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Ecosystem Service Valuation

The UK National Ecosystem Assessment has refined methods for placing monetary values on many services provided by the natural environment. It will also demonstrate convincingly that relying on how present markets handle such services will not deliver the best outcomes for society. This POSTnote summarises methodologies for determining reliable values for changes in natural resources and ecosystem services and the policy implications of such valuations.

Overview

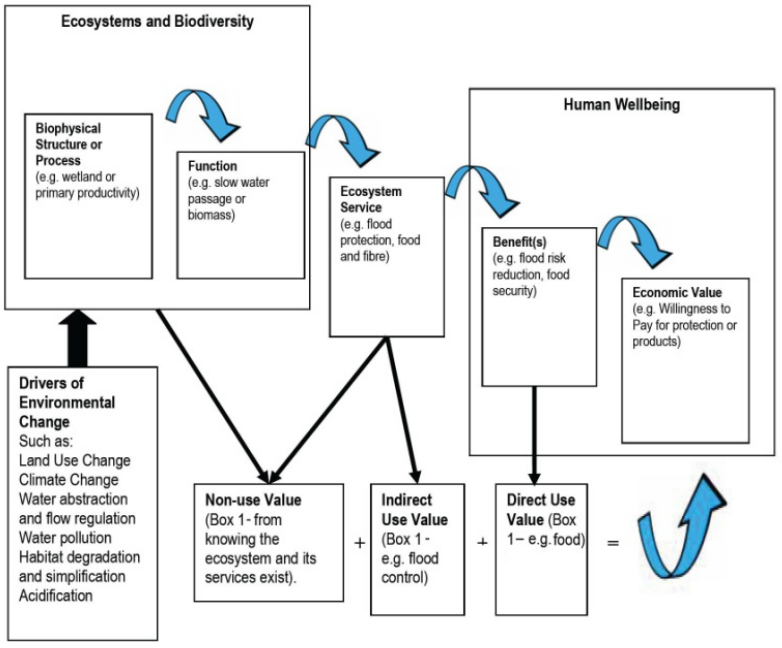
- Ecosystems in the UK are managed to provide desired levels of specific benefits, such as the provision of food and fibre, to meet human needs. However, other benefits from ecosystems important to human wellbeing do not have a market value.
- If economic values are placed on different benefits from ecosystem services, such as flood protection, they can alter the way ecosystems are managed through the planning system and other decision making frameworks that affect natural resource use.
- Valuation techniques on their own will not provide sufficient understanding to make 'wise' decisions about managing natural resources.
- They may, however, contribute towards the development of new markets and payments schemes for the provision of ecosystems services to compensate those forgoing benefits to maintain delivery of others.

Background

The concept of ecosystem services is helpful in understanding the links between human wellbeing and ecosystems. This based on making a distinction between the ecosystem interactions that give rise to a flow of benefits, such as soil stabilisation and pollination, and a particular aspect of human well-being, such as food security (POSTnote 378 and Figure 1). A number of recent reports, such as the Millennium Ecosystem Assessment and The Economics of Ecosystems and Biodiversity (TEEB), have highlighted the declining capacity of ecosystems to sustain ecosystem services, increasing risks to future human wellbeing.[1]

Ecosystem services are indirectly paid for if the benefit is a tangible material product, such as food or timber, which is traded (an "ecosystem good").[2] However, most benefits from ecosystem services are an improvement in the condition or location of things of value to human wellbeing (public benefits), rather than directly traded products. For example, if a tree sapling is sold, it could be grown to harvest the timber, to offset the carbon emissions of the purchaser or for the appreciation of its beauty in a garden.

Figure 1.The Relationship Between Ecosystems and Human Wellbeing[3]



For the first of these options, the benefit is realised as a material product; for the second, the benefit is derived via regulating ecosystem services; for the third, the primary benefit is in terms of cultural ecosystem services. Some benefits arising such as recreational opportunities from improving a garden are less straightforward to determine.

The UK National Ecosystem Assessment, to be published in June, has refined value transfer methods for placing monetary values on many benefits provided by the natural environment. It will also clarify the links between ecosystem services and human needs in the UK and will highlight the point that if present market approaches continue they may not deliver the best outcomes for society. Without intervention, markets may fail to allocate sufficient resources to maintain the provision of ecosystem services, despite the benefit to society as a whole, due to the 'public nature' of the benefits (POSTnote 376).

