Integrating Environmental Services within Decision Making

"The implementation of national strategies for sustainable development in all countries by 2005, so as to ensure that current trends in the loss of environmental resources are effectively reversed at both global and national levels by 2015"

International Development Target for the environment[1]

"… despite the many successful and continuing efforts of the international community since the Stockholm Conference and the fact that some progress has been achieved, the environment and natural resource base that support life on earth continue to deteriorate at an alarming rate."

UN General Assembly Decision on Rio+10, 20 December 2000[2].

Building on Rio: Ensuring Action for Change

Given the recognised continuing deterioration of the world's natural resources, there is an urgent need for further integration of the environment within decision-making processes. Clearly, we are far from achieving the goal of sustainability outlined at Rio. Integrating concepts of ***environmental services*** within development is an important part of this process and will enable a more holistic approach to sustainable development. Indeed, this is essential if international development targets are to be reached and if trends in the loss of environmental resources are to be reversed.

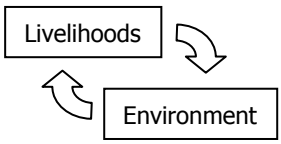
Donor institutions, including DFID[1] and the World Bank Group[3], have initiated strategies that identify mechanisms to address the international concerns of poverty and the environment. Following on from the Rio Environment Summit, the subsequent focus on sustainable development, and the OECD International Development Targets, these mechanisms promote environmental sustainability and regeneration via national strategies of sustainable development[4].

Key areas to be addressed within the strategies include an understanding of ***ecological functions,*** how they relate to poverty through ***environmental services***, and how this knowledge can be used to improve decision making at individual, local, national, regional and global level.

In response to this fundamental concern, a working group, co-ordinated by the Centre for Sustainable Development within the Natural Resources Institute, has set out to explore the issues of practical integration of environmental services within decision-making processes.

Environmental Services – A Focus of Concern

Environmental Services comprise the benefits provided, by ecosystems, through ecological functions, that are used to sustain human livelihoods. Examples include soil fertility, water supplies and CO_2 sinks, and also the goods (such as extracted resources) resulting from these services. In the context of this paper we consider the pressures on people that result from the loss or instability of environmental services. We also consider the potential for enhancing the delivery of goods and services through a more informed approach towards environmental services.



Inadequate incorporation of environmental services as a concept in the decision making process has already contributed to a loss of these services and to consequent environmental degradation. This in turn has led to increased competition for remaining resources and often to conflict, in which the poor are frequently the most vulnerable and hardest hit.

Figure 1 indicates the central role of environmental services in decision-making, and identifies key interrelated components.

A recent study[5] showed that degraded soils, dried-out aquifers, polluted waters and the conversion of natural forest to agricultural land seriously threaten potential world food supplies. The same study found that depletion of soil organic matter (SOM) is widespread, reducing fertility, moisture retention, and increasing CO_2 emissions.

Good land use practices can rebuild SOM levels – illustrating the value to be gained from maintaining environmental services. Other examples of loss of environmental services include the clearance of mangroves with subsequent coastal erosion and reduced fisheries productivity. These types of losses typically affect marginal and exposed communities but also have much wider implications.

Core themes for understanding Environmental Services, discussed first in this paper are:

- The dependency of livelihoods on environmental services
- The complexity of interrelationships between ecological functions and environmental services, and
- The encompassing dimensions of space, time and institutions

These themes focus on the loss or maintenance of ecological functions and environmental services. They also point to the need to cope with complexity within a decision-making framework, to evaluate institutional entry points, alternatives and trade-offs, and to the importance of building the precautionary principle into decision-making. Key aspects of decision-making discussed here are:

- The changing approaches to valuation of environmental services
- The decision making process: bridging disciplines, seeking consensus;
- Implementing the precautionary principle.

