Policy and Best Practice Document 5

Marine Biodiversity

Colophon

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Preface

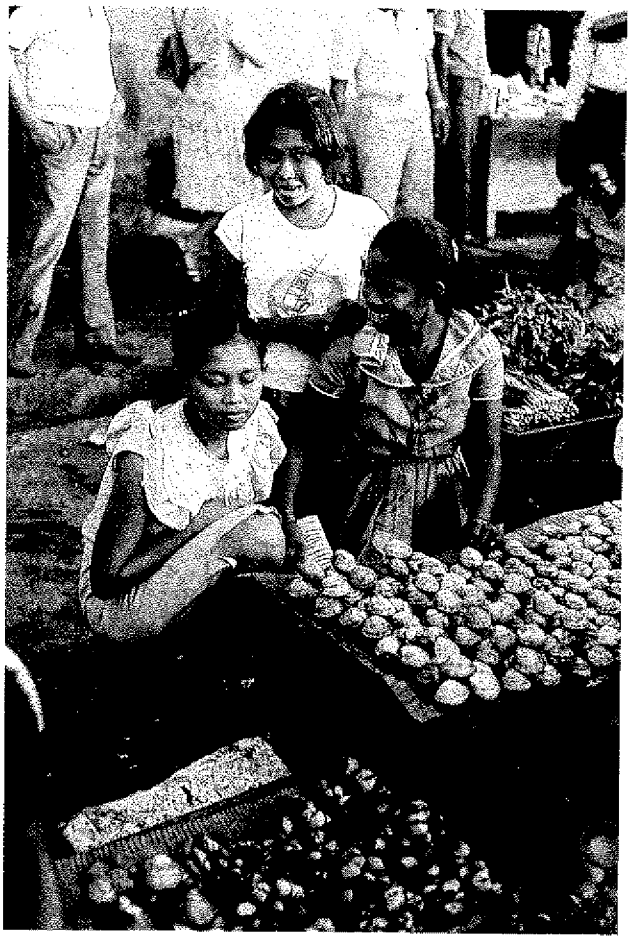
This document outlines the importance of marine living resources for humankind and gives guidelines for the sustainable development with regard to marine biodiversity. To make the document as applicable as possible, a number of field experiences are discussed together with the lessons that can be learned from them. On the basis of these, practical guidelines are given. It should be emphasised that this document is not meant to be a technical handbook on marine biodiversity, it should be used as a general description on the Netherlands policy with technical elaboration on some aspects.

The importance of the conservation of marine biodiversity is often associated with fisheries and tourism. The existence however of any marine organism is in one way or the other dependant on the presence of others. The marine environment can be seen as one huge ecosystem whereby the direct and indirect connections between different subsystems or species are only partly understood. Also, the extent of the diversity of living marine resources is hardly known.

In international forums marine resources are receiving more and more attention. In the context of the Biodiversity Convention policies are now being prepared to tackle the most pregnant problems. In the Netherlands, development co-operation policies have been stated for biodiversity in general, with a focus on terrestrial systems and on fisheries. A policy in which the conservation or use of marine biodiversity is addressed is being presented by this document.

This document has been prepared for personnel of the Netherlands Government especially at embassies abroad, dealing with the implementation of marine activities and involved in policy discussions. Besides, the document may also be useful for those who seek assistance from the Netherlands with regard to marine biodiversity in the context of development co-operation.

To the Dutch government, it is very important that target beneficiaries have ownership of development co-operation. Organisations and moreover "people" are in the centre of present policy, which is demand driven instead of donor driven.



Fish market at Zamboanga City, Philippines, showing the variety of products for sale (photo: Peter van der Heijden)

Summary

In Chapter 1 biological diversity is defined as the diversity within species, between species and of the ecosystems of which they are part. The most important economic values of marine biodiversity for coastal states and for coastal communities are the direct use value (as a source of food, fuel, etc) and the indirect use value (nursery area, nutrient recycling, protection against waves, etc.). The contribution to total income and to nutrition of activities based on marine resources vary from place to place but can be very important . Human activities taking place in the coastal and inland areas are the major threat to the rich marine biodiversity of many coastal developing countries. Capture fisheries, infrastructure development, human settlements, mining, industry, marine transport, tourism, agriculture and aquaculture contribute to loss and degradation of marine habitats, pollution, the introduction of new and harmful species, overexploitation and climatic change. The root causes of the processes that threaten marine biodiversity are lack of knowledge, awareness and appreciation of the various values of marine biodiversity; limited political commitment, limited sources and the consequential weakness of agencies charged with biodiversity conservation and management; inadequate national and international legislation; population increase in especially the coastal areas.
The resource base of a great number of coastal inhabitants is under threat, but with effective management, protection and sustainable levels of exploitation the important contribution of marine resources to the livelihoods of millions can be maintained and possibly even increased in some places.

The policy principles that guide Dutch international assistance in the field of biodiversity are briefly described in Chapter 2. Dutch assistance takes place within the framework of important international agreements such as UNCLOS and the Convention on Biodiversity, and has poverty alleviation and support to sustainable development as its principle objectives.

Important lessons learnt from experiences with various projects dealing with marine biodiversity are described in Chapter 3. When coastal communities can capture the profits of conservation and development, f.i. by means of sustainable harvest or ecotourism, they will have a stake in the protection of these ecosystems. Often the exploitation to more sustainable levels is stimulated when the use rights from a formerly open access coastal resource are transferred to a limited group that is also given responsibility for management and the design of regulating measures. Alternative sources of income have to be developed in a situation where marine living resources are under stress from harmful forms of exploitation of from over-exploitation by poor resource users.
For the introduction of Integrated Coastal Zone Management programmes an incremental and adaptive programme design that can give visible results in a short time is the most successful. Participation by resource users in the initial demarcation and in the design of management plans for marine protected areas is of vital importance.
Fisheries management that aims to incorporate biodiversity issues should take the direct and indirect impact of fisheries on the whole aquatic ecosystem into consider-

ation. During the planning and implementation of coastal tourism projects that are based on the attractiveness of marine ecosystems it is crucial to make sure that the interests of the coastal resource users are not affected and that a fair part of the benefits goes to the coastal communities. Marine aquaculture projects should be executed within the framework of a coastal land use plan and should follow the guidelines and rules designed to minimise adverse ecological and social impacts. The rehabilitation of certain degraded coastal ecosystems can successfully be accelerated by planting of mangroves and other plants and by stocking of juvenile stages of certain animals.

Chapter 4 describes the focal areas for Dutch development assistance and gives general guidelines for staff charged with assessment of proposals and with the initiation of activities in the field of marine biodiversity and development activities in coastal communities. The Jakarta Mandate, a follow-up of the Convention on Biodiversity, has guided the selection of the focal areas of which Integrated Marine and Coastal Area Management, and improved management aimed at the sustainable exploitation of living marine resources are the most important ones. The main target groups for support are coastal communities of marine resource users. Guidelines are given that deal with the following topics: Environmental Impact Assessments, Integrated Marine and Coastal Area Management, marine protected areas, sustainable exploitation, sustainable mariculture, control of harmful exotic species, tourism, bio-prospecting, rehabilitation of natural areas, training and education, research, national legislation, and actions in Europe in support of sustainable use and conservation of marine biodiversity.

1. Introduction

In the first chapter of this operational policy document the importance and value of marine biodiversity for Mankind is explained. The major threats to marine biodiversity and the role of marine biodiversity in sustainable development are described.

Box 1. Definition of Biodiversity

Biological diversity is defined as "the variability among living organisms from all sources, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes the diversity within species, between species and of ecosystems".
Source: Convention on Biological Diversity.

1.1 The importance of Marine Biodiversity

Marine biodiversity is vast in scope but far less known than terrestrial biodiversity due to the less accessible nature of submerged habitats. It is very well possible that there are more aquatic species than terrestrial species, although 80 percent of the approximately 1.7 million species now known to science are terrestrial. Of these known species 15% are marine. Estimates of the total number of species on earth range between 3 and 100 million, but 12.5 million species is used as a conservative working estimate. The deep-sea appears to contain far more species than was expected and over the years various kinds of small and earlier unknown habitats have been described. The great range of habitats found near the coast explains the high species diversity that is found in coastal ecosystems.

Going from polar via temperate to tropical climate zones species richness tends to increase. Southeast Asia, the South-Pacific, the Indian Ocean and the Caribbean Sea are especially rich in species, making the waters surrounding tropical developing countries the richest marine source in the world. Examples of high diversity coastal ecosystems include coral reefs, seagrass meadows, estuaries and mangrove forests (Annex 1).

The marine area can be divided in an onshore zone (accessible on foot), an inshore zone (accessible with canoes and small boats) and the offshore area (only accessible with bigger vessels). The coastal zone covers the sea area up to 200 nautical miles from the shoreline. In the context of development co-operation the ecosystems in the coastal zone, especially the onshore and inshore zone, are the most important components of marine biodiversity because the population in developing countries have most interactions with these systems. In coastal communities it is often the women and youth who exploit the onshore zone by catching fish or by gleaning the mudflats, mangroves and reefs for molluscs and other animals and plants. The products of this activity are mostly for household consumption and only a minor portion enters the market. As a result the contribution of women and youth, and of marine resources to total production and household food security are often underestimated. Men in small fishing craft exploit the inshore resources, and work on the

bigger fishing vessels that operate in the inshore and offshore area. In many coastal regions in developing countries a significant part of the population consists of people who have migrated recently from more inland villages because they were affected by drought or other natural disasters, by changing land use or land ownership patterns or by unemployment. Lack of other sources of income has forced many of them into fisheries because in general access to coastal waters and their resources are open. Often the poorest members of the community (widows and other female headed households, etc) that depend most on the exploitation of the aquatic resources suffer relatively more than others from the negative impact of various human activities on marine biodiversity. These human activities (see paragraph 1.2) affect not only the quality of the marine ecosystems and the amount of living resources, but they may also affect the access to and availability of such resources. Reduced access may have profound effects and is probably of far greater concern to rural poor than loss of species or a qualitative change of the coastal ecosystems. The cause of altered access may be social, economic, political or even for environmental conservation reasons.

The value of biodiversity to mankind

Marine and coastal ecosystems and the biological diversity they contain hold significant social, economic, aesthetic and cultural value for the local population which is using the resources as well as for mankind and our planet as a whole. From an economical point of view marine biodiversity has various types of values:

Direct value: Marine animals and plants have a direct value as a source of food, livestock feeds, medicine, fertiliser, building material and for ornamental purposes. Marine creatures provide ingredients for the food, pharmaceutical, cosmetics and chemical industry. Seahorses and other fish play a role in traditional Asian medicines. Products made from various parts of sharks are gaining popularity as ingredients in medicines. Seaweeds are used in the health food industry. Coral is mined and used as building material in Asia and east Africa. Shells, coral and colourful fish species are used for ornamental purposes.

Box 2. **The socio-economic value of fish and fisheries**

In 1995, 84 million tons of marine fish were landed. Of this amount 31.5 million tons was processed to fishmeal and fish oil and used in livestock and fish feeds. Aquaculture in coastal areas contributed 6.7 million tons of marine fish for human consumption. Low-income, food-deficit countries accounted for 35% of the total fish production.

Fish is an important source of animal protein; it accounts for about 16 percent of the average individual's intake world-wide, but this proportion is much higher for especially the poorer sections of the population in many developing countries. Fish provides more than 50% of the average animal protein intake of the

population of Bangladesh, the Philippines, Vietnam, Indonesia and 15 African countries (SIDA, 1997). Dried or smoked fish is often transported far inland where it can make an important contribution to the diet.
Fisheries are a major source of employment for many coastal states. World-wide there are 28,5 million fishermen; 95% of these are small-scale and the fast majority lives in developing countries. An even larger number of people are working in fisheries related industries. Women play a leading role in processing and distribution of fisheries products. Fish and fish products are important economic commodities. The total value of fresh, unprocessed fish sold in the auction or on the beach is estimated at US$ 80 billion/year. The total income generated by fish processing, distribution and fisheries related industries may exceed the total value of the unprocessed products. In 1994 developing countries received US$ 16 billion from internationally traded fish and fish products
Sources: The state of World fisheries and aquaculture 1996 (FAO, 1997). Review of the state of world fishery resources: marine fisheries. Fisheries Circular no. 920 (FAO, 1997)

Coastal resources can have a direct value without being harvested and consumed: they play an important role as recreation areas, attract tourists and scientists, and play a role in education. Especially tourism, with an annual growth rate of 5.5% one of the worlds fastest growing economic sectors, plays an important role in the economy of many islands and coastal regions. Nature-based tourism or eco-tourism can provide economic and social incentives for promoting conservation of marine habitats while at the same time providing a source of income for the local population. Attention from abroad for the beauty of certain marine resources (plus the possible economic spin-offs) can start and support local and national interest in protecting the resources. However, when its development is not properly regulated tourism can also become a threat to the living resources of marine areas.

Indirect value: coastal ecosystems such as mangrove forests, coral reefs and seaweed fields play an important role as a spawning, nursery or feeding area for fish and other species which are directly used by people (Box 5). They also protect the coastal area from high waves and storms, prevent erosion, recycle nutrients and assimilate wastes. Coastal and marine creatures play an important role in stabilising the biosphere and regulating the climate. Marine plants (algea, phytoplankton) remove a great part of the primary greenhouse gas, carbon dioxide, from the atmosphere, and produce 30-50% of the global oxygen supply. Phytoplankton and mangrove forests occurring in tropical coastal areas and estuaries produce gasses (dimethyl sulphide and carbon sulphide) that are believed to play an important role in the preservation of the radiative balance of the earth's atmosphere by initiating cloud formation.

Option value: some of the creatures that make up the marine and coastal ecosystems

may be used directly or indirectly in the future, possibly in ways that we can not imagine at present. Genes present in wild stocks of fish, shrimp and seaweed species that are used at present in marine aquaculture play an important role in breeding programs aimed at improvements in growth, reproduction, disease resistance, and other characteristics. Only several dozen species of marine plants and animals are cultured, but many more may turn out to be suitable for domestication and culture and may have a potential future role in the production of food, fuel, medicines, or other items.
The use of naturally occurring genes by the biotechnology industry has the potential to offer a number of benefits for developing countries. Biodiversity prospecting by genetic and pharmaceutical companies can offer the opportunity for income for coastal communities and states through arrangements which guarantee a fair share of future profits from the sale of products based on collected material. This also creates economic incentives for biodiversity conservation.

