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Curriculum on

Coastal and Marine Biodiversity and Protected Area Management

Module 4
Coastal and Marine Protected Areas and Sustainable Fisheries Management

For Field-Level MPA Managers

Imprint

Training Resource Material:

Coastal and Marine Biodiversity and Protected Area Management for Field-Level MPA Managers

Module 1: An Introduction to Coastal and Marine Biodiversity and Ecosystem Services
Module 2: Coastal and Marine Biodiversity and Ecosystems Services in the Overall Environment and Development Context
Module 3: Mainstreaming Coastal and Marine Biodiversity into Overall Development and Environmental Planning
Module 4: Coastal and Marine Protected Areas and Sustainable Fisheries Management
Module 5: Governance, Law and Policies for Managing Coastal and Marine Ecosystems, Biodiversity and Protected Areas
Module 6: Assessment and Monitoring of Coastal and Marine Biodiversity and Relevant Issues
Module 7: Effective Management Planning of Coastal and Marine Protected Areas
Module 8: Communicating Coastal and Marine Biodiversity Conservation and Management Issues

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Module 4
Coastal and Marine Protected Areas and Sustainable Fisheries Management

For Field-Level MPA Managers

Summary

This module provides the much needed information on the basics of fisheries management, principles and practices of sustainable fisheries management in and around marine protected areas, and on the marine protected areas (MPAs). The modules provides insights into the differences between MPAs and terrestrial protected areas, the categories and types of MPAs, their management systems and an overview of the elements of sustainable fisheries management. This module covers the key issues of fisheries and indigenous communities in the context of MPAs. Apart from providing information on different types of MPAs in India and their locations, the module elaborates benefits of and challenges for MPAs.

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Acronyms

CBD	Convention on Biological Diversity
CMS	Convention on Migratory Species
EIA	Environmental Impact Assessment
EMP	Environment Management Plan
FAO	Food and Agriculture Organization
GCBA	Generational cost benefit analysis
NBAP	National Biodiversity Action Plan
NEP	National Environment Policy
SEA	Strategic Environmental Assessment
SLEIAA	State Level Environmental Impact Assessment Authority

Learning outcomes

After completing this module, the participants are able to

- explain the term 'Protected Area' and describe different types of natural protected areas based on their management and resources uses
- differentiate between the key characteristics and factors governing a terrestrial protected area and an MPA
- describe different types of management models for MPAs and challenges associated with each
- outline the key principles of sustainable fisheries management
- explain the difference between small-scale and commercial fisheries and their respective relevance to coastal and marine biodiversity
- appreciate the intricate relationship of fishing and biodiversity conservation
- appreciate the role of sustainable fisheries in ensuring effective conservation of coastal and marine biodiversity

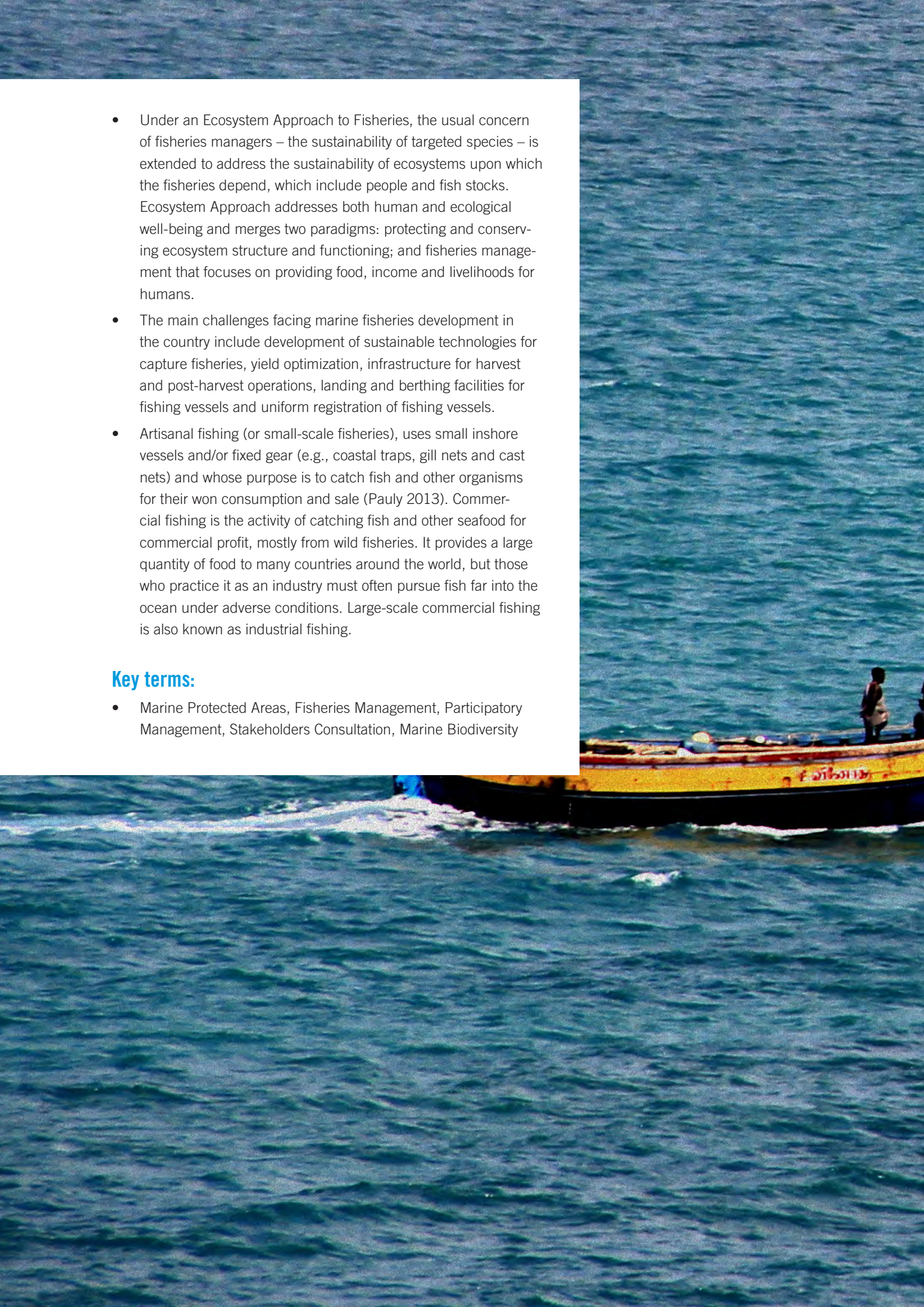
Key messages

- A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means is mandatory to achieve the long-term conservation of nature with associated ecosystem services and cultural values.
- One of the most effective means for protecting marine and coastal biodiversity is through the establishment and proper management of Marine Protected Areas (MPAs) . Marine Protected Areas cover many different types of protection. Some are "no-take zones or protected zones" that are essential to enable fish stocks to recover while others allow multiple use of their resources. MPAs protect key ecosystems such as coral reefs. Not only do they act as safe breeding ground for fish, they also generate tourism, which in turn bring jobs. Creating more Community Managed MPAs would enhance the flow of benefits to local people.
- India has designated four legal categories of protected areas viz. National Parks, Wildlife Sanctuaries, Conservation Reserves and Community Reserves. India has created a network of PAs representing all its 10 biogeographic regions. A total of 693 protected areas have been established comprising, 103 National Parks, 525 Wildlife Sanctuaries, 61 Conservation Reserves and 4 Community Reserves, besides designating 26 wetlands as Ramsar sites
- In India, PAs that fall in whole or in part within swath of 500 m from the high tide line and to marine environment are included in the Marine Protected Area Network. Based on this definition, there are 24 Marine Protected Areas present in the Peninsular India and more than 100 MPAs in its islands. Of the 24 MPAs in the peninsula, Gulf of Mannar Marine National Park, Sundarbans National Park, Gulf of Kutchch National Park, Bhitrakanika National Park, Coringa Wildlife Sanctuary, Chilika Wildlife Sanctuary have unique marine biodiversity and provide a range of services to local communities around these MPAs.
- Protected Area managers face a wide range of challenges, from lack of governmental funding and support, to antagonism from local communities. With good communication and awareness programmes, this trend could be reversed. Involving the local communities in the management of marine protected areas would help generate sustainable livelihoods through revenue from fishing and tourism
- India has vast potential for fisheries in view of our long coastline of about 8,000 kms apart from the inland water resources and India is the second largest producer of fish in the world contributing to about 5.43% of global fish production. It has been recognized as a powerful income generator and is a source of cheap protein besides being a source of foreign exchange earner.

