ASSESSING SOCIO-ECONOMIC BENEFITS OF NATURA 2000

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A TOOLKIT FOR PRACTITIONERS

Output of the EC project

Financing Natura 2000: Cost estimate and benefits of Natura 2000

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TABLE OF CONTENTS

ANNEXES

ABBREVIATIONS

CAP	EU Common Agricultural Policy
CDM	Clean development mechanism
EAFRD	European Agricultural Fund for Rural Development
EC	European Commission
EEA	European Environment Agency
ETS	Emission trading system
EU	European Union
GDP	Gross Domestic Product
GNP	Gross National Product
GWP	Gross World Product
IPCC	Intergovernmental Panel on Climate Change
LIFE	European Environment Fund
MA	Millennium Ecosystem Assessment
NVP	Net present value
PES	Payments for environmental services
PPP	Purchasing power parity
SCC	Social Cost of Carbon
TEV	Total economic value
WEI	Water exploitation index
WTA	Willingness to accept
WTP	Willingness to pay

1 THE OBJECTIVE & OVERVIEW OF THE TOOLKIT

This Toolkit is a practical guide for practitioners involved in the management of Natura 2000 sites. It is hoped that the Toolkit will inspire managers and help them explore the existing and potential economic and social benefits of their sites.

Protected areas, such as Natura 2000 sites, contain biodiversity and ecosystems of high conservation value. In addition, these areas provide a range of benefits (direct and indirect) to our societies and economies. These benefits are often referred to as **ecosystem services** (see Box 1.1). These services include an array of natural resources (e.g. timber, crops, fish, game and medicinal products) and several valuable ecosystem processes, such as an ecosystems' ability to regulate floods and climate, purify water and secure the pollination of crops. In addition, nature forms an important basis for maintaining human health, both physical and mental, and creating opportunities for recreation and tourism. Biodiversity and ecosystems are also essential in forming our cultural characteristics and values. Consequently, it has been widely acknowledged that living nature is fundamental for human wellbeing and furthermore it also plays an essential role in supporting the functioning of our societies and economy.

Box 1.1 Ecosystem services

Ecosystem services are the benefits that people obtain from ecosystems. According to the widely used classification developed by the Millennium Ecosystem Assessment (2005) these services can be categorised as follows:

1. Provisioning services, such as food, fibre, fuel and water.
2. Regulating services, i.e. benefits obtained from ecosystem processes that regulate our natural environment, such as the regulation of climate, floods, disease, wastes, and water quality.
3. Cultural services such as recreation, aesthetic enjoyment and tourism.
4. Supporting services, i.e. services that are necessary for the production of all other ecosystem services, such as soil formation, photosynthesis, and nutrient cycling.

Millennium Ecosystem Assessment. 2005. Ecosystems and Human Wellbeing: Biodiversity Synthesis. World Resources Institute, Washington, DC. 100 pp.

Natura 2000 forms the foundation for biodiversity conservation in the EU. The main purpose of this EU-wide ecological network of protected areas is to ensure the protection of habitats and species of Community interest within the Union. In addition to safeguarding our common

conservation values, the network plays also an important role in providing and maintaining a range of ecosystem services amongst the sites and in the wider environment (see also Section 4.1 below). These services and their associated socio-economic benefits remain, however, poorly understood and appreciated. Indeed biodiversity protection and Natura 2000 are still often perceived as mainly imposing costs or restrictions on communities and economies.

The purpose of this Toolkit is to increase the awareness of the positive existing and potential role of the Natura 2000 network by providing guidance that can help identify and value the various socio-economic benefits provided by the Natura 2000 sites. In addition, the Toolkit also aims to improve the communication of these benefits to different stakeholders and the general public. It is particularly hoped that the Toolkit will provide practical assistance in making the Natura 2000 related benefits clearer and more tangible in practice.

Therefore, the main focus of this Toolkit is to help assessing and communicating socio-economic benefits related to existing and established Natura 2000 sites. However, the questions that conservationists (e.g. Natura 2000 site managers) often face are also related to comparing conservation benefits with benefits arising from other types of land use. For example, what are the implications for biodiversity and related ecosystem services when grassland is converted to cropland or when a wetland is drained for agricultural use? These questions require a detailed analysis of costs and benefits of the alternative land uses that fall outside of the scope of this Toolkit. However, it is hoped that information provided by the Toolkit (e.g. information on trade-offs between different services, see Chapter 3 below) can also provide support for more thorough cost-benefit considerations.

Finally, whilst we draw attention to the socio-economic benefits of the Natura 2000 network the we do not wish to undermine the primary role of the network, i.e. the conservation of threatened species and habitats in Europe in their own right. It is merely hoped that highlighting socio-economic benefits of the network will create further support for the management of the network and its sites.

1.1 Who is the toolkit for?

This Toolkit is, first and foremost, a practical guide for **practitioners involved in the management of Natura 2000 sites** (e.g. site managers, landowners and other land users). It is hoped that the Toolkit will inspire and help these practitioners in exploring the different values and socio-economic "potential" of their sites, e.g. possible socio-economic benefits gained by managing sites and land in a sustainable manner.

Additionally, even though the Toolkit is specifically aimed at promoting the socio-economic benefits of Natura 2000 it can also be used to assess the benefits of **other protected areas**.

Finally, it can also be used by a **broader audience** interested in the value of biodiversity and ecosystem services, particularly in the context of protected areas.

1.2 What are the foreseen benefits?

Identifying and valuing the Natura site related socio-economic benefits can be beneficial for several reasons. Demonstrating socio-economic importance of the site can significantly **increase political and stakeholder support** for the site. This support can further lead to positive changes in policies and decision-making. For example, it has been acknowledged that identifying socio-economic benefits of water use has supported the development and implementation of the Water Framework Directive.

It is also foreseen that the Toolkit will provide useful information for decision-making at a practical level, e.g. by supporting local and regional land use planning. It is hoped that recognising the array of benefits provided by Natura 2000 sites (or other conservation areas) will help to **support sustainable land use** in the area. For example, this information could be used when considering the "net" impacts of alternative land management practices (e.g. their impacts on different benefits provided by the site and the possible trade-offs between different benefits) and when trying to resolve conflicts between different interest groups. Insights on Natura 2000 related benefits are also needed to identify a combination of actions and land use practices that best support the sustainable and equitable utilisation of these benefits, while keeping in mind a site's conservation goals.

In addition, identifying different benefits associated with the site and their related beneficiaries (see Section 2.1 below) can help to discover **alternative and sustainable sources for financing** the management actions. This is based on the idea that the provisioning of certain benefits could be supported by the stakeholders benefiting from this service. For example, visitors' fees could contribute to covering the maintenance costs of a Natura site's paths and trails; or municipalities connected to a wetland Natura 2000 area could pay for the maintenance of the wetland in recognition of its water purification capacity. Therefore, the guidance provided by this Toolkit could also support the development of Natura 2000 management plans and business planning strategies.

Finally, it is also hoped that the Toolkit will help to increase the **general appreciation and understanding** of the value of biodiversity and Natura 2000 areas to the broader audience. In particular, it is hoped that highlighting the multiple socio-economic benefits provided by Natura 2000 sites will convey a clear message on the value of biodiversity and functioning ecosystems to all stakeholder groups.

Better understanding and increased communication of the Natura 2000 related socio-economic benefits will play an important role in creating wider support for the network in the future, including ensuring resources for its management.

1.3 Approach, structure & application

1.3.1 Approach & guiding principles

The approach adopted in the Toolkit is twofold:

1. The Toolkit aims to help to understand, assess and communicate the total overall socio-economic benefits and value of a site (including qualitative, quantitative and monetary estimates) (Chapters 4 & 6, 7).

2. It also provides more specific guidance on how to determine more specific (e.g. monetary) values of individual benefits provided by the site (Chapter 5).

The assessment of Natura 2000 related socio-economic benefits in the context of this Toolkit focuses primarily on **identifying and valuing various ecosystem services** provided by Natura 2000 sites. This is because we wish to target not only the tangible and most commonly understood benefits derived from the sites (e.g. sustainably harvested timber, crops, game, wild berries and mushrooms) but its wants to draw a specific attention to the more hidden values, such as the socio-economic significance of different beneficial ecosystem processes supported by the site (e.g. regulation of floods, climate and water quality). These values are traditionally overlooked, thus raising awareness on their role is considered of high importance.

In addition, in this Toolkit we build on a number of **underlining guiding principles** that should be kept in mind through out its application.

1) The benefits of biodiversity are manifold & cannot always be captured in Euros.

The total socio-economic benefit of Natura 2000 sites consist of different components including, for example, a site's tourism, recreational and cultural heritage value, a site's role in supporting wild pollinators and the value of wild berries and game provided by the site. In practice only some of these values can be estimated in terms of money (see Chapter 3). Therefore, the final assessment of the overall value of the site is always likely to be a combination of qualitative, quantitative and monetary estimates that cannot easily be merged into one single Euro figure.

2) In order to exist, ecosystem services need someone to benefit from them.

Ecosystem services and related benefits are defined by their users, i.e. no service exists without someone benefiting from it. In principle, these beneficiaries could be both humans and also other species; however, most commonly the definition is based on the human perspective.

For example, Natura 2000 sites can play an important role in supporting a sustainable population of game species (e.g. elk and deer). However, if there are no hunting activities in the area then, by definition, no current service related to the provisioning of game exists. Similarly, the site can create a buffer zone against the impacts of a storm but there is no "storm protection" service unless someone in the area benefits from this natural buffer. Identifying the current beneficiaries (or possible future beneficiaries) is also key to identifying how the estimated value could be turned into real financial support for the site (see above).

Some services may be potential services, i.e. they do not benefit anyone at the moment but they might do so in future. It is therefore important when considering the values of a site to try to identify potential beneficiaries of services (e.g. create new markets for Natura 2000 related products or establish new recreation activities) and this way generate "real" value. A potential service could turn into an active service when the general circumstances in the area change (e.g. due to climate change).

3) Identified benefits should be used sustainably respecting sites' overall biodiversity goals and management plans.

The value of any ecosystem service considered in the context of this Toolkit should be determined on the basis of its sustainable use. This is of particular importance when considering the benefits related to the extraction of biodiversity resources at a site, i.e. estimated values should not be calculated based on non-sustainable levels of producing crops or harvesting timber, fish etc. In addition, the benefits considered and promoted should be compatible with the objectives and management plans of the site. In some cases conflicts between the two might arise. For example, an important Natura 2000 wetland for birds could, in principle, be used for mitigating the impacts of floods (i.e. by providing a flood storage area). However, water levels might need to be kept lower than desirable for wetland habitats in order to maximise the area's flood mitigation potential, thus there might a conflict between the specific conservation goals of the site and its potential to provide benefits for flood mitigation. Similarly, rapidly growing forest plantations are often very effective in sequestrating carbon but they are also rather biodiversity poor.

4) Ecosystem services are often linked and these linkages should be understood in order not to overestimate the total value of a Natura 2000 site.

Ecosystem services consist of different types of benefits ranging from the provisioning of resources to the fundamental processes that underpin ecosystem's whole existence (See Box 1.1). These services are often interlinked, i.e. the existence of one service is dependent on the existence of some other services. For example, provisioning of crops is often dependent on the availability of fresh water, pollinators, flood and erosion control etc. Therefore, an economist would say that the value of pollination and flood and erosion control is already partly captured in the value of crops. Consequently, assessing the total economic value of a site by simply summing up different (monetary) value estimates available can lead to overestimating the total value. This problem, called "double counting", is further explained in Chapter 3 and it should be kept in mind when interpreting and communicating the valuation results.

1.3.2 Structure & application

This Toolkit consists of three main parts:

Part 1 "Contextual guidance" provides an overview of the ecosystem services and other possible socio-economic benefits provided by Natura 2000 areas. In addition, Part 1 also gives an introduction to the general principles of biodiversity valuation.

Part 2 "Applying the Toolkit" provides a conceptual and methodological framework to carry out an assessment of benefits related to a Natura 2000 site. This part consists of two main steps that are summarised below.

- **Step 1. A rapid overall assessment of possible benefits.** This first step shows how to carry out a rapid first-stage assessment of the possible ecosystem services provided by a Natura 2000 site. It 1) helps to obtain a general view of the full range of services provided by the site, including an initial assessment of their relative importance; 2) gives guidance on how to interpret these first-stage results and communicate them to relevant stakeholders; and 3) helps to identify which ecosystem services could be selected for further in-depth analysis for Step 2 (below).

- **Step 2. Estimating different Natura 2000 related benefits.** The purpose of this second step is to provide more specific guidance on methodologies available to estimating the value of Natura 2000 related ecosystem services and other possible socio-economic benefits. The introduced methodologies could be used to derive estimates on qualitative, quantitative and monetary value of different services.
  Step 2 focuses specifically on value estimates considered feasible to be obtained by practitioners, such as site managers and other interested stakeholders. A general introduction of these standard methodologies can be found in **Annex 1** (see below).

Part 3: "Guidance on how to interpret, present & communicate the different values" provides general guidance on using the results of the valuation(s) carried out in the context of Part 2. In particular, Part 3 aims to assist in using the different value estimates to form an overall picture of the total value of the site. In addition, some suggestions for presenting and communicating the results to relevant stakeholders and a wider audience are provided.

References section provides the literature cited in the the Toolkit. In addition, the Toolkit includes the following Annexes:

Annex 1. An overview of a selection of standard economic methodologies used in assessing the value of ecosystem services. Annex 1 also briefly introduces some more complicated standard economic valuation methodologies that can be used in assessing biodiversity related values. It is not, however, assumed these complicated economic assessments would be carried out by most users of this Toolkit without appropriate support (e.g. from professional economists). These methodologies are introduced mainly for information purposes and to give some ideas as to the possibility of carrying out wider and more detailed valuations in the future.

Annex 2 & 3. Annex 2 presents a suggested template that can be used as a basis for presenting and communicating the results from a Natura 2000 socio-economic valuation case study. Annex 3 provides a template for visual presentation of ecosystem services provided by a Natura 2000 site.

PART 1: CONTEXTUAL GUIDANCE

2 NATURA 2000 SITES & THEIR SOCIO-ECONOMIC BENEFITS

2.1 Ecosystem services provided and supported by Natura 2000 sites

The variety of ecosystem services provided by the Natura 2000 network (both directly and indirectly) is extensive. For example, Natura 2000 sites often conserve habitat types that provide important services, such as water purification and retention (wetlands), carbon storage (peat bogs) and protection from erosion and avalanches (forested mountain areas). The sites also support populations of many more species than those for which they are designated as a protected area; many of which may be of socio-economic value, e.g. pollinating insects, game animals and fish,. In addition, Natura 2000 areas are known to provide a number of ecosystem services related to recreation, education and tourism. In several cases Natura sites are also recognised as an important part of local cultural heritage and identity.

An overview of the possible ecosystem services provided by Natura 2000 sites is given in Table 2.1. In addition, Table 2.2 lists some examples of ecosystem services that could, for example, be connected with certain biogeographical regions.

It is also important to note that Natura 2000 sites provide and/or maintain ecosystem services both within and outside their boundaries. Therefore, the identification of possible Natura 2000 related services should not be limited to the site scale only. For example, the site itself can, of course, support several recreational and tourism activities within its borders but it can also be essential in attracting tourism to the wider region. Similarly, Natura 2000 sites with fire resistant vegetation may limit the spread and intensity of forest fires at broader local and regional levels.

Table. 2.1. An overview of potential ecosystem services provided by Natura 2000 sites

Ecosystem service		**Is this service likely to be associated with Natura 2000 sites?**
Provisioning services		
Biodiversity resources	Food, e.g. crops, fruit, livestock, wild berries & fungi, game	
	Fibre / materials, e.g. wool, skins, leather, plant fibre, timber, cork	
	Fuel, e.g. biomass, firewood	
	Natural medicines	
	Ornamental resources, e.g. wild plants, wood for handcraft, seashells	
Biochemicals & pharmaceuticals		

Water	
Cultural & social services	
Ecotourism & recreation	
Cultural values & inspirational services, e.g. education, art and research	
Landscape & amenity values	
Regulating services	
Climate / climate change regulation	
Water regulation, e.g. flood prevention, aquifer recharge	
Water purification & waste management	
Air quality regulation	
Erosion control	
Avalanche control	
Storm damage control	
Wild fire mitigation	
Biological control	
Pollination	
Regulation of human health (physical and mental)	
Genetic / species diversity maintenance, e.g. protection of local and endemic breeds and varieties	
Supporting services	
Production	These ecosystem processes form the basis for all the services above.
Nutrient cycling and decomposition	
Water cycling	
Weathering / erosion	
Ecological interactions	
Evolutionary processes	

Legend

Very likely  Likely  Some potential  Unlikely 

Table. 2.2. Examples of ecosystem services that could, for example, be connected with certain biogeographical regions.

Note: This is not an exhaustive list of ecosystem services provided by certain biogeographical regions. The table only aims to illustrate what the provisioning of ecosystem services could mean in practice in different areas.

Biogeographic region	Characteristic ecosystems	Characteristic services	Comments
Alpine	Semi-natural grasslands Heaths Forests Rocky habitats, e.g. glaciers, Rocky slopes	Cultural & amenity values Storm protection Avalanche protection	In the Alpine region extensive farming practices and small-scale forestry have all contributed to a complex mosaic of different cultures and landscapes, characterised by a relatively cold and harsh climate, high altitudes, complex and varied topography, forests and semi-natural grasslands as well as rocky habitats. Culture and environment are strongly linked, and measures aiming at cultural identity often also promote environmental conservation. In addition, rocky habitats and forests play an important role as natural avalanche mitigation instruments, and to modulate the effects of storms.
Atlantic	Open sea Coastal habitats Sand dunes Bogs	Flood prevention Erosion control	The region includes over half of Europe's long and indented coastline, and two of the most productive seas in the world: the North Sea and North-east Atlantic Ocean. Coastal habitats like sand dune systems have an important function in reducing the erosive impact of the sea by absorbing wave energy and acting as a vital buffer between land and water in the region.
Continental	Deciduous forests Freshwater habitats Alluvial forests Semi-natural grasslands	Biological control Water purification and water regulation	The vast area of the Continental region was once covered in lowland deciduous beech forests, including extensive floodplains, marshland and bogs. However, much of the forests have since been replaced by large scale agricultural production. Remaining natural vegetation patches intermingled with crops are the habitat of many natural enemies against insect pests and can thus play an important role regarding pests and disease control in agricultural or silvicultural systems. On the other hand, alluvial forests and bogs contribute to water regulation (timing, the seasonal distribution of flows) and purification (quality, including biological purity as well as sediment load).

Boreal	Coniferous forests	Climate regulation Fuel, e.g. biomass, firewood	The Boreal region includes Europe's largest area covered by forests, mainly conifers. They contribute to climate change mitigation by reducing the percentage of carbon dioxide in the atmosphere, and in addition are an increasingly important source of renewable energy supply in Europe.
Mediterranean	Mediterranean sclerophyllous/deciduous forests Sclerophyllus scrub	Food, e.g. crops, fruit, livestock, wild berries & fungi, game Wild fire mitigation	Mediterranean woodlands have a long history of cultural influence. Extensive traditional silvi-pastoral practices have been an important source of products (fiber, wood, livestock) in the region over the ages. At the same time resulting open habitats may prevent wild fires, which are increasingly frequent in the region. They have less vegetation fuel and are less inflammable and sensitive to fire events due to smaller quantities of dry wood compared to secondary forests and scrubs resulting from land abandonment. In addition, there are also other important services including carbon sequestration, water regulation and soil conservation. These services can only be maintained if cultural landscapes with their human presence are preserved.
Macaronesian	Open sea Coastal Habitats Sand dunes Rocky, vulcanic habitats Macaronesian heaths Laurel forests	Ecotourism & recreation Education and research	All three island groups included in the Macaronesian region benefit from a warm climate all the year round and they are able to offer a whole range of different activities to suit different tastes – from hiking through the mountains of the Canaries, whale watching in the Azores or walking the levadas of Madeira (ancient watercourses that carry rainfall from the mountains to irrigate the cultivated terraces). Madeira hosts the largest expanse of laurel forest in the world, where the level of endemism in plants and animals is reported to be particularly high, thus offering a vast source of research and education.
Black Sea	Coastal Habitats Sand dunes Grassland	Food, e.g. fish, algae Waste management and water purification Biochemicals & pharmaceuticals	The main biotopes in the Black Sea region are sandy-bottom shallow-water areas. Besides being an important source for food, coastal wetlands play an important role in water quality regulation by capturing and filtering sediments and organic wastes in transit from inland regions to the ocean. Furthermore, marine algae and invertebrates can be a potential source for biochemical and pharmaceutical compounds.

Steppic	Natural and semi-natural grasslands Freshwater habitats	Soil formation Pollination	The soil in the Steppic region is characterised by an approximately one meter thick layer of humus, which is the result of the particularly high productivity of the steppic vegetation, especially the roots, and its subsequent decomposition. The high activity of the soil fauna are an important element in the formation of these particularly fertile soils. Furthermore, natural and semi-natural grasslands can significantly influence size and quality of harvests for a number of crops by providing wild pollinators.
Pannonian	Pannonian woods dominated by oaks Natural and semi-natural grasslands	Fibre/Materials Natural medicines	Similarly to the Steppic region, the Pannonian region is characterised by vast grassland areas, which have a significant function for the provision of food, but also of fibres. On the other hand, pannonian woods have been traditionally managed as coppices, delivering a diversified portfolio of products such as furniture, construction material or firewood. Both ecosystems can also be an important source of natural medicines for local populations.

2.2 Other socio-economic benefits

In addition to the direct benefits associated with different ecosystem services, the broader socio-economic significance of Natura 2000 sites can also be demonstrated by assessing the benefits arising from the overall 'existence' of the site (i.e. looking at benefits that cannot be easily attributed to one specific ecosystem service as such). A number of examples of these benefits are listed in Box 2.1.

Box 2.1. Broader socio-economic benefits related to the overall "existence" of the Natura 2000 site

Broader socio-economic benefits provided by Natura 2000 that are more related to the overall "existence" of the site (i.e. cannot be easily linked with a specific ecosystem service as such) include, for example:

- direct employment supported by Natura 2000 site, e.g. employment of site management staff;
- indirect employment generated by Natura 2000 site;
- direct expenditure of the reserve benefiting local businesses;
- spending created by Natura 2000 site employees and volunteers supporting local economy; and
- Natura 2000 role in supporting broader aspects of rural and regional development.

These aggregate estimates reflecting the socio-economic value at the site level are often rather easily available. Thus, they are of high relevance when demonstrating the value of Natura 2000 sites and they complement well the information obtained on the value of specific ecosystem services provided by the site.

Naturally, these benefits are often closely linked with different ecosystem services provided by a site. The overall economic impacts assessed are, however, broader (e.g. the secondary and induced effects of visitor and employee spending) and they cannot be traced to a single service only. However, due to these linkages the problems related to double counting (as outlined in Chapter 3) need to be considered and one should never sum up ecosystem service specific estimates and the available estimates of wider socio-economic benefits without considering their linkages.

More detailed information and guidance on assessing the value of these broader socio-economic benefits is provided in Chapter 5.

3 GENERAL PRINCIPLES FOR THE VALUATION OF ECOSYSTEM SERVICES

The purpose of Chapter 3 is to provide Toolkit users with a quick introduction to the world of ecosystem service valuation.

This chapter presents an overview of the different terms and tools used in the valuation of biodiversity, ecosystems and their services. It attempts to present the terms and tools in practical terms to help avoid some of the "mystique" surrounding valuation methods, and help make the terms more familiar to users.

This chapter is complemented by the greater details in Part 2 of the Toolkit (i.e. the rapid assessment framework and the "service by service" guidance) which offers both practical low resource methods for understanding the Natura 2000 related benefits and also guidance for more detailed valuation.

It is hoped that the information provided by this chapter will help users reflect upon the content of this Toolkit and the benefits of their own Natura 2000 sites in a broader context of economic valuation.

The application of the Toolkit (Parts 2 and 3) builds on the principles presented in this chapter – with a strong focus on turning them into practical guidance to users at Natura 2000 site level.

3.1 What benefits does biodiversity provide?

As explained in Chapter 2, biodiversity and ecosystems provide a wide range of services to our societies and economies. Some of these benefits are **apparent through market transactions**. For example, food, medicinal and ornamental products can be sold in markets. Other market related benefits might be less obvious but still of high importance, for example house prices may be higher near Natura 2000 sites, which in some countries can, in turn, lead to higher local authority incomes from local property taxes. Natura 2000 sites can also contribute to local economies by creating job opportunities (related to tourism or site management) and increasing the income of local businesses both on- and off-site (e.g. through direct expenditures of the reserve and of its employees).

In addition, there are also several benefits provided by ecosystem services (e.g. services supported by Natura 2000 sites) that are **not captured by the market** and therefore are not traditionally valued in monetary terms. This does not, however, diminish the economic value of these services. For example, ecosystems' natural ability to purify water can significantly lower the cost of pre-treatment by water

companies. Similarly, some Natura 2000 sites can play an important role in water retention, helping to mitigate potential downstream flooding and to avoid related costs to property and livelihoods (e.g. costs of clean up shared between individuals, the insurance industry and the state). Natura 2000 sites can also help to reduce the risk and mitigate the impacts of other natural hazard such as storms, avalanches and wild fires. Natura 2000 sites can also function as "green lungs" supplying clean air to towns and cities. This can in turn reduce incidents of respiratory diseases diminishing heath related expenditure (e.g. reduced costs to society and states) and losses of output (e.g. days off work). These avoided costs are not visible on balance sheets or national budgets but appear in economic statistics as sizable costs when hazards actually occur.

There are also benefits with **potential market value**. For example, given the great concerns related to climate change there are expectations that the stock of carbon stored in ecosystems (e.g. Natura 2000 sites) might soon receive an explicit market value. Similarly, some Natura 2000 sites may harbour genetic material that may provide the basis of valuable medicines in the future.

Finally, Natura 2000 sites have several **non-economic values** (e.g. non-use values, see below) that are, for example, related to recreational, mental health and even spiritual benefits provided by the site. People may also value the possibility of using a certain Natura 2000 site in the future or just simply appreciate the existence of the sites and their species and habitats, even though they have no intention of visiting any of them. This appreciation may be cultural (i.e. Natura 2000 sites are a part of the local landscape and historic identity), spiritual, philanthropic or caused by a wider vision of responsibility (i.e. that nature has values in its own right).

3.2 How to present, measure and communicate the different values?

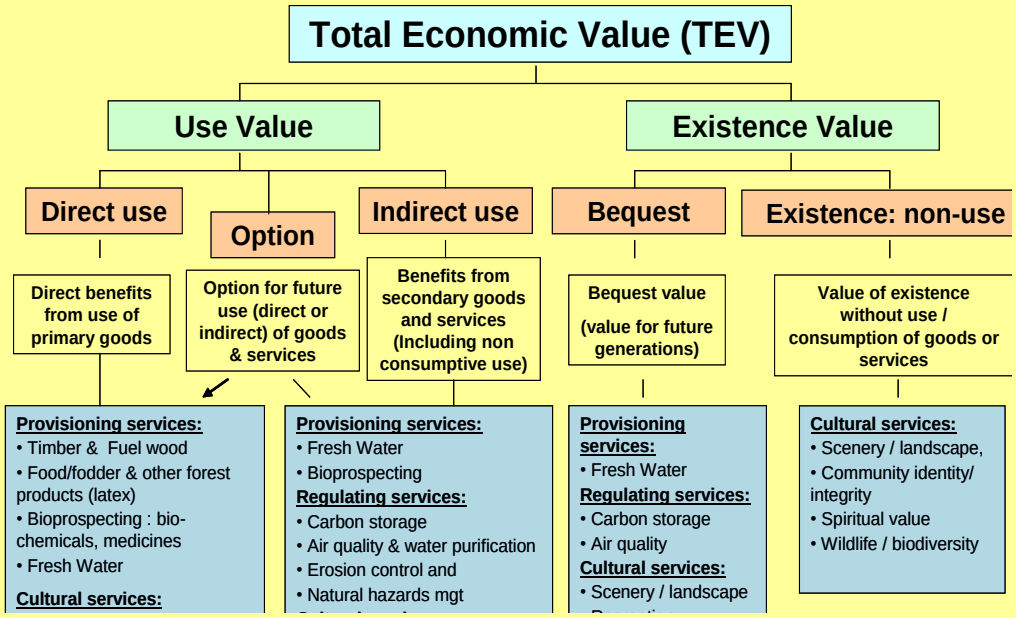
The need to create some "order" into the range of values and benefits described above has led to the creation of the term "Total Economic Value" (TEV) (Box 3.1). This economic term refers to the total value of biodiversity and related ecosystem services. It also provides a logical framework that can be used to classify different ecosystem services according to the way they are valued or used, e.g. market and non-market values, and use and non-use values.

The range of benefits provided by biodiversity and ecosystems (e.g. Natura 2000 sites) can be measured and communicated by different means. In general, most Natura 2000 related benefits can be identified and described in **qualitative** terms[1]. Several benefits can also be assessed in a **quantitative** manner. There are, however, significantly fewer benefits whose **monetary** value can be easily estimated. These limitations on what can be measured are illustrated in Figure 3.1 below. In many cases qualitative and quantitative estimates may be adequate for communicating Natura 2000 related values and benefits to stakeholders (e.g. the number of jobs supported by the site, or highlighting the site's unique cultural, historic or religious value). However, it is beyond doubt that for a number of important and influential audiences

[1] With the exception of marine sites, as marine ecosystems have been less studied to date.

(e.g. decision-makers, the finance sector and the press), monetary values carry the highest weight.

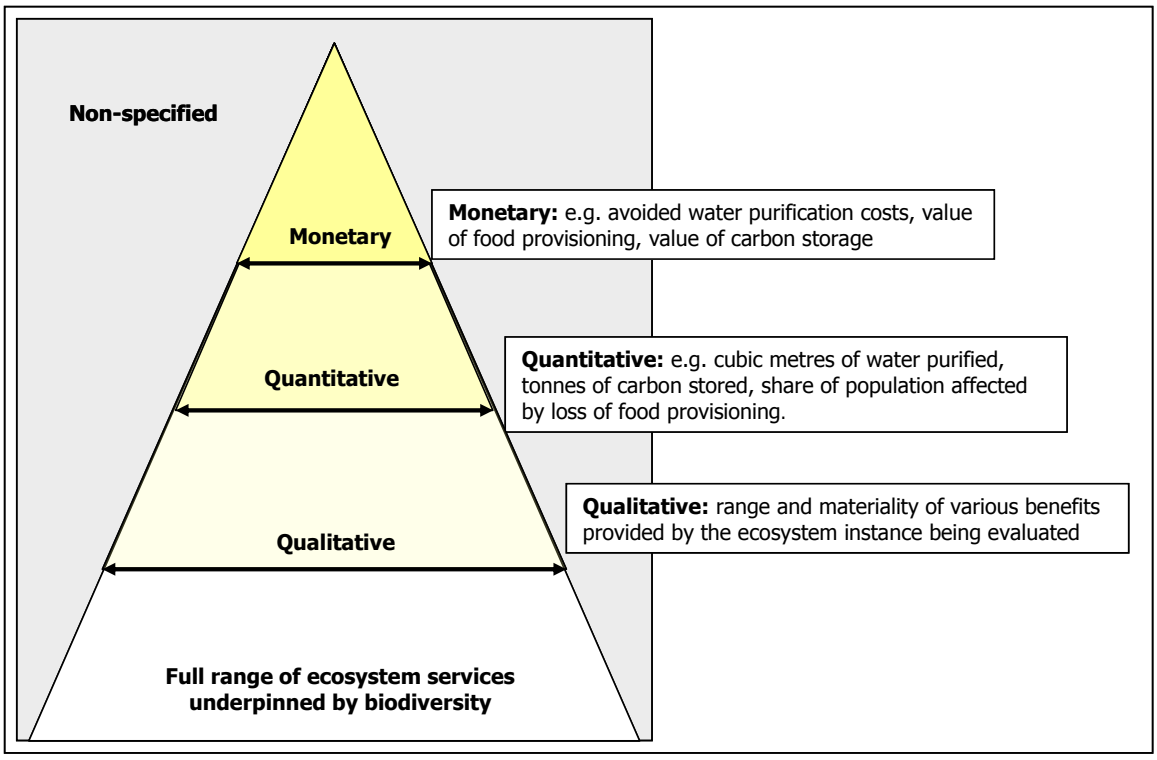
Box 3.1 The "Total Economic Value" framework and how it relates to different ecosystem services.



The literature talks of "Total Economic Value" that combines: *use values* (i.e. the value of direct, indirect and optional use) and *non-use values* (i.e. existence and bequest values). Direct use -values arise from the direct exploitation of the environment; either as consumptive goods (e.g. fisheries) or non consumptive use (e.g. wildlife viewing). Indirect use -values are related to benefits arising from regulating and supporting ecosystem services. Option use -value is the value associated with an individual's willingness to pay to safeguard the option to use a natural resource in the future, when such use is not currently planned. Existence -value is the value placed on simply knowing that a natural resource is there, even if it is never experienced. Bequest -value is the value an individual places on ensuring the availability of a natural resource to future generations.

Source: Beaumont et al. 2006 and Pearce & Moran 1993

Figure 3.1. The valuation pyramid



Source: P. ten Brink, workshop on the Economics of the Global Loss of Biological Diversity, 5-6 March 2008, Brussels.

3.3 A key question: who benefits where?

Benefits created by Natura 2000 sites can be received at multiple levels. The key levels where Natura 2000 related benefits can occur are:

- **local public benefits**: a site's role in supporting local identity, local recreation, local non-market forest products, and the local "brand", etc.;
- **local private benefits**: a site's support to natural water purification resulting in lower pre-treatment costs to the local water supply company, etc.;
- **local public sector benefits**: a site's abilities to mitigate floods resulting to lower public investment in flood control and / or flood damage, etc.;
- **regional and cross-border benefits**: regulation of climate and floods, mitigation of wild fires, provisioning and purification of water in transnational river basins), etc.;
- **international / global public benefits**: a site's provision of habitat for a migratory species at some point in its annual cycle, regulation of climate (carbon capture and storage), maintenance of global species and genetic diversity), etc.; and
- **international private benefits**: new pharmaceutical or medicinal product derived via bioprospecting, etc.

Therefore, it is of key importance to understand the geographic "distribution" of the benefits and also to whom the benefits accrue. This helps to identify stakeholders to whom the benefits would need to be communicated, e.g. to increase public support for the site. In addition, it might help to identify possible beneficiaries that could financially contribute to the maintenance of these benefits, e.g. create a basis for measures to reward previously unrecognised benefits (e.g. funding for carbon storage, contributions for site management / land purchases for water supply or purification etc).

3.4 How to estimate the value of ecosystem services?

In practice, the assessment of overall socio-economic benefits provided by Natura 2000 sites is likely to be a combination of qualitative, quantitative and monetary estimates. This is simply because developing monetary estimates tends to be complex and resource consuming; therefore utilising qualitative and quantitative estimates where necessary is often the most practical way forward. However, trying to assess the economic value of a site's most important ecosystem services is generally recommended.

There are a range of tools and approaches for estimating the economic value of biodiversity and related ecosystem services. As only some of the services are fully recognised in the markets, both **market valuation techniques** and **non-market valuation techniques** are needed. Market valuation techniques deal with use values where as the non-market techniques are also suitable for non-use values. More detailed information on these different methods is given in Chapter 5 and Annex 1 of the Toolkit.

In addition, it is also possible to build on insights from other studies (i.e. a "**benefits transfer**" technique, see Box 3.2). Information from previous studies and assessments can be of help when trying to find "low cost" ways to assess the benefits of Natura 2000 sites.

Estimates of economic value can be assessed by using different market and non-market valuation techniques introduced in Chapter 5 and Annex 1 of the Toolkit. Commonly used estimates include, for example:

- **revenues (gross/net) from ecosystem services**: e.g. revenues from provisioning services (fish, timber and non-timber-forest products), revenues from new products (bioprospecting leading to new pharmaceuticals or medicines), and revenue related to tourism and recreation;
- **avoided expenditure / investment costs:** e.g. avoided costs of water purification, expenditure avoided due to free access to forest products (e.g. berries, fruit, nuts), health costs avoided by mitigating natural hazards;
- **avoided damage:** e.g. avoided impacts and reduced risk of natural hazards;

- **value of carbon storage**: e.g. obtained by multiplying the tonnes of sequestered carbon by the price of carbon;
- **jobs and employment created:** e.g. number of jobs supported directly or indirectly by a Natura 2000 site; and
- **estimates based on people's stated preferences**: e.g. assessing the economic value for non-marketed goods and services, such as visiting accessible parts of Natura 2000 sites.

In addition, the costs of losing, artificially replacing or restoring ecosystem services can be used as an indicator of their value. Examples of these so called "cost based value estimates" include, for example:

- **losses of revenue**: e.g. reduced fish catches, reduced crop yields due to lack of pollinators;
- **costs of artificially replacing or substituting a service**: e.g. cost of water purification and waste water treatment, costs of desalination of water;
- **damage costs:** e.g. damage from flooding, wild fires, drought;
- **compensation costs:** i.e. compensation of losses / damages to people;
- **restoration or repair costs:** e.g. restoring a wetland site for water purification;
- **replacement cost**: e.g. re-creating a habitat elsewhere; and
- **insurance costs:** e.g. cost of insurance coverage to natural hazards.

Box 3.2 Benefits Transfer

Benefits transfer is a pragmatic way of dealing with information gaps and resource (time and money) constraints. The underlying thinking is that there might be sufficient commonalities between different areas (e.g. Natura 2000 sites) and the ecosystem services provided to allow insights from one area to be transferred to another. Naturally, the suitability for using a benefits transfer technique needs to be carefully considered. In this context it is important to assess both the ecological and socio-economic similarities of the two areas.

For example, it could be possible to use insights from existing studies to estimate the value of Natura 2000 sites in regulating air quality. It has been statistically shown that the relationship between exposure to air pollution and incidence of illness is generally similar across peoples across the world. The dose-response relationship established in one country can therefore be applied with some confidence in another country. The main location specific differences that need to be considered include: level of air quality (i.e. how polluted the air is locally), number of people benefiting from air quality (e.g. pollution density, proximity and visitors), and the value of good air quality to the public / society in question (e.g. avoided illness, reduced hospitalisation costs, loss of work output and eventual loss of life expectancy / early mortality). Some of these location specific factors can be addressed relatively easily, e.g. allowing a quantitative assessment of the number of avoided cases of illness and early mortality.

As regard economic estimates, an accepted benefits transfer approach between countries has been, for example, to weight willingness to pay estimates (See Annex 1) by the relative GDP per

capita. Similarly, people's estimated willingness to pay for the protection of a particular animal (e.g. charismatic species such as gorilla, panda or whale) can be transferred between countries also by weighting the new estimate for relative wealth.

3.5 Economic valuation and the risk of double counting

When assessing the economic value of ecosystem services an important issue to bear in mind is the risk of double counting. In short, a Natura 2000 site offers a range of services, some of which are closely related, e.g. maintaining pollination (a regulating service) leads to greater provision of food. Thus, when both of these services are included in a monetary assessment there is a risk that the same benefit be counted twice. The double counting principle is also the reason why supporting services (i.e. the key ecosystem functions forming basis for all other ecosystem services) should not be included in developing aggregate estimates for monetary value of a site (See Chapter 6).

In practice, however, there are often difficulties in obtaining estimates for the monetary value of ecosystem services (e.g. for several regulating services). Therefore, even though caution towards double counting is advised it is rather unlikely for any monetary estimation to overstate the benefits provided by a Natura 2000 site.

It is also to be noted that the provisioning of one ecosystem service may have a negative impact on another (such that they may be inversely related). For example, forests are valuable carbon stores and they can also have value as providing timber or fuel wood. The latter, however, diminishes the value of the former. Careful consideration of the inter-linkages between different services and their changes over time is therefore needed when assessing the overall value of benefits provided a Natura 2000 site.

PART 2: APPLYING THE TOOLKIT

4 STEP 1. A RAPID OVERALL ASSESSMENT OF POSSIBLE BENEFITS

This Chapter introduces a framework for the rapid first-stage assessment of the possible ecosystem services provided by a Natura 2000 site (Table 4.1 below).

The purpose of this rapid assessment framework is three fold. Firstly, it helps to obtain a general view of the full range of services provided by the site, including an initial assessment of their relative importance. Secondly, it gives guidance on how to interpret these first-stage results and communicate them to relevant stakeholders. Finally, the assessment framework helps to identify which ecosystem services could be selected for further in-depth analysis in the context of this Toolkit.

Instructions on how to apply and interpret the rapid assessment framework are provided in Sections 4.1 – 4.2 below. In general, the rapid assessment framework (Table 4.1) includes two types of questions 1) questions aims at guiding your thinking and analysis; and 2) questions you would need to provide a specific answer to.

The questions requiring a specific answer from you are highlighted in orange in Table 4.1.

4.1 Identification and rapid assessment of the services

The information below explains the different columns of the rapid assessment table (Table 4.1) and provides guidance on its completion.

"Ecosystem service" This column lists different categories (provisioning, regulating, cultural & supporting) and types of ecosystem services that could provide socio-economic benefits at Natura 2000 sites (within or outside the sites). Go through these possible services and, for each, ask yourself the following questions.

- **"Does the Natura site provide this service?"** There are a number of possible situations where the service in question is of relevance at the Natura site. These specific key questions help to establish whether a service in question is of actual or potential relevance at the assessed site.

- **"Who benefits from this service"** *This question should be answered by you and it applies generally to the service in question, i.e. there is no need to draw a distinction between Options 1 – 3.* This question aims to broadly identify who are the main beneficiaries of this service, i.e. local (e.g. farmers, local inhabitants and

consumers), regional (e.g. region's water consumers) national (e.g. finance ministries) or global (e.g. international tourists, consumers of an internationally marketed product) stakeholders. This information helps to create a picture of the "benefits flow" from the site to the users and it gives a first indication on which scale(s) the benefits occur. These aspects are important when considering the potential future financing of the site and its services, i.e. assessing whether the beneficiaries of services could support the management efforts (e.g. via payments for environmental services) (*see Section 4.1 for more detailed discussion*).

- **"Significance of this service / service potential"** *This question should be answered by you and it applies generally to the service in question, i.e. there is no need to make a distinction between Options 1 – 3.* Here you are requested to provide your own initial estimate on how important the ecosystem service in question is at your Natura 2000 site (0 = service is not relevant at the site, 1 = service is of very limited significance, 2 = service is of limited significance 3 = service is of moderate significance, 4 = service is of high significance and 5 = service is of very high significance). This estimate follows up from the key questions above and it is mainly based on your own expert opinion and current knowledge of the situation, i.e. only a limited amount of additional research (e.g. data searching and consultation of other relevant experts) is foreseen to be carried out. When developing your own estimate you should consider aspects related to both the "volume" of the service (e.g. amount of water purified by a wetland) and the number of beneficiaries depending on the service. In general, the socio-economic significance of a given service increases with the number of people benefiting from it. Also, the level of dependency of the beneficiaries on the service should be considered, e.g. harvesting forest products might be the most important source of livelihood for a local community even though these activities might be insignificant monetary value to the region.

This initial assessment can then also be used to identify services for more the detailed in-depth assessments in Chapter 5 (*see Section 4.3 below*).

4.2 How to present the results of the rapid assessment

The questions above (Section 4.1) establish an overview of the full range of services provided by the site and they also provide an initial scoping assessment of the relative importance of different services and the scale of which they are provided.

Naturally, this rapid assessment is only a first estimate of the values and socio-economic benefits provided by the Natura 2000 site. Thus, one of its main purposes is to provide a basis for further consideration of the most important services according to the more detailed guidance made available in Chapter 5 (see Section 4.3 below).

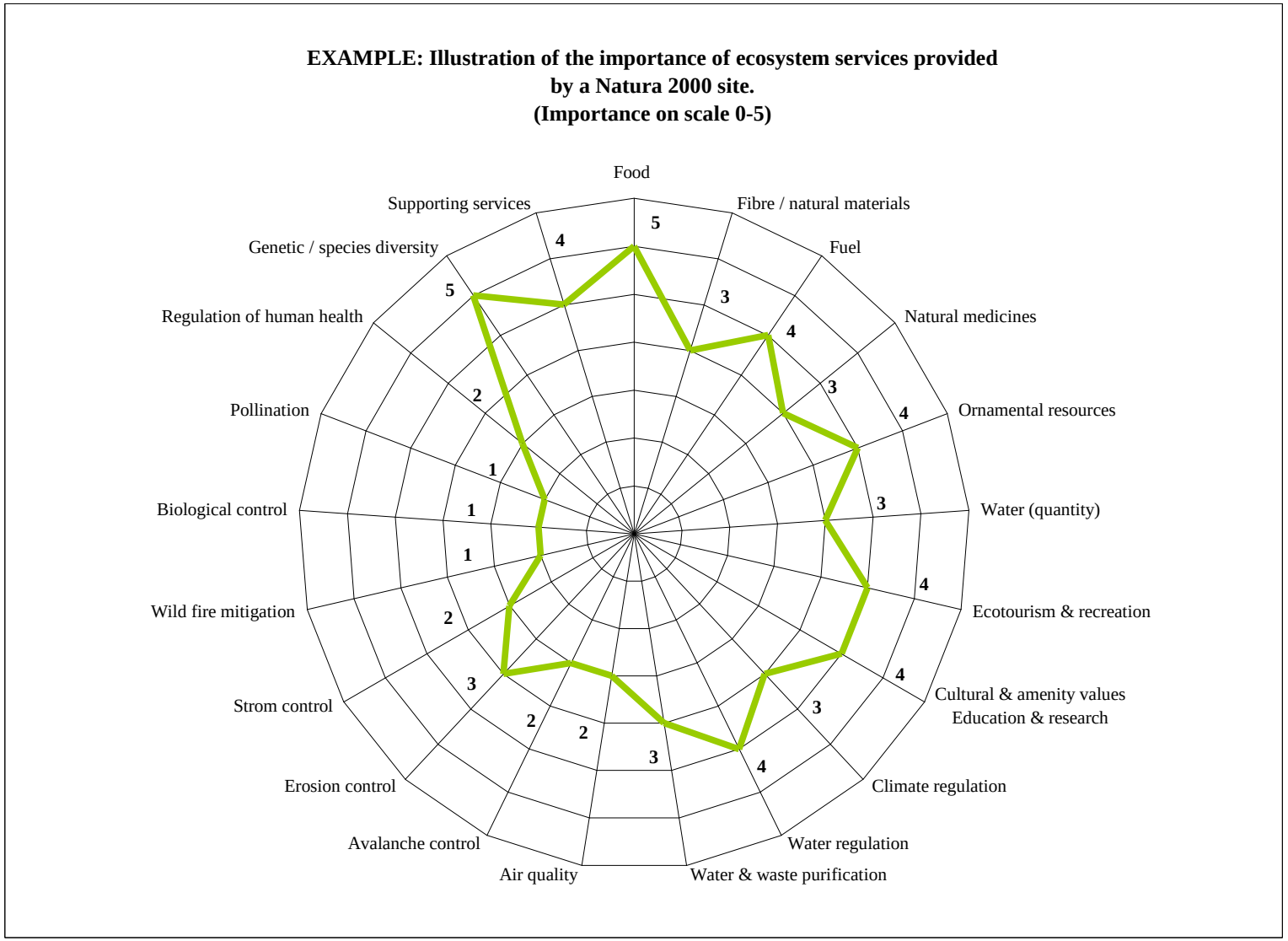
In addition, this initial **assessment might be useful** as a basis or framework for initial discussions with a broader group of stakeholders on the possible socio-economic values associated with the site.

For the purposes of communicating the results of the rapid assessment, a simple **spider diagram format** has been developed to help to visualise the results of the rapid assessment (See Figure 4.1 and Annex 3 for template). The diagram represents the overall importance of the ecosystem services provided by the site (as according to your own estimate). It does not indicate what the prospects for actually capturing that value are.

