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The Ecosystem Approach

The ecosystem approach makes explicit the link between the status of natural resource systems and ecosystem services that support human well-being. It seeks to maintain the integrity and functioning of ecosystems as a whole to avoid rapid undesirable ecological change. It also recognises that the impacts of human activities are a matter of social choice, and are as integral to ecosystem interactions as ecosystems are to human activities.

Overview

- The objective of the ecosystem approach is to ensure that governance mechanisms balance use of natural resources with their conservation.
- An evidence base is being developed to implement the ecosystem approach in the UK, a key part of which is the UK National Ecosystem Assessment.
- Changes in the way ecosystems are managed can be contentious, as they result in different flows of benefits from ecosystem services, and costs to be borne. The ecosystem approach requires transparency about the potential impact of changes being considered.
- It remains unclear what kind of governance structures and institutions are most capable of delivering the ecosystem approach and sustaining flows of ecosystem services in the longer term.

Background

The Convention on Biological Diversity (CBD) describes the ecosystem approach as “a strategy for the integrated management of land, water and living resources that promotes conservation and sustainable use in an equitable way”. The ecosystem approach adopted by the CBD in 2000 has a broad scope that goes beyond ecosystems themselves to encompass social, cultural and economic factors that are fully interdependent with biodiversity and ecosystem services (Box 1). In line with the revised strategic plan of the CBD, the UK Biodiversity Partnership now places greater emphasis on landscape-scale approaches to maintain the integrity of natural resource systems and less on site-based approaches or on recovering target species.

Biodiversity conservation has been seen historically as a secondary government policy objective compared with the delivery of social and economic objectives such as housing, transport, industrial production, agriculture and other land uses. In addition, the present UK and European legislative framework for nature conservation and land use planning was not designed to manage and maintain the flow of ecosystem services (Box 2), and there has so far been little progress in incorporating relevant practices into the actual management programmes for natural resources. Conservation policy has previously focused on protection of areas of high species diversity, but it is not yet understood how these coincide with high levels of ecosystem services.[1]

Who Gains and Who Bears the Costs

The ecosystem approach requires open and explicit choices to be made between alternative stable ecosystem states and levels of benefits they deliver. There are numerous different stable ecosystem states possible for any area of land, each with different combinations of services and reflecting the different aspirations of those who could benefit or lose from changes in service delivery. For example, both forest and moorland ecosystems can be sustained in UK upland areas, and choices between these alternate states could be made through agri-environment schemes to achieve desired service levels, such as water quality and carbon sequestration.

If an ecosystem is primarily managed to deliver one ecosystem service, this may reduce the ability of ecosystems to deliver other ecosystem services. For example, a forest managed exclusively for timber production, could have less recreational value, may store

less carbon and be less effective at retaining nutrients. A key role for scientific advice is to provide understanding of these relationships between services and how best to manage their interactions.

Box 1 CBD Principles of the Ecosystem Approach

Agenda 21, developed at the Earth Summit in Rio de Janeiro in 1992, stated that integrated management of natural resources is the key to maintaining ecosystems and the essential services that they provide. The CBD principles (2000) are elaborated from the ten principles of ecosystem management defined in 1996 at the Sibthorp Seminar in the UK.[2] The 12 complementary and interlinked principles are:

1. The objectives of management of land, water and living resources are a matter of societal choices.
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 programme should: reduce those market distortions that adversely affect biological diversity; align incentives to promote biodiversity conservation and sustainable use; and, 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.

Bringing Ignored Benefits into Decision-Making

Benefits over a long-term horizon from regulating and supporting ecosystem services, such as climate regulation or flood alleviation, are frequently ignored as they are not an overt part of the land manager's financial reward. Decisions often take more account of shorter term gains in private benefits, such as increased agricultural productivity from wetland drainage. This is at the expense of public benefits, the loss of which accumulates over a longer time period, such as increased risk of flooding and decreased water quality. The benefits generated by ecosystem services are both private and public goods, occur over a range of temporal and spatial scales and can be associated with a variety of property rights and other institutional arrangements. [3]

