The Ecosystem Concept and the Identification of Ecosystem Goods and Services in the English Policy Context - A Review Paper

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England's Terrestrial Ecosystem Services and the Rationale for an Ecosystem-Based Approach (NR0107)

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Notes:

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Executive Summary

This paper discusses the conceptual framework for the current project which seeks to explore the issues surrounding the task of making an assessment of the goods and services associated with England's major terrestrial ecosystems, and the rationale for using an ecosystem approach in decision making. The work specifically aims to:

- clarify terminology surrounding the ecosystem approach;
- review the background to the ecosystem approach and in particular identify its strengths and weaknesses; and,
- consider ways in which we might go about making an audit of the goods and services associated with England's major terrestrial ecosystems, and how the application of the ecosystems approach might help to sustain them into the future.

Although the philosophy underpinning the ecosystem approach has been presented in a number of ways, and this has resulted in different terminologies, there is a common and shared understanding of what the approach involves, which is expressed in the principles suggested by the Convention for Biological Diversity (CBD). Following Maltby (2000), we suggest that the ecosystem approach is defined as *a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way, and which recognises that people with their cultural and varied social needs, are an integral part of ecosystems*. We recommend that the principles of the approach as set out in the CBD are taken as the starting point for this project, and the extent to which they provide an appropriate and relevant framework for assessing and managing the goods and services associated with England's major terrestrial ecosystems is considered.

Following the impetus to thinking provided by the Millennium Ecosystem Assessment, this paper also reviews the ways we might go about making an audit of the goods and services associated with England's major terrestrial ecosystems. It is argued that we could adopt either:

- A **'habitats approach'** in which the focus of effort is very much on the BAP Broad and Priority Habitats and the extent to which we can identify the services associated with them or to which they contribute.
- A **'services approach'** in which the focus is more on the identification of the ecological structures and processes that generated the service, which may or may not relate to any specific habitat type. According to this approach we would let the service define the ecosystem, rather than *a priori* classification of habitats.

This position paper argues that these different ways of proceeding are not mutually exclusive and that we need to explore both in order to make recommendations about how an overall assessment for England might be made. Consideration of ecosystem goods and services at a landscape scale is recommended as one way forward.

It is argued that given the many uncertainties that exist in terms of the availability of base-line data, and the user requirements for an 'MA for England', the focus of this project should be to explore methodological options and issues, rather than to attempt a complete, but imperfect, assessment. By making a critical assessment of the different approaches to the problem of assessing the state and trends of ecosystem goods and services in England, the aim of the study is to shape a robust recommendations about how the evidence base can best be developed and used more effectively in decision making at local, regional and national scales.

1. Introduction

> *'The ecosystem approach is a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way, and which recognises that people with their cultural and varied social needs, are an integral part of ecosystems'* (Maltby, 2000).

The Ecosystem Approach has been widely promoted as a framework for managing environmental systems and for achieving the goals of sustainable development. The aim of this paper is to review the concept's key ideas, and in particular to examine how it can help resolve the sustainability issues affecting England's major terrestrial ecosystems. The discussion will form part of the work required by Defra's current research programme on Natural Resource Protection, which is examining whether a case can be made for intervention on an ecosystem scale to ensure the on-going supply of ecosystem goods and services to the benefit of people.

The need to understand the contribution that environmental assets make to the economy, and the capacity and limitations that they have for supporting human well-being is particularly timely given current policy debates that centre around ideas about 'one planet living' vs 'three plant consumption'[1]. It is, for example, now widely recognised that at global scales human impact on biophysical systems is undermining their capacity to provide many of the things on which people depend. These include benefits such as sufficient quantity and quality of water, sustained harvests of food or fuel, or the freedom from environmentally triggered hazards. The calculation of our 'environmental foot print', and the development of other indicators that more fully express the importance of the environment to sustainable forms of social and economic development, is now seen as fundamentally dependent on an understanding of the benefits that ecosystems can provide and the biophysical limits that are associated with them.

Access to the benefits generated by natural capital (Costanza et al., 1997; Daily, 1997a) can vary over time and space because of differences in geology, relief, climate, history and patterns of economic and social development. If broad objectives, such as those embodied in the UN Millennium Development Goals[2] are to be achieved then we need to understand what this heterogeneity means, and what can be done to ensure that benefits are maintained and shared between people on a more equitable basis, at levels above the minimum that is needed to support life. To do this we need better tools for valuing the different ways in which the environment can contribute to human well-being so that its importance can be more appropriately taken into account by decision makers and issues conveyed to society at large. The Ecosystem Approach has emerged as a conceptual framework that might achieve such ends. This study considers its relevance and utility in the English policy context.

This document provides a brief overview of the development of the 'Ecosystem Approach' and the principles that it embodies. It then moves on to consider how the concept can be operationalised for assessing the state and trends of England's major terrestrial ecosystems, in terms of the goods and services that they can provide. The assessment of England's ecosystem services is the major focus of this study (NR0107). It forms part of Defra's wider research programme on natural resource protection and ecosystem services, which covers valuation and application issues[3].

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[1] http://www.wwf.org.uk/oneplanetliving/index.asp
[2] http://www.un.org/millenniumgoals/
[3] http://www.defra.gov.uk/wildlife-countryside/natres/research.htm

2. The Ecosystem Approach: Principles and Interpretations

The Ecosystem Approach emerged as a focus of discussion for those concerned with the management of biodiversity and natural resources in the late 1980s and early 1990s, particularly amongst commentators in North America (Hartje et al., 2003). At that time the limitations of traditional approaches to resource management were being recognized. It was argued that a new focus was required to achieve robust and sustainable outcomes, involving integrated management at a landscape-scale with more decentralized decision making and public participation. Much of the recent interest in the Ecosystem Approach can, however, be traced to the influence of the Convention for Biological Diversity (CBD), which in 1995 adopted it as the 'primary framework' for action (IUCN, 2004). Under the convention, the approach is the basis for considering all the goods and services provided to people by biodiversity and ecosystems (Secretariat of the Convention for Biological Diversity, 2000).