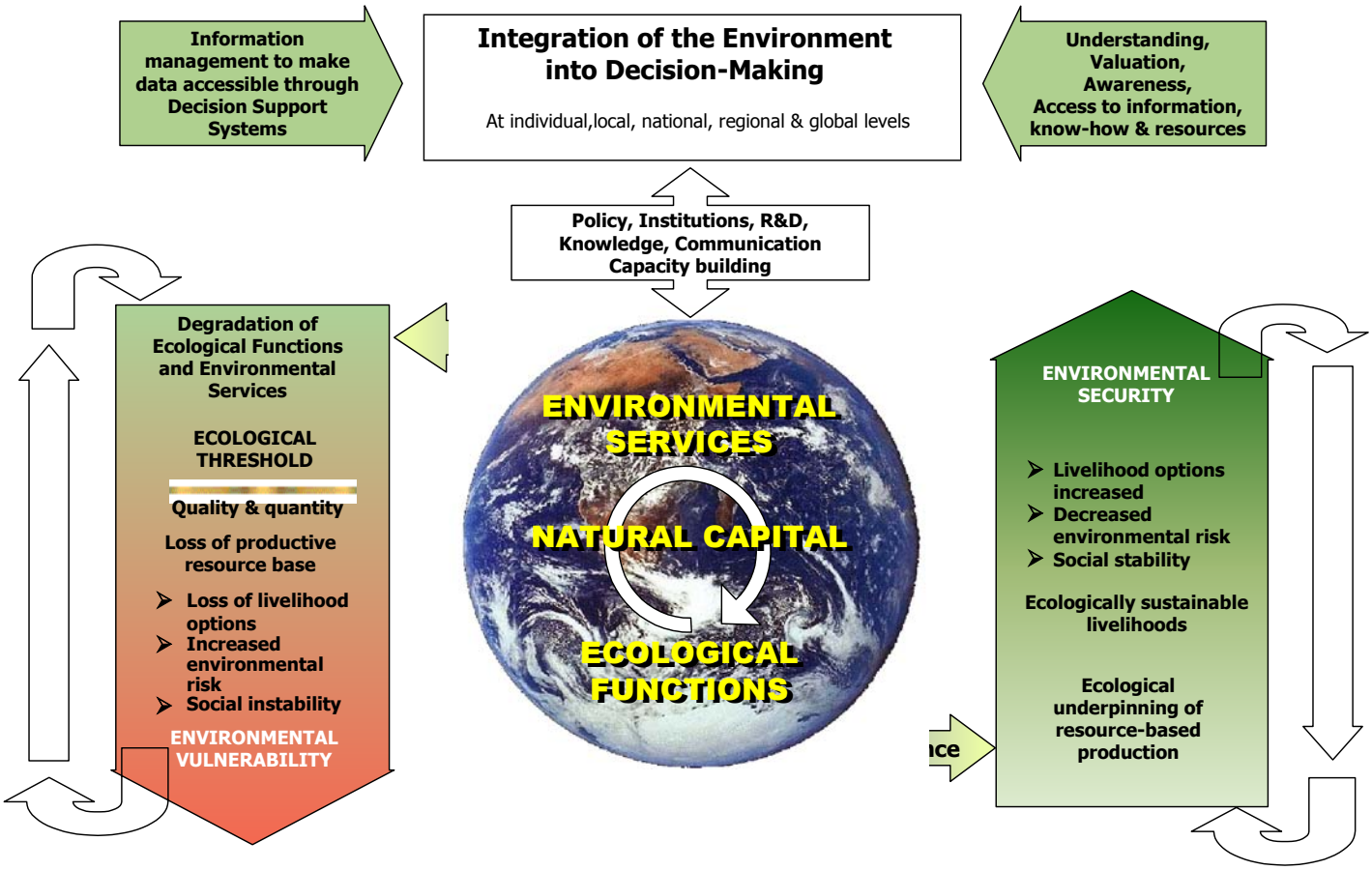


Figure 1. Environmental services in decision making and sustainable livelihoods

Core Themes for Understanding Environmental Services

The dependency of livelihoods on environmental services

All human life depends on environmental services. This dependency is often more direct for the rural poor in developing countries, being more exposed to environmental influences and utilising many forms of natural capital for their livelihoods. To maintain the sustainability of livelihoods it is important to identify the driving forces, pressures and impacts that multiple use has on environmental services. It is therefore essential to examine in detail the nature of the relationships between "environmental security" and social context.

