

ECOSYSTEM APPROACH: FROM PRINCIPLE TO PRACTICE

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SUMMARY

The ecosystem approach is not a static model but is a holistic process for integrating and delivering in a balanced way the three objectives of the Convention on Biological Diversity: conservation and sustainable use of biodiversity and equitable sharing of the benefits.

The ecosystem approach is not a substitution for the traditional approach to conservation such as emphasis on single species, rarities or protected areas which remain essential parts of the delivery mechanism for biodiversity conservation. The need for a wider approach arises at least in part because of the deficiencies of 'classical' approaches to conserve biodiversity and natural resources as evidenced by the unprecedented rate of species extinction and increasing conflict over natural resource use. Such historic limitations include failure to recognise the importance of ecosystem functioning in providing important goods and services for people as well as wildlife involving multiple sectoral interests and stakeholders participation in management, inappropriate division of costs and benefits resulting from ecosystems and the inadequate links between nature and culture.

Recently considerable effort has been directed at clarifying the meaning of 'ecosystem approach' and defining the underlying principles or elements that should guide its *modus operandi*. Some of these elements, when defined broadly meet general approval e.g. *inter alia*.

- ◆ *There is no single or unique ecosystem approach.*
- ◆ *The final goals of the approaches acknowledge human participation and interests.*
- ◆ *Emphasis is on maintaining the interactions within and functioning of natural systems.*
- ◆ *The approach may be applied over a wide range of scales.*

An important next step to further clarification and agreement of the use of an ecosystem approach is to identify cases where it is already being implemented on the ground. From an analysis of the successes and failures of these cases, it should be possible to identify the value and scope of an ecosystem approach in implementing the Convention's objectives. A considerable number of such 'case studies' have been compiled already, and some analysis of these has been prepared, but these are by no means regionally or nationally comprehensive.

It is necessary for as many countries as possible to provide what experience they have in implementing what they perceive as adopting an ecosystem approach and to give their views on how applicable they are and what constraints operate in their context. We need to make sure an analysis of these experiences is shared with other parties of the Convention, and can lead to better guidance on when and how to use an ecosystem approach under the Convention.

Already some of the lessons learnt include the importance in many instances of a non-prescriptive approach and new non-statutory organisations for effective implementation on the ground; a close working relationship with local people, guidance and support measures based on demonstration of practical, simple techniques at the appropriate scale. The potential economic benefits to individuals from better ecosystem management are important incentives for applying methods which will also maintain or restore biodiversity.

In order to effect implementation we need:

At the management level: Involvement of many actors to ensure (i) Integrating scientists into decision making, (ii) linking ecosystem functions to socio-economics and (iii) cross-sectoral institutional integration or new institutional mechanisms.

At the science level: a better understanding of structure, function and processes, as well as temporal and spatial dynamics, and the effects of different management scenarios and natural change of ecosystems.

At the social level we need to evaluate the alternative means for redistributing costs and benefits particularly in relation to externalities such as subsidies; new environmental

incentives and non-regulatory as well as regulatory mechanisms.

There is a new way of thinking about biodiversity conservation and management that is encapsulated in the CBD. The ecosystem approach is vital for meeting this new challenge. Thinking still needs to be advanced at three levels: conceptual and technical (especially application); regional and national guidance; constraints on implementation. There are key roles for the CBD Secretariat, the contracting parties and the scientific community and technical networks.

Keywords biodiversity conservation, ecosystem approach, equitable benefit sharing, IUCN, species extinction, sustainable use

INTRODUCTION

The Convention on Biological Diversity has adopted and has continued to emphasise the importance of "ecosystem approach" in delivering its three key objectives: conservation of biological diversity, sustainable use of its components, fair and equitable sharing of benefits arising out of the use of genetic resources (Article 1). Yet there is still substantial confusion and misunderstanding as to the precise meaning of the term and underlying concept. The scientific debate has been examined recently by Yaffee (1999) who considered that the confusion arose in part because people interpret it from at least three different perspectives: an anthropocentric perspective, a resource management or biocentric perspective and an ecoregional or ecocentric perspective. As far as the implementation of the Convention is concerned there are still many who interpret the concept as looking at Biodiversity on a biome basis or as an approach which simply includes all biodiversity within particular geographical units. Considerable effort has been devoted since 1995 at clarifying the meaning of "ecosystem approach" and defining the underlying "principles" or "elements" that should guide its *modus operandii*. (Table 1).

