COSTING THE ENVIRONMENTAL NEEDS RELATED TO RURAL LAND MANAGEMENT

FINAL REPORT

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EXECUTIVE SUMMARY

Background and Objectives

Many of Europe's objectives for the rural environment, such as halting the decline of biodiversity, can be achieved only by appropriate land management, especially by farmers and foresters. In the past, the aim has been to bring this about either through regulation or by incentives for land managers, paid for through a range of funds andfinancial instruments at EU, Member State or even regional level. Currently, by far the greatest level of expenditure on these incentives is through the Common Agricultural Policy (CAP). However, it is clear that the current policy framework has not been sufficient to deliver environmental results at the scale required to meet EU targets and policy objectives. There are a number of reasons for this, one of which is the limited budgetary resources focused on achieving these objectives.

There are many competing demands on the EU budget which is increasingly under pressure. Robust estimates of the scale of expenditure required to meet the pressing environmental challenges we face across the EU are urgently needed, therefore, to feed into the debates on the next multi-annual financial framework. The purpose of this study is to produce a systematic and pan-EU set of figures estimating the costs of meeting the environmental needs associated with agricultural and forestry land use and to determine the degree to which this would need to be funded from the EU budget, assuming the EU continues to rely on incentives to a large degree. The environmental issues covered are biodiversity, landscape protection, sustainable water management, soil conservation and climate change mitigation.

The evidence points towards substantial challenges facing nearly all aspects of the environment where rural land use is a critical factor. There is still a long way to go to meet European targets on climate change and biodiversity and significant problems remain in relation to water scarcity, water quality, soil conservation and mitigating the effects of climate change. However, there is less evidence on either the total area of land on which action is required or the type of management that it would need to be under in order to address these challenges.

Existing Cost Estimates

There is very little literature on the anticipated costs of incentive policies to address these environmental needs. Where studies have been undertaken the studies tend to be either site or regionally specific or focused on one particular environmental issue. They range from fairly detailed estimates in relation to specific topics, such as the costs of achieving favourable conservation status on Natura 2000 sites or meeting biodiversity targets in particular Member States to more generic costs associated with maintaining High Nature Value (HNV) farming across the farmed landscape or addressing soil erosion and declines in soil organic matter. Such studies are often rather schematic and only one study to date has looked at the costs associated with addressing the full range of environmental needs, taking into account the synergies involved in delivering multiple benefits together on the same area of land. This was conducted for the UK. However, what all these studies have in common is that they identify the need for a significantly higher level of financial resources than is available under current spending plans if Europe is to meet its demanding environmental targets in the future. For example, the UK study estimated that the total cost of meeting the UK's future environmental land management requirements, not including provision of advice for farmers, was in the region of three times the existing annual agri-environment budget.

The Methodology Used

A methodology was developed specifically for the purposes of this study to provide a detailed estimate of the costs of addressing the different environmental priorities through incentives for largely voluntary agricultural and forestry management in the EU-27. To improve the depth and reliability of the estimates, a series of specific case studies were also carried out. These provide more context-sensitive cost data for three particular environmental issues (arable farmland birds, HNV farmland, soil conservation in Southern Spain).

Developing these sorts of cost estimates with any degree of precision is a complex task. For example, there will be significant variations in costs between countries. To make it manageable, within the resources available, a number of simplifying assumptions were made. In addition, the overall cost estimates produced are aggregate figures for the EU-27 as a whole as it was not feasible within the scope of this study to provide a detailed set of costs associated with every environmental outcome or for every Member State. However the costs have been estimated in a transparent way. Both the method and the key assumptions are open to examination and provide a foundation on which it is hoped that more detailed analyses at the national and regional levels will be able to build.

The central methodology follows a logical stepwise approach. First the environmental pressures facing the principal environmental media in rural areas were identified, along with the main land uses concerned and the area of land subject to the pressure had to be estimated. Second, types of land management action thought necessary to respond to each of the pressures were identified and an estimate made of the area of land under pressure requiring active management in order to meet the relevant environmental objectives. This focused on management actions additional to those required by legislation and cross compliance, ie those where voluntary incentives would need to be used. Thirdly, the costs of delivering this management over the estimated land area was calculated, taking steps to allow for any duplications, for example where one management action was addressing a range of pressures over the same area or where a range of management actions could deliver the same outcome on the same area of land.

Costs were estimated using an average cost per hectare for individual management actions, with the costs based on the standard 'income foregone plus additional costs' formula used to calculate payment rates under current agri-environment measures.

Current payment rates from approximately one third of Rural Development Programmes were used to calculate the average cost per hectare for the EU-27. In reality, however, payments based on this formula may not always be sufficient to achieve the required response by farmers to put the desired management into practice. This has been shown by the low uptake of certain management options under agri-environment schemes in some Member States. The method may therefore result in an underestimate of financial resources that are required in practice. On the other hand, if other approaches to meet these needs were adopted in the future, such as increasing the role of regulation or changing the basis of payments, then the cost to the public purse may be able to be reduced.

The methodology assumes that payments under Pillar 1 of the CAP continue in their current form after 2013 and so the agri-environment payment levels in the current RDPs continue to be relevant. The regulatory baseline remains as it is currently, albeit with the full implementation of existing EU environmental legislation of relevance to agriculture, including the Water Framework Directive and the Directive on the Sustainable Use of Pesticides. Given the focus of the study, only those costs that need to be met by the public sector are included, not those that are the responsibility of private individuals. Therefore, any form of management that is required by law, the costs of which fall entirely on private owners, is not included within the cost estimates, nor are the costs involved with the implementation and enforcement of regulation, as they will fall either on the private operator or national governments. The administrative costs of running voluntary incentive measures are not considered either. The only form of regulatory compliance cost taken into account is in cases where compensation payments for compliance are specifically allowed under rural development policy – for example to compensate for the restrictions placed on management within Natura 2000 sites.

Estimated Costs of Environmentally Beneficial Agricultural and Forestry Management

Based on this methodology, the costs of undertaking environmentally beneficial land management on agricultural and forested land in 2020, were calculated to be in the region of €34 billion/year. Payments would rise towards this level over the period 2014-2020. Given the methodology used it is not possible to calculate formal confidence limits for the cost calculations. A margin of error of plus or minus 25 per cent (+/-€8.5 billion) is used, however, to demonstrate the potential range within which the estimated costs might fall. This is an arbitrary figure, but one considered to be large enough to take account of inaccuracies in the figures as a result of the broad assumptions made. To this figure were added the costs of three other elements considered necessary for the delivery of good environmental management. These are the provision of a basic per hectare payment over 60 per cent of the LFA, to contribute to the economic survival of environmentally sensitive farms, as well as an estimate for investments needed in physical infrastructure and advice and training. These added an additional €9 billion/year to provide an overall estimate of €43 billion/year (+/- €8.5 billion) as the approximate level of financial resources needed (from EU and national/regional sources) to deliver the EU's environmental objectives using incentive based measures.

A large proportion of the costs associated with environmentally beneficial management on farmland and woodland are associated with arable land (€18 billion/year). These costs relate to approximately 40-50 per cent of arable land which would be under one or more relevant farm management practices. A further 30 per cent of the costs (€10 billion/year) are associated with grassland management, covering approximately 70-80 per cent of grassland in the EU-27. Of these figures, organic management (on arable and grassland) and in-field options on arable land, such as maintaining stubble over the winter, account for a large proportion of the overall costs (22 per cent each). In comparison, the costs of maintaining 100 per cent of landscape/structural features on farms appears to be a fairly low cost option, accounting for only 4.6 per cent of total costs, but with significant environmental benefits. However this does not take account of the significant costs that would be associated with the need to recreate landscape features that have been removed previously in many areas.

In addition, ten per cent of the costs (€3.4 billion/year) relate to the creation or management of woods and forests. This is a significant increase in the current levels of spending on forests, but is based on the assumption that the current level of spending is disproportionately low, given the increasing importance placed on woodland for meeting the EU's environmental objectives, particularly in relation to climate change.

The results from the case studies provide some indication of the costs associated with individual environmental issues. For example it was calculated that approximately €12 billion/year would be needed to halt soil organic matter decline in the EU27 (with €188 million/year in addition to a one off cost of €137 million needed to address soil degradation issues in the Murcia region of Spain alone), that between €16-23 billion/year would be needed to maintain HNV farmland (depending on the proportion of such farmland requiring support) and that approximately €1 billion/year is needed to halt biodiversity declines on arable land (of which €854 million/year is estimated to be needed to halt declines of arable bird populations).

These estimates compare with predicted current expenditure under agri-environment and other relevant measures operated through rural development policy of approximately €13.5 billion/year (including national co-financing), with perhaps another €1 billion/year focused on meeting environmental objectives associated with agricultural and forestry management through other funding programmes, such as LIFE+ and the Structural Funds. These figures include co-financing from national sources for rural development measures amounting to approximately €5 billion/year. EU resources being used to address environmental needs associated with rural land management currently, therefore, amount to approximately €9.5 billion/year. If the current average ratio of EU/national co-financing is applied (64 per cent EU to 36 per cent Member States), the proportion of the cost estimates presented here that would need to be sourced from the EU budget would come to approximately €27 billion/year. This could be accommodated within the CAP in a variety of different ways.

The study highlights, however, that it cannot be assumed that simply having sufficient budgetary resources available will lead to the environmental outcomes being achieved. Policy design and effective implementation are critical factors that will influence the cost of achieving the desired results. Persuading land managers to engage in management activities that impact upon their productive activities often requires more than just a payment for the income foregone and additional costs of the change in management. In many cases achieving changes in management practices also requires a change in attitude and approach to a farm's core business activities. Significant resistance is often experienced, some of which may be reduced through advice and training activities and some of which can be tackled through higher payment rates.

The final part of the study makes a brief assessment of the implications of a range of possible future policy and economic conditions for the cost estimates provided. These include the implications of changes in commodity and input prices, changes in the regulatory baseline, in the architecture of CAP direct payments and in the design, targeting and implementation of environmental incentive schemes. The analysis shows that the interplay of these different factors is complex and that not all work in the same direction. Any impact on the overall cost estimates is therefore difficult to quantify. An increase in the regulatory baseline, a change in the basis of payments or the introduction of a lower cap on the level of payments per hectare could reduce the cost estimates significantly. On the other hand, if a greater proportion of land were deemed to be needed under environmentally beneficial management, the regulatory baseline stayed the same, and the current 'income foregone plus additional costs' formula for calculating environment payments were interpreted more flexibly, then the costs might increase substantially. Further work in this area is needed, including an exploration of the trade-offs between regulation and incentive measures in the economic conditions of the coming decade.

1 INTRODUCTION

1.1 Background and Rationale for the Study

The environmental needs met through rural land management have traditionally been paid for through a range of financial instruments at EU, Member State or even regional level. Currently, by far the greatest level of expenditure is through the Common Agricultural Policy (CAP), with Rural Development funding providing some €6 billion a year specifically for measures for environmental land management and another €8 billion a year for measures that have the potential to have a positive impact on the farmed or forested environment. This is additional to the LIFE+ instrument, which provides around €400 million a year for environmental policies as a whole, and to the Structural Funds, with an estimated €15 billion a year allocated to the environment, although only a very small proportion of this, perhaps only €1 billion/year is related to rural land management.

The debate on the EU Budget for the next multi-annual financial framework will intensify over the coming months as formal proposals are drawn up for publication in summer 2011. The discussions on the future size and focus of the 2014-2020 EU budget is taking place against the backdrop of vigorous debate on the future rationale, structure and design of the CAP, a review of the 6EAP, discussions on the future rationale for Cohesion policy, the need to reflect the objectives of the EU2020 Strategy into all EU policies, and the financial crisis that is besetting some of the economies in the Eurozone.

In the context of such competing demands on the EU budget, robust estimates of the scale of expenditure required to meet the pressing environmental challenges we face across the EU is urgently needed. Indeed, initial estimates have served to demonstrate the difference in the scale of funding estimated to be needed to achieve European environmental targets, and the scale of funds currently available under EAFRD and through other instruments. Many of these initial estimates are site or regionally specific, and therefore a more robust, systematic and pan-EU set of figures is needed for an informed political debate.

1.2 Objectives of the Study

The purpose of the study is to provide robust and systematic estimates of the scale of the environmental need with respect to the following environmental media - biodiversity, landscape protection, sustainable water management – including water quality and water quantity, soil conservation, climate change mitigation – including reduction of greenhouse gas emissions and carbon sequestration – as well as of the costs associated with meeting these needs. The needs are identified both on the basis of assessments at present time, as well as on the prospective needs, in order to reverse environmental decline, to fully mitigate the threats faced, or in response to a more ambitious policy agenda. A broad-brush approach has been taken to identify the scale of the need at the EU level, along with an identification of those measures that support beneficial forms of land management. These are set out in Chapter 2 and Annexes 4, 5 and 6.

The overall cost estimates provided within this report are necessarily broad brush in nature, however they have been developed in a transparent way that ensures they are able to withstand examination. The cost estimates are aggregate figures for the EU-27 as a whole as it has not been within the scope of this study to provide a detailed set of costs associated with every environmental outcome for every Member State in the EU-27. It should be noted that the costs have been calculated with respect to the current policy framework, in other words they assume the continuation of Pillar 1 direct payments at their current level. The cost estimates, therefore, give a sense of the scale of the funding necessary to address the range of environmental needs identified and represent a best estimate, given the availability of data and the timescale of the study. The way in which these cost estimates might vary in relation to changing economic or policy factors is discussed in Chapter 9.

There are three distinct elements to the approach we have taken to estimate the costs of meeting the environmental needs associated with rural land management in the EU-27:

1. Firstly, a **literature review** has been carried out of studies that have been undertaken in different Member States or for different environmental issues to estimate the costs of meeting particular environmental needs (see Chapter 3).
2. Secondly an **estimate of costs** based on a methodology developed specifically for the purposes of this study (see Annex 1 for details) has been carried out. This approach provides a detailed estimate of costs based on the area of land needed under a range of management practices identified as being needed to address the different environmental priorities (see Chapter 4).
3. Thirdly, these aggregate figures have been interrogated through a series of specific **case studies** which provide more context-sensitive and robust cost data for particular environmental issues (arable farmland birds, HNV farmland, soil conservation) to help assess the accuracy and robustness of the headline figures and explore the challenges associated with the aggregation and upscaling of data (Chapter 5).

The study examines the way in which these needs are currently met through fully EU funded instruments, EU funding with Member State co-financing, and through private financial contributions and state aids (Chapter 7). It proceeds to assess the scale of unmet need and provides estimates of the scale of additional funding required for the environment to encourage an informed political debate (Chapter 8).

The costs of meeting these needs have been estimated with reference to both agriculture and forestry. However, the competence for forest policy lies primarily with the Member States, and as a result a limited proportion of EU expenditure is devoted to forestry in the current programming period - a situation that is unlikely to change in the next Financial Perspective. For this reason, the focus of the study is largely agricultural, with forestry management and associated costs examined in so far as data allow.

The final part of the study makes a brief assessment of the implications of a range of possible future policy and economic conditions for the cost estimates provided, including the implications of changes in commodity and input prices, changes in the regulatory baseline, in the architecture of CAP direct payments and in the design, targeting and implementation of environmental incentive schemes (Chapter 9).

2 IDENTIFICATION OF ENVIRONMENTAL NEEDS ASSOCIATED WITH RURAL LAND MANAGEMENT

Agriculture has been practiced in Europe for millennia and at present it dominates as a land use, accounting for approximately 39 per cent (168 million hectares) of the territory of the EU-27 Member States. As a productive activity – the primary purpose of which is the production of food and other materials – it transforms the natural environment, by impacting on the pattern of resource use, on the functioning of natural systems and by restricting the species present. Forestry covers a further 41 per cent of the land area of the EU-27 (177 million hectares). Forests and woods vary in terms of their origin, character, composition, density and the types of management practised. Consequently, the environmental impact of agriculture and forestry – both positive and negative – is considerable and raises important issues about how best to deliver environmental needs and the substitutability of different types of rural land use in Europe.

2.1 Environmental Issues

The focus of this study is on five key environmental issues that can be addressed via appropriate rural land management as follows:

- The conservation and enhancement of biodiversity – both species and habitats
- Landscape protection
- Sustainable water management - both in relation to water quality and quantity
- Soil conservation
- Climate change - both mitigation (reduced greenhouse gas emissions and Carbon sequestration), and adaptation[1]

The majority of these issues are specified as objectives of Rural Development Policy. The Community Strategic Guidelines for Rural Development (Council Decision 2006/144/EC) highlight 'biodiversity and the preservation and development of high nature value farming and forestry systems and traditional agricultural landscapes; water; and climate change' as core objectives for the 2007-13 programming period. Since 2008, the importance of these issues has been reinforced further in the context of the 2008 CAP Health Check (Council Regulation (EC) 74/2009), in which 'climate change, water management (including both water quality and water quantity) and biodiversity' were identified as crucial 'new challenges'. As yet, soil conservation has not been identified as an explicit objective of rural development

[1] Assessing the need and the appropriate forms of management needed to facilitate ecological adaptation to climate change adaptation is not straightforward. To a large extent ecological adaptation is facilitated through existing conservation measures pertaining to protected area networks and the wider environment.

programmes but it is clearly important as well. It is one of the priorities identified in the sixth Environment Action Programme, because of the growing need for further action to prevent soil degradation (see Soil Thematic Strategy (COM(2006)231), and thus it is seen to be a critical priority for the rural environment and so an important element of the study.

2.2 Assessing the Scale of Environmental Need

In order to establish the scale of environmental need up to 2020 in relation to the five environmental issues that form the focus of this study it is necessary to define the scale and type of environmental delivery needed to meet EU targets and priorities in relation to each of the environmental issues. This is challenging. To estimate the scale of need accurately requires, for each environmental issue, quantified targets, data on the extent of the pressures facing the environment, and the land area affected as well as data on the management required to counteract these pressures and the area over which these are needed. In many cases these data are difficult to obtain for the EU-27. In some cases data does exist at the national or regional level, but the accessibility, consistency and comparability of the data often constrain the ability to use them in a meaningful way.

This chapter seeks to establish the environmental need associated with the main environmental issues, based on the data available. It summarises the data available, identifies where the gaps in the evidence are. Detailed supporting information can be found in Annexes 2, 3, 4 and 5.

Given the timeframe of this study, we have focused our attention on compiling data at the EU level under the following three-step approach:

1. Identification of EU objectives and targets for the environment in the spheres that form the focus of the study. These are a concrete expression of the level of societal demand and desired outcomes for the range of environmental issues addressed here.
2. Identification of the pressures and constraints facing the environment that need to be addressed to achieve these environmental outcomes in the period to 2020 and the type and area of land affected.
3. Assessment of the beneficial forms of land management/land management practices required to mitigate these threats and a quantification of the area over which such beneficial land management practices are required to achieve the targets.

2.2.1 Identifying EU level targets

The first step to identifying the scale of environmental needs in the EU-27 is to identify the desired level of provision. There are many sources of evidence that demonstrate the scale of individual preferences and demands in relation to different components of the environment. However, it is not possible to scale these up to derive a collective level of demand for society, not only because the evidence is variable, but because it is difficult to capture and take account of the non-use values of the environment as well as the needs of future generations. Policy targets, however, as determined through a political decision-making process, do provide a useful representation of society's collective demand for a particular environmental good or service, setting out the desired outcomes that need to be achieved, sometimes by a specific date.

For the purposes of this study, therefore, a series of targets associated with the environmental issues that form the focus of this study have been identified in order to provide a point against which to assess the scale of environmental action that needs to be taken between now and 2020. This provides a basis for subsequent cost calculations.

Defining the level of environmental provision needed in this way is not straightforward, not least because in certain cases there are multiple EU targets for each of the environmental issues, and in other cases there are none. Although the number of targets relating to the environment has increased over time, there are still no formal legislative targets for landscape, soils or climate change adaptation, for example. The nature of the targets also differs. In some cases the targets are explicit, in others they are not. In some cases the targets are legally binding, in other areas they are more aspirational in nature. Where EU targets do exist, these may have been translated into national and/or regional targets by Member States. The level of specificity and detail of such targets varies, along with their geographic scope. In many cases Member States are required to develop Action Plans to demonstrate how these targets will be achieved (for example River Basin Management Plans to deliver the requirements of the Water Framework Directive). Many of the actions identified in the Action Plans for meeting the targets, including those where expenditure on incentives for land managers is required, will subsequently be achieved through the use of measures within Rural Development Programmes, Regional development Programmes under the Structural Funds as well as other sources, such as LIFE+ and national funding streams.

Based on the range of targets set out in legislation, EU strategies and Action Plans for each of the environmental issues addressed in this study (see Annex 3 for a full list), a single overarching qualitative target has been established, to form the basis for calculating the costs. Where there are no formal EU targets, we have created targets based on other sources of information, for example, targets set out in the Soil Thematic Strategy and the Sixth Environmental Action Programme. These set out in Table 2.1.

Table 2.1: EU Environmental Targets used within the Study

Environmental Issue	Target
Biodiversity	To halt the loss of biodiversity ... in the EU by 2020 (Decision of the European Council, 15 March 2010).
Water Quality	To enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands ... reduce water pollution and to achieve good ecological status of all water bodies by 2015 (Water Framework Directive 2000/60/EC).
Water Quantity	To promote the sustainable use of water and to mitigate the effect of droughts (Water Framework Directive 2000/60/EC).
Soils	No formal EU target. Derived target: To protect and ensure the sustainable use of soil by preventing further soil degradation, including erosion, deterioration, contamination and desertification (from Thematic Strategy for Soil Protection COM (2006) 231 Final and 6EAP 1600/2002/EC).
Climate Change mitigation	To contribute to the reduction of EU greenhouse gas emissions by at least 20% below 1990 levels (EU Climate and Energy Package, 2008) by 2020.
Climate Change adaptation	No formal EU targets. Derived target: To increase the resilience of agricultural and forest habitats to adapt to climate change – in practice this is likely to require management also identified under the biodiversity objective
Landscape	No formal EU targets. Derived target: to protect and enhance the EU's traditional agricultural landscapes, to maintain landscape features and to conserve and appropriately restore areas of significant landscape value (from 6EAP 1600/2002/EC) .

For practical reasons we have focused on the aim of halting the loss of biodiversity, and have not attempted to cost restoration measures (except where these are necessary to halt current losses). This is because the current target does not quantify the level of restoration that is considered to be feasible. Indeed, it seems unlikely that significant restoration will be feasible before 2020 given the magnitude of the challenge of halting biodiversity losses. Where significant restoration does occur this is likely to be driven by ecosystem service needs such as soil condition, carbon sequestration and water quality issues, in which cases their associated costs will be captured by other components of this study.

It should be noted that, in the majority of cases, these targets are not quantified at the EU level. It has been beyond the scope of the study to look at the national targets for each environmental issue, but even where these do exist they are not necessarily comparable between Member States (for example Member States have targets within their national Biodiversity Action Plans that vary in their scope and ambition) or they are not quantified systematically (for example quantified targets are not available for all River Basin Management Plans). This lack of quantification makes it difficult to assess accurately the extent of the actions needed to achieve the target in practical terms.

2.2.2 Identification of the environmental pressures associated with rural land use

Having identified the required or desired outcomes in relation to each of the environmental issues that form the focus of the study, the next step for determining the scale of environmental need involves the identification of the key pressures and constraints to achieving these outcomes.

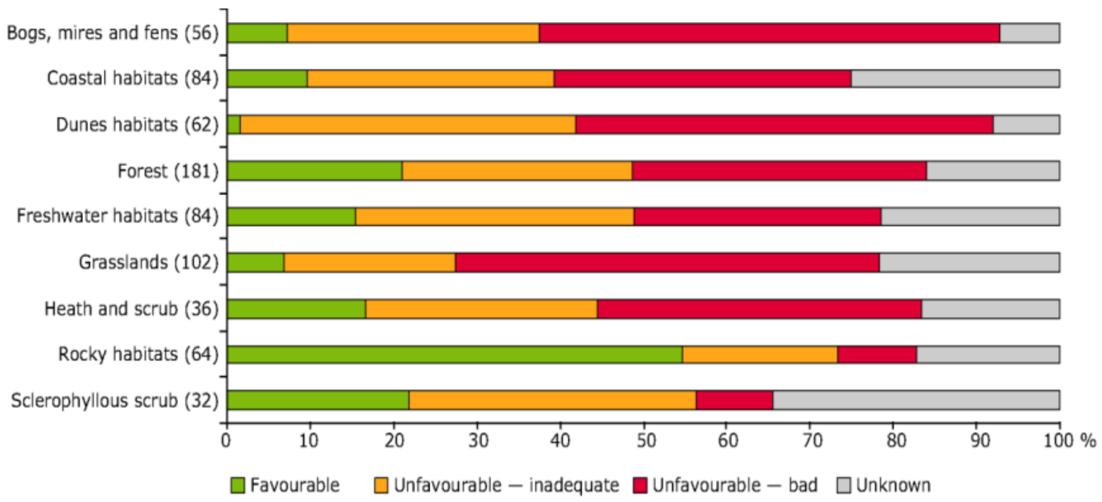
There is a considerable body of evidence that points to the ongoing challenges facing all aspects of the environment in relation to rural land use. There is still a long way to go to meet European targets on climate change and biodiversity and significant problems remain in relation to water scarcity (EEA, 2009c and 2010 c) and achieving good soil management. Data from a range of environmental indicators (for example EEA, 2005c; EEA, 2009b; OECD, 2008) and other literature show a continued large-scale deterioration in the state of many environmental media that are impacted on by EU agriculture, albeit with some notable exceptions – for example, improvements in some aspects of air quality, some regional improvements in soil functionality and water quality as well as reductions in greenhouse gas emissions from agriculture, partly due to a falling number of livestock (EEA, 2010c).

The recently published State of the Environment Report (EEA, 2010c) highlights that, although the EU is on track to meet its Kyoto targets, this will not be sufficient to keep temperature increases below 2^0C. To do this emission cuts of 25-40 per cent will be needed by 2020, which will require greater efforts to mitigate greenhouse gas emissions and an increased focused on adaptation measures. The agricultural sector has already achieved a significant decrease in GHG emissions (more than 20 per cent since 1990) but will inevitably have a role to play in achieving further reductions to 2020. The main sources of GHG emissions from agriculture include: the emissions of CO_2 from soils, resulting from land use change, particularly the drainage of organic soils, particularly peatland, and have been estimated to amount to 20-40 tonnes of CO_2 per hectare per year in the EU (Alterra *et al*, 2008); emissions of N_2O from soils; CH_4 emissions from enteric fermentation; N_2O and CH_4 emissions from manure management and CH_4 emissions from rice cultivation (UNFCC, 2008).

In relation to biodiversity, given the failure to meet the 2010 target, major efforts will be needed to reach the new 2020 target, adopted in 2010, and agriculture will have an important role to play here. Although the common farmland bird indicator has stabilised more recently, policy changes, such as the loss of set-aside could lead to further declines if suitable alternative measures are not put in place (Tucker *et al,* 2010). More importantly, the status of rarer threatened farmland bird species continues to be of considerable concern (BirdLife International, 2004). Furthermore, declines in farmland birds appear to be less severe than in some other more sensitive species groups. For example, data on grassland butterflies continue to show significant declines (more than 50 per cent since 1990). In addition, reports from EU Member States on the conservation status of species and habitats of

Community interest (ie those targeted by the Habitats Directive[2]) indicate that habitats associated with agricultural activity, particularly grassland habitats are in a very poor condition. For example, Figure 2.1 shows that less than 10 per cent of grassland habitats of Community Interest had a favourable conservation status in 2008.

Figure 2.1: Conservation Status of Habitats of Community Interest in 2008

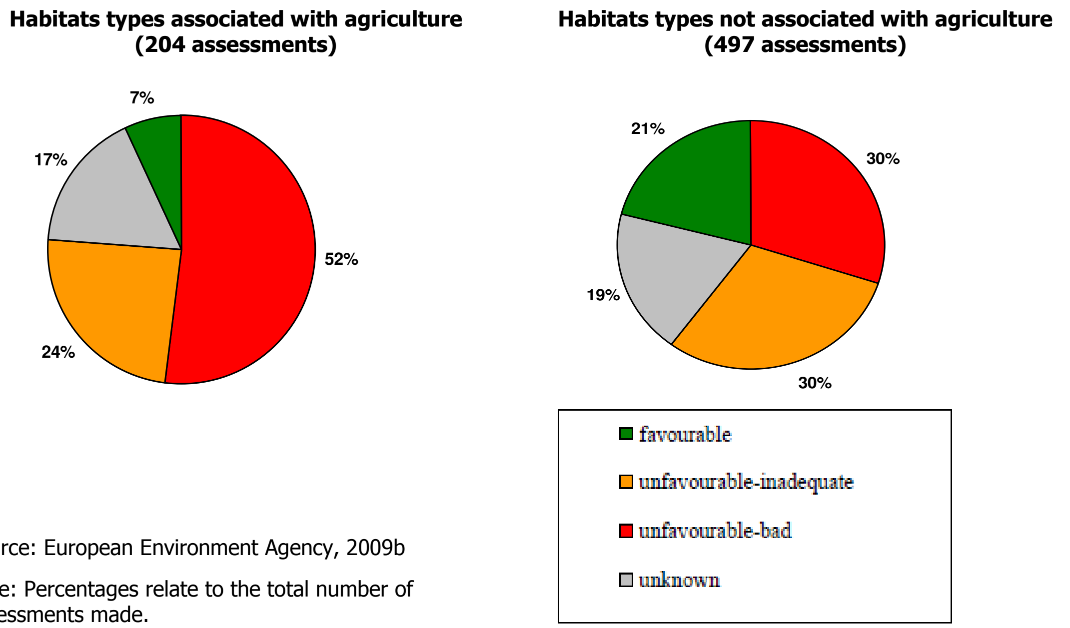


Source: EEA, 2010c Note: Number of assessments in brackets. Geographical coverage: EU except Bulgaria and Romania

Overall only seven per cent of habitats linked to agro-ecosystems have a favourable conservation status, compared to 17 per cent for habitat types not related to agro-ecosystems (Figure 2.2). The reasons given for these poor results are, shifts towards more intensive agriculture in some parts of the EU, and in other areas, shifts towards reduced management and at the most extreme, outright agricultural abandonment.

2 According to the provisions of Article 17 of the Habitat Directive, the EU 25 Member States (i.e. excluding Romania and Bulgaria) reported, in 2008, on the conservation status of all the species and habitats listed in the annexes of the Habitats Directive which occur in their territory. On the basis of this, the Commission produced a consolidated report on the conservation status of each species and habitat type at a biogeographical and EU level. According to the composite report published in June 2009, 50% of species and up to 80% of habitats of European conservation interest have an unfavourable conservation status. These reports provide useful contextual information and are available at: http://biodiversity.eionet.europa.eu/article17.

Figure 2.2: Conservation status of habitat types listed under Annex I of the Habitats Directive associated with agriculture and other land use



Source: European Environment Agency, 2009b

Note: Percentages relate to the total number of assessments made.

In relation to forest habitats, although Europe's forest area has been growing and it is increasingly being managed sustainably (MCPFE, 2007), significant issues for forest biodiversity remain. According to the European common forest bird indicator (EBCC/RSPB/BirdLife International/Statistics Netherlands, in EEA, 2010b), populations of common forest species have declined by 31 per cent in Northern and 35 per cent in Southern Europe while they remained stable in Western and Eastern Europe between 1980 and 2005. In 2009, IUCN estimated that 27 per cent of mammals, 10 per cent of reptiles and eight per cent of amphibians associated with forest habitats were threatened with extinction in the EU (EEA, 2010a). In addition, reporting under the Habitats Directives shows that 52 per cent of forest species and 63 per cent of forest habitats of Community interest have an unfavourable conservation status (EEA, 2010b).

More positively, the agricultural nutrient balance for nitrogen and phosphorous has improved in recent years for many Member States. However, atmospheric nitrogen deposition continues to be a significant problem, with over 40 per cent of terrestrial and freshwater ecosystems subject currently to atmospheric nitrogen deposition beyond their critical loads (EEA, 2010c). Nitrogen loads for the agricultural sector are also predicted to remain high over the coming years as increases of 4 per cent in nitrogen fertiliser use are predicted for the EU to 2020 (EFMA, 2009). Linked to this, a study of draft River Basin Management Plans published before 2009 showed that diffuse and/or point source pollution by nitrogen is reported in 124 out of 137 River Basins, phosphorous in 123 cases and pesticides in 95 cases (Dworak *et al,* 2010) The main sources of nitrogen and phosphates are inorganic fertilisers, organic manures and slurries, livestock feed and silage effluent. Indeed, the EEA have recently stated that ‘a significant number of water bodies face a high risk of not achieving good ecological status by 2015’ (EEA, 2010c).

The agricultural sector also exerts significant pressure on the quantity of EU water resources. It is one of the largest consumers of water in the EU, utilising a combination of natural precipitation, water abstracted from aquifers and surface sources, and that stored in tanks and reservoirs, for irrigation and use by livestock. On average the sector accounts for 24 per cent of total water abstraction within the EU. However agricultural water use is distributed unevenly, and in some southern European regions it accounts for up to 80 per cent of water extraction. In the context of climate change the problem of water scarcity is of growing concern, and the number of MS experiencing seasonal or long-term droughts has increased over the years.

Although soil degradation processes vary considerably from region to region, with different threats having different degrees of severity, soil degradation remains an issue all over the EU. An estimated 115 million hectares or 12 per cent of Europe’s total land area are subject to water erosion, and 42 million hectares are affected by wind erosion (EEA, 2005a). However, more recent estimates using the Pesera model provide more accurate figures, relating to the area of agricultural land in Europe at risk of soil erosion. The outputs from this model indicate that approximately 57.7 million hectares of agricultural land are at risk of erosion of more than 1 tonne/ha/yr and that 47.2 million hectares are at risk of soil erosion of more than 2 tonnes/ha/yr (Jones, pers. comm.), with the Mediterranean Member States particularly affected. An estimated 45 per cent of European soils have low organic matter content (ie have below 3.4 per cent soil organic matter or 2 per cent soil organic carbon), although this varies considerably between Member States. In southern Member States, approximately 75 per cent of soils have low organic matter content, partly reflecting the nature of the soils, the bioclimatic environmental and the extended cultivation periods in these countries. Soils in certain areas of France, the UK and Germany also suffer from low soil organic matter content. Attempts to model the potential risk to soil organic matter from climate change indicate that without changes to management, soil organic matter is at risk on the majority of arable soils across Europe. Compaction from regular cultivation and heavy equipment is also widespread although data on the scale of the problem are difficult to obtain.

The pressures and threats facing the environment result from two main trends in agricultural land management, notably increasing specialisation, concentration and intensification of production at one end of the spectrum, and marginalisation and abandonment at the other (EEA, 2005b; Stoate *et al,* 2009; EEA, 2010c). Each of these trends will result in changes in farm management practices as well as changes in farm structures, including the move towards fewer, larger farms, with resulting impacts on the environment.

Intensification, specialisation and concentration of production have tended to lead to an increased use of inputs, such as fertilisers and pesticides, the conversion of grass to arable land, higher stocking densities, the conversion of hay to silage making, the use of maize as a fodder crop, the removal and declines in management of boundary features such as hedgerows, stone walls and other farmland features such as ponds, individual trees etc. Although this trend is less marked than previously, the less-intensively farmed regions, particularly the New Member States, have considerable potential to intensify their production methods, given low levels of investment in the agricultural sector in the past. The prospects of further increases in fertiliser use in many parts Europe to 2020 (EFMA, 2009), both on arable and grassland, will continue to put pressure on a range of environmental media, including biodiversity, water quality, soil functionality and emissions of GHGs.

Marginalisation, and eventual land abandonment leads to a decline in grassland and arable habitats and an increase in scrub and forest in the landscape. Whether these changes are beneficial or detrimental to the environment largely depends on their context and local priorities. In predominantly open landscapes, small-scale abandonment can lead to increases in habitat and species diversity that can be beneficial, although the species that may benefit are often generalist species of low biodiversity value (IEEP and Alterra, 2010). Large scale abandonment, however, can lead to declines in habitat heterogeneity and species diversity across the landscape. All land abandonment impacts upon the character of the agricultural landscape and whether or not this change is viewed as positive or negative will depend on the geographic location, cultural heritage of the area and social preferences. In semi-arid areas, land abandonment may also lead to soil erosion where vegetative growth is slow and leaves land susceptible to erosion from wind and rain (Cerda, 1997; Pointereau *et al,* 2008).

A summary of the key pressures identified facing the environment and therefore requiring some form of action to address are summarised in Table 2.2. More detailed information on the specific pressures facing biodiversity, water and soils from changes in land use and management practices as are set out in Annex 4.

Table 2.2: Pressures faced by a range of different environmental media

Environmental Pressure
P1 - Scrub encroachment and reduction in agricultural condition of land through under management and reduced stocking density.
P2 - Changes in the timing of operations and the specialisation of crop types and rotations in particular the change from spring-sown to autumn-sown cereal varieties, and the associated earlier ploughing of stubbles and earlier crop growth.
P3 - The potential for the conversion of permanent grassland to arable crops.
P4 - Drainage of land.
P5 - Grassland management (including ploughing and reseeding) at a level which is detrimental to the natural functioning of grassland and soil systems.
P6: Irrigation resulting in water abstraction beyond the natural recharge capacity of the land.
P7 - Lack of open space for forage and nesting within or adjacent to cereal crops.
P8 - Frequent mechanised farming operations causing soil compaction.
P9 - Nutrient surpluses resulting from the inappropriate use of pest and weed control substances, and inorganic fertilisers
P10 - Specialisation and the reduction in the variety of livestock.
P11 - Stocking densities above the carrying capacity of the land.
P12 - Changes in the number of landscape features present in the landscape (including hedgerows, trees and 'rough patches', historic buildings, olive groves, and vineyards) leading to a change in landscape character.
P13 - Inappropriate forestry and woodland management operations including: Short rotation forestry cycles using high production/fast maturing species; certain woodland harvesting practices (incl. clear felling of woodland); and the reduction in density of native species.
P14 - Clearance of ground vegetation (eg in olive groves).
P15 - Soil salinisation.
P16 - Specialisation and reduction in the variety and age of tree species.
P17 - Soil organic matter decline (inc reduction in organic carbon).
P18 - Soil erosion (including landslides).
P19 - Atmospheric nutrient pollution.
P20 - Reliance on oil based energy.

The information sources reviewed suggest that, whilst many threats have been identified reliably, their magnitude and extent rarely have been quantified, especially at international and EU scales. It is therefore difficult to establish the area over which rural land use measures that counteract each threat are required. However, wherever possible the proportion of different types of land cover that are likely to be subject to these have been identified, using a combination of literature, economic model outputs forecasting likely structural and land use changes and expert judgement, to assess critically such assumptions. The details of the information sources used are set out in Annex 4 and the resulting figures included within the 'costs spreadsheet' in Annex 7.

2.2.3 Identifying the beneficial forms of land management required to counter these threats

Having identified the desired environmental outcomes at the European level and the threats and constraints to achieving them, the next stage is to identify the range of land management practices associated with agriculture and forestry that are needed to address these pressures.

There is a wide body of literature on the different land management practices needed to achieve different environmental objectives. In many cases particular management practices will deliver multiple environmental benefits simultaneously if well chosen and located appropriately. However there are instances where very specific management practices are needed to achieve a specific purpose and in some situations management practices that achieve benefits for some environmental media could conflict with the delivery of other environmental priorities. The nature of the specific management practices required to deliver particular objectives will vary depending on a range of factors, including geographic, climatic, and topographic factors as well as the nature of previous and current land use and the size and structure of the holding and the fields within in.

Based on a review of the literature, a review of the main options used within agri-environment schemes and expert judgement, the key agricultural management practices that have the potential to deliver different environmental benefits were brought together in a recent study looking at the provision of public goods through EU agriculture (Cooper *et al,* 2009). In relation to forestry, a review of the literature as well as those management practices promoted under agri-environment and forest-environment measures (for example Agate, 1980; Forestry Commission, 2002; UKWAS, 2006; Natural England, 2010) has highlighted a number of management practices that are particularly important for the sustainable management of forests. These farming and forestry practices have been These have been critically reviewed for the purposes of this study and combined with information derived from a review of approximately a third of all RDPs in a selection of Member States on the different types of management options that are used within the agri-environment and forestry measures. Based on this long list of management practices a shorter list of practices that are the most beneficial for delivering the desired environmental outcomes has been identified for the purpose of providing cost estimates for the delivery of environmental needs. These are set out in Table 2.3.

Table 2.3: The range of environmental benefits provided by different farming and forestry practices

Type of management required to address pressure	Biodiversity	Landscape	Water Quality	Water Quantity	Soils	Climate Change Mitigation	Climate Change Adaptation
MO1: Boundary management (including maintenance of stone walls, ditches, banks, and hedges (*NB.* hedgerow management for biodiversity is a separate measure).	Y1	Y1	Y1	P	Y1	-	Y2
MO2: Scrub management and removal (including juniper, bracken etc.).	Y1	Y1	-	-	-	-	-
MO3: Compensation for income forgone by forest owners due to voluntarily following certain environmental restrictions.	Y1	Y1	Y1	-	Y1	Y1	-
MO4: Reduction of inputs (fertilisers and plant protection products).	Y1	-	Y1	-	Y1	P	P
MO5: Compensation for restricted economic activity in Natura 2000 forestry and woodland sites (forbidden activities include clear cutting, final felling and thinning).	Y1	Y1	Y1	-	Y1	Y1	Y1
MO6: Conversion of arable land to grassland, environmental land use change, and specification of input levels.	Y1	Y1	Y1	Y1	Y1	Y1	Y1
MO7: Creation of buffer strips (incl. riparian zones, buffer strips along watercourses, grass margins and field corners).	Y1	-	Y1	-	Y1	Y1	-
MO8: Creation of field margins for the enhancement or protection of species (incl. grassland strips of defined varieties, beetle banks).	Y1	-	Y1	-	Y1	Y1	Y1
MO9: Crop rotation and diversification to reduce disease.	Y1	-	-	-	Y1	Y1	-
MO10: Tree maintenance (eg pruning, avoidance of root ploughing).	Y1	-	-	-	-	-	-
MO11: Fallow (whole field).	Y1	-	Y1	Y1	Y1	Y1	-
MO12: Fallow (zones, eg Skylark plots).	Y1	-	-	-	-	-	-
MO13: Forest conservation and restoration (eg Improving species composition, clearing of unwanted/non-native tree species, mowing, pollarding).	Y1	Y1	-	-	Y1	-	Y1
MO14: Genetic conservation ((rare or threatened animal breeds).	Y1	-	-	-	-	-	-
MO15: Genetic conservation (rare or threatened crop species).	Y1	Y2	-	Y1	-	-	-
MO16: Genetic conservation (rare or threatened tree varieties).	Y1	-	-	-	-	-	-
MO17: Grassland management (including grazing, mowing and cutting regimes, reduced fertiliser inputs).	Y1	Y1	Y1	-	Y1	P	-
MO18: Grazing management (including reducing and increasing grazing pressure on land).	Y1	Y1	-	-	Y1	P	-

MO19: Hedgerow management (including cutting regimes, improvement of species composition, and planting).	Y1	Y1	Y2	-	-	P	Y1
MO20: Historic feature management (including reduced cultivation depth, maintaining high water levels, management of scrub).	Y2	Y1	-	-	-	-	-
MO21: Integrated Farm Management (including rational nutrient management, integrated plant protection and soil protection).	Y1	-	Y1	Y1	Y1	P	-
MO22: Water protection from pollution (including activities to limit nitrate leaching and soil erosion, controlled irrigation, permanent green cover).	Y1	-	Y1	-	Y1	P	Y1
MO23: Organic management (in accordance with certified organic standards).	Y1	-	Y1	Y1	Y1	P	-
MO24: Over-winter crops / stubble management (eg maintenance/ inclusion of over-winter stubbles, catch crops and green cover crops in rotations).	Y1	-	Y1	Y1	Y1	Y1	-
MO25: Soil management (including crop rotation, reduction of soil inputs and change in ploughing regime).	Y1	-	Y1	Y1	Y1	Y1	Y2
MO26: Spring cultivation (to reduce nitrogen leaching).	Y1	-	Y1	-	Y1	-	-
MO27: Wetland management (including options for maintenance of ponds, reedbeds, protection of wildlife in rice fields, and reed frames).	Y1	Y1	Y1	Y1	Y1	Y1	Y1
MO28: Traditional management (including location specific traditional management practices, mosaic-like small-parcel cropping.	Y1	Y1	-	-	Y1	-	P
MO29: Traditional orchard maintenance (including traditional, native or rare varieties).	Y1	Y1	-	-	-	-	-
MO30: Organic conversion (in accordance with certified organic standards).	Y1	-	Y1	Y1	Y1	P	-
MO31: Compensation for income forgone resulting from afforestation.	Y1	P	Y1	-	Y1	Y1	Y1
MO32: First afforestation of agricultural land.	Y1	P	Y1	-	Y1	Y1	Y1
MO-C1: Improvements to new livestock housing and/or handling facilities.	Y2	-	P	-	-	Y1	-
MO-C2: Investment in more efficient, environmentally sustainable technology.	Y2	-	-	-	-	Y1	-
MO-C3: Improvements in manure handling/ processing/ storage equipment.	Y2	-	P	-	-	Y1	-
MO-C4: Improved irrigation systems/technologies.	P	-	Y2	Y1	Y1	Y1	P
MO-C5: Installation of solar panels to provide renewable energy.	-	-	-	-	-	Y1	-

Y1 = Management option contributes directly to environmental objective
Y2 = Management option contributes indirectly to environmental objective
P = Management option has the potential to contribute to environmental objective depending on how and where it is applied.

The review of the literature has attempted to be as thorough as possible in identifying the range of management options that are needed to address the pressures facing the environment. However, we are mindful of the fact that there may be a number of specific management practices that address particular environmental issues, particularly those addressing climate pressures, that do not feature overtly within this list (for example maintaining the water table at the appropriate level in peatlands, precision farming practices etc). In many cases, however, these practices are subsumed within the generic management options described in the table above. In some cases they have not been included due to the fact that they are not yet in frequent use in the EU-27 and therefore there is little information to determine their environmental benefits in practical terms as yet.