Resolving Conflicts between Stakeholders

The gainers and losers from any environmental change vary depending on the type and scale of ecosystem service provided, the mix of stakeholders involved, the economic characteristics and the cultural context. Consumers of benefits are likely to vary geographically, socially and economically, with increased consumption of one service by one group having implications for the delivery of other services to different groups. For example, the beneficiaries of ecosystem service provision, particularly provisioning services for commodities such as timber, palm oil or soya, are distant from the places where ecosystem transformation occurs.[4] In addition, changes in some present benefits, such as biodiversity, have implications for future consumers of ecosystem service benefits.[5]

Box 2 Ecosystems and Ecosystem Services

The Convention on Biological Diversity (CBD) defined ecosystems as "a dynamic complex of plant, animal and micro-organism communities and their non-living environment interacting as a functional unit". The key feature of ecosystems is that they are fully integrated systems,[6] with 'emergent properties' arising from interactions between the living and non-living elements of which they are composed.[7] These interactions between structures and processes, which may be physical (such as infiltration of water), chemical (such as oxidation) or biological (such as photosynthesis), all involve biodiversity, although this relationship is not always straightforward. These interactions give rise to ecosystem functions, an intrinsic characteristic of the ecosystem, such as nutrient cycling, which are fundamental to an ecosystem maintaining its integrity. Ecosystem services (POSTnotes 248, 376) are usually defined as the aspects of ecosystems used (actively or passively) to produce human wellbeing.[8] The Millennium Ecosystem Assessment separated these services into four categories: *provisioning services*, for example, food and water; *regulatory services*, for example, flood and disease control; *cultural services*, for example, spiritual and recreational benefits; and *supporting services*, for example, soil formation and photosynthesis that maintain the conditions for life on Earth. Ecosystem services are regarded as the link between ecosystems and human wellbeing, with ecosystem service transformed by other forms of capital to provide benefits (POSTnote 376). For example, the built capital of water treatment and distribution infrastructure is used to make drinking water available from the ecosystem service of clean water provision.[9]

Role of Valuation

While provisioning services create marketable goods such as agricultural crops, most ecosystem services are not sold in markets. However, economic valuation techniques can be used to attach an appropriate value to benefits arising from them. The value of the loss of benefits from changes in ecosystem services can be used to increase the transparency of decision-making, particularly where they are traded off against economic gains.

Even if ecosystem services have no formal economic valuation, they can still be traded. For example, where conflicts arise in ecosystem service provision and management, "compensation in kind" could be provided to users who make sacrifices that benefit others. Examples are as land swaps, or direct payments made to those providing benefits under agri-environment schemes. Nonetheless, changes in the way ecosystems are managed can be contentious as they alter the incidence of both beneficial and adverse consequences, whether these are financial or in kind. There is not only conflict over private gains versus wider public benefits but also about who gains benefits and who bears costs. These issues may not be resolved through any single approach such as economic valuation of ecosystem services or public participation, but will require a range of different techniques.

An Integrated Approach to Managing Ecosystems

To maintain natural resource systems within environmental limits, the appraisal of government policies and projects should ensure that the value of natural capital and

ecosystem services is considered, as well as future costs arising from any increase in environmental risks identified. Although the appraisal of new policies already requires environmental impacts to be taken into account,[10] the methodologies used do not take account of the costs and benefits of how ecosystems are managed, in terms of the levels of provision of different ecosystem services.

Quantifying Impacts on Ecosystem Services

Several recent frameworks have suggested approaches for evaluating the cost of impacts on ecosystem services,[11] which include:

- establishing the environmental baseline (describing the habitats present and the ecological processes they support, for example, as has been shown for wetlands);[12]
- Identifying and providing qualitative assessment of the potential impacts of policy options on ecosystem services, through an ecosystem service valuation assessment (ESVA);
- quantifying the impacts of policy options on specific ecosystem services and assessing the effects on human welfare; and,
- valuing the changes in ecosystem services, through an ecosystem service valuation (ESV).

These steps are intended to provide a framework for a systematic approach to accounting for impacts on ecosystems (Box 3). However, even an initial assessment of ecosystem services affected by a policy choice can indicate how potentially significant impacts could be and where uncertainties and evidence gaps lie.