- Under an Ecosystem Approach to Fisheries, the usual concern of fisheries managers – the sustainability of targeted species – is extended to address the sustainability of ecosystems upon which the fisheries depend, which include people and fish stocks. Ecosystem Approach addresses both human and ecological well-being and merges two paradigms: protecting and conserving ecosystem structure and functioning; and fisheries management that focuses on providing food, income and livelihoods for humans.
- The main challenges facing marine fisheries development in the country include development of sustainable technologies for capture fisheries, yield optimization, infrastructure for harvest and post-harvest operations, landing and berthing facilities for fishing vessels and uniform registration of fishing vessels.
- Artisanal fishing (or small-scale fisheries), uses small inshore vessels and/or fixed gear (e.g., coastal traps, gill nets and cast nets) and whose purpose is to catch fish and other organisms for their won consumption and sale (Pauly 2013). Commercial fishing is the activity of catching fish and other seafood for commercial profit, mostly from wild fisheries. It provides a large quantity of food to many countries around the world, but those who practice it as an industry must often pursue fish far into the ocean under adverse conditions. Large-scale commercial fishing is also known as industrial fishing.

Key terms:

- Marine Protected Areas, Fisheries Management, Participatory Management, Stakeholders Consultation, Marine Biodiversity



4.1 What are protected areas?

Protected areas have been used as a tool to manage natural resources for biodiversity conservation and for the well-being of people dependent on these resources. They are widely regarded as one of the most successful measures implemented for the conservation of biodiversity, drawing upon traditional and community-based approaches, governance regimes, scientific and traditional knowledge and contemporary practices of governments and conservation agencies (IUCN).

IUCN defines a protected area as: A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values.

IUCN together with UNEP-WCMC jointly manages the World Database on Protected Areas. As per the Aichi

Biodiversity Targets, a total of 12% of the terrestrial part and 10% of the marine ecosystem need to be protected globally to safeguard the biodiversity and its dependent communities in the future.

India has a very long tradition of setting aside areas for conservation of wild flora and fauna. After independence, several Protected Areas (PAs) were designated in the form of National Parks and Wildlife Sanctuaries, but the approach was largely ad hoc. In 1983, the Government of India (GoI) decided that rational planning and implementation of a comprehensive network of PAs would be the keystone of the National Wildlife Action Plan and entrusted the Wildlife Institute of India (WII) to formulate plans for such a network (Rodgers et. al., 2002). The WII prepared a biogeographic classification of India designed to facilitate conservation planning, with a review of existing protected areas and recommendation of new PAs to ensure an adequate network covering the range of biological diversity in the country. Thus, from a network of 54 National Parks covering 21,003 km and 373 Sanctuaries covering 88,649 km , giving a combined coverage of 109,652 km or 3.34% of the country's geographical area in 1988, this network has grown steadily, and as of May 2015 there are 700 PAs (103 National Parks, 528 Wildlife Sanctuaries, 65 Conservation Reserves and 4 Community Reserves) covering 166,851 km or 5.07% of the country's geographical area. India has also established 24 MPAs in peninsular India and 105 in the islands.

Table 1: Definition and Primary Objectives of IUCN Protected Area Categories (Dudley, 2008).

IUCN Category	Definition	Primary Objective	Designation in India
Ia	*Category Ia are strictly protected areas set aside to protect biodiversity and also possibly geological/ geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.*	To conserve regionally, nationally or globally outstanding ecosystems, species (occurrences or aggregations) and/ or geodiversity features: these attributes will have been formed mostly or entirely by non-human forces and will be degraded or destroyed when subjected to all but very light human impact.	National Park e.g. Gulf of Mannar Marine National Park
Ib	*Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.*	To protect the long-term ecological integrity of natural areas that are undisturbed by significant human activity, free of modern infrastructure and where natural forces and processes predominate, so that current and future generations have the opportunity to experience such areas.	Wildlife Sanctuary e.g. Coringa Wildlife Sanctuary
II	*Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.*	To protect natural biodiversity along with its underlying ecological structure and supporting environmental processes, and to promote education and recreation.	Wildlife Sanctuary e.g. Malvan Wildlife Sanctuary

IUCN Category	Definition	Primary Objective	Designation in India
III	*Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine caverns, geological feature such as a caves or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.*	To protect specific outstanding natural features and their associated biodiversity and habitats.	Wildlife Sanctuary e.g. Malvan WLS
IV	*Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.*	To maintain, conserve and restore species and habitats.	Conservation Reserve/ Community Reserve
V	*Category V protected areas are where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value: and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.*	To protect and sustain important landscapes/ seascapes and the associated nature conservation and other values created by interactions with humans through traditional management practices.	Conservation Reserve/ Community Reserve
VI	*Category VI protected areas conserve ecosystems and habitats together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in natural condition, where a proportion is under sustainable natural resource management and where low-level non industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.*	To protect natural ecosystems and use natural resources sustainably, when conservation and sustainable use can be mutually beneficial.	Conservation Reserve/ Community Reserve

4.2 Coastal and Marine Protected Areas (MPAs)

4.2.1 Definition and overview:

The need to manage the use of existing aquatic resources for sustainability and to safeguard their environment better is increasingly being recognized worldwide. In sustainable fisheries management, the consideration of wider ecosystems, including the human component, is now extensively accepted, and methods such as the ecosystem approach to fisheries (EAF) are being promoted (FAO, 2011). Therefore, the use of marine protected areas has taken on greater importance and reverse the degradation of aquatic habitats. MPAs are commonly described as a tool for biodiversity conservation and as part of the ecosystem. Spatial temporal fishing closures are also used in fisheries management, and MPAs and fisheries are linked through this common avenue of spatial management and through EAF.

As defined by the Convention on Biological Diversity ,

A 'Marine and Coastal Protected Area' means any defined area within or adjacent to the marine environment, together with its overlying waters and associated flora, fauna, and historical and cultural features, which has been reserved by legislation or other effective means, including custom, with the effect that its marine or coastal biodiversity enjoys a higher level of protection than its surroundings (CBD, 2004).

As defined by the IUCN, '... a marine protected area is any area of the intertidal or sub-tidal terrain, together with its overlying water and associated flora, fauna, historical and cultural features, which has been reserved by law or other effective means to protect part or all of the enclosed environment' (Kelleher 1999).

However, in India, PAs that fall-in whole or in part-within swath of 500 m from the high tide line and to marine environment are included in the Marine Protected Area Network. Based on this definition, there are 24 Marine Protected Areas present in the Peninsular India and more than 100 MPAs in its islands. Simply, any marine geographical area that is afforded with greater protection than the surrounding waters for biodiversity conservation (or fisheries management) purposes will be considered an MPA

The marine protected area network is still in its infancy. As of December 2014, 6594 MPAs were established around the world which covers 2.09% of total marine areas available.

Spatial areas which may incidentally appear to deliver nature conservation but **do not have stated** nature conservation objectives should **not** automatically be classified as MPAs, as defined by IUCN. These areas include the following:

- Fishery management areas with no wider stated conservation aims.
- Community areas managed primarily for sustainable extraction of marine products (e.g. fish, shells, etc).
- Marine and coastal management systems managed primarily for tourism, which also include areas of conservation interest.
- Wind farms and oil platforms that incidentally help to build up biodiversity around underwater structures and by excluding fishing and other vessels.
- Marine and coastal areas set aside for other purposes but which also have conservation benefit: military training areas or their buffer areas (e.g. exclusion zones); disaster mitigation (e.g. coastal defences that also harbour significant biodiversity); communications cable or pipeline protection areas; shipping lanes etc.
- Large areas (e.g., regions, provinces, countries) where certain species are protected by law across the entire region.

Any of the above management approaches could be classified as an MPA if instead they had a primary stated aim and are managed to deliver nature conservation.