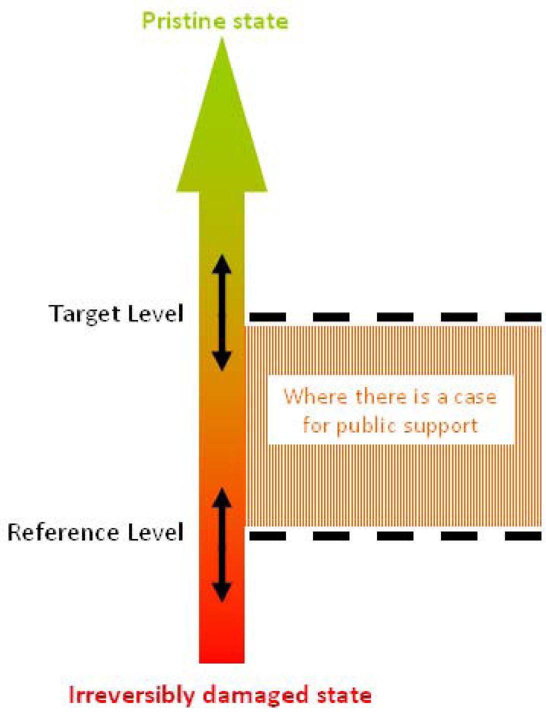
2.2.4 Identifying the scale of delivery required

The final step in identifying the environmental needs associated with rural land management is to estimate the scale of delivery required and hence the area of land that needs to be under beneficial management to deliver the outcomes specified. As demonstrated in the sections above, most of the goals and aspirations set out in EU targets are not specific and provide no quantification of what type of management is needed or at what scale.

Estimating the total number of hectares that need to be under management practices required to deliver agreed environment outcomes is not straightforward, therefore, and is potentially a very large task. Not only are a range of management practices needed to deliver a particular environmental outcome, but different combinations of management practices may be appropriate in different situations and over different areas to deliver similar outcomes. In addition, not all management practices will be mutually reinforcing. Some may conflict with one another and where multiple environmental outcomes cannot be achieved on the same area of land, judgements need to be made about the trade-offs between environmental objectives. In addition, since the focus of this study is to identify those costs that need to be met through the public purse, it is important to identify where actions to address the issues identified should be addressed through regulatory means and therefore sit below the reference level.

The concept of the ‘reference level’ - a cost allocation mechanism - was developed by the OECD in the 1990s. It serves to distinguish between those costs associated with the achievement of environmental outcomes that must be borne by the operator, and those for which private actors should be remunerated (OECD, 1998; Scheele, 1999). The reference level, therefore, defines the dividing line between the level of environmental provision that farmers are expected to deliver at their own expense, and an enhanced level of environmental quality for which farmers may be paid to deliver, for example through agri-environment schemes (Kristensen and Primdahl, 2006) as shown in Figure 2.3. The reference level is not static, however, and varies both geographically, with significant differences between (and within) Member States in the scope and requirements of the reference level, and over time, as new environmental legislation is introduced. For the purposes of identifying the area over which the beneficial management practices identified in section 2.2.3 are needed, we have assumed that the current regulatory baseline continues to apply and be enforced, alongside the introduction of any regulatory requirements that are due to come into force by 2020 (for example the implementation of integrated pest management requirements under the Pesticides Directive). The implications of any further potential strengthening of the reference level on the area of land requiring financial support to carry out environmental management is considered in Chapter 9.

Figure 2.3: Provision of environmental benefits above and below the reference level



Source: Cooper *et al*, 2009

The evidence available to support the estimations of the necessary scale of delivery is very limited. The data sources used are set out in Annex 5 and have been supplemented with information from the case studies, which have explored in depth the evidence available to assess the scale of need in relation to three specific issues – arable birds, High Nature Value farming and soil degradation issues (see Chapter 5). As the proportion of land under management is relative to the area under pressure, the estimates of the areas of different land types subject to different pressures provides a good basis from which to estimate the areas that need to be under the various types of management. However, the area over which beneficial management is needed relates to the efficiency of the management option to a large extent. If correctly targeted, less land may need to be managed in a particular way to address the related pressure. For example, habitat for some ground nesting birds, such as Skylark, can be very efficiently provided by Skylark plots, which only need to be provided at low densities.

This combination of data has been used to prepare a suite of quantitative estimates of the area of land that needs to be under different sorts of management. However, in many cases the evidence remains scarce. For example there is no data to enable an assessment to be made of how many terraces or metres of stone walls will need to be maintained, how many hectares of arable land needs to be under some form of cover crop or how many hectares of HNV farmland require management to ensure targets for biodiversity, landscape, water, soils and climate mitigation and adaptation are met. Ultimately, in the absence of any data, informed judgements have been made and we have tried to strike a balance between a detailed assessment of need and being overly specific. The rationale for all judgements is set out in Annex 5.

3 EXISTING COST ESTIMATES – A LITERATURE REVIEW

A number of studies have been conducted that attempt to estimate the costs of meeting various environmental targets through rural land management, including the management of agricultural land as well as forested areas. These range from fairly detailed estimates in relation to specific areas, such as the costs for achieving favourable conservation status (or some vaguer objective) on Natura 2000 sites to more generic costs associated with maintaining HNV farming across the farmed landscape or addressing soil erosion. Some costs have been estimated for the EU-27, while other exercises have been undertaken at the individual Member State level. Most studies focus on the costs associated with delivering specific environmental needs, with the majority of studies focusing on the costs of managing the land to meet biodiversity targets. Considerable work has also been carried out of the costs of addressing soil degradation issues, with EU costs identified as part of the Impact Assessment carried out for the objectives of the Soil Thematic Strategy. The main gaps in the literature surround the environmental issues of landscape, water quality, water quantity, climate change mitigation and climate change adaptation. Only one study has been found, conducted in the UK for the UK Land Use Policy Group (Cao *et al,* 2009), that considers the costs of meeting the priorities associated with the full range of rural environmental issues, including an assessment of the overlaps in meeting multiple objectives.

It should be noted that many of these studies are very recent, and some are still ongoing and not yet published. This chapter provides a review of the various literature and studies that have been undertaken in different Member States or for different environmental issues to provide a point of comparison for the cost estimates undertaken under the auspices of this study and summarised in Chapter 4. It provides a summary of the studies found to date, their focus, the methodologies and assumptions used and the costs estimates calculated and are summarised in Table 3.8.

3.1 Overarching Studies

Only one study has been identified that estimates the costs of meeting the priorities associated with the full range of rural environmental issues and this is focused on the UK (Cao *et al*, 2009). This study provides estimates of the scale of funding needed to meet future environmental land management requirements in the UK, covering biodiversity, landscape, climate change mitigation, flood risk management, farmland historic environment, soil quality, water quality, resource protection and public access objectives associated with agricultural and forestry land uses. The approach taken was similar to that chosen for this study. First the type and scale of environmental management needed to meet UK environmental policy objectives and targets was identified and secondly the costs of delivering the management practices identified were estimated, based on current agri-environment payment rates. The continued existence of LFA payments and Pillar 1 direct payments was assumed and costs for ancillary activities needed to support the delivery of environmental management in the agricultural and forestry sectors, such as advice and training, were not included.

The total cost of meeting the UK's environmental targets in relation to agricultural and forestry land management was estimated at £1.986 billion per year. These costs are intended to cover environmental management over a large proportion of agricultural and forestry land in the UK, estimated as 16.2 million hectares. This compares with current planned expenditure under agri-environment schemes in the UK of £742 million/year. In calculating these costs, allowances were made for the management of land to meet more than one environmental objective. The main overlaps identified related to biodiversity, resource protection and climate change. Where overlaps were identified, the cost estimate was based on the most expensive management option available (usually biodiversity focused). Given the assumptions made and the lack of available detailed data for certain environmental issues and in certain regions, it is considered that these cost estimates are likely to be a significant underestimate of the funding needed in practice to deliver the UK's environmental targets through land management.

3.2 Estimates focused on specific rural environmental issues

A limited number of studies and other evidence sources have been found that attempt to provide cost estimates for achieving objectives related to specific rural environmental issues. The majority of these studies are focused on the delivery of biodiversity objectives, and range from studies that have estimated the costs of managing the Natura 2000 network, to those that have considered the costs of delivering biodiversity across the wider countryside, for example through considering the costs of maintaining HNV farmland, to studies that have looked at the costs associated with delivering Biodiversity Action Plan targets in specific Member States. Evidence related to other environmental issues, such as water quality, soil functionality or climate objectives is much less well developed and patchier in nature.

3.2.1 Biodiversity

High Nature Value (HNV) Farming: The concept of HNV farming recognises the biodiversity benefits that are associated with particular types of farming, particularly low intensity farming systems. Although there is some debate about precisely how to define HNV farmland, estimates of the area of HNV farmland in the EU-27 have been produced (Parrichini *et al,* 2008) and Member States are also producing more detailed figures as the basis for monitoring success in maintaining this resource.

Two estimates have been produced on the scale of support needed to maintain HNV farming practices in the EU-27, one calculating the funding needed under Pillar One to maintain the economic viability of HNV farming systems and the other calculating the cost of maintaining HNV farming through the agri-environment measure.

The first of these provides costs for the introduction of a targeted scheme for HNV farming under Pillar One of the CAP, as part of a wider strategy for maintaining HNV farming in the EU-27 (Beaufoy and Marsden*,* 2010). Rough calculations suggest that, to maintain HNV farming systems in all Member States would require expenditure of €16 billion/year, assuming an average payment for HNV farming of €200 per hectare per year over an estimated HNV farmland area of 80 million hectares (likely to be a significant overestimate of the actual HNV farmland area). This cost estimate, however, is only one element of the total potential funding needed to maintain HNV farming. On top of this cost would also be costs associated with more specific and targeted management needs, for example for certain threatened species or habitats, funded for example through the agri-environment measure, as well as costs associated with capital investments, and presumably also LFA type payments, although this is not made clear.

The second estimate attempted to estimate the total economic costs associated with maintaining HNV farming through the agri-environment measure in the EU-27 (Kaphengst *et al,* 2010, in preparation). To do this, an average payment rate for HNV management was calculated, based on data on a range of relevant management practices collected from six RDPs[3] and this was applied to an estimated target area of HNV farmland to which agri-environment actions are anticipated to be applied, again based on relevant targets identified within the RDPs and scaled up to the EU-27 to a target area of 26 million hectares of HNV farmland. An average per hectare figure for maintaining HNV grassland under the agri-environment measure was derived of €169/hectare and a total cost of maintaining HNV farming practices over 26 million hectares of HNV farmland in the EU-27 was calculated as €4.37 billion. It should be noted that these costs are concerned solely with the costs of delivering the necessary management through current agri-environment actions. Therefore it is assumed that land managers would also be in receipt of Pillar 1 direct payments and LFA payments.

Semi-natural forests: Estimates have also been made of the costs associated with the management of semi-natural forests in the EU-27 (Kaphengst *et al,* 2010, in preparation). Although these are produced under the guise of 'HNV forestry', given the continued issues surrounding the definition and interpretation of what exactly constitutes HNV forestry, the area of semi-natural forests has been used as a proxy. Under the study, the costs are simply extrapolated from the figures derived for the costs of management of forest Natura 2000 sites (Gantioler *et al,* 2010). These costs were estimated to be €1.5 billion annually (using an average payment of €37 per hectare per year over approximately 40 million hectares). This per hectare figure was then applied to the total area of semi-natural forest in the EU-27 of 150 million hectares, giving a total figure for managing semi-natural forests in the EU-27 as €4.5 billion hectares. These figures include both privately and publically owned forests and, given that forests under public ownership are only eligible to receive funding for certain activities (establishment costs rather than management costs), this figure is

[3] The six RDPs used were Austria, Bulgaria, Czech Republic, Poland, Romania, UK (England)

likely to be a significant overestimate of the costs required from the public purse. The study did not include any estimates of the potential costs associated with non-productive investments needed to support the management of semi-natural forests.

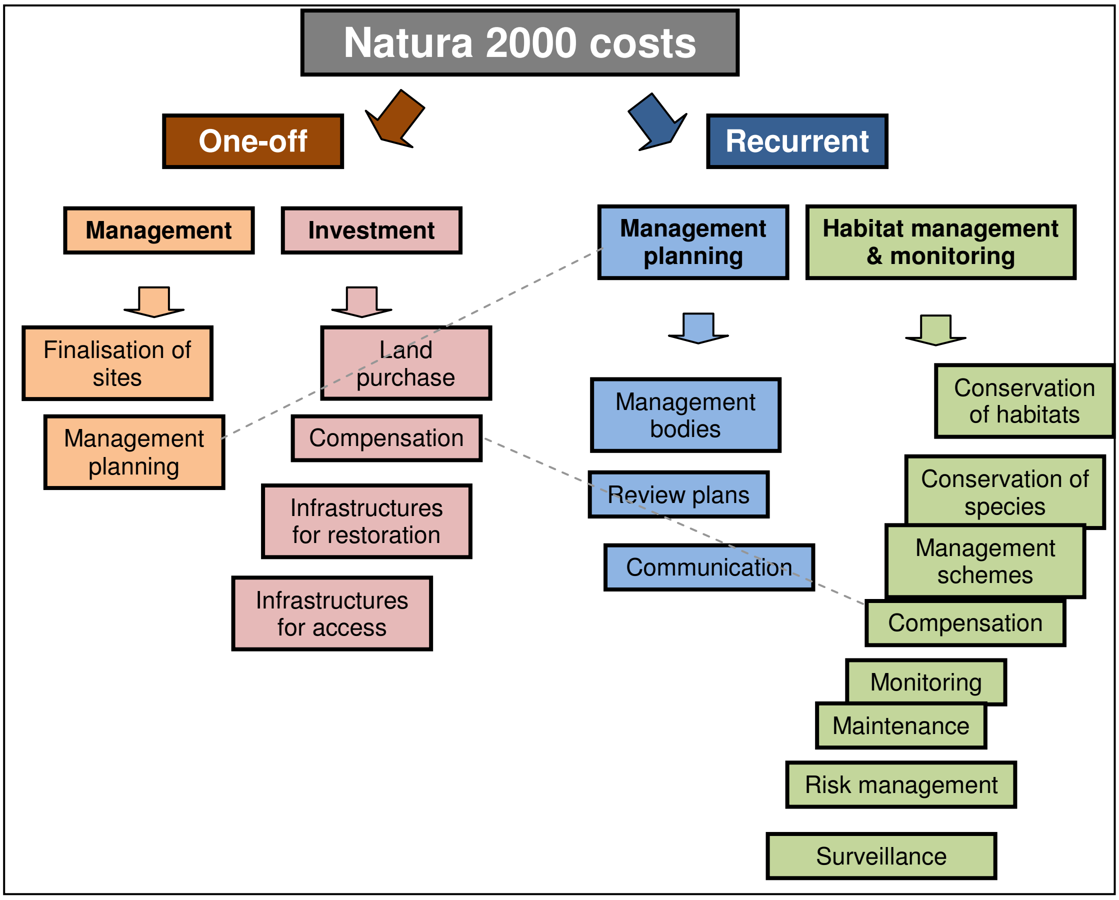
Natura 2000: A number of studies have sought to estimate the costs associated with the management needs of the Natura 2000 network. These estimates focus on the management of the Natura network as a whole, not just sites under agricultural or forestry management. The estimates are mainly based on Member States' own estimates, building on a variety of estimation methods. Some Member States based their estimates on detailed studies, but in other cases little information about how figures were calculated was provided and so the basis for the figures are less clear.

A first estimate of the costs of managing Natura 2000 sites across the EU-25 Member States was produced in 2004, which indicated that €6.1 billion / year was needed[4]. This estimate has recently been reviewed and revised within the frame of a project undertaken by IEEP, Ecologic and GHK for the European Commission (Gantioler *et al,* 2010). The study produced a revised estimate of €5.8 billion/year based on an extrapolation to the EU-27 of the average cost of €63/hectare/year derived from the 25 Member States that provided data. Of this figure €3.9 billion/year is associated with agricultural or forest Natura 2000 sites. This overall estimate is lower than previous estimates and is likely to be a significant underestimate of the total costs needed to bring Natura 2000 sites into favourable conservation status. The Commission's own earlier figures based on the Markland Report (2002) suggested an annual cost of around €107/ha and the recent BirdLife International (2009) report indicates costs associated with management of the Natura network at €128/ha/yr, based on estimates from six Member States provided by the organisation's national partners.

The 2010 review (Gantioler *et al,* 2010) represents an improvement in relation to certain data, for example regarding the area requiring management, and it applied a more consistent methodology for estimating costs compared to previous exercises. The typology of costs analysed by the study distinguished between one-off and recurrent costs (see Figure 3.1), the latter representing two thirds of the estimated overall figure. Eleven out of the 25 Member States which submitted the cost questionnaire provided a detailed breakdown related to the different categories. A thorough analysis of this information indicated that the level of one-off costs was particularly influenced by spending for infrastructure needed regarding the improvement or restoration of habitat and species, and in some Member States by the budget allocated to land purchase. Recurrent costs were particularly influenced by investment in conservation measures for the maintenance and improvement of the conservation status of habitats of Community interest as well as the implementation of management schemes and agreements with owners and managers of land or water.

[4] COM 2004(431), Communication from the Commission to the Council and the European Parliament: Financing Natura 2000, 15 July 2004

Figure 3.1: Cost Typology used for data collection



Source: Gantioler et al. 2010

Despite improvements in the methodology, wide variations in average costs per Member States were provided, ranging from €14/hectare/year in Poland to more than €800/hectare/year in Cyprus, Luxembourg and Malta. There were several reasons for these differences. In some cases, the higher cost estimates related, in part, to the scale of fixed infrastructure that was estimated to be needed to ensure appropriate management, relative to the area of land requiring management. This was the case particularly in smaller countries, such as Luxembourg. Different conservation strategies (for example contractual agreements versus land purchase) also affected the level of costs (for example in Cyprus). Other drivers of the costs related to the level of previous expenditure as well as the maturity of the network in the country concerned, with higher expenditure experienced in the earlier years.

However, the discrepancies also reflect differences in the interpretation of the exercise. In some cases the estimates were based on the costs of maintaining Natura 2000 sites in their current condition and in only a few cases were they based on the costs of achieving favourable conservation status of habitats and species of Community interest within them (which is the aim of the Habitats Directive). Very often estimates were based on what is achievable under currently available budgets and in some situations the cost estimates only included management that is additional to that required by law (UK for example). Only a few Member States estimated the expenditure that would be needed ideally if the resources were available. Only Spain provided two estimates, the cost of managing the network within existing resources and another estimate of what would be 'desirably' spent if resources were available, the latter being 60 per cent higher. A key reason for the likely underestimate of the costs is therefore the fact that many countries focused on historic and/or budgeted investment costs, and only a few provided information on future needs.

Only 10 out of 25 responding Member States provided a detailed breakdown of costs by land use type, and the area of each land use in the network. Therefore, the study was not able to provide a comprehensive overview of the costs attributed to different types of land use. However, the data were used to calculate indicative estimates of costs by land use for the EU-27 by apportioning the overall cost estimate of €5.8bn/yr according to the calculated percentage by land use (Table 3.1).

Table 3.1: Estimated Breakdown of EU27 Costs for the management of the Natura 2000 network by Land Use

Land Use	Estimated %	Estimated Cost (€m)
Agricultural	35%	2,025
Forests	33%	1,915
Other Terrestrial	11%	649
Inland Waters	7%	430
wetlands	6%	320
Coastal	6%	352
Marine	1%	78
Total	**100%**	**5,769**

Source: Gantioler *et al,*2010

In 2005, the German Federal Agency for Nature Conservation commissioned a study (Guethler and Oppermann, 2005) that provided a detailed estimate of the financing needs of Natura 2000 conservation and restoration activities based on contractual agreements with the agriculture sector. A particularity that Germany shares only with few other EU Member States (eg Austria) is the extensive use of contractual agreements (Vertragsnaturschutz) to achieve nature conservation objectives, including those stipulated under the Habitats and Birds Directives. For their cost analysis, the authors of the study considered sites designated under the Habitats Directive (excluding marine areas, water bodies and forests) and grassland rich in biodiversity. They multiplied the area of different habitat types with the payment rates applied across federal states for different management activities, based on income forgone and assuming that farmers receive €300/ha as direct payments under the Pillar One. A rough national average estimate was then calculated, amounting between €628 million/year (only sites with minimal level of protection) to €961 million/year (if the costs of agricultural intensification in neighbouring areas are taken into account).

Country Specific Estimates for meeting biodiversity targets in the wider countryside: Two interesting studies have been undertaken in Germany (Hampicke,

2010) and the Netherlands (Overmars and van Zeijts, 2010) which have attempted to calculate the costs of management needed to meet biodiversity needs in agricultural areas. In both cases the biodiversity needs are based on targets established in the national Biodiversity Action Plans. The studies are both focused solely on the delivery of biodiversity benefits and do not consider the other benefits that may also be delivered for other environmental priorities, or conflicts that may arise. In both these studies it is assumed that direct payments continue in their current form.

In Germany, the costs focus specifically on the management deemed necessary to achieve a 'more natural management' of agricultural land in order to secure the habitats of endangered species as well as to increase the numbers of characteristic species, habitats and landscape elements of traditional cultivated landscapes that are not endangered currently but considered to be under pressure. The cost estimates were based on the following types of management:

- Maintenance of semi-natural landscapes and extensive grassland including:
    - Grazing with sheep on neglected calcareous grasslands;
    - Grazing with suckler cows/young cattle on neglected delicate grasslands;
    - Mowing and hay production;
    - Bringing grassland that is reverting to scrub back into production through scrub removal;
- Extensification of 10 per cent of the land under intensive grassland management;
- Protection of arable flora on low yielding arable land;
- 7 per cent of land to be 'structural elements' – includes woodland, hedgerows, strips of grassland along roads, water bodies, hedgerows etc.

Estimates were produced for the total area over which the different types of management were needed and the per hectare cost for each type of management was calculated, based on income foregone and additional costs, using detailed data on the likely changes in productivity as well as the costs associated with additional labour, forage, built infrastructure etc (see Table 3.2). These estimates suggest that the management practices identified are needed over 2.3 million hectares (15 per cent of Germany's UAA) and that this will cost at least €1.5 billion/year. Current funding available under EAFRD for similar management in Germany is €1.25 billion/year.

Table 3.2: Total annual cost estimate for biodiversity managed in farmed landscapes in Germany

Type of Management	Area (ha)	€/ha per year	Millions of € per year
Semi-cultivated landscapes and traditional grassland	1,000,000	500	500
Extensification of highly productive grassland	400,000	1,000	400
Protection of wild field flora	300,000	300	100
Structural elements, arable land	600,000	700	400

Additional amount to round up figures			100
TOTAL	**2,300,000**		**1,500**

Source: Hampicke, 2010

The study in the Netherlands aims to provide an assessment of the area and budgetary requirements to fulfil the needs for biodiversity in agricultural areas in the Netherlands. The biodiversity needs are identified through an examination of the objectives of the national biodiversity targets. Estimates on the area of land required under different types of management are identified using a low and a high estimate. The lower estimate is based on the management being carried out within a core area where a sufficiently large proportion of the habitat or species is present to allow the objective to be met if uptake of the management practices is high enough. The higher estimate is based on a country wide approach in which more farmers can participate, but where the contribution of each farmer to meeting the conservation objectives population is lower.

The costs of carrying out the different types of management were based on similar the payment rates of similar agri-environment measures. Where no similar measures were available, new costs were identified, based on an income foregone calculation. The management practices identified included those needed for the conservation of meadow birds (mosaic management, later mowing dates), other farmland birds (no application of pesticides in cereal field margins, use of spring-sown cereals, creation of field margins, use of winter feed crops) and for wild flora (ecological grassland management, field margin management). Overlaps between the different management practices are not taken into account in the estimations. Estimates suggest that if management were restricted to core areas, then 159,300 hectares of land (8.8 per cent of UAA) would need to be managed at an average cost of €476/hectare/year, coming to a total of €76 million/year. If management were carried out across the farmed countryside, the area that would be needed to be under such management is estimated to be 377,900 hectares (20.8 per cent of UAA) at an average cost of €616/ha/year, coming to a total of €232 million/year (see Table 3.3). The differing per hectare for certain management actions depending on whether they are implemented only within core areas or across the wider countryside are based on cost margins for these types of management calculated as part of a separate study (Bos *et al*, 2010). To put these figures in context, the current budget for environmental measures under Axis 2 of the rural development regulation for 2007-13 is €41.2 million annually (including national co-financing).

Table 3.3 Costs of farm measures for achieving biodiversity policy targets in agricultural areas in the Netherlands

	ha		euros/(ha*yr)		million euros/yr	
Biodiversity measures	Core area	Habitats countrywide	Core area	Habitats countrywide	Core area	Habitats countrywide
Meadow birds						
Various measures of Black-tailed Godwit management (including postponed mowing date), farm measures geared to those taken on other farms (mosaic management)	120,000	250,000	250	250	30	63
Bird communities on cropland or mixed farmland						
No application of pesticides along field margins of cereal fields	2,550	17,700	1037	664	3	12
Replacement of regionally dominating crops (fodder maize or winter wheat) with summer cereals.	2,150	16,200	750	994	2	16
Set up of wide botanical field margins	6,000	51,000	1,760	1,903	11	97
Growing winter feed crops	600	6,000	1,745	1,745	1	10
Flora						
Continuation of botanical grassland management	22,000	22,000	1,136	1,136	25	25
Management of 15,000 km of field margins	6,000	15,000	833	667	5	10
total	159,300	377,900	476	616	76	233

Source: Overmars and van Zeijts, 2010

3.2.2 Soil Quality

The impact assessment accompanying the introduction of the Soil Thematic Strategy estimated that the costs to society of soil degradation (erosion, organic matter decline, salinisation, landslides and contamination) if no action were taken would be up to €38 billion annually. No cost estimates were possible for compaction, soil sealing and biodiversity decline. An estimated 115 million hectares, or 12 per cent, of Europe's total land area are subject to water erosion, and 42 million hectares are affected by wind erosion. Of the total cost estimate of €38 billion/year, the estimated cost of addressing soil erosion issues in the EU-27 has been calculated as being between €0.7 to 14.0 billion per year (Thematic Strategy for Soil Protection COM (2006) 231), although not all of these costs will be associated with agriculture or forestry management.

As part of the impact assessment for the Soil Protection framework (CEC, 2006a), the annual costs of addressing soil organic matter decline for Europe have been estimated to be at least €3.4 – 5.6 billion (CEC, 2006b). These costs were derived from estimates of annual on-site costs of €2 billion from SOM decline, mainly affecting productivity, and off-site costs of between €1.4 and 3.6 billion. These costs were derived from regional studies scaled to the EU level and not from EU level assessments of SOM decline. However these costs did not include costs to address the ongoing degradation of soil functions and therefore the real costs are likely to exceed these values. Of course, it should be stressed that these costs do not take account of the increased income that may result from improved productivity levels should improved soil management practices be implemented. As a result, these costs overestimate the financial resources needed from the public purse to encourage the uptake of soil management practices on farms.

In calculating these costs, various assumptions were made (see Kuhlman *et al*, 2010). For soil organic matter decline, for example, the risk area was considered to be all arable soils where soil organic carbon was <2 per cent. Building on the costs presented in the impact assessment (CEC, 2006b), the costs of a series of management measures suitable for addressing soil organic matter decline, including residue management, conservation tillage, cover crops and the application of exogenous organic matter (EOM) were calculated, along with measures to address other soil degradation issues, for example erosion and compaction. The potential area over which these measures were needed was estimated (eg 10 per cent for EOM) and the cost/benefits were based on the impact of nutrients for productivity. The benefits of soil organic matter management for reducing the risk of soil erosion were also considered. Table 3.5 shows that the costs for implementing soil organic management practices in areas of low soil erosion risk range from €44 to €384/ha/yr, with an overall cost of €116/ha/yr for a measure integrating all practices. The application of EOM was revealed as the most expensive option, reflecting the costs of sourcing, transporting and applying this material. The total cost of addressing the loss of soil organic matter is estimated at €3.5 billion per year based on a risk area of 30.5 million ha across Europe (Table 3.6).

Table 3.4: Costs of agricultural practices for erosion control which also include soil organic matter loss

Measure	Practice	Threat at which it is aimed	Cost per ha per year (€)	Share in measure (%)	Cost per ha/y for measure
1. Serious erosion (>10 t ha^{-1} yr^{-1})	Conversion of arable land into forest	Erosion, SOM loss	299	8	296
	Conversion of arable land into pasture	Erosion, SOM loss	155	8	
	Terracing (construction)	Erosion	893	0.5	
	Terracing (maintenance)	Erosion	200	10	
	Buffer strips	Erosion	230	74	
	Residue management	Erosion, SOM loss	44	59	
	Conservation tillage	Erosion, SOM loss	59	42	
	Cover crop	Erosion, SOM loss, compaction	57	25	
2. Moderate to serious erosion (2–10 t ha^{-1} yr^{-1})	Buffer strips	Erosion	125	50	140
	Residue management	Erosion, SOM loss	44	70	
	Conservation tillage	Erosion, SOM loss	59	50	
	Cover crop	Erosion, SOM loss, compaction	57	30	
3. Moderate erosion (0.5–2 t ha^{-1} yr^{-1})	Linear elements	Erosion	150	25	120
	Contour ploughing	Erosion	20	50	
	Residue management	Erosion, SOM loss	44	70	
	Conservation tillage	Erosion, SOM loss	59	50	
	Cover crop	Erosion, SOM loss, compaction	57	30	

Source: Kulhman *et al,* 2010.

Table 3.5: Cost of agricultural practices to prevent SOM loss in areas of low erosion risk

Measure	Practice	Threat at which it is aimed	Cost per ha per year (€)	Share in measure (%)	Cost per ha/y for measure
4. Level areas, SOM loss only	Residue management	SOM loss	44	70	116
	Conservation tillage	SOM loss	59[a]	50	
	Cover crop	SOM loss, compaction	57	30	
	Application of EOM	SOM loss	384	10	

[a] Additional cost of conservation tillage as compared to conventional tillage.

Source: Kulhman *et al,* 2010.

Table 3.6: Overview of quantifiable costs and benefits.

Measure	Practices	Threat at which it is aimed	Cost per ha per year for measure (€)	Risk area (m ha)	Total cost of measure per year (million €)	Current yearly expenditure (non-action scenario)	Additional cost of proposed policy (million €)	On-site benefits per year (million €)	Off-site benefits per year (million €)	Balance: net benefit per measure (million €)
1. Serious erosion (>10 t ha^{-1} yr^{-1})	Conversion of arable land into forest conversion of arable land into pasture terracing (construction) terracing (maintenance) buffer strips residue management cover crop conservation tillage	Erosion, SOM loss, compaction	296	8.1	2398	1292[a]	11578	3250	1800	–1354
2. Moderate to serious erosion (2–10 t ha^{-1} yr^{-1})	Buffer strips residue management cover crop conservation tillage	Erosion, SOM loss, compaction	140	22.7	3178					
3. Moderate erosion (0.5–2 t ha^{-1} yr^{-1})	Linear elements contour ploughing residue management cover crop conservation tillage	Erosion, SOM loss, compaction	120	31.3	3756					
4. Level areas, SOM loss only	Residue management cover crop conservation tillage application of EOM	SOM loss, compaction	116	30.5	3538			2057	3117	
5. Specific anti-compaction measures	Low-pressure tyres	Compaction	4.5	40.4	182	60	122	1027	–	905
6. Level areas, salinization	Drip irrigation	Salinization	1076	7.15	7688	384	7304	2887	606	–3811
7. Soil protection in forests	Reduced-impact logging	Erosion, SOM loss, compaction	450[b]	1.2	547	109	438	18.2	280	140
8. Soil protection on construction sites	Safe stormwater disposal, sediment trapping, seeding, stabilized entrance	Erosion	22159	0.011	246	0	246	0	60	–186

[a] Erosion and SOM loss measures combined.

[b] Per hectare logged, not per year.

Source: Kulhman *et al,* 2010

3.2.3 Water Quality

There is very little literature available on the costs of delivering water quality targets through the use of public money, perhaps due to the fact that until fairly recently the main policy mechanisms used to improve water quality have been regulatory in nature through the implementation of the Nitrates Directive[5], the Groundwater Directive[6], the Sewage Sludge Directive[7], and more recently the Water Framework Directive (WFD)[8]. However, Member States have increasingly turned to the use of agri-environment schemes to work alongside regulation to encourage land management practices that can address issues of diffuse pollution from agriculture in particular. In some Member States, considerable investment is also made in the provision of advice to farmers and other land managers.

Estimates of costs associated with the implementation of the WFD in theory should give a good indication of the scale of funding needed to meet a range of objectives associated with both water quality and water quantity. However, the Impact Assessment carried out on the WFD did not contain any cost estimates and the River Basin Management Plans (RBMP) that have been developed by Member States as a requirement of the WFD contain very little cost information.

RBMPs must are required to demonstrate how Member States plan to meet the objectives of the Water Framework Directive (see Box 3.1). The RBMPs set out a programme of measures (PoM) that will be implemented to meet these objectives. However, Member States are not obliged to set out the costs of the PoM or the sources of funding that will be used (Dworak *et al*, 2010). Although many RBMPs do calculate the total costs of the PoM, the cost of the agricultural PoM is generally not separated out. Where costs are identified, it is clear that a number of Member States intend to use Pillar 2 of the CAP, the agri-environment measure in particular, to support the implementation of the necessary measures.

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5 Council Directive 91/976/EEC of 12 December 1991 concerning the protection of waters against pollution caused by nitrates from agricultural sources (OJ L 375, 31.12.1991), amended by Regulation (EC) No 1882/2003 (OJ L 284, 31.10.2003).

6 Council Directive 80/68/EEC of 17 December 1979 on the protection of groundwater against pollution caused by certain dangerous substances (OJ L 020, 26.01.1980).

7 Council Directive 86/278/EEC of 12 June 1986 on the protection of the environment, and in particular of the soil, when sewage sludge is used in agriculture (OJ L 181, 04.07.1986), amended by Directive 91/692/EEC (OJ L 377, 31.12.1991).

8 Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community Action in the field of water policy (OJ L 327/1, 22.12.2000).

Box 3.1: Content of River Basin Management Plans as required under the WFD

River Basin Management Plans, as required under the Water Framework Directive, must demonstrate how they intend to:

- prevent deterioration in the status of aquatic ecosystems, protect them and improve the ecological condition of waters;
- aim to achieve at least good status for all water bodies by 2015. Where this is not possible and subject to the criteria set out in the Directive, aim to achieve good status by 2021 or 2027;
- meet the requirements of Water Framework Directive Protected Areas;
- promote sustainable use of water as a natural resource;
- conserve habitats and species that depend directly on water;
- progressively reduce or phase out the release of individual pollutants or groups of pollutants that present a significant threat to the aquatic environment;
- progressively reduce the pollution of groundwater and prevent or limit the entry of pollutants;
- contribute to mitigating the effects of floods and droughts

Detailed data on the use of different measures and their costs, where available, were collected from the draft RBMPs in 2009 (Ecologic, 2010). This information only relates to eight Member States (FR, IE, EE, BE, SL, HU, BG, RO), but covers annual management and capital costs related to a range of measures including:

- livestock oriented farming measures – improving manure storage, reducing nutrient content of animal feed, reducing livestock numbers etc
- chemical fertiliser input reduction measures
- pesticide measures – including investment in farm infrastructure as well as integrated pest management measures, use of different crop varieties etc
- integrated farming measures, including precision farming and organic farming; and
- land use intervention measures including land conversion to forestry

It is not clear from this data, however, what time frame the costs relate to or the area of land that they are intended to cover. In the majority of cases there is also no information given about the intended source of the funding.

To complement the data collected through the Ecologic study, a review of a number of final RBMPs has been carried out to see if it were possible to ascertain any additional estimates of the costs of undertaking the PoMs. This exercise confirms the issues raised in the previous study by Dworak *et al* (2010). Where cost estimates are available, these are extremely variable in terms of the type of costs identified which makes any comparability very problematic. However, these examples do give some indication of the scale of costs involved in meeting WFD requirements in different parts of Europe. Cost estimates drawn from a number of RBMPs, are set out in Table 3.7.

Table 3.7: Total costs of undertaking PoMs in selected RBMPs

Member State and RBMP	Total Costs	'Additional costs' as a result of WFD requirements
Netherlands	until 2015: €2.3 billion 2015–2027: €1.9 billion	
UK – South West	£ 66 million /year	£3 million/year
UK – Anglian	£ 114 million/yr	£64 million/year
UK – South East	£ 39.5 million /year	
Estonia – East Estonia	EEK 4030 million /year	EEK 330 million /year
Belgium – Scheldt	€ 171-845 million /year	€32—345 million/year
Spain: Catalunya	€6.3 billion to 2015	€4.2 billion to 2015

Source: Selected River Basin Management Plans

3.2.4 Climate Change

Very little literature has been identified that has estimated the costs associated with agricultural or forestry management to meet climate objectives. The little that has been identified relates to the costs of reducing GHG emissions on farms. The cost estimates relating to the prevention of soil organic matter decline in section 3.2.2 are also relevant in relation to reducing emissions of CO_2 from agricultural soils. No information has been found that has calculated the costs associated with climate change adaptation.

Reduction of Greenhouse Gas Emissions

While there are a number of studies that have identified the range of management practices that could help reduce GHG emissions from the agricultural sector (for example Frelih-Larsen *et al*, 2008; Alterra *et al*, 2008; UNFCC, 2008), very little information has been found on their associated costs, and the proportion of these that would need to be financed from the public purse.

At the EU level the IMPACCT study, carried out by Hertfordshire University in the UK, is developing models and software tools for both policy makers and farmers, to aid the development and evaluation of policy and help farmers and growers to identify and adopt agricultural practices that will reduce greenhouse gas emissions and increase carbon sequestration. As part of the process of developing such tools, the study has identified a suite of management practices that could contribute to reducing GHG emissions and increasing carbon sequestration. The model then scores the mitigation options chosen to demonstrate whether or not they are cost saving or would incur additional costs, particularly capital costs, based on data from case studies, available literature and expert judgement. It is not possible to derive generalised outputs from this study as the costs are context specific, varying significantly between different parts of the EU.

In the UK, analysis has been undertaken for Defra and the Climate Change Committee[9] to identify the cost-effective abatement potential from the agricultural sector. However, the

[9] The Climate Change Committee (CCC) is an independent body established under the Climate Change Act (2008) to advise the UK Government on setting and meeting carbon budgets and on preparing for the impacts of climate change.

evidence base on the level of emissions and abatement potential is at a very early stage of development relative to other sectors of the economy. A report carried out for the Climate Change Committee has produced a Marginal Abatement Cost Curve for agriculture, first published in 2008, and recently updated for the Committee's progress report in summer 2010 (CCC, 2010). The analysis undertaken for these studies, have provided various estimates on both the potential and feasible reductions that are possible within the agricultural sector through changing on-farm management practices.

The original SAC report in 2008 suggested that there was potential for cost-effective (ie at a cost up to £40/tCO2e[10]) emissions reduction up to 6 $MtCO_2e$ in 2020 for the UK, taking account of barriers to uptake and the scope of policy to address these needs. The main measures identified for reducing emissions included:

- Decrease N_2O emissions arising from crops and soils by improving the efficiency of fertiliser application and reducing the rate of conversion of applied fertiliser to N_2O
- Decrease CH_4 emissions from livestock through introduction of productivity and fertility measures as well as dietary additives that reduce enteric fermentation.
- Decrease CH_4 emissions from manures through the installation of on-farm or centralised anaerobic digestion (AD) plants (Moran *et al*, 2008).

The analysis highlighted that there was significant potential to reduce emissions through measures that were cost-saving in nature, particularly in relation to soils and livestock. Of the potential 6 $MtCO_2e$ reduction, the analysis suggested that 4 $MtCO_2e$ would be achievable at negative or no cost to farmers. The feasibility of achieving this scale of reduction has been disputed by the farming sector and much a much lower projection put forward. This has led to revised estimates being produced by ADAS and SAC in 2010, which suggest that there is between 5 to 12 $MtCO_2e$ technical emissions reduction potential in 2020 in the UK at a price below £40/tCO2e (price of carbon identified for original 2008 analysis). Indeed the June 2010 report highlighted that estimated falls in agriculture emissions in the UK in 2008 were largely due to less fertiliser use and reduced livestock numbers as a result of the decoupling of support payments from production under recent CAP reforms.

These estimates imply that not all management needed on farms to reduce GHG emissions in agriculture incurs a cost on the farmer, and therefore only a proportion of actions may require some form of support from the public purse, although they may need advice and training to encourage their take up.

A number of policy mechanisms have been identified that could be used to encourage the necessary changes in management, including: voluntary action by farmers; advice provision; grants, subsidies, charges, levies and taxes; Cap and trade schemes; and direct regulation (Frelih-Larsen *et al*, 2008; Committee on Climate Change, 2010). Work carried out by ADAS (2009) for Defra on the use of different policy instruments for reducing GHG Emissions associated with agriculture in England, showed that payments to farmers under schemes,

[10] This figure was used as a proxy for the market price for carbon

such as agri-environment schemes, do have a role to play, for example to encourage reductions in fertiliser use, the use of cover crops, and potentially the use of practices such as no-tillage management, but that other instruments such as extending the coverage of Nitrate Vulnerable Zones or cross compliance would achieve far greater abatement.

Many of the practices identified as helping to reduce greenhouse gas emissions will also contribute to the delivery of other environmental benefits, such as biodiversity, soil conservation, and water quality.

3.2.5 Summary

This literature review has uncovered a limited number of cost estimates for delivering different environmental needs at different scales. The accuracy of these estimates is very variable and in many cases the assumptions that sit behind the calculation of the cost estimates are at worst unclear and at best extremely variable which makes any comparability of the data problematic. In addition, the estimates tend to be context-specific and not necessarily amenable to upscaling to the EU level. In a few cases, cost estimates have been built up from average costs/hectare in different Member States and these have the potential to be investigated further to see if they could form the basis for creating cost estimates for the EU-27.

However, these limitations aside, these figures do provide a useful counterpoint to estimates that will be derived through the detailed methodology used specifically for this study. A number of common factors are apparent from these studies which have helped inform, and will continue to help refine the methodology used for this study. In particular:

- All cost estimates, with one exception (the EFNCP HNV figures), have been calculated in relation to the current CAP policy framework and system of payments – direct payments and LFA payments are, therefore, assumed to continue. This is the basis on which we intend to develop the cost estimates under this study.
- Most studies focus on the costs associated with meeting targets for a single rural environmental issue and do not take account of the synergies that exist in meeting other environmental objectives through the same management practices on the same area of land. The ADAS study for the LUGP (Cao *et al,* 2009) is the exception and the methodology for taking account of overlaps in the delivering of different environmental objectives will be informed by this study.
- Where specific costs for different land management practices have been identified, these tend to be based on agri-environment payment rates as a proxy for the costs of delivering specific land management practices. Where specific agri-environment options do not exist for particular land management practices, the costs of such options tend to be calculated using a similar payment calculation formula including income foregone, additional costs and in some cases the transaction costs that fall on the land manager.

Table 3.8: Summary of cost estimates for delivering environment priorities in the EU-27 based on evidence from the literature

Environmental Issue	Geographic Scale	Cost Estimate	Source	Comments and Assumptions
Overarching				
Meeting environment al targets for biodiversity, landscape, climate change mitigation, flood risk management, farmland historic environment, soil quality, water quality, resource protection and public access	UK	€1.986 billion/year	Cao *et al,* 009 (ADAS and SAC report for LUPG)	Based on established UK targets and current agri-environment payment rates. Assumes the existence of LFA and direct payments. Estimates cover management on all agricultural and forestry land in the UK (16.2 million hectares Given assumptions and data availability, considered to be a significant underestimate of costs of environmental land management in the UK
Biodiversity				
Management of HNV farmland	EU-27	€16 billion/year €200/hectare	Beaufoy and Marsden*,* 2010*,* 2010	Assumes a payment of €200/ha over 80 million hectares - includes N2K area
Management of HNV farmland	EU-27	€4.37 billion/year €169/hectare	Kaphengst *et al*, unpublished	Assumes an average payment of €170/ha applied over 25.7 million hectares (area targeted within agri-environment schemes extrapolated from targeted from 6 RDPs).
Management of HNV forestry	EU-27	€6billion/year €40/hectare	Kaphengst *et al*, unpublished	Assumes 150 million hectares of semi-natural forests managed at a cost of €40/ha (includes N2K area)
Natura 2000 areas – all terrestrial sites	EU-27	€5.7 billion/year €63/hectare	Gantioler *et al,* 2010	NB: This is likely to be an underestimate as the estimates provided by Member States are based on different assumptions and, in the majority of cases, do not include the cost of bringing N2K sites into favourable condition.

Natura 2000 forested areas	EU-27	€1.5 billion/year €37/hectare	Gantioler *et al,* 2010	NB: This is likely to be an underestimate as the estimates provided by Member States are based on different assumptions and, in the majority of cases, do not include the cost of bringing N2K sites into favourable condition.
Natura 2000 areas – terrestrial	EU-27	€128/ha/yr	BirdLife International, 2009	Based on estimates for 6 Member States
Meeting BAP targets	Germany	€1.5-€1.8 billion/year	Hampicke, 2010	Assumes a range of management of grassland and arable land over 2.3 million hectares (15% of UAA)
Meeting BAP targets	Netherlands	€0.076 - €0.266 billion/year	Overmars and van Zeijts, 2010	Assumes different types of management, on grassland and arable land over between 159,300 hectares (8.8% UAA) to 377,900 hectares (20.8% UAA). Overlaps may occur
Landscape				
No studies found				
Water Quality				
Reduction of diffuse and point source pollution from agriculture	Various figures identified in RBMPs in 8 Member States		Dworak *et al*, 2010	Figures are very variable and there is lack of clarity on timeframe and source of funding
Water Quantity				
No studies found				
Soil conservation				
Soil degradation (erosion, organic matter decline, salinistation, landslides and contamination)	EU	€38 billion per year	Soil Thematic Strategy Impact Assessment (CEC, 2006)	These costs do not take account of the increased income that may result from improved productivity levels should improved soil management practices be implemented. As a result, these costs do not equate to the financial resources required from the public purse to encourage the uptake of soil management practices on farms.
Soil erosion	EU	€0.7-€14 billion per year	Soil Thematic Strategy Impact Assessment (CEC, 2006)	
Climate Change				

Carbon Storage				
Soil Organic Matter content		€12.8 billion per year	Kuhlman *et al*, 2010	Assumes actions are undertaken on all agricultural areas at risk (high to low)
Reducing GHG emissions	UK	No specific figures, although estimates indicate that only a proportion of measures will require support from the public purse	CCC, 2010	Study on identifying the marginal cost abatement potential of agriculture for the Climate Change Committee, UK
Climate Change Adaptation				
No studies found				

4 ESTIMATING THE COSTS OF MEETING THE ENVIRONMENTAL NEEDS ASSOCIATED WITH RURAL LAND MANAGEMENT

This chapter sets out a more comprehensive and systematic estimate of the costs of delivering the environmental needs associated with rural land management, identified in Chapter 2. It forms the main empirical focus of the study.

