EU 15 - many sites are near completion, therefore most of the costs envisaged for the finalisation and for reaching favourable conservation status are mostly expected from the maintenance of the site – i.e. through monitoring and management activities.

Investment costs represent the second major cost category, although significantly lower than site management (about 18.5 of total costs). This category covers both land purchase payments (about 7.2% of total costs) and infrastructures costs (about 11.3%), including infrastructure for the improvement/restoration of habitat and species and infrastructures for public access, interpretation works, observatories and kiosks, etc. It should be noted that land purchase costs per hectare are very variable across countries .see examples above of countries with high costs), given differences in land type/land value and their potential use (e.g. land that could be potentially used for development/building was attribute a higher value). This may hence also reflect a form of opportunity costs - see discussion below.

Administrative costs represent about 12.7 per cent of total costs, with the most prominent figures being for running costs of management bodies (7.3) and staff costs (4.7) and only a small contribution from outreach and communication costs (about 0.7%).

The figure for opportunity costs in table 32 includes both (recurrent) compensation for income foregone and (one-off) compensations for development rights, on the basis of the definition used for this study. It can be inferred that such costs are mainly borne by farmers/land owners, which are then compensated by central/local government for their foregone economic opportunities.

Only 7 MS provided explicit information on opportunity costs. Other countries either did not have any information on opportunity costs, or were not able to separate them from other categories. Overall, opportunity costs data provided in the questionnaire represent about 7 per cent of the total costs. As only a few countries were able to identify and separate such costs from other categories, this should be seen as a lower bound.

[106] *Ibid.*

It should be noted that the category 'land purchase' costs could also be used as a proxy for opportunity costs. Such payments are often assessed taking into account the income foregone by land owners for selling their land, as selling would imply stopping any economic activity they used to carry out in their property. Although these payments can be assessed in different ways, and may in some cases be higher or lower than the actual opportunity costs, they can still represent an indication of the value lost by land owners.

Information on land purchase payments were provided by most countries (18 MS). High variation on per hectare values were registered across countries, as this were likely influenced by the type of land and economic activities taking place, the country income, and the methods and assumptions used to assess the payments. Overall, the total cost for land purchase is fairly high (about as much as other compensation costs), i.e. about €350 million. If such cost was to be included under the definition of opportunity costs, the share of opportunity costs (in terms of compensation for income foregone + compensation for development rights + value of land purchased) over total costs would double, reaching almost 14% of the total costs.

Table 33. Overview of costs for 23 MS – with land purchase as opportunity costs

Cost category	Costs included	Total for all 23 MS (€)	% over total
Investment/ capital costs	• Infrastructure	555,562,258	11.05
Transfer payment costs		0	0.00
Site management costs	• Planning • Management and monitoring	3,157,676,550	62.80
Administrative costs	• Staff • Outreach • Running costs	621,716,817	12.36
Additional transaction costs		0	0.00
Opportunity costs	• Compensation for income foregone& compensation for development rights • Land purchase	341,503,594+ 351,774,613 = **693,278,207**	**13.79**
Economic costs		0	0.00
Environmental costs		0	0.00
TOTAL		5,380,008,446	100.00

Overall, the opportunity cost figure presented in table 33 (i.e. including only figures for compensation for income foregone and compensation for development rights) could only be seen as a very lower bound, as the data were provided only by 7 over 23 MS. Even the figure on table 32 (which includes land purchase figures) may reflect but an approximation, given the lack of data. It should be noted that some countries have not been able to provide information on such costs not only for methodological reasons (i.e. difficulty to isolate specific payments from broader categories) but also because some of them, especially among the new MS, may not have yet in place fully functioning compensation mechanisms. Therefore

more data on opportunity costs related payments can only be expected in the future. Finally, it should be noted that the figures provided through the questionnaire can only represent opportunity costs in terms of compensation/payments paid to land owners for lost economic opportunities, and would likely fail to capture other opportunity costs that remain uncompensated.

Data gaps

As only 7 countries provided explicit information on opportunity costs, there is clearly an issue of under-representation, as other opportunity costs are likely either covered under other costs, or not taken into account at all (egg where no compensation payments are in place, or were compensation does not reflect the full value of opportunities lost).

Land purchase values could be used to approximate other opportunity costs not captured by compensation payments. However, this raises the issue of how opportunity costs are defined, and would also require to investigate in further depth how the land purchase payments are calculated, i.e. how much they reflect lost opportunities and how much they reflect other costs (egg transaction costs etc).

Species specific measures

Species are undeniably an important part of biodiversity. Protecting endangered species helps to maintain high levels of biodiversity and thus support the delivery of ecosystem services as well as the supply of environmental and socio-economic benefits. Maintaining genetic biodiversity, for example, benefits the pharmaceutical industry as well as increases crop variety in agriculture. Endangered and rare species occurring in protected areas attract tourists and stimulate job creation in local and regional economies. Some species have a more indirect influence on the provision of ecosystem services; for example, microorganisms support high-quality water and soil species contribute to the maintenance of soil fertility.

The Health Check of Europe's protected nature carried out by the European Commission highlights that most of the examined species and habitats have an 'unfavourable conservation status'[107] and that the populations of many species are in decline. The review assessed over 1,000 terrestrial and marine animal and plant species. For most biogeographical regions, over 20% of the species have a bad status and over 30% have an inadequate status. The review also showed that climate change is already having noticeable impacts on wetland habitats and the species contained therein (COM 2010).

A wide range of political commitments within the EU aims to protect nature and biodiversity, having species conservation[108] at the forefront. In order to achieve their objectives, the

[107] 'Unfavourable status' can be distinguished in 'bad' and 'inadequate status'

[108] Species protection in the EU member states is co-financed through the Commission's LIFE Nature Programme as well as European Agricultural Fund for Rural Development in addition to national conservation programmes.

Habitats Directive (92/43/EEC) and the Wild Birds Directive (2009/147/EC) require the establishment of a network of protected sites and species - the Natura 2000 network. These directives show that efficient species protection can only be guaranteed through adequate habitat conservation. Species protection is also an important part of the EU Biodiversity Action Plan (BAP), emphasizing the implementation of existing action or management plans for threatened species, ex-situ research in the EU (zoo, botanical gardens etc.), conservation programmes for wild species and the implementation of the Natura 2000 network as a tool for the strict protection of animal species.

In addition to findings from the Natura 2000 network, the literature review also examined scientific and grey literature dealing with cost estimations of specific species conservation measures at a national level in Europe as well as the published results from the LIFE programme.

Cost Estimates

Cost estimates are available for a variety of protection measures and are often calculated on the basis of local and regional species protection case studies from within the EU. These case studies include, for example, the protection of predators in Sweden (Boman 1995), restoration of ecosystem services by reintroducing beavers in Germany (Bräuer 2006), conservation of endangered butterfly species in Bavaria/Germany (Drechsler et al. 2007) and wild goose conservation in Scotland (MacMillan et al. 2004).

No overall cost assessments of EU measures for species conservation could be found in the reviewed literature. Instead, only rough figures on EU expenditures in the EU LIFE programme are available. Specifically, the total LIFE contribution to nature conservation projects in the period 1996 - 2006 amounted to EUR 637 million.[109] These projects covered about half of the animals species (especially mammals) listed in the Annex II of the Habitats Directive; the coverage for plants listed in the Annex II was lower (COM 2009a). While expenditures for bird protection amounted to 22 % (EUR 139,6 million)[110] of the LIFE co-financing budget, the rest of the budget was mainly spent on habitat restoration projects.

In the available costs estimates for species conservation, the following cost types are included:

- conservation management costs,
- transaction costs (e.g. arising from participation in conservation schemes),
- compensation payments to farmers (for income foregone including *inter alia* damage costs caused by predators killing livestock or protected species such as goose to agriculture)
- financial costs (e.g. land purchases) and
- opportunity costs (e.g. income foregone)

[109] Total budget amount to EUR 1224.1 million, including contributions at national level (COM 2009b).

[110] Total budget amount to EUR 245,7 million, including contributions at national level (COM 2009b).

Diverse valuation techniques for non-market values have been applied to calculate the costs (including opportunity costs) and benefits of species conservation. These methods include the Travel Cost Method (e.g. Becker et al. 2009), Contingent Valuation Methods (including Willingness to Pay Analysis or Willingness to Accept)(e.g. Becker et al. 2009, Hynes and Hanley 2009, Bräuer 2006, Zander et al. 2009, MacMillan et al. 2004), Replacement Cost Method (e.g. Bräuer 2006,) and Cost-Benefit-Analysis (e.g. Boman 1995, Becker et al. 2009, MacMillan et al. 2004). Further methods entail *inter alia* the development of scenarios (e.g. Bauer et al. 2008, Bräuer 2006, Eppink and Wätzold 2009), integration of economic and ecologic models e.g. to estimate welfare loss in wood product markets (Montgomery et al. 1994) and standard gross margin calculations e.g. Drechsler et al. 2007). Different methods (e.g. Contingent Valuation Methods and Replacement Cost Method / Travel Cost Method)are often combined to conduct a complete Cost-Benefit-Analysis (e.g. Bräuer 2006, Becker et al. 2009).

Very often, cost estimates for species protection serve to design cost-effective compensation and transfer payments (e.g. Drechsler et al. 2007, Bomann 1995, Hynes and Hanley 2009, Wätzold et al. 2008, Holzkämper and Seppelt 2007). This underlines the fact that compensation payment schemes for land-use measures play an important part in conservation efforts in Europe as well as in other parts of the world, particularly regarding agri-environmental policiesand carnivore conservation projects, e.g. for wolverine, lynx, bear and wolf. The later often evokes direct costs in terms of damage to livestock (e.g. reindeer in Sweden) as well as indirect costs from conflict mediation measures, arising from the divergent interests of and costs endured by involved stakeholders as a result of the protection measures. A study from the European Commission (COM 2003) provides country-examples for species protection measures and their payment rates under the European Rural Development Programmes (see Box 12).

Box 11. Good practice examples for species conservation supported through rural development programmes in the EU

Great bustard:

Castilla y León - Villafáfila Lagoons Reserve (Spain): Different types of voluntary contracts were devised which included incentive payments for:

Type 1 and 2 contracts for: increasing the area of fallow and pastures on the holding, and improving their condition for great bustards, reducing fertiliser use, creating small woods or hedgerows.

Type 3 contracts: for establishing long-term set-aside of land (20 years)

Type 4 contracts: for re-introducing or maintaining alfalfa cultivation or maintaining threatened crop varieties.

In 2000, the number of type 1 and 2 contracts covered a total area of 215.000 ha in Castilla y Leon (close to the 13 % of potential area), at a total cost of 21.4 Mio.€. In the same year, the number of type 3 and 4 contracts covered 4.465 ha and a total cost of 0.94 Mio.€. By 2004 some 64.6% of cultivated land in the Lagoons Reserve area was participating in agri-environment measures.

Large Blue Butterfly:

Lithuania: Grassland Management scheme - Annual payment of 809 LTL per ha (234 € per ha) was calculated by adding up costs for each undertaking listed in the agreement plus a 10% incentive.

Common hamster:

France: Obligation of having at least three years of alfalfa on a field during a five year period: Payment is 309 €/ha*year; obligation of having at least three years of winter cereals on a field during a five year period: Payment is 169 €/ha*year

Netherlands: Four different schemes: Maximum payment is as high as 2300 €/ha/year for all schemes

Flanders/Belgium: Creating buffer strips with alfalfa (600 €/ha*year) or creating unharvested buffer strips with cereals (415 €/ha*year).

Ortolan bunting:

Lower Saxony/Germany: Farmers committed themselves to reducing the sowing density of their crops and abstaining from using sprinklers, herbicides or fertilisers on their fields. The compensations paid ranged from 510€/ha for cereals, 1600€/ha for potatoes ad 1200€/ha for sugar beet (pilot study). Based on this pilot study a new agri-environment measure was introduced into Lower Saxony's RDP for bird conservation on arable land: present subsidy for this is between 320-615€/ha.

In addition to Europe-focused studies, there are also valuable studies on cost estimates from the US, Africa and Israel, providing insights into the different methods for calculating the overall and opportunity costs of nature protection (Bauer et al. 2008, Becker et al. 2009, Hamaide et al. 2006, Zander et al. 2009, Montgomery et al. 1994, Shogren et al. 1999).

Opportunity costs

For the calculation of cost estimates of species conservation, increasing attention is being given to opportunity costs as they represent the basis for calculating compensation payments for protection measures. However, the literature offers only a few clear estimates of opportunity costs resulting from species conservation. Most studies remain at a qualitative and theoretical level when discussing opportunity costs. The following table attempts to

categorize such incurred costs, while also acknowledging their sometimes multifaceted and overlapping nature.

Table 34.Opportunity costs resulting from species specific measures

Cost category	Source of Cost	Examples
Economic opportunity costs	Income foregone	• Welfare loss in wood product markets due to protection of the Northern Spotted Owl (resulting from selling one more unit of timber for harvest now rather than later) (Montgomery et al. 1994) • Foregone profit in adopting alternative mowing regimes for farmers supporting butterfly conservation (Drechsler et al. 2007) • Benefits foregone from not spending resources on causes other than species preservation[111]
	Restrictions on development	• Costs of rejecting, modifying and delaying development projects ('Hidden Costs') (Eppink and Wätzold 2009) • Costs of foregone land rent associated with land remaining underdeveloped (Bauer et al. 2008)
	Restrictions on land management practices	• Costs of payments to landowners for species protection measures e.g. for delaying mowing and for using "corncrake-friendly" mowing (Hynes and Hanley 2009) • Cost of changed farm management practices supporting goose protection (MacMillan et al. 2004)
	Restrictions on species control measures	• Costs of damage to agriculture by protected geese (MacMillan et al. 2004) • Costs of damage[112] due to livestock killed by predators covered through compensation payment (Boman 1995)
	Additional considerations	• Costs of keeping livestock species as a means of maintaining animal genetic resources on behalf of the public good (Zander et al. 2009) • Costs of a engaging in wildlife associated activities, such as wildlife viewing, in terms of time spent (Becker et al. 2009) • Cost of covering more species as redundant coverage of rare species decreases and cost of diversity in terms of species abundance

[111] According to Shogren et al. (1999): Economics matters because (1) human behavior generally, and economic parameters in particular, help determine the degree of risk to a species; (2) in a world of scarce resources, the opportunity cost of species protection – the costs of reduced resources for other worthwhile causes - must be taken into account in decision making; and (3) economic incentives are critical in shaping human behavior, and consequently the recovery of species. Endangered species protection that explicitly addresses these basic principles can avoid wasting valuable resources that yield no gain in species protection.

