Secretariat
of the Convention on
Biological Diversity

CBD Technical Series No. 14

INTEGRATED MARINE AND COASTAL AREA MANAGEMENT (IMCAM) APPROACHES FOR IMPLEMENTING THE CONVENTION ON BIOLOGICAL DIVERSITY

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INTEGRATED MARINE AND COASTAL AREA MANAGEMENT (IMCAM) APPROACHES FOR IMPLEMENTING THE CONVENTION ON BIOLOGICAL DIVERSITY

Compiled by:
AIDEnvironment
National Institute for Coastal and Marine Management / RIKZ
Coastal Zone Management Centre, the Netherlands

January 2004

Published by the Secretariat of the Convention on Biological Diversity. ISBN: 92-807-2409-6

Citation
AIDEnvironment, National Institute for Coastal and Marine Management/Rijksinstituut voor Kust en Zee (RIKZ), Coastal Zone Management Centre, the Netherlands.(2004). Integrated Marine and Coastal Area Management (IMCAM) approaches for implementing the Convention on Biological Diversity. Montreal, Canada: Secretariat of the Convention on Biological Diversity. (CBD Technical Series no. 14).

For further information, please contact:
Secretariat of the Convention
on Biological Diversity
World Trade Centre
393 St. Jacques Street, suite 300
Montreal, Quebec, Canada H2Y 1N9
Phone: 1 (514) 288 2220
Fax: 1 (514) 288 6588
E-mail: secretariat@biodiv.org
Website: http://www.biodiv.org

The Secretariat gratefully acknowledges the financial assistance of the Government of the Netherlands for the publication of this volume

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FOREWORD

The programme of work on marine and coastal biodiversity under the Convention on Biological Diversity aims to assist the implementation of the Convention at the national, regional and global levels. It identifies operational objectives and priority activities within five key programme elements, namely: implementation of integrated marine and coastal area management, marine and coastal living resources, marine and coastal protected areas, mariculture, and alien species and genotypes.

Integrated marine and coastal area management (IMCAM) is a participatory process for decision making to prevent, control, or mitigate adverse impacts from human activities in the marine and coastal environment, and to contribute to the restoration of degraded coastal areas. IMCAM approaches have been recognized as the most effective tools for implementing the Convention on Biological Diversity with respect to conservation and sustainable use of marine and coastal biodiversity. This acceptance of the effectiveness of IMCAM was already evident at the second meeting of the Conference of the Parties, where, in decision II/10, the Parties encouraged the use of IMCAM as the most suitable framework for addressing human impacts on marine and coastal biological diversity and for promoting conservation and sustainable use of this biodiversity. Subsequently, the fourth meeting of the Conference of the Parties adopted IMCAM as the first of the five key programme elements of the programme of work, and the fifth meeting endorsed further work on developing guidelines for coastal areas, taking into account the ecosystem approach, the main framework for action under the Convention. Most recently, the Convention's Subsidiary Body on Scientific, Technical and Technological Advice (SBSTTA) at its eighth meeting, in March 2003, recommended that an effective marine and coastal biodiversity management framework would comprise of sustainable management practices and actions to protect biodiversity over the wider marine and coastal environment, as well as of an integrated marine and coastal protected areas (MCPA) network (SBSTTA recommendation VIII/3 B).

Although the effectiveness of IMCAM is accepted within the Convention process, existing IMCAM guidance documents and practices often fail to take biodiversity considerations fully into account. The present document seeks to fill this gap by providing practical guidance on integrating IMCAM practices and those under the Convention, and represents the culmination of a series of activities undertaken by the Government of the Netherlands to that end. It is the result of an extended participatory process with contributions from numerous practitioners and policy makers working with IMCAM approaches and the Convention on Biological Diversity. A six-week online discussion was held to identify priority needs and issues from all over the world. The outcome of the online discussion provided the groundwork for the further elaboration of four themes: ecosystem approach, indicators, restoration of habitats, and incentives. This document is a synthesis of the online discussion and the work of the assigned specialists and aims to provide a tangible and pragmatic input to further the implementation of the Convention on Biological Diversity in marine and coastal areas.

I am confident that the information contained in this document can provide invaluable assistance as the Parties to the Convention strive to achieve their target of significantly reducing the rate of biodiversity loss by the year 2010.

I wish to thank all those individuals and institutions who have contributed to the completion of this technical report.

Hamdallah Zedan
Executive Secretary

ACKNOWLEDGEMENTS

The Secretariat of the Convention on Biological Diversity wishes to acknowledge with appreciation the editors of this document: AIDEnvironment and the National Institute for Coastal Management (Netherlands)/RIKZ Coastal Zone Management Centre, as well as the Government of the Netherlands for funding this work, including the publication of this document. In addition, the Secretariat and the editors of this document would like to express their gratitude to the specialists who elaborated on the four main themes in this document. They are, in alphabetical order, Peter Burbridge, Lucy Emerton, Pippa Gravestock, Yves Henocque, Jan Joost Kessler, Jake Rice, Lida Pet Soede, Martin Le Tissier and Paula Warren. Thanks also go to the many people that contributed to the online web discussion. Their valuable contributions resulted in the backbone of this document and provided interesting case studies and examples.

The Secretariat would like to thank the staff of RIKZ and AIDEnvironment who provided assistance and advice during the whole process of the online discussion and the preparation of the guidance document itself: Joris Geurts van Kessel, Riny Heijdendael, Saa Kabuta, Josine Kelling, Marinka Kiezebrink, Rolf Kleef, Robin Pistorius, Maarten Scheffers, Janette Worm and Carien van Zwol.

We also would also like to acknowledge the staff of UNEP Coordination Office for the Global Programme of Action for the Protection of the Marine Environment from Land-based Activities (UNEP/GPA), Wetlands International, EUCC—the Coastal Union, the Secretariat of the Convention on Wetlands (Ramsar, Iran, 1971) and the Secretariat of the Convention on Biological Diversity for their support and helpful suggestions.

Finally, the Secretariat of the Convention on Biological Diversity, RIKZ and AIDEnvironment would like to thank DG Water of the Dutch Ministry of Transport, Public Works and Water Management for providing financial assistance to make the participatory process and the publication of this report possible.

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1. GENERAL INTRODUCTION

1.1 BACKGROUND

The Convention on Biological Diversity (CBD), the first global agreement on the conservation and sustainable use of biological diversity, has three main goals:

1. the conservation of biodiversity,
2. sustainable use of the components of biodiversity, and
3. sharing the benefits arising from the commercial and other utilisation of genetic resources in a fair and equitable way.

The Conference of Parties of the CBD initiated work on five thematic work programmes, including marine and coastal biodiversity. The oceans cover 70 per cent of the planet's surface area and marine and coastal environments contain diverse habitats that support an abundance of marine life. Examples of marine and coastal communities include mangroves, coral reefs, sea grasses, algae, pelagic or open-ocean communities and deep-sea communities. A large percentage of the global community is directly or indirectly dependent on coastal zones for their livelihood.

In view of their common concern for the conservation and sustainable use of marine and coastal biodiversity, the Parties to the Convention on Biological Diversity agreed on a programme of action for marine issues, focusing on integrated marine and coastal area management, the sustainable use of living resources, protected areas, mariculture and alien species.

Integrated marine and coastal area management approaches (such as IMCAM, ICM and ICZM) are recognised as the most effective tools for implementing the CBD with respect to the conservation and sustainable use of marine and coastal biodiversity. In spite of this common agreement, it is still a challenge to find the right balance between biodiversity conservation and the sustainable use of its components. The relevance and applicability of existing IMCAM instruments for the implementation of the Convention has not been clarified. Existing IMCAM guidance documents and IMCAM practices often fail to take biodiversity considerations fully into account. The potential of ICZM for maintaining and enhancing marine biodiversity has yet to be realised.

1.2 THE WAY FORWARD

In 2001 the Dutch government initiated a consultative and participatory process aimed at producing practical guidance for better incorporating CBD elements into both the design and implementation phases of IMCAM projects. A preliminary review of numerous IMCAM documents and three case studies on IMCAM projects was conducted in 2001 (see Box 1). This analysis was based on a set of criteria inferred from the objectives and provisions of the Convention on Biological Diversity and Decisions by the CBD Conferences of Parties. Box 1 provides a review of IMCAM literature with numerous strategies that can be considered as 'success factors' enabling fuller integration of CBD objectives into the IMCAM programmes.

The literature review revealed several specific topics that required further guidance:

- Elaboration and operationalisation of the Ecosystem Approach (EA)
- Restoration and rehabilitation of degraded ecosystems and promotion of the recovery of threatened species
- Support to local populations to develop and implement remedial action in degraded areas
- Economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity
- Protection and encouragement of customary use of biological resources in accordance with traditional cultural practices that are compatible with conservation or sustainable use requirements
- Development of indicators to enable performance monitoring of the implementation of CBD objectives

Box 1: 'Success factors' enabling fuller integration of CBD objectives into the IMCAM programmes

- Explicitly identify biodiversity conservation as a key goal of the programme and adopt a balanced approach to maintain the health and productivity of coastal ecosystems so that they can continue to supply resources that sustain economic and social well being of the community.
- Build and implement programmes around a participatory process, which enables local stakeholders to have more control over the natural resources upon which their livelihood depends and thus results in sustainable solutions.
- Develop multiple use management approaches to the use of coastal ecosystems and resources, which allow to meet economic objectives without adversely affecting the ecosystems that sustain these.
- Utilise a variety of tools such as regulation, zoning plans, setbacks, EIA etc. for minimising the impacts of human activities on natural habitats/areas.
- Ensure the capacity and mandate to coordinate inland activities that lead to degradation and destruction of coastal and marine biodiversity.
- Incorporate a system of coastal and marine protected areas, which is a well-recognised means of conservation.
- Build constituencies that support biodiversity conservation measures and coastal management through public information and awareness programmes. Develop awareness at all levels of government, NGOs, and local communities that they have a common interest in promoting the conservation of coastal ecosystems.
- Incorporate conflict resolution.
- Improve scientific understanding of the functions performed by different coastal ecosystems, the resources they generate and how human activity impact on the functioning of the ecosystem.
- Set specific targets in terms of ecosystem condition and establish a monitoring system.
- Invest in developing the ability of those with responsibility for coastal systems to plan for and manage sustainable forms of resources use.

The latter findings were summarised and discussed at a side event, 'Towards better incorporation of CBD elements in IMCAM projects', during CBD-COP-6, held in The Hague in April 2002. Further discussion and consultation on these topics by a wide group of ICZM practitioners and specialists was conducted via the internet during October and November 2002, with the aim of obtaining consensus on which issues most urgently required further elaboration. The following four topics were selected;

1. Ecosystem Approach
2. Indicators
3. Restoration of habitats
4. Incentives

Discussion documents summarising the most important 'critical issues' for these topics were the subject of a second Internet discussion (September to October 2003). This final document is based on the outcome of the second discussion and contributions from several international experts.

1.3 AUDIENCE AND OBJECTIVES OF THE GUIDANCE DOCUMENT

The present document is aimed at IMCAM practitioners and policy makers from local to national policy levels all over the world. It aims to provide practical guidance on incorporating issues concerning the conservation and sustainable use of marine and coastal biodiversity into IMCAM programmes. More specifically, it promotes possible approaches to implementing the four topics: the Ecosystem Approach, Indicators, Restoration of Habitats and Incentives. Each topic is introduced briefly, the critical issues are discussed, and examples from around the globe are used to illustrate possible practical applications of often-complex concepts and approaches.

2. ECOSYSTEM APPROACH

2.1 GENERAL INTRODUCTION TO ECOSYSTEMS APPROACH

The CBD sees the Ecosystem Approach (EA) as 'a strategy for integrating the management of land, water and living resources and promoting conservation and sustainable use in an equitable way'. Use of the Ecosystem Approach will help in achieving a balance between these three objectives of the Convention. 'An ecosystem approach is based on the application of appropriate scientific methodologies focused on levels of biological organisation, which encompass the essential structure, processes, functions and interactions among organisms and their environment'. The EA also 'recognises that humans and their cultural diversity are an integral component of ecosystems'. The majority of the legislative and institutional arrangements as well as tools and techniques recommended are directly or indirectly aimed at managing and regulating human activities that potentially lead to the degradation of the coastal and marine ecosystem and ensuring sustainable development of the coastal areas.

IMCAM is one of the priority activities of the CBD's marine and coastal programme of work launched to protect and restore biodiversity in specific ecosystems. "Integrated" (from IMCAM) as opposed to traditional sectoral approach to management involves a holistic, cross-sectoral, multidisciplinary approach in which land and sea areas of the coastal zones are managed as an integrated unit.

2.2 ECOSYSTEM APPROACH PRINCIPLES

The CBD defines 12 principles and 5 operational objectives to guide the incorporation of the approach. These so-called Malawi Principles or characteristics of the ecosystem approach to biodiversity management were identified to facilitate the development of the ecosystem approach of the CBD (See Box 2).

Box 2: Principles of the Ecosystem Approach (decision V/6)

1. Management objectives are a matter of societal choice.
2. Management should be decentralized to the lowest appropriate level.
3. Ecosystem managers should consider the effects of their activities on adjacent and other ecosystems.
4. Recognizing potential gains from management there is a need to understand the ecosystem in an economic context, considering e.g., mitigating market distortions, aligning incentives to promote sustainable use, and internalizing costs and benefits.
5. A key feature of the ecosystem approach includes conservation of ecosystem structure and functioning.
6. Ecosystems must be managed within the limits to their functioning.
7. The ecosystem approach should be undertaken at the appropriate scale.
8. Recognizing the varying temporal scales and lag effects which characterize ecosystem processes, objectives for ecosystem management should be set for the long term.
9. Management must recognize that change is inevitable.
10. The ecosystem approach should seek the appropriate balance between conservation and use of biodiversity.
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.

The CBD also recognises that there is no single way to implement the ecosystem approach, as it depends on local, provincial, national, regional or global conditions. Indeed, there are many ways in which ecosystem approaches may be used as the framework for delivering the objectives of the Convention in practice.

Traditional management approaches based on a static understanding of ecosystems have in many cases been shown to be unsuitable for achieving a sustainable use of natural resources. The EA requires an integrated strategy for the management of land, water and living resources that promotes conservation and sustainable use in an equitable way in line with the following principles:

1. Sustainability principle
2. Adaptive management
3. Precautionary principle
4. Marine and coastal protected areas and buffer zones
5. Collaborative conservation
6. Participatory approach (involving non-scientists and stakeholders)
7. Economic incentives/disincentives

The example described in Box 3 below illustrates several of the above- mentioned principles and can be seen as a successful application of the EA. Some of the critical issues concerning the implementation of the EA in IMCAM are discussed separately in sections 2.4 and 2.5 and illustrated with additional examples.

2.3 SUSTAINABLE DEVELOPMENT

Sustainability is about trying to reconcile the three basic aspirations of social, economic and ecological development. The crucial question, therefore, is: **How can the ecosystem and its biological diversity be placed central in the integrated management of coastal areas subject to major human pressures, without compromising the socio-economic development of these areas?**

Box 3: The tri-national Sulu Sulawesi Marine Eco-region (SSME), Indonesia contains the most biologically diverse assemblage of marine life known on Earth. It also provides a livelihood for millions of people and is a major economic engine of the regional economy. Human population growth, destructive fishing practices, poorly planned development, overconsumption and pollution pose threats to the long-term sustainability of these natural resources. Existing management efforts were not sufficient to protect endangered species and conserve key habitats. To rectify this, Marine Protected Areas (MPAs), designed to include multi-purpose land-use zones, were identified. In the absence of extensive databases and knowledge of ecosystem linkages, these MPAs were selected according to four main guiding principles:

1. Representation: include examples of all biological communities and habitats.
2. Viability: areas must be large enough with broad enough distribution to maintain viable populations of all species in the Eco-region.
3. Ecological and evolutionary processes: cross-boundary controls on activities occurring outside MPAs should be strict enough to allow the continuation of the ecological and evolutionary processes that shaped the Eco-region.
4. Resilience: MPAs should contain areas that are sources of recruits for other parts of the Eco-region that have a high survival or recovery rate following impacts.