Table 1. Chronology of the CBD process and external fora exemplifying key steps in development of an ecosystem approach under the CBD.

SBSTTA1 (Paris, 1995)	<ul style="list-style-type: none">● Recommendation I/3: Recommends that a holistic approach be taken towards conservation and sustainable use of biological diversity and that the Ecosystem Approach should be the primary framework for action taken.
COP2 (Jakarta, 1995)	<ul style="list-style-type: none">● Decision II/8: Reaffirms that the Ecosystem Approach should be the primary framework of action taken.
SBSTTA2 (Montreal, 1996)	<ul style="list-style-type: none">● Recommendation II/1: Advocated regional or Ecosystem Approaches to the development of guidelines and indicators and identified certain priority tasks.
COP3 (Buenos Aires, 1996)	<ul style="list-style-type: none">● Decision III/10 & SBSTTA3 (Montreal, 1996) Recommendation III/5, Recommendation III/7 Annex 3: : Endorsed II/1 (above) and outlined work in thematic areas and indicators.
The Keystone National Policy Dialogue on Ecosystem Management (Colorado, 1996)	<ul style="list-style-type: none">● Policy recommendations for facilitating implementation including use of market-based tools; streamlining government decision-making

processes, reforming proposed tax laws, addressing statutory barriers and strengthening the science base.

Sibthorp(IUCN) Seminar (London 1996)

- Questions conventional thinking and traditional approaches to conservation and sustainable development. Distils 10 Principles of Ecosystem Management.

COP4 (Bratislava, 1998)

- Decision IV/1B: For SBSTTA to develop principles and other guidance on the Ecosystem Approach and report to COP V.

Malawi Workshop (Government of Malawi/Netherlands and CBD Secretariat,1998)

- Distils 12 Principles that build on the output from the Sibthorp Seminar and elsewhere and introduces new elements. Analysis presented - UNEP/CBD/COP4/Inf.9

Isle of Vilm (German Federal Agency for Nature Conservation,1998)

- Examination of the European Context. Participants proposed a set of priority actions for implementation of the Ecosystem Approach to key target audiences.

IUCN, Commission on Ecosystem Management, Technical meeting on the Ecosystem Approach (UNESCO/CBD) (Costa Rica, 1999)

- Participants stressed the importance of pilot projects in demonstrating the approach and the feedback of scientific research to stakeholders.

Workshop on Integrated Planning at different scales: Policy & Practice (Scottish Natural Heritage/IUCN UK Committee Perth, 1999)

- The importance of removing perverse incentives and market distortions for the future implementation of the Ecosystem Approach was stressed.

Trondheim Meeting (Norway/UN Conference on Ecosystem Approach and Biodiversity., September 1999)

- Broad consensus that the Ecosystem Approach including adaptive management is the most appropriate framework to achieve the optimum balance of the Conventions objectives.

The principles of “Ecosystem Approach” have been recognised as a significant foundation for both thematic areas as well as cross-cutting issues of the Convention process. In addition to the formal CBD decisions and recommendations the Ecosystem Approach has been extensively debated at international workshops in Malawi, Germany, Scotland, Costa Rica and, most recently now, in Norway. Several hundred technical experts have thus had an opportunity of contributing to the debate now crystallising under the framework of the Convention.

DEFINITION

Numerous attempts have been made to explain the meaning of the ecosystem approach and it is useful to cite the definition of the United States Interagency Ecosystem Management Task Force (1995) and the description independently agreed to in Malawi (1998) (Table 2). A key point is that the ecosystem approach is not a static model but is a holistic process for integrating and delivering in a balanced way the three key objectives of the Convention on Biological Diversity: conservation and sustainable use of biodiversity together with equitable sharing of the resulting benefits.