The value of the natural resource systems is the value of the flow of benefits less the cost to produce them (POSTnote 375). Some of these have direct market values, such as crops, whereas others such as the regulation of water flows by wetlands do not. Typically, the relevant natural capital stocks cannot be transported to another location, meaning that some ecosystem services are location specific, particularly regulatory, supporting and cultural ecosystem services (Box 2).

Mapping Ecosystem Services

The spatial layout of ecosystems and the natural capital stock within them is important for the interactions that give rise to beneficial processes and ecosystem services. For example, linkages between ground water, surface water and rainfall within in the area of a river catchment mean that impacts on any one of these can affect hydrological processes within the catchment and the ecosystem services linked to these processes, such as clean water provision. Equally, the social value of ecosystem services relates spatially to where they are consumed. The development of spatially explicit ecosystem service indicators at appropriate scales is critical to assessing impacts of changes.

The soon to be published UK National Ecosystem Assessment (UK NEA) will provide a measure of ecosystem service provision at the national scale. The relevant scale for mapping ecosystem services remains a matter of debate as ecosystem management decisions can be taken at the national, regional or local level. Local scale areas are based more on natural landscape boundaries, such as an area of similar geology like chalk downland or a river catchment. The size of the area should not only be ecologically relevant, but also socially, economically and culturally appropriate, such as national park authority area. However, ecological scales do not usually match decision-making scales, creating difficulties for assessments and valuation.[13] The recent Foresight report on land use called for new policy frameworks that create landscapes that are more "resilient" and "sustainable" in the long term.[14]

Box 3 The Alkborough Flats Managed Realignment Scheme[15]

The Humber is a major estuary, draining one fifth of the land area of England. Alkborough Flats is located on the south bank of the inner Humber estuary at the confluence of the River Ouse and the River Trent. The flats lie below the village of Alkborough, adjacent to the Trent and Humber. They were identified as a location for managed realignment, which involves breaching sea walls to allow the sea to cover uninhabited land as far inland as the nearest high ground or new sea walls (POSTnote 342). The realignment was part of a wider Humber Flood Risk Management Strategy. By allowing the 440 hectare Alkborough Flats to flood, high water levels are reduced by 150mm over a large part of the upper Humber estuary. With a projected annual sea level rise (POSTnote 363) of 4mm per year until 2025, and then 8.5mm per year until 2055, this should continue to reduce high water levels for another 25 years and make it possible to defer the building of flood defences upstream.[15]

The ecosystem approach offers one means by which decision-makers could transparently trade off loss of local benefits against reducing the regional coastal flooding risk. 170 hectares of the site are now permanently exposed to flooding, reverting to mudflat, saltmarsh and, in parts, reedbeds, with the remaining 230 hectares primarily used for grazing but acting as flood storage during extreme surge events. The ecosystem service benefits arising from the realignment have been assessed and economic values for non-marketed benefits derived where the benefit could be quantified. The baseline used for the assessment was the previous intensive arable farming across the site.

It had been assumed that benefits from provisioning services (e.g.food production) would be reduced in favour of other services (e.g. flood regulation). However, the assessment estimated that the change in land use was neutral or slightly positive for provisioning services, with the value from wool and meat from rare breed grazing of sheep and cattle offsetting loss of arable production of food and fibre. It is likely that commercially-exploited fish species using the saltmarsh as a nursery area add substantial extra value, but methodological shortfalls prevented their valuation. The section permanently exposed to flooding now supports a wide range of wildlife including waders and other birds.[16]

Longer-term maintenance of biodiversity will depend on allowing the estuary to change and adapt in response to sea level rise. Overall, the assessment found a significant improvement in ecosystem service benefits arising from improved ecosystem functioning.[15] However, the main economic value of flood risk reduction benefits accrues mainly to the more densely populated urban areas and there can be substantial difficulties in communicating such benefits to local stakeholders, as:

- although land is purchased prior to flooding, the loss of high grade agricultural land is a major local issue.
- the flood risk may be reduced by the realignment, but at the site the reduction in distance between Alkborough village and flooded areas is perceived as increasing the risk.
- Concerns arose from disparate sectoral interests, including shellfisheries, navigation, public access and protected biodiversity.