According to the CBD, the Ecosystem Approach embodies a core set of management principles [4] (Table 1). They seek, for example, to promote an ***integrated approach*** to management that operates across both natural and social systems and between different ecosystems. An understanding of the way in which natural and social systems are coupled is seen as particularly important because, it is argued, management decisions have to be seen in their ***economic and social context***. The principles proposed by the CBD accommodate the conservation and sustainable use of resources, and the sharing of benefits derived from natural resources. However, while management strategies are essentially a matter of societal choice, the principles proposed under the CBD recognise that decisions have to be grounded on a scientific understanding of ***biophysical limits*** that constrain ecological processes, and the spatial and temporal scales at which they operate. Finally, the principles recognise the inherently dynamic nature of ecosystems and the uncertainties involved in any attempt to manage them. Thus the principles seek to promote an ***adaptive and flexible*** approach to natural resource management.

The 'principles' that the CBD sees as making up the Ecosystem Approach are, of course, not unique to the Convention. Indeed, just as the Convention sought to capture and represent a range of concerns that were being voiced at the time it was drafted, others have subsequently interpreted, extended and emphasized the ideas in a number of different ways. As Hartje et al. (2003) note, 'decision V/6' (Table 1) is not the final word on the matter, given the 'persistent demand for further elaboration of some inaccuracies in the usage of terms and several inherent conflicts of the approach'. For example, the place that ideas about 'sustainable use' have within the Ecosystem Approach has been actively discussed (IUCN, 2004). It has been suggested that while the former was promoted independently in a number of forums, such as the World Conservation Strategy in 1980 and the Rio Conference in 1992, 'sustainable' or 'wise' use is probably best viewed as part of the more 'overarching' Ecosystem Approach. While the concept of sustainable use tends to focus attention on the individual components of biodiversity, the Ecosystem Approach, it is claimed, involves the idea that ecosystems and the services that are more generally associated with them, should be managed both 'for their intrinsic values and for the tangible and intangible benefits for humans' (IUCN, 2004).

[4] For more extensive documentation see https://www.biodiv.org/programmes/cross-cutting/ecosystem/sourcebook/advanced-guide.shtml?approach

Table 1: The Principles of the Ecosystem Approach

Adopted by The Conference Of The Parties to the Convention On Biological Diversity at its Fifth Meeting, Nairobi, 15-26 May 2000. Decision V/6, Annex 1. CBD COP-5 Decision 6 UNEP/CBD/COP/5/23

1. The objectives of management of land, water and living resources are a matter of societal choice.
2. Management should be decentralised to the lowest appropriate level.
3. Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
4. Recognising potential gains from management, there is usually a need to understand and manage the ecosystem in an economic context. Any such ecosystem-management programme should:
    a. Reduce those market distortions that adversely affect biological diversity;
    b. Align incentives to promote biodiversity conservation and sustainable use;
    c. Internalise costs and benefits in the given ecosystem to the extent feasible.
5. Conservation of ecosystem structure and functioning, in order to maintain ecosystem services, should be a priority target of the Ecosystem Approach.
6. Ecosystems must be managed within the limits of their functioning.
7. The Ecosystem Approach should be undertaken at the appropriate spatial and temporal scales.
8. Recognising the varying temporal scales and lag-effects that characterise ecosystem processes, objectives for ecosystem management should be set for the long term.
9. Management must recognise that change is inevitable.
10. The Ecosystem Approach should seek the appropriate balance between, and integration of, conservation and use of biological diversity.
11. The Ecosystem Approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.
12. The Ecosystem Approach should involve all relevant sectors of society and scientific disciplines.

Note: These are the principles set down in the 1998, 'Malawi workshop'

Subtle, but significant differences in meaning have been found in the way the 'Ecosystem Approach' has been presented. Thus we find in some of the literature[5] the use of the term 'ecosystem***s*** approach' with the use of the plural that the framework can be represented or applied in a number of ways. The implication is that the approach is not prescriptive. Elsewhere[6,7] we also find reference to an ***ecosystem-based approach*** which although consistent with the general principles of the CBD definition, emphasises more strongly the specific management implications (Table 2).

[5] http://www.defra.gov.uk/wildlife-countryside/natres/develop.htm;
[6] http://www.jncc.gov.uk/page-1576
[7] 'Safeguarding our Seas', A Strategy for the Conservation and Sustainable Development of our Marine Environment. http://www.defra.gov.uk/environment/water/marine/uk/stewardship/index.htm

Table 2: The ecosystem-based approach

Following 'Safeguarding our Seas', adopting an ***ecosystem-based*** approach means:

- Providing and working within a set of clear environmental objectives
- Greater use of environmental and socioeconomic assessments
- More strategic management of our activities in the marine environment
- Taking policy decisions and management actions that take account of biological diversity and ensure sustainable development
- Making better use of scientific knowledge in the policy-making process
- Developing more focused research and monitoring
- Full stakeholder involvement

From 'Safeguarding our Seas', A Strategy for the Conservation and Sustainable Development of our Marine Environment, page 9

Loffoley et al. (2003, 2004), following Maltby (1997) and McNeely et al. (1999), also note a distinction between what some have called ***ecosystem management***, involving the direct manipulation of species and/or biophysical processes (cf. Maltby, 2000), and ***ecosystem-based management***. The latter has been used to describe situations where the linkage between natural processes and human impact is explicit and central to the analysis. Maltby (2000) suggests it also involves defining a 'clear vision of future desired' and a strategy for integrating and balancing environmental, social and economic factors.

Finally, it is apparent that the term '***ecosystem services approach'*** is also now often widely used, generally to signify that the main focus of attention of policy or management is on the sustainable output of ecosystem goods and services, and the benefits that they provide for people. Although reference to the concept of ecosystem goods and services is explicit in the set of principles promoted by the CBD, the recent publication of the Millennium Ecosystem Assessment (MEA)[8] has served to highlight this particular aspect of the Ecosystem Approach. The advantages of emphasising the goods and service aspect of the Ecosystem Approach, is that it places a specific set of outputs firmly at the centre of interest and gives sustainable use a more equal treatment alongside conservation. Formal definitions of the terms 'ecosystem service' and 'benefit' are given in Box 1.

Reflecting upon the many ways in which the notion of an Ecosystems Approach has been framed, Smith and Maltby (2003), like Hartje et al. (2003), have concluded that there is probably no final definition of the concept, and that its meaning is likely to develop as it is applied and shortcomings detected. Indeed, Maltby (2000) has observed that this fluidity is appropriate, since the principles that under-pin it are not equally applicable in all circumstances, and ideally solutions have to be tailored to meet the requirement of the problem in hand. One of the merits of the Ecosystem Approach is that it helps focus decision makers on longer-term perspectives rather than on shorter-term fixes that may be difficult to sustain. An overview of the diversity of work that is now being encouraged by the ecosystem approach can be gained through the case study database currently being developed under the CBD[9].