Note: given that supporting services form a prerequisite for all other services (e.g. the related problems of double counting, *see Section 3.3.3*) these services are considered jointly in the spider diagram.

Furthermore, identifying the scale(s) on which the benefits are received can help to locate the relevant stakeholders benefiting from the service. Insights on the "flow" of services can be further used to explore possible options to maintain different services, e.g. establishing who could / should financially contribute to maintaining appropriate management practices at the site. For example, if the benefits are mainly obtained at the local level then it is likely that the stakeholders most interested in supporting the maintenance of the site and its services can also be found at the local level. Alternatively, if some benefits are of regional or national significance then it could be argued that the maintenance of the site should also be supported by regional and national mechanisms.

Figure 4.1. Example of a spider diagram that can be used as a visual aid for communicating the results of the rapid assessment.



4.3 How to use the rapid assessment for identifying which services to analyse in more detail?

This final step helps to identify which ecosystem services could be selected for further in-depth analysis in the context of this Toolkit (Chapter 5). The information below helps to interpret and fill in the final columns of the rapid assessment presented in Table 4.1.

"Types of evaluation" This question provides an initial indication of what type of value estimates (monetary, quantitative and qualitative) might be available and/or possible to obtain. It also indicates how easy it might be to obtain the different estimates. The valuation methods and value estimates available depend on the current "status" of the service provisioning (Option 1, 2 or 3). For example, monetary estimates are easier to obtain if markets for the service already exist (Option 1). However, if the value of the service is not captured by the markets then monetary estimates are more laborious to obtain (Options 2 and 3). These links between the "service provisioning status" and available methods and estimates are useful to keep in mind as they are likely to have resource implications for further valuation.

Joint consideration of "Significance of this service / service potential" & "Types of evaluation" Given the above, it is advisable to identify the services for more detailed valuation based on 1) their importance (i.e. your own 1-5 estimates under Section 4.1 above) and 2) the feasibility of obtaining the various value estimates. The following general rules of thumb are suggested.

- Estimated significance of the service 4-5: In all circumstances (Option 1, 2 or 3), look into the possibility of obtaining monetary and quantitative value estimates.

- Estimated significance of the service 2-3: Look into the possibility of obtaining monetary and quantitative value estimates if the "provisioning status" of the service is Option 1 or 2.

- Estimated significance of the service 1: Preliminary focus on qualitative estimates, only focus on monetary and quantitative estimates if they are easy to obtain (Option 1).

- Estimated significance of the service 0: Service is not relevant at the site, therefore no further consideration is needed.

Based on these indicative results and advice please continue with more detailed assessment of the services you have selected – as according to the guidance provided in Chapter 5.

Table 4.1 Rapid assessment framework for identifying the ecosystem services provided by a Natura 2000 site. For further instructions see Sections 4.1-4.3 above.

	Ecosystem service	Does the Natura site provide this service?			Who benefits from this service? Local / regional / national / global stakeholders **Your own estimate** (NOTE: no need to distinguish between Options 1-3)	Significance of this service / service potential? **Your own rapid estimate 0– 5** (NOTE: no need to distinguish between Options 1-3)	Types of evaluation possible	
							Easy to obtain	Possible, but laborious to obtain
	Provisioning Services							
Biodiversity resources	**Food** Sustainably produced / harvested crops, fruit, wild berries, fungi, nuts, livestock, semi-domestic animals, game, fish & other aquatic resources etc.	**Option 1.** The **site is a source** for food and these food items **are sold** on the market	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative	
		Option 2. The **site is a source** for food but these food items **are not sold** but used locally for subsistence	YES →	This service **is** of socio-economic relevance at the site			Quantitative Qualitative	Monetary
		Option 3. The **site could be a source** for food but this potential is not used at the moment	YES →	This service **could be** of socio-economic relevance but there is need to create this			Qualitative (potential value)	Monetary Quantitative (potential value)

	Fibre / materials Sustainably produced / harvested wool, skins, leather, plant fibre (cotton, straw etc.), timber, cork etc.	**Options 1, 2 & 3 as above**				
	Fuel Sustainably produced / harvested firewood, biomass etc.	**Options 1, 2 & 3 as above**				
	Natural medicines Sustainably produced / harvested medical natural products (flowers, roots, leaves, seeds, sap, animal products etc.	**Options 1, 2 & 3 as above**				
	Ornamental resources sustainably produced / harvested ornamental wild plants, wood for handcraft, seashells etc.	**Options 1, 2 & 3 as above**				
	Biochemicals & pharmaceuticals The site is a (once-off or continuous) for ingredients / components of biochemical or pharmaceutical products	**Option 1.** The **site is a source** for ingredients / components of biochemical or pharmaceutical products that are developed or under development	YES →	This service **is** of socio-economic relevance at the site		Monetary Quantitative Qualitative

	Option 2. The **site could be a potential / likely source** for ingredients / components of biochemical or pharmaceutical products but there are no such activities yet	YES →	This service **could be** of socio-economic relevance but there is need to create this			Qualitative (potential value)	Monetary Quantitative (potential value)
Water quantity The site is / has in its area an important water reservoir (fresh or sea water)	**Option 1.** The **site is** / has in its area an important water reservoir used by local / regional stakeholders (e.g. municipalities, industries)	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative	
	Option 2. The **site could be** / has in its area an important water reservoir but at the moment this potential is not used. The situation could change, however, depending on the future developments (e.g. climate change)	YES →	This service **could be** of socio-economic relevance in the future			Qualitative (potential value)	Monetary Quantitative (potential value)
Cultural & social services							
Ecotourism & recreation Hiking, camping, nature walks, jogging, skiing, canoeing, rafting, recreational fishing,, animal watching etc.	**Option 1.** The site **is actively used** for tourism and recreation and these **activities create revenue** via entrance fees, accommodation, food, souvenir shops, paid excursions and outdoor activities, permits for sustainable recreational fishing, higher property values around site's recreational possibilities etc.	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative	

	Option 2. The site **is actively used** for tourism and recreation but these **activities do not create revenue** (i.e. the access to the site is free and there are no business related to visiting the site)	YES →	This service **is** of socio-economic relevance at the site			Quantitative Qualitative	Monetary
	Option 3. The site is **not used** for tourism and recreation but there could be a **potential for these activities** (e.g. given investment and promotion)	YES →	This service **could be** of socio-economic relevance but there is need to create this			Qualitative (potential value)	Monetary Quantitative (potential value)
Cultural values and inspirational services, e.g. education, art & research Site is a part of the local / regional environmental education curricula (e.g. school visits, field work assignments) , site is a destination for nature photographers, sites is used for research activities etc.	**Option 1.** The site **is actively used** for education, art and research purposes and these **activities create revenue** via fees paid by schools or research group on the use of site, research project funding, sales from research projects, accommodation for researches, copy rights of commercially used nature photos etc. **Options 2 & 3 as above**	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative	
Landscape & amenity values Amenity of the site, cultural diversity & identity, spiritual values, cultural heritage values etc.	**Option 1.** The site **has cultural & amenity value** and this value plays a role in **creating revenue**, e.g. attracting investments and financial support to culture and affecting property prices	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative	

	Option 2. The site has cultural & amenity value but this **value cannot be connected to revenue**	YES →	This service **is** of socio-economic relevance at the site			Qualitative	Monetary Quantitative
	Option 3. The site has a low current cultural & amenity value but its **profile in creating such value could be raised**	YES →	This service **could be** of socio-economic relevance but there is need to create this			Qualitative (potential value)	Monetary Quantitative (potential value)
Regulating services							
Climate / climate change regulation Carbon sequestration, maintaining and controlling temperature and precipitation	**Option 1.** The site **has** a high carbon sequestration capacity (e.g. forest area) and/or important role in regulating microclimate. There is also some relevant **data available** (amount of wood biomass, carbon capture capacity, estimates for sequestered carbon etc.)	YES →	This service **is** of socio-economic relevance at the site			(Monetary) Quantitative Qualitative	Monetary
	Option 2. The site **has** a high carbon sequestration capacity (e.g. forest area) and/or important role in regulating microclimate but there is **a lack of existing relevant data**	YES →	This service **is** of socio-economic relevance at the site			Qualitative	Monetary Quantitative
	Option 3. Site's current **climate regulation services could be enhanced** via appropriate management and obtaining site's favourable conservation status	YES →	This service **could be** of socio-economic relevance in the future			Qualitative (potential value)	Monetary Quantitative (potential value)

Water regulation Flood prevention, regulating surface water run off, aquifer recharge etc.	**Option 1.** The site **is** important for water regulation on the area, there are **clear beneficiaries** to this and there is also some **relevant data** available (data on flood damages, costs of artificial flood prevention, amounts of ground water, effects of water quantity on fish catch, health costs due to floods etc.)	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative	
	Option 2. The site **is** important but there is **a lack of existing relevant data**	YES →	This service **is** of socio-economic relevance at the site			Qualitative	Monetary Quantitative
	Option 3. The site **does not** play a role in water regulation in the area. The **situation could change**, however, depending on the future developments (e.g. climate change, development of local / regional business and industry) and/or obtaining site's favourable conservation status	YES →	This service **could be** of socio-economic relevance in the future			Qualitative (potential value)	Monetary Quantitative (potential value)

Water purification & waste management Decomposition / capture of nutrients and contaminants , prevention of eutrophication of water bodies etc.	**Option 1.** The site **has** an important function in purifying water and neutralising waste on the area (e.g. wetland sites). This function clearly **benefits some stakeholders** in the area (e.g. municipalities' water purification plants, businesses dependent on clear water etc.) and there is relevant **data available** (replacement costs for water purification, effects of water quality on aquaculture and fishing, wetland restoration costs etc.) **Options 2 & 3 as above**	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative
Air quality regulation Removal of pollution and atmospheric particles by forest canopy	**Option 1.** The site **has** an important function in maintaining air quality in the area (e.g. forest). This function clearly **benefits some stakeholders** and there is relevant **data available** (amount of pollution absorbed by trees, replacement costs for air purification, air pollution related health costs etc.) **Options 2 & 3 as above**	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative

Erosion control Maintenance of nutrients and soil cover and preventing negative effects of erosion (e.g. impoverishing of soil, increased sedimentation of water bodies(	**Option 1.** The site /appropriate management of the site (e.g. intensive use prohibited) **has** an important role in preventing erosion in the area. This function clearly **benefits some stakeholders** and there is relevant **data available** (area protected from erosion, costs of maintaining soil quality with fertilizers, reduction of production due to erosion, cost of removal sediments from water bodies etc.) **Options 2 & 3 as above**	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative
Avalanche control Preventing / mitigating damage by avalanches in mountain regions	**Option 1.** The site /appropriate management of the site (e.g. intensive use prohibited) **has** an important role in preventing avalanches in the area. This function clearly **benefits some stakeholders** (forest owners, ski centres etc.) and there is relevant **data available** (area protected from avalanche, costs of avalanche damage, costs of artificial avalanche protection etc.) **Options 2 & 3 as above**	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative

Storm damage control Preventing / mitigating damage by hurricanes or large waves in coastal zones / along fresh water bodies	**Option 1.** The site /appropriate management of the site (e.g. intensive use prohibited) **has** an important role in preventing storm damages in the area. This function clearly **benefits some stakeholders** (coastal aquacultures, fisheries and agriculture, tourism activities and tourist resorts etc.) and there is relevant **data available** (area protected from damage, costs of storm damage, costs of artificial protection, restoration of natural storm protection etc.) **Options 2 & 3 as above**	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative
Wild fire mitigation Preventing wildfires and regulating fire intensity	**Option 1.** The site /appropriate management of the site (e.g. the site's fire resistant vegetation cover) **has** an important role in fire prevention in the area. This function clearly **benefits some stakeholders** (forest owners, municipalities, propriety owners etc.) and there is relevant **data available** (costs of fire damage, costs of fire prevention and fighting, health costs and casualties due to fires, restoration costs etc.) **Options 2 & 3 as above**	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative

Biological control Maintenance of natural enemies of plant and animal pests, regulating the populations of plant and animal disease vectors etc.	**Option 1.** The site /appropriate management of the site (e.g. intensive use prohibited) **has** an important role in maintaining natural biological control in the area. This function clearly **benefits some stakeholders** (forest and agricultural activities etc.) and there is relevant **data available** (damage by pests, costs of replacing natural control by pesticides etc.) **Options 2 & 3 as above**	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative
Pollination Maintenance of natural pollinators and seed dispersal agents (e.g. birds and mammals)	**Option 1.** The site /appropriate management of the site (e.g. intensive use prohibited) **has** an important role in maintaining natural pollinators and seed dispersal agents in the area. This function clearly **benefits some stakeholders** (crop production etc.) and there is relevant **data available** (reduction in yields due to lack of pollinators, costs of artificial pollination or forest regeneration (e.g. oak forests) etc.) **Options 2 & 3 as above**	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative

Regulation of human health (physical and mental) Regulation of vectors for pathogens, supporting mental and physical health by creating setting for outdoor activities	**Option 1.** The site **has** an important role in regulating / supporting human health in the area and there is relevant **data available** on the created benefits (costs of treatment / prevention of illnesses in the absence of the service, estimates on the role of nature and green areas in reducing stress etc.) **Options 2 & 3 as above**	YES →	This service **is** of socio-economic relevance at the site			Monetary Quantitative Qualitative
Genetic / species diversity maintenance Protection of local and endemic breeds and varieties, maintenance of game species gene pool etc.	**Option 1.** The site hosts a population of **local / endemic breed or variety** of crop / livestock or it plays an important role in maintaining (genetically) **healthy populations of species** (game species, pollinators, natural enemies of pests etc.) in the area. There is relevant **data available** on the created benefits (increased yields due to use of different breeds, cost of conservation of local breeds, revenues from specific products from specific breeds etc.)	YES →	This service **is** of socio-economic relevance at the site			(Monetary) Quantitative Qualitative Monetary
	Options 2. The site plays a role in maintaining genetic and species diversity in the area but there is **a lack of existing available data**	YES →	This service **is** of socio-economic relevance at the site			Qualitative Monetary Quantitative

	Options 3. The site's role in maintaining genetic and species diversity in the area is likely to **increase in the future** due the effects of climate change, habitat degradation, fragmentation etc. The diversity also increases the resilience of ecosystems and their ability to adapt to changing conditions.	YES →	This service **could be** of socio-economic relevance in the future			Qualitative (potential value)	Monetary Quantitative (potential value)
Supporting services – These services are the fundamental ecosystem processes and they form the basis for all other services above. Therefore, they are of relevance at all sites. Given the above, estimating specific quantitative and monetary values for this service is difficult and it often leads to problems with double counting (*See Section 5.2*). Nevertheless, when discussing the value of ecosystems, e.g. Natura 2000 sites, it is also important to systematically highlight the role of these fundamental services. Some guiding considerations are provided below to identify situations where a supporting service might be of specific significance. **Note**: The list below includes only some of the most prominent supporting services. It should not be considered as an exhaustive list of all key ecosystem processes.							
Primary production	The site is a significant source of sustainably produced / harvested biological resources or it has a high carbon sequestration capacity. Thus, production of biomass plays an important role at the site.	YES →	This supporting service is of specific importance, thus it merits specific consideration.			Qualitative	Monetary Quantitative

Nutrient cycling and decomposition	The site plays an important role in providing provisioning & regulating services closely dependent on ecosystem's ability and capacity to decompose organic material, e.g. water purification, waste management. The site is a significant source of sustainably produced / harvested biological resources or it has a high carbon sequestration capacity. Thus, nutrient cycling supporting production of biomass plays an important role at the site.	YES →	This supporting service is of specific importance, thus it merits specific consideration.		Qualitative	Monetary Quantitative
Water cycling	The site is an important water reservoir or plays an important role in regulating the flow of water on the area. Thus, processes related to water cycling are of high significance.	YES →	This supporting service is of specific importance, thus it merits specific consideration.		Qualitative	Monetary Quantitative

Ecological interactions	The site hosts a high number of species and habitats and this results in a high rate of ecological interactions at the site. The complexity and diversity of these ecological interactions is considered fundamental for the characteristic functioning of site's ecosystem(s), thus securing the provisioning of its services.	YES →	This supporting service is of specific importance, thus it merits specific consideration.			Qualitative	Monetary Quantitative
Evolutionary processes	The site plays an important role creating variations within or among species and ecosystems, e.g. by functioning as an important refuge / steppingstone / corridor in fragmented landscape, thus helping to maintain a healthy gene flow within species.	YES →	This supporting service is of specific importance, thus it merits specific consideration.			Qualitative	Monetary Quantitative

5 STEP 2. GUIDANCE TO ESTIMATING DIFFERENT NATURA 2000 RELATED BENEFITS

This chapter, i.e. Step 2 or this Part 2 of the Toolkit, provides detailed guidance to estimating the value of different Natura 2000 related ecosystem services and other possible socio-economic benefits. It is a continuation of the overall rapid assessment of Natura 2000 related ecosystem services carried out in Step 1.

Chapter 5 consists of the following sections. The guidance provided by different sections can be used independently depending on the specific interest of the user.

Section 5.1. Biodiversity resources
Section 5.2. Water provisioning
Section 5.3. Biochemicals & pharmaceuticals
Section 5.4. Ecotourism and recreation
Section 5.5. Cultural, landscape & amenity values and inspirational services
Section 5.6. Climate regulation
Section 5.7. Water regulation (e.g. flooding, aquifer recharge)
Section 5.8. Water purification & waste management
Section 5.9. Air quality regulation
Section 5.10. Erosion regulation
Section 5.11. Avalanche regulation
Section 5.12. Storm damage control
Section 5.13. Wild fire mitigation
Section 5.14. Biological control
Section 5.15. Pollination & seed dispersal
Section 5.16. Human health
Section 5.17. Maintaining genetic & species diversity
Section 5.18. Supporting services
Section 5.19. Wider socio-economic benefits

Note: the users of this Toolkit do not need to familiarise themselves with all sections of this chapter. Instead, they should proceed directly to the sections most relevant to their site.

For each service category (i.e. section) the following aspects are discussed:

What is this service? This part of each section briefly introduces the service in question and summarises why it has socio-economic value. In this context, a number of relevant insights, e.g. on ecosystem functioning, are given to help to understand the "nature" of this service and further determine whether it is relevant to the Natura 2000 site in question. It also considers who is responsible for maintaining the service and who the possible stakeholders benefiting from it are? In addition, it also provides some general insights on which Natura 2000 sites this service might be of potential relevance to.

How to estimate the value of this service? This part of each section aims to provide information on the key estimates that could be obtained and used to demonstrate the value of Natura 2000 related services (e.g. qualitative, quantitative and monetary estimates). The possible estimates focus specifically on values considered feasible to be obtained by practitioners, such as site managers and other interested stakeholders. A number of concrete examples of different estimates are also provided. A general introduction to these standard methodologies can be found in Annex 1. Annex 1 also gives examples on a number of more complicated economic valuation methods that could be applied for estimating the value of ecosystem services. These are, however, mainly for information purposes and to give some ideas of the possibility of carrying out wider and more detailed valuations in the future.

How can the estimated value be turned into real money? This part of each section gives some preliminary thoughts and insights on how the estimated value of different services could help to attract financial support for a site. Even though these considerations remain at a rather general level it is hoped that they will help to create some ideas and encourage interested practitioners to think about different funding opportunities.

Based on the indicative results of the rapid overall assessment of the site (Step 1, Chapter 4) please proceed considering the services that are of specific importance at your Natura 2000 site (presented in Sections 5.1-5.19).

For an overview of different valuation methodologies mentioned in this Chapter please consult Annex 1.

5.1 Provisioning: Biodiversity resources

What is this service?

Provisioning of biodiversity resources consist of the following:

- crops and livestock (extensively[2] produced);
- marine and inland fisheries (e.g. aquaculture and recreational fishing, marine fisheries);
- wild animal products / game;
- plant fibre (e.g. timber, grass for livestock, cork);
- plant (and animal) fuel (e.g. fire wood, dung, energy crops);
- ornamental plant and animal products (e.g. garden plants and seeds, cut flowers, wild pets, etc.); and
- medicinal plants

These resources can either be produced at or outside the site. In the latter case, the Natura 2000 site plays an important role in contributing to the provisioning of these resources even though the actual harvesting of these resources takes place outside the site. This could be the case, for example, when a Natura 2000 site functions as an important refuge or breeding place for fish or game species.

In the modern world the provisioning of biodiversity resources is heavily influenced by human, activities and inputs (i.e. "non-natural" manipulations of the ecosystem), including establishment of monocultures, use of fertilizers and pesticides, irrigation etc. Thus, when talking about provisioning of biodiversity resources as an ecosystem service the focus should, in principle, be on the **contribution / role of "real" nature and natural ecosystems** in supplying the goods in question. For example, wild animal products, marine and inland capture fisheries, wild timber, natural flowers and seeds, and natural grassland grass (for grazing) are benefits provided by / dependent on natural ecosystems. Also, in some ecosystems a certain level of human activity is required to maintain its biodiversity (e.g. the extensively farmed High Nature Value pastures). Therefore, in the context of this Toolkit

[2] i.e. As opposed to intensive farming, e.g. extensive farming uses no or limited amount of fertilizers and other inputs.

biodiversity resources provided by these kinds of semi-natural ecosystems are also considered as ecosystem services. However, crops, livestock products and timber from heavily cultivated systems cannot be, by definition, considered as genuine ecosystem services. In the latter case, however, the contribution of wild nature is indirect, taking place through natural processes that are necessary for the production of goods, e.g. pollination, biological control of crops, regulation of erosion and maintenance of soil quality for crops. The value of these regulating and supporting services is dealt with in the latter sections of this Chapter.

Closely linked services you should also look into: regulating and supporting services maintaining production, e.g. pollination, biological control, regulation of erosion. These services are addressed in Sections 5.6 – 5.17.

Why is this service valuable?

The provisioning of biodiversity resources is one of the ecosystem services most heavily used by humans. These resources are used both for subsistence and they also form a basis for our local and global economies. They can be either used and/or sold as such (e.g. unprocessed food, fire fool, seeds, natural cut flowers etc.) or they form a basis for several further processed products (e.g. processed food and fuels).

It is to be noted that, in general, the current benefits (monetary benefits in particular) obtained from biodiversity resources around the world do not often reflect sustainable extraction or production patterns. For example, marine capture fisheries and several wild timber species are known to be heavily overexploited. Similarly, intensive extraction of biodiversity resources, such as the production of crops and livestock and extensive logging, also often degrades several other ecosystem services, including ecosystems' ability to control soil erosion and surface water runoff. Thus, when considering and assessing benefits arising from biodiversity resources in the context of this Toolkit the key issue is to consider their value under sustainable production and/or extraction.

Also, the importance of different biodiversity resources varies between geographic areas and stakeholders. In general, it is known that wild products and the role of natural processes in sustaining crop and livestock production are more important in rural areas inhabited by people with low incomes. This is because people with low incomes have very limited means and resources to replace ecosystem services with viable alternatives, e.g. to compensate for a decrease in soil quality through input of fertilizers. Therefore, any assessments of benefits arising from biodiversity resources should consider the relative importance and value of these resources to their users. For example, the monetary value of non-timber products (NTPs) might be next to nothing in comparison to extraction of timber, however the NTPs might be invaluable for a group of specific beneficiaries who are heavily dependent on them.

Who maintains this service & who benefits from it?

Natura 2000 land users (e.g. farmers, foresters or other landowners and stakeholders) are the key parties maintaining the provisioning biodiversity resources. They can be responsible for actively cultivating a resource on the site (e.g. producing sustainably managed crops and livestock) or their role can be more related to securing the overall management of the site that

in its turn maintains production of resources within or outside the site (e.g. wild fish, berries, mushroom and game).

The possible beneficiaries of biodiversity resources are various ranging from local to regional, national and international level. Examples of these beneficiaries are given in the Table 5.1.1 below.

Table 5.1.1. Some examples of service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers / foresters Landowners	Individuals, e.g. land users themselves	Local (Regional)	Sustainable production of goods for own use or for sale (e.g. crops, cultured fish, livestock, wood for fuel) Sustainable collection / catch of goods for own use or for sale (e.g. berries, fish, mushrooms, wild flowers, wood for fuel)
	Different businesses & industries (small / large)	Local Regional (Global)	Raw materials, e.g. cork for wine industry, game meat for restaurants and shops, and sustainably produced timber for crafts / furniture
	Consumers	Local Regional (Global)	Purchase of several sustainably produced goods, e.g. timber, crops, honey.
	Governments & administration	Local Regional (Global)	Support of Natura 2000 sites in maintaining food supply and security

Which Natura 2000 sites provide this service?

The majority of Natura 2000 sites can benefit human wellbeing by supplying biodiversity resources. Naturally, the type of resource depends on the site in question. For example, forest sites play a key role in providing game, wild berries, mushrooms, skins, leather, timber, cork, natural medicines and wood for handicrafts. On the other hand, grassland areas are important for maintaining semi-wild livestock (e.g. reindeer), providing grass for livestock and hosting wild plants. Marine, coastal and inland water sites are sources for fish and other aquatic resources whereas bog lands and marshes can be an important source for wild berries, plants and natural medicines.

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

Quantitative and qualitative data on possible biodiversity resources provided by Natura 2000 sites is often available including, for example, information on the general importance, volume and quantity of a resource in question. This information can provide an easy way to demonstrate and promote the socio-economic values of a site and it also forms a basis for further monetary valuation.

Available or easily accessible qualitative and quantitative value estimates could include, for example:

- reviews of the general importance of a biodiversity resource (e.g. collecting information on existing similar examples elsewhere);
- amount / volume of biodiversity resource collected;
- number of people / households dependent / collecting the resource;
- number of visits to collect the resource;
- time used to collect the resource;
- number of jobs created by cultivating / extracting the resource;
- number of jobs otherwise dependent on the resource;
- number of licences sold for accessing the resource (e.g. for fishing);
- number of households or factories dependent on the resource for their subsistence or livelihood; and
- amount of biodiversity resource used by industries / households.

Monetary value estimates

<u>Market price of the service</u>

Biodiversity resources are tangible goods that are frequently traded in an established market. Therefore, values based on observed or estimated market prices are often available, unlike with several other ecosystem services. In general, the market price method uses the price of biodiversity resources that are bought and sold in commercial markets as an indicator of their socio-economic value. Box 5.1.1 provides some examples on the market value of biodiversity resources.

The available market prices do not necessarily reflect how sustainably the resource has been extracted / cultivated (unless certification schemes are implemented). Therefore, any market prices used as an indication of biodiversity related socio-economic benefits of Natura 2000 should be, in principle, based on sustainable production / extraction of the resource in question.

The market price of a given biodiversity resource provided by a Natura 2000 site can be estimated by the steps outlined below.

- **Step 1**: Find out what is the price and quantity of the biodiversity resource / goods sold.
- **Step 2:** Assess the costs of producing the marketed resource / goods. This helps you to estimate the actual value of the biodiversity resource (i.e. market price = value of biodiversity resource + costs of production).
- **Step 3:** The estimated value of your biodiversity resource based on market price = quantity of sold resource x unit price – costs related to production.
- **Step 4:** Market prices might be affected by a monopoly, government intervention, taxes, subsidies etc. In this case, this should be noted and, if possible, the prices should be corrected for any distortions.

Important to consider: The estimated potential market value could be higher than the current selling price on the market. Therefore, assessing consumer's willingness to pay (WTP) for a good could be used to explore potential markets for new biodiversity resources, such as sustainably produced (e.g. eco-labelled or "Natura 2000 branded") fuel, timber etc. Estimating WTP could be done based on contingent valuation methods, see Annex 1 for more details and "*How can the estimated value be turned into real money*" below.

Costs of replacing the service or costs of avoided damage

The costs of losing or replacing the biodiversity resource in question or finding an alternative for the resource can be used as an estimate for its value. In addition, the loss of income foregone due to the loss of service could also be used as an indication for the value. Box 5.1.1 provides some examples of these value estimates.

In the case of provisioning services, the cost based methods are often used when no market prices for biodiversity resources in question are available, e.g. in the case of non-timber products collected for household use. Some examples of costs based methods are listed below.

- **Opportunity costs**: calculating the time spent for collecting fuel wood or wild products and estimating the monetary value of that time based on, for example, average wages in the area.
- **Costs of replacement**: estimating costs of replacing food, fuel etc. by exports of the same good or replacing it by a different alternative (such as replacing herbaceous biomass for grazers with synthetic food).
- **Costs of alternative**: estimating costs of purchasing / transporting biodiversity resource outside the area.
- **Costs of loss**: costs of losing the biodiversity resource, e.g. costs for businesses and industries dependent on it.

The application of a cost based approach requires data on the likely alternative. In several cases, e.g. in the case of defining the opportunity costs in terms of time spent (above), this might require collecting some previously unavailable information via surveys or questionnaires.

Box 5.1.1. Examples of valuing biodiversity resources

Market values of biodiversity resources

The value of grassland supporting livestock production on opuntia scrublands of Ayacucho, Peru was estimated as 235.57 Nuevas soles / ha / year (i.e. about 56 EUR / ha / year). This was done by estimating the contribution of grass feedstock in annual livestock profits (i.e. value of grass = annual livestock profits x the proportion of grass in the total feedstock intake by cattle) (Rodrigues et al. 2006).

The value of fish production dependent on the forested area of Leuser National Park on Sumatra, Indonesia was estimated as US$ 33 million / year (in 2000). Deforestation was expected to reduce this value by an annual rate of 1 per cent, consequently prices for fish were expected increase by 0.5 per cent annually (Van Beukering, P. J. H. et al. 2003).

Cost based estimates

The value of time spent in collecting non-market wild food products by the communities of Thung Yai Naresuan Wildlife Sanctuary, western Thailand was estimated to be 7005 min / household / year. This equals to opportunity costs of 1168 Baht / year (based on 10 Baht / hour wage) (Deland 2006)

In Israel, the value of replacing natural biomass by alternative livestock food source was estimated to cost 116.5 $ / ha / year for sheep and 83.23 $ / ha / year for cattle (Fleischer & Sternberg 2006).

How can the estimated value be turned into real money?

Biodiversity resources are often sold on the open market, i.e. they already have value in terms of "real money". However, there can be possibilities to either 1) increase the market value of an already sold biodiversity resource or 2) create markets for new biodiversity products.

Increasing the existing market value: The existing price of biodiversity resources / goods might not be as high as it could be. For example, buyers might be willing to pay a premium for a product that has been sustainably produced and that helps to support the management of a valuable Natura 2000 site. In this case, a survey of the buyers' willingness to pay (e.g. a questionnaire addressing the customers of a local shop selling the product) might help to increase the value of the product. In addition, there might be a possibility to increase the demand for existing products via their promotion and certification.

Creating markets for new products: There might be a possibility to create markets for new biodiversity resources, such as sustainably produced (e.g. eco-labelled and certified) biofuel or timber etc. Also in this case willingness to pay estimates (WTP) (see Annex 1) could be used to assess the potential value of a new product. While exploring the possibility for new markets one should also consider existing possibilities for using public / private funds to support the creation of markets for sustainably produced goods, e.g. available funding instruments to support eco-labelling. For example, according to a recent WTP study, estimates of the additional value of eco-label products ranged between 7.5 per cent - 16 per cent of the price of an unlabelled alternative in UK and 2 - 6 per cent in Norway, depending on method used (Veisten 2007).

For example, a number of EU projects funded by the EU Financial Instrument for the Environment (LIFE) have focused on "Natura 2000 branded" products (see Box 5.1.3)[3].

In both cases it is important for those providing the service, e.g. Natura 2000 site managers, farmers and land owners, to establish who the actual and/or potential beneficiaries of the service are (See Table 5.1.1). This is the key for increasing or establishing new markets for biodiversity resources.

Box. 5.1.2 Examples of LIFE projects supporting Natura 2000 related products

- Production of "bear friendly" branded cheese: a LIFE project (LIFE04 NAT/IT/000144) aimed to conserve bears and wolves in France, Italy and Spain promotes cheese produced by farmers supporting the conservation initiatives.
- Production of "pasture-fed cattle" branded meat: a LIFE project (LIFE02 ENV/FIN/000319) in region of Salo, south-west Finland supported the promotion of pasture-fed cattle meat produced by farmers protecting and maintaining Natura 2000 meadows.
- Production of local beer by using a plant from Natura 2000 site: a LIFE project (LIFE04 NAT/B/0010) supported the brewing of local beer on the wet heathlands of De Liereman, Belgium as this beer was produced by using a plant growing on the site.
- Production of mushrooms: a LIFE project (LIFE00 ENV/E/000402) in Navarra, Spain supported ecotourism focused on the collection of mushrooms.

Source: Natura 2000 Newsletter (no 24) (July 2008):
http://ec.europa.eu/environment/nature/info/pubs/docs/nat2000newsl/nat24_en.pdf

[3] More detailed information on the use of current EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online:
http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.2 Provisioning: Water

What is this service?

Ecosystems, e.g. forests and wetlands, play an important role in the hydrological cycle including regulating the provisioning of water, i.e. "capturing" quantities of water for human or other use (including both surface and ground water). For example, a Natura 2000 site can harbour an important water reservoir in its area (e.g. support a ground water aquifer or an important fresh water reservoir used by local municipalities). Alternatively, a Natura site can play a key role in maintaining the water quantities in surrounding areas, e.g. by maintaining vegetation cover that prevents rain water runoff and helps to recharge ground water reservoirs during wet / rainy periods[4].

In the context of biodiversity conservation, water provisioning as an ecosystem service often refers specifically to the contribution of an ecosystem's biotic "components" in supplying (quantities of) water. However, the total quantity of water available is also affected by a number of abiotic attributes, such as topography, temperature etc. It is often difficult to specify what proportion of fresh water supply is related to biodiversity as such. Therefore, total quantities of water provided by an ecosystem are often used as an estimate for the value of this service. In the purest sense, however, these total quantity values might need to be considered as slight overestimates of the actual biodiversity value.

Important to consider: In general, all ecosystems use water, e.g. water is required for photosynthesis to take place. Consequently, vegetation cover inherently reduces fresh water quantities and the quantity of water taken up by vegetation increases, for example, when moving from grassland to forest ecosystems. Therefore, the role of Natura 2000 sites in supporting fresh water provisioning (i.e. supplying quantities of water) needs to be always carefully considered, based on site-specific characteristics and detailed information on an area's water cycle.

Closely linked services you should also look into: provisioning of water; water purification and waste management. These services are addressed in Sections 5.7 and 5.8 below.

[4] Current evidence on wetlands suggests that ecosystems do not necessarily help in providing a reserve of water during dry periods (Bullock & Acreman 2003).

Why is this service valuable?

Water is a fundamental resource for maintaining human wellbeing and it has manifold value to our society. This includes, for example, water used for human consumption (e.g. fresh water), water for industry and businesses (e.g. cooling water for machinery, water required for production processes, water for irrigation of crops and for livestock, water for electricity production (e.g. amount of water in rivers used for electricity production), and water required for recreation, leisure and tourism (e.g. natural lakes and ponds favoured by tourists). In general, agriculture and irrigation practices are one of the biggest users on water resources in Europe (UNEP 2004). It has been estimated that agriculture accounts for approximately 30 per cent of total water abstraction and about 55 per cent of water use in Europe.

Who maintains this service & who benefits from it?

As in the case of biodiversity resources, Natura 2000 land users (e.g. farmers, foresters or other landowners and stakeholders) are the key parties in maintaining the service as the appropriate management of the site can be essential in maintaining the ecosystem's ability to provide water. The possible beneficiaries of water resources range from local to regional and national level (see Table 5.2.1 below and also Figure 5.2.2 above).

Table 5.2.1. Some examples of service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers / foresters Landowners	Individuals, e.g. land users themselves	Local Regional, e.g. crossborder	Maintaining water supply for individual use, e.g. water for household, irrigation, water for livestock.
	Different businesses & industries (small / large)	Local Regional, e.g. crossborder	Maintaining water supply for the use by industries, e.g. water for cooling down the machinery, water for production processes Availability of renewable electricity based on hydropower
	Electricity sector	Local Regional, e.g. crossborder	Potential for hydropower
	Consumers	Local Regional (Global)	Purchase of material and goods that require water for their production process. Availability of renewable electricity based on hydropower
	Governments & administration	Local Regional, e.g.	Support of Natura 2000 sites to maintaining energy security

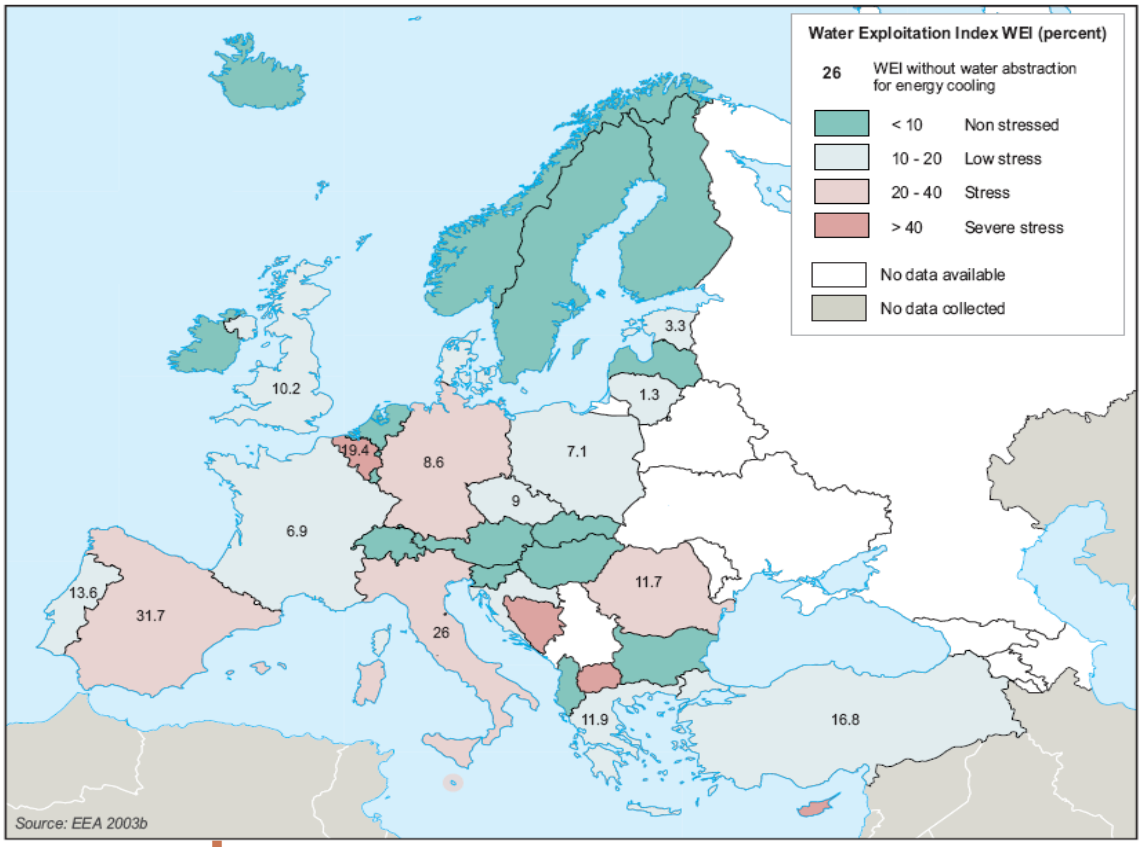
		crossborder	(hydropower)

Which Natura 2000 sites provide this service?

Several Natura 2000 sites support the provisioning of water and, as noted above, considering a site's biotic and abiotic characteristics and its role in the local / regional hydrological cycle is important. For example, natural ecosystems can provide benefits in terms of water provisioning when the alternative vegetation cover would use more water that the existing one. This is the case, for example, when protecting grassland Natura 2000 sites from abandonment and related forestation. Similarly, invasive alien plants are often intensive users of water and therefore the value of native vegetation, as protected by a Natura 2000 site, in providing water can be significantly higher than its non-native substitute. Similarly, wetlands can play a role in recharging water reservoirs during rainy / wet periods. However, according to a recent study they do not necessarily help in providing a reserve of water during dry periods (Bullock & Acreman 2003).

In general, value of water (e.g. ecosystems' value to retain it) increases with increasing water demand and scarcity. Therefore, Natura 2000 sites that have a proven water retention capacity and are located in these high demand / scarcity regions could have a particularly significant value in maintaining water supply in the area. For example, the amount of water used for irrigation in Italy and Spain is about 10 times higher than in the central EU countries combined. France, Greece and Portugal each use about the same amount of water for irrigation as central EU countries (UNEP 2004). Given high temperatures and high evapotranspiration these countries are also among the ones most affected by droughts. Figure 5.2.1 shows the water exploitation index (WEI) for Europe (UNEP 2004). WEI is the mean annual total demand for freshwater divided by the long-term average freshwater resources. It gives an indication of how the total water demand puts pressure on the water resource.

Figure 5.2.1. Water exploitation index for Europe.



Source: UNEP 2004

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

Quantitative and qualitative data on local and regional water supply is often available including, for example, information on the general importance, volume and quantity of water. This information can provide a useful means to demonstrate and promote the socio-economic values of a Natura 2000 site, given the site's role in maintaining water balance can be demonstrated (e.g. based on existing studies on area's hydrology).

Available or easily accessible qualitative and quantitative value estimates could include, for example:

- reviews of the general importance of water in the area (e.g. collecting information on existing similar examples elsewhere);

- amount / volume of water used on the area / by households, different sectors etc.;
- reduction in the amount of water available for irrigation, households, hydropower etc. due to deforestation;
- number of people / households dependent on sustainable water supply; and
- number of companies and jobs dependent on sustainable water supply.

Monetary value estimates

Market price of the service

The market price method for assessing benefits of fresh water supply can be based on the value of water as such or the value of other market goods clearly dependent on the availability of water.

Potential market price estimates illustrating the value of water provisioning could include, for example:

- price for water (m^3) (for example, see Figure 5.2.3);
- value of (fully or mainly) irrigated crops;
- value of fish catch;
- price for hydroelectric energy; and
- value of water transport, e.g. passenger or trade of goods.

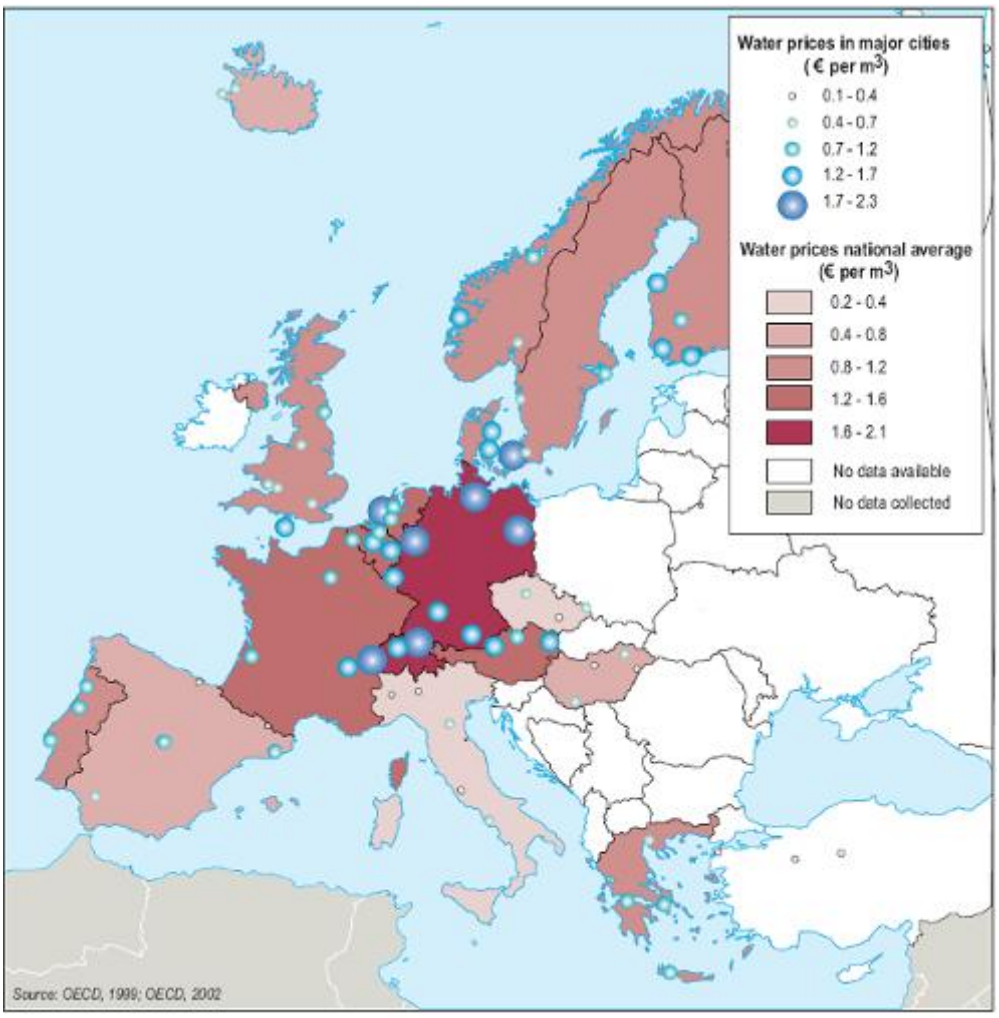
As with biodiversity resources, the observed prices are not purely related to water resource but they also encompass different production related costs, e.g. costs of infrastructure and maintenance. If possible, these production related costs should be excluded from the final estimate.

Similarly, market prices for water might be affected by monopoly, government intervention, taxes, subsidies etc. In this case, this should be noted and, if possible, the prices should be corrected for the distortion. For example, if the existing market value for water is subsidised by the government or local / regional authorities (i.e. kept "artificially" low to support the economic sectors depending on it) it might not reflect the real value of the resource. In this case, it should be highlighted that the real market value of water resource would actually be even higher than the observed price.

Important to consider: In principle, when using the market price of water or "water dependent goods", the role of Natura 2000 in maintaining water quantities in the area, e.g. in supporting the freshwater reservoirs, needs to be clearly demonstrated. In addition, there needs to be a clear interdependency between the supply of considered goods (e.g. irrigated crops) and availability of water.

In addition, the market price for ground water often integrates other ecosystem service values, such benefits related to water purification and water supply (Sections 8.7 and 8.8). It is often difficult to tease apart contributions from these individual services, therefore the market price based value estimates often reflect the value of a bundle of water related ecosystem services.

Figure 5.2.3. Water prices in Europe (Data from 1998 for city water prices, and from 1996 for national average water prices)



Source: UNEP 2004

Costs of replacing the service or costs of avoided damage

The costs of losing or replacing natural water supply or finding an alternative for it can be used as an estimate for its value. In addition, opportunity costs, i.e. loss of income foregone due to the loss of water supply, can also be used as an indication for the value. Box 5.2.1 provides some examples of these value estimates.

The cost based value estimates for water provisioning can, for example, include:

- **costs of replacement**: estimating costs of replacing natural water supply by a different alternative (such as constructing artificial ground water aquifers);
- **costs of alternative**: estimating costs of purchasing / transporting water outside the area; and
- **costs of loss**: losing fish catch or crop yield due to lack of water supply.

Important to consider: As above, the role of Natura 2000 sites in maintaining water quantities in the area needs to be clearly demonstrated and there needs to be a clear

interdependency between the supply of considered goods (e.g. irrigated crops) and availability of water. In any case, cost based estimates are only a proxy, thus they can over- or underestimate the real value of a service.

Box 5.2.1 Examples of valuing water supply

Cost based estimates

WWF (Schuyt and Brander 2004) estimated the global value of fresh water provision in wetlands, on the basis of a statistical synthesis (meta analysis) of 89 selected wetland sites. This was €60.2/ha, in 2008 prices (as in Braat et al. 2008).