A full spatial classification of ecosystem services and their quantification and mapping for each location would also take into account local, regional and global consumers of ecosystem service benefits. This would allow ecosystem service flows between different regions to be determined, and the identification of areas or stakeholders obtaining the benefits provided by them, as well as the identification of areas or stakeholders seeing a loss of service provision. The extent to which this is necessary is depends on the policy being considered and the scale of the likely impacts.

Integration into Policy Frameworks

Globe International's Natural Capital Action Plan recommended that all policy and project proposals that influence the environment should undergo economic appraisal that includes the valuation of ecosystem services, with government departments obliged to incorporate a costed explanation of how their policies will enhance or deplete natural capital or transform it into other forms of capital (POSTnote 376).[17] To inform the development of an effective ecosystems approach policy framework that assesses the likely outcomes on benefits from natural resource systems, there would need to be consideration of:

- explicit measures of the condition and trends of biodiversity associated with the relevant ecosystems;
- determination of the delivery of ecosystem benefits in biophysical terms (both quantity and quality), to inform economic valuation or measurements required. This should include quantification of how different types of ecosystems use change the delivery of benefits;
- the context of contrasting future scenarios, which incorporate both the value of ecosystem services and the cost of actions affecting those ecosystems, so that the impacts of alternative decisions on ecosystem services can be assessed;
- integration of an analysis of risks and uncertainties, including the limitations of knowledge of the impacts of human actions on ecosystems;
- economic valuation applied to changes in services, which requires a good understanding of the service flows and the determinants of demand; and,
- understanding of the role of property rights and entitlements in the use of ecosystem benefits.

The European Academies Science Advisory Council (EASAC) have recommended that one means of maintaining delivery of ecosystem services would be an EU Ecosystem Services Directive, analogous to the existing EU Habitats Directive that sets out the strategy and targets for biodiversity conservation in Europe. EASAC suggests that the Directive could set out a strategy for the conservation and maintenance of ecosystem functions to protect the levels of ecosystem service benefit provision not only for European populations but also globally. [18]

Decision-makers, such as parliamentarians, will want to be aware that there are ranges of potential outcomes for any decision affecting ecosystems, and to judge the capacity of proposals to withstand uncertain future risks. Scenarios for ecosystem services up to 2060 are a key output from the UK NEA. [19] Such Scenarios can be used by policymakers or stakeholders to:

- consider possible long term consequences of decisions
- examine the implications of future uncertainties for various management options; and,
- enhance stakeholder participation by representing conflicting opinions and different world views.

Stakeholder and Public Participation

A key tenet of the ecosystem approach is that it should involve all stakeholders and balance local with the wider public interest. This requires engagement with a broad range of institutions, organisations, groups and individuals that have an interest in, understanding of, or potential influence over, the management of a given ecosystem. Participation should start at an early stage to clarify both the issues to be addressed by the decision making process and where the priorities of stakeholders lie and also to identify constraining factors. There is a substantial academic literature on the uses and challenges associated with stakeholder participation in natural resource management.[20] Defra has recently consulted on guidelines on "participation and an ecosystems approach to decision making". The guidance suggests that participatory and deliberative techniques (PDT) could be incorporated into policy appraisal and evaluation procedures in accordance with the HM Treasury 'Green Book'. [21]

Community Influence over Decision Making

The closer management is to the ecosystem, the greater the responsibility, ownership, accountability, participation, and use of local knowledge. It is only at the local scale that holistic decision-making which can accommodate consideration of multiple benefits, trade-offs between ecosystem service benefits, environmental limits and appropriate levels of stakeholder participation is possible. Where communities are equipped with suitable information on the consequences of decisions, participatory approaches can improve outcomes. However, economic and participatory methods are complementary to existing decision making processes rather than alternatives. They provide new inputs to the process and facilitate debate and scrutiny of the reasoning and assumptions behind decisions, but alone are unlikely to resolve fundamental conflicts in the management of natural resources.[3]

Endnotes

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