4.2.2 Explanation of protected area definition.

[Source: Day et. al 2012]

Phrase	Explanation provided in the 2008 Guidelines	Discussion and example of application in the marine realm
Clearly defined	*Clearly defined implies a spatially defined area with agreed and demarcated borders. These borders can sometimes be defined by physical features that move over time (e.g., river banks) or by management actions (e.g., agreed no-take zones).*	This implies that MPAs must be mapped and have boundaries that are legally defined. However, while some MPAs can be clearly defined (e.g. an entire bay bounded by headlands), for others it may be difficult to mark the boundaries, especially if the MPA is offshore. Even boundaries on the landward side, where tide levels can be used (e.g. Low Water Mark), can be difficult to establish. Increasingly, MPA or zone boundaries are defined by high resolution latitude and longitude coordinates, as determined by modern GPS instruments. **Example:** • Indian Protected Area Network system identifies sanctuaries legislated under the Wildlife (Protection) Act, 1972, with boundaries defined in a series of associated maps.
Geographical space	*Includes land, inland water, marine and coastal areas or a combination of two or more of these. "Space" has three dimensions, e.g., as when the airspace above a protected area is protected from low-flying aircraft or in marine protected areas when a certain water depth is protected or the seabed is protected but water above is not: conversely subsurface areas sometimes are* not *protected (e.g., are open for mining).*	All protected areas exist in three dimensions, but the vertical dimension in MPAs is often a substantial management consideration. In MPAs, management may need to address the airspace above the sea surface, the actual water surface, the water column (or parts of it), the seabed and the sub-seabed, or just one or a combination of two or more of these elements. For example, some MPAs protect just the seabed/benthos and not the water column above. It is therefore important that an MPA has a clear description of the dimensions that are actually protected. **Examples:** • In Gulf of Mannar Marine Biosphere Reserve, Tamil Nadu, the boundaries of National Park and Biosphere Reserve is clearly defined. • The National Park is described as 'No use zone' whereas the 'Biosphere Reserve' is described as buffer zone with multiple use.
Recognised	*Implies that protection can include a range of governance types declared by people as well as those identified by the state, but that such sites should be recognised in some way (in particular through listing on the World Database on Protected Areas – WDPA).*	**Example:** • The Government of Canada and the Council of the Haida Nation co-manage Gwaii Haanas National Park Reserve and Haida Heritage Site, and the Gwaii Haanas National Marine Conservation Area Reserve off the Pacific coast of Canada.
Dedicated	*Implies specific binding commitment to conservation in the long term, through e.g.:* • *International conventions and agreements* • *National, provincial and local law* • *Customary law* • *Covenants of NGOs* • *Private trusts and company policies* • *Certification schemes*	Examples: • The Galápagos Marine Reserve is designated under national law and is also an integral part of the Galápagos Islands World Heritage Site. • Vueti Navakavu in Fiji is a locally managed marine area (LMMA) established by the community and declared through local cultural protocol systems.

Phrase	Explanation provided in the 2008 Guidelines	Discussion and example of application in the marine realm
Managed	*Assumes some active steps to conserve the natural (and possibly other) values for which the protected area was established; note that "managed" can include a decision to leave the area untouched if this is the best conservation strategy.*	The requirement that a site is managed applies to both marine and terrestrial situations. As on land, many types of MPA management are possible. **Example:** • Bonaire National Marine Park in the Netherlands Antilles has clearly defined regulations that apply to all users of the park.
Legal or other effective means	*Means that protected areas must either be gazetted (that is, recognised under statutory civil law), recognised through an international convention or agreement, or else managed through other effective but non-gazetted, means, such as through recognised traditional rules under which community-conserved areas operate or the policies of established non-governmental organisations.*	As for terrestrial protected areas, 'effective means' include agreements with indigenous groups; **Example:** • Dhimurru Indigenous Protected Area, an area of land and sea in the Northern Territory of Australia, on the Gulf of Carpentaria, is run by the Dhimurru Land Management Aboriginal Corporation which works with the Traditional Owners to manage the protected area.
… to achieve	*Implies some level of effectiveness – a new element that was not present in the 1994 definition but which has been strongly requested by many protected area managers and others. Although the category will still be determined by objective, management effectiveness will progressively be recorded on the WDPA and over time will become an important contributory criterion in identification and recognition of protected areas.*	As for terrestrial protected areas, this implies some level of effectiveness and therefore requires that the MPA is subject to monitoring, evaluation and reporting. **Example:** • The assessment of management effectiveness of the Aldabra World Heritage Site in the Seychelles, undertaken as part of the Enhancing our Heritage project with the UNESCO World Heritage Centre, provides information on the extent to which the objectives of this MPA are being achieved.
Long term	*Protected areas should be managed in perpetuity and not as short term or a temporary management strategy.*	As with terrestrial protected areas, long-term protection (over timescales of human generations) is necessary for effective marine conservation. Seasonal closures of an area for a specific purpose (such as fish spawning, whale breeding, etc), in the absence of any additional biodiversity protection and any primary nature conservation objective are not considered to be MPAs. Seasonal protection of certain species or habitats may be a useful component of management in an MPA. **Examples:** • The Cockle Bay Shellfish Seasonal Closure area in New Zealand is NOT an MPA as it is only in force for the months of October to April when collection of shellfish is banned. • In the Marine Mammal Protection Zone of the Great Australian Bight Marine Park (Commonwealth Waters) the use of vessels is prohibited 1 May - 31 October each year to protect an important calving and breeding area for Southern Right Whales.

Phrase	Explanation provided in the 2008 Guidelines	Discussion and example of application in the marine realm
Conservation	*In the context of this definition conservation refers to the* in situ *maintenance of ecosystems and natural and semi-natural habitats and of viable populations of species in their natural surroundings and, in the case of domesticated or cultivated species, in the surroundings where they have developed their distinctive properties*	**Examples:** • Ecological Reserves in the Florida Keys National Marine Sanctuary in the United States are designed to provide natural spawning and nursery areas for the replenishment and genetic protection of marine life and aim to protect and preserve all habitats and species found throughout the Sanctuary. • The inclusion of a minimum of 20% of all 70 bioregions within Australia's Great Barrier Reef Marine Park is designed to provide in situ protection of representative examples of all species and ecosystem processes.
Nature	*In this context nature always refers to biodiversity, at genetic, species and ecosystem level, and often also refers to geodiversity, landform and broader natural values.*	All protected areas, whether terrestrial or marine should aim to protect all the features of conservation importance within their boundaries. **Example:** • The overall objective of the Great Barrier Reef Marine Park is to provide for the long term protection and conservation of the **environment, biodiversity and heritage values** of the Great Barrier Reef Region.
Associated ecosystem services	*Means here ecosystem services that are related to but do not interfere with the aim of nature conservation. These can include provisioning services such as food and water; regulating services such as regulation of floods, drought, land degradation, and disease; supporting services such as soil formation and nutrient cycling; and cultural services such as recreational, spiritual, religious and other nonmaterial benefits.*	MPAs provide a wide range of ecosystem services: **Examples:** • Ecosystem services: The MPA network in Belize has been estimated to contribute nearly US$20 million annually in reef-related visitor expenditure. • Regulating ecosystem services, for example seagrass meadows, mangroves and kelp forests as carbon sinks: The four MPAs designated by the Malta Environment and Planning Authority to protect Malta's *Posidonia* (seagrass) beds together protect over 80% of this habitat in Malta. Areas set up for wave/wind power are generally NOT MPAs (see section 2.3).
Cultural values	*Includes those that do not interfere with the conservation outcome (*all *cultural values in a protected area should meet this criterion), including in particular:* • *Those that contribute to conservation outcomes (e.g., traditional management practices on which key species have become reliant)* • *Those that are themselves under threat.*	Areas set aside for cultural values are only protected areas under the IUCN definition, if they have nature conservation as a primary aim. However, many MPAs contain sacred sites or have significant cultural and heritage value and understanding of this is important. **Examples:** • Nosy Ve, an island in southern Madagascar protected under a local 'dina' agreement is both a sacred site and an area important for corals and as a tropic bird nesting colony. • Papahanaumokuakea Marine National Monument in the North West Hawaiian Islands is important for Native Hawaiians at genealogical, cultural, and spiritual levels.