[112] Boman (1995) considers these costs as "social costs" without defining this term in more detail.

		(Hamaide et al. 2006)

Two illustrative and useful examples of (opportunity) cost estimates are provided in the following box.

Box 12. Examples of (opportunity) cost estimates in the EU

Eppink and Wätzold (2009): Hidden costs of the Habitats Directive: Hamster conservation in Germany:

Opportunity costs (OC) are defined as i) costs of rejecting, modifying and delaying development projects (hidden costs); ii) income foregone resulting from species protection measures (e.g. applying less intensive production techniques) calculated as compensation payments to landowners (TPC). Costs have been calculated for two different scenarios (estimation of profit loss through parking garage and costs of foregone development):

Low cost scenario:TPC: € 214,453, Hidden costs: € 19,6 Mio., further costs (Management costs): € 769,101; Total costs: € 20,57 Mio; share of OC of total costs: € 19,8 Mio. (96%)

High cost scenario: MC: € 263,647, Hidden costs: € 38,3 Mio., further costs (Management costs): € 924,881; Total costs: € 39,48 Mio. Mio; share of OC of total costs: € 38,6 Mio. (96%)

This study shows that hidden costs by far exceed compensation payments and management costs.

MacMillan et al. (2004): Costs and benefits of wild goose conservation in Scotland

Opportunity costs are not directly mentioned but can be defined as costs of damage caused by geese to agriculture[113] and of changed farm management supporting goose protection. Cost calculations entail Willingness to Pay Analysis for specified goose conservation measures, cost estimates of damage caused by geese to agriculture and a Cost-Benefit-Analysis (of changes in the population of wild goose species). Results obtained from two case study areas are:

Case study 1 (Islay): Total costs for all 18 Islay farms in the sample were estimated to be £206,000 (€235,635) , giving an average of ≤ £11,500 (€13,154) per farm; Islay-wide cost figure of £560,000 (€640562) (for 1999/2000)

Case study 2 (Strathbeg): Total cost for the sample was approx. £88,000 with an average of £5800 (€6,634) per farm, and £22 (€25) per productive hectare; costs for the whole area were estimated at £219,000 (€250,505) (for 1999/2000)

Comparing costs and benefits shows that benefits greatly exceed the costs of wild goose conservation. For example, for a 10% increase in endangered geese numbers, benefits would be around £10 (€11.4) million even with a downward calibration of 3.3:1, implying a benefit–cost ratio of 200/1. Aggregate net benefits would, at £12.6 (€14.4) million, still greatly outweigh costs.

OC – Opportunity costs, MC – Site Management costs, TPC - Transfer payment costs

Cost-Benefit-Analyses on species conservation showed in many cases that the benefits significantly outweighed the costs (Hynes and Hanley 2009, Bräuer 2006, MacMillan et al. 2004) and thus are an important tool for external communication to promote species conservation and the necessary financing. Within this context, Hynes and Hanley (2009)

[113] "Grazing by geese, especially in areas where goose numbers are highly concentrated, can cause damage to spring-sown cereals and grass, delay turn-out of stock, and can cause problems with soil puddling and compaction" (MacMillan et al. 2004). These effects result mainly in yield losses or losses of winter grazing (income foregone) as well as additional costs such as for reseeding grass.

point out an interesting phenomenon, namely that people tend to be more aware of opportunity costs when they have a high Willingness to Pay regarding conservation issues.

Conclusions

The opportunity costs of species conservation are predominantly defined as the income foregone as a result of management restrictions in agricultural areas. Additionally, conservation projects aiming to protect carnivores such as the lynx, bear and wolf often evoke costs to farmers and hunters in terms of livestock lost or reductions in game species available for hunting, respectively. Therewith it can be resumed that in case damage costs result in income foregone for farmers, landowners etc. these costs can be considered as opportunity costs. The calculation of such costs is needed to adequately design compensation payments at the regional level for those individuals affected. Therefore, the outlays for compensations are usually a good approximation of the opportunity costs of the protection measures.

Other types of opportunity costs are not reflected in financial flows, such as costs arising from rejecting, modifying and delaying development projects (Eppink and Wätzold 2009). In such cases, the real cost of conservation might be underestimated or not be considered in the budget planning at all.

Furthermore, the following aspects need to be considered in the assessment of opportunity costs: timing of costs or i.e. the cost-effective allocation of financial resources over time (Eppink and Wätzold 2009), spatiotemporal habitat heterogeneity when designing cost-effective compensation payments for endangered species (Drechsler et al. 2007, Ulbrich et al. 2008) and the inclusion of estimates of equity impacts[114] in order to improve the analysis of the economics of species conservation (Montgomery et al. 1994). Equity impacts are important to consider, particularly in the discussion about the overall distribution of the costs of protecting non-use-values.

Further research may also address the question of whether or not, given the same levels of financial resources, an earlier start to conservation measures would result in better species conservation (Eppink and Wätzold 2009). Hamaide et al. (2006) emphasize that biodiversity can be greatly and effectively promoted by targeting a set of relatively rare or infrequent species, including those individuals appearing in, for example, less than 10% of the study area.

Finally, the results obtained regarding cost estimates can be viewed as being complementary to the cost estimates linked to *inter alia* the Natura 2000 network and agri-environmental measures.

[114] "Unless appropriate compensation transfer mechanisms are devised, many of the benefits will likely accrue to the well-off-northern hemisphere, while much of the opportunity costs of preservation programs will fall on developing southern hemisphere countries […] in the US less wealthy, rural economies bearing the costs of protecting non-use-values for the general (and on the average, wealthier) population." (Montgomery et al. 1994: 112)

Agri-environmental measures and HNV farmland

The agri-environment measure is one of the most important land management mechanisms developed under the EU Common Agricultural Policy (CAP). The measure is funded by the European Agricultural Fund for Rural Development (EAFRD) under Pillar 2 of the CAP, and is an obligatory Pillar 2 policy instrument. The nature of the agri-environment measure varies significantly between Member States (MS) reflecting differences in their needs and environmental priorities and in the reference level established in each MS. This flexibility (subsidiarity) in the development of the measure is important to ensure that financial incentives for environmental protection can be matched to local needs.

The baseline for the calculation of payments under the agri-environment measure is defined by the reference level. This comprises both EU-derived and national (or regional) legislation applying to all farmers, and cross compliance requirements (Statutory Management Requirements and Good Agricultural and Environmental Condition standards) that apply only to farmers who receive direct payments under Pillar 1 of the CAP. The reference level defines the minimum environmental standards required of farmers, such that payments under the agri-environment measure may only be made for activities that exceed this baseline requirement. However, since the reference level varies between MS, it is possible for farmers in one part of the EU to be paid for certain management practices through an agri-environment scheme that not paid for elsewhere because the practices are included under GAEC standards or national legislation. Hence the scope and level of agri-environment payments in each MS reflects both historical and political decision-making as well as current environmental priorities.

The rationale underpinning the agri-environment measure is the need to encourage farmers and other land managers to serve society by introducing or continuing to apply agricultural production methods compatible with the protection and improvement of the environment, the landscape and its features, natural resources, the soil and genetic diversity[115].

Actions under the agri-environment measure (code 214) relevant to Biodiversity

Within the EU, the EAFRD (Pillar 2) funding used for agri-environment and other measures to improve the environment and the countryside is expected to '*contribute to three EU-level priority areas: biodiversity and the preservation and development of high nature value farming and forestry systems and traditional agricultural landscapes; water; and climate change*'[116]. This study focuses on the priority area of biodiversity and as such, the actions examined under the agri-environment measure (code 214) in each MS are those that are

[115] Preamble 35 of Council Regulation (EC) 1968/2005

[116] Community Strategic Guideline for Rural Development (programming period 2007 to 2013) Council Decision of 20 February 2006 (2006/144/EC)

primarily targeted at the maintenance and enhancement of biodiversity on land used for agriculture.

The selection of agri-environment actions reported here is based primarily on information set out in the Rural Development Programmes (RDPs) for each MS for the period 2007-2013. One exception for this is the UK (England) where payment calculations from the previous programme period (2000-2006) are used. The types of action specified under the agri-environment measure vary considerably between MS and for this study are broadly categorised as follows:

- maintenance of extensive management to prevent agricultural intensification or abandonment of habitats
- habitat management to maintain or enhance biodiversity including an additional payment category for undertaking difficult operations due to the nature of the terrain or of the management activity itself
- actions to protect specific animal species
- specific management to enhance the biodiversity potential of arable land
- restoration and/or creation of habitats

A number of actions have been excluded from this section either because they are considered elsewhere in the report or because they are not focused primarily on biodiversity conservation (although some benefits for the latter may occur). These excluded actions are focused on:

- organic farming or conversion to organic production
- integrated production
- habitats managed or established primarily for protecting water, soils, air quality, reducing erosion or greenhouse gas emissions
- conservation of genetic diversity or resources of domestic livestock and domestic plants
- Natura 2000 (funded under a separate measure)

Agri-environment actions are applied to a broad range of semi-natural habitats and agricultural land types. Again due to significant variation in the classification of the former, the analysis presented here focuses on land or habitats that are used in whole or in part as:

- either agricultural grassland (for grazing livestock or for forage production)
- or arable cropping land.

Whilst there are several other possible land types such as orchards, horticulture, vineyards and olive groves, these two land types and the actions associated with them occur most commonly across the different MS.

Support for High Nature Value (HNV) farming under the agri-environment measure is also considered briefly. This farm type is singled out because it is characterised by low intensity farming systems that are favourable to wildlife (Baldock *et al.* 1993). The farmland can be divided into three types (after Parrachini *et al.* 2008): 1) farmland with a high proportion of semi-natural vegetation, 2) farmland with a mosaic of low intensity agriculture and natural

and structural elements such as field margins, hedgerows, stone walls, patches of woodland or scrub, small rivers *etc.* and 3) farmland supporting rare species or a high proportion of European or world populations. Within the EU, HNV farmland is most strongly represented in the southern and eastern regions and in the north-west.

Agri-environment actions from fourteen Member States ten MS or regions were examined, namely Austria, Belgium (Flanders), Belgium (Walloon), Bulgaria, Czech Republic, France, Germany (Brandenburg), Germany (Baden Wurttemberg), Poland, Romania, Spain (Navarra), Spain (Andalucia), Sweden and the UK (England). In the final analysis of costs, however, only six countries were used (Box 13) as the agri-environment actions for these countries could be clearly linked to HNV farmland or to habitats likely to be present on such land.

The types of costs included in the calculation of agri-environment payments and relation to the project cost typology

The type of costs (and the activities that generate them) that arise from different agri-environment actions undertaken on agricultural grassland and arable cropping land are shown in table 34. Within the calculation of payments under the agri-environment measure, these costs are generally classified as either Income Foregone or Additional Costs (Table 34).

Table 35. Classification of costs arising from activities associated with agri-environment measures on arable land and grassland in five MS*

COSTS	Countries	Income Foregone	Additional costs
MEASURES ON ARABLE LAND			
Machinery/fuel for sowing over-wintering cover / catch crop or for establishment of additional features *e.g.* bio-belts, beetle banks	At, Cz, Es(N), Se, UK(E)		√
Labour for establishing green cover/additional features	At, Cz,		√
Loss of yield due to restrictions in crop sowing date	At, Cz, Se, UK(E)	√	
Loss of yield due to increased competition from weeds	UK(E)	√	
Management of land set-aside for nature conservation	At,		√[1]
Loss of production on land converted to grass / seed mixture for birds / other crop / not harvested/ conservation headland	Cz, Es(N), UK(E)	√	
Income gained from sale/use of grass biomass	Cz, UK(E)	+	
Use of additional seed or regional/special seed mixes for catch crops/bio-belts *etc.*	Cz, UK(E)		√

Restrictions on choice of main crop after use of catch crop	Cz, Se	√	
Lower input costs	Se, UK(E)		+
Savings on fixed costs	UK(E)		+
Additional weed control on established margin / buffer strip	UK(E)		√
Machinery cost for mowing margin/ buffer strip	UK(E)		√
Reduced grain drying cost	UK(E)		+
Slower combining, increased grain cleaning and drying	UK(E)		√
Labour / machinery cost for undersowing	UK(E)		√
MEASURES ON GRASSLAND			
Lower yield due to reduced inputs	Cz,	√	
Lower fertiliser requirement	Cz,		+
Lower or loss of yield due to restrictions on mowing or grazing	Cz,	√	
Labour for manual mowing or raking	Cz, Se		√
Machinery& fuel cost for complex mowing requirement	Cz,		√
Lower income from livestock due to restriction on stocking rate	Cz, UK(E)	√	
Labour requirement for spot applications of herbicide	Cz, Se, UK(E)		√
Lower herbicide requirement	Cz,		+
Requirement to mow ungrazed vegetation	Cz,		√
Reduced forage costs	UK(E)		+
Establishment & management of grass margin (around in-field pond), wild bird or pollen & nectar seed mix	UK(E)		√
Savings on fixed costs for arable	UK(E)		+
Savings on fixed costs for livestock	UK(E)		+
Likelihood of land abandonment	At, Se		
Mowing of steep slopes / inaccessible areas	At,		√

*(Austria At, Czech Republic Cz, Spain-Navarra EsN, Sweden Se and England UKE).

Use of a √ indicates an item that is included as a cost, whilst use of a + indicates an item that is included as a saving

In establishing the methodology for calculating the overall costs of different agri-environment actions, income foregone can be defined broadly as a measure of the difference in crop or forage yield or in livestock performance arising from the implementation of an agri-environment action compared to non implementation of the action or to conventional agricultural practice; an example of an income foregone calculation undertaken for arable crops on steppe land in Navarra Spain is shown in Annex . Additional costs relate to the costs of activities needed to establish and maintain the agri-environment action, for example, the cost of grassland mowing or of establishing a feature such as a beetle bank in an arable field. A further category cost savings (indicated as a + under additional costs in Table 35) can occur as a result of reduction in management activities or costs, for example: a reduction of inputs, higher value produce, or savings on the use of capital equipment such as a reduction in grain drying time.