The costs comprise two principal elements. One is support for appropriate farm and forest management delivered via voluntary incentive measures. The other is assistance for capital investment. The cost estimates are based on a methodology developed specifically for the purposes of this study and provide the first attempt to systematically assess these costs for the EU-27. The approach taken is systematic and transparent so that they can readily be subjected to scrutiny. However, it should be noted that the results represent broad brush estimates, based on available information about the extent of environmental needs in relation to rural land management as identified in Chapter 2, combined with expert judgement.

It has not been within the scope of this study to estimate a detailed set of costs associated with every environmental outcome for every Member State in the EU-27. The focus has been on the broad European scale, preparing estimates for the EU-27 as a whole. The intention is to provide a sense of the scale of the funding necessary to address the range of environmental needs identified and to offer a best estimate, given the availability of data and the timescale of the study. In some cases the costs will be an underestimate of what is required and in others an overestimate. However the methodology that has been used provides a basis for further more detailed assessments at different geographic scales that can take account of more detailed variables than has been possible under this study.

To improve the depth and reliability of the estimates, these aggregate figures have also been interrogated through a series of specific case studies which provide more context-sensitive cost data for particular environmental issues (arable farmland birds, HNV farmland, soil conservation in Southern Spain). These illuminate a range of challenges and issues that need to be considered in relation to the central cost estimates (for example issues of aggregation and upscaling of data) and help to assess the accuracy and robustness of the headline figures.

4.1 Methodological Approach, Caveats and Assumptions

For the purposes of this study, the cost estimates provided include those costs associated with both agriculture and forestry management. Although the study is specifically focused on identifying those costs that are, or need to be, met at least in part through EU funding instruments – specifically through EAFRD (Pillar 2 of the CAP), but also other relevant EU and national funding instruments, such as the Structural Funds or LIFE+ - the first step is to identify the full range of costs that need to be met through the public purse, before identifying which should be met from national funding sources and which from the EU Budget.

For this reason, the relevant costs are those that need to be met by the public sector, mainly through incentive schemes, not those that are the responsibility of private owners and managers of land. Any form of management that is required by law, the costs of which fall entirely on private owners, is not included within the scope of this study, nor are the costs involved with the implementation and enforcement of regulation, as they will fall either on the private operator or national governments. The only form of regulatory compliance cost taken into account is in cases where compensation payments for compliance are specifically allowed under rural development policy. Most notably these are payments to compensate for the restrictions placed on management within Natura 2000 sites or priority catchments under the Water Framework Directive. Member States are permitted to make such payments and to include them within EU co-funded Rural Development Programmes, although not all do so.

The methodological approach that we have adopted for estimating the costs associated with meeting the environmental needs associated with rural land management follows a logical stepwise approach. It has been developed to be as straightforward and systematic as possible. The approach provides an estimate for the overall cost of meeting these needs, irrespective of the source of the funding (for example whether from EU or national sources). Chapter 7 discusses the current funding used to address these needs and, on the basis of these figures, Chapter 8 estimates the additional annual budgetary requirements from the EU budget, if all the environmental needs identified in Chapter 2 were to be met.

In order to make the task manageable, however, a number of significant simplifying assumptions have had to be made. Where these occur, they are highlighted in the text.

It should not be forgotten that the cost estimates are based on the assumption that direct payments under Pillar 1 of the CAP continue in their current form and that the regulatory baseline remains as it is currently, albeit taking into account those requirements that will have come into force by 2020. The impact that changes to the current policy framework could have on the cost estimates is explored in Chapter 9.

Secondly, it is important to note that we have estimated costs using an average cost per hectare for individual management actions, with the costs based on 'income foregone plus additional costs' as determined under the Rural Development Regulation. In reality, however, payments based strictly on this formula may not always be sufficient to achieve the required management in practice, as has been shown by the low uptake of certain management options under agri-environment schemes in some Member States. This problem is likely to affect the estimation of costs relating to measures on the most profitable agricultural land, especially if they involve substantial, large-scale and long-term change in farming practices, as well as those relating to measures on less productive land where low levels of income can lead to the calculation of very low payment rates. The question of the level of incentives required to achieve a high uptake of these management options is reviewed as part of the arable birds case study (see Chapter 5) and is also discussed, alongside the other variables affecting uptake of management options, in Chapter 8 in relation to an assessment of the unmet need.

A third important issue is the extent to which the land management options needed to respond to a particular environmental concern will address more than one of the environmental objectives. For example the introduction of buffer strips along the banks of watercourses or along field margins, or the conversion of conventional production to organic, may address a range of pressures and result in a range of benefits for soil conservation, water quality and biodiversity, although the extent to which this is achieved in practice will depend on the location of the management option as well as the specific circumstances. This creates a challenge in estimating the extent to which different measures are required on the same area of land for different purposes and the level of overlap that occurs if we consider the area of application of each measure individually. Given the difficulty in quantifying the extent to which these multiple benefits and overlaps occur in physical terms without using maps or other spatially explicit information, the estimates on the area of land needed under particular forms of management have been identified in relation to the full range of environmental priorities, rather than explicitly seeking to establish the proportion of land needed under different management for each environmental priority separately. The issue of meeting multiple objectives and calculating the spatial overlaps of parallel measures, as well as identifying where conflicts may occur, is dealt with further in Chapter 6.

The methodology centres around three key steps as follows:

Step 1: Identification of the environmental concerns facing the principal environmental media (referred to as 'pressures' for simplicity) in rural areas, the type of land use on which the pressure is experienced and the area of the particular type of land use that is subject to the pressure.

Step 2: Identification of the management option(s) best placed to respond to the pressures under Step 1 and an assessment of the area of rural land under pressure on which the management option is needed. These area estimates only refer to land where incentive payments are considered likely to be required, once any management efforts needed in response to regulations or standards of Good Agricultural and Environmental Condition have been carried out.

Step 3: Calculation of the costs of delivering specific voluntary management options over the estimated land areas in order to meet the suite of environmental priorities, having removed any duplications, for example where management options have been identified as addressing multiple pressures, and taking account of overlapping management options, ie situations where multiple management options could deliver the same outcome on the same area of land.

These three steps are outlined briefing below. A detailed explanation of the methodology is set out in Annex 1.

4.1.1 Step 1: Identification of Pressures

The identification of the main environmental pressures relevant to agriculture and forestry is fairly straightforward as these are well documented in the literature (see Chapter 2 and Annex 4). What is less clear cut, however, is the area of different types of land that is subject to the pressure. To derive these figures we have reviewed a range of literature and supplemented this with expert judgement where data were lacking. It has not been possible to break these figures down by region or individual habitats under this study due to the lack of comparable data for all EU-27 Member States. However this would be desirable to do to give a more regionally/geographically differentiated pattern of pressures across the EU.

4.1.2 Step 2: Identification of Management Options to address the Pressures

There is a considerable body of evidence that provides information on the different types of land management activities (in agriculture and forestry) that are most appropriate to address each of the identified pressures. These have been compiled based on two sources. One was a review of the relevant literature. The other was a review of a mixture of land management and investment measures adopted already in a range of different Member States and included within their Rural Development Programmes (RDPs). Thirty one RDPs were examined, chosen to reflect a range of natural and economic situations in the EU-27 - 25 in relation to agricultural management options and 16 in relation to forestry management options. Of these 10 RDPs were reviewed for both types of management.

A short list of the most significant management options for the provision of environmental benefits was then compiled, determined by taking those options that were able to deliver multiple benefits, those that were most frequently used by Member States in RDPs or those that were essential for the delivery of a specific environmental objective. The short list of management options is set out in Table 2.3 in Chapter 2, with further detail provided in Annex 5.

However, assessing the area over which the desired form of management is needed is much more problematic. Although some information is available for specific management options in certain regions or Member States and specified within their RDPs, these indicative targets are a reflection of what is possible using existing funding resources rather than an indication of the full extent of management required to meet the environmental priorities that form the basis of this study. On these more ambitious objectives, no information was found at the EU scale, although some data do exist at the national level for specific environmental priorities. For example the area of different types of management needed to support populations of arable farmland birds has been estimated for the UK (see arable birds case study in section 5.1) and that needed for soil conservation measures has been calculated for the Murcia region of Spain (see the soil case study in section 5.3). As a result, our estimates have been derived using the expert judgement of the study team members, based on a long experience of agricultural management practices and processes and their interrelationship with the delivery of environmental outcomes. There would be considerable merit in conducting more detailed analysis at the regional level to identify what data exists at this level in order to inform the production of more accurate estimates that are regionally specific.

Where the same management practice has been identified multiple times as suitable for addressing a range of pressures on the same area of land, the costs are only recorded once to avoid any double counting. In other cases a number of management options can be used to address the same pressure and help meet the same environmental objectives on the same area of land. In these cases where the management practices are clearly mutually exclusive, the area of land requiring each different management practice has been calculated to avoid any overlap (for example, the area proposed for organic management, the area for integrated crop management and the area for extensive arable management are calculated so as not to overlap with one another).

4.1.3 Calculating the Costs of Voluntary Measures

The only readily available data that provide information on the costs of specific types of land management are the payment rates associated with the schemes available through rural development measures under the EAFRD, such as the agri-environment, natural handicap, Natura 2000 and forestry measures. Costs for actions requiring capital investments are not readily accessible as these vary depending on the type, scale and location of the investment. As payments for capital investments are based on a proportion of actual costs, there are no standardised costs available and no consistent or comparable information available through the literature on the proportion of farm and forestry investment in Member States that is linked to the delivery of environmental outcomes.

The costs of the two main types of measure have been calculated as follows:

a) **Costs associated with land management**, principally area based payments.

The current agri-environment and forest management payment rates have been used as a proxy for the costs of supporting the management needed to meet the environmental needs addressed in this study. The payments associated with the natural handicap measures were not used as the basis for calculating relevant cost estimates at this stage as they are not focused directly on promoting positive environmental management, rather they provide compensation for the existence of natural constraints on production.

Nevertheless a large proportion of these compensation payments do underpin positive environmental management either by helping to ensure the ongoing economic viability of the farm in question (particularly in the case of the natural handicap payments) or by providing an important incentive for adhering to the management requirements of Natura 2000 sites. For this reason an additional figure has been included in the final cost estimates to account for these.

Including the costs of providing a proportion of farmland within LFAs with an additional per hectare payment, over and above the costs associated with undertaking specific environmental management practices within the overall cost estimates is justified on the basis that such payments compensate for the additional costs farmers face in these areas as a result of natural constraints, given the importance of maintaining appropriate, predominantly extensive management practices in these areas for the delivery of environmental objectives. In effect LFA payments could be seen as a form of "lower tier" agri-environment measures in these areas which should not be omitted from the costs of delivery. What proportion of land within the LFA justifies such expenditure on environmental grounds, however, is not clear cut. According to the latest statistical information (DG Agri, 2010), 29 per cent of the LFA area is designated as mountain, 66 per cent is designated as 'other' and 5 per cent is designated as 'areas affected by specific handicaps'. Within the context of this study we have opted for a figure of 60 per cent of the total LFA area justifying additional payments on environmental grounds, given that some parts of the designated area will not be farmed and that some LFAs contain a significant proportion of more productive land where it is not necessary to support continued management on environmental grounds. However it is recognised that this is a rather arbitrary figure and could be adjusted either upwards or downwards on the basis of more accurate information breaking down the different types of farmland within LFAs.

Within the context of the current CAP framework, the existence of Pillar One decoupled direct payments needs to be recognised as well. These payments play a role in maintaining income stability and for certain farms form a significant proportion of farm income thereby supporting the provision of considerable environmental benefits indirectly. However, it is unclear the extent to which direct payments are essential for farm viability for different farming types. Although it is clear that the absence of direct payments would lead to structural change, increasing the average size of holdings, some of which would be deleterious to the environment, it is difficult to quantify this in any meaningful way. It is, therefore, impossible to estimate what proportion of direct payments currently contribute to the provision of environmental benefits on farmland, and should therefore be factored into the costs estimates. Therefore, no additional costs have been included in the estimates to account for the contribution currently made by direct payments, although the cost estimates do assume their continued existence. This issue is considered briefly in Chapter 9.

It should be noted, however, that in many situations current payment rates, based on the income foregone and additional costs formula, are likely to be insufficient to achieve the necessary level of uptake of management options that would be needed to meet environmental needs in full. This is particularly true in relation to in-field options in arable systems where the actions needed are likely to require significant changes to farm operations and may impact to some degree on the productive capacity of the farm business. Therefore the costs for incentive measures in this study are likely to be an underestimate of what would be required in practice to achieve the desired management at the scale required, unless alternative means of delivering such management were to be found, for example by requiring farmers to put a certain proportion of their land under environmental management in return for a basic per hectare payment. These issues are explored further in Chapter 9.

b) **Payments associated with Capital Costs and Advice and Training**

Given the variability in the costs of different types of environmentally directed capital investments on farms in different regions of the EU-27 and the lack of data availability on these costs it has not been possible to estimate the cost of supporting the investments needed to meet specific environmental needs. The variability in the costs of aid for capital investment relating to climate change mitigation options in different Member States is highlighted by information from the IMPACCT study, currently being undertaken by Hertfordshire University. This shows that the cost of solar panels in the warmer Mediterranean countries (where they are commonplace) can be up to ten times lower than in cooler countries. Another example is the installation of insulation for buildings where the cost can be very much lower in less affluent countries such as Poland and Hungary compared with the richer countries such as the UK, France and Germany as much of the cost is for labour (K Lewis, pers. comm.).

Given these issues, the only available data on which to start to base an estimate of the costs needed for environmentally beneficial capital investments are those relating to the funds that have been allocated to capital investment in the farming and forestry sectors under the current programming period. Only a proportion of this allocated budget is focused currently on environmentally beneficial investments (for example to introduce improved slurry storage or manure management facilities, to improve livestock housing, to introduce more sustainable irrigation technologies etc). A larger proportion is concerned with increasing farm competitiveness. However, given that the available literature highlights the need for investments of this kind to help achieve the environmental targets set out in Chapter 2, particularly to address climate mitigation, water quantity and water quality issues, it could be assumed that, at the very minimum, the total EAFRD budget currently allocated to capital investments would be needed in the future to address environmental needs. These costs are therefore added to the estimates for area based management payments.

Similarly there is little quantified information available at the EU-27 level on the cost of providing advice and information to land managers in relation to environmental management. Not only does the cost of providing advice and training to farmers and foresters differ between Member States, but so too does the institutional capacity to deliver such activities. As with the capital investment costs, a proxy is needed, although estimating this is not straightforward as data are not readily available. However, based on evidence from the UK that the transactions costs associated with agri-environment scheme delivery average approximately 10 per cent of total scheme costs, we have estimated that advice provision requires at least five per cent of the costs associated with payments to encourage environmental management. The arbitrary nature of this figure is recognised. Nonetheless, it provides a marker that acknowledges the need for such costs to be taken into account. Currently, the majority of advisory costs tend to be funded from national budgets, rather than using EU funds, however the importance of advice in achieving beneficial outcomes and long term behavioural change is being recognised increasingly and it may be that the amount of money allocated to advice provision from EU sources grows in the future.

4.2 Cost Estimates – The Results

Using the methodology outlined above broad brush figures have been produced on the scale of funding required from the public purse (both European and national sources) to meet the range of environmental needs in farming and forestry identified in chapter 2. These figures provide a first attempt to quantify the estimated level of costs that are needed to meet the environmental priorities identified in the EU-27 in relation to biodiversity, landscape, water quality, water quantity, soil conservation, climate mitigation and climate adaptation.

The cost estimation is based on a combination of figures for:

- the costs of undertaking environmentally beneficial land management on agricultural and forested land, based on payment rates used under the agri-environment and forestry rural development measures
- costs to account for basic payments over 60 per cent of the LFA
- costs for investments in physical infrastructure
- costs for advice and training

As explained in the methodological section above, given the generalised nature of the assumptions that underpin the calculations for environmentally beneficial land management, the figures should be treated with caution. They are an informed estimate based on a review of the available literature and expert judgement. The detailed figures on which these estimates are based are set out in Annex 7. Given the methodology used it is not possible to calculate formal confidence limits for the cost calculations. There are a number of parameters that affect the accuracy of the cost estimates, the most significant of which are the area of land deemed to be needed under particular management actions and the cost per hectare of undertaking the management. A margin of error of plus or minus 25 per cent has been calculated to demonstrate the potential range within which the estimated costs might fall. This is an arbitrary figure, but one considered to be large enough to take account of inaccuracies in the figures as a result of the broad assumptions made.

Based on this methodology, the costs of undertaking environmentally beneficial land management on agricultural and forested land in 2020, were calculated to be in the region of €34 billion/year. Payments would rise towards this level over the period 2014-2020. To this figure were added the costs of three other elements considered necessary for the delivery of good environmental management. These are the provision of a basic per hectare payment over 60 per cent of the LFA, to contribute to the economic survival of environmentally sensitive farms, as well as an estimate for investments needed in physical infrastructure and advice and training. These added an additional €9 billion/year to the costs to provide an **overall estimate of €43 billion/year (+/- €8.5 billion) as the approximate level of financial resources needed (from EU and national/regional sources) to deliver the EU's environmental objectives using incentive based measures.**

These are set out in Table 4.1. As can be seen, the largest proportion of these costs are associated with providing payments to farmers directly for carrying out environmentally beneficial management on farmland and woodland.

Table 4.1: Cost Estimates for Meeting the Environmental Needs Associated with Rural Land Management

Type of Cost	Costs (€ billion) per year	Basis of Cost Estimate
Costs associated with environmentally beneficial management on farmland and woodland (A)	34.2 -25% = €25.65 billion +25% = €42.8 billion	Methodology – Annex 1 Detailed cost estimates – Annex 7
Additional allocation for 60% of farmland within LFAs (B)	4.0	Average Member State LFA payment rate (€74/ha) X 60% LFA area
Capital Investment Cost (C)	3.2	Based on average annual budget

		allocation under EAFRD measures 121, 125, 216 and 227 for the EU-27 over the 2007-13 programming period
Advice and Training (D)	1.7	Based on estimate that approximately 5% of the costs delivering environmental management are required for advisory services
TOTAL	**43.1**	
Range allowing for Cost A to vary +/- 25%	**34.6 – 51.7**	

Source: IEEP own calculations

4.2.1 Important Caveats

These figures represent an indication of the scale of funding that is likely to be needed to address many of the pressures facing the environment through rural land management in all EU-27 Member States. However, they need to be treated with caution. Not only are the data to underpin such cost estimates limited, but the level of financial resources required, and whether they are sourced from the EU or national budgets, are affected by numerous factors (policy, institutional, behavioural, financial). The estimates, therefore, have had to rely on expert judgement, to a significant degree. For this reason a margin of error of +/- 25 per cent on the core cost estimate has been calculated to allow for any inaccuracies in the assumptions underpinning the figures.

There are a number of additional important caveats to the cost estimates that should be borne in mind, as follows.

Firstly, we have taken an "integrationist approach" to calculating the costs of delivering the EU's environmental targets, in the sense that we have assumed the that there is a need to introduce environmentally beneficial management practices on areas of highly productive land as well as less productive areas. The cost calculations do not take account of the relative cost effectiveness of delivering environmental objectives through one route over another.

Secondly in relation to biodiversity, the figures represent only an estimate of the costs of halting the loss of biodiversity, and not the costs of biodiversity restoration. Estimating the scale of habitat restoration needed in Europe and its associated costs requires a far more detailed assessment than is possible within the scope of this study, but the additional costs associated with such activity would need to be added to the cost estimates provided within this study.

Thirdly, the methodology used has meant that the cost estimates are largely based around those management options that are prioritised under current rural development programmes. This may underestimate the costs of management or capital investments needed to address forthcoming priorities for climate mitigation or adaptation needs in 2020 as these are not adequately reflected in current rural development programmes in Member States. Such actions might include the costs associated with reduced or no tillage practices, nutrient management techniques such as slurry injection, the appropriate management of peatland areas, such as restoring water tables etc. An indication of the potential scale of such costs, particularly where they relate to soil carbon management, is investigated in the soil case study in Chapter 5.

Fourthly, the additional administration costs that would be associated with the additional environmental delivery required have not been accounted for. In practice these would be likely to be considerable.

Finally, as highlighted previously, the cost estimates have assumed the continuation of the current policy structure. This assumes Pillar 1 direct payments are maintained at their current level and full implementation of the current environmental regulatory framework. The estimates do not, therefore, assume any shift of payments for environmentally beneficial management into Pillar 1, as proposed in the Commission Communication of November 2010 (COM (2010)672 final). A discussion on the impacts that changes to these factors would have on the costs of delivering environmental outcomes is elaborated in Chapter 9.

4.2.2 Breakdown of Costs by Land Use

The overall costs associated with environmentally beneficial management on farmland and woodland can be broken down by land use following the categories used in the CORINE Land Cover database (Table 4.2). This shows that just over half the total costs associated with meeting the EU-27's environmental needs are associated with the management of arable land. These costs relate to approximately 40-50 per cent of arable land being under one or more relevant management practices. A further 30 per cent of the costs are associated with grassland management over approximately 70-80 per cent of grassland in the EU-27. Ten per cent of the costs relate to the creation or management of forested area. This is a significant increase in the current levels of spending in this area, but is based on the assumption that the current level of spending is disproportionately low, given the increasing importance placed on woodland for meeting the EU's environmental objectives, particularly in relation to climate change.

Table 4.2: Cost Estimates Associated with Different Land Uses

Land Use	Cost Estimate for Environmental Management needed (€ billion)	Proportion of cost estimate (%)
Arable	17.6	51.5
Grassland	10.1	29.5
Permanent Crops	1.5	4.4
Rice	0.1	0.3
Wetland Habitats (including, grazing marsh, peatland etc)	1.5	4.4
Forest and Woodland	3.4	9.9
Total	**34.2**	**100**

Source: IEEP own calculations

When these figures are broken down further by type of management (

Table 4.3), the results indicate that the largest proportion of the costs are accounted for by two types of management, each accounting for 22 per cent of total costs - organic management and in field options on arable land. The costs of both organic conversion and providing payments for the ongoing management of land according to certified organic standards have been calculated based on the assumption that 9 per cent of arable land, 9 per cent of permanent crops and 18 per cent of grassland would be managed as organic in 2020 and assuming an organic conversion rate of one per cent a year for grassland and 0.5 per cent per year for arable and permanent crops. This produces a total cost associated with organic management of €7.8 billion/year (22.8 per cent of the total cost estimate). An equally significant proportion of the total costs is associated with in-field management options on arable land, for example requiring farmers to crop using less inputs, using crop rotations and green cover, changing the timing of cropping by using overwinter stubbles and spring cropping, reducing tillage practices etc. This is unsurprising as the price of cereal crops is such that compensating farmers for the income foregone in reducing yields by undertaking these management practices will be substantial.

Although these two sets of management options account for almost 45 per cent of the total costs of environmental management, the management involved is critical for meeting the EU's resource protection targets for water quality, soil conservation, including maintaining high levels of soil carbon, and water quantity as well as for halting the decline of common farmland birds and reducing GHG emissions.

Approximately 30 per cent of the costs are associated with the environmental management of grassland, with over half of this cost estimated to be needed to maintain or introduce extensive grazing practices over approximately 50 per cent of the grassland area, and a further 38 per cent of the costs needed to convert and maintain 18 per cent of grassland under organic management. The costs associated with wetland habitats relate to maintaining a high proportion of grazed wetland habitats under management, ensuring that they are not over or under-grazed and that the water table is kept at the appropriate level to maintain the semi-natural habitats and prevent the loss of soil carbon.

In comparison, the costs of maintaining 100 per cent of landscape/structural features appears to be a fairly low cost option, accounting for only 4.6 per cent of total costs, but with significant environmental benefits. However, as noted in section 4.2.1, this does not take account of the significant costs that would be associated with the need to recreate landscape features that have been removed previously in many areas.

Table 4.3: Cost Estimates for Different Land Uses by type of management

Land Use	Cost Estimate for Environmental Management needed (€ billion)	Proportion of total cost estimate (%)	Proportion of cost estimate for each land use (%)
Arable	**17.6**	**51.5**	
Organic Management	3.5	10.2	20.1
Integrated Farm Management	1.9	5.6	10.7
In field management options[1]	7.5	22.0	42.9
Non productive options[2]	2.3	6.7	12.8
Conversion to grassland	1.7	5.0	9.8
Management of structural features[3]	0.7	2.0	3.8
Grassland	**10.1**	**29.5**	
Organic Management	3.9	11.4	38.1
Extensive management	5.3	15.5	52.0
Buffer strips/Grass Margins	0.2	0.6	3.0
Management of structural features[3]	0.7	2.0	6.9
Permanent Crops	**1.5**	**4.4**	
Organic Management	0.4	1.2	24.9
Integrated Farm Management	0.2	0.6	13.2
Extensive management	0.7	2.0	49.0
Buffer strips/Grass Margins	0.1	0.3	3.9
Management of structural features[3]	0.1	0.3	9.0
Rice	**0.1**	**0.3**	
Extensive Management	0.1	0.3	100
Wetland Habitats (Grazing Marsh, Peatland etc)	**1.5**	**4.4**	
Extensive management	1.3	3.8	90.8
Buffer Strips/Grass Margins	0.1	0.3	5.8
Management of structural features[3]	0.1	0.3	3.4
Forest and Woodland	**3.4**	**9.9**	
Management of existing woodlands	3.0	8.9	88.2
Creation of new woodland on agricultural land	0.4	1.0	11.8
Totals	**34.2**	**100**	

Source: IEEP own calculations

[1] In field options include reduced inputs, crop rotations, green cover, overwinter stubbles, spring cropping, reduced tillage, using rare or threatened crop species, and other soil protection measures.
[2] Non productive options include fallowing part or whole fields, creating grass margins, beetle banks, buffer strips etc.
[3] Structural features include stone walls, ditches, banks, hedges, trees, terraces etc.

4.2.3 Breakdown of Costs by Environmental Issue

It has not been possible to determine with any accuracy the area of land required for each management option by environmental objective, given limited data availability and the absence of spatial data to indicate the degree to which the area required under a particular management practice to meet different environmental objectives differs or is geographically congruent. However, in order to provide some indication of the breakdown of costs by environmental issue, a rather simplistic approach has been taken.

An assessment has been made of the degree to which each management option delivers against each environmental objective, whether it contributes directly to achieving the environmental objective, makes an incidental contribution, has the potential to contribute or does not contribute towards meeting the environmental objective at all. However, this simply provides an estimate, for each environmental issue, of the combined costs of the various management options that have been identified as making a direct contribution to meeting the associated target. This does not provide any meaningful information in relation to the cost estimates, although they do indicate the high number of management options identified that can deliver benefits for biodiversity, soil conservation and water quality, and that in many cases the same management option can deliver benefits for multiple environmental media (see Table 4.4). Chapter 6 considers in more detail the issues of assessing the spatial overlaps between different environmental priorities and the management practices that can be used for their delivery.

Table 4.4 Number of management options contributing towards each environmental priority

Contribution towards objective	Biodiversity	Landscape	Water Quality	Water Quantity	Soils	Climate Change Mitigation	Climate Change Adaptation
Y1	31	13	19	10	24	17	9
Y2	4	1	2	0	0	0	2
P	1	2	2	1	0	8	3

Y1 = Management option contributes directly to environmental objective
Y2 = Management option contributes indirectly to environmental objective
P = Management option has the potential to contribute to environmental objective depending on how and where it is applied.

5 THE CASE STUDIES: INTERROGATING THE COST ESTIMATES IN RELATION TO SPECIFIC ENVIRONMENTAL NEEDS

To complement these broad brush cost estimates and to interrogate critically their robustness in meeting the identified environmental needs, three case studies have been undertaken in relation to the following environmental issues:

- Halting the decline of arable farmland birds,
- Maintaining HNV farmland across the EU; and
- Delivering improvements in soil conservation

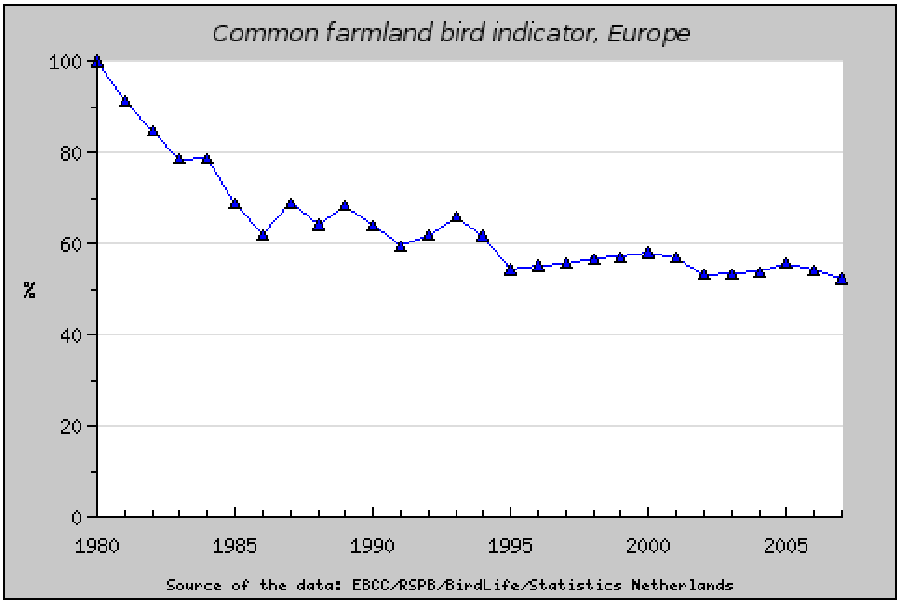
As well as focusing on core environmental issues, the case studies serve to examine some of the methodological issues associated with the costing exercise, for example, aggregation and upscaling, data availability, and the robustness of the estimates, given wide regional differences.

5.1 Case Study 1: Cost Estimates for Halting the Decline in Common Farmland Birds in Intensive Arable Systems

5.1.1 Introduction

Recent changes in agricultural practices have had well documented, widespread and significant impacts on biodiversity in Europe (Stoate *et al*, 2009). Of these, perhaps the most obvious and best quantified in recent years have been declines in farmland bird populations (Donald *et al*, 2001). Such species have been relatively well monitored, and therefore their trends have been used to develop a Common Farmland Bird Indicator, which forms part of the set of indicators that are used by the EEA to monitor the status of biodiversity in the EU (EEA, 2010b). It is also used as an Impact Indicator for estimating the biodiversity impacts of rural development policy measures under the Common Monitoring and Evaluation Framework (CMEF). The indicator provides an index of common farmland bird population changes in Europe in relation to 1980 levels (see Figure 5.1), and clearly shows a substantial decline in their populations to about 50 per cent of their baseline level. The decline appears to have been particularly rapid up to about 1985. Although there is a suggestion from the combined data that the rate of decline may have decreased in recent years, examination of regional trends indicate that the declines are continuing unchecked in all regions other than southern Europe. It is also important to remember that these trends relate to common farmland birds and that population declines in rarer threatened farmland species appear to be unabated and are therefore of particular concern (BirdLife International, 2004).

Figure 5.1 Changes in the Common Farmland Bird Indicator in Europe



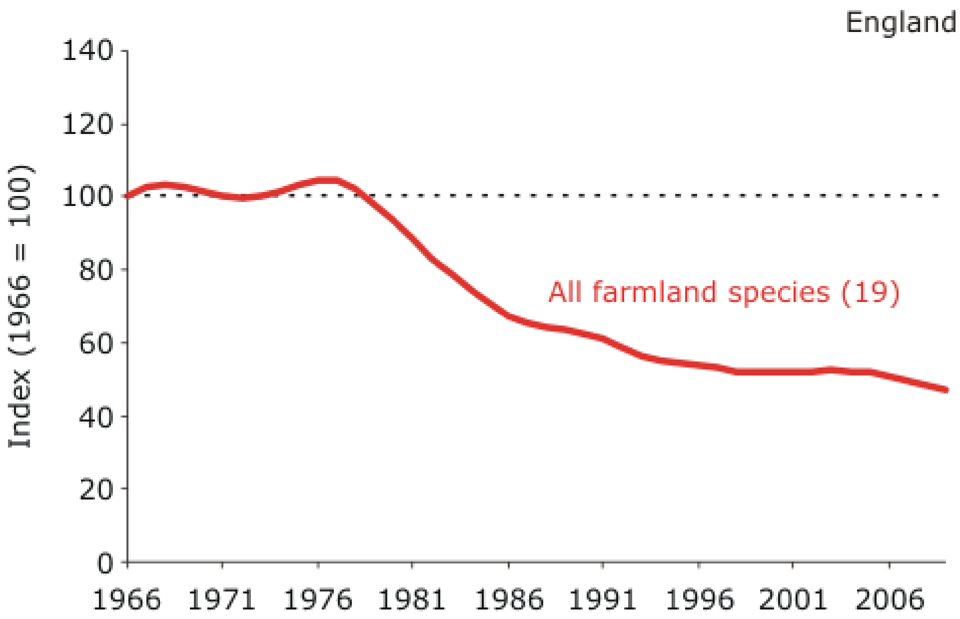
Note: Individual national species indices are produced by annually operated national breeding bird surveys from 22 European countries that cover different periods and are obtained through the Pan-European Common Bird Monitoring Scheme (PECBMS).The most recent report provided by the European Census Council and Birdlife International presents the combined population trends of 135 common bird species based on data collected from 21 European countries (pan-European level), covering the period 1980–2006. The most recent version of the combined indicator does not cover AT, CY, EL, LT, LU, MT, RO, SI, SK.

Source: European Bird Census Council http://www.ebcc.info/index.php?ID=382

Declines in farmland bird populations have been especially well documented and significant in the UK, particularly between the mid-1970s and mid-1980s (Figure 5.2). Although in recent decades the rate of decline has diminished, the farmland bird index is now 53 per cent below its 1966 starting level, its lowest recorded value. Furthermore, there is some indication that the rate of decline is increasing again, possibly as a result of the loss of set-aside. These declines have been of considerable public and governmental concern and consequently the UK Department for Environment, Food and Rural Affairs (Defra) selected farmland bird trends as one of its sustainable development indicators (Defra *et al*, 2010) and adopted a Public Service Agreement target between 2000 and 2010 to reverse their decline in England[11].

[11] All Public Service Agreements have subsequently been abolished by the new UK Government in 2010.

Figure 5.2 Populations of farmland birds in England, 1966 to 2009 (smoothed index)



Source: Defra, Statistical data release[12], 29 July, 2010

The causes of these declines have also been studied in considerable depth in the UK, especially over the last couple of decades. As a result, the key causes have been reliably ascertained and it is clear that most of them relate to changes in agricultural practices (eg Newton, 2004; Wilson *et al*, 2009). These findings are broadly consistent with studies of the impacts of agricultural practices on farmland birds elsewhere in Europe (Stoate *et al*, 2009). In general the declines have been driven by reductions in both the extent and quality of key farmland habitats, leading to reductions in food supply (in particular, the loss of seed-rich habitats in winter and invertebrate-rich habitats during the breeding season), and/or suitable nesting sites (especially in-field nesting sites for ground nesting species). According to Newton (2004) the main agricultural causes of these ecological impacts have been 1) weed-control, mainly through herbicide use; (2) the change from spring-sown to autumn-sown cereal varieties, and the associated earlier ploughing of stubbles and earlier crop growth; (3) land drainage and associated intensification of grassland management (especially re-seeding and artificial fertilisation); and (4) increased stocking densities, mainly of cattle in the lowlands and sheep in the uplands. Other contributory causes include increased use of pesticides; simplification of cropping patterns/rotations due to farm/regional specialisation and loss of mixed systems; loss of interstitial habitats (hedges, ditches, ponds etc) and increased mechanisation/efficiency of cropping (eg leading to less spilt grain).

12 http://www.defra.gov.uk/evidence/statistics/environment/wildlife/download/pdf/100729farmland-birds-release.pdf

The findings of these studies have been used by bird conservation and research organisations to identify and quantify the practical measures that are needed to reverse declines in farmland birds (Vickery *et al*, 2008; Winspear *et al*, 2010). Some of these measures are still under development, but most are now available within the two principal English agri-environment schemes under the England Rural Development Programme. There are the Entry Level Stewardship (ELS) and Higher Level Stewardship (HLS) agri-environment schemes. ELS aims to provide widespread but basic level environmental measures, and is available to all farmers. It is a whole farm scheme with the funding per farm limited to £30/ha/annum. HLS provides more specific and targeted measures through a competitive scheme.

In response to requests from farmers and advisors, conservation organisations have developed a Farmland Bird Package, which is a set of recommended ELS and HLS measures that, in combination, provide the key ecological requirements of the most common arable farmland birds (Winspear *et al*, 2010). Thus, if adequately and properly implemented, the package would be expected to halt the decline in arable farmland birds.

This case study draws on this relatively good understanding of environmental needs to estimate the cost of halting the decline in bird populations in intensive arable farming systems within England on the basis of the implementation of the Farmland Bird Package. The cost estimates for England are then extrapolated, with appropriate weighted adjustments, to other Member States, to produce an overall approximate estimate of the cost of halting the decline of bird populations in intensive arable farming systems across the EU-27.

The case study only covers arable habitats, including temporary grasslands (usually less than five years old) that form part of rotational arable systems. It does not cover intensive permanent grasslands and other non-arable farmland habitats because there is insufficient knowledge of the practical measures and scale of response that is necessary to adequately mitigate the pressures affecting farmland birds in these habitats. In particular, although some agri-environment measures have been identified and developed that address the ecological requirements of grassland birds, the mix of measures and area over which each needs to be applied is insufficiently well known to provide reasonably reliable estimates of costs.

5.1.2 Methods

A description of the methods is provided below, with full calculations provided in Annex 8.2.

Step 1. Identification of measures needed to reverse declines of key species

The case study covers the following farmland bird species that are the focus of the Farmland Bird Package (see Annex 8 for scientific names of all species mentioned in this study): Corn Bunting, Grey Partridge, Lapwing, Linnet, Reed Bunting, Skylark, Turtle Dove, Tree Sparrow, Yellowhammer and Yellow Wagtail. These are widespread species that have undergone particularly large declines in the UK and elsewhere in much of Europe over recent decades

(BirdLife International, 2004). Although these are a subset of arable farmland species, they include most of the common and declining species associated with the habitat.

Table 5.1 outlines the recommended options within ELS and HLS that in combination can provide all the necessary requirements for the target arable farmland birds in terms of winter seeds, summer invertebrate food and in field nesting habitats. Other habitat requirements (eg breeding sites for hedge-nesting species) are not generally considered to be the primary factors limiting the target species. Therefore measures, for example, relating to hedgerow maintenance or restoration are not included in the package. In some cases such measures might be necessary, but these requirements would probably not substantially alter the estimated cost of halting the decline of these species.

Table 5.1 Options under Entry Level Stewardship and Higher level Stewardship in England for meeting the key ecological requirements of farmland birds in the arable Farmland Bird Package

Resource	Options
Winter seed food	Wild bird seed mixture or Weed-rich stubble or A combination of the two
Spring-summer invertebrate food	Conservation headlands, low-input spring cereals, undersown spring cereals+, uncropped cultivated margins, nectar flower mixtures, field corners*, beetle banks*, flower-rich margins*
In-field nesting habitat	Skylark plots Fallow plots (or extended over-wintered stubbles+)

*Not included in ELS package, + Not included in HLS package.
Source: Winspeare et al, 2010.

As indicated in Table 5.2, it is anticipated that the Farmland Bird Package will provide most of key broad ecological requirements of the target species, although some, such as Turtle Dove, may require additional specific measures. The range of measures for these species also probably covers most of the ecological requirements of other less common declining farmland birds, such as Cirl Bunting and Stone Curlew. Some farmland species may require some additional specialist and targeted measures (such as nest protection actions for Stone Curlew), but the impact on overall costs of arable farmland birds measures would be expected to be insignificant given the scarcity of such species.

Table 5.2 Requirements of the target arable farmland bird species that should be provided by the farmland bird package of ELS and HLS measures

Species	Winter seed food	Summer insect food	In-field nesting habitat
Grey Partridge	√	√	
Lapwing			√
Turtle Dove		√*	
Skylark	√	√	√
Yellow Wagtail		√	√
Tree Sparrow	√	√	
Linnet	√		
Yellowhammer	√	√	
Reed Bunting	√	√	
Corn Bunting	√	√	

* Turtle dove will only benefit from the summer insect food measures that also encourage broad-leafed arable plants

Source: Winspeare *et al*, 2010

It is apparent from Table 5.1 that a range of measures can be used to meet each of the key ecological requirements of farmland birds. The most obvious approach is to reverse previous damaging changes in farming practice. For example, the principal cause of the decline in winter seed food has been the increase in autumn sowing of cereal crops, which means that stubbles are now regularly ploughed up in late summer. Furthermore, where stubbles are retained they now tend to have low levels of weed seed due to the use of herbicides in the preceding crop. Therefore one way of providing weed seeds in winter is through agri-environment measures that reduce herbicide use and require the maintenance of over-winter stubble. However, such whole-field measures tend to be expensive and unpopular with farmers for a variety of reasons, so alternative and novel measures that provide the same ecological benefits are increasingly being developed. For example, research has led to the development of a range of agri-environment measures that provide seeds for birds in winter by planting seed crops that are not harvested but left solely as a bird food resource.

Consequently the Farmland Bird Package includes a variety of options with varying costs that can be used to meet the ecological requirements of the target species. This means that the actual cost of implementing the package cannot be calculated with certainty because the scheme is still being developed and rolled out and therefore the eventual uptake of each option is unknown. The assumed implementation of each option is therefore a balance between the measure that provides the most beneficial ecological impact and those that are most frequently taken up by participants (see Annex 8). For example, we assume that 75 per cent of the required area of winter seed food will be provided by wild bird seed mixtures, whereas only 25 per cent will be through weed-rich stubble.

Step 2. Calculation of area over which each measure is required and scheme coverage

A particular challenge in the development of the Farmland Bird Package has been estimating the minimum area of each option (eg the amount of weed-rich stubble habitat) that is required in the arable farmland landscape. This is a complex ecological issue which needs to take into account the impacts of each measure on the key demographic factor limiting population growth in each target species and the proportion of the population of each species that may benefit from each measure. The former factor is primarily related to ecological quality of the provided habitat, whilst the latter will vary according to the uptake of each measure (ie total area affected) and its spatial distribution in relation to that of the species concerned.

The results of some empirical studies and modelling of the amount of each option that will be required to reverse population declines (Vickery *et al*, 2008) have been taken into account in setting minimum areas for each ecological resource / option combination in the Farmland Bird Package (see Table 5.3). The estimates of required areas of options that provide winter seed food are considered to be relatively reliable, and are supported by empirical evidence (Gillings *et al*, 2005). Nevertheless, the recommended area for weed-rich stubble varies to take into account the possible variation in its ecological quality. Knowledge of the area of invertebrate-rich habitat that is required in summer is much less precise, and is largely based on autecological studies of one species, Grey Partridge. Furthermore, there are significant differences in the ecological benefits of the various options for providing spring-summer invertebrate food, with low-input spring cereals, uncropped cultivated margins and nectar flower mixtures likely to be most beneficial for farmland birds. There is therefore some uncertainty over the adequacy of providing 1 ha of invertebrate-rich habitat per km^2 (100ha) through ELS.

For the calculations in this case study, the midpoints of minimum area required are used for weed-rich stubbles (ie 7.5 ha) and spring-summer invertebrate food options (ie 2.5 ha under HLS).

Table 5.3 Summary of options and minimum area requirements in the Farmland Bird Package for Entry Level Stewardship and Higher level Stewardship in England

Resource	Options	ELS (minimum per km^2)	HLS (minimum per 100 km^2)
Winter seed food	Wild bird seed mixture or Weed-rich stubble or A combination of the two	2 ha or 5–10 ha	2 ha or 5–10 ha
Spring-summer invertebrate food	Conservation headlands, low-input spring cereals, undersown spring cereals+, uncropped cultivated margins, nectar flower mixtures, field corners*, beetle banks*, flower-rich margins*	1 ha	2–3 ha
In-field nesting habitat	Skylark plots Fallow plots (or extended over-wintered stubbles+)	20 or 1 ha	20 plus 2 ha (if appropriate)

*Not included in ELS package, + Not included in HLS package.
Source: Winspeare *et al*, 2010.

In combination, the area requirements for each resource and option set out under ELS are considered to be adequate to halt population declines. However, the scheme would need to cover a high proportion of the arable farmland landscape habitat to be effective (Winspear *et al*, 2010). The provision of higher proportions of habitat is possible through ELS, but constraints on the payments and other aims of the scheme probably limit further provision of these options in practice. The HLS scheme therefore aims to provide greater areas of habitat to increase population impacts in the areas with high concentrations of declining farmland bird species, or particular species (ie Lapwing).

There is a further complication that needs to be considered in the costing of the package. The spatial distribution of the measures will be particularly important in relation to measures that are specifically designed for less common species. Thus, HLS measures need to be spatially targeted to be cost-effective. If untargeted and sparsely implemented there will be a low chance that the intended species will benefit (because the species and measures will infrequently coincide), in which case the measures will be ineffective. If they are widely implemented but untargeted then there is a greater chance that the target species will benefit, but the scheme will be inefficient (ie paying for measures in locations that cannot provide a benefit).

Targeting is therefore an important strategic tool that reduces the costs of delivering the farmland bird target considerably. Consequently, Natural England targets certain ELS/HLS options to Nationally Important Farmland Bird Hotspots (see Phillips *et al*, 2010). Within arable farmland these are defined as areas supporting three or more of the following range restricted arable birds: Grey Partridge, Corn Bunting, Lapwing, Turtle Dove, Tree Sparrow and Yellow Wagtail. Targeting is based on maps of the known location of target species from breeding bird atlases (and these maps are available on the internet[13]). The cost estimates in this case study therefore assume that effective targeting is carried out, although this is unlikely to be feasible to the same degree in many other countries with less developed farmland bird mapping and census schemes.