Table 2. Defining the Ecosystem Approach

Definition (1995)	Description (1998)
The ecosystem approach is a method for sustaining or restoring natural systems and their functions and values. It is goal driven, and is based on a collaboratively developed vision of desired future conditions that integrates ecological, economic and social factors. It is applied within a geographic framework defined primarily by ecological boundaries. (<i>Report of the Interagency Ecosystem Management Task Force, 1995</i>)	The ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organisation that encompasses the essential processes and interactions among organisations and their environment. The ecosystem approach recognises that humans are an integral component of ecosystems. (<i>Report of the Workshop on the Ecosystem Approach, Lilongwe, Malawi, 1998</i>)

PRINCIPLES, ELEMENTS, FEATURES

There has been considerable interest in identifying principles that might underpin the ecosystem approach. The so-called Malawi Principles drew significantly on earlier thinking of those involved in formulation of the Convention as well as the "Sibthorp Principles" developed from a scientific workshop some 18 months earlier, Table 3 (Maltby, 1999, annex 1).

Table 3. Comparison of Sibthorp and Malawi "Principles" (Maltby E. et al., 1999, UNEP/CBD/COP4/INF.9, 1998)

Sibthorp 1996 (Ecosystem Management Workshop)	Malawi 1998 (Ecosystem approach workshop)
Guiding Principles	12 Principles
Management objectives are a matter of social choice	Management objectives are a matter of societal choice
Ecosystems must be managed in a human context	Management should be decentralised to the lowest appropriate level Recognizing potential gains from management there is a need to understand the ecosystem in an economic context. The ecosystem approach should involve all relevant sectors of society and scientific disciplines.
Ecosystems must be managed within natural limits	Ecosystems must be managed within the limits to their functioning
Management must recognise that change is inevitable	Management must recognize that change is inevitable.
Ecosystem management must be undertaken at the appropriate scale, and conservation must use the full range of protected areas.	The ecosystem approach should be undertaken at the appropriate scale.
Operational Principles	
Ecosystem management needs to think globally but act locally	Ecosystem managers should consider the effects (actual or potential) of their activities on adjacent and other ecosystems.
Ecosystem management must seek to maintain or enhance ecosystem structure and functioning	A key feature of the ecosystem approach includes conservation of ecosystem structure and functioning.
Managers must act with caution	Recognizing the varying temporal scales and lag effects which characterize ecosystem processes, objectives for ecosystem management should be set for the long term. The ecosystem approach should seek the appropriate balance between conservation and use of biological diversity.
A multi-disciplinary approach is needed. Decision-makers should use appropriate tools derived from science.	The ecosystem approach should consider all forms of relevant information, including scientific and indigenous and local knowledge, innovations and practices.

Comparison of the Sibthorp and Malawi principles confirms considerable overlap between the concepts of "ecosystem management" and "ecosystem approach". It is, however, important to realise an essential distinction. Ecosystem Management may have a strong sectoral purpose and may be recognised in human terms as good, bad, or neutral (such as the debate that might surround the management of a lake for a particular fish species, overall biodiversity, recreation or water supply). Such judgement may change over time and also as a result of environmental or ecological changes (Maltby, in press). An "ecosystem approach" however, represents not only a clearly defined vision of desired future conditions but is also a distinctive process intended to integrate ecological, economic and social factors and balance the three overall objectives of the CBD.

The principles underpinning the ecosystem approach reflect concerns over the shortcomings of traditional nature conservation approaches in protecting biodiversity. These were discussed in Malawi and include lack of sufficient consideration of issues such as:

- ecosystem resilience
- ecosystem process
- ecosystem boundaries
- multiple equilibria
- variable spatial scales
- variable time scales
- resident human populations
- ecosystem services

The ecosystem approach is a response to making good such limitations that inevitably result from concentration on single species, rarities or uniqueness and protected areas, all key elements of traditional conservation methodology. The approach however, is not a substitute for such traditional approaches which are still essential tools in the conservation armoury.

Debate in Bratislava, Vilm and Perth has questioned the suitability of retaining the term "Principles" in view of the fact that they are not equally applicable in all contexts and certainly may not adequately reflect important regional or national characteristics. Instead it may be better to regard them as "elements" which describe the ecosystem approach and promote the elaboration of more country or regionally-specific principles

and/or guidelines on which to base practical application.