How are people dependent on environmental services, and how are they vulnerable to their loss or degradation?

Environmental security as a term means different things to different disciplines. Here we use it to mean the state resulting from sustainable access to required natural resources and the environmental goods and services they provide to support sustainable livelihoods. These services may be found at individual, farm, local, landscape, regional and global levels.

The corollary of environmental security is "environmental vulnerability". In this context environmental vulnerability is seen as the overall social/economic/environmental state cascading from the unsustainable use of environmental services and over-exploitation of the underlying ecosystem, leading to degradation of basic ecological functions and to loss of environmental services. Once critical thresholds are breached, this is likely to lead, unless rapid corrective or restorative actions are taken, to a loss of the productive resource base and to competition and conflict over dwindling natural resources. In turn such changes may also result in social instability and constrained livelihood options, often of the poor and those most dependent on natural resources. Ultimately, all humans are affected, although the loss of environmental services hits the poor hardest.

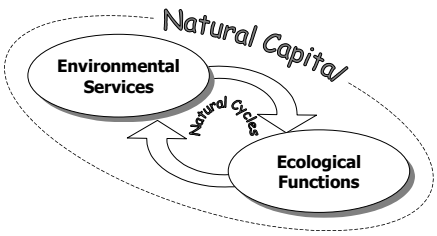
The complexity of interrelationships between ecological functions and environmental services

The need to protect the integrity of ecological functions is increasingly critical. The interrelationships between human, manufactured and natural resources and any changes that may result from them are complex. Resource systems, or their individual components, may adjust to these changes and continue to function effectively or at times may even improve. However, a majority of examples illustrate reduced production from natural resources as a result of impaired ecological functions.

How can one measure the integrity of ecological functions? Can critical thresholds for support and maintenance of environmental services be identified?

An important issue is the lack of knowledge and understanding of the manner in which external or internal influences can change individual components of the system. In a practical way, this understanding also needs to be widely disseminated and to be translated into the form of decision support systems.

There may be threshold values beyond which a system cannot recover or ceases to function (even with benefit of human intervention) or "flips" to a new state. Removal of a "keystone" species may disrupt food chains – perhaps resulting in, say, unpredicted and exorbitant costs for control of newly emergent pest species. An example relates to the export of frogs from Bangladesh. Between 1977 and 1989 Bangladesh exported frogs to a growing western market, reaching 50 million per year by 1988, earning $10.5 million in foreign exchange. By eating paddy-field pests frogs performed an essential environmental service not recognised in their market value. By 1989, when an export ban was introduced, the frog population had fallen dramatically and farmers were importing $30 million worth of petro-chemical products annually – with further long-term environmental repercussions. Within a year of banning these exports, frog populations began to rebound and pesticide imports dropped by 30-40 percent. Indonesia has now become a major exporter of frog's legs.



While such relationships and values are researched, there is a need to simultaneously define criteria and indicators to guide resource use, and assist in policy formulation. Knowledge is required, and even more so its dissemination and practical use, of the probabilities underlying the concepts of risk, insurance, and environmental security in relation to various thresholds and the fundamental ecological functions that underpin those vital services essential to sustain livelihoods (see 'Implementing the Precautionary Principle' below).

The encompassing dimensions of space, time and institutions

There is a parallel need to understand the complex set of interactions and flows between resources and people over time, space, and institutional levels, and to understand the multiple decisions that shape these interactions.

What scales of interaction do we need to take into account, both in space and time? How can current decisions incorporate the needs of future generations?