To complete the calculation of cost it is necessary to estimate the proportion of the arable landscape over which the package needs to be applied. This is very difficult to quantify with certainty as spatial data on the extent of all the key pressures is lacking. However, there is widespread agreement that most, if not all, arable farmland in England is under management that is sufficiently intensive to result in deficiencies in supply of at least one of the key ecological requirements for farmland birds. This is particularly the case since the abolition of set-aside, which was shown to provide some of the key resources (such as stubbles) now delivered through ELS (Wilson *et al*, 2009). Although organic farming systems are known to provide a range of ecological benefits, including for farmland birds (Bengtsson *et al*, 2005), these are variable and unlikely to widely meet all the ecological resource requirements of all the species covered by the Farmland Bird Package.

The broad extent of pressures on farmland birds is acknowledged by Defra, and consequently it aims to have at least 70 per cent of farmland covered by ELS. However, modelling work by the British Trust for Ornithology for Defra suggests that, if achieved, this level of uptake would not be sufficient to halt farmland birds declines if the current pattern

[13] http://www.natureonthemap.org.uk/map.aspx?map=aes

of option uptake is maintained (Vickery *et al*, 2008). With 70 per cent ELS uptake, the area under management options for farmland birds would be sufficient for four species, provide mixed outcomes for two and be insufficient for five species. In general, the main problems are due to uncertainty over the effectiveness of grassland measures and the low uptake of in-field options (and efforts are therefore being made to address these issues).

To take into account the plausible combinations and variation in scheme coverage (ie proportion of arable landscape under ELS or HLS) and the areas of each specific measure required to halt farmland bird declines, the calculation of costs was based on the following four scenarios that were applied to arable farmland in England on the basis of the farmland bird package described in Table 5.3 above.

- **Scenario 1: 70 per cent ELS coverage, 1 ha per km^2 summer invertebrate-rich food habitat**
  This is based on Defra's target of achieving ELS over 70 per cent of farmland, and follows the current recommendations in the Farmland Bird Package for the area of summer food provision.

- **Scenario 2: 100 per cent ELS coverage, 1 ha per km^2 summer invertebrate-rich food habitat**
  This scenario increases the coverage to 100 per cent, because as discussed above, it is likely that some farmland birds will be impacted by at least one key resource factor over most if not all arable farmland.

- **Scenario 3: 70 per cent ELS coverage, 1 ha per km^2 summer invertebrate-rich food habitat + targeted HLS with 2.5 ha per km^2 summer invertebrate-rich food habitat**
  This scenario, equates to the currently proposed Farmland Bird Package for ELS and HLS, and aims to provide sufficient coverage and address uncertainty over the required levels of summer invertebrate-rich food habitat by adding targeted HLS measures. Although this does not provide 100 per cent coverage of arable farmland, it may provide the optimal combination of coverage and area of measures by targeting areas with concentrations of arable farmland species, and increasing key demographic rates in these areas such that they offset declines in areas that are not covered by either scheme.

- **Scenario 4: 100 per cent ELS coverage, with 2.5 ha per km^2 summer invertebrate-rich food habitat**
  As in Scenario 3, this scenario aims to provide sufficient coverage and address uncertainty over the required levels of summer invertebrate-rich food habitat, but in this case this is through 100 per cent ELS coverage and high densities of summer invertebrate-rich habitat provision in all areas. This therefore addresses the possible need to halt all losses outside the targeted HLS areas (ie if increases in key demographic rates in targeted areas are insufficient to offset declines elsewhere). This is the most onerous and costly scenario, but is simple and mostly likely to reverse declines, and requires no targeting of measures.

Of these scenarios, Scenario 3 is considered to be the most realistic in terms of being able to cost-effectively halt arable farmland bird declines.

Step 3. Extrapolation to the EU

This case study uses the estimated cost of halting the loss of arable farmland bird declines in England as a basis for an estimation of the costs of halting declines in such birds across the EU. This was done by firstly extrapolating the costs to the whole of the UK, assuming that ecological requirements, quantities and costs of measures in England are comparable to those of Northern Ireland, Scotland and Wales. From this a cost of halting farmland bird declines over each arable km^2 was calculated.

Extrapolation of UK costs to the EU obviously needs to take into account the fact that arable farmland varies significantly across Europe, especially in terms of management intensity. However, most of the declining arable species are common to all Member States and their ecological requirements are likely to be similar. Therefore, although exact measures will need to vary according to circumstances, it is considered that a reasonable estimate of costs for the EU can be ascertained if corrected for ecological needs. In particular, the extent of required measures will greatly depend on the intensity of farming in each country and its current impacts on farmland bird species.

The per km^2 cost of measure was therefore revised for each Member State by calculating the proportion of common arable species that are declining in the country and adjusting the cost in relation to the proportion of declining species in the UK. In other words, it is assumed, for example, that the cost of halting the loss of farmland birds per unit area in a country would be half that of the UK if half as many farmland birds are declining. The most recent bird population trend data that could be used for this calculation were those for the late 1990's (BirdLife International, 2004). These data may therefore not be entirely reliable indicators of current trends, but are considered to be adequate for these purposes. More recent data from the Pan-European Bird Monitoring Scheme are insufficiently complete for the purposes of this study.

It also needs to be borne in mind that payment rates for agri-environment measures are likely to vary significantly amongst the Member States as these are based on income foregone plus additional costs, and these will be primarily driven by the profitability of farming. Therefore the costs of addressing farmland bird declines amongst the Member States should also be corrected according the profitability of arable farming in each country (by for example comparing Standard Gross Margins in the each Member Sate with those of the UK). Complete consistent Standard Gross Margin data could not be found for arable crops at a Member State level. Without this correction it is likely that the overall cost of halting the farmland birds declines will be over-estimated, because UK agri-environment payments are likely to be atypical and towards the higher end of the EU range.

5.1.3 Results

The projected cost of each scenario, in terms of payments to farmers in England to undertake each of the measures, is outlined in Table 5.4 below (see Annex 8 for detailed calculations). This suggests that these costs are likely to vary from approximately €51 million under Scenario 1 to €96 million under Scenario 4. However, Scenario 3 is considered to be the most realistic means of halting the loss of arable farmland birds, through its combination of widespread ELS options and targeting of denser areas of habitat provision under HLS. At approximately €59 million its cost is appreciably lower than under Scenario 2 and 4. This clearly shows the cost-effectiveness of targeting measures (as also illustrated in Phillips et al, 2010). Although bird surveying, data management and farm advisory costs associated with targeting are unknown and therefore not taken into account here, it is reasonably certain that they would be a small proportion of the total costs of the scheme. However, it should be borne in mind that most of the bird data that are used for targeting are supplied by volunteer fieldworkers, albeit under the guidance of professional bird conservation and research organisations.

The Scenario 3 estimate of €59 million (£49 million) per annum comprises 47 per cent of the total agri-environment budget of £105 million in 2006, or 13 per cent of the expected budget of £368 million for 2010/11. This suggests that the full funding of the measures would be plausible under the foreseen 2010/11 budget.

Table 5.4 Summary of projected costs of halting farmland declines on arable farmland in England

Scenario	ELS coverage	HLS coverage		Summer insect food (ha per km2)		Costs (£)		Costs (Euro)	
		Summer insect food	**In-field nesting habitat**	**ELS**	**HLS**	**Total**	**Per km²**	**Total**	**Per km²**
1	70%	0%	0%	1		43,037,332	986	51,214,425	1,174
2	100%	0%	0%	1		61,481,903	1,409	73,163,464	1,677
3	70%	18%	21%	1	2.5	49,568,743	1,136	58,986,804	**1,352**
4	100%	0%	0%	2.5		81,115,403	1,859	96,527,329	2,212

NB. Exchange rate of £1 = €1.19

Table 5.5 provides a summary of the expected costs of halting arable farmland bird declines in each Member State, on the basis of extrapolation of costs in England under Scenario 3 (ie €1,352 per km^2) and after adjustments that take into account the recent trends in farmland bird populations in each country. On the basis of simple extrapolation by area of arable farmland, the total costs for the EU-27 of halting arable farmland bird declines would be approximately €1.3 billion/year.

However, this is probably an over-estimate of potential EU-27 costs because UK arable farmland has been highly impacted by intensive management for some time, and therefore many farmland bird populations and their important ecological resources are considerably depleted. This is reflected in recent bird trends. Out of 15 arable farmland birds that occur in Europe, 13 occur in the UK, and 11 (76 per cent) of these have shown recent declines. Consequently the Farmland Bird Package in England requires a high level of intervention (including wide scheme coverage and the need for significant quantities of high quality habitat measures). This level of intervention is unlikely to be required in many other Member States, and especially those in southern and Eastern Europe that have more extensive arable farming systems at least in some regions and where farmland bird populations are healthier.

The whole EU cost estimate for halting the decline of arable farmland birds has therefore been adjusted in Table 5.5 by multiplying the area based cost estimate by the proportion of declining arable farmland species in relation to the number declining in the UK. After adjustment for these bird trends (ie ecological needs) the projected cost for the EU-27 as a whole is approximately €854 million.

Ideally the cost estimate for the EU should also be adjusted according to the payment rates in each Member State for the agri-environment measures that could provide equivalent ecological benefits to those described in Table 5.3. However, equivalent measures are lacking in many of the Member States' current RDPs, or they cover a range of issues and are therefore difficult to adjust. Such an adjustment was not therefore considered to be within the scope of this study, but could perhaps help to refine future environmental delivery cost estimates.

Table 5.5 Extrapolation of UK costs (according to Scenario 3) to each EU Member State and the EU-27 as a whole

Country	Arable area (km^2)	Cost based on area (Euro)	Proportion of arable farmland birds declining	Adjusted cost
UK	56,143	75,904,106	0.769	NA
AT	13,419	18,142,464	0.000	0
BE	8,548	11,557,250	0.533	8,015,431
BG	31,080	42,019,479	0.067	3,642,781
CY	925	1,250,580	0.143	232,320
CZ	26,027	35,188,069	0.200	9,151,643
DE	117,843	159,321,154	0.667	138,119,769
DK	24,567	33,214,046	0.600	25,914,730
EE	6,785	9,172,495	0.267	3,180,753
EL	21,114	28,545,125	0.533	19,797,226
ES	80,859	109,319,867	0.200	28,431,695
FI	23,689	32,027,550	0.462	19,222,297
FR	181,200	244,978,024	0.800	254,853,601
HU	44,654	60,371,770	0.067	5,233,790
IE	11,246	15,204,886	0.500	9,886,142
IT	72,317	97,770,729	0.286	36,325,740
LT	18,937	25,602,409	0.600	19,975,872
LU	622	840,390	0.500	546,417
LV	1,292	1,746,485	0.267	605,630
MT	80	108,158	0.714	100,463
NL	10,461	14,142,772	0.600	11,034,673
PL	118,818	160,639,874	0.467	97,484,102
PT	11,029	14,911,237	0.154	2,983,142
RO	92,972	125,696,242	0.267	43,587,774
SE	27,018	36,527,744	0.600	28,500,190
SI	1,824	2,466,414	0.533	1,710,560
SK	13,731	18,564,282	0.400	9,656,323
Total (EU-27)	**1,017,201**	**1,375,233,601**		**854,097,170**

NB. No common arable farmland species were considered to be declining between 1998-2002 in Austria, and therefore no cost is included here. Subsequently, Pan-European Monitoring data have shown significant declines, but for consistency this is not taken into account here, as additional actions for farmland birds in Austria would not make a significant difference to the overall EU-27 cost.

5.1.4 Discussion

It is important to remember that the costs estimates given above do not include transaction costs. As discussed in Chapter 7, the development and delivery of agri-environment measures requires a range of actions to be undertaken (eg research, scheme promotion and guidance, administration, provision of advice, monitoring and reporting), which entails significant costs. Furthermore there is evidence that, to be effective, biodiversity measures need to be based on particularly detailed research, carefully implemented and often targeted to particular species (Wilson *et al*, 2009). Thus, although data on transaction costs for biodiversity-specific measures are not available, it is likely that they will be significant, and perhaps in the order of approximately 10 per cent of payment rates. These costs should therefore be taken into account, but it is important to bear in mind the results above strongly suggests that such scheme support and targeting etc is cost-effective, as it reduces required uptake levels.

It also necessary to consider that additional costs may be required to meet the ecological requirements of other arable farmland bird species not covered by the measures for common birds. Similarly, specific measures may be necessary for other taxa groups, such as arable plants, which are now highly threatened in many countries. However, information is lacking on the specific ecological requirements of many such species, as well as the practical conservation measures than can meet these and the area of over which they need to be implemented. But, as discussed above with respect to farmland birds in the UK, it seems likely that many requirements will be met by the types of measures described above, perhaps in combination with additional measures to restore and manage habitat elements such as hedgerows, ditches, ponds and trees. Furthermore, where specific and potentially expensive requirements are required for particular species these are likely to be for scarce species, and will therefore have a relatively small impact on the overall EU cost figures described above.

Thus it seems unlikely that the cost of halting all biodiversity losses on arable farmland would require more than an additional 10 per cent above the cost of halting bird declines. But it must be remembered that these actions would only halt declines in arable farmland and not restore biodiversity across what is a highly impoverished landscape in many countries. Such restoration costs would depend on the overall objectives, but would undoubtedly be considerably greater than those estimated here.

Lastly, it is important to bear in mind that these cost estimates are based on income forgone payments, and are therefore to some extent theoretical. In practice these payment levels are unlikely to achieve the very high levels of uptake that are likely to be necessary to halt farmland bird declines in many countries, especially where whole field measures are required, because these are often unpopular with farmers for a variety reasons. Indeed, ELS uptake data (Natural England, 2010) show that the most popular options on arable land include hedgerow maintenance, grass margins and buffer strips, and uptake of the most valuable Farmland Bird Package options is inadequate. In England this problem is being addressed by a farming industry led initiative[14] to encourage uptake of the Farmland Bird Package, but to date there is little sign of a significant shift in option uptake. It is therefore clear that the true cost of halting biodiversity losses would be greater than estimated here. Adequate uptake of all required measures would probably require higher payments, or some form of regulatory mechanism (such as through linkages to cross-compliance requirements) that would require minimum implementation levels for key measures.

5.2 Case Study 2: Cost Estimates for Maintaining High Nature Value (HNV) farmland

5.2.1 Background

The principal aim of this case study is to derive an estimate of the cost of maintaining the EU's HNV farmland resource to illustrate the costs of maintaining the biodiversity resource in the wider countryside, particularly through maintaining extensive grazing practices under the current CAP framework.

Substantial tracts of Europe's agricultural area continue to be managed in ways that provide significant benefits for the environment, particularly biodiversity. Increased recognition of this fact led to the development of the concept of HNV farming and the characterisation of HNV farmland as a means of defining and communicating the biodiversity benefits associated with certain types of farming, in order to find ways of supporting the farming practices and systems that are needed to ensure the ongoing provision of these benefits. In 2005, the 'preservation and development of high nature value farming systems' was formalised as one of three core priorities to be addressed under Pillar 2 of the CAP, as set out in the Community Strategic Guidelines for Rural Development (Council Decision 2006/144/EC). As such, the maintenance of HNV farmland is a central part of a strategy to meet biodiversity objectives in the EU. An impact indicator has subsequently been developed as part of the Common Monitoring and Evaluation Framework (CMEF) to allow progress in achieving this priority to be measured.

As described in Beaufoy and Cooper (2008), HNV farmland is typically characterised by a combination of low intensity land use, the presence of semi-natural vegetation and unfarmed features, and a diversity of land cover and land uses. HNV farmland is not only important for its biodiversity value, but can also provide a range of other environmental benefits, such as the maintenance of good soil functionality (which helps to prevent significant water pollution), cultural landscapes and carbon storage. These farming systems also make a significant contribution to sustaining rural communities and shaping rural culture and traditions.

These types of farming systems tend to be found in the more marginal areas of the EU where agricultural productivity is constrained by factors such as poor soils, steep slopes, high altitude, low rainfall etc. Those farmers who deliver the greatest biodiversity benefit are therefore typically farming under the most difficult circumstances (social, economic and environmental) and are subject to the greatest pressures to abandon their traditional way of

[14] http://www.cfeonline.org.uk/

life (Keenleyside and Tucker, 2010). Economic forecasts anticipate significant changes in the structure of livestock and mixed farms over the next 20 years, with a decline in the number of farms and livestock, particularly in the suckler cow sector. Those that are extensive in nature and producing low returns are likely to be the most vulnerable.

The maintenance of HNV farmland – in the face of threats such as intensification, abandonment and land use change – is critical in contributing to halting the loss of farmland biodiversity in the EU. Understanding the scale of costs needed to maintain this resource in the EU-27, therefore, will be critical to inform decisions regarding the targeting of financial resources in the next programming period.

5.2.2 Estimating areas and costs

This is the one of the first studies which has attempted to provide an aggregate figure for the costs of maintaining the EU's HNV farmland resource with support from both Pillar One and Pillar Two. For the purposes of the estimate we have assumed that the main forms of support for HNV farms include decoupled direct payments under Pillar 1 and support through the LFA and agri-environment measures under Pillar 2. In some Member States, farmers in Natura 2000 areas may also be eligible for payments under the Natura 2000 measure to compensate for the restrictions placed upon their management. However these are very small in financial terms and have not be incorporated into the cost calculations. The methodology undertaken to provide an estimate of the current costs of maintaining HNV farmland under the current system of support is set out below.

Step 1: First an estimate of the number of hectares of HNV farmland in each Member State was produced. This was established using the latest JRC and EEA figures (Paracchini *et al,* 2008). They estimated that HNV farmland covers approximately 32 per cent of agricultural land (Corine definition), covering about 74 million hectares (see Table 5.6). This exercise has attempted to combine the Corine Land Cover data for permanent grassland with other datasets for Natura 2000 sites, International Bird Areas, Prime Butterfly Areas, and supplemented with national biodiversity datasets, in order to calculate the area of land that is likely to be of High Nature Value. This proportion differs considerably between Member States, with the highest proportions of HNV farmland being found in the Mediterranean and central and eastern Member States. There continue to be issues with the accuracy of the data, with particular issues identified in relation to the data for Austria, Cyprus and Finland. In addition, due to the fact that there is no data at the pan European scale that allow the identification of low intensity grassland, estimates of the spatial extent of the HNV resource are likely to be an overestimate and provide at best a proxy distribution (Paracchini *et al,* 2008). Despite these deficiencies, the data is complete with the exception of Malta, and produced using a transparent, replicable methodology, based on Europe-wide datasets. It is therefore the most robust source of HNV farmland area data available at the current time.

The most recent estimates of HNV farmland undertaken by Member States to provide data for the CMEF baseline HNV indicator provide another data source. However, their accuracy is highly problematic. Although some Member States have made progress with indicative mapping of HNV farming, the approaches taken are variable and give an approximate picture of geographic distribution at best (Beaufoy and Marsden, 2010). For example, data are unavailable or incomplete for eight Member States, either because they did not submit figures for the baseline indicator (Austria, Lithuania, Luxembourg, Malta, Poland and the UK), or they submitted incomplete data for some regions rather than a complete federal figure (Italy and Germany). Of the Member States that have calculated the extent of HNV farmland in their countries, the methodologies employed vary significantly. For example, Ireland has based the area of HNV farmland on the number of hectares of LFA and Scotland has defined it as the area not under urban or forest cover (Beaufoy, pers. comm.). Other Member States calculated their HNV farmland as equivalent to their Natura 2000 area or have derived figures from the Corine Land Cover database similar to the JRC and EEA study (Beaufoy, pers. comm.).

However, despite this, the CMEF indicator figures for the 19 Member States where data are available suggest that the area of HNV farmland accounts for approximately 37 per cent of UAA, which is not significantly different from the JRC/EAA figures (see Table 5.6), although figures for individual Member States do differ considerably. Recognising the discrepancies between the Member State figures and acknowledging that the data on which the estimates are based are unable to reflect the extent of HNV farmland accurately, the JRC/EEA figures, as the most complete set of data available, have been used as the basis for the subsequent cost estimates.

Table 5.6 Estimates of HNV farmland by Member State according to Paracchini *et al*,2008 and the CMEF indicators

	JRC & EEA study estimates (Paracchini *et al*,2008)					Common Monitoring and Evaluation Framework (CMEF) indicators				
Member State	**HNV farmland area according to this study (ha)**	**Total Agricultural land according to this study (ha)**	**UAA (official figures from EUROSTAT FSS)**	**Discrepancy between total agricultural land and UAA**	**Share of agricultural land that is HNV**	**CMEF Baseline Indicator**	**CMEF Target Indicator**	**% increase from baseline to target**	**HNV as % UAA - baseline**	**HNV as % UAA - target**
AT	2,447,292	3,578,621	3,266,250	109.6%	68.4%					
BE	347,960	1,786,942	1,385,580	129.0%	19.5%	397,246	397,246	0%	29%	29%
BG	2,509,989	6,734,217	2,729,390	246.7%	37.3%	400,000	400,000	0%	15%	15%
CY	342,045	637,043	151,500	420.5%	53.7%	110,000	110,000		73%	73%
CZ	1,043,973	4,950,869	3,557,770	139.2%	21.1%	550,000	550,000	0%	15%	15%
DE	3,162,699	21,607,362	17,127,350	126.2%	14.6%					
DK	172,267	3,446,150	2,707,690	127.3%	5.0%	176,000	254,000	44%	7%	9%
EE	380,879	1,695,820	828,930	204.6%	22.5%	57,000	57,000	0%	7%	7%
ES	18,986,960	34,038,906	26,085,390	130.5%	55.8%	7,486,507	7,486,507		29%	29%
FI	1,330,797	2,967,068	2,215,970	133.9%	44.9%	259,739	300,000	16%	12%	14%
FR	7,797,145	35,311,870	27,856,320	126.8%	22.1%	17,200,000	18,300,000	6%	62%	66%
GR	5,349,572	9,122,263	3,583,180	254.6%	58.6%	1,910,000	1,910,000		53%	53%
HU	1,906,124	6,822,877	4,555,110	149.8%	27.9%	1,400,000	1,917,000	37%	31%	42%
IR	1,162,594	5,777,390	4,443,970	130.0%	20.1%	1,155,432	1,155,432	0%	26%	26%
IT	6,127,030	18,359,587	13,062,260	140.6%	33.4%					
LT	627,202	4,159,700	2792040	149.0%	15.1%		1396020			50%
LU	12,871	142,632	127,510	111.9%	9.0%		6000			5%
LV	568,400	2,853,680	1,432,680	199.2%	19.9%	18,620	25000	34%	1%	2%
MT										
NL	368,788	2,621,717	1,958,050	133.9%	14.1%	39,161	39,161	0%	2%	2%
PO	4,813,243	20,231,887	14,754,880	137.1%	23.8%					

PT	2,900,462	5,035,890	3,736,140	134.8%	57.6%	2,152,017	2,532,017	18%	58%	68%
RO	4,860,372	14,433,920	13,906,700	103.8%	33.7%	2,400,000	2,400,000	0%	17%	17%
SI	591,314	754,255	485,880	155.2%	78.4%	444,658	447,358	1%	92%	92%
SK	547,582	2,485,476	2,159,900	115.1%	22.0%	310,400	640,400	106%	14%	30%
SE	1,136,030	4,759,869	3,192,440	149.1%	23.9%	600,000	810,000	35%	19%	25%
UK	5,165,466	19,368,468	13,174,690	147.0%	26.7%					
Total	**74,659,056**	**233,684,479**	**171,277,570**	**136.4%**	**31.90%**	**39,856,779**	**43,893,141**	**10%**	**35%**	**37%**

Source: Paracchini et al (2008); European Commission, Common Monitoring and Evaluation Framework Indicators.

Step 2: The average per hectare payments received by HNV farmland from decoupled direct payments under Pillar 1 were calculated. Decoupled payments form a significant proportion of total farm income of a majority of farmers managing land within marginal areas (Swinnen *et al,* 2008) and therefore it is assumed that a certain level of decoupled direct payments will need to continue to be provided to HNV farmers in the future to contribute tot their economic viability. However, estimating an average per hectare direct payment for HNV farmland is not straightforward, not least because in the EU-15, Pillar One payments continue to be calculated on a historic basis in the majority of Member States. For the EU-12 calculating the current per hectare payment rate is less of a problem, since the direct payments are paid through the Single Area Payments Scheme, where payments are made on a flat-rate basis per hectare of farmland within a national budget ceiling. Therefore the same rate of payment applies to HNV farmland as to highly intensive arable cropland. These are the figures we have used within the calculations, therefore, although in some cases these may well be an overestimate of what is required in reality in the future (for example, figures for Hungary and Cyprus).

Currently, there is a proportion of agricultural land in Romania and Bulgaria specifically, but also in other Member States to some extent, which falls outside the decoupled direct payment system entirely but a proportion of which is of high environmental value. This is either because the farm size falls below the eligibility threshold, or because of eligibility issues excluding land with a significant proportion of scrub existing on the holding. For the purposes of these cost estimates, however, all land that is considered to be HNV farmland has been allocated a per hectare payment. Average direct payment rates per hectare have been calculated for the EU-12 by dividing the area in receipt of the SAPS by the total national envelope (see Annex 9). Payments vary significantly across Member States, ranging from € 47 per hectare in Latvia to € 176 per hectare in Cyprus.

In the EU-15, obtaining information for average direct payments for extensively grazed farmland is more problematic as payments are based on historic production levels, and therefore average per hectare payments that are available are likely to be significant over-estimates for HNV. There are three exceptions to this, Germany, Finland and England (UK), where a regional flat-rate model is used for calculating direct payments, where the total amount of support under the relevant Pillar 1 regimes paid in a given region in the reference years 2000-2002 is converted into an average amount of entitlement per hectare of eligible farmland. In England, the payment rate in 2009 was €27.37/ha in land that is classified as 'Severely Disadvantaged Areas –Moorland' (DEFRA, 2010). This payment rate is 60 per cent flat rate, 40 per cent historic entitlement, but gradually the entire payment will be a flat rate, and should total approximately €45/ha.

For the remaining EU-15 Member States, some information can be gleaned from the recent modelling work carried out for case studies for the recent EEA study 'The distribution and targeting of the CAP budget from a biodiversity perspective' (EEA, 2009a, which provided information on the Netherlands, France and the Spanish region of Extremadura.

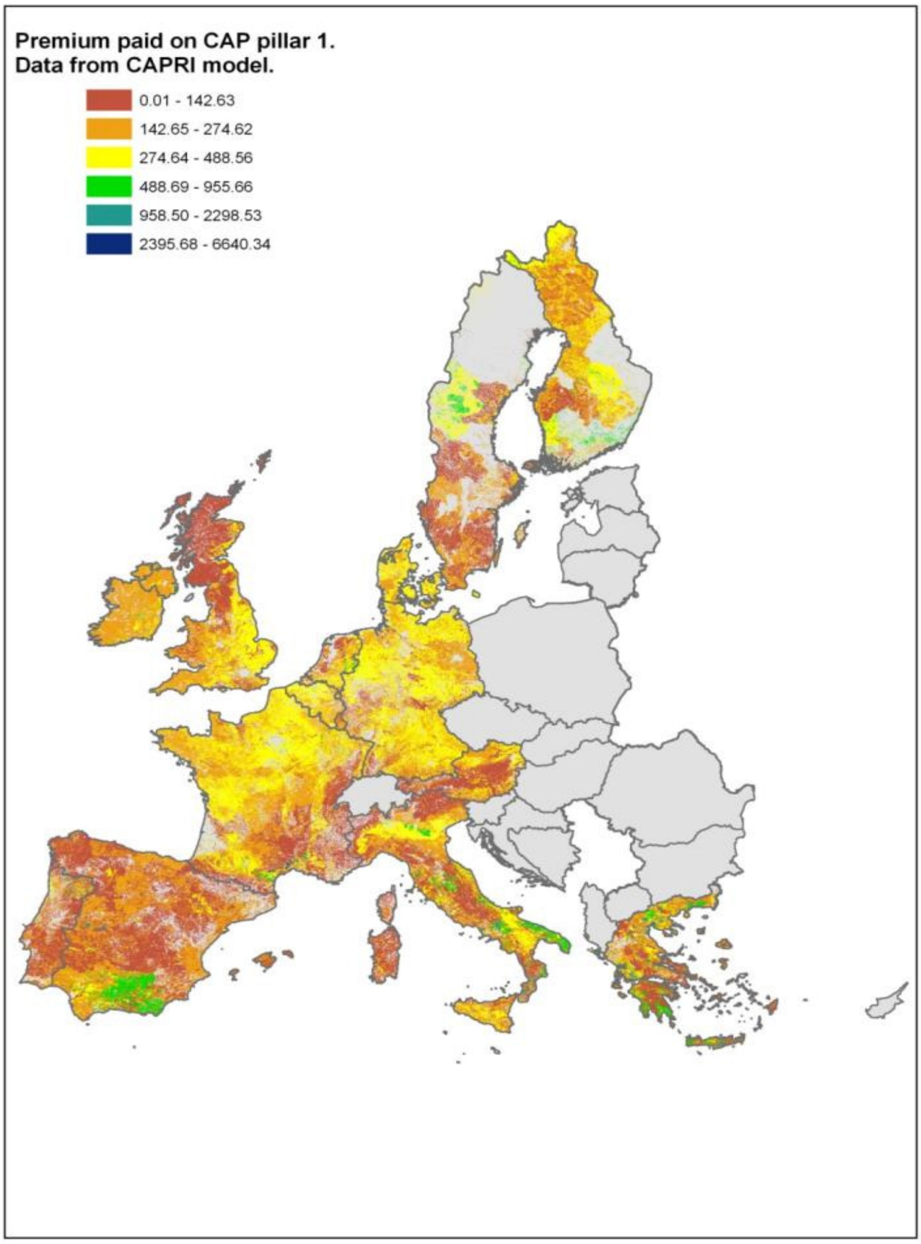
In the Netherlands, given the historic basis for distributing SPS, a relatively large amount of the payments continue to go to certain sectors such as dairy, cattle farms and certain arable farms (Elbersen *et al,*2009). The dairy and cattle farms are mostly concentrated in the areas of grassland on peaty and sandy soils. These grasslands are also those that are most overlapping with environmentally sensitive areas, including HNV. Therefore the HNV areas in the Netherlands tend to receive higher payments than other Member States; however within these environmentally sensitive areas the more intensive farms continue to receive higher payment rates per hectare and per farm than less intensive farms (Elbersen *et al,* 2009). By relating the geographical distribution of CAP spending (Eur/ha) to the distribution of HNV farmland, Elbersen *et al,*(2009) found the average Pillar 1 payment for HNV livestock grazing farms to be €349 /ha.

The Spanish region of Extremadura has relatively small areas of highly intensive agriculture, with almost half of the region covered by grazing land consisting of permanent grassland, scrub, forest and dehesa, the majority of which is under semi-natural vegetation used for extensive grazing, and can be expected to be HNV (EEA, 2009a. Direct payments are based on historic rates and therefore payments are weighted heavily in favour of more intensive farming systems. Low-yielding arable land is estimated to receive approximately € 38/ha of UAA, extensive sheep €75/ ha, goats € 37/ha and marginal olives €100/ ha (EEA, 2009a).

In France, like the Netherlands and Extremadura, Pillar 1 support is weighted heavily in favour of arable land in areas with higher historic yields. The average payment for livestock farms is € 248/ha, however this average masks the fact that a significant proportion of the payments these farms receive is in the form of support for maize cropping (EEA, 2009a). Farm types that rely more heavily on permanent grassland used at low livestock densities receive less support per hectare, particularly low-intensity sheep farming (EEA, 2009a).

Due to the difficulties in finding average payments for the EU-15, the JRC has carried out an analysis of the breakdown of Pillar One payments in the EU-27 using the CAPRI model as a means of determining the level of payments in HNV farmland areas. From the map in Figure 5.3 it can be seen that HNV farmland receives the lowest rate of payments – up to €142/hectare. It is not clear, however, how payments within this range are distributed across HNV farmland. For the purposes of this study, therefore, we have assumed a Pillar 1 payment rate for HNV farmland of €80/hectare, recognising that in some cases this will be an overestimate and in some an underestimate of what is needed in practice.

Figure 5.3: Breakdown of CAP Pillar One premia in the EU-27



Source: JRC using data from the CAPRI model

Using the per-hectare direct payments of €80 per hectare, the total payments were calculated simply by multiplying these payments by the area of HNV farmland (see Table 5.7). This gives a total figure of €6.1 billion/year.

Table 5.7 Per-hectare Pillar 1 support and total Pillar 1 payments by Member State

Member State	Area of HNV (ha)	Direct payment (€/ha)	Total payment € (assuming 100% of area supported)
Austria	2,447,292	€ 80.00	€ 195,783,360
Belgium	347,960	€ 80.00	€ 27,836,800
Germany	3,162,699	€ 80.00	€ 253,015,920
Denmark	172,267	€ 80.00	€ 13,781,360
Spain	18,986,960	€ 80.00	€ 1,518,956,800
Finland	1,330,797	€ 80.00	€ 106,463,760
France	7,797,145	€ 80.00	€ 623,771,600
Greece	5,349,572	€ 80.00	€ 427,965,760
Ireland	1,162,594	€ 80.00	€ 93,007,520
Italy	6,127,030	€ 80.00	€ 490,162,400
Luxembourg	12,871	€ 80.00	€ 1,029,680
Malta			-
Netherlands	368,788	€ 80.00	€ 29,503,040
Portugal	2,900,462	€ 80.00	€ 232,036,960
Slovenia	591,314	€ 80.00	€ 47,305,120
Sweden	1,136,030	€ 80.00	€ 90,882,400
United Kingdom	5,165,466	€ 80.00	€ 413,237,280
Total	**57,059,247**	**€ 80.00**	**€ 4,564,739,760**
			-
Bulgaria	2,509,989	€ 65.39	€ 164,128,181
Cyprus	342,045	€ 175.69	€ 60,093,886
Czech Republic	1,043,973	€ 126.19	€ 131,738,953
Estonia	380,879	€ 63.29	€ 24,105,832
Hungary	1,906,124	€ 132.83	€ 253,190,451
Latvia	568,400	€ 47.30	€ 26,885,320
Lithuania	627,202	€ 71.76	€ 45,008,016
Poland	4,813,243	€ 99.89	€ 480,794,843
Romania	4,860,372	€ 60.76	€ 295,316,203
Slovakia	547,582	€ 96.64	€ 52,918,324
Total	**17,599,809**	**€ 93.97**	€ **1,534,180,008**

Step 3: Thirdly, the cost of maintaining HNV farmland through the use of the LFA measure was calculated. The most recently available information on LFA payment rates is provided by the 2006 evaluation of the LFA measures (IEEP, 2006) which covered the previous programming period. This study showed that average rates of payment per hectare vary significantly between Member States, with an average payment rate of €74 per hectare for the EU-25 (2004 data). The average payment rate in the EU-15 was somewhat higher compared to the new Member States (€78 per hectare versus €60 per hectare). Payments range from €15-25 per eligible hectare (Spain, Estonia) to €180-250 per hectare (Malta, Finland, Austria).

To determine the area of HNV farmland likely to be in need of LFA support payments data it was necessary to know what proportion of HNV farmland is currently designated as LFA. These figures were obtained from the JRC. An average payment rate of €74/ha was then allocated to the total area of HNV farmland estimated to be within a Less Favoured Area, giving a total cost of €4.5 billion/year (see Table 5.8).

Table 5.8: Cost of LFA support on HNV farmland

Member State	Area of HNV	Proportion of HNV within LFA	Total HNV area needing LFA support	Average payment rate for LFA	Total LFA payment
Austria	2,447,292	91%	2,227,036	74	164,800,643
Belgium	347,960	92%	320,123	74	23,689,117
Bulgaria[1]	2,509,989	49%	1,229,895	74	91,012,201
Cyprus	342,045	56%	191,545	74	14,174,345
Czech Republic	1,043,973	86%	897,817	74	66,438,442
Germany	3,162,699	86%	2,719,921	74	201,274,164
Denmark	172,267	8%	13,781	74	1,019,821
Estonia	380,879	97%	369,453	74	27,339,495
Spain	18,986,960	86%	16,328,786	74	1,208,330,134
Finland	1,330,797	100%	1,330,797	74	98,478,978
France	7,797,145	87%	6,783,516	74	501,980,195
Greece	5,349,572	96%	5,135,589	74	380,033,595
Hungary	1,906,124	47%	895,878	74	66,294,993
Ireland	1,162,594	99%	1,150,968	74	85,171,636
Italy	6,127,030	87%	5,330,516	74	394,458,191
Lithuania	627,202	96%	602,114	74	44,556,430
Luxembourg	12,871	99%	12,742	74	942,929
Latvia	568,400	95%	539,980	74	39,958,520
Malta	-	-	-	-	-
Netherlands	368,788	80%	295,030	74	21,832,250
Poland	4,813,243	74%	3,561,800	74	263,573,187
Portugal	2,900,462	90%	2,610,416	74	193,170,769
Romania[1]	4,860,372	37%	1,798,338	74	133,076,985
Slovenia	591,314	95%	561,748	74	41,569,374
Slovakia	547,582	98%	536,630	74	39,710,647
Sweden	1,136,030	93%	1,056,508	74	78,181,585
United Kingdom	5,165,466	95%	4,907,193	74	363,132,260
Total	**74,659,056**		**61,408,120**		**4,544,200,886**

Source: JRC (Maria Luisa Paracchini) pers. comm.
[1]Bulgaria and Romania were not included in the IEEP LFA study; therefore the EU-10 average payment rate of €60 was assigned to them here.

Step 4: Fourthly, the cost of maintaining HNV farmland using the agri-environment measure was estimated. To calculate the average per hectare cost of management options for HNV farmland, a subset of the management options used within the central cost estimates for this study were chosen that were relevant for HNV farming systems. These management options were selected to address the pressures faced on HNV farmland, such as under-grazing, over-grazing and the loss of landscape features (ie maintenance of extensive grazing practices; maintenance of landscape features; shepherding payments, etc). These management options were broken down further into sub-options (taken directly from the RDPs) to exclude any that were obviously not applicable to HNV, and to separate them into three groups according to the type of land they applied to (extensive grassland, extensive arable and permanent crops). The grassland measures were the most numerous at 193 (compared to 23 for permanent crops and 14 for arable). Average payments rates were calculated for each type of land, following the same methodology as for the main cost calculations (see Chapter 4 and Annex 4).

However, only the extensive grasslands cost estimate was used to calculate the costs of maintaining HNV because it was the most robust, being derived from a large number of management options and RDPs. This was considered acceptable as, although this case study is looking at all types of HNV farmland, extensive grasslands make up the biggest proportion of this (approximately 85 per cent). The details of the management options included within the grassland estimate are provided in Table 5.9.

Table 5.9 Management options used to estimate the cost of maintaining HNV grasslands

Management option	Number of sub-options included	Number of RDPs covered
MO01: Boundary Management	8	5
MO11: Extensive Management	39	8
MO18: Grassland Management	110	21
MO19: Grazing Management	11	3
MO21: Habitat Management	18	6
MO23: Historic Feature Management	5	1
MO32: Traditional Management	2	2
Total	193	23

The mean was taken of the payment rates for the 193 management sub-options to give an average rate of €167.71 /ha. Our estimate was corroborated by an estimate of the total costs of Type 1 HNV produced by Kaphengst *et al,* forthcoming). This study used a similar methodology, focusing on six Member States and a selection of agri-environment management options from their RDPs, obtaining an overall mean total cost of € 169.21 /ha for HNV management options in the EU-27 (Kaphengst *et al,* forthcoming).

There is no agreement about the proportion of HNV farmland that requires agri-environment support to maintain its environmental value. Some would argue that the entire EU HNV resource is in need of some form of support in order for the necessary management to be maintained, and that without such support management practices would change or cease and its biodiversity value would decline However, others argue that this is unnecessary because certain areas would continue to be managed irrespective of the receipt of agri-environment payments, particularly if a basic support payment continued to apply, and/or that 100 per cent coverage of agri-environment support would be unrealistic. Indeed some evidence from reviews of trends in drivers of land use change and related modelling results suggest that abandonment of extensive farmland over the next 20-30 years would probably be modest, with the continuation of current policies and support. For example, model projections in a study by IEEP and Alterra (2010) suggest that between 2000 and 2030, nine per cent of non-irrigated land would become semi-natural vegetation as a result of abandonment with an additional 10.8 per cent classed as recently abandoned land. Abandonment rates are likely to be higher amongst grasslands, with 20.4 per cent projected to form recently abandoned land and 7.7 per cent expected to develop semi-natural vegetation. As a result of these contrasting views it was decided to use a number of scenarios to apply different proportions of HNV farmland area to receive support. Table 5.10

shows the different support scenarios and the areas of land they would cover in the EU-27. Detailed figures for all Member States can be found in Annex 9.

Table 5.10: Cost of agri-environment support for HNV farmland in the EU-27 under six scenarios

Proportion of HNV farmland in receipt of AE support	Area of HNV farmland in receipt of AE support ('000 ha)	Cost (€ million) (using average payment rate of €167.71/ha)
50%	37,330	€ 6,261
60%	44,795	€ 7,513
70%	52,261	€ 8,765
80%	59,727	€ 10,017
90%	67,193	€ 11,269
100%	74,659	€ 12,521

Step 5: Total cost estimate. Combining the estimated costs of the support needed for HNV farmland from direct payments, LFA payments and agri-environment payments under these six scenarios, it becomes possible to find an aggregate range of cost estimates for maintaining the EU HNV farmland resource. It is assumed that, as at present, HNV farmland will require some form of income support, plus LFA payments plus additional agri-environment payments in order to remain viable and deliver the environmental outcomes desired. The costs of the three different types of support and the combined costs are presented in Table 5.11 and a breakdown of the cost estimates by Member State is set out in Annex 9. This shows that the potential cost of maintaining the current area of HNV farmland in the EU-27 ranges from €16.9 – 23.1 billion per annum, the range being a result of the differing proportions of the HNV resource requiring agri-environment support at this level (in practice HNV farmland is likely to require a range of different agri-environment measures). It should be noted that these costs do not include any allocation of support for advice and training or for any capital investment costs that might be required – for example support for improving or introducing housing for overwintering livestock.

It should be noted that a significant proportion of the costs of supporting HNV farmland, using this methodology, are attributable to Pillar One direct payments and LFA support, with the agri-environment payments only making up between a third and half the costs estimated to be required, albeit the single largest element of the costs (between €6.3 and €12.5 billion depending on the area of HNV farmland under agreement).

Table 5.11. Combined estimate of costs needed to maintain HNV farmland (€ billion)

Type of Payment	Area of HNV Farmland under Agri-Environment Payments					
	50%	60%	70%	80%	90%	100%
Direct Payments	6.1	6.1	6.1	6.1	6.1	6.1
LFA	4.5	4.5	4.5	4.5	4.5	4.5
Agri-Environment	6.3	7.5	8.8	10.0	11.3	12.5
Total	**16.9**	**18.1**	**19.4**	**20.6**	**21.9**	**23.1**

5.3 Case Study 3: Estimating the Costs of Agricultural Soil Conservation, with a specific focus on the Murcia Region of Spain

5.3.1 Background

Soil degradation is a serious problem in Europe with significant regional variations, driven or exacerbated by human activities such as inappropriate agricultural and forestry practices. Although soil degradation processes vary considerably from region to region, with different threats having different degrees of severity, soil degradation is an issue all over the EU. There is also an urban dimension to soil degradation, notably with contaminated industrial and waste sites and the progressive "sealing" of soils for urban development. However, the focus of this case study is on rural issues and particularly on those induced by inappropriate or insufficiently soil sensitive agricultural management.

The aim of this case study is to provide a robust estimate of the scale of expenditure required to face agricultural soil degradation threats in Europe, with a specific focus on the Murcia Region, in south eastern Spain. It considers the issues of producing a cost estimate for improving soil management in the EU-27, given the lack of clear and specific targets, and the shortage of available data on the scale of the need, by focusing on an analysis of the issues in a particular regional context. The case study follows the same broad methodological approach as the overall study, but focuses on establishing costs solely for the major soil degradation threats facing the agricultural soils in Murcia - soil erosion, decline in organic matter content and salinisation.

Soil issues in relation to forest areas are also considered insofar as data allow. By focusing on a specific issue in a specific region, the case study allows the central methodology to be tested at a more fine grained level and explores some of the issues arising in relation to data availability and reliability, the variability of the practices required at the farm level and their relative merits depending on location and the implications of these for the scaling-up of cost estimates for the EU-27.

5.3.2 Characteristics of the Case Study Area

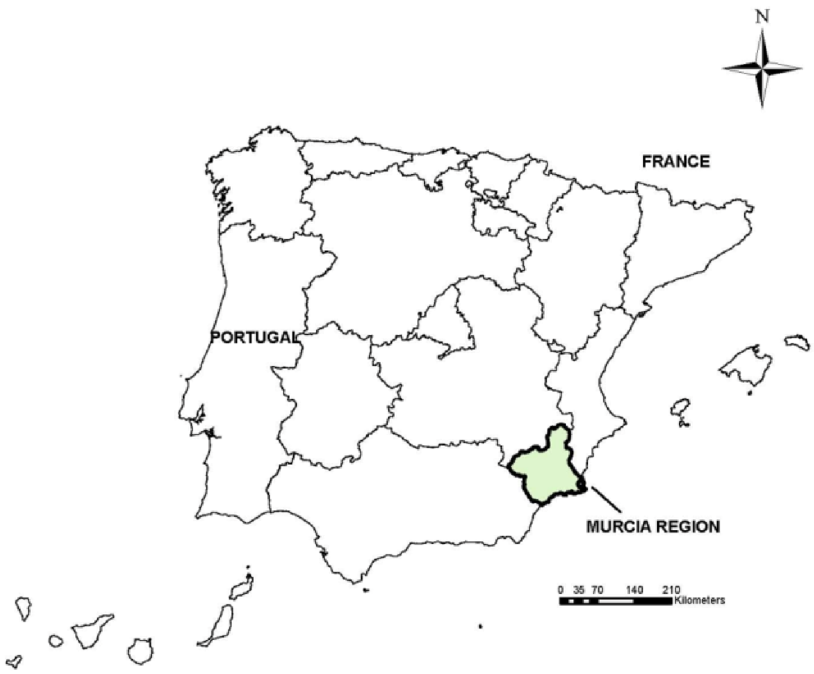
The Autonomous Community of Murcia, located in south eastern Spain, was selected for the case study for the following reasons:

- Soil degradation and desertification threats are severe in many areas of the region due to a combination of erosive farming practices and land abandonment in an area with semi-arid climatic conditions, vulnerable soil types and scarce but very intense rains;
- It is representative of most Spanish Mediterranean areas and therefore the soil degradation threats are similar to those in other Mediterranean areas;
- There is good data availability due to the fact that soil degradation and desertification has been the subject of a range of research projects over the past decade and the Regional Department of Agriculture has a complete on-line database of land use statistics.