Boundaries of MPAs

[Source: Day et al 2012]

There are a number of issues to consider when determining the boundaries of an MPA. On the landward side, it is important to make it very clear as to exactly what boundary is being used and this must be explained; for example 'Mean Low Water' is a different boundary from that of `Lowest Astronomical Tide'. Wherever possible highest astronomical tide or high water mark should be used (highest astronomical tide generally suits areas with large tidal ranges, whereas high water mark suits small tidal ranges). Both low water and high water marks can result in boundaries that are difficult in legal and administrative terms because:

- The low water mark is usually covered by water. It is thus difficult to inform the public of its precise location, and therefore to enforce; in addition, low water mark moves with erosion and accretion and is often not marked on charts or defined in any publically available way.
- Boundaries based on high water mark may cause problems as, for example, what may appear to be relatively stable 'lines' can also be influenced by erosion and accretion. Also established rights of use often reflect terrestrial ownership of the adjacent land.
- In rivers, estuaries or narrow bays, there are no clear principles for defining low or high water and it may be unclear as to which bays and channels are part of a MPA, and which may be regarded as 'internal waters'.

Offshore waters within and beyond national jurisdiction

Offshore waters are generally considered to be those that lie beyond a country's territorial seas, i.e. beyond 12 nautical miles from shore in most cases. They include the major part of all Exclusive Economic Zones (EEZs - waters under national jurisdiction out to a maximum of 200 nautical mile), as well as the high seas and seabed beyond the limit of national jurisdiction. For MPAs in offshore waters, designation should follow the 2008 Guidelines as for any protected area. Thus, a site may be considered as an MPA provided it: (a) has defined boundaries that can be mapped; (b) is recognised by legal or other effective means; and (c) has distinct and unambiguous management aims that can be assigned to a particular protected area category.

Example:

The South Orkney Islands Southern Shelf Marine Protected Area was the first fully high seas MPA to be designated under the Convention on the Conservation of Antarctic Living Marine Resources with specific management aims and a responsible body: the Commission on the Conservation of Antarctic Marine Living Resources (CCAMLR).

Recently, CBD initiated the process of describing 'Ecologically or Biologically Significant Marine Areas' in the open-water or high seas to achieve Aichi Target 10. In this process, India has proposed to describe the 'Angria Bank', the largest submerged coral reefs of India as the EBSA. Angria Bank is located 105 km off coast of Malvan, Maharashtra, India.

4.2.3 World's largest MPA

The Pacific Remote Islands Marine National Monument was established in January 2009 and expanded in 2014 by Presidential Proclamation. It consists of Wake, Baker, Howland, and Jarvis islands; Johnston Atoll; Kingman Reef; and Palmyra Atoll, which lie to the south and west of Hawaii. The Pacific Remote Islands Monument is the largest MPA in the world and an important part of the most widespread collection of marine life on the planet under a single country's jurisdiction.

The monument encompasses seven islands and atolls in the central Pacific Ocean area, spreading over approximately 1.3 million km2—equal to 40 per cent of the size of India. It sustains a diversity of species including corals, fish, shellfish, marine mammals, sea birds, land birds, insects, and vegetation not found anywhere else in the world. Many threatened, endangered and depleted species thrive in the Pacific Remote Islands, including the green and hawksbill turtle, pearl oyster, giant clams, reef sharks, coconut crabs, groupers, humphead and Napoleon wrasse, bumphead parrotfish, dolphins and whales. Both Palmyra Atoll and Kingman Reef support higher levels of coral diversity (180–190 species) than any other atoll or reef island in the central Pacific.

The waters surrounding Baker, Howland, and Jarvis Islands have abundant fish biomass due to the equatorial undercurrent that moves from west to east along the equator, creating localized, nutrient-rich upwelling in the shallows adjacent to the islands. The islands afford unique opportunities to conduct climate change research at the equator, far from population centres. The coral skeletons there have recorded the earth's climatic history for millennia. The Pacific Remote Islands contain some of the most pristine coral reefs in the world and monument status ensures these special areas are conserved.

Commercial fishing and other resource extraction activities, such as deep sea mining, are banned within the boundaries of the MPA and non-commercial fishing is restricted. This has led to protests from fishing and canning groups, such as the Hawaii Longline Association, as the area used to be commercially important, especially for tuna fishing.

The world largest continuous MPA was declared by Great Britain in the waters surrounding the Chagos Archipelago in the Indian Ocean. It, however, is challenged in the UN's permanent court of arbitration in the Hague. In 2015 Britain announced the establishment of another large continuous MPA around remote Pitcairn Island in the Pacific.

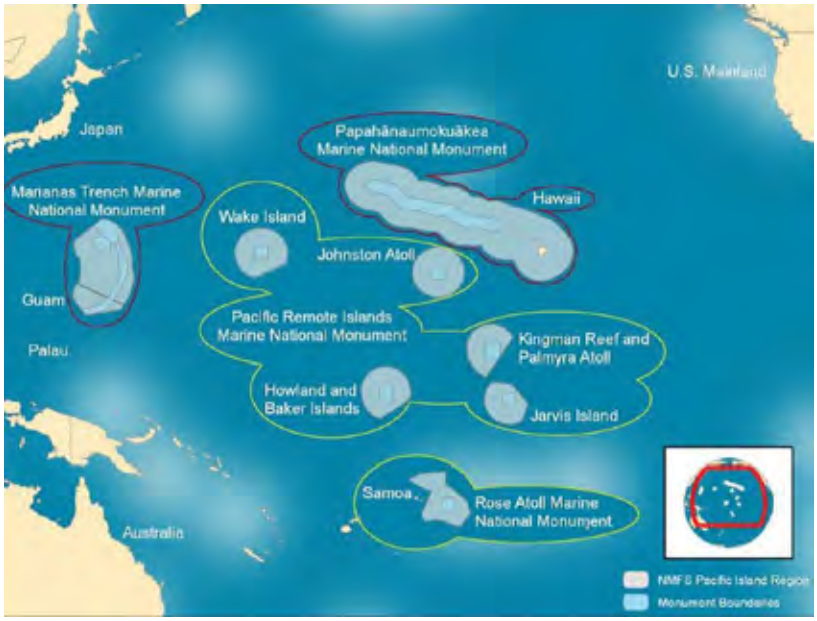


Figure: Map of the Pacific Remote Islands Marine National Monument – the world's

4.2.4 When is a marine area that may achieve conservation outcomes not an MPA?

A protected area as defined by CBD describes a precise set of management approaches with limits, and must have nature conservation as a primary rather than a secondary aim, as explained above.

There are however many managed areas that protect biodiversity, either indirectly, incidentally or fortuitously. Indeed, it is a principle of the Convention on Biological Diversity's "ecosystem approach" that all land and water management should contribute to conservation, and as a result the distinction between what is and what is not a protected area is sometimes unclear. However, such areas do not necessarily fulfil the IUCN definition of a protected area.

This is particularly the case in the marine environment where there is a long history of spatial fisheries management and a growing interest in spatial planning and spatial management of other activities that often have no stated aim or interest in nature conservation – it is just an incidental or apparent link. Understanding the IUCN protected area definition is thus critically important.

Areas subject to some form of management could be MPAs or parts of MPAs in some cases, but MPA status should not be assumed and decisions must be made on a case-by-case basis, the essential criterion being whether nature conservation is the primary objective.

The following types of management area are not necessarily MPAs:

- Fishery management areas with no wider stated conservation aims.
- Community areas managed primarily for sustainable extraction of marine products, e.g. fish.
- Marine and coastal management systems managed primarily for tourism, even where these also include areas of conservation interest.
- Wind farms and oil platforms that incidentally help to build up biodiversity around underwater structures by excluding fishing and other vessels.
- Marine and coastal areas set aside for other purposes but which have an indirect conservation benefit: military training areas or their buffer areas (e.g. exclusion zones); disaster mitigation (e.g. coastal defences that also harbour significant biodiversity); communications cable and pipeline protection areas; shipping lanes, etc.
- Large areas (e.g., regions, provinces, countries) where certain species are protected by law across the entire region.

4.2.5 Areas managed for fishing

[Source: Day et. al. 2012]

Temporary or permanent fishing closures that are established primarily to help build up and maintain reserve stocks for fishing in the future, and have no wider conservation aims or achievements are not considered to be MPAs. For example, Norway, Iceland and the Faroe Islands close areas to fishing at short notice if the percentage of juveniles or bycatch goes above a certain number. These areas do not qualify as MPAs. IUCN's advice is that areas set aside purely to maintain fishing stocks, particularly on a temporary basis, should not be considered to be PAs even though they may well reflect good fishery management. For such sites to meet IUCN's definition of a PA, managers would need to address the overall health and diversity of the ecosystem and have a stated primary aim to this effect.