Role of Valuation

For the most part, policy decision-making processes take account only of traded goods, for example, the market price of land or the value of crops it will produce. They ignore the value of the majority of ecosystem services that will be altered by land use change. The valuation of benefits enables decision-makers to place a value on changes in services that are not captured by markets (Box 1).

Box 1 Total Economic Valuation

The Total Economic Value (TEV) conceptual framework views ecosystem goods and services as the flows of benefits to humans. Values are assessed through the ways in which ecosystem services support people's own consumption (use values) and provide intangible human benefits (non-use values).

Use Values

Use values (Figure 1) can be sub-divided into direct use value and indirect-use value:

- Direct use values arise from human use of natural resource systems, including extractive use such as timber or fisheries and non-extractive use such as tourism and recreation.
- Indirect use values result from the regulatory or supporting ecological processes that contribute to the ecosystem services giving rise to benefits. For example, processes occurring in wetlands remove excess nutrients, improve water quality and provide flood protection through retaining water.

Non-use values

Non-use values (Figure 1) do not involve direct interaction between humans and ecosystems and include:

- altruistic values, derived from knowing that *others* can enjoy the goods and services from ecosystems
- bequest values, associated with knowing that ecosystems are passed on intact to future generations
- existence values, arising from the knowledge the ecosystem and its services continue to exist
- option values, the benefit from the security of knowing that an ecosystem is being preserved for possible but unforeseen future uses, such as a species with possible pharmaceutical applications.

Valuation is not intended to displace the broader factors already present in environmental decision-making frameworks, and most commentators agree that its application to ecosystem services should be regarded as a complementary, rather than sole, component in decision-making. However, valuation can be used to:

- Understand the contribution that an ecosystem makes to an area and the dependencies between the different ecosystem services arising from it.
- Determine whether a policy intervention is justified and any losses or gains in ecosystem service benefits.
- The costs and benefits for different stakeholders from how an ecosystem is managed.
- Justify the need for financial resources to sustain, restore or enhance ecosystem services.[4]

Valuation Methodologies

There is an extensive literature on various valuation methods (Box 2), the contexts in which they are applied and their limitations.[5] The NEA, in line with other ecosystem service valuation frameworks such as TEEB, classifies and values the benefits arising from ecosystem services, rather than the ecosystem services themselves to avoid double counting of the 'means and the ends' (POSTnote 377). It is neither practicable nor necessary to produce an economic valuation study for every policy decision and methods have been developed to make the best use of existing benefit valuation studies within decision-making.

Box 2 Deriving Values for Ecosystem Service Benefits

Economic, deliberative and participatory methodologies are used to try to reveal use values of ecosystem service benefits. These attempt to establish either individuals' willingness to pay (WTP) for an ecosystem service (or to avoid its degradation) or willingness to accept (WTA) compensation for any degradation (or for forgoing an improvement or restoration of an ecosystem service). Five main sets of methodologies are employed, which will be appropriate depending on the application and data available:

- Market prices, which can be used to estimate the value of ecosystem goods that are traded in formal markets, such as timber or fish. The prices need to be adjusted for any environmental market distortions, as they are a price, not a value
- Cost methods, based on the cost of damage caused by the loss of an ecosystem service, or expenditure to prevent that damage, or the cost of replacing the ecosystem service altogether. These do not assess the welfare impact of gains or losses and hence provide estimates of 'value' in the same way revealed or stated preference methods can.
- Revealed preference methods, based on observed behaviour. For example, values are estimated from proxies such as the cost and number of recreational visits or differences in property values;
- Stated preference methods. An example is surveys to determine people's willingness to pay for ecosystem services in hypothetical markets.
- Deliberative and participatory valuation methods. These include group-based deliberative monetary valuation and citizens' juries.

Values for the many ecosystem services that are not directly traded in markets must be derived through the last three sets of approaches, and non-use values can be determined only through stated preference methods. These often require extensive time, skills and data, and the findings can be disputed. However, as the number of robust primary valuation studies of ecosystem services grows, it is feasible to transfer these estimates to assess values in other situations. New insights on how humans value items beyond their market price are arising from disciplines such psychology and neuroscience, in combination with behavioural economics. These approaches are seeking to provide a better understanding of how values are constructed and change in response to different circumstances and external factors, (such as perceptions of threat or opportunity), how they vary with knowledge and experience, and how they are constructed by individuals or groups working collectively.[4]