Bequest and existence value: many people especially in developed countries are willing to pay for the protection of certain ecosystems or species in developing countries because they consider them to be a valuable heritage mankind should pass on undamaged to future generations (bequest value). Others are willing to contribute to the cost of protection because they value the continued existence of certain species or areas for moral, esthetical, symbolic, spiritual or religious reasons (existence value). This willingness to pay affects the value of such ecosystems and species.

For people (and governments) of tropical coastal states the most important value of coastal ecosystems is the direct use value, followed by the indirect use value. However, an international organisation concerned with environmental issues and nature conservation may put more emphasis on the type of values ranked lower in Table 1.

Scene at a coastal community with marine turtle slowly dying on the background, Sri Lanka (photo: Arthur Ebregt)

Table 1. The various economic values of biological diversity

Use Values:		**Examples**
Direct Use	Output that is directly consumable or tradable	Food, medicines, building materials, ornamental items, recreation
Indirect Use	Output that provides functional benefits	Nursery area, protection from waves, nutrient recycling, waste assimilation, climate regulating functions
Non Use Values:		
Option Value	Future direct and indirect uses	Maintenance of biodiversity and habitats for future direct and indirect use and non-use
Bequest Value	Use and non-use value of environmental legacy	Prevention of irreversible change in habitats
Existence Value	Value from the knowledge of continued existence	Cultural and spiritual assets, intrinsic value of nature

Source: Koziell, 1998 (adapted).

1.2 Major threats to marine biodiversity

In many parts of the world marine ecosystems are increasingly damaged and disturbed. Mankind is the main actor and force behind a number of processes that result in damage, disturbance, and erosion of marine biodiversity. The most important activities and their impact on marine biodiversity are:

Development of coastal areas for human settlement, industrial areas, infrastructure and mariculture. Often this requires drainage of wetlands, removal of natural vegetation, land reclamation, dredging, and construction of harbours, ports, dikes, roads and other infrastructure. This process leads to considerable decreases in the total area of certain habitats and to a detrimental quality of the remaining areas. Economic development in coastal regions is in many respects more rapid than elsewhere. Sixty % of the world population lives within 60 km from the coast, and this part is growing. Twelve of the 15 largest cities in developing countries (all with a population of more than 7.5 million) are situated on or near the coast. It is estimated that between 1990 and 2010 over a billion people in developing countries will move from rural areas to large cities. The already heavy pressure on critical systems

like wetlands, barrier islands, mangrove swamps, sea grass beds and coral reefs will increase, and conflicts among different competing groups and types of use will become more intense.

Overexploitation of marine living resources. The growing world population and the increase in purchasing power have resulted in a rising demand for fish on the world market. A growing gap between supply and demand has led to an increase in prices of most fish. Direct and indirect subsidies for fisheries expansion and modernisation have supported and still support an increase in fishing pressure. Of the marine catches 80 percent is taken from the continental shelf, the area where the most productive fishing grounds are found. Fisheries impact biodiversity at all levels. At the genetic level, continued capture of a certain part of the population may change population characteristics, resulting in alterations of the genetic composition. At species level, selective fisheries for certain species, and by-catch of non-target species effect species composition and interactions. Through physical alterations fisheries impact certain marine habitats and the functioning of ecosystems. Examples of such alterations are the effects of bottom trawls on upper sediment layers and their communities, and the destruction of coral reefs by explosives used for fishing. A problem especially associated with modern industrial harvest technologies is the additional killing of animals like turtles, birds, marine mammals and by-catches of non-target fish species. Overfishing and destructive methods are prevalent in many regions and the need for sustainable fisheries is urgent (Box 3). Collapse of fisheries will lead to (and is in many cases already causing) reduction of income for local fishery communities, changes in resource exploitation patterns and possibly adverse socio-economic impacts like migration.

Box 3. Over-exploitation of fisheries resources

In the last few decades the efforts exerted to harvest the bounty of the seas have shown a steady increase. From 1970 to 1989 the total gross registered tons of the world fishing fleets increased from 13.6 to 25.3 million GRT. Since 1980 the number of fishermen has grown with 60%. The total amount of government subsidies for fisheries that were effort and capacity-enhancing is estimated at US$ 3.5 to 4.5 billion/year (Millazo, 1998). Between 1991 and 1995 more than 1500 new vessels were added to the world's industrial fishing fleet. Technological developments in equipment used to find, catch, process and store the fish have increased the efficiency especially in the industrial sector. When present at all, attempts to keep fishing efforts in balance with the carrying capacity of the fish stocks have only seldom been successful. Of the 200 major marine fish resources 25% is over-fished, depleted or slowly recovering, and 44% are intensively or fully exploited. It can be concluded that almost 70 percent of the world's major marine fisheries are in need of corrective measures and better management.

Source: Review of the state of world fishery resources: marine fisheries. Fisheries Circular no. 920, FAO, 1997.

Pollution. Land-based sources are the primary source of marine pollution. In many places sewage water, agricultural runoff, industrial wastewater and mine tailings have serious impacts on the quality of the coastal systems. For offshore areas the problems of pollution are less outspoken because of the dilution of pollutants. Particularly persistent organic pollutants are a source of concern because of their bio-accumulative properties and toxicity. Man and other top predators eating fish and shell-fish are particularly at risk from substances that accumulate in the food chain. Continued exposure to sub-lethal levels of cocktails of harmful chemicals such as chlorinated organic compounds and heavy metals can affect reproduction success of marine mammals, birds and fish species.

Introduction of exotic species. Deliberate, accidental or incidental introductions of exotic species, for instance via ship's ballast water or the unnoticed companions of fish or shrimps introduced for aquaculture purposes, can have serious effects. Exotic species can prey upon local species, compete with them for space and food, or bring in new diseases and pathogens. The fisheries yield of the Black Sea is seriously affected by the proliferation of an introduced American jellyfish species thought to have entered the Sea with ship's ballast water.

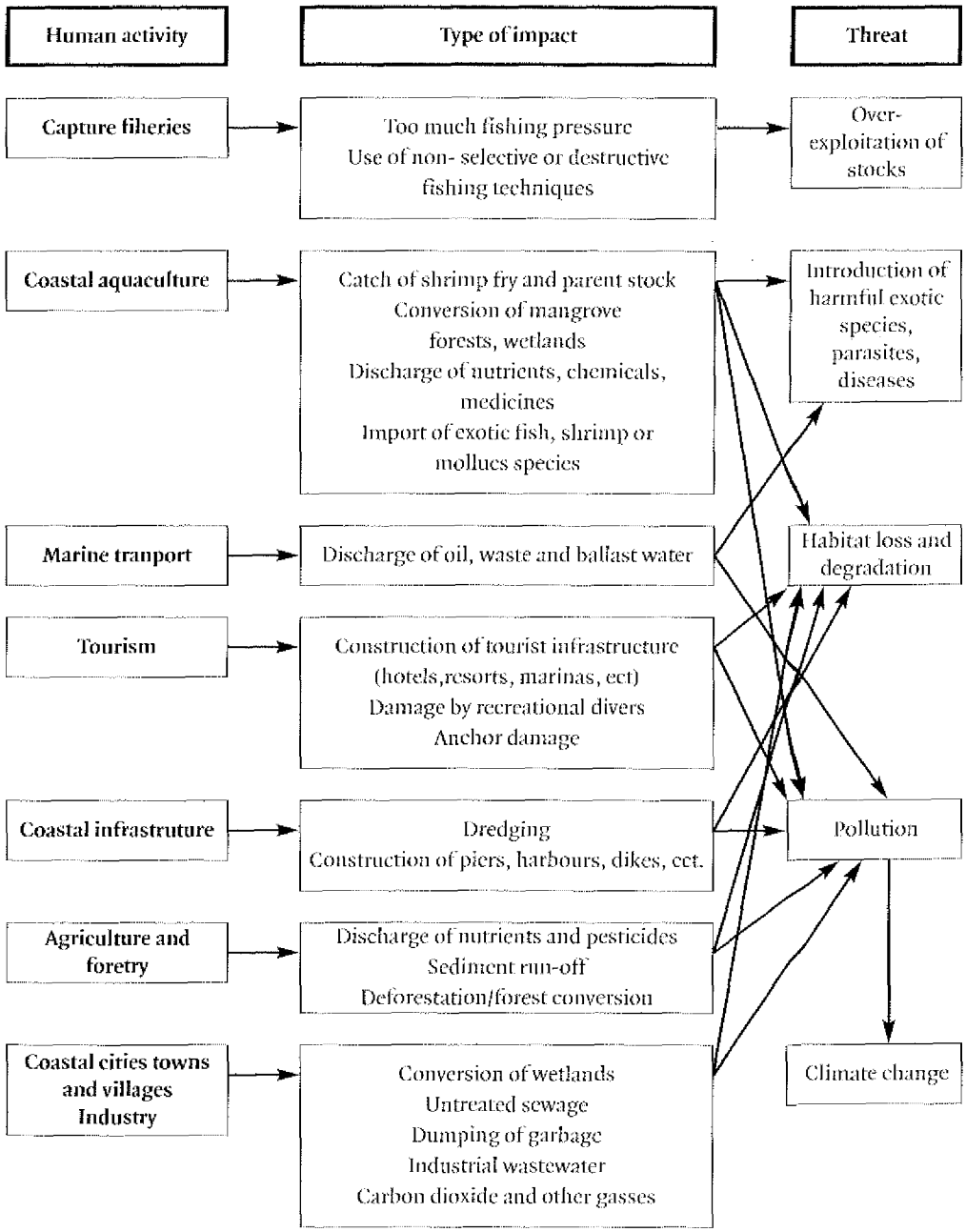
Climate change. Increased ultra-violet radiation, global warming and the rising sea level that may be its result can have significant impact on marine biodiversity, the coastal zone and its ecosystems. A possible effect of the rising sea level is a dramatic loss of (coastal) habitat for threatened and endangered species. Some experts fear that organisms may not be able to adapt to climate change for two reasons: First, many organisms are unlikely to be able to adapt or migrate fast enough to keep up with the changes. Second, some organisms such as coral inhabit waters whose temperatures are already close to the upper limit they can tolerate. Increases in seawater temperature can lead to the increased occurrences of coral bleaching, a phenomenon that was reported more from at least 32 countries in 1997-1998. Increased levels of ultra-violet radiation may affect phytoplankton and many animal species that spend their first life stages as plankton near the surface of the sea.

The way these processes and activities affect marine biodiversity is summarised in Figure 1.

Most of the described threats are more outspoken in tropical developing countries, which often possess areas rich in (marine) biological diversity. Coral reefs, seagrass meadows, and wetlands (including mangroves) are widely considered to be amongst the most important because of their high biodiversity, the vital ecological functions they serve and the social and economic importance of the resources they provide. All of these systems are under severe threat, and on a global scale they could therefore be considered first priority for marine biodiversity conservation projects. Details of their importance and of the threats to these ecosystems are found in annex 1.

The **causes that lie at the root of the processes and activities threatening marine biodiversity** are:

- policy and economic plans that fail to incorporate the value of the environment


Human activity
Type of impact
Threat
Capture fiheries
Too much fishing pressure
Use of non- selective or destructive fishing techniques
Over-exploitation of stocks
Coastal aquaculture
Catch of shrimp fry and parent stock
Conversion of mangrove forests, wetlands
Discharge of nutrients, chemicals, medicines
Import of exotic fish, shrimp or mollues species
Introduction of harmful exotic species, parasites, diseases
Marine tranport
Discharge of oil, waste and ballast water
Habitat loss and degradation
Tourism
Construction of tourist infrastructure (hotels,resorts, marinas, ect)
Damage by recreational divers
Anchor damage
Coastal infrastruture
Dredging
Construction of piers, harbours, dikes, ect.
Pollution
Agriculture and foretry
Discharge of nutrients and pesticides
Sediment run-off
Deforestation/forest conversion
Coastal cities towns and villages Industry
Conversion of wetlands
Untreated sewage
Dumping of garbage
Industrial wastewater
Carbon dioxide and other gasses
Climate change

and of biodiversity. The value of the harvest of sustainable small-scale exploitation is underestimated because a great part is consumed directly and does not enter a market while the value of commercial exploitation and conversion resulting in high but unsustainable benefits are over-estimated. The value of indirect benefits of coastal systems, such as spawning and nursery areas for commercially important species, are not adequately incorporated in decisions and activities affecting coastal ecosystems.

- population increase in the coastal areas due to natural growth and migration from inland rural areas;
- inequitable distribution and excessive consumption of resources;
- insufficient knowledge and understanding, hampered transfer of information to decision makers;
- limited political commitment;
- limited sources –technical, financial, scientific, technological, institutional- to devote to effective management of marine resources.
- limited public awareness with regard to the value of marine ecosystems for food, employment, cultural benefits, and the desirability of sustainable use of marine resources.
- the weakness of agencies charged with biodiversity conservation;
- inadequate national and international legislation and poor enforcement;

1.3 The role of Marine Biodiversity in sustainable development

The value of biodiversity for development co-operation might be measured in terms of its current or potential contribution to sustainably reducing poverty (and/or risk of poverty) in existing or future generations. A loss of biodiversity equals a loss of resources and opportunities available and would increase the vulnerability of coastal communities. Loss of biodiversity would decrease their production choices and food security and would mean an increased exposure to risks (Koziell, 1998). Prevention or limitation of such loss and maintenance of biodiversity is therefor of immediate concern for development co-operation programs.

The poor coastal people (the ultimate target group for development co-operation activities in the coastal zone) are not only the victims of biodiversity-threatening processes, often they themselves have no options but to exploit the resources at excessively high levels. This is frequently combined with habitat-damaging harvesting methods. By doing this the coastal poor forsake their tomorrow in a desperate attempt to survive today. The immediate need for food and income of a growing population combined with the lack of alternatives and the collapse of traditional common property resource management systems are the reasons for this. The immediate victims of this process are marine (and terrestrial) biodiversity, and coastal inhabitants themselves because their resources decline in amount and variety.

Table 2: **Potential benefits provided by maintenance of sustainable use of marine biodiversity**

Improved food security by maintaining a range of marine organisms that is available for harvesting or for non-consumptive uses.
Over a longer period of time a greater total yield can be expected than when exploitation rates above optimum or maximum levels are applied.
Exposure to environmental risks is reduced through supporting ecosystem processes that give protection from floods, absorb wastes, filter water, take care of sediment settlement, recycle nutrients, etc.
Genetic information is available for future cultivation and for pharmaceutical industries, the outputs of which can contribute to food security, income opportunities and improved human health.
A range of unique social and cultural identities that have developed as a result of interactions with a range of marine ecosystems and living resources is maintained.
(Source: Koziell, 1998, adapted)

Preventing the erosion of marine biodiversity in tropical regions is not only important for the maintenance of the resource base (natural capital) of the coastal communities. The biological diversity of coastal ecosystems offers possibilities for sustainable development of the population (Box 4). Depending on the location opportunities may exist for increased income from higher yield levels, from reduced waste, from environmentally less harmful harvesting methods, or from using the existing resources in a different way which may not yet be explored and known to the local population.