In addition, existing regulations to eradicate illegal and unreported fisheries outside the MPAs have been improved and implemented under policies adopted by the three countries.

This collaborative conservation effort is accompanied by economic incentives that address priority problems. Little science is needed to understand that fishing practices that destroy habitats should be banned and that nesting turtles should not be disturbed or exploited. Participatory patrols in Bunaken National Park have significantly reduced blast and cyanide fishing. Participatory enforcement of the ban on egg collection on Derawan island ensures widespread confidence, and means, that more turtle chicks will hatch than before. Participatory monitoring by community members, student volunteers and government officials includes counting and taking simple measurements of nesting female turtles on Derawan and recording catches on Bunaken. The scuba diving community helps to conduct regular Reef Check surveys to help monitor progress with management.

The answer lies in the concept of sustainable development as defined by the five main criteria of sustainability:

1. Ecosystem productivity
2. Environmental protection
3. Social acceptability
4. Economic viability
5. Dependence security

These highly interdependent criteria cover the trade-offs between knowledge of how ecosystems function and respond to anthropogenic forces and the processes of governance—the way in which a particular society is governed. The following section describes these two processes: generating integrated knowledge through the Ecosystem Approach and developing successful governance. These are the two pillars of IMCAM.

2.4 INTEGRATED KNOWLEDGE THROUGH EA

The EA focuses on understanding the function of biodiversity and how this relates to ecosystem processes and ecosystem stability. It considers species relationships and how these influence the rate of ecosystem processes, and external variables, which drive the system, such as solar energy, flows of water and input of nutrients. Taking an ecosystem perspective is a necessary first step towards planning for the management of ecosystems. It provides a good understanding of how coastal ecosystems function, the flows of economic and environmental resources each system can generate, which environmental processes create and maintain the functional integrity of each system and how human activities can influence that functional integrity. Moving up a scale, we should then try to identify the functional linkages between different coastal systems so that we can obtain a broader understanding of how such systems are mutually supportive and contribute to the sustainability of human development.

The available tools for doing this include knowledge, experience and theories of ecosystem structure and function, biodiversity and the resilience of ecosystems to perturbations, scale and hierarchy, productivity, and ecological indicators. The assessment tools consist of field methods and analytical techniques for collecting data and assessing ecosystem states.

Defining the boundaries of EA

Several factors have to be considered when trying to define the boundaries of the ecosystem processes to be measured in the field. By definition, an ecosystem study incorporates the movement of energy and materials into and out of the boundaries of the ecosystem. In the case of waterborne pollutants, for example, some may be retained within the watershed boundaries if they are transferred to the riparian zones (the shores and banks of these water systems), but some will very likely be carried beyond the watershed boundaries by the river draining the watershed or in groundwater flows. Effective management involves making a compromise between natural and administrative boundaries to come up with manageable areas from which information can be organised and scaled up using the D-P-S-I-R system (Driving forces-Pressure-State-Impact-Response; see Section 3.3). The resulting sensitivity/vulnerability mapping of ecosystems can be a highly useful tool in negotiating the planning process with all the stakeholders involved.

Scaling information

Using information for analyses on different spatial and temporal scales may lead to several problems, many of which are related to the fact that the quantity and type of information needed to analyse a system depends on scale of analysis. For example, spatial variability in the 'infiltration of rainfall' over a distance of only a couple of meters can play a pivotal role in water and nutrient availability and ecosystem resilience. The water level of a one in ten year flood may determine where particular tree species occur, or the one in ten year drought may determine the real value of a particular wetland to people and wildlife. We need, therefore, to expand our understanding of how an individual structure or function occurring at a specific scale interacts with processes occurring at other scales, and how this, in turn, feeds back to affect the functioning of the core system at another scale.

The example below (Box 4) illustrates how human activities may influence ecosystem processes in a shallow lagoon, which in turn determine the commercial shell production capacity in terms of shellfish stock. It addresses the need for knowledge on the scale of the whole lagoon, the physical, chemical and ecological processes within the lagoon, and the interaction of the lagoon system with the adjacent marine environment.

2.5 GOVERNANCE

From a governance perspective, the initial question has to be turned around—'How can socio-economic development be a main goal of integrated coastal management without compromising the ecosystem and its biological diversity?' It will be hard to manage any ecosystem without considering the human element in all its dimensions. Indeed, if we have no control over the dynamic forces and environmental processes that create and sustain coastal ecosystems, we can only manage the human activities that seek to use or have access to coastal areas and resources. Both coastal governance and coastal ecosystems must be conceived as 'nested systems' across a range of spatial scales. Ideally, national and IMCAM initiatives should encompass areas that extend from the upper limit of water catchments to the outer limits of exclusive economic zones. In practice, most initiatives are currently on a far smaller scale and address only fragments or individual ecosystems such as coral reef, mangrove swamps or estuaries. Some larger-scale initiatives are succeeding, though, such as in the Chesapeake Bay Agreement,

Box 4: In the Thau lagoon in the north-western Mediterranean there is a fragile balance between activities and productivity. Almost all the typical human activities associated with lagoons are encountered here. Its natural productivity sustains commercial shell farming (an estimated standing stock of 35,000 tons with an annual production of 15,000 tons per year), fish farming (40 tons per year) and commercial and recreational fishing of both fish and shellfish.

This shallow (<10 m) ecosystem is sensitive to both natural (climate change) and artificial changes. At the turn of the century, when agriculture was not important in the region, the morphology and depth of water in the lagoon were the sole determinants of nutrient concentrations. The first oyster farms were established between 1911 and 1915. The expansion of the shell farming industry since 1945 (700 commercial concessions) and additional human activities on the lagoon's shore led to a significant enrichment of the bottom sediments by the 1960s. This enrichment in turn caused the severe oxygen deficiency during the 1970s that drastically affected shell farming and fishing in the lagoon. More enlightened development since the early 1970s and a lagoon cleanup programme initiated in 1974 have slowly had a positive effect on the lagoon despite the simultaneous expansion of shell farming in the region. The lagoon still contains high levels of silt originating both from deep water (where organic matter has accumulated) and from shell farming, which together fertilise the sediments and favour the growth of marine plants such as Zostera (seagrass or eelgrass). This in turn probably reduces the excess nutrient load. However, shell farming cannot be sustained throughout the year without some additional external source of nutrients, which means that the circulation of water in the lagoon as a whole plays a role in shell farming production. These exchanges occur continually, except during the summer when the shellfish in the farms consume such large quantities of phytoplankton that supplies of these microscopic plants inside the farming structures themselves are depleted, despite the supply from outside. This makes it important to quantify the standing stock of dissolved organic matter and identify its role in localised regeneration of primary production.

Further studies will focus on the assessment of nearby marine waters to obtain a better understanding of the links between the lagoon and its neighbouring ecosystems, as well as evaluating the downstream socioeconomic consequences of possible ecological degradation of the lagoon system.

the South Florida Restoration Plan and the Great Barrier Reef Marine Park. An example of a large-scale initiative with zoning and multiple use is the Soufriere Marine Management Area along 11 km of coastline in St. Lucia, Caribbean (see Box 5).

Box 5: The Soufriere Marine Management Area in St. Lucia, Caribbean

Following a long period of public consultation an 11-kilometre stretch of the coastline was legally designated as a management area in 1994. Zones were set aside for recreation, a marina, marine reserves (with no fishing, but diving permitted) and fishing priority areas, mainly adjacent to the marine reserves. Since 1999 the annual fees paid by the 6300 divers and 3600 visiting yachts have made the management authority self-financing. Fish biomass has tripled in the marine reserve areas and fishers are reporting increased yields from the adjacent fishing priority areas.

Ecosystem management is essentially a blend of natural science tools and data with administrative and social science techniques. A balance must be struck between the physical and biological features of ecosystems and equally real human factors. Manageable indicators are needed to make comparisons between trends in the 'natural' elements of ecosystems and trends in the associated human population (see also Section 3.6). This requires a very sophisticated and integrated approach to development planning and resources management based on integrated information from both the natural and social sciences that provides a more holistic view. However, it is proving difficult to develop the cross-disciplinary skills needed to generate the integrated scientific information for policy makers, planners and managers.

2.6 ADAPTIVE MANAGEMENT

Adaptive management acknowledges a continuous process of action based on doing, learning, sharing and improving, while sustainability is not absolute: the responses of ecosystems, agencies and people depend on changing circumstances, whether these are the climate, the population pressure or economics factors. The main problem lies with the temporal mismatches between the cycles of coastal ecosystem change and cycles of coastal governance. It is therefore fundamentally important to allow for adaptive management and locate coastal governance initiatives within the longer-term cycles of ecosystem change. Using simple trend projections and models to forecast the impacts of any decision in the development path could increase the relevance of the messages coming from the scientific community into the governance process. Methods such as Strategic Environmental Analysis can be highly instrumental in this respect, not only for identifying the issues at stake but also how they relate to different stakeholders and different spatial and temporal scales. In the longer term, when dealing with the possible consequences of global warming, such as sea-rise level, it is wise to seek to predict these changes and plan scenarios that take account of changing habitats.

Adaptive management recognises the differences between stakeholders, science and policy and allows for self-correction and mutual learning, instead of relying on the concept of instant consensus and effective adoption in decision-making processes. The ecosystem approach adopted by the CBD recognises the importance of an adaptive management approach. Decision V/6 describes this as 'a learning process, which helps to adapt methodologies and practices to the ways in which these systems are being managed and monitored. Ecosystem management should be envisaged as a long-term experiment that builds on its results as it progresses.'

The basic elements of adaptive management processes are:

- Collection of ecological, socio-economic and institutional information
- Definition of goals and priorities
- Formulation of assumptions and working hypotheses
- Testing assumptions via ecological and socio-economic monitoring
- Reassessment of assumptions and adoption
- Learning and integrating lessons into decision making

Most examples show that at a local decision-making level, individuals and their institutions are more likely to respond to changes in their environments and that these responses represent important sources of innovation and learning for whole organisations. This emphasises the importance of decentralisation, site-specific policy approaches, coalition networks, multistage processes and encouraging the participation of a broad range of stakeholders.

2.7 THE PRECAUTIONARY APPROACH

We will never have perfect knowledge of the marine ecosystems we are using and managing. This is the case for any biodiversity management function, but the problems are particularly intense in marine ecosystems because of their complexity and dynamic nature and the difficulties of working in the marine environment. In addition, there are fewer resources devoted to marine ecosystem research than to many other ecosystem types. This raises a crucial question:

How to deal with the limited knowledge of ecosystem structure and functioning, and the resulting uncertainties, when determining ecosystem performance?

The answer lies in the fact that the precautionary approach should be central to our IMCAM work. This approach has been incorporated into most UN biodiversity-related processes, including Rio (Agenda 21, UNCED), the Convention on Biological Diversity (CBD) and the Code of Conduct on Responsible Fisheries. It also appears in regional agreements, such as the Convention on the Conservation of Antarctic Marine Living Resources (CCAMLR) and the Framework Agreement for the Conservation of Living Marine Resources on the High Seas of the South Pacific (The Galapagos Agreement).

Although the precautionary approach has been expressed in different ways in these forums, the approach generally encompasses two key elements:

1. The need to base any decisions on the **best available science**
2. The need to **take into account the gaps in our understanding** as we make decisions

2.7.1 Best Available Science

Scientific data on the marine environment is a scarce resource and so efforts should target priority needs for better information and understanding to support decision-making. One priority is to understand the key drivers of ecosystem function and the key parameters needed to assess ecosystem condition. Such understanding is essential for predicting the probable effects of decisions and for establishing optimal indicators of change. A list of priorities, once agreed, would provide a clear focus for future scientific work (e.g. to improve understanding of the basic physical ecosystem processes) and data gathering (e.g. to better assess the degree of modification of ecosystems by current human activity or the modifications that can be expected as a result of changes in behaviour). There is also an urgent need for better models and conceptual approaches that make more effective use of the available knowledge, particularly for predicting the effects of management decisions.

The connection between the available information and decision-makers (government and communities) must improve. The ecosystem approach adopted by the CBD (decision V/6) emphasises the fact that management objectives are a matter of societal choice. These choices should be based on knowledge and science to allow people to make more rational judgements (e.g. to help people to understand that an ugly organism may have a high economic value) and translate their values into practice (e.g. if society values endemic species, scientists can then identify which species are endemic).

The ecosystem approach also stresses the need to conserve ecosystem structure and functioning, to manage ecosystems within the limits of their functioning and to carry out management at appropriate spatial and temporal scales. All these aspects of the ecosystem approach require scientific information. That information must be provided to the decision-makers in a form they can use. It will often be necessary to improve the general ability of the decision-maker to understand scientific concepts and coastal and marine ecosystems. Training courses, glossaries illustrated field guides, field trips and other tools can be used.

Legislation and institutional arrangements may also need to be changed to allow more scientifically sound decisions to be made: decision-making criteria should have a proper scientific basis, decision-making processes should be transparent so that logical inconsistencies can be exposed and addressed, institutions must have good access to scientists, etc. Box 6 provides an example of the identification of priorities for ecosystem management and linkages to parameters and data gathering efforts.

2.7.2 The use of non-scientific data

We can increase the amount of information we have by drawing on the widest possible range of sources and using efficient collection techniques. While some work requires scientific skills, there is considerable potential to use non-scientists to undertake data collection. Possible data sources include:

- Data collected for other purposes; for example, catch records for fisheries enforcement or management purposes can also support ecosystem assessments.
- Capturing data collected while people undertake other activities; for example, birdwatchers and shell collectors have probably collected most of the data on seabirds and molluscs.
- Encouraging volunteers to collect data for coastal management purposes; for example, Coastwatch Europe is a network of organisations in 23 countries that organises volunteers to undertake annual surveys covering around 10,000 km of coastline.
- Enhancing the quality of data collected by voluntary groups by providing training in new techniques and access to better data management systems.

Box 6: In New Zealand work on ecosystem management has identified key human-induced modifications and drivers of ecosystem functions: loss of species through hunting, fishing, consumption and competition from introduced species (including competition for space and nutrients), resource modification (e.g. changes in nutrients, sediment movements and types, light penetration) and fragmentation (including loss of connectivity and edge effects on remnant ecosystems). The following key factors for acquiring good data and knowledge and for prioritising management actions were identified:

- The value of the ecosystem in terms of distinctiveness, importance and natural character
- The effect of management on the value of the site
- Urgency
- Feasibility
- The ability to generate an enhanced capacity to carry out future management (e.g. by generating new information or building community support)
- The risk of collateral damage to other ecosystems or reducing the ability to undertake other management activities (e.g. by reducing community support)
- The information provided by the scientific and monitoring community must be packaged in a form that is appropriate to the needs of the decision-maker. This includes consideration of issues such as:
- Translating material into the correct language (e.g. into the local or indigenous language of community decision makers)
- Making material easy to understand by removing unnecessary scientific jargon
- Matching information to match the questions facing the decision maker
- Disseminating the information to the decision maker

The boxes below (Box 7 and 8) provide examples of using non-scientific data to improve our knowledge base and enable adaptive management.