With respect to the cost typology used in this project, all three costs have been included in the category opportunity costs. In reality only the income foregone cost can be considered as an opportunity cost but the amount assigned to this cost is rarely specified in the RDP of an individual MS.

Variation in agri-environment action payments between MS

Within the RDPs of different MS, the cost categories of income foregone, additional costs and cost savings are usually combined into a single figure (normally referred to as the income foregone) to determine the amount to be paid to a farmer for undertaking a particular agri-environment action. Payments are usually expressed as an amount per hectare and normally (but by no means always) cover 100 per cent of the calculated costs incurred.

The range of payments available for different management activities undertaken to maintain or enhance biodiversity of agricultural grassland habitats and arable cropping land in different MS is shown in Table 36and Table 37respectively.

With respect to agricultural grassland, the activity *Maintain habitat* refers to payments to maintain extensive management practices and prevent conversion to intensive agriculture or habitat abandonment. In addition, the activity *Species management* refers to payments for actions designed to enhance the population of specific animal species, notably wading birds and corncrake (*Crex crex*) in the Czech Republic, grassland birds in Belgium- Flanders and endangered species in Germany-BW. It is evident from Table 36that payments for a single activity, for example mowing, vary considerably within an individual MS. This variation tends to reflect differences in the management requirements of different habitats, for example a requirement to mow, rake, remove mown biomass and overgrown for meadowland of particular value in Sweden as opposed to mowing only in meadowland of general value.

Table 36 Range of value of payments (€ / ha) paid for different management activities to maintain or enhance biodiversity on agricultural grassland in nine Member States/regions*

Management	AT	BE	CZ	DE	FR	SE	UKE

Activity							
Maintain habitat	68 or 570	200-508 (Wall)	544	120-130 (BB) 150-200 (BW)	---	---	144 or 222
Mowing	33-315	------	23-284	75-95 (BB) 280-300 (BW)	---	78-278	----
Grazing	38-273	326-824 (Fl)	76-175	165-220 (BB) 195-320 (BW)	---	67-278	6-167
Reduce inputs	19-464	718-827 (Fl)	88-171	140-200 (BW)	76	---	39-167
Remove trees / scrub	90-271	-----	------	------	---	222 (max)	---
Difficult operations	10-444	------	20-295	120 (BW)	---	111	---
Species management	----	40-517 (Fl)	215-236	50-150 (BW)	---	---	657-689

Data sourced from country or regional Rural Development programmes for the period 2007-2013

*At Austria; Be Belgium, Fl-Flanders, Wall-Walloon; Cz Czech Republic; De Germany, BB-Brandenbug, BW-Baden Wurttemberg; Fr France, Se Sweden and UKE England

Payment rates for arable cropping land also show a large variation within each country but with similar ranges occurring between countries. Payments for introduced features such as beetle banks, sowing of seed mixes for birds or botanical diversity and field margins are generally higher than operations affecting crop management since they incur greater income foregone from loss of yield.

Table 37 Range of value of payments (€ / ha) paid for specific management activities to enhance biodiversity on arable land in eight Member States / regions*

Management Activity	AT	BE	CZ	ES	SE	UK
Botanical/ habitat management	221-331	1000 (Fl)	---	---	444	---

Field margin, grass/ buffer strip	64-191	280,590 (Fl) 22-44 (Wall)	467	---	444	333-444
Reduce input (pesticide, fertiliser)	19-255	50-150 (Fl)	---	36-74 (Navarra) 185-271 (Andalusia)	---	111-367 (cons. head)
Stubble/ strip retention	37-184	50-210 (Fl)	---	---	433	133
Beetle bank	---	310 (Fl)	---	---	---	644
Animal species protection	---	485-1490 (Fl)	---	---	---	500, 523

Data sourced from country or regional Rural Development programmes for the period 2007-2013

*At Austria; Be Belgium, Fl-Flanders, Wall-Walloon; Cz Czech Republic; Es Spain; Se Sweden and UKE England, cons. head refers to conservation headland

Support for HNV farmland under the agri-environment measure

The total area of HNV farmland in the EU has been estimated at 74 659 056 ha (Paracchini *et al.* 2008), representing 32% of EU farmland (EEA 2009). All of the countries studied (except Belgium) include significant areas of HNV farmland (Table 37) but only Austria, Bulgaria and Romania have has included specific actions targeted at HNV farmland under the agri-environment measure within its RDP for 2007-2013. These actions are focused on agricultural grassland (Table 38), arable land (Table 39), landscape maintenance and ponds.

Table 38 Estimated area (ha) of HNV farmland present in each of the Member States used in this study

Country	Estimated area of HNV farmland (ha)	HNV farmland as a percentage share of agricultural land (latter based on Corinne Land Cover classes see source below)
Austria	2 447 292	68
Belgium	347 960	19
Bulgaria	2 509 989	37

Czech Republic	1 043 973	21
France	7 797 145	22
Germany	3 162 699	15
Poland	4 813 243	24
Romania	4 860 372	34
Spain	18 986 960	56
Sweden	1 136 030	24
United Kingdom	5 165 466	27
EU Total (not including Malta)	74 659 056	32

Source: Paracchini (2008 et al.), EEA (2009)

None of the remaining countries studied include actions targeted specifically at HNV farmland within their RDPs. However agri-environment actions targeting extensively managed or semi-natural vegetation (for example meso- and hydrophilic meadows, species rich pasture, heathland, dry steppe grassland and moors) can be used to infer the level of payments available to managers of Type 1 HNV farmland in different Member States. For example, almost 80 per cent of agri-environment spending in the Czech Republicis targeted at grazing land (EEA 2009), much of it HNV land. Similarly Germany (Baden Wurtemberg and Brandenburg), Poland, Sweden and England (UKE) include specific actions targeting extensive grassland, meadow of particular value, hay meadow, heathland and moor (see Table 38 below). The extent to which Belgium includes specific actions targeted at extensively managed or semi-natural vegetation is less clear as these vegetation types are not named specifically within the Belgian RDP for 2007 – 2013.

As noted earlier, payments for agri-environment actions normally include an element of income foregone and additional costs. Of these two elements Income Foregone provides an indication of the Opportunity Cost of choosing a management or agricultural production practice that is compatible with the maintenance and/or enhancement of farmland biodiversity. In Table 38, the opportunity cost associated with agri-environment actions in different semi-natural or extensively grazed habitats is expressed as a percentage of the agri-environment payments (in €/ha**)** available for specific habitats. Member States are not obliged to publish the explicit breakdown of their agri-environment payments into Income Foregone and additional costs in their national RDPs, although such information is provided to the European Commission. Of the Member States included in this study, an explicit breakdown was given in the RDPs for the Czech Republic, Bulgaria, Romania and Belgium, and was known from released government figures for the UK(England) and for some agri-environment actions for Sweden and Spain. For Germany and Austria the figures have been inferred from the classification of costs against different agri-environment actions as given in their respective RDPs. As noted in Table 35, several actions may be applied to a particular

habitat. The estimate of income foregone as a percentage of the different payments available for each habitat type is thus shown as an average and a median value (Table 38) for the different habitats present in each Member State studied and for which agri-environment payments are available.

Table 39 Estimation of Income Foregone as a percentage of the payments made for agri-environment actions on different semi-natural grasslands or grazed habitats

(In Czech Republic, Germany (2 regions), Belgium (2 regions), Austria and Sweden)

Country	Habitat	Income Foregone € / ha	Number of agri-environment actions included	Income foregone as % of total payment Average value	Income foregone as % of total payment Median value
Czech Republic	Meadows: meso-, hydro-, xerophilic & mountain	88 - 171	7	92	97
Czech Republic	Pasture	108 or 175	2	82 or 88	82 or 88
Czech Republic	Dry steppe grassland & moors	76	1	21	21
Germany (Bad Wurtemberg)	Mown meadow (? Intensive)	140 - 300	6	64	61 or 65
Germany (Brandenburg)	Extensive grassland	75 - 130	4	95	100 or 100
Germany (Brandenburg)	Grazed heathland and dry grassland	0	2	0	0
Belgium (Flanders)	Grassland for botanical management	185 - 643	5	73	76
Belgium (Walloon)	Natural grassland	200	2	68	65

Austria	Hay meadow, mown pasture	23 - 464	4	71	52 or 82
Austria	Grazing pasture	63 - 276	5	76	70 or 75
Austria	Set-aside grassland	239 - 328	3	77	86
Austria	All habitats	23-464	12	75	75
Sweden	Meadow of particular value	???	1	25	25
Bulgaria	HNV grassland	97	2	n/a	63 or 100
Poland	Extensive grassland	128-307 (IF % n/a see Box 1)	11	n/a	n/a
Romania	HNV grassland	124	2	n/a	68 or 100

The nature and extent of agri-environment payments available to managers of Type 2 and Type 3 HNV farmland is more difficult to determine. Type 2 farmland is characterized by the occurrence of low intensity agriculture with less semi-natural vegetation and more cultivated land than Type 1 farmland and an "ecological infrastructure of landscape features" such as hedges and field margins (Paracchini *et al.* 2008). Whilst the agri-environment measure in several Member States includes actions for the establishment and/or maintenance of ecological infrastructure, such actions are not confined to HNV farmland and indeed are more likely to be targeted at intensively managed farmland (EEA 2009). Their uptake on HNV farmland may thus be low and the costs associated with the action not representative of the costs and income foregone on HNV farmland. Similarly rather few agri-environment actions target extensive cultivation of arable land but focus rather on reducing inputs along the margins of cultivated fields or introducing features such as beetle banks and wildflower/wildlife strips to encourage a greater diversity of flora and fauna. Such actions and the cost estimates associated with them are more typically applied to intensively managed arable land rather than to HNV farmland. However, payments for the adoption of a more extensive form of cultivation are included among the agri-environment actions for Austria and Spain (Navarra) (Table 39).

Table 40 Estimation of Income Foregone as a percentage of the payments made for agri-environment actions on arable / cropped land in Austria and Spain.

Country	Habitat	Income Foregone € / ha	Number of agri-environment actions	Income foregone as % of total payment	Income foregone as % of total payment

			included	Average value	Median value
Austria	Set-aside	221 - 331	4	68	63
Austria	Managed arable	19 – 250	8	100	100
Bulgaria	Birds on HNV arable land	20-102	5	100	100
Spain	Dry steppe land (cereal production)	36 - 271	3	100	100

Type 3 HNV farmland is distinguished from the other two types as being land under more intensive production but supporting significant populations of species of conservation concern – usually birds (EEA 2009). As such it is difficult to distinguish agri-environment actions that are appropriate for this type of farmland. A number of agri-environment actions are designed to protect specific species but these are available for all farmland types and not just HNV and hence the costs calculated for these actions are unlikely to reflect the true cost of species protection on HNV farmland.

The opportunity costs of managing HNV farmland

The cost of actions to manage specific semi-natural habitats and the income foregone from crop and livestock production are probably the largest recurrent costs associated with biodiversity action on HNV farmland. Both costs are considered in the calculation of agri-environment payments to farmers.

Of these two cost types, income foregone provides a measure of the opportunity cost of managing farmland, including HNV farmland, for biodiversity. The significance of this opportunity cost is indicated by the percentage that it represents of the per hectare agri-environment payment. For semi-natural or grazed habitats in the five Member States studies (Table 38), Income foregone represents, on average, between 64–95 per cent of the total payment or a slightly broader range of 52-100 per cent if the median value is chosen. A similar percentage range is evident for payments on arable or cropped land (Table 39), although the data available to this study on these payments are few.

These data suggest that the opportunity cost of managing farmland, including HNV farmland, may potentially be quite high. The data should, however, be treated with caution for the following reasons. Firstly, whilst the percentage Income Foregone for most semi-natural habitats was high, there were some notable exceptions. These were for dry steppe grassland and moors in the Czech Republic, for grazed heathland and dry grassland in Germany (Brandenburg) and meadow of particular value in Sweden. For these three habitats, Income Foregone represented 21, 0 and 25 per cent respectively of the total agri-environment payment. These three habitats are likely to be of marginal value for agricultural production

and hence attract only a low income foregone. Moreover these are habitats that are likely to be classified as HNV farmland and that can extend over a large area. The lower opportunity cost associated with these habitats suggests that the overall opportunity cost for the management of biodiversity on HNV farmland may not be as high as that for other farmland types. This variation in income foregone has been taken into account in the method developed to assess the EU-wide total cost and opportunity cost for HNV farmland (Box 13).

Secondly, results from a recent EEA study suggest that overall implementation of the agri-environment measure across Member States does not consistently target HNV farmland but tends to be focused on productive agricultural land (EEA 2009). This suggests that a strict application of the percentage income foregone to the EU wide area of HNV farmland would significantly over-estimate the opportunity costs of HNV farmland. Estimates of the true opportunity cost of HNV farmland would thus need to take account of both the payment rate and the areal uptake of agri-environment actions on HNV farmland, data for which are not currently available to the consortium. Instead for the analysis presented in this report, the Target Area specified for each agri-environment action (where available) in the Rural Development Programmes for individual Member States has been used for the analysis of both country and EU-wide total and opportunity costs (Box 13).

Finally, many of the semi-natural habitats associated with HNV farmland provide environmental goods and services that benefit and are valued by society. Classic examples include the provision of amenity and recreation, water storage, purification and flood control services and carbon storage. Loss of these goods and services would need to be included within any cost-benefit analysis of biodiversity management actions on HNV farmland.