An obvious dimension in the sustainable development debate is that of time: balancing *inter*generational equity with *intra*generational equity, assuring the long term needs of future generations are met, while at the same time balancing the short term needs of different stakeholders in the present, especially of the poorest. This also brings in a spatial dimension. Balancing the needs of present populations implies an understanding of the interactions not only of different groups of people in different areas on a social and political basis, but also through separated populations affecting each other through ecosystem interactions.

Decisions are addressed at levels ranging from local to global. Local implementation may either conflict with or compliment wider global policies. Both in turn may be driven by changes in global economics. Different levels of institutions take different types decisions, often relating to areas of jurisdiction, which may, but mostly do not coincide with ecosystem boundaries. There is also a dimension of time lag between the problems being identified, the decisions made, and the effects of those decisions being felt, which has to be taken into account. Obviously, the more decision levels there are, the longer it will take before, for example, climate change can be addressed.

A key role for science is to identify realistic, practical and simple measures that can encapsulate and make understandable the complex relations – yet at the same time promote a more holistic understanding which integrates ecological functions and environmental services. The "Ecological Footprint" concept goes part of the way towards providing an accumulated picture of a unit of "impact" of an individual or nation on comparable scales. In this concept, effects and interactions taking place elsewhere, say through the effect of trade, can be incorporated into an indicator or index capable of influencing policies. These and other indices have an important role to play in policy guidance and decision support systems, and are the subject of the next section.

Key Aspects for Integrating Environmental Services into Decision-making

The changing approaches to valuation of environmental services

A full and realistic valuation of environmental services is vital if they are to be considered adequately alongside economic, political and social criteria in policy formulation and decision-making. Traditional valuation methodologies such as cost-benefit analysis (CBA) have not been successful in capturing environmental values. Attempts have been made to extend CBA and other valuation methodologies to better incorporate environmental concerns, but with varying degrees of success. A major complicating factor is the subjective nature of the task - individuals and cultures have contrasting perceptions of the value of particular services. Values may also be strongly dependent on time scales. Below are two areas of debate linked to valuation.

How do we value environmental services - considering their complexity as well as their often largely non-economic values?

What degree of uncertainty in information (the precautionary principle) can be accounted for within the decision-making process?

Weak – vs – Strong Sustainability

Current thinking focuses on the ability to substitute between the economy and the environment or between natural and manufactured capital – a debate captured by the concept of 'weak – vs – strong' sustainability, and the extent to which substitution over time might be equated with "mining the environment". If sustainability depends on the maintenance of capital, an important issue is whether the total capital must be maintained – with substitution allowed between its components – or whether these components, particularly natural capital, are non-substitutable and must individually be maintained. In other words, to what extent does natural capital, and the environmental services that it provides, contribute to livelihoods in a way that is unique and cannot be replicated by other capital components? Attempts to substitute for such unique contributions will inevitably lead to a decreased ability to support livelihoods.

Weak sustainability captures sustainability in largely economic terms, with the perception that sustainability can be achieved by maximum substitution between different forms of capital. Strong sustainability, on the other hand, results from a more holistic perspective and the perception that there are serious limitations such as irreversibility, critical components and thresholds, which result in a unique contribution from natural capital. While there is a considerable challenge in putting an increased emphasis on the latter, the question lies not in whether it should be done, but in how to do it and how to adapt present systems of decision-making.

From Environmental Economics to Ecological Economics

The field of ecological economics represents an attempt to base decisions on a holistic and sustainable footing and in so doing claims to be better at promoting sustainability. To understand ecological economics it is useful to consider the central concepts of neo-classical environmental economics, its contradictions and shortcomings. Similarly, in order to more clearly understand the importance and place for valuation of environmental services and ecological functions, it is necessary to consider the background and development of the ecological economics framework. Table 1 contrasts the basic tenets of environmental and ecological economics.

In particular, an important theme within environmental economics is that measurable units are recognised as almost the only the legitimate source of values. In contrast, ecological economics tends to be multi-disciplinary and employs a much wider range of value definitions.