Another way of increasing and improving data collection and analysis is by using innovative techniques. New technologies, such as remote sensing, Global Position System (GPS), data loggers, imaging technology and improved diving and deep sea exploration technology, have great potential for improving the efficiency of data collection and analysis.

2.7.3 The gaps in our understanding

No matter how much we intensify scientific research, there will always be gaps, uncertainties and errors in our information and understanding. The second element of the precautionary approach is to ensure that decision-making take these gaps into account. Decisions must be made, regardless of the deficiencies in the available information. We cannot simply wait for full knowledge.

Box 7: Fisher communities in Eastern Samar and Bohol, Philippines applied simplified coastal resource monitoring methods to empirically evaluate the effectiveness of marine reserves for the rehabilitation of reef trophic function disrupted by overfishing. In this three-year training programme for participatory monitoring and evaluation of protected reefs, monitoring by local communities has tightened the adaptive management cycle because the functions of management and evaluation are carried out by one group. For further information see the following document: Monitoring and Evaluation of Reef Protected Areas by Local Fishers in the Philippines: Tightening the Adaptive Management Cycle.

Box 8: The Reef Check organisation, USA, established five years ago, is a successful example of a global, community-based coral reef monitoring programme that increases public understanding of the value of coral reefs and the need to protect them. The programme enlists volunteers for data collection and couples local knowledge with scientific research.

The obvious pre-requisite for taking these gaps and uncertainties into account is to know they are there and this requires conceptual models into which we can put the information we have. Clearly, we need better conceptual models for the marine environment that include some important features:

- A clear hypothesis that is being tested, i.e. a clear and transparent basis for the decision being made.
- A process that will allow the results of the management programme to be measured and compared with those expected under the hypothesis. This is likely to require carefully designed monitoring processes, with baseline measures.
- The ability to assess the differences between results and expectations and learn from them. The better our conceptual understanding, the more likely we are to be able to assess any differences (e.g. to distinguish between responses to management and stochastic change). Good analysis will also depend on the quality of the data. It is therefore essential that any monitoring programme is well designed.
- The ability to make new decisions that reflect this learning so the cycle can be repeated. This requires adaptive institutions.
- The ability to control any changes in the management programme so that those changes do not jeopardise the ability to learn more. This requires good governance arrangements.

2.8 PROTECTED AREAS AND BUFFER-ZONES (MPA)

World Conservation Union defines Marine Protected Areas as “any area of the intertidal or subtidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment”

There are two important roles that fully protected reserves can play in this overall picture of protecting ecosystems and applying the precautionary principle. First, they can provide a control against which management effects can be compared. In dynamic and poorly understood ecosystems, control areas are probably essential for understanding the effect of management. A baseline measure for the managed area cannot on its own help us to distinguish between management effects and stochastic change. Second, they provide resilience or a buffer against the effects of mistakes. Where the effects of management are highly uncertain and all areas are used, the precautionary approach is likely to result in low levels of resource use in order to achieve sustainability. But if there is a network of fully protected areas, these can be treated as 'insurance' against mistakes in management, allowing higher levels of resource use in the exploited areas. For example, they can provide:

- Protection for genetic diversity if management results in the loss of genetic diversity in harvested stocks
- A pool of breeding animals to restock overharvested areas
- Refuges for particularly sensitive species

In addition, the presence of these areas allows managers to achieve overall biodiversity goals without needing to achieve those goals in every location. This is the approach taken with terrestrial biodiversity, where protection of sensitive species may be provided through protected areas, not within production areas.

2.9 THE WAY FORWARD

To manage ecosystems we must conduct systematic scientific studies of human uses and their effects on the ecosystem. Ecosystem management requires a balancing of both sides of the equation and applying the sustainability concept. There is no 'free lunch'—loss is inevitable as expanding human uses affect existing ecosystem functions. Ecosystem management is ultimately about presenting the choices and trade-offs, and estimating and monitoring the costs and benefits of making these choices.

The scale of ecosystem management must be flexible enough to respond to management goals and objectives; no one spatial scale by itself is adequate to manage ecosystems. Similarly, the temporal scale must be adaptable enough to allow for 'reorganisation' of an ecosystem throughout its full cycle, either under the pressure of long-time changes or catastrophic disturbance.

Adaptive management is an essential part of ecosystem management. The rules and criteria must be flexible enough to adapt to changing biophysical conditions, human behaviour, economics and scientific advances. Adaptive ecosystem management requires a system that learns from its own mistakes and is not rigid, but has feedback loops.

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3. INDICATORS

3.1 GENERAL INTRODUCTION

The Convention on Biological Diversity (CBD) promotes indicators as information tools for summarising data on complex environmental issues. Indicators are important for

1. monitoring the status and trends of biological diversity, sustainable use and equitable sharing,
2. continuously improving the effectiveness of biodiversity management via IMCAM programmes, and providing inputs to organisational learning systems,
3. signalling key issues to be addressed through policy interventions and other actions (including early warning systems).

The primary purpose of indicators is to inform society and decision makers on the status and recent trends in marine and coastal management, including biological diversity, sustainability of uses, socio-economic pressures and opportunities, and the institutional issues involved. Three broad groups of people will use indicators: scientists and other technical experts, decision makers and policy setters, and stakeholders and the general public. The difficulty is finding a framework for selecting indicators that will provide all three audiences with the information they need. Indicators should be simple and facilitate communication between the three audiences, and should be limited in number. If many indicators are used, the necessary monitoring will be too expensive and the flow of information so large and sometimes contradictory that the basic purpose—to inform—will not be met.

Monitoring and the effective use of indicators is an essential part of an adaptive management system (see Chapter 2). Such a system aims to adapt policies and practices to the realities on the ground and to learn from experience in a continuous process of learning by doing.

This chapter discusses the following issues:

1. Frameworks that can be used to structure the identification and presentation of indicators, focusing on the log-frame for project monitoring and the DPSIR framework
2. Indicators for different phases of the IMCAM cycle, including those for monitoring the IMCAM process and indicators for issues like participation, partnerships, etc.
3. Criteria for selecting indicators
4. Guidelines for involving stakeholders in the definition and use of indicators as part of a monitoring system

3.2 FRAMEWORKS FOR SELECTING INDICATORS THAT COVER ALL CBD OBJECTIVES

Given the above context, this section has to address two core questions. Is there a framework which can meet this challenge? If so, how can it be put in practice? If not, what alternatives exist? We try to find answers to these questions by considering the common characteristics of the indicators and of the target audiences.

Characteristics of indicators

To fulfil the requirements of the CBD there must be indicators of

- the status of coastal ecosystems, including ecological, socio-economic and institutional parameters (including threats and opportunities),
- the economic benefits of activities impacting the coastal ecosystems, and
- the social well-being arising from the use made of coastal ecosystems.

Social well-being includes aesthetic and ethical considerations, which may not be measured well by economic indicators. Ecological indicators range from easily monitored counts of key species to abstract outputs of complex ecosystem models. Social and economic indicators range from directly measured commercial values of fish catches to subjective measures of people’s satisfaction with social choices that have been made. Institutional issues include rules and regulations, organisational arrangements and policies for coastal governance and management.

A leading characteristic for an indicator framework is the flexibility to deal with a range of different contexts, scales, management objectives and audiences. Rigid frameworks will not be effective in bringing consistent interpretations to a suite of indicators, including the status of key species, biodiversity, economic returns from activities as varied as fishing and tourism, and the contribution of activities in coastal areas to social equity.

The three audiences mentioned above—scientists and technical experts, policy makers and decision makers, and stakeholders and the general public—need indicators that are informative and reliable, but they do not necessarily use the same standards to judge whether an indicator is informative and reliable. Scientists and technical experts need indicators with suitable properties for technical applications: good statistical properties, information about cause-and-effect linkages in natural and human systems, etc. Policy makers need indicators that are a reliable basis for decision-making and clearly reflect the consequences of different management choices. Stakeholders and the public need indicators that relate to their experiences and provide the information necessary for informed dialogue about the degree to which goals consistent with their economic, cultural and ethical values are being achieved through the uses of coastal ecosystems. Coastal areas differ in both the degree of scientific and technical support that is available and in the degree to which the decision-making authority is shared between central government agencies and communities and stakeholders. The framework that is most suitable for a given application will have to be sensitive to these local conditions.

Some common frameworks

An indicator framework can be a helpful tool in the process of selecting and developing a suitable set of indicators that reflect the CBD objectives. Two common frameworks are:

- Driving forces-pressure-state-impact-response framework

2. Logical Framework Approach (LFA, Australian Agency for International Development, 2003)

It is advisable to use a combination of frameworks in order to provide a core set of indicators covering all the CBD objectives in IMCAM projects and programmes. A major requirement in this approach is a proper knowledge of the relative strengths and weaknesses of the common frameworks.

3.3 THE DPSIR FRAMEWORK

The DPSIR (driving forces-pressure-state-impact-response) framework is well suited to take different cultural, social, economic, institutional, political, and environmental aspects into account. The idea of the framework was however originally derived from social studies and only then widely applied internationally, in particular for organising systems of indicators in the context of environment and, later, sustainable development. The DPSIR framework is structured to follow causal chains from an indirect root cause ('driving forces'—D) to a direct pressure and finally a management response (R) between interacting components of social, economic, and environmental systems;

- Driving forces of environmental change (e.g. industrial production)
- Pressures on the environment (e.g. discharges of waste water)
- State of the environment (e.g. water quality in rivers and lakes)
- Impacts on population, economy, ecosystems (e.g. water unsuitable for drinking)
- Response of the society (e.g. watershed protection)

Variations of DPSIR framework include PSR (Pressure-State-Response) (e.g. OECD 1994), DSR (Driving forces-State-Response) (e.g. UNCSD 1996) and many others.

The sequence presupposes substantial understanding of the underlying causal relationships between human activities and impacts on ecosystems, coastal economies and communities, and human response mechanisms. It has been used widely, for example by the European Environmental Agency to select indicators for evaluating the implementation EU environmental policies. Box 9 gives definitions and examples.

This knowledge presupposes a good analysis of the current situation. This does not necessarily require quantitative analyses and the involvement of scientific experts, but could be combined with stakeholder knowledge and qualitative indications (see also section 3.10 on participatory approaches).

Where management is weakly supported by scientific research and historic monitoring, superficial correlations or reasoning by analogy risk that indicators might not inform users about important changes occurring in the ecosystem or communities, or that observed changes in the indicators will be attributed to the wrong causes and ineffective management actions will be taken.

Box 9: Definitions of the DPSIR framework with examples for the coastal environment

Variables of the DPSIR framework	Examples
The driving force variable refers to issues on the macro scale broadly and indirectly affecting marine and coastal ecosystems. Driving forces might be considered as 'root causes'.	• Social: population growth rate in urban coastal areas • Environmental: changes in stream patterns • Economic: the dependency of communities on fishing • Institutional: the level of enforcement of laws and regulations related to coastal region management
The pressure variable describes the immediate cause of the problem. Pressure is synonymous with threats or causal activities.	• The amount of pollution by wastewater • The efficiency of water use • The amount of fish produced and exported from the area • Climate change
The state variable describes some physical, measurable characteristic of the environment or social livelihood system.	• Income levels, level of poverty • Chemical composition of the water • Employment in the fishing industry • Fish consumption indices
The impact variable monitors the long-term or more pervasive impacts of a project or ongoing change. There are socio-economic (livelihood) and environmental impacts.	• Socio-economic: incidence of diseases caused by polluted water; changes in fishing behaviour; appreciation by tourists of coastal resorts • Environmental: changes in fish mortality; sea warming; physical changes to the seabed
The response variables are policies, actions or investments that are introduced to solve the problem or reduce undesirable impacts.	• Social: budget given to environmental education; number of awareness raising campaigns • Environmental: changes in fish population dynamics • Economic: the use of more efficient fishing techniques • Institutional: the number of co-management arrangements to improve management efficiency

3.4 LOGICAL FRAMEWORK APPROACH

The Logical Framework Approach is geared to monitoring the performance of a policy, programme or project (PPP). It measures only what has to be known from a programme point of view. It aims to present the PPP in a logical and well-structured format which indicates the goal, objectives, results, activities, means and costs, assumptions and indicators. Monitoring and evaluation using indicators are tools used in the ongoing project management cycle to compare actual achievements with the objectives of the projects and to verify whether changes in the context require adjustment of the project design. The basic structure of a log-frame with examples for the marine environment is illustrated in Box 10.

An example of the effective application of the log-frame is a project to reduce the detrimental effects of fishing on corals in East Africa. In this case the Logical Framework Approach makes use of objectively verifiable indicators to assess project progress and its impacts on the ecosystem. In addition it promotes community participation in fisheries management and improves the capacity to manage the fisheries. Different types of indicators related to the project cycle can be distinguished (see Box 11 and section 3.6).

Box 10: Logical format (log-frame) of an IMCAM project
This simplified example is derived from a situation where fishers are confronted with overfishing, leading to social conflicts and decreasing incomes

	Intervention logic	Objectively verifiable indicators	Sources of verification	Assumptions
Overall project goal	Improved socio-economic conditions for fishers, with an emphasis on income security and safety	Income levels and variability of incomes from fisheries; safety improved to less than 5 conflicts annually	not specified	not specified
Project objective	Sustainable management of coastal area by an effective co-management system	Continuity of annual fish catches; degree of destruction of habitats of fishing grounds; number of external threats effectively reduced by co-management measures	not specified	not specified
Expected results	1. Creation of co-management committee with different stakeholders 2. Agreement on norms for fishing intensity 3. Formalisation of co-management regulations	1. Level of satisfaction by all stakeholders; number of stakeholders actively involved 2. Number of stakeholders involved in setting norms; number of complaints on norms; 3. Number of regulations being formalised	not specified	not specified
Activities	1.1 Stakeholder analysis 1.2 Review of existing management regulations 1.3 Formulation of mandate for co-management team	**Means** Input indicators (not specified)	**Costs** not specified	not specified

Box 11: Types of project performance indicators with linkages to log-frame items and examples from the above IMCAM project		
Type of log-frame indicator	**Linkage to log-frame item**	**Examples**
Input indicator (inputs provided by the project)	Activities and means	Number of new fishing gears provided Number of freezers installed
Process indicator (project management and approach)	Means and costs	Number of trainings given Number of workshops organised
Result indicator (immediate results of the project)	Results	Number of stakeholders actively participating
Effect indicator (outcome of the use of the project outputs)	Results and objective(s)	Number of fishing norms agreed upon by the co-management committee
Impact indicator (ultimate changes resulting from project effects)	Goal, objective(s) (and assumptions)	Reduced destruction of habitats in fishing grounds

3.5 OTHER FRAMEWORKS

The above two frameworks are not the only ones, and many variations exist. In fact, formal frameworks are often not strictly followed, but they are indispensable for good structuring and logical thinking. For example, Annex III of the Bergen Declaration, adopted by the Council of North Sea Ministers following a series of consultations, primarily among scientific experts, contains a number of indicators for the health of the North Sea marine ecosystem and the impacts of several human activities on that system (Box 12). Note that these are only ecological indicators.