Summary and conclusion on the agri-environment measure as an indicator of opportunity costs of HNV farmland

This section has focused on the use of agri-environment payments as a potential indicator of the opportunity costs of HNV farmland for biodiversity conservation. These payments provide information on income foregone estimates for different actions and on additional costs incurred for managing land for biodiversity. They also provide a useful indication of the variation in costs between habitat types and to a lesser extent between Member States. Variation in the latter would, however, appear to be smaller than the variation between habitat types, which primarily reflects the size of the additional costs associated with the management of different habitat types. This within and between country variation has been taken into account in the overall analysis of the total cost and opportunity cost of biodiversity action on HNV farmland (Box 13).An important conclusion from this review, is the recognition that the use of agri-environment payments as an indicator of the Opportunity Costs of biodiversity conservation on HNV farmland needs to include information on the uptake of different agri-environment actions and of the extent of different semi-natural habitats occurring on HNV farmland, as the latter vary in their productive value for agriculture. For the analyses used in this report, the target area (specified or estimated) for agri-environment action for HNV farmland or habitats was used (Box 13)

Opportunity costs will also be incurred for other foregone activities not included in the agri-environment measure. Such activities might include the conversion of HNV farmland to other land uses such as forestry, biomass or game production (grouse shooting, deer stalking

etc.), the development of utility services such as wind energy and water storage or the establishment of extractive industries such as quarrying, mineral or peat extraction.

Box 13 Methodology developed for estimating the EU-wide costs Total Cost and Opportunity Cost of biodiversity action on HNV farmland

The following data were used for the Member States or regions of Austria, Bulgaria, Czech Republic, Poland, Romania and UK (England): agri-environment payments for HNV farmland or habitats likely to occur on HNV farmland (see Tables 38 and 39), percentage income foregone shown or estimated for each of these agri-environment payments, total HNV farmland area, target area for each of these agri-environment payments (expressed as a proportion of total area).

A distribution of total and opportunity cost estimates was generated for each country, from which an overall mean value, variance and standard deviation for these country specific costs could be estimate. Each distribution is constructed from 100,000 estimates of cost for each country. Each estimate of total cost was obtained by assigning a random weighting to each agri-environment payment, reflecting the likelihood of the payment being applied to the target area. This was done because each country has a range of payment values (see Tables 38 and 39).

A unit cost (€/ha) was established for each country by dividing total cost and opportunity cost estimates by the Target Area for the habitat or agri-environment action in each country. To establish an EU-wide unit cost (in €/ha), the country means were summed and divided by the number of values. The same approach was used to estimate an EU-wide variance in total and opportunity cost.

These EU-wide parameters were then applied to the HNV target areas for the remaining 20 countries not included in this initial analysis (note no data are available for Malta). However no clearly specified target areas were available for these 20 countries, hence the values were derived by applying a random variable from the distribution of Target Areas (expressed as a proportion of total HNV area) from the original six Member States named above.

The EU-wide unit cost was then multiplied by the estimated target areas for each of the 20 countries (and for the original six Member States) to generate an EU-wide Total Cost and Opportunity Cost. Since the proportion selected for the Target Area (from total HNV farmland) for each country is a random variable (which can vary from 0.08 – 0.7), the estimate was repeated 100,000 times to generate a distribution of possible values. An EU-wide mean, variance and standard deviation were then generated from this distribution to indicate the size and variation in potential costs that may occur at the EU-wide level

Forest conservation and forest management

European forests, though varied in terms of their physical attributes and tree species compositions, share the characteristics of generally being intensively managed, supporting a wide range of plant and animal species and being subject to a diversity of social requirements (Winkel et al, 2009). In recent years, both ecological (e.g. climate change,

increased emissions and depositions) and socioeconomic trends (e.g. changing societal demands/expectations and globalization of the forestry industry) have greatly impacted forest ecosystems. In some areas, such developments have resulted in dramatic consequences for the biodiversity, placing species and habitats under stress and threatening natural forest dynamics (e.g. species migration)(Winkel et al, 2009).

Due to the often contradictory demands arising from the provisioning of goods, e.g. timber and non-wood forest products, and supporting biodiversity, Europe's forests are often the source of complex dilemmas in terms of management decisions. Policies of forest and forest management are mainly in responsibility of Member States. Coordinating activities to gain a common understanding on the concept of Sustainable Forest Management (SFM) are mainly facilitated by the Ministerial Conference on the Protection of Forests in Europe (MCPFE) which included also European States outside of the EU.

On EU level, there are two main forestry policies that have been developed to enhance coordination between Member States in sustainable forest management and increasing competitiveness of European forestry while also attending to other stakeholder concerns. The non-legally binding EU Forestry Strategy, adopted in 1998, attempt to improve coherency between national and EU-level forest related policies while giving a special consideration to conserving and enhancing biological diversity. In 2006, the EU Forest Action Plan (FAP) arose out of a multi-stakeholder process as a framework to build on other EU forest-related policies, such as the biodiversity focused Natura 2000 (Winkel et al, 2009). Currently, almost 30 percent of designated Natura 2000 sites comprise forest habitats and an additional 30 percent at least partially contain woodland elements and related species. The considerable number of livelihoods and incomes dependent on the harvesting or removal of forest products add an additional element to the intricacy of management decisions, underlining the need to address the idea of costs incurred and benefits obtained from the protection[117] of European forests when discussing biodiversity conservation.

Opportunity costs of forest conservation

While the benefits of forest conservation are generally complex and difficult to value, the associated costs are more easily defined as they are based on the implementation costs and, to a greater extent, on the opportunity costs incurred from not converting or utilizing the forest land differently(Kniivilä, 2002; Pagiola, 2004).Beginning with implementation costs, expenses will arise throughout the entire duration of a protection program and include the initial gathering of information and ongoing enforcement and monitoring activities (Mullan and Kontoleon, 2008). This type of cost is rather straight-forward in nature and is therefore easily quantified by reviewing actual expenditures and using these figures to project future costs.

Opportunity costs, however, are more abstract and complex, necessitating the use of various non-market valuation methods. Both formal valuation methods (e.g. travel cost methods, hedonic pricing, contingent valuation and choice methods) as well as environmental pricing

[117] Within the context of this paper, forest protection is to be understood as "an integrated approach of (impact) management that regulates threats to forests in order to safeguard ecosystem services" (Winkel et al, 2009: 30).

techniques (e.g. changes in productivity, loss of earnings, or opportunity cost approaches) are commonly utilized to estimate this genre of costs as relates to forests (Mullan and Kontoleon, 2008). Within all of these techniques, a key feature to be considered is the potential variations in the magnitude and distribution of OCs depending on the policy instruments and mechanisms selected to reach the desired conservation outcomes; therefore, an important consideration is *who* incurs the OCs (Mullan and Kontoleon, 2008). Another central aspect is temporal variance in costs created by changing OCs for the land in question (e.g. Costello and Polasky, 2004; Drechsler and Wätzold, 2003). For instance, the foregone benefits obtained by not developing land for commercial purposes (Costello and Polasky, 2004) or the OCs for labour and the economic losses associated with conservation actions may change with time (Wätzold and Schwerdtner, 2005).

More specifically, opportunity costs of conserving forest biodiversity can be as following (mainly based on Mullan and Kontoleon, 2008):

- losses due to less timber output or other valuable forest products
- income foregone for alternative uses (e.g. a parking lot or industrial facility, conversion to agricultural land, urban development),

which would have led to

- food or cash income for farmers,
- employment opportunities for local households
- profit for timber companies

Some calculation methods for foregone income of alternative uses utilise market prices of comparable land as a measure of the highest valued alternative use of a forested area, presuming that all values of alternative uses are adequately reflected in land prices. However, this is not always the case as social benefits, planning restrictions and not well established land markets in some countries might distort prices (Mullan and Kontoleon, 2008).

As many assessments based on the methodologies discussed above were conducted for countries outside the EU, data on EU estimates are scarce. However, an indication on opportunity costs of forest-related activities targeting *inter alia* biodiversity protection can be drawn from rural development measures funded under the EAFRD (European Agricultural Fund for Rural Development). In addition Sustainable Forest Management practices are to some extent reflected by the criteria of certain forest certification schemes. The Forest Stewardship Council certification scheme is the most restrictive among relevant widespread certification schemes (133.519.356 ha of certified forest across the world of which 44,29% in Europe[118]) and the costs incurred by its adoption and by the implementation of its criteria can provide indications on the cost of biodiversity action in forest outside of protected areas (see box 15). The SFM concept is also central to the MCPFE process (Ministerial Conference on the Protection of Forests in Europe) but this latter has not yet generated cost data on the

[118] Global FSC certificates: type and distribution, June 2010, accessed 21.06.10 http://www.fsc.org/facts-figures.html

implementation of some of the biodiversity relevant commitments (i.e. Vienna Resolution on Conserving and Enhancing Forest Biological Diversity in Europe).

Box 14 Costs of Sustainable Forest Management through forest certification – the case of FSC

Forest Stewardship Council (FSC) certification

Within the discussion of forests and biodiversity conservation, it is necessary to include the concept of 'Sustainable Forest Management' and the subsequent certification schemes that have since been created for promoting such practices and maximizing the contribution of industrial logging to biodiversity conservation (FSC, 2009a). Forestry certification schemes can potentially contribute to this goal in three ways, as outlined by Gullison (2003):

- Improve the value of certified forests for biodiversity (difference between conventional and sustainable forest management practices);
- Create sufficient profits, enabling land owners to manage forests for the production of certified timber rather than clearing them for agriculture; and
- Reduce logging pressure on high conservation value forests (HCVF) by increasing consumption of products from well managed, lower conservation value forests.

The most widespread and transparent international forestry certification scheme with rigorous biodiversity standards is that of the Forest Stewardship Council (Gullison, 2003). Requirements for Principle 6 of FSC certification aim to mitigate the environmental impacts of timber production, specifically requiring that, among other measures: safeguards shall exist which protect rare, threatened and endangered species and their habitats; conservation zones and protection areas shall be established; inappropriate hunting, fishing, trapping and collecting shall be controlled; and ecological functions and values shall be maintained intact, enhanced, or restored (FSC, 2009b).

Costs involved with the certification process have been broadly categorized by Gullison (2003) as either direct (cost of the certification process itself) or indirect (cost required to change management to meet the stainable forestry standards). A more detailed categorization by Cubbage et al. (2003) includes the necessary investments of time and resources for: preparatory activities (pre-audit meetings, document preparation, collection of evidence and training); internal and external auditing fees; changes in management (needed to comply with the new conditions and standards e.g. increased number of retention trees, larger buffer zones); and, in the case of FSC, re-certification costs arising every five years.

Forest certification also includes less easily measured opportunity costs. Such costs arise from managing forests "in an environmental manner that would yield less income than could be achieved by profit maximization alone" (Cubbage et al., 2003; p.3). This area of future research is central to increasing the participation in such certification schemes as the returns gained from such a process must outweigh the costs in order to be appealing, both in terms of concrete and opportunity costs. Durst et al. (2006) highlight this point, emphasizing that "if the opportunity costs of 'responsible forest management' become too large, people will logically shift land uses to more lucrative alternatives" (p. 197).

Forest ecosystems and biodiversity action in the context of the EU Rural Development Policy

Rural development expenditure in the EU provides the best available basis for quantitative comparison of forest biodiversity measures, and the type of costs and payments they incur.

Among the rural development measures proposed in the EC regulation 2005, it was attempted to selector further review only measures clearly aimed at protecting forest biodiversity and ecosystems. Although afforestation measures, which represent the largest share of EAFRD expenditure for forest related measures, can through certain regional applications of the measure clearly benefit forest biodiversity protection, support measures in the context of forest environment payments and non-productive investments seem to best address issues of biodiversity protection.[119]

Forest environment payments are generally targeted at sustainable forestry practices, but are also used in some regions as an additional tool for the implementation of forested Natura 2000 sites or other protected areas. Many varying measures can be compensated under this heading: improvements to the species composition of forest stands, not performing final forest cutting operations in woodland key habitats, protection of old trees, improvement or protection of gene pools, conservation of dead wood and habitats, creation of areas of natural dynamic regeneration etc.

Support for non-productive investments is in part linked to "the achievement of commitments undertaken pursuant to forest environment payments or other environmental objectives" (Council regulation 1698/2005) and includes for example conversion to deciduous or indigenous forests, conversion of forest structure, creation and protection of natural habitats, creation and renovation of small ponds etc.

As mentioned above In the context of this study afforestation measures (hereafter measure 221) are more ambiguous than forest-environment payments (hereafter measure 225) and non-productive investments in forests (hereafter measure 227). The EU BAP even refers to this ambiguity by recommending in one of its actions to assess the potential impact on biodiversity of plans, programmes and projects for afforestation (COM, 2006). Thus the partial inclusion of measure 221 in this analysis has to be justified here by its proportional importance in total axis 2 expenditure. Furthermore, depending on its further specification and adaptation to the specific regional context and to ecological objectives, in some regional cases measure 221 clearly contributes to the protection of biodiversity and of forest ecosystems. It is only within these restrictions that information on the cost types included and compensated via this measure can be considered in the context of this study.

Council regulation EAFRD support for rural development

National and regional specifications of measures have to refer to a common understanding of these measures at EU level as defined in the Council regulation (No 1698/2005)[120] on EAFRD support for rural development. The regulation prescribes which types of costs can be

[119] Natura 2000 payments are dealt with separately in section 3.3.1

[120] Council of the European Union (2005): Council Regulation (EC) No 1698/2005 on support for rural development by the European Agricultural Fund for Rural Development.

covered by the EAFRD contribution and also sets minimum and maximum values for compensation payments.

With regard to forest environment payments (measure 225), the regulation foresees that compensation payments for voluntary commitments shall in general be granted for 5 to 7 years, covering additional costs and income foregone. The value of the annual payment (including both additional costs and income foregone) is set at a minimum of 40€/ha and a maximum of 200€/ha[121].

Support for first afforestation of agricultural land (measure 221) can cover:

- Establishment costs
- Maintenance costs: Annual premium per ha over 5 years
- Income foregone: annual premium per ha over 15 years

It should be noted that support for income foregone is especially important for biodiversity relevant activities seeing that for fast growing (economically attractive) species only support for establishment costs will be granted. Also the proposed duration of support acknowledges the important time aspect related to income foregone in case of afforestation of more ecologically valuable species (slower growing rate). In annex of the regulation the maximum premium value for income loss is set at 700€/ha/y for farmers and 150€/ha/y for other natural persons or private-law bodies.

National and regional Rural Development Programmes

A look at some of the national and regional specifications for measures 221225 and 227 gives further indications on the types of activities that are considered under the eligible cost types pre-defined by the regulation. An overview of the value of the payments for measure 225, the cost types covered and their differentiation and justification in certain regional or national rural development programmes can be found in Annex C of this document.