A study from the island of Sumatra estimated that the decline in water quantity due to deforestation caused 2 per cent increase in costs to electricity supply (Van Beukering 2003).

Property price based estimates (see Annex 1 for more detailed explanation of the method)

A study valuing services provided by urban wetlands of the Gnangara Mound in Western Australia (e.g. supply of ground water) observed that one meter increase of distance from wetland decreased property prices in the area by AU$ 463. The study also noted that the added value of second wetland within 1.5 km of the property increased the property price by 6081AU$. (Tapsuwan et al. 2007)

How can the estimated value be turned into real money?

In areas where the value of Natura 2000 sites in maintaining natural water balance can be clearly demonstrated (e.g. with evidence on an area's hydrological cycle) there could be a potential for obtaining financial support for preserving the site.

The questions listed below could give initial ideas to identify some possibilities for concrete funding.

- Who uses water resources in the area? Are some of these users clearly dependent on the water supply supported by Natura 2000 site (see "*Who maintains this service & who benefits from it?*" above)?
- What kinds of mechanisms exist / could be used to engage these beneficiaries in financing the management of the site so that the natural water supply is maintained?
- What are the possibilities for using existing public / private funds? For example, the EU funding instruments, e.g. Structural Funds, could support actions aiming to address environmental risks such as drought.[5]
- Is there a scope for advocating the use of market based mechanisms? For example, could local industries, farmers or municipalities depending on the water supply from a Natura 2000 area be requested to pay for maintaining / managing the site (i.e. establishing a system for payment for environmental services (PES))?

[5] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.3 Biochemicals & pharmaceuticals

What is this service?

What is this service and why is it valuable?

Biodiversity provides an important source for the development of new medicines, cosmetics and biochemicals. For example, a discovery of a new biochemical compound can lead to the development of a drug or biochemical product based on the natural compound itself or alternatively a synthetic compound can be developed based on the natural blueprint.

According to recent assessments altogehter 50,000 to 70,000 plant species are used for traditional and modern medicine (Schippmann et al. 2006). For example, in some Asian and African countries, up to 80 per cent of the population depends on traditional medicine for primary health care (World Health Organization 2008). Access to natural compounds also plays a significant role in modern pharmaceutical research and development. It has been estimated that 25 per cent of the drugs sold in developed countries and 75 per cent of those sold in developing countries were developed using natural compounds (Pearce and Puroshothamon 1995), demonstrating that biodiversity is of value to pharmaceutical firms in their efforts to develop new drugs. Box 5.3.1 below provides examples of medicines that have been developed based on plant-based natural compounds.

Box 5.31. Examples of medicines based on natural compounds

Some prominent plant-based medicines widely used today include:

- quinine – the anti-malarial drug from the bark of *Chincona* species;
- morphine – the analgesic from the opium poppy;
- digoxin – for heart disorders from *Digitalis purpurea (Foxglove)*;
- ephedrine – an anti-asthma agent from *Ephredra sinica*;
- ubocurarine chloride – the muscle relaxant from curuare, an extract of *Chondrodendron tomentosum;* and
- rauwolfia - for hypertensia and schizophrenia, based on snake root.

Microorganisms have also been extremely important in drug applications:

- anti-bacterial agents from the *Penicillium* species;
- immunosuppressants, such as mevastatin and lovastatin from the *Penicillium* species; and
- a potential new anti-diabetic agent from a *Pseudomassaria* fungal species.

Several key anti-cancer agents have been produced from natural sources, including:

- vinblastine and vincristine – isolated from the periwinkle, *Catharanthus roseous* - treatment for blood and lymph cancers*;*
- etoposide & teniposide – semi-synthetic derivatives of natural product epidophyllotoxin; and
- taxol – initially isolated from the bark of *Taxus brevifolia*.

Who maintains this service & who benefits from it?

The discovery of new biochemical compounds is directly related to the genetic and molecular diversity available in an area. Therefore, people responsible for protecting or maintaining biodiversity rich areas, e.g. Natura 2000 managers, can be seen to support the reach of new pharmaceuticals and biochemicals. The benefits derived from nature based medical compounds can be individual (e.g. access to an improved drug) or they can take place at commercial level (e.g. revenue to a private firm selling the medicine). In addition, benefits can also fall to local communities, for example, when these communities are paid for bioprospecting (i.e. reach of new natural compounds) up front or when the benefits from a developed drug or biochemical are shared with its "place of origin". Table 5.3.1 below provides a summary of the potential beneficiaries of pharmaceuticals and biochemicals.

Which Natura 2000 sites provide this service?

Biodiversity is the fundamental resource for bioprospecting but it is rarely possible to predict which genes, species, or ecosystems will become valuable for bioprospecting in the future. In principle, any Natura 2000 site could be a potential source for a new biochemical discovery, however, it is likely that the most diverse and also possibly the least researched locations might have the greatest potential for bioprospecting. For example, marine protected areas could still be a potential source for both new life forms and also new biochemical compounds.

Table 5.3.1. Some examples of service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers / foresters Landowners	Individuals	Local Regional Global	Access to new / improved drugs and biochemical products.
	Local communities	Local	Payments / compensation for bioprospecting or shared revenue from a new commercially used compound
	Different businesses & industries (small / large)	Regional National Global	Revenue from sold drug / biochemical / cosmetic products
	National & regional governments	Regional Global	Reduced health costs due to improved drugs Increased food security due to improved biochemicals

How to estimate the value of this service?

Please note: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

Qualitative and quantitative valuation aims to answer the question as to whether there has been / is / could be value in prospecting the site's biological resources for potential products, knowledge or applications. Relevant evidence could be found from the review of existing scientific evidence (either literature review of existing work or new research) and / or carrying out a survey of local knowledge to determine what is already known or suspected (e.g. via ethnobotanic research).

The qualitative and quantitative assessment could involve, for example:

- **looking at biodiversity hotspots**: species richness increases the probability of there being a useful species for bioprospecting;
- **looking at (the number of) species living in extreme conditions**: species able to withstand harsh conditions may well offer insights into interesting survival / adaptation processes; and
- **looking at (the number of) species with valuable traits**: e.g. salt, drought and pest resistance.

Monetary value estimates

In the case where bioprospecting has led to a commercially available product, information on market prices can be used to estimate the monetary value attached to a Natura 2000 site functioning as the source of the new product. This would entail calculating the sale revenues (e.g. price of drug x amount of drug sold) and the cost of production. The estimated value of the natural compound itself would be the total revenue from drug sales minus costs related to the production of the drug (e.g. costs of further laboratory research, patenting costs, costs of production and transport).

Other methods to assess the value of bioprospecting can include estimating health related benefits from pharmaceutical products derived from natural compounds. These could include, for example, avoided costs related to reducing early mortality, illness and hospitalisation. For example rosy periwinkle has been valued at benefits from avoided early mortality in excess of $100 million[6]. Similarly, building on value of lives saved, Pearce and Puroshothaman (1992)

[6] http://www.island.net/~hjr/coralwb.htm

estimated that 40 plant species led (via the medicines based upon these plants) to US$7 billion annually.

How can the estimated value be turned into real money?

Demonstrating a site's potential to be a source of new valuable biochemical compounds (e.g. based on local ethnobotanic knowledge) can be used as one of the general arguments for protecting the site, e.g. attaining funding to the site.

Obtaining money to a Natura 2000 site through bioprospecting usually requires raising the interest of pharmaceutical or biochemical companies. If such interest is raised then there is a need to agree on a compensation for the site from possible bioprospecting activities / outcomes. Such compensation could include, for example, annual access fees, defrayal of collection costs, payments per sample, milestone payments and royalties, license fees (in case of commercialisation) and funding for research. In addition, transfer of technology, upgrading of site facilities, capacity building and training for staff etc. could be used as ways for the site to benefit from bioprospecting activities.

5.4 Cultural & social services: Ecotourism and recreation

What is this service?

Natura 2000 sites are excellent destinations for nature tourism, i.e. tourism relying primarily on the natural environment for its attractions or settings. In addition, the sites provide numerous recreation opportunities for local communities. Relevant recreation and tourism related activities include, for example, hiking, biking, fishing, swimming, camping, horse riding, hunting, bird- and nature-watching. Alternatively, nature related tourism can also include visits to sites of cultural heritage. In addition, Natura 2000 sites often offer excellent possibilities for rural tourism (Bramwell & Lane 1994, Pedford 1996, Turnock 1999), i.e. activities related to life on a farm, rural customs and folklore, and local and family traditions.

Closely linked services you should also look into: cultural values and inspirational services as well as landscape and amenity values (Section 5.5) and wider socio-economic impacts (Section 5.19).

Why is this service valuable?

Tourism is one of the largest industry in the world economy and it is also one of the fastest growing sectors. With a growing worldwide population and, for example, people having increasingly more leisure time, recreational activities in, and tourism to natural areas and cultural landscapes are also very likely to continue to increase in the future. According to the International Ecotourism Society (TIES 2005), since the 1990s the rate of growth for ecotourism has been in the range of 20-30 per cent per year. In 2004, ecotourism/nature tourism was growing globally three times faster than the tourism industry as a whole.

The protection of natural and cultural areas is increasingly connected to the ecotourism and recreational sector. Increasing recreational activities and ecotourism will have financial and economic impacts, such as increasing incomes, jobs and business opportunities at local and regional level. These impacts further contribute to the economic and social development of an area/region.

In addition, several socio-cultural values form an important part of the total benefits created by Natura 2000 related ecotourism and recreation. These values include, for example, pleasure derived from viewing landscapes, the amenity of nature, and nature's contribution to education, religious pilgrimages and social relations.

In addition, recreational activities undertaken to enjoy the amenity that nature offers may result in restorative effects or increased health. Travel for educational reasons may result in increased social integration because of the contact with different cultures. Those benefits and related valuation methods are additionally addressed in the respective sections on cultural and amenity services (Section 5.5) and education and research (Section 5.4) of the Toolkit.

Important to consider: Tourism and recreational activities can also have negative impacts on biodiversity conservation, mainly linked to uncontrolled visitation and related land use changes, disturbances of species, invasive alien species, waste or pollution. Therefore it is essential to emphasise that this section focuses on the values arising from sustainable forms of recreation and tourism[7].

Who maintains this service & who benefits from it?

The services related to tourism and recreation are maintained by all those responsible for managing and conserving landscapes appealing for recreation and tourism (e.g. protecting species attracting visitors). This includes farmers or landowners, who contribute to the maintenance and creation of attractive and diversified habitats through sustainable farming procedures and sustainable forest management, as well as local Natura 2000 land users who are responsible for maintaining and restoring fascinating habitats and species at a favourable conservation status. Furthermore, these stakeholders also support the development and maintenance of recreational and tourism facilities and help to regulate accessibility.

Figure 5.4.1 provides an overview of different products and services linked to the tourism industry, their providers and thus, in the end, different potential beneficiaries of advantages arising from recreational and ecotourism services provided by the Natura 2000 network (Table 5.4.1).

Table 5.4.1 Service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers	Individuals, e.g. land users themselves, local population, consumers such as visitors and tourists	Local (Regional)	Creation of jobs for site managers or other individuals providing supporting services Restorative effects and increased health Education
Landowners	Different businesses & industries (small / large)	Local Regional	Income to protected sites through entrance fees or

[7] The Convention on Biological Diversity (CBD 2003) has developed Guidelines on Biodiversity and Tourism Development to provide a framework towards sustainable tourism development. The document addresses aspects such as strengthening protected area management system, increasing the value of ecosystems through generating income, jobs and business opportunities in tourism, capacity building, sharing information and allowing people to internalise the benefits of the biodiversity that has been a part of their historical, natural, and cultural heritage.

		(Global)	excursions Income to local and regional businesses providing services related to recreation and tourism Economic development of a region Creation of regional identity

Which Natura 2000 sites provide this service?

A variety of landscapes, natural and cultural environments offer different opportunities for recreational and tourism activities. In general, the suitability of a Natura 2000 site for a tourism or recreation activity depends on the target group in question. For example, open and diversified rural landscapes might attract a more generic group of visitors whereas closed old forests with a high amount of deadwood are usually for a more "acquired taste" (e.g. ecologist). The same applies for habitats with flagship species such as wolves, bears and vultures compared to habitats of less-known plant species or insects, as well as for larger sites such as national parks compared to small sites. In addition, certain areas may be not suitable for recreation or ecotourism at all due to their fragile ecosystems. In these cases it might be necessary to limit public access to be able to maintain or restore their favourable conservation status.

The potential for a Natura 2000 site to provide tourism and recreation services also depends on the reasons attracting visitors to a certain site. Some visitors may be driven by educational reasons others for inspirational search. Those aspects are addressed in the related Section 5.3.

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

Quantitative and qualitative information on recreation and ecotourism activities often form an important basis for any further monetary valuation and can represent an easy way to estimate and promote the value of a Natura 2000 site for this service.

The questions below help assess the value of tourism and recreation in a qualitative manner.

- What are benefits visitors associate with a site or a region?
- What are reasons for visiting a certain Natura 2000 site or region?

- What knowledge do you have regarding structures and features of the site?
- In what kind of recreational activities is the visitor interested in?
- What are core areas of a site people usually visit?
- What did a visitor like and what not?
- Would a visitor recommend the visit to a site?

The quantitative estimates illustrating Natura 2000 related benefits could include:

- amount of visits to the site;
- frequency of visits;
- length of stays;
- availability of accommodation, i.e. how many hotels, bed and breakfasts, self-catering apartments, camping sites, cruise ships offering offer ecotourism opportunities near to a site;
- availability of relevant facilities, i.e. how many recreational and tourism facilities such as tracking routes or tourism centres have been established;
- number of jobs provided by the site;
- amount of scheduled means of access to the site (e.g. ferries to an island); and
- amount of tourism and recreational licences sold or rented.

In addition, adding an evaluation of related changes over the past years could further help in valuing the benefits of ecotourism and recreation at a site (i.e. asking how data changed over time).

The following Box 5.4.1 provides different examples on what values can be obtained with a quantitative analysis.

Box 5.4.1 Quantitative examples of valuing tourism & recreation

A wide variety of examples of quantitative analysis to show the recreational benefits of Natura 2000 sites or ecosystems in general exist:

- A Special Protection Area (SPA) on Germany's Baltic coast, provided 67 full-time jobs in 1996 and visitor numbers increased from 1.6 million in 1992 to 2.2 million in 1995.
- In Prespa, a Greek national park and SPA, two information centres have been developed. In 1995, more than 13,000 visitors were received.
- In Spain, site visitors to the Monego Refuge grew by a factor of three over three years, and the accommodation infrastructure grew from 5 to 11 hotels/hostels.
- The number of overnight stays near to the "Steirische Grenzmur" Natura 2000 site in Austria rose from 8,438 in 1970 to over 400,000 in 2001. The landscape and nature resource form an important basis for the growing tourism (Ten Brink et al. 2002).
- In Scotland a survey was carried out amongst whale-watchers and other tourists regarding their length of stay. The results showed that the mean length of stay for the whale-watchers (6.4 nights) was higher than that of the mean length of stay for the general tourists (4.8 nights) (Parsons et al. 2003).

Monetary value estimates

The market price method helps to estimate the economic value of products and services related to recreation and ecotourism that are bought and sold in commercial markets. Three types of data are needed to apply this method: market prices (e.g. data on prices for product and services provided), quantity (i.e. data on the amount of products and services provided) and costs (i.e. costs linked to the provision of products and services). Potential sources of data on quantity and price can be market research studies, government statistics or income and expenditure surveys.

The market price method links data from the different categories, e.g. number of visitors to a certain area/protected site to direct sales or rent, and (if information is easily available) to costs arising from product and services provided to visitors. This provides information on profit gained from products and services such as accommodation, transport, food, events, special equipment, entrance fees, licences or excursions. For example, one can link the number of visitors participating on excursions to the fee they pay. If easily available one can then subtract all the costs that arise from providing this service, such as salaries or costs of purchased equipment.

Important to consider: Prices may have to be adjusted according to distortions such as taxes and subsidies, where possible. It can also be rather difficult to find studies that explicitly provide information on consumer or producer surpluses created by recreation and tourism activities directly related to Natura 2000 sites. This can be explained by the difficulty when using this method of separating those activities related to the Natura 2000 sites from the general recreational and tourism visits that may occur to an area, as the Natura 2000 site may be only one of the reasons for the visit.

Box 5.4.2 Examples of economic values of tourism & recreation

Market values

The Muritz National Park in north East Germany received about 400,000 visits and generated a net income of €11 million for the region based on data in 2004. Collected information on the number of visitors was connected to daily expenditures for hotel and restaurants, retail, and services such as entrance fees, ground transport, parking fees, cultural and sportive activities (Job et al. 2005).

The Isle of Mull at the west coast of Scotland receives around 350,000 visitors every year, of whom two-thirds spend their holidays in Mull and 33 per cent are day-trippers holidaying outside the island, or coming from home. In total, visitors spend £38 million on the island every year. Of this, between £1.4-1.6 million per year is attracted by the presence of the reintroduced white-tailed sea eagle. To estimate the contribution of sea-eagles watching to the overall tourism expenditures a survey was conducted to determine the intention of the visitor and the average amount of money spent per day (Dickie 2006)

In 1998, an estimated 40–44 UK whale watching operators took 121,125 people whale-watching and generated £1,142,000 in direct expenditure (i.e. ticket sales) with an estimated total expenditure of £5 million, if including other expenditures (Parsons et al. 2003).

Estimates based on cost of travel (see Annex 1 for more detailed explanation of the method)

Environment Group Research Report (2004) collected data on the number of trips made by an individual to the Scottish forest during 12 months and the cost of travel to that forest. User-group-specific count models were used to produce estimates of per-trip values for five user groups. It identified that cyclists, horse riders, walkers and general visitors attained welfare benefits from visiting the forest equivalent to £15 per-trip, while nature watchers attained lower welfare benefits of £8 per-trip.

In a study by Karimzadegan. et al. (2007) the recreational services of forest ecosystems in Iran was calculated by using the travel cost method. It was estimated at USD 7700 million per year (data below).

Ecotourism potential (people-day / year)	**Ecotourism potential** (people / year)	**Generated income via tourism** (people-day US$ per year)	**Generated income from tourism** (million US$)	**Generated jobs** (million US$)
27,468,760	3,924,108	2,746,876,000	2,700	5000

Estimates based on stated preferences (see Annex 1 for more detailed explanation of the method)

In an assessment of the economic benefits of the Scottish Natura 2000 sites (Environment Group Research Report 2004) the general public and visitors to the study area were asked how much they would be willing to pay for using the Natura 2000 sites for recreation (e.g. walking and angling) in the situation where all Natura 2000 sites in Scotland would be fully designated and implemented. The study resulted in an estimate of around £ 210 million per year related to non-use values and £1.5 million per year related to use values (e.g. walking and other recreational services).

Since the 1950s, the site of **Loch Garten in Scotland**, an important habitat for ospreys, attracted 290,000 visitors each year. In 1989 Harley and Haney carried out a study to estimate the recreational benefit from the site. The researchers asked people how much they would be willing to pay as a hypothetical entrance fee to the reserve. The resulting value lay between £1.96 and £2.65 per visitor in 2005 prices. If this figure were representative of 2005 visits to osprey sites, the 290,000 visitors would be willing to pay approximately £0.57 to £0.77 million just for recreational reasons. (Dickie 2006).

A study by Costanza et al. (1997) calculated the value of ecotourism for a number of biomes across the world, on the basis of published studies and a few original calculations. In many cases the values were based on willingness-to-pay methodologies. It was estimated that in North America the value of recreation and ecotourism was about €403.44/ha in mangrove forests (as in Braat et al. 2008).

Woodwand and Wui (2001) assessed the value of ecosystem services in wetlands using results from 39 different studies. The average value of ecotourism and recreation services in wetlands worldwide was estimated at €431.34 per ha for recreational fishery, €84.58/ha for bird hunting and €1,464.36 per ha for bird watching (as in Braat et al. 2008).

How can the estimated value be turned into real money?

As already described in the introduction, tourism can generate jobs and income for local areas in Natura 2000 sites. In many cases expenditures for food, accommodation or ground transport will have a greater economic impact than expenditures directly related to a Natura 2000 site, e.g. entrance fees or excursions (ten Brink et al. 2002). The overall economic impact will vary depending on typical characteristics of the site and the surrounding area. This may refer to the site's location, its accessibility, but also accommodation type.

However, generally there is the possibility of attracting more visitors to a site and region, to address visitors already in the region for other reasons, and to persuade site visitors to spend more time in the area in order to increase the already existing market value. This can result in an increase of profits arising from the provision of services such as food, accommodation, ground transport or from entry pricing and excursion fees.

Ecotourism can be potentially linked to Natura 2000 sites in rural landscapes. For example, a 'Touring Nature' initiative[8] sets up routes of rural areas throughout Europe and promotes them by including territories in a wider network and providing international customers with guarantees and recognisable references.

Several instruments exist that make use of the price systems and market forces to capture returns from activities that help to conserve ecotourism and recreation services. The example above on the Touring Nature initiative uses the method of **eco-labelling** in order to increase the attractiveness of an area or region.

Analternative method for turning economic values into real resource flow is through the establishment of schemes that provide **payments for environmental services** (PES). Such schemes pay land users for environmental services they provide. With regard to recreation and ecotourism this could refer to all management activities that help to conserve landscapes, habitats or species attractive for residents, visitors and tourists. Payments could come either from public authorities or the private sector which profits from the services provided and are willing to invest in maintaining it.

There might also be an opportunity in establishing **cost-sharing or management agreements,** with the tourism and recreation sector profiting from the specific features of a site. This usually entails agreements regarding the provision of tourism and recreation infrastructure such as tourism centres or trail systems as well as for the support of excursions.

Regarding recreational opportunities such as fishing or hunting the establishment of **transferable and tradable quotas or licences** might be another alternative funding mechanism.

Other mechanisms that can be used include the development of **entrance fees** or **road/parking place pricing** (e.g. for roads leading to a Natura 2000 site or parking places in the vicinity of the site). Please consider that these methods might also have impacts on the affluence of an area.

[8] http://www.touringnature.com

Before determining which method best suits your site, it is important to establish who the beneficiaries of this service are (e.g. farmers, visitors or different businesses benefiting from recreational services; see "*Who maintains this service & who benefits from it?*") and thus who might be most appropriate in supporting management financing or the maintenance of the service.

Please also consider that using existing **public / private funds**, e.g. **EU funding instruments** such as Rural Development Programmes under the European Agricultural Fund for Rural Development (EAFRD) or Structural Funds might be an important instrument in supporting initiatives taken[9].

[9] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online:
http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm

5.5 Cultural & social services: Cultural, landscape & amenity values and inspirational services

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What is this service?

Natural environments have been responsible for shaping cultural identity and values throughout human history. Consequently, a variety of lifestyles, livelihoods, different knowledge systems and cultural differences have been developed. For example, for many traditional societies culture and nature are strongly linked, and measures aimed at cultural identity often also promote nature conservation (MA 2005). Culture and the use of natural resources can also be strongly influenced by belief systems. These systems can attach a spiritual value to an ecosystem (e.g. holy forests), species or a landscape feature (e.g. mountains). Ecosystems and landscapes also inspire cultural and artistic expression and are an invaluable resource for science, scientific research and education**.**

People all over the world derive aesthetic pleasure from natural environments. The beauty of nature is often obvious and self-evident, and very difficult to grasp. However, several studies indicate that people prefer natural environments over built environment (e.g. Millennium Ecosystem Assessment 20005, Ulrich 1983, Kaplan and Kaplan 1989, Hartig and Evans 1993). These preferences are often linked with the ecological status of the environment, with people especially looking for healthy, lush and green/colourful landscapes**.**

The perception of aesthetic qualities is, however, very subjective and does not necessarily fully match with the ecological quality and integrity of an area. For example, according to Kellert (1993), European, North American, and Asian populations prefer park-like settings with wilderness even being seen as something negative and threatening. In particular, farmers and low-income groups have been found to prefer managed natural landscapes with a high degree of human influence, while urbanites and high income groups have been found to prefer wild natural landscapes with a low degree of human influence (Kaplan and Kaplan 1989, Van den Berg 1999). Therefore, it is important to keep the variations between preferences in mind when assessing values related to the beauty of landscapes and nature.

Closely linked services you should also look into: ecotourism & recreation (Section 5.4) and regulation of human health (5.16)

Why is this service valuable?

Traditional knowledge on ecosystems and their functioning is a fundamental element of societies' and individuals' cultural identity. In addition, culturally important landscapes, such as several semi-natural ecosystems and landscapes in the EU, can be of high heritage value which can further provide an important basis for the 'branding' of an area. Ecosystems, including Natura 2000 sites, are also a source of inspiration for verbal art and writing, performing arts, fine arts, design and fashion, and the media in general. For example nature can inspire architectural designs, influence clothing (e.g. natural dyes) or be a source of inspiration for the production of TV programmes.

Nature can also act as a 'library of biological information' enabling us to understand important natural processes, e.g. to observe changes in the past to be able to understand potential changes in the future. Environmental research might then be used for technological and medicinal purposes. For example, biological methods and systems available in nature are often used for the study and design of engineering systems and modern technology. Similarly, bioindicators help to assess and monitor changes in the environment. Protected sites can also play an important role in awareness raising regarding environmental issues and can offer children an arena to get a practical insight into natural processes.

Finally, environmental factors such as noise and air pollution are making people's lives more stressful and especially people living in urban areas are strongly affected by a stressful environment. According to recent findings people prefer nature over urban areas twice as strongly when suffering from stress and fatigue (Staats 2003). This suggests that especially urban residents benefit from nature's reviving abilities.

Important to consider: For the valuation of landscape and amenity values, the strong link between these services, and recreation and tourism services has to be kept in mind. Aesthetic benefits are one of the main drivers of recreational and tourism activities, and very often it will be difficult to separate these services from one another.

Who maintains this service & who benefits from it?

Cultural values and inspirational services are maintained by those responsible for managing and conserving landscapes and species with regional / local cultural value. This often refers to farmers or landowners, who contribute to the maintenance and creation of semi-natural habitats through sustainable farming procedures and sustainable forest management. Public authorities can also play an important role by providing educational facilities. In addition, indirect contributions might arise from individuals or businesses supporting educational, recreational and tourism services (see also Section 5.4).

Table 5.5.1 Service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers	Individuals, e.g. land users themselves, residents, visitors and tourists	Local (Regional)	Education and inspiration Goods for own use or for sale (e.g. crops, cultured fish,

Farmers Landowners Public authorities Local population			livestock, wood for fuel) linked to traditional knowledge and cultural values Restorative effects and increased health
	Different businesses & industries (small / large)	Local Regional (Global)	Research resulting in technological development Inspiration for the development of products such as books, movies, TV programmes Enhanced employability, reduced criminal behaviour Increased value of real estate property
	Wider society	Regional (Global)	Education Traditional knowledge Increased social integration Decreased levels of aggression and criminality

Which Natura 2000 sites provide this service?

Any Natura 2000 site protecting culturally important landscapes, habitats or species can be an integral part of the identity of a region. This may especially refer to traditional semi-natural habitats (e.g. species with cultural significance depending on these habitats) or to sites situated in areas with a special importance for belief systems and inspiration, e.g. seascapes and mountains.

Natura 2000 sites also represent an important resource for education. This can be promoted by offering educational excursions to provide insights into nature and its processes. Some sites might be more suitable for educational purposes than others, for example habitats with flagship species such as wolves, bears and vultures might attract more visitors compared to habitats of less-known plant species or insects. In addition, certain areas may not be suitable for educational recreation or tourism at all due to their fragility. However, on the other hand, these habitats might be invaluable resources for science and scientific research.

Natura 2000 sites situated close to /easily accessible from urban areas can be an important source of the enjoyment of landscape and amenity, offering a possibility to escape from the stressful life in cities. Additionally, the vicinity of Natura 2000 sites may also make areas more desirable and attractive for maintaining old and attracting new residents. This may further result in sustaining vital local facilities and services in the area.

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

Examples of qualitative information useful for demonstrating cultural and inspirational benefits of Natura 2000 are listed below.

- Does the Natura 2000 site provide important learning opportunities?
- Does the Natura 2000 site play a (potential) role in awareness raising activities?
- Does the site also protect cultural heritage, e.g. archaeological heritage?
- Does the site attract inspirational activities, e.g. artists and film makers?
- Does the site play a role in local arts, fine arts, design and fashion?
- Does the site have distinguished landscape and amenity values that, for example, are known to attract tourism and visitors to the site?

The quantitative estimates illustrating Natura 2000 related benefits could include:

- total amount of / trends in the number of visits to the sites, specifically related to educational or cultural activities;
- total amount of / trends in the number of educational excursions to the site; and
- total amount of / trends in the number of TV programmes, studies, books etc. featuring the site and its surrounding area.

Box 5.5.1 provides examples on what information you could focus on within a quantitative or qualitative analysis.

Box 5.5.1 Quantitative examples of cultural and inspirational values

In the natural area of the Riaza River Gorges in Spain (SPA since 1989) €230,000 has been invested in organising training activities at the site. A number of locally run courses, including the management of information centres, voluntary work and environmental education, have been organised. In addition, various awareness raising activities and school visits have taken place, involving altogether 1,300 local people.

A review of exiting research (1993-2003) suggests that outdoor adventure programmes and contact with nature is associated with improved discipline, emotional development and enhanced community integration (Rickinson et al. 2004).

Monetary value estimates

Monetary estimates for landscape and amenity values and inspirational services often require more complex economic valuation methods. Therefore, only some methods have been

considered feasible for a "non-expert" to use. In addition, Box 5.4.1 below provides a number of examples where other, more complicated, valuation methods have been used. Please see Annex 1 for more detailed information on these methods.

The market price method can be used to help estimate the economic value of commercial products and services related to educational recreation and ecotourism. In simple terms, this method multiplies the fee for an educational excursion by the number of participants. The final estimate for the value of the service is then created by subtracting all the costs related to providing the service (e.g. salaries or cost for equipment) from the total price paid by the participants.

In the case of research, one can collect information on sales achieved through research results. However, the information usually is rather difficult to extract or to gather. If this is the case one should focus on costs spent for research by public authorities, research institutes or the industry. This may help to describe the importance of a subject based on the interest in spending money for relevant research.

Property prices can be used to estimate the economic values of landscape and amenity services from a Natura 2000 site by analysing their effects on the price of properties. In other words, it could be assumed that the price of houses located near a site that has a certain cultural or inspirational value are higher than elsewhere. In order to develop such an estimate data on property sales in the region is needed. This includes information on prices as well as the location itself (e.g., environmental, structural and neighbourhood attributes).

Important to consider: Property values can be influenced by different attributes such as structural attributes (e.g. age of the house), neighbourhood attributes (e.g. school quality, crime or demographic aspects) and environmental attributes (e.g. air quality, landscape and amenity). For the analysis it is very important to try to separate the landscape and amenity aspect from other attributes.

Box 5.5.2 Examples of cultural and inspirational values

Market values

Costanza et al. (1997) estimated that the market price of cultural values in mangrove forests in Thailand were about €171.21 (2008 values, as in Braat et al. 2008).

Cost based estimates

In a study on the economic evaluation of marine biodiversity, the authors estimated the value of marine environmental research to be £292 million per year (Pugh and Skinner 2002). They compiled data on marine research funding, including research in higher education, the public sector and the industrial sector, and the calculated value added to research and development in the marine sector.

Property price based estimates

A study covering over 100 000 properties in UK found that broad-leaved trees had a positive effect on house prices, while mature Sitka spruce reduced their value (Willis and Garrod 1992). Furthermore, the prices of properties situated near to woodlands rose by 7 per cent during the study period.

A statistical analysis of more than 800 house sales in Guam during 2000-2004 showed that with every additional metre from the coast the value of a given house declined by USD 17,000 (Van Beukering 2007). The value was extrapolated resulting in an annual amenity value of coastal attributes in Guam at USD 9.6 million.

Estimates based on stated preferences (see Annex 1 for more detailed explanation of the method)

The recreational and bequest values related to cultural heritage in the Tieler and Culemborgerwaard area (In the Netherlands) have been measured by using a contingent evaluation method (Ruijgrok 2006). These values were calculated by multiplying the average willingness to pay with the relevant number of stakeholders (see also below). The total number of visitors in the study area was 28,000 per year. Thus, the total recreational value is at EUR 35,990 per year. The number of households willing to pay for heritage conservation in the study area was estimated to be 2.8 million. The bequest value therefore amounted to EUR 33.8 million per year.

Value	Average willingness to pay	Unit	Standard deviation	Number of observations
Recreation	EUR 1.22	Per visit	2.72	213
Bequest	EUR 11.88	Per year per household	28.18	391

Gunawardena and Rowan (2005) estimated that the existence, bequest and option values to local community of cultural values in Sri Lankan mangrove forests is about €24.31/ha (2008 values, as in Braat et al. 2008).

Eade and Moran (1996) assessed the existence value of cultural values in the Rio Bravo tropical forest (Belize) at €173.06/ha (2008 values, as in Braat et al. 2008).

Rodriguez et al (2006) estimated the cultural value of scrubland in Ayacucho (Peru) at €1,124.35/ha using an experimental method called cultural domain analysis (2008 values, as in Braat et al. 2008).

A study by Costanza et al (1997) calculated the value of ecosystem services for a number of biomes across the world, on the basis of published studies and a few original calculations. In many cases the values were based on willingness-to-pay methodologies. The average value of cultural services was estimated at €1.63/ha in North American temperate forest, and at €2.39/ha in tropical forests (worldwide) (as in Braat et al. 2008).

Schuyt and Brander (2004) estimated that the cultural value related to wetland biodiversity is between €285.59/ha and €268.24. Similarly, Woodward and Wui (2001) evaluated that the average amenity value of wetlands worldwide was €3.62/ha. Furthermore, according to Woodward and Wui the cultural value of grasslands (globally) is €369.72/ha. (2008 prices, as in Braat et al. 2008).

A survey of over 400 residents across England, Scotland and Wales was carried out to estimate the value of woodland views from properties and on journeys (Garrod 2002). According to the survey, the willingness to pay for a view from home over peri-urban broad-leaved forest landscapes was £269 per household per year, falling to £227 for views on regular journeys. The resulting aggregate capitalised value was over £4 billion, with an annual present value of £150 million.

How can the estimated value be turned into real money?

There are already markets for several cultural and inspirational services. For example, there might be possibilities to establish commercial activities based on the educational visits to the site, e.g. by increasing the attractiveness, quantity and / or promotion of educational excursions to the site. Also for inspirational services such as books and TV programmes, **labelling** might be an option to make these services more visible.

Payments for environmental services (PES) might be used to create new markets for cultural services. For example, stakeholders involved in management activities that help to conserve landscapes, habitats and species providing inspiration to people or considered as cultural heritage could receive compensation for their efforts. PES could also support management activities that help to conserve healthy and attractive landscapes. These payments could come from public authorities or industry that profits from scenic landscapes and other inspirational services (e.g. books, TV programmes, technology development) and may be willing to invest in their maintenance.

There might also be possibilities for establishing **cost-sharing / management agreements** with public authorities or private sector interested in the educational opportunities the site has to offer. This could entail looking for public / private "sponsorships" to create new infrastructure at the site, the promotion of activities at schools or sharing the costs for providing educational excursions.

Before determining which method mostly suits a given site, it is important to establish who the beneficiaries of this service are (e.g. farmers, visitors or different businesses benefiting from recreational services; see "*Who maintains this service & who benefits from it?*"), and thus who might be most appropriate in supporting management financing or the maintenance of the service.

It is also important to note that existing **public / private funds**, e.g. **EU funding instruments** such as Structural Funds or the European Agricultural Fund for Rural Development (EAFRD) might provide opportunities for financing the maintenance of cultural services[10].

[10] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.6 Regulating services: Climate regulation

What is this service?

Ecosystems influence the processes that regulate **local and regional climate conditions**. For example, the density and type of vegetation cover affects solar heat absorption, cloud formation and water retention leading to regional and local impacts on precipitation, temperature and wind conditions.

Biodiversity is also fundamental for **carbon sequestration** (i.e. the absorption of carbon from the atmosphere by plant tissue) that plays an important role in mitigating climate change. The characteristics of different plant species determine how much carbon is taken up from the atmosphere and how much is released into it. Important characteristics are the speed of plants' growth, which governs carbon inputs, and woodiness, which enhances carbon sequestration. Plant species also strongly influence carbon loss via decomposition processes and through the effect of other ecosystem services, e.g. the regulation of fire (which in turn affects the amount of carbon released in the atmosphere) (MA 2005).

In addition to actively sequestering carbon, ecosystems (e.g. bogs and old forests) are also important **storages for carbon** captured in the course of time. Therefore, the destruction of these ecosystems would result in releasing high amounts of carbon to the atmosphere, contributing negatively to climate change.

In addition to terrestrial ecosystems and their vegetation cover, climate regulation is also affected by marine biodiversity via its effect on biogeochemical cycling and carbon sequestration. In short, biodiversity influences the effectiveness of the biological "pump" that moves carbon from the surface ocean and sequesters it in deep waters and sediments. (MA 2005).

Important to consider: Given the key role of forests in carbon sequestration there is a growing interest to use reforestation as a means to mitigate climate change. In this context, it is important to note that not all reforestation activities are beneficial for biodiversity, e.g. plantation of monocultures is still generally considered as negative for biodiversity. Therefore, any attempt to increase carbon sequestration by reforestation should clearly consider the related impacts on biodiversity.

Closely linked services you should also look into: water regulation and wild fire mitigation (Sections 5.7 and 5.13).

Why is this service valuable?

As noted above, ecosystems play an important role in maintaining and regulating climate related elements such as precipitations, temperature, cloud formation etc. For example, tropical deforestation and desertification have tended to reduce local rainfall. Changes to climate conditions can also affect the spreading of infectious diseases, therefore influencing human health (MA 2005). Climate can also affect food availability and quality, induce population displacement, influence local and regional economies and even social relations, e.g. it can lead to conflicts over natural resources or affect development.

Furthermore, acting as carbon storage and with their potential for carbon sequestration, ecosystems can contribute to climate change mitigation by reducing the percentage of carbon dioxide in the atmosphere. Currently, the biosphere is a net sink of carbon, absorbing about one–two billion tons of carbon per year, or approximately 20 percent of fossil fuel emissions. Therefore, preservation and restoration of ecosystems should be considered as an important means for mitigating climate change. (MA 2005).

Who maintains this service & who benefits from it?

The service is maintained by local Natura 2000 site managers, farmers and land owners whose land use practices maintain certain vegetation cover in an area. For instance, greater structural diversity of forest canopies can increase the efficiency with which water, heat and carbon are exchanged between the ecosystem and the atmosphere. This in turn has impacts on the local and regional climate conditions.

As for climate change mitigation, maintaining important carbon storages (e.g. old-growth forests) can significantly reduce carbon emissions. In addition, choice of plant species for agriculture and forestry can affect carbon sequestration, according to their growth and woodiness and the way they decompose. Plants traits and distribution also affect the probability of fire, wind throw, floods and other climate-related disturbances (MA 2005). For instance, the presence of trees monocultures can speed up the spread of forest fires and pests, which are important agents of disturbance and carbon loss. Some of these specific effects are described in more detail under other regulating services.

Importantly, activities by site managers and land owners/managers (especially in the case of forests) have a strong influence on permanence, i.e. the time over which sequestered carbon is removed from the atmosphere. Plantations that are harvested and not re-established do not contribute to long-term carbon sequestration. On the contrary, if the harvested plants are burned, the carbon sequestered will be released back in the atmosphere, so that in the long run there will be no positive effect in terms of climate change mitigation. But, if an ecosystem is maintained so that harvest equals net growth, they can both be a source of revenue (e.g. from selling wood or food) and still retain the captured carbon.

Table 5.6.1. Service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers Land owners	Individuals, e.g. land users themselves. Local residents, farmers etc	Local (Regional)	Climate regulation (e.g. precipitation, temperature etc, including extreme weather events) affecting human well being, security, health, food production etc
	Society at large	Global	Climate regulation, e.g. precipitation, temperature at global / macro regional level Contribution to climate change mitigation through carbon sequestration and storing carbon.

Which Natura 2000 sites provide this service?

Many Natura 2000 sites offer significant opportunities for carbon sequestration, such as sites located on forest lands, agricultural lands (especially crop lands, grasslands, and range lands), biomass croplands, deserts and degraded lands and boreal wetlands and peatlands[11]. The biological potential for carbon sequestration depends mainly on climatic factors. Climates with high temperatures, sufficient rainfall and long day lengths are most favourable for rapid plant growth, i.e. they also have the highest carbon sequestration rates (Alexandrov et al. 2000, 2002).

The Figure 5.6.2 provides an overview of the biological potential for carbon sequestration across the world. Equatorial regions, where both rainfall and temperatures are high, have the highest biological potential for carbon sequestration. The map below (Figure 5.6.3) represents a geographic distribution of the costs involved in sequestering carbon (EUR / ton), calculated by combining the biological potential for carbon sequestration with estimated costs of reforestation. In principle, areas with the lowest costs are the most cost effective locations for carbon sequestering.

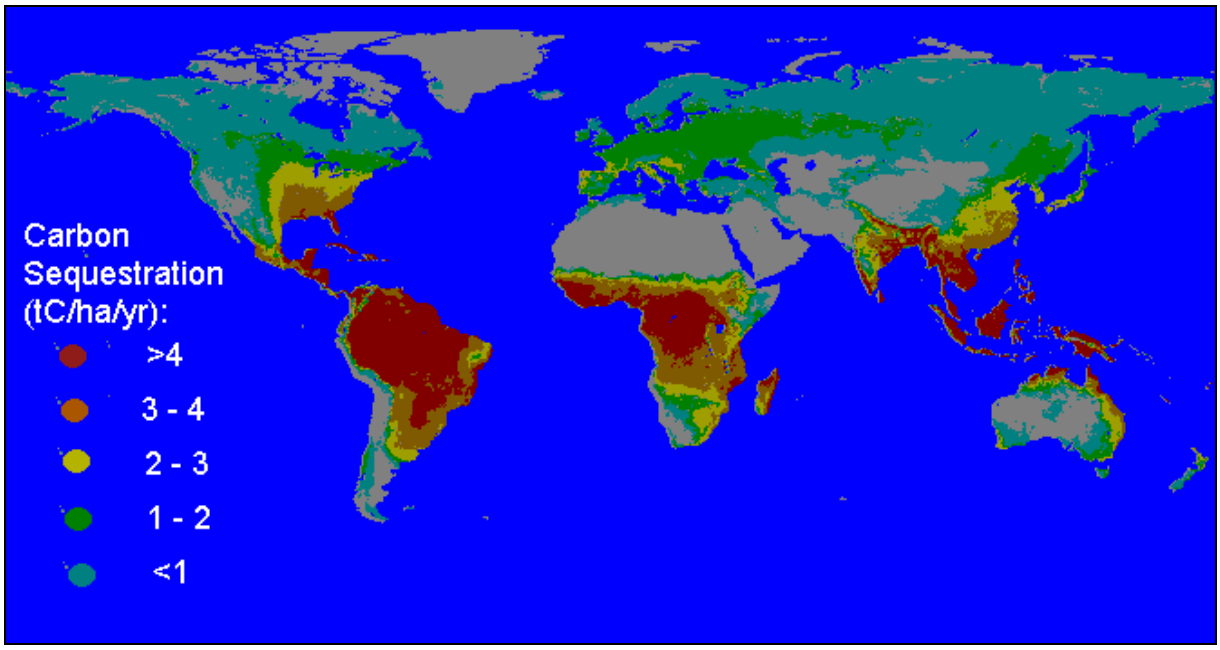
In the context of Europe and the Natura 2000 sites, some areas (e.g. the southern Europe) appear to have a higher potential for carbon sequestration. These areas appear to be located in Portugal, Spain, Italy, Southern France and in some Eastern European countries like Hungary, Romania and Serbia (See areas in yellow in the Figure 5.6.1). Costs of establishing forest areas appear to be higher in central and northern Europe, especially in some areas in northern Italy, Austria, Scotland, Ireland and also around the Balkan area (as according to the Benitez et al. 2007, Figure 5.6.2).

[11] CSITE http://csite.esd.ornl.gov/faq/faq.html (last visited 26 Nov 2008)

In addition to sequestration, Natura 2000 sites harbour several ecosystems that are important current storages of carbon, e.g. peat bogs and old-growth forests. These ecosystems are of key importance in retaining already captured carbon and in this way reducing carbon emissions.

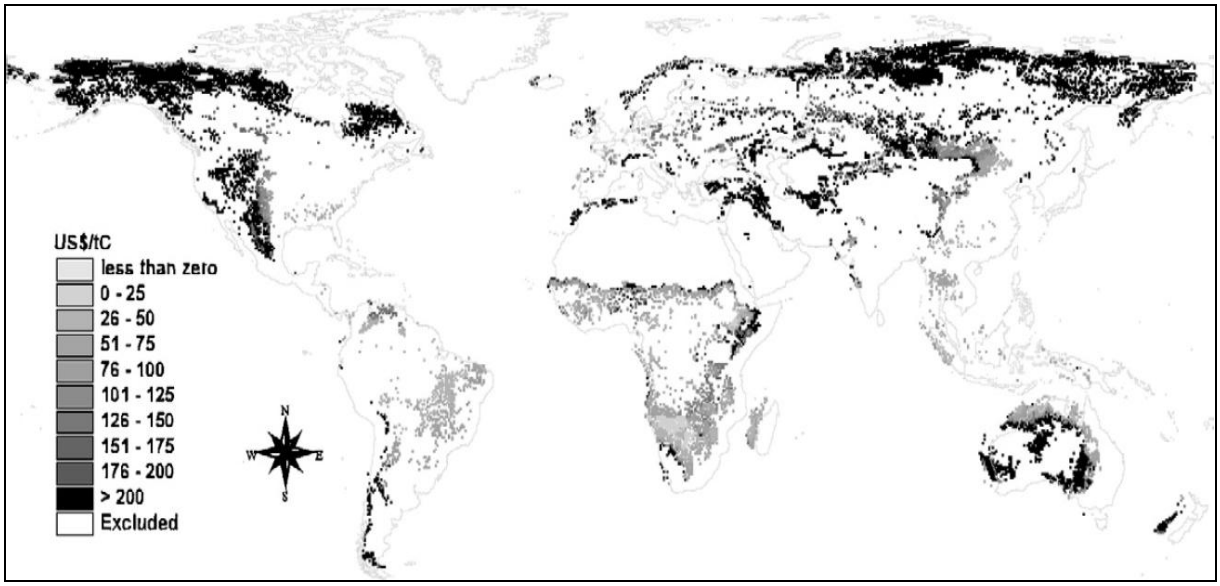
Finally, Figure 5.6.3 below illustrates the role of vegetation in the hydrologic cycle. In short, it gives an indication of the general increase in recycling water back into the atmosphere (mm/day) via evapotranspiration when vegetation in present. The increase is obtained by comparing the ratio of land evapotranspiration to precipitation with present-day vegetation and a simulated ratio if all vegetation was removed leaving bare soil (Betts 1999). The figure can give a general idea on the importance of ecosystems in water cycling at the geographic level.

Figure 5.6.1 Biological potential for carbon sequestration rates over the world.