- Unpublished data from a representative survey of 243 farmers in the Murcia Region relating to soil erosion control practices carried out in 2009/10 is available.

Natural characteristics
Murcia is located in the south east of the Iberian Peninsula (Figure 5.4). It covers an area of 11,313 km^2, approximately three per cent of the land area of Spain. About three per cent of the Spanish population live in the region, although this is increasing rapidly.

Figure 5.4: Location of the Murcia Region in SE Spain



The topography of the region varies from the mountainous interior areas (with altitudes reaching a maximum of 2,000 m above sea level) to coastal areas. Most of the Region combines very steep sierras (500 to 1000 m) with meseta-like plains at altitudes above 600 m and flat valleys and coastal plains, where the majority of urban conurbations are found. The Segura is the only main river of the region, whose main tributaries are small rivers with low water flows (CHS, 2007). Because of its geological characteristics, there are a large number of aquifers that supply an important share of the region's water resources.

The areas of the region that are more distant from the coast have a Mediterranean climate, characterised by a severe summer drought followed by intense rains in autumn (CHS, 2005). Average rainfall is 300 mm/year, with a high inter-annual variability and large differences between the inner mountains and 'mesetas' and the coastal areas (Martínez-Fernández and Esteve, 2005). Average temperatures range from 12ºC in the inner areas to 18ºC in the coastal areas. Maximum temperatures can reach 40 - 45ºC in some interior parts of the Region.

Land use and farming

Agricultural land accounts for 46.6 per cent of the region, with a further 47.5 per cent of the land occupied by forest or Mediterranean shrub lands (MAPA, 2007). According to data from the Spanish National Statistics Institute (INE, 2007), total agricultural land accounts for 571,076 hectares, and Utilised Agricultural Area (UAA) is 400,221 hectares. Of the UAA, arable land accounts for 95 per cent (Table 5.12) and permanent pasture for five per cent.

Table 5.12: Arable land use in the Murcia Region

	All arable land	Herbaceous crops	Fruit trees	Olive trees	Vineyards	Other arable land
Rainfed	223,333	112,588	75,661	13,631	21,443	10
Irrigable	156,939	65,248	69,189	8,044	13,956	501
Total	380,272	177,836	144,850	21,675	35,399	510

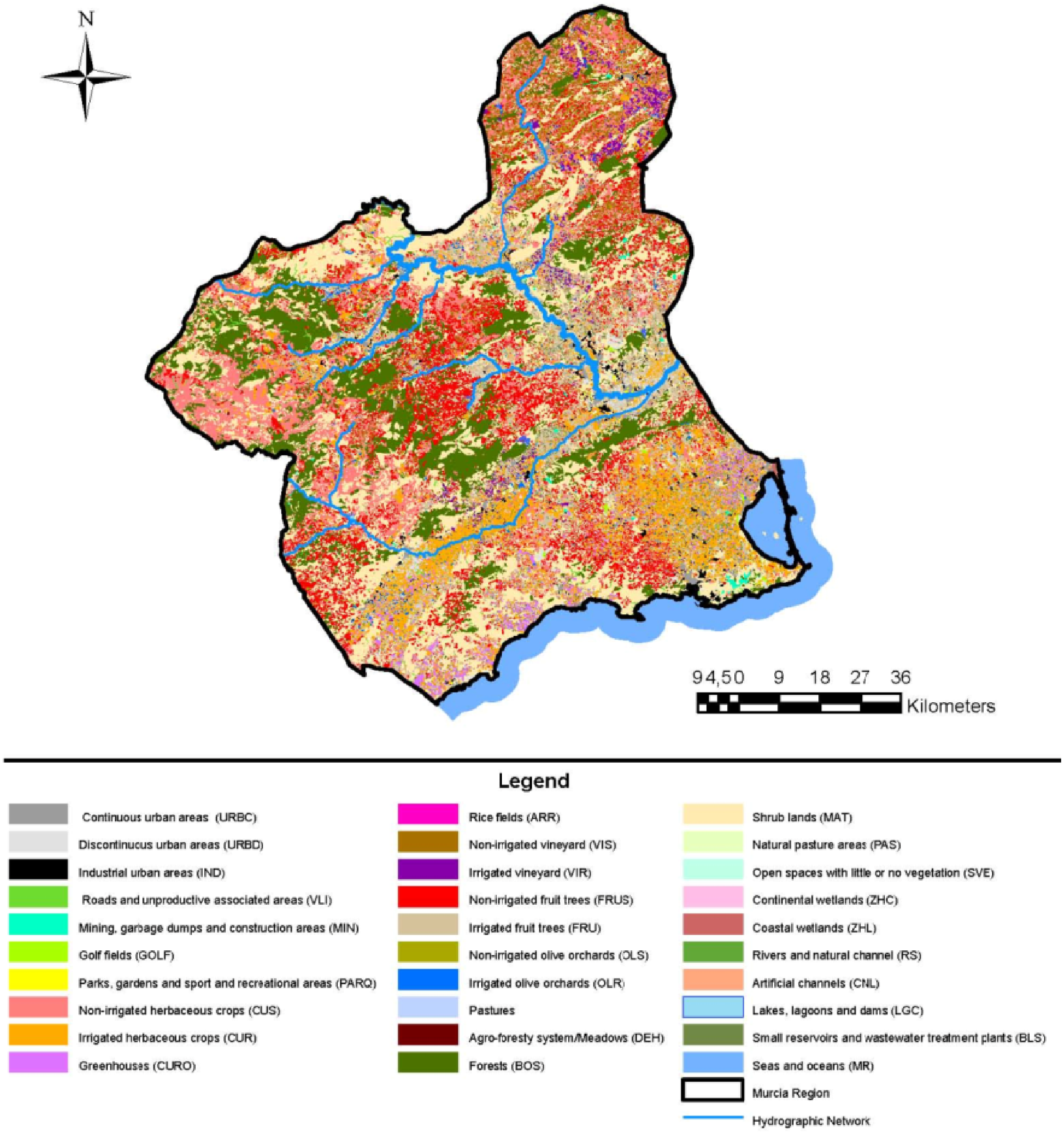
Note: Herbaceous crops include vegetables and fallow
Source: INE (2007)

Agriculture in the region falls into two very distinct categories. On the one hand, rainfed agriculture accounts for 69 per cent of agricultural land, characterised by classical Mediterranean crops (cereals, vines, olive and almond trees). This type of agriculture is mostly located in less-favoured areas, on steep and more marginal agricultural land, experiencing problems of low farm profitability and risk of abandonment because of its lower crop yields. On the other hand, irrigated agriculture accounts for 31 per cent of agricultural land and is characterised by very high yields and farm profitability. The irrigated area has almost doubled in the last thirty years as a result of the exploitation of groundwater resources and the transfer of water resources from other river basins in central Spain.

The agricultural sector, mainly the irrigated horticultural sector, plays an important role in the region's economy, both in terms of the market value of agricultural produce, the demand for agricultural labour and the value of exports. As a result these systems are fairly sophisticated in their use of agricultural technologies, such as irrigation systems, crop varieties, fertiliser and plant protection products.

There is good data availability on different types of agricultural land use in the region, although the Land use statistics from the Spanish National Institute of Statistics (INE, 1999 and 2007) and the Regional Government's Department of Agriculture (CARM, 2008) are not geo-referenced. The only source of spatial data on land uses is the map of crops and land use as illustrated in Figure 5.5 (MAPA, 2007).

Figure 5.5: Land use categories in the Murcia Region



Source: MAPA (2007)

5.3.3 Assessment of the main soil degradation pressures and their spatial extent

The most pressing and widespread pressures leading to soil degradation in Murcia are, in this order:

- Water erosion;
- Declines in soil organic matter content; and
- Salinisation.

Other issues, such as soil compaction and soil contamination are significant in some parts of the region, but are less well documented. For this reason, these are not considered further within the case study.

Soil degradation in the Region is the result of a combination of several driving forces, such as the expansion of intensive agricultural activity, urbanisation in rural areas, the use of surface and groundwater resources beyond their natural recharge capacity, combined with vulnerable soil types and a dry climate, exposed to both drought and flood events (Martínez-Fernández and Esteve, 2005; Hein, 2007). Intensification of agriculture in the region has led to an increase in the cultivated area and to a much higher use of water resources, machinery and chemical inputs. As a result, traditional practices, such as crop rotation, and the maintenance of structural elements, such as terraces, hedgerows etc have widely disappeared and this has led to increased water scarcity and the loss of soil, vegetation and biodiversity.

There is a considerable literature on most soil degradation threats, their severity and spatial distribution in the Murcia Region. Data on the risk of soil erosion and soil losses, nitrate pollution, soil organic content and soil salinity are available from the Murcia Regional Government, the Spanish Ministry of the Environment and the EU Ispra Joint Research Centre. Some of these sources present different assessments of the severity and spatial extent of each degradation pressure, but these are largely due to the different methodologies used. However the figures provide sufficient accuracy for the objective of the present study.

Research has shown that 58 per cent of land in the region is subject to some form of soil degradation threat, the most severe being droughts, soil erosion and forest fires as shown in Table 5.13 (INUAMA, 2000). This is backed up by research in the Guadalentin basin (Calatrava *et al,* 2008; forthcoming, which also highlights soil erosion as the main soil degradation problem, as well as salinisation (especially acute in this particular area) and the decline in soil organic matter. However the risk of soil erosion has slightly decreased in the last decade because of the adoption of some conservation measures by farmers and the implementation of hydrological-forest restoration by the Regional Government and the Segura River Basin Authority (CHS).

Table 5.13: Proportion of area affected by erosion, desertification and salinisation threats in the Murcia Region, Spain

Type of threat	Percentage of area at risk
Drought	21.19
Medium soil erosion and drought	12.56
Medium soil erosion	7.30
Risk of forest fire	7.77
High risk of erosion and drought	4.03
High risk of erosion	1.80
Soils in process of salinisation	3.09
Saline soils	0.08
Medium soil erosion in soils in process of salinisation	0.53
Medium erosion in saline soils	0.02
Low sensitivity to soil degradation	41.63

Source: PEDREMU Project (INUAMA, 2000)

However, the current severity of each threat varies depending on the crop, both as a result of the farming practices implemented but also because of the characteristics of the areas where each crop is being cultivated (Calatrava *et al*, 2008 and forthcoming and see Annex 10). Soil salinisation is associated with intensive irrigated agriculture in particular. Soil erosion is more severe in rainfed areas, where marginality and/or land abandonment are the main causes, but also occurs in irrigated areas where the radical transformation of land is its main driver. The decline in soil organic matter content is common to all areas and agricultural systems, being associated with the loss of top-soil in soils that are naturally poor in organic matter (Calatrava *et al*, forthcoming).

Soil erosion by water: This is the main cause of soil degradation in the Murcia region and results from hill-slope cultivation, excessive or inadequate cultivation techniques, irrigation with saline water, cultivation of previously natural areas with subsequent removal of the vegetation cover, land abandonment, burning of stubbles, etc., in semi-arid climatic conditions with sparse but torrential rainfall and on highly erodible soil types. There are considerable differences in estimates of the extent of soil erosion in the region (see Martínez-Fernández and Esteve, 2005 and Boix-Fayos *et al,* 2005 for a critical review of the range of studies and estimates produced). According to official estimates, average soil loss is approximately 25 tons per hectare, defined as a moderate level of soil erosion, with annual soil losses of greater than 25 tons per hectare in 15-34 per cent of the region[15] (see Annex 10).

In general, water erosion is a less severe threat for irrigated agriculture than for rainfed agriculture (Calatrava *et al*, 2008). The highest rates of soil erosion tend to be associated with land without vegetative cover located in mountainous areas and dry river banks and creeks (15 to 300 tons/ha/year) and to rainfed steep agricultural areas growing olives, almonds and vines (up to 80 tons/ha/year) (INUAMA, 2000). These rainfed tree crops usually have low plantation densities and are intensively ploughed to improve water infiltration to the root systems, making the soil vulnerable to intense rainfall (Govers *et al*, 2006). In addition, the inadequate maintenance and/or the abandonment of traditional Soil Conservation Structures (SCS), such as terraces, banks and stonewalls, due to the high costs involved, increase the risk of erosion. For rainfed cereals the main causes of soil erosion are the lack of soil cover during the autumn rains, the semi-arid climate and practices such as the burning of stubbles and intensive tillage, leaving the soil bare between summer and winter and therefore unprotected for the torrential autumn rains. Land abandonment increases the risk of soil erosion as it causes the formation of soil crust and an increase in run-off and thus top-soil loss even when compared to cultivated plots. In abandoned plots regrowth of natural vegetation occurs slowly because of the semi-arid climate as well as soil erosion itself, which reduces the soil's capacity to sustain new vegetation.

Lower levels of soil erosion (under 10-12 tons/ha/year) are found in non-irrigated extensive cereal crops, pastures and areas of scrub as well as in irrigated areas and forest areas. Although commonly thought to be at high risk, rates of erosion on scrub lands with a natural semi-arid dense vegetation cover, are usually below 1 t/ha/year (Boix-Fayos *et al*, 2005; Martínez-Fernández y Esteve, 2005). However, the removal of

[15] These figures should be treated with caution as the methods used are thought to overestimate the risk (Boix-Fayos *et al*, 2005; Martínez-Fernández y Esteve, 2005).

soil conservation structures in these more intensively farmed areas does mean that they would be very vulnerable to soil erosion if land were to be taken out of cultivation and the vegetative cover were to become less dense in the future. Table 5.14 summarises the areas affected by soil erosion by type of land use.

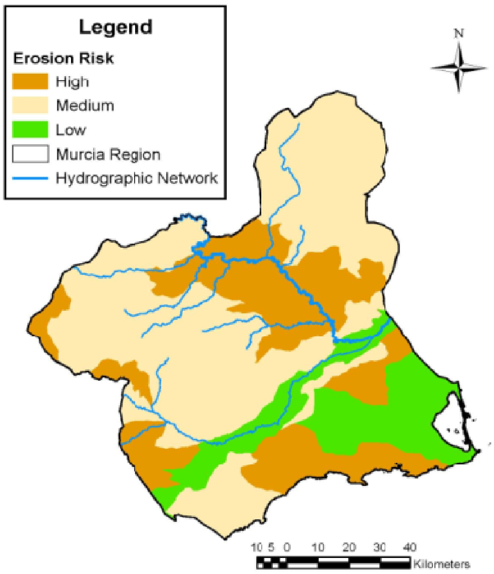
Table 5.14: Percentage of area by uses affected by different levels of soil erosion

Land use	Severity of soil erosion		
	Low	**Medium**	**High/severe**
Forest land with trees	53	27	20
Forest land with sparse trees	27	18	55
Forest land without trees	35	24	41
All forest land	40	25	35
Non-irrigated	30	30	40
Irrigated	76	2	22
All agricultural land	59	8	33

Source: Own elaboration using data from the National Inventory of Soil Erosion (MMA, 2002) and the Map of Crop and Soil Uses (MAPA, 2007).

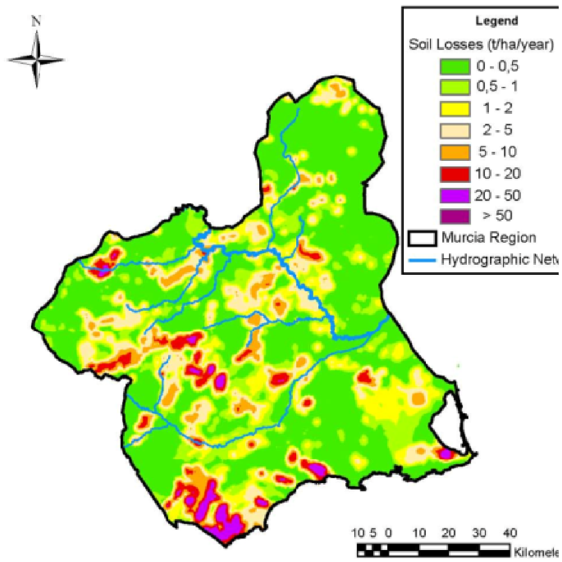
Some of these data are also available spatially (CARM, 2007; MMA, 2002, Kirkby *et al*, 2004), which allow the areas at greatest risk of soil erosion to be identified and targeted with suitable action (see Figure 5.6).

Figure 5.6: Risk of soil erosion in the Murcia Region



Source: Rural Development Plan of the Murcia Region (CARM, 2007)

Figure 5.7: Soil erosion rates in the Murcia Region (PESERA project)

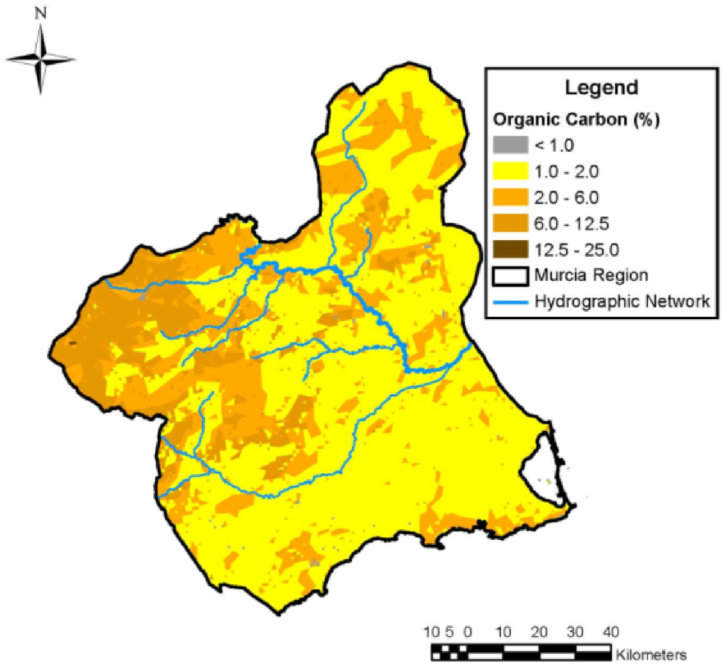


Source: Own elaboration from Kirkby *et al*, (2004)

Declines in soil organic matter: The content of organic matter in the Region's soils is low. Although not considered as serious a risk to soil functionality as soil erosion, its impact is more extensive and the majority of crops and areas in the region are subject to this problem (Calatrava *et al*, 2008). Apart from affecting the soil's productive capacity, the decline in organic matter content also makes soils more vulnerable to erosion (Boix-Fayos *et al*, 2005). The high vulnerability of rainfed crops and some irrigated crops to soil erosion is associated to the loss of the top-soil layers that are the richest in organic matter (Calatrava *et al*, 2008).

Figure 5.8 shows the spatial distribution of organic carbon content in the Region (see Annex 10 for a table setting out the organic carbon content by category of land use).

Figure 5.8: Organic carbon content (%) in the surface soil horizon (<30 cm)



Source: Own elaboration from the OCTOP INSPIRE Raster (Jones *et al*, 2005).

There are two causes of low soil organic matter content in the region. First, the natural level of organic content in the region's soils is generally low as a result of climatic conditions. Second, inappropriate agricultural practices, such as intensive tilling and the removal of weeds, have led to reductions in soil organic matter. As rainfall is low in the region, farmers in non-irrigated areas till the land frequently (3-5 times per year) to facilitate water infiltration and eliminate weeds that compete with the crop for water. In irrigated areas, and especially in vegetable production, soil is intensively ploughed to prepare seedbeds and row-lines. This promotes aeration and the destruction of soil aggregates, thereby facilitating the loss of organic matter (Martínez-Mena *et al*, 2008). In forest systems, the reduction in the soil's vegetation cover has been found to be related with the loss of soil organic carbon (Martínez-Mena *et al*, 2002).

The decline in organic matter, mostly caused by a reduction in vegetation, has an important impact on the soil's physical properties that determine the extent of erosion processes (Boix-Fayos *et al*, 2005). Even very low levels of soil organic matter are an important factor in preventing soil erosion because, contrary to soils in humid areas, soil organic carbon content of less than one per cent in semiarid conditions still has an important effect on aggregation (Martínez-Mena *et al,* 2002).

Salinisation: Salinisation results from an increase in a concentration of soluble salts in the soil, resulting in a severe decrease in soil quality and yields, as experienced in many areas of south eastern Spain (Pérez-Sirvent *et al*, 2003). It is estimated that 0.1 per cent of land[16] is saline in Murcia, with 3.6 per cent of soils in the process of becoming saline (INUAMA, 2002). Soils at risk of salinisation tend to be located in flat areas in the bottom of the valleys and do not tend to overlap with areas at high risk of soil erosion.

Salinisation tends to be associated with intensive irrigated horticultural production, especially with highly profitable vegetable production in areas where water supply is very scarce and farmers have to rely on low quality water resources. Salinisation may also have natural causes (the natural salinity of soil types) (Pérez-Sirvent *et al*, 2003). The main causes of soil salinisation are:

- Irrigation with water from agricultural return-flows and the excessive use of fertilisers;
- Irrigation with groundwater from saline aquifers – as a result of the water table level increasing in some aquifers in the region, salinisation has occurred through the movement of water from deeper aquifers that are naturally saline, and in other aquifers, sea intrusion is the cause of its salinisation;
- Irrigation with reused wastewater without tertiary treatment; and
- Drip irrigation, which is currently the dominant irrigation technology in the Murcia Region, although increasing water efficiency and productivity, tends to increase the concentration of salts in the soil.

Summary of practices that cause soil degradation

Table 5.15 summarises the main land management practices that cause soil degradation. The majority of the practices have negative impacts on more than one aspect of soil functionality. For example, practices that increase soil erosion also have a negative effect on the organic matter content of soil and vice versa. In addition, management practices associated with causing other environmental issues can also contribute to soil problems. For example, although the main cause of soil salinisation is irrigating with low quality water, those practices that cause diffuse pollution of soil and aquifers have an impact on the quality of groundwater and thus contribute to the salinisation problem.

[16] However, natural saline soils have a great value from the point of view of biodiversity in some areas of the Region (Calatrava *et al*, 2008).

Table 5.15: Practices that causes soil degradation and their associated impacts

Practice	Impacts		
	Water erosion	**Decline in organic matter content**	**Salinisation**
Intensive farming	X	X	
Intensive livestock			
Intensive tillage	X	X	
Intensive farm mechanisation	X	X	
Cultivation on steep slopes	X	X	
Removal or abandonment of non-farmed features (ponds, hedgerows, stone walls, patches of vegetation, field boundaries, etc.)	X		
Absence/reduction of crop rotations and crop specialisation	X	X	
Elimination of crop residues by tillage and/or burning of stubbles in cereals	X	X	
Stocking rates above the land's carrying capacity (over-grazing)	X	X	
Intensive use of inorganic fertilizers			X
Inadequate fertilization practices that increase nutrient run-off			X
Intensive use of pesticides & insecticides			X
Increased weed-control, mainly using herbicides		X	
Irrigation with low quality/saline water			X
Irrigation practices that increase nutrient run-off			
Conversion of natural areas into agriculture	X	X	
Abandonment of farmland	X		
Inadequate forestation	X	X	
Inadequate 94management of land and vegetation in natural areas	X		
Intensive commercial forest management	X		
Forest fires /deforestation	X	X	

5.3.4 Recommended land management practices to address the main soil degradation threats

This section considers how far measures to improve soil conservation could be met by implementation of good farming practice and proper observance of current regulation, as well as better advice and information. Building on this analysis, those management practices that require payments to be made from the public purse to ensure adequate uptake have been identified, drawing on data from previous studies and relevant scientific literature as well as management practices identified within relevant policy measures with soil conservation objectives. Some measures which are not focused primarily on protecting soils, such as the conversion of land to organic production or the introduction of catch crops to reduce nutrient leaching, will contribute to soil objectives to varying degrees. Whilst it is difficult to be precise about their impacts on the main soil pressures identified, these are also taken into account. In general, however, there is a lack of information on the relationship between the area needed under management of a particular management practice and the resulting benefits achieved for soil conservation in relation to the different pressures.

Tillage practices

Tillage is a key factor for soil conservation. Tillage prepares the soil to ease the emergence and development of plants, controls weeds that compete with the crop for water, light and nutrients, and improves soil structure to favour the infiltration of water. However, inadequate tillage practices accentuate erosion leading to the degradation of soils. Reduced tillage and no tillage can significantly reduce soil erosion rates in comparison with traditional tillage practices (Gómez *et al*, 1999; Milgroom *et al*, 2007).

When tillage is reduced, soil porosity tends to increase and often, surface sealing occurs, reducing the infiltration rate. Moreover, minimum or no tillage reduces soil carbon emissions (Montanaro *et al*, 2010). The ecological footprint of no tillage in olive production has been estimated at 80 per cent of that of conventional tillage with bare soil production systems (Hernández-Laguna *et al,* 2004). However, reduced tillage practices tend to require the increased application of herbicides compared to conventional tillage, and there is a risk of weeds developing resistance to herbicides.

The effectiveness of conservation tillage increases when combined with other practices such as soil cover or building of soil conservation structures, such as terraces. Reduced tillage practices also have positive effects on conserving soil organic matter content, in particular no-tillage and direct drilling techniques. In order of their effectiveness in maintaining soil organic carbon no-tillage has the most benefit, followed by reduced tillage, subsoiling tillage and conventional tillage (Alvaro-Fuentes *et al*, 2008).

Conservation tillage is not common in Murcia. The only practice with a relatively high rate of adoption is contour tillage as it is a requirement under GAEC (Calatrava *et al,* 2008).

Soil Conservation Structures

The maintenance of structural features in the landscape, such as bench terraces, ditches, hedges, walls, retention ponds, etc significantly reduce the risk of soil erosion (Bellin *et al*, 2009). In Murcia, many of these types of structures are not adequately maintained or have been abandoned because of the high costs associated with their maintenance, despite of farmers recognizing their importance for soil conservation (Calatrava *et al*, 2008).

Maintaining green cover

Ensuring a continuous covering of the soil using vegetation or mulch also provides an effective means of preventing soil erosion, reducing the soil's exposure to erosive agents. For instance, vegetation strips have been shown to be a highly effective measure that can almost completely offset run-off and erosion in permanent crops such as almonds and olives by reducing the size of soil sediment particles (Martínez-Mena *et al*, 1999; Martínez-Raya *et al*, 2006, Francia-Martínez *et al*, 2006; Gómez *et al*, 2009). The percentage of soil area covered with vegetation strips to provide an optimal protection from water erosion increases exponentially with slope (Belmonte *et al*, 1999). However, vegetation covers/strips are used infrequently by farmers in Murcia and southern Spain more generally (Calatrava *et al*, 2008; Franco and Calatrava, 2010; Calatrava and Franco, 2011) as they are seen as competing with crops for water resources.

Using vegetation residues as mulch can also help control erosion, conserve water resources, improve nutrient recycling and the efficiency of humification processes as well as provide an import source of carbon for soils (Xiloyannis *et al*, 2008; Montanaro *et al*, 2010; Rodríguez-Lizana *et al*, 2008). Such residues remain in the soil for a long time, reducing weed growth and therefore herbicide application. Traditionally these residues were burnt, which can cause damages to trees, results in CO2 emissions and increases wildfire risk (Rodríguez-Lizana *et al*, 2008). Mulch using pruning residues is becoming increasingly popular among olive farmers in Southern Spain as an alternative to maintaining vegetated strips on steep slopes, as farmers do not have to pay for the material and save the costs of needing to get rid of the pruning resides from the farm (Calatrava and Franco, 2011). The main drawbacks of this practice are that special machinery is required to grind the residues and that pruning must be done every year (Xiloyannis *et al*, 2008).

Crop Rotations, Intercrops and Undersown Crops

Changes in crop rotations that reduce the level and time of exposure of soil to eroding agents, especially during the autumn rainfall, are also considered by experts as an effective practice to reduce water erosion to soils as well as being effective in combating a decline in soil organic matter content.

The opportunity costs of changing the rotation of crops is very high for irrigated agriculture, and soil and climatic conditions restrict the potential for crop rotations in non-irrigated agriculture. In most rainfed areas of the Murcia Region the only rotation crop that can be considered is leaving land to fallow.

Other commonly recommended practices are intercrops or undersown crops. As it is the case with vegetation strips or covers, farmers are reluctant to use these practices, as they believe that they compete with crops for water. However, and contrary to the case of vegetation strips, experts consider that although intercrops and undersown crops would mitigate the problem of water erosion and off-site damage, they would not be very effective under the region's climatic conditions (Calatrava *et al*, 2008).

Restricting cultivation on steep slopes

The only way to eliminate soil erosion on very steep slopes is to cease agricultural activity and reinstate natural vegetation (Calatrava *et al*, 2008). For this reason, agricultural land with slopes above 20 per cent is not permitted to participate in any agri-environmental measures in Murcia, unless effective soil conservation and water retention structures exist. Afforestation is the preferred land use on slopes of these gradients. However, the natural rate of vegetation regrowth in the region is very slow and therefore active re-vegetation or afforestation is required, using species that combine soil protection, fast growth and ecological integration.

Addition of soil organic matter
The addition of exogenous organic matter is considered to be the most effective and cost-effective measure to increase soil organic matter content. It also improves soil structure and infiltration capacity and therefore it also has a positive effect in helping to prevent water erosion. The addition of organic matter in horticulture production is subsidised within the 'Integrated production' agri-environmental measure (CARM, 2007). Among the different sources of organic matter, pig manure is the most commonly used. However, this practice may cause soil and crop pollution so, it needs to be combined with appropriate technical training for farmers (Calatrava *et al*, 2011). Green manure is not an option that is of wide relevance in the region, as it is restricted to irrigated areas where crop residues are abundant.

Water management
The options for addressing salinisation involve controlling water quality (for example, by mixing water of different qualities) and water management. Reducing diffuse pollution from inorganic fertilisers, pesticides and herbicides also has a positive effect on reducing this threat. However, in periods of water scarcity, farmers have to rely on poor quality water. The only options in such case are either to cease production when the quality of water is low, resulting in a heavy cost for farmers due to the high profitability of irrigated agriculture in areas vulnerable to salinisation, or sourcing water from desalinisation plants, a solution that is also very expensive (two to three times the cost of pumping low-quality water from aquifers).

Soil conservation practices in forest areas
Soil conservation in forests requires different types of practices. In many cases afforestation to create tree cover is used as a soil conservation measure in itself, particularly on steep slopes. Within forested areas, management practices need to ensure that ensure the effective conservation of the soil resource by maintaining appropriate tree cover, preventing forest fires and maintaining, restoring or creating appropriate soil conservation structures. In particular, transverse structures, such as check dams, are frequently used in Spain to stabilise gullies and ephemeral streams and to reduce channel incision and prevent sediment deposition downstream (Castillo *et al*, 2007). In some areas, restoration activities may be needed to re-afforest areas that have been subject of forest fires or other natural disasters such as floods or landslides. To be of most benefit, native species and low-impact planting techniques should be used.

Recommended practices
Annex 10 provides a table summarising the main land management practices that are considered beneficial for soil conservation. However not all of these practices are suitable for addressing the soil needs in Murcia largely due to the region's climatic conditions or where the economic costs of implementing such management practices in terms of reductions in production are considered too great to be practical, especially where alternative management could be used. Those management practices most suited to Murcia are set out in Table 5.16.

Table 5.16: Recommended soil conservation practices for the Murcia Region

Practice	Main soil conservation benefits	Other soil conservation benefits
Contour tillage	Erosion	Organic matter
Reduced tillage	Erosion Organic matter	Compaction
Soil conservation structures (bank, terraces, ditches, stonewalls, retention ponds, etc.)	Erosion	Pollution Organic matter
Hedgerows/natural vegetation on field boundaries and edge of rural tracks and banks of water courses	Erosion	Pollution Organic matter
Overwinter stubbles	Erosion	Organic matter Compaction
Change crop rotations/ Increase fallow index in crop rotations	Organic matter	Erosion Compaction
Vegetation strips/fringes	Erosion	Organic matter Pollution
Addition of exogenous organic matter	Organic matter	Erosion Compaction
Mulching using crop residues	Organic matter	Erosion
Green manure	Organic matter	Erosion Pollution
Non-harvested fringes on annual rain fed crops	Erosion	Organic matter
Restrict fertiliser and manure inputs	Pollution	Salinisation
Nutrient management planning	Pollution	Salinisation
Minimise herbicide application / Mechanical removal of weeds	Pollution	Salinisation
Minimise pesticide application	Pollution	Salinisation
Integrated pest management	Pollution	Salinisation
Drip irrigation/fertirrigation	Pollution	
Irrigation management/Good quality water	Salinisation	
Organic farming	Pollution	Organic matter Erosion
Afforestation	Erosion	Organic matter
Management of natural vegetation on forests and scrubland, including sustainable grazing	Erosion	Organic matter
Pest control in forests	Erosion	
Forest fire prevention measures	Erosion	Organic matter
Hydrologic restoration	Erosion	

Source: Own elaboration based on the reviewed literature.

Current policy measures used to promote soil conservation

There is a range of management practices currently used in Murcia to promote the sustainable management of soils. These include those required by law, those required under cross compliance and standards of Good Agricultural and Environmental Condition (GAEC), as well as payments provided through agri-environment schemes and other rural development measures. The practices include restrictions to the type and timing of tillage, changes in crops rotations, restrictions to the use of agro-chemical inputs, building and maintenance of soil conservation and water retention infrastructure, soil cover using vegetation or residues, afforestation, changes in irrigation techniques, integrated pest management and conversion to organic farming.

The details of these management practices are set out in Annex 10 and Table 5.17 summarises the current policy measures that apply in the Murcia region.

Table 5.17: Recommended management practices and existing policy measures

Practice	Nitrates Directive	Sewage Sludge Directive	Natura 2000	Forest Policy	GAEC	GFP	AEM	Afforestation of agricultural land RDP	Other RDP measures
Contour tillage					B	A	B		
Reduced/conservation tillage	A				B		A		
Soil conservation structures			A		B		B		
Hedgerows/natural vegetation on field boundaries, edge of rural tracks and river banks			A				AB		
Keeping overwinter stubbles			A		B	A	A		
Green manure							AA		
Change crop rotations/Increase fallow index in crop rotations						A	AAA		
Vegetation fringes			A		B		AB		
Mulching using crop residues							B		
Non-harvested crop fringes on annual rain fed crops							A		
Addition of exogenous organic matter							B		
Restrict fertiliser and manure inputs	A		A			B	AAA		
Nutrient management planning	A	A	A			B	AAA		
Minimise pesticide application	A		A			A	AA		
Integrated pest management	B						AAA		
Minimise herbicide application / Mechanical removal of weeds	A				B		AA		
Drip irrigation / Fertirrigation									B
Irrigation management/Good quality water					A	A	A		
Organic farming	B						A		
Afforestation				B				A	BB
Management of natural vegetation on forests and scrubland				A				A	A
Pest control in forests				A					A
Forest fire prevention and defence				A					A
Hydrologic restoration				B					BB

Note: A: always applicable; B: applicable only under certain conditions. For AEMs and other RDP measures, the number of letters indicates the number of measures where the practice is considered.

Effects of the management practices on other environmental media

It should be noted that the recommended land management practices also deliver positive benefits for other environmental media. Many practices, for example, aim to increase the area of grass margins and buffer strips along the edge of cereal crops, hedgerows and other semi-natural vegetation, all of which will have a positive impact on biodiversity, and in some instances will also help to improve water quality. Similarly, the restoration of degraded areas and afforestation can be beneficial for biodiversity.

In relation to climate change, practices that reduce the intensity of tillage, that require the incorporation of stubbles, organic matter or green manure into the soil, that increase the area of soil under some form of green cover, with a crop or semi-natural vegetation, and that reduce the use of chemicals inputs in farming have a positive effect both in terms of the soil carbon balance and the emission of greenhouse gases. The reforestation of natural areas also has positive impacts in terms of carbon sequestration.

5.3.5 Overlaps between the recommended practices

In some circumstances, a number of management practices can provide the same benefits for soil conservation in the same location. In other circumstances, different management practices are needed, depending on the geographic and climatic situation in order to deliver the same outcome. These factors need to be taken into account when determining the area needed under different types of management. The main overlaps between practices are related to the different options for maintaining some type of vegetation cover on the soil and on different options for reducing chemical pollution. These are summarised as follows:

- Green manure is restricted in practice to crops where a large amount of biomass is produced, i.e. in irrigated annual crops such as vegetables and fruits. For non-irrigated annual crops, overwinter stubbles is the preferred management option. In both cases, the practices are compatible with maintaining grass margins.
- In relation to the cultivation of permanent tree crops, the practice of using chopped crop residues is an alternative to maintaining vegetation margins around crops. However, as the gradient of the slope increases, the effectiveness of permanent vegetation margins is greater than mulching and is the recommended option in such circumstances.
- The practice of leaving non-harvested crop areas on annual non-irrigated crops is an alternative to establishing vegetation strips or margins.
- Organic farming involves a combination of management practices that are also defined separately, especially those restricting the use of chemical fertilisers, manure and pesticides, the mechanical removal of weeds and biological methods for pest control. Organic farming management therefore is an alternative to implementing these practices individually.
- Similarly, the role of drip irrigation technologies and fertirrigation systems in reducing chemical percolation could be substituted to some extent by adequate nutrient management planning and completely by organic farming techniques.

5.3.6 Spatial extent of each recommended practice

Table 5.18 summarises the type of land use where each recommended land management practice should be applied, including an indication of the criteria used to establish the extent of each practice within each land use category in which it would be applied and the total area over which each of the recommended practices needs to be implemented.

Ideally, the area of land needed under specific management options needs to be determined at the most detailed level possible to ensure that the most appropriate management is identified for the specific needs and issues on a particular area of land. However, this sort of precision is not within the scope of the study, and therefore broad estimates have been made, based on a series of criteria, derived from recommendations in the scientific literature, from the SoCo project case study (Calatrava *et al*, 2008) and from the targets identified for specific policy measures with soil conservation objectives. In some cases these criteria were conflicting. For example, in some cases conservation tillage is proposed only for steep slopes whereas in other cases this type of management is proposed for all agricultural areas regardless of the slope gradient.

The existence of available spatial data on land use and soil degradation threats allows the application of these criteria to provide rough estimates of the spatial extent of the measures. However, the land use data is disaggregated by crop type but not by crop which makes it difficult to produce a more accurate estimate of the area where some practices should be applied. Nonetheless it is not thought that this has a particularly significant impact on the total cost estimates.

Table 5.18: Areas where each recommended practice would be applied in Murcia

Practice	Areas where it would be implemented	Non-irrigated herbaceous crops	Irrigated herbaceous crops	Greenhouses	Rice fields	Non-irrigated tree crops	Irrigated tree crops	Forests	Shrub lands	Area affected (hectares)	Comments
Contour tillage	All agricultural land except greenhouses and rice fields.	X	X			X	X			515,793	
Reduced/conservation tillage	All agricultural land except greenhouses.	X	X		X	X	X			516,243	
Soil conservation structures	Slopes > 8 per cent in areas with medium and high risk of erosion, except on rice fields.	X	X	X		X	X			79,041	Build in 25 per cent of the area; Maintain in 100 per cent of the area
Hedgerows/natural vegetation on field boundaries, edge of rural tracks and river banks	All agricultural land except greenhouses	X	X		X	X	X			516,243	Hedgerows not considered. Only natural vegetation.
Keeping overwinter stubbles	Annual rain fed crops.	X								142,856	In annual irrigated crops: green manure and vegetation fringes.
Green manure	Irrigated annual crops.		X							111,316	In annual non-irrigated crops: keeping overwinter stubbles and vegetation
Change crop rotations/Increase fallow index in crop rotations	Non-irrigated herbaceous crops and rice fields.	X			X					143,305	
Vegetation fringes	All agricultural land except greenhouses and rice fields.	X	X			X	X			515,793	In annual rainfed crops: keeping overwinter stubbles and non-harvested/non-cultivated fringes. In annual irrigated crops
Mulching using crop residues	Tree crops as an alternative to vegetation cover/fringes on less					X	X			261,622	On average 2 out of 3 years

	steep slopes.										
Non-harvested fringes on annual rain fed crops	Annual rain fed crops. Alternative to vegetation fringes.	X								142,827	Alternative to vegetation fringes
Restrict fertilisation and manure	Irrigated agriculture		X	X	X		X			397,525	Every three years
Nutrient management planning	Irrigated agriculture		X	X	X		X			236,688	NVZ: 53,024 hectares; Non-NVZ: 183,664 hectares
Minimise pesticides application	Irrigated agriculture		X	X	X		X			236,688	NVZ: 53,024 hectares; Non-NVZ: 183,664 hectares
Integrated pest management	Irrigation		X	X	X	X	X			515,793	NVZ: 54,393 hectares; Non-NVZ: 461,400 hectares
Minimise herbicides application/ Mechanical removal of weeds	All agricultural land except greenhouses and rice fields	X	X			X	X			66,150	Area where it has not been adopted
Drip irrigation/Fertirrigation	Irrigated areas where not already adopted, except on rice fields. Not necessary with organic farming.		X	X			X			98,877	
Irrigation management/Good quality water	Areas in risk of salinisation		X	X			X			527,776	Alternative to pollution control practices, integrated production and drip irrigation.
Organic farming	All agricultural areas. Alternative to pollution control practices, integrated pest management and drip irrigation.	X	X	X	X	X	X			2,618	Not compatible with any farming practices.
Forestation	Non-irrigated agricultural areas with very high soil losses and shrub lands with high losses	X				X			X	33,893	
Management of natural vegetation on forests and scrubland	All natural areas							X	X	529,886	Pest control in forests included
Pest control in forests	All natural areas							X	X	529,886	
Forest fire prevention and defence	All natural areas							X	X	52,082	
Hydrologic restoration	Forests and shrub lands with high soil losses.							X	X		

5.3.7 *Assessment of the costs of the recommended practices*

Using the widest range of sources available, an assessment of the costs associated with encouraging the management practices identified has been carried out. The main source of information used is the payment rate calculations for conservation practices required in the current agri-environment measures in Murcia and neighbouring regions. To assess the robustness of these costs, they have been checked against a variety of other sources of information including:

- Cost calculations for conservation practices required in AEMs from two neighbouring Spanish regions (Valencia and Andalusia) where practices are similar.
- Cost estimates for soil conservation practices in other Spanish regions, identified in scientific papers.
- Cost estimates for some practices obtained from farmers' responses to a survey that have been used to check the validity of the other estimates.

For some practices, the cost estimates found differed significantly in each source. In these cases the official agri-environment payment estimates for the agriculture related management options have been used, as they are based on technical information that is usually available and can be checked. For the forestry management practices, the figures from the National Association of Forestry Enterprises (ASEMFO, 2004) have been used as these tend to represent an average of the different cost estimates available from the range of sources.

Table 5.19 summarises the cost estimates found for the practices recommended for the soil erosion and organic matter content threats, including changes to tillage regimes, soil cover, maintenance of semi-natural vegetation and addition of organic matter. Table 5.20 sets out the cost estimates found for afforestation and forestry management practices.

In many cases, the available costs refer to a group of practices rather than individual farming practices. In some cases, data were available to split up the cost of each individual practice, while in others it is not. The costs of the different practices depend on different factors (slope, type of soil, type of crop), however it is not always easy to include these factors in the cost assessment. As a result per hectare cost estimates are distinguished per crop type and/or average farm slope for only a few management practices. For the afforestation measures, the per hectare costs are high due to the fact that the payments take account of the income foregone in taking the land out of agricultural production. The details of the data sources used and the calculation used to develop these overall per hectare costs are set out in Annex 10.

Table 5.19: Costs of practices recommended for the soil erosion and organic mater content threats

Practice	Increased costs (€/ha)	Reduced production (€/ha)	Source of the cost estimate	Observations
Contour Tillage	20	-	EC (2006)	
	15	-	Own survey	Cost of conventional tillage minus cost of contour tillage
Reduced tillage	-	-	Several	
Building SCS	2,500	-	Martínez-Raya *et al* (2006)	Average one-off value for bank terrace building in olive in Eastern Andalusia (on the range 2,000-4,000 €/ha)
	12,000	-	EC (2006)	
	1,860-2,900	-	Own survey	Values for medium-high slope. Based on a reduced number of observations.
Maintaining SCS	125	-	Martínez-Raya *et al* (2006)	Average value for maintaining terraces in olive orchards in Eastern Andalusia. Estimated as 5% of building costs
	52	-	CV (2007)	Conservation of terraces and other SCS
	200	-	EC (2006)	Average of AEM payments in Spain and Portugal
	125		Own survey	Based on a reduced number of observations
Establishing hedgerows on field boundaries	400	-	JA (2007)	Calculated as an average per hectare based on budget and objective area.
	325	-	Own survey	Average establishment cost expressed by a majority of non-adopters
Maintaining hedgerows/natural vegetation on field boundaries	52	-	CV (2007)	Conservation of hedgerows and vegetated field margins
	50	-	JA (2007)	Maintaining hedgerows and vegetation fringes
Buffer strips on the field	400-800		EC (2006)	Establishing 3-meters wide buffer strips for medium and high erosion respectively
	75-150	20	EC (2006)	Maintaining 3-meters wide buffer strips for medium and high erosion respectively
Keeping overwinter stubbles	-	60.6	CARM (2007)	Cost of not cultivating the following season: 32.6 (equal to the increase in fallow index to 100) Cost of not selling/grazing the straw: 28
	-	26	JA (2007)	Cost of not selling/grazing the straw: 26
Green manure	90	-	CV (2007)	Grinding and burying straw in rice in Valencia
	44	-	JA (2007)	Grinding and burying crop residues in extensive herbaceous crops in

				Andalusia
	44	-	EC (2006)	Cost of residue management
Change crop rotations/Increase fallow index	-25.7	58.3	CARM (2007)	Cost of increasing the fallow index from 40 to 100: 32.6
Vegetation fringes	33.5-217	73.5-452	CARM (2007)	Maintaining vegetation strips on tree crops. Varies depending of slope. Table 22.
	30-86	25-73	CARM (2007)	Maintaining vegetation strips on annual crops. Varies depending of slope – see Annex
	130-787	-	CARM (2007)	Establishing vegetation strips on tree crops. Varies depending of slope – see Annex
	148-408	-	CARM (2007)	Establishing vegetation strips on annual crops. Varies depending of slope – see Annex
	120	-	JA (2007)	Seeded vegetation fringes in olive. Implantation of fringes: 50; maintenance of fringes: 70.
	110	-	JA (2007)	Seeded vegetation fringes in vineyards. Implantation of fringes: 50; maintenance of fringes: 60.
	50	-	CV (2007)	Establishment, maintenance and control of cultivated or natural vegetation covers.
Mulch using pruning residues	136	-	CARM (2007)	Machinery: 100; Labour: 36
	175	-	Calatrava and Franco (2011)	Average cost expressed by olive farmers from the neighbour Granada province
	60	-	JA (2007)	In vineyards
	209	-	Own survey	
Non-harvested fringes on annual rain fed crops (10 per cent of area)	-9.6	27.2	CARM (2007)	Value of non-harvested crop: 27.2 Saved harvest cost: 9.6 Total cost: 17.6
	-	19.2	JA (2007)	
Non-cultivated fringes on annual rain fed crops (10 per cent of area)	-12	27.2	Own calculation using data from CARM (2007)	Value of unharvested crop: 27.2 Saved harvest cost: 12 Total cost: 15.2
Addition of exogenous organic matter	400	-	CARM (2007)	Annual cost estimated to maintain organic matter content in 2 per cent
	384	-	EC (2006)	
	405	-	Own survey	

Table 5.20: Costs of afforestation, forest management and hydrological restoration

Practice	Increased costs (€/ha)	Reduced production (€/ha)	Source	Observations
Forestation	Forestation: 3,655	Rain fed annual crops,	CARM (2007)	Conversion from arable to forest. Maintenance costs includes 26

	Annual maintenance: 565	pasture and shrub lands: 76; Rain fed tree crops: 512		euros/ha of pest control
	Forestation: 700 Annual maintenance: 150	200	EC (2006)	Conversion from arable to forest.
	Forestation: 1,787 Reposition of trees: 990	-	MARM (2007)	
	Forestation: 1,800 Annual maintenance: 500	-	ASEMFO (2004)	
Management of natural vegetation	200	-	JA (2007)	Several measures for the conservation of natural vegetation
Soil conservation in forests	500	-	EC (2006)	Average cost of soil conservation measures. Includes management of natural vegetation
Pest control in forests	26	-	CARM (2007)	Included in maintenance costs
Forest fire prevention	2,200	-	CV (2007)	Per hectare management cost for fire prevention and defence estimated from budget
	630	-	JA (2007)	Average payment of fire prevention measures estimated from budget
Hydrological restoration	8,000-15,000 Mean: 9,000	-		Range of cost of specific restoration projects in the area of study.