Box 4. **Definition of Sustainable Development**

Sustainable development is, according to Brundtland (WCED, 1987) a process of change in which the exploitation of resources, the direction of investments, the orientation of technological development and institutional changes are in harmony and enhance both current and future potential to meet human needs and aspirations. Such a development (in the agricultural, forestry and fisheries sectors) requires a trade-off between the conservation of land, water, plant and animal genetic resources and economic feasibility and social criteria.
In the debate on sustainability the North tends to stress inter-generational (concern for the future) aspects which is often perceived in the South as an attempt to obscure the intra-generational imbalances that exist today between North and South. Within a country imbalances also exist between groups, and between men and women at the household level.

Exploitation rates are intensified and areas are converted and used in ways that are expected to give high economic returns on the short run. In many cases such conversions are unsustainable and future rates of return may be even lower than are achieved at present (Box 5). In places where the exploitation of the resources is at a level too high to be sustainable international co-operation can play a role in assisting the development of improved management systems that safeguard the continued existence of the biological diversity as well as sustainable exploitation patterns, and by providing alternative sources of income for part of the resource users. This can result in recovery of the resource and eventually in higher yields for those who continue to be involved in the exploitation.

Box 5. **Mangrove utilisation versus conversion to shrimp ponds**

Gammagge compared the costs and benefits expected to be derived over a period of 55 years of 3 scenarios for the mangroves along the coast of the Gulf of Forensa (El Salvador). The scenarios were: leaving all mangrove forest intact and apply a sustainable timber and fuel wood harvesting method; continue present unsustainable rates of mangrove logging; and leaving some mangrove intact but with conversion of all suitable sites to shrimp ponds. The sustainable timber and fuel wood harvesting method was designed together with the local population of forest users. Over the given time span the sustainable management of mangrove forests turned out to be nearly 50% more profitable than the other 2 scenarios. The major reason was the expected continuation of high yields and profits from the capture of shrimps by both industrial and artisanal fishermen when mangrove forests were left intact.

Source: Gammage, S. (1997) To great a cost, Samudra no. 18, International Collective in Support of Fishworkers (ICSF), Madras, India.

2. International and Dutch policy principles

2.1 International Conventions and policy principles

There is a large number of regional and global conventions and agreements dealing with marine biodiversity or related issues. Among these conventions etc., and among the committees, secretariats, boards, programs and organisations charged with implementation a considerable overlap, fragmentation, and confusion exists. There is no international structure or body in charge of directing or co-ordinating the multitude of efforts. The lack of co-ordination and structure, combined with the voluntary nature and the escape clauses in most agreements plus the lack of control and sanctions for non-compliance, hamper the effective implementation.

The most important agreements and conventions relating to marine biodiversity and development are the following:

The **United Nations Convention on the Law of the Sea** (UNCLOS) was agreed upon in 1982. It gives coastal states sovereign rights regarding the use and exploration of living and non-living resources in an exclusive economic zone (EEZ) to a maximum of 200 nautical miles from the coast. Part 12 of the Convention states the obligation of coastal states to protect the marine environment. UNCLOS also obliges coastal states to assess the size of the stocks of living resources in the EEZ, and to manage the exploitation of these stocks at a sustainable level. When the national exploitation capacity is not sufficient the coastal states are obliged to make the stocks accessible to foreign fishing vessels by selling access rights, through joint enterprises, or by other means.

At the United Nations Conference on Environment and Development (Rio de Janeiro, 1992) **Agenda 21** was accepted. Chapter 17 of this Agenda deals with protection, rational use and development of the oceans, seas and coastal areas. Seven specific areas for action on the global, regional and national level are described: Integrated management and sustainable development of coastal and marine areas, including exclusive economic zones; Marine environmental protection; Sustainable use and conservation of marine living resources of the high seas; Sustainable use and conservation of marine living resources under national jurisdiction; Addressing critical uncertainties for the management of the marine environment and climate change; Strengthening international, including regional, cooperation and coordination; Sustainable development of small islands. For each of these action areas rather detailed action programs are given which can guide the action plans of national governments, research institutes, the private sector, etc.

The most important international convention in relation to biological diversity is the **Convention on Biodiversity** (Rio de Janeiro, 1992) that has as its objectives the conservation and sustainable use of biological resources plus a fair distribution of their benefits and use. The parties to this Convention have agreed to prevent activities that will harm biological diversity within and outside their area of jurisdiction, to assess the situation regarding biological diversity within their area of jurisdiction and to

develop national strategies for the conservation of biological diversity and the sustainable use of living resources. Implementation of the strategies should take place by means of the integration into the plans for other policy sectors. The developed countries agreed to support developing countries with the implementation of the Convention. For this purpose the Global Environmental Facility (GEF) was created.

The consequences of the Convention on Biological Diversity for the marine realm have been specified in more detail during the second Conference of Parties (Jakarta, 1995) which resulted in the so-called **Jakarta Mandate**. In the Mandate five specific areas for action are identified:

- development and implementation of Integrated Marine and Coastal Area Management
- establishment and maintenance of marine protected areas
- sustainable use of marine and coastal living resources
- sustainable mariculture operations
- control, eradication, and the prevention of introduction of harmful alien species

A part of the marine living resources travel over wide areas or are found in territorial waters and EEZ of several neighboring coastal states and in the area beyond the EEZ (the "High Seas"). To facilitate the management of these resources the **Agreement on Conservation and Management of Straddling Fish Stocks and Highly Migratory Fish Stocks** (1995) was signed. International cooperation and coordination are essential for the management of these valuable stocks.

A series of meetings initiated by FAO has led to the **Code of Conduct on Responsible Fisheries** (FAO, 1995). The Code is voluntary, global in scope and directed to all nations, organizations, entities and persons concerned with the conservation, management and development of fisheries resources. It offers principles and criteria for the elaboration and implementation of national policies, for the establishment and improvement of legal and institutional frameworks, for the formulation and implementation of international agreements, and for the promotion of technical and financial cooperation, the protection of living aquatic resources, trade and research. It provides standards of conduct for all persons involved in the fisheries sector. The European Union that represents the fisheries interests of its members including the Netherlands has adopted the Code.

The **Ramsar Convention on Wetlands of International Importance, especially as Waterfowl Habitat** (1971) aims to protect inland and coastal wetlands that are of special importance for sedentary and migrating waterfowl. It gives detailed guidelines for the sustainable use of such wetlands.

2.2 Dutch International Policy on Marine Biodiversity

The international aspects of the management of coastal areas, oceans and seas and their living resources by the Netherlands government have been described in various

Woman with Tunafish, Cape Verde Islands (photo: Lineair)

policy documents. These include the "Nature Policy Plan of the Netherlands" (1990), "Strategic Action Plan for Biodiversity" (1994), "Nederland en wetlands in het buitenland. Nieuwe Kansen" (1995), the "Programme International Nature Management 1996-2000" (1995), and the "Fourth Policy Document on Water Management" (1997).

Being a coastal nation with a long history of maritime trade, fisheries, coastal infrastructure construction and land reclamation the Netherlands has considerable expertise on a variety of marine issues. The country is involved in activities that affect marine biodiversity in developing countries in various ways. Seas and coastal areas have been selected as priority ecosystems for Dutch support together with forests, wetlands, and rivers. The government will assume an active role in reducing the negative impacts of activities on wetlands (which include coastal waters up to 6 m deep) and will stimulate activities that will benefit this ecosystem, especially by means of the realization of protected areas. The Netherlands has a strong interest in ensuring the sustainable use of the oceans.

2.3 Dutch policy on development assistance

The main objectives of the assistance of the Netherlands to developing countries are the reduction of poverty and contributing to sustainable development. The over-all framework for Dutch development assistance has been laid down in documents such as **"A world of difference"** (DGIS, 1990) and **"A world of dispute"** (DGIS, 1992). In these documents the importance of biological diversity is recognized as a basis for sustainable development, for its important support functions and in its

own right. The Netherlands Development Agency's policy regarding biological diversity has been worked out in **"Biological Diversity. Sectoral policy document no. 8"** (DGIS, 1995). It is stated that as much as possible biodiversity issues should be incorporated into projects. Increase in knowledge on biodiversity and the improvement of the availability of this knowledge in developing countries is seen as a prerequisite for protection of biological diversity, and should therefore be supported. Protection of ecosystems and habitats should get more emphasis than species protection. However, key species of ecosystems deserve special attention and for threatened species special protection measures should be promoted. All wetlands, including coastal areas with a water depth up to six meters are considered important natural ecosystems under threat. Shallow coastal seas, mangroves, and coral reefs are mentioned as systems deserving special attention.

The main objectives and approach towards development assistance in the fisheries and aquaculture sector as described in **"Fisheries in developing countries. Sectoral policy document no. 9"** (DGIS, 1995) are the promotion and conservation of aquatic ecosystems and their sustainable use, the improvement of the living conditions of communities depending for their livelihood largely or partially on artisanal fisheries and small-scale aquaculture, and strengthening of the institutional capacities of the fisheries sector.

3 Lessons learnt

This chapter presents some lessons learnt from experiences with projects and programmes dealing with the management of marine and coastal areas and resources, the conservation and rehabilitation of natural marine habitats, tourism, mariculture and bio-prospecting. Where possible experiences are presented as cases in boxes. Each case is followed by the lessons that can be drawn from it.

A general conclusion that can be drawn from the cases below is the following: When an area is not a popular tourist spot the local population obtains the greatest amount of revenues on the short term from a high extraction level of the resources. The major challenge to be met is finding new ways to enhance the livelihoods of reef- and other coastal resource dependent communities and to enhance the benefits derived from the productivity of coastal ecosystem while not undermining the integrity of these systems. It is of vital importance that the poorest communities concerned capture the profits for conservation and development. If continuous benefits flow to them, they will have a stake in protecting the coastal ecosystems. Biodiversity conservation should be designed to focus on providing such benefits, for instance from the sustainable harvest of animals and plants for consumption or ornamental purposes, the development of (eco-)tourism, aquaculture, carefully designed stock enhancement and habitat restoration, and bio-prospecting (Moffat e.a. 1998).

At present it is often easier to obtain funds to protect certain charismatic fauna than to improve the standards of living of coastal people. As a consequence many coastal projects have as objective to save species and habitats from destruction and focus on the conservation of biodiversity instead of developing alternatives to destructive practices or over-exploitation of the resources. Community management and development are often a secondary goal exploited to service the primary conservation aim. But attempts to safe threatened species and habitats will not be successful on the long-term when the well being of local people is not put at the forefront.

3.1 Management of marine and coastal areas

The coastal zone is used by a variety of users and for a number of purposes that may be in conflict with each other. It is impossible to manage an area with such a variety by using a sectoral approach. Integrated Coastal Zone Management (ICZM), also called Integrated Coastal Area Management (ICAM) or Integrated Marine and Coastal Area Management (IMCAM), is a management process which attempts to integrate or co-ordinate the activities of existing users of the coastal resources. Its purpose is to maintain livelihoods in coastal communities, conserve biodiversity, prevent erosion, control pollution, and regulate the demands of the leisure, transport, fishing and other industries. Its approach is multi-sectoral and integrated. ICZM is a continuous, dynamic and adaptive day-to-day process. It is a rather young endeavour and the learning process should be given sufficient consideration. ICZM has been attempted in countries where problems occurred as a result of extensive conversion of mangrove areas for shrimp culture (Box 6, 7).

Box 6. **Attempts to control mangrove conversion to shrimp ponds by ICZM in Ecuador**

Ecuador is one of the world leaders in shrimp culture and the economic importance of the industry is significant. For pond construction large areas formally covered with mangroves have been converted. The spread of shrimp farms was anarchic because of the lack of proper planning and co-operation between relevant government agencies, and weak or no enforcement of legislation. Environmental effects resulting from the disappearance of shrimp nursery areas and pollution by pond effluents have affected the quality of the coastal zone and the aquaculture industry itself and have resulted in problems with shrimp diseases and a shortage of shrimp larvae needed for stocking the ponds.

Attempts to build constituencies supporting improved resource management started in 1986. A gradual, two-level approach was followed: on a national level an inter-ministerial commission was established chaired by the Office of the President. At community level efforts were concentrated in 5 Special Area Management Zones. Emphasis on education and training characterised the activities on both levels. Each Zone had its own Ranger Corps under the supervision of a Navy Port Captain and composed of personnel of various agencies responsible for the enforcement of coastal management laws and regulations. The Corps worked closely with a Zonal Committee representing local users and local government. The Committee is involved in each step of the management process. For each special area an ICZM plan was developed in a highly participatory process. Mariculture and fisheries development, environmental sanitation, use of the shorefront and mangrove management are the major issues in each plan. Latrine building, beach clean-ups and experiments on co-management in mangrove areas were some of the concrete manifestations that took place at the community level. The program has successfully generated strong central government support for ICZM, it has increased public awareness of various coastal zone issues and has succeeded in reducing water pollution and the restoration of mangrove forests. It has stimulated the development and application of shrimp larvae collection techniques that improve shrimp larvae survival rates and reduce catch and mortality of non-target species.

Sources: Clark, J.R. (1996); D.Robadue (ed) Eight years in Ecuador: the road to integrated coastal management. Coastal

Resources Center, University of Rhode Island, 1995. D. Robadue, pers.comm.

Lessons learnt:

ICZM has to be initiated with understanding of and respect for the local socio-political context. An incremental and adaptive program design is recommended to facilitate the building of trust and capacity. Co-operation between line departments may be difficult and a separate institution with strong support from the highest level may be needed to force such co-operation. Local capacity in resource management must

be built simultaneously at both community and at central government level. Visible and concrete results are needed in an early stage to acquire and maintain support from coastal citizens. For countries that have seen little success in implementing resource management initiatives a focus on selected special areas can be an effective strategy for accelerating the learning process.