Establishment costs or transfer costs: one-off payments including for instance soil preparation and stabilisation and drainage, cost of seedlings, labour costs, transport costs. Support payments for non-productive investments mainly consist of compensation for this type of direct costs and can range between 50 and 3200 EUR/ha (and sometimes cover a some share of management costs).

In addition to establishment costs the Flemish region[122]in Belgium for instance also provides ecological financial incentives in the form of one-off payments during the period of establishment. These payments serve a prioritisation of ecological purposes of afforestation through specific targeted payments:

[121] Increased in exceptional cases taking account of specific circumstances to be justified in the RDPs.

[122] Flemish RDP: Programma voor Plattelandsontwikkeling Vlaanderen 2007 – 2013, 27 january 2010, Beheersautoriteit, Departement Landbouw en Visserij. Last retrieved 26.06.10 at http://lv.vlaanderen.be/nlapps/docs/default.asp?id=1538

- Specific differentiation of compensation for tree species: using 7 categories of tree species ranging from 850 to 3700 EUR/ha
- 500 EUR/ha for undergrowth of bushes or trees and
- 100 EUR per 100 m for a forest border (lower bushes or trees) or living fire-break,
- The use of trees of recommended origin (to avoid "genetic pollution") is compensated with 250EUR/ha

Maintenance or site management costs: these are recurring costs for weed control, cost of protection measures e.g. against browsing and grazing, costs of soil erosion prevention measures, investments in fire prevention equipment and training, other material costs, labour costs. The payments for these types of costs as presented in the national and regional rural development programmes are often either lump-sum (and without justified differentiation between expenses), sometimes a percentage of eligible costs is compensated or payments are based on sent invoices to justify maintenance costs incurred.

Opportunity costs are mainly defined and calculated as income foregone. In some rural development programmes the calculated range of opportunity costs is given in comparison to the actual amount of payments which is almost always lower. This is often justified by noting that the main purpose of the support payment is only to provide an incentive to the adoption of certain measures.

In the context of support to measure 225 it has been observed that although some compensation for income foregone is generally mentioned as included in the payment, the identification of the share of income foregone as part of the compensation payment is hardly specified except in case the payment is targeted only at compensating for foregone income (e.g. Czech Republic, Lithuania and Bavaria) (see Annex C).

A more detailed approach of forest environment payments and the calculation of payments can for instance be found for Bavaria (DE)[123]. The compensation payments are based on the calculation of income foregone for foresters by implementing voluntary and contractually agreed measures of nature, habitat and species protection[124].

- Conservation and improvement of coppice shoot woods: Opportunity cost is calculated based on the difference of contribution margin compared to a tall tree forest. The compensation payment is slightly below the computed income foregone (appr. 0,5%) and varies between 40 and 70 EUR/ha.
- Conservation and establishment of less dense forest structures: compensation is from 40 to 200 EUR/ha/y, the value of the premium depends on the type of tree and the percentage decrease of density of the forest (from 30% to more than 75 %) it is based on the calculation of the proportional income foregone by renouncing the

[123] "Bayerisches Vertragsnaturschutzprogramm Wald", Chapter 5.3.2.2.5, Status Feb. 2010, last retrieved 23.06.10 at http://www.stmelf.bayern.de/agrarpolitik/programme/eler/24245/linkurl_0_13_0_9.pdf

[124] In the case of Bavaria the forest environment payments are targeted at forests in areas of specific ecological value or in protected areas. These payments are thus not applicable to any forest in Bavaria.

contribution margin of yearly mean growth across a dense forest (the compensation payment is slightly below the computed income foregone (appr. 0,5%))

- Conservation of old –and habitat-trees (minimum 6 pc. per ha): the premium is calculated based on the income, interest and value loss. The income foregone for 3 habitat trees and 3 old trees on 1 ha amounts to 84 EUR/ha, thus the value of the premium is 80 EUR/ha.
- Dead wood (minimum 7 pc. per ha of a minimum size of 0,4m x 3m): The calculated income foregone amounts to 43 EUR/ha from 7 pieces on, and to 74 EUR/ha from 20 pieces on. (the compensation payment is slightly below the computed income foregone (appr. 0,5%))
- Conservation of beaver habitats (strips of up to 20m width along beaver habitats): The premium is based on a 2006 calculation of loss of average contribution margin due to important constraints on the exploitation of riparian forest (deciduous riparian and spruce) and by allowing flooding by beaver activity which amounts to 155 EUR/ha.
- Forest area set-aside from exploitation (in natural old and decaying forests): The premium is calculated based on the income foregone for varying types of trees with low or medium growth. Depending on the tree (wood) type the income foregone is 83 EUR/ha and 42 EUR/ha for deciduous softwood (e.g. alder types).

Varying approaches to payments for specific forest environment measures could also be identified in the rural development programmes and can give an indication of the different aspects of opportunity costs that are considered. Nevertheless, due to the variety of measures that can be supported under the heading of forest environment measures it is difficult to establish a clear comparison between these approaches:

- Income foregone calculated in comparison with a mean yearly contribution margin in similar conditions and with the same forest stand. (DE - Bavaria)
- The income foregone equals the annual interest rate for long-term deposits that could be received in case of selling the wood after allowed final forest felling or allowed clear-cutting. (LT)[125]
- Opportunity costs are presented in terms of the lost revenue associated with felling timber before its optimum harvesting date. (UK)
- Income foregone for increased share of deciduous trees which reduce the felling premium. (CZ)

Support to afforestation on agricultural land (221) offers a clearer basis for comparison as the action differs less between regions. The only variation depends on the degree to which ecological prescriptions are included to the agreement and these are often reflected in the

[125] Rural Development Programme for Lithuania, 2007 – 2013, September 19, 2007. last retrieved 23.06.10 at www.zum.lt/min/failai/RDP_2007-2013_2007_09_19_EK.pdf

calculation of payment value. Several aspects influence the calculation of opportunity costs and payments for income foregone, these include:

- Former land use (grassland or arable land)
- Beneficiary of the payment (farmer or other forest owner): the opportunity cost for farmer is calculated based on the weighted average gross margin in the region, whereas the opportunity cost for other forest owners can be calculated based on the market value of their land.
- The motivation (i.e. incentive needed) of the person engaging in a new voluntary activity. The principle of additionality of the effect of the support can thus be reflected in the payments: the payments are calculated based on the level of incentive that seems necessary.
- The time until the new activity generates income can be reflected by the foreseen length of the payments. This period of time is longer when implementing measures aimed at increasing or protecting biological diversity.
- The time that has been released by the new activity (e.g. forestry instead of agriculture) to spend on other economic activities.
- Reduced income because of some of management restrictions: e.g. reduced felling premium because of higher share of deciduous trees

Value of expenditure

The approximate EU 27 planned expenditure for the selected measures (221, 225 and 227) in the 2007-2013 programming period sheds some light on the proportional importance of these measures as a percentage of total planned EAFRD contribution (appr. 91 000 000 000 EUR) and thus also gives an indication of foreseen costs of these measures[126].

- First afforestation (221 & 223): 2 400 000 000 EUR and 360 000 000 EUR respectively (2.6% and 0.4% of total expenditure)
- Forest environment payments (225): 260 000 000 EUR (0.3% of total expenditure)
- Non-productive investments (227): 800 000 000 EUR (0.9% of total expenditure)

As a further indication of general costs of forest environment payments in the EU (225) Table 40 offers an overview of total planned expenditure for this measure categorised according to the source of the contribution.

Table 41 Total planned expenditure for the selected forest measures under the Rural development programmes (RDP)

[126] DG AGRI, 2009, Rural development in the European Union, statistical and economic information, Report 2009.

Member State	Planned EAFRD contribution 2007-2013 (in EUR)	Total planned public Expenditure (in EUR)*	Planned private Expenditure (in EUR)
Denmark	2 530 000	4 600 000	
Czech Republic	10 588 795	13 256 702	
Spain	50 524 539	82 767 573	205 000
France	55 000	100 000	
Italy	22 449 788	44 053 162	
Cyprus	500 000	1 000 000	
Luxembourg	162 000	648 000	277 715
Austria	7 487 625	14 987 073	
Lithuania	8 000 000	10 000 000	
Hungary	68 637 054	89 306 167	0
Slovakia	19 927 144	25 135 375	
Portugal	11 680 625	14 322 844	
United Kingdom	32 162 413	84 839 176	5 910 000
Germany	28 733 986	51 623 294	

** this value thus reflects the sum of EAFRD contribution and national or regional contribution*

Limitations and conclusion

Quantitative data on costs of biodiversity and ecosystem actions in EU forests is scarce. The compensation payments for forest-environment measure offer the best available basis of review of costs in this area across the EU. A comparison of payments for this measure offers some insight on cost types incurred and the approaches for considering opportunity costs (in the form of income foregone) in the calculation of the payments. Although the actions included under this measure are clearly targeted at the protection of forest biodiversity and ecosystems inside and outside of the Natura 2000 network and other protected areas, it is difficult to identify a quantitative range of costs that is much more precise than what is prescribed by the Council regulation (Council regulation 1698/2005), i.e. between 40 and 200 EUR per ha. This lack of precision is due to the diversity of actions supported by this measure across the EU. It is equally difficult to identify the share of opportunity costs in the total cost picture of these actions as, most often, either this share is not further defined or the entire payment is targeted at this type of cost.

In comparison with the two other measures selected in this review (first afforestation of agricultural land and non-productive investments) it can be noted that mention and calculation of opportunity costs in the justification of the payment seems to a certain degree to be related to the conditions defined by the Council regulation (which foresees compensation for income foregone for 221 and 225 but not for 227) and to the targeted land use (221 being targeted at agricultural land and 227 at forested lands), even though the compensated action can be quite similar, e.g. establishment of deciduous forest.

In order to obtain a better understanding of total costs incurred by forest biodiversity actions, especially sustainable forest management practices, protection of High Conservation Value Forests (HCVF), conservation of (intra- and inter-specific) genetic variation and diversity in trees and forests, and conservation and protection of forest habitats and species, based on the available per ha costs, it would also be necessary to obtain a more accurate picture of the forest area that is currently subject to such measures and the area that requires various types of forest-biodiversity protection and management measures in order to fully implement the EU biodiversity policy, e.g. by identifying the area of EU HCVF or Biologically important Forests[127]. As for forests most data is either compiled at national level (national forestry inventories) or at a wider geographic European level (in the framework of the MCPFE) it is difficult to assess which forest surface area at EU level is targeted by various forest biodiversity actions (forested Natura 2000, forests in national protected areas, forest subject to voluntary forest-environment measures. SFM measures in public forests, FSC certified forests). As a reference value the area of forested Natura 2000 sites amounts to approximately 5,28%[128]of the EU land surface and in total forests and other wooded land in the EU 27 (2008) cover 177 million hectares of land area (i.e. 42%).[129]

The marine environment

Intensifying pressures on marine resources stem from an expanding range of economic and recreational activities connected with the increasing utilization of oceans, seas and coastlines (e.g. for maritime transport, fishing, aquaculture, oil and gas extraction and tourism) (EC Maritime Affairs). Overfishing has become widespread and many of the fish stocks in European waters are below safe biological limits (European Commission, 2008). Resultant consequences for ecosystem health have prompted considerable discussions about the need to increase marine habitat protection (e.g. Balmford et al, 2004; IUCN, 2009) and

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[127] BIF is a concept of forest protection and SFM prioritisation that has been developed by Birdlife. " The term Biologically Important Forest is a "basket" for all existing designations that refer to forests of high nature value and important ecological functions, regardless of their legal conservation status". http://www.forestmapping.net/forestmapping/aktualnosci.php?wid=14&news=81

128 30% of Natura 2000 sites are forested and the entire Natura 2000 network covers 17,6% of EU27 terrestrial area. See http://ec.europa.eu/environment/nature/natura2000/db_gis/index_en.htm#area_calc and http://ec.europa.eu/environment/forests/biodiversity.htm

129 Eurostat, 2008. Forest covers 42% of the EU27 land area. 20-24 October 2008. European Forest week. STAT/08/146. Press release of the Statistical Office of the European Commission, Luxembourg. Available at: http://europa.eu/rapid/pressReleasesAction.do?reference=STAT/08/146&format=HTML&aged=0&language=EN&guiLanguage=en [Accessed 23 June 2010].

improve the sustainability of fisheries practices (e.g. Juda, 2007; van Hoofe and van Tatenhove, 2009).

Given the European Union's (EU)extensive maritime territory (the largest in the world when including the outermost regions[130]) and the centrality of biodiversity to ecosystem health, the Commission's 2005-2009 Strategic Objectives stress the need for a wider marine policy addressing sustainability considerations[131]. Among other initiatives, the Common Fisheries Policy (CFP, created in 1970 and last reformed in 2002), the Integrated Maritime Policy[132] (MP, 2007) and the Marine Strategy Directive[133] (MSD, 2008see Box 16 for requirements) address the areas of marine ecosystem and biodiversity protection within the sustainability context. Within the MSD, Marine Protected Areas (MPAs) are a commonly utilized tool to help achieve these aims (Adams et al, 2010) and subsequently ensure the viability of fisheries (Kelleher, 1999).

Box 15 Marine Strategy Framework Directive

The Marine Strategy Framework Directive (2008/56/EC)[134] (MSFD) requires Member States to determine Good Environmental Status (GES) for their marine waters, and design and implement programmes of measures aimed at achieving it by 2020, using an ecosystem approach to marine management.

Each Member State must put in place a marine strategy whose chief requirements are:

(i) An initial assessment of the current environmental status of that Member State's marine waters (to be completed by July 2012), using a series of 11 indicators laid down in the Directive, and for which the Commission, Member States and European Parliament are required to agree criteria and methodologies by 15 July 2010;
(ii) A determination of what Good Environmental Status means for those waters (also by July 2012);
(iii) Establishment of targets and indicators designed to show whether a MS is achieving GES (also by 2012);
(iv) Establishment of monitoring programmes to measure progress towards GES (to be established by July 2014); and
(v) Establishment of programmes of measures designed to achieve or maintain GES (subject to certain safeguards to relieve Member States of the burden of pursuing measures which are not cost-effective, or which relate to issues for which they are not responsible). Programmes of measures are to be developed by 2015 and made operational by 2016.