Overall cost of delivering soil conservation objectives in Murcia

The overall cost estimates of using the recommended management practices to address the soil conservation needs of the region have been obtained by multiplying the unitary per hectare cost of each practice by the area where it needs to be applied.

These calculations indicate that addressing soil erosion and soil organic matter issues in Murcia requires an annual cost of €187.7 million, plus a one-off cost of €137.4 million for the establishment of soil conservation structures and vegetation covers (see Table 5.21). This is the equivalent of an average of €383 per hectare per year of agricultural land, plus a one-off cost of €266 per hectare. The largest share of these costs relates to the addition of exogenous organic matter and the maintenance of soil covers (fringes, strips, mulching) and the management of natural vegetation along the edges of field parcels. In addition, the costs of implementing the management practices recommended to tackle the soil salinisation threat in the areas at risk of salinisation are estimated to require €30.7 million per year (Table 5.22).

Table 5.21: Total costs of practices to address soil erosion and organic matter content issues

Practice	Area to be managed (ha)	Unitary one-off costs (€/ha)	Unitary annual costs (€/ha)	Total one-off costs (€)	Total annual costs (€)	Comments
Contour tillage	515,793	0	20	0	10,315,860	
Reduced/conservation tillage	516,243	0	0	0	0	
Soil conservation structures	79,041	2,500	125	49,400,579	9,880,116	Build in 25 per cent of area; maintain in 100 per cent
Natural vegetation on edges of fields and rural tracks and water banks	516,243	0	50	0	25,812,136	Hedgerows not considered.
Keeping overwinter stubbles	142,856	0	28	0	3,999,958	Cost of crop rotation not included
Green manure	111,316	0	44	0	4,897,899	
Change crop rotations/Increase fallow index in crop rotations	143,305	0	32	0	4,585,772	
Vegetation strips	515,793	Calculated crop by crop		83,262,015	50,554,646	
Mulching using crop residues	261,622	0	136	0	23,838,963	Calculated for 2 applications every 3 years
Non-harvested fringes on annual rain fed crops	142,827	0	0	0	0	Vegetation fringes considered instead
Addition of exogenous organic matter	397,525	0	400	0	52,473,255	1 application every 3 years
Forestation of agricultural lands	2,618	1,800	500	4,712,491	1,309,025	
			TOTAL	**137,375,085**	**187,667,630**	

Source: Calculated using data from Tables 20 to 23.

Table 5.22: Total costs of practices to address salinisation

Practice	Area (ha)	Unitary one-off costs	Unitary annual costs	Total one-off costs	Total annual costs	Comments
Irrigation management	98,877		100	0	9,887,655	Areas in risk of salinisation
Good quality water			210	0	20,764,075	
	TOTAL			**0**	**30,653,730**	

Source: Calculated using data from Tables in Annex 10

5.3.8 Comparison with EU Cost Estimates

As a comparison to the figures estimated under the Murcia case study, the costs of management to address soil organic matter (SOM) decline for the EU-27 as a whole were explored by using the per hectare cost estimates for the range of management practices identified as being needed to address SOM issues from Kuhlman *et al* (2010) (see Chapter 3) and a review of data on the potential extent of application of different management options and areas of risk across Europe. Although there is no official risk assessment for soil organic matter at the European scale (Tóth *et al*, 2009), various approaches have been taken to defining areas of risk by defining universal soil organic matter thresholds (Van-Camp *et al*, 2004), defining thresholds for different bioclimatic regions (Louwagie *et al*, 2009), and exercises to model the response of SOM to various pressures and drivers. In the absence of an official approach to risk mapping for soil organic matter in the EU, estimates of the area at risk have been derived from a combination of the data provided under these three approaches.

Table 5.23 summarises these results. Estimated total costs for individual management practices to address soil organic matter range from €2.1 billion per year for catch crops to €18 billion per year for application of exogenous organic matter, based on application to a risk area of 45% of arable land. However, many of these management actions overlap and different combinations of these types of management may be needed to address soil degradation issues in different bioclimatic and topographic circumstances. As such, the costs identified cannot be summed to provide an overall cost. The only overarching cost available for halting soil organic decline on arable soils has been calculated by Kuhlman *et al* (2010), who estimates the annual costs at €12 billion/year. It is thought that the areas at risk from SOM decline are likely to be the same as those at risk from erosion, and therefore these costs would also contribute to meeting soil erosion objectives.

Table 5.23: Estimated costs of addressing soil organic matter decline in the EU-27

land use	Total area (million Ha)	% area likely to be affected by threat	Management practices required to address key issues identified	% of area where management is needed	Total area (Mha) where management is needed	Cost per ha of achieving required area (€)	Total cost for measure (million €)	Notes
productive arable	104.3	45	Implementation of management options where SOC<2%, if using this as a trigger threshold	100%	47.0	116	5,447	assuming risk area 45% of arable lar based on <2% SC
productive arable	104.3	100	integrated approach for all soils at risk from soil organic matter decline	100%	104.3	116	12,104	assuming (i) retain SOM at risk of loss areas with low SC content and (iii potential to increa SOM in other are Based on outputs f SOCO project
permanent grassland	56.8	100	integrated approach for all soils at risk from soil organic matter decline	100%	56.8	116	6,588	
productive arable	104.3	45	Incorporation of legumes into the ground	100%	47.0	57	2,676	assuming risk area 45% of arable lar based on <2% SC
productive arable	104.3	45	Incorporation of organic materials	100%	47.0	382	17,936	
productive arable	104.3	45	arable stubble management	100%	47.0	44	2,066	
productive arable	104.3	45	no burning of stubble or crop remains	100%	47.0	44	2,066	
productive arable	104.3	45	incorporation of crop remains	100%	47.0	44	2,066	
productive arable	104.3	45	residue management - no removal with mulching crop remains and stubble	100%	47.0	44	2,066	
productive arable	104.3	45	retaining stubble	100%	47.0	44	2,066	
productive arable	104.3	45	conservation agriculture, with three underlying practices – reduced and no-tillage, cover crops and crop rotation	100%	47.0	116	5,447	
productive arable	104.3	45	Catch crops / green manure / less fallow / winter cover	100%	47.0	57	2,676	
productive arable	104.3	45	Adding legumes / N fixing crops to rotation or undersowing	100%	47.0	57	2,676	
productive arable	104.3	45	Conservation / reduced tillage	100%	47.0	59	2,770	
productive arable	104.3	45	Residue management	100%	47.0	44	2,066	
productive arable	104.3	45	Application of manure / biosolids to cropland as opposed to grassland	100%	47.0	384	18,030	
productive arable	104.3	45	Improved application methods for application of manures / biosolids to prevent C / CO2 eq losses	100%	47.0	384	18,030	
agricultural land	172.5	100	catch crops	21	36.22	57	2,065	
agricultural land	172.5	100	adding legumes	28	48.30	57	2,753	
agricultural land	172.5	100	reduced tillage	42	72.44	59	4,274	Areas from PICCM project

agricultural land	172.5	100	residue management - no removal	49	84.52	44	3,719	
productive arable	104.3	100	Conservation / reduced tillage	42	43.82	59	2,586	Areas from Tebrüg and Böhrensen (1997b)

The cost estimates from the Murcia region are high proportionately in comparison with these estimates for the EU-27, even when the costs for soil organic matter are taken alone. This is most likely as a result of two factors. Firstly Murcia has a higher proportion of land with soil related problems than in the EU as a whole and secondly, the calculation of cost estimates at the regional level constitute a more accurate reflection of the costs of management needed to address the specific soil degradation issues in this region.

This highlights the need to treat any estimation of costs that have been calculated for the EU-27, without recourse to detailed assessments at the national or regional level, with considerable caution. The detailed assessment and comparison of the costs and benefits of potential management options to address a particular environmental pressure, for example a decline in soil organic matter, will strongly depend on the extent of the pressure and the type and extent of the implementation of the options by Member States under local social, economic and environmental conditions.

Taking the case of soil degradation, there is a general lack of suitable economic data for a comprehensive assessment of costs of loss in soil organic matter (Darmendrail *et al*, 2004). This also affects any assessment of costs for management options to address soil organic matter decline. There remains a lack of empirical or modelled data on the real extent and spatial distribution soil organic matter decline (i.e. losses, or increases) across the Member States (as opposed to C sequestration from flux estimates). In parallel, there is need to determine the effectiveness of specific management options on soil organic matter declines across different bioclimatic zones and in relation to local field conditions. The data from the Murcia region in Spain serve as a useful example of how the availability of such data can provide much more robust estimates of the costs necessary for addressing soil conservation. They demonstrate the value of developing detailed regional estimates of costs to inform the funding needs of particular environmental issues more accurately in the EU-27.

6 MEETING MULTIPLE OBJECTIVES – IMPLICATIONS FOR THE COST ESTIMATES

As highlighted in Chapter 4, one of the key methodological challenges of the study is the calculation of the degree to which different types of land management can be used to address a number of different environmental pressures and achieve multiple environmental objectives in the same location. Additionally, it is important to identify those situations in which management practices that achieve benefits for one environmental issue could conflict with the delivery of other environmental priorities so that such conflicts can be resolved.

Experience from the design and implementation of policy measures to address environmental issues through agricultural and forestry management practices over the last quarter of a century have demonstrated that it is neither necessary nor efficient to develop entirely different and separate suites of measures to pursue environmental objectives individually. To do so would result in overly complex programmes of voluntary incentive measures that could deter farmers from participation and increase transaction costs for delivery bodies and recipients of support alike. Therefore, as is the case under the majority of agri-environment schemes operating in the EU-27, a combination of measures to deliver across a full range of environmental objectives is likely to be required in any realistic programme of incentives to address environmental needs in the future. Some of these will be multi-purpose to varying degrees and others will be very sharply focused, for example, on creating the habitat conditions required by a particular species. Even the latter group is likely to have some environmental benefits beyond the primary focus of the measure.

This has implications for the overall estimation of costs for addressing the EU's environmental priorities. Clearly, the more environmental benefits that can be achieved in one location through the adoption of a particular set of the management options, the more cost-effective the expenditure will be. However, determining where, and under what circumstances, multiple objectives can be met through implementing the same management practices is not straightforward as there is very little evidence available either to determine the overlap of pressures facing different environmental media or to demonstrate the effectiveness of different management activities in meeting multiple environmental needs.

Identifying where one type of management can address multiple pressures as well as deliver multiple environmental benefits can be derived from the literature to some degree, including academic research and the results of agri-environment evaluation exercises (eg Bishop *et al,* 2008) (see Table 2.3 in Chapter 2). However, the nature of the specific management practices required to deliver particular objectives varies according to location and depends on a range of factors, including geographic, climatic, and topographic factors as well as the nature of previous and current land use, the size and structure of the holding and the fields within it. In addition, although it is often the case that the areas targeted for environmental intervention are the same as those areas with the environmental problem, this is not always the case. For example, water quality issues (the environmental problem) occurring in one part of a catchment may require the environmental management to take place elsewhere in the catchment.

Even more problematic, however, is quantifying the area over which management is needed to address a specific environmental need (see, for example the arable birds case study in section 5.1) and the degree to which this overlaps spatially with the area requiring management for other environmental needs. In locations where several environmental needs are deemed a priority, issues also arise about whether the management required is complementary or conflicting, and whether certain actions need to take precedence over others.

The cost estimates produced in Chapter 4 have addressed the issues of overlap to some degree by estimating the total area needed under a particular management option to meet a range of environmental objectives. However, due to the limitations of data availability at the EU level, it has not been possible to distinguish the areas needed under management by individual environment objective, such as biodiversity or water quality for example. The cost estimates for this study, therefore assume that all environmental objectives will be achieved through applying a particular management option over a specified area of land. In reality, this will clearly not be the case as priority areas will differ depending on the environmental pressure. For example measures to address diffuse water pollution will not necessarily be needed on the same area of land as measures to address the declines in arable farmland birds, even if similar management options may address both issues (for example field margins, over-winter stubbles, green cover etc).

This chapter looks in more detail at some of the methodological challenges, evidence and data available to enable a quantified and spatially explicit analysis of the overlap of priority areas for different environmental issues, and the degree to which particular management options can deliver these benefits concurrently.

6.1 Challenges Associated with the Identification and Management of Areas to address Multiple Environmental Needs

The interconnectedness of different components of landscapes and ecosystems is increasingly recognised. It is clear, therefore, that changes to one aspect of a system have the potential to have cascading, albeit unequal effects, throughout other components of the landscape/ecosystem (Groot *et al,* 2010; Willemen *et al,* 2010). In addition, different environmental management actions need to be implemented at different spatial scales depending on the specific goals and context of the landscape in question in order to achieve the desired environmental effect.

The implications of this for the development of programmes of measures designed to address a range of environmental needs, whether on farmland or woodland can be summarised as follows (Bathgate *et al,* 2008; Bryan and Crossman, 2008; Finn *et al,* 2009; Lehmann *et al,* 2009; Rounsevell *et al,* 2010):

- The production of environmental benefits from a particular landscape/ecosystem may depend on finding ways of addressing multiple, rather than singular, environmental issues (and potentially over a variety of scales);

- A variety of types of management can generally produce the same environmental benefit, and therefore may be at least semi-substitutable with each other - however, these traits differ in terms of the amount of any given service that they can create on a particular scale and under particular conditions;
- Single management actions targeting single environmental benefits (such as improved water quality, soil conservation, or biodiversity) have the potential to impact either positively or negatively on the delivery other categories of environmental benefits;
- Management actions focused on the delivery of single environmental benefits have the potential to impact either positively or negatively on the *effectiveness* of other management actions designed to target other categories of environmental benefits within the same landscape/ecosystem.

There are, therefore a range of synergies and/or conflicts in achieving a range of environmental outcomes generated by various combinations of management activities on different types of land use. It is important to understand these interactions in order to maximise synergies, minimise conflicts and thereby deliver environmental outcomes more efficiently. This requires a systematic and quantitative investigation of the potential trade-offs between various environmental goals and various management actions, on a variety of scales. Some examples of potential synergies and conflicts between the delivery of different environmental media are highlighted below.

As a first example, buffer strips in certain conditions decrease erosion, increase water quality, increase biodiversity, and extend the range of wildlife at the same time and in the same space (Borin *et al,* 2010; Lovell and Sullivan, 2006; see Box 6. 1). Recognising the conditions under which this is the case and prioritising this management practice in areas where these goals overlap may help to maximise the efficiency of delivering the environmental outcome, while at the same time reducing the costs required. At the same time, it is also possible that certain environmental interventions decrease the effectiveness of other environmental interventions, or are otherwise undermining the delivery of desired environmental benefits, as is sometimes the case when trying to meet objectives for both flood management and improved biodiversity, or recreation and biodiversity objectives (Posthumus *et al,* 2010; Reed and Merenlender, 2008).

Box 6. 1: **Examples of factors which can influence the potential for buffer strips to provide multiple environmental benefits**

The type of buffer strip, its width, length, and the type of activities that take place on it need to vary significantly depending on its purpose, specific location and context (Bradbury and Kirby, 2006; Lovell and Sullivan, 2006; Nerbonne and Vondracek, 2001).

The roots of the vegetation in buffer strips hold soil in place, allow greater infiltration of water and trap the sediment in run-off from neighbouring fields. Buffers can remove up to 97 per cent of soil sediment before it enters a stream. But maintenance is essential if the buffers are to remain effective as sediment sinks: compaction from machinery and livestock has to be avoided and excess sediment has to be removed. Nitrogen is trapped and assimilated by the plants in buffer strips and nitrate-N levels can typically be reduced by 50 per cent per year by a buffer strip or wetland before entering a watercourse. Phosphorus run-off can also be reduced, but removal rates can vary greatly (from 25 per cent to 95 per cent) depending on the percentage of soil-bound versus soluble phosphorus, length of buffer strip, vegetation type and underlying hydrology. Buffer strips can also become saturated, which reduces their effectiveness in removing phosphorus.

Buffer strips planted with a variety of plant species will improve the ecological conditions for terrestrial wildlife species, and buffers containing woody plants are likely to contain greater species richness than grassy buffers. Riparian buffers, particularly those containing trees, can also help the health of aquatic species by cooling stream waters, providing food and habitat and increasing the dissolved oxygen in water. Buffer strips can also benefit biodiversity by providing corridors that connect wildlife habitats and allow safe movement between fragmented patches of natural areas. However, their length and width must be appropriate to allow movement of the desired species from one location to another and their use as corridors will depend on them providing connections between relevant natural and semi-natural habitats.

Buffer strips have been found to provide environmental benefits in site-specific studies, but relatively little is known about their impact at other spatial scales. Hence it is difficult to ascertain the extent to which pollutant concentrations could be reduced if a high percentage of landowners in a particular catchment established buffer strips in sensitive areas, or the relative benefit to biodiversity of buffer strips placed adjacent to ditches, rivers and streams or those placed within fields.

Source: Lovell, S. T. & Sullivan, W.C. (2006)

However, although there is a broad, qualitative discussion in the literature regarding the delivery of multiple benefits, the availability of data and literature that focus on the quantitative trade-offs between, or multiple benefits derived from, various management actions is very limited. This is largely due to the complexity of agro-environmental systems and the availability of data required to understand them (Koniak *et al,* 2009). Investigating these trade-offs requires not only considering and testing the impact of land use change on multiple geographic and temporal scales (Bathgate *et al,* 2008), but also attempting to understand which components of various environmental systems (both within and across trophic levels) deliver various environmental benefits across various scales, and how they do so (de Bello *et al,* 2010).

A review of the available literature reveals a number of issues. Most critically, it highlights widespread gaps in ecological knowledge detailing the functional relationships between different components of ecosystems, thresholds within different parts of the ecosystems, and the roles that various components of ecosystems play in the delivery of the desired environmental benefits. As the synergies and trade-offs between the achievement of environmental benefits are direct consequences of these ecological relationships, and as these ecological relationships can impact significantly on the effectiveness, efficiency, and cost of environmental management, this points to a key area requiring future research and highlights the significance of ecological research to contemporary policy design (see, in particular, Lovell and Johnston, 2009 and Willemen *et al,* 2010). This is a key issue highlighted within the case study relating to farmland birds (see Section 5.1). Another issue raised in the literature is the fact that, while local variability is extremely important in terms of the particular synergies and trade-offs between the delivery of various environmental objectives in particular locations, management attempting to capitalise on these synergies and trade-offs often needs to be focused at the scale of the landscape or ecosystem to maximise its effectiveness.

In addition, these studies highlight that, although opportunities exist for prioritising multiple benefits, there are important caveats that need to be borne in mind. These are as follows:

1) Policies intending to prioritise a specific environmental benefit may not, in fact, be the most effective at achieving that benefit due to unanticipated interactions between different environmental elements (Posthumus *et al,* 2010)
2) The degree of emphasis and focus matters in terms of achieving complementary environmental improvements (Rabotyagov *et al,*2010)
3) The policy actions that provide benefits for the most environmental issues may not provide the maximum benefit across each category of environmental benefit considered (Bradbury *et al,*2010)
4) Using one action to target more than one benefit can lead to sub-optimal delivery of the secondary environmental benefits in comparison with the level of benefits that could be achieved if each secondary environmental benefit were targeted directly (Kurkalova *et al,*2004)

Research undertaken by Posthumus *et al,* (2010) (see Box 6. 2), explored the effectiveness of a range of different policy measures to deliver 14 ecosystem services in lowland floodplains in England. The study found that, while a policy intended to target biodiversity would produce excellent water quality results, and reasonable biodiversity results, it would fail to produce the highest cumulative benefits to the full range of ecosystem services, and would not produce the highest species score, habitat score or landscape score. Furthermore, this policy would produce a noticeably lower score for floodwater storage than some of the other alternative policy options. This demonstrates that, at least in the lowland flood plains of England, there is the potential for unanticipated yet significant conflicts between biodiversity and the achievement of other environmental benefits like floodwater storage. Importantly, their work also highlights that biodiversity, while often a necessary condition for supporting the provision of other environmental benefits, is not in and of itself always a sufficient condition to generate these environmental benefits.

The influence of the primary focus of the management options put in place on the environmental outcomes achieved is highlighted by Rabotyagov *et al,* (2010). They found that a policy that intended to decrease the nutrient loading into freshwater systems, but did so by focusing firstly on reducing annual nitrate loadings in a particular watershed by 30 per cent, would also result in a 36 per cent reduction in the annual phosphorus loading.

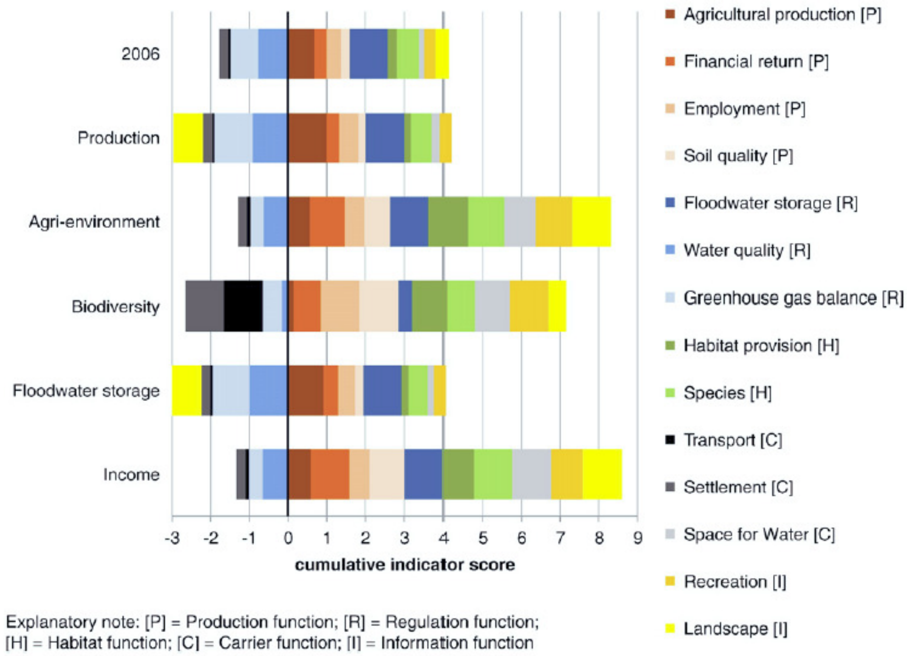
However, the reciprocal policy - a policy that aimed to reduce nutrient loading in the freshwater system, but by targeting a 30 per cent reduction in phosphorus loading first - would generate only a 9 per cent reduction in the annual nitrate load to the watershed.

Box 6. 2: Comparing the performance of different management strategies on ecosystem goods and services within the Beckingham Marshes, England

The hypothetical performance of six different management strategies – five of which aim to achieve one specific objective and one of which represented the 2006 business as usual scenario – were assessed against the delivery of 14 categories of ecosystem goods and services within the Beckingham Marshes (Posthumus *et al*, 2010. The outcomes were modelled using a variety of pre-established indicators and normalised to facilitate comparisons between the different services and management strategies. The details of each management strategy are set out as follows:

	2006	Agricultural production	Agri-environment	Biodiversity	Flood water storage	Income
Total days with surface water	35	3	73	115	0	113
Mean water table depth (m)	0.5	0.6	0.4	0.1	1.0	0.3
Annual flood probability (%)	10%	10%	50%	50%	10%	60%
Land use	Cereals, grazing marsh	Cereals, root crops	Grazing marsh, floodplain meadow	Reed beds, wet woodland, grazing marsh	Cereals	Grazing marsh
Cereals	39%	64%			63%	
Oilseed rape	19%	21%			25%	
Peas / beans	19%	11%			13%	
Potatoes / sugar beet		4%				
Set-aside	6%					
Improved permanent pasture	15%		6%	15%		20%
Alluvial hay meadow			48%			
Floodplain grazing marsh			46%	8%		80%
Reed bed				46%		
Woodland				32%		
Livestock	Extensive beef	–	Extensive beef	Extensive beef	–	Extensive beef
Stocking rate during grazing season (LU ha^{-1})	2.59	0	2.41	2.86	0	2.58

The outcomes of the analysis demonstrated that the strategies that generate the highest cumulative service provision are the agri-environment and the income strategies. The biodiversity policy produces excellent water quality results, and reasonable biodiversity results, but fails to deliver for all ecosystem services, and fails to produce the highest species, habitat or landscape score. This policy would also produce a noticeably lower score for floodwater storage than some of the other alternative policy options. This demonstrates that, in at least the lowland flood plains of England, there is the potential for unanticipated yet significant conflicts between biodiversity and the achievement of other ecosystem services like floodwater storage.



Source: Posthumus *et al* (2010)

Bradbury *et al,* (2010) (see Box 6. 3) assessed the impact of a number of different management options in the English Entry Level Stewardship agri-environment scheme on various ecosystem services, such as climate regulation, water regulation, erosion, water quality, pest control, and pollination, in addition to promoting farmland bird biodiversity. The management practice that scored the highest for delivering multiple non-biodiversity benefits – permanent grassland with very low inputs – was assessed as delivering considerably better provision of the service in two of the six environmental benefits categories, the equivalent to slight improvements in three of the categories, and had a neutral impact on one category. Therefore, while multiple services are being provided (and none degraded) through this one action, there are still trade-offs between the categories of environmental benefit provided. The extent to which this is significant ultimately depends on whether the improvement seen in those categories of environmental benefit experiencing moderate improvement was enough to meet the desired outcomes. If this is not the case, then the value of using this management would need to be re-assessed and the impact on any changes on the environmental outcomes achieved would need to be reconsidered - see Box 6. 3.

Box 6. 3: Environmental benefits associated with management options in the English Entry Level Environmental Stewardship Scheme

A study by Bradbury *et al*, (2010) investigated the relative impact of a range of the management options in the English Entry Level Environmental Stewardship agri-environment scheme on a range of ecosystem services: climate regulation, water regulation, erosion, water quality, pest control, and pollination, as well as farmland bird biodiversity. This study gives an indication of the scale of trade-offs and synergies that arise in delivering different services using different land management options, and shows that the delivery of ecosystem services does not necessarily deliver benefits for biodiversity. Scores were attributed to each management option as follows to 'reflect the net impact of each option on each service, compared to the most typical business as usual practice in the absence of that agri-environment option':

2:	*Considerably better provision by the option per unit area*
1:	*Slightly better provision by the option per unit area*
0 (blank):	*No difference*
-1:	*Slightly worse provision by the option per unit area*
-2:	*Considerably worse provision by the option per unit area*

Ecosystem service scores were derived by scoring each management option independently (relative to an agreed upon baseline action), and resolving any discrepancies through discussion prior to the final scoring [1]. Farmland bird rankings were derived from an extension of Vickery et al [2]. The scores are shown below:

- *Blue rows represent management options that generate the 1st or 2nd highest cumulative ecosystem services*
- *Orange rows represent management options that generate the 2nd – 5th highest scores for farmland birds*
- *Green rows represent other management options that generate the highest score for individual regulating ES categories that are not already listed in the orange or blue rows.*

ELS Option	Regulating ES								
	Climate	Water Reg.	Erosion	Water Qual.	Pest Cont.	Poll.	**Total Score**	**ES Rank**	**Bird Rank**
EK3 – Permanent grassland with very low inputs	**2**	1	1	**2**		1	**7**	**1**	**1**
EL3 – Manage in-bye pasture and meadows with very low inputs	**2**	1	1	**2**		1	**7**	**1**	**7**
EE3 – 6m buffer strips on cultivated land	1	1	1	1	1	1	**6**	**2**	**10**
EF7 – Beetle Banks	1	1	1	1	**2**	-1	**6**	**2**	**11**
EE1 – 2m buffer strips on cultivated land	1	1	1	1	1	1	**6**	**2**	**12**
EE2 – 4m buffer strips on cultivated land	1	1	1	1	1	1	**6**	**2**	**12**
EE8 – Buffering in-field ponds in arable land	1	1	1	1	1	1	**6**	**2**	**17**
EF4 – Pollen and Nectar flower mix	1	1	1	1	-1	**2**	**6**	**2**	**19**
EG4 – Cereals for whole crop silage followed by over-wintered stubbles		-1	-1	-1			**-3**	**9**	**2**
EF11 – 6m uncropped cultivated margins (in arable)		-1	-1	1-1	1	1	**0**	**8**	**3**
EG2 – Wild bird seed mixture in grassland areas	-1	-1	-1	-1	1-1	1	**-3**	**9**	**4**
EF2 – Wild bird seed mixture					-1	1	**0**	**8**	**5**
EG1 – Under sown spring cereals	1	1	**2**	1	-1		**4**	**4**	**13**
EF10 – Unfertilised conservation headlands in cereal fields	1			**2**	1-1	1	**4**	**4**	**14**
EG3 – Pollen and nectar flower mix on grassland	-1		-1		1	**2**	**1**	**7**	**18**

Sources: [1] Land use Consultants & GHK Consulting, Ltd. (2009) [2] Vickery, J.A., *et al,*(2008) Finally, an American study looked at the level of environmental outcomes achieved when one action is focused on the delivery of one environmental outcome directly but may have several indirect benefits for other environmental needs (Kurkalova *et al,* 2004). This study looked at the multiple benefits derived from conservation tillage, and focused on evaluating the impacts in terms of carbon sequestration, erosion rates and nitrogen-based runoff.

The results demonstrated that targeting one of the environmental objectives also provided good outcomes for the other benefits relative to the outcomes that could have been achieved if they had been targeted directly, but that the two were never equivalent. This is important to consider because it implies that even where one type of management can substantially contribute to the achievement of both primary and secondary objectives, that there may still need to be additional management options in place to ensure that the secondary objectives are also met.

Deriving estimates of the areas over which environmental management is needed to meet multiple environmental objectives is almost impossible to determine accurately without recourse to GI data. Although increasingly spatial data do exist for different environmental priorities in a number of Member States and at the EU level, they have very rarely been overlaid with one another with this purpose in mind.

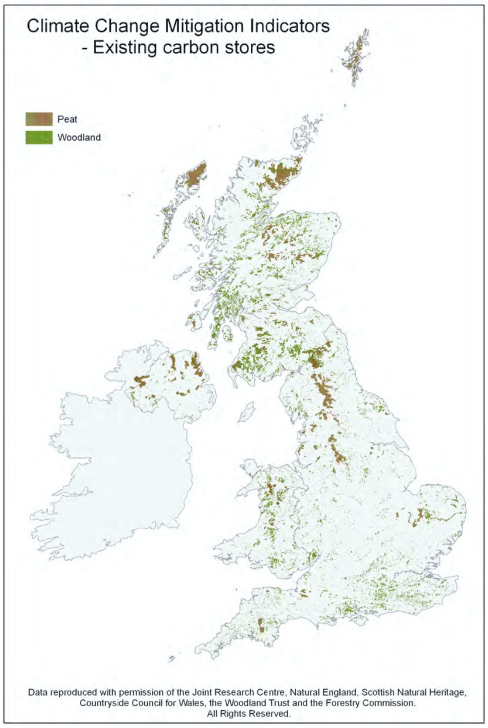
The only study found that has sought to estimate the scale of future environmental land management requirements, taking into account the overlaps between different environmental objectives is a UK study (Cao *et al,* 2009 and see Box 6. 4). It considered nine different categories of environmental needs, including those that form the focus of this study and others such as flood risk management, public access and protecting the historic environment. The priority areas for each of these environmental issues were mapped for the UK to identify where in the UK each of the issues most needed to be addressed; the scale (eg hectares of land or length of linear feature) at which they needed to be addressed; and the degree of potential spatial overlap between the different priority areas identified. Box 6. 4 provides an illustration of the approach taken.

Considerable overlaps were identified, confirming the importance of taking this factor into account when calculating the costs of addressing environmental needs. The study used this data to refine their estimates of the costs of delivering environmental objectives, taking into account the spatial overlap of priority areas and assumptions on the degree of which management options were able to achieve multiple objectives.

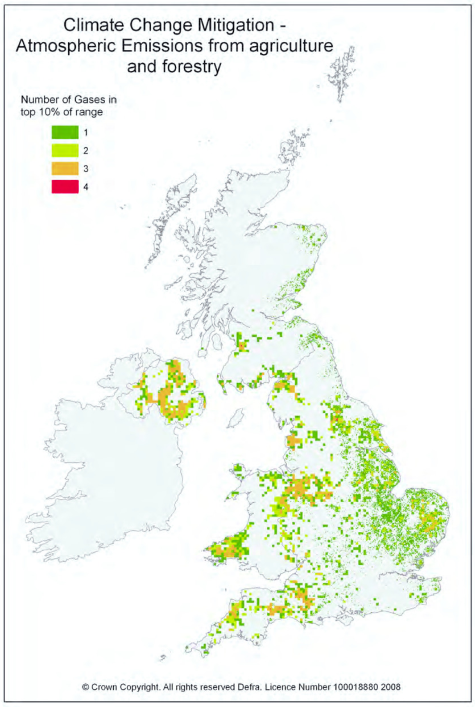
Box 6. 4: Estimating the degree of spatial overlap between different environmental issues in the UK

Data were collected and combined using GIS to provide an indication of the areas across the UK where climate change mitigation measures needed to be targeted (see maps a and b). These priority areas for climate change mitigation were then compared, using GIS, with similar maps produced for each of the other environmental objectives to locate and calculate the extent of any overlaps. Figure (c) illustrates where the priority areas for climate change mitigation were found to overlap with the priority areas identified for resource protection (in brown) and biodiversity conservation (in red). Once all combinations had been investigated, the degree of overlap was found to be most significant for resource protection in each of the four UK countries, ie between 34 per cent-50 per cent of the area identified as a priority for resource protection also overlapped with those identified as priority areas for one or more of the other environmental issues.

(a)



(b)



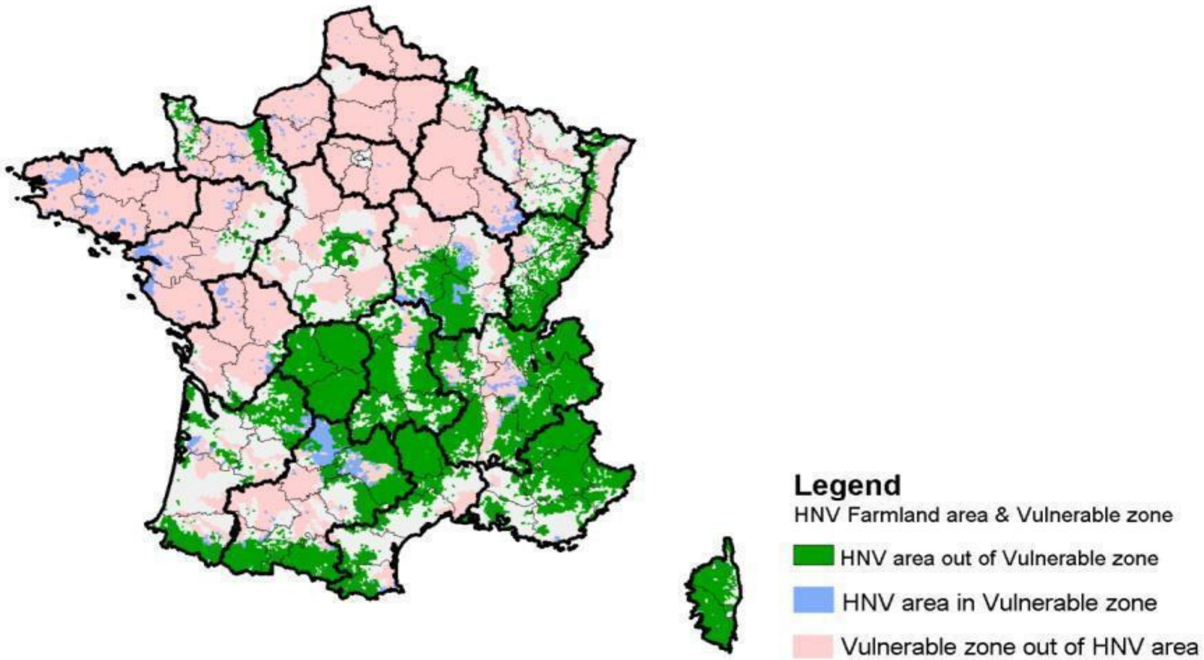
(c)

Source: Cao *et al,* 2009

The following examples from France and the Czech Republic provide an illustration of the sort of spatial data that are available increasingly in different Member States and that could be developed and overlaid to provide the basis of more detailed and accurate estimates of the costs of addressing the environmental needs at the regional or national level.

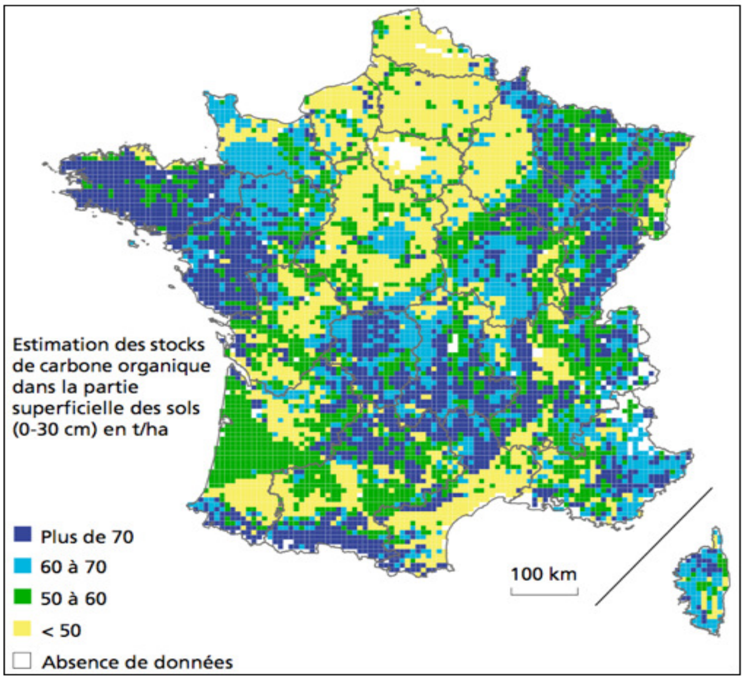
In France, a series of maps have been produced to illustrate the distribution of High Nature Value farmland. These have subsequently been overlain with other datasets to demonstrate the degree or lack of overlap between HNV farmland and other environmental concerns or priorities. The example in Figure 6.1 has overlain data on the location of HNV farmland Nitrate Vulnerable Zones and shows that there is very little overlap between the two with Figure 6.2, and Figure 6.3 show the location of areas with low organic carbon or areas at high risk of soil erosion. When these are compared with the distribution of HNV farmland, again it is clear that there is no significant overlap between them. This is useful information, as it demonstrates that, although management to maintain HNV farming systems may also be beneficial for water quality, soil organic carbon and maintaining soil functionality, those tracts of farmland classified as HNV are not necessarily the areas where specific action is needed to address the needs associated with these other environmental priorities, at least in France.

Figure 6.1: Overlap between HNV farmland and Nitrate Vulnerable Zones in France



Source: Solagro, 2010

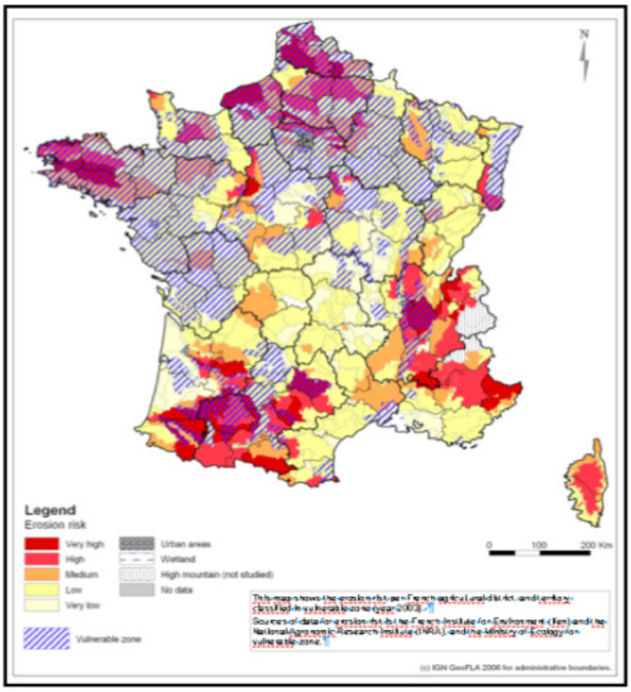
Figure 6.2: Estimate of the stock of organic carbon in the top soil (0-30 cm) in tons per hectare in France



Map 2 : Estimation of the stock in organic carbon in the top soil (0 – 30 cm) in tons per hectare (Source : INRA 2001 in Antoni et Arrouays, 2007).

Source: INRA 2001 in Antoni and Arrouays, 2007

Figure 6.3: Annual erosion risk and vulnerable zones in France



Source: INRA-Ecology, 2003

In the Czech Republic, the Ministry of Agriculture has digitised the information on the areas of land under different management options under the Czech agri-environment scheme. The maps in the following figures illustrate the spatial distribution of selected options. This type of data, if overlain with spatial data on the priority areas for different environmental issues, would allow for a much more sophisticated targeting of environmental management practices, which in turn would lead to more accurate estimates of the costs needed for environmental delivery, and more efficient and cost effective targeting of public funding.