Box 7. Rehabilitation of Mangrove Forest Project, Southern Mekong Delta, Vietnam

The once extensive mangrove ecosystem in the Southern Mekong Delta has suffered heavily from chemical warfare during the 1970's, from excessive cutting for timber and charcoal, and from the rapid conversion to shrimp ponds in the present decade. This has led to increased coastal abrasion, floods and salt-water intrusion, and reduced biodiversity. From 1996 to 1999, the Netherlands Directorate-General for International Co-operation (DGIS) has supported, with Dutch technical assistance, a project aimed at mangrove rehabilitation and economic development of the Delta's coastal zone. An important project output has been a zoning plan which divides the area in a Full Protection Zone (to be kept under fully protected mangrove forests, in order to achieve coastal protection and to enhance and sustain the productivity of coastal ecosystems; shrimp farming is not allowed), a Buffer Zone (where mangroves are restored to at least 60% coverage, the rest can be used for aquaculture) and, further inland, a zone where sustainable socio-economic development is possible, the Economic Zone. An innovative system of shrimp farming has been developed, in which shrimp farming in the Buffer Zone is combined with and takes advantage of the restoration of mangrove coverage. Its success is shown by the fact that the local population has started to apply the system on their own initiative. During the project period approximately 7,400 hectares of degraded coastal mangrove forests have been rehabilitated, about half by replanting with mangrove seeds, and the rest through improved protection. The project also had a community development component (hand pumps, wells, primary school buildings, loans for aquaculture improvements) and a training and education component aimed at the local population and at provincial and local government officials.

The project has successfully facilitated the development of institutional structures, and has led to increased and more effective support from the Vietnamese Government for integrated coastal zone management that incorporates conservation and development of coastal ecosystems.

Source: ARCADIS Euroconsult / HASKONING, The Netherlands

Lessons learnt:

After a training needs assessment had taken place, the emphasis of the training sessions in the villages shifted from awareness raising on nature conservation to technical aspects of forestry and aquaculture. However, nature conservation topics were

dealt with as well. The economic component, which was mainly concerned with the improvement of shrimp culture practices by means of integrating mangrove forestry, supported the ecological rehabilitation component and contributed to its success. The flexibility that allowed the shift of emphasis of the training sessions in favour of expressed local training needs has contributed to the success of the programme.

The combined mangrove forestry/shrimp farming system has the potential to become an important part of a solution for areas where the population's wish to develop economically through shrimp farming has to be reconciled with programmes to rehabilitate mangrove forests.

ICZM has also started from attempts to solve local cases of degradation of other resources than mangroves (Box 8).

Box 8. **Attempts to reduce coral mining on Mafia Island, Tanzania**

On Tanzania's Mafia Island 5500 m3 of coral were mined annually to support the lime needs of building and construction projects. Mining was shown to reduce the number of fish species on the site with 24%; total numbers decreased with 41%. The cost of locally produced lime was nearly 8 times lower than imported cement. After extensive consultations with local lime users and other stake holders a 2-stage program was started aimed at providing alternative construction materials and income sources and awareness raising. In the first stage the production of sun-dried bricks was started, the development of land-based lime stone sources, and the construction of closed, more efficient lime kilns using coconut wood instead of mangrove wood. In the second stage mining of life coral will be limited through a permit system. The brick production and the expanding tourist industry are expected to become alternative income sources. As a result significant progress towards reduction of mining activities has been reported. Source: Dulvy, N. & W.R.T. Darwell in Clark, J.R.,(1996);

Lessons Learnt:

Enforcement of coastal management rules can be very difficult if jobs are threatened. Management must carefully balance people's dependence on a resource. Alternative livelihood programs must be part of any coastal conservation project. Only when alternative sources of income or alternative materials replacing those extracted from the reefs are available and economically attractive on the short term, will local users shift away from unsustainable and harmful ways of exploration. Consulting all stakeholders can help to identify the conditions that guide the selection of viable alternatives.

Attempts to solve one problem in a specific coastal area can develop gradually into a full-fledged ICZM program on national scale. However, such a development may take ten or more years.

Initiating ICZM on a national scale may bog down in bureaucratic mapping procedures without any impact on the ground, as was shown in the case of Brazil (Box 9).

Box 9. **ICAM experience in Brazil.**

In Brazil a National Coastal Zone Management Program was institutionalised by national law in 1988. In the first attempt a coastal zone governance area was created of approximately 200.000 square kilometres. "From the start the whole exercise became extremely bureaucratised, as coastal management was limited to creating different maps of the land potential and constraints, based on sophisticated remote sensing and GIS techniques. Consulting firms interested only in selling emerging technologies of remote sensing were the basis for initial exercises. Over a dozen years were spent in producing overlays and maps of different coastal states, but until now not a single coastal management plan has been actually implemented. As a result, ecologically and socially, the situation in the coastal ecosystems became critical."
(Diegues, 1998, p 124).

Not in all cases a formal ICZM framework is needed: in the small island-state of the Maldives absorption of an innovative concept such as ICZM may take long time due to strong cultural traditions. A more informal approach is also effective to a certain extent due to the fact that Maldives government is concentrated and near continuous communication takes place. An Environment Commission with representatives of various departments that serves to make policies and to co-ordinate developments is operating. Super-imposing a new, formal structure on a society that functions along traditional, less formal lines may even be counter-productive. In situations where rapid economic changes occur but strong cultural traditions seem to be opposed to an ICZM concept the first priority is to create an educated cadre of locals who can balance tradition with innovation to meet ICZM challenges posed by the rapid change.

ICZM projects in developing countries often depend heavily on foreign support and have low national government ownership. Very rarely projects are designed to establish self-sufficient activities, and chances of continuation of ICZM projects are low when foreign support ends. There is also heavy emphasis on external, often expatriate assistance. During a workshop in which experiences with ICZM in Eastern Africa were reviewed project managers recommended to start small, and stressed the necessity to build up strong local capacity in the communities and the identification and testing of approaches for sustainable financing of successful activities after a project ends. Community ownership and control of the project were mentioned as a short-term indicator for sustainability (Moffat e.a., 1998).

3.2 Marine protected areas

Coastal and marine protected areas can be defined as areas that are subjected to substantially reduced harvest pressure and other forms of ecological stress by restrictions of human activities. In the last decade many have realised that nature and biodiversity can not be conserved successfully by preventing local people access to areas rich in biological variety. Experience in Brazil showed that expelling the local inhabitants that depended on the natural resource also meant the removal of the potential supporters of conservation efforts, making the area more accessible for outsiders (poachers, tourists, fishing companies) who had less or no interest in sustainable use and conservation (Diegues, 1998). Community participation in the decision making process regarding boundaries, access and allowable exploitation levels and methods, and in the management of coastal areas and marine resources is nowadays considered essential for the success of such schemes.

Community-based coastal resource management (CBCRM) and protected marine areas can lead to improvement of local biodiversity in combination with better catches by local fishermen (Box 10).

BOX 10. Improved biodiversity and income from a successful CBCRM project: Danao Bay, Philippines.

Danao Bay is a 2000 ha large Bay situated on the Northern shore of the island Mindanao. About 400 full-time and part-time resident fishermen and their families rely for the main part of their livelihood on the Bay's fish resources. Catches have been declining because of heavy exploitation pressure, destruction of mangrove forest, and dynamite fishing. In 1991 a 74 hectares coral reef sanctuary was established in the Bay by the SNV-supported NGO "Pipuli Foundation". No fishing is allowed inside the sanctuary and in a 25 ha buffer zone surrounding the protected area only reef gleaning during the daytime is allowed. Local residents guard the sanctuary and intruders are "talked out". After the establishment of the sanctuary Pipuli focussed its attention on ecological awareness raising, training and the formation of organisations in the coastal communities surrounding the Bay and initiated various income-generating projects. At present the expenses for sanctuary guards and operating costs for an information centre are covered with the income from an eco-tourism project.

The sanctuary and accompanying regulations have had positive effects on marine biodiversity and on the income of the fishermen. The number of fish species encountered during diving surveys inside the protected area increased from 48 in 1993 to 85 in 1995, and in the same period the number of shellfish, sea-cucumber, and sea-urchin species increased from 28 to 74. In 1995 fishermen using fish traps near the sanctuary reported a doubling of the catch compared to the years just before the sanctuary was established. These results attracted more

fishermen from nearby areas. Due to increased fishing pressure by resident and visiting fishermen the increased catch could not be sustained in later years.
Source: A. Heinen & A. Laranjo, in Ferrer e.a., 1996; A. Heinen, personal communication.

Lessons learnt:
The abstract ideas of a sanctuary or coastal resource management were difficult to explain to the local residents. Because of this the Pipuli staff choose to concentrate first on a concrete management measure which was expected to give quick visible results for all residents. The availability of other sites in the Philippines where marine protected parks had been established earlier with support of the local population helped to clarify to staff and key fishermen leaders the initial concept and possible mode of operation.

Many problems related to non-compliance were encountered in the first 2 years and a core of dedicated local leaders who did not back out in difficult times was crucial for the success of the project. The training program in the fishing communities made more people aware of the purpose of the sanctuary and led to increased local support. The positive effects on fish yields contributed to this result.

Outside technical assistance was needed during the first 3 –5 years to start the program. With growing local support for the sanctuary a group of volunteers from

Fishermen in Mozambique (photo: Lineair)

nearby communities replaced a small group of staff that was paid to guard the sanctuary during the first 2-3 years. At present guards are paid from the income earned with an eco-tourism project.

The regular monitoring and recording activities help to demonstrate the effects of the marine reserve and other management measures to local residents, authorities and a far wider public, and greatly enhance the value and impact of the project by serving as an example for other coastal communities in South-east Asia.

A legal base is needed for institutions with strong representation of resource users to play a significant role in resource management. In the Philippines the Local Government Code that came into force in 1991 gave programs aiming at CBCRM an appropriate legal framework. The Code allows the establishment of Resource Management Councils on municipal level in which organisations of resource users and supporting NGO's, the municipal government and local branches of relevant departments can participate in decision making and actual management of the coastal resources within the municipal territory.

Diving surveys in 3 other protected reef areas situated near small Philippine islands and managed with strong community participation revealed an increase in total numbers of fish as well as number of species. All fishermen that were interviewed near the protected areas stated that the reserve had not negatively affected their catches, and most believed that the reserve had improved their fishing (Clark, 1996).

Community participation in the decision making process regarding boundaries, access and allowable exploitation levels and methods, and in the management of coastal areas and marine resources is nowadays considered essential for the success of such schemes.

3.3 Community participation and sharing of benefits from coastal resource use

In the past, efforts to preserve marine biological diversity by establishing protected areas often lead to the government curtailing the usual exploitation methods or in some cases even to issuing a complete ban for local fishermen to their traditional fishing grounds. In most cases the fishing communities involved were not sufficiently consulted and informed. As a result they did not accept this situation and did not follow the intended regulation of fisheries.
This made nature conservation organisations realise that biodiversity conservation had to be combined with local development initiatives. Wells has reviewed the first experiences of non-governmental environmental organisations with such projects (Box 11).

Box 11. Environmental conservation organisations embrace development: the first experiences

In his assessment of the first projects that tried to combine (mostly terrestrial) biodiversity conservation with development, Wells noted that although environmental NGO's had hardly any prior experience in the field of local development, surprisingly few efforts were made to use the existing knowledge of development institutions to enhance local participation or to appraise social and economic conditions in an efficient way. Many of the projects were in the category of "small-scale" or "pilot projects". Seldom was enough attention given to monitoring of ecological as well as socio-economic parameters, and to the learning process on the side of the project implementers and the local population. To avoid bureaucracy and delays the involvement of governmental departments and other actors was often kept to a minimum. As a result up-scaling (needed to make a significant impact) of the successful projects, or imitation of the model or approach used by the successful projects, proved to be problematic.
"In practice there has been an acute shortage of biodiversity conservation and sustainable economic development projects implemented in a way that would allow their experiences to be seriously analysed and lessons to emerge".
Source: Wells, M.P. in Perrings, e.a., 1995, p 319 – 343.

Lessons learnt

"Project success is based on a high degree of fit between programme design, beneficiary needs and capacity of the assisting organisation. (...) Achieving this fit requires organisations with a well-developed capacity for responsive and anticipatory adaptation – organisations that embrace error, plan with the people, and combine knowledge building with action" (Wells, in Perrings e.a., 1995).

The success of projects that attempted to combine the conservation of biodiversity with local development is in most cases measured in terms of observed changes in the numbers of specimens, number of species or reduction of threats to biological diversity and ecosystems. Impact on food security, income or other socio-economic parameters are seldom monitored in a systematic way. Only when base-line and monitoring data are available will it be possible to analyse the factors behind success and failure, can lessons be drawn and can successful projects and approaches serve as models elsewhere.

Compared with other countries where the community-based approach towards resource management was introduced and applied only later, the Philippines has the widest experience and highest number of community-based coastal resource management programs. The experiences with CBCRM in the Philippines have been evaluated (Pomeroy, 1994; Ferrer e.a., 1996) and the following lessons emerged:

Fishers must be equal and active participants in resource management. An open dia-

logue must be maintained between all stakeholders. Property rights must be assigned directly to the coastal communities and resource users. The community must be invigorated through a multi-sectoral, integrated approach to both resource management and community development. The community must be provided assistance to organise and develop the capability to take responsibility for resource management. Formation of local community organisations that can play a role in marine resource management is a complex activity that takes time, and needs a heavy educational component. Committed staff working full-time in the communities were a key factor in establishing trust and for building effective local organisations and management regimes. This made staff members of NGO's in general more effective than government employees.

In more participatory forms of fisheries management government officials will often have to change their roles and ways of working. Policy makers will have to learn to collect, consider and incorporate the needs, suggestions, and views of resource users and other stakeholders. Field staff will have to add meeting facilitation, education, mediation and institution building to their usual activities (which are often data collection and controlling). Training will be needed that is aimed at acquiring new skills and a different attitude to be able to play the new role effectively.

Community-based management has also been successfully applied for sustainable exploitation of mangroves (Box 12).

Box 12. **Community-based use of mangrove resources in St Lucia, Caribbean.**
The largest mangrove area of the island of St. Lucia in the Caribean is a 40 ha forest near Mankòtè. Since the area was opened to the public in 1960 waste dumping, intensive fishing, hunting as well as woodcutting for charcoal and construction took place. In 1981 monitoring showed that the local charcoal makers (15 tot 20) applied some sort of management. Cutting took place in strips of 10-20 meters wide. A rotation scheme was used, and each strip was cut again after about 2 years. Mankòtè was identified as a priority area for conservation and in 1986 the eastern Caribbean Natural Area Management Programme (CANARI) started a program aimed at conservation and sustainable use of the area. A community-based management was initiated and the status of the area shifted from open access to communal property used and managed by a limited number of organized charcoal makers. To reduce pressure on the mangroves a fuelwood plantation and a community vegetable garden were started. The program has been a success: people changed their cutting practices to conserve resources, and the trend of declining tree cover in the area was reversed. Over the period 1986 – 1992 the density of mangrove trees in the area increased while the average annual production of charcoal from Mankòtè mangrove wood has been maintained at the same level. Hunting and waste dumping have been reduced.