As the basis of this study, we therefore propose taking a pragmatic approach which uses as a starting point the principles proposed by the CBD. These principles, or 'guidelines' as Maltby (2000) prefers to call them, represent the 'ecosystem approach' as *a strategy for the integrated management of land, water and living*

[8] http://www.millenniumassessment.org/en/index.aspx
[9] https://www.biodiv.org/programmes/cross-cutting/ecosystem/sourcebook/search.shtml

Box 1: Definitions

An **ecosystem service has been defined in several ways:**

(1) According to the MEA (2003 Ch 2, p53) ecosystem services *are the benefits people obtain from ecosystems.* This formulation draws on earlier definitions which suggest:
- *Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life. They maintain biodiversity and the production of ecosystem goods, such as seafood, forage timber, biomass fuels, natural fiber, and many pharmaceuticals, industrial products, and their precursors (Daily, 1997b:3*).
- *Ecosystem goods (such as food) and services (such as waste assimilation) represent the benefits human populations derive, directly or indirectly, from ecosystem functions* (Costanza et al., 1997:253).

(2) Boyd and Banzhaf (2006) define services in a more restricted way, as *a component of nature, **directly** enjoyed, consumed, or used to yield human well-being*.

In the context of ecosystem services, a **benefit** *is taken to be anything that contributes to human well-being.* Thus 'health' would be regarded as a benefit, while the ability to provide clean water via the ecological processes operating at a catchment level would be regarded as an ecosystem service.

In this project (NR0107) we use the Ecosystem Approach which is defined as *a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way, and which recognises that people with their cultural and varied social needs, are an integral part of ecosystems* (Maltby, 2000).

resources (see also Box 1). A goal of this study is to consider how these principles can be applied in the English planning and policy contexts, and what value it has in comparison to other approaches. There is, we suggest, little merit in exploring differences in how the Ecosystem Approach has been formulated and presented, when the key issue that needs to be addressed is the contrast between this broad framework, and approaches to environmental management and policy that do not take ecosystems and people into account in an integrated way.

In the remaining parts of this document we, therefore, begin to explore the strengths and weaknesses of the concept, with a view to assessing the extent to which it can be used by policy makers for promoting the conservation and sustainable use of England's major terrestrial ecosystems. A key concern will be to identify the challenges that need to be overcome if the Ecosystem Approach is to be used 'operationally' as a framework for policy development, delivery and appraisal – that is to identify what needs to be done if we are to 'transform the idea from principles to operational guidance' (Maltby, 2000, 214).

3. The Ecosystem Approach: Setting the Framework

Hartje et al. (2003) have provided a useful critique of the Ecosystem Approach and in particular the challenges that have to be faced by those seeking to apply it. The CBD has three major objectives, namely conservation, sustainable use and benefit sharing. Hartje et al. (2003) suggest that while the principles of the ecosystem approach recognise their importance, in practice it is often difficult to apply them and to focus on all three simultaneously. The strength of the approach is that it encourages those concerned with environmental management or natural resource issues to take a broader perspective and consider ***multiple objectives***. However, in the real world its application is often constrained by narrowly interpreted organisational responsibilities and existing institutional structures that limit working together in more integrated ways. Perspectives are also constrained by the shortness of political or institutional time-frames and the difficulties of resolving the local and global aspects of problems.

In addition to the problem of framing and resolving multiple objectives, Hartje et al. (2003) suggest that in any operational situation there is also a good deal of ***uncertainty***, over both the way management of policy objectives should be prioritised, and the dynamics of the ecosystems themselves. Like many other commentators, these authors argue that 'traditional science' (and policy making for that matter) is often not sufficiently well prepared for delivering an Ecosystem Approach (cf. Kates et al., 2001). It is evident, for example that the concept requires both inter- and transdisciplinary approaches to problem solving that cut across traditional knowledge domains. As a result, institutions and individuals often lack the skills needed to meet the challenge of adopting an Ecosystem Approach. Moreover, while the principles eschew the virtues of decentralised ***adaptive management*** as a means of overcoming uncertainties and of coping with the unforeseen consequences of actions, institutional structures often prevent such flexibility from being achieved. It is also argued that ideally there must also be a 'good fit' between the structure of the organisation charged with management or policy responsibilities and ecosystem or ecosystem processes.

The case for adaptive management is further underlined by the possibility that ecosystems may not be in equilibrium with their environment, either because of past disturbance or because of changes in external drives, such as climate or human pressure, which may previously have held the system in some kind of stasis. A growing body of literature suggests that ecological systems may exhibit non-linear or even threshold dynamics (e.g. Haines-Young et al., 2006) a situation that may therefore require continued surveillance and incremental review of management objectives.

A mis-match between institutional structures and the relevant 'process-response' unit that delivers a particular set of ecosystem goods and services is often a major cause of management or policy failure (Brunckhorst et al., 2006). However, the problem is not simply one that can be overcome by better organisation because to some extent it is inherent in the nature of the ecosystem concept itself, which is largely uncommitted about where and how the boundaries of an ecosystem might be drawn.

A major difficulty of applying the approach that is not discussed by Hartje et al. (2003) is that it is extremely difficult to decide what 'an ecosystem' actually is. Indeed, what many regard as a virtue of the concept, namely that it can be applied on any scale, poses a considerable operational difficulty. Decisions about what constitutes an ecosystem are not solely determined by the way in which ecological structures and functions are thought to be linked up, but also by what features of the system (e.g. outputs, characteristics, or processes etc.) particular people or groups

(scientists, managers, policy makers, publics) think are significant. One of the benefits of adopting a 'goods and services' focus is clearly that it can help to define what the operational unit represented by an ecosystem actually is, given the sorts of things society values or needs. A goods and services approach can also help to frame discussions about what the multiple objectives of ecosystem management might or should be. What this discussion emphasises, however, is the importance of understanding the societal contexts in which ecological structures and processes are set (Potschin and Haines-Young, 2006).