Figure 6.4: Area under agri-environment grassland management options in the Czech Republic

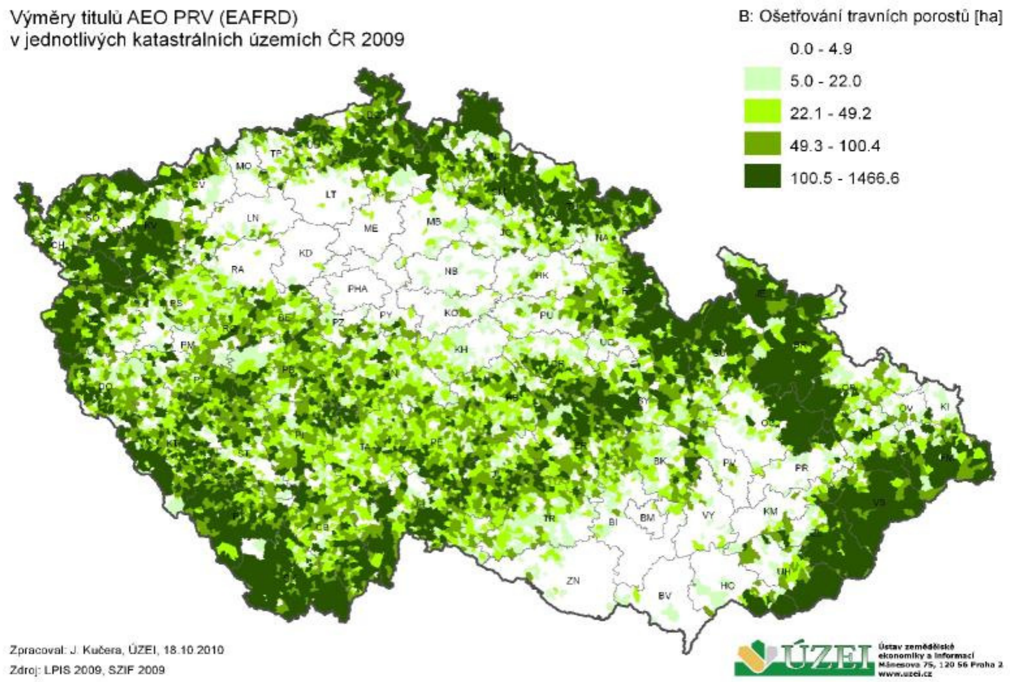


Figure 6.5: Area under conversion from arable to permanent pasture (agri-environment agreements), Czech Republic

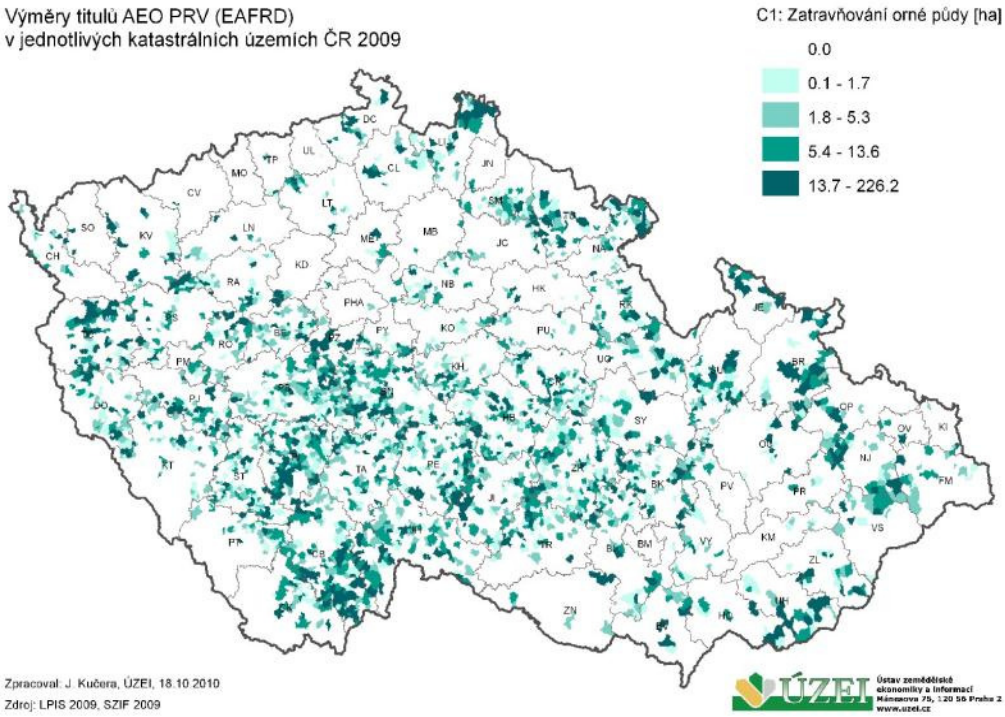
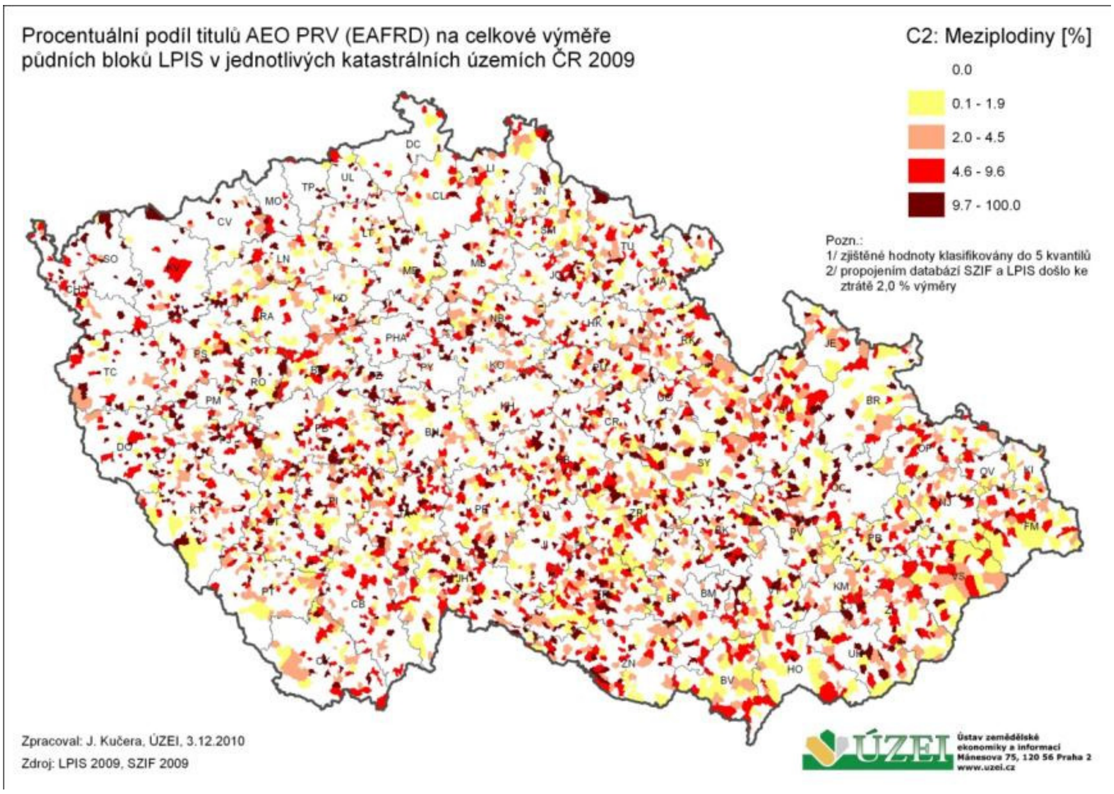


Figure 6.6: Area under cover crops, Czech Republic



This chapter has illustrated the importance of addressing the issue of overlapping priority areas for different environmental objectives and the use of management options to deliver multiple environmental benefits in planning the design of environmental incentive schemes and their associated costs. Progress on providing the data to allow this to happen is evident at the local level, although not yet available for the EU-27. However, despite this, the central cost estimates produced within the context of this study did take account of overlapping priorities and management by adopting a much more generic and stylised approach (see Chapter 4 and Annex 1 for details).

7 CURRENT FUNDING AVAILABILITY

Based on the environmental needs and priorities associated with rural land management identified in Chapter 2 and the overall costs of meeting these needs in Chapter 4, this chapter provides an outline of the levels of expenditure that are currently in place for delivering these environmental needs and provides a brief assessment of the impact and effectiveness of this spending to date. This information is then used to inform the calculation of the scale of unmet need and the cost of meeting these unmet needs, which forms the focus of Chapter 8.

Given the focus of this study on the environmental needs relating to rural land management, the CAP, and specifically the EAFRD, is the most significant source of funding for securing the delivery of environmental benefits across the farmed landscape, both in terms of its spatial coverage and the resources allocated to it. In addition to the EAFRD, dedicated funding exists for biodiversity through the LIFE+ programme and the Structural Funds. Beyond EU funds and their national co-financing requirements, other national state aided measures and private initiatives also have a part to play, although these tend to be far less significant in terms of overall levels of funding.

This chapter explores the degree of existing funding availability in two parts. Firstly the availability of funding from the EU budget for delivering the key environmental media which are the focus of this study is considered, focusing mainly on the EAFRD, but also considering other relevant funding sources. Secondly, non European sources of funding are identified, including co-financing, state aids as well as private sources of funding. As a final step, the impact that this funding has had on meeting the needs and priorities identified in Chapter 2 is assessed, identifying the positive impacts as well as those areas where there is need for improvement.

Providing information on the availability, scale and distribution of funding to meet the environmental needs that form the focus of this study is not straightforward. Where measures are focused directly on the delivery of environmental benefits, they are often designed to deliver multiple benefits (for example, agri-environment schemes) and therefore expenditure is not broken down by environmental priority. In cases where the delivery of environmental benefits is not a direct objective of the measure (for example the farm modernisation measure or advice and training measures), only a proportion of expenditure is likely to address environmental priorities. This proportion will differ significantly between Member States, and no data are available currently to ascertain the extent of such environmentally focused spending. Figures presented in this chapter are therefore likely to be an overestimate of what is spent in reality on meeting the environmental needs associated with rural land management.

7.1 Current funding from the EU budget

Data on predicted expenditure through the EAFRD for the 2007-13 programming period is available in relation to the individual measures available under its four Axes. A number of these measures, particularly those related to environmental land management (forestry and agriculture) have multiple objectives and provide benefits for the full range of environmental media considered in this study.

There is a range of measures within the EAFRD that have the potential to help deliver the environmental outcomes identified in the EU targets. Based on an assessment of their logics of intervention as well as on evaluation literature on their actual impacts, the measures that have been identified as being the most important for delivering environmental benefits can be divided into three broad categories:

- Area based payments that provide incentives to farmers to carry out environmentally beneficial land management practices, for example the agri-environment measure and the forestry measures as well as measures that may help to support the maintenance of environmentally beneficial management indirectly, such as the natural handicap and the Natura 2000 measures;
- Investment aid that provides assistance with the costs of physical capital investment, for example, the farm modernisation and infrastructure development measures under Axis 1 and the non productive investment measures in Axis 2; and
- Measures that provide advice, training and capacity building to improve human capital, for example, in the training and advice measures in Axis 1.

Other measures, such as the conservation and upgrading of cultural heritage can also provide environmental benefits, through, for example funding the development of management plans for Natura 2000 sites.

Given the EAFRD programming, monitoring and financial reporting requirements, it is difficult to identify accurately the funding associated with meeting individual environmental objectives. Attempts were made to break down agri-environment expenditure by environmental priority by the EAA in 2005, but attempts to update these figures more recently have been hampered by the lack of data availability. The only budgetary information available that distinguishes between measures according to the principal environmental priority that they are addressing is that relating to the use of the additional funds available for rural development as a result of the CAP Health Check and the European Economic Recovery Plan (EERP) (see Table 7.2).

Programmed EU expenditure for the 2007-13 programming period for the main measures that have the potential to deliver environmental outcomes (either directly or indirectly) is calculated to be €58.4 billion (or approximately €8.4 billion/year), of which €8 billion (€1.1 billion/year) is estimated as being allocated to forestry management or forest-related measures. For forestry measures this represents a decline in comparison to the 2000-2006 programming period (EC, 2009). The division of total anticipated expenditure from EU funds (EAFRD) by measure is set out in Table 7.1 for the EU-27, EU-15 and EU-12.

Table 7.1: Anticipated EU expenditure on selected measures for the 2007-13 programming period – EAFRD contributions –EU27.

Measure	EAFRD Funding (Millions of Euros)		
	EU15	EU12	EU27
Advice and Training (111, 114, 115)	1,088	714	1,802
Farm Modernisation (121)	5,095	5,116	10,211
Infrastructure Development (125)	3,670	1,385	5,055
Natural Handicap (211, 212)	8,127	4,920	13,047
Natura 2000 (213)	360	112	472
Agri-Environment (214)	15,824	5,948	21,772
Non Productive Investments (216)	524	12	536
First Afforestation of Agricultural Land (221)	908	1,012	2,390
Other Forestry Measures (222, 223, 226, 227)	2,099	414	2,758
Natura 2000 Payments (224)	22	73	102
Forest-Environment Payments (225)	160	108	268
TOTALS	**37,876**	**19,815**	**58,412**

Of these, three measures (the agri-environment, natural handicap and farm modernisation measures) account for almost 50 per cent of total allocated public expenditure across all 88 RDPs for the programming period 2007 – 2013. The figures are based on budgetary information from January 2010 (EC, 2009b) which includes the additional allocations for 2010-2013 as a result of the CAP Health Check agreement on increased rates of compulsory modulation, and the additional funds made available through the EERP.

However, there are considerable differences in the distribution of the EAFRD budget between RDPs and Member States. Figure 7.1 and Figure 7.2 illustrate the variance in distribution in different parts of Europe for two of the measures with the greatest proportion of financial resources allocated to them – the agri-environment and the farm modernisation measures. Total budgetary expenditure by measure will partly reflect the size of the country in question as well as its total EAFRD budget allocation, rather than difference in the intensity of expenditure per hectare or on particularly environmental objectives. For example, estimates of the intensity of spend under the agri-environment measure per hectare of UAA, showed that expenditure in five RDPs, including Austria, Finland and Malta, equated to over €100/ha/year, whereas it was below €50/ha/year in 52 of all RDPs (Farmer *et al*, 2008).

Figure 7.1: EAFRD 2007-13 allocated expenditure for the Agri-Environment Measure by Member State

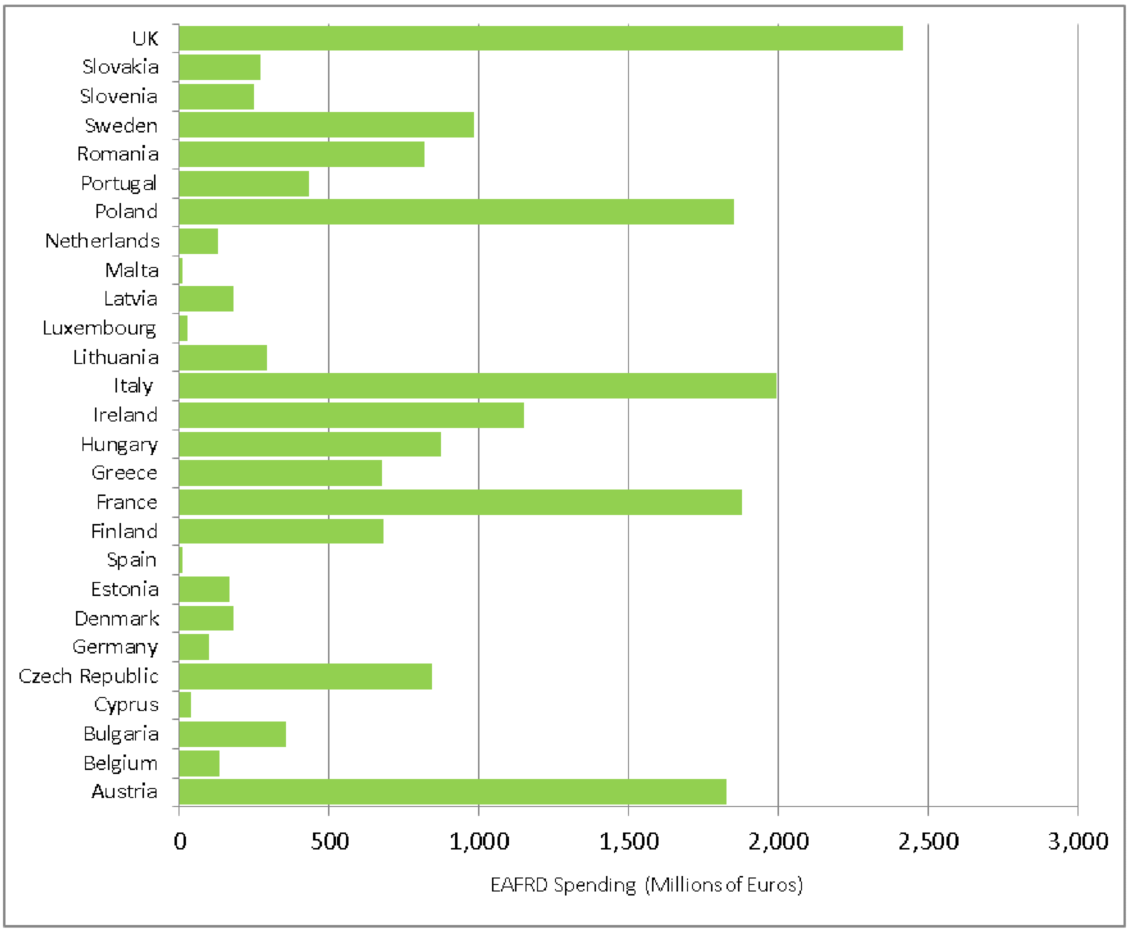
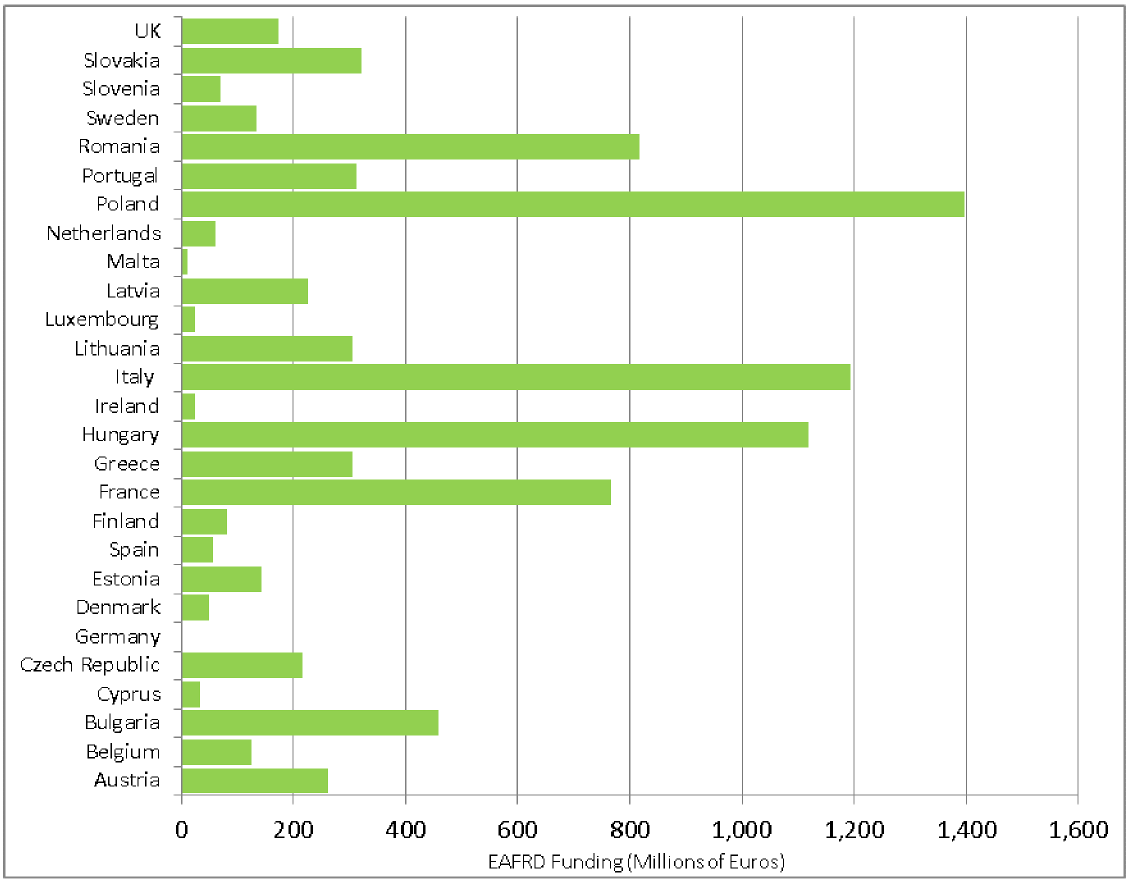


Figure 7.2: EAFRD 2007-13 allocated expenditure for the Farm Modernisation Measure by Member State



Although it is not possible to break down the total EAFRD budget according to specific environmental priorities, data are available on the amounts of additional funding allocated to the 'new challenges' as a result of the CAP Health Check in 2009. These provide some indication of the priority given to specific environmental issues within RDPs and between Member States. This information is set out in Table 7.2 and shows that, for the EU as a whole, the largest proportion of additional funds will be concentrated on biodiversity (€1.5 billion or 31 per cent) and water management (€1.3 billion or 27 percent), with measures focused on climate change priorities accounting for €0.7 billion or 14 per cent of the total amount of additional funding. However, these overall figures mask some significant differences between Member States. For example, biodiversity has not been prioritised by the majority of new Member States, with eight of the twelve not using the additional funds to target biodiversity at all. Indeed four Member States (Malta, Estonia, Hungary and Latvia) have chosen not to allocate funding to any of the environmental challenges, with Lithuania and Portugal allocating less than five per cent of their additional resources to the environment, choosing instead to prioritise dairy restructuring and increasing broadband coverage.

Biodiversity is the main focus (over 30 per cent) of the additional funding in a significant group of Member States including Slovakia, Spain, France, the UK, Cyprus and Ireland. Water management is seen as a particular priority in Bulgaria, Greece, Finland, Denmark, France, Belgium and Spain, with climate change activities prioritised in a number of the new Member States, such as the Czech Republic, Slovenia and Slovakia as well as some of the EU-15, such as Luxembourg, Belgium, Germany and the UK.

Table 7.2: Overall distribution of CAP Health Check and EERP funds between environmental 'new challenges'

RDP	Climate change	Renewable energy	Water management	Bio-diversity	Total
in million euro					
AT	21			21	97
CY				1	2
MT					1
DK	22	7	61	34	124
PL		4	34	10	169
LT		0			22
NL	23	19	21	23	98
LU	2				5
LV					13
EE					9
SI	5	1	1		12
BG		12	19		33
EL	20		70		176
RO	18	36	22	14	102
SE	19	34	13	31	120
SK	12			11	27
CZ	15	8	7		42
HU					54
IE	18		26	89	146
IT	83	29	88	86	465
BE	18	10	22	12	68
UK	129	4	104	235	482
ES	26	70	189	243	574
DE	252	22	166	264	942
FI	3	3	31	1	68
FR	17	16	461	468	992
PT	1			1	102
EU27	**704**	**275**	**1332**	**1,542**	**4,946**

Source: IEEP own calculations based on data within DG Agriculture's Press Release IP/10/102
Note: These figures do not include national co-financing

In terms of other EU funding sources available for supporting the delivery of environmental needs related to rural land management, for the 2007 – 2013 programming period, the LIFE + programme has a budget of €2.14 billion and the Structural Funds have a budget of €347 billion.

Only a proportion of the funding under the LIFE+ programme is used to support activities associated with rural land management. In July 2010 the third tranche of funding for environmental projects was announced totalling €515 million. Many of the 210 projects that will receive funding will be targeted at making farming more environmentally sustainable. The largest beneficiaries of the funds are Spain, Italy and the Netherlands, with projects being funded to improve the management of wetlands and riverbank forests for biodiversity, to develop tools for carrying out energy and GHG audits on farms and reducing GHG emissions as well as piloting new agri-environment measures.

In general, it is difficult to estimate precisely the proportion of EU expenditure under the LIFE+ and Structural funds that is targeted at the delivery of individual environmental priorities. However, in relation to the LIFE+ programme, 40 per cent of expenditure is anticipated to be allocated to nature and biodiversity projects (approximately €800 million), with the remaining 60 per cent spent on other environmental priorities such as energy and climate, and the management or waste and water for the current programming period (Kettunen *et al,* 2009).

In relation to the Structural Funds, it is estimated that, in the 2007 - 2013 programming period, €105 billion of the total budget, will be spent on the environment – twice as much as during the period from 2000 - 2006. A majority of these investments directly support infrastructure related to water and waste treatment, renewal of contaminated sites, pollution reduction, as well as providing support for nature protection and risk prevention. The majority of this expenditure will not be linked to rural land management. Within this total figure it has been estimated that, under the European Fund for Regional Development (EFRD), €2.7 billion has been allocated to support the protection of biodiversity and nature and €2.5 billion is available for the promotion of natural assets and the protection and development of natural heritage (Kettunen *et al,* 2009). This has not necessarily been taken up by Member States, however.

7.2 Current funding from other sources (non EU budget)

To provide as complete a picture as possible, funding that is provided from non EU sources also needs to be identified.

The most significant element in this regard is national co-funding that is linked to the EAFRD. This includes the national co-financing for the key EAFRD measures delivering environmental benefits, which is compulsory for all Member States, as well as any additional national state aided funding provided as ‘top-ups’ to specific EAFRD measures and for which European Commission approval has been given. Some activities funded under rural development measures, particularly those that provide support for capital investments, also require an element of private investment to be provided by the beneficiary. The co-financing rate varies significantly across Member States, especially between “convergence” and “non-convergence” regions. The maximum Community co-financing rates (EAFRD contribution), as stipulated in Council Regulation 1698/2005 are as follows:

- Axes 1 and 3: 50 per cent (75 per cent in Convergence regions)
- Axes 2 and 4: 55 per cent (80 per cent in Convergence regions)
- All axes: maximum 85 per cent in outermost regions.

Programmed expenditure from national sources (co-financing plus state aids) for the 2007-13 programming period for the main measures that have the potential to deliver environmental outcomes (either directly or indirectly) is calculated to be €36.5 billion. This is set out in Table 7.3 for the EU-27, EU-15 and EU-12.

Table 7.3: Anticipated national expenditure on selected measures for the 2007-13 programming period – national co-financing contributions –EU27.

Measure	National Co-Financing (Millions of Euros)		
	EU15	EU12	EU27
Advice and Training (111, 114, 115)	918	209	1,127
Farm Modernisation (121)	4,628	1,456	4,628
Infrastructure Development (125)	2,387	408	2,795
Natural Handicap (211, 212)	7,883	1,193	9,076
Natura 2000 (213)	264	23	286
Agri-Environment (214)	13,840	1,373	15,213
Non Productive Investments (216)	448	2	450
First Afforestation of Agricultural Land (221)	908	228	1,136
Other Forestry Measures (222, 223, 226, 227)	1,478	100	1,578
Natura 2000 Payments (224)	22	17	38
Forest-Environment Payments (225)	121	21	141
TOTALS	**32,897**	**5,029**	**36,469**

As with the EU expenditure data, the distribution of national co-financing across different Member States for different measures is extremely variable, but essentially mirrors the pattern of EU expenditure set out in Figure 7.1 and **Figure 7.2** above.

In addition to these sources of national funding, in some Member States, private funding is also used to fund sustainable land management activities. For example, in the UK, the water company United Utilities provides funding alongside that available through the agri-environment measure to influence sustainable management within one water catchment that it uses for supply purposes, and in France, Vittel, the bottled water company, provides incentives to farmers to address diffuse water pollution. Equally, in many countries advice to land managers is provided through nationally funded extension services. For example, in England environmental farm advice is provided to land managers free of charge via a range of mechanisms, such as the Catchment Sensitive Farming Delivery Initiative in relation to management to address diffuse pollution in priority catchments, the Farm Advisory Service, set up as a requirement of Council Regulation 73/2009 (previously 1782/2003) to provide advice and guidance on cross compliance and GAEC management as well as focused advice in relation to the setting up of agri-environment agreements.

A systematic and quantified assessment of the range of private measures and associated funding that are implemented in different Member States is beyond the scope of this study. However, in general the level of funding provided through these measures is extremely small compared with expenditure through the EAFRD, although in some circumstances the impacts of the schemes are locally significant. Nonetheless what this does show is that there is some potential for private sources of funding to be used to meet specific environmental objectives in specific localities, and that in some Member States at least, this approach is being used to support the delivery of environmental benefits either to supplement, or as an alternative to, European sources of funding.

7.3 Assessing the environmental impact of the funding

Assessing the impact of current expenditure on achieving the range of environmental needs that form the basis of this study is important in order to inform an assessment of the gap in provision and the scale of additional funding needed. Not only is information on the environmental impact of the funding important, but information on any barriers to uptake of particular management practices or factors that have led to successful outcomes being achieved are also significant. For example, policy evaluations have shown that better results can be improved by greater coherence in the objectives of rural development programmes, through increased levels of advice and training, and through changes in the targeting of schemes.

A systematic evaluation of impacts across all forms of funding is not feasible within the scope of the study. Given that the majority of funding is derived currently from the EAFRD, this section focuses on examining the environmental impact of those rural development measures identified as being most significant in supporting environmentally beneficial land management practices.

In many cases, there continues to be limited quantified and consistent data available to assess the impacts and outcomes of different EAFRD measures on the range of environmental media at the EU level. Although a number of measure specific, or issue specific assessments have been undertaken at the national, regional and local level (for example, Primdahl *et al,* 2003; EPEC, 2004; Agra CEAS, 2005; ECA, 2005; Oréade-Brèche, 2005; IEEP, 2006; EC 2009; Kleijn *et al,* 2006; CSL and CCRI, 2008 ; BirdLife International*,* 2009; Natural England, 2009; JRC, 2009) comprehensive quantitative and qualitative assessments of the environmental impacts of different rural development measures at the EU level are not available. This is often due to the fact that the objectives are not sufficiently clearly set, outcomes are difficult to measure, causality is difficult to determine or because detailed monitoring programmes are not in place. Despite this, most evaluations are positive about the overall effectiveness and efficiency of rural development measures. Although some inefficiencies are apparent, on the whole, it is suggested that in most cases rural development payments are set at appropriate levels to achieve the required outcomes (EPEC, 2004). However, studies have shown that, even where rural development measures can be shown to deliver against specific objectives, there is scope for positive effects to be enhanced by increased targeting and increased training for farmers.

7.3.1 Impacts on Biodiversity

Although there has been some debate about the effectiveness of different measures, particularly the agri-environment measure, in delivering quantified improvements in biodiversity associated with agricultural habitats (for example ECA, 2005; Kleijn et al, 2006; CSL and CCRI, 2008), in general, evaluations have shown that overall, its implementation has achieved positive outcomes for biodiversity (Oréade-Brèche, 2005; CSL and CCRI, 2008). Often this results from their requirements for reduced agrochemical inputs, the promotion of extensive management practices and the maintenance of existing low intensity systems (EPEC, 2004; Kleijn et al, 2006). While the focus in most Member States tends to be on the maintenance of existing extensive grassland management rather than targeting more intensive farming systems, increasingly agri-environment schemes are introducing options such as creating grass field margins, maintaining small patches of uncropped land or maintaining stubbles over winter within arable systems, which have significant benefits for biodiversity (for example, birds, small mammals, butterflies) as well as over environmental benefits, such as for soil and water protection. Most Member States also use the agri-environment measure to encourage organic farming practices, providing incentives to cover conversion costs and in some cases to provide payments for the maintenance of these practices. Figures show that between 2000-2006 the area of land certified as organic and in conversion rose by 34 per cent to over 7 million hectares and that between 2007-2008 the area increased by a further 7.4 per cent to 7.7 million hectares (Eurostat, 2010). It can be assumed that the majority of these increases are likely to have been funded through the agri-environment measure, although market forces will also have played a major role.

The high level of flexibility given to Member States in the design and implementation of their agri-environment schemes means that the impacts on biodiversity, and other environmental objectives is very variable both across and within Member States. For example where schemes are designed to have a broad reach, they often require fairly simple management to be undertaken across the whole farm, focusing on maintaining existing environmentally beneficial farming practices. In other situations, schemes are more targeted in nature, focusing on the more complex management requirements needed for the enhancement or restoration of particular habitats or species (Hart, 2010).

Although not an explicit aim of the natural handicap measures, LFA schemes have been used to support extensive livestock based systems which, if appropriately managed, are crucial to the maintenance of species rich semi-natural pastures and the avoidance of land abandonment (IEEP, 2006). The same evaluation study demonstrated that payments have contributed to continued agricultural land management in marginal areas but that the measure has been poorly targeted at need, for example at areas of high environmental value, and where the risk of land abandonment is greatest.

In relation to the forestry measures, evaluations have shown their environmental impact to be variable, depending on how the measures are implemented. The species of trees that are planted and the biodiversity value of the land on which any planting takes place are critical to the environmental benefit delivered. If used appropriately, the targeted planting of appropriate tree species may help improve the functional connectivity of habitats, and provide significant benefits for biodiversity. While there are examples of poor implementation of these measures in the previous programming period, which have been environmentally damaging, Member States are now required to ensure that any afforestation is suited to local conditions and compatible with environmental requirements, particularly biodiversity. There are some reports, however, that this requirement is not always heeded in practice, for example Hungary intends to use these measures to create new plantations of non-native black locust trees, which, while having potentially positive benefits for soils, carbon sequestration and water quality, could have negative implications for biodiversity (FERN, 2008).

7.3.2 Impacts on Landscape

The majority of Member States include the protection of cultural landscapes as a key priority of their agri-environment schemes. However, there is very little evaluation literature that assesses their effectiveness in achieving these aims. An evaluation of the agri-environment measure (Oréade-Brèche, 2005), showed that it had a generally positive impact upon landscape particularly in terms of maintaining, restoring and recreating landscape features, such as hedges, or small patches of woodland, by maintaining extensive grassland, reverting arable land to grassland, and maintaining or improving the habitat mosaic within a particular area; and by helping to prevent land abandonment in some cases. The natural handicap measures also deliver some landscape benefits, by helping to support the continuation of farming activity in areas of high landscape value as can the afforestation measures, as long as planting is sensitive to the character of the surrounding landscape and native species are planted. However there is no quantified information on the extent to which rural development measures have contributed to the protection and enhancement of the EU's agricultural landscapes and their associated features.

7.3.3 Impacts on Water Quality and Availability

Evaluations from the 2000-2006 programming period suggest that it is actions supported under the agri-environment measure that deliver the most for water quality, beyond management which is required by legislation either through maintaining nutrient inputs at a sustainable level or reducing them (EPEC, 2004; ADAS, 2005; Oréade-Brèche, 2005; CSL and CCRI, 2008). Very little quantifed data on the impacts of agri-environment scheme in relation to water quality improvements is available, particularly at the EU-27 level. Early modelling of the impacts of Entry Level Stewardship (ELS) in England (UK) on water quality, indicates, however, average potential reductions in nitrogen losses from soil of between 2.1 and 4.3% and of approximately 4% for phosphorous, based on levels of uptake of relevant management options in 2006/07 (CSL, 2007). Figures for Umbria (Italy), quoted in the 2005 DG Agriculture evaluation of the agri-environment measure showed that measures focused on reducing nitrogen inputs had delivered an estimated reduction of 2.6 – 3.1 million kg/N/year between 2000-2003.

The use of the farm modernisation measure and the training and advice measures can also play a significant role in improving water quality. For example Sweden, Italy, Austria and the UK all focus a proportion of their farm modernisation measures on improved manure storage and spreading and in Ireland this measure is used to provide investment aid for animal manure storage, winter housing for cattle and sheep, silage storage and equipment for spreading animal wastes. However, there is no published information as yet on the impact that these types of measures have had in practice. The publication of the mid term evaluation reports of the 2007-13 programming period may shed some light on this when they become available later in 2011.

The farm modernisation measure can also deliver benefits for water availability, through funding, for example, investment in more efficient irrigation systems. However, there is no data on the extent to which different Member States have used this measure for this purpose, although there are individual examples of some, most notably Portugal and other Mediterranean Member States, using rural development measures to fund such projects. The outcomes of such expenditure are unclear as yet, particularly in terms of whether such funding increases the overall use of water for irrigation purposes or genuinely contributes to the more sustainable use of surface and groundwater supplies in the EU-27.

7.3.4 Soil Conservation

Although a range of management practices have been identified as beneficial for improving the functioning of soils (see Chapter 2), there is a lack of information on the impact of agri-environment schemes on soil conservation within the evaluation literature, although there are indications that measures have led to some improvements in soil quality and reductions in soil erosion, albeit unquantified (EPEC, 2004).

It is also clear that the presence of trees and woodlands can also help to protect soils and reduce soil erosion as the maintenance of a complex root structure can improve the stability of soils (CSL and CCRI, 2008) and a number of RDPs have used the afforestation measures with the specific aim of improving soil quality and reducing soil erosion. In addition, the provision of farm advice and training has been identified as particularly important in improving soil management in many parts of Europe (JRC, 2009). Again, however, no data are available to quantify the impacts.

7.3.5 Impacts on Climate mitigation and adaptation

Although EAFRD measures are used increasingly to deliver climate mitigation and adaptation outcomes, this is a more recent priority than is the case for the other environmental issues. Many of the actions funded under agri-environment schemes that are designed to deliver benefits for landscape, biodiversity, soil conservation or water quality, will also lead to improvements in the capacity of the land to sequester carbon or to reductions in greenhouse gas emissions. A number of Member States report using the afforestation measure as a means of enhancing the carbon storage capacity of the land, including the Czech Republic, Germany, Italy, Romania and the UK. Evidence from the UK (Natural England, 2009) suggests that the agri-environment schemes have a positive impact on climate change mitigation and adaptation, but can be improved to make more of a contribution to meeting the challenges of climate change in the future, by operating in conjunction with other measures outside of the CAP.

However, as with many of the environmental issues, few data are available to provide any quantified information on the impact that such measures have had in practice on meeting climate objectives.

This snapshot of the results of evaluation literature on the impacts of different rural development measures on the environment highlights the absence of good quality and comparable quantified data with which to assess the environmental effectiveness of current expenditure. This makes it very difficult to make judgements about the extent to which financial resources are the limiting factor to meeting the EU's environmental targets, and the degree to which other factors, such as scheme design or delivery, institutional issues, farmer behaviour etc, may play a role.

7.3.6 CMEF Indicators

In addition to the evaluation literature, the Common Monitoring and Evaluation Framework (CMEF) output indicators provide information, for the area based environment measures, on the target area in hectares that are anticipated to be under agreement for each of these measures by 2013. This information cannot tell us about the nature of the management that will take place or has taken place under these agreements, and therefore the environmental outcomes are difficult to discern from the data, but it does provide us with a sense of the anticipated scale of delivery of schemes that are intended to deliver environmental benefits. The output indicator target figures for the agri-environment measure, the Natura 2000 measures (both agriculture and forestry), as well as the measures for the afforestation of agricultural land and forest-environment are set out in Table 7.4. This indicates that by 2013, it is anticipated that up to 25 per cent of UAA will be under an agri-environment agreement, five per cent of the Natura 2000 agriculture area will be in receipt of compensation payments, and that 0.3 per cent of agricultural land will be converted to woodland. These are much lower proportions of land than have been estimated as requiring environmentally directed management under the central cost estimates of this study.

Table 7.4: Output Indicator targets for selected RDP measures (pre Health Check)

	Natura 2000 payments (farmland)	Agri-environment payments		First afforestation of agricultural land	Natura 2000 payments (forestry)	Forest-environment payments	
	213	214		221	224	225	
	UAA supported (Ha)	Total area supported[3] (Ha)	Physical area supported (Ha)	Area of afforested land (Ha)	Forest land supported (Ha)	Total forest area supported (Ha)	Physical forest area supported (Ha)
AT	8,400	4,150,000	2,130,000	250	35,000	35,000	35,000
BE	25,462	572,116	341,316	840	22,000	n/a	n/a
BG	n/a	160,000	160,000	n/a	n/a	n/a	n/a
CY	n/a	40,135	29,135	30		1,100	1,100
CZ	4,000	1,510,000	1,000,000	9,000	12,000	40,000	40,000
DK		335,600	335,600	5,100	n/a	3,800	3,800
EE	38,000	545,000	535,000	1,700	61,300	-	-
FI	n/a	2,175,900	1,925,900	-	n/a	n/a	n/a
FR	n/a	7,626,000	6,015,000	3,612	n/a	70	No data
DE	107,190	5,718,600	3,846,460	6,560	57,000	83,500	68,000
EL	32,000	700,000	700,000	33,000	6,600	n/a	n/a
HU	250,000	2,800,000	2,100,000	66,000	n/a	170,000	170,000
IT	14,606	2,989,154	2,872,866	94,480	11,593	97,733	59,653
IE	300,000	2,250,000	2,250,000	n/a	n/a	n/a	n/a
LV	68,700	375,728	325,000	-	54,173	-	-
LT	54,000	358,000	262,000	10,500	91,500	13,500	13,500
LU	n/a	142,480	120,000	n/a	n/a	1,500	1,500
MT	n/a	7,794	3,897	n/a	n/a	n/a	n/a
NL	n/a	96,000	96,000	2,500	n/a	n/a	n/a
PL	n/a	2,073,000	1,500,000	80,769	n/a	n/a	n/a
PT [1]	320	587,340	576,090	26,450	1,325	3,250	3,250
RO	n/a	2,698,000	2,323,000	49,348	n/a	n/a	n/a
SI	4,000	850,000	650,000	600	30,000	500,000	310,000
SK	n/a	365,000	204,000	n/a	n/a	n/a	n/a
ES	128,140	4,804,201	4,200,304	216,102	n/a	385,980	141,647
SE	n/a	3,708,500	2,500,000	n/a	n/a	n/a	n/a
UK [2]	n/a	12,411,435	5,827,435	17,500	n/a	800,500	100,500
TOTAL	**1,034,818**	**60,049,983**	**42,829,003**	**624,341**	**382,491**	**2,135,933**	**947,950**

[1] Measure 221 not applied to the Azores, 213 only applicable to the Azores, 222 and 225 not applicable to Madeira, and 224 not applicable to the continent.

[2] 221 has no data for Scotland, 223 has no data for Scotland and not provided for N. Ireland, 225 not programmed for Wales, and the physical forest area not given for Scotland.

[3] Formal definition: Supported UAA of farmers and other land managers who make on a voluntary basis agri-environmental commitments, going beyond the relevant mandatory EU/national standards (i.e. some hectares may be counted more than once if they are subject to more than one agri-environment measure/scheme).

[4] Formal definition: Supported UAA of farmers and other land managers who make on a voluntary basis agri-environmental commitments, going beyond the relevant mandatory EU/national standards without double counting of the area in which more than one agri-environmental scheme is applied.

Source: EC DG Agriculture and Rural Development data, 2009.

The CMEF result indicators provide more detailed information on the approximate numbers of hectares that it is anticipated will be brought under beneficial forms of agricultural and forestry management to benefit different environmental media using Axis 2 measures. Table 7.5 sets out the (CMEF) result indicator targets for Axis 2 measures in the EU-27 showing the total area and proportion of UAA under successful land management contributing to biodiversity, the avoidance of marginalisation, water quality, soil quality and climate change. Table 7.6 and Table 7.7 provide a breakdown of these figures for each Member State. From these tables it can be seen that the level of accuracy of these figures is highly variable. Different Member States appear to have estimated their targets using differing methods and basic assumptions and do not appear to be related solely to factors such as the area designated as LFA or the nature of the agri-environment schemes implemented (for example broad coverage or tightly targeted).

Table 7.5: Result indicator targets for the area under successful agricultural land management for different environmental media through Axis 2 measures for the EU-27 for 2007-2013

	Area of land under successful agricultural land management (million hectares)	Proportion of land under successful agricultural land management (as % of UAA)
Biodiversity	48.4	26.5
Avoidance of marginalisation	54.6	29.9
Water Quality	36.1	21.5
Soil Quality	25.9	14.2
Climate Change	19.7	10.8

Source: EC DG Agriculture and Rural Development data, 2009.
Note: These figures are likely to be an underestimate as data are missing for a few Member States.

Table 7.6:Result Indicator targets for Axis 2 measures relating to biodiversity and the avoidance of marginalisation

Member State	Area under successful land management contributing to:			
	Biodiversity		Avoidance Marginalisation	
	Result Indicator Target	% of UAA	Result Indicator Target	% of UAA
Austria	2,800,000	86	2,500,000	77
Belgium	155,180	11	58,160	4
Bulgaria	116,000	2	76,750	2
Cyprus	74,786	50	15,610	10
Czech Republic	1,371,000	32	780,000	18
Denmark	493,700	18	No data	No data
Estonia	535,000	65	350,000	43
Finland*	5,615,900	249	2,175,900	96
France*	11,967	0.04	10,502	0.04
Germany	5,759,065	34	5,500,200	32
Greece	2,031,324	51	0	0
Hungary	1,130,000	19	102,000	2
Italy	3,157,035	22	2,089,124	14
Ireland	4,000,000	94	4,000,000	94
Latvia	375,728	9	1,055,000	57
Lithuania	774,000	29	140,000	5
Luxembourg	120,000	92	120,000	92
Malta	293	3	0	0
Netherlands	96,000	5	9,128,290	56
Poland	793,000	5	9,128,290	28
Portugal	760,860	21	1,042,500	28
Romania	5,938,000	43	5,938,000	43
Slovakia	300,000	16	1,140,000	59
Slovenia	373,600	75	300,000	60
Spain	7,488,160	30	7,781,647	31
Sweden	1,500,000	48	1,200,000	38
UK **	2,656,000	16	4,520	27
TOTAL	**48,426,598**		**54,636,493**	

Source: DG Agriculture and Rural Development data, 2009.

* For Finland, the biodiversity figures are over 100% of UAA due to double counting of multiple agri-environment measures operating on the same parcels. For France, the figures are low due to a strict interpretation of what constituted 'successful management'.

** The figures for the UK are low due to the fact that no data are available for Scotland.

Table 7.7:Result Indicator targets for Axis 2 measures relating to water quality, climate change and soil quality.

Member State	Area under successful land management contributing to:					
	Water Quality		Climate Change		Soil Quality	
	Result Indicator Target	% of UAA	Result Indicator Target	% of UAA	Result Indicator Target	% of UAA
Austria	2, 600, 000	80	1, 200, 000	37	3, 300, 000	102
Belgium	141, 632	10	4, 394	0	119, 414	9
Bulgaria	7, 000	0	118, 000	2	363, 250	7
Cyprus	0	0	0	0	18, 000	12
Czech Republic	436, 000	10	No data	No data	1, 407, 000	33
Denmark	No data	No data	No data	No data	No data	No data
Estonia	500, 000	61	535, 000	65	500, 000	61
Finland*	4, 712, 400	209	4, 212, 400	187	372, 400	17
France*	11, 967	0.04	2, 420	0.01	11, 597	0.04
Germany	5, 576, 880	33	2, 590, 500	15	4, 563, 100	27
Greece	74, 384	2	167, 884	4	1, 913, 634	48
Hungary	0	0	0	0	768, 000	13
Italy	6, 974, 040	48	1, 803, 848	12	2, 563, 697	18
Ireland	4, 000, 000	94	4, 000, 000	94	4, 000, 000	94
Latvia	375, 728	20	375, 728	20	375, 728	20
Lithuania	108, 000	4	174, 000	6	220, 000	8
Luxembourg	120, 000	92	120, 000	92	120, 000	92
Malta	No data	No data	No data	No data	No data	No data
Netherlands	0	0	1, 880	0	0	0
Poland	1,000, 000	6	0	0	650, 000	4
Portugal	400, 290	11	157, 000	4	1,285, 500	35
Romania	2,323, 000	17	375, 000	3	1, 159, 660	8
Slovakia	450, 000	23	200, 000	10	250, 000	13
Slovenia	132, 200	26	65, 000	13	96, 000	19
Spain	3,702,820	15	3, 497, 435	14	4, 842, 218	19
Sweden	1,200, 000	38	Marginal	Marginal	1, 000, 000	32
**UK ** **	1, 294, 100	8	83, 900	1	1, 288, 400	8
TOTAL	36,140,441		19,684,389		25,979,934	

Source: DG Agriculture and Rural Development data, 2009.

* For Finland, the figures are an over-estimate and in certain cases are over 100% of UAA due to double counting of multiple agri-environment measures operating on the same parcels. For France, the figures are low due to a strict interpretation of what constituted 'successful management'.

** The figures for the UK are low due to the fact that no data are available for Scotland.

7.4 Discussion

It is clear from this overview that there is a lack of data to allow a full assessment of the degree to which current measures funded under Pillar 2 of the CAP are contributing towards meeting the rural environmental needs addressed in this study.

The unsuitability of the indicators used for measuring scheme success prior to the current programming period was a key criticism of the European Court of Auditors in relation to agri-environment schemes (ECA, 2005). Not only was this an issue for those measures that focus directly on the environment, but no indicators were in place to capture information on the delivery of environmental outcomes through the use of rural policy measures whose primary objective is not environmental. In practice, of course, there are likely to be quite significant environmental impacts from many such measures, both positive and negative. The variability in the quality of baseline data as well as in investment in monitoring scheme outcomes has also an issue. However, in the current programming period the position has been improved through the development of a new set of rural policy indicators that include a significant environmental element (COM(2006) 508 final)). This together with the introduction of the Common Monitoring and Evaluation Framework (CMEF) should go some way to address the deficiencies in baseline indicator data, as well as data relating specifically to measure and programme impacts over time. In addition, as the mid term evaluations of the 2007-13 RDPs become available, these should provide additional data on the environmental impacts of different measures.