Such areas, however, may be important components in the management of an MPA. For example, seasonal closures of fish spawning aggregation areas or pelagic migratory routes, at specific and predictable times of the year for certain species when they are extremely vulnerable, may be essential to the effective management of an MPA.

Examples of MPAs with seasonally closed zones:

- Within the Great Barrier Reef Marine Park, Australia, there are seasonal closures to all reef fish fishing for specific periods at certain times of the year.
- The Galapagos Marine Reserve has seasonal closures to fishing of, for example, sea cucumbers. Examples where management of fishing is essential to nature protection throughout the site:
- Eastport Marine Protected Area, in Canada, consists of two MPAs (Duck Island and Round Island, both of which are no-take areas) within the 400 km_2 Eastport Peninsula Lobster Management Area. The larger management area is open to commercial exploitation of lobsters according to the fisheries management regime in place and is not itself an MPA, and the two no-take areas, each of which meets the definition of a PA, play a key role in the lobster's management.
- Belize has 11 multispecies fish spawning aggregation sites that are closed to fishing permanently through marine reserves that restrict all fishing.

Spanish fishermen fight for MPAs

After years of overfishing, illegal fisheries and the consequences of a big oil spill caused by a ship accident, the fishermen's association (COFRADIA) of Lira, a small town in the coast of Galicia (northwestern Spain), has pioneered a comanagement initiative in the region by proposing the creation of a marine reserve. The proposal was designed and developed by the fishers in partnership with biologists, social scientists, environmentalists and members of the autonomous government of Galicia in a highly participatory process.

The views of different stakeholders on the implementation process for the marine reserve were assessed through a programme of semistructured interviews. These findings were also used to analyse issues related to the implementation process, employing a governance analysis framework. It was observed that the inclusion of fishers in the decision-making and the use of their traditional ecological knowledge in the design of the reserve promoted a better understanding of its benefits and an improved compliance with the fishing regulations. The effectiveness of the marine reserve was very high during the first years but it has been recently undermined due to the reduction of State financial support for enforcement in the light of the current economic recession in Spain. Though this marine reserve is driven by the stakeholders, the prospects depend on an adequate state enforcement capacity.

Source: *de Oliveira, L.P. 2013.*

4.2.6 Indigenous people and community-conserved territories and areas (ICCAs)

Indigenous people and community conserved territories and areas (ICCA) are defined by IUCN as 'natural and/or modified ecosystems containing significant biodiversity values, ecological functions and benefits, and cultural values voluntarily conserved by indigenous peoples and local communities both sedentary and mobile–through customary laws or other effective means.'

Determining when an ICCA is also a PA, and therefore eligible for listing on the WDPA, is more complex than for some other PA governance types and has two stages:

- **Agreement by the indigenous people or community involved:** no community-managed site should be identified as a PA or listed on the WDPA without express consent by the community. Recognition and listing can bring benefits but also costs, such as increased exposure.

- **Alignment with the IUCN definition of a PA:** the 2008 definition of a PA stipulates that for a site to be a PA, priority must be given to nature conservation; other values present may be of similar importance, but in the event of conflict between values, nature conservation must be considered the most important. As is the case with other governance types, community areas managed primarily for sustainable extraction of marine products will not be considered PAs according to the IUCN definition unless nature conservation is the primary stated objective of the management regime.

Many ICCAs have been established by coastal communities in marine ecosystems. The ICCA Registry website is an online information portal and secure database, developed by UNEPWCMC with support from UNDP's GEF Small Grants Programme, that documents indigenous and community conservation areas, including in the marine environment.

It aims to increase awareness of the biodiversity values of areas managed by communities and provide information on a wide range of aspects. As part of this process, it is hoped that further guidance on implementing the IUCN categories in terrestrial and marine ICCAs will be developed. Additional information is available through the ICCA Consortium, and the primary reference for determining whether a marine community conservation area is an MPA will be the 2008 Guidelines.

Source: http://www.iccaregistry.org/

Combination of indigenous and scientific knowledge for Fiji's marine biodiversity

Fishworkers and scientists have worked hand in hand on an assessment of changes in the occurrence and abundance of over 1000 species that have occurred over the past 50 years within the fishing grounds of Vanua Navakavu in the Fiji Islands.

The assessment was based on a comparison of time–depth testimonies of surviving older male and female fishworkers with results from more recent surveys in an effort to record and correlate observed changes with factors such as intense overfishing, use of fish poisons, increased pollution, a 1953 tsunami and the establishment of locally managed marine areas in 1991.

At present, local vernacular names for over 1000 species have been recorded and the recovery status of almost 900 assessed. Results show that the successful restriction of fish poisons, dynamite fishing, and small-mesh gill netting, combined with the establishment of a successful MPA, seems to be largely responsible for the return and increasing abundance of many species not seen for decades.

The basis for this success was a partnership of local fishers and communities who had personally witnessed and been involved in the collapse of their fisheries, with the Fiji national and provincial government agencies, NGOs, private industry, the University of the South Pacific and international funders. More than 200 villages have entered the Fiji Locally Managed Marine Areas Network. They can see impressive improvements in reef ecosystems and gains in marine biodiversity.

Source: UNESCO

The IUCN definitions of ‘protected area’ and management categories are neutral about the type of ownership or management authority. With respect to who holds decision-making and management authority and responsibility for protected areas, IUCN distinguishes four broad governance types—governance by governments, shared governance, private governance and governance by indigenous people and local communities. All combinations of protected area categories and governance types are possible in an MPA. IUCN suggests that the governance type of a protected area be identified and recorded at the same time as its category in national environmental statistics and accounting systems and in protected area databases.

4.3 Where are the MPAs located in India?

India has a vast coastline of 7, 517 km, of which, 5, 423 km belong to Peninsular India and 2, 094 km to the Andaman, Nicobar, and Lakshadweep Islands, and with an EEZ of 2.02 million sq. km. This coastline also supports a huge human population, which is dependent on the rich coastal and marine resources.

It is estimated that nearly 250 million people live within the swath of 50 km from the coastline of India. Therefore, the ecosystem services of marine and coastal ecosystems of India play a vital role in India's economic growth. India represents 2.5 percent of the world's landmass and supports a population of over one billion people. India is also one of 17 mega-biodiverse countries in the world, with 7.8% of the recorded species of the world, including 45,500 recorded species of plants and 91,000 recorded species of animals.

In India, PAs in whole or in part that falls within swath of 500 m from the high tide line and to marine environment are considered in the Marine Protected Area Network. Based on this definition, India has designated four legal categories of PAs, National Parks, Wildlife Sanctuaries, Conservation Reserves and Community Reserves.

Marine Protected Area Network of India

India has designated four legal categories of protected areas viz. National Parks, Wildlife Sanctuaries, Conservation Reserves and Community Reserves. India has created a network of PAs representing all its 10 biogeographic regions. A total of 693 protected areas have been established comprising, 103 National Parks, 525 Wildlife Sanctuaries, 61 Conservation Reserves and 4 Community Reserves, besides designating 26 wetlands as Ramsar sites.

There are 24 Marine Protected Areas present in the Peninsular India and more than 100 MPAs in its islands. Of the 24 MPAs in the peninsula, Gulf of Mannar Marine National Park, Sundarbans National Park, Gulf of Kutchch National Park, Bhitrakanika National Park, Coringa Wildlife Sanctuary, Chilika Wildlife Sanctuary have unique marine biodiversity and provide a range of services to local communities around these MPAs.

The Gulf of Mannar National Park (GOMNP) comprises a group of 21 uninhabited islands, located on the Tamil Nadu coast in south India. It was created in 1986 to conserve the coral reef, mangroves and seaweed habitat of the area. The national park, with an area of 560 sq km, forms the core area of the biosphere reserve (GOMBR).

The biosphere reserve was set up in 1989 under the United Nations Educational, Scientific and Cultural Organization Man and Biosphere (UNESCO-MAB) programme, and covers 10,500 sq km, making it India's largest (including the land and territorial sea component) marine and coastal protected area (MCPA). Rough estimates suggest that there are 125 fishing villages and 35,000 active fishers who depend on the resources in the Gulf of Mannar (GOM) area, especially on fishing, and collection of seaweed and other marine resources. There are approximately 5,000 fisherwomen who depend on seaweed collection in and around the 21 islands, and 25,000 fishermen who dive to collect sea cucumbers.