3.6 INDICATORS FOR ALL PHASES OF THE IMCAM CYCLE

The IMCAM policy cycle has the following phases common to any policy or planning cycle:

1. Planning, with sub-phases for issue identification (including diagnosis), preparation (including design and formulation), agreement, adoption and funding
2. Implementation, including monitoring and learning
3. Evaluation, including policy adjustments, which can then feed into a next planning cycle

Indicators are usually used to assess progress in terms of performance because this is what donors and governments want to know first (see Box 10, p.18). This type of monitoring is associated with the implementation and evaluation phases and measures whether the stated objectives have been reached. This approach leaves three issues unaddressed:

1. Indicators for the planning phase, which, if not carried out properly, will affect the other phases of the policy cycle (for instance, if set objectives are unrealistic).
2. Indicators to monitor the policy cycle, including organisational, management and learning aspects. A good process is important for attaining the goals of capacity building and is an indication that set objectives will be reached.
3. Indicators to measure policy outcomes leading to the goal, realising that goals and long-term impacts will often be difficult to reach within a limited time frame.

Box 12: Ecological indicators from Annex III of the Bergen Declaration **The term 'ecological quality element' can be interpreted as the indicator for the issue of concern**	
Issue	**Ecological quality element**
1. Commercial fish species	(a) Spawning stock biomass of commercial fish species
2. Threatened and declining species	(b) Presence and extent of threatened and declining species in the North Sea
3. Sea mammals	(c) Seal population trends in the North Sea (d) Utilisation of seal breeding sites in the North Sea (e) By-catch of harbour porpoises
4. Seabirds	(f) Proportion of oiled Common Guillemots among those found dead or dying on beaches (g) Mercury concentrations in seabird eggs and feathers (h) Organochlorine concentrations in seabird eggs (i) Plastic particles in stomachs of seabirds (j) Local Sand Eel availability to Black-legged Kittiwakes (k) Seabird populations trends as an index of seabird community health
5. Fish communities	(l) Changes in the proportion of large fish and hence the average weight and average maximum length of the fish community
6. Benthic communities	(m) Changes/kills in zoobenthos in relation to eutrophication (n) Imposex in Dog Whelk (*Nucella lapillus*) (o) Density of sensitive (e.g. fragile) species (p) Density of opportunistic species
7. Plankton communities	(q) Phytoplankton chlorophyll *a* (r) Phytoplankton indicator species for eutrophication
8. Habitats	(s) Restore and/or maintain habitat quality
9. Nutrient budgets and production	(t) Winter nutrient (DIN and DIP) concentrations
10. Oxygen consumption	(u) Oxygen

Activities have been listed for each phase of the IMCAM policy cycle, including the planning phase and sub-phases (see IMCAM discussion website). Olsen refers to these activities as 'clusters of indicators' (for instance: 'assessment of the principal issues', or 'definition of the goals for ICM'). These are what are commonly referred to as 'milestones', i.e. intermediate steps towards working out the policy through each phase (see Box 13, below). However, milestones do not say much about the quality of activities and so we also need indicators that say something about the quality of these milestones. For instance, a context analysis should also examine future threats and opportunities. This often requires knowledge of policies and economic measures. Coastal areas may be threatened by plans for port development, or by subsidies to stimulate the tourism sector, or by rapid urban development

Box 13: Some possible indicators for a good planning phase (in terms of concrete results)	
Elements of a good planning phase	**Examples of indicators**
Issue identification and diagnosis	• Quality / reliability of information and database • Key issues addressing major threats and opportunities • Analysis of past trends and future projections • Different sectors involved
Design and preparation	• A vision that is ambitious yet realistic • Quality of log-frame • Clarity of boundaries
Adoption and funding	• Volume and diversity of funding sources • Number of comments / feedback received on draft

and population growth resulting in water pollution. On the other hand, new ecological techniques may present opportunities for wastewater treatment.

3.7 INDICATORS FOR THE PROCESS OF THE POLICY CYCLE

The IMCAM policy cycle can be regarded as a continuous process that by itself will generate impacts, such as capacity building, awareness raising, collaboration between stakeholders, etc. Indicators must be defined that say something about the quality of this process. Process-related indicators can be based on criteria of good governance, and include issues such as participation, organisational learning, internal management, capacity development, communication, transparency, financial management, accountability, replication of successes, etc. Box 14 (following) contains some examples of indicators.

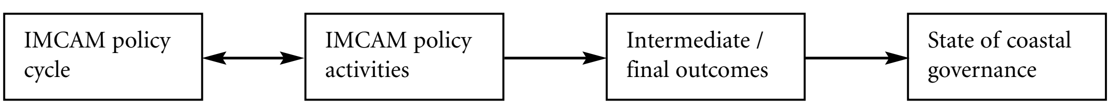
Box 14: Some examples of indicators for a good policy process	
Criteria for a good policy process	**Examples of indicators**
1. Participation	• Active participation by private, public and civic sectors • Number of relevant inputs from stakeholders • Number of partnerships agreed upon, or in the pipeline
2. Organisational learning	• Number of learning events with all staff • Time and budget allocated for learning • Active involvement of partners in learning events
3. Capacity development	• Personal development and training goals set for staff • Fields of expertise covered by the team • Public sector involvement
4. Transparency & communication	• Frequency of communication with all stakeholders • Time available for feedback into policy decisions • Decision-making based on democratic procedures

It should be noted, however, that quantitative indicators are not always the most suitable for assessing the quality of the process. In many cases, interviews with staff and stakeholders will be sufficient to build up a good picture of the quality of the process. Descriptive or qualitative indicators should meet three criteria: refer to concrete evidence, show causality and be convincing. An indicator-based approach to assessing the performance of European marine fisheries and aquaculture makes use of 4 different types of indicators: descriptive, performance, efficiency and welfare.

Performance-based and organisational (process-oriented) monitoring are often two different entities, as illustrated by many institutions dealing with coastal zone monitoring that do not reach decision makers. The challenge would be to have organisations responsible for IMCAM determine what they consider to be ‘good performance’ and link this to organisational management. A way to establish linkages between performance and organisational monitoring is a Quality Management System using self-assessments and a Balanced Scorecard approach with critical success factors and indicators set by the parties involved (see Box 15).

3.8 INDICATORS FOR COASTAL GOVERNANCE—OUTCOMES AND IMPACTS

Monitoring of the IMCAM policy cycle should be linked to a system for monitoring outcomes and the state of coastal governance. Outcome monitoring and indicators aim to assess which changes can be seen as outcomes of the policy actions taken and thus form the linkage between the IMCAM policy, the policy process and the state of coastal governance. The following figure shows the linkages.



Box 15: An example with both quantitative and qualitative indicators.

Success factor	Quantitative indicators	Qualitative indicators
1. Partnerships with the private and public sectors, credibility	• Number of successful IMCAM activities with private sector parties	• *Description of how partnership developed* • *Interviews showing level of satisfaction*
2. Quality of communication, collaboration, learning	• Time spent on learning events • Reference to lessons learned in reports • Number of adjustments made based on learning events	• *Minutes of meetings, interviews with participants* • *Information from programme officer on the changes made and why*
3. Capacity to influence policies and participate in policy dialogue	• Number of times public policies are adjusted on the basis of inputs by the programme	• *Success stories about policies adjusted as a result of programme inputs*
4. Financial viability of the programme	• Volume of portfolio • Diversity of donors and funding sources, private sector	• *Success stories about the acquisition of private sector funding*

Box 16: Examples of outcome indicators.	
Orders of outcome indicators	**Examples of indicators**
1. Enabling conditions, including institutional, policy and legal issues, funding and planning	• Awareness at policy levels in different sectors • Legislation supportive of ICM • Area of protected coastal ecosystems
2. Behavioural changes, including institutions and interest groups, those affecting coastal areas, and investment in infrastructure	• Functional public-private partnerships • Incidence of activities affecting coastal area • Number of rehabilitation measures
3. Environmental and social improvements, including improvements in coastal zone ecosystem qualities and social qualities	• Fish biodiversity, coral reef quality • Poverty incidence, number of income generation activities from use of the coastal area
4. Sustainable and adaptive forms of management that take into account ecosystem and social change	• Existence of stakeholder platforms • Existence of early warning mechanisms • Adequacy of response to calamities

The *way* coastal zones are governed, managed or administered, e.g. Coastal governance, includes institutions, actors and current social and environmental qualities of coastal ecosystems. Outcomes are defined as the changes in behaviour, relationships, institutions or activities that the policy helped to bring about. By using outcome mapping a policy or programme will not be solely responsible for achieving impacts but rather contributes to the achievement of desirable intermediate or final outcomes

Four different levels or orders of outcome indicators can be defined. These are listed in the following Box 16 with some examples. In the first instance, IMCAM policies address the enabling conditions, which lead to behavioural change, which in turn causes environmental and social improvements. However, another sequence is also possible. This framework displays similarities with the DPSIR framework (see section 3.3).

Traditionally, most emphasis is given to ecological indicators. However, in line with the above mentioned issues there is a need to define other indicators for other sectors and for policy processes related to research (e.g. 'available expertise on a certain theme'), awareness raising and education (e.g. 'quality of communication techniques'), legislation and institutional strengthening (e.g. 'number of threatened species for which legislation is available'), and collaboration (e.g. 'number of agreements signed and implemented'). These issues would fit into the above framework at orders 1 and 2.

To identify good indicators, good diagnostic studies and strategic planning are needed during the first phase of the IMCAM policy cycle. Diagnostic studies must look at the coastal site in its broad spatial context (e.g. look at spatial interactions), have a long-term perspective (e.g. look at trends and scenarios) and take an integrated approach by considering the relations between biodiversity and institutional and socio-economic issues. This can help to put IMCAM into a sustainable development perspective and identify the priority issues for which indicators are required.

3.9 CRITERIA FOR THE SELECTION AND DEVELOPMENT OF INDICATORS

Why use criteria for selecting indicators?

Criteria are needed for selecting the most useful indicators and to avoid having large lists of indicators that will never be monitored because this would put too heavy a burden on management. Key considerations are costs and the effective use of the indicators in decision-making and consensus-building. With regard to consensus building, there is a risk that large sets of indicators will contain contradictions, which undermines one of the attributes that made indicators an attractive tool for supporting policy decisions and public choices—the provision of an objective basis for action. Sometimes the contradictions are more apparent than real when two or more indicators give unreliable information because of different weaknesses. Sometimes, though, the contradictions are real because the indicators provide reliable information on the tough choices facing society. Contradictory indicators may provide a starting point for negotiation and conflict resolution.

So what is meant by 'choosing wisely' in this context? It means reducing the list of candidate indicators without reducing the information being made available to all three groups, which use them: scientific and technical experts, policy makers and managers, and stakeholders and the general public. Two considerations guide the making of 'wise choices' to achieve such reductions.

- What criteria should we use?
- How should they be used?
- How do these fit into a monitoring system?

The most commonly used criteria for selecting indicators are those referred to by the acronym SMART: Specific, Measurable, Achievable, Realistic, Time-bound

The purpose of using SMART indicators is:

- to monitor, assess and compare conditions and trends on a local, regional and global scale
- to assess the effectiveness of policy-making or targets
- to mark progress against a stated benchmark or targets
- to track changes in public attitude and behaviour
- to ensure understanding, participation and transparency between interested and affected parties
- to forecast and project trends
- to provide early warning information.

How to use the criteria?

Indicators can be assessed against the various criteria either by instrumental means or in a consensual process with participants from all the relevant interest groups involved. In practice, a combination of the two is best. More formal approaches have been tried experimentally, but none have yet been shown to be superior to alternative approaches, or even to the consensus method. No single indicator is likely to score highly for all criteria. What matters most is that the performance of each indicator against the various criteria is known. By knowing the performance of all the potential indicators, users will gain an understanding of the strengths and weaknesses of each one. A suite of indicators can then be selected that serve the needs of all three main user communities well. Each indicator can be used in ways that emphasise its strengths and with an awareness of its potential weaknesses.

How to set up a monitoring system?

Finally, we address the question of how selected indicators fit into a monitoring system.

The following steps for establishing a monitoring system for a project can be distinguished.

Step 1: Context analysis and development of a logframe—the backbone of any monitoring system. This is discussed in section 3.4.

Step 2: Definition of the type of information required: *why* monitor environmental qualities? This refers to the audiences to be addressed, section 3.10, the linkages to the IMCAM process, and section 3.7.

Step 3: Determination of the indicators and the reference situation: *what* should be monitored? This has been addressed in this section and in section 3.2.

Box 17: A set of criteria defined by the CDB

Policy relevant and meaningful
Indicators should send a clear message and provide information at a level appropriate for policy and management decision making by assessing changes in the status of biodiversity (or pressures, responses, use or capacity), related to baselines and agreed policy targets if possible.

Biodiversity relevant
Indicators should address key properties of biodiversity or related issues as state, pressures, responses, use or capacity.

Scientifically sound
Indicators must be based on clearly defined, verifiable and scientifically acceptable data, which are collected using standard methods with known accuracy and precision, or based on traditional knowledge that has been validated in an appropriate way.

Broad acceptance
The power of an indicator depends on its broad acceptance. Involvement of the policy makers, and major stakeholders and experts in the development of an indicator is crucial.

Affordable monitoring
Indicators should be measurable in an accurate and affordable way and part of a sustainable monitoring system, using determinable baselines and targets for the assessment of improvements and declines.

Affordable modelling
Information on cause-effect relationships should be achievable and quantifiable, in order to link pressures, state and response indicators. These relation models enable scenario analyses and are the basis of the ecosystem approach.

Sensitive
Indicators should be sensitive to show trends and, where possible, permit distinction between human-induced and natural changes. Indicators should thus be able to detect changes in systems in time frames and on the scales that are relevant to the decisions, but also be robust so that measuring errors do not affect the interpretation. It is important to detect changes before it is too late to correct the problems being detected.

Representative
The set of indicators provides a representative picture of the pressures, biodiversity state, responses, uses and capacity (coverage).

Small number
The smaller the total number of indicators, the more communicable they are to policy makers and the public and the lower the cost.

Aggregation and flexibility
Indicators should be designed in a manner that facilitates aggregation at a range of scales for different purposes. Aggregation of indicators at the level of ecosystem types (thematic areas) or the national or international levels requires the use of coherent indicators sets (see criteria 8) and consistent baselines. This also applies for pressure, response, use and capacity indicators.

Step 4: Definition of the information flow: *how* should the monitoring be carried out? This refers to the different methods that can be applied, such as transects, interviews, observations, etc.

Step 5: Definition of responsibilities, required means and costs: *who* is responsible for the monitoring? This also refers to participatory aspects, which will be treated in the next section.

Step 6: Analysis of data.

3.10 STAKEHOLDER INVOLVEMENT AND INDICATORS

What is meant by participation?

The term participation is commonly used but different people mean different things by participation, so it is important to specify what type of participation is wanted. 'Participation' can be interpreted in a range of different ways, including, in order of increasing intensity and equality of exchange, information gathering, consultation, participation for material incentives, functional participation, interactive participation and self-mobilisation. Others propose a 'participation ladder' based on a sequence of three criteria:

- Openness regarding the content (room for new ideas)
- Transparency regarding the process
- Openness of the arena (for multiple actors)

As these characteristics improve the participation becomes more equal. Indicators can be associated with these different levels of participation.

Why is participation important?

The reasons for participation when working with indicators in coastal zone management are:

1. To obtain different views on IMCAM and identify appropriate indicators
2. To improve the enforcement of legislation and strengthen institutions
3. To raise the level of support for and efficiency of project implementation
4. To raise awareness, create insight and solve conflicting interests
5. To bring together stakeholders with different views and stimulate stakeholder exchange.