However, despite the fragmented evidence, it is evident is that there is still a considerable way to go to meet the EU's environmental targets. The current set of policy interventions has been strengthened over time and now revolves around EU legislation and resources channelled through EAFRD. This support, especially through Axis 2 of the EAFRD has been central to the progress made, although it is still not sufficient. At the same time, some measures, such as the agri-environment measure, have made a significant contribution to maintaining environmentally beneficial farming practices in areas where these practices might otherwise have disappeared. Without such measures, certain environmental indicators, such as the common farmland birds, would have been likely to have declined further, rather than stabilise and the extent of loss of semi-natural habitats and landscape features, for example, would have been far greater than has been the case.

Nonetheless, it is clear that the effectiveness of such measures will need to improve in the future to ensure that all expenditure is made as effectively and efficiently as possible. Reviewing the design, targeting and implementation of measures will be essential so that they are able to bring about the environmental improvements on the scale that is needed. They will also need to adapt to meet new environmental challenges in the light of climate change and the expected adoption of more demanding targets for the agriculture and forestry sectors. This may require the inclusion of additional measures to address climate mitigation and adaptation needs as well as the restoration of habitats as required under the new EU2020 biodiversity target.

8 ESTABLISHING THE SCALE OF UNMET NEED

An assessment of the scale of environmental needs in the EU-27, as expressed through EU and national targets, was made in Chapter 2. This was then translated into a set of quantified land management needs derived from two sources. The first was an analysis of the management practices needed to deliver the range of environmental outcomes. The second was an assessment of the scale at which such management practices are likely to be needed within Europe. The results in terms of the measures thought to be required and the costs of implementing them on the necessary scale are set out in the cost tables in Annex 7. They have been used as the basis of estimating the cost of delivering the environmental needs associated with rural land management in the EU-27 through the public purse. The case studies in Chapter 5 have used slightly different approaches to develop cost estimates associated with meeting specific environmental objectives, such as halting the decline of arable farmland birds, maintaining HNV farmland and addressing soil degradation issues.

The estimates developed within this study indicate that public expenditure in the region of €43 billion/year (+/- €8 billion) is needed to meet the full environmental needs associated with rural land management. This figure is based on costs calculated under the current framework of the CAP and includes the costs of supporting environmental land management practices as well as an allocation for compensation for natural handicaps within LFAs, capital investments and resources for advice and training.

The results of the case studies indicate that approximately €1 billion/year is needed to halt biodiversity declines solely on arable land (of which €854 million/year is estimated to be needed to halt declines of arable bird populations). At a broader scale, that between €16-23 billion/year would be needed to maintain HNV farmland (depending on the proportion of HNV farmland requiring support) and about €12 billion/year would be needed to halt soil organic matter decline in the EU27. An estimate of €188 million/year as well as a one-off cost of €137 million would be needed to address soil degradation issues in the Murcia region of Spain alone). However, not all of these costs will need to be sourced from the EU budget, and various degrees of co-financing would be appropriate in different regions of the EU.

These estimates compare with current expenditure under the EAFRD of approximately €13.5 billion/year (including national co-financing), with perhaps another €1 billion/year focused on meeting environmental objectives associated with agricultural and forestry management through other funding programmes, such as LIFE+ and the Structural Funds (see chapter 7). These figures include co-financing from national sources for EAFRD measures amounting to approximately €5 billion/year. EU resources being used to address environmental needs associated with rural land management currently, therefore, amount to approximately €9.5 billion/year.

In light of this, it is clear that there is a gap between current rates of expenditure and the scale of funding estimated to be required to meet current and prospective targets. This is despite the level of support for land management noted in Chapter 7 and the value of agri-environmental measures in particular.

In many areas the state of the rural environment continues to deteriorate and the improvements needed to meet common objectives and political targets are, for the most part, not being achieved (EEA, 2010c). As highlighted in Chapter 2, state of the environment indicators point to continuing concerns about the status of common farmland birds, the poor conservation status of a majority of Natura 2000 sites, continuing problems with diffuse pollution, the poor 'ecological status' of many water bodies resulting from nitrate and phosphate contamination, unsustainable levels of water abstraction particularly in water stressed areas (EEA, 2007), high rates of soil erosion by water and wind, and a decline in soil organic matter (EEA, 2007; OECD, 2008). In addition there continues to be a decline in landscape character through landscape simplification and homogenisation. Together with data on the trends to intensification and specialisation of agricultural production and the loss of permanent grassland habitats, they provide the best empirical evidence to suggest that many environmental media remain under pressure. Both the European Commission in its 2009 Annual Environment Policy Review (EC, 2010) and the EEA, in its 2010 State of the Environment report (EEA, 2010c), conclude that the magnitude of many of the challenges is increasing.

Identifying how much additional land needs to be brought under beneficial management to meet the greater effort required and the subsequent costs is not straightforward. It is overly simplistic to assume that if €13.5 billion/year is currently allocated to the delivery of environmental benefits associated with land management and the estimate from this study is €43 billion/year (+/- €8.5 billion), then the additional resources needed equate to €29.5 billion/year, a proportion of which will need to come from the EU budget. This is because the availability of funds is not the sole factor limiting the uptake of environmentally beneficial management practices in voluntary incentive schemes. A range of other factors influences not only the area of land required under environmental management to meet different environmental objectives, but also the cost of the incentives involved. Most agricultural and forestry focused environmental schemes are voluntary in nature, so the likely willingness of land managers to carry out such management practices and the institutional and administrative costs and capacity associated with such schemes also needs to be taken into account.

8.1 Factors influencing the Costs of Addressing Unmet Environmental Needs

The factors involved are various. They include:

- the availability of data on the nature, scale and location of the different environmental pressures and the management needed to address them;
- the effectiveness and efficiency of current funding mechanisms;
- the choice of land management or investment to be promoted;
- the relative attractiveness of different options to land managers;
- the degree to which management is targeted at appropriate locations;
- the provision of advice and training; and

- the institutional and administrative capacity to deliver environmental schemes at a much larger scale.

Changes in commodity and input prices as well as any changes to the overall policy framework are also of central relevance to the level and cost of incentives required. These are discussed further in Chapter 9.

However, none of these factors are easy to quantify. The following section provides some indications of the implications these factors may have on the scale of unmet need.

Data Availability: there continue to be large gaps in the availability of robust and comparable data on the scale and location of environmental needs associated with rural land management. Although progress is being made in some areas, for example the identification of areas at risk of soil erosion, or priority catchments in relation to improvements required in water quality, other data, particularly on the biodiversity status of non-protected agricultural habitats or landscape features is lacking at the EU-27 level. Particularly in the case of biodiversity the complex interactions between the ecological requirements of the considerable number of species concerned, different management practices, and the location in which the management is needed to be effective all have to be understood in order to make these estimates with any degree of accuracy. The gaps here are often large and it is not clear how far experience in one Member State is necessarily relevant in another. This is perhaps more of a limiting factor for biodiversity than for other environmental issues, such as soil erosion or soil organic matter, which are affected by factors that are more easily identifiable, such as climate, slope etc and where the management needed to address the issues, often is more clear cut. However, local factors are important and EU level generalisations will not capture these. Technological change also needs to be taken into account. For example there is a growing range of reduced tillage options, with new equipment on the market, potentially altering the best management practices to counter soil erosion and related problems. With improved data availability and understanding of the interactions between different management practices and the achievement of environmental outcomes, it would be possible to estimate with far greater accuracy the area of land required under different types of environmentally beneficial management and where such management should be located. From this one could make a better estimate of the areas of land not currently managed appropriately.

Effectiveness and efficiency of current funding: As discussed in Chapter 7, evaluations of current environmental schemes funded under rural development policy, particularly agri-environment schemes, show that in general these schemes have been successful in delivering certain environmental benefits. The effectiveness of schemes clearly varies but overall progress can be seen in several areas, for example in halting the loss of certain habitats and species that may have declined further had these schemes not been in place. However, with few exceptions there is a lack of evidence to demonstrate such impacts in quantified terms. This is often due to a combination of inadequate baseline data being available and an absence of detailed monitoring taking place. As a result it is difficult to assess with any accuracy the degree to which current expenditure is being used to deliver environmental priorities in the most cost effective and efficient way. More work is required on the extent to which these schemes are maintaining the existing environmental resource by preventing its further decline or contributing to the enhancement of the environment. It is also unclear to what extent the scale at which the management is carried out (i.e. at the individual holding level) is a limiting factor to the effectiveness of delivering environmental outcomes. Whole landscape measures might be more effective for certain purposes. The lack of adequate quantified information on the degree to which scheme objectives are being met with existing levels of expenditure and on the efficiency of such spending, is a key barrier to the preparation of more precise estimates of the scale of additional funds that would be required to address the full suite of environmentally priorities adequately.

Attractiveness of management options to land managers: In many situations there is a range of management options that could be implemented to deliver the same or similar outcomes. For example, in the case of soil management, mulching bare soil is an alternative to introducing vegetative strips within fields and over-winter stubbles could be used as an alternative to green manures. For arable farmland birds, as another example, spring-summer invertebrate food could be provided through various forms of management including the introduction or maintenance of conservation headlands, low-input spring cereals, undersown spring cereals, uncropped cultivated margins, nectar flower mixtures, field corners, beetle banks or flower-rich margins. In reality, however, not only will certain of these management options be more appropriate depending on the geographic and biophysical characteristics of the area in which they are needed, but equally some will be more popular with farmers than others. For example management options that are less disruptive to core farming operations tend to be more popular.

Predicting the likely level of uptake of the different management options discussed here in future years requires a number of assumptions about the conditions facing land managers and judgements about how they will react to them. However, evidence from the case studies shows that, locally, attempts are being made to develop new management options that would provide the same environmental benefits but impinge on productive operations less. One example of this concerns the provision of seeds for birds in winter by planting seed crops that are not harvested but left solely as a bird food resource as an alternative to options that require reductions in herbicide use and the maintenance of over-winter stubble. Not only are such options more likely to be used by farmers, and therefore the environmental outcomes more likely to be achieved, but they are also less likely to impinge on crop production. Equally, to protect soils from erosion, although the introduction of vegetated strips alongside or within fields or the use of planted green cover crops is seen to be most beneficial to prevent erosion, these practices are not popular with farmers as it reduces their productive area. As a result, the use of crop residues as mulch is becoming a much more popular option, particularly as this also saves farmers the costs of disposing of them by other means.

The relative attractiveness of environmentally beneficial management is dependent, to a large extent, not only on the degree to which it impacts on a farm's core operation, but whether the payment rate offered is sufficient to induce such a change. In many situations, particularly on more productive land, the current payments where the sums are based on income foregone and additional costs to the farmer, are not seen as sufficiently enticing to warrant a significant change in management. Developing management options that have minimal impact on the productive capacity of land managers and yet still deliver the environmental benefits required would therefore be likely to increase uptake.

Consequently, it might result in improved environmental outcomes, but potentially at a lower cost per hectare, given that the income foregone element of the payment calculation may be reduced if the management interferes less with the productive capacity of the land.

Targeting: Ensuring that management options are located in the appropriate place and at the appropriate scale is essential to maximise the environmental outcomes delivered. Evidence from the arable birds case study shows that if the appropriate management options are not targeted and sparsely implemented across the farmed landscape then there will be a low chance of arable birds benefitting from the measures and they will ultimately be ineffective. If the same options are untargeted but widely implemented across the countryside, there is a greater likelihood of arable birds benefitting from the options but it is not the most efficient means of achieving the objectives. A more targeted approach, where the management options are targeted specifically at the geographical areas and locations that they are needed, means that a small overall area of farmland is needed under the specific options, thereby reducing the overall costs of management. This principle is true for the efficient delivery of many environmental outcomes. For example buffer strips to control the pollution of water courses need to be in the right location and of the right width to maximise their benefits, and management practices to control soil erosion and losses of soil organic matter need to be appropriately sited if benefits are to be maximised for least cost (ADAS, forthcoming;). Although more targeted approaches do require more planning at the farm level and the provision of expert advice or guidance on the optimum siting of management options, the costs of this are considered to be less than the additional costs associated with applying management options in a non-targeted manner across the farmed countryside.

It is difficult to ascertain the degree to which efficiently targeted approaches are used for the delivery of environmental outcomes in the EU-27, although it is clear that non-targeted approaches are certainly widespread. One might assume, therefore, that if more emphasis were placed on targeting management in the most appropriate locations, that greater environmental benefits would be achieved with the funding available.

Advice and training; advice and information provision have proven to be crucial for the successful implementation of voluntary schemes and the achievement of environmental outcomes, particularly where the choices facing farmers in terms of desirable management or investment are not straightforward. Arrangements for the provision of advice to land managers vary across Member States, with most using a mix of public and private sector funding, and more than one organisation involved in providing advisory services. Although most governments appear to provide support for farmers to obtain advice and up-to-date information about agricultural activities, there is often less advice available on environmental management practices and how these might best be integrated on farm.

Farmer attitudes play an important role in influencing participation in voluntary environmental schemes. In all countries these will range from those with a strong resistance to engaging in environmental management, viewing this as separate to the core business of producing food for the market, to those who strongly believe in the need to integrate environmental management into the farming system even if this results in some extensification of management (Morris, 2000; Quinn, 2009; Van Dijk et al, 2009). Attitudes are formed partly by cultural values, upbringing and education, but can also be influenced by training, better access to information and by interaction and sharing experiences with other land managers. A positive correlation has been shown between the training given to farmers, the availability of demonstration farms and the level of uptake of environmentally beneficial management options through agri-environment schemes (Morris, 2000). This showed that the greater the understanding of the benefits of environmental schemes and the outcomes expected, the more likely a land manager is to want to commit to undertaking such management.

Institutional and administrative capacity: The effective and efficient delivery of environmental outcomes through voluntary environmental schemes cannot be achieved in a mechanistic way and requires the use of appropriate administrative and technical resources and expertise. This involves having appropriately trained staff who understand the dynamic interactions between agriculture and the environment, adequate databases, and suitable systems in place in order to be able tot target and monitor measures well, to deliver payments efficiently and to ensure effective control and enforcement. Effective and efficient delivery can also be improved through good interactions between the public sector, farming organisations, agronomists, foresters, advisers, environmental interests and research bodies. This can lead to new approaches and solutions being found to deliver outcomes and make the delivery of schemes more effective. The relationship and level of interaction between these different actors can have a significant impact on the way in which environmental schemes are delivered and the outcomes achieved. Evidence from a survey carried out for the European Network for Rural Development showed that 'in both Finland and Estonia, the high level of cooperation has resulted in improved implementation, … better agreement on objectives and more transparent objectives and use of funds'. In contrast, conflict and lack of communication were perceived to have reduced the effectiveness of environmental measures in Slovakia and Greece (ENRD, 2010).

The level of institutional, technical and administrative capacity in individual Member States will not impact on the overall estimation of the costs of environmental need from EU funds, as the costs fall on national administrations. However, it will impact upon the degree to which there is the ability to deliver the environmental priorities on the ground and therefore the level of expenditure that can be spent realistically in practice. The estimates of expenditure required in this study imply a larger increase in the overall scale of payments in agr-environment and forestry measures. Irrespective of any increase in quality and effectiveness, the additional volume of contractual agreements with land managers would demand more administrative capacity within Member States for this purpose.

8.2 Implications for establishing the costs of unmet environmental need

At the most simplistic level, ignoring the influence of the factors identified in the previous section, the cost estimates presented here indicate that, to meet EU environmental targets through voluntary rural land management will require an increase in resources in the order of approximately 300 per cent. If the current average ratio of EU/national co-financing is applied (64 per cent EU to 36 per cent Member States), **the proportion of the cost**

estimates presented here that would need to be sourced from the EU budget would come to approximately €27 billion/year. This could be accommodated within the CAP in a variety of different ways. Not all of this cost requires additional budgetary resources to be made available. A proportion of these costs are already allocated to relevant measures under Pillar 2 of the CAP and a significant proportion could potentially be met through a refocusing of the resources already available within Pillar 1.

Although this appears high, this is not disproportionate to estimates that have been carried out in individual Member States. For example a study in the UK in 2009 demonstrated that €2 billion per year was needed to deliver the UK's environmental targets through rural land management, compared with current planned expenditure under agri-environment schemes of £742 million/year. Indeed, given the assumptions made and the lack of detailed data available for certain environmental issues and in certain regions, it was considered that the cost estimates for the UK were likely to be a significant underestimate.

However, to advance from a desk based estimate of this kind to a more realistic projection requires further consideration of a range of factors that relate not only to the cost of incentivising the relevant management options, but also to policy design and delivery as well as cultural and behavioural issues as discussed in the previous section.

For example, it is clear that many land managers, particularly those in more productive areas, at present do not consider the current payment rates as sufficiently attractive to adopt management practices that impinge on their productive operations. This has created barriers to achieving the adoption of certain management practices, particularly in-field management that is essential for example for reversing the declines in arable farmland birds. As a result it could be argued that the cost estimates provided here, although much higher that current levels of expenditure, in reality might need to be even higher if a change in management practices on a significant proportion of productive arable land and grassland is to be achieved.

On the other hand, with appropriate targeting and accompanying advice and training, the area over which management would be necessary to achieve a significant improvement in environmental condition may need to be much lower than is currently proposed. For example, if evidence were available to ensure that buffer strips were targeted in those locations where they deliver the most benefit for either water quality and/or biodiversity, the desired outcomes could be achieved with a more focused effort. This is not the case for all types of management option, however. Extensive grazing management is required over a large proportion of existing HNV grassland, for example, for its environmental value to be maintained. A more targeted, focused approach to environmental management would certainly lead to a more efficient use of public resources in terms of outcomes delivered. However, although it may reduce the cost associated with incentivising farm and woodland management, it would require a much higher investment in advice and training. The importance of advisory services in building the environmental knowledge base of land managers is highlighted frequently in the literature and increased investment in this area requires serious consideration (see for example, European Commission, 2010b). However, whether it is appropriate that any of this additional funding should come from the EU budget is a separate question.

Equally, the annual cost estimates for environmental land management have assumed a continuation of current expenditure rates for providing support to land managers for capital investments, albeit assuming that the full amount should be allocated to sustainable investments in the future. However, given the focus of the EU2020 strategy on 'green growth' and the emphasis on innovation, reduced GHG emissions and resource efficiency, there is likely to be an increased call on the CAP and the EU budget to help to support the agriculture and forestry sectors to make the necessary investments to meet these goals.

In conclusion, therefore, although there are certainly ways in which the effectiveness and efficiency of expenditure to deliver environmental outcomes within the agriculture and forestry sectors can be improved, this will not necessarily bring with it a reduction in the cost estimates set out in this study. Although they are broad brush in nature, they do demonstrate the scale of additional resources that are likely to be needed to meet the EU's environmental needs to 2020, indicating the need for a three-fold increase in resources allocated to the environment. How this might differ under different economic and policy scenarios is explored in Chapter 9.

9 COSTS UNDER VARYING ASSUMPTIONS

Looking ahead to the period 2014 – 2020, it is certain that conditions in rural Europe will not be identical to those applying today. This will have consequences both for the land management activities that we have projected to be needed in order to meet environmental objectives and for the likely costs of incentivising these practices. Without an elaborate forecasting exercise it is difficult to predict precisely how conditions will develop but we can identify a number of factors which potentially could have a significant impact on the precise nature of the land management challenge and, more particularly, on the anticipated costs. Some of the assumptions and conditions that could be expected to have the greatest impacts on costs, and therefore on the broader conclusions of this study, are discussed in this chapter.

9.1 Baseline Assumptions

The central costing exercise in this report had to utilise a number of rather critical assumptions about the wider policy framework and economic conditions in which farmers and foresters would be operating in 2020. Deliberately these departed rather little from business as usual so that a fairly transparent baseline could be established. The result was not intended to be a forecast but a baseline around which variations could be explored. The critical assumptions can be summarised as follows:

- Payment rates not assumed to be different from those established in a sizeable sample of Member States in their current Rural Development Programmes. In most cases these were set around 2006/2007.
- The full implementation of EU environmental legislation of relevance to agriculture, including the Water Framework Directive, the Directive on the Sustainable Use of Pesticides and the Habitats Directive, takes place within the Member States on the timescale envisaged in the respective measures. The implication of this is that there will be an upward shift in the regulatory baseline or reference level applying to farmers, for example in relation to diffuse water pollution and the use of integrated pest management. Potentially this reduces the level of payment required in incentive schemes to achieve certain environmental goals from the present level, particularly in relation to water quality.
- Aside from bioenergy related crops, which include maize and wheat in some parts of Europe, broadly stable demand for food commodities in the EU is assumed. However, this is accompanied by a significant increase in demand for bioenergy, including biofuel feedstocks, in response to the targets set for Member States in the Renewable Energy Directive. In the absence of intervention, this results in pressure for further conversion from grass to arable and greater arable intensification. Measures to mitigate the environmental impact have played a significant part in the baseline assumption and central cost estimates.
- Aggregate input prices are assumed to be fairly stable, including no substantive change in the oil price.

- No major changes are assumed in trade agreements, such as the WTO, that would have significant impacts on the agriculture sector in Europe. For example, no significant increase in market access to the EU for third countries is assumed.
- A steady implementation of reforms within the CAP that already are agreed is assumed. This would comprise almost complete decoupling of direct payments and a more even distribution of these payments between individual farms in the EU, with the Single Payment Scheme fully phased in for the EU-12. No substantial changes in the Pillar 1 / Pillar 2 architecture or in the level of support within Pillar 1 are assumed. It is taken that current cross compliance conditions relating to the environment are broadly unchanged but that there are benefits arising from a longer period of implementation, particularly in the new Member States where they have been introduced more recently. No assumptions are made about the 'greening' of direct payments in Pillar 1, as proposed in the recent Commission Communication on the future of the CAP.
- Changes in farm practice do not arise to a significant degree due to purely market pressures, such as developments in consumer preferences and the requirements of retailers. While such changes clearly will take place, with retailers and processors increasingly introducing requirements that affect farm practice, it is difficult to forecast the overall impact of such trends.
- Climate change continues, with average global temperatures rising over the period, with consequences for agriculture, including a greater concern about efficient water management and other forms of adaptation. This also has had implications for the pattern of measures proposed, for example the continuing need to address soil and water management issues, at an intensified level in some regions.
- Changes in technology leading to greater efficiency in production and gradual improvement in resource efficiency take place, particularly in relation to energy and water use.
- Some improvement occurs in the efficiency of agri-environment measures over time, as reflected in the capacity to meet agreed environmental objectives at a given cost. This arises as a result of greater experience, both within the farming community and the administrations responsible for the design and implementation of these measures.

These assumptions are clearly stylised rather than predictive or precise. A number of the assumptions suggest that there will be some scope for slightly reducing expenditure on agri-environment incentives relative to today's levels as the reference level rises and some improvements in targeting and efficiency occur over time. Such savings could arise from a combination of lower average payments per hectare for certain measures and a reduced requirement for certain measures. Some market trends, for example in relation to pesticide use, also may help to deliver some environmental goals. However, there are also pressures in the other direction, with costs at farm level having risen since 2006/07, a current surge in many commodity prices and rising income expectations in the farming community. The assumption in the central costs scenario neither to inflate nor reduce the payment levels applying in the existing RDPs was made in the absence of evidence about which of these factors would predominate.

Different assumptions need to be made in the forestry sector, where there is a considerable possibility of increasing prices for wood and other forestry products in the next few years in response to changing market conditions and growing demand for biomass for energy purposes. The reach of forestry / environment measures will need to increase in response to greater pressures on sustainable woodland management over the period to 2020.

In practice, conditions are almost certain to be rather different than in this baseline and the implications for the measures that will be required and the costs entailed could be very significant. A number of potentially important factors are set out below under two broad headings.

9.2 Economic Conditions

Incentive based measures need to take account of a range of economic conditions that will influence not only the additional costs and income foregone by land managers but also their expectations about the future, their willingness to enter agreements and the level of payments that will be required to achieve a particular level of output. At the farm level, decisions are influenced by inflation, growth, interest rates, the availability and cost of labour, opportunities to diversify and invest in alternative economic activities, the availability of credit and other considerations. More rapid economic growth for example, could increase farmers' income expectations, labour costs and opportunities outside agriculture and feed through into higher prices for agricultural land and woodland. The cost of voluntary agri-environmental measures could be expected to increase in response. Conversely, more stagnant economic conditions might be expected to increase the willingness of land managers to enter voluntary schemes at lower payment levels.

Greater economic convergence within the EU, particularly between new and older Member States (EU-15 and EU-12) is anticipated and could be expected to reduce the diversity of conditions in Europe and the discrepancies in farm incomes. Other things being equal, payments for voluntary measures would need to rise in the EU-12 to maintain a given level of participation in agri-environment schemes. In practice, however, the differences between agri-environment payment levels are just as great between EU-15 and EU-12 Member States as between the EU-12 and the EU-15, reflecting the different management requirements and the variable profitability of different sectors, and therefore they may not need much adjustment in practice.

9.2.1 Commodity Prices

The level of commodity prices both in agriculture and in forestry has a major influence on farm incomes and on gross margins per hectare. Commodity prices tend to have an immediate impact on economic returns and on opportunity costs but also influence farmers' expectations of future income and willingness to participate in agreements, since these usually stretch several years ahead.

It is clear that the level of payments is not the only factor explaining levels of uptake of voluntary agreements and that farmers are also concerned about environmental sustainability and constraints on their future management options arising from agreements and transaction costs more broadly. Nonetheless, payment levels remain a critical variable in determining participation. In some countries with long term experience of agri-environment schemes, such as Sweden, there has been a growth in reluctance by farmers during recent years to re-enter schemes when their agreements have expired (Holstein, personal communication). This may become a more widespread phenomenon in future, particularly if farmers expect rising commodity prices. On the other hand if expectations of greater fluctuations in commodity prices turn out to be justified, farmers may have a greater preference for guaranteed, stable sources of income of the kind provided by agri-environment schemes. On balance it seems likely that, other things being equal, aggregate payment levels to incentivise environmental management may need to increase rather than fall over time in response to motivation factors of this kind in the farming community.

Commodity prices have a direct impact on economic returns and farm incomes and therefore are a critical variable. Nonetheless, changes in commodity prices do not necessarily translate into corresponding changes in gross margins per hectare because of the variable extent to which they are translated into receipts at farm level and the potential for changes in input costs.

The trend set out in the most recent FAO/OECD forecasts for agricultural commodities is for modest price increases over time, partly concentrated in certain sectors, such as oilseeds and rice. However, this may not prove correct and there are a number of forces contributing to long term increases in prices. These include rising populations and levels of affluence at a global level, leading to increased food consumption particularly of foods requiring more inputs, such as meat and dairy products. Other factors, such as substantially increased demand for bioenergy and growing supply constraints such as climate induced drought and lower water availability could increase pressure on commodity prices and aggravate volatility. If commodity prices at the farm gate rose in real terms by more than, say, ten per cent by 2020 the consequences would be significant. Potential changes can be summarised as:

- Significant increase in real farm incomes and in investment levels.
- Corresponding increase in the price of farmland and in rents.
- Further trend towards arable cropping, particularly if livestock prices were softer than crop prices, as many expect.
- Potentially less pressure of land abandonment although this depends on the profitability of the grazing livestock sector which may not necessarily increase in line with aggregate movements in commodity prices and will be influenced by trade agreements, including the WTO and Mercosur.
- More pressure on water quality, landscape and biodiversity and energy consumption.
- Consequently, there would be likely to be a greater need to intervene in land management to pursue key environmental objectives, for example to maintain grassland, protect field margins and landscape features, ensure appropriate soil management etc.
- In principle, there would be a greater political opportunity to raise the regulatory baseline affecting the farmed environment, partly through better enforcement, in light of buoyant farm incomes.

In these circumstances, the policy response could be expected to be different from that in the central costs estimate in a number of respects. For example, there would be:

- Greater potential to achieve some environmental goals without the use of incentive payments or through a more targeted approach.
- Less need for investment aid related to productive activities on farms which have both production and environmental benefits, such as equipment for improved slurry management, because of greater farm profitability and liquidity.
- An enhanced need for intervention in some areas, eg to protect permanent pasture.
- A need for higher payment rates to encourage environmental management on many farms because of greater profit foregone and greater confidence about future profits, particularly on more productive farmland. Incentives are likely to have to increase by more than the rise in commodity prices in many cases.
- Some potential savings in payments made to reduce the risk of land abandonment, depending on trends in the livestock sector and the profitability of more marginal farmland.

The combined impact might be the need for an increase in expenditure on land management payments, only partly offset by reduced investment aid.

On the other hand, aggregate commodity prices in Europe could decline over time in real terms, if there is a large supply response to current prices, there is a WTO agreement granting increased access to the EU market, or global investment in potentially productive areas outside Europe accelerates technological advances. Sizeable fluctuations might still be expected, as would differences between sectors. The livestock sector, particularly beef production, might be most affected, especially if the driver for lower prices was trade liberalisation and imports from Latin America and elsewhere increased. Input prices might not follow the same trend, particularly those linked to the oil price, such as inorganic fertiliser costs, so there could be a squeeze on farm incomes.

The potential consequences for land management and the delivery of environmental outcomes through incentive schemes can be summarised as:

- The likelihood of lower agricultural incomes, which in turn would lead to less investment than under the baseline situation, lower land prices and more structural change, with the underlying trend to larger holdings accelerating.
- The potential for land abandonment on a larger scale due to reduced profitability in the uplands and mountains and almost certainly some decline in the intensity of production would be likely.
- Pressure to use a larger proportion of agricultural support to maintain farm incomes, affecting both the CAP and Member State budgets. This would reduce the resources available for addressing environmental needs.
- Less political scope for using regulation to pursue environmental objectives, given the pressure on farm incomes.
- The potential for less intensification and concentration of production, resulting in a reduced pressure on the farmed environment in general, but it is still possible that

arable conversion would be a major concern, especially if the profitability of grazing livestock is low.

- Potentially under-management, for example of landscape features, pastures and livestock would be a greater concern.
- In principle payments per hectare would be lower in agri-environment schemes because of lower opportunity costs, although in very marginal areas facing abandonment, opportunity costs may increase.
- Farm investments for commercial or environmental purposes would be more difficult to mobilise with weaker output prices, so investment aid costs would be likely to increase.

In total, management costs might be lower than under the baseline assumptions, although with considerable variations and costs to support investment in capital items might increase. However, the level of environmental ambition might fall given other pressures on the resources available for agriculture through the CAP.

The current literature and debates on commodity prices suggests that the balance of probability is more on the side of higher than lower prices and hence points towards an increase in the cost of the incentive payments, based on an 'income forgone and additional costs' formula, set out in the central cost estimates.

9.2.2 Input Prices

Changes in input prices can have an impact on gross margins and also in the choice of practices adopted on farms. Recently prices of oil, inorganic fertilisers and several other inputs have been rising. Feed prices are an important variable in livestock profitability and will be linked to overall commodity prices. Higher prices will offset some of the impact of higher farm gate commodity prices, as occurred in 2008, so need to be considered alongside other drivers of profitability. In principle they will also lead to farmers taking opportunities to scale back input use where they can. This could reduce certain pressures on the environment, for example from inorganic fertiliser use and in turn trim the level of incentives needed to reduce input use.

9.3 Policy Conditions

Alongside economic conditions there is a further set of important considerations related to policy that will influence both farm practice and the cost of incentivising desired environmental outcomes. These are discussed briefly below.

9.3.1 Direct Payments

The design, scale and availability of direct payments to farms under the CAP will influence both farm management decisions and the cost of incentive schemes. Direct payments represent a substantial percentage of gross income from agriculture on many farms, especially in the grazing livestock sectors which are of particular environmental importance. In this sense they are a major determinant of the economic viability of many farms, although they are now decoupled from production in most sectors in most Member States.

The continued shift to decoupled payments in Member States where this has not yet fully taken place will itself have management implications, which may have knock-on implications for the costs of supporting environmentally beneficial management practices.

While in principle it could be argued that changes in decoupled direct payments should not affect farm management choices, in practice the literature suggests that many farm families seek to adjust their enterprise to any such changes. In practice such changes have been, and are likely to continue to be, in a downward direction at an aggregate level, although this will vary between farms. The responses to lower direct payments have been varied, with some farmers or farm households seeking supplementary or alternative sources of income, with implications for farm structures in some cases. Reductions in direct payments could be expected to trigger an acceleration of the trend towards larger holdings. Lower direct payments may also lead to changes in management, for example reductions in investment or in livestock numbers in response to reduced liquidity. These responses are difficult to anticipate or to model but there is a growing body of empirical evidence of destocking in response to the switch to direct payments and the evidence base on farmer response to changes in these payments can be expected to become more illuminating over time.

In appraising future scenarios it is worth emphasising that policy design also is an important determinant of costs. There are trade-offs between an approach that seeks to target environmental outcomes as precisely as possible through measures that require potentially demanding management changes, perhaps on a more limited scale, and those which adopt a more broad brush approach, accepting a lower degree of precision over a larger area. The more targeted approach is usually associated with a lower area needed under specific management measures but higher costs per hectare, greater need for investment in advice and training and more demands on public administration. Member States vary in their preferences and technical capacity to follow such approaches, but over time the more targeted option may become more available and attractive to a larger number.

9.3.2 The role of regulation

In principle, payments to land managers are made only when they undertake commitments which are in addition to those required by legislation. Incentives are required above a 'reference level' in the terminology of the OECD (Cooper *et al*, 2009). This reference level varies between Member States in Europe and changes over time. It comprises a combination of EU legislation and national measures with a bearing on the property rights and obligations of land managers. It will include a local element, for example land use planning constraints applying in the countryside. Over time this reference level has tended to rise and there is an expectation that it will continue to do so, partly because of a number of EU obligations that are yet to be implemented at Member State level, exemplified by the Water Framework Directive, and partly because of a tendency for the gap between Member States with higher standards and those with lower standards to narrow over time, not least because of the operation of the single market. This historic trend should not be taken for granted, however, as evidenced by the current debate about simplification in the Agriculture Council, but it is a factor with significant implications for land managers and incentive measures.

Payments for actions already required under EU legislation are not eligible for EU support, with certain exceptions related to Natura 2000 and the Water Framework Directive. Assuming no greater elasticity in these exceptions, one could expect that the need to pay for voluntary agri-environmental payments will fall as the reference level rises. This could cut the cost of achieving land management goals very considerably in the areas affected, which might include input use, water quality requirements, basic soil management, the retention of existing farm features and other environmental parameters where some Member States already have mandatory standards. Cost reductions of more than a third are not difficult to envisage. However, this would represent a major transfer of costs to private land managers.

Within the regulatory framework, cross compliance has three distinctive roles. One is to reinforce compliance with certain elements of the EU acquis at farm level, with respect to the environment and other issues such as farm animal health and welfare. This applies to all farms receiving direct payments throughout the EU in a uniform way. The second role is to address certain specific issues, such as soil erosion, following rules established by Member States and varying according to national and regional choices within an EU framework, established as Good Agricultural and Environmental Condition (GAEC). The third role is to constitute a reference level for agri-environmental measures, below which payments to farmers should not take place.

By varying cross compliance conditions and so the demands on farmers, it is possible to make considerable alterations in the suite of farm management practices that qualify for agri-environment payments. Member States can make alterations to their GAEC standards without changes in EU legislation so have considerable flexibility. If cross compliance standards become more demanding this will reduce the scope for incentive schemes and either lower their cost or allow them to do more for other environmental objectives with the available funding. This may occur in relation to water pollution, for example as the Water Framework Directive leads to increased requirements at the farm level over time. Nonetheless, there are limits to the extent to which cross compliance requirements can be increased if the scale of these payments is falling over time, both absolutely and as a proportion of gross farm income. If cross compliance standards were as demanding throughout the EU as they are in certain Member States, this alone would reduce the role of voluntary agri-environment schemes but there is little sign of this occurring at present.

9.3.3 Targeting measures

The approach underlying the central cost estimate is that agri-environment incentive measures would follow broadly the same model as at present. This involves individual farm contracts, typically extending over a period of four to ten years, sometimes with payment review periods, accompanied by some degree of advice or monitoring. Whilst scheme design and implementation varies significantly within Europe, this is the essential model, underpinned by the requirements of EU regulations. However, in principle this model could be varied in several respects. For example, short one year only agreements sometimes are proposed on the argument that they would give farmers more flexibility and therefore encourage uptake. Indeed the proposals for 'greening' direct payments in the Commission's November Communication on the CAP point in this direction.

There are also arguments for developing measures that are targeted more precisely and applied more intensively, with sustained expert advice to maximise the environmental value of the management practices supported. This can be an effective means of securing environmental outcomes more precisely and confidently over a smaller land area, where this is appropriate. It is illustrated for the case of arable farmland bird case study, where relatively demanding changes in management applied in an integrated way at some cost can in principle produce robust results. Where it is appropriate to the environmental goal in question, this approach results in a smaller area of land being required under the specific management and a reduced number of farmers being involved. However, the demands on them are greater and so is the level of commitment required. The overall cost of payments might be lower under this approach but the support costs falling on public administration regarding research, preparation, targeting, advice and information, monitoring and feedback would be greater. The approach lends itself more to certain biodiversity requirements than to others, such as widespread problems of soil erosion and loss of soil organic matter, where a more universal approach may be more desirable and where less tailoring of measures to local conditions may be required.

The more broad brush approach of less tightly stipulated annual payments applied to large groups of farmers, as set out in the 'greening' Pillar 1 proposals in the November Communication (COM (2010) 672 final) also has advantages and drawbacks. Given the likely mandatory nature of the measures (if farmers wish to continue to receive direct payments) then it is likely to the associated per hectare payments could be relatively modest and applied over large areas. Average support costs per farm would therefore be much lower. These would not substitute for more highly stipulated and targeted measures and a combination of both could be required to meet the objectives considered here.

Both approaches have their merits in relation to specific goals and could be applied in parallel with trade-offs considered carefully. The most cost effective measures may be the most demanding administratively, particularly in the early years to set up the administrative requirements of running the schemes and generating uptake. However, if a proportion of the environmental management required were to be delivered through broad brush measures under Pillar 1 rather than Pillar 2, then the overall costs of meeting environmental objectives would be likely to be reduced if the per hectare payment rates offered were at a significantly lower level than is currently the case.

9.3.4 Support for incentive measures

The cost effectiveness of agri-environment measures is a consequence of many factors, including scheme design, targeting, the determination of appropriate payment rates, advice, support and information, good administration and relationships with farmers and other stakeholders, effective monitoring and other considerations (Keenleyside *et al,* forthcoming). Some objectives are difficult to pursue adequately without considerable investment in support measures. As noted above, accumulated experience, improved data, greater familiarity within the farming community and the lessons learned from monitoring and evaluation should give rise to greater effectiveness over time. Nonetheless, investment in extension services, administrative capacity and monitoring needs to be maintained. There are trade offs between the cost of payments and that of support costs but where the latter are persistently minimised the value of voluntary schemes in relation to clear objectives can diminish greatly.

9.4 Conclusion

The analysis does show that there is an interplay of different factors influencing the costs of addressing environmental goals relating to rural land use and that not all of these work in the same direction. Estimating the total impact of such varied factors in quantitative terms would seem to be particularly hazardous, therefore.

The central cost estimates developed in Chapter 4 need to be seen in the context of a changing world, not least the near certainty of alterations to the CAP before 2020. There are several factors which could lead to the cost of the kind of measures outlined here rising or falling fairly significantly relative to the central cost estimate, although it has not been possible to quantify this with any degree of accuracy within the scope of this study. Changes in the CAP and regulatory regimes would be likely to give rise to the most significant departures from the central estimate. For example, an increase in the regulatory baseline, a change in the basis of payments or the introduction of a lower cap on the level of payments per hectare could reduce these cost estimates significantly. On the other hand, if a greater proportion of land were deemed to be needed under environmentally beneficial management, the regulatory baseline stayed the same, and the current 'income foregone plus additional costs' formula for calculating environment payments were interpreted more flexibly, then the costs might equally increase substantially.

Given the limitations of this exercise, further work on this topic is required before more precise cost estimates are arrived at.

10 SUMMARY AND CONCLUSIONS

Estimating the cost of meeting Europe's environmental needs associated with rural land management to 2020 is a challenging task. Not only are the data to underpin such cost estimates limited, but a large number of assumptions about future conditions need to be made. A considerable range of factors need to be taken into account, such as policy design and implementation, institutional, behavioural and financial conditions. Expert judgement, therefore, has played an important role in this study.

The costs derived in this study are necessarily broad brush in nature. They give an indicative sense of the scale of the financial resources needed from the public purse (EU and national sources) to address a suite of environmental needs through agricultural and forestry management. The costs have been calculated for the EU-27 using average figures and for this reason cannot be broken down by Member State. The proportion of resources required in each Member State will differ given the varying proportions of land use, the extent of the pressures facing different environmental priorities and varying regulatory frameworks. More detailed work on costs at the Member State level would help improve the accuracy of the overarching EU-27 figures.

The central approach uses a methodology developed for the purposes of this study and systematically considers the pressures facing different environmental issues by land use, the management options required to address these pressures, the area of land needed under such management and the associated costs per hectare, using average costs for the EU-27. The costs of delivering specific environmental outcomes were then interrogated in more detail, focusing on the costs of halting declines in arable bird populations on arable farmland, maintaining HNV farmland at present levels and of delivering soil conservation objectives.

The central approach has generated an estimate of approximately €43 billion / year (+/- 8.5 billion) as the approximate level of financial resources needed to deliver the EU's environmental needs related to rural land management using incentive based measures. Of this figure, it is estimated that approximately €27 billion /year would need to be sourced from the EU budget (based on the current average ratio of EU:national funding under the EAFRD). This figure is based on costs calculated under the current framework of the CAP and therefore assumes the continuation of the CAP framework and the regulatory baseline as in place currently but with the relevant provisions being implemented fully in 2020. The estimates include the costs of supporting environmental land management practices as well as an allocation to compensate farmers for natural handicaps, capital investments and resources for advice and training. These costs could be met from different parts of the CAP and would not all require additional financial resources to be made available, given that a proportion of these costs are already made available under Pillar 2 and a further proportion could be met through a refocusing of payments currently under Pillar 1.

The results of the case studies indicate that approximately €1 billion/year is needed to halt biodiversity declines on arable land (of which €854 million/year is estimated to be needed to halt declines of arable bird populations), that between €16-23 billion/year would be needed to maintain HNV farmland (depending on the proportion of HNV farmland requiring support) and that €12 billion/year would be needed to halt soil organic matter decline in the EU27 (with figures of €188 million/year as well as a one off cost of €137 million needed to address soil degradation issues in the Murcia region of Spain alone).

Providing accurate costs for the different actions required to meet environmental objectives is not straightforward. Reasonably robust average figures for area based land management practices can be derived from the cost of similar actions currently incentivised under various rural development policy measures in the EU-27. On the other hand, deriving an estimate of the costs needed in the future in relation to providing aid for capital investment or for advice and training, is much more problematic. Not only is it much more difficult to estimate what the future need might be, but there are no data available at the EU level on which to base estimates. Therefore, the baseline for estimating these costs is much more obscure.

The availability and accessibility of comparable data for Europe as a whole is the biggest limiting factor in the ability to determine accurate cost estimates for meeting the environmental needs associated with rural land management. For example:

- The principal pressures on the environment in the EU are relatively well known, yet there is limited data on the area of different types of land that are subject to such pressures;
- A considerable amount of literature exists on the types of land management needed to deliver environmental benefits on different habitats, however almost no data is available on the area of different types of land use or habitats needed under such management to address the pressures and deliver optimum environmental outcomes.
- Very little data are available on the extent to which the different pressures facing the environment overlap spatially and hence the degree to which the management needed to respond to these pressures are contributing to the delivery of multiple objectives in the right locations.

In some circumstances such data are available at the Member State or regional level. More specificity could be gained, therefore, if the cost estimates were built up from the Member State level.

The estimation of costs are very sensitive to a range of factors, including the level of the regulatory baseline, issues of policy design and implementation as well as the assumptions made on the degree to which benefits for multiple environmental objectives can be achieved by the same management options in the same locations.

The central cost estimates assume the current regulatory baseline, albeit with the full implementation of existing EU environmental legislation of relevance to agriculture, including the Water Framework Directive and the Directive on the Sustainable Use of Pesticides. However, if increased environmental regulation were to be introduced (which should not be taken for granted given current debates on simplification), this could cut the cost of achieving the environmental priorities associated with land management very considerably in those areas affected, which might include input use, water quality requirements, basic soil management, and the retention of existing farm features. Given the substantial costs associated with addressing these environmental priorities this could represent a significant reduction in the total cost needed from the public purse. However, it would represent a major transfer of costs to private land managers.

Policy design and implementation are critical factors that will influence the cost of achieving the environmental outcomes required. The data from the arable birds case study shows that for some outcomes, the use of specific, targeted measures can be cost-effective, because it reduces the area of land needed under specific, albeit often higher cost, management options. The success of this approach, however, tends to be conditional on the availability of significant levels of advice, spatial biodiversity data, and such support may not be available currently in all Member States. Other outcomes, for example maintaining semi-natural grassland vegetation require a larger proportion of farmland to be managed in a particular way, ie with low stocking densities and minimal use of chemical inputs.

It cannot be assumed, however, that simply having sufficient budgetary resources will lead to the environmental outcomes being achieved. Persuading land managers to engage in management activities that impact upon their productive activities often requires more than just a payment for the income foregone and additional costs of the change in management. In many cases achieving changes in management practices also requires a change in attitude and approach to the core business activities. Significant resistance is often experienced, some of which may be reduced through advice and training activities and some of which can be tackled through higher payment rates.

In practice, however, it is unlikely that an enhanced programme to address environmental requirements would rely solely on incentive measures. More would be likely to be invested in advice and information and regulatory approaches might have a larger role. Changes in economic factors, such as commodity prices and input prices as well as in the structure of the CAP framework, the level of the regulatory baseline, and the way in which policies are designed and implemented will all influence the level of financial resources needed to meet those environmental priorities related to rural land management. However these different factors do not always influence the costs of delivering environmental benefits in the same direction. Changes in assumptions related to these economic and policy factors could lead to changes in the cost of measures needed in either direction and changes to the CAP and regulatory regime could result in even greater reductions or increases in the financial resources required. Further work on understanding the interplay between these various factors is necessary before more accurate estimates of the costs related to future policy and economic scenarios can be arrived at. Nonetheless, the scale of expenditure likely to be needed to meet the EU's environmental targets in the future is very much greater than that deployed today.

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