Challenges to Using Ecosystem Service Valuation

The scale and relative importance of ecosystem services to society has yet to be fully determined. There is scientific uncertainty about how ecosystem interactions should be categorised and defined, as reflected by the lack of agreement on definitions of ecosystem services. In

identifying what constitutes an ecosystem service, understanding of spatial characteristics and societal values is as important as knowing the structure and dynamics of ecological processes (POSTnote 377).[5] For example, carbon sequestration is global, while other services, like pollination (POSTnote 348), depend on proximity, and can be used at source, or 'flow' to a different point of use.[6]

Critics of valuation question whether the true future economic consequences of the loss of any ecosystem service provision can be anticipated with any confidence. The capacity to deliver an ecosystem service exists independently of whether its benefits are used. However, humans will value benefits from ecosystem services differently in different places at different times. These values vary significantly with people's awareness of background issues, cultural norms and status. Furthermore, it is widely recognised that valuation of ecosystem services is highly context specific and should be guided by the perspectives and requirements of the beneficiaries within these contexts.

There is also a need to distinguish clearly between benefits and values, because different groups may place different values on benefits. For example, agricultural ecosystems can provide biodiversity, carbon storage, food provisioning, cultural and recreational benefits which diverse groups may value differently and these values will also differ over time in response to other factors. They also differ geographically, with the cultural importance of the outcome of particular agricultural practices, (such as upland hay meadows in the northern Pennines) being valued more highly by society than food production in that area. [5]

The values attached to benefits from ecosystem services are subjective and variable over time, space and issue. The diversity of the attitudes, preferences and values that people hold can pose problems in applying valuation techniques to decision-making that seek to aggregate the diversity into a single or a small number of metrics. Consequently, the use of some methods remains contentious. Valuation works for tangible benefits like water quality or reduced flood risk, where people hold well formed and stable preferences, but for others like biodiversity it may not.

Some commentators suggest that the subjective and ephemeral nature of ecosystem service values held by different groups could also potentially conflict with the society-wide aggregation and 'impartial nature' of economic analysis and governance structures acting in the national interest. Use of economic valuations could reinforce the dominance of a small number of ecosystem services over the rest.

In addition, the difficulties in making a spatially explicit quantification of ecosystem service benefits, which allows identification the suppliers and users of ecosystem service benefits, are cited. Wherever possible, valuation should be spatially and temporally explicit at scales meaningful for policy, as the ecosystem services giving rise to benefits are specific to areas and occur over differing time scales.

For example, a Cost Benefit Analysis (CBA) using ecosystem service valuation to compare multi-purpose woodland creation with the current agricultural grassland, has shown that the benefits from an increase in woodland cover, substituting for sheep grazing, would be greater than the costs in many parts of Wales. The analysis also showed that existing forests are not optimally located to fulfil their potential. The ideal places would be adjacent to population centres, as the closer it is the more people will use and therefore value a forest.[7]

A recent review has concluded that there is scope for better guidance on the selection, design and application of the different methods, and a need to include tests for rigour and robustness of the analysis and results.[4] The Natural Environment Research Council has set up the interdisciplinary "Valuing Nature Network", as part of the "Living with Environmental Change" project, to address these issues and to provide the necessary standard of evidence and advice required by decision makers.

Policy Uses of Valuation Evidence

All ecosystems deliver a broad range of services, some of which have particular economic or social value. However, many ecosystem services are either undervalued, or have no value, in current decision making frameworks, although crucial to human well-being.[1] For example, a forest can:

- be a major store of carbon, helping to regulate climate
- be a resource for industry in the form of fibre or fuel
- prevent loss of soil and nutrients, flooding and avalanches
- play a role in the water cycle, ensuring cycling of water vapour back to the atmosphere
- provide a location for recreational activities.

Most of the benefits above tend to be undersupplied, due to the emphasis on provisioning services from which land managers can secure market returns, in this case timber as a resource for industry.

Policies tend to take more account of shorter term and more localised private gains of benefits (such as increased agricultural productivity from wetland drainage) than longer term and more distant loss of public benefits (such as increased risk of flooding and decreased water quality). If an ecosystem is managed primarily to deliver one ecosystem service, such as a provisioning service, this may reduce levels of other ecosystem services supported by the ecosystem.

For example, a forest managed exclusively for timber production may have less recreational value, store less carbon and be less effective at retaining nutrients. The role of economic analysis in environmental policy is to determine where a change in practices or policies may be in the wider public interest. Public benefits from regulating and supporting ecosystem services over a long-term horizon, such as climate regulation or flood alleviation, have frequently not been accounted for in such analysis.