Box 18: The following table contains some principles and indicators for successful co-management

Principles	**Indicators**
Local communities have one voice	• Level of organisation • Number of conflicts • Clarity of rights and responsibilities
Clear boundaries to IMCAM	• Boundaries accepted by all stakeholders • Boundaries supported by legislation • Boundaries respected by stakeholders
Sufficient human, social and financial resources for co-management	• Level of education • Expertise for all co-management functions • Volume of available funds
A legitimate structure within which local communities and the state can meet and negotiate	• Negotiation platform supported by legislation • Democratic decision-making procedures • Formal arrangements between all parties
A favourable policy and legal context	• Number of management tasks devolved • Tax and revenue systems for local management
Positive expectations and outcomes from the co-management arrangement	• Positive perceptions by parties • Benefits from co-management for all parties • Shared vision between all parties • Trust between all parties involved

The most important form of participation is to have stakeholders from the public and private sectors identify appropriate indicators that they can measure by themselves. This reduces costs and involves stakeholders in project implementation, while raising awareness at the same time. Stakeholders should also be involved in setting realistic targets, which contributes to a sense of ownership and commitment. Local stakeholders often have profound knowledge of certain indicator species (e.g. a fish species that is highly sensitive to pollution).

In general, participation and co-management should become the norm for IMCAM. Co-management is about shared responsibilities for various IMCAM policy functions, such as planning, implementation, monitoring and communication, all of which can be shared responsibilities for reasons of efficiency, effectiveness and accountability. Co-management can also ensure the effective use of indigenous knowledge and resource management practices.

Who should participate?

There is a general recognition that participation should include:

- The civil society, including local communities. Care should be taken that community-based organisations and NGOs really represent local people, are trusted and do not just promote their own agenda.
- The public sector, including government authorities, agencies and institutions from different sectors. Care should be taken that their formal plans, conventions and rules are respected.
- The private sector, particularly key actors currently influencing coastal management.

It is important not to involve all stakeholders, which would be far too costly and time-consuming, but it is critical to select a number of priority stakeholders. Selection criteria may be power, information, dependency, and relevance. Some examples:

1. At the local level it is important to know who is in charge. In some cases urban people far from the location own the fishing boats and decide where and when fishing takes place, not the fishers.
2. Local fishers may depend on other actors in the marketing chain for loans and contracts. A stakeholder analysis will show who really pulls the strings.
3. Examples of critical stakeholders are port authorities, municipal councils, water agencies, etc. In many coastal areas sewage is the main source of pollution and institutions dealing with water and sanitation must be involved.
4. Global actors (multinational corporations) may play an important role. In coastal areas fishing boats operating at a global scale may be responsible for overfishing. Financial institutions make funds available to develop port or tourist facilities, with potentially negative impacts. If these stakeholders can be persuaded to adopt more sustainable policies, the benefits can be considerable.

Risks

Stakeholders may provide false or unreliable information on indicator values if their interests conflict with those of other stakeholders. The risk of this happening can be overcome if different parties make independent indicator measurements and these are then compared, although this will increase costs. However, if participants have conflicting interests, participation (e.g. through joint monitoring) can be an opportunity for them to openly discuss apparently conflicting interests and understand each other's positions. For instance, joint monitoring may reveal different interpretations of overfishing. One group may consider standards and quota setting to be a biological imperative and another simply a case of adhering to quotas. Another problem is that participants may have to be trained or coached before they can operate effectively by themselves, and this could take some time. Participation is often considered a way to obtain quick results through a process of bargaining or compromise, but this ignores the fact that outcomes may have long-term consequences.

The potential for participation depends on the local political, cultural and historical context (e.g. stakeholders may be frustrated if their expectations of earlier attempts at participation were not met), whether there is a tradition of transparency and open debate or not, and whether there are severe conflicting interests between stakeholders. Participation should be well planned and placed in its context.

How and when

Participation must start in the early phases of ICM planning and formulation as part of a dynamic process. A communication plan can provide a useful framework for identifying how and when participation exercises will be useful. A good stakeholder analysis in the early stages of planning and formulation is essential for selecting stakeholders for participation. When involving stakeholders in monitoring activities, it is advisable to use methods and tools appropriate to each stakeholder; for example, simple observation sheets for fishers, computer programs on product sales for traders, or socio-economic statistics for local authorities. It is important to ensure that every stakeholder group has a role to play, and not to focus on a strategic partner or stakeholder group. Only when all stakeholder are involved one might expect a high level of interaction and equality (see Box 19).

3.11 THE WAY FORWARD

The log-frame and the DPSIR frameworks are two commonly used structured frameworks. The linkages between the two are explored further in the next section. As a generalisation, structured frameworks like these, which emphasise causal linkages between activities, consequences and management actions, are useful as a starting point to stimulate logical reasoning. However, they should not be applied strictly and local communities should be consulted to make use of local knowledge and local values. What matters in every case is that the supporting scientific capacity is judged correctly when the framework is developed, and that all parties with the power to make the management programme a success or a failure are included in the framework. There may be several routes for turning the available knowledge into indicators that can make management effective at achieving the goals of the Convention on Biodiversity.

Criteria are required to select a limited set of useful indicators that cover the range of issues to be measured and inform the different audiences involved in IMCAM. Ideally, a mix of well-structured criteria and a process of consensus building involving different stakeholders should be used. Indicators that have been selected in a systematic way and with stakeholder involvement will provide a sound basis for informed decision-making, adaptive management and dialogue between individuals and groups with different values and goals. This in itself is a major accomplishment.

Box 19: Tanga Coastal Zone Conservation and Development Programme (TCZCDP)

Under the Tanga Coastal Zone Conservation and Development Programme (TCZCDP), collaborative management plans for coral reefs and fisheries were formulated by the villagers of Kigombe and Kipumbwi and local government officers to address the problem of declining fish yields and incomes. The division of tasks and responsibilities for the monitoring system were specified in advance, with an emphasis on the local communities. This approach was successful in obtaining agreement between government and users on what should be done and who should do what. However, villagers' expectations of government are too high and some government officers outside the programme remain cynical about the villagers' ability to undertake their allocated activities. Nevertheless, enforcement has been successful, largely due to the villagers' efforts, which has led to a more positive attitude among those officers directly involved with implementing the programme.

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4. RESTORATION OF HABITATS

4.1 HABITAT DETERIORATION

Change is a natural phenomenon in all ecosystems and habitats. As ecosystems change, species shift roles and functions. Darwin originally proposed the idea that species richness produces ecological stability in 1859. Presently, it is well accepted that over ecologically brief periods, increased species richness (biodiversity) increases the efficiency and stability of some ecosystem functions, resilience. However, within the timescale of the past generation, human population growth and migration, particularly into coastal zones, have progressed at unprecedented rates and have been the most significant factors behind the current levels of environmental degradation and deterioration, which has undermined the resilience of ecosystems.

Approximately half of the World's wetlands and over half of the World's mangroves have been degraded. Nearly 60% of the World's coral reefs are degraded or threatened with degradation. Within this context, it is important to recognise that deterioration of habitats can originate from direct over-exploitation of resources and from reclamation of land, for example mangrove to aquaculture. The current rate and intensity of resource exploitation and alteration of habitats is overwhelming natural processes of buffering and amelioration of change. This has led to the failure of natural regenerative processes, leading to a loss of biodiversity and an associated loss of ecosystem functionality. To reverse these trends intervention in the form of rehabilitation and restoration is required to accelerate processes of recovery and re-creation of habitats so that ecosystems can continue to provide goods and services. In coastal zones this rehabilitation of natural ecosystem function and services can prove extremely valuable for societies and economies (see Box 20 below).

Box 20: The value of natural coastal defences in the United Kingdom

The UK Department for Environment, Food and Rural Affairs has recently evaluated [the costs of maintaining coastal defences in England and Wales. In the UK, climate change poses the greatest threat of flooding of coastal areas. Without any flood and coastal defences, the annual average economic damage from flooding and coastal erosion would be over £3.5 billion per year. This estimate is based on the following facts:

- Approximately 10% of the population of England and Wales live within areas potentially at risk from flooding or coastal erosion and approximately 12% of the agricultural land is also located in these areas.
- Property worth over £220 billion and agricultural land worth approximately £7 billion is located within the areas potentially at risk.
- The capital works and maintenance investment that is needed to provide and maintain present defence standards is in excess of £0.3 billion per year.
- Accommodating climate change is likely to require a further increase in investment of between 10% and 20% over and above that required to meet indicative standards under present day conditions.

Guiding approaches and principles

Three categories of habitat deterioration can be identified:

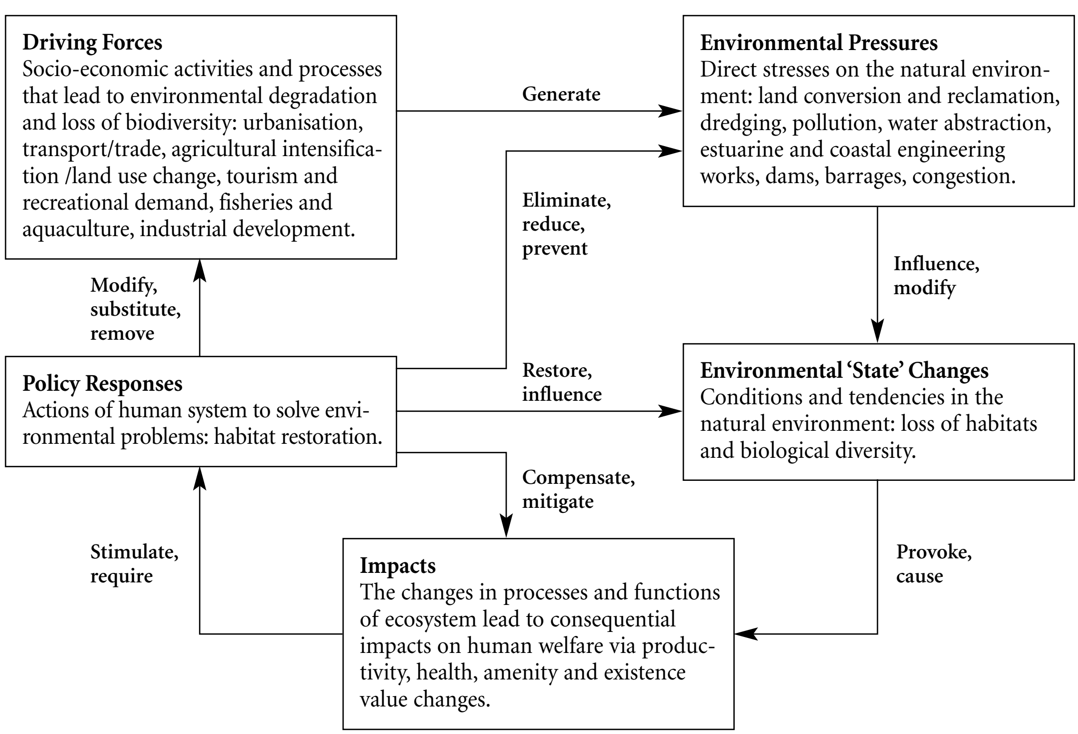
- **Habitat degradation** involves loss of environmental quality and the ability to support biological communities. Its adverse effects can be immediate or cumulative.
- **Habitat loss** is the outright destruction of a habitat. Its impacts on biological communities are immediate and catastrophic.
- **Habitat fragmentation** is a result of habitat loss and is the disassembly of habitats into discontinuous, often isolated, patches. Its adverse effects are cumulative and not immediately noticeable.

Management interventions to remedy the impacts and effects of habitat deterioration are generally categorised by the planned end-point:

- **Rehabilitation** is where the functional characteristics of an ecosystem or component are re-established.
- **Restoration** is where the ecosystem, or one or more of its components is re-established in its original condition. In this document the terms 'restoration' and 'rehabilitation' are used interchangeably.

The principle barriers to restoration, and hence the incorporation of biodiversity objectives, is not the technological and mechanical aspects of habitat restoration, but rather the process of policy and decision-making needed to plan and implement restoration goals. For habitat restoration to be successful IMCAM needs to provide suitable guidance on building partnerships and consensus among the plethora of agencies and stakeholders involved. Interestingly, none of the experts consulted questioned the role and importance of biodiversity issues in achieving successful habitat restoration. Perhaps biodiversity—and the implied gains resulting from habitat restoration and losses resulting from habitat destruction—could in itself be a useful tool for building consensus if the objectives are presented in a careful and suitable manner. Full consideration is given to ecosystem, governance, sectoral and technological issues within a decision-making framework is the Driver-Pressure-Impact-State-Response (DPSIR) framework, illustrated in Box 21. This is a general framework for organising information about the state of the environment, (see also section 3.3 on DPSIR) which assumes cause-effect relationships between interacting components of the social, economic and environmental systems. Each component in the DPSIR generates a demand for information from different stakeholders, particularly from policy makers, but also from scientists, educators, advocacy groups and the civil society.

Box 21: The Driver-Pressure-State-Impact-Response (DPSIR) model for restoration



Restoration is a form of active management that tries to return a system to stability. Guiding approaches and principles for restoration programmes are:

- Monitoring of successional processes, timescales and sensitivity of species
- Multi-level management, with a particular focus on community management
- Multi-sectoral approaches to ecosystem restoration that recognise the multiple functions of resources
- Strive for complete and integrated scientific knowledge of marine biodiversity

These guiding approaches should be considered when traditional single sector/discipline approaches do not work because they (i) presume system equilibrium and constancy, and (ii) do not account for variability and complex relationships, which leads to unpredictability and a tendency to break systems into parts, resulting in 'narrow' conservation. In practice, a 'fix' may not be sustainable in the medium to long term and often produces a suite of 'new' problems on the site in question and/or elsewhere. A unique feature of human interactions is that they create novel environmental states in a short time compared with natural processes. The alternative is adaptive management that acknowledges the changes that humans make and must respond to, and which encourages partnerships between the public and private sectors for co-management of activities that promote wider ownership, responsibility and stewardship of the environment.

4.2 THE ROLE OF IMCAM IN RESTORATION

IMCAM is an instrument that supports an adaptive management approach and leads to more successful restoration of habitats because it seeks to unite government and community, science and management, and sectoral and public interests. An important outcome of this approach is that the goals of restoration can be tailored to local and regional needs. This is because adaptive management inculcates a series of principles that recognise natural processes, resource exploitation and conflicts resulting from interactions between multiple users within a habitat context.

However, recent analyses of IMCAM literature and an on-line discussion (http://www.aidenvironment.org/projects/A1025/) suggest that technology for the engineering of habitat restoration has been advanced particularly in North America and Europe. In contrast, there appears to be a relative absence of habitat restoration programmes outside North America and Europe. Therefore, the challenge for IMCAM is to provide support for project design, management and modalities of implementation for Habitat restoration.

IMCAM explicitly seeks to develop a holistic process that integrates all components of the coastal system community: the state, the market and the environment. Barriers to achieving this appear to have their origin in issues of ecological function and change in time and space, the governance of the coastal landscape, single sectoral approaches and the integration of multi-sector and multi-discipline technologies. A theme running through all of these issues is the incorporation of humans within the coastal landscape instead of as spectators.

4.3 ECOLOGICAL FUNCTIONS OF HABITATS—SCALE (TIME AND SPACE) AND CHANGE

When restoring degraded landscapes it is important to understand the underlying physical and ecological processes within the system so that we know where the landscape has 'come from' and where the 'natural' processes were taking it. This recognises that ecosystems are variable and are constantly changing in time and space. If restoration 'challenges' the direction of natural processes, the result may be a system that is even less able to provide natural goods and services. One way of overcoming such potential problems is to consider the area to be restored from a landscape ecological perspective in which each component of the system is described in relation to the role and function of adjacent components. This allows us, for example, to restore one component in such a way that it can buffer or mitigate pressures on and changes in other components of the landscape.