The area was designated as a Marine Reserve Area and visitors' tours were started.

Source: Smith, A.H. & F. Berkes (1993) in International Journal for Environmental Studies, Vol 43: 123-131.

Lessons learnt:
Reversal of the status of the area from open access to communal property exclusively exploited by a limited group of local users can change the way the resource is harvested. When communities are given exclusive harvest rights over natural resources with a long-term perspective they have the incentive to be involved in developing this resource sustainably. Resource users may be more willing to sacrifice certain short-term benefits in order to safeguard the continued existence and to enable higher harvest yields in the future.

The change of an open access system to a management system that limits the use to a restricted group may cut off the most needy sectors of society from a last source of food and income. The needs of these groups have to be taken into consideration when access regimes for fishing grounds or mangrove areas are changed to enable sustainable management of these resources. Provision of alternative sources of income will be necessary.

3.4 Management of living aquatic resources

Traditionally the management of living marine resources in many countries is aimed at the preservation of especially commercial stocks and at the maintenance of maximum yields and social and economic benefits. Only recently have biodiversity aspects become part of the objectives of managers in some countries.

The species targeted for food or other purposes do not live in isolation, but depend for feed and suitable living conditions upon complex ecological systems. Impacts on the system as a whole, or on non-target species can therefore indirectly affect the species that are of commercial interest. The opposite can also occur: (over)-exploitation of certain commercial species can threaten the existence of other species for which special conservation programs have been put in place (Box 13). Incorporation of biodiversity objectives in marine resource management requires an ecosystem approach that takes all the functions of the ecosystem (as food source, spawning area, nursery, migration routes) into consideration.

Box 13. Killer whales becoming a threat to giant seaweed fields.

At the East Coast of North America orcas or killer whales are reported to feed more on the protected sea otters, a species on its way of recovery from near-extinction. The orcas had to add these animals to their menu because their nor-

mal prey, sea lions and seals, have decreased in number, probably due to the heavy exploitation of the fish stocks in the region. As a result of this the number of sea urchins (a major food source of sea otters) has shown a dramatic increase. The increase of grazing pressure by growing numbers of sea urchins is a threat to the kelp (a large seaweed) fields along the coast. These fields are considered a critical habitat for the region because they provide a favourable habitat and sheltered nursery area for many fish species and other animals.
(Source: Science,Vol. 282, no 5388, October 1998, page 390).

It is often assumed that the reproductive capacity of populations was not threatened as long as enough specimens were able to spawn at least once during their life. Recently more appreciation has developed for the role of old, big females of for example grouper, cod and other fish species for the maintenance of healthy populations and for the continued supply of recruits that also have the genetic potential to grow to a large size. Not only contribute these large individuals significantly more eggs per kg bodyweight than their smaller sisters, but their experience in finding suitable breeding and feeding places and knowledge of migration routes may be of great value to survival and reproduction success of the rest of a school.

An analysis of the use of marine resources for the purpose of their maintenance, sustainable management and development should explicitly include the role of women. As is often the case on the land women's contribution to the use of marine resources is in many cases not very visible. Women often play a leading role in preservation, processing and distribution of fish and other marine products. Changes that affect the amount of marine resources to be harvested as well as the composition of the harvest will directly affect the women who are occupied in processing and distribution of fishery products.

3.5 Tourism

Tourism based on the beauty of marine ecosystems can make an important contribution to the economy, income and employment opportunities of local people (Box 14).

Box 14. Estimated costs and benefits of diving tourism for the population of Bonaire and Maldives.

The coastal waters surrounding the 288 km2 island of Bonaire in the Caribbean (population: 10,800 in 1990) were declared Marine Park in 1980. More than 17 000 divers visit the island each year. This type of tourism is one of the pillars of the local economy and is estimated to be responsible for nearly 1000 jobs, of which local residents occupy 755. Gross revenues from diving tourism are estimated at $ 23.2 million, of which $ 0.19 million were earned from a fee per visi-

tor of the park. The annual recurring costs for park management are $ 0.15 million. Although nearly all boats taking divers to the sites use mooring buoys, stress on the reefs resulting from frequent visits became noticeable on the more popular dive sites. Research showed that the maximum visitor level to a site before visible stress on the reef occurred was at 4500 dives/site/year.

Approximately 350 000 tourists/year visit the Maldives, and 50% go diving. The most attractive dive sites are the ones that offer a high chance of seeing sharks. In 1992 76 850 dives took place at 35 specific shark watching sites. Current expenditure by tourists on shark watching is estimated to exceed $ 2.3 million/year. Most sites have their own resident population of sharks. By using estimates of the average expenditure/dive and the number of resident sharks/site the economic value of a single reef shark at the 35 sites was estimated at $ 3 300/year. Realising the importance of good dive spots fifteen top dive sites (of which 9 were shark watching sites) were declared protected sites in 1995 by the Maldives Government. Even after protective measures had been declared shark fishing continued, sometimes even near the dive sites. When as a result of fishing only seldom a shark was seen at the most popular site the number of visitors dropped dramatically. Economic loss resulting from reduced visitors at this site was estimated at $ 500 000/year.
The value of a dead shark in a fishing boat is about $32.

Sources: Dixon, J.A., L.Fallon Scura & T. van 't Hof, in: Perrings e.a.,1995, p 127 – 145.
R.C. Andersen: Economics of shark watching in the Maldives. Paper presented at Conference on sustainable use of aquatic biodiversity: data, tools and cooperation. Lisbon, 3-5 September 1998.

Lessons learnt:
Protected coral reefs can be a major source of income and employment on a sustainable level especially for small island populations. Conditions are that enough tourists visit the place, and that proper management including measures to reduce negative impacts of visitors are put in place. The running cost of managing the reserve can be recovered by means of entrance fees. Divers need to be evenly distributed over various sites since damage and stress to reefs do occur locally when the number of dives per site exceed 4500 per year.

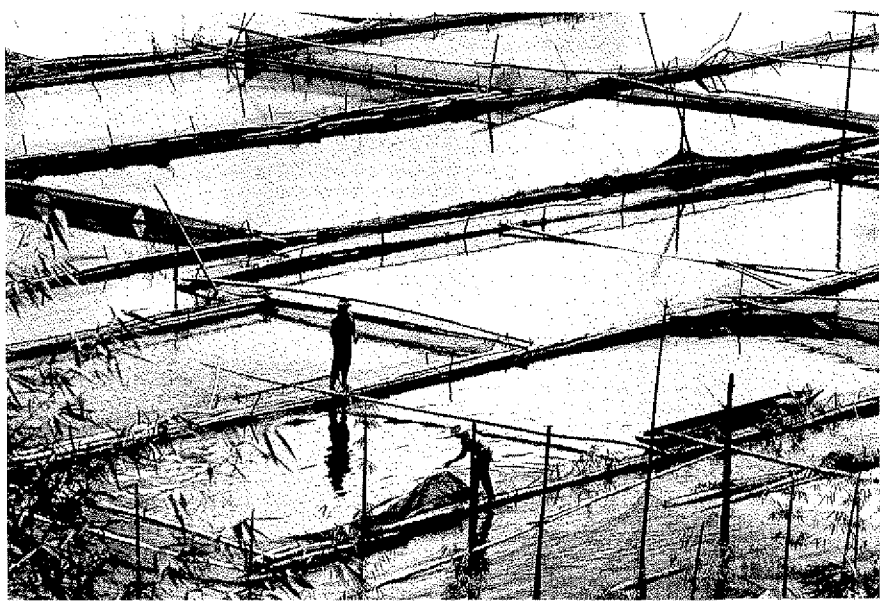
Distribution of the benefits from diving and other tourist activities needs to be as wide as possible and should explicitly include the group that earns a living from the harvest of the living resources. When direct or indirect income from tourism exceeds potential short-term income from exploitation this section of the population is provided with a powerful incentive for participation in conservation efforts.

A limited number of large fish and other animals often serve as a special attraction and can have a very high economic value. Special attention to the protection of these "crowd pullers" is economically warranted.

3.6 Coastal aquaculture

For centuries extensive culture of milkfish and other species has been practised in brackish water ponds in Indonesia, Philippines and other Asian countries without great impacts on nearby coastal waters. The extensive character of these activities, with only low fish densities and limited inputs, and the extend of remaining mangrove forest, has mainly been responsible for the limited impact. In the past 2 decades coastal aquaculture has developed and spread with great speed in some developing countries. Bio-diversity is impacted by this activity in various ways: natural ecosystems are transformed, resources are consumed, and waste is produced. Alien species and new parasites and diseases may be introduced when larvae or broodstock are imported. Especially shrimp farming has earned a bad reputation because its expansion in recent years has been at the expense of almost 10% of the world's mangrove forests. In some countries this percentage is much higher. Although especially large enterprises are blamed, it appears that smaller owners have contributed relatively more to the number of ponds abandoned after only a few years of operation due to the lack of sufficient capital needed for proper pond construction and for more responsible management. Mangrove areas serve as nurseries for shrimps and certain fish species. In Indonesia a direct relationship was found between the amount of shrimp caught from the sea and the mangrove coverage along the coast. For the Mekong Delta area in Vietnam it was estimated that one hectare of mangroves supports approximately 450 kg/year of fish and shrimp catch

Fishing pond, Philippines (photo: Linenir)



from the sea. When shrimp farming is extensive (low yield per hectare) its production may not outweigh the reduction of catches from the sea resulting from reduced mangrove coverage. However, a clear, direct relationship between reduction of mangrove coverage and declining shrimp catches was not found everywhere, f.i. not along the coast of Kerala, India, probably due to the presence of extensive backwater lagoons that can serve as nursery areas.

The effective implementation of land use plans for the coastal area that incorporate the protection of natural ecosystems such as mangroves and estuaries can control the conversion of natural areas and vegetation to ponds. (see paragraph 3. 2). Innovative combinations of shrimp farming and mangrove forestry (Box 7) can also help to reduce environmental impacts.
Great numbers of fish larvae are killed during collection of shrimp larvae from coastal waters. To feed the shrimps great quantities of fish are converted to fishmeal, and the discharge of nutrient-rich, polluted waters have a harmful effect on ecosystems in nearby estuaries and coastal waters. Guidelines and Codes of Conduct have been developed to reduce such negative impacts from modern forms of coastal aquaculture (see paragraph 4.2.2.6).

In various countries of Asia and East Africa seaweeds are grown in shallow coastal waters. It is estimated that in the Philippines 40,000 people depend on this activity. So far no major negative impact on the environment has been reported. On the island of Zanzibar seaweed culture has expanded rapidly in the past decade and women have played a leading role (Box 15).

Box 15. Women dominate seaweed culture along coast of Zanzibar.

Between the 1940's and 1960's naturally occurring seaweeds were collected along the coasts of the mainland of Tanzania and exported in dried form from Zanzibar (up to 600 tons/year). The industry collapsed when the government took over the private enterprises involved. With help of a Philippine company the cultivation of seaweed was introduced in 1989 in 2 villages at the east coast of Zanzibar. The company provided ropes, seedlings and advice, and bought the dried seaweed. After initial scepticism women were the first to take up the activity. Being their daily fishing ground, this group was most familiar with the intertidal zone where seaweed culture takes place. Good growth rates, high returns, relatively simple techniques, low labour time and a lack of alternative income opportunities in the area constituted the right mix for success. In 1993 seaweed farmers earned between 6000 and 15000 T.shillings, depending on the size of the plot. This compared very well with the average wage of T.Shs 1500 from agriculture or fishing. Their involvement in seaweed cultivation has clearly raised women's purchasing power and consequently their status in the communities. The seaweed plots attract rabbit fish that are caught by the women while taking

care of the plots. As a consequence their families have a higher fish consumption than others in the community.
In 1992 more than 15 000 farmers (90% women) along the coast of Zanzibar were involved in seaweed cultivation. The number of people involved in the industry in 1998 was estimated at 40,000. More than 5000 tons of dried seaweed were produced and exported to Denmark and the USA. Colloids extracted from seaweed are used in the production of bread, and in the cosmetics and pharmaceutical industry.
Sources: ALCOM News, No 3: p. 4 – 8, 1990; ALCOM News No 11, p. 11-16. 1993; Moffat e.a. 1998.

Lessons learnt:
In areas where they are used to collect fish and other food items in shallow coastal waters women can successfully take up seaweed and possibly other forms of mariculture. In areas where they are the main food producers on small-scale farms, women may find it easier to start seaweed farming due to the similarity between seaweed culture and agriculture.

Initiatives of private enterprises can be the basis of successful developments in a coastal area.

3.7 Bio-prospecting

Although some marine organisms are used in traditional medicine especially in the Far East, the traditional knowledge regarding medical use of marine creatures seems to play a less important role in prospecting activities as is the case with bio-prospecting of terrestrial plants and animals. Pharmaceutical companies interested in the use of marine organisms rely more on the results of screening done in laboratories. Some promising compounds have been found but so far no commonly used medicine based on a marine animal or plant has been taken into production. Clear arrangements that regulate exploitation and benefit-sharing in case valuable compounds are discovered should be made between the prospecting company or institute, the national government and the communities near the place where the prospecting takes place before prospecting activities start. Contractual arrangements such as the one between a major pharmaceutical firm and a Costa Rican institute (see Box 17 in Chapter 4) can serve as an example for countries and communities near rich coral reefs.

3.8 Rehabilitation of marine biodiversity

When destruction has not gone beyond certain limits most marine ecosystems have the capability to recover once the causes of their degradation are removed. It is possible to restore part of the biodiversity at degraded sites by re-introducing certain critical elements. Many successful mangrove planting projects in Asia are examples of this (see Box 7). Attempts to re-introduce seagrass at sites in the tropics where

this plant had disappeared are less common. Unlike with mangrove trees it is seldom the active harvest of this plant by man that is the course of its disappearance, but changed environmental conditions such as increased turbidity, siltation, and frequent bottom trawling. Seagrass can return only when the factors that contributed to its disappearance are mitigated. Once conditions are favourable again it will often return on its own, as result of the spread of seed from seagrass fields upstream. When such fields do not exist replanting can be attempted.

Recovery of degraded coral reefs can be enhanced by transplantation of pieces of life coral. Transplantation is more successful with some species than with others, but successful transplantation of some coral species stimulated the natural colonisation by other coral species.