Although the concept of ecosystem goods and services can assist in clarifying questions about what constitutes 'an ecosystem', it is clear that considerable challenges remain in developing this particular approach. Hartje et al. (2003) observe, for example, that there are significant knowledge gaps, particularly in relation to the ***valuation of ecosystem services.*** '…..Existing empirical literature', they suggest, 'fails to apply economic valuation to the full range of ecosystem services and the benefits of biodiversity preservation'. There is also limited experience, they claim, in developing economic incentives to encourage the conservation and sustainable use of biodiversity, particularly where the costs of preserving ecosystem function have to be met locally while the benefits are shared at more national or international scales. Wilson and Howarth (2002) for example, have argued that conventional valuation methods often rely on individuals being asked to express the (monetary) value that they place on ecosystem goods and services in social isolation, even though the allocation of ecosystem goods and services directly affects whole communities, thus raising issues about social equity and well-being. Effective use of the ecosystem approach is intended to help ensure that social equity goals are achieved.

Unfortunately, the problems we face in using the goods and services' concept cannot simply be resolved by developing better valuation tools and market mechanisms, as Hartje et al. (2003) have suggested. In an operational context, there is a more fundamental difficulty, namely of specifying what an ecosystem service actually is[10]. As Banzhaf and Boyd (2005), and Boyd and Banzhaf (2005, 2006) have noted, the literature is extremely ambiguous about how to distinguish between ecosystem functions and services, and what this means for the way we might value the benefits that people eventually enjoy from them. This situation prevails despite the many attempts to provide systematic typologies of ecosystem functions, goods and services (De Groot, 1992; Daily, 1997b; De Groot et al., 2002; MEA, 2005).

[10] By 'service' we mean both goods and services

Figure 1: The logic underlying the ecosystem goods and services paradigm (after Haines-Young et al., 2006)

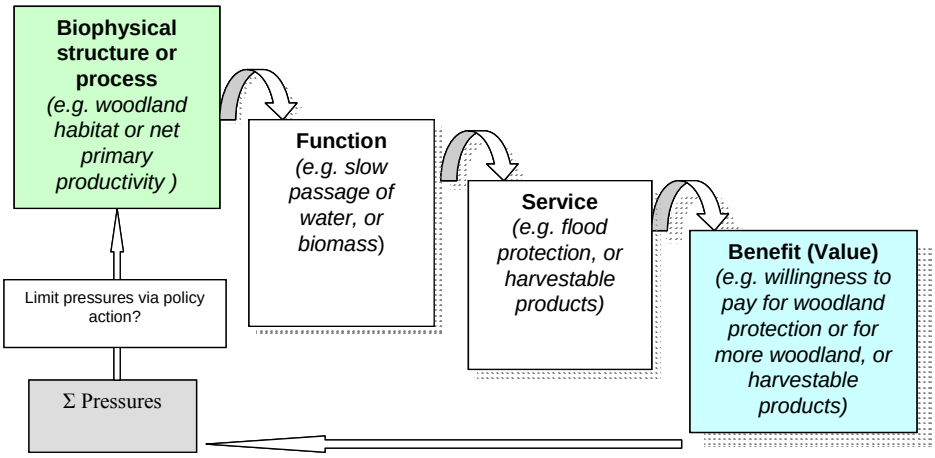
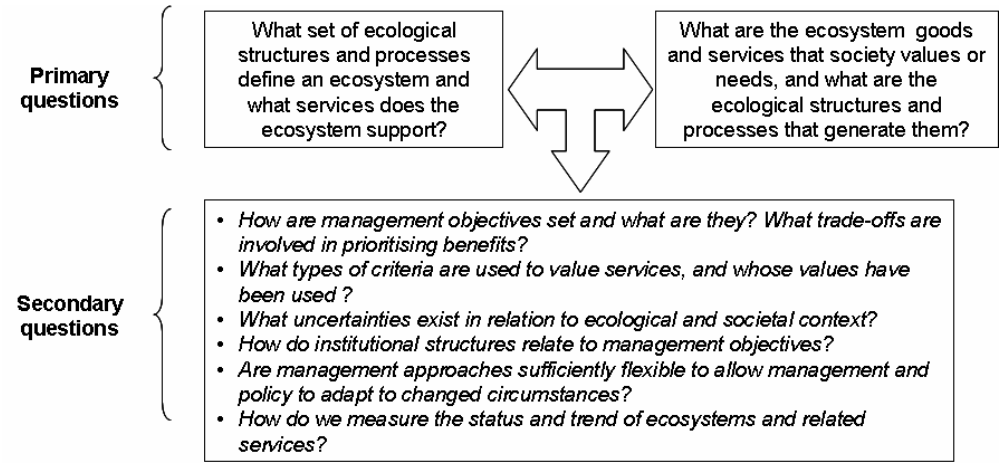


Figure 1 summarises the logic that underlies the 'goods and services paradigm'. The diagram makes distinction between what can be regarded as ecological structures and functions and the eventual services and benefits that they provide to people.

The key point emphasised in Figure 1 is that a particular function that a given ecological structure or process might have, depends on whether people actually place a value on that particular output (i.e. regard the service as producing some 'benefit'). Thus woodlands or the presence, of other habitats such as wetlands in a catchment, may have the capacity (function) of slowing the passage of surface water, thereby modifying the intensity of flooding. Whether this function is regarded as a service depends upon whether 'flood control' is considered as a benefit or not. People or society will value this function differently in different places at different times. Therefore in defining what the 'significant' functions of an ecosystem are and what constitutes an 'ecosystem service', an understanding of spatial context (geographical location), societal choices and values is as important as knowledge about the structure and dynamics of ecological systems themselves.

The critique of the ecosystem concept provided by Hartje et al. (2003) is useful in setting out some of the issues that need to be considered if the ecosystem approach is to be applied as a framework for natural resource management. Indeed the way issues that relate to the setting and prioritisation of multiple objectives, the resolution of uncertainty, and the setting of institutional responsibilities, could be regarded as a set of performance criteria against which the success of the approach might be judged against other, more traditional approaches. However, it is clear that while these issues are important, they are of secondary importance compared to questions about, how in operational terms, the notion of an ecosystem itself is framed and how this relates to some set of services that society values (Figure 2).