India has taken several steps for achieving Aichi Biodiversity Targets especially Target No. 11 (at least 10% of coastal and marine areas are conserved in networks of protected areas) and Target No.14 (Ecosystems that provide water, health, livelihoods and well-being are restored and safeguarded). Towards achieving these two targets, 106 coastal and marine sites have been identified and prioritized as Important Coastal and Marine Areas (ICMBA).

Along the west coast of India 62 ICMBAs and along the east coast of India 44 ICMBAs have been identified. These sites have also been proposed as Conservation or Communities Reserves with participation of local communities. Efforts are currently underway in securing and strengthening community participation in management of the marine protected area network in India.

India has also identified 12 protected areas as trans-boundary protected areas under the framework for IUCN Transboundary Protected Area programme. Among these sites, two are MPAs viz. Sundarbans Tiger Reserve and Gulf of Mannar Biosphere Reserve. India has also designated five UNESCO-World Heritage Natural sites and Sundarbans National Park is one among them.

4.4 Why do we need MPAs to conserve the oceans?

[Source: Kelleher,1999]

Clearly, conservation of the seas is vital, but why MPAs? This question is often asked, especially in the light of what marine scientists term the inter-connectivity of the sea.

Fish, algae, nutrients, pollutants and much else besides move freely in the water column. There are few natural boundaries in the oceans. Setting up an MPA will not stop fish moving out nor prevent pollutants moving in.

4.4.1 A Summary of major benefits of MPAs

- protecting ecosystem structure, functioning and beauty, allowing recovery from past damage, and serving as stepping stones for migratory/dispersive species;
- protecting the genetic variability of exploited species;
- improving fishery yields, including through protecting spawning stocks, enhancing recruitment, reducing over-fishing of vulnerable species;
- providing other direct and indirect social and economic benefits, such as attractions for tourists, by providing benefits to traditional users of biodiversity, or preserving reefs which prevent wave erosion of the shore or shelter moorings;
- providing opportunities for the public to enjoy natural or relatively natural marine environments, and opportunities for public education and to allow the public to develop an understanding of the effects of humans on the marine environment.

Marine and coastal biodiversity is under increasing stress from intense human pressures, including rapid coastal population growth and development, over-exploitation of commercial and recreational resources, loss of habitat, and land-based sources of pollution (IUCN-WCPA, 2012). Almost half of the world's fisheries are fully exploited, while about a fifth are over-fished. About 90% of large predatory fish biomass has been lost since pre-industrial times. Approximately 35% of mangrove forests have been lost over the past two decades.

At the same time, people around the world are increasingly dependent on these threatened resources for food, tourism, shoreline protection, and numerous other ecological services.

Prevailing climate change is posing a major threat to humankind as well as biodiversity. More than 90% of the world's carbon dioxide is stored in the oceans, and they remove 30% of the carbon dioxide released to the atmosphere. MPAs, which often encompass 'barrier or bioshield' ecosystems such as coral reefs or mangroves, can also reduce the impact of damage from natural disasters such as hurricanes. Waves are slowed by the reefs while mangroves are effective windbreaks that reduce soil erosion.

Close to 25% of fishing in developing countries is carried out near a coral reef and more than 70% of the world's fisheries are in danger. Studies have shown that the knock-on effect of "no take" marine protected areas, not only doubles the amount of fish but also their size in a very short period of time. The global MPA network, including in the High Seas, are key to replenishing biodiversity and nourishing the growing human population. They also serve as nurseries for key threatened species including whales and turtles whilst protecting a variety of marine ecosystems and the rich biodiversity they sustain. Furthermore, global networks of MPAs provide "stepping stones" for migratory species.

4.4.2 Major Benefits of MPAs for Fisheries Management

- producing fish of exploitable size, which then directly disperse "spill over" into the surrounding area where they become available to fishers;
- producing more offspring (from a greater density of breeding adults within MCPAs) which are then dispersed by currents to eventually recruit into surrounding fisheries;
- providing information that is necessary to make regulatory decisions about controls (e.g. Measures of natural mortality, reproduction, maximum size, trophic interactions, etc.);
- providing insurance against resource management mistakes outside of MCPAs by providing a refuge from the collection of organisms (e.g., corals, sponges, aquarium fish), and from fishing and making overfishing more difficult;
- providing insurance by preserving populations

Presently, only about 1% of the global ocean is protected. There has been a worldwide collapse in fisheries and attendant environmental damage and disruption to ecosystem structure and function. There have been many global calls to create many more marine protected areas. The World Summit on Sustainable Development, the World Parks Congress, and the Convention on Biological Diversity have all committed to a goal of establishing a global network of marine protected areas by 2012, including on the high seas.

An effective MPA system is needed to ensure that the oceans recuperate, continue to store carbon dioxide, that fish stocks recover and that coastlines are protected from harsh climatic conditions. It is no longer a technical question but a matter of survival for the planet and humankind. Some existing and proposed MPAs have been criticized by local communities as impinging on land usage rights. This criticism is stronger in poor and developing countries. Therefore, securing and strengthening community participation in management of the marine protected area is need of hour.

As these pressures intensify, Marine Protected Areas (MPAs) are increasingly recognized as a critical management tool to protect, maintain, and restore natural and cultural resources in coastal and marine waters. A network of marine protected areas, elimination of destructive fishing practices, and the implementation of ecosystem-based management could help meet the global goal of maintaining or restoring fisheries stocks to levels that can produce the maximum sustainable yield no later than 2015.

4.5 Challenges in managing coastal and marine biodiversity and MPAs:

FAO Guidelines of Fisheries Management within MPAs (2011) reiterate that MPAs relatively close to the coast can either help or hurt the local people and communities. Diverse groups within a community or within the fisheries sector may be affected in different ways. For example, resource users that have relatively high economic mobility (such as large-scale fleets that can move their fishing operations to other areas) are affected differently from smallscale fishers, who may be dependent on nearby fishery resources. Subsistence or traditional fishers, depending on fishing for their livelihoods, are more vulnerable to restrictions in resource access than recreational fishers. When certain fishing activities continue to be allowed (e.g. with small-scale passive gear), while others are prohibited (e.g. trawling), there may be a significant reallocation of benefits among diverse groups of fishers.

An important distributional issue for MPAs is that the benefits tend to be diffuse while costs are concentrated. A potential cost to the fisher is that catch (and revenues) may be decreased, at least in the short term, as a result of the implementation of a closure. Coastal communities adjacent to the MPA, especially those with a high economic dependence on the fishery, may face a disproportionate impact as a result of aggregate reduction in fishing revenue. On the other hand, they could also potentially capture most of the benefits in the form of reduced variations in aggregate catch levels, increased total catches or more valuable larger-sized fish catches owing to spillover effects. Such benefits may not occur immediately, although there are cases in which the biological response – and hence the socio-economic impact – is quite rapid. Examples include coral reef MPAs or where the establishment of an MPA limits the use of destructive fishing methods.

The way costs and benefits are distributed will depend on the particular circumstances and the way the MPA has been designed – including access and tenure arrangements. Resource reallocation can be an explicit objective of the MPA. By prohibiting or limiting certain activities and regulating access to a protected area, benefits and costs among diverse resource users are redistributed and the interests of, for example, traditional or small-scale fishers can be protected. If the benefits are likely to be generated only in the longer term for certain groups of fishers or other community members, it is important to combine resource management with the promotion of livelihood opportunities that provide economic benefits in the short run to address any economic disruptions to the individual or household. However, the local context must be considered, as viable alternative livelihoods are not always feasible or not socially and culturally desirable.

Protected Area managers face a wide range of challenges, from lack of governmental funding and support, to antagonism from local communities. With good communication and awareness programmes, this trend could be reversed. Involving the local population in the protection of marine protected areas would help generate sustainable livelihoods through revenue from fishing and tourism.

4.5.1 Characteristics of marine ecosystems

[Source: Secretariat of the Convention on Biological Diversity, 2004]

Key aspects of the marine and coastal environment that are relevant to MPAs:

- Ocean and coastal environments cover most of the earth and contain all marine biodiversity. All the 29 known phyla of free-living, multicellular animals are known to have occurred in the ocean and 14 are known only from the oceans.
- Most marine organisms in offshore waters are very sensitive to 'unknown' disturbances and pollution, especially as they are physiologically 'open systems,' not well protected against external harmful agents.