At least five salient points emerge from the technical discussions to date:

- 1) there is no single or unique ecosystem approach
- 2) it is either explicit or implicit that the final goal of the approach acknowledges human participation and interests
- 3) emphasis is on the interactions within and functioning of natural systems.
- 4) the approach may be applied over a wide range of scales
- 5) there may be many instances and experiences of applying an ecosystem approach without it ever being referred to in those terms.

We should regard the ecosystem approach as a holistic methodology or "process" to better integrate the biodiversity agenda.

CLARIFICATION

There is still much potential for confusion among contracting parties as to the meaning and means of application of an "ecosystem approach" to deliver the objectives of the Convention.

In practical terms it is important now to transform the idea from a conceptual framework to operational guidance. There are a number of dimensions to this which would support a more robust strategy for implementation: general guidance; guidance in relation to specific biomes, regions and national context; guidance on key scientific and technical queries; lessons from experiences and case studies. Examples are given below of the sort of guidance required for implementation in a European context (Table 4).

Table 4. Examples of guidance required for implementation of an Ecosystem Approach in a European context. (Maltby, 1999).

1. Defining the constraints to adopting an Ecosystem Approach

- Market/economic distortions (agriculture)
- Conflicting traditional social practices e.g. fishing, peat-cutting
- Natural forces of change (climate, sea-level)
- economic/social development (technological change, desire for higher level of living)
- Existing land use constraints (e.g. settlements)

2. Identify alternative mechanisms to remove constraints on adoption

- Redistribution of costs and benefits to better reflect the efforts of management
- Agricultural subsidies review

- New environmental incentives to promote positive actions
- Regulatory mechanisms to reduce damaging impacts

3. Develop Implementation Strategy (at different scales, regional contexts, and range of specific objectives)

- Engage Stakeholders
- Awareness and Capacity Building
- Use of Examples
- Link Policy to the requirements for delivering an ecosystem approach
- Support from European Commission R&D to develop appropriate tools and protocols.

To date technical discussions have drawn more heavily on experts from some geographical areas and disciplines than others. Yet it is recognised that applicability of the approach will vary between countries and it may be difficult to reach an agreement on a universal definition or principles. Many countries simply may not have the capacity or resources to implement the approach.

IMPLEMENTATION

There are at least three main requirements to achieve a significant step from concept and principles to operational practice.

GUIDANCE

Further development of the ecosystem approach needs to be discussed among a wider geographical and disciplinary audience. The process of consultation would be a key ingredient in awareness and consensus building. It is essential that the wider regional consultation should not be restricted to the academic or natural science community. As well as technical expertise it is essential to engage policy-makers and those with access to natural-resource stakeholders as well as stakeholders themselves. There needs to be stronger involvement than hitherto by environmental economists, and public and social policy analysts. Guidance is required in a number of key areas which include:

- Science and technical issues e.g. relationships between ecosystem structure, processes and functioning and of the part played by biodiversity; economic and social value of ecosystem functioning.
- Regional/national approaches e.g. need for country-specific approaches
- Delivery mechanisms e.g. lessons from case studies; how to mobilise/integrate

existing institutional mechanisms or develop entirely innovative institutional structures or decision-making protocols.

EXPERIENCES

There is an increasing wealth of relevant experience available from various case studies (see Meynell & Pirot, 1998; Maltby et al 1999; Korn H. et al, 1999, Crofts R.S, Maltby E., Safford L., in press).

Distillation and analysis of the lessons learnt can contribute significantly in the practical application of an ecosystem approach by others. It is necessary for as many countries as possible to promote what experience they have in implementing what they perceive as adopting an ecosystem approach and to give their views on how applicable they are and what problems have had to be overcome. Such experiences also need to be shared with other parties to the Convention.