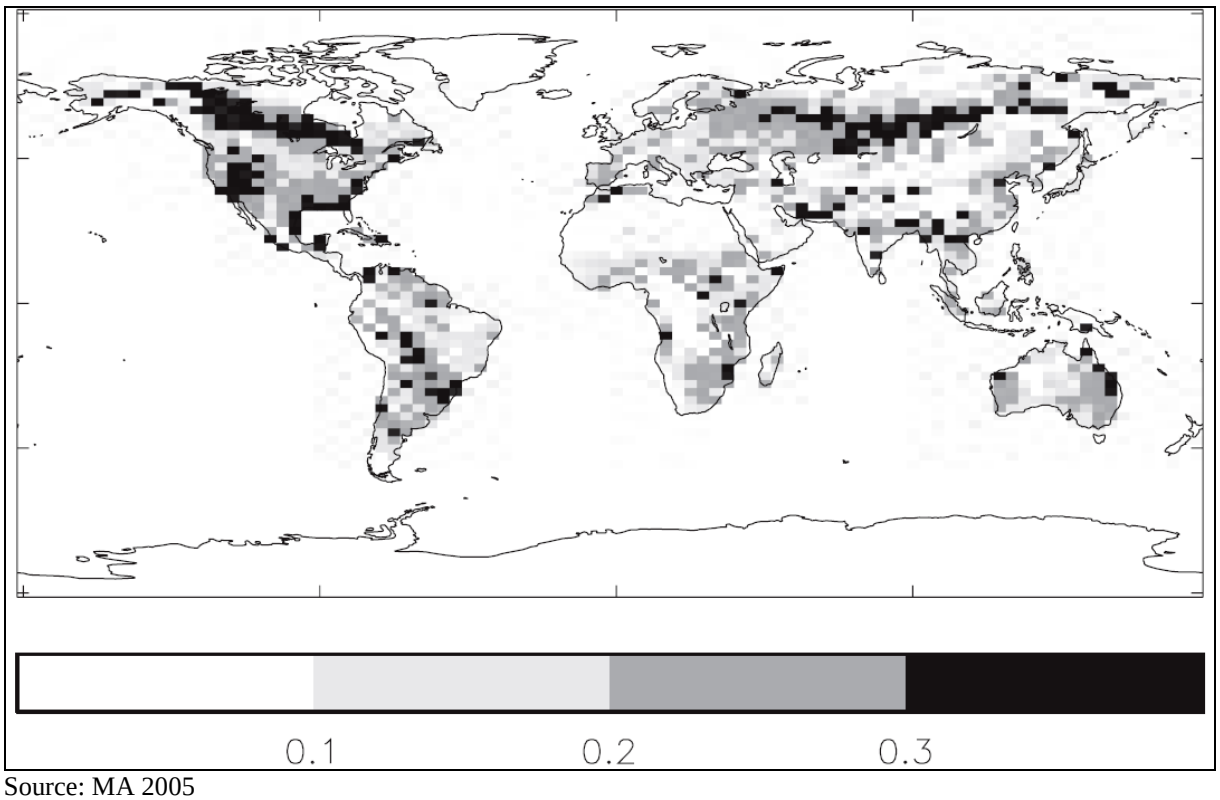
Source: Alexandrov et al. 2000 http://www-cger.nies.go.jp/carbon/pannel.htm (last visited 26 Nov 2008)

Figure 5.6.2 Geographical distribution of carbon costs



Source: Benitez et al. 2007

Figure 5.6.3 The influence of terrestrial vegetation on water recycling (in mm/day).



Source: MA 2005

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

The potential contribution of an ecosystem to climate regulation can be assessed qualitatively, for example, with the help of the following questions.

- Is the ecosystem effective in sequestering carbon, e.g. does its vegetation cover, plant growth rate and soil conditions support this process?
- Is the site a significant storage of carbon, e.g. bogs, old forest area?
- Beside carbon sequestration and storage, is the ecosystem further stabilising local and regional climate conditions (e.g. affecting temperature, precipitation, cloud formation)?
- Is there evidence that the climate conditions in the area (or in a similar ecosystem elsewhere) have changed due to changes in ecosystem characteristics?

As for quantitative estimates, the quantity (tonnes) of carbon (either carbon or carbon dioxide CO_2)[12] sequestered or stored in a given area (hectares, m^2, acres etc.) can be estimated. The basic concept/formula is the following:

Total amount of carbon sequestered or stored
= sequestration or storage capacity x total area

It will be important to make sure that the units used in calculations are consistent, i.e. if for example sequestration capacity is measured in tonnes per hectare, the area size will have to be calculated in hectare, and the resulting amount of carbon sequestered will be in tonnes.

The sequestration / storage capacity of each ecosystem depends on a wide range of values and assumptions (e.g. type of plants and age, woodiness). The easiest way to calculate carbon sequestration / amount of carbon stored in vegetation is hence to use average values for sequestration / storage capacity from ecosystems similar to the one in the study area. When looking for existing data, one has to keep in mind the specific attributes of the site (such as biome type, latitude, altitude, aridity/humidity, plant growth rate and woodiness) and choose data from areas with similar characteristics. For example, mid-latitude forests sequester more carbon annually than high latitude forests, and middle-aged forests sequester more annually than old forests. On the other hand, old forests store more carbon than younger forests. Values can be obtained from existing literature and databases with some examples provided in the Box 5.5.1 below.

[12] Note that in this report we refer to both tonnes of carbon (C) and of carbon dioxide (CO_2). These elements have different weights, hence when assessing the amount of carbon sequestered one should make sure to use the right unit (the two are not interchangeable).

A more case specific, but also complex, approach will require calculating the sequestration / carbon storage capacity of the ecosystem(s) at the Natura 2000 site in question. This can be fairly onerous as carbon sequestration varies spatially depending on the vegetation cover and structure, growth rates and soil conditions. Therefore, detailed information on the physiological characteristics of the study area need to be gathered.

Box. 5.6.1. Quantitative examples of valuing carbon sequestration & storage

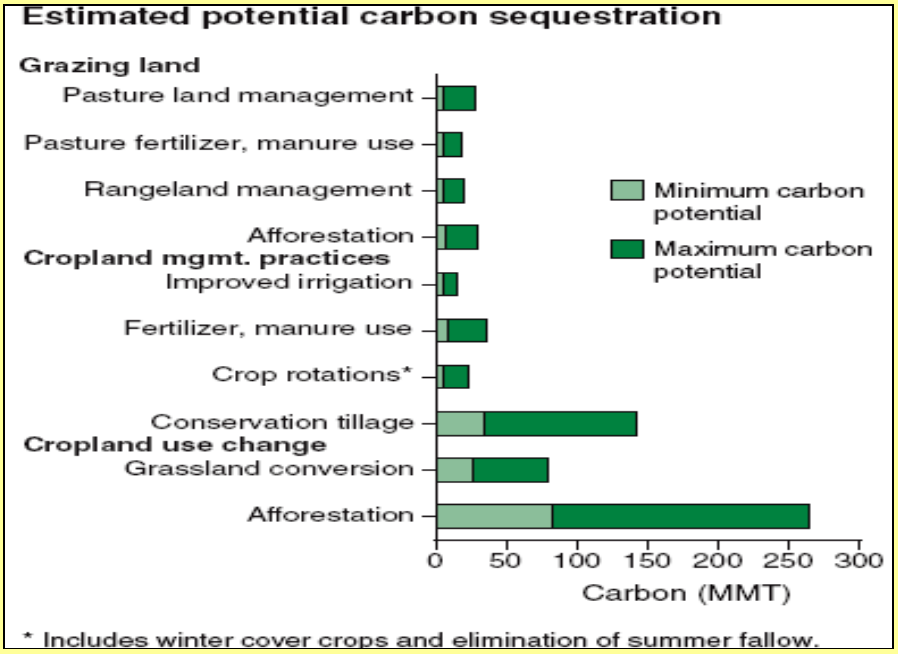
Please note: In order to use the values below, the existing examples and the Natura 2000 site in question have to share similar ecological characteristics. As a rule of thumb, averages for biomes and regions that are based on information from several different areas can be used to as proxies if more specific or suitable data is not available,

Carbon sequestration

In the mountain forest of the Uttarakhand region (India) it was assumed that the average values of carbon sequestration were about half of those for relatively undisturbed forests (i.e. between 4 and 5.6 t C/ha/yr). It was estimated that the whole mountain forest area could sequester about 6.6 million tonnes of carbon per year. (ANSAB 2006)

In the mountain forest of Nepal the carbon sequestration rate was calculated based on the information on total stem volume and stem density. Productivity was estimated on the basis of appropriate quotients derived from studies in the Uttaranchal region and in certain sites of Nepal. Fifty per cent of dry mass was used as carbon values. Based on this information, it was estimated that about 126 million t of C were sequestered every year in the area. (ANSAB 2006)

Estimated potential of carbon sequestration in agriculture areas are presented in figure below (as in Rice 2008).

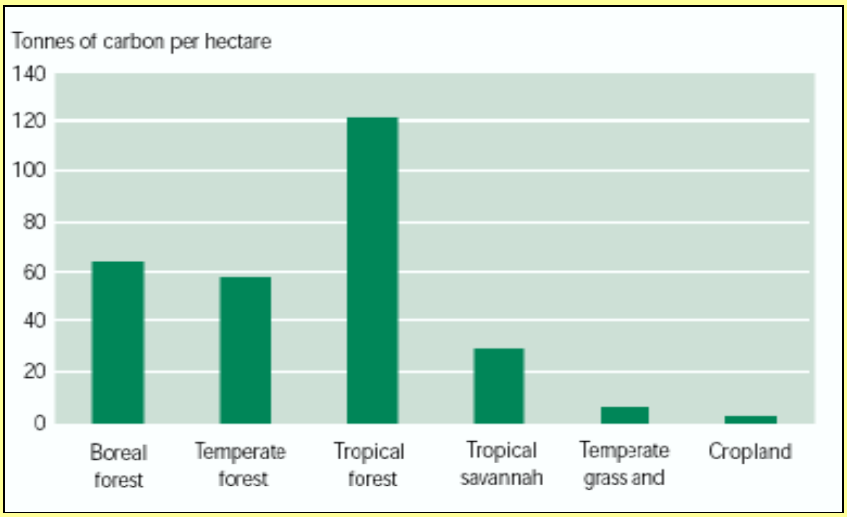


Carbon storage

Estimates of global carbon stocks in vegetation and soils to 1 m depth. **(**based on Bolin et al. 2000; based on WGBU, 1998 as in IPCC 2001c – IEEP calculations)

Biome	Area		Carbon stocks (GtC)			C stocks/ha
	million km^2	billion Ha	Vegetation	Soils	Total	Average
Tropical forests	17.6	1.76	212	216	428	243.18
Temperate forests	10.4	1.04	59	100	159	152.88
Boreal forests	13.7	1.37	88	471	559	408.03
Tropical savannas	22.5	2.25	66	264	330	146.67
Temperate grasslands	12.5	1.25	9	295	304	243.20
Deserts & semideserts	45.5	4.55	8	191	199	43.74
Tundra	9.5	0.95	6	121	127	133.68
Wetlands	3.5	0.35	15	225	240	685.71
Croplands	16	1.6	3	128	131	81.88
Total	151.2	15.12	466	2,011	2,477	163.82

Above ground carbon density (C/Ha/year) in forested areas is presented in figure below. (Dixon et al. 1994, Schlesinger 1997, IPCC 2000, FAO State of the World's Forests 2001 – as in Curtis 2008)



Estimated ranges of total carbon storage values by ecosystems have been estimated as follows: forest: 211-324 t C/ha, grassland: 123-154 t C/ha, agriculture: 122– 54 t C/ha, other (incl. wetlands, human settlements, and barren land): 46–60 t C/ha. **(**based on Matthews et al. 2000)

For estimates of minimum, medium, and maximum carbon densities in major world ecosystems based on Olson et al. 1983, 1985. See http://cdiac.ornl.gov/ftp/ndp017/table.html.

Monetary value estimates

Estimates based on the costs of carbon emissions

The method considers the cost arising in relation to the provision of the carbon sequestration. This can be simplified as:

Value of carbon sequestered or stored = amount of carbon sequestered or stored x cost of carbon

In order to use this method, assumptions have to be made on the cost of carbon. One should be aware that the range of available estimates is very broad, and hence it is important to clearly state when and where the values are taken from. The value of carbon can be based on relevant studies and literature (some are provided in the box 5.6.2 below). These values often refer to the so-called Social Cost of Carbon (SCC), i.e. the net present value of climate change impacts over the next 100 years (or longer) of one additional tonne of carbon emitted to the atmosphere today, i.e. the marginal global damage costs of carbon emissions

Alternatively, if carbon taxes exist in a given country, the amount of this tax could be used as a proxy for carbon cost. Although this tax may not reflect the actual value of carbon sequestration as well as the SCC estimates, the calculations behind carbon tax rates can take into account the cost of externalities and can hence represent a compromised value between the carbon actual value and the value 'recognised' by the market. It is important to note, however, that carbon taxes are country-specific, e.g. dependent on the national political decisions. Therefore, it is not advisable to use them as proxies for the value of carbon sequestration / storage in locations outside their country of origin. For instance, Sweden imposes a carbon tax of 0.365 SEK/kg ($150 per ton) of CO_2 released. This tax may be seen as a proxy of the value attributed to carbon in Sweden, and could be used to calculate the value of carbon sequstration by Swedish Natura 2000 sites.

Otherwise, one could use the current price of carbon in the EU Emissions Trading Scheme (ETS). This is a market value, and reflects political choices (e.g. the level of the emission cap) and technological options rather than the actual externality costs. It has, however, the advantage of being specific to Europe, and hence can be used for any Natura 2000 site. Carbon prices are dynamic and determined by the market, hence when referring to the ETS carbon price one should clarify the date in which the value was taken. The current value of carbon in the EU ETS market can be observed in real time in websites such as http://www.pointcarbon.com/productsandservices/carbon/.

Finally, it should be noted that the cost of carbon chosen can lead to very different values, hence potentially overestimating or underestimating the actual value of the service. In some cases it may be useful to use a range of values (e.g. a lower bound, a higher bound and an average value) to provide a broader picture. More accurate analysis can also take into account the change of the 'value of money' across time, i.e. using an appropriate interest rate(s) to calculate the net present value (NPV) of the sequestered carbon.

Costs of damage due to climate change

This method aims to assess the benefits derived from the climate regulation service of ecosystems. The monetary value of the benefits derived from climate regulation are calculated as a percentage of GDP (or Gross Regional Product, or Gross National Product or other measures of national/local wealth), i.e. a sort of opportunity cost based on the likely impact of climate change on domestic economies. Such percentage can be based on existing studies/relevant literature.

For example, Costanza (1997) assessed the value of forests' climate regulation as US$ 141 per hectare. Nordhaus (1992) first estimated the (average) damage caused by climate damage at one per cent reduction in GNP, on the basis of market sector losses for a central estimate of climate change. Later on this value was revised, and it was estimated that the loss of gross world product (GWP) resulting from a three degree Celsius warming by 2090 varied between a loss of 0 and 21 percent of GNP with a mean of 1.9 percent. (Nordhaus, 1994) (as in Karimzadegan, 2007).

Once the theoretical percentage of GDP attributed to climate regulation has been chosen, the calculation can be carried out based on the formula below. Nevertheless, the approach may be an oversimplification of the actual climate service value as it is based on very broad assumptions on the impact of climate change on GDP.

Value of climate regulation = GDP x damage of climate change on GDP (per cent)

Box 5.6.2 Examples of carbon sequestration & storage monetary value

Please note: Some average values presented below can be used as proxies when more site-specific values are not available. However, it should be kept in mind that average values found in literature are often broad calculations based on information from different locations, hence these may not always be suited to specific sites. As for existing site-specific examples, these vary widely (e.g. depending on underlying assumptions made) and therefore it is important to consider how applicable these values might be for proxies on other locations.

Costs of carbon emissions

The price of carbon in the ETS market in November 2008 was around EUR 13.5 per tonne (Source: http://www.pointcarbon.com/productsandservices/carbon/ last visited 8 November 2008).

The value of carbon sequestered in the mountain forests of the Uttarakhand region in India was estimated to be about US $85.5 million, using a rate of $13/t carbon (ANSAB 2006).

A study in five Iranian vegetative regions estimated that the annual value of carbon sequestration in these areas was $3,08 billion, i.e. about $212.5/ha on average. The study used a mean cost of carbon of $100 per ton. (Karimzadegan 2007)

Early calculations by the IPCC (1996) estimated that the average social cost of carbon ranges between US$5 and US$ 125 per tonne of carbon (in 1990 price). After surveying the literature, Clarkson and Deyes (2002) proposed a central value of US$105 per tonne of carbon (in 2000 prices), with upper and lower values of US$90 and US$210. Tol (2005) gathered over 100 estimates of the SCC in 2003 and calculated a mean value of UK$93 per tonne of carbon. Peer reviewed studies generally reported lower values, the mean being

US$43. Stern (2007) calculated a mean estimate of SCC in 2006 around US$85 per tonne CO2 (US$310 per tonne of carbon) (from IPCC 2008).

Costs of damage due to climate change

A study which assessed the ecosystem value of five forest and rangeland regions in Iran estimated that the value of the climate regulation service provided by these areas was about $137 billion per year. The study was based on the assumption that damages related to climate change represent one per cent of GDP, applying this percentage to the Iranian GDP (in 2002). (Karimzadegan 2007)

Estimates based on stated preferences (see Annex 1 for more detailed explanation of the method)

According to Ruijgrok et al. (2006) the value of climate regulation in pristine grassland sites, on the basis of WTP studies, was €102/ha/year worldwide. Climate regulation in scrubland in Europe was estimated at €346.70/ha/year (2008 values, as in Braat et al. 2008).

A study by Costanza et al. (1997) calculated the value of climate and gas regulation for a number of biomes across the world, on the basis of published studies and some new calculations. In many cases the values were based on willingness-to-pay methodologies. The average global value of climate regulation in forests was estimated at €71.58/he/year in temperate forests. The value of gas regulation was €5.69/ha/year in grasslands and rangelands, and 317.27 in swamp and flood plains in 2008 values. (2008 values, as in Braat et al. 2008).

How can the estimated value be turned into real money?

Although a market for carbon emission reductions exists (e.g. the Kyoto Protocol Clean Development Mechanisms (CDM), the EU Emission Trading System), these are not applicable to Nature 2000 sites (as they are either targeted at developing countries or on specific economic/industrial sectors).

Smaller voluntary markets/funds for climate regulating services, however, could be set up through private or public payments, for examples through payments for environmental services (PES). Voluntary buyers can be interested in the positive social and economic co-benefits stemming from climate regulation (such as carbon sequestration, climate change mitigation etc.), and may be, for instance, willing to invest in low-income areas and to utilize carbon payments to restore degraded lands and encourage agro-forestry on a large scale [13].

It will be important for Natura 2000 site managers, farmers and land owners to explore the potential benefits and beneficiaries of PES, as well as other possible funding sources – including EU Common Agricultural Policy (CAP) second pillar measures (e.g. by looking at national Rural Development Plans), the interest of the private sector for ecosystem services and the potential for public/private partnerships. The following questions can help in clarifying where to look for funding.

- **Who are the beneficiaries of this service** (e.g. local residents and farmers benefiting from climate regulation, society at large benefiting from climate change mitigation see

[13] FAO http://www.fao.org/ES/esa/pesal/ESmarkets3.html (last visited 26 Nov 2008)

Table 5.6.1). Given that the benefits arising from carbon sequestration and climate change mitigation are usually broad/global in scale, there is an argument here for national or even international support. What kind of mechanisms exist / could be used to engage these beneficiaries in financing the management of the site and maintenance of the service it provides?

- Are there possibilities for using existing **public / private funds**, e.g. **EU funding instruments**? [14]

- Is there a scope for advocating the use of **market based mechanisms**? For example, could Payments for Environmental Services (PES) schemes be established between the beneficiaries and service "managers / providers", e.g. could the property owners maintaining the climate regulating services be supported to maintaining or improving their management practices, e.g. to maintain/increase carbon sequestration potential?

[14] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.7 Regulating services: Water regulation

What is this service?

Natural ecosystem, including Natura 2000 sites, can play an important role in regulating water flows in the area. These regulation services include, for example, regulation of timing and magnitude of runoff, regulation and mitigation of floods and support to recharging of ground water resources.

From the ecosystem functioning point of view, water regulation services are based on the combined effects of vegetation and soil characteristics. Vegetation cover maintains certain soil characteristics, e.g. permeability, that enable infiltration of rain water into the ground. Reduced vegetation cover can thus increase surface runoff and decrease infiltration, resulting in lower recharging of the groundwater reserves. Increased surface runoff, e.g. due to the clearing of forests in the upper catchment area, can also cause higher peak flows during the wet season which in turn adds to increasing the risk of flooding. Similarly, straightening of rivers and suppression of natural flood plains can increase in the likelihood and adverse impacts of extreme flood events.

Closely linked services you should also look into: provisioning of water, climate regulation, water purification and waste management (Sections 5.2, 5.6 and 5.8)

Why is this service valuable?

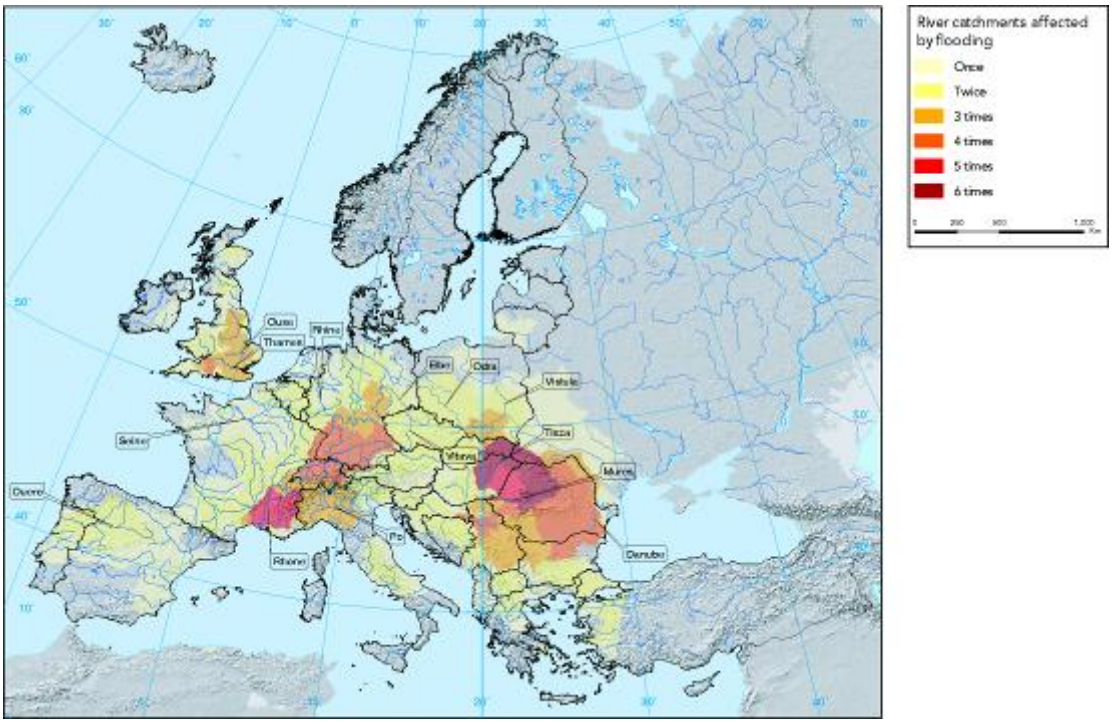
Flooding is one of the main natural disasters in Europe (Figure 5.7.1), thus ecosystems' natural ability to control flooding events can be of high value. According to the statistics, Europe has suffered over 100 major damaging floods in the recent years. It has been estimated that since 1998 floods have resulted in about 700 fatalities, the displacement of about half a million people and at least €25 billion in insured economic losses (EEA 2004). In addition, floods may also have negative impacts on human health. For example, substantial health implications can occur when floodwaters carry pollutants, or are mixed with contaminated water from drains and agricultural land (European Commission 2007).

It is also widely acknowledged that the flooding risk in Europe is increasing (IPCC 2001). This is because the magnitude and frequency of floods is likely to increase in the future as a result of climate change (i.e. higher intensity of rainfall as well as rising sea levels).

Additionally, there has been a marked increase in the number of people and economic assets located in flood risk zones (European Commission 2007).

Changing climate also affects the amount of rainfall and available water resources, including the availability of groundwater (See also Section 8.2). This can lead to water scarcity and over-exploitation of water which in turn can have several adverse effects, including economic costs. For example, the over-exploitation of ground water can cause saltwater intrusion[15] (Figure 5.7.2). Therefore, the ability of ecosystems, including Natura 2000 sites, to regulate water flows is of increasing significance.

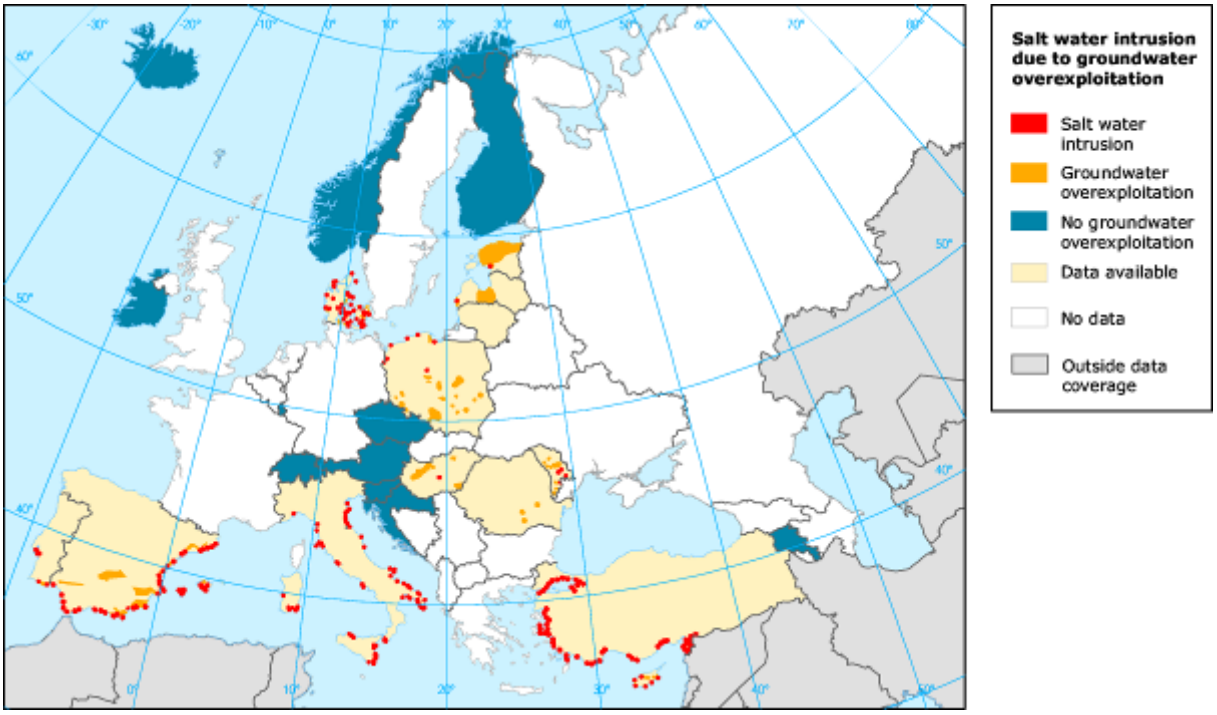
Figure 5.7.1. Recurrence of flood events in Europe between 1998-2002



Source: EEA 2004

[15] In general, fresh groundwater is discharged into the sea. If the demand for groundwater exceeds renewal rates, the seaward flow of groundwater decreases or is reversed. Seawater then advances inland within the aquifer leading to seawater intrusion (European Environment Agency. 1999. Groundwater quality and quantity in Europe. Copenhagen, Denmark. 123 pp. http://reports.eea.europa.eu/groundwater07012000/en)

Figure 5.7.2 Groundwater overexploitation and saltwater intrusion in Europe



Source: EEA 2006

Who maintains this service & who benefits from it?

As with all other services, Natura 2000 managers (e.g. farmers and land owners) play a key role in maintaining sites' natural abilities to regulate water cycle (e.g. preserving natural vegetation cover). The beneficiaries of this service are numerous consisting of several stakeholders facing potential flood risk or dependent on natural water supply. Examples on potential beneficiaries are given in Table 5.7.1 below.

Table 5.7.1 Some examples of service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers / foresters Other landowners and managers	Individuals, e.g. land users themselves, property owners	Local Regional	Reduced risks of flooding and related costs, e.g. cost to crops and reduced water quality Maintenance of natural water supply, e.g. ground water balance
	Different businesses & industries (small / large)	Local Regional	Reduced risks of flooding and related costs to business and industries, e.g. damage to infrastructure, reduced availability of processed resources (crops)

			Maintenance of natural water supply used by businesses and industries, e.g. ground water balance
	Health sector	Local Regional Global	Reduced flooding related damages to health (physical and mental)
	Insurance and financing sector	Local Regional Global	Reduced flooding related damages to properties, industries, health etc.
	Governments & administration	Local Regional Global	Support of Natura 2000 sites to reduce flood risk and maintain water security

Which Natura 2000 sites provide this service?

Natura 2000 site's ability to control the water flows depends on the ecosystem type and characteristics. In general, sites located at catchments areas (e.g. river slopes and floodplains) and coastal zones are likely to play a role in regulating water flows in the area. In addition, sites located in areas suffering from water scarcity could help to maintain area's water balance.

For example, inland waters, such as lakes and wetlands, are traditionally considered to be very important for the temporal regulation of water flow, mainly by accumulating water during wet periods (reducing peak flow). In addition, there is evidence that floodplain wetlands have the effect of reducing or delaying floods. However, the role of headwater wetlands (e.g., bogs and river margins) in reducing floods has not been demonstrated. Given these variations, it is important that the actual role of a Natura 2000 site in regulating water flows is always carefully considered and established before any valuation of the possible benefits takes place.

Important to consider: Evidence on the role of water regulating services is usually broader than a Natura 2000 site in question. In this case the key is to 1) demonstrate that the site in question also contributes in maintaining the water regulating services and 2) if possible to quantify the specific contribution of Natura 2000 to maintaining the service.

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

The qualitative and quantitative value estimates for water regulation can include, for example, the following:

- information on case studies and scientific evidence on ecosystems role in regulating run off and floods, mitigating negative effects of flooding and contributing to ground water recharge;
- area and volume of ground water reservoir;
- area protected from flooding;
- number of households / people / properties protected from flooding;
- number of businesses situated at flood risk zones, e.g. more detailed information on their importance to local and regional economy;
- infiltration capacity of the site (e.g. amount of water / surface area); and
- amount of crop yields / fish catch supported by regulated water flow or flood mitigation.

Some of these estimates, such as data on ecosystems' infiltration capacity, often require field measurements and specific calculations. Therefore, collecting and analysing this information is rather laborious and it requires input from experts. In this case, existing data or cooperation with relevant researchers can help to establish these value estimates.

Box 5.7.1. Quantitative examples demonstrating the value of water regulation

A case study in the Momoge National Nature Reserve wetland area, China estimated that the flood mitigation capacity of the soil in the area was 7.15 x 100 000 m^3 / ha / year (Ming et al. 2007).

It has been estimated that increased water flow by 1 m^3 increases the following year anchovy catch by 189 kg / month in the Ebre River delta (Lloret et al. 2004).

The International Panel for Climate Change estimate that the annual number of victims of actual coastal erosion or flooding will reach 158 000 in 2020 while half of Europe's coastal wetlands is expected to disappear as a result of sea level rise. (Eurosion 2004)

Monetary value estimates

Market price of the service

The market price method can be mainly used in the context of assessing ecosystems' value in recharging groundwater reservoirs. In this context the price of ground water can be used as an indicator for the ground water recharging service. The observed market price for ground water often reflects also the costs of production, e.g. water purification and transportations costs. In order to obtain a more accurate estimate for ground water recharge services the costs of production should be deducted from the observed price.

If possible, one could also try to calculate the change in the net value of ground water due to degradation of the ecosystem and use that as an indicator of the value of related water

regulation service (so called "production function approach"). In this case the net value of ground water (i.e. gross revenue from selling ground water minus production costs) in the normal situation is compared with the net value of ground water in a situation with changes in ecosystem functioning (i.e. gross revenue from selling ground water minus increased production costs). Relevant information (i.e. information on the current and changes situation) for developing this estimate might be, however, difficult to find. For example, data from similar but degraded ecosystems elsewhere could be used as a proxy for the costs of change.

Important to consider: When applying the market price based methods it is to be noted that the supply of ground water is also dependent on other factors than the vegetation cover (e.g. topography and abiotic soil characteristics). The price of ground water is therefore relatively suitable for reflecting the value of ecosystem in ground water provisioning as a whole but strictly speaking it is always a slight overestimate of the value of biodiversity in supplying ground water.

In addition, the market price for ground water also often integrates other ecosystem service values, such as benefits related to water purification and water supply (Sections 8.2 and 8.8). It is often difficult to tease apart contributions from individual services, therefore the market price based value estimates often reflect the value of a bundle of ground water related ecosystem services.

Costs of replacing the service or costs of avoided damage

The cost based approaches have been commonly applied to estimate the value of ecosystems in regulating water runoff and controlling floods. In addition, they can be also used to assess the value of ecosystems in retaining ground water. The costs used as indicators include, for example:

- costs of damage to properties and infrastructure;
- costs of loss of harvest due to flooding;
- flooding related heath costs (e.g. costs of accidents);
- costs of death due to flooding;
- avoided costs of flooding;
- costs of establishing artificial flood control;
- costs of transferring ground water from a longer distance; and
- costs of establishing an artificial system for ground water supply.

In general, the application of a cost based approach requires data on the likely alternative. In the case of water regulation this type of information should be rather easily available, however collection of some previously unavailable information and reanalysis of existing data might be needed. Box 5.7.2 lists some examples of these value estimates.

Important to consider: Estimates based on costs of damage / cost of mitigation / flooding related health costs etc. need to be clearly linked with qualitative (scientific) evidence on natural ecosystem(s) role in water regulation in the area.

Box 5.7.2. Examples of the monetary value of water regulation

Public expenditure dedicated to coastline protection against the risk of erosion and flooding reached an estimated 3,200 million Euros in 2001 (Eurosion 2004)

It has been estimated that more than 10 million people live in the areas at risk of extreme floods along the Rhine, and the potential damage from floods in the area amounts to € 165 billion. Similarly, the total value of economic assets located within 500 metres of the European coastline, including beaches, agricultural land and industrial facilities, is currently estimated at € 500 to 1,000 billion. (Eurosion 2004)

Some reference values for the water regulation services provided by a range of ecosystems (biomes) are listed below. These are based on a number of different studies (the source is noted in the last column) and are often averages of values obtained from literature reviews. They provide a useful overview of ranges of water regulation values used for specific biomes. All the values are in 2008 prices, as in Braat et al. 2008.

Biome	EUR/ha	Services provided	Location	Source
Grassland	2.44	water regulation	USA	Costanza et al. 1997
Swamps, flood plains	35.92	water regulation	Malaysia	Costanza et al. 1997
Temperate forest	51.92	watershed protection		Howard, 1999
Temperate forest (warm, mixed)	980.37	flood control	Lao PDR, Sekong Province	Rosales et al., 2005
Temperate forest	0.17	water regulation	Mexico	Costanza et al. 1997
Tropical forest	79.61	Flood Control	Rio Bravo, Belize	Eade, Jeremy D.O., and Dominic Moran., 1996
Tropical forest	3061.20	watershed protection		Emerton, 1999
Tropical forest	926.61	watershed protection		Kaiser and Roumasset, 2002
Wetlands	619.22	Water regulation	global	Schuyt and Brander, WWF (2004)
Wetlands	474.83	Flood control	global	Woodward and Wui (2001)

How can the estimated value be turned into real money?

In areas where the value of Natura 2000 in regulating water flows can be clearly demonstrated (e.g. with evidence on areas hydrological cycle) there could be a potential for obtaining financial support for preserving the site on this basis.

The following questions could give initial ideas to identify some possibilities for concrete funding:

- Is the site situated at a flood risk area and who are the stakeholders facing the risk of flooding? Alternatively, is the site located in an area suffering from water scarcity, e.g. are the ground water resources limited? Who are the stakeholders dependent on sustainable natural water supply? (see "*Who maintains this service & who benefits from it*?" above)?

- What kind of mechanisms exists / could be used to engage these beneficiaries in financing the management of the site so that the natural water supply is maintained?

- What possibilities are there for using existing public / private funds? For example, the EU funding instruments, e.g. Structural Funds, could support actions aiming to address environmental risks such as flooding and drought[16].

- Is there a scope for advocating the use of market based mechanisms? For example, could local industries, farmers or municipalities depending on natural flood defence be requested to pay for maintaining this service (i.e. establishing a system for payment for environmental services (PES))?

- Is it likely that the role of the Natura 2000 site in regulating floods and mitigating the impacts of droughts is to increase in the future due to climate change? If so, it might be also beneficial to highlight these increasing risks when seeking financing.

[16] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.8 Regulating services: Water purification & waste management

What is this service?

Ecosystems can help to filter out and decompose organic wastes introduced into inland water and marine areas and assimilate and detoxify compounds through soil and sub-soil processes. In general, vegetation, microbes and soils remove pollutants from overland flow and from groundwater by, for example, physically trapping water and sediments, reducing water speed to enhance infiltration, biochemical transformation of nutrients and contaminants, and diluting contaminated water (Brauman et al. 2007, see also Table 5.8.1). In addition to microbes, a number of animals, such as aquatic filter feeders and some mammals, can play a role in maintaining water quality.

For example, riparian areas along rivers and streams act as "living filters" that intercept and absorb sediments, and store and biogeochemically transform nutrients and pollutants carried in runoff from adjacent lands. Living and dead vegetation slow down the rate of water that runs off of land surfaces, allowing adsorption of nutrients, metals, and other contaminants on sediment surfaces and providing an opportunity for microbial breakdown of chemicals and uptake of nutrients for growth. Sediments are trapped and excess nutrients (such as nitrogen and phosphorus), heavy metals, and other materials may be incorporated into living plant tissue or broken down to less harmful substances by soil microbes and other organisms (ESA and UCS, undated). Studies suggest that a riparian buffer needs to be a minimum of 25m wide to remove nutrient and pollutions and a minimum of 50m to provide detritus removal and bank stabilisation (Scherr and McNeely 2008)

Similarly, forests and other mature ecosystems generally improve water quality in a catchment by reducing surface erosion and increasing water infiltration and therefore soil filtration of pollutants. Surface erosion is rarely significant in areas where the soil surface is protected against the direct impact of the rain through a litter layer maintained by some sort of vegetation (Bruijnzeel 2004). Furthermore riparian (streamside) forests can remove 80 per cent to 90 per cent of sediments and sediment bound pollutants in the surface runoff from agricultural fields (Naiman and Decamps 1997) and reduce local nitrate concentrations by 5 per cent to 30 per cent per metre of width. (Brauman et al 2007).

Important to consider: a certain degree of water purification would take place even in the absence of life, as water can be filtered by passing through soil and rock. It would therefore be incorrect to attribute the value of all water purification in a watershed to its natural vegetation.

Closely linked services you should also look into: provisioning of water, water regulation. These services are addressed in Sections 5.2 and 5.7.

Table 5.8.1 Some ecosystem characteristics that affect its ability to maintain water purification and waste assimilation services

Aspect of ecosystem	Benefit
Plant Cover	Reduce run-off and reduce erosion, facilitating water intrusion into the soil (see next point)
Soil	Filters the water; valuable e.g. to reduce nitrates
Mussels	Valuable in filtering clay, silt, bacteria, phytoplankton and zooplankton increasing water quality and clarity (McIvor 2004)
Microbes and macrophytes – in wetlands	These are particularly abundant in wetlands and help denitrification and other biochemical processes that improve water quality, removing suspended solids, phosphorus, and nitrogen from wastewater (e.g. Sundaravadivel & Vigneswaran 2001). Wetland biota can also remove waterborne toxins and heavy metals from the water (e.g. Simpson et al. 1983).
Mammals- beaver	Support nutrient cycling and improve downstream water quality (Naiman et al. 1986)
Reedbed systems	Waste removal/quality improvement; can address bacteria too - *e. coli*.

Why is this service valuable?

Water quality is a measure of the chemicals, pathogens, nutrients, salts, and sediments in surface and groundwater. The importance of water quality to domestic use, particularly to drinking supply, is obvious (Dudley & Stolton 2003). Water quality is also very important for food production (including crops, livestock and inland and marine fisheries) and for recreational use (Vörösmarty et al. 2005). Sediments reduce the storage capacity of reservoirs, thereby affecting water supply and hydroelectric production (Postel & Thompson 2005, Arthurton et al. 2007).

Ecosystems ability to purify water provides added value to the benefits dependent on fresh water. These include, for example, decreased need for pre-treatment of drinking water and lower costs of waste water. Water quality also directly influences the use of water bodies for recreation and the availability of clear water underpins agricultural and fisheries production. Finally, the proximity to clean water streams can also increase the property values. These benefits can take place both at the close vicinity of ecosystem in question of further away within the same river basin or catchment area.

Who maintains this service & who benefits from it?

Natura 2000 land users (e.g. farmers, foresters or other landowners and stakeholders) are the key parties maintaining the water purification and waste management ecosystem services. They can contribute to the effectiveness of the service by maintaining riparian plant communities, avoiding deforestation, protecting wetlands and the ecosystems contributing to water purification and waste management.

The beneficiaries of these services are various, ranging from local to regional, national and international level. In general many people enjoy the benefits of cleaner and clearer water, from citizens to private companies. Examples of these beneficiaries are given in the Table 5.8.2 below.

Table 5.8.2. Some examples of service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers / foresters Landowners	Individuals, e.g. land users themselves	Local (Regional)	Cleaner drinking water for local households. Cleaner bathing water for residents.
	Different businesses & industries (small / large) – public and private water companies	Local Regional (Global)	Cleaner drinking water for local companies For water supply and waste water treatment companies (public or private): lower costs of water treatment and purification For local tourism activities: benefits from tourism attracted by clean and clear water

Which Natura 2000 sites provide this service?

Many Natura 2000 sites can provide the service of water purification and waste management. The actual influence of a site on the quality of surface or underground water will depend on the type of ecosystem and the site's proximity to the water source. For example, forests and wetlands have great potential for water purification, as well as other ecosystems hosting riparian plant communities.

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

Some key questions for the qualitative assessment of water quality are listed below.

- Does the Natura 2000 site contribute to the purification of water / waste water in the area – e.g. is there water coming into the site (river/streams, groundwater, rainwater) that is polluted in any way?
- Is there any water coming from the site that is subsequently an input to agriculture or drinking water or useful for other activities (e.g. downstream fisheries)? Is the provision of the clean water appreciated by those benefiting?
- Are there rivers / streams / lakes that are the focus of recreation/tourism or have the potential for recreation tourism?
- Is there housing near by and are the water related assets seen as valuable by the residents?
- Which of the above are already significant or potentially significant?

To answer these questions requires a physical analysis of the site and its hydromorphological characteristics and its interactions in the local/regional landuse, i.e. a mapping of the provision of the service and the use of the service. In addition, qualitative assessment could usefully include an analysis of uses (this will then become part of a quantitative analysis) and survey of users' perceptions of benefits (which could also be a part of a monetary evaluation if suitable questions are added).

The quantitative assessments build on qualitative information above, aiming to find appropriate indicators to represents the scale of benefits. The quantitative estimates on the value of water regulation service could include, for example:

- **recreation: swimming / rafting / recreational fishing etc.:** number of visitor to the site and duration of visit;
- **recreation:** number of fishermen using of the area, frequency of visits etc.
- **housing value:** number of houses dependent on the Natura 2000 site for their water supply;
- **water purification:** changes in water quality from upstream to downstream (surface and ground waters), e.g. measurement of nitrate content, sediment levels, iron levels, pH etc.
- **production of goods**: the amount of water used for drinking and for agricultural abstraction downstream associated with water that has passed through the site (e.g. million m^3);
- **production of goods:** the proportion of fisheries or agricultural production downstream that benefit from the provision of clean water by (or partly by) the site (e.g. tonnes landed, hectares of agricultural land); and
- **production of goods**: the level of electricity output and how this varies over the years due to siltation, also, has there been any dredging activities and if so volume of sediment removed.

Monetary value estimates

Avoided costs including costs of waste water treatment (e.g. where a reed bed is used) or avoided water pre-treatment (e.g. where there is reduced need for pre-treating drinking water or agricultural waters) and potentially avoided dredging costs (sediment in hydropower zones) can be used as estimates for the value of water purification. The method here is simply an avoided cost analysis, i.e. looking at the potential cost of physical infrastructure that would be needed had the service not been in place.

Case examples of avoided costs and also on other more complex valuation methods are included in Box 5.8.1.

Box 5.8.1 Examples of values related to water purification

Please note: Some average values for water purification could be used to estimate the value of this service also at different Natura 2000 sites if no site-specific values are available. However, it should be kept in mind that average values found in literature are often broad calculations based on values from different sites, hence these may not always be suited to specific sites.

Cost based estimates

New York city has benefitted from clean water provision (from the Catskills mountains) though the degradation of the natural ecological purification system led to a choice – either investment in the replacement/substitution of the natural system with an artificial filtration plant (the estimated price tag for this installation was $6 to 8 billion in capital costs, plus annual operating costs of $300 million) or invest in restoring the watershed's natural purification services (about $1 billion). New York City invested $1 billion in natural capital. (as in Braat et al. 2008)

In an analysis of 27 US water suppliers, treatment costs for drinking water deriving from watersheds with 60 per cent forest cover were half the cost of treating water from watersheds with 30 per cent forest cover and one third of the cost of treating watersheds with 10 per cent forest cover (Ernst 2004, Postel & Thomson 2005). This at the same time demonstrates two issues – one is the benefits and the other is the fact that benefits are not linear with landcover.

Ruijgrok et al (2006) estimated a number of values for water purification services for pristine scrubland in Europe, ranging from €0.19 to €628/ ha in 2008 Purchasing Power Parity (PPP) -adjusted usable values (as in Braat et al. 2008), using the avoided cost method. In grassland, the value ranged from €11.4 to €124.6/ha.

The restoration cost of the Florida Everglades : $685 million. (as in Braat et al. 2008)

The restoration costs for three rivers project in Leinster (Ireland) were €8.3 million; while for Lough Dreg and Lough Ree Catchment Monitoring and Management project costs were €3 million. (as in Braat et al. 2008)

Estimates based on market values (see Annex 1 for more detailed explanation of the method)

In the River Errif or Moy the fishing rights are valued at €4-8000/salmon or €500,000 per kilometre of river bank. Caution should be applied when considering transferring this value to other areas, as the high values represent a scarcity rent[17] (Marine Institute 2003)

[17] Scarcity rent is the marginal opportunity cost imposed on future generations by extracting one more unit of a resource today. It is the cost of "using up" a finite resource because benefits of the extracted resource are unavailable to future generations. (Economic glossary http://glossary.econguru.com/)

The Marine Institute (2003) estimated that water related recreation accounted for 45 per cent of domestic tourism expenditure.

Property price based estimates (see Annex 1 for more detailed explanation of the method)

A study on water clarity and eutrophication in Main, using the hedonic pricing method, revealed that water clarity significantly affects property prices, and 1 meter (clarity) improvement in lake water quality can generate benefits in the millions of dollars. It was estimated that the average implicit price of water clarity was about $ 16,000 (Michael et al. 1996)

Estimates based on stated preferences (see Annex 1 for more detailed explanation of the method)

A study by Costanza et al (1997) calculated the value of waste treatment services for a number of biomes across the world, on the basis of published studies and a few original calculations. In many cases the values were based on willingness-to-pay methodologies. The average global value of waste treatment was hence estimated to be about €104.16/ha /year, in 2008 values (as in Braat et al, 2008), in grasslands and in tropical and temperate forests.

Other methods

WWF (Schuyt and Brander 2004) estimated the global value for water purification in wetlands, on the basis of a statistical synthesis (meta analysis) of 89 selected wetland sites. This was $288/ha in 2004, i.e. €384.35/ha in 2008 values (as in Braat et al. 2008).

How can the estimated value be turned into real money?