Figure 2: Key challenges for confronting the Ecosystem Approach



Given the need for this study to develop an operational framework through which the status of England's ecosystem goods and services might be assessed for a range of policy applications, this document will explore further the two primary questions that underlie the nature of the ecosystem and the identification of goods and services. A comparison of the effectiveness of the Ecosystem Approach using the set of more secondary issues is outside the scope of this project, and will be provided mainly by the 'case studies' that are being funded under Defra's current research programme[11]. Clearly the extent to which it can be made operational and applied successfully will form part of the overall case for adopting and the ecosystem approach in the English policy context.

[11] See for example Parrett Catchment case study (NR0111), www.catchmentfutures.org.uk

4. What are England's major ecosystems?

The nature of the problem about ecosystem definition can be illustrated by reference to the brief for this project, which refers to 'England's major terrestrial ecosystems' and their associated goods and services without specifying what these are considered to be. In the absence of any such guidance, a first key practical step is to determine what 'operational units' are to form the analytical framework. Two alternative approaches to the problem have been identified (see Figure 2).

What might be termed a ***'habitats-focus'*** could be used to define the operational units for this study, by assuming that the major habitats that we find across the English landscape are our primary ecosystem units. If such habitat units can be identified, then the key challenges for this study are therefore to:

- identify the ecosystem goods and services associated with each of them;
- assess the current trends in their ability to continue to deliver these services in terms of the integrity or health of the habitat units; and,
- evaluate the extent to which existing institutional structures, available scientific knowledge and current management objectives are likely to allow us to sustain or enhance the output of these goods and services from each major habitat type.

In the UK we are particularly well-placed to explore this assessment strategy, because as a result of the Biodiversity Action Plan, there is in place a system of 'Broad' and 'Priority Habitats', that could be used initially, at least, to represent the 'major ecosystem types' (Jackson, 2000). A clear advantage of using these habitats as a framework for representing the output of goods and services, is that as distinct ecological units they could be seen in terms of the 'bundles' of services that they can deliver. As a result, the importance that they have as elements of 'natural capital' can be more properly assessed, and any trade-offs in the output of ecosystem goods and services that arise through current or future management choices can be better understood.

The difficulty that arises when adopting a habitats-focus is that by dividing the world up into separate habitat types, the framework might not capture all the important goods and services that England's natural capital can deliver. There may be some functions and services, for example that arise from the ***combination*** of habitats in a broader mosaic of land cover types or in distinct topographical units such as drainage basins. Such higher level services might be difficult to assess by looking at habitats separately. Moreover, if we are eventually to promote the approach as a general way of including issues that impact on ecosystem goods and services in decision making, a habitats focus might appear to make the approach 'too ecological' from the outset, and therefore prevent it being taken up more widely as a policy framework. As a result it is useful to consider the advantages of other conceptual approaches beside that which primarily divides the world up into habitat units.

As an alternative to a 'habitats focus' for defining ecosystems, we could consider an ***'ecosystem services perspective'***, in which attention shifts from some set of pre-defined habitat units to the goods and services themselves. The aim here is to identify the fundamental functional units that are needed to understand the processes that give rise to a particular good or service, and which are therefore more relevant to understanding current threats and trends to sustaining this stream of benefits. Assuming that a set of ecosystem goods and services can be identified then the key challenges that arise for those adopting this perspective are to:

- determine, at an appropriate spatial and temporal scale, the set of ecological functions that deliver the specified goods and services of interest (i.e. specify what the 'ecosystem' is);
- assess the integrity or health of the ecological system and therefore its ability to sustain the output of the good or service of interest; and,
- consider, in relation to the set of functions identified, the adequacy of current scientific knowledge, existing institutional structures and associated management objectives, the extent to which the output of the good or service can be sustained.

The suggestion that we could adopt a 'goods and services' focus does not deny that particular types of habitat patch may not be important in supporting the benefits that natural capital can provide. Rather it is to suggest that the 'functional units' that form the framework for the analysis are likely to vary from one service to another and may be defined at far broader scales than the individual habitat patch. The fundamental point is that the set of ecological functions that support the output of a good or service must be considered at an 'appropriate spatial and temporal scale'. It is this understanding that is used to define 'the ecosystem'. The 'ecosystem', as such, may consist of a mosaic of many different habitat patches, and their spatial combination may be a fundamental part of the system that delivers that good or service. This is often the case, for example, in the context of recreation or, say, or of water quality.

A clear advantage of a 'goods and services' approach is that for decision makers, the focus is clearly on the processes that give rise to the things that people value and which therefore relate directly to questions of 'well-being'. The challenge it poses, however, is that, as many commentators have emphasised (Loreau et al., 2001), we generally lack any systematic understanding of the way ecological functions link to the output of ecosystem goods and services and their societal benefits. The question 'how we may identify what constitutes a 'service unit'?' is still unresolved. If we 'pick-off' ecosystem goods and services one by one, then this may lead to a fragmented understanding of the ways they are linked to each other, and the potential conflicts and synergies that might arise or be overlooked if they are managed separately.

The contrast between the 'habitat' and 'goods and services' perspectives underlines the point made by Smith and Maltby's (2003) that there is probably no single way to implement the Ecosystem Approach – but that it must be developed through its application. The principles map out a pragmatic framework designed to achieve sustainable outcomes. Thus the two methodological alternatives outlined above are probably not mutually exclusive, providing the short comings of each are considered. Thus, as an analytical strategy it is proposed that in this study both perspectives are compared across a range of different spatial units that extend from the individual habitat patch, whole landscapes (as might exist at the scale of the river catchment or Joint Character Area), through to the level of the major government office regions at which broad strategic decisions are currently made.

At each spatial scale, the relationship between the BAP terrestrial Broad and Priority habitats (Table 3) and their associated goods and services will be considered, and the extent to which they capture all the services that are relevant at the catchment, landscape and regional scales will be assessed. The BAP framework is a particularly useful one to explore in the context of this study, because of its general policy relevance, and the recent reassessment of the action plan targets.

Table 3: The Biodiversity Action Plan Broad Habitats

Terrestrial Broad Habitats	**Marine and Coastal Broad Habitats**
Arable and horticulture	*Continental shelf slope*
Acid grasslands	*Inshore sublittoral rock*
Calcareous grassland	*Inshore sublittoral sediment*
Improved grassland	*Littoral rock*
Neutral grassland	*Littoral sediment*
Boundary and linear features	*Oceanic seas*
Broadleaved, mixed and yew woodland	*Offshore shelf rock*
Coniferous woodland	*Offshore shelf sediment*
Bogs	
Bracken	
Dwarf shrub heath	
Fen, marsh and swamp	
Inland rock	
Montane habitats	
Urban	
Built up areas and gardens	
Rivers and streams	
Standing open water and canals	
Supralittoral rock	
Supralittoral sediment	

Note: Only the terrestrial broad habitat will be considered in this study. For information about the broad habitats are defined and how the Priority Habitats are nested within the Broad Habitat units, see Jackson (2000).