CONSTRAINTS

The Ecosystem Approach places emphasis on our total natural resource base in an integrated, holistic model that is neither spatially constrained nor necessarily (or easily) linked to formal, traditional conservation organisations or agency structures. The integration of social and economic dimensions with ecology and natural resource management is still more conceptual than practically orientated. Science, society and government are all sectorally organised and institutional structures (both government as well as non-governmental) reflect this. There are daunting organisational constraints in the practising of an ecosystem approach. It is doubtful whether we can ever dismantle the sectoral structures currently in place. Instead we need to determine protocols and enabling mechanisms for cross cutting bodies to deliver the objectives of the CBD through appropriate participatory processes, adaptive management and partnerships. These in essence will comprise the "ecosystem approach". Successful implementation will depend on the ability of societies to take a more flexible position on policies as wide ranging as trade and subsidy, taxation and consumption, agriculture and environmental protection. It will depend also on countries actually having the resources to apply the ecosystem approach.

CASE STUDY - SOME LESSONS LEARNT

The Tamar 2000 SUPPORT (sustainable practices project on the river Tamar) is a pathfinder project in the South West of England which works closely with farmers, riparian owners and the wider community to develop and implement, sustainable land management practices. (Maltby et al 1999, Maltby, 1999, Rickard, in press). The overall aim is to restore and conserve environmental quality for both people and wildlife while delivering economic gains. Previous attempts to restore environmental quality have generally failed because they have lacked the appropriate scale, have not integrated diverse sectoral interests and in particular have not engaged fully the local people. The approach of Tamar 2000 has attempted to rectify these shortcomings by providing a coordinated, integrated, large-scale, practical and on-going demonstration of what can be achieved by applying techniques already proven at a smaller scale. The basic tool for implementation is an integrated farm and river-based management plan. The project, although funded substantially from government and European Union sources, is coordinated by a voluntary trust- the West Country Rivers Trust, in partnership with technical experts and in close cooperation with statutory bodies and commercial interests. Key lessons learnt from the successful implementation of Tamar 2000 include:

- 1) The importance of an implementing body independent of statutory and regulatory agencies of government in building the confidence and securing the engagement of landowners and farmers by means of a non-prescriptive, volunteer approach.
- 2) The significance of actions that also result in economic benefits as well as advantages to biodiversity and environmental quality.
- 3) The value of one to one personal contact in delivery of objectives and of demonstration and competitive adoption of practices when landowners see the success of neighbours.

Such lessons have already been of value in the development of similar approaches in other parts of the country and clearly have application elsewhere in Europe and possibly more widely.

THE WAY AHEAD

The "ecosystem approach" provides us with an emerging new paradigm for implementing the CBD. It deals with delivery of the multiple objectives of the CBD to

which traditional approaches to nature management contribute only in part. Converting the concept into practice is a major challenge and will only occur if there are clear advantages over existing approaches. The advantages and limitations/ constraints of the ecosystem approach need to be explored regionally and with the widest possible practical consultation involving technical experts, managers, and policy-makers. The Trondheim conference provides a further stepping stone in a process of development gaining momentum under the auspices of the Convention. Yet successful operationalisation of ecosystem approaches depends fundamentally on the commitment and willingness of nation states. Therein lies the greatest challenge especially for those where biodiversity conservation already is viewed as an ill-affordable luxury. The international scientific and aid communities need to recognise the opportunity this provides for assistance with potentially high returns not only for the global gene pool but also human welfare.

Annex 1 Principles and Rationale for Ecosystem Management, Consequence for Management, and Recommended Actions for Implementation of an "Ecosystem Approach"(Prepared for the Malawi workshop by Safford L. & Maltby E, see also Maltby, 1999)