It is important to encourage a participatory approach to facilitate management at the community level, to gain an understanding of the underlying reasons for habitat change and to understand the impacts on human uses. Future uses and development should be planned in such a way that they promote good stewardship and sustainable use of the natural resources and support habitat restoration. We need to 'sell' the benefits of the restoration activity and support the changes to community practices that are required—especially where the exploitation of resources is concerned.

Our understanding of the relationship between communities and ecosystems is often confused by a lack of appreciation of the heterogeneity of communities and the often-contradictory needs and desires of different groups. Community management includes the task of convincing all stakeholders that compromise and adjustment is essential and those concepts of win-win or win-lose are too simplistic. Participation is habitually too confined to the community–state axis to the exclusion of the market, which often provides the strongest drivers for the interactions between humans and their environment. An example of the need to understand ecosystem functioning from the perspective of the use of natural resources is given in Box 22.

4.4 LINKING ECOSYSTEM FUNCTION TO THE HUMAN DIMENSION

A key feature of habitat restoration is that it depends on cooperation and understanding between different stakeholders. Particularly the linkages between the technical expertise and the understanding of ecosystem functioning on one hand and the governance on the other hand is crucial for enabling any restorative activity (see Box 23).

Box 22: *Melaleuca leucodendron* Wetlands, Vietnam

The coastal system
The Mekong Delta in Vietnam once possessed extensive areas of freshwater *Melaleuca* wetland forest. This provided many different forms of renewable resources, including wood products, honey, game and medicinal plants, and important environmental services such flood mitigation, breeding and nursery areas for fish and rare and endangered species of birds. The wetlands have been altered by the application of herbicides, draining, burning and mechanical clearance of vegetation, both for agricultural purposes and resulting from the effects of war. The primary obstacles to successful rehabilitation were 1) the lowered water table, which exposed the underlying potential acid sulphate soils (PASS), which has led to the acidification of water drained from the wetlands, the groundwater and the soils, 2) continuing pressures on land to meet the needs of landless farmers and the production of food crops, and 3) use of the drainage canals as waterways for transport.

Alternative approaches to rehabilitation
From an agricultural perspective (rice cultivation), rehabilitation of the ecosystem by further drainage and flushing of acids from the soil is adequate. While technically feasible, this does not address other issues, such as the impact on fisheries, domestic water supplies, the loss of economic resources and environmental services, and the impact of flooding hazards. An alternative, holistic approach seeks to integrate the rehabilitation of the hydrology and functions of the wetland forest system with a mixed cropping and forest product management system. This approach builds on and modifies a model that divides the degraded wetlands into 10-hectare units: 7.5 hectares devoted to replanting *Melaleuca* and 2.5 hectares allocated to agriculture. There was no significant modification of the hydrology, canals were retained to form firebreaks and the agricultural system was based on paddy rice. This approach seeks to re-establish the functions of the wetland forest system while meeting the needs of different economic interests. Examples include forestry and the production of primary and secondary forest products, agriculture in which farmers can take part in integrated agro-silviculture systems, fisheries, flood mitigation and nature conservation.

Box 23: Rehabilitation of wetlands reclaimed for shrimp aquaculture in a Development context

Over the past 20 years there has been a major expansion of brackish water shrimp aquaculture along tropical coastlines in South-East Asia, Latin America and, to a lesser extent, Africa. Mangrove forests are favoured for shrimp pond development, with a consequent loss of this habitat. While there have been economic gains, there have been corresponding negative economic and ecological impacts. The impact of these losses is often borne by people living in rural communities who have no say in decisions to clear mangrove forests, while the economic benefits are often gained by wealthy investors from urban centres.

Factors influencing the sustainability of shrimp culture

The sustainability of brackish water shrimp culture depends on high standards of site selection, pond preparation, water management, hygiene and disease control, and economic considerations.

Key points for sustainable restoration

A. Ecosystem functions and multiple use management of coastal ecosystems.
Mangroves, like many coastal ecosystems, perform many environmental and economic functions that help to sustain a wide variety of human activities. However, they are often the responsibility of single sectoral agencies that focus on the more tangible resource features, such as the trees and secondary forest products, to maximize product related revenues. In addition, the single sector mandate gives little incentive to protect ecological functions of value to other sectors, such as fisheries, leading to low incentives to maintain or rehabilitate the mangrove.

B. Integrated planning and management.
Management of mangrove and other coastal systems is generally poorly developed in both developed and developing nations. Consequently, the flows of economic and environmental resources are not used in the most sustainable way. A multi-sector approach is required to illustrate the broad range of economic, ecological and social benefits that could be gained by rehabilitating degraded mangrove. This should involve cross-sectoral governance and harmonisation of policies and strategies for natural resources management.

C. Land rights.
Reclamation of mangrove, salt marshes and other intertidal systems is seen by many entrepreneurs and landless people as a way of gaining land. While it is possible to insist on a strictly legal process of evicting squatters or developers, more may be gained by treating these people as stakeholders and integrating them into the rehabilitation process. This reduces resistance, delays and costs and people become part of the solution.

4.5 GOVERNANCE

In the context of IMCAM, 'governance' extends beyond comprehension of the 'institutions, rules and systems of the state and how they operate and relate towards those they seek to govern' to include the ecosystem. This is because IMCAM focuses on interacting ecological, economic and social components to understand societal goals and design mechanisms by which institutional structures and processes can lead to sustainable management of the coastal zone and activities. A defining feature of IMCAM is that it addresses the allocation of resources and the interactions between often competing uses within specified geographic areas so that participation by many stakeholders and their property rights are included in the governance process.

For governance to be effective, communities affected by restoration projects should be included within the process of governance to make the decision-making process accountable. This promotes ownership of the outcomes and good stewardship of the resources, goods and services provided by the environment, which are almost always shared between different stakeholders. The 'Delta Works' in the Netherlands are an example of the evolution of a process of governance that led to a change in the way decision making is applied to ecosystem management (see Box 24).

Box 24: Biodiversity and flood protection, The Netherlands

After the disastrous floods of 1953 the Dutch began to lay plans for the 'Delta Works', a series of dikes and dams that would complete the North Sea flood defences. However, by the middle of the 1960s a small number of Dutch citizens had become concerned that by creating a wall between the salt water of the sea and the fresh water of the river deltas. These barriers had disturbed and largely destroyed the tidal ecologies and biodiversity of the estuaries. In the Eastern Scheldt Delta a complex food web supports a high diversity of organisms, ranging from plankton to birds. The Eastern Scheldt Delta is one of the three most important overwintering grounds for birds in Europe.

A combination of **political will and technological ingenuity** created a way for the Dutch people to meet the needs both of safety and of the environment. The political forces included small pressure groups and politicians who recognised that, in addition to issues of ecology and of safety, there were matters of economy and of quality of life that affected fishing, shellfishing and tourism industries.

The technological piece of the solution was founded on a simple observation: the threat of flooding is intermittent. In fact, flooding along the North Sea coast of the Netherlands can only be caused by 'storm surges'. If a dike could be designed that could be shut when there was a threat of a storm surge, and for the rest of the time could be left open, the tides would continue to come and go and the Delta's ecology would remain essentially intact. Safety, environment, and economy would be protected. Sixty-six giant towers with steel gates between them now stretch across 5.6 miles of seabed. Although the new design cost twice as much as a conventional dike, it successfully protects the tidal environment. Moreover, economic activities in the area, such as fishing and tourism, can continue and help to offset the higher cost.

4.6 THE ROLE OF STAKEHOLDERS

It is particularly important to develop mechanisms for dialogue and understanding between primary stakeholders (those individuals and groups who are ultimately affected by an activity, either as beneficiaries, i.e. positively impacted, or disbeneficiaries, i.e. adversely impacted), secondary stakeholders (individuals or institutions with a stake, interest or intermediary role in the activity) and key stakeholders (those who can significantly influence or are important to the success of an activity). This is a crucial prerequisite for promoting a climate in which management measures necessary to sustain the restoration outcomes are accepted and may include ceding some legislative authority to local organisations or institutions. A further critical component is the issue of property rights that encompasses a space within the landscape and/or the resources within that space. Property rights may be linked to the power of an individual stakeholder and its relative needs. This can mean that there may be external (to the restoration activity) pressures to any given stakeholder group that may lead to a weak voice, but which does not necessarily mean that they have no interest or claim in the activity and outcomes. Indeed, pressures externals to those operating within the realms of the restoration activity are important factors that should be considered within the management process. An example of the demands of governance and competing demands is given in Box 25.

4.7 SECTORALISM

The challenge of ensuring that all sectors are represented in the restoration process centres upon the inclusion of all stakeholders within the restoration process and the integration of secondary stakeholders (in this case those that design and implement the project) in the restoration activity. This requires a holistic approach that brings all the various stakeholders together and promotes their inclusion in the restoration process. This suggests that stakeholders are an integral component of the mosaic of nature that makes up the landscape. It also recognises that there may be conflicts and competition between the agencies involved in restoration projects

Box 25: The Wadden Sea-development of integrated governance, the Netherlands

The ecosystem and the human activities it sustains

The Wadden Sea is one of the World's largest and most important intertidal wetland ecosystems and is of great ecological, economic and social importance. This complex mosaic of coastal ecosystems (mud flats, sand banks, sea grass beds, salt marshes, mussel beds, islands, estuaries and river systems) contains great biological diversity and is highly productive and is an important habitat for migrating birds as well as spawning, nursery and feeding areas for fish. Its landscape provides renewable resources that sustain a wide range of economic activities, from fisheries to tourism and recreation.

Governance

Three countries share responsibility for this ecosystem: Denmark, the Netherlands and Germany. Growing awareness of the unique and valuable nature of the Wadden Sea, coupled with mounting concern about deteriorating environmental conditions, resulted in a trilateral agreement for the development of a unified vision for the future of the sea, the harmonisation of national development objectives and policies, better integration of management strategies and the application of ecosystem management.

Achievements and obstacles

The three Wadden Sea nations have set an example for the transnational governance of a common ecosystem. Significant progress has been made towards achieving the objectives and a major part of the Wadden Sea now enjoys strong environmental protection. Multiple use management is being adopted by the three states, which are also attempting to unify their interpretation and effective use of international agreements that can strengthen the protection of coastal and marine ecosystems (e.g. EC Habitats Directive, Ramsar Convention, Bonn Convention, Berne Convention, EC Birds Directive, EU Recommendation on Integrated Coastal Zone Management, and the EC Water Framework Directive). However, there are factors that hinder full integration and rapid harmonisation:

1. Three different legal systems for managing the Wadden ecosystem.
2. The concept of sustainable development has not been fully translated into working management objectives and achievable targets, or a common policy on how the concept should be implemented.
3. Distinctly different management approaches and jurisdictional boundaries have been adopted in each of the three nations. While each is appropriate to its respective legal and governance systems, there are few common principles for guiding and, where necessary, controlling development activities.
4. None of the three management systems has real control over issues and problems outside their jurisdictions (e.g. diffuse land based sources of pollution).
5. Differing development pressures and attitudes influence the application of controls over individual rights of access to and use of the resources of the Wadden Sea.
6. Strong pressures from different resource users to avoid restrictions on economic activities.
7. Different opinions on the sustainability of large-scale engineering modifications to marine and coastal areas for coastal defence and infrastructure development.

for ownership of the landscape and resources within the restoration area, which often result in implementation by just one agency.

Sectoral barriers to restoration

Where single-sector agencies implement restoration projects the results are often not ecologically sound and so ecosystem function is not re-created. A multi-sectoral approach is needed which can promote a process that enables restored habitats to behave in a 'natural' manner within the broader landscape. The functionality of ecosystems should include the present needs of stakeholders as well as the suite of functions that any given piece of landscape might have provided prior to degradation. To this end, biodiversity is an integral component of a wide range of descriptors that determine the functionality of an ecosystem. These descriptors are an essential and fundamental element within restoration.

The resulting complexity may become a barrier to successfully restoring habitats that requires huge resources to overcome. If this problem is not resolved, restoration becomes a case of building consensus between competing groups in which the effectiveness of the outcome becomes diluted in the process of reaching a consensus. This is particularly important where the issue is the degradation of habitats and biodiversity in urban areas, where the planning process may not take the natural environment and resource availability properly into account. There is a major role here for sound scientific thinking to maintain a clear focus and come up with rigorous arguments (see Box 26).

4.8 TECHNICAL METHODOLOGIES AND MECHANISMS

Technology is not a major barrier to effective restoration. What can be a problem, though, is combining different technologies—which often originate from different actors in the process—to achieve a common goal.

In relation to this, any IMCAM support measure should be based on an assessment of the financial and ecological implications in the short and long term. For example, the restoration of a particular habitat may be very costly and the only major short-term benefits may be ecological and not economic. However, the longer-term economic benefits may be considerable if the restoration allows a more sustainable economic use of resources because the

Box 26: Rehabilitation of the mangrove wetlands in the Indus delta, Pakistan

Context

The Indus delta extends over some 225 square miles [585 km2] and was once colonised by a variety of different mangrove species. However, the number of species started to decline in the 1960s and by the 1980s Avicenia was the dominant species. The perceived loss of biodiversity led to major replanting schemes with the aim of re-establishing the former diversity of mangrove species. Replanting schemes were led by the Forestry Department, supported by NGOs and donors, who planted species that had disappeared in the specially prepared sites.

Obstacles to successful restoration

The replanting schemes had limited success because the major impoundments and water abstraction in the river system had, over the years, altered the hydrology and sediment budget of the estuary. This change in environmental conditions caused a number of conditions:

1. The reduction in sediments and organic material has altered the morphology of the delta to the point where it is subsiding, possibly exacerbated by regional sea level rise.
2. Reduction in freshwater flows has increased the salinity of the delta waters and soils.
3. Contamination of the freshwater by agricultural and other wastes has altered the chemistry and nutrient budget if the estuary and delta.

Together, these factors have added to the environmental stress on the mangrove. As a result, the species that are less tolerant of deep water, long periods of inundation and increased salinity cannot survive. In contrast, species such as *Avicenia marina* are better adapted to such stressful conditions and often form the first colonisers along prograding shorelines with muddy substrates, making them better adapted as survivors when conditions deteriorate.

Lessons Learned

1. A broad systems perspective in which major environmental processes are analysed to determine the root causes of decline in the health, productivity and biological diversity of a coastal system is essential to the formulation of sustainable strategies for their rehabilitation.
2. It may not be feasible to re-establish former levels of biodiversity due to the irreversible conditions caused by competing development objectives and pressures.

system as a whole is more resilient. Habitat restoration may also be a way of preventing long-term economic losses. Traditional activities may have already altered the landscape and restoration may require reversing these processes and so restoration must aim for resilience in the system itself and in human organisational structures. This may require more interventionist approaches for more heavily degraded habitats.

Tools that provide an auditable mechanism for rationalising and appraising different approaches can be used to develop an efficient and equitable management programme in which the outcomes provide incentives for the different actors to provide appropriate inputs to the restoration process. One such mechanism is managed re-alignment, which seeks to re-establish the buffering capacity of natural coastal ecosystems for coastal protection, while incorporating local social and economic requirements. It attempts to use technological innovation and expertise within a broad planning environment. This approach is illustrated by the example of Nigg Bay in Scotland (see Box 27).