The value of water purification can be substantial, and attract the interest of public and private organisation, since the service can affect the costs of water treatment and purification, e.g. to supply drinking water to local households, or to produce bottled mineral water. Opportunities for public and private funds hence should be sought.

For instance, though payments for environmental services (PES) local farmers forest managers within the Natura 2000 could obtain financial support to maintain the water purification service, e.g. through appropriate forest management and the maintenance of riparian plant communities (e.g. reed beds). For example, in France private payments to farmers have been made by the water company Vittel to reduce nitrate in water, while in the US, the Conservation Reserve Program (CRP) promoted water quality and wildlife habitats and helped prevent soil erosion.

In order to set up a PES, it will be important for Natura 2000 site managers, farmers and land owners to identify who are the beneficiaries of the service and the approximate amount of this benefit, e.g. are private water companies or public water treatment plants present in the area? How much do they pay for water purification? What will the cost be if ecosystems provided no water purification service?

Other financial opportunities could be offered by CAP pillar 2, such as agri-environmental measures (under axis 2) rewarding agri-environmental commitments beyond usual good practice, to reduce environmental risk and/or preserve/enhance nature or the landscape.[18]

[18] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.9 Regulating services: Air quality regulation

What is this service?

Ecosystems effect the concentrations of many atmospheric compounds that have a direct deleterious effect (for example, pollution) or a beneficial effect (e.g. fertilization) on human well-being. The service of atmospheric cleansing is provided by ecosystems due to their capability of functioning as sinks for different air pollutants. Plants facilitate the uptake, transport and assimilation or decomposition of many gaseous and particulate pollutants. Indeed, the layered canopy structure of trees, which has evolved to maximise photosynthesis and the uptake of carbon dioxide, provides a surface area of between 2 and 12 times greater than the land areas they cover (MA 2005).

Ecosystems are often both sources and sinks, however, for various trace gases that undergo complex atmospheric reactions, simultaneously affecting several aspects of air quality in different ways. It is therefore often hard to quantify the current net effect of ecosystems or of ecosystem change on a particular aspect of air quality and especially on the effect of cleansing the atmosphere from pollutants (MA 2005).

Closely linked services you should also look into: regulation of human health (Section 5.16)

Why is this service valuable?

The benefits related to decreased air pollution can be listed as follows:

- a reduced amount of pollutants directly affects people's health by reducing respiratory diseases;
- reduced impacts on ecosystems caused by air pollutants (e.g., acid rain, eutrophication), which may affect agricultural, timber and fish production;
- by limiting damages to ecosystems, the service preserves values related to aesthetic, cultural, religious, recreational or educational benefits; and
- reduces negative radiative forcing and so the impacts of climate change (See Section 5.6 on climate regulation).

Table 5.9.1 Attributable mortality and disability-adjusted years from environmental risk factors, 2000 (in thousands)

	World	Africa	North America[b]	South and Central America	Eastern Mediterranean	Europe	Southeast Asia	Western Pacific
				(thousand)				
Mortality								
Unsafe water, sanitation, and hygiene	1,730	608	1	54	270	18	699	77
Urban air pollution	799	32	28	35	59	107	164	373
Indoor smoke from solid fuels	1,619	392	0	26	118	21	559	503
Climate change[c]	154	54	0	0	21	0	74	3
DALYs								
Unsafe water, sanitation, and hygiene	54,158	18,636	61	2,045	8,932	736	19,727	4,018
Urban air pollution	7,865	485	200	360	727	859	1,852	3,386
Indoor smoke from solid fuels	38,539	12318	6	773	3,572	544	15,227	6,097
Climate change[c]	5,517	1,893	3	94	768	17	2,572	170

[a] Uncertainty ranges (range of coefficient of variation): water and indoor air pollution 0 to 4.9; urban air pollution 10 to 14.9; climate change >15.

[b] North America: United States, Canada, and Cuba.

[c] Climate change impacts are modeled effects on disease, flood risk, and food production for modeled climate in year 2000 compared with mean climate in 1961–90.

Source: MA 2005

Who maintains this service & who benefits from it?

Air cleansing capacity is especially supported by the maintenance and management of healthy forests with diverse vegetation structures and features increasing the surface area for the removal of pollutants. This service is thus provided by land users maintaining and restoring a favourable conservation status of forest habitats as well as by landowners contributing to the stability and healthy conditions of forests through sustainable management measures. This can refer to measures such as natural regeneration, management guaranteeing stands with different ages and development stages, and reducing the construction of roads.

Table 5.9.2 Service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers	Individuals, e.g. land users themselves, residents, and tourists	Local (Regional)	Reduced respiratory diseases and increased health
Landowners	Different businesses & industries (small / large)	Local Regional (Global)	Reduced damage to crops or timber production due to increased health of ecosystems. Preserved recreational values of a site leading to increased housing values.

Which Natura 2000 sites provide this service?

Although different types of landscapes and biomes provide air cleansing services, especially forest ecosystems can affect air quality in a region. The higher the number of trees the higher is the removal of air pollutants from the atmosphere. This especially refers to healthy forests with diversified structures, and to conifers due to the extent of the surface area available for the removal (please see also "*Why is this service valuable?"*).

Habitats presenting these characteristics are especially suited in providing this service. Please also consider that air pollution can have severe impacts on the conditions of forests (e.g., acidification and over-eutrophication) and so affect their cleansing capability.

Table 5.9.3 The estimated air cleansing capacity of broadleaved and coniferous forests and heath land (Source: Ruijgrok et al. 2006)

Ecosystem	Amount captured	Prize (cultivated)	Prize (non-cultivated)
Broadleaved forest	110-190 kg dust / ha / year	300 EUR / kg	70 EUR / kg
Coniferous forest*	220-380 kg dust / ha / year	300 EUR / kg	70 EUR / kg
Heath land**	50 kg dust / ha / year	300 EUR / kg	70 EUR / kg

*Assumption is that the capacity of coniferous forests is twice the capacity of broadleaved forests as they remain green though out the year.
**Assumption is that the capacity of heath land is half the capacity of broadleaved forests (WUR mileusysteemanalyse 2006)

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

The following question can help to establish the role of Natura 2000 in regulating air quality.

- How does a Natura 2000 site contribute to air cleansing?
- How do Natura 2000 sites influence the health of people living in the region?
- Are there special recreational areas such as lakes and forests and how might air pollution affect those areas (e.g. via airborne eutrophication)?
- Are air related assets seen as valuable by the residents?

Furthermore, the quantitative analysis could fortify results obtained through a qualitative analysis by providing data on the following aspects.

- What is the actual atmospheric cleansing capacity a Natura 2000 site can offer in kg per ha per year?
- What is the scale of health benefits arising from a site? How does the mortality or morbidity rate linked to respiratory diseases look like (quality, utility and disability-adjusted life years, life expectancy)?
- How many houses are located near to a site and within what distance?
- How many visitors come to a site because of its air quality services?
- What is the number of nights they spend in the area?
- How many visitors come to a site for recreational fishing and how might this be influenced by a deterioration of the site due to increased air pollution, e.g. eutrophication?

Box 5.8.1 provides an example of how the valuation of the cleansing of an area might be used to show the benefits of certain vegetation.

Monetary value estimates

The replacement cost method estimates the value of ecosystem services as the cost of replacing them with alternative man-made goods and services. In practice this would need an (rough) assessment of the volume of air cleaned by a Natura 2000 site. This information would then need to be linked with the costs of replacing this service by the development and use of related technologies, e.g. filter systems, providing the same scale of service can be gathered.

The damage cost avoided method uses either the value of property and assets protected, or the cost of actions taken to avoid damages, as a measure of the benefits provided by an ecosystem (King & Mazzotta 2000). Regarding air quality, this could mean collecting information on health costs (damage to people's health) that have been avoided by conserving natural areas functioning as sinks for air pollutants. One could also try to gather data on the damage costs caused by impacts of air pollutants on ecosystems, such as eutrophication of lakes and its impacts on recreational fishing, or the costs arising from reduced timber production due to unhealthy forests.

The information can be collected from secondary sources such as scientific studies and available statistics or by consulting different experts.

Box 5.9.2 provides an example on how health costs can be used to show the benefits of air cleansing services.

Box 5.9.1 Examples of the value of air quality regulation

Quantitative value estimate

A study by Nowak *et al.* (Powe 2002 and references within), for example, found urban trees in Philadelphia, USA, to have removed over 1,000 tons of air pollutants from the atmosphere in the year of 1994.

Monetary values based on avoided costs

In a study (Ruijgrok et al. 2006) in the Netherlands, the avoided costs method was applied to demonstrate the benefits of air quality. The authors collected data on the costs arising from diseases caused by air pollution and related them to particulate matter, SO_x and NO_x emissions per km and year. They also took into account the absorbance capability of the landscape in ha per year, derived from scientific literature. Costs were calculated per kg emissions in a certain area or per habitant.

Similarly, in the UK the results of a study (Powe 2002) have found net pollution absorption by trees to have reduced the number of deaths brought forward by air pollution by between 65-89 deaths and between 45-62 hospital omissions, with the net reduction in costs estimated to range somewhere between £222,308 and £11,213,276.

In terms of health effects, Hewitt (2002) found that doubling the number of tree in the West Midlands would reduce excess deaths due to particles in the air by up to 140 per year (Powe, 2002 and references within).

How can the estimated value be turned into real money?

Similarly as for other regulating services such as avalanche or storm protection focusing on the opportunity costs (see above) arising from the existence or the loss of the service might be one approach to turn economic value into real money. This mainly consists of enforcing arguments for the financing of activities necessary to maintain this service. Regarding air quality this can refer to health care costs saved because of the level of air quality maintained, or the costs that might arise when the service is no longer in place (e.g. increasing health care costs, costs for the recreation industry linked to eutrophication of freshwater ecosystems).

If damages arising from the loss of the air quality maintenance function of a Natura 2000 site can be clearly linked to detrimental activities of legal persons, **environmental liability** and the polluters-pay principle might be applied and used for financing restructuring measures. This could, for example, refer to increasing costs for healthcare or the costs arising for the recreational industry due to eutrophication of freshwater ecosystems.

Another alternative method are **payments for environmental services** (PES). The scheme focuses on paying land users for environmental services they provide. With regard to air quality this could refer to all activities that influence the air cleansing capacity of an ecosystem. Payments could come either from public authorities, which are interested in reducing health care costs, or the recreation and tourism industry, which is, for example interested in a reduced eutrophication of freshwater ecosystems.

Air quality might also be an important driver for recreation and ecotourism related to a specific site. Therefore it might also be interesting to consider the application of methods described in the related Section 5.4.

Before determining which method mostly suits your site, it is important to establish who the beneficiaries of this service are (e.g. farmers, visitors or different businesses benefiting from recreational services; see "*Who maintains this service & who benefits from it?*") and thus who might be most appropriate in supporting management financing or the maintenance of the service.

Please also consider that using existing **public / private funds**, e.g. **EU funding instruments** such as Structural Funds or the European Agricultural Fund for Rural Development (EAFRD) might be an important instrument in supporting initiatives taken[19].

[19] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online:
http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm

5.10 Regulating services: Erosion regulation

What is this service?

Erosion is commonly defined as carrying away or displacement of solids (e.g. sediment and soil) and other particles) by wind or water. Erosion is a natural process but is heavily increased by human land use, in particular by intensive and inappropriate land management practices such as deforestation, overgrazing, unmanaged construction activity and road-building.

Managed areas, e.g. areas used for the production of agricultural crops, generally experience a significant greater rate of erosion than areas under natural vegetation. This capacity of natural ecosystems, e.g. Natura 2000 areas, to control soil erosion is based on the ability of vegetation (i.e. the root systems) to bind soil particles thus preventing the fertile topsoil from being blown or washed away by water or wind. In addition, healthy vegetation cover can also mitigate the negative impacts of tramping by livestock.

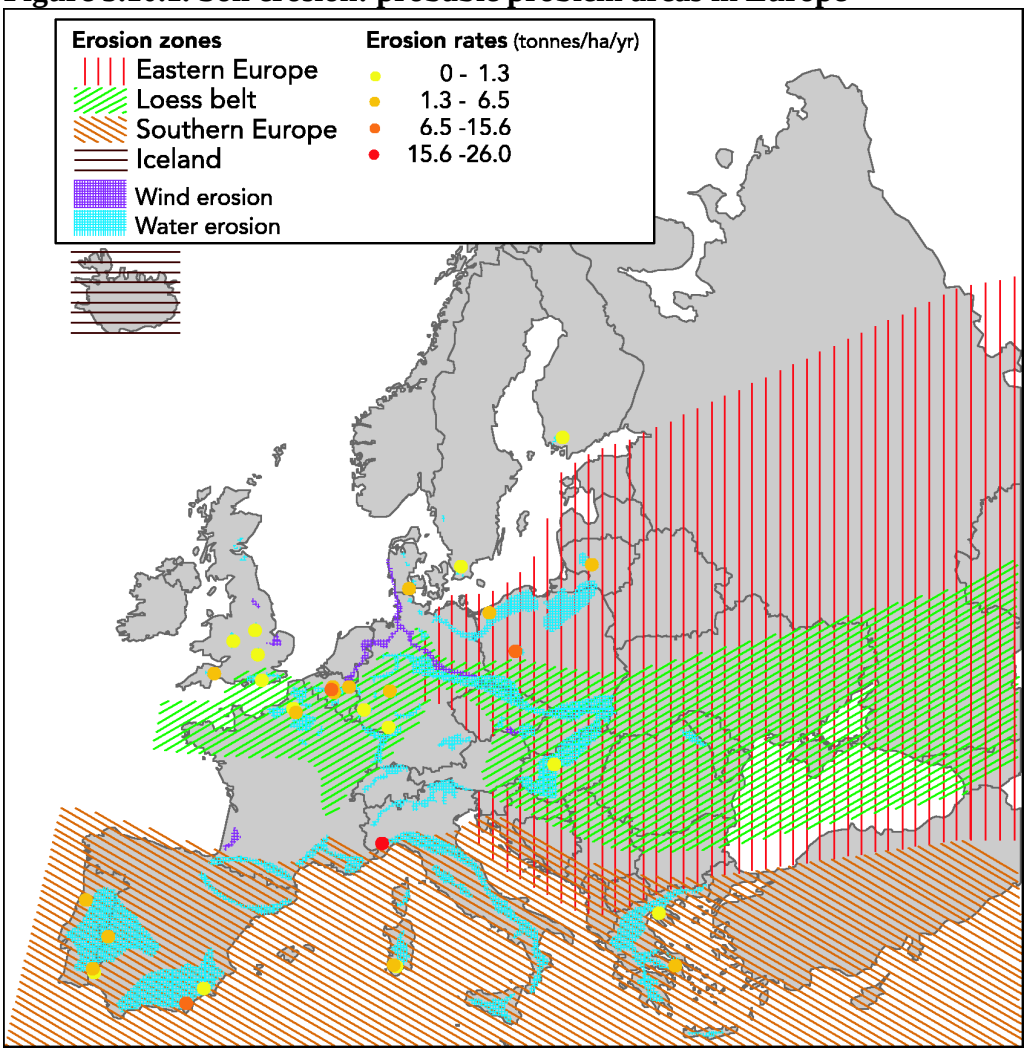
Closely linked service that you should also look into: biodiversity resources and regulation of water quality (Sections 5.1. and 5.7.)

Why is this service valuable?

Soil erosion can cause several negative impacts. For example, erosion diminishes soil fertility resulting in reducing crop yields and biomass for livestock. In addition, soil erosion increases the sediment load in water bodies which in turn can cause a decline in water quality and alter the flow of water.

Soil erosion, in particular water induced erosion, is a widespread problem throughout Europe. It has been estimated that about 12 million hectare of land in Europe (e.g. part of the former Soviet Union), or approximately 10 per cent of the area, is strongly or extremely degraded by water erosion (as in Jones et al. 2003). In general, the highest erosion rates are located in the central and southern Europe, including the Mediterranean region (see Figures 5.10.1 and 5.10.2 below). For example, in parts of the Mediterranean erosion has reached a stage of irreversibility leaving behind areas with no soil cover (Jones et al. 2003). Therefore, it is evident that ecosystems' ability to control soil erosion is of high value in Europe.

Figure 5.10.1. Soil erosion: probable problem areas in Europe



Source: EEA 2003 (http://dataservice.eea.europa.eu/atlas/viewdata/viewpub.asp?id=489)

Who maintains this service & who benefits from it?

Ecosystem's natural ability to retain soil is maintained by adopting land management practices that preserve sufficient vegetation cover in the area. Therefore, land managers, e.g. managers of Natura 2000 sites, play an important role in preserving this service. Minimising soil erosion benefits several stakeholders examples of which are given in Table 5.9.1.

Table 5.10.1. Some examples of service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers / foresters	Individuals, e.g. land users themselves	Local (Regional)	Maintaining soil productivity for crop and livestock production

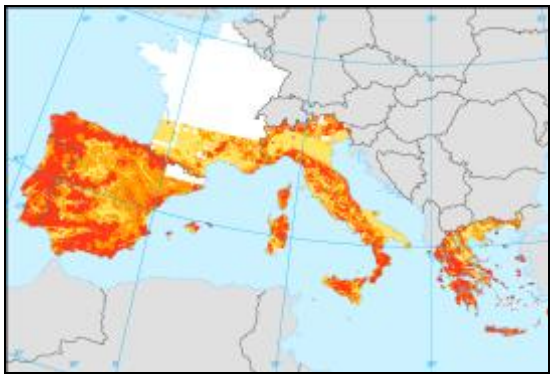
Other landowners and managers			Preventing the degradation of nearby water bodies due to sediments, e.g. maintaining the quality of drinking water and preserving area's recreation value
	Different businesses & industries (small / large)	Local Regional (Global)	Maintaining supply of resources used by industry and businesses (e.g. crops, livestock and timber) Maintaining the quality of lakes, rivers and coastal areas supporting tourism business
	Water purification plants	Local Regional	Securing the quality of drinking water
	Water transport sector	Local Regional	Maintaining the navigability of water bodies by limiting their sedimentation
	Consumers	Local Regional (Global)	Maintaining the availability of agricultural products
	Governments & administration	Local Regional (Global)	Support of Natura 2000 sites to maintaining food supply and security and securing "free for all" possibilities for leisure and recreation

Which Natura 2000 sites provide this service?

Preventing erosion can be of relevance to all terrestrial Natura 2000 sites located in erosion prone areas. These areas include, for example, steep slopes and areas with naturally thin soil cover. In addition, sites situated close to lakes, river banks and sea might be of high value, given the possible negative effects of soil erosion on the status and quality of water bodies.

For example, the Mediterranean region is particularly prone to erosion (Figure 5.10.2). This is because it is subject to long dry periods followed by heavy bursts of erosive rain, falling on steep slopes with fragile soils, resulting in considerable amounts of erosion (Jones et al. 2003).

Figure 5.10.2 Actual soil erosion risk in southern EU Member States (2003)



Source: EEA 2003 (http://dataservice.eea.europa.eu/atlas/viewdata/viewpub.asp?id=9)

How to estimate the value of this service?

Please note: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

The qualitative evidence and quantitative data on ecosystems ability to regulate erosion could include the following information:

- information on case studies and scientific evidence on ecosystems role in mitigating erosion and maintaining soil cover in the area (or similar areas elsewhere);
- coverage of area protected by erosion (km^2);
- crop yield dependent on naturally fertile soil protected by the site;
- amount of water (e.g. drinking water) that is protected by sedimentation and related decline in water quality;
- quantity of input (e.g. required fertilisers etc.) needed to replace natural control of erosion; and
- difference in quantity of production on area with natural erosion control in comparison to area with increased erosion (due to intensive use).

Important to consider: Available evidence on the value of natural erosion control is usually broader than a Natura 2000 site in question. In this case the key is to a) demonstrate that the site in question plays a role in maintaining this service in the area and b) if possible to quantify the specific contribution of Natura 2000 to maintaining the service.

Monetary value estimates

Market price of the service

A handful of market price-based estimates could be feasibly available to demonstrate the value of Natura 2000 site in controlling erosion. These are mainly based on the market price of resources closely dependent on this service, including the value of crops and livestock dependent on fertile soil or the value of naturally high quality drinking water. In erosion prone areas these prices could be used as (partial) indicators for the value of natural erosion control. However, as the observed market prices often reflect the costs of production, e.g. water purification, costs of fertilizers and transportations costs, these costs should be deducted from the observed price in order to create a valid estimate of the service (See also Sections 5.1 for explanation).

If possible, one could also try to estimate the change in the net value of Natura 2000 site's erosion control due to possible degradation of ecosystem (i.e. so called "production function approach"). In this case the net value of ground water or crops (i.e. gross revenue from selling these resources minus production costs) in the normal situation is compared with the net value of resources in a situation with changes in ecosystem functioning (i.e. gross revenue from selling resources minus increased production costs). Relevant information (i.e. information on the current and changes situation) for developing this estimate might be, however, difficult to find. For example, data from similar but degraded ecosystems elsewhere could be used as a proxy for the costs of change.

Important to consider: When applying the market price based methods it is to be noted that the supply of crops and water is also dependent on other factors than the vegetation cover (e.g. topography and abiotic soil characteristics). In addition, these market prices also often integrate other ecosystem service values, such benefits related to pollination, natural biological control, water purification and water supply (Sections 5.2, 5.15, 5.14, 5.8 and 5.2). Consequently, it is to be kept in mind that the market price-based value estimates might often reflect the value of a bundle of ecosystem services.

Costs of replacing the service or costs of avoided damage

The possible cost-based estimates reflecting the value of erosion control could include, for example:

- cost of the reduction of production / yield due to erosion and decrease in soil quality;
- cost of maintaining impoverished soil quality with fertilisers;
- costs of removal of increased sediment load in rivers / accumulated sediment from dams etc;
- loss of revenue from tourism due to the degradation of terrestrial areas and/or water bodies; and
- increased costs of water purification due to sedimentation.

Important to consider: Estimates based on costs of damage / cost of mitigation / flooding related health costs etc. need to be clearly linked with qualitative (scientific) evidence on natural ecosystem(s) role in water regulation in the area.

Box 5.10.1 Quantitative examples of valuing erosion control

A study by Ruijgrok et al. (2006) estimated that the value of erosion control in pristine scrubland areas in Europe and in Belgian grasslands was €44.5/ha, at 2008 prices (as in Braat et al, 2008). These values were estimated on the basis of the avoided cost method.

How can the estimated value be turned into real money?

In areas where the value of Natura 2000 in reducing erosion can be clearly demonstrated there could be a potential for obtaining financial support for managing the site on this basis.

The following questions could give initial ideas to identify some possibilities for concrete funding.

- Is the site situated in an area with high risk of erosion? If so, who are the stakeholders that would face the negative impacts of increased erosion (see "*Who maintains this service & who benefits from it?*" above)?

- What kind of mechanisms exists / could be used to engage these beneficiaries in financing the management of the site so that the natural water supply is maintained?

- What possibilities are there for using existing public / private funds? For example, the EU funding instruments, e.g. European Agricultural Fund for Rural Development (EAFRD), could support actions aiming to reduce soil erosion.[20]

- Is there a scope for advocating the use of market based mechanisms? For example, could local industries, farmers or municipalities depending on natural flood defence be requested to pay for maintaining this service (i.e. establishing a system for payment for environmental services (PES))?

- Is it likely that the role of the Natura 2000 site in regulating floods and mitigating the impacts of droughts is to increase in the future due to climate change? If so, it might be also beneficial to highlight these increasing risks when seeking financing.

[20] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.11 Regulating services: Avalanche regulation

What is this service?

What is this service and why is it valuable?

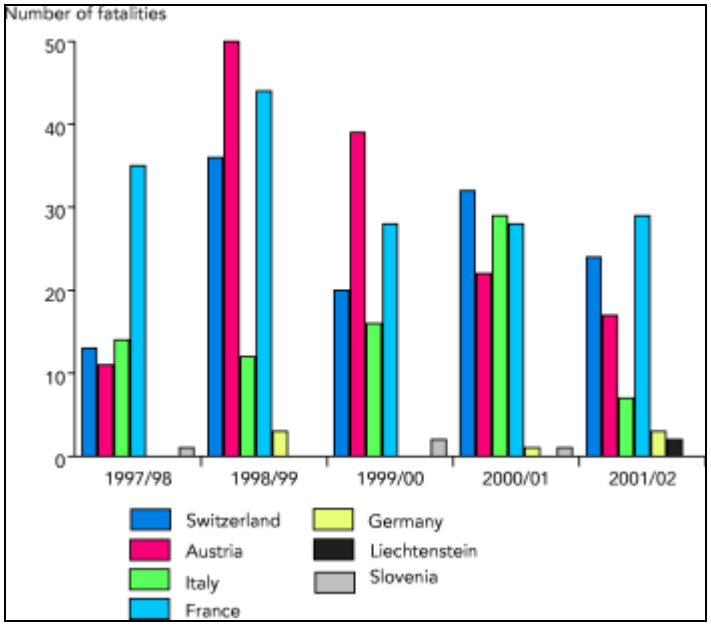
An ecosystem's ability to mitigate avalanches is directly related to its forest cover and the density of trees that can reduce the strength of avalanches. Firstly, tree cover holds snow in place and in an event of an avalanche the impact of the snow against the trees slows it down.

Avalanches endanger the life of human beings (Figure 5.11.1) and can have strong impacts on the economy by destroying infrastructure such as buildings, roads or rails and recreational areas in mountain areas. Avalanches endanger only a small part of a country's surface, but they are problematic mostly because of their spatial and temporal unpredictability[21].

Since more tourism and infrastructure has entered mountain areas in recent years, the number of conflicts between those and extreme events like avalanches has also increased. This led to high investments by the public sector in technical avalanche mitigation measures (e.g. avalanche defence such as snow supporting structures, avalanche nets, dams). Besides technical protection measures, natural ecosystems also offer protective functions and help to avoid damages caused by natural hazards. This especially refers to the role of healthy and stable forests in avoiding major damages to people and infrastructure caused by avalanches, debris or rock fall.

[21] Pavšek

Figure 5.11.1 Human casualties caused by avalanches in Europe.



Source: EEA 2004 (http://dataservice.eea.europa.eu/atlas/viewdata/viewpub.asp?id=894)

Who maintains this service & who benefits from it?

Impacts of natural hazards such as avalanches can be lessened or stopped through the maintenance and management of certain vegetation structures and features as well as healthy and stable ecosystems. This service is therefore provided by land users maintaining and restoring mountain forest ecosystems as well as by landowners contributing to the stability of forests through sustainable management measures. This can refer to measures such as natural regeneration, use of species native to a certain location and the maintenance of structured and diverse forests.

Table 5.11.1 Service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers	Individuals, e.g. land users themselves, residents, and tourists	Local (Regional)	• Reduced damage to buildings and infrastructures – e.g. private dwellings, electricity transmission infrastructures, roads, schools etc
Landowners	Different businesses & industries (small / large)	Local Regional (Global)	• Reduced damage to local industrial/commercial buildings, equipments and infrastructures. • Reduced damage to local produce – e.g. wood, agriculture products etc

Which Natura 2000 sites provide this service?

Mountain forest ecosystems as well as natural rocky habitat can affect both the probability and severity of avalanche events, and modulate their effects. This especially refers to healthy forest and rocky ecosystems with diversified structures and advantageous natural geo-morphological features. Habitats presenting these characteristics are especially suited in providing this service.

How to estimate the value of this service?

Please note: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

The following questions can guide a qualitative and quantitative assessment on the potential role of a Natura 2000 to mitigate avalanches.

- Is the area exposed to frequent/disruptive avalanche events?
- Are there ecosystems existing in the area able to mitigate such phenomenon?
- What structures and features does a Natura 2000 provide and how do they influence the site's protective functions? This can refer to issues such as stability, role of deadwood in forests or role of rocky shapes.
- What is the linkage between a Natura 2000 site's condition and its protective functions?
- Are there infrastructures, villages and other human installations that can significantly be affected by avalanche events?
- Are there tourist activities or other economic activities which can be significantly damaged by avalanches?
- Have man-made infrastructures/equipment been put in place to reduce impacts of avalanches?

Monetary value estimates

The replacement costs can be used to estimate the value of ecosystem services as the cost of replacing them with alternative man-made goods and services. With regard to avalanche protection, one should first identify the features of an ecosystem helpful in providing this service, and asses the scale of protection Then, information on the costs of *replacing* natural avalanche protection with artificial infrastructure such as avalanche nets, dams, flexible barriers should be gathered.

The damage cost avoided method uses either the value of property and assets protected, or the cost of actions taken to avoid damages, as a measure of the benefits provided by an

ecosystem[22]. In this regard, you could collect data on the costs *avoided*, which would arise from damages caused to buildings, roads and people; or you could estimate the costs arising from preventive measures such as technical avalanche mitigation measures. The information can be collected from secondary sources such as scientific studies and available statistics or by consulting different experts.

Box 5.11.1 provides an example on how replacement costs can be used to show the benefits of natural avalanche protection.

Box 5.11.1 Examples of valuing avalanche protection

A study (Grêt-Regamey 2005) in Switzerland used the replacement cost method to value the service of avalanche protection. The study found that new snow fences and restorations of habitats to compensate for the impacts caused by a large sport event can cost up to 2.3 millions CHF. A forest densification and a raise in timberline could provide benefits of approximately 8 millions CHF as avalanche protection.

How can the estimated value be turned into real money?

As for storm damage control (see Section 5.12) and wild fire mitigation (see Section 5.13) the real value of natural ecosystems regulating impacts of avalanches can be significant. This is particularly the case in areas that are heavily exposed/ vulnerable to avalanches and where damages have been experienced in the past, such as alpine areas

By quantifying costs that might arise by the disappearance of this service or costs that have been saved due to its existence, arguments for obtaining financial support to the site are enforced. This especially refers to the argument that man-made infrastructure would be needed to recreate a lost service, or if pay for significant damages caused by an avalanche due to the absence of the natural protective mechanism.

An alternative method, which helps to create new markets and turn economic value into real resource flow, are **payments for environmental services** (PES). The concept focuses on paying land users for environmental services they provide. With regard to avalanche protection this could refer to all silvicultural activities that help to maintain the protective function of forests. Payments could come either from public authorities, which are interested in a cost-effective approach, but also from industry that profits from the protective function of the ecosystem.

If damages arising from the loss of the protective function of a Natura 2000 site can be clearly linked to detrimental activities of legal persons, **environmental liability** and the polluters-pay principle might be applied and used for financing restructuring measures.

Before determining which method mostly suits your site, it is important to establish who the beneficiaries of this service are (e.g. farmers, visitors or different businesses benefiting from recreational services; see "*Who maintains this service & who benefits from it?*") and thus who

[22] King, Mazzotta (2000)

might be most appropriate in supporting management financing or the maintenance of the service.

Please also consider that using existing **public / private funds**, e.g. **EU funding instruments** such as Structural Funds or the European Agricultural Fund for Rural Development (EAFRD) might be an important instrument in supporting initiatives taken[23].

[23] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.12 Regulating services: Storm damage control

What is this service?

What is this service & why is it valuable?

Ecosystems play important roles in moderating the effects of extreme events, such as storms, on human systems. They affect both the probability and severity of events, and they moderate the effects of extreme events, for example by protecting coastal communities from storms and hurricanes.

Storm protection refers to the role of ecosystems in protecting society from storm damage. Storm impacts can be lessened through maintenance and management of environment vegetation and through natural or human-made geomorphological features (e.g. natural rivers, channels, dune systems, terrace farming etc). Ecosystems such as coral reefs, mangrove forests and sand bars for instance can act as natural buffers to mitigate the effects of storms on coastlines, where storm risk to local population is likely to become higher with the rising of sea level due to climate change. Coastal wetlands for instance are said to reduce the damaging effects of hurricanes on coastal communities by absorbing storm energy in ways that neither solid land nor open water can. (Simpson and Riehl 1981).

Closely linked services you should also look into: water regulation, e.g. flood prevention (Section 5.7)

Who maintains this service & who benefits from it?

Local Natura 2000 land users, farmers and landowners can play an important role in the maintenance and management of ecosystems and their related storm protection service, by protecting the natural buffers reducing storm risk. The main beneficiaries of this regulating service are local population and landowners, who will be less exposed to the damaging effects of storms, e.g. on farm land, forests and private dwellings. Some of the benefits could also be shared by other players at regional/national level, e.g. industry/business and consumers of crops/woods and other produce growing in the Natura 2000 site that are affected by the service.

Table 5.12.1. Service "managers / providers" and possible beneficiaries of the service

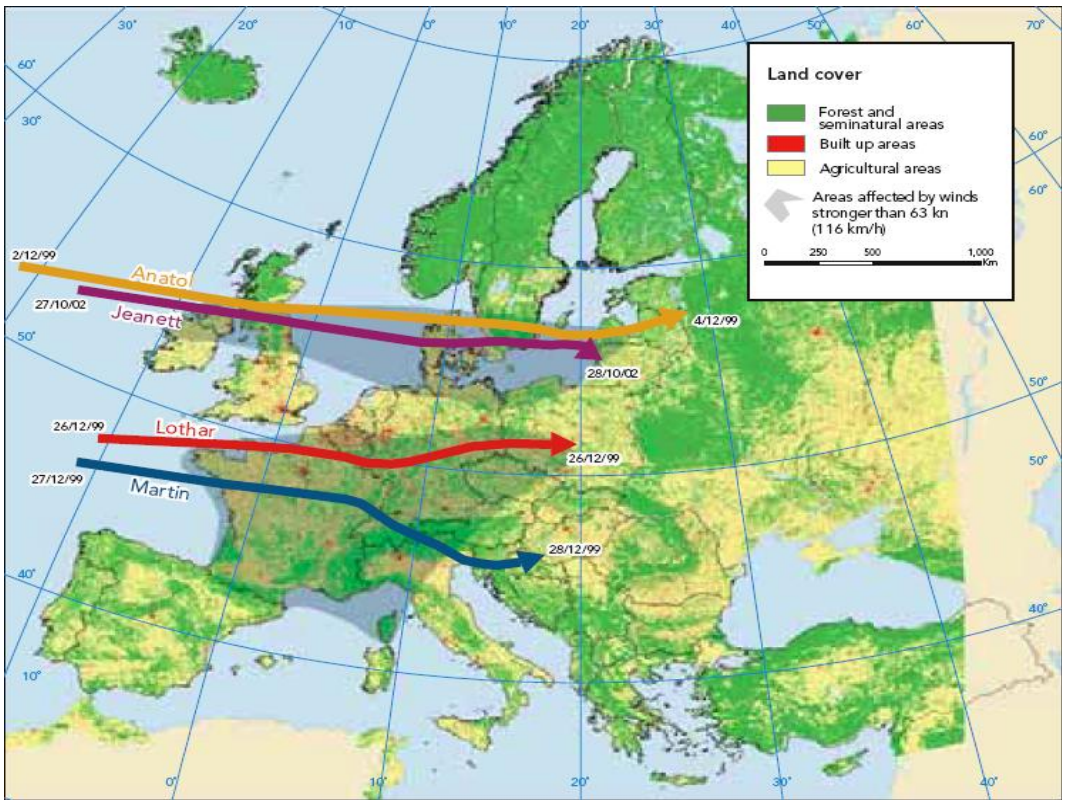
Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers Landowners	Individuals, e.g. land users themselves, local citizens, tourists	Local	Reduced damage to public and private buildings and infrastructures due to reduced storm impacts.
	Farmers and some local business	Local (regional/national)	Reduced damage to crops, cattle etc and to business buildings, plants and infrastructures and tourism installations

Which Natura 2000 sites provide this service?

Among the ecosystems existing in Natura 2000 sites, coastal wetlands, beaches, forests, rivers and channels, and also terraced land and other farmed areas are of particular relevance for storm protection.

The map below shows the course of major storms that hit Europe between 1998 and 2002. Ecosystems and Natura 2000 sites could be particularly helpful to mitigate the effect of storms in the area most hit, especially in central and western Europe and countries such as France, Denmark, Germany, Sweden, Poland, Lithuania and Austria.

Figure 5.12.1 Course of major storms in 1998–2002



Source: EEA 2004

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative & quantitative estimates

The potential for ecosystem to mitigate the impacts of storms can be assessed qualitatively and (to a certain extent) quantitatively by, for example, addressing the following questions.

- Is the area exposed to frequent/disruptive storm events? How many of such disruptive events took place in the past year – 10 years – 30 years?
- Is there a pattern in the frequency of these events? In particular, are they becoming more frequent?
- Are there ecosystems existing in the area able to mitigate such phenomena. If so, which are they and how can they mitigate the effect of storms?
- Are there infrastructures, villages and other human installations that can significantly be affected by storm events?

- How many people are living in the area exposed, i.e. potentially at risk of suffering from the damaging effect of storms?
- Are there tourist activities or other economic activities which can be significantly damaged by storms? How many tourists are there each year? What is the turnover of tourism activities? I.e. this is relevant to understand the potential economic loss due to damages to tourism caused by storms
- Have man-made infrastructures/equipment be put in place to reduce impacts of storms? If so, which are these? What was their cost?

Monetary estimates

In the case of storm protection, the damage cost avoided can be calculated on the basis of the estimation of actual losses due to storms that could have been avoided if the ecosystem service were in place. These estimates could include the following.

- Losses incurred during past storm episodes which took place in the Natura 2000 site under analysis. Alternatively the value of these losses could be transferred from other areas that experienced storms and that are considered similar (in terms of ecosystems, economic and social patterns) to the site under observation. Such losses can be difficult to quantify. One possibility is to look at data available on actual damages, e.g. to houses, infrastructures, etc. If subsidies/compensation have been paid to cover for such costs (e.g. through the EU Solidarity Fund, or via other national/regional/local resources), this can be taken as a proxy of the damages incurred.

- Other additional values to be taken into account may derive from missed revenues from tourism and other economic activities, e.g. on the basis of reduced revenues due to disruptive storms compared to revenues obtained in previous years, or expected in the future.

- In addition, if a storm led to the loss of human lives (mortality) or injuries (morbidity), these can be converted into monetary terms, e.g. adopting values obtained from existing willingness to pay studies. Quantifying the value of mortality and morbidity cases recorded in other comparable storm episodes, it will be possible to estimate the reduced human health risk reduction, through a benefit transfer approach. It should be noted that WTP values tend to vary in different countries, depending inter alia on economic factors such as GDP and GDP per capita, hence leading to different values of human lives. This may be objectionable from an ethical point of view, nevertheless such values can act as a proxy of the health benefits of ecosystem services. It is important to bear in mind that the aim of a monetary evaluation is to highlight the importance of the problem, and not to suggest that the money value is an equivalent worth to the premature mortality. (ten Brink et al 2008)

The ‘alternative cost’ method considers the cost of providing a substitute good that would perform a similar function to an environmental good (Defra 2007). For example, in the case of storm protection, the service may be valued on the basis of the cost of undertaking activities to reduce its impacts, e.g. flood barriers.

Box. 5.12.1 Examples on valuing storm protection based on avoided costs

Please note: The examples below were used to estimate regulating services in some tropical countries and in the US, where the effect of storms are relatively stronger than in Europe. Although these figures may not be suitable to be transferred to Natura 2000 sites, the examples should be useful to understand how the methodologies work.

The value of damage created by storms was assessed in the Bhitarkanika mangrove system in India. The losses due to a major cyclone in 1999 were estimated in monetary terms. In 2 villages far from the mangrove forest the costs due to the cyclone were US$ 44.07 and US$ 153.74. It is interesting to note that the higher costs were registered in a village that actually had a man-made embankment, which was meant to protect the area in the event of flood (e.g. due to storms). In the village in the shadow of mangrove the losses were limited to US$ 32.31. Data used in the analysis was obtained through door-to-door survey in selected villages to assess their socio-economic status, the actual damage to houses, livestock, fisheries, trees and other assets and the rate, level and duration of flooding due to cyclone. (Badola et al. 2005)

A study which assessed the ecosystem value of 5 forest and rangelands regions in Iran estimated that the value of the climate regulation service provided was about $137 billion per year. The study was based on the assumption that damages related to climate change represent 1 per cent of GDP[1], and applied this percentage to the Iranian GDP (in 2002). (Karimzadegan et al. 2007)

Mean Value of Coastal wetlands for storm protection was estimated at $33,000/ha/year. Coastal wetlands in the U.S. were estimated to currently provide $23 Billion/yr in storm protection services. (Sutton, undated).

A study on the mangrove forests in Cambodia estimated that the value of storm protection services was $32/ha/year, i.e. about €299/ha in 2008 values (as in Braat et al. 2008). The value was estimated on the basis of the cost of house construction if nearby villages were to suffer storm destruction. This estimate may be taken as an upper bound figure for the damage protection function of mangroves since it is unlikely that all houses would be completely destroyed by storms. (Bann 1997)

An assessment based on the analysis of 39 wetland valuation studies estimated a mean value for storm buffering in wetlands of 237 $/acre, i.e. €286 per ha in 2008 PPP-adjusted usable values (as in Braat et al. 2008). This is a mean value and could be used as a reference value for wetland – i.e. if it is not possible to apply the methods suggested above. Nevertheless, it should be noted that, although some general trends can be identified across the literature, the prediction of a wetland's value based on previous studies remains highly uncertain and the need for site-specific valuation efforts remains large. (Woodward 2001)

How can the estimated value be turned into real money?

The real value of natural ecosystems regulating impacts of storm can be significant This is particularly the case in areas that are heavily exposed/ vulnerable to storms and where damages have been experienced in the past, such as some coastal and forest areas.

Furthermore, arguments for obtaining financial support to the site are enforced if it is possible to quantify the opportunity cost (see above) for the natural storm protection provided, i.e. if in the absence of protection provided by the natural ecosystem a concrete investment in man-made infrastructure would be needed to recreate the lost service, or if significant damages were caused by a storm due to the absence of the service.

The following questions could give initial ideas to identify some possibilities for concrete funding.

- Who are the **beneficiaries of this service** (e.g. local farmers whose fields and crops are protected from storm damage; regional businesses dependent on the supply of these crops; private or public owners of property & infrastructure etc. see Table 5.12.1) and what kind of mechanisms exist / could be used to engage these beneficiaries in financing the management of the site and maintenance of the service it provides?

- Are there possibilities for using existing **public / private funds**, e.g. **EU funding instruments**? For example, in some cases storms could be considered a significant environmental risk addressed under the EU Structural Funds.[24]

- Is there a scope for advocating the use of **market based mechanisms**? For example, could payments for environmental services (PES) schemes be established between the beneficiaries and service "managers / providers", e.g. could the property owners protected from storm damage support the maintenance and existence of the site?

[24] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.13 Regulating services: Wild fire mitigation

What is this service?

Ecosystems ability to mitigate wild fires can be defined as the capacity of ecosystems to maintain natural fire frequency and intensity (MA 2005). One of the main ecosystem factors affecting fire resistance is the amount of vegetation (and hence fuel) in the system. This is in turn linked to climate conditions, land cover and land use. In general, regions with climates characterised by distinct dry and wet seasons are potentially exposed to a higher risk of fire as vegetations (and hence fuel load) tends to grow substantially in wet periods and to become highly flammable in the dry season.

Land cover and land use can affect fuel load, flammability, number of ignitions events and spread conditions. In this context, there are also several important direct anthropogenic drivers that can effects ecosystem ability to mitigate wild fires, e.g. land management practices, land clearance and agriculture, housing development, logging, harvesting and reforestation and fire suppression schemes (MA 2005). For instance, inappropriate forest land use planning that does not take into consideration the environmental characteristics of the area, e.g. leading to monocultures of fire prone tree species, can contribute to forest fires. (Bassi et al 2008). Also, trees with deep root systems for instance may resist reduced precipitation longer before becoming flammable compared with trees with shallower roots. Biological decomposition processes reduce potential fuel for wildfire. Also, ecosystems with soils that have low water-holding capacity are more prone to become flammable after short dry periods (MA 2005).

Closely linked services you should also look into: provisioning of water, climate and water regulation (Sections 5.2, 5.6 and 5.7).

Why is this service valuable?

The number of fires increased significantly on all continents over the past 60 years (MA 2005). In Europe, forest fires are the most important threat to forest and wooded area in the south. Reports of forest fires in France, Greece, Italy, Portugal and Spain show that in these areas more than 450,000 ha burned on average each year between 2000 and 2006 (EC 2006), while in 2007 the total area burned was about 500,000 ha (EFFIS 2007).

Fires have caused extensive damage in recent years, leading to loss of human lives, affecting human health, burning properties, infrastructures and business and causing extensive environmental damage in forest and agriculture areas. Many argue that fires also contribute to global warming through the emission of CO_2. (Bassi et al. 2008).

Who maintains this service & who benefits from it?

Local Natura 2000 site managers, farmers and landowners can maintain this service by making the appropriate land planning and management, in terms of choice of land cover and land use, type and amount of vegetation, agriculture, land clearance practices, logging, harvesting and reforestation practices and the use of appropriate fire suppression or prevention schemes. They should for instance avoid large monocultures, especially of fire prone species, ensure sufficient monitoring and early warning systems, especially in the hottest and driest months.

In addition, discouraging land abandonment is often of high importance as abandonment can lead to increased risk of fire (e.g. encroachment of inflammable shrubs and the lack of control and vigilance for fires). For example, the maintenance of traditional extensive grazing areas can act as effective fire breaks.

Land managers and local population, land owners, farmers and local industries and business, as well as tourists resident in the area and other commercial/industrial activities benefiting from agriculture/logging products grown on the area are those benefiting the most from the service, as fire prevention/mitigation will limit fire damages to local buildings, infrastructures and produce.

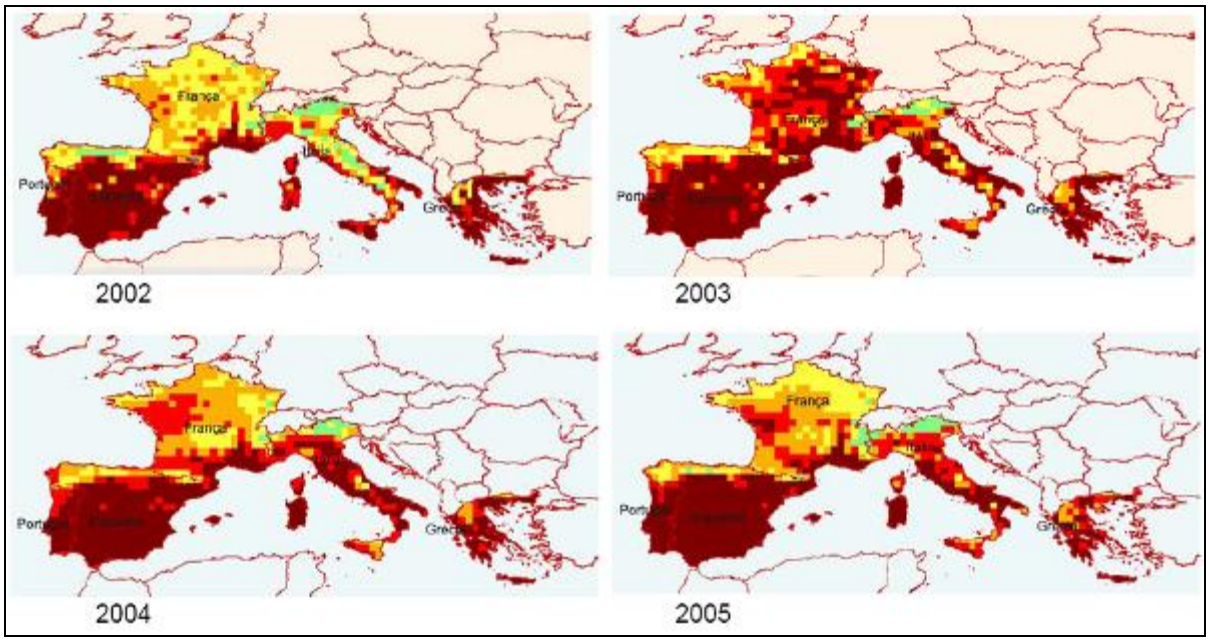
Table 5.13.1 Service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 land users	Individuals, e.g. land users themselves	Local	Reduced damage to buildings and infrastructures – e.g. private dwellings, electricity transmission infrastructures, roads, schools etc
	Different businesses & industries (small / large)	Local Regional (Global)	Reduced damage to local industrial/commercial buildings, equipments and infrastructures. Reduced damage to local produce – e.g. wood, agriculture products etc

Which Natura 2000 sites provide this service?