A better understanding of ***the geography of England's ecosystem goods and services*** is thus seen as one of the major contributions that this study can make, because of its relevance to current spatial planning agendas and the DCLG's Sustainable Communities programme of work. An awareness of the importance of the state and trends of the goods and services associated with England's major ecosystems may, for example, enable Local Authorities, Local Area Agreement Partnerships and Local Strategic Partnerships to use existing decision making approaches more effectively, by helping them take account of a broader range of issues through a commonly understood framework for assessing ecosystem goods and services.

5. What are goods and services of ecosystems?

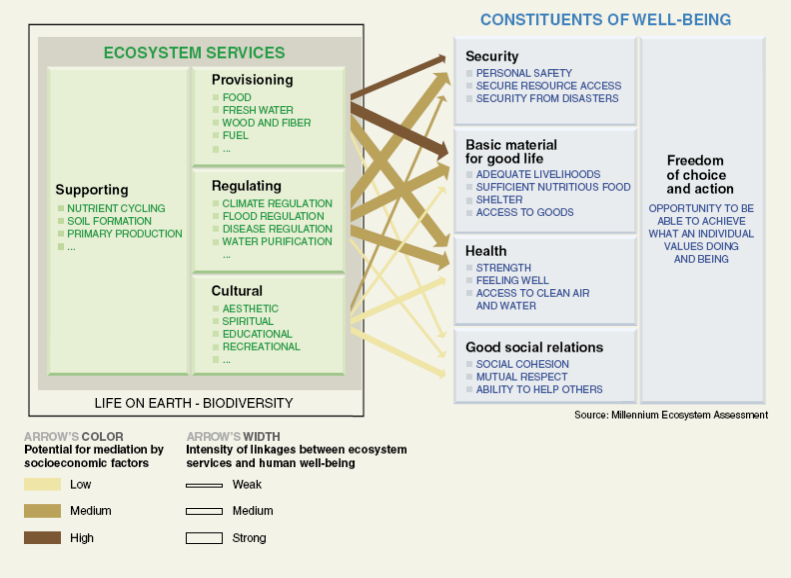
Current interest in the assessment of the state and trends in ecosystem goods and services has been stimulated by the recent publication of the Millennium Ecosystem Assessment (MEA, 2005). It therefore seems desirable to consider the way in which this study formulated the key concept of an ecosystem service, with a view to making a similar assessment for England.

In the volume that summarises the main findings of the MEA, ecosystem services are regarded as 'the benefits people obtain from ecosystems' (MEA, 2005, Box 1, p.3). Expanding on this idea it is suggested that services include:

> '…..*provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits'* .

Figure 3 illustrates the way in which these key 'functional groups' map on to the various elements of 'human well-being', which for the authors of the MEA *'has multiple constituents, including basic material for a good life, freedom and choice, health, good social relations, and security'* (MEA 2005, Box 1, p.3).

Figure 3: Linkages between Ecosystem Services and Human Well-being (after MEA, 2005)



In support of their definition of an ecosystem service, elsewhere in the volume (MEA, 2005, p.55) it is suggested that it is derived from two widely influential sources, namely Daily (1997b), who has proposed that:

> *'Ecosystem services are the conditions and processes through which natural ecosystems, and the species that make them up, sustain and fulfill human life. They maintain biodiversity and the production of ecosystem goods, such as seafood, forage timber, biomass fuels, natural fiber, and many pharmaceuticals, industrial products, and their precursors'* (Daily 1997b:3).

and Costanza et al. (1997) who suggest that:

> *'Ecosystem goods (such as food) and services (such as waste assimilation) represent the benefits human populations derive, directly or indirectly, from ecosystem functions'* (Costanza et al. 1997, p.253).

If we consider these various positions, then several features are apparent:

- Unlike the position of Daily (1997b), for the MEA the analysis of ecosystem services is seen as relevant to ***any*** type of ecosystem and not just those regarded as 'natural'. This point is particularly relevant in a country such as the UK, where many ecosystems have been modified and even enriched by people, and many of our most valued habitats are the direct result of management.
- It is important in any analysis to make the distinction between 'services' and 'benefits'. Goods and services are generated by ecological functions (or processes) (cf. Costanza et al., 1997) and give rise to 'benefits', which are the things that have ***value*** to people. This point is particularly relevant in terms of locating this study within Defra's current research programme. The focus of this work is on the ecological functions and processes that generate services and not the significance of the benefits *per se*. In terms of Figure 1, the study will concentrate more on exploring the ecological production functions, associated with the left hand side of the diagram, rather than the value of the outputs that might be generated by them.

It is worthwhile to consider the distinction between services, and benefits in more detail, particularly given the critique of Banzhaf and Boyd (2005), who have argued that if the concepts are to be made operational then a much clearer formulation of them is needed.

Banzhaf and Boyd (2005) suggest that the conventional typologies of ecosystem goods and services are ambiguous because they often combine the notions of ecological function, service and benefit. They argue that if our interest is eventually to value the services that nature provides, then a service must be regarded essentially as something that is ***consumed*** as an input in a '(household) production function'. The point can be clarified by reference to the example they provide concerning bees and the production of apples.

Apple production could be viewed as dependent on the input of human labour (human capital) and the pollination activity of bees (natural capital). The latter can be measured in various ways, but realistically the most appropriate measure is something like the number of bees within a certain distance of the orchard. For those concerned with assessing the value of the 'ecosystem service' that we recognise as 'pollination' the key step would be to analyse how changes in bee abundance impact on yield and hence the value of the crop (holding all other variables, such as labour costs, constant).

The first key point that Banzhaf and Boyd (2005) seek to make using this example is that it is the 'number of bees' that represents the ecosystem service. Thus in assessing the 'value of nature', as represented by the value of bees to fruit production, we do not have to consider all the other ecological structures and processes on which bees depend. Edge habitats, for example, might be important in maintaining bee populations, but their value is taken into account through the measure of bee abundance and its influence on yield. As such edge habitats are more properly regarded as 'ecological assets', because they themselves do not directly enter into the 'production function' for apples.