Cases of successful mass breeding of marine animals are rare. Research efforts especially on high value fish species such as groupers, snappers and seahorses are ongoing and have met some success, but captive breeding on a commercial scale has been achieved with only a handful of species. It is expected that successful reproduction in captivity plus the culture of more marine species will lead to reduction of pressure on wild stocks (Box 16).

Box 16. Restoration of Giant Clam populations

From many reefs in Asia and the Pacific Giant Clams have nearly disappeared due the high demand in Japan and other Asian countries for the muscle that close the clam. At the Coastal Aquaculture Centre on the Solomon Islands the International Centre for Living Aquatic Resources Management (ICLARM) is since 1987 involved in research on Giant Clams. Successful reproduction of various giant clam species has been achieved and young clams produced at hatcheries are re-introduced in various countries in the Indo-Pacific region at reefs from which the clams have disappeared. It is expected that by re-introduction on depleted reefs new clam populations will establish. Giant clams are also introduced for culture to coastal communities of the Solomon Islands. By introducing clam culture in combination with reef stocking activities, pressure from local communities on wild stocks can be reduced and redirected to farming the clams. The Coastal Aquaculture Centre has expanded its program to other shell fish species and sea cucumbers.

Sources: Naga, January 1993: p. 8 – 10. ICLARM Annual Report 1996.

4. Guidelines for Support for Conservation and Sustainable Use of Marine Biodiversity

This chapter presents the focal areas for DGIS-supported activities related to marine biodiversity, and gives guidelines for development activities in this field. The main areas to be supported will be Integrated Marine and Coastal Area Management, and the management and sustainable exploitation of marine living resources. After dealing briefly with possible impacts of land-based activities on the coastal and marine environment general guidelines are given for activities that are directly aimed at the users of marine and coastal biodiversity. The activities have been selected according to the major action areas of the Jakarta Mandate (see paragraph 2.1), but other major sectors and issues believed to be especially relevant for marine biodiversity have been added. These are tourism, biodiversity prospecting, rehabilitation of coastal ecosystems, training & distribution of information, research, national legislation, and actions in Europe in support of sustainable use and conservation of marine biodiversity in developing countries.

4.1 Focal areas for DGIS-supported activities

As a consequence of the international commitments in the field of (marine) biological diversity and national policies regarding international assistance, DGIS will direct the main part of its efforts with regard to marine biological diversity at the following areas:

Integrated Marine and Coastal Area Management (IMCAM)
Integrated Marine and Coastal Area Management, or varieties of it such as Integrated Coastal Zone Management, is widely considered the most appropriate tool to solve the complex problems in the coastal zones. It is the backbone of Dutch policy with regard to coastal areas and seas.

Improved management aimed at sustainable exploitation of living marine resources
Management of marine living resources should be aimed at exploitation at a level that is in balance with the carrying capacity of the target stocks and should take the links of these stocks with other components of the ecosystem and the impact of exploitation on non-target components into consideration.

Besides from these two major focal areas Dutch international assistance will also support sustainable forms of marine aquaculture (under the conditions mentioned in 4.2.2.6), the improvement of relevant national legislation, eco-tourism, and measures to prevent the introduction of harmful alien marine species or their eradication. Also coastal and marine protected areas and the rehabilitation of natural coastal ecosystems will be supported.

In support of these focal areas the Netherlands development assistance will support:
- the strengthening of capacity of relevant institutions,
- the increased involvement of coastal communities and resource users in marine resource management,
- alternative economic activities in areas suffering from heavy exploitation of

coastal and marine resources by coastal inhabitants,
- research in direct support of improved management and sustainable exploitation,
- the development and implementation of code of practices and guidelines aimed at sustainable exploitation of marine living resources and sustainable marine aquaculture,
- the distribution of information and raising public awareness with regard to marine biodiversity.

The instruments available at DGIS to shape this support can be applied on three levels (between brackets those responsible for implementation):

International field:
- Consultations in international forums (conventions, donor co-ordination, UN, etc) can be used to promote the mentioned policies and activities (embassies and DGIS/The Hague);
- Coherence of policies in an EU context should be pursued (DGIS/The Hague);
- Central or regional budgets can be applied to support activities in several countries (embassies and DGIS/The Hague);
- Deliberations with international organisations may give opportunities to encourage them, when relevant, to establish a sectoral policy for marine bio-diversity (DGIS/The Hague).

Trout hatchery in Titicaca Lake, Peru (photo: Lineair)

At national level:

- Assistance can be given to national governments to develop sectoral policies in which the above mentioned DGIS supported issues are incorporated (embassies);
- DGIS country policies in which the above can be tackled (embassies and DGIS/The Hague);
- Contacts with national governments and other donor organisations can be used to incorporate the above mentioned issues in different programs (embassies);
- For programs supported by the Netherlands the above issues should be considered;
- Environmental funds available at a number of Netherlands embassies can be used for the implementation of field activities (embassies).

At local levels:
Embassy funds can be applied by embassies to implement the above mentioned activities. The approach will be to start pilot projects aimed at ICZM, sustainable exploitation, and distribution of information and awareness raising. Such projects will serve as models and training sites for the rest of the country and for the wider region. Support to these projects will have to be long-term because of the complexity of the problems in many areas, the number and variety of stakeholder groups involved and the generally slow pace of changes that involve new approaches, skills and attitudes. In this context coastal communities involved in the exploitation of marine living resources and in small-scale aquaculture are priority target groups for support.

4.2 Guidelines for land-based activities with possible impacts on marine biological diversity

Planned activities in the field of agriculture, forestry, industry, mining, drilling or hydrological infrastructure even located far from the sea can have an impact on marine living resources which should be taken into consideration when an EIA is carried out. Such impacts can be through alterations of volume or quality (nutrients, pollutants, sediment levels) of water flows in rivers, physical obstacles for migrating fish species, atmospheric pollution and through the import of exotic aquatic plants and animals. At present software (Dr.EIA) is being developed in the Netherlands that will assist decision makers to gauge whether an EIA for planned development activities is necessary.

Activities such as the construction of new wastewater and sewage treatment facilities, and improvement or expansion of existing facilities, contribute to a reduction of pollution of river waters but are also beneficial to coastal marine ecosystems. Such activities should preferably take place within the framework of an environmental management plan that covers the complete river basin. This will require international co-ordination in case the river basin is located in more than one country. The experience in the Rhine Commission can be valuable as an example of international co-operation that has succeeded in improving the quality of the water of a river in a densely populated and highly industrialised basin.

4-3 Guidelines for activities directly aimed at coastal and marine living resources and their users

4-3-1 Environmental Impact Assessment.

The Sectoral Policy Document on "Biological Diversity" (DGIS, 1995) from the Dutch Ministry of Foreign Affairs states that an Environmental Impact Assessment (EIA), of which impact on biological diversity is an important component, is required when activities are planned in sensitive areas such as wetlands, areas of exceptional importance to biodiversity, areas used by indigenous people and areas of exceptional cultural value. Land-based or coastal activities that may affect biodiversity-rich marine ecosystems such as coral reefs, mangroves, and seagrass meadows certainly have to be assessed for their potential impact.

More detailed information about EIA can be found in the "Guidelines for Environmental Impact Assessment of Development Assistance Projects" (FINNIDA, 1989).

To ensure that the interest, opinion and view of local communities of marine resource users are taken into consideration during an EIA social scientists should be part of the team. Whenever possible, organisations representing the resource users should be allowed to select or recommend scientists that can participate in the assessment team.

4-3-2 Initiate pilot projects that can serve as regional models

There is a great need for development projects related to marine biodiversity management that can serve as models for other parts of the country and for other countries in the region. To make such projects into successful models great care has to be taken that from the initial stages onward communities are fully informed. Conditions within coastal communities may not be optimal for effective participation (contradicting interests and internal conflicts, weak local leadership, insufficient skills needed for successful participation, negative experiences that led to damaged trust and confidence in government authorities), and local activities can take a long time to take off. Projects and programs should direct part of their attention and resources to creating better conditions and building skills for effective local participation. Support for projects and activities aimed at meaningful participation at the local level should be for a longer period (8 to 10 years).

At the onset socio-economic and ecological baseline surveys should be made and monitoring of both ecological and socio-economic aspects should be carried out regularly. The baseline surveys do not have to be comprehensive but should be directed at the main problems and issues expected to be tackled by the project.

Activities in line with the Jakarta Mandate

In the Jakarta Mandate five priority areas for action on conservation and sustainable

use of marine biodiversity were identified (see paragraph 2.1). All activities carried out within the framework of this action plan will affect resource users indirectly or directly to some degree, but those activities that are primarily aimed at the use and users of marine living resource and that are directly beneficial to the poor segment of the population are clearly within the mandate of institutions primarily concerned with development. Activities under the first 4 priority areas of the Mandate seem most likely to combine socio-economic development with improvements of (or reductions of adverse impact on) marine biological diversity.

4.3.3 Integrated Marine and Coastal Area Management (IMCAM)

Ideally all activities related to use and management of the coastal zone and its living resources should take place within the framework of an Integrated Marine and Coastal Zone Management plan. For the initiation of IMCAM in a country where the concept is not yet known the training of a small core group of staff in the concepts of, and approaches to IMCAM is a useful and necessary first step. Next step could be the start of an operational pilot project on a local (district or province-wide) scale. Such pilot projects should be aimed at solving a specific problem so that results can be booked in a fairly short time. Such an approach can result in a model for implementation at a larger scale, allows the authorities to become familiar with the concept, and gradually builds up local capacity and trust.

The major steps needed for instituting IMCAM at local or national level include:

- Designation of a competent authority that can stimulate action, co-ordinate efforts, monitor and evaluate progress, develop legislation and regulations and enforce decisions. It should support on wide acceptance from the population, stakeholders, and administration.
- Identification of the major sectors, industries and activities that have impacts on coastal and marine biodiversity, and the assessment of the relative importance of their contributions. The suitability and carrying capacity of the site for each of the activities and the impact on- and off-site needs to be assessed.
- Bringing stakeholders and relevant local, provincial and national agencies together for an integrated planning process. Local communities should be given the legal authority, opportunity, necessary training and support to play a leading role in regulating and managing coastal areas. Broad-based public constituencies can be created to support comprehensive coastal development plans.
- The development of a management plan, in which all relevant issues should be addressed simultaneously. Alternatives and scenarios can be developed based on stakeholder wishes, government objectives and future projections of current developments. The alternatives should be compared and discussed by all stakeholders.
- Implementation of the management plan. This may require some institutional reorganisation at both the national and regional level, where institutions carry out functions relevant, but not exclusive, to biodiversity issues. If necessary, authoris-

ing legislation should be developed with regulations and management policies that form a basis for sustainable development.
- Development of mechanisms and strategies for monitoring and enforcement.

4.3.4 Establishment and management of marine protected areas

All potential stakeholders and especially the communities of local resource users should be involved in an early stage in decisions regarding the establishment of protected marine area.

Introducing the idea to the local population

A marine protected area often has positive effects on the availability of commercially important species and on the economic situation of the users of marine living resources in nearby areas. However, its benefits to fisheries are often not easily understood and accepted by the fishing communities. Introducing protected areas to local communities as tools to enhance the yield and income from fisheries may avoid initial resistance and generate support more quickly than an introduction of measures emphasising the protection of animals, plants and habitats. It needs careful explanation and convincing. Exposure of community leaders to areas where protected areas have been functioning for some time can help to gain local support.

Establishment and management

In many cases, local communities have knowledge and experience that enable them to play a key role in protected area management, monitoring and enforcement. Local knowledge regarding spawning areas and movements of fish and other organisms should be solicited and resource user's suggestions regarding exact location, shape and size of protected areas, allowable levels and ways of exploitation should be taken into consideration. Taking local wishes sufficiently into consideration while deciding on size of the area and the management measures reduces the chance of future conflicts and problems.

To be effective the establishment of protected areas should be supplemented with a comprehensive set of broader conservation measures such as regulation of major activities that threaten the ecosystems under consideration and the creation of buffer zones around protected areas.

Other guidelines for the establishment and management of a marine reserve are:
- The boundaries of the reserve must be clearly marked with buoys, posts or landmarks.
- Fish migration routes should be protected as completely as possible.
- For coral reefs, the reserves should include the breeding areas for fish. The combined knowledge of marine biologists and the local population will be helpful for establishing the location of migration routes and breeding areas.
- The reserve should aim to include representative portions of all available ecosystem types, including mangroves, estuaries, sea grass beds and reefs.

- Where possible, the landward side of the reserve should also be protected and maintained in a natural state,
- Money needed for management and maintenance of the reserve and benefits for local resource users can be generated from visitors via entry or mooring fees. Measures should be taken to reduce damage by visitors as a result of anchors, coral and shell collection, etc.

More detailed guidelines for the establishment and management of marine protected areas have been developed by International Union for the Conservation of Nature (IUCN), the Ramsar Convention and UNESCO.

Support to existing protected areas

Many governments have established protected areas, but due to a shortage of financial and human resources needed for surveillance, enforcement and research programmes, many protected areas are essentially "paper parks". For existing protected areas development activities should focus on capacity building aimed at improved management. Active involvement of all stakeholders, making a fair share of the benefits derived from the protected areas available to the local communities, and making alternative sources of income available to reduce pressure on the protected ecosystems are important considerations.

Act both on local and global level

The small-scale management approach developed for the protection of terrestrial systems will be ineffective if applied uncritically to the oceans. Issues related to fisheries, pollution, migrating species and global threats such as ozone depletion and global warming can make local initiatives such as protected areas useless. To be effective local and national actions should be combined with regional and global initiatives.

4.3.5 Sustainable exploitation of marine and coastal living resources

In the DGIS document "Fisheries in Developing Countries" (Policy Document 9, DGIS 1995) more detailed guidance on the sustainable use of living aquatic resources and on development activities directed at the artisanal fisheries sector is given. This paragraph will deal mainly with the aspects that are of relevance to the issue of integrating marine biodiversity issues into management and sustainable exploitation of fish stocks.

In places where fish stocks are harvested at unsustainable levels and with adverse effects on marine ecosystems management efforts should be supported that aim at bringing fishing pressure in balance with the carrying capacity of fish stocks and ecosystems. Improvement of fisheries management on a regional, national, and local level is necessary and often urgent. On an international level this includes support to the implementation of international agreements such as the UN Agreements on Straddling and Highly Migratory Fish Stocks, the implementation of the FAO Code of Conduct for Responsible Fisheries, and to regional initiatives aimed at better co-ordination of fisheries management, research surveillance and enforcement.