The wild fire mitigation service of Natura 2000 sites can be particularly important especially in areas subjected to frequent and disruptive forest fires, e.g. in South and Eastern Europe. Past forest fires in these areas led to major damage not only to the natural areas but also to human activities and infrastructures, and in some cases they led to the loss of human lives. Assessing the value of wild fire mitigation hence can be important to raise awareness on the importance of the Natura sites and stimulate better policies, e.g. policies regarding land use, forest management, choice and location of species (e.g. in case of reforestation). A map of fire risk in recent years is provided below.

Figure 5.13.1 Fire risk in EU countries (2002-2005)



Danger Risk:
Very Low Risk
Low Risk
Moderate Risk
High Risk
Very High Risk

Source: European Forest Fire Information System/ European Forest Fire Risk Forecasting System

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative estimates

The potential for ecosystem to mitigate the impacts of fire can be assessed qualitatively and (to a certain extent) quantitatively, e.g. by addressing the following questions.

- Are fire episodes frequent in the area? How many fires take place every year/ 10 years/ 30 years? What is the size of the area burned in the past year/10 years/ 30 years?
- Does the Natura 2000 site can help regulate fire frequency and intensity in the area. If so, how?
- Are there land use / management factors that can lead to better/worse wild fire mitigation in the Natura 2000 site (e.g. monocultures of fire prone species or intensive agriculture – increasing fire risk; or sustainable forest management decreasing the risk, etc)?
- Are there human infrastructures and activities that can be significantly damaged by fires spreading in the area?
- How many people live in the area, i.e. potentially exposed to fire risk?
- Have fire events caused the loss of human lives or lead to significant health issues in the past years? How many victims or injured people?
- Is the area a centre for recreation / tourism or has it the potential to be so, and how is this going to be affected by possible fire episodes? How many tourists arrive every year? What is the turnover of tourism activities? This information can help estimating the potential economic loss due to fire episodes affecting tourism.

Monetary estimates

The 'alternative cost' method considers the cost of providing a substitute good that would perform a similar function to an environmental good (Defra 2007). For example, in the case of fire protection, the service may be valued on the basis of the cost of undertaking activities of fire fighting and prevention, building fire breaks and setting up other man-made technologies substituting the ecosystem's wild fire mitigation service.

The 'damage cost avoided' method looks at the costs of avoiding damages due to lost services. The damage cost avoided method uses either the value of property protected, or the cost of actions taken to avoid damages, as a measure of the benefits provided by an ecosystem[25]. In the case of wild fire mitigation, its value could be calculated on the basis of the estimation of actual losses due to fires that could have been avoided if the ecosystem service were in place. These could be losses incurred during past fire episodes which took place in the area under analysis (e.g. a Natura 2000 site), or the value of these losses could be transferred from other areas that experienced fire episodes and that are considered similar (in terms of ecosystems, economic and social patterns) to the site under observation. One possibility is to look at data available on actual damages, e.g. to houses, infrastructures, etc. caused by fire. If subsidies/compensation have been paid to cover for such costs (e.g. through the EU Solidarity Fund, or via other national/regional/local resources), this can be taken as a proxy of the damages incurred.

[25] http://www.ecosystemvaluation.org/cost_avoided.htm

Other additional costs may derive from missed revenues from tourism and other economic activities, e.g. on the basis of reduced revenues due to fire episodes compared to revenues obtained in previous years or expected.

If the fire episodes led to the loss of human lives (mortality) or injuries (morbidity), these losses can be converted into monetary terms by valuing mortality and morbidity on the basis of willingness to pay studies. By quantifying the value of mortality and morbidity cases recorded in other comparable fire episodes, it will be possible to estimate the reduced human health risk reduction, through a benefit transfer approach. It should be noted that WTP values tend to vary in different countries, depending inter alia on economic factors such as GDP and GDP per capita, hence leading to different values of human lives. This may be objectionable from an ethical point of view; nevertheless such values can act as a proxy of the health benefits of ecosystem services. It is important to bear in mind that the aim of a monetary evaluation is to highlight the importance of the problem, and not to suggest that the money value is an equivalent worth to the premature mortality. (ten Brink et al 2008)

It should also be noted however that in some cases ecosystem services alone may not be enough to prevent forest fires, hence only a limited portion of the damages cost could be transferred and used for avoided costs methods.

Box 5.13.1 below provides some examples of damages caused by forest fires in some EU Member States are listed, based on a recent study on forest fires (Bassi et al. 2008). Although this is not a calculation of the actual ecosystem service, it can give an idea of the scale of damages that could be avoided or reduced if ecosystems were managed in such a way as to have an effective use of their regulating services. The collection of similar values for Natura 2000 sites under observation (e.g. the number of victims and the damage to infrastructures/ production/ tourism due to fire recorded before the service was in place, or in nearby areas where the service in not existing) will be helpful to assess the damage cost avoided.

Box. 5.13.1. Examples on valuing wild fire mitigation based on avoided costs

The forest fires that took place in Greece in summer 2007 caused damages worth €5 billion, 110 villages were damaged or destroyed and livestock, cultivated land and forests were burned down. The events lead to a particularly high death toll (60-68 people). (Bassi et al. 2008)

The total area burned due to forest fires in central and southern Italy in July 2007 was 130,000 ha - of which 36,000 ha were on NATURA 2000 sites. The fire led to 1,800 Kt of CO2 emissions and to significant damage to tourism activities, with for instance more than 4,000 holidaymakers evacuated from Gargano peninsula in Puglia. More than 5,000 ha of farmland were destroyed, worth about €1 billion (according to Italian Farmers Confederation). 3 deaths were caused by these fire events. (Bassi et al. 2008)

Forest fires in July and August 2007 in Serbia burned more than 40,000 ha; direct damage from fires was €4.6 m (estimates of public enterprise for forest management. (Bassi et al. 2008)

How can the estimated value be turned into real money?

The real value of fire prevention regulating systems can be significant, especially in areas particularly exposed to fires, were damages have been experienced in the past, such as in south Eastern Europe.

European and national funds have been already invested in the past in activities such as forest management and planning, and should be applied further also with the specific objective of increasing/maintaining the regulating ecosystems services that ensure fire prevention or limit the damages caused by fire. Funding should be provided, among others, to support land management reducing fire risk, fire prevention activities (e.g. prescribed burning, fire breaking zones, monitoring and patrolling to discourage arson and set up early warning systems etc), training activities for Natura 2000 managers and other related activities.

The following questions could give initial ideas to identify some possibilities for concrete funding.

- Who are the beneficiaries of this service (e.g. local farmers whose fields and crops are protected from fire damage; local citizens that can potentially be affected by fire damages to buildings, infrastructures and health etc. see Table 5.13.1)

- What kind of mechanisms exists / could be used to engage these beneficiaries in financing the management of the site and maintenance of the service it provides?

- Are there possibilities for using existing **public / private funds**, e.g. **EU funding instruments**? For example, in some cases fire can be considered a natural hazard of significant entity that could be addressed under the EU Structural Funds. Forest management enhancing fire protection regulating services could be supported by CAP measures.[26]

- Is there a scope for advocating the use of **market based mechanisms**? For example, could Payments for Environmental Services (PES) schemes be established between the beneficiaries and service "managers / providers", e.g. could the property owners protected from fire damage support the maintenance and existence of the site?

[26] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.14 Regulating services: Biological control

What is this service?

Biological control is the process by which an organism reduces the population density of a plant / animal pest or a pathogen, for example through predation, parasitism or competition on resources. Biological control may be natural, without direct intervention from man, or it may be enhanced by humans through increasing the populations of natural enemies or by introducing a novel bio-control agent (e.g. predator) in the system (Bale et al. 2008).

In the case of ecosystem services, the focus is on ecosystem's natural ability to keep pest and pathogen populations under control. For example, (semi-) natural vegetation patches intermingled with crops provide an important habitat for many natural enemies of insect pests in agri- and silvicultural systems (Balmford et al. 2008). Similarly, agricultural areas hosting a variety of different habitats (e.g. agro-forestry systems) can be more resistant to the outbreaks of plant pathogens that monocultures.

Natural and semi-natural ecosystems play also an important role in suppressing the establishment of invasive alien species. For example, in Central Europe more invasive plant species can be found at nutrient rich locations created by human land use (such as fields and road sides) than in forests or fens. In addition, the reintroduction of large predators may help to control red deer populations, reducing so browsing damages to forests.

Closely linked services you should also look into: provisioning of biodiversity resources, regulating and supporting services supporting production (Sections 5.1 and 5.6 – 5.18).

Why is this service valuable?

Ecosystems' natural ability to control pests and pathogens is (directly or indirectly) an added value to several provisioning services (e.g., food, fuel, biochemicals, natural medicines) and regulating services (e.g. water quality). Benefits may include:

- **suppressing damages** caused by pests, plants and animals;
- **improving yields** of crop, timber, raw material in general;
- **maintenance of an ecological equilibrium** that prevents, for example, herbivore insects from reaching pest status, or red deer population from reaching a level where it can have major impacts on timber production (Zhang et al. 2007);
- **reduced costs** due to lesser use of chemical pesticides;

- **reduced impact** of chemical pesticides on water and soil due to reduced use of chemical products to combat pests;
- **positive impact on organic farming** due to increased opportunities of biological control; and
- **increased attractiveness of an area** for nature tourism due to preventing an invasion of a troublesome alien species (e.g. bushy and thorny plant species) or due to the reintroduction of large predators.

Box 5.14.1 Overview of the economic losses caused by agricultural pests

Agricultural pests cause significant economic losses worldwide. Globally, more than 40 per cent of food production is being lost to insect pests, plant pathogens, and weeds, despite the application of more than 3 billion kilograms of pesticides to crops, plus other means of control (Pimentel 2008). In the US alone, it is estimated that more than US$18 billion are lost due to insect damage (including more than US$ 3 billion spent in insecticides), of which about 40 per cent attributed to native species and the remaining to exotic pests (Losey & Vaughan 2006). These values, however, would be much higher if biological control was not in place. Losey & Vaughan (2006) estimate that 65 per cent of potential pest species are being suppressed in the US, with a total value of pest control by native ecosystems around US$ 13.60 billion. Through a predator removal experiment, Östman et al. (2003) showed that the presence of natural enemies increased barley yields 303 kg/ha, preventing 52 per cent of yield loss due to aphids

Source: Balmford and references within (2008)

Who maintains this service & who benefits from it?

The service is maintained by local Natura 2000 land users (e.g. farmers, foresters and other land owners) whose management practices support the maintenance of natural enemies of pests and pathogens in the area. Farmers and landowners are the primary beneficiaries of the services as natural biological control helps to suppress damages caused by pests, plants or animals and thus can improving the yields of crop and timber. Further beneficiaries are consumers and local populations as improved crop yields support food security and the reduced use of pesticides and fertilisers limits possible negative impacts of these compounds to human health.

Table 5.14.1 Service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers	Individuals, e.g. land users themselves, residents, visitors and tourists	Local (Regional)	Decreased health impacts due to decreased use of fertilisers and pesticides
Farmers Landowners	Different businesses & industries (small / large)	Local Regional (Global)	Improved yields Less costs for fertilisers and pesticides Support of the booming organic products market

	Consumers	Local Regional (Global)	Decreased health impacts due to decreased use of fertilisers and pesticides Increased food security

Which Natura 2000 sites might be most appropriate for providing this service?

Biological control is dependent on the abundance and diversity of natural enemies. Those, on the other hand, are again influenced by the number, area and quality of habitats that host natural biological control agents (e.g. predators). Also the diversity and connectivity of a landscape play an important role in maintaining the overall populations of natural enemies in the area. Natura 2000 sites can contribute significantly to all these aspects and, therefore, they can play an important role in maintaining natural biological control in an area.

Also, proximity of crop fields to semi-natural habitats highly influences the abundance and diversity of available natural enemies to crop pests (Balmford et al. 2008). Therefore, a Natura 2000 site situated in the vicinity of agricultural fields could play an important role in keeping crop pests in control.

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

Qualitative information valuable in demonstrating Natura 2000 site's role in maintaining natural biological control could include the following.

- Does a Natura 2000 site play a role in reducing pests and influence the productivity of nearby crop fields? This could include a comparison between organic farming fields (profiting at a high level from biological control) and conventional farming fields.
- Do large predators hosted by a Natura 2000 site influence the amount and severity of browsing damages caused, e.g. by red deer populations?
- What could be the linkage between the provision of biological control and distance to a site (related to the dispersal and foraging movements of natural enemies)?
- Does a Natura 2000 site have an impact on the amount of chemical pesticides used?

Quantitative analyses could try to fortify the results of qualitative analyses by providing data on the following aspects.

- What is the amount of pesticides used at agricultural areas close to a Natura 200 site. How does this differ from the amount of pesicides used elsewhere?

- What is the number of farmers using less pesticides in the vicinity of a Natura 2000 site?
- What is the scale of browsing damages near to a site compared to damage elsewhere?

Monetary value estimates

The replacement cost method estimates the value of ecosystem services as the cost of replacing them with alternative man-made goods and services. With regard to biological control, this can mean information on the costs of pesticides needed to replace natural biological control in order to improve yields of crop and timber. Alternatively, information on replacement costs related to establishing targeted hunting activities to control pest populations can be used, e.g. to keep red deer populations below the level where their grazing can have major negative impacts on timber production (Zhang et al. 2007).

Alternatively, costs of avoided damage or avoided cost of action can also be used as an estimate for the value of natural biological control (King & Mazzotta 2000). For example, information on the costs avoided by not using chemical pesticides could be used.

Box 5.14.2 Examples of monetary estimates demonstrating the value of natural biological control

Cost based estimates

A study (Pimentel et al. 2001, Pimentel et al. 2005) on the assessment of known environmental and economic costs of invasive alien species in the United States (US), United Kingdom (UK), Australia, South Africa, India and Brazil was carried out in 2001 and updated in 2005. This study estimated that invasions of non-native species in the six countries concerned cause over USD 314 billion in damage per year. This sum translates into USD 240 annual cost per capita in these six countries. Assuming similar costs worldwide, the author estimated that damage from invasive species would be more than USD 1.4 trillion per year, representing nearly 5 per cent of the world GDP.

In 2001, the total volume of pesticides sold in the EU15 amounted to 327,642 tonnes of active ingredients (Eurostat 2001).

Estimates based on stated preferences (see Annex 1 for more detailed explanation of the method)

A study by Costanza et al. (1997) calculated the value of ecosystem services for a number of biomes across the world, on the basis of published studies and a few original calculations. In many cases the values were based on willingness-to-pay methodologies. The average global value of biological control in grasslands was estimated at € 27.54/ha and in temperate forests at €4.79/ha, in 2008 values (as in Braat et al. 2008).

How can the estimated value be turned into real money?

One approach to turn the economic value of this service into real money is to focus on the **opportunity costs**. This means to enforce arguments for financing the maintenance of this service by focusing on costs that have been saved by the services being in place (e.g.,

pesticides and herbicides) or costs that may arise by the service being lost (e.g. increasing costs for the use of pesticides and herbicides, increasing impact on human health).

If damages arising from the loss of the control function of a Natura 2000 site can be clearly linked to detrimental activities of legal persons, **environmental liability** and the polluters-pay principle might be applied and used for financing restructuring measures. This could, for example, refer to increasing costs for the use of pesticides and herbicides.

Another alternative method is **payments for environmental services** (PES). The concept focuses on paying land users for environmental services they provide. With regard to biological control this could refer to site management activities or extensive agricultural activities that influence productivity, costs and human health by maintaining structures and features necessary for this service. Payments could come either from public authorities, who are interested in keeping the use of pesticides and herbicides as low as possible due to the impact on human health, or the agriculture sector like organic farming that profits from the service by potentially increased productivity or reduced costs related to the use of pesticides. Especially regarding the private sector it might be very important to prove the relation between this service and the yield of a marketed good (see above).

Before determining which method mostly suits your site, it is important to establish who the beneficiaries of this service are (e.g. farmers, visitors or different businesses benefiting from recreational services; see "*Who maintains this service & who benefits from it?*") and thus who might be most appropriate in supporting management financing or the maintenance of the service.

Please also consider that using existing **public / private funds**, e.g. **EU funding instruments** such as Structural Funds or the European Agricultural Fund for Rural Development (EAFRD) might be an important instrument in supporting initiatives taken.[27]

[27] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online:
http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm

5.15 Regulating services: Pollination

What is this service?

Pollination is one of the most important ecosystem services maintaining both natural and agricultural systems (Nabhan & Buchmann 1997). This ecosystem service is typically carried out by insects, including bees, flies, beetles, moths, butterflies and wasps. In addition, vertebrates (particularly birds and bats) can also function as pollinators for some plant species.

The availability of wild pollinators, and therefore the pollination service, is known to be dependent on a number of factors (see Balmford et al 2008 and the reference within). These include:

- availability and/or proximity of (semi)natural habitat (i.e. surface area, distance from agricultural fields);
- quality of (semi)natural habitat;
- abundance and diversity of wild pollinators on the crop site; and
- identity of pollinating species.

Important to consider: In many agricultural systems pollination is actively managed through the establishment of populations of domesticated pollinators, particularly the honeybee *Apis mellifera*. However, in the contest of ecosystem services the main focus is to be given to the pollination of agricultural ecosystems by natural, wild pollinators.

Closely related services you should also look into: biodiversity resources (i.e. crops) (Section 5.1)

Why is this service valuable?

In general, the importance of wild pollinators for agricultural production is being increasingly recognised (See Balmford et al. 2008 and the reference within). For example, evidence exist that wild pollination increases the size and quality of harvests for a number of crops. Wild pollinators may also interact synergistically with managed bees to increase crop yields. Furthermore, a diverse assemblage of native pollinators provides insurance against year-to-year population variability or loss of specific pollinator species, and might better serve flowers because of pollinator-specific spatial preferences to a flowering plant or crop field.

Estimating economic value is difficult and controversial, but the global value of wild and domestic pollination has been estimated at $120 billion per year (Costanza et al. 1997). Similarly, Losey & Vaughan (2006) estimated that wild pollinators alone are responsible for about $3 billion of fruits and vegetables produced in the United States. It is difficult to estimate how well these estimates reflect the real value of the wild pollinators. However, given current problems with managed honeybees (e.g. collapse of colonies and problems with invasive alien bee species) the importance of wild pollination is likely to increase.

Naturally, the value of wild pollinators in maintaining crop production has usually gained most attention. However, the value of wild pollinators could also be relevant, for example, in the following cases:

- value of wild pollinators in maintaining some charismatic plants (e.g. flowering plants) in the area, with further implications for cultural and tourism values;
- value of wild pollinators in wild berry production (e.g. blue berries); and
- value of wild pollinators in provisioning of natural ornamental plants sold on local markets.

Who maintains this service & who benefits from it?

The abundance of pollinators is heavily dependent on management practices at the site and surrounding areas. Therefore, the land users (e.g. farmers and other managers) play a key role in maintaining the service. Examples on potential beneficiaries of the service are listed in Table 5.15.1 below.

Table 5.15.1 Some examples of service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmer / foresters Other landowners and managers	Crop producers, e.g. land users themselves	Local (Regional)	Maintaining natural pollination of crops to secure yields
	Other individuals	Local Regional	Availability of biodiversity resources dependent on pollination, e.g. wild berried and flowers
	Different businesses & industries dependent on crop production (small / large)	Local Regional (Global)	Maintained supply of "raw material" for production
	Consumers	Local Regional (Global)	Availability of crop based food products
	Governments & administration	Local Regional (Global)	Role of natural pollination in maintaining food supply and security

Which Natura 2000 sites provide this service?

The availability of (semi)natural habitats is one of the key attributes in maintaining the levels of wild pollinators. Therefore, the vicinity of Natura 2000 sites, in particular grassland and forest sites harbouring pollinator species, can be of high importance in maintaining the pollination service within agricultural systems.

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

The possible estimates demonstrating the importance of wild pollinators in qualitative and quantitative terms could include the following:

- studies on the general ecological distribution and importance of wild pollinators in the area or from similar areas elsewhere;
- abundance and/or diversity of wild pollinator species on a site;
- information on any species dependent on the existence of a specific pollinator(s);
- number of plants dependent on wilds pollinators in the area, any plants with socio-economic and/or cultural importance in particular;
- amount of harvest of wild pollinator-dependent products (e.g. crops, berries, ornamental flowers); and
- number of people / households dependent on these goods for their livelihood or income.

Monetary value estimates

<u>Market price of the service</u>

The value of wild pollinators can be estimated by using the market price / net revenue of pollination-dependent goods as a proxy for the value of the service. This could include, for example, calculating the net revenues (i.e. gross revenue minus costs of production) from crops, berries, ornamental flowers etc.

To be more precise, the total final net revenue due to loss of wild pollinators could be calculated (i.e. using the "production function approach"). This is done via comparing the original net revenues (i.e. gross revenue – minus production costs) from a wild pollination dependent good with net revenues in case of a decrease in wild pollinator levels. The decrease

in net revenue can then be used as an estimate of the value of lost service. The production function approach requires rather detailed information on the relationships between the inputs (e.g. different relevant ecosystem services) and output of the good. This might limit the application of the approach in practice.

Important to consider: when using the market price method it would be important to be able to identify what proportion of production is dependent on pollination by wild insects or mammals (i.e. to exclude wind pollination and pollination by domesticated pollinators).

Costs of replacing the service or costs of avoided damage

Cost based approaches for estimating the values of wild pollinators could include the following:

- costs of replacing wild pollinators with domesticated ones (e.g. maintenance);
- costs of declined crop / berry / ornamental flower harvests due to decline in wild pollinators; and
- costs of replacing wild pollinator dependent products by imports.

Box 5.15.1 Example on the value of pollination

In a Canadian study the potential increase in crop production-based income when increasing pollination rate vi increasing areas around the fields resulted in 38 per cent increase in producer surplus / field (Morandin & Winston 2006).

A study by Costanza et al (1997) calculated the value of ecosystem services for a number of biomes across th world, on the basis of published studies and a few original calculations. In many cases the values were based o willingness-to-pay methodologies. Based on this information, the average global value of pollination i grasslands was estimated at € 29.93/ha (as 2008 values) (as in Braat et al. 2008).

How can the estimated value be turned into real money?

The following questions could give initial ideas to identify some possibilities for concrete funding to a Natura 2000 site based on maintaining its ability to support natural pollinators.

- Does crop or berry production play an important role in the area? If so, is it mainly dependent on the availability of natural pollinators?

- In addition, is the area important for charismatic plants (e.g. flowering plants with further implications for cultural and tourism values), wild berries (e.g. blue berries) or natural ornamental plants?

- Who benefits from these resources, e.g. local crop, berry and flower producers?

- Are there possibilities for using existing **public / private funds**, e.g. **EU funding instruments?**[28]

- Is there a scope for advocating the use of **market based mechanisms**? For example, could Payments for Environmental Services (PES) schemes be established between crop producers and the Natura 2000 land users?

[28] For example, more detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.16 Regulating services: Human health

What is this service?

What is this service and why is it valuable?

The role of ecosystems in supporting human health is two fold. Firstly, naturally functioning ecosystems can regulate the range and abundance of species that are hazardous to human health. For example, a number of species (e.g. birds and insects) are known to be vectors of human diseases (e.g. malaria, dengue fever, Lyme disease etc.). In a natural state the functioning of ecosystems (e.g. competition on resources and predation) keeps the populations of these species under control. However, in a changed situation the populations of these harmful species might increase exponentially causing an epidemic of the disease they carry.

In addition, natural ecosystems are also often best "equipped" against the invasion of alien species with harmful health impacts, such as exotic pathogens, disease vectors and allergenic species. This is because, in comparison to disturbed areas, natural ecosystems tend to have a higher capacity to sustain their natural status under changed conditions. For example, several invasive alien species are known to cause allergies and skin damage, e.g. giant hogweed (*Heracleum mantegazzianum*), common ragweed (*Ambrosia artemisiifolia*) and silver wattle (*Acacia dealbata*) (Kettunen et al. 2008).

Secondly, natural ecosystems are known to play an important role in supporting physical and mental health by providing possibilities for outdoors activities, recreation and relaxation. For example, the importance of urban green areas for human wellbeing has been demonstrated in several studies (See Box 5.16.1 below). Protecting the diversity of species and habitats helps to maintain a wider variety of possibilities for recreation and mental enjoyment, e.g. different natural settings to enjoy and more opportunities for wildlife watching.

Finally, it is to be noted that ecosystems also play a positive role in protecting human health via a number of other functions, e.g. mitigation of natural hazards and maintaining air quality. The value of these health related aspects is considered in other sections of this Chapter (see below).

Other closely linked services you should also look into: tourism & recreation, regulation of natural hazards and air quality (Sections 5.3, 5.7, 5.9, 5.11 and 5.13)

Who maintains this service & who benefits from it?

Managing ecosystems' natural functioning and processes is the key for protecting their ability to protect human health. As Natura 2000 managers play an important role in preserving these ecosystems' "natural" qualities, they also ensure that the positive impacts of a site on regulating human health are maintained. Finally, examples of potential stakeholders benefiting from this service are listed in Table 5.16.1.

Table 5.16.1 Some examples of service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers / foresters Other landowners / managers	Individuals, e.g. land users themselves	Local (Regional)	Reduced risk for diseases caused by pathogens Reduced risk for allergies etc. Access to nature and green areas that supports mental health
	Health sector	Local (Regional)	Decline in health sector's costs due to reduced risk for diseases, allergies and mental health problems
	Private and public sector employers	Local Regional National	Reduced costs related to employees' health and higher work efficiency (e.g. reduced likelihood for burnout)

Which Natura 2000 sites provide this service?

Regulation of human health can be supported by all Natura 2000 sites. In particular, the following sites might have a specific contribution to maintaining this service:

- sites located in a reasonable distance from urban areas and therefore easily accessible for recreation;
- sites offering a variety of recreational possibilities and therefore being visited by different user groups, e.g. hiking, canoeing and climbing: and
- sites situated in an area otherwise heavily infested by allergenic plants, e.g. invasive alien species such as giant ragweed and giant hogweed, thus providing a recreational "sanctuary" from these species.

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

Following aspects could be addressed and/or quantified:

- information on the status of possible pathogens, diseases vectors, allergenic species in the area, in particular data on the natural status and any possible changes overtime;
- number of people using green urban spaces / parks for health purposes (e.g. jogging);
- number of people that consider nature / green areas important for their mental wellbeing;
- number of different health related initiatives and activities dependent / taking place in green areas / parks;
- trends in the distribution and/or number of disease vector populations;
- number of people affected / protected by vector-borne disease; and
- number of patients treated due to allergies caused by allergenic species.

Monetary value estimates

The role of ecosystems in supporting human health could, on a broad scale, be valued by assessing the following costs related estimates:

- costs / avoided costs of treatment of different vector-borne diseases (such as malaria, Lyme diseases, schistosomiasis);
- costs of preventing or mitigating the vectors for these diseases;
- costs of treating allergies and other health problems (e.g. burns) caused by invasive alien species;
- costs / avoided costs of health problems that can be related to lack of exercise, e.g. obesity; and
- costs of treating mental health problems, although in these cases it is often somewhat difficult to demonstrate and identify any exact relationships between the ecosystems service related attributes and mental health issues.

Box 5.16.1 Examples of valuing human health regulation

Cost based estimates based on the negative health impacts of invasive alien species

Asian tiger mosquito (*Aedes albopictus*) in Italy (Emilia Romagna): species poses a health risk as it is a vector for Dengue and Chikunguna fever and it also has painful stings. Costs related to preventing negative

health impacts (e.g. eradication program and communication) 1.1 million EUR / year. (Kettunen et al. 2008 and the sources within)

Oak processionary moth (*Thaumetopoea processionea*) in the UK: Caterpillars have defensive bristles containing an urticating toxin. When this toxin becomes airborne it can cause epidemic caterpillar dermatitis (lepidopterism), with symptoms such as rash and respiratory distress. Costs of control this species in the UK estimated to be £ 20,000 - 30,000 / year. (Kettunen et al. 2008 and the sources within)

Giant hogweed (*Heracleum mantegazzianum*) in Germany: Plant can cause serious burns when in contact with human skin. Medical costs and costs related to controlling the plan are estimated to be around 11 million EUR / year. (Kettunen et al. 2008 and the sources within)

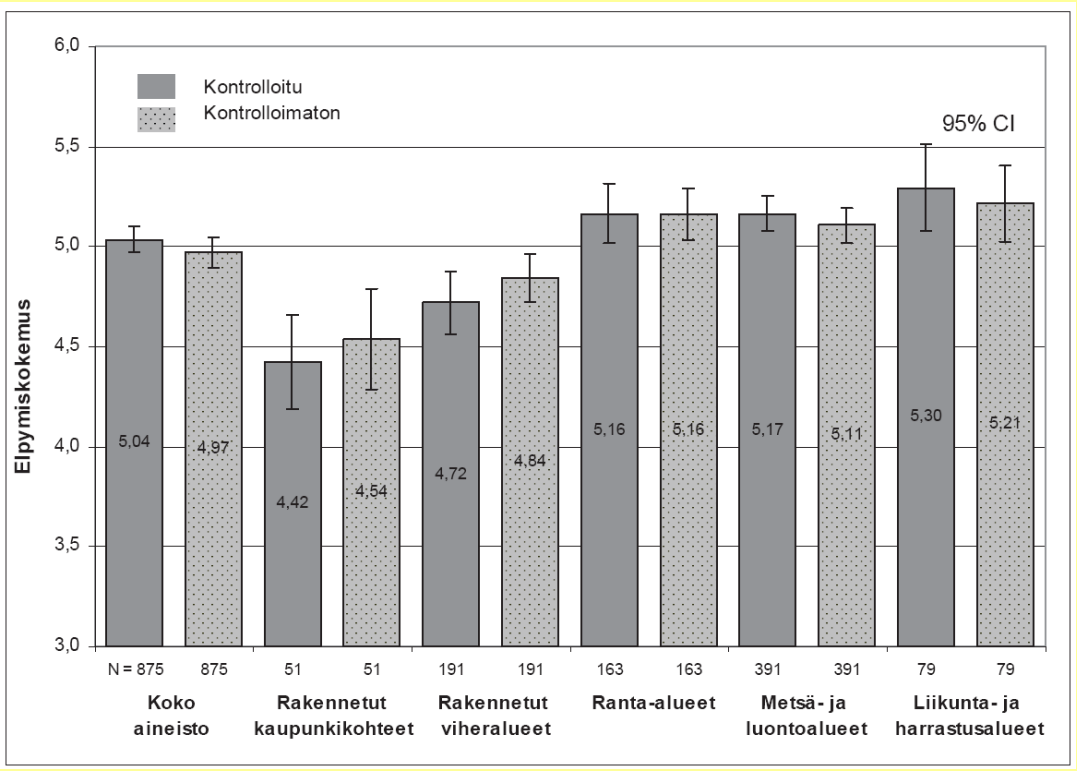
Estimates based on stated preferences (see Annex 1 for more detailed explanation of the method)

Urban green areas' health impacts in Denmark: when estimating the importance of urban green areas to human health (e.g. mental) in Denmark over 90 per cent of survey respondents replied that green areas played a role in increasing their health (RSPB 2005, Nielsen & Hansen 2007).

"Health walks" initiatives in the UK: over 50 initiatives in the UK have taken place with 64 per cent of the participants saying that the "health walks" have positively changed their habits and lifestyle (RSPB 2005).

Role of nature in human mental wellbeing in Finland: a survey assessing the role of nature and green areas in helping to recover from negative feelings, e.g. stress. See Figure 5.16.1 below. (Tyrväinen et al. 2007)

Figure 5.16.1. Role of nature and green areas in helping recovery from negative feelings, e.g. stress.



Elpymiskokemus = level of recovery on a scale 1 -7 (1 = no recovery, 7= full recovery)
Koko aineisto = full data
Rakennetut kaupunkiympäristöt = built urban environment
Rakennetut viheralueet = built urban green areas
Ranta-alueet = shore areas

Metsä- ja luontoalueet = forests and natural areas
Liikunta- ja harrastusalueet = sport and recreation areas
Kontrolloitu = controlled
Kontrolloimaton = uncontrolled

How can the estimated value be turned into real money?

The following questions could give initial ideas to identify some possibilities for concrete funding to a Natura 2000 site based on its positive contribution to human health.

- Does the area play an important role in people's "every day" recreation, i.e. is it close to urban centres and frequently visited by different recreational users? If so, it is possible that the site also supports mental and physical health of local / regional population.

- Alternatively, is the site situated in an area that is heavily infested by allergenic plants? In this case it can provide an important "safe haven" for recreation activities in the area.

- Are there possibilities for using existing **public / private funds**, e.g. **EU funding instruments** based on site's health related role? [29]

- Who receives the health benefits, e.g. local / regional public, health sector etc. (see Table 5.16.1) and is there a scope for obtaining financial support from these beneficiaries? For example, could the local employers be challenged into a promotion campaign supporting the health of their employees?

[29] More detailed information on the use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.17 Regulating services: Maintaining genetic & species diversity

What is this service?

The regulation of genetic and species diversity refers to ecosystem's ability to support diverse assemblages of species and maintain the genetic variation within species.

Species diversity is supported by several ecosystem characteristics including, for example[30]:

- the composition, distribution, and abundance of the major vegetation types and successional stages of an area;
- ecosystem's productivity and energy flows, e.g. rate of photosynthesis;
- water resources, e.g. flow regimes and the abundance and distribution of aquatic and riparian systems in an area;
- soil resources, such as soil productivity and the rate of soil loss; and
- state of "naturalness", e.g. the level of anthropogenic disturbance, habitat loss and degradation, overharvesting, and the prevalence of invasive or noxious plant or animal species commonly decrease species diversity in an area.

The **genetic diversity** amongst species is a direct result of the species and population diversity amongst these species. Thus, genetic diversity is affected by changes that lead to species/populations extinctions, such as loss and degradation of natural habitats (Balmford et al. 2008).

Amongst **domesticated species**, loss of varieties and diversity within varieties is expected from the loss of area under traditional agricultural practices and associated local breeds, such as when these are either abandoned or converted to intensive agriculture (Balmford et al. 2008).

Close linked services that you should also look into: biodiversity resources (Section 5.1)

Why is this service valuable?

Food production and security depend on the conservation of crop and livestock biodiversity and genetic resources. Crops, livestock and their wild relatives have the genetic variability

[30] Note: this is not meant to be an exhaustive list of all ecosystem characteristics influencing species diversity.

that provides the raw material for breeding new crop varieties, through classical breeding and biotechnological techniques (FAO 1997, 2007).

The loss of local species and varieties usually results in irreversible loss of the genetic diversity they contain. This has dangerously shrunk the genetic pool that is available for natural selection, and for selection by farmers and plant and livestock breeders. Consequently, the vulnerability of agricultural crops and livestock production to sudden changes, such as changes in climate and the appearance of new pests and diseases, has increased (Esquinas-Alcázar 2005). See Box 5.17.1 for examples of such loss.

Who maintains this service & who benefits from it?

The conservation of genetic resources for food and agriculture relies on the preservation of both the variety of domesticated species and their wild relatives. One of the main threats to the genetic diversity of crops and livestock is the marginalization of traditional production systems and the associated local breeds (FAO 1997, 2007). Therefore, Natura 2000 sites and their managers can play an important role in preserving traditional extensive forming systems and supporting the maintenance of genetic diversity.

In addition, Natura 2000 sites can also function as 'refuges' and breeding places for species, e.g. pollinating insects, game animals, natural enemies of pests and fish., this way helping to maintain (genetically) healthy populations of species in the area.

Various beneficiaries of this service are listed in the Table 5.17.1 below.

Table 5.17.1 Some examples of service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers / foresters Other landowners / managers	Individuals, e.g. land users themselves	Local (Regional)	Availability of natural pollinators and natural pest control agents Availability of crop varieties and breeds that can sustain different environmental conditions Availability of game and fish
	Different businesses & industries (small / large)	Local Regional (Global)	Availability of resources (crop, meat, fish etc.) required for the production of goods
	Consumers	Local Regional (Global)	Secured availability of food (e.g. in the case of drought, pest epidemics etc.)
	Governments & administration	Local Regional	Support to maintaining food supply and security

		(Global)	

Which Natura 2000 sites provide this service?

Several Natura 2000 areas can play a role in preserving species and genetic diversity. Specific examples could include, for example:

- marine, coastal, forest and grassland etc. sites that support viable local / regional populations of game, pollinator insects and natural enemies of pests; and
- sites supporting extensive agriculture and local crops varieties and breeds of livestock in the area.

How to estimate the value of this service?

Please note: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

Qualitative and quantitative value estimates

The genetic diversity of crops and livestock has been declining markedly, but the overall rates of loss are not easy to quantify (FAO 1997). However, a number of qualitative and quantitative estimates can be available to help to highlight the importance of this service:

- evidence on the importance of genetic variability in supporting food production in the area or elsewhere;
- evidence on the importance of protected breeding places and refuges in maintaining stable population levels of species;
- ethnobotanic reviews of the value / importance of crop genetic resources;
- number of crops and livestock species at risk and / or suffering from genetic erosion in the area;
- amount of crop and meat production dependent on only a few species;
- reduction in crop and livestock varieties / breeds overtime; and
- increase in yields based on use of different breeds.

Monetary value estimates

Market price of the service

Market prices can also function as a proxy for the value of genetic variation, however this can only happen in the case where a certain market product can be directly linked to a particular genetic attribute, e.g. when revenues from specific product (meat, cheese, milk, wool etc.) are related to a specific local / regional sub-species or breed. Alternatively, measuring the value

that farmers place on different breeds (when purchasing livestock) can also be used as a basis for a value estimate for genetic variation.

Important to be considered: The market price estimate for the value of genetic resources often is the same as the estimate used to highlight the value of biodiversity resources (e.g. price of local products, Section 5.1). In this case, one should not double count this value.

Costs of replacing the service or costs of avoided damage

As for the value of maintaining the genetic variation, a number of examples on cost based approaches exist. There include, for example:

- known / estimated costs of damage due to crop pests / diseases;
- opportunity costs measured as the difference between economic performance of local breed and higher yielding alternative breed (See Box 5.17.2);
- cost of conservation of local breeds / varieties, e.g. financial support to cultivation of local breeds / crop varieties (e.g. within EU agri-environment programmes, often calculated as opportunity costs);
- costs of research and development programmes related to developing animal / crop genetic resources.

Box 5.17.1 Examples of valuing genetic diversity

Quantitative estimates

In China nearly 10,000 wheat varieties were in use in 1949, but only 1,000 were still in use by the 1970s. In the US, 86 per cent of the apple varieties, 95 per cent of the cabbage, 91 per cent of the field maize, 94 per cent of the pea, and 81 per cent of the tomato varieties documented as having been in use between 1804 and 1904 apparently no longer exist (FAO 1997, in Balmford et al. 2008).

Of the 7,616 livestock breeds listed by FAO's Global Databank for Animal Genetic Resources for Food and Agriculture, around 20 per cent are classified as at risk and 62 breeds became extinct during the 2001-2007 period – amounting to the loss of almost one breed per month (FAO 2007).

The three main crops (rice, maize and wheat) that provide over half the world population's requirement for protein and calories (Bioversity International 2008) are increasing reliant on a small number of modern varieties. Indeed 80 per cent of the wheat area sown in developing countries are modern, semi-dwarf varieties and over 75 per cent of all rice in Asia are improved semi-dwarf varieties (Cassman et al. 2005, in Balmford et al. 2008)

In the United States in 1970, the fungus *Helminthosporium maydis* destroyed more than half the standing maize crop in the southern part of the country. The crop had been grown from seeds that have a narrow genetic base and are susceptible to this disease. In this case and others, the problem was resolved by breeding resistant varieties using genetic resources that were obtained from other parts of the world (Esquinas-Alcázar 2005, in Balmford et al. 2008).

Estimates based on market prices

In an Ethiopian study 10 per cent increase in coffee production was noted when using different coffee breeds. The extra benefits received by the cultivators of naturally low caffeine coffee were estimated as US$ 0.5 / kg of coffee produced. Also 90 per cent reduction of coffee crop losses was noted as a benefit

from conserving genetic diversity (Hein & Gatzweiler 2006).

How can the estimated value be turned into real money?

The following questions could give initial ideas to identify some possibilities for concrete funding to a Natura 2000 site based on its ability to maintain genetic and species diversity.

- Does the area play an important role in maintaining special local or regional crop varieties or breeds?

- Alternatively, does it function as a known breeding site or refuge for species such as game, fish, pollinating insects, natural enemies of pests, thus maintaining sustainable population at a regional and local scale?

- Are there possibilities for using existing **public / private funds**, e.g. **EU funding instruments**? For example, do some funds provide specific support for maintaining regional crop varieties and livestock breeds?[31]

- Is there a scope for developing specific goods or services based on regional biodiversity, e.g. branded products from regional crops and breeds or agro-tourism, education, cultural and art initiatives, connected to these resources?

[31] More detailed information on the possible use of EU funds for managing Natura 2000 can be found in Financing Natura 2000 Handbook and IT-tool available online: http://ec.europa.eu/environment/nature/natura2000/financing/index_en.htm.

5.18 Supporting services

What is this service?

What is this service and why is it valuable?

Supporting service refer to the basic processes and functions of ecosystems that form the basis for the other services, i.e. provisioning, regulating and cultural services. These processes include, for example, primary production, nutrient cycling, soil formation and seed dispersal. In addition, the ecosystems can also be seen as a common "nursery" that supports the proliferation and breeding of all species. For example, the coastal ecosystems often play a crucial role in maintaining the populations of several fish and crustacean species.

As indicated above, supporting services are ecosystem processes required to maintain all other services and benefits provided by nature. Thus, **from the economic point of view the value of these services is already included in the quantitative and monetary estimates of other related services.** For example, the value of primary production is already incorporated in the market price of crops. Therefore, addressing the value of primary production and provisioning of crops separately and then forming an aggregate estimate of the two would lead to double counting and overestimating the value of the total ecosystem benefits. However, keeping the dangers of double counting in mind it is still often recommendable to also address the value of supporting services separately as this helps to highlight the multiple roles of ecosystems in supporting human wellbeing.

Who maintains this service & who benefits from it?

Natura 2000 related supporting services are maintained by the land users ensuring the maintenance of good ecological status of their sites. The beneficiaries of these services are manifold including the following examples listed in Table 5.18.1.

Table 5.18.1 Some examples of service "managers / providers" and possible beneficiaries of the service

Service "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples

Local Natura 2000 land users	Individuals, e.g. land users themselves	Local (Regional)	Maintaining conditions supporting production, e.g. soil formation, nutrient cycling, primary production etc. Maintaining fist stock levels and the availability of other aquatic resources. Also, supporting availability of game and wild products. Maintaining conditions favourable for human wellbeing, e.g. economy, social aspects, culture, health, safety etc.
	Different businesses & industries (small / large)	Local Regional (Global)	Secured resources for production of biodiversity related goods and services, e.g. food, tourism etc.
	Consumers	Local Regional (Global)	Availability of food and other resources and services, e.g. recreation.
	Governments & administration	Local Regional (Global)	Maintenance of food and water supply, support to safety and reduction of environmental risks

How to estimate the value of this service?

<u>Please note</u>: the methods presented in this section are mainly for "easy to obtain" value estimates and they do not require special skills on economic valuation. Additional supporting information is provided in the text boxes with examples of actual value estimates, which are based on more complex economic valuation methods. For more information on the complex valuation methods please consult Annex 1 of the Toolkit.

As mentioned earlier, in economic terms the value of supporting services is included in quantitative and monetary estimates of other services. Therefore, possibilities for valuing these services specifically are somewhat limited. However, qualitative and quantitative estimates are often available and in some cases the value of other services (e.g. the provisioning of biodiversity resources) can be used as a proxy for ecosystems' supportive functions.

Qualitative and quantitative value estimates

The possible qualitative and quantitative estimates for supporting services include, for example:

- studies demonstrating the inter-relationships between ecosystem's natural state, its functioning and the overall productivity of the system;
- rate of soil formation in the area;
- (high) level of primary production in the area;
- rate of nutrient cycling in the area; and
- number of species / size of fish stocks and presence of other species populations dependent on the site for their breeding success.

Monetary value estimates

In some cases market prices can be used as indicators for the value of supporting services. This is the case when there is a clear ecological link between the marketed good and the supporting service in question. Possible examples could include, for example, the price of / revenue from species which population levels heavily depend on the Natura 2000 site (e.g. Natura 2000 site is an important breeding area).

Important to be considered: The market price estimate for supporting services are often same as the estimate used to highlight the value of biodiversity resources (e.g. price of local products, Section 5.1). In this case, one should not double count this value.

The cost based estimates for supporting services include, for example;

- cost of replacing the nursery function of certain ecosystems or habitats by creating an alternative, artificial way to maintain the normal propagation of species. For example, this can be estimated based on the related labour costs of artificially maintaining the nursery function; and
- the costs of replacing the seed dispersal can be used as a proxy for this supporting service that maintains the regeneration of forests.

Box 5.18.1 Examples of valuating supporting service

Quantitative estimates

The study assessing the effects of oak deforestation on soil organic matter quality in Iran concluded that deforestation decreases soil organic matter quality by more than 60 per cent (Nourbakhsh 2006)

The US study on valuing the overall function of oyster reef as habitat supporting fish and crustacean species / populations concluded that 10 m^2 of restored reef habitat increased the fish and crustacean production by 2.6 kg / year (Peterson et al. 2003).

Cost based estimates

In Peru, cost of replacing the "nursery function" of opuntia plant by creating an alternative substitute was estimated to cost 1589.85 Nuevas soles / ha / year (labour costs) (Rodrigues et al. 2006).

Estimates based on production function (see Annex 1 for more detailed explanation of the method)

Valuing the "nursery function" of saltmarshes for fish production (Scotland) estimated that these marches created a marginal value of at least EUR 1087 / ha/ year to shellfish industry (Coclough et al.

2003 in RSPB 2005).

Value of the ecosystem processes supporting the recharge of a wetland area in Nigeria was estimated as US$ 13 029 / day for households and US$ 32.5 / farmer / dry season for agricultural production (Acharaya 2000).

The net present value of forested watershed's contribution to groundwater recharge in Hawaii was estimated to be $1.42 - 2.63 billion (Kaiser et al. 1999).

Estimates based on stated preferences (see Annex 1 for more detailed explanation of the method)

A study by Costanza et al (1997) calculated the value of ecosystem services for a number of biomes across the world, on the basis of published studies and a few original calculations. In many cases the values were based on willingness-to-pay methodologies. Based on this study, the average global value of soil formation in tropical and temperate forests was estimated at €11.97/ha worldwide. The value of nutrient cycling in Indian tropical forest was instead €1,103.85/ha. (as 2008 prices) (as in Braat et al. 2008).

Gren et al. (1995) assessed the values of ecosystem services in the Danube flood plains through rough calculations of values obtained in other studies made in the area. Based on this study, it was estimated that the average value of swamps and floodplains as nutrient sinks was about €286/ha, in 2008 prices (as in Braat et al. 2008).

How can the estimated value be turned into real money?

Given the "hidden" value of supporting services it might be difficult to obtain direct financing for their maintenance. However, drawing attention to the fundamental for of these services can help to enforce the case for obtaining financing for the site.

5.19 Wider socio-economic benefits

What are these benefits?