Principle and Rationale	Consequence for management	Recommended Action for implementation
<p>1. Management objectives are a matter of social choice</p> <p>Those societies who are dependent on an ecosystem will want to manage the ecosystem to meet both their present and future political, economic, cultural and social needs.</p> <p>Both local, national, regional and global societies may be dependent on an ecosystem</p>	<p>Successful ecosystem management must:</p> <ul style="list-style-type: none"> a) balance the potentially conflicting demands of different interest groups, b) balance the needs of present societies with the need to maintain the potential of the ecosystem to provide for future generations. c) take account of the likely political, legal, economic, social, cultural and ecological implications of the various management options to achieve those goals. 	<ol style="list-style-type: none"> 1. The goals of ecosystem management in a region should be decided through dialogue between all interested parties (including private owners of resources), and especially the area's inhabitants. Goals may be dominated by local concerns and needs but global implications must be recognised. 2. Independent expert advice should be obtained on the likely political, legal, economic, social, cultural and ecological implications of the various management options to achieve agreed goals. 3. Risk assessment and cost benefit analysis studies on the management options should be performed by independent experts. These should include, where possible, political, legal, economic, social, cultural and ecological factors. 4. Methods of comparing economic costs and benefits with cultural and social costs and benefits need to be developed. 5. The expert advice and analysis should be presented to all interested parties (or their representatives) in an understandable and accessible format. 6. A management option should only be decided on after further discussion of the expert advice, risk assessment and cost benefit analysis by interested parties
<p>2. Ecosystems must be managed in a human context.</p> <p>Human activity is usually the key factor driving change within ecosystems and social choice will determine the objectives of management plans.</p>	<p>As human activity is determined by economic and political pressures, management goals must be compliant with the economic and political position of the region.</p> <p>Conservation of Biological diversity and Sustainable use of natural resources must be accepted as essential to, rather than in competition with, the long term provision of human requirements.</p>	<ol style="list-style-type: none"> 1. Management plans must take into account who is to manage a particular area and its component ecosystems, and ensure management decisions fit the wider political process. 2. Protected areas must be integrated into ecosystem management plans which aim to harness the human demand for natural resources to conserve biodiversity. For example, through programmes like the CAMPFIRE (Communal Areas Management Programme For Indigenous Resources) in Zimbabwe. To this end protected area managers may need retraining in sustainable methods of resource use.

		<p>3. Within their wider strategies and policies, countries should develop systems of protected areas, using the full range of IUCN categories, rather than networks of highly protected parks and reserves</p>
<p>3. Ecosystems must be managed within natural limits</p> <p>Management objectives which capitalise on the natural productivity of the ecosystem will be the most easily obtainable.</p>	<p>In considering the likelihood or ease of obtaining the management objectives, consideration must be given to both the local and global ecological framework surrounding the area to be managed, and how dependent the objectives are on temporary, unreliable natural conditions, or artificially maintained conditions.</p>	<p>1. In the development of an ecosystem management plan expert independent advice should be obtained on the likelihood and practicality of having to artificially maintain conditions to achieve the management objectives.</p> <p>2. Further research is needed on the methodology of determining both (a) and (b).</p>
<p>4. Management must recognise that change is inevitable</p> <p>The ecological nature of ecosystems, and the social, cultural, political and economic nature of the human populations dependent on them are constantly changing.</p>	<p>Management should aim to conserve options for development rather than necessarily preserve ecosystems in their current state.</p> <p>Management must be adapted to and accommodate expected change in habitat conditions (notably climate and hydrology) rather than obstructing it.</p> <p>Management must be adapted to and accommodate expected change in the political, economic, social and cultural nature of the human populations dependent on the ecosystem.</p> <p>Management may need to include sustainable action to enable society to tolerate the new conditions. For example, the introduction or reintroduction of appropriate species, the reorganisation of resource use.</p> <p>Management objectives must be developed using the precautionary principle. That is management decisions should recognise that advice is based on imperfect knowledge, and always built in a safety margin in to ensure maintenance of essential environmental services.</p>	<p>1. Expert independent advice should be obtained on;</p> <p>a) the probability of change in ecological, political, economic, social and cultural conditions.</p> <p>b) what impact these changes could have on the biodiversity and environmental services of the ecosystem, and the human populations dependent on them.</p> <p>c) What sustainable action would be required to mitigate unacceptable changes</p> <p>d) What affect these changes would have on the chances of or effort involved in achieving the management objectives.</p> <p>e) whether achieving the objectives would constrain the number of management options for the ecosystem in the future.</p> <p>2. Management objectives must be determined in the light of the above advice and on the assumption that changes and the accompanying consequences will be more, rather than less extreme than estimated.</p>
<p>5. Ecosystem management must be undertaken at the appropriate scale.</p> <p>Management actions within one component area of an ecosystem (e. g a forest) can impact on other areas beyond the areas boundaries (e.g. a coral reef) because ecological processes (e.g. water movement) connect them.</p>	<p>Management plans must be developed on a sufficiently large geographic scale to take into account large scale processes which can affect or be affected by the outcome of management actions. For example, drainage basins. However when the underlying aquifer does not coincide with the surface river basin, and groundwater plays a significant role, a group of basins overlying an aquifer may constitute</p>	<p>1. In the development of management plans</p> <p>a) the large scale ecological processes relevant to the proposed management plan for that area should be identified together with those areas linked by these processes and likely to be affected by or affect the management objectives.</p> <p>2. Resource managers representing areas of an ecosystem linked by such processes should</p>