On national and lower levels improving the capacity and capability to manage fisheries plus making other sources of income (aquaculture, tourism, agriculture, small-scale industries) available to especially the poor members of coastal communities can contribute to both reduction of excessive fishing pressure and to improvement and diversification of income.

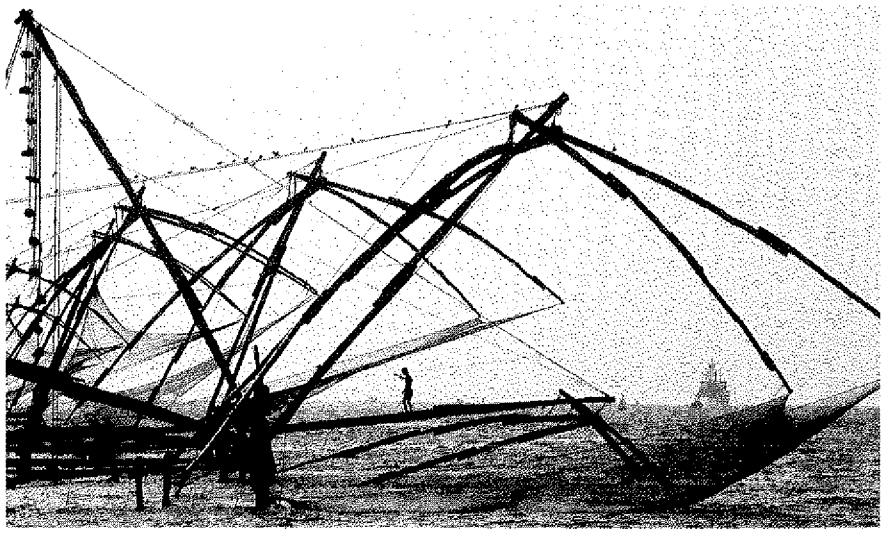
Reduction or eradication of particularly harmful fishing methods (dynamite, cyanide and other poison, reef destruction) can be achieved through a combination of public awareness raising, better control and improving the availability of less destructive exploitation methods. Control and enforcement by members of the same community can be difficult due to social and family ties and will only be effective when supported by the leaders and the majority of the community.

In many cases government fisheries management is focussed on the commercially important fish stocks. The importance of other species and habitats for such stocks (as food, predator or habitat with an important function in the life cycle of the commercial species or its prey) is often not given enough consideration. Also the effects of fishing on species and habitats not of immediate commercial importance is seldom a matter of serious concern. Additional information, training and means are needed to enable local authorities and researchers to adopt an approach which takes all ecological links, the complete ecosystem and the effects of fishing on biological diversity into consideration.

A focus on species and stocks of commercial importance also leads to ignoring commercially less interesting species in monitoring programs. However, trends in the size and composition of the catch of such species (often as by-catch which is discarded in the case of most industrial fisheries) in various types of fisheries can give valuable information of ecosystem changes taking place in the sea that might otherwise remain undetected. Fisheries Departments could consider a systematic monitoring program of by-catch and discards as part of their regular catch monitoring activities. This can be a cost-effective way of detecting and following changes in the composition of marine ecosystems.

In many coastal communities women and youth scan the reef, mud flats or mangrove stands nearly daily in search for edible items. As a consequence they do have a considerable knowledge of the creatures present. With additional training and proper incentives women and youth can play an important role in programmes aimed at monitoring the living resources of shallow or inter-tidal coastal waters.

Bottom trawling for shrimp and fish is one fishing method that results in considerable amounts of by-catch and discards. The introduction of technical devices such as turtle-excluding devices in trawl nets and fish-excluding devices in shrimp fisheries will contribute to the reduction of the environmental impact of these fisheries. Also technical measures which mitigate ghost fishing (= the continued capture of fish by



Chinese fishingnets, India (photo: Linear)

lost or discarded fishing gear) will have positive effects on marine biodiversity. Introduction of such devices and adjustments of fishing gear often means additional cost or is otherwise economically less attractive. Programs for the introduction of such devices or adjustments may have to include some financial support for the users at an initial stage to overcome such economic obstacles.

Government staff working in relevant departments may have to learn how to incorporate and support the participation of coastal communities and resource user groups. Also user groups may have to increase their skills to play their role in participatory forms of management effectively. Training aimed at building capacity for participatory forms of resource management will be necessary. Inclusion of traditional local knowledge about fish stocks, fish behaviour and the effects of fisheries in management schemes should be endeavoured.

The women working in fish processing, marketing and distribution of marine resources depend on marine resources as much as the men who are in charge of catching. This justifies women's right to participate in decision-making regarding resource use and conservation. Local culture will determine the most effective way to achieve women's participation.

Due to environmentally harmful collection methods and poor storage and transport practices a great part of marine fish and other animals collected for ornamental purposes dies shortly after capture. Part of the ornamental fish industry has formed the Marine Aquarium Fish Council that tries to encourage the collection and transport

of marine ornamental fish according to best practices. It takes care of certification of firms which collect, pack, transport and sell fish according to the guidelines given, and assists members by making information and training material available which can contribute to reduced mortality of collected specimens. Support to these and similar activities can help to transform a harmful and destructive form of resource extraction into a sustainable and profitable income generating activity of members of coastal communities.

4.3.6 Sustainable mariculture operations.

The DGIS document "Fisheries in Developing Countries" (Sectoral Policy Document 9, DGIS 1995) provides more detailed guidance on sustainable aquaculture development for especially the small-scale producers. The following guidelines deal more specifically with the effects of marine aquaculture on biodiversity.

Netherlands assistance to the development of new mariculture projects can be considered when:

- taking place in the context of a comprehensive land use or coastal zone management plan that has taken the protection and conservation of marine biodiversity and natural coastal ecosystems into consideration;
- adverse ecological and social effects are minimal, clearly outweighed by the potential benefits for especially poor coastal inhabitants, and can be mitigated. Such can be assessed by an environmental impact study.
- the economic benefits for especially poor coastal inhabitants are clear and significant.

The reduction of harvest pressure on marine natural resources by stimulating the development of an alternative source of income can be an important additional consideration for support to the various forms of mariculture. Fish and shrimp culture can take place in ponds, floating cages, within fences (pens) and on the bottom in shallow areas. The ecological effects differ for each culture system.

Ponds for shrimp culture should be properly sited taking soil characteristics in relation to salination of ground water into consideration. Construction on acid sulphate soils should be avoided. Ponds on sandy soils should be lined with a layer of clay or plastic to avoid saltwater infiltration into aquifers. Between the coast or river and the planned construction site a setback zone should be left in its natural state. Instead of supporting the constructing of ponds for only shrimp or fish, systems that combine mangrove forestry and shrimp culture such as described in Box 8 could be considered. Projects that demonstrate the suitability of such systems in other areas and support the wider application can contribute to both economic progress and restoration of natural tree coverage.

Existing and new shrimp culture operations should be obliged to operate according to the code of conduct or best practices which are developed at present by various international organisations (Southeast Asian Nations Fisheries Network, Network of Aquaculture Centers in Asia-Pacific, Australian Prawn Farmers Association) to minimise environmental effects.

The culture of fish in floating cages and pens can provide an alternative source of income for coastal people. However, pen and cage culture often take place in semi-protected areas such as bays and lagoons, and concentration of cages or pens can lead to eutrophication and algae blooms as a result of feeds and fish waste dissolving in the water. Sediments under and near the cages will also be affected by the amounts of fish waste deposited. Proper siting taking direction and strength of currents into account, clearly marked limits to the areas that can be covered with cages and pens plus proper information on the type and amount of feeds to be fed is needed to keep the environmental impact at acceptable levels.

Culture of seaweed and shellfish can be undertaken with limited economic resources and without major environmental impacts since feeding is not required. Where conditions (physical environment, marketing infrastructure, economic conditions) are suitable, this type of activity may offer interesting opportunities for additional income for coastal communities, especially women and youth.

In many places where mariculture is practised on a large scale fingerlings and larvae collected from wild stocks form the basis of the industry. To reduce this pressure research to solve problems in the artificial propagation of marine species (whether kept for ornamental or for food purposes) and other activities aimed at reducing the negative effects (whether direct or indirect) of mariculture on coastal ecosystems can be considered for support.

4.3.7 Prevention of introduction, and control of harmful alien species

Introduction of exotic marine species for aquaculture or other purposes should take place according to the ICES Code of Practice for Conservation of Transfer and Introductions of Marine and Freshwater Organisms (ICES, 1995) and the FAO Code of Conduct for Responsible Fisheries (FAO, 1995). Possible effects of planned species introductions for mariculture should be included in the Environmental Impact Assessment for such activities. The construction of canals that link different coastal water bodies carries the risk of unintended introductions and should be considered in the EIA.

For the prevention of the introduction of unwanted aquatic marine organisms and pathogens from ships' ballast water and sediment discharges the implementation of the International Guidelines of the International Maritime Organisation should be encouraged in f.i. projects supporting harbour and port management. One way to avoid unintended introductions of new species is emptying and re-filling the ballast tanks far from any coastal area in the centre of the ocean.

4.3.8 Bio-prospecting

Marine biodiversity offers considerable potential as a source of new products such as medicines, environmental restoration technologies (micro-organisms that decompose pollutants), environmental sensors, enzymes for biotechnological and indus-

trial application, adhesives, anti-fouling agents, dyes, etc. Various firms and institutions such as the National Cancer Institute in the USA, are collecting and analysing especially coral reef organisms for their value as a possible source of drugs or other chemicals.
The Biodiversity Convention states that access to resources should be by prior informed consent and under mutually agreed terms. This refers to access to all living resources in the EEZ of a coastal state. At present agreements about bio-prospecting are most often made between private sector parties and research institutions, and seldom are national institutions involved. There is a need for many developing countries to design an appropriate legal framework for bio-prospecting and to assign a national authority to co-ordinate and oversee access to (marine) genetic resources. Legislation should deal with access to genetic resources and traditional knowledge concerning the use and the sharing of benefits with the source nation and with local communities. Activities that are aimed to build a country's capacity to regulate access and especially appropriate benefit sharing with coastal communities can be supported.

For arrangements between countries or institutions and companies involved in bio-prospecting the one made in Costa Rica can serve as an example (Box 17).

Box 17. Co-operation with pharmaceutical giant contributes to biodiversity protection.

The Instituto Nacional de Biodiversidad (INBio) has as its objectives to catalogue and conserve the Costa Rican biodiversity and to generate funds from it without exhausting it. In return for funds INBio delivers chemical extracts of plants, micro-organisms and animals collected in the Costa Rican rainforest to Merck & Co., the world's largest pharmaceutical company. Merck screens these extracts for the presence of compounds for medical use. Ten % of the funds received by INBio is used for protection of national parks. When one of the samples is processed into a commercial medicine INBio receives the royalties from the product. Half of these royalties will be conferred on the national parks. Merck also assists in the training of Costa Rican researchers.

Source: Meijerink, G.W (1995) Function endowment of tropical forests. Safeguarding the goose with the golden eggs. Work Document no. 71 of the Netherlands National Reference Centre for Nature Management (IKC-N).

4.3.9 Tourism

(Eco)-tourism projects can be supported when they contribute significantly to economic progress and alleviation of poverty in an area, and when damage to natural areas, marine life and to the interest of local communities is avoided. Minimal damage and disturbance should be aimed for while planning and executing infrastructure projects for tourists. If negative impact on existing local activities can not be

avoided negotiations leading to just compensation should take place. Crucial is that a fair part of the benefits flow to local communities (in the form of employment, profit sharing, supply contracts, etc).

Every possible reduction of environmental impacts resulting from increased numbers of people in an area (litter, sewage, traffic, noise, collection of shells and other souvenirs, etc) should be attempted. Maximum levels of divers visiting coral reef sites and other attractive natural spots should be observed (see Box 14).

The aggregation of people who are attracted (among other things) by nature's beauty, offers a good opportunity for spreading information and raising awareness of marine biodiversity issues. Divers and visitors of natural areas can be requested to take part in monitoring and research projects while visiting the reefs or coastal forests. The way the Jean-Michel Cousteau Institute was built and is operating can serve as a model for other tourist projects. (Box 18).

Box 18. The Jean-Michel Cousteau Fiji Islands Resort

This small tourist resort (20 houses) is located near a coral reef on one of Fiji's islands. An energy-saving design has been used in the construction of the guesthouses. Solar energy is used for heating of water and electricity generation. Solid waste is recycled as much as possible or used as compost or animal feed. Wastewater is treated in artificial wetlands and the treated water is used for irrigation of the surrounding gardens and fruit trees. Integrated pest management is applied and mosquito populations are kept under control by eliminating possible breeding sites. Visitors take part in the collection of mangrove seedlings from other areas to rehabilitate the mangrove stands removed by the former owner. Divers are requested to take part in reef monitoring programmes. Small laboratories have been added to accommodate research needs of visiting scientists.

People from nearby communities (especially youth) are invited for various educational activities organised by the staff biologist. In one type of educational activity, which is considered as extremely effective, a direct 2-way audio-visual communication link is established between the visitors and a diver and cameraman out on the nearby reef.

Source: World Bank, 1998. Coral Reefs. Challenges and opportunities for sustainable management.

4.3.10 Rehabilitation of natural areas

When a threat to a natural area is removed nature is often able to restore the previous state, although this can take decades as is the case with destroyed coral reefs. Seagrass meadows will return when natural conditions are favourable and when patches with such plants are still present in the vicinity. Recovery can be enhanced

by deliberate action such as mangrove reforestation, transplanting pieces of life coral, restocking with giant clams or other marine species, but such activities will only be successful when the processes leading to habitat degradation and disappearance of certain natural elements have been stopped. To create diversity a mixture of species should be used to rehabilitate degraded mangrove stands. Damage and overexploitation of areas where seedlings or juvenile stages of animals are collected should be avoided.

Replanting or restocking programmes aimed at the rehabilitation of habitats that have important functions for local communities can offer (mostly temporary) income opportunities for coastal inhabitants, especially for women. After initial planting or stocking some maintenance and guarding will be needed. Education and involvement of local communities starting from the early planning stages is important for their support and participation.

To reduce pressure from collection of seedlings or juvenile stages of animals in natural areas the creation of regional centres such as the Coastal Aquaculture Centre on the Solomon Islands (Box 17) for mass propagation of marine species in support of marine ecosystem rehabilitation programmes could be supported.