This section presents an overview of the methodologies that can be used to assess some broader socio-economic benefits related to Natura 2000 sites. These are not ecosystems services as such, but additional economic and social benefits that stem out from the existence of a Natura 2000 site, such as:

- direct employment supported by the Natura 2000 site (in terms of number of jobs and salaries);
- Natura 2000 site's role in generating indirect employment in the area;
- Natura 2000 site's role in supporting local economy through direct spending of the reserve (i.e. site's actual spending on local or regional services);
- Natura 2000 site's role in supporting local economy through spending generated by direct employment and volunteers (i.e. consumption generated by salaries of the reserve's employees, farmers, volunteers etc.); and
- Natura 2000 site's role in supporting rural and regional development, e.g. contributing to rural/regional economies development and bringing in EU, national and/or regional financial support (funding for a Natura 2000 site).

These benefits provide real money and job opportunities to the area and are significant as they can help to sustain the local / regional (in some cases national) economy. Therefore, when evaluating the overall benefits and value provided by Natura 2000 sites one should keep in mind the direct and indirect economic spin-offs generated by the activities taking place in the area.

Who maintains these benefits & who benefits from it?

By managing and protecting the site, Natura 2000 managers, land owners, farmers and foresters ensure that their protected site's generate money and work opportunities. These benefits are enjoyed by a number of local and regional actors listed in Table 5.19.1 below,

Table 5.19.1 Service "managers / providers" and possible beneficiaries of the service

Benefits "managers / providers"	Possible beneficiaries	Scope of the benefit	Examples
Local Natura 2000 site managers Farmers,/ foresters Other land owners / managers	Individuals, e.g. land users themselves, local and regional citizens	Local (Regional)	Site managers hired to manage the site, other staff members working in the site, employees in sectors/activities related to the site (e.g. food processing/distribution business, tourism etc). Farmers/land owners benefiting from financial support for maintaining/improving the site. Individuals benefiting from support to rural development (e.g. strengthening of social bonding, reduced land abandonment, increased investment in education etc.).
	Different businesses & industries (small / large)	Local Regional (Global)	Economic activities (all sectors) stimulated by spending by land users/staff and site-related employees.

Which Natura 2000 sites provide this service?

All Natura 2000 sites can bring these types of additional benefits, as their mere existence can bring opportunities for employment, spending in local/regional products and increase local/regional development.

The benefits will be particularly great in sites that can attract significant activities, e.g. sites that require substantial site management (direct employment), sustain a number of ancillary activities (processing/distribution of natural produce, souvenir/traditional products shops etc.), attract a large number of tourists, receive substantial regional/national/international funding for site management or related activities, etc.

How to estimate the value of this service?

Different methods and examples can be identified to calculate different benefits. The most common are summarised below.

Direct employment supported by Natura 2000 site

In order to assess the effect of direct employment on Natura 2000 sites, data on current and, when available, future number of jobs (or Full Time Equivalents - FTEs) and salaries should be collected from official sources, studies or surveys. Assessing direct employment benefits by a Natura 2000 site is considered relatively straightforward, however in some cases data availability can be a limiting factor. When data on future jobs are available, uncertainty regarding future employment developments should be taken into consideration and highlighted. Direct jobs can be on-site and also off-site. The latter can be more difficult to assess and in this case one can focus on on-site jobs only.

Indirect employment generated by Natura 2000 site – multiplier effect

Indirect employment benefits are calculated by using multipliers to the number of direct jobs. Therefore, developing this estimate naturally requires knowledge on the number of direct jobs. In addition, there is a need to select a suitable multiplier. A common standard multiplier used is 0.5 although other multipliers can be used, e.g. based on findings from existing literature in the area. The use of a multiplier is relatively simple though it relies on the availability of data on direct employment.

Direct expenditure of the reserve

Information on market prices can be used to calculate the extent and value of the Natura 2000 site's consumption of / spending on local and regional services. The collection of relevant data can be based on surveys, official statistics or existing studies. Data requirements can be low or medium, depending on the availability of existing information. As above, multiplier effects can be taken into consideration (as the money continues to circulate in the local economy).

Spending created by Natura 2000 site employees and volunteers supporting local economy

Site employees and volunteers can support local economies through their spending on local products and services (e.g. food, rent, etc.). For example, local restaurants, hotels and shops can significantly benefit from the expenditure of the staff working at the Natura 2000 site. If exact data on expenditures are not available, the amount of spending from site employees and volunteers could be calculated as a percentage of local activities turnover, i.e. when it is possible to ascertain that site workers contribute to a certain share of turnover (e.g. 10 per cent, 20 per cent or 50 per cent of a hotel or shop revenue). Furthermore, if site workers are paying a rent or purchase a house in the area, these expenses could also be added to the overall spending supporting the local economy.

Natura 2000 site's role in supporting rural and regional development

The role of Natura 2000 sites in supporting rural and regional development can be based on the estimates provided above, e.g. calculating the contribution of Natura 2000 related economic activities to total rural / regional economy. Furthermore, data could be collected on possible EU / national / regional financial support received by Natura 2000 site. This kind of data could be obtained from e.g. EU Commission documents, national / local public accounts, existing studies etc.

Box 5.19.2 Examples of wider socio-economic benefits related to Natura 2000

Direct and indirect employment

55.9 FTEs (Full Time Equivalent) were directly employed by the Natura 2000 site in Central-Limburg (Belgium) thanks to on-site activities in 2001. It was estimated that the site also generated between 65 and 85 FTE indirect jobs. A multiplier effect between 1.3 and 1.4 was used, in the basis of Belgium and Netherlands studies.

In the Natura 2000 site of Lille Vildmose (Denmark) it was estimated that 68 direct jobs were generated in 2002, while 167 were expected in the following 5-10 years. 2002 data were obtained from the local municipality, and uncertainties were highlighted as for future jobs estimates.

In Latvia, the Natura 2000 site of Salaca river led to 11 direct FTEs (on- and off-site) in 2002. This was estimated to increase to 21 FTEs in the future. The site also generated about 5.5 FTE indirect jobs in 2002 and was expected to generate 10.5 indirect jobs in the future. A standard 0.5 multiplier was used on the estimated current/future direct jobs.

Direct expenditure

In the Salaca River site (Latvia) the value added from catering, purchases and lodging was estimated to be 45,667 Lats in 2002.

Support of Natura 2000 to rural and regional development

The Natura 2000 site of the Mur river in the Gamlitz and Gnas streams in Styria, Austria, received about € 66.2 millions worth of public support, taking into account the funding received through the EU LIFE programme (€ 60 m), and 2 Interreg projects (€ 2.6 and € 3.6 m) across several years.

Source: IEEP & WWF 2002

PART 3: HOW TO INTERPRETE, PRESENT & COMMUNICATE THE DIFFERENT VALUES OF NATURA 2000

6 NATURA 2000 SITE RELATED BENEFITS: THE OVERALL PICTURE

The aim of this final Chapter is to help the users of this Toolkit to interpret, present and communicate the results of their Natura 2000 valuation exercise.

The Chapter consist of two different sections:

Section 7.1 How to present the results: This Section provides two templates for presenting (and communicating) the overall benefits provided a Natura 2000 site (Tables 7.1 and 7.2). Finally, the Section also provides some guidance related to creating aggregated value estimates for the site while bearing in mind the issues related to double counting.

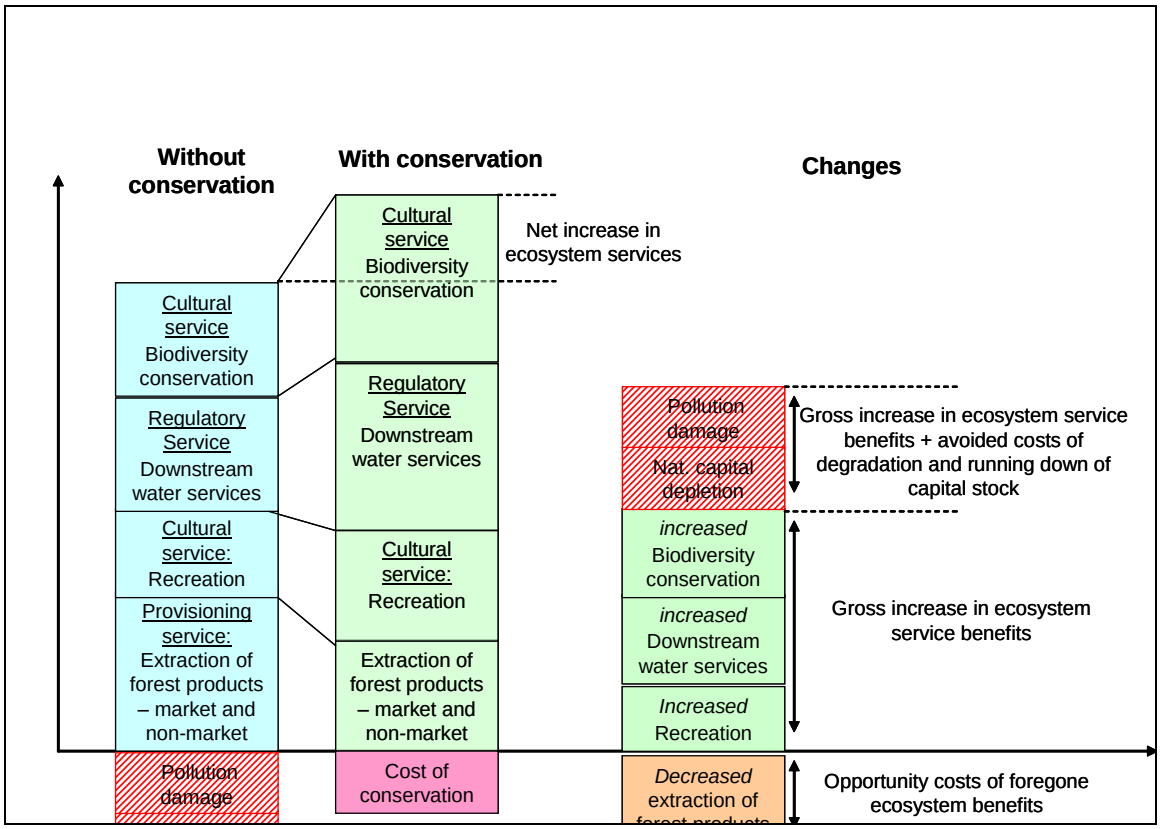
Section 7.2. Interpreting and using the results at site level: This Section outlines a number of key issues to be considered when considering the practical implications of the valuation results. For example, it highlights issues related to the trade-offs between different services and provides some considerations regarding the value of whole network (i.e. not just the value of a site). It also provides a suggested template for communicating possible site specific valuation case studies.

Section 7.3. Interpreting and using the results in the context of multiple sites: Even though the main purpose of this Toolkit has been to help the users to assess the socio-economic benefits of Natura 2000 at site level this final section of the Toolkit aims to provide some brief insight on how to estimate socio-economic importance of multiple sites and how to develop aggregate value estimates at broader regional, national and EU level.

A key challenge for the evaluation of the benefits of a Natura 2000 site is to be able to present and interpret the whole picture of these benefits. The general underlying idea is that the total (long term) benefits provided by an ecosystem increase with conservation and sustainable use. Figure 6.1 presents an overview of how the different value derived from a given system change with increased conservation efforts. In general, despite of the costs of conservation and reduced extraction of biodiversity resources it is foreseen that the net socio-economic benefits provided by the ecosystem remain positive.

This is also envisaged to be the most likely outcome with Natura 2000 sites when taking into consideration **all benefits** provided by the site. Naturally, however, if the focus is only on benefits that can be estimated in monetary terms the overall socio-economic picture might not appear favourable to site's conservation. Therefore, it is crucial to be able to communicate the full value of the site, including all current and potential benefits it provides. It is also important to understand, for example, how the identified benefits relate to the conservation goals of the site (e.g. do they conflict with site management plans) and how different stakeholders are affected by these benefits.

Figure 6.1. The benefits and costs from an ecosystem with and without conservation (with examples)



7 HOW TO INTERPRET, PRESENT AND COMMUNICATE THE OVERALL BENEFITS?

7.1 How to present the results?

Table 7.1 below provides a suggested template for presenting the overall benefits of Natura 2000 sites. It provides a framework for summarising benefits related to the ecosystem services provided by the site. It also presents the information on the possible wider socio-economic benefits of the site (i.e. benefits related to the "existence" of the site, not to singe ecosystem services).

The template is also accompanied by an updated "rapid assessment" spider diagram (created in Chapter 4) illustrating the final outcomes of the exercise (Figure 7.1).

Note: These framework tables for presenting the overall benefits provided by the site focus on highlighting only some key aspects related to the current status and trends of the benefits. Sections 7.2 and 7.3 below provide a broader guidance on how to interpret and communicate these identified site-related values.

General instructions for filling in the templates are provided below. In addition, the templates already include some examples aimed to help to illustrate their use.

- **"Benefit description"** Add here the specific name of the identified benefit. In the case of biodiversity resources etc. please include additional rows as necessary.

- **"Estimated value of the benefit: qualitative, quantitative & monetary"** Include here the qualitative, quantitative and monetary estimates obtained.

- **"Estimated value of the benefit: your own estimate"** *This question should be answered by you based on the rapid overall assessment.* The purpose of this column is to update the rapid assessment carried out in Chapter 4. Here you are again requested to provide your own estimate on how important the ecosystem service in question is at your Natura 2000 site (0= service is not relevant at the site, 1 = service is of limited significance, 2 = service is of moderate significance, 3 = service is of high significance and 4 = service is of very high significance). This estimate is based on the initial "rapid assessment" opinion, updated with any possible new insights and more detailed information obtained with the help of Chapter 5. You are then also requested to *update the spider diagram* developed as a part of the rapid assessment. Figure 7.1 provides an example of a final diagram, based on fictional examples in Table 7.1.

- **"Who are the beneficiaries?"** As stated before, it is important to highlight who the beneficiaries of different services might be. Furthermore, identifying the scale(s) on which the benefits are received can help to locate the relevant stakeholders benefiting from the service. To highlight these aspects one could usefully differentiate between the following beneficiaries: *local private benefits / local public benefits / regional (crossborder) private benefits / regional (crossborder) public benefits / global benefits*

etc. (for more information see Section 3.3). Insights on the "flow" of services can be further used explore possible options to maintain different services, e.g. establishing who could / should financially contribute to maintaining appropriate management practices at the site.

- **"What is the current status of the benefit?"** *This question should be answered by you – based on your own expert opinion and available knowledge.* This column aims to draw attention to the status of a given service and what its related benefits are. In particular, it hopes to draw attention to any services that might be endangered and therefore need some careful consideration in the future. See also Sections 7.2 and 7.3 for further consideration.

- **"Is the importance of this benefit likely to increase in the future?"** *This question should be answered by you – based on your own expert opinion and available knowledge.* This column hopes highlight the future importance of services. Future actions following up from the valuation should specifically look into the service with increasing importance, e.g. due to climate change. See also Sections 7.2 and 7.3 for further consideration.

- **"Can I sum up my monetary values to form an aggregated estimate?"** This final column provides some key insights for creating possible aggregated monetary estimates for the site (i.e. summing up obtained values for different services to illustrate the overall value of the site).

Table 7.1. A framework synthesising the benefits of a Natura 2000 site related ecosystem services. For further instructions see Section 7.1.above. Note: partly filled in for example only.

BENEFIT CATEGORY	BENEFIT DESCRIPTION	ESTIMATED VALUE OF THE BENEFIT				WHO ARE THE BENEFICIARIES?	WHAT IS THE CURRENT STATUS OF THE BENEFIT	IS THE IMPORTANCE OF THIS SERVICE LIKELY TO INCREASE IN THE FUTURE?	CAN I SUM MY MONETARY VALUES TO FORM AN AGREGATED ESTIMATE?
		Qualitative	**Quantitative**	**Monetary**	**Synthesis - based on your own estimation** (see instructions in Section 7.1)				
Ecosystem service related benefits									
Provisioning services									
Food, e.g. crops, fruit, livestock, wild berries & fungi, game	E.g. Wild berries	[Add any specific qualitative information available]	[Add info, e.g. xx local households collect wild berries from the site]	[Add info, e.g. Revenue of wild berries and related products sold in a local shop about xx EUR / year]	**4**	local inhabitants (local private benefit) local shop (local private benefit)	Service threatened / in poor condition due to over-exploitation	**YES due observed consumer preferences for sustainably produced food**	**YES -** monetary estimates for different provisioning services could be summed up to form an overall value estimate.
	E.g. Game meat	[Add any specific qualitative information available]	[Add info. e.g. xx members are member of the local hunting association]	[Add info, e.g. Income from "Natura 2000 supported" game sold to restaurants in the area xx EUR / year]		local inhabitants (local private benefit) local / regional restaurants (local / regional private benefit)	Service in good condition		
	Ect.								

Fibre / materials, e.g. wool, skins, leather, plant fibre, timber, cork					**0**				
Fuel, e.g. biomass, firewood	E.g. Sustainably produced grass for biofuel	[Add any specific qualitative information available]	[Add info, e.g. xx tons / year is the amount of grass provided for biofuel production]	[Add info, e.g. xx tons / year is the amount of grass provided for biofuel production]	**2**	local farmers (local private benefit) local biofuel industries (local private benefit)	Service in good condition (as secured by good site management practices)	**YES due increased markets for sustainable biofuels**	
Natural medicines		[Add any specific qualitative information available]	[Add info, e.g. xx is the number of species used as medicines etc. from the site]	[Add info, e.g. xx EUR revenues from products based on the natural ingredients from the site]	**3**	consumers (local, regional, global private benefit) medicine producer (regional private benefit)	Service in good condition	**YES due increased markets for natural medicines**	
Ornamental resources, e.g. wild plants, wood for handcraft, seashells					**1**				
Biochemicals & pharmaceuticals									

Water	E.g. Fresh water quantities supported by the site	[Add any specific qualitative information available]	[Add info, e.g. xx tons / year is the amount of water used in the area]	[Add info, e.g. xx EUR / m3 is the price of water, leading to xx EUR total value / year (with certain annual consumption rate)]	**2**	fresh water companies in the area (local private benefit) farmers using water for irrigation without a fee (local public benefit) consumers down stream (regional crossborder public benefit)	Service threatened / in poor condition due to over-exploitation	**YES due to increased dry periods & climate change**	
Cultural & social services									
Ecotourism & recreation	E.g. Value of tourism	[Add any specific qualitative information available]	[Add info, e.g. xx is the number of tourists visiting the site / year]	[Add info, e.g. xx EUR revenues from entrance fees / year]	**5**	local tourists (local public) other tourists (regional and global public) site management collecting fees (local private)	Service threatened due to unsustainable tourism practices in the area	**YES due increasing ecotourisim in the area**	**YES -** monetary estimates indicating the value of different tourism etc. activities could be summed up to form an overall value estimate. Also, tourism revenues could be often combined with values of
	E.g. Benefits of accommodation related to tourism	[Add any specific qualitative information available]	[Add info, e.g. xx is the number of nature tourists staying in the local accommodations]	[Add info, e.g. xx EUR revenues from accommodation / year]		local tourist businesses (local private)	Sevice threatened due to unsustainable tourism practices in the area		

Cultural values & inspirational services, e.g. education, art and research		Etc.			**4**				provisioning services. **BE CAREFUL** - revenues from tourism etc. might also already reflect the value of other services maintaining the ecosystems the tourists have come to visit (e.g. regulating and supporting services). Therefore, forming agragated monetary estimates is not recommended.
Landscape & amenity values					**4**				
Regulating services									
Climate / climate change regulation		[Add info, e.g. according to available studies site's characteristics make it a good carbon sink]	[Add info, e.g. xx ton / ha is the carbon sequestration capacity of the ecosystem]	[Add info, e.g. xx EUR / ton / ha is the value of carbon sequestration of the ecosystem]	**4**	all stakeholders affected by climate change (global public)	Service in slight decline due to general trends for deforestation in the area	**YES due to climate change**	**BE CAREFUL** - regulating services are often interlinked with one another and other service categories. For

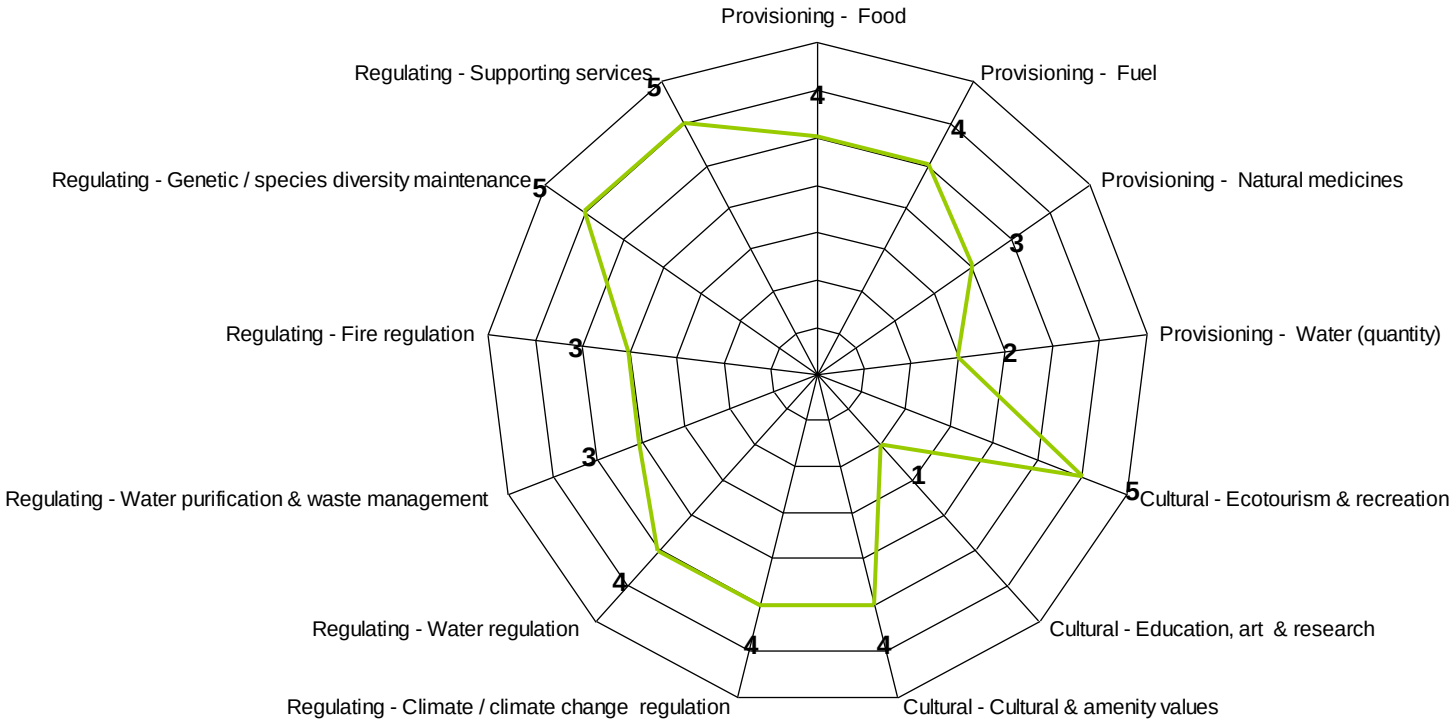
Water regulation, e.g. flood prevention, aquifer recharge		Add info, e.g. according to available studies site plays an important role in mitigating floods]	[Add info, e.g. xx properties protected from flood risk]	[Add info, e.g. xx EUR value of crops / year protected from flooding]	**4**	fresh water companies in the area (local private benefit) local property owners (local public benefit) properties protected down stream (regional crossborder public benefit)	Service in poor condition as the restoration of site's natural floodplains has been delayed	**YES due to increased risks of flooding & climate change**	example, the monetary **value of crops, timber and livestock** also partly incorporates the value of different services supporting the production of these resources (e.g. different regulating services). Also *vice versa*, valuing **pollination** based on the value of crops if a classic case of double counting etc.). Similarly, **water** prices often reflect a number of services related to its supply (e.g. quantity and quality of water). Also, revenues from **tourism** might also already reflect the value of services
Water purification & waste management		Etc.			**4**				
Air quality regulation					**2**				
Erosion control					**3**				
Avalanche control									
Storm damage control					**1**				
Wild fire mitigation		[Add info, e.g. according to available studies site plays an important role in mitigating fire]	[Add info, e.g. xx km2 area threatened by increased frequency of fires]	[Add info, e.g. xx EUR increase of costs of fire fighting in the area / year]	**2**	Local property owners (local public) Municipalities responsible for fire prevention and fighting (regional public)	Service threatened due to general decrease of natural fire resistant vegetation in the area	**YES due to increased dry periods & climate change**	
Biological control					**1**				
Pollination /					**1**		Etc.. Etc..	**YES due to [xxxx]**	

Regulation of human health (physical and mental)					**4**				regulating the ecosystems the tourists have come to visit. Therefore, forming agragated monetary estimates is not recommended.
Genetic / species diversity maintenance, e.g. protection of local and endemic breeds and varieties					**5**				
Supporting services					**Provide a combined estimate for all supporting services**				
Production					**5**				**BE CAREFUL** - as the name indicates supporting services form the basis for all other services. Therefore, their monetary value is already integrated in estimates for provisioning, cultural and regulating services.
Nutrient cycling and decomposition									
Water cycling									
Weathering / erosion									
Ecological interactions									
Evolutionary processes									
Wider socio-economic benefits									

Direct employment supported by Natura 2000 site					**Not applicable**			**YES** - the monetary estimates of different wider socio-economic benefits could be (to a certain extent) summed up. **BE CAREFUL** - These value estimates arise from the "overall existance of teh site". Thus, they are close linked with all ecosystem services provided by the site. Combining these value estimates with the ecosystem service specific estimates above could result in double counting.	
Indirect employment generated by Natura 2000 site									
Direct expenditure of the reserve									
Spending created by Natura 2000 site employees and volunteers supporting local economy									
Natura 2000 site's role in supporting rural and regional development									

Figure 7.1. Illustration of the importance of ecosystem services provided by a Natura 200 site.

(As according to examples in Table 7.1. Importance on scale 0-5)



7.2 Interpreting and using the results at site level

Naturally, the estimated socio-economic benefits of a Natura 2000 site need to be seen in a broader context of in order to apply them in practice. This refers to considering a number of aspects related to the management of the site itself (e.g. it management goals) and to planning the land use at wider local and regional scales.

Some questions aimed at helping to judge the obtained insights on socio-economic benefits in wider context are given below. The consideration of these questions can then help the users of this Toolkit to formulate some key messages they wish to communicate to different stakeholders and the wider public.

In addition, a suggested template for communicating possible site specific valuation case studies is provided in Annex 2.

What are the important benefits provided by a site and could they be valued? This is naturally the first key question to answer and it also forms a key message to be communicated to different stakeholders. In this context, it is also important to identify if some of the important benefits provided by the site could not be properly valued, in particular in monetary terms. These considerations help to focus possible future valuation efforts and they also highlight that any decisions affecting the site should not be based on monetary values only.

Are some of the identified benefits in danger? It is also important to consider whether some of the identified ecosystem services are in decline or facing serious risks. This can help to identify the immediate (and also long term) actions required to secure the maintenance of these services.

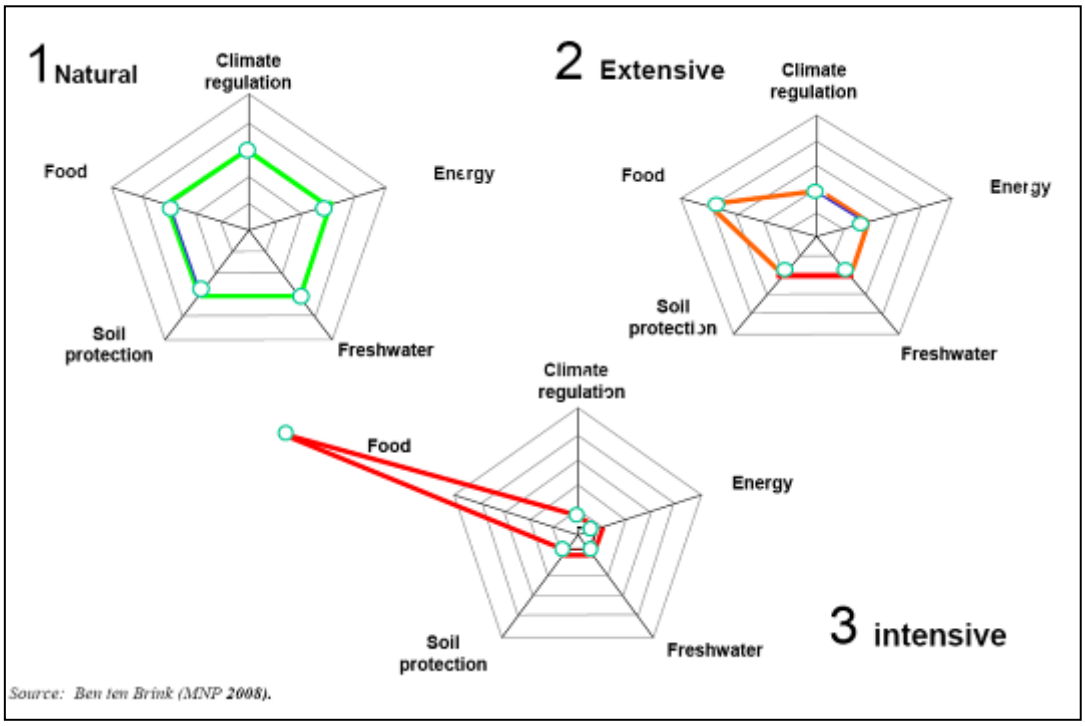
Is the importance of any given ecosystem service likely to increase in the future? It has been acknowledged that the role of ecosystems, including Natura 2000 sites, in regulating and balancing our natural environment is only likely to increase in future, in particular due to impacts of climate change. In addition, markets for sustainably produced and environmentally friendly goods and services continue to increase steadily. Consequently, emphasising sites' future socio-economic importance is likely to further support their maintenance.

Can identified benefits be sustainably managed and promoted? As highlighted already, it is important to ensure that the promotion of different socio-economic benefits provided by the site is in line with a site's conservation goals. In particular, it is essential to identify possible conflicts between these two aspects. In addition, there also a need to clearly establish what is the sustainable level of "using" the identified benefits, e.g. sustainable level of extracting biodiversity resources or water.

What are the trade-offs between different benefits? The existence and supply of different ecosystem services is often interlinked. Consequently, focusing only on enhancing the level of one service can have negative effects on other services or area's biodiversity conservation goals. For example, focusing on maximising the production of biodiversity resources, such as food production, is know to lead reducing the value of several other services such as erosion control and climate regulation (as due to converting forest areas to farming) (Figure 7.2). Similarly, aiming to enhance carbon sequestration by reforestation with monocultures is

usually considered negative to biodiversity. The consideration of different potential trade-offs is therefore important in order to decide which Natura 2000 related benefits to be promoted (e.g. their sustainable extraction level, see above).

Figure 7.2. Consequences of maximising one ecosystem services (food production) on the expense of other linked services.



What are the possible implications in the wider context of the Natura 2000 Network? One should also not forget that one of the goals of the Natura 2000 is to establish a functioning ecological network of protected areas in Europe. In practice, this means that the management of the network, including its individual sites, should also take into consideration ecological connections between the sites, e.g. by allowing the movement of species between sites. Therefore, promoting different socio-economic benefits at site level (e.g. decisions to enhance certain ecosystem services) should also reflect possible implications (e.g. positive and negative) to the wider overall network. In general, using socio-economic arguments to support the sustainable management of individual sites and their surroundings also improves the overall status of the network.

In the light of the results, what could / should the future actions be? Finally, the users of the Toolkit should be able to reflect what the possible future actions promoting the management of their Natura 2000 sites and related socio-economic benefits could be. For example, is there a need to revisit site's management plans to better address possible "win-win situations" between site's conservation goals and their potential for supplying different ecosystem services. Finally, as highlighted throughout the Toolkit, does the consideration of site's socio-economic benefits provide new possibilities for obtaining concrete funding to the site (e.g. see specific guidance in Chapter 5).

7.3 Interpreting and using the results in the context of multiple sites

The Toolkit focuses on assessing and communicating the benefits of Natura 2000 at the level of individual and already existing sites. As explained above, the obtained insights on ecosystem services and socio-economic value can be very useful to communicate the importance of the site to various stakeholders in order to 1) increase acceptance of the designation, 2) increase engagement in activities that relate to the site and 3) to help raise additional funding for the site. In addition to these site level considerations, it is also important to consider the implications of the results in the context of other sites at local, regional and broader network level. Even though these consideration call outside the scope of this Toolkit, some insights are given below.

Estimating the socio-economic benefits of Natura 2000 at a wider EU level will be further examined in the context of a follow-up work supported by the European Commission in 2009-2010.

How to estimate socio-economic importance of multiple sites?

In most of the cases the value of ecosystem services provided by a site (e.g. both their current value and the possible increased value following further investment in conservation) will be complementary, or additive, to the value of ecosystem services from other sites. In other words, this means that the promoting the role of services at one site does not diminish or cancel out the importance and socio-economic value of these services at neighbouring sites.

However, in some cases the promotion of and investment in an ecosystem services at a site may lead to competitive impacts and the decline of socio-economic value of the same service on other sites. In this context, it is vital to understand the spatial interrelations between the provision of a service and the beneficiaries / users of this service. In short, services such as pollination, provisioning and regulation of water, and mitigation of natural hazard are less "mobile" from one site to the next, i.e. they have a spatially fixed set of beneficiaries. Therefore, if these services exist at the site they are less likely to suffer from competition with similar services from other sites. On the other hand, beneficiaries defining the existence of provisioning and cultural services (particularly at a broader regional level) are more mobile and therefore competition may occur between services provided by different sites.

For example, development and branding of "Natura 2000 friendly" products might diminish the market share of similar products produces on other sites in the same region. Similarly, encouraging ecotourism and recreation at one site may lead to reducing visitors and the value of ecotourism at a neighbouring site. However, on the other hand increasing tourism and recreational opportunities at multiple sites within the same region might also attract more tourism to the area as it would be seen as an opportunity to enjoy several sites during one visit.

Given the above, one should not take for granted that the socio-economic importance of and obtained values for different ecosystem services can be simply added up across sites. The more sites there are in the area the greater is the risk of individual sites "competing" over the provisioning of some ecosystem services. As a rule of thumb, if the demand and/or

appreciation of an ecosystem service can sustain supply of this services from multiple sites then it is possible to add up the values of the service in question across sites.

In summary, when looking at the socio-economic value of a site from the broader regional perspective it will be useful to understand the level of competition in service provisioning between different sites. It may be that due to the displacement of benefits the potential value of a site from a local or site-specific perspective is higher than from a regional perspective.

Chapter 3 of the Toolkit provides information on the benefit transfer technique, i.e. the use of same value estimates on different geographic locations. Naturally, none of the Natura 200 sites are identical and ideally, therefore, a fully accurate picture of the socio-economic value of a site should be based on site-specific information and studies. Unfortunately, however, this is often beyond the time and resources available and therefore it is often more feasible to consider basing the assessment on already existing estimates from a similar site. In many cases this methods can give values that are sufficiently solid to be demonstrate, robustly, the value of a site. However, one should give due consideration to the aspect above as it cannot always be assumed that value estimates from one site can automatically be used as a proxy for the same service on another site.

Is it possible to develop aggregate value estimates?

Ultimately, the users of the Toolkit may also interested in using the results from multiple sites to develop aggregated (e.g. monetary) estimates reflecting the socio-economic value of Natura 2000 at broader level. This raises the question as to how to combine information from a range of sites and develop the "pyramid of benefits" for Natura 2000 at a wider regional, national and the EU level. These kind of estimates would also allow comparing the benefits of the Natura 2000 network as a whole. Although this further analysis fall outside the scope of this Toolkit, a number of initial thoughts and general insights are briefly outlined below.

In general, the development of aggregated estimate on the value of Natura 2000 can pose a number of challenges. As described earlier in this Toolkit, the economic valuation of biodiversity is a complex task that requires the application of different approaches and methods. It is also important to consider the risks of double counting and trade-offs between different ecosystem services. Therefore, the available information on monetary benefits provided by Natura 2000 sites remains scarce and focused on those ecosystem services where market values are easily available, e.g. some branded products, recreation and tourism. Consequently, an assessment of Natura 2000 related socio-economic benefits on a wider scale would require combining and extrapolating information from different sites in order to form an aggregated estimate on the overall benefits. As described above, the consideration and transfer of benefits across multiple sites can be a complicated task.

Given the lack of existing information, any national or EU level assessment of the Natura 2000 related benefits should aim at providing a set of qualitative, quantitative and monetary estimates that can be used to build a comprehensive picture of the overall situation. This "three level assessment" is likely to give more accurate results than a single monetary figure. It is also likely that due to the lack of data the aggregated estimate(s) would need to be developed based on information from a small number of sites and/or Member States. Therefore, careful consideration would need to be given to the representativeness of the developed estimates. In addition, the assessment should also clearly describe the data and

methods used to develop the estimates, e.g. outline the underlying assumptions for scaling up site-specific information.

A broader assessment of Natura 2000 benefits could for example combine following information, focusing on one or all of the before mentioned levels of assessment:

- identification of the most common benefits at regional / national / EU level (qualitative);
- aggregated / extrapolated estimates of the value of some ecosystem services, where adequate amount of information available (quantitative and monetary);
- assessing and mapping the spatial provision of benefits at national and EU level, i.e. forming an overall picture of different services provided by different Natura 2000 sites and assessing the local, regional and global beneficiaries of these services (qualitative);
- possible trends in the provisioning of different / selected benefits (qualitative and possibly quantitative);
- overview and insights of methodologies used to estimate Natura 2000 related benefits (qualitative, quantitative and monetary);
- data availability and level of awareness on different benefits among stakeholders (qualitative and quantitative); and
- use of information on Natura 2000 related benefits in practise, e.g. in land-use planning, investment etc.

Similarly, given the problems in estimating monetary values for the full range of ecosystem services it is also difficult to try to assess the net monetary benefits of Natura 2000 sites / network. Therefore, it is not recommended to base these assessments on a monetary cost benefit analysis alone. As before, the use of qualitative, quantitative and monetary information is required to build a more comprehensive and reliable picture on the situation.

The following broader aspects related to the costs and benefits of Natura 2000 could, for example, be considered:

- comparison of the overall scale and extent of costs and benefits (qualitative and quantitative);
- comparison of monetary cost and benefits for some ecosystem services, where comparable information available (monetary);
- identification and comparison of stakeholders (e.g. the number of stakeholders) benefiting from the Natura 2000 site vs. facing management / opportunity costs (qualitative, quantitative and monetary); and
- comparison of current knowledge on costs and benefits, e.g. information gaps and related implications.

REFERENCES

KEY GUIDANCE FOR THE VALUE & ECONOMIC VALUATION OF ECOSYSTEM SERVICES

Defra. 2007. An introductory guide to valuing ecosystem services. Defra Publications, London, the UK. 65 pp. http://www.defra.gov.uk/wildlife-countryside/natres/pdf/eco_valuing_exe.pdf

De Groot, R. S., Stuip, M. A. M., Finlayson, C. M. and Davidson, N. 2006. Valuing wetlands: guidance for valuing the benefits derived from wetland ecosystem services, Ramsar Technical Report No. 3/CBD Technical Series No. 27. Ramsar Convention Secretariat, Gland, Switzerland & Secretariat of the Convention on Biological Diversity, Montreal, Canada

EFTEC. 2005. The Economic, Social and Ecological Value of Ecosystem Services: A Literature Review. Report for the Department for Environment, Food and Rural Affairs.
http://www.fsd.nl/downloadattachment/71609/60019/theeconomicsocialandecologicalvalueofecosystemservices.pdf

IEEP and WWF. 2002. Promoting the socio-economic benefits of Natura 2000. Background report, conference proceedings & European case studies. Available at
http://www.ieep.eu/publications/publicationssearch.php?search=author&author=80&page=0&limit=5
http://www.ieep.eu/publications/pdfs/natura2000/backgroundreport.pdf
http://www.ieep.eu/publications/pdfs/natura2000/naturaproceedings.pdf

MA Millennium Ecosystem Assessment. 2005. Ecosystems and Human Well-being: Biodiversity Synthesis. World Resources Institute, Washington, DC. http://www.millenniumassessment.org/en/condition.aspx

Van Beukering, P., Brander, L., Tompkins, E. and McKenzie, E. 2007. Valuing the Environment in Small Islands - An Environmental Economics Toolkit. JNCC, UK.

OTHER REFERENCES USED IN THE TOOLKIT

Acharya, G. 2000. Approach to valuing the hidden hydrological services of wetland ecosystems. Ecological Economics, 35/1: 63-74.

Alexandrov, G.A., Yamagata, Y. and Oikawa, T. 1999. Towards a model for projecting net ecosystem production of the world forests. Ecological Modelling, 123, 183–191. Available at http://www-cger.nies.go.jp/carbon/pannel.htm (last visited 26 Nov 2008)

Alexandrov, G.A., Oikawa, T. and Yamagata, Y. 2002. The scheme for globalization of a process-based model explaining gradations in terrestrial NPP and its application. Ecological Modelling, 148(3): 293-306.

Alexandrov, G. A., Yamagata, Y. and Oikawa, T. 1999. Towards a model for projecting Net Ecosystem Production of the world forests. Ecological Modelling. 123(2-3): 183-191.

ANSAB. 2006. Regional Stakeholders' Workshop on Valuation and Options for Payment of Ecosystem Services of Mountain Forests - August 22-23.2006. Workshop proceedings. Available at http://www.ansab.org/downloads/rsw_proc.pdf

Acharya, G. 2000. Approaches to valuing the hidden hydrological services of wetland ecosystems. Ecological Economics, 35/1: 63-74.

Badola, R. and Hussain, S. A. 2005. Valuing ecosystem functions: an empirical study on the storm protection function of Bhitarkanika mangrove ecosystem, India. Environmental Conservation 32 (1): 85–92

Bale, J., van Lenteren, J. and Bigler, F. 2008. Biological control and sustainable food production. Philosophical Transactions of the Royal Society B: Biological Sciences 363: 761-776.

Balmford, A., Rodrigues, A.S.L., Walpole, M., ten Brink, P., Kettunen, M., Braat, L. and de Groot, R. 2008. The Economics of Biodiversity and Ecosystems: Scoping the Science. Cambridge, UK: European Commission

(contract: ENV/070307/2007/486089/ETU/B2) Available at http://ec.europa.eu/environment/nature/biodiversity/economics/teeb_en.htm

Bann, C. 1997. An Economic Analysis of Alternative Mangrove Management Strategies in Koh Kong Province, Cambodia. Economy and Environment Program for Southeast Asia, International Development Research Centre 1997.

Barbier, E. B., Acreman, M. and Knowler, D. 1997. Economic Valuation of Wetlands: a Guide for Policy Makers and Planners. Ramsar Convention Bureau Gland, Switzerland) Available at http://ramsar.org/lib/lib_valuation_e.pdf

Bassi, S., Kettunen, M., Kampa, E. and Cavalieri, S. 2008. Forest Fires: Causes and Contributing Factors to Forest Fire Events in Europe Study for the European Parliament Committee on Environment, Public Health and Food Safety under contract IP/A/ENVI/FWC/2006-172/LOT1/C1/SC10.

Beaumont N., Townsend M., Mangi S. and Austen M. C. 2006. Marine Biodiversity. An Economic Evaluation. Defra-Report, UK

Benitez, P.C., McCallum, I., Obersteiner, M. and Yamagata, Y. 2007. Global potential for carbon sequestration: Geographical distribution, country risk and policy implications. Ecological Economics, 60(3): 572-583.

Besbes, B., Tixier-Boichard, M., Hoffmann, I. and Jain, G. L. 2007. Future trends in poultry genetic resources – presentation in the International conference "Poultry in the 21st Century" (Bangkok, 5-7 November 2007). Available at http://www.fao.org/ag/AGAInfo/home/events/bangkok2007/docs/presentation/6.Besbes.pdf

Betts, R.A. 1999. Self-beneficial effects of vegetation on climate in an Ocean–Atmosphere General Circulation Model. Geophysical Research Letters, 26(10), 1457–1460.

Boardman, J. and Poesen, J. (eds). 2006. Soil Erosion in Europe. Environmental Change Institute, University of Oxford.

Bolin, B., Sukumar, R., Ciais, P., Cramer, W., Jarvis, P., Kheshgi, H., Nobre, C., Semenov, S. and Steffen, W. 2000. Global perspective. In Land Use, Land Use Change and Forestry. R.T. Watson, I.R. Noble, B. Bolin, N.H. Ravindranath, D.J. Verardo, and D.J. Dokken (eds.), A Special report of the IPCC, Cambridge University Press, pp. 23-51.

Braat, L. and ten Brink, P. (eds.) with J. Bakkes, K. Bolt, I. Braeuer, B. ten Brink, A. Chiabai, H. Ding, H. Gerdes, M. Jeuken, M. Kettunen, U. Kirchholtes, C. Klok, A. Markandya, P. Nunes, M. van Oorschot, N. Peralta-Bezerra, M. Rayment, C. Travisi, M. Walpole. 2008. The Cost of Policy Inaction. The case of not meeting the 2010 biodiversity target. A project for the European Commission. Available at http://ec.europa.eu/environment/nature/biodiversity/economics/teeb_en.htm

Brainard, J., Lovett, A. and Bateman, I. 2003. Carbon Sequestration Benefits of Woodland. Report to Forestry Commission, Edinburgh. Available at http://www.forestresearch.gov.uk/pdf/carbonseqrep0603.pdf/$FILE/carbonseqrep0603.pdf

Bramwell, B. and B. Lane. 1994. Rural Tourism and Sustainable Rural Development, Channel View, London, UK.

Brush, St B. and Meng, E. 1998. Farmers' valuation and conservation of crop resources. Genet-resour-crop-evol, 45/2: 139-150.

Bullock, A., and Acreman, M. 2003. The role of wetlands in the hydrological cycle. Hydrology and Earth System Sciences 7: 358-389.

Charles W. Rice 2008. 'Carbon Sequestration in Agro-Ecosystems'– presentation at Scientists Brief Policymakers on Carbon Sequestration by Ecosystems on 25 September 2008 http://www.ecosystemresearch.org/2008%20Meeting/hill%20briefing.htm

Christie M., Hanley N., Garrod B. et al. 2005. Valuation of forest recreation activities. Phase 1, Phase 2 and Technical Reports to the Forestry Commission, UK.

Clarkson, R. and Deyes, K. 2002. Estimating the Social Cost of Carbon Emissions, Government Economic Service Working Paper 140, Department of Environment, Food and Rural Affairs: London.

Costanza, R., d'Arge, R., Groot, R.d., Farber, S., Grasso, M., Hannon, B., Limburg, K., Naeem, S., O'Neill, R.V., Paruelo, J., Raskin, R.G., Sutton, P. and Belt, M. 1997. The value of the world's ecosystem services and natural capital. Nature 387: 253 - 260.

Costanza, R. and Folke, C. 1997, Valuing Ecosystem Services With Efficiency, Fairness and Sustainability as Goals. Pp. 49-68. In G. C. Daily ed. Natures Services: Societal Dependence on Natural Ecosystems. Island Press. Washington DC.

Curtis, P. S. 2008. Lessons from the Past and Predictions for the Future - presentation at Scientists Brief Policymakers on Carbon Sequestration by Ecosystems on 25 September 2008. Available at http://www.ecosystemresearch.org/2008%20Meeting/hill%20briefing.htm

Delang, C. O. 2006. Not just minor forest products: The economic rationale for the consumption of wild food plants by subsistence farmers. Ecological Economics, 59: 64-73.

Dickie, I., Hughes, J. and Esteban, A. 2006, Watched Like Never Before…the local economic benefits of spectacular bird species, RSPB, UK.