Member States are required to determine what constitutes GES at a regional level – in other words, each Member State must make its determination of GES in consultation with those other Member States (and third party countries) it shares regional seas with. In the UK"s case these are Ireland, France, Belgium, Denmark, the Netherlands, Germany, Sweden and Norway. Once GES is

130 European Commission, 2006

131 Decision No. 1600/2002/EC of the European Parliament and of the Council of 22 July 2002. Article 6(2) (g).

132 COM (2007) 575 final. Communication from the commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: An Integrated Maritime Policy for the European Union.

133 COUNCIL DIRECTIVE 2008/56/EC of 17 June 2008 on establishing a framework for community action in the field of marine environmental policy (Marine Strategy Framework Directive).

134 See: http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2008:164:0019:0040:EN:PDF

determined, a Member State must establish targets and indicators aimed at achieving or maintaining it by 2020, and subsequently devise and implement programmes of measures for this purpose. Member States are not required to carry out measures which are not cost effective, provided the quality of their marine waters does not deteriorate as a result, and the Directive also recognises that natural forces or other factors for which individual Member States are not responsible may prevent GES targets from being achieved. What the Directive does, therefore, is to oblige Member States to put in place cost effective and proportionate programmes of measures aimed at achieving GES to the extent to which that is in a Member State's power, including by cooperating with other Member States and by seeking additional international action. This process has not yet begun.

Progress to date:

On 1 September the Commission published a Decision on criteria and methodological standards on good environmental status (GES) of marine waters (Decision 2010/477/EU)[135] to assist in the implementation of the marine strategy framework Directive (MSFD). Work on the development of the criteria was supported by a Working Group which published its report in March 2010.[136]

Marine Policies and Biodiversity

The Common Fisheries Policy, while heavily criticized for its limited results regarding both the sustainable usage of aquatic resources and socio-economic support for fishermen (Khalilian, 2010), serves as the legal foundation for the conservation of (commercially exploited) fish stocks in European waters (van Hoof and van Tatenhove, 2009). The policy employs total allowable catches (TACs), species quotas, limitations on fishing efforts and minimum net sizes (Hadjimichael et al, 2010) due to mounting external pressure to more stringently follow scientific advice for stock management (European Council, 2002; van Hoof and van Tatenhove, 2009); the intention of such measures is to reduce overfishing and maintain marine ecosystem resilience.

Additionally, the Marine Strategy Framework Directive was released as part of the greater EU Marine Strategy for the "protection and preservation of the marine environment, the prevention of its deterioration and, where practicable, the restoration of that environment in areas where it has been adversely affected" (Article 1.2). The MSD requires the establishment of a global network of MPAs by 2012[137] (including those areas that have already been designated under the Habitats[138] and Birds[139] Directives), therefore working in

[135] Commission Decision of 1 September 2010 on criteria and methodological standards on good environmental status of marine waters (2010/447/EU) http://eur-lex.europa.eu/LexUriServ/LexUriServ.do?uri=OJ:L:2010:232:0014:0024:EN:PDF

[136] JRC and ICES. Scientific Support to the European Commission on the Marine Strategy Framework Directive Management Group Report. March 2010

[137] COUNCIL DIRECTIVE 2008/56/EC, Point 18.

[138] COUNCIL DIRECTIVE 92/43/EEC of 21 May on the conservation of natural habitats and of wild fauna and flora

[139] COUNCIL DIRECTIVE 79/409/EEC of 2 April 1979 on the conservation of wild birds

synergy with the Natura 2000 network and contributing to the Biodiversity Action Plan (BAP) and the BAP-Fisheries[140] to protect marine habitats and species.

A more holistic approach is taken by the Integrated Maritime Policy for the EU in an effort to improve upon the previous sector-oriented approaches that increased environmental degradation and negative externalities (van Hoof and van Tatenhove, 2009). Encompassing the ecological focus of the MSD and the fisheries management concentration of the CFP, the MP includes the concepts of "sustainable, scientific and commercial exploitation of the deep seas, protection of global marine biodiversity [and] reduced ship pollution" in its external priorities.

In connection with this legislation, extensive research has been conducted in the areas of: marine (protected) areas, sustainable fisheries strategies and the ecological consequences of current fishing and management practices. As such topics involve complex interactions between natural systems and the humans utilizing them, the exploration of biological as well as socio-economic considerations is necessary, particularly regarding the establishment of MPAs.

Cost Estimates

Research to date has largely investigated the diversity of valuable services provided by marine systems (see e.g. Kelleher, 1999) and the potential capacity of MPAs and quota systems to control resource overexploitation and allow fish stock recovery (e.g. IUCN, 2007). The use and non-use values of marine ecosystems have been quantitatively (e.g. Beaumont et al, 1998; Brenner et al, 2010; Samonte-Tan et al, 2007) as well as qualitatively evaluated (e.g. Beaumont et al, 2007; Carter, 2003). Similar studies have also been conducted regarding the benefits provided by MPAs specifically, but have failed to identify concrete values (e.g. Angulo-Valdes and Hatcher, 2010; Charles and Wilson, 2009; Kelleher, 1999; Rudd, 2007).

Delineations of the various costs arising from the delivery of biological benefits via the creation and maintenance of (no-take) MPAs as well as the establishment of species quotas and other marine policies remain more elusive in the literature, especially regarding the European context. The spatial orientation and permanency of MPAs, however, enable a more straightforward identification of costs and beneficiaries than for other fisheries policies (Carter, 2003) and are therefore particularly highlighted throughout this section though, again, the studies are more global in nature or focus on areas outside of the EU marine territory.

Diverse valuation techniques for non-market values lay the foundation for establishing cost estimates, including the Travel Cost Method (Alban and Boncoeur, 2008), Contingent Valuation Method (Alban and Boncoeur, 2008), goods and values approach (Beaumont et al, 1998), Cost-Benefit Analysis (Rudd, 2007; Wilen and Abbott, 2006), choice experiments (Rudd, 2007) and Willingness to Pay (Wallmo and Edwards, 2008). This multiplicity of approaches presents an equally extensive range of factors included in such estimates.

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[140] European Commission on the Environment: http://ec.europa.eu/environment/nature/natura2000/marine/index_en.htm

Costs associated with conserving marine biodiversity can generally be classified either as standard operational type costs or as socioeconomic costs relating to the various stakeholders affected by the formation of the protected area or implementation of the fisheries policy. Within the first cost category, several scholars (e.g. Balmford et al, 2004; Charles and Wilson, 2009; Greenville and MacAulay, 2007; Rudd, 2007) have compiled a relatively exhaustive outline of costs specifically relevant to MPAs, including:

- Start-up, managerial and direct operating costs (including monitoring and enforcement costs); and
- Costs for building social and political capital and capacities before and during the creating of the MPA.

Such costs are also applicable to another marine conservation measure, namely the certification of fisheries by the Marine Stewardship Council (MSC). The three core principles of this certification scheme are: supporting sustainable fish stocks; minimizing impacts on the surrounding ecosystem; and implementing management measures that maintain stock sustainability (Marine Stewardship Council, 2008). Such costs can range from $20,000 for small community-based fisheries to $300,000 for large industrial fisheries (one time costs) and can increase with pre-assessment and annual audit/licensing fees, additional certification management expenses and mandatory improvements to address the fishery improvements (Goyert, 2010).

While Rudd (2007) describes operational type costs as frequently being short-term and explicit in nature, Balmford et al. (2004) stress the high annual costs; regarding a global MPA network consisting of 20-30% of the world's seas, for example, they project costs between US$ 5 and 19 billion per year (in year 2000 US$) for the operational costs alone (socioeconomic aspects were not included).

However, numerous authors point out the value of tolerating these investment costs in biodiversity conservation in order to reap long-term benefits. Regarding MSC certification, European retailers such as Marks and Spencer, Sainsbury's and Lidl are selling only MSC-certified products and providing certified fisheries with economic rewards for improving their management and ecological sustainability (Goyert, 2010). MPA induced benefits such as increased fish stocks within protected areas resulting in improved surrounding fisheries, secured ecosystem services and enhanced sustainability and reduced risk levels also help to compensate cost investments (e.g. Balmford et al, 2004; Fletcher, 2007; Kvamsdal and Sandal, 2008).

Socioeconomic costs comprise the second variety of costs and consist of various kinds of opportunity costs (OC) for relevant stakeholders (see the following section for more details). Numerous authors highlight the importance of including such costs into estimates in order to minimize the impacts on resource users and thus conflicts (Ban and Klein, 2009; Jones, 2009), produce cost-effective and sustainable management plans while minimizing the effects on implicated stakeholders (Ban and Klein, 2009; Greenville and MacAulay, 2006; Sunde and Isaacs, 2008) and gain the acceptance of affected fishers in the political economy (Carter, 2003). Pascoe (2006) affirms this importance, stating that fisher behaviour (species targeted, level of exploitation and gear used) often relates directly to the costs incurred and benefits received, having considerable potential effects on the success or failure of biodiversity conservation efforts.

Opportunity Costs

The relevance of opportunity costs in marine policy creation and MPA planning has been highlighted by several authors, as introduced above. Yet, although the concept is present in marine literature, the dialogue remains predominantly on a qualitative and theoretical level and includes a diverse range of interpretations. The majority of scholars associate opportunity costs with direct impacts on fishers and the fishing industry (Ban and Klein, 2009; Carter, 2003; Juda 2007).

Regarding marine policy implementation, Pascoe (2006) identifies the centrality of incentive selection such as compensation payments and support measures as a means to counteract opportunity costs and influence the compatibility of fisher behaviour and sustainability objectives (e.g. complying with fishing quotas, equipment regulations and designated protected area restrictions). Juda (2007) outlines opportunity costs faced by the fishing industry resulting from the Marine Environment Strategy (see Table 41 below). According to Juda (2007), the Commission holds such costs to be sacrifices necessary for the attainment of long-term benefits, such as healthy ecosystems and maintained biodiversity, thus generating economic benefits for the fishing and tourism industries.

The main opportunity costs of both marine policy implementation and marine reserve creation are summarized in the table below[141]. It should be noted, however, that the outlined categories are intended to serve as a basis for discussion and that the multifaceted nature of the examples and application to several of the source categories are recognized.

Table 42 Opportunity costs resulting from marine protection measures

Cost category	Source of Cost	Examples
Economic opportunity costs	Foregone endeavours	• Foregone returns from bio-prospecting and/or drilling (Carter 2003) • Foregone income from economic production (Wallmo and Edwards 2008) • Foregone income from maintaining unused areas (for potential future benefit) (Adams et al, 2010) • Foregone income during fish stock recovery periods (Juda 2007)
	Restrictions on fishing practices and equipment	• Higher capital costs from investing in new fishing equipment (Greenvillen and MacAulay 2006) • Cost of inefficient technology mixes arising from input controls (Pascoe 2006) • Loss of 'way of life' due to prohibited fishing techniques and practices (Jones 2009) • Costs of new requirements impacting dredging,

[141] As European based studies are extremely limited, most of these conclusions are based on global reviews or site specific case studies. The restricted ability to generalize these results or apply them to a European context is discussed in the conclusion.

		mineral exploitation and shipping practices (Juda 2007)
	Restrictions on ecosystem or species exploitation	• Net decrease in fishing offtake(Balmford et al. 2004; Charles and Wilson 2009; Pascoe 2006) • Displacement and relocation costs(e.g. fuel usage, crew employment and less time available for fishing) (Carter, 2003; Charles and Wilson, 2009; Greenville and MacAulay, 2006) • Crowding externalities in new fishing locations (Charles and Wilson 2009; Sanchirico 2000) • Loss of 'attachment to place' due to relocation (Charles and Wilson, 2009)

Numerous considerations have been underlined in the literature as being central in approximating an MPA's opportunity costs. Sanchirico (2000) and Carter (2003) emphasize the importance of considering regional variations stemming from differences in oceanographic conditions and site-specific aspects. Distributional aspects of costs are also important (Adams et al, 2010; Ban and Klein, 2009; Charles and Wilson, 2009). A study on UK MPAs shows that inshore fishermen, for example, are particularly vulnerable to the OC arising from MPAs; due to having smaller boats that are unable to steam offshore, they are more critically dependent on their local, customary grounds than offshore fishers (Jones, 2009).

Ban and Klein (2009) stress the centrality of temporal considerations, calling attention to the dynamic nature of MPAs and subsequent variations in fishing costs throughout the year (due to both seasonal migrations and diverse weather/fishing conditions) and spillover benefits (fish stocks increasing in areas bordering and outside the MPA). Such considerations require additional information on e.g. fleet behaviour, fish populations and other dynamic parameters (Ban and Klein, 2009). Furthermore, non-consumptive user interests such as scuba divers, managers and conservationists are cited as being significant factors in the calculation of opportunity costs (Klein et al, 2008).

Although abundant theoretical approaches to calculating opportunity costs have been cited, concrete models are rare. Adams et al. (2010) provides one equation for calculating such costs in quantitative terms: the opportunity cost of a fishing site is the sum of OC to all stakeholder groups weighted by the current proportion of the total fleet of gear types and fishers currently in the fishery. Using this approach, Adams et al. (2010) reached several conclusions:

- Based on overall species abundance distributions, opportunity cost models were highest for inshore fringing and patch reefs because there are both high value fish and high abundances of low value fish;
- Opportunity costs models are likely to have high values for areas that currently have high fishing effort as fishermen will likely choose to exploit the most abundant accessible fishing ground;
- Speargun users are the most correlated with total opportunity cost because of the high efficiency of spearguns vs. other gear types; and

- Factors such as prestige associated with specific gear types, values placed on time versus money, risk aversion and restricted opportunities such as access to transport or marine tenure systems have been cited as affecting fisher behaviours.

Concrete estimates of opportunity costs as relates to marine (protected) areas and fisheries/marine policy have not been produced to date despite their recognized importance in the literature. The study by Adams et al (2010) serves as a useful starting ground to assess the inequalities in costs incurred across and within stakeholder groups regarding MPAs, but fails to consider intergenerational considerations or OCs from foregone endeavours.