> *'Assets are intermediate in that they are necessary to the production of services but are not services themselves. Assets are inputs to an ecological production function that yields the ecological service'* (Banzhaf and Boyd (2005, p. 19).

In the most general sense Banzhaf and Boyd (2005) argue that assets can also include ecological processes which give rise to a particular ecosystem service. In terms of the chain of reasoning set out in Figure 1, therefore, ecological assets are essentially the structures and functions identified on the left-hand side of the diagram.

The second key point that Banzhaf and Boyd (2005) seek to make using the example of bees is that it is important to distinguish between the service and the benefit actually being derived from it. In this example, the benefit would be the contribution that pollination by bees makes to the value of the apple crop, and ultimately to 'well-being'. That value could be viewed in the context of the costs that would be incurred if pollination needed to be done by artificial rather than natural means. Clearly while the service that the bees provide may be ubiquitous the benefit or value of that service may, however, vary from place to place. This distinction can be further illustrated using the example of 'flood control' (Figure 1). While the service provided by the capacity of trees to slow the passage of water through a drainage system might be 'available', the extent to which it can be regarded as constituting a benefit, in the sense that it has a value, may be dependent on the number of people or properties potentially affected in a given location.

Banzhaf and Boyd (2005) argue that the typologies of ecosystem services such as that of Daily (1997b) and the MEA (2005) are unhelpful because they represent as services what are more properly considered as functions and benefits[12]. These authors suggest that it is particularly important to identify clearly what a service is because only then are we likely to be able to develop measures of ecosystem services that are consistent with approaches used for the construction of national economic accounts. They go on to illustrate how this could be done through the construction of an Ecological Services Index (ESI) (see Box 2). The complexity of the task is however, considerable, because as these authors observe *'….ecosystem services are contingent on particular human activities or wants'* (Banzhaf and Boyd, 2005, p.12). The problem can be illustrated by reference to Figure 4, which has been reproduced from their work which concerns the different roles that water quality can have in the analysis of ecosystem services and societal benefits.

Box 2: The construction of an ecosystem services index (after Banzhaf and Boyd, 2005)

An Ecosystem Service Index (ESI) could be thought of as an overall measure of the overall level of benefits derived from a 'bundle' of ecosystem goods and services that can be derived from a given place at a particular time. The index could be based on the contribution that each service that is available makes to the overall output, as follows:

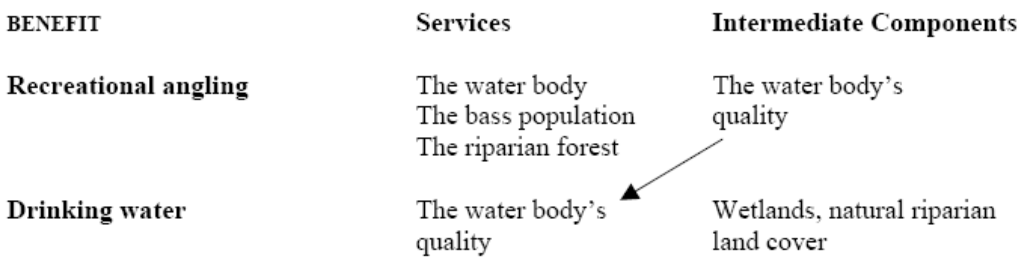
$$ESI=q_1p_1+q_2p_2+\ldots+q_np_n$$

Where q is the level of given service in that place at a particular time, and q, is a weight that expresses the significance or contribution of that service. The weights 'q' can be based the values assigned to that service. The ESI attempts to sum the contributions over all the services from 1 to n.

[12] Note, for example, how the MEA (2005) defines ecosystem services as 'the *benefits* people derive from ecosystems'

Clearly the quality of the water body plays an important role in the service chains that give rise to the benefits we recognise as 'recreational angling' and 'the provision of drinking water'. However, only in the case of drinking is the water directly consumed, and so only here is 'the water body's quality' to be regarded as a service. Wetlands, natural riparian land cover are important assets that help deliver that service, but they are not services in themselves. By contrast for recreational angling, the water body's quality is no longer the service. Here the things being used directly are the fish population (bass) and elements of the environment such as the presence of the surrounding vegetation through their influence of the angling experience. The value of the water body's quality is taken account of in the service represented by the fish stock. Thus in this situation the quality of the water body is an asset ***not*** a service.

Figure 4: The identification of benefits, service and functions in the context of recreational angling and the provision of drinking water (after Banzhaf and Boyd, 2005)



The observation that ecosystem services appear to be 'contingent' or determined by human activities and needs, has considerable implications for this study because it suggests that it is unlikely that we can devise a generic checklist of goods and services that ecosystems or regions might support, as many commentators have done. As the brief for this study sets things up, the focus of effort appears to be very much on 'supply side' issues, and to involve the identification of a particular set of ecosystem goods or services and then to form some judgement about state and trends in relation to the systems that provide them. This is clearly not easy unless the work is grounded on an analysis of more 'demand side' issues, relating to identifying the benefits arising from elements of natural capital that people value. In terms of understanding the demarcation between this and the other studies supported by Defra's current research programme, it seems clear that while this work does not need to make a monetary valuation of services, it has to be based on a clear understanding of the social assessment of the putative value of a particular good and service, and the ways people might view the trade-offs between benefits that might arise in situation involving multiple management or policy objectives.

'Stakeholder valuation' is therefore not simply a by-product of the 'ecosystem-services approach', or the last step in some linear process of assessing the value of nature (cf. Vaze, 2006, Table 2). Rather it has to be seen as part of a more iterative process that helps shape our understanding of what a service actually is. As the work of Robertson and Hull (2003), Agyteman and Angus (2003), and Irwin (2006) illustrates, a goods and services perspective has to be grounded in efforts within public policy research to foster a more participatory and deliberative framework for environmental management. Such an approach is particularly relevant if issues relating to social equity/environmental justice or environmental rights are to be taken

into account[13]. This issue is also more deeply explored in the Defra Phase II case studies, e.g. NR0111 (the Parrett Catchment).