The most innovative valuation methodologies attempt to combine traditional economic analysis with participatory techniques, so as to achieve mutually acceptable values that are not necessarily financial. Although few would argue that any economic valuation methodology can confidently capture the true value of environmental services without a measure of uncertainty, it remains the case that valuation is still the policy-maker's instrument of choice. This in turn raises interesting questions about applicability and potential of non-economic methods of valuation such as citizens' juries as well as issues of access/barriers to information and the practical limits of participation. The question of "whose value" also arises. For example, a central tenet of contingent valuation, the "willingness to pay", has obvious congruence with "ability to pay". Are local opinions of most value, or are some issues of such importance that global policy-makers need to assign value themselves? Equity is also an important consideration.

Table 1 Basic tenets of environmental economics and ecological economics compared

	Environmental Economics	**Ecological Economics**
Approach	Allocation of resource use	Scale, distribution and allocation of resource use
Source of Values	Measurable units, assigned by "experts"	Attempts to be holistic and inclusive
World-view	Mechanistic, reductive	Evolutionary, holistic
Knowledge acquisition process	Positivist – intended to be value free	Subjectivist, reflecting values and ideology
Disciplinary base	Mono-disciplinary (economics only)	Multi-disciplinary (economics, ecology, evolution, with some sociology)
Perception of scarcity	Relative	Absolute
View of the future	Technological optimism	Prudent pessimism, Attempts to incorporate sustainability
Problem solving	Based on the "market system"	Based on the "laws of nature"
Focus / time scale	Short-term (weak sustainability)	Long-term (strong sustainability)
Primary methods of evaluation	Cost Benefit Analysis and related tools	Environmental Impact Statements, Positional analysis, Carrying capacity
Dominant Theme	Anthropocentric	Anthropocentric with attempts to include biocentric and ecocentric considerations

Source: Adapted from Tacconi (2000)[6].

The decision making process: bridging disciplines, seeking consensus

How can one integrate environmental services within decision-making systems? What instruments can be used to support these processes?

Few concrete and lasting achievements can be expected in the absence of a holistic viewpoint that recognises uncertainty and incorporates environmental services and multiple stakeholders from the outset. Decisions require guidance based on principles, criteria, indicators, policies, and regulations that are relevant to the maintenance of environmental services. Once a choice has been made, a heirarchy of strategic, tactical and operational plans require to be developed and implemented, and must be monitored so as to provide the feedback required within an adaptive process. The process of improved decision making is thus both cyclical and iterative – with feedback designed to improve future decision making.

Key concerns for understanding ecological services involve the bridging of disciplines in order to support this process – ecology, evolution, economics, sociology, politics – as well as philosophical and cultural points of view. This is partly accomplished through support for National Strategies for Sustainable Development (nssd)[7] which merge disciplines and sectors so as to focus on the overall balance of short and long term needs. Other key areas are the inclusion of civil society in decision making, community and resource user groups who have most at stake and perhaps a strong, but at times highly biased understanding of the resources, and NGOs with their ability to short-cut and catalyse new processes. Consensus building processes are therefore key, and trade-off mechanisms for fair and open decisions between difficult decisions are needed.

Implementing the precautionary principle

How can potentially damaging resource exploitation be limited until it can be demonstrated that risks are within acceptable limits? How can decision-makers be made aware of, and act on, such uncertainties?

The core themes explored above relate to increased knowledge and understanding of the issues surrounding environmental services. It is, however, important to realise that decisions are being made without the information needed in order to make a truly informed decision. It must also be recognised that answers to many key questions are currently not available.

Many governments have already signed up to the precautionary principle. As defined in the Rio declaration, this states that where there are threats of serious or irreversible damage, lack of full scientific certainty shall not be used as a reason for postponing cost-effective measures to prevent environmental degradation. A more liberal interpretation is that "when in doubt about the impact of development, manage according to the worst-case scenario of its effect upon the environment". Politically, the principle (even in its more conservative guise) has proved difficult to apply and is in practice ignored in most countries. However, the recent statement issued by the General assembly of the UN (highlighted at the beginning of this document), makes it clear that more stringent enactment of the precautionary principle is urgently required.