Eade, J. D. O. and Moran, D. 1996. Spatial Economic Valuation: Benefits Transfer Using Geographical Information Systems. In Journal of Environmental Management, 48: 97-110.

Eagles, P., M. Bowman, and T. Chang-Hung. 2001. Guidelines for Tourism in Parks and Protected Areas of East Asia, IUCN, Gland, Switzerland, 99 pp.

Ecological Society of America (ESA) and the Union of Concerned Scientists (UCS USA). Communicating Ecosystem services web site http://www.esa.org/ecoservices/

EEA. 2004. Mapping the impacts of recent natural disasters and technological accidents in Europe. European Environment Agency, Copenhagen, Denmark. 48 pp.

EEA. 2006. Map on the groundwater overexploitation and saltwater intrusion in Europe. http://dataservice.eea.europa.eu/atlas/viewdata/viewpub.asp?id=196

EFFIS. 2007. Newlsetters – issues 1, 2 and 3 Available at http://effis.jrc.it/documents/2006/ForestFiresInEurope2006.pdf
http://effis.jrc.it/documents/2007/EFFIS_Newsletter_2_2007.pdf
http://effis.jrc.it/documents/2007/EFFIS_Newsletter_3_2007_small.pdf

Emerton, L. 1999. Mount Kenya: the economics of community conservation. IIED Evaluating Eden Series, Discussion Paper 4.

Emerton, L. and Bos, E. 2004. Value: Counting Ecosystems as an Economic Part of Water Infrastructure. IUCN, Gland, Switzerland and Cambridge, UK. 88 pp Available at http://www.iucn.org/themes/wani/pub/VALUE.pdf

EPA 1993. The Role and Function of Forest Buffers In the Chesapeake Bay Basin for Non-Point Source Management. EPA, Annapolis, MD, Chesapeake Bay Program Report. CBP/TRS 91/93.

Esquinas-Alcázar, J. 2005. Protecting crop genetic diversity for food security: political, ethical and technical challenges. Nature Reviews Genetics 6:946-953.

European Commission. 2007. European Flood Action Programme. Available at http://ec.europa.eu/environment/water/flood_risk/consult.htm (last updated in November 2007)

European Commission. 2006. Forest Fires in Europe 2005.

Eurosion. 2004. Living with the coastal erosion in Europe – results from the Eurosion study. Office for Official Publications of the European Communities, Luxemburg. 38 pp.

Fankauser, S. 1994. The social costs of greenhouse gas emissions: an expected value approach. The Energy Journal 15, 157-184.

Fankauser, S. 1995. Valuing Climate Change: The Economics of the Greenhouse Earthscan, London.

FAO. 1997. The State of the World's Plant Genetic Resources for Food and Agriculture. Rome, Italy.

FAO. 2005 Global Forest Ressources Assessment 2005. Chapter 6, Protective Function of Forest Resources Available at ftp://ftp.fao.org/docrep/fao/008/A0400E/A0400E07.pdf

Fleischer, A. and Sternberg, M. 2006. The Economic impact of global climate change on Mediterranean range land ecosystems: a Space-for-Time approach. Ecological economics, 287-295.

FNNPE (Federation of Nature and Natural Parks of Europe). 1993. Loving Them to Death? Sustainable Tourism in Europe's Nature and Natural Parks, Eupen, Belgium.

Garrod G. 2002. Social and Environmental Benefits of Forestry. Phase 2 : Landscape benefits. Report to the Forestry Commission, UK

Gren, I. M., Groth, K. H. and Sylven M. 1995. Economic Values of Danube Floodplains. In Journal of Environmental Management, 45: 333-345.

Grêt-Regamey A. 2005. Spatially explicit valuation of ecosystem services in the Alps as a support tool for regional decision making.

Gunawardena, M. and Rowan, J. S. 2005. Economic Valuation of a Mangrove Ecosystem Threatened by Shrimp Aquaculture in Sri Lanka. In Environmental Management, 36 (4): 535-550.

Desmyttere, H. and Dries, L. 2002. Promoting the socio-economic benefits of Natura 2000 - Case Study in the Pond Complex of Central-Limburg. Available at http://ieep.org.uk/publications/pdfs/natura2000/belgiumcasestudy.pdf

Hartig, T. and Evans, G.W. 1993. Psychological foundations of nature experience. In: Behavior and Environment: Psychological and Geographical Approaches, T. Garling and R.G. Golledge (eds.), Elsevier Science Publishers, Amsterdam, the Netherlands, pp. 427–57.

Hassan, R., Scoles, R. and Ash, N. 2005. Ecosystems and human well-being: current state and trends: findings of the Condition and Trends Working Group (The millennium ecosystem assessment series; v. 1). ISBN 1-55963-227-5. Available at http://www.millenniumassessment.org/documents/document.766.aspx.pdf

Hein, L. and Gatzweiler. F. 2006. The economic value of coffee genetic resources. Ecological Economics 60.1: 176 – 185

Hourner, C., Colding, J. and Soderqvist, T. 2006. Economic valuation of a seed dispersal service in the Stockholm National Urban Park. Ecological Economics, 59/3: 364-374

Howard, P. 1995. The economics of protected areas in Uganda: costs, benefits and policy issues. Dissertation for University of Edinburgh.

Intergovernmental Panel on Climate Change, Climate Change (IPCC) 1995. Economic and Social Dimensions of Climate Change. Cambridge University Press, Cambridge, pp. 183–224.

Intergovernmental Panel on Climate Change, Climate Change (IPCC). 2001a. Climate Change 2001: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Houghton, J. T., Y. Ding, D. J. Griggs, M. Noguer, P. J. van der Linden, X. Dai, K. Maskell, and C. Johnson (eds.), Cambridge University Press, Cambridge, UK, 881 pp.

Intergovernmental Panel on Climate Change, Climate Change (IPCC). 2001b. Climate Change 2001: Impacts, Adaptation, and Vulnerability. Contribution of Working Group II to the Third Assessment Report of the Intergovernmental Panel on Climate Change, McCarthy, J. J., O.F. Canziani, N.A. Leary, D.J. Dokken, and K.S. White (eds.), Cambridge University Press, Cambridge, UK, 1032 pp.

Intergovernmental Panel on Climate Change, Climate Change (IPCC). 2001c. Climate Change 2001: Mitigation. Contribution of Working Group III to the Third Assessment Report of the Intergovernmental Panel on Climate Change, Metz, B., O Davidson, R. Swart, and J. Pan (eds.), Cambridge University Press, Cambridge, UK, 752 pp.

Intergovernmental Panel on Climate Change, Climate Change (IPCC). 2001d. Climate Change 2001: Synthesis Report, (Watson, R. T. and Core Writing Team (eds.), Cambridge University Press, Cambridge, UK, 398 pp.

Intergovernmental Panel on Climate Change, Climate Change (IPCC). 2001. Climate Change: The Scientific Basis. Contribution of Working Group I to the Third Assessment Report of the Intergovernmental Panel on Climate Change. Edited by J.T. Houghton et al.

Environmental Economics Research Group. 2004. An Economic assessment of the costs and benefits of Natura 2000 Sites in Scotland. Edinburgh. Available at www.scotland.gov.uk/publications

Job, H., Harrer, B., Metzler, D. and Hajizadeh-Alamdary, D. 2005. Ökonomische Effekte von Großschutzgebieten - Untersuchung der Bedeutung von Großschutzgebieten für den Tourismus und die wirtschaftliche Entwicklung der Region BfN-Skripten 135, Bonn.

Jones, R. J. A., Le Bissonnais, Y., Sanchez Diaz, J., Düwel, OP., Øygarden, L., Bazzoffi, P., Prasuhn, V., Yordanov, Y., Strauss, P., Rydell, B., Berenyi Uveges, J., Loj, G., Lane, M. and Vandekerckhove, L. 2003. Nature and Extent of Soil Erosion in Europe (Interim report). Available at http://eusoils.jrc.ec.europa.eu/ESDB_Archive/pesera/pesera_cd/index.htm)

Kaiser, B., Krause, N. and Roumasset, J. 1999. Environmental Valuation and the Hawaiian Economy. Online publication at UHERO
http://www.uhero.hawaii.edu/workingpaper/HawaiiEnviroEvaluation.pdf

Kaiser, B. and Raumasset, J. 2002. Valuing indirect ecosystem services: the case of tropical watersheds. Environment and Development Economics, 7: 701-714

Kaplan, S. and Kaplan, R.1989. The Experience of Nature: A Psychological Perspective,Cambridge University Press, New York, NY.

Kaplan, S. 1987. Aesthetics, affect and cognition: Environmental preference from an evolutionary perspective, Environment and Behavior, 19, pp. 3–32.

Karimzadegan, H., Rahmatian, M., Dehghani Salmasi, M., Jalali, R. and Shahkarami, A. 2007. Valuing Forests and Rangelands-Ecosystem Services. Int. J. Environ. Res., 1(4): 368-377

Kellert, S.R. 1993. The biological basis for human values of nature. In: The Biophilia Hypothesis, S.R. Kellert and E.O. Wilson (eds.), Island Press, Washington, DC.

Kettunen, M., Genovesi, P., Gollasch, S., Pagad, S., Starfinger, U. ten Brink, P. and Shine, C. 2008. Technical support to EU strategy on invasive species (IAS) - Assessment of the impacts of IAS in Europe and the EU (final module report for the European Commission). Institute for European Environmental Policy (IEEP), Brussels, Belgium. 43 pp. + Annexes. (draft version)

King D. and Mazzotta, M. 2000. Website on ecosystem evaluation, University of Maryland, Available at http://www.ecosystemvaluation.org/

Lloret, J., Palomera, I., Salat, J. and Sole, I. 2004. Impacts of freshwater input and wind on landings of anchovy and sardine in self waters surrounding the Ebre River delta. Fish. Oceanogr. 13:102–110.

Loewenstein, W. 1992. Die monetaere Bewertung der Schutzfunktion des Waldes vor Lawinen und Rutschungen in Hinterstein (Allgaeu), edited by: Bergen, V., Loewenstein, W., and Pfister G. Studien zur monetaeren Bewertung von externen Effekten der Forst- und Holzwirtschaft, Sauerlaender, Frankfurt, 117–177, 1995.

Losey, J. E. and Vaughan, M. 2006. The Economic Value of Ecological Services Provided by Insects. BioScience 56: 311-323.

Lyashevska, O. 2007. Analysis and valuation of the water purification service of wetlands. Available at http://topshare.wur.nl/questionnaires/pubdb/aspx/PublicViewBook.aspx?key=76316

Marti´n-Lo´ pez B., Montes C. and Benayas J. 2007. Influence of user characteristics on valuation of ecosystem services in Do˜nana Natural Protected Area (south-west Spain). Environmental Conservation 34 (3): 215–224.

Matthews, E., Payne, R., Rohweder, M. and Murray S. 2000. Pilot analysis of global ecosystems: Forest ecosystems.

Meyerhoff, J. and Dehnhardt, A. 2004. The restoration of floodplains along the river Elbe. Available at http://www.landschaftsoekonomie.tu-berlin.de/fileadmin/a0731/uploads/publikationen/workingpapers/wp01104.pdf

Holly, M., Boyle, J., Kevin, J. and Bouchard, R. 1996. Water quality affects property prices: a case study of selected Maine Lakes, University of Maine.

Miscellaneous Report, vol. 398. Agricultural and Forest Experiment Station.

Minga, J., Xian-guoa, L., Lin-shuc, X., Li-juand, C. and Shouzhenga, T. 2007. Flood mitigation benefit of wetland soil - a case study in Momoge National Nature Reserve in China. Ecological Economics, 61/2-3: 217-223.

Morandin, L. A. and Winston, M. L. 2006. Pollinators provide economic incentive to preserve natural land in agroecosystems. Agriculture, Ecosystems and Environment, 116/3-4: 289-292.

Nabhan, G. P., and Buchmann, S. L. 1997. Services provided by pollinators. Pages 133-150 in G. C. Daily, ed. Nature's services. Island Press, Washington, D.C.
Natura 2000 Newsletter (no 24), July 2008 (e.g. information on different benefits obtained from the Natura 200 sites)

Neidlein, H-C. and Walser, M. 2005. Natur ist Mehr-Wert Ökonomische Argumente zum Schutz der Natur/Nature is more worth - the economic value for the protection of nature. Available at http://www.bfn.de/fileadmin/MDB/documents/skript154.pdf

Nielsen, T. S. and Hansen, K. B. 2007. Do green areas affect health? Results from a Danish survey on the use of green areas and health indicators. Health & Place, 13/4: 839-850.

Nordhaus, W.D. 1992) An optimal transition path for controlling green house gases. Sci. 258, 1315-1319.

North Carolina State University, undated. web site: www.bae.ncsu.edu/programs/extension/wqg/

Nourbakhsh, F. 2006. Decoupling of soil biological properties by deforestation. Agriculture, Ecosystems and Environment,121: 435

Olson, J. S., J. A. Watts, and L. J. Allison. 1985. Major World Ecosystem Complexes Ranked by Carbon in Live Vegetation (NDP-017). Carbon Dioxide Information Center, Oak Ridge National Laboratory, Oak Ridge, Tennessee

Olson, J. S., J. A. Watts, and L. J. Allison. 1983. Carbon in Live Vegetation of Major World Ecosystems (ORNL-5862). Oak Ridge National Laboratory, Oak Ridge, Tennessee.

Parry, M., Canziani, O., Palutikof, J., Linden, J. P and Hanson, C. 2008. Climate Change 2007: Impacts, Adaptation and Vulnerability. Working Group II Contribution to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change. Published by Cambridge University Press, 2008. 976 pages

Parsons E.C.M., Warburton, C. A., Woods-Ballard, A., Hughes, A., Johnston, P., Bates, H. and Luck, M. 2003. Whale watching in West Scotland. Report for Defra. http://www.whaledolphintrust.co.uk/cust_images/research%20publications/whalewatchingtourists.pdf

Pavšek M. 2002. Avalanches in Slovenia. Geography of Slovenia 6. SFI (Swiss Federal Institute for Snow and Avalanche Research Davos), 2008. Avalanches, Debris and Rockfall Unit. Available at http://www.wsl.ch/forschung/forschungsunits/lawinen/index_EN?-C=&

Pearce, D.W., Cline, W.R., Achanta, A., Fankhauser, S., Pachauri, R., Tol, R., Vellinga, P. 1996. The social costs of climate change: Greenhouse damage and the benefits of control. In: Stern, N. 2007. The Economics of Climate Change. The Stern Report. Cambridge University Press. Cambridge. 692 pp

Pearce, D.W. and Puroshothaman, S. 1992. Protecting biological diversity: the economic value of pharmaceutical plants. Discussion Paper 92-27. Centre for Social and Economic Research on the Global Environment, London.

Pedford, J. 1996. Seeing is believing: The role of living history in marketing local heritage. In: The Marketing of Tradition, T. Brewer (ed.), Hisarlink Press, Enfield Lock: pp. 13–20.

Penny F. 2005. 'Ecosystem Services – Water Purification'. Science NetLinks. Available at http://www.sciencenetlinks.com/lessons.cfm?Grade=6-8&BenchmarkID=11&DocID=275

Peterson, C. H., Grabowski, J. H. and Powers, S. P. 2003. Estimated enhancement of fish production resulting from restoring oyster reef habitat: quantitative valuation. Mar. Ecol. Prog. Ser., 264:249-264.

Pimentel, D., McNair, S., Janecka, J., Wightman, J., Simmonds, C., O'Connell, C., Wong, E., Russel, L., Zern, J., Aquino, T. and Tsomondo, T. Pimentel, D. 2001. Economic and environmental threats of alien plant, animal, and microbe invasions. Agriculture, Ecosystems and Environment, 84: 1–20

Pimentel, D.; R. Zuniga and D., Morrison. 2005. Update on the environmental and economic costs associated with alien-invasive species in the United States. Ecological Economics, 52: 273-288.

Poor, P. J., Pessagno, K. L. and Paul, R. W. 2007. Exploring the hedonic value of ambient water quality: A local watershed-based study. Ecological Economics, 797–806

Powe N.A. and Willis K.G. 2002. Social and Environmental Benefits of Forestry. Phase 2 : Mortality and Morbidity Benefits of Air Pollution Absorption by Woodland Landscape benefits. Report to the Forestry Commission, UK

Pugh D. and Skinner L. 2002. A new analysis of marine-related activities in the UK economy with supporting science and technology. IACMST Information Document No.10

Ramakrishnan, P. S., Saxena, K.G. and Chandrashekara, U.M. (eds.). 1998. Conserving the Sacred for Biodiversity Management, UNESCO, Paris, France/Oxford & IBH Publishing, New Delhi, India, pp. 101–21.

Ramsar. 2000. Background papers on Wetland Values and Functions. Available at http://www.ramsar.org/info/values_waterpurification_e.htm

Reisinger, Y. 1994. Tourist–host contact as a part of cultural tourism, World Leisure and Recreation, 36(2).

Revenga, C., Brunner, J., Henninger, N., Payne, R. and Kassem, K. 2000. Pilot Analysis of Global Ecosystems. Freshwater Systems. World Resources Institute. Available at http://pubs.wri.org/pubs_description.cfm?PubID=3056

Rickinson, M., Dillon, J., Teamey, K., Morris, M., Choi, M., Sanders, D. and Benefield, P. 2004. A review of research on outdoor learning. Field Studies Council report. Available at http://www.peecworks.org/PEEC/PEEC_Research/S000F79A7-000F7A75

Rodriguez, L.C., Pascual, U., Niemeyer, H.M. 2006. Local identification and valuation of ecosystem goods and services from Opuntia scrublands of Ayacucho, Peru. In Ecological Economics, 57: 30-44.

Roosen, J, Fadlaoui, A, Bertaglia, M. 2005. Economic evaluation for conservation of farm animal genetic resources, Journal of Animal Breeding Genetics, 122: 217 - 228

Rosales, R.M.P., Kallesoe, M.F., Gerrard, P., Muangchanh, P., Phomtavong, S., Khamsomphou, S. 2005. Balancing the returns to Catchment Management: The economic value of conserving natural forests in Sekong, Lao PDR. IUCN Water, Nature and Economics Technical Paper No. 5

RSPB. 2005. Wellbeing through Wildlife in the EU. BirdLife International European Division Office, Brussels. Available at http://www.birdlife.org/eu/pdfs/Wellbeing_EU_final_version_2mb.pdf

Ruijgrok E.M.C. and Groot, R.S. de. 2006. Kentallen Waardering Natuur, Water, Bodem en Landschap. Hulpmiddel bij MKBA's. Available at http://www.mkbainderegio.nl/docs/Kentallen_waardering_natuur_water_bodem_en_landschap.pdf.

Ruijgrok, E.M.C. 2006. The three economic values of cultural heritage. A case study in the Journal of Cultural Heritage.

Ruijgrok, E.M.C. 2007. Blending ecology in actual economic decisions. The Dutch national guideline for ecosystem valuation applied on the Schelt estuary in Belgium. Belgium

Schuyt, K. and Brander, L. 2004. Living Waters: Conserving the Source of Life. The Economic Values of the World's Wetlands. Gland, Switzerland: WWF International and Amsterdam: Institute for Environmental Studies.

Schippmann, U., Leaman, D. and Cunningham, A.B. 2006. Cultivation and wild collection of medicinal and aromatic plants under sustainability aspects. In: R.J. Bogers, L.E. Craker and D. Lange (eds), Medicinal and Aromatic Plants: Agricultural, Commercial, Ecological, Legal, Pharmacological and Social Aspects, pp. 75–95. Wageningen, The Netherlands, Springer, Dordrecht.

Simpson, R. H. and Riehl, H. 1981. The hurricane and its impact: Louisiana State University Press, Baton Rouge, 398 p.

Skayannis, P. 1999. Planning Tourism, Development and the Environmental Protection in the Coastal Area of Magnesia: Local Interests and Expectations, Associationof European Schools of Planning annual conference, 7–10 July, Bergen, Norway,AESOP, University of Groningen, Groningen, The Netherlands.

Staats, H., Kieviet, A. and Hartig, T. 2003. Where to recover from attentional fatigue: An expectancy-value analysis of environmental preference, Journal of Environmental Psychology, 23, pp. 147–57.

Stevens, S. 1997. Conservation Through Cultural_Survival: Indigenous Peoples and Protected Areas, Island Press, Washington, DC.

Sutton, P. C. Undated. Presentation: Coastal Wetlands and Storm Protection: A spatially explicit estimate of ecosystem service value

Tapsuwan, S., Ingram, G. and Brennan, D. 2007. Valuing Urban Wetlands of the Gnangara Mound: A Hedonic Property Price Approach in Western Australia. Conference paper, the Australian Agricultural and Resource Economics Society (AARES) 51st Annual Conference. 13 pp.

Ten Brink P., Monkhouse C., Richartz S. 2002. Promoting the socio-economic benefits of Natura 2000. Background report for European Conference on 'Promoting the Socio-Economic Benefits of Natura 2000, Brussels, 28/29 November 2002.

Ten Brink, P. and Bassi, S. 2008. Benefits of Environmental Improvements in the European Neighbourhood Policy (ENP) Countries – A Methodology. A project working document for DGENV.

The EU-funded ALARM (Assessing Large-scale Risks for Biodiversity with Tested Methods) project Available at http://www.alarmproject.net.ufz.de/index.php?pid=4140

The National Center for Ecological Analysis and Synthesis (NCEAS) Working Group on "Restoring an ecosystem service to degraded landscapes: native bees and crop pollination" Available at http://www.nceas.ucsb.edu/projects/9381

The Natural Capital Project, a joint venture among The Woods Institute for the Environment at Stanford University, The Nature Conservancy, and the World Wildlife Fund, is developing tools for modelling and mapping the delivery, distribution, and economic value of ecosystem services and biodiversity. Available at http://naturalcapitalproject.org/california_prim.html

Tol, R.S.J. 2005. The Marginal Damage Costs of Carbon Dioxide Emissions: An Assessment of the Uncertainties, Energy Policy, 33 (16), 2064-2074.

Turnock, D. 1999. Sustainable rural tourism in the Romanian Carpathians, Geographical Journal, 165, pp. 192–99.

Turpie, J., Smith, B., Emerton, L. and Barnes, J. 1999. Economic Valuation of the Zambezi Basin Wetlands, IUCN. The World Conservation Union Regional Office for Southern Africa, Harare.

Ulrich, R.S. 1983. Aesthetic and affective response to natural environment. In: Human Behavior and Environment: Advances in Theory and Research, I. Altman and J.F. Wohlwill (eds.), Volume 6, Plenum Press, New York, NY, pp. 85– 25.

UNEP. 2004. Freshwater in Europe – facts, figures and maps. United Nations Environment Programme / DEWA~Europe, Switzerland, 88 pp.

Van Beukering, P. J. H., Cesara, H. S. J. and Janssen, M. A. 2003. Economic valuation of the Leuser National Park on Sumatra, Indonesia. Ecological economics, 44: 43-62.

Veisten, K. 2007. Willingness to pay for eco-labelling wood furniture: choice-based conjoint analysis versus open-ended contingent valuation. Journal of Forest Economics, 13: 29-48.

Walser, M. and Neumann, C. 2008. The Value of our Oceans. The Economic Benefi ts of Marine Biodiversity and Healthy Ecosystems. WWF Germany

Water Science and Technology Board. 2004. Valuing Ecosystem Services: Toward Better Environmental Decision-Making. Available at http://fermat.nap.edu/books/030909318X/html/

WBGU (Wissenschaftlicher Beirat der Bundesregierung Globale Umweltveränderungen). 1998. Die Anrechnung biologischer Quellen und Senken im Kyoto-Protokoll: Fortschritt oder Rückschlag für den globalen Umweltschutz? Sondergutachten 1998, WBGU, Bremerhaven, Germany, 76 pp., (available in English).

Willis K. G., and Garrod G. D. 1992. Amenity Value of Forests in Great Britain and its Impact on the Internal Rate of Return from Forestry. Forestry 1992 65(3):331-346.

Willis, K. G., Garrod, G., Scarpa, R., Powe, N., Lovett, A., Bateman, I. J., Hanley, N. and Macmillan, D. C. 2003. The Social and Environmental Benefits of Forests in Great Britain. Report to Forestry Commission, Edinburgh http://www.treefestscotland.org.uk/website/pdf.nsf/pdf/sebreport0703.pdf/$FILE/sebreport0703.pdf

Woodward, R. and Y. Wui. 2001. The economic value of wetland services: a meta-analysis. Ecological Economics, 372: 257-270.

World Health Organization. 2008. Traditional medicine. Fact sheet No. 134. Revised December 2008. Available at http://www.who.int/mediacentre/factsheets/fs134/en/print.html. Accessed: 20 July 2009.

World Resources Institute. 2007. Economic Valuation of Coral Reefs, Methodology v2.1. Available at http://pdf.wri.org/coral_reefs_methodology-10-2007.pdf

WTO. 1998. Tourism Market Trend: Americas 1988–1997, WTO, Madrid, Spain.

WTTC (World Travel and Tourism Council). 1999. Agenda 21 for the travel and tourism industry: Towards environmentally sustainable development progress, Report no. 2, Summary 4 pp. Available at http://www.wttc.org.

WWF. 2004. Living waters conserving the source of life: The economic values of the world's wetlands. Available at http://assets.panda.org/downloads/wetlandsbrochurefinal.pdf

Yamagata, Y. and G.A. Alexandrov, 1999: Political implication of defining carbon sinks under the Kyoto Protocol. World Resource Review, 11(3): 346–359.

Zhongwei, L. 2006. Water Quality Simulation and Economic Valuation of Riparian Land-Use Changes. PhD, University of Cincinnati, Arts and Sciences: Geography. Available at http://www.ohiolink.edu/etd/send-pdf.cgi/LIU%20ZHONGWEI.pdf?acc_num=ucin1153507620

ANNEXES

ANNEX 1. OVERVIEW OF A NUMBER OF STANDARD ECONOMIC AND NON-ECONOMIC METHODOLOGIES USED IN ASSESSING VALUE OF ECOSYSTEM SERVICES

This Annex provides information on the most commonly used valuation methods (economic and non-economic) used to assess the value of ecosystem services. Table 1 (annex) provides a summary of these methods. In addition, more detailed examples on the key economic valuation methods are given below.

Table 1 (annex). A summary of the standard methodologies (economic and non-economic) used to assess the value of different ecosystem services. Please note: this table has been obtained / adapted from the Introductory Guidance for Valuing Ecosystem Services by Defra (2007) http://www.defra.gov.uk/wildlife-countryside/pdf/natural-environ/eco-valuing.pdf

Economic valuation methods	Description	Ecosystem services valued
Revealed Preference methods		
Market prices	These can be used to capture the value of ecosystem services that are traded e.g. the market value of forest products. Even where market prices are available, however, they may need to be adjusted to take account of distortions such as subsidies. Market prices can act as proxies for direct and indirect use values but do not capture non-use values; the price will be a minimum expression of the willingness to pay.	Ecosystem services that contribute to marketed products, e.g. timber, fish, genetic information, value of clean water that is an input to local companies
Averting behaviour	This approach focuses on the price paid by individuals to mitigate against environmental impacts.	Depends on the existence of relevant markets for the ecosystem service in question. For instance, the cost of water filtration may be used as a proxy for the value of water pollution damages; or costs of buying pollution masks to protect against urban air pollution (although this will only represent part of the damage value).

Production function approach	This focuses on the relationship that may exist between a particular ecosystem service and the production of a market good. Environmental goods and services are considered as inputs to the production process and their value is inferred by considering the changes in production process of market goods that result from an environmental change.	Regulating and supporting services that serve as input to market products e.g. effects of air or water quality on agricultural production and forestry output.
Hedonic pricing	This assumes that environmental characteristics (e.g. a pleasant view or the disamenity of a nearby landfill site), as well as other property features, are reflected in property prices. The value of the environmental component can therefore be captured by modelling the impact of all possible influencing factors on the price of the property.	Ecosystem services (e.g. regulating cultural and supporting services) that contribute to air quality, visual amenity, landscape, quiet i.e. attributes that can be appreciated by potential buyers.
Travel cost method	This is a survey-based technique that uses the costs incurred by individuals taking a trip to a recreation site (e.g. travel costs, entry fees, opportunity cost of time) as a proxy for the recreational value of that site.	All ecosystems services that contribute to recreational activities.
Random utility models	This is an extension of the travel cost method and is used to test the effect of changing the quality or quantity of an environmental characteristic at a particular site.	All ecosystems services that contribute to recreational activities.
Stated Preference methods		
Contingent valuation	This is a survey-style approach that constructs a hypothetical market via a questionnaire. Respondents answer questions regarding what they are willing to pay for a particular environmental change.	All ecosystem services.
Choice modelling	This is a survey-style approach that focuses on the individual attributes of the ecosystem in question. For example, a lake may be described in terms of water quality, number of species etc. Participants are presented with different combinations of attributes and asked to choose their preferred combination or rank the alternative combinations. Each combination of attributes has a price associated with it and therefore the respondents reveal their wiliness to pay (WTP) or willingness to accept (WTA) for each attribute.	All ecosystem services.

Cost based approaches	These approaches consider the costs in relation to provision of environmental goods and services and only provide 'proxy' values. Examples of cost-based approaches are those that infer a value of a natural resource by how much it costs to replace or restore it after it has been damaged.	
Opportunity cost	This method considers the value forgone in order to protect, enhance or create a particular environmental asset (e.g. opportunity cost of agricultural production lost if land is retained as forest).	Depends on the existence of relevant markets for the ecosystem service in question. Examples include man-made defences being used as proxy for wetlands storm protection; expenditure on water filtration as proxy for value of water pollution damages.
Cost of alternatives/substitute goods	This approach considers the cost of providing a substitute good that has a similar function to the environmental good. For example, wetlands that provide flood protection may be valued on the basis of the cost of building man-made defences of equal effectiveness. Given that wetlands provide a range of ecosystem services, this costing would be a minimum estimate of the value of a wetland.	
Replacement cost method	This technique looks at the cost of replacing or restoring a damaged asset to its original state and uses this cost as a measure of the benefit of restoration. The approach is widely used because it is often easy to find estimates of such costs.	
Non-economic valuation methods	**Description**	**Ecosystem services valued**
Focus groups, in-depth groups	Focus groups aim to discover the positions of participants regarding, and/or explore how participants interact when discussing, a pre-defined issue or set of related issues. In-depth groups are similar in some respects, but they may meet on several occasions, and are much less closely facilitated, with the greater emphasis being on how the group creates discourse on the topic.	All ecosystem services.
Citizens' Juries	Citizens' juries are designed to obtain carefully considered public opinion on a particular issue or set of social choices. A sample of citizens is given the opportunity to consider evidence from experts and other stakeholders and they then	All ecosystem services.

	hold group discussion on the issue at hand.	
Health-based valuation approaches	The approaches measure health-related outcomes in terms of the combined impact on the length and quality of life. For example, a quality-adjusted life year (QALY) combines two key dimensions of health outcomes: the degree of improvement/deterioration in health and the time interval over which this occurs, including any increase/decrease in the duration of life itself.	All ecosystem services.
Q-methodology	This methodology aims to identify typical ways in which people think about environmental (or other) issues. While Q-methodology can potentially capture any kind of value, the process is not explicitly focused on 'quantifying' or distilling these values. Instead it is concerned with how individuals understand, think and feel about environmental problems and their possible solutions.	All ecosystem services.
Delphi surveys, systematic reviews	The intention of Delphi surveys and systematic reviews is to produce summaries of expert opinion or scientific evidence relating to particular questions. Delphi relies largely on expert opinion, while systematic review attempts to maximise reliance on objective data. Delphi and systematic review are not methods of valuation but, rather, means of summarising knowledge (which may be an important stage of other valuation methods).	All ecosystem services.

EXAMPLES OF USING MORE COMPLEX ECONOMIC VALUATION METHODS FOR ASSESSING THE VALUE OF ECOSYSTEM SERVICES

Biodiversity resources & water

The monetary value of biodiversity resources can be estimated by using contingent valuation and choice modelling that estimate potential market prices of a good by surveying people's willingness to pay (WTP) for it.

These methods can be used to estimate the value when no markets / price for a biodiversity resource yet exist. For example, WTP estimates could be used to assess the potential value of sustainably produced (e.g. eco-labelled) fuel, timber etc. In addition, stated preference methods could be used to estimate the difference between the market price value (i.e. the minimum amount of willingness to pay) and the maximum value stated by the respondents. In this case WTP can actually increase the estimated value for a good. In some cases people can also be asked about their willingness to accept (WTA) compensation to give up using a certain biodiversity resource.

Data from property sales in a region (i.e. hedonic valuation), can be used to estimate the value of natural water supply in the area. In short, this economic method aims to single out the proportion of property price that is linked with provisioning of water supply. This method can be of particular interest in areas that regularly suffer from drought.

Cultural & social services

Contingent valuation, i.e. willingness to pay surveys are commonly used to determine the value of different cultural and social services ecosystems provide. The general steps for undertaking willingness to pay studies are outlines in Box 1 below.

Box 1. General steps required to carry out a "willingness to pay" analysis

Step 1: Define the focus of the survey, like recreational opportunities a site offers and the definition of the relevant group to be addressed. In a survey you might for example address cyclists, horse riders, nature watcher, fishers or all of them. You may refer to site visitors only or to the entire general public. Furthermore, the type of the survey should be defined. It can be conducted on the phone, by handing out questionnaires in hotels or during excursions or electronically when booking travel accommodation, transport or certain events.

Step 2 (Option A): Formulate the 'willingness to pay' question for the contingent valuation method. This question could be, for example "How much would you be willing to pay as a daily, per person entrance fee to a restricted high value area in a national park, in addition to other costs of the trip?"

Step 2 (Option B): Alternatively, ask the respondent to state a preference between one group of characteristics, at a given price or cost to the individual, and another group of environmental characteristics at a different price or cost (contingent choice method). For example: Question: Which option would you choose? Response option 1: Full access to the entire national park. Entrance fee: €20 per day; or Response Option 2: Restricted access to the park. Free entrance.

Step 3: At the final stage an analysis of data takes place, dealing with missing responses and extrapolating to the relevant population size. This can be quite resource intensive.

The willingness to pay studies can also be usefully used to estimate the difference between the price actually paid and the maximum amount that an individual is willing to pay for it (i.e. consumer surplus). For example, one can compare general prices for fishing licences with prices visitors would be willing to pay for those licences at a Natura 2000 site. The difference between the actual existing price and the price visitors would willing to pay can be used as an indictor of the value of fishing at a Natura 2000 site. This value can then be further used to estimate how much higher the overall revenues arising from fishing at a Natura 2000 site could be compared to other locations. In addition, consumer surplus can also be used to re-estimate the selling price of products or services at a higher price than one would have expected. You can measure it by defining the difference between the total revenues earned from a good or services, and the total variable costs of producing it.

Similarly, choice modelling asks people to make choices between different options for different alternatives. It creates hypothetical scenarios from which people might choose instead of asking directly for values. A concrete example of this is given in a Box 2 below.

Box 2. Example of using choice modelling for estimating the value of recreation

Christie (2005) conducted a choice modelling study to value changes in visitors' welfare resulting from a range of improvements to recreational facilities in forests. Within the study, respondents were presented with a series of choice tasks in which they were asked to choose their preferred policy option from a list of three options; one of which was a 'stay-at-home' option. Each choice option was described in terms of attributes; in this case facilities provided at the hypothetical forests.

Results showed that cyclists were willing to pay high values for the creation of downhill courses (£9.74 per visitor), technical single-track trails (£8.40), cross-country trails (£5.81) and optional obstacles such as jumps and drop-offs (£7.56). Bike-wash facilities were also valued (£4.27). Nature watchers were found to value the provision of wildlife hides (£6.83), wildlife viewing centres (£5.56), 'off-the-beaten-track' nature trails (£6.48) and enhancements to the forest surrounds for viewing wildlife (£3.62).

The travel costs method estimates the costs incurred by individuals to visit a Natura 2000 site. This can include actual travel expenses (e.g., public transport tickets or flight tickets, petrol used for private cars), entry fees and time costs or it can be based on people's willingness to pay to visit a site (See above).

Data on costs are usually collected through surveys such as visitor interviews or questionnaires. This generally requires several samples to cover different seasons, times of the year and various types of visitors to a site. Besides travel costs the survey also collects information on the frequency of visits, site attributes, motives for the trip and demographic data.

To carry out a travel cost assessment, a questionnaire is created asking how much money a visitor would be willing to spend on travel to visit the site. In order to obtain diversified values, the questionnaire needs to be distributed to various types of visitors (e.g. bikers or walkers) during different seasons / times of the year (e.g. high season, low seasons). Furthermore, the number of trips and related travel costs need to be assessed and, if possible, grouped with the different sources of visitors, with increasing distance from an area. The latter makes the method more resource intensive and it also requires more skills in statistical analysis and modelling.

An extension of the previously described travel cost method consists of testing the effect of changing the quality and quantity of environmental characteristics of a site on the travel costs (random utility mode). For example, one can determine the effect of reducing the access to certain areas on the willingness to pay to visit a site. The value of these areas is so described by the difference in the amount visitors are willing to pay to get to the site when the access has been restricted.

Finally, other methods such as hedonic pricing, replacement costs and net factor income may also be used in the context of cultural and social services. For example, recreation and tourism may affect the price of residential properties due to the proximity of recreational possibilities. Replacement costs may occur due to the necessity of creating similar recreation possibilities to replace those provided by nature, and so can show the benefits arising from those services. Net factor income can be applied to calculate the revenues received from selling excursions, minus the labour, equipment and other costs providing the service. The general application of the methods is described in chapters addressing other relevant ecosystem services (e.g., amenity and avalanche protection).

Regulation & supporting services

The actual revealed preferences, e.g. the production function approach and hedonic pricing, are often used to valuate different regulation services. In addition, stated preferences, such as contingent valuation methods (wiliness to pay, WTP) and choice modelling can also be used to estimate the value of these services.

Regulating services, e.g. water purification, waste management, pollination and biological control can be beneficial for several sectors, e.g. recreation, tourism and agriculture. For example, activities such as swimming, boating, angling and recreational fishing is dependent on the quality of water. Similarly, clean water and pollination are key inputs to the production of crops and livestock (e.g. annual yields). Consequently, a part of the revenue from these sectors is also dependent on the existence of these services.

In these cases, the production function approach can be used to try to estimate what proportion of the marketed good can be attributed to the availability of the service in question. This means that the net value of different regulating services (i.e. gross revenue from selling these resources minus production costs) in the normal situation is compared with the net value of resources in a situation with changes in ecosystem functioning (i.e. gross revenue from selling resources minus increased production costs). The production function approach is often considered as a relatively good (however technically challenging) alternative to estimate the monetary value of supporting services.

However, the application of the production function approach in practice is often limited by relatively high requirements for scientific information on how and to what extent different services contribute to the final output. In addition, it is often difficult to differentiate the contributions from individual services to production. Consequently, the production function estimates often reflect the value of a bundle of ecosystem services that have been inputs to the production of a good.

Hedonic pricing can be, for example, used to address a number of regulating services, such as water and air quality regulation. The method aims to determine the value of these services in determining property prices, i.e. it compares the price between properties in the vicinity of natural areas with water / air regulation "abilities" and properties further away from these areas. The difference between these prices is then considered as the value of water regulating services in question.

Stated preference methods are also often used to valuate both regulating and supporting services. For example, assessing the value of climate regulation through contingent valuation focuses on assessing people's willingness to pay for maintained climate regulation service or their willingness to accept payments to compensate the loss of it. However, as the issues with regulating services can be fairly technical it may be difficult for the general public to quantify their views, especially if their level of knowledge and awareness on the issue is low. The risk is hence that stated preference results can under- or overestimate the actual value of the service.

Stated preference methods can be also used to estimate the value of maintaining genetic variation based on people's willingness to pay to preserve the variation of a crop or livestock species. The possible estimates could include, for example, WTP for products from local varieties and breeds, WTP for viewing certain traditional breeds, and WTP for conserving traditional breeds for securing food security.

The willingness to pay methods can also be used to estimate the value when no markets / price for a biodiversity resource yet exist. For example, WTP estimates could be used to assess the value attributed by local/regional residents for clean water. In addition, stated preference methods could be used to estimate the difference between the market price value (i.e. the minimum amount of willingness to pay) and the maximum value stated by the respondents. In this case WTP can actually increase the estimated value for a good. In some cases people can also be asked about their willingness to accept compensation to give up the service, i.e. to accept the use of less "naturally" clean water.

ANNEX 2. CASE STUDY TEMPLATE

1. INTRODUCTION

1.1. Description of [site name]

- Very brief introduction of the site focusing on the key characteristics of the site, e.g. its main habitats and species of Community interest, key conservation values and goals etc.

- Include map / some images if available

1.2. Why is the site of socio-economic importance?

- Start by briefly explaining why Natura 2000 areas have also socio-economic importance. Useful information for developing this introduction can be found from the Toolkit Chapter 2.

- A brief introduction why it has been considered important to highlight the socio-economic benefits of the site. For example: site has some clear socio-economic significance or potential; site is under a pressure from several possible land use practises and therefore information on its different socio-economic benefits / ecosystem services (e.g. trade offs between different services) is important; or site is in need of more political / stakeholder support and / or innovative financing possibilities.

2. SOCIO-ECONOMIC BENEFITS OF [SITE NAME]

2.1 Overview of site's socio-economic benefits

- A brief overall description and discussion of <u>all</u> the benefits provided by the site – using the spider diagram developed in the context of the Toolkit Chapter 4 as a basis (envisaged Figure 2.1 below).

- <u>Note</u>: please note a brief explanation on how the spider diagram has been developed, i.e. the socio-economic importance/ value on scale 1-5 is your own estimate based on information on the value of different services.

- Also, a brief discussion on who are the beneficiaries for these different benefits provided by the site (possible using Table 2.1 below, as introduced in the Toolkit Chapter 5)? It is important to highlight who the beneficiaries of different services might, including identifying the scale(s) on which the benefits are received. These insights on the "flow" of benefits / services can be further used explore possible options to maintain different services, e.g. establishing who could or should financially contribute to maintaining appropriate management practises at the site (Chapter 4 below).

Figure 2.1 The overall socio-economic benefits provided by the site (on scale 1-5) [Figure 7.1. of the Toolkit

Table 2.1 How is responsible of managing the benefits provided by the site and who are the different beneficiaries. (Filled in as example**,** see Toolkit Chapter 5 for example)

2.2. Detailed valuation of different benefits

- A more detailed description and discussion of the benefits provided by the site – using the summary table developed in the context of the Toolkit Chapter 7 as a basis (envisaged Table 2.2 below).

- You can start by a "service by service" discussion on the value of different services, focusing on the most important (current or potential) services (Estimated by using guidance provided in Toolkit Chapter 7).

- What are the important benefits provided by a site & could they be valuated? In this context, it is also important to identify if some of the important benefits provided by the site could not be properly valuated, in particular in monetary terms. These considerations help to focus possible future valuation efforts and they also highlight that any decisions affecting the site should not be based on monetary values only.

- Finally, you can also provide information on any additional wider benefits related to the site, i.e. looking at benefits that cannot be easily pinned down to one specific ecosystem service as such but are more related to the "existence" of the site. See Toolkit Section 2.1 and 5.19 for more detailed information on these benefits.

Table 2.2. A synthesis of the benefits of a Natura 2000 site related ecosystem services [based on Table 7.1. of the Toolkit, add / remove lines when needed]

3. STATUS & FUTURE TRENDS OF DIFFERENT BENEFITS

- Linking the identified benefits to a broader context re: their status and possible future developments. This Chapter is to help to develop the discussion on key messages in Chapter 4. This Chapter should consider, for example, the following questions:

- Are some of the identified benefits in danger / in decline or facing serious risks? This can help to identify the immediate (and also long term) actions required to secure the maintenance of these services.

- Is the importance of any given ecosystem service likely to increase in the future? It has been acknowledged that the role of natural ecosystems, including Natura 2000 sites, in regulating and balancing our natural environment is only likely to increase in future, in particular due to impacts of climate change. In addition, markets for sustainably produced and environmentally friendly goods and services continue to increase steadily. Emphasising sites' future socio-economic importance is likely to further support their maintenance.

4. KEY MESSAGES FOR THE FUTURE MANAGEMENT OF THE SITE

- This final Chapter should consider the overall implications of case study findings, e.g. questions listed below. This Chapter is based on the guidance provided in Section 7.2 of the Toolkit.

- Can identified benefits be sustainably managed and promoted? It is important to assure that promoting different socio-economic benefits provided by the site is inline with site's conservation goals.

- In particular, it is essential to identify possible conflicts between conservation goals and site's socio-economic aspects. In addition, there also a need to clearly establish what is the sustainable level of "using" the identified benefits, e.g. sustainable level of extracting biodiversity resources or water.

- What are the possible trade-offs between different benefits that should be taken into consideration? Focusing only on enhancing the level of one ecosystem service and related benefits can have negative effects on other services. The consideration of different potential trade-offs is therefore important in order to decide which of the site's benefits to be promoted (e.g. their sustainable extraction level).

- Are there any possible implications in the wider context of the Natura 2000 Network? One should also not forget that one of the goals of the Natura 2000 is to establish a functioning ecological network of

protected areas in Europe. In practise, this means that the management of the network, including its individual sites, should also take into consideration ecological connections between the sites, e.g. by allowing the movement of species between sites. Therefore, promoting different socio-economic benefits at site level (e.g. decisions to enhance certain ecosystem services) should also reflect possible implications (e.g. positive and negative) to the wider overall network. In general, using socio-economic arguments to support the sustainable management of individual sites and their surroundings also improves the overall status of the network.

- Given the identified beneficiaries (Chapter 5 of the Toolkit), what is the "flow" of service from the site and at what scale are site's benefits important (i.e. are they mainly local or are there also some regional (e.g. cross-border), national or global benefits? What different importance do these considerations give to the site and its future management?

- Does the consideration of site's socio-economic benefits and difference related beneficiaries provide new possibilities for obtaining concrete funding to the site (see Chapter 5 for specific ideas)?

- Did you identify some future evaluation needs, e.g. were there some significant ecosystem services which would merit a more complex and resources intensive valuation (e.g. monetary valuation) in the future?

- In the light of the results, what could / should the possible future actions promoting the management of their Natura 2000 site and related socio-economic benefits be. For example, is there a need to revisit site's management plans to better address possible "win-win situations" between site's conservation goals and their potential for supplying different ecosystem services.

- Given the overall results could you identify some possible key decisions affecting the site (e.g. current or foreseeable decisions related to land use etc.) that, given your valuation results, should not be based on available monetary information only but should take into consideration also the wide overall value of the site (e.g. qualitative and quantitative information).

ANNEX 3. A TEMPLATE FOR VISUAL PRESENTATION OF ECOSYSTEM SERVICES PROVIDED BY A NATURA 2000 SITE

Please copy this table into MS Excel and fill in the second column with your own estimates (on scale 1-5) on the importance of ecosystem service at your site. For more detailed instructions developing your own estimates please see Chapter 4 of the Toolkit. Finally, please use the MS Excel to draw a spider diagram illustrating your results.

Please note: you adapt the services categories / exclude services that are not relevant at your side. Also, numbers are for demonstration purposes only, please replace them with your own estimates

Type of ecosystem service	**Your estimate on how important this service is at the site**
Food	5
Fibre / natural materials	3
Fuel	4
Natural medicines	3
Ornamental resources	4
Water (quantity)	3
Ecotourism & recreation	4
Cultural & amenity values Education & research	4
Climate / climate change regulation	3
Water regulation	4
Water & waste purification	3
Air quality	2
Avalanche control	2
Erosion control	3
Strom control	2
Wild fire mitigation	1
Biological control	1
Pollination	1
Regulation of human health	2
Genetic / species diversity maintenance	5

Supporting services	4

EXAMPLE: Illustration of the importance of ecosystem services provided by a Natura 2000 site. (Importance on scale 0-5)