Permanent structures made of car tyres, concrete, cars or ship wracks have been placed at appropriate sites in shallow seas to serve as a base for new reef communities. Such so-called artificial reefs initially attract and concentrate fish and other organisms from nearby areas, but will after some time become a more productive and biodiversity-rich part of the reef on itself. Artificial reefs can only be successful as a measure to enhance fisheries production and marine biodiversity when the exploitation of organisms living on or near the reef is regulated and controlled. Without such measures artificial reefs can even contribute to further pressure on fish stocks due to increased harvesting rates made possible by aggregation of fish and other animals from a wider area.

4.3.11 Training, education and public information

For the initiation, expansion and improvement of activities aimed at IMCAM, fisheries management and the sustainable use of marine biodiversity additional training and education are needed on a wide range of topics of government and NGO staff on all levels, and of coastal and marine resource users.

For assessing the present condition of marine ecosystems and for monitoring changes, taxonomists specialised in marine creatures are indispensable. Such specialists are rare in many developing countries, and additional training to biologists in this aspect is needed. When also trained as educators their knowledge can make such specialists to very effective advocates for the conservation of marine biological diversity. Marine taxonomist knowledge can be used to develop public information

campaigns or special programmes for school youth about marine biological diversity.

Increased information about the value, threats and beauty of marine biodiversity to the general public of coastal nations through all types of media and in the general education curriculum is necessary to create understanding and support for programmes aimed at more sustainable use and the conservation of marine biodiversity. Financial support for the production of video films, slide shows, posters and books which show the submerged beauty of the marine habitats of a country can be effective means to raise knowledge, awareness and pride in the youth and general public.

Sea aquariums are an attractive and successful medium to inform the public about the beauty and value of marine biodiversity and the threats to it. Financial support for the establishment and the start-up phase can combine the creation of a powerful public information and education tool with a self-supporting and possibly profitable small-scale enterprise. Especially in coastal nations with big cities and a considerable medium-income group such projects can be profitable. Existing experience with such enterprises in developing countries are rare but should be assessed before decisions to support plans for such enterprises are made. Initially the interest of the public can be tested with a simple, attractive small-scale facility. Active involvement of national marine biologists should be encouraged and the co-operation with programmes for applied marine or mariculture research should be explored. Useful experience with the construction and management of public seawater aquariums is available in many developed countries including the Netherlands and on Curacao.

4.3.12 Research

Most coastal developing countries have only a limited core of marine scientists whose resources for research activities are as a rule severely restricted. Politicians and decision-makers are often not fully aware of the potential value of research for sustainable management of marine resources. However, marine biologists have not always selected topics that are of direct use for management of marine living resources. And if they did, they were often not successful in presenting the results in a way that is understandable and of use for people making management and financial allocation decisions or for coastal communities.

Regional co-ordination and co-operation of researchers should be encouraged and supported to ensure exchange and an optimal use of the scarce resources available.

Research initiatives that directly support the solution of problems and issues discussed in paragraph 4.3.3 to 4.3.10, and which combine possibilities for socio-economic improvements of resource users and coastal communities with protection of (or reduction of negative impacts on) marine biological diversity are especially relevant. Possible topics for biological and technical research are: devices and methods

to reduce by-catch, discards and ghost fishing; identification of spawning grounds, migration routes and feeding grounds of important fish species, possibly in collaboration with traditional resource users; the eradication of harmful exotic species; indicators for changes in marine ecosystems; controlled propagation and culture of species for aquaculture and for restocking in natural habitats; treatment of waste water from mariculture operation.
Possible topics for social and management research are: the factors leading to success or failure of traditional and community-based aquatic resources management; appropriate arrangements for sharing responsibilities, tasks and benefits related to resource management, (eco-)tourism, and bio-prospecting; indicators for socio-economic conditions in coastal communities (project monitoring tools); assessment of the value of services and products resulting from sustainable use of marine and coastal resources; the development of scenarios comparing various forms and levels of exploitation or conversion; quantification of women's contribution to the harvest of coastal living resources and to food security in coastal communities.

4.3.13 **National legislation in relation to use and conservation of marine resources**

The result of programmes and projects related to various aspects of management, sustainable use, conservation and rehabilitation of coastal and marine resources are often be affected by a weak or absent legal base which can support sustainable and multiple uses and effective conservation of marine biological diversity. To increase effectiveness a part of the activities of national projects should be aimed at building support for legal reforms and additional regulation. The following areas are often weakly supported or defined by national laws:

- Land use plans to regulate developments and activities in the coastal area;
- Recognition of traditional right of access and use of marine living resources by local communities;
- Possibilities for resource regulation and enforcement by user groups, local communities or local resource management committees in which resource users participate;
- Regulations regarding marine bio-prospecting: access to resources, and benefit sharing with local government and communities.

To be effective attention for improved legislation regarding coastal and marine resource use should be balanced with sufficient means for proper enforcement.

4.3.14 **Action in Europe in support of conservation and sustainable use of marine biodiversity in developing countries**

Dutch and other European fishing vessels operating in tropical waters within the framework of international fisheries agreements with developing countries should preferably operate only within the framework of an effectively enforced fisheries management plan. Such a plan should take the effects of all fisheries on local ecosystems as well as the social and economic effects of foreign fisheries on the

local fishing industry and artisanal fishing communities into consideration. The companies should ensure that technical measures aimed at reducing the catch of juvenile fish and of non-target species are implemented.

Market mechanisms can be used to encourage sustainable fisheries in developing countries. The possibilities for eco-labels for marine species (ornamental and food) from developing countries on European markets should be further explored and evaluated. Fish caught from sustainably and effectively managed fisheries (taking social and/or fishery effects on the whole ecosystem into consideration) could qualify for sale in the developed world with a special label.

Within Europe the Netherlands is an important country for the import and further distribution of ornamental fish and other aquatic organisms. Legal measures aimed at reducing the import of fish collected with methods that are harmful to the ecosystem and non-sustainable should be developed. Illegal collection and export can be reduced by making import licences available on condition of possession of all proper export licences.

Implementation by Dutch maritime firms of the International Guidelines made by the International Maritime Organisation for preventing the introduction of unwanted aquatic marine organisms and pathogens from ships' ballast water and sediment discharges should be encouraged by the Netherlands' government. Methods that prevent unintended transfers of marine species such as emptying and refilling ballast tanks at mid-ocean, special filters, or ballast tank coatings should be encouraged.

The governments of the Netherlands and other countries that are the home base of companies involved in marine bio-prospecting could support the enforcement of compliance with regulations regarding access and use of genetic resources. This could include the issuing of import permits on condition of a valid export permit; requirements to keep records of the origin of genetic resources and traditional knowledge; economic incentives for research co-operation, technology transfer and other forms of benefit-sharing.

The considerable number of Dutch tourists visiting coastal areas in developing countries offers opportunities for special information and awareness programmes. Such programmes could possibly be developed in co-operation with Dutch travel agents and tourist organisations should aim at reduction of the negative impacts of the tourist visits on marine ecosystems and local communities, and at raising awareness of the value of the habitats visited. Enhancement of positive effects of tourism on the local economy and ecology should be aimed for.

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Annex 1.

Tropical marine ecosystems with high biodiversity

Coral Reefs

Coral reefs are among the most productive ecosystems on earth and also among the richest in species diversity. Coral reef faunas are the most diverse in the world, in terms of higher taxonomic variety. The framework of corals and algae supports a variety of sponges, sea whips, sea anemones, worms, tube worms, shrimps, crabs, lobsters, snails, clams, starfish, brittle star, feather-stars, sea urchins, sea cucumbers and fish. 60 percent is located in the Indian Ocean, 25 percent in the Pacific and 14 percent in the Caribbean. They protect coastlines from storm damage and beach erosion and provide homes, breeding areas, nurseries and food for thousands of fish and shellfish species including a number of commercial species. Estimates of 55 % of artisanal fish catch in Philippines and 90% in Indonesia is related to coral reefs (J.R.Clark, 1996). They also have a high potential as a source of new drugs. In order to cope with the competition, a large number of reef organisms have developed substances harmful to other organisms, a number of these highly active compounds have useful medical application. Furthermore, coral reefs can be very attractive for tourists.

Estimates on the decline are shocking; ten percent is degraded beyond recognition, 30 percent is in critical condition and will be lost in 10-20 years, another 30 percent could be lost in 20-40 years if no effective management will be implemented. Coral reefs at greatest risks are situated in the developing regions in South and Southeast Asia, East Africa and the Caribbean.

Human activities leading to loss or degradation of coral reefs

- Antropogenic pollution, for instance by untreated sewage, municipal garbage and industrial wastewater.
- Eroded sediment due to deforestation and poor agricultural practices
- Overexploitation of fish and other species
- Blast fishing in Africa, Southern and South East Asia and Central America
- Coral mining
- Poison fishing, especially in Southeast Asia
- Bleaching of corals, possibly linked to global warming
- Tourism, for instance by recreational divers and through anchor damage
- Dredging
- Coastal infrastructure activities related to harbours and coastal development

Sea grass meadows

Sea grass meadows are spread over a large part of the earth, in both temperate and tropical seas close to shore in shallow waters. They trap and consolidate sediment, slowing down erosion and filtering the water for filter feeders such as clams, oysters

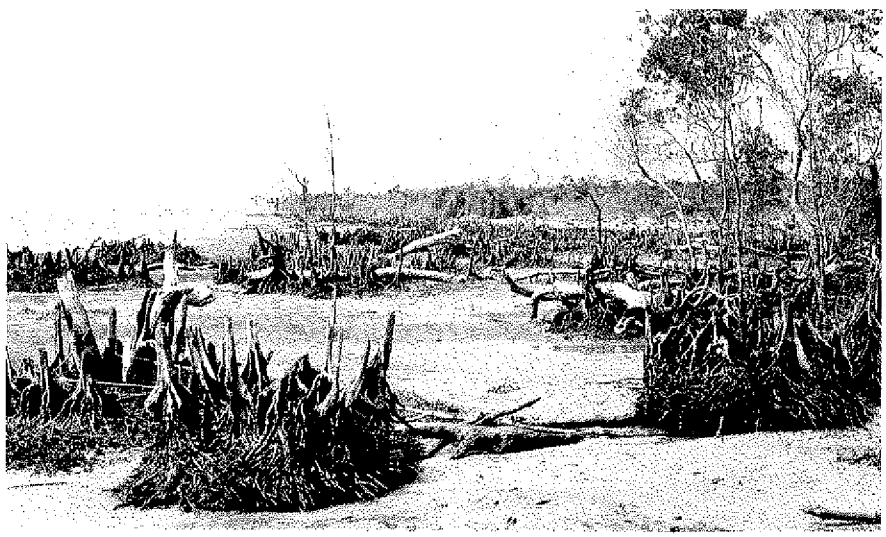
and mussels and nearby coral reefs. They provide nursery grounds, shelter and food for a large number of fish and shellfish, including commercial species. Sea turtles, manatees and dugongs graze submarine meadows. For herbivorous and fish eating waterfowl sea grass meadows have an important function as feeding grounds and moulting areas.
Productivity is very high, and sea grass beds can support important fisheries. Sea grass beds are under increasing threat, but very little information on the estimated decline in total area is available.

Human activities leading to loss or degradation of sea grass beds
Coastal development causing habitat loss
Deforestation
Pollution
Smothering of sea grass beds by mining for sand, coral and minerals
Dredge and fill operations in ship channels and harbours
Eutrophication
Changes in turbidity
Intensive bottom trawling

Wetlands (including mangroves)
Wetlands are areas permanently or for shorter or longer periods covered with water. Coastal areas up to 6 meters depth are often included in this definition. Important wetlands include mangrove forests, lagoons, estuaries and salt marshes. These areas provide vital spawning, nursery and feeding grounds for thousands of species of fish and shellfish; filter out pollutants washed off the land (such as heavy metals and nitrates); trap and stabilise sediments and serve as buffers between land and sea (coastal protection). Furthermore, wetlands can be important as "linkage areas" in migratory routes of water fowl.
Mangrove forests are considered one of the most diverse and productive wetlands, supplying habitats for over 2000 species of fish, shellfish and other marine organisms. Mangrove estuaries shelter endangered marine mammals such as dugongs, manatees and otters. A high percentage of fish and shellfish caught by commercial and artisanal fisheries are dependent on mangrove swamps. However, large parts of East Asia, East Africa and the Caribbean have been deforested and the West African mangroves are threatened. The unregulated conversion of mangrove forests into shrimp ponds is a large threat in many countries. Because mangroves are often situated near river mouths, construction or expansion of harbours is causing a considerable loss of area. The development of irrigated agriculture in pyrite containing mangrove areas can lead to strong acidification of the soil and the formation of so-called Acid-Sulphate soils.

Human activities leading to loss or degradation of mangroves

Logging and shifting cultivation
Conversion to shrimp and fish farms
Construction of dykes, dams, levels and seawalls for flood control, water supply, irrigation and storm protection
Sediment diversion by dams, deep channels and other structures
Filling for solid waste disposal, roads, commercial, residential harbour and industrial development
Dredging and stream channelling for navigation and flood protection
Drainage for agriculture, forestry and mosquito control
Discharges of pesticides, herbicides, nutrients from domestic sewage and industrial waste waters, agricultural runoff and sediment
Hydrological alterations by canals, roads and other structures



Vietnam, increased erosion on the Mekong Delta's coast (photo: W. Benthem, ARCADIS)

Annex 2

Selected list of Dutch Institutes operating in the area of Marine Biodiversity

CZMC	Integrated Coastal Zone Management
IBN-DLO	Wetlands and Nature Conservation *Wetlands ecology, mangrove forests*
IKC	Wetlands and Nature Conservation *Policy oriented*
ILRI	Tropical culture technique *Tropical agriculture, mariculture*
NIOO-CEMO	Marine and Estuarine Ecology *Fundamental ecological research and modelling*
NIOZ	Marine ecology *Research of coasts , seas and oceans*
RIVO	Fisheries research *Ecological, technical and social aspects*
RIZA	Wetlands and Integral Water Management *Water quality*
RIKZ	Coastal and Marine Management *Coastal defense, water quality, impact of human activities*
TNO	Effects of human activities on marine systems *Ecotoxicology, ecology, pollution aspects*
IAC	Advice on development projects; international training *Fisheries management, aquaculture, ICZM, rural development projects*
RUG (University Groningen)	Scientific research and education; *Diversity of marine plant species; coastal biodiversity (extinction, introductions).*
UvA (University Amsterdam)	Scientific education and research *Marine animal taxonomy*
KUN (University Nijmegen)	Scientific education and research; Seagrass