	<p>the appropriate unit of water resource management.</p> <p>Management plans to tackle issues of air quality, such as acid rain, must encompass both source areas (for example industries in UK or Germany) and affected areas (such as affected river basins in Scandinavia)</p> <p>Management plans need to ensure that the management objectives of component areas are compatible with one another, and taken together ensure the best sustainable and equitable use of resources within the ecosystem.</p>	<p>a) discuss the objectives of management actions within each component area</p> <p>b) discuss how the processes and management actions of any one area will affect those processes and actions taken in others, and</p> <p>c) define management objectives that are not compatible, unsustainable or unequitable, and discuss alternative strategies.</p> <p>3. Research is needed to increase detailed understanding of the sizes of the unit that are necessary for effective ecosystem management.</p> <p>4. Research is needed into methods for assessing the benefits of alternative management strategies (for example of managing a forest for timber, by rotational harvest or for multi-purpose extraction of non-timber forest products, or for ecotourism, or - as an extreme case - by replacing the forest by cultivation or pasture).</p>
<p>6. Ecosystem management needs to think globally but act locally</p> <p>The ultimate scale of ecosystem management is global, since all components of the earth's system are interrelated. Policies for ecosystem management may be developed by intergovernmental panels at a global or regional scale. However, ecosystem management has to be implemented at a national and local scale.</p>	<p>Implementation means willing local participation. Management plans must support, and be supported by local people, national regional and global policy, in that order of priority.</p> <p>Local people, national, and regional policy makers need to be aware of the impact of their activities on one another and on the global community.</p> <p>Global policy frameworks need to be linked to national and local actions</p>	<p>Management plans must:</p> <ol style="list-style-type: none"> 1. support good local social conditions, for example security of land tenure or the alleviation of poverty. 2. ensure local communities have the capacity to care for their own resources sustainably 3. ensure the linkage between local, national, regional and global processes is understood and disseminated at each level of social structure. 4. ensure good communication between different levels of social structure.
<p>7. Ecosystem management must seek to maintain or enhance ecosystem structure and functioning</p> <p>The physical, chemical and biological components of ecosystems perform processes which together determine the structure and function of an ecosystem, and hence the environmental services the ecosystem can provide, and the support it can give to both human and wildlife populations (both locally and distally). Changes in the components of the ecosystem lead to changes in the support it can provide in the present and future.</p>	<p>Management must ensure that human activities do not reduce the ecosystem's ability to provide these services, that is damage structure and function.</p>	<ol style="list-style-type: none"> 1. Those involved in implementing the management must appreciate the role components of the ecosystem play in determining the goods and services the ecosystem supplies and understand that human welfare and the structure and functioning of ecosystems are interdependent 2. Further research and education is required on <ol style="list-style-type: none"> a) the linkage between ecosystem processes, functions, goods and services, especially the role of micro-organisms in functioning b) the political, social, cultural, economic and ecological value of ecosystem structure and function. 3. Management plans should incorporate monitoring of the key components of an ecosystem, in order to detect changes in the ecosystem which could impact on structure and function