Valuation of ecosystem service benefits is one means of incorporating their consideration in decision making. For example, South West Water is restoring the natural water storage ability of upland ecosystems and reinstating river habitats by reducing damage from agriculture to halt water quality deterioration, to reduce water treatment costs and to provide flood protection through a £8.8million programme of

projects. When assessed over 30 years period, the value of benefits that will arise from the programme were estimated to be cost-effective for water consumers and to sustain water supplies in the long-term.[8]

However, no single approach, such as valuation, is likely to provide sufficient understanding of the relationships between services and how best to manage their interaction. A whole toolbox of approaches will be needed, such as participatory methods (POSTnote 377), to provide a wider array of inputs and understandings of the numerous and diverse values held by stakeholders in decision-making.

Cost Benefit Analysis

Economic analysis, in the form of CBA, is the most frequently used policy decision support tool for quantifying trade-offs between economic benefits and environmental and social losses. The 'right' decision in economic analysis has a precise meaning: a decision that, on the whole, has more benefits to society than costs. There is an extensive academic literature on the effectiveness of CBA and alternative economic analysis tools.

CBA is used to set out the relative merits of alternative policy approaches when advising ministers in the UK, in accordance with the principles set out by the HM Treasury.[9] A recent example of ecosystem service valuation being used for policy impact assessment was for the 2009 Marine and Coastal Access Act. This used the economic value of marine ecosystems to inform the CBA of the impact of proposed measures, such as marine spatial planning and marine conservation zones, contained in the Act.

CBA was developed to help to make decisions between similar projects, (e.g. infrastructure projects), to inform decisions about how resources are allocated and investments made. However, it is not usually used at the strategic level, and the economic valuations relate to the impact of marginal environmental changes, such as the costs of small changes in air quality due to a policy decision to expand an airport. Although this decision might be insignificant when assessed in isolation, it could be important when evaluated in the context of the cumulative effect of all past, present, and reasonably foreseeable future activities that may have, or have had, an impact on air quality.

CBA and economic valuation of marginal changes are not generally regarded as being best-suited to determining whether large scale, long-term environmental risks, such as the possible exceedence of environmental limits, should be managed, but rather to reveal the most cost effective means of mitigating an environmental risk. The use of discount rates within CBA for long term environmental impacts over long time scales is a contentious issue.[1]

Loss of Benefits and Compensation

Both private and public costs and benefits are generated by ecosystem services. These occur over a range of temporal and spatial scales and can be associated with a variety of property rights and other institutional arrangements. They are likely to be unequally distributed, with the gainers and losers from any environmental change varying depending on the type and scale of ecosystem service provision, the mix of stakeholders involved, the economic characteristics and the cultural context.

A given benefit has the value of what humans are willing to pay or forgo to have it, which can be used in economic analysis to quantify the value of the loss of benefits from a decision. The transparency of decision-making may be increased by attaching an appropriate value to ensure that any loss of benefits is acknowledged within decision-making or management frameworks.

Monetary compensation to the losers from changes in the delivery of ecosystem service benefits would be one possible policy response. For example, at present, water companies are restricted to paying for 'capital works' to be undertaken, but in the next Periodic Review of Water Companies (PR14), proposals will be made to allow them to make payments to landowners for changes in land management above water companies principal water sources.

Compensation could also be provided in the form of the recreation or restoration of habitat elsewhere to deliver ecosystem services. For example, where conflicts arise in ecosystem service provision and management, 'compensation in kind', such as land swaps (of land with the same value or size**)** could be provided to users who have to make sacrifices to provide benefits to others. However, although there are established frameworks for 'offsetting' biodiversity loss through the creation of alternative sites and other forms of compensation, methodologies for offsetting ecosystem services have yet to be developed (POSTnote 369).

Not all sites will deliver the same level of provision of ecosystem service delivery. For example, under current ecosystem service valuation frameworks, sites near high levels of population density, such as the Barnes Wetland Centre in London, may provide higher levels of cultural benefits (such as use value, Box 1) than remote sites, such as Antarctica (which may provide higher benefits as in terms of non-use values, Box 1). Other habitats in Britain, such as ancient woodland or chalk grassland are so rare, unique or locally specific that valuation is not applicable and recreation of compensatory habitat is not possible within relevant time scales.

Endnotes

1 POST long report 370.February 2011. *Living with Environmental Limits*.
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6 Constanza, R, 2008, *Biological Conservation* 141:350-352
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