Although there are multiple studies that have examined the extent and type of opportunity costs associated with MPAs specifically, the level of analysis remains on a very localized level (e.g. Fiji, California, Philippines, Canada) or tends to generalize trends and project them on a global scale (Balmford et al., 2004, Charles and Wilson, 2009) without having particular relevance to the European context. The only study identified in this review with a specific European focus was that of Jones (2009), exploring the UK's MPAs. Balmford's study (2004) includes 13 European cases, but the general nature of the extrapolations fail to distinguish features that can be classified as being uniquely 'European' in nature. Regarding marine policy cost estimates, Hadjimichael et al (2010) emphasize the need for awareness regarding the large differences in the potential costs and effects incurred from such legislation, even within the European Union (particularly between the northern and southern seas)[142].

Further research is therefore necessary on MPAs within European countries as the economic, social and biological features of EU marine areas vary greatly from those that have been studied to date, as well as on both the general and opportunity costs associated with European marine policy implementation, such as the CFP, MP and MSD. Such studies should also look at national implementation efforts with the EU Member States and provide site-specific cost delineations and estimates in order to develop a more accurate perception of associated costs and potential future paths of action necessary for the successful conservation of marine biodiversity.

The UK Biodiversity Action Plan

The **UK Biodiversity Action Plan (UKBAP)** was first published in 1995 and has undergone a series of developments since then, with new species and habitat action plans (SAPs and HAPs) introduced in different tranches, and BAP targets reviewed in 2006.

The UKBAP now covers a list of 1150 priority species and 65 priority habitats. Action plans were developed for a large number of these, each setting out actions to be completed in relation policy and legislation, site safeguard and management, species management and protection, advisory, research and monitoring and communications and publicity. For the

[142] Hadjimichael et al (2010), in the study 'Distribution of the burden of fisheries regulations in Europe: The north/south divide', find that the northern seas are more heavily burdened than the southern and therefore that European-wide generalizations are inappropriate within the context of marine cost estimates discussions.

more established habitats and species, targets have also been agreed for the extent and condition of habitats and the population or status of species.

The costs of implementing the UK BAP were estimated at the time of its introduction in the late 1990s and were subject to a further detailed assessment in 2005/06.[143] This study provided a detailed assessment of the costs of implementing HAPs and SAPs, as well as current levels of funding for UK BAP delivery.

The following methodology was employed in the costings work:

- The estimated costs of delivering terrestrial HAPs were largely based on the costs of meeting area based targets for maintenance, restoration and re-creation of habitats, which were found to represent a large proportion of total HAP costs and were costed on a £/ha basis;
- Estimates of the costs of freshwater, coastal and marine HAPs were less amenable to target based assessment and it was necessary to assess the costs of particular actions (such as research, survey, monitoring, advice and restoration work);
- The costs of delivering action for individual species were estimated by assessing the cost of species focused actions such as research, survey, monitoring and site management work;
- Meeting species targets also requires action for widespread species at the landscape scale. For example, farmland bird and plant species require collective action through the agri-environment programme to deliver widespread habitat change. The costs of this were estimated by modelling the action required to deliver targets for a range of bird species, and assessing their costs through agri-environment measures.

The cost estimates have recently been revised[144] to take account of developments since 2006 and to facilitate comparison with the results of a new study to estimate the benefits of the UK BAP[145].

Cost Estimates

The latest estimates of the costs of delivering the UK BAP are as follows (Table 42). The total annual cost of implementing the UKBAP are estimated at €957.4 million[146] annually between 2010 and 2015, with the largest costs relating to HAPs, followed by land management actions for widespread species. Individual species focused actions represent a small proportion (6%) of the total cost estimates.

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[143] Summarised in GHK (2006) UK Biodiversity Action Plan: Preparing Costings for Species and Habitat Action Plans

Costings Summary Report Revised Report to Defra and Partners. http://www.ukbap.org.uk/library/BRIG/TargetsReview06/PreparingCostingsForSAPsAndHAPs.pdf

[144] GHK (2010) Costs of the UK Biodiversity Action Plan – Update. Report to Defra and partners.

[145] Aberystwyth University. Forthcoming report to Defra and partners on value of benefits of UK BAP.

[146] These amounts have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010

Table 43 Estimated Costs of UK BAP Delivery

	2010 to 2015		2015 to 2020	
	£m (€m[147])	Percent	£m (€m)	Percent
Habitat Action Plans	516 (590)	62%	477 (545.6)	60%
Individual Species Action Plans	47 (53.8)	6%	47 (53.8)	6%
Action for Widespread Species	274 (313.4)	33%	274 (313.4)	34%
Total	**837 (957.4)**	**100%**	**798 (912.8)**	**100%**

The cost estimates assess the *financial* costs of BAP delivery, rather than the full *economic* costs of the UK BAP. The methodology recognises that there are **opportunity costs** in the delivery of BAP actions and targets, but takes account of these **only to the extent that they are reflected in the financial costs of BAP delivery.**

For example:

- For **terrestrial and some coastal HAPs**, the largest costs are the costs of land management. These are based on combining hectare targets for management, restoration and re-creation with unit costs, based on agri-environment payments and other data (e.g. estimated restoration costs). For the purposes of the costings, all land is treated as if in private ownership and therefore eligible for land management payments (i.e. there is no reduction in estimated cost for the small proportion of publicly owned land for which there is no need to compensate for income foregone). Therefore, **to the extent that land management payment rates accurately incorporate estimated income foregone, the estimates incorporate the opportunity costs of habitat management.** The estimates do not include other opportunity costs (such as foregone development opportunities), although these are more directly related to other policies (such as site designations) than the UK BAP itself.
- For **marine and freshwater HAPs**, the costs are largely based on the financial costs of research, survey, monitoring, advisory and restoration work, and **opportunity costs are largely not included.** Some freshwater HAPs will indirectly give rise to opportunity costs, for example by requiring changes in management of adjacent land (such as reduced fertiliser inputs). However, these are also required by other policies such as the Water Framework Directive, and the only costs therefore attributed to the BAP are those costs directly focused on the habitat. For marine habitats, it is possible that future management regimes will give rise to opportunity costs, for example

[147] These amounts have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010

through regulation of fisheries, although at this stage most of the focus is on research and survey work.

- For **individual species**, most of the costs relate to particular research, monitoring and advisory actions and **opportunity costs are insignificant and largely not included in the costings.** Individual SAPs rarely require significant land management activity. Furthermore, few if any of the priority species are pests which impose significant damage on economic interests. SAPs may give rise to opportunity costs relating to the protection of particular sites, though these are likely to be designated as SSSIs and the BAP itself is not the mechanism by which they are protected.
- For **widespread species,** the costings are based on the implementation of a package of land management measures at the landscape scale designed to meet targets for farmland birds and other widespread species. These estimates are based on agri-environment payments and therefore **incorporate opportunity costs to the extent that payment rates compensate for income foregone.**

An assessment of the treatment of opportunity costs within the UK BAP costings is given in Table 43.

Table 44 Opportunity Costs within the UK BAP Costings

Category	Estimated Annual Costs 2010 to 2015 (£k)[148]	Estimated Land Management Costs (£K)	Opportunity Costs	Estimated Income Foregone from land management (£k)*
Terrestrial HAPs	447,122 (€511,445)	370,217 (€423,476.4)	Included in land management costs as income foregone	259,152 (€296,433.6)
Coastal HAPs	57,989 (€66,331.3)	55,554 (€63,546)	Included in land management costs as income foregone	38,888 (€44,482.4)
Marine and Freshwater HAPs	11,063 (€12,654.5)	0	Not included	-
Individual SAPs	274,000 (€313,417.6)	274,000 (€313,417.6)	Not included	191,800 (€219,392.3)
Widespread Species	47,267 (€54,066.8)	0	Included in land management costs as income	-

[148] The amounts in EUR have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010

			foregone	
Total	**837,441 (€957,915.3)**	**699,770 (€800,438.9)**		**489,839 (€560,307.2)**

**Estimated at 70% of land management costs, using ratio derived from agri-environment schemes below*

The costs of land management – for habitats and widespread species – amount to an estimated £700 million (€800.7 million) per annum.

These land management costs include:

- Resource costs – cost of labour, materials, energy and equipment;
- Opportunity costs – costs of income foregone through changes in land management practices.

An indicative assessment of the likely scale of income foregone from land management for biodiversity can be made by assuming that income foregone represents 70% of land management payments, based on the analysis of agri-environment schemes, below. This suggests that income foregone from changes in land management practices could account for approximately £490 million (€560.5 million), or 58% of the overall estimated cost of delivering the UK BAP. Furthermore, evidence suggests that, since agri-environment payment rates are on average less than the true costs of delivery of options, the actual costs of delivering the land management elements of the UK BAP could be greater than the £700 million (€800.7 million) estimated.

Other UK Cost Estimates

Sites of Special Scientific Interest (SSSI)

SSSIs are the principal designation for wildlife sites in Great Britain.

The costs of management of England's 4,000 SSSIs have been estimated by Defra at approximately £102 (€116.7) million in 2009/10. More than 80% of this cost relates to land management, through incentives to land managers and direct expenditures by government. The remainder is accounted for by advice and advocacy, programme and project management, and regulatory costs. The costs of management of the 1,000 SSSIs in Wales have been estimated at a further £10 (€11.4) million per annum.

The above cost estimates include an element of income foregone, through land management incentives. In addition, SSSIs, by protecting designated sites from development, are likely to impose additional opportunity costs through foregone economic opportunities, which are not included in the cost estimates. It is debateable whether these represent net opportunity costs at the national level or whether they merely displace development to more suitable sites.

There is likely to be some overlap between the SSSI cost estimates and the UK BAP cost estimates, given that SSSIs cover many priority species and habitats. These overlaps are likely to relate particularly to land management costs and less to other measures such as advice and advocacy, programme and project management and regulation.

The Natura 2000 Network

The costs of managing the Natura 2000 network in the UK have been estimated by the UK authorities for the recent DG Environment study on the costs and benefits of the network.

The UK cost estimates relate to the additional costs of the network, over and above the costs of national designations such as SSSIs.

These costs are put at[149]:

- One-off costs of establishing the network - £66 million (€75.5 million);
  - Includes land purchase - £3.5 million (€4 million);
- Recurrent costs of management planning - £16 million per year (€18.3 million);
- Recurrent costs of habitat management and monitoring - £95.6 million per year (€109.3 million). This in turn includes:
  - Management agreements - £70.1 million per year (€80.2 million);
  - Conservation management of habitats - £12.8 million per year (€14.6 million);
  - Conservation management for species - £8.5 million per year (€9.7 million);
  - Compensation payments - £0.3 million per year (€0.34 million);
  - Other (monitoring, surveillance, public access, risk management) - £3.8 million per year (€4.3 million).

Opportunity costs are likely to be reflected in the one-off costs of land purchase, the payment of compensation for foregone opportunities, and in management agreements. As for BAP costs and SSSI management costs, the largest element is likely to be in payment for income foregone within management agreements.

However, as for SSSIs, it is likely that some opportunity costs are not included within the financial cost estimates. These could relate, for example, to foregone development opportunities where compensation is not paid, the opportunity costs of managing public land for conservation, and the opportunity costs of marine protected areas (e.g. foregone fisheries output).

The UK Agri-Environment Programme

Agri-environment payments are calculated to incorporate:

- The costs incurred in implementing land management practices, e.g. through inputs of labour, management, materials, energy and equipment;
- Income foregone from changes in agricultural practices, e.g. as a result of lower yields, reduced stocking rates, and changes in land use and management. These are effectively the opportunity costs of environmentally focused changes in land management practices.

A review of calculations of agri-environment payments allows the significance of income foregone estimates within overall costs and payment rates to be assessed (Table 44).

[149] The amounts in EUR have been converted from GBP to EUR at an exchange rate of 1 GBP = 1.14393 EUR in October 2010

Table 45 Income Foregone within Agri-Environment Payments and Costs

Country and Source	Average Income Foregone as a percentage of*:		Costs + income foregone as a percentage of payment rates:
	Total costs + income foregone	Payment Rates	
England – Higher Level Stewardship Payment Review 2004	57%	70%	121%
England – Entry Level Stewardship Payment Review 2004	74%	81%	117%
Wales – Tir Gofal Payment Review 2004	84%	77%	93%
Scotland – Rural Stewardship Scheme 2006 Payment Review	37%	40%	126%
Average across all relevant prescriptions in above	66%	70%	114%

**Based on a simple, unweighted arithmetic mean across different payments relevant to biodiversity*

In each case prescriptions relevant to biodiversity have been identified, and the proportion of calculated income foregone in overall cost estimates and in payment rates has been calculated. The figures in the table are based on simple arithmetic means of these percentages, across the relevant payments, rather than being weighted for the overall level of spending on each prescription.

The analysis suggests that income foregone accounts for between 37% and 84% of the calculated costs of the relevant prescriptions in each country, and between 40% and 81% of the actual payment rates. Averaging across all the relevant payments, income foregone is estimated to account for 66% of calculated costs and 70% of agri-environment payments.

The estimated overall costs (including income foregone) of implementing the prescriptions exceed payment rates, on average, for all countries except Wales, and on average are equivalent to 114% of payment rates overall.

This gives a possible measure of opportunity costs within land management payments – for the UK, a rough estimate would be that **opportunity costs (through measured income foregone) account for approximately 70% of relevant land management payments.**

Variations in different types of payments are apparent. For example:

- Income foregone represents a large proportion of the costs and payment rates for options which primarily limit inputs, such as fallow plots, conservation headlands, and buffer strips;

- Income foregone is also a high proportion of costs and payments for the maintenance of unproductive features, such as ancient trees;
- Income foregone is often high for options which re-create habitats (such as intertidal habitats, wetlands and semi-natural grasslands) from productive farmland;
- Income foregone is estimated to be low, or zero, for options relating to restoration or management work on unproductive land and features such as former mineral workings, ponds, unproductive forests, scrub, some wetlands and ponds;
- Income foregone may also be low or zero for particular management operations which do not adversely affect production, such as bracken control, shepherding and management planning.

Research and education

In terms of cost assessments it is difficult to assign opportunity costs to biodiversity research funding. However, for the calculation of EU costs of biodiversity action, research and awareness raising campaigns obviously have to be taken into account.

Therefore, this section provides a brief overview of funding activities for biodiversity research and promotional campaigns in the EU. The overview focuses primarily on the EU level and to a lesser degree on Member State and international activities.