Marine and coastal environments are three-dimensional and highly dynamic in space and time. Primary productivity is often accomplished by small, mobile organisms. Marine food webs are in general more complex than terrestrial food webs. There are strong linkages between the pelagic and benthic components, as well as between the land and nearshore waters. All of these characteristics make the understanding of marine biodiversity, and its management, more complex and difficult. Most marine organisms have at least one free-swimming or fl oating stage in the life cycle, enabling wide dispersal. It is not possible to physically enclose the marine portion of MPAs. This has the advantage of allowing dispersal from the MPAs to enhance biodiversity in the surrounding areas ('stepping stone' function), but carries the substantial disadvantage that the MPA is strongly affected by'upstream' events, for example, water quality and sedimentation.

- Human exploration of these areas is difficult, and so we cannot easily observe and measure what is happening. Our knowledge of marine biodiversity is poor (e.g., new species are constantly being discovered), as is our knowledge of the way in which marine ecosystems and processes operate.

Acquisition of new information is generally a good deal more expensive and requires more sophisticated equipment than terrestrial equivalents. Environmental degradation is less easily observed by both scientists and others than on land, making it more likely that degradation will need to reach a catastrophic level before it is recognized and addressed. It also makes gaining political and public support for measures such as MPAs more difficult.

4.5.2 Managing MPAs in India: General issues

- Having clear rules and boundaries
- Ensuring adequate enforcement
- Undertaking active restoration work where necessary to help an area recover from past damage
- Provision of goods and services for users (e.g., visitor facilities)
- Gathering information to assess the achievement of the objectives and support management decisions
- Undertaking activities to facilitate stakeholder understanding and support and allow stakeholder participation
- Undertaking activities to ensure appropriate benefits are generated and equitably shared (e.g., allocation of resource usage)
- Controlling activities within or affecting the area to prevent additional damage from occurring
- Preventing entry of or eradicating/controlling alien species.

These characteristics have some important implications for marine management and MPAs.

- The uniqueness of marine biodiversity makes marine biodiversity management a critical part of any coastal country's response to the CBD.
- The complexity of the marine environment, combined with our lack of understanding of marine biodiversity and the problems of detecting what is happening to take corrective action in time, means that good management will need to rely on simple and certain methods, which are precautionary in nature. As discussed in the foregoing, PAs that exclude most human interventions can provide that simplicity and certainty.
- If we are to have long-term, effective and sustainable management of marine biodiversity, we will need to greatly increase our knowledge and our ability to observe changes. Highly protected MPAs are important sources of information about the natural functioning of marine ecosystems and also provide vital controls to allow us to better detect the effects of management decisions. The relative absence of physical limits, the presence of mobile reproductive stages and strong interactions across long distances for many wide-ranging species means that a network approach to MPAs will be essential. It also increases both the potential for detrimental impacts within MPAs from outside activities, and conversely, the potential for recovery within MPAs to benefit areas outside their boundaries

Integrated Marine and Coastal Area Management (IMCAM) Approaches for Implementing the Convention on Biological Diversity

Elements of the framework

A national framework that will deliver ICMAM should comprise the following three elements, representing, respectively, high, intermediate and low levels of resource protection for biodiversity:

- a representative network of highly protected areas where extractive uses are prevented, and other significant human pressures are removed (or at least minimised) to enable the integrity, structure, functioning and exchange processes of and between ecosystems to be maintained or recovered
- an ancillary network of areas that support the biodiversity objectives of the highly protected network, where specific perceived threats are managed in a sustainable manner for the purposes of biodiversity conservation and sustainable use
- sustainable management practices over the wider coastal and marine environment.

[Source: CBD 2004]

The marine environment has particular characteristics that are often absent or relatively uncommon on land. As a result, MPAs present management challenges that may need different approaches from those used for PAs in terrestrial environments. These are described in next section.

In India, seven threatened marine species have been selected for preparation of recovery plans, for the Dugong, the Whale Shark, marine turtles (two species), giant clams, holothurians (sea cucumbers), the Horseshoe Crab and sea horses. The MoEFCC has already chosen the threatened Dugong, marine turtles, coral reefs and mangroves under its Integrated Development of Wildlife Habitats programme as a priority. Conservation actions have already been initiated. Further, the coastal ecosystem is more vulnerable to climate change than any other ecosystem in the world. Therefore, it is of foremost importance to have a climate change adaptation plan for the coastal and marine PAs in the country.

4.5.3 Characteristics of the marine environment that affect protected areas.

[Source: Day et. al. 2012]

Characteristic	How does this characteristic affect MPAs?
Multi-dimensional environment	MPAs are designated in a fluid multi-dimensional environment. As a result, in some cases different management may be needed at different depths. In some MPAs vertical zoning has been used to achieve this. In others, there may be no vertical zoning, but the management put in place may nevertheless vary with depth. There is a general presumption against the use of vertical zoning, as there is increasing evidence of strong ecological bentho-pelagic coupling and the subsequent vertically tiered management is particularly difficult, if not impossible, to effectively police and enforce. The sub-seafloor may also need management, if there is a potential impact such as mining below the seabed. This is similar to the situation in terrestrial protected areas where activities such as mining might potentially impact on the protected area below ground.
Currents and tides causing flows/ impacts	MPAs are subject to surrounding and 'up-current' influences from tides and currents. These are generally outside the control of the manager or management agency and cannot be managed. Although similar to the situation of airborne or wind-borne impacts on terrestrial protected areas, MPAs are perhaps more consistently subject to such influences.
Lack of clear tenure or ownership	Tenure and ownership in the marine environment is often different from on land, where there is usually clear public or private ownership. Under the United Nations Convention on the Law of the Sea (UNCLOS), nations have the right to use their Exclusive Economic Zones (EEZs), which extend from shore out to 200 nautical miles, and to establish management regimes such as MPAs. However, within an EEZ, there is generally no individual ownership of either the seabed or water column and the EEZ may often be used and accessed by all those belonging to the nation concerned. There are some exceptions, generally in inshore areas: thus in the UK, the Crown Estate owns about 50% of the foreshore (tidal land between Mean High Water and Mean Low Water as well as most of the seabed from Mean Low Water out to 12 nautical miles (i.e. the territorial sea); and in many countries, coastal communities may own or have tenure and rights over of certain marine areas or resources, as in Fiji where local communities have customary rights over traditional fishing grounds known as 'qoliqoli'. Outside the EEZs, i.e. on the High Seas, the oceans are invariably considered to be 'commons' which may be used and accessed by all nations. MPAs can represent a legitimate restriction on such rights under the UNCLOS or Regional Sea Agreements, according to provisions of the Convention on Biological Diversity (CBD) or Regional Fisheries Agencies
Multiple jurisdictions	Often the water column, seabed, sea life and foreshore are managed by different jurisdictions or government agencies, which may create difficulties for designation and management.
Difficulties in enforcement and management	Restricting entry to, and activities in, an MPA is often more difficult than for terrestrial protected areas (and often impossible) as there are usually multiple access points, the site is often remote and thus difficult and expensive to patrol, and under international law, rights of 'innocent passage' are afforded to all vessels. While controlling activities in the marine environment is more difficult than on land, modern satellite technology is making it easier.
Lack of visibility of features being protected	Being unable to see sub-tidal features poses particular problems in terms of management and enforcement. Illegal or unregulated activities may damage features within an MPA without anyone knowing, unless appropriate monitoring or surveillance is undertaken (and this may be expensive, requiring SCUBA diving).
Boundary demarcation	It is often difficult to know where the boundary of an MPA is, both seawards (where electronic charts, a Global Positioning System (GPS) or similar technology are needed), and on the landward side where boundaries based on high and low water marks may be difficult to locate in the field or may be only loosely defined. In a few cases, vertical zoning has been attempted, and horizontal boundaries have been established at certain depths if an MPA does not extend to either the sea surface (such as a protected area for a seamounts) or to the seabed. However, such boundaries are difficult if not impossible to mark and thus effective and practical compliance is also extremely difficult, if not impossible.
Connectivity between ecosystems and habitats	The scale over which marine connectivity occurs can be very large. Since the extent of connectivity may be critical to the health of an MPA, sufficiently large areas must be considered to ensure adequate protection of ecosystem values.

4.6 Relationship between the categories and different activities

Fishing and extraction of wild living resources is still very widespread in the marine environment, and more so than on land (marine fisheries are the last wild commercial 'harvest' in the world), though hunting is obviously a significant issue for some terrestrial protected area. Many people thus still make their living from the exploitation of wild marine resources. As a result, the conflict between fishing and MPAs tends to be a much greater issue than that between extraction of living resources in terrestrial protected areas.