		<p>and hence management goals.</p> <ol style="list-style-type: none"> 4. Monitoring requires the identification of indicators and criteria to assess: <ol style="list-style-type: none"> a) the structural and functional status of an ecosystem. b) the success or failure of management practices and achievability of management objectives. 5. Guidelines are required to enable decision makers and managers to manage ecosystem functioning, especially to recognise critical conditions before they become irreversible. 6. Guidelines are required to enable decision makers and managers for restoring degraded ecosystem functioning is particularly urgent
<p>8. Decision-makers should use appropriate tools derived from science Ultimately, physical, chemical and biological processes determine whether or not management goals are achieved. Ecosystem management plans must therefore be based on a scientific understanding of these processes. The challenge is to distil the understanding into guiding tools for ecosystem managers. The use of the concept of Critical loads (the maximum input of a pollutant that an ecosystem can tolerate without undergoing a significant degenerative change) is a good example making ecological theory applicable by practical ecosystem managers</p>	<p>The most recent fundamental scientific knowledge . needs to be distilled and translated for practical application by decision makers and ecosystem managers, especially in respect of maintaining ecosystem functioning.</p> <p>Procedures for assessing wetland functions interpret the role of naturally occurring ecosystem processes in maintaining vital functions and developing indicators that can be used by decision-makers to assess (i) overall functioning of the ecosystem, (ii) a particular function of interest, and (iii) the effect of specific impacts on the system or individual features of it. In collaboration with potential users, this concept could be extended to other ecosystems, but it is essential that development is in dialogue with potential users.</p>	<p>Mechanisms for distilling and translating scientific knowledge for practical application need to be developed, especially in respect of ecosystem functioning.</p> <p>Monitoring of the ecosystems and the effects of management must feed back into future practices and policy decisions.</p> <p>Practical guidelines for managers on how to keep pollutants within bounds useful e.g. Forestry methods to reduce impacts of acid rain</p>
<p>9. Managers must act with caution We can not and never will be able to predict the exact consequences of any management action. Consequently, a precautionary approach should be adopted by managers to minimise the risk of loss or degradation of ecosystem characteristics.</p>	<p>The “polluter pays” principle should be adopted and generalised to cover all resource use. Behaving in a risk-averse manner may avoid losses or unacceptable risks, achieve equity among user groups and between generations, and make use sustainable.</p> <p>Ecosystem managers must be willing and able to amend management policies and practices as often and as quickly as necessary, this must include the willingness to abandon concepts and to admit mistakes</p>	<p>Scientists must characterise risk and uncertainty in terms that lay people can understand, differentiating carefully between fact and judgement.</p> <p>Policy makers should not ask for firm conclusions where the facts do not support them, or distort scientific results to suit preferred policy objectives</p> <p>The precautionary approach should be developed in relation to the maintenance of ecosystem functioning.</p> <p>Areas of high diversity and high functional significance (e.g. natural resources, fisheries production, erosion control) should be targeted for conservation resources.</p> <p>The management process must be fully accountable to all stakeholders and should continually undergo biological, social and economic appraisal</p>

<p>10. A multi-disciplinary approach is needed</p> <p>It is critical that inter-sector, interagency collaboration is established on all aspects of planning and implementation of projects, including problem analysis, project design, data collection, analysis and modelling, policy development, management and enforcement, monitoring and evaluation.</p>	<p>These teams need to address a wide range of sectoral topics including population dynamics, natural resources quality modelling, irrigation, health problems, natural resources plant, fish, herding, legislation, training, and participatory rural appraisal. In addition there will be many cross-sectoral issues, such as development of a geographical information system to overlay various spatial data sets, equitable allocation of resources, development of community participation in resource management, establishment and running of authorities to co-ordinate planning and management</p>	<p>Ecosystem managers should construct Inter-disciplinary teams including hydrologists, natural resources engineers, biologists, agriculturists, foresters, physicists, pedologists, planners, human and animal health experts, ecologists, sociologists, demographers and legal experts. Other specialisms should not be excluded where a relevant contribution can be made.</p> <p>There is a need to develop effective mechanisms for interaction between different disciplines in the social decision process. Some techniques for community decision-making, conflict resolution and the like offer prospects here. It is clearly important to enhance cost effectiveness, using economics and commerce as well as science</p> <p>Links between conservation and development need to be strengthened, so that improvements in welfare are sustainable ecologically and integrated with sound ecosystem management.</p>
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