Funding for Biodiversity Research

Funding for biodiversity research is covered primarily by Framework Programme (FP) at the EU level. The Seventh Framework Programme (FP7) began in 2007 and is scheduled to run until 2013, and its available funding is expected to rise quite steeply towards the end of its budget period. FP7 was preceded by the Framework Programmes, FP5 and FP6. The EU, through the Framework Programmes, FP5, FP6 and FP7, has funded a variety of areas involving biodiversity. Notably, the Programmes support projects that **assess risk** and the impacts of biodiversity loss regarding specific ecosystems and species. **Conservation** projects of specific ecosystems or species are also highly endorsed by the EU Framework Programmes. Finally, support for biodiversity **research** and **network building** is also supported under FP6 and FP7. (IEEP 2009)

BiodivERsA, is an ERA-Net project in biodiversity and receives funding from both the FP6 and Member States. The project builds a network of 19 research-funding institutions across 13 European countries to provide support for research and research training in biodiversity.[150]

At the national level, it appears that at least 14 Member States have a dedicated national or sub-national programme that supports biodiversity research (Belgium, Bulgaria, Cyprus, Czech Republic, Finland, France, Germany, Hungary, Ireland, Luxembourg, Netherlands, Spain, Sweden, UK), 7 Member States do not have programmes (Austria, Denmark, Estonia,

[150] BiodivERsA (2010)

Greece, Latvia, Lithuania, Romania) and for 6 it is unknown (Italy, Malta, Poland, Portugal, Slovakia, Slovenia).[151]

Table 46 Summary of EU and Member State Funding for Biodiversity Research

	Total Budget	Funding	Biodiversity Research	Percent of programme budget
FP5 (1998-2002)	€ 13,700 Mio.[152]	n.a.	€ 136 078 000 for biodiversity projects (within environmental research)[153]	0,1%
FP 6 (2002-2006)	€ 17,883 Mio.	€769 Million for Global Change and Ecosystems – biodiversity and ecosystems is one of six categories.[154]	€ 78 608 847 for biodiversity projects focusing on ecosystems[155]	0,4%
BiodivERsA (ERA-Net in Biodiversity research)	n.a.	n.a.	EC provides € 2 837 440 Member States € 20 Million	
FP 7 (2007 -2013)	€ 47,770 Mio.[156]	€ 1.9 Billion for environmental research funding	€ 29.6 Million to date supporting biodiversity projects[157]	0,06 % **to date**

** excluding Euratom Framework Programme*

Source.: Table made by Ecologic, 11.05.2010

DIVERSITAS: An International Programme for Biodiversity Science

DIVERSITAS is an international programme of biodiversity science and proposes an integrated research framework to the international scientific community. The goals of the

[151] European Commission (2008)

[152] Fifth Framework Programme (2010)

[153] European Commission (2008)

[154] Sixth Framework Programme (2010)

[155] European Commission (2008)

[156] Seventh Framework Programme (2010)

[157] IEEP (2009)

programme are to provide accurate scientific information and predictive models of the status of biodiversity, to find ways to support a more sustainable use of the Earth's biotic resources, and to build a world-wide capacity for biodiversity science. DIVERSITAS is a partnership of inter-governmental and non-governmental organisations formed to 'promote, facilitate and catalyse scientific research on biodiversity'. The programme receives funding through contributions from National Committees and in 2009 received contributions from fifteen countries, eight of which were EU Member States (Austria, Belgium, France, Germany, Spain, Sweden, The Netherlands, and the UK) and also Norway and Switzerland. National contributions typically come from a number of organizations within each country. DIVERSITAS also acquires additional funding from sponsors and grants. The programme uses a scale based on national GDP to suggest contributions for members. According to the 2006 scale, EU Member States, Germany, France and the UK, were suggested to contribute € 61,200 while the others were suggested to contribute € 20,400.[158]

Funding for Biodiversity Promotion

In addition to biodiversity research, campaigns that promote awareness of biodiversity also receive EU and Member State funding. The EU, for example has established a budget of €2,300,000 for its European outreach campaign on biodiversity titled "Halting the Loss of Biodiversity by 2010 – and Beyond: Sustaining ecosystem services for human well-being".[159] Additionally, the 2010 "European biodiversity campaign - state of play" received a budget of € 3,000,000 to promote biodiversity as part of the EU Biodiversity Action Plan.[160] On the national level, for example, the UK has established an estimated budget of € 1,200,000 for its Muck4Life 2009 campaign, which aims to enhance biodiversity by increasing citizen involvement in conservation and other activities.[161]

Summary

According to the European Commission (2008), "research is essential to achieve the benefits of the EC Biodiversity Action Plan". Therefore, both the EC and Member States are encouraged to allocate resources which support biodiversity research. Furthermore, biodiversity, and the value that it creates, is commonly considered a public good which is important at both the community and national level.. IEEP 2009 suggests that funding for biodiversity should be supported on both a community and national level in a strategic framework, due to the difficulty of the EU to support biodiversity goals on its own and the increased likelihood of biodiversity goals being accepted in the Member States.

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[158] cf Diversitas (2010)

[159] European Commission (2006)

[160] The European Biodiversity Action Plan – State of Play and prospects after 2010

[161] GSN Best Practice Competition (2009)

Annex B. Methodology of cost calculation for agri-environment payments

A worked example of the calculation of agri-environment payments for nature conservation in dry land arable crops in Navarra

The agri-environment measure to support nature conservation in dry land arable crops is a vertical measure in the RDP of the Navarra Region (Spain) targeting farmers in the South of Navarra where steppe[162] or pseudosteppe land areas with birds of particular conservation interest can be found. The conservation and protection of steppe birds, the natural value of the area and soil protection is the main objective of this measure.

The measure includes two groups of actions, one for cultivated areas and the other for fallow areas. The specific management requirements for these actions are for:

a) Cultivated area:
   - No harvesting or baling at night
   - To keep 5 per cent of the land cultivated with legume or protein crop (mainly peas or vetch)
   - To leave in 25 per cent of the cultivated cereal area a 3 metre-wide area around the edge of the parcel.

b) Fallow area:
   - 25 per cent of the land will be left with no tillage, fertilisation or pesticides until the 1st of July.
   - Another 25 per cent of the land will be sown with vetch, this area can be grazed from 15 April onwards.
   - On the rest of the land tillage will be allowed from 15 April onwards.
   - Preparation for sowing can be done from 15 September.

The calculation of income foregone for a shift from **conventional to agri-environmental cereal production in Navarra**, is undertaken in four steps:

Step 1 involves the calculation of production costs for two different municipalities in Navarra (Table 46) where the cultivated areas for each have a yield index (YI) of 1.8 t/ha. The calculations are made for the two predominant cereals in the area, wheat and oats

[162] Steppe / pseudosteppe land is characterised by grassland plain without trees (except near waterways). The climate of steppe land is typically continental and semi-arid

Table 47 Production costs from two municipalities in Navarra

ELEMENTS	AMOUNT (€/Ha/year)			
	OAT		WHEAT	
	MUN. 1	MUN.2	MUN.1	MUN.2
1.Gross production	494.27	232.23	553.68	181.20
2.Direct costs	127.71	60.00	148.55	48.62
3.Standard gross margin	366.56	172.23	405.12	132.59
4.Machinery costs	82.33	36.68	66.74	21.84
5.Labour costs	0.00	0.00	5.96	1.95
6.Gross margin	284.24	135.55	332.42	108.79
7.Paid indirect costs	85.87	40.34	89.64	29.34
8.Available income	198.37	93.20	242.78	76.46
9.Capital investments	45.39	21.33	47.82	15.65
10.Net margin	152.98	71.88	194.96	63.81

Each of the elements in Table 46 are calculated as follows:

- Gross production = production X sale price + subsidies.
- Direct costs = seeds and plants, fertilisers, herbicides and fungicides, forage, sub-products and pastures, grain, pesticides, others inputs.
- Standard gross margin = gross production – direct costs.
- Machinery costs = contracted labour and works; fuel and similar; repairs and parts.
- Labour costs = general labour and associated costs.
- Gross Margin = Machinery + labour.
- Paid indirect costs = interest and other finance costs, taxes, building maintenance and improvements and others.
- Available income = Gross margin - paid indirect costs
- Capital investments
- Net margin = available rent - capital investments.

In Step 2, the elements for the two municipalities are averaged to derive a cereal crop net margin for areas with a yield index (YI) of 1.8 t/ha (Table 47).

Table 48 Averaged costs from the two municipalities in Navarra with YI of 1.8 t/ha

ELEMENTS	AMOUNT (€/Ha/year)
1.Gross production	365.35
2.Direct costs	96.22
3.Standard gross margin	269.13
4.Machinery costs	52.40
5.Labour costs	1.98
6.Gross margin	214.75
7.Paid indirect costs	61.30
8.Available income	153.45
9. Capital investments	32.55
10. Net margin	120.90

In Step 3, the additional costs of higher machinery and labour and the income foregone from not harvesting a 3m perimeter belt around each field are calculated. These costs are incurred by a farmer when implementing the agri-environment measure on dry arable land (for the purpose of enhancing steppe bird populations of high conservation value). Both elements cause the net margin from each hectare of cereal land to diminish. The specific calculations are shown as follows:

- Higher machinery and labour costs, 0.45 h/ha x 17.75 €/ha = 7.99 €/ha
- Lower gross production since a 3m area along the land perimeter is not harvested (for a 100m^2 land): 1,345.30 kg/ha x 0.1164 ha x 0.135 €/kg = 21.14 €/ha.
- Where:
  - non harvested area is 1.162m^2
  - average cereal sale price is 0.135 €/kg
  - average yield is 1,345.30 €/ha

These figures are then used to calculate the gross production, standard gross margin, machinery costs, gross margin, available income and net margin costs associated with agri-environmental production of cereals. The differential obtained is shown in Table 48.

Table49 Comparison of net margins in Conventional and AE cereal cropping systems

ELEMENTS	AMOUNTS (€/Ha)		
	CONVENTIONAL CEREAL	AE CEREAL	DIFERENCE
1.Gross production	365.35	344.21	21.14
2.Direct costs	96.22	96.22	0.00
3.Standard gross margin	269.13	247.99	21.14
4.Machinery costs	52.40	60.39	- 7.99
5.Labour costs	1.98	1.98	0.00
6.Gross margin	214.75	185.72	29.13
7.Paid indirect costs	61.30	61.30	0.00
8.Available income	153.45	124.32	29.13
9.Capital investments	32.55	32.55	0.00
10. Net margin	120.90	91.77	29.13

The fourth and final step in the calculation takes account of the second requirement of the agri-environment action, notably that 5 per cent of the cereal area should be planted with a protein crop. The income foregone due to shifting from conventional cereal to agri-environmental protein crop production is calculated by repeating Steps 1 to 3 but using pea as a reference crop. With the latter there is a difference in net margin of 165 €/ha.

The annual final income foregone for a shift from conventional to agri-environmental cereals and peas is given as follows:

- 95% cereal: 0.95 x 29.13 €/ha = 27.67 €/ha
- 5% protein crop: 0.05 x 165.00 €/ha = 8.25 €/ha
- **TOTAL Income Foregone:** 27.67 €/ha + 8.25 €/ha = 35.92 €/ha

A rounded figure of 36 €/ha is used as annual per hectare figure of income foregone and additional costs incurred for the implementation of this agri-environment action.

Annex C. Costs of Rural Development Programmes

Table 50 Costs of Rural development programmes with relevance to forest biodiversity for selected Member States

Country	Actions under measure "forest environment payments" (code 225)	Value of total payment	Value of OC compensated (and calculated real OC)	Share of OC in value of total payment	Cost types considered in payment	Justification/ explanation of payment
CZ	improvements to the species composition of forest stands	See OC	20 to 81 *€/ha/y*	100%	**income foregone**	Income foregone for increased share of deciduous trees which reduce the felling premium. Payment range is for minimum share of 5-15% to >36% share of deciduous trees
AT	Conversion, measures increasing the quality of the forest stand, protection of old trees, improvement or protection of gene pool, support to qualitative regeneration of stands etc.	min. 40; max. ,- 400 *€/ha/y*	N/A	N/A	**income foregone** and maintenance costs	Yearly subsidy for direct material and personnel costs and yearly premium for income foregone[163]. The difference in value of payments is related to the direct maintenance costs resulting from varying requirements.
DE - Bayern	Nature, habitat and species protection measures - In Natura 2000 and other protected areas.	See OC	From 40 to 200 *€/ha/y*	100%	Income foregone	The calculated income foregone is always appr. 0,5% above the compensated amount. Income foregone calculated in comparison with a mean yearly contribution margin in similar conditions and with the same forest stand.

[163] The premium is calculated based on the individual requirements of the project description, which is without exception calculated on the following basis of calculation: Determining the benefits without conditions for forest management (Baseline) ; determine the loss of economic value ; Identification of additional costs due to the constraints , The documentation of the determination of the premium is part of the project. (Austrian RDP, 2009)

DE - Niedersachsen	Conservation of old trees, dead wood and habitats, creation of areas of natural dynamic regeneration, - In Natura 2000 and other protected areas.	min. 40; max. ,- 400 *€/ha/y (appropriation period up to 40 years)*	N/A	N/A	**Income foregone** and extra maintenance/management costs	Payment depends on varying forest management measures
DK	Sustainable forestry payments		N/A	N/A	Maintenance costs and **income foregone**	The level of support is fixed on the basis of standard costs and standard assumptions of income foregone per hectare. The standardised support rates are within the scale of likely silvicultural costs incurred by the forest owner. The grants are somewhat lower than the roughly estimated costs, but the rates are likely to be significant enough to fulfill their role as a policy instrument providing an incentive for the forest owners.
HU	225 – forest environment payments	min. 40; max. ,- 200 *€/ha/y*	N/A	N/A	Extra maintenance/ management costs **and income loss**	Payment depends on varying forest management measures
LT	not performing final forest cutting operations in Woodland key habitats, non-clear forest cutting operations (no longer than 7 years)	See OC	85 – 170 *€/ha/y*	100%	**income foregone**	the income foregone equals the annual interest rate for long-term deposits that could be received in case of selling the wood after allowed final forest felling or allowed clear-cutting