Box 27: Managed realignment, Nigg Bay, Scotland

The coastal system

The wetlands along Nigg Bay have been reclaimed for agriculture but as the sea level rises it is eroding the sea walls protecting the reclaimed land. At the same time, the sea walls prevent the natural adjustment of the shoreline through the creation of mudflats and salt marshes. The low value of the agricultural land reclaimed from the former salt marsh and mudflats makes it uneconomic to continually repair and strengthen the sea wall. At the same time, there is increasing public awareness of the environmental services provided by mudflats and salt marshes, including their role in helping to conserve biological diversity and in reducing the risk of coastal flooding. As a result, there is increased public support for innovative measures to rehabilitate reclaimed coastal habitats.

Rehabilitation through Managed Realignment

The Royal Society for the Protection of Birds (RSPB) has purchased 25 hectares of reclaimed land for rehabilitation by breaching the sea wall. Before any action was taken, the RSPB discussed their rehabilitation plans with all adjacent landowners to gain their consent, and consulted community groups and local NGOs to explain the proposed actions. The area now forms a buffer zone that absorbs wave and wind energy, which reduces pressures on adjacent shorelines. This has led to a saving of about 4200 euros per kilometre in the public costs of maintaining sea defences in other parts of the bay.

Key technical considerations

1. Managed realignment and rehabilitation of reclaimed areas can form a cost-effective and environmentally sound alternative to hard engineering and inflexible and costly coastal defences.
2. There are economic and social benefits to be gained from re-invigorated coastal ecosystems that can absorb the high energy from winds and waves, which help to reduce erosion and coastal flooding.
3. Coastal systems such as beaches, sand dunes, mudflats and salt marshes will be able to migrate shoreward to accommodate sea level changes;
4. Public consultation is essential to ensure that the managed realignment and rehabilitation of former coastal systems, as an alternative to hard defences, is fully understood by all interested and affected parties.
5. With managed realignment, there is time to consider alternatives and to plan for relocation of development that may become increasingly vulnerable to environmental changes.
6. To be fully effective, managed realignment and coastal and marine habitat rehabilitation needs to be considered within a broad planning and management framework in which the plans, management strategies and investments by different sectors and levels of governance can support integrated coastal management. The EU Water Framework Directive and the EU Recommendation on Integrated Coastal Zone Management are powerful tools that can help governments formulate policies and sustainable management strategies to deal with rising sea levels and the hazards associated with coastal flooding and erosion.

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5. INCENTIVES

5.1 GENERAL INTRODUCTION TO OPPORTUNITIES AND CONSTRAINTS

Article 11 of the Convention on Biological Diversity (CBD) states that:

"Each Contracting Party shall, as far as possible and as appropriate, adopt economically and socially sound measures that act as incentives for the conservation and sustainable use of components of biological diversity."

As well as a further reference in Article 20, this commitment to incentives has been re-iterated in a string of decisions and recommendations by both the COP and SBSTTA. These guidelines are designed to assist resource professionals in using incentives to integrate the objectives of the CBD—specifically the conservation of biodiversity and the sustainable use of its components, into integrated marine and coastal area management (IMCAM).

A range of information papers and notes have been prepared in support of SBSTTA and COP that refer to both incentive measures and marine and coastal ecosystems, and various COP and SBSTTA decisions and recommendations have been made which also relate to these.

5.2 WHAT ARE INCENTIVES AND WHY USE THEM?

Defining incentives

Incentives can be defined as inducements, which are specifically intended to incite or motivate governments, local people and organisations to act in a certain way. The basic aim of an incentive for biodiversity conservation would be to induce people to conserve or sustainably use, as opposed to degrading or depleting biodiversity in the course of their activities.

A programme on incentive measures typically includes three components: formal policy instruments, social and institutional measures, and compliance mechanisms. An incentive is created and reinforced by the interaction of these three aspects of the institutional environment governing resource use, rather than by any single measure operating alone. These three aspects are described below in Box 29.

Incentives are usually seen in terms of five broad types: economic, legal or regulatory, communication, social and cultural and institutional (Box 30). It is usually essential that these incentives are used in combination, in order to address different types of biodiversity threats as well as to respond to the different motivations that influence people's behaviour.

Box 28: Categories of incentives

SBSTTA 7 (11) identified four categories of incentive:

Positive incentive
measure designed to encourage beneficial activities e.g. incentive payments for organic aquaculture, relatively lower tax rates on biodiversity-conserving products and technologies

Disincentive
mechanism that internalises the costs of use of and/or damage to biodiversity e.g. non-compliance fees, environmental penalties and fines

Indirect incentive
mechanism that affects potential changes through variables other than changing the levels of potential damage directly e.g. trading mechanisms that improve markets such as emission trading schemes

Perverse incentive
measure that induces unsustainable behaviour that reduces biodiversity e.g. subsidies to biodiversity-degrading sectors or technologies

Box 29: Components of a programme on incentive measures

- Formal policy measures include economic and legal instruments, regulations, and public investment;
- Social and institutional measures include information provision, capacity-building and stakeholder participation.
- The compliance component of a programme on incentive measures may include measures to encourage both socially enforced compliance and legal enforcement.

Box 30: Different types of incentives

- Economic: Instrument designed to make it worthwhile in economic terms for individuals and organisations to conserve or sustainably use biodiversity
- Legal / regulatory: Command and control mechanism that use the force of law to ensure the conservation and sustainable use of biodiversity
- Communication: Measures that provide learning experience and knowledge appropriation, technology and know how.
- Social and cultural: cultural norms and social conventions.
- Institutional incentives: Measures that provide the necessary tools for coordination and interaction among different institutions in charge of biodiversity management. These instruments guarantee participation mechanisms and local community responsibility in the management of the natural resources and biodiversity.

Although each of the groups of incentives plays an important role in conserving and sustainably using biodiversity in the coastal area, the main focus of these guidelines will be on economic incentives. The primary reason for this being that economic incentives are a key tool in achieving the objectives of the CBD as economic factors lie at the heart of biodiversity loss in the coastal zone.

In brief, economic incentives aim to make it worthwhile in economic terms for people to conserve biodiversity (or economically unattractive to degrade or deplete it), for example working through people's consumption and production opportunities, profits or livelihoods or through economic policies, prices and market mechanisms.

Economic activities impact directly on biodiversity through using up non-renewable resources, by converting resources and habitats to other uses and by adding waste and effluent to the environment. In turn, the fact that prices and markets are often distorted and under-value biodiversity, because they fail to reflect the full benefit of biodiversity conservation or the full costs of its degradation, constitutes a major underlying or root cause of biodiversity loss. All too often it remains more profitable or economically desirable for people to degrade marine and coastal biodiversity rather than to conserve it.

A wide range of structural economic factors—such as widespread poverty and inequity, or unsupportive trade and economic policy arrangements exacerbate these trends. In addition, there is always an economic cost to marine and coastal conservation, including the direct physical expenditures of implementing conservation activities, as well as the opportunity costs of alternative (biodiversity-depleting) activities foregone and the indirect costs of possible congestion effects on other sites and stocks that remain available for unrestricted use and development. As long as these costs outweigh the economic benefits of conservation for particular groups or sectors, marine and coastal biodiversity is likely to continue to be degraded and lost. The economic incentives presented in these guidelines are intended to ensure that all of the economic costs incurred in the use of biodiversity are fully reflected in the decision-making agenda of the user thereby discouraging degradation and exploitation of marine and coastal resources.

It is important to note that the economic issues detailed here are often particularly intense in the case of marine and coastal ecosystems. The boundaries of marine and coastal ecosystems are often unclear, markets and prices tend to be undeveloped, many natural resources are subject to open access or unclear ownership and management regimes, multiple sectors and activities impact on natural resources and ecosystems, and there is often confusion or overlap in the economic and development policies governing marine and coastal areas.

As well as improving the efficiency of the markets, economic incentives have a number of other advantages as mechanisms to encourage biodiversity conservation and sustainable use. As they usually rely on markets to function, they are by their nature cost-effective to implement and do not usually require a significant administrative capability to enforce. This can be of particular benefit to developing nations, which do not have either the funds or the capability to enforce extensive legal restrictions. Related to this point is the fact that some economic incentives such as charging systems can be revenue raising. Examples of the advantages and disadvantages of specific economic incentives are shown in Box 31 while Box 32 provides some case study examples of how economic incentives have been used in IMCAM around the world.

5.3 TYPES OF ECONOMIC INCENTIVES

There are numerous types of economic incentives, but they can usefully be placed in the following six categories: property rights, markets and charge systems, fiscal instruments, bonds and deposits, livelihood support and financial instruments. Although not an incentive as such, the removal of perverse incentives is also an important economic tool and is

Box 31: Advantages and disadvantages of economic incentives

INCENTIVE	ADVANTAGES	DISADVANTAGES
Property Rights	• reduce uncertainty over the ownership of the biodiversity "asset" • provide a long-term incentive to enhance the value of the resource • economically efficient to administer • create efficiency in pricing of the resource	• provide no "guarantee" that privately owned biodiversity will be sustainably used or conserved
Markets and charge systems	• create efficiency in pricing of the resource • economically effective—charging systems can raise funds • economically efficient to administer	• not all of the attributes of biodiversity can be easily priced in the market
Fiscal instruments	• economically effective—can be useful revenue raising tools • easily understandable • clearly promote beneficial activities and deter harmful ones	• economically inefficient—can be expensive to administer
Bonds and deposits	• economically effective—the financial risk is transferred away from the state	• may be expensive to administer
Livelihood support	• can ensure support for IMCAM goals—particularly in the transitional stage • economically inefficient—can be expensive to implement	• economically inefficient—can be expensive to implement
Financial instruments	• raise funds and allocate them to particular groups, sectors or activities related to conservation	• divert resources from alternative priorities
Removal of perverse incentives	• economically effective– can often be significantly revenue saving if subsidies are withdrawn • improves economic efficiency of market concerned	• often strongly opposed by interested parties • can be difficult to identify—lack of transparency

Box 32: Real-life case studies of economic incentives used in IMCAM
The use of economic incentives for marine and coastal conservation, St Lucia

Property Rights In a MPA in St Lucia, a collaborative management arrangement has been established between government and a community institution with the capacity to manage the park. Fees raised are placed in a separate government fund, which makes quarterly payments directly to the community institution for the management of the MPA.Markets and Charges

Biodiversity friendly markets and alternatives to degrading activities: In the Bazaruto Archipelago in Mozambique a number of new markets and enterprises (such as eco-tourism, permaculture, vegetable farming and support to artisanal fishing) have been promoted among local fishing communities as a way of stimulating sustainable biological resource use, and to compensate for the losses in land and natural resources incurred by the establishment of a National Park.

Tradable quotas: To reduce over-fishing, the New Zealand government issued tradable catch quotas on all fish harvested, allocated to individual fishermen. Fees were charged for these quotas, which could then be sold back to the government or to other fishermen. The scheme achieved a number of objectives: it set fisheries catch at a maximum level, protected the resource, raised revenues, increased efficiency, made fishing allocations more equitable and was self-financing.

Tradable development rights: Coastal areas of the Akamas Peninsula in Cyprus have been zoned by government as a non-development area. Developers, instead of being compensated for land loss, retain their rights to development but cannot exercise them on site. Rather, development rights can be traded for property in other areas or sold for cash to conservation groups.

Bioprospecting: Imperial Chemical Industries has acquired the rights to develop a number of coral reef pigments for use as sunscreens for humans, and in 1992 the Coral Reef Foundation entered into a 5 year contract worth $2.9 million for the supply of reef samples to the US National Cancer Institute for use in cancer screening programmes.

Fiscal Instruments Exports of crocodile skins, mainly to Japan, earns significant foreign exchange in Papua New Guinea. To comply with its obligations under CITES, and its own directives concerning sustainable resource use, a costly control and monitoring operation is mounted by the Department of Conservation. Taxes levied on exports provided an important source of funding for these costs.

Bonds and Deposits Since 1987, the Great Barrier Reef Marine Park Authority of Australia has required performance bonds to be posted for semi-permanent or temporary structures on the Reef. The bond constitutes part of a permit issued by the Authority, setting out the type of activity allowed and the location of that activity. For example, the permit may allow charter boat operations, tourism or waste disposal. Up to 1993 there were 33 instances where performance bonds had been required as a condition of permits. They ranged from $1,000 to $1 million. They are set on the basis of the expected costs of site rehabilitation. The larger bonds are adjusted annually in line with movements in the consumer price index.

Livelihood Support The Foundation for the Philippine Environment is working on the island of Bohol with communities who harvest Nipa (a palm-like species of mangrove whose leaves are used for thatching houses). The project has helped the community to organise themselves into an organisation which was granted stewardship rights over the mangroves, and is engaged in more efficient, value-added and sustainable mangrove utilisation activities.

Financial Instruments

Private investment: Chumbe Island Coral Park in Zanzibar is managed by a company formed specifically for this purpose. Incentives for private investment were provided by the government by allocating a lease and management contract to this company. While particular project components were funded by donor small grants and credit facilities, running costs are mainly covered by income generated.

Debt-for nature swap: The Jamaica National Parks Trust Fund was established in 1991 and capitalised in 1992 with money from a debt-for-nature swap. It is managed primarily as an endowment funds, making grants to two National Parks including contributing to the operating costs of Montego Bay National Marine Park.

Trust Fund: The Vanuatu Biodiversity Conservation Trust Fund, administered by the Pacific International Trust Company of Vanuatu, is designed to generate lease payments to landowners of the Erromango Kauri Protected Area who have foregone their opportunity to log the area. The sinking fund arrangement, begun in 1995, has a five-year life but may be further extended by the landowners through a perpetual fund under a 75-year lease. A prior assessment of the area calculated the lease payment which was the annuity equivalent of the revenue foregone from logging.

therefore included as an additional instrument at the end of this section.

Property rights: Measures, which allocate rights to own, use or manage biodiversity. By allocating well-defined property rights to biodiversity it is anticipated that the holders of the rights will aim at maximising the value of their property over time and will therefore be encouraged to manage their resource sustainably. Under an open access system i.e. one without private property rights, there is little benefit from using the resource sustainably as the costs of doing so are not incurred by the user. Examples of property rights include the allocation of legal rights, tenure, leases and concessions over the ownership, management and use of biodiversity.

Markets and charge systems: Measures, which rationalise prices and improve markets for the goods and services, which depend or impact on biodiversity. The creation of markets and the proper pricing of biodiversity helps avoid the situation whereby biodiversity is degraded because it is artificially cheap. A functioning market in biodiversity ensures that its price reflects its "real" value. Examples of a market creation scheme might be the issuance of tradable rights in biodiversity such as pollution permits or development rights. An example of a charge system might be to charge for biodiversity benefits traditionally received for no charge such as downstream water-catchment benefits.

Fiscal instruments: Budgetary measures which apply taxes and subsidies to the goods and services, which depend, or impact upon biodiversity. By using fiscal measures such as taxes and subsidies, the consumption of biodiversity can be encouraged or discouraged by changing its price relative to alternatives. A typical example of a fiscal measure would be a higher tax rate on a biodiversity depleting land use.

Bonds and deposits: Measures which require the provision of monetary security when economic activities are carried out, refundable against any biodiversity degradation and loss occurring as the result of the activity. By imposing a bond or deposit on a given activity the responsibility of harming biodiversity is shifted to an individual or organisation and thereby acting as a disincentive to potentially damaging activity. The levying of a bond on clean-up operations following a public event would be a typical example of this type of incentive.