The need to consider demand-side issues will involve questions about who the customers for particular goods and services are, how they value the benefits that ecosystems can provide, and what limits or thresholds are important for monitoring the state and trends of the systems that deliver those benefits. This type of approach is illustrated in the Quality of Life Capital Approach (Countryside Agency et al., 2001; Potschin and Haines-Young, 2003; Thérivel, 2000), which seeks to explore with local communities what aspects of the environment of an area are felt to be important, what levels of benefit are required, and what management actions are appropriate, in the context of national and global trends.

Given the need to base the definition of what constitutes an ecosystem good or service on some understanding of societal context, it is proposed that the methodological strategy adopted for this work must involve some review of the way people view the benefits associated with England's major terrestrial ecosystems. This will involve both a literature review and consultations with key stakeholders and organisations to identify the benefits associated with the individual BAP Broad and Priority Habitats, and the ways they are combined in wider land cover mosaics at the catchment, landscape and regional scales.

6. Implications and Next Steps

The aim of this paper has been to review the key aspects of the Ecosystem Approach, and in particular to explore how it can be used to identify and assess the goods and services associated with England's major terrestrial ecosystems. At this stage it would be premature to draw any firm conclusions about whether, in the words of the brief, *'a case can be made for intervention on an ecosystem scale to ensure the on-going supply of ecosystem goods and services'.* Nevertheless, a framework for collecting the evidence that needs to be assembled to resolve this question can be identified.

A key task for this project is to establish the geography of England's ecosystem goods and services. This will be done by basing the analysis in part on the framework provided by the Biodiversity Action Plan Broad and Priority Habitats, and extending it through consideration of wider land cover mosaics at catchment, landscape and regional scales. Given that the identification of particular goods and services is dependent on both public and expert values or needs, the cross tabulation of ecosystems and services (see D2.1 and D2.2) must be grounded on an understanding of 'stakeholder' perspectives. It is proposed that this understanding is achieved by a combination of a literature review and a consultation exercise targeted on individuals and organisations that could be considered as 'key informants'.

The development of a cross tabulation of ecological functions, services and benefits against the BAP Broad and Priority Habitats at different spatial scales is therefore seen as the next major step in the current work programme (Box 3). This framework will then allow an assessment of:

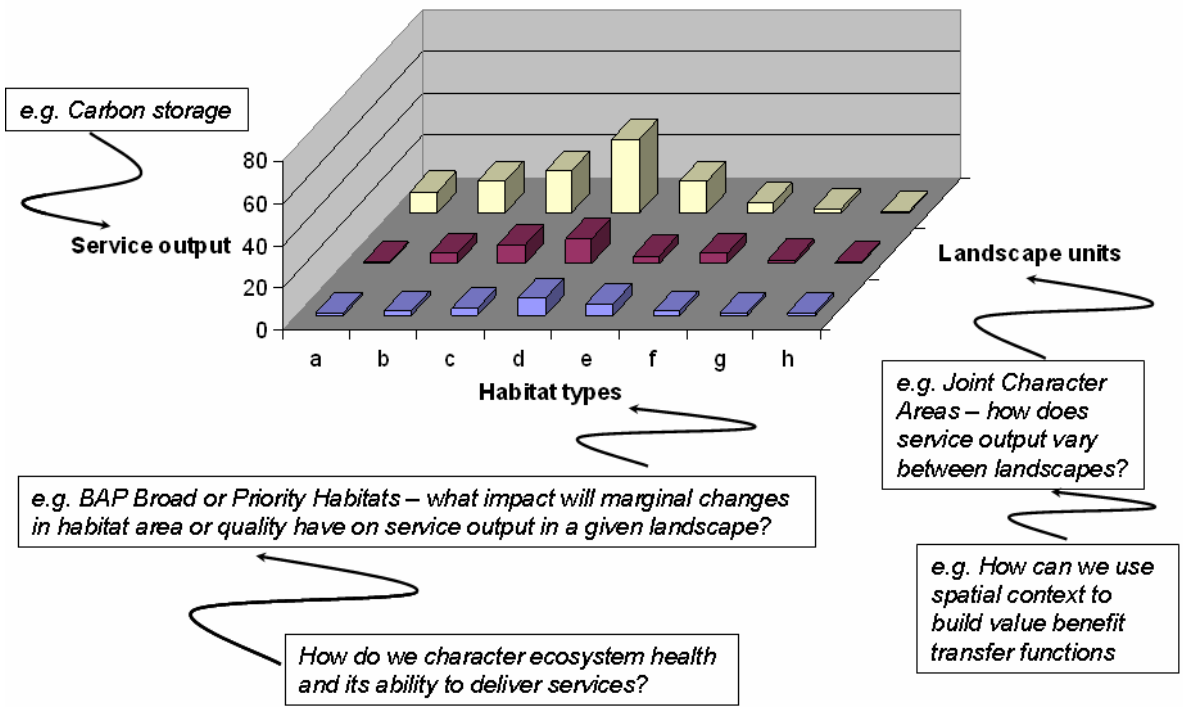
- how the concepts of ecosystem health can be used to characterise the integrity of those systems;
- the current status and trends the ability of England's major ecosystems to maintain the benefits that are associated with them;

[13] http://www.sd-research.org.uk/documents/SDRNbriefingTwo_Final.pdf

- the extent to which the revised BAP targets (and broader land cover change) will affect the **'marginal capacity'** of our major habitat or ecosystem types to enhance well-being through the ecosystem services that they can deliver;
- how an understanding of spatial context might facilitate the construction of benefit transfer functions and therefore service valuation; and, eventually,
- the extent to which current institutional structures and decision making frameworks are able to monitor and potentially intervene on an 'ecosystem scale', to ensure the on-going supply of ecosystem goods and services.

Although much of the current interest in ecosystem goods and services has its origins in concern about the scale of human impacts on natural systems, studies such as this should not be seen as only looking at the threats to human well-being. Understanding the ways in which ecosystems, and the goods and services that are associated with them, contribute to the economy can also be used to identify new opportunities for economic and social development. If the value of ecosystem goods and services can be assessed and expressed in robust ways, then the ecosystem approach may enable more integrated economic and environmental accounting systems to be constructed and used as the basis for future decision making. The approach could therefore be an essential element of sustainability appraisal.

BOX 3: The geography of England's ecosystem goods and services: Methodological framework for linking habitats and landscapes to services and concepts of ecosystem health and value



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