Where decision-makers receive only subjective and perhaps biased or conflicting advice, then emphasis on the precautionary principle needs to be highlighted and the possible scenarios of not adopting it explored. A clear outline of options will enable decision-makers to face this issue in a realistic manner and perhaps help to turn around the present rate of environmental degradation.

Emerging Areas of Research and Development

As these environmental challenges continue, their impacts on the potential escalation of conflicts are of concern to policy-makers. It is increasingly recognised that environmental stresses, brought about by a failure to recognise the importance of fundamental ecological functions and environmental services, pose a potential threat to security at all geographic levels. However, until now and despite this recognition, the potential benefits of maintaining ecological functions have not gained the necessary recognition or support at political or policy levels. The discussion in this paper illustrates the urgent need for improved and easily accessed decision support systems to provide information that will enable decision makers to cope with the increasing complexity imposed by the often opposing forces of development and environmental sustainability. These complexities also give rise to emerging areas where research is needed that can can guide and inform decision-making:

- Identification of key or critical environmental services for the most vulnerable sectors of society, including present generations and future stakeholders, and those services over which conflicts are likely to arise. At the same time it is also important to identify the potential for these resources to improve livelihoods.

- Improved understanding and dissemination of information on ecological functions, why and how they are important.
- Improved understanding and mechanisms for quantification of key thresholds for the wide range of ecological functions underpinning environmental services.
- The generation of indicators and indices for the condition and value of ecological functions and environmental services.
- Identification of indicators and indices required to facilitate the use of the precautionary principle and to account for the closely related issues of environmental and social vulnerability.
- Research, promotion, dissemination and utilisation of techniques of valuation, including more holistic approaches than those in current general use.
- Understanding of the extent to which artificial ecosystems or manufactured resources can substitute for natural ecosystems in providing environmental services.
- Identification of best practice so as to develop guidelines, present background information, provide valuation and other tools within structured and open access decision support systems. Such systems need to be accessible to policy makers, at low cost, and be available as generic tools capable of being adapted to local circumstances - with local examples, case studies and win-win scenarios. The use of Internet based decision support systems or "Toolboxes" will enable the development of a holistic approach towards the incorporation of environmental services within decision making.

These areas of research are crucial for informed decision-making in relation to environmental services. However, the future will judge present decision-makers on their success in turning round current rates of environmental degradation before irrevocable damage is done. Whilst we have an incomplete knowledge of critical thresholds for ecological functions, or of the key environmental services, and are unable to value these services adequately, wise and firm use of the precautionary principle towards the environment in all areas of policy may prove to be the only practical means of achieving this.

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March 2001

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1 DFID, (2000). Achieving sustainability: poverty elimination and the environment. http://www.dfid.gov.uk/public/what/pdf/tsp_environment.pdf. Accessed 20/11/00.

2 Ten-year review of progress achieved in the implementation of the outcome of the United Nations Conference on Environment and Development. http://www.un.org/rio+10/web_pages/resolution.htm. Accessed 22/02/01.

3 World Bank Group, 2000. Towards an Environmental Strategy for the World Bank Group. Progress report and discussion draft

4 The next round of Rio conferences, Rio+10, or "World Summit on Sustainable Development", due to be held in South Africa in 2002, will focus on national strategies for sustainable development.

5 Wood, S., Sebastian, K. & Scherr, S.J. (2000) Pilot Analysis of Global Ecosystems, Agroecosystems. International Food Policy Research Institute and World Resources Institute, Washington D.C. http://www.wri.org/wr2000/agroecosystems_page.html. Accessed 14/2/01.

6 Tacconi, L. (2000) Biodiversity and ecological economics: participation, values and resource management. Earthscan. London.

7 See http://www.nssd.net