Livelihood support: Measures, which strengthen and diversify the livelihoods of people whose production and consumption activities impact upon biodiversity. In many parts of world poverty and low-standards of living force individuals to deplete and degrade biodiversity. Through providing livelihood support biodiversity-consuming activities may be made more attractive. The encouragement of biodiversity "friendly" fishing methods might be one such example. In order to ensure the sustainability of livelihood support measures, they should be based upon self-financing systems.

Financial instruments: Measures, which generate funds to be used in support of marine and coastal conservation or sustainable use. Financial instruments can be considered a special sub-category of economic incentives, which act through the provision of cash funding as an incentive for biodiversity conservation. A wide range of financial instruments can be used, including direct payments from various private and public sources, trust funds and green funds, debt-for-nature swaps, and the provision of venture capital and investment support.

The removal of perverse incentives: The removal of perverse incentives is just as important as the imposition of positive incentives or disincentives in the conservation and sustainable use of biodiversity. By removing a perverse incentive pressure on the underlying biodiversity may be removed, often to a significant economic advantage to the taxpayer. The subsidies awarded by some countries to their fishing fleets to harvest unsustainably their fish stocks are often cited as a typical perverse incentive.

5.4 CHOOSING ECONOMIC INCENTIVES

Choosing the incentive or incentives—economic or otherwise—is not a straightforward process. The context for selection is extremely complex with no two sets of circumstances being identical. As a consequence of this, no "off-the-shelf" solutions are available for pre-determining appropriate action. In this section some of the factors to be considered when selecting incentives are presented along with some of the issues that have to be taken in account when making the selection. Some examples of what economic incentives might be used in a series of hypothetical scenarios are given in Box 33.

Choosing the incentive

The variety of potential factors negatively impacting upon biodiversity in the coastal area is vast—from unsustainable harvesting of marine species and offshore pollution, through sea shore development, to inland agriculture and industry. Multiple sectors affect biodiversity including those that directly depend on marine and coastal resources (such as fisheries, marine product harvesting, tourism, forestry, mining and other extractive industries) as well as those which have secondary or knock-on impacts on the status and integrity of resources and ecosystems (such as shipping, urban development, agriculture, and industry).

The array of other issues that go towards determining the nature and implications of these threats and their solutions is similarly complex, ranging from the political organisation, level of economic development and social fabric of the communities involved, to the significance of the threat and the nature of the technology and investment required to relieve it. Because of this complexity there is no straightforward list of incentives which can be identified for any given problem; rather the solution more often than not involves a combination of mutually reinforcing instruments developed to suit a particular set of circumstances and to meet the needs of multiple sectors or groups. These instruments may, as mentioned earlier, be political, legal, social or administrative. Which instrument or combinations of instruments are used will depend upon a wide range of factors. Box 33 gives a list of possible factors that must be taken into account when selecting an economic incentive and indeed any other instrument.

The factors determining the selection of incentives given in Box 33 above are not in any order of importance. Just as it is not possible to predetermine what incentives should be used, neither is it possible to prioritise the determining factors. In many developing countries for example, ease of administration will be crucial to incentive selection, while the cost of implementing an incentive is likely to influence decision making in most circumstances around the world.

There are of course a wide range of guidelines produced by a number of authoritative international bodies such as the IUCN, World Bank and regional Development Banks, designed to assist in the implementation of IMCAM. Although the CBD is rarely mentioned explicitly, the CBD objective of sustainable development is a common theme within these guidelines. Because of this overlap of the commitment to sustainable development, the guidance to using economic incentives within most of these

Box 33: Factors determining incentive selection

- Cost to implement
- Efficacy
- Political acceptability
- Social acceptability—issues of divisiveness and equity
- Complexity
- Compatibility with other political, economic and social goals
- Ease of administration
- Timescale of effectiveness
- Compatibility with international obligations
- Practicability
- Sustainability—can the incentive been sustained in the long run
- Nature, extent and urgency of the threat

existing IMCAM guidelines provides a solid platform upon which to develop an incentive programme.

Where the IMCAM guidelines do appear to be lacking with respect to the CBD, is in respect of the objective of the conservation of biodiversity. Box 34 gives a number of hypothetical scenarios of how economic incentives might be used in both the sustainable development and conservation of biodiversity in IMCAM. Box 35 presents a real-life case study of the use of economic incentives in coastal management.

It is worth noting here that notwithstanding the many advantages of economic incentives, they are rarely fully effective in conserving biodiversity when used in isolation. When conserving particularly significant or fragile elements of biodiversity, legal restrictions are very often also required. For example, the holding of private property rights in coastal areas of some parts of South East Asia and South America has in some cases lead to the destruction of wetland forests and water pollution amongst other things, by entrepreneurs investing in shrimp cultivation. Social mechanisms, too, are often a prerequisite to the successful use of economic incentives, especially where targeting activities and livelihoods of poor coastal communities in developing countries.

This is not to say, however, that economic incentives do not play a vital role in biodiversity conservation in IMCAM. Take the example of marine protected areas (MPAs)—one of the primary tools for marine conservation. Economic incentives can be used in order to raise funds for their management, generate and share benefits with surrounding communities and set prices and markets for the use of their recreational facilities and other products.

5.5 INCENTIVES AS OPPORTUNITIES OR CONSTRAINTS

The different types of incentives each function in one of two ways: to discourage or encourage certain behaviours. Some incentives act as restraints to discourage certain activities and impacts while others act as opportunities to encourage more sustainable acts and practices by perhaps stimulating promising conservation initiatives. An example of an economic incentive which acts as a constraint might be a punitive tax rate on environmentally damaging activities, while and example of an economic incentive which acts as an opportunity would be a financial subsidy for the development of a green technology. Although constraints to behaviour will always be essential, in assembling a portfolio of appropriate incentives, the primary focus should be on enabling beneficial activities in order to encourage what might hopefully become a deep-seated commitment to the conservation and sustainable use of biodiversity.

5.6 IMPLEMENTING ECONOMIC INCENTIVES

A comprehensive and clear procedure for implementing incentives for biodiversity conservation is given in publications by the OECD (1999) and Emerton (2000).

In addition, the SBSTTA has identified four factors that constitute the basic conditions necessary for the effective application of incentive measures. They appear to be particularly applicable in the context of the guidelines on economic incentives presented here as they synthesise some of the basic principles of established approaches to IMCAM.

1. *Information.* Information about biodiversity is central to the implementation of appropriate incentive measures. Without information on both the underlying biodiversity and its threats and pressures, suitable management tools cannot be developed and implemented. Similarly, any information gathered must be distributed to all interested parties.
2. *The involvement of stakeholders including indigenous and local communities.* The involvement of stakeholders in the incentive process should begin with collaboration over the design of the incentive measures and continue with their development and implementation. A high level of cooperation should bring a

Box 34: Hypothetical scenarios of how economic instruments might be used in the conservation and sustainable use of biodiversity	
Scenario	**Possible solutions**
Tourism and recreation Increased number of tourists leading to congestion of public facilities, beaches and dive sites and species exploitation and disturbance	• Encouragement of ecotourism through favourable investment opportunities using tax breaks, grants and competitive loan rates • Creation of MPAs. Private investment in MPAs encouraged by creation of private property rights, subsidies and tax breaks • Development of markets for MPA benefits e.g. charging for use of protected area by tourists, divers etc. retailing of associated goods such as souvenirs • Coastal zone protection tax levied on structures, buildings, works and activities in the coastal area • Livelihood assistance given to those displaced by protected area • Taxes on trade in certain species
Increased urbanization and population growth Development projects giving rise to landscape alterations, habitat loss and sewerage discharge	• Valuation studies to understand full value of undeveloped resource e.g. amenity value • Development of markets for previously un-marketed coastal benefits such as watershed protection • Creation of private property rights to all coastal resources to ensure all costs are taken in to account in private development decisions • Creation of markets in waste products through the introduction of tradable permits in order to incentivise least-cost solutions to waste treatment • Development restricted to certain areas by e.g. land easements • Clean-up / re-habilitation deposits required for major developments • Tax breaks for investment in clean technologies
Agriculture and forestry Landscape alteration, habitat loss, water use and run-off	• Investment in environmentally friendly solutions to waste management encouraged by fiscal instruments, subsidies, grants and favourable loan schemes • Valuation studies to understand full value of agriculture and forestry. Analyse external costs of e.g. pollution to and increased sedimentation of, waterways • Removal of perverse incentives—especially those which encourage over-production and production particularly environmentally sensitive areas • Proper pricing / creation of market in water use to discourage waste in water usage • Creation of markets in waste products i.e. through the introduction of tradable permits in order to incentivise least-cost solutions to waste treatment • Creation of private property rights i.e. creating secure land tenure to encourage sustainable production. For example a permanent tenant / property owner is more likely to introduce e.g. soil conservation measures, than a farmer with only transitory rights.
Mariculture—shrimps and fisheries Habitat loss; especially mangroves, water use, pollution and spread of disease	• Use of fiscal instruments to encourage organic production and environmentally friendly solutions to waste management • Creation of markets in waste products i.e. through the introduction of tradable permits in order to incentivise least-cost solutions to waste treatment • Proper pricing / creation of market in water use to discourage waste in water usage: implementation of polluter pays principle • Valuation studies to understand full value of coastal forests; often a very economically undervalued resource. Include values of non-marketed benefits such as fuel collection, watershed protection and existence values.

Box 35: Case study of choosing economic incentives for IMCAM

Choosing pro-poor economic incentives for ICZM in India, Maldives, Pakistan and Sri Lanka.

A Regional Strategic Plan for marine and coastal management in India, Maldives, Pakistan and Sri Lanka has recently been produced by IUCN, Asian Development Bank and relevant national government departments. This has as its goal to improve both the livelihoods of poor coastal communities at the same time as promoting environmental conservation, and is based on an integrated approach to coastal zone management.

Economic incentives form a key part of this regional strategy for coastal poverty alleviation and environmental conservation. A range of incentives have been proposed, targeting both the large industries that contribute towards biodiversity and ecosystem degradation (such as shipping, industry and upstream agriculture) as well as the local communities and government agencies who are responsible for on-the-ground conservation and are currently in a weak economic position to implement conservation activities. Key factors in the choice of these incentive mechanisms were extensive stakeholder consultation to determine economic threats and possible solutions, the need to target incentives to local cultural norms and political systems, and the necessity of designing a broad package of mutually reinforcing mechanisms that could cheaply and simultaneously operate for different groups, sectors and economic threats.

number of benefits to the IMCAM process including the increased commitment and accountability of stakeholders to the process and greater innovation and more appropriate design solutions.

3. *Valuation.* Valuation is a condition absolutely central to the application of economic incentives. As a non-market good, biodiversity is often assigned no value with the consequence that it is under-provided and over-exploited by the market. If biodiversity can be given an economic value it will, as Pearce explains “level the playing field for policy making that would otherwise be dominated by the financial benefits of land use conversion”.

   The most effective method of valuing biodiversity in economic terms is enabling it to be traded in a market in which all of its value is fully internalised. In the absence of such a market there are a number of non-market valuation tools covered in great detail throughout the literature, which can be used to attain at least a partial value. Whether the final valuation is comprehensive or partial, quantitative or qualitative, the exercise should produce a more informed base upon which policy decisions can be made.

4. *Capacity-building.* Sufficient capacity is necessary at all stages of the incentive design and implementation process, from the capacity needed to gather the initial information to that required to fund the execution of the incentive programme.

5.7 THE WAY FORWARD

Integrated coastal area management is an enormously challenging process in economic terms: the range of interests in, and threats to, the coastal zone are extensive. Given the complex nature of the process, the problems it presents are equally multifaceted and a wide range of instruments are required as solutions to its impacts. Central amongst these instruments are legal, social and economic incentives; tools designed to incite or motivate the stakeholders in IMCAM to conserve or sustainably use biodiversity.

Given the significance of economic factors in degrading biodiversity in the coastal area, the focus of these guidelines is on economic incentives. Economic incentives have many advantages as tools in the IMCAM process. They can be used to both correct and direct the economic policy, price and market failures that lie at the heart of environmental degradation in the coastal zone. Most importantly, they help to ensure that the “real” costs of depleting biodiversity are accounted for in the decisions made to either conserve or consume it.

Analysis of economic incentives—of both their theory as expressed in the CBD itself and in various IMCAM guidelines, and their application to different situations, issues, countries and groups in the real world—yield important lessons learned for coastal management.

One lesson is the need to use economic incentives as part of a broad and mutually-reinforcing package of inducements or motivations. Notwithstanding both the efficiency and efficacy of economic incentives, they have some fundamental limitations. Although economic incentives may encourage the sustainable development and conservation of biodiversity, they cannot guarantee it. One recommended approach therefore, is what the OECD refers to as the "market plus" approach—hybrid instruments that use the market in conjunction with regulatory measures to ensure that the public good aspects of biodiversity are taken into account in decision making, in conjunction with the private ones. At the same time it is usually essential to complement economic incentives with other types of incentive mechanisms that address the other underlying threats to coastal biodiversity, and the enabling factors for its conservation and sustainable use—legal, communication, social, cultural and institutional mechanisms.

Another lesson is the specificity of different situations and needs for incentives. In the face of the complexity and variation of the issues impacting upon the coastal zone, the solutions to the degradation of biodiversity have to be considered on a case-by-case basis. Selecting the appropriate incentive or incentives will depend upon a gamut of factors ranging from their cost of execution to the nature of the threat. There is no hierarchy of importance of these factors: their significance will vary at different times and between different places in order to achieve the IMCAM goals. The successful implementation of the chosen incentives is based more upon a more clearly defined set of requirements however, and particularly on the fulfilment of a number of basic conditions; specifically the avail-

Box 36: Case study of the implementation of economic incentives in IMCAM

Setting in place economic incentives measures for conservation in Kisite-Mpunguti Marine Protected Area, Kenya

Kisite Marine National Park and Mpunguti Marine National Reserve face a number of economic threats and problems. Of particular importance is the lack of funding for government to run the park, the hostility of local communities to the protected area, and high and often unsustainable levels of fishing and marine resource use. It was clear that a number of financial and economic incentives needed to be deployed to address these problems.

Economic valuation of the costs and benefits of the area formed a key step in identifying and setting in place incentives. This found that although the MPA generated high economic benefits, these were unequally distributed. For example the local opportunity costs of MPA conservation through exclusion from the park and its resources were some 10 times higher than direct management expenditures and several times as high as local benefits received. As a result local fishing villages incurred a net loss from the MPA and proved unwilling to abide by park regulations and resource use restrictions. Meanwhile, government received only a small fraction of total park revenues back as annual budget allocations, and existing income constituted only a tiny proportion of potential revenues and values. Private sector tour companies, while receiving high income from MPA activities, contributed little to the costs of running the park.

A series of financial and economic incentives were proposed to address these economic-related management issues. These were based on redistributing MPA economic values between groups to provide better motivations and an enabling economic environment for them to conserve biodiversity. They included a range of financial instruments to raise additional funding for both government and communities (including private sector cost-sharing, rationalisation of park entry fees and the establishment of a trust fund), as well as incentives targeted directly at improving the profitability of sustainable marine resource use and strengthening local livelihoods through providing alternative sources of income and subsistence to replace currently damaging activities.

ability of information about biodiversity, the involvement of stakeholders, the valuation of the biodiversity concerned and sufficient implementation capacity.

Overall, perhaps the most important lesson learned is the fact that economic incentives are, in most cases, essential for the conservation and sustainable use of coastal biodiversity. Ultimately, unless people tangibly benefit from conservation in economic terms, they are unlikely to be either willing or economically able to manage it sustainably over the long-term.

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