This has implications for assignment of the IUCN protected area management categories to MPAs. In the conservation community as a whole, there is a general understanding that the more highly protected areas (Categories I-III) should be closed to extraction, and as a result these categories have become associated with no-take areas. However, there are many who feel that limited extraction (whether for research or traditional use) carried out under appropriate management can still result in the objectives of a highly protected MPA being achieved. As a result, those MPAs that have been assigned to categories so far include no-take MPAs assigned to all six different categories, and conversely, open-access MPAs also assigned to all categories.

Table provides a summary of the various activities that may be appropriate in MPAs (and marine zones of predominately terrestrial protected areas) according to the different management categories. However, this table should NOT be used as the basis for assigning categories, which MUST be based on the stated nature conservation objectives for the MPA. The table provides some generic guidance to illustrate the broad relationship and acceptability or otherwise between activities and the different category types.

Features of MPAs that reduce risks to biodiversity loss in India

1. Participatory spatial planning to identify 'Go' and 'No-Go' areas
2. Community involvement that incorporates local knowledge
3. Management plan that reflects legal framework and includes goals specific to threatened species
4. Strong education and outreach programmes
5. PA network large enough to protect ecological processes and include a high proportion of the threatened species population throughout the year
6. Co-management involving government, NGOs, local communities and researchers
7. Effective enforcement of management plan
8. Capacity building, including succession planning for all partners in the comanagement arrangement: government, NGOS, community, researchers
9. Management informed by active research programme
10. Alternative livelihoods for those community members affected by the implementation of the management plan.

Matrix of marine activities that may be appropriate for each IUCN management category.

[Source: Day et. al. 2012]

Activities	Ia	Ib	II	III	IV	V	VI
Research: non-extractive	Y*	Y	Y	Y	Y	Y	Y
Non-extractive traditional use	Y*	Y	Y	Y	Y	Y	Y
Restoration/enhancement for conservation (e.g. invasive species control, coral reintroduction)	Y*	*	Y	Y	Y	Y	Y
Traditional fishing/collection in accordance with cultural tradition and use	N	Y*	Y	Y	Y	Y	Y
Non-extractive recreation (e.g. diving)	N	*	Y	Y	Y	Y	Y
Large scale low intensity tourism	N	N	Y	Y	Y	Y	Y
Shipping (except as may be unavoidable under international maritime law)	N	N	Y*	Y*	Y	Y	Y
Problem wildlife management (e.g. shark control programmes)	N	N	Y*	Y*	Y*	Y	Y
Research: extractive	N*	N*	N*	N*	Y	Y	Y
Renewable energy generation	N	N	N	N	Y	Y	Y
Restoration/enhancement for other reasons (e.g. beach replenishment, fish aggregation, artificial reefs)	N	N	N*	N*	Y	Y	Y
Fishing/collection: recreational	N	N	N	N	*	Y	Y
Fishing/collection: long term and sustainable local fishing practices	N	N	N	N	*	Y	Y
Aquaculture	N	N	N	N	*	Y	Y
Works (e.g. harbours, ports, dredging)	N	N	N	N	*	Y	Y
Untreated waste discharge	N	N	N	N	N	Y	Y
Mining (seafloor as well as sub-seafloor)	N	N	N	N	N	Y*	Y*
Habitation	N	N*	N*	N*	N*	Y	N*

Key:

No	N
Generally no, unless special circumstances apply	N*
Yes	Y
Yes because no alternative exists, but special approval is essential	Y*
* Variable; depends on whether this activity can be managed in such a way that it is compatible with the MPA's objectives	*

Examples of MPA Objectives

Category Ia: South Orkney Islands Southern Shelf MPA

- The protection of representative examples of marine ecosystems, biodiversity and habitats at an appropriate scale to maintain their viability and integrity in the long term.
- The protection of key ecosystem processes, habitats and species, including populations and life-history stages.
- The establishment of scientific reference areas for monitoring natural variability and long-term change or for monitoring the effects of harvesting and other human activities on Antarctic marine living resources and on the ecosystems of which they form part.
- The protection of areas vulnerable to impact by human activities, including unique, rare or highly biodiverse habitats and features.
- The protection of features critical to the function of local ecosystems.
- The protection of areas to maintain resilience or the ability to adapt to the effects of climate change.

Category II: Mu Koh Surin Marine National Park, Thailand

The main objectives of the park are:

- Preserve and conserve natural resource and the environ- ment in a condition whereby they can provide sustainable benefits to society.
- Provide opportunities to the public for education, research and recreation that is within the park's carrying capacity.

Category IV: Macquarie Island Commonwealth Marine Reserve (with a category Ia zone)

Strategic Objectives for the Marine Reserve as a whole:

1. To protect the conservation values of the south-eastern portion of the Macquarie Island Region including protecting:
   - the migratory, feeding and breeding ranges of marine mammals and seabirds.
   - threatened species that depend on the area; and
   - the unique benthic habitat.
2. To provide an effective conservation framework, to contribute to the integrated and ecologically sustainable use and management of the Macquarie Island Region.
3. To provide a scientific reference area for the study of ecosystem function within the Macquarie Island Region.
4. To manage the area as part of the National Representative System of Marine Protected Areas.

Management goals for the Highly Protected Zone of 58,000 km² (Category Ia):

- Provide a scientific reference area for further studies of natural ecosystems, including baseline areas.
- Protect threatened species and migratory and foraging marine mammals and seabirds from direct human disturbance.
- Protect pelagic species and the benthic communities from direct human disturbance.

Management Goals for the two Habitat/Species Management Zones (IUCN category IV):

- Minimise human impacts on the habitats of threatened species, migratory and foraging marine mammals and seabirds, and benthic and pelagic fauna that depend on the area.
- Promote scientific research and environmental monitoring as primary activities associated with sustainable resource management and use.

Management strategies for the Highly Protected Category Ia zone are:

- No commercial or recreational fishing.
- No mining operations, including petroleum and/or mineral exploration or extraction.
- No commercial tourism activities.
- Passive transit of vessels through the zone allowed.
- Non-intrusive scientific research compatible with the strategic objectives of the Marine Park and management goals for this zone allowed.
- No dumping of waste or littering, in accordance with the EPBC Regulations.

Management strategies for the Habitat/Species Management Zones (Category IV) are:

- No mining operations, including petroleum and/or mineral exploration or extraction.
- Commercial fishing in accordance with a fishing concession granted by AFMA will be allowed in the Marine Park, subject to determinations or permits made by the Director under EPBC Regulations.
- Limited commercial tourism will be allowed under a permit issued by the Director under the EPBC Regulations.
- Scientific research that is compatible with the strategic objectives of the Marine Park and management goals for this zone will be allowed.
- In accordance with the EPBC Regulations, no dumping of waste or littering.

Additional management goals and management strategies relate specifically to scientific research and monitoring in the Marine Park.

Category IV: South Water Caye Marine Reserve, Belize (Wildtrack, 2009)[19]

Overall goal:

To provide for the protection, wise use, understanding, and enjoyment of the natural resources of South Water Caye Marine Reserve in perpetuity.

Objectives:

- Maintain and conserve the natural resources of South Water Caye Marine Reserve for the benefit of current and future generations.
- Engage fishermen in the management of sustainable fisheries.
- Provide opportunities for recreation, interpretation, education, and appreciation for all visitors.
- Strengthen education and understanding of users and potential users of the dynamics of coral reef systems within South Water Caye Marine Reserve and the human impacts affecting them.
- Identify, implement and strengthen priority research and monitoring through on-site activities, collaboration and partnerships.

Category V: Iroise Parc Naturel Marin, France Objectives:

- To maintain, conserve, restore biodiversity, natural heritage of habitats, species, landscapes, under protection status.
- To maintain key ecological functions (spawning areas, nursery, feeding zone, rest areas, productivity areas, etc.).
- To protect, preserve and restore cultural heritage.
- To promote sustainable management / development of socio-economic activities.
- To manage natural resources exploitation.
- To improve governance on the MPA territory.
- To improve water quality.
- To educate on environmental issues and improve public awareness.
- To foster scientific research.
- To create socio economic added values

***[source:** Day et al 2012]*

4.7 Sustainable Fisheries Management

4.7.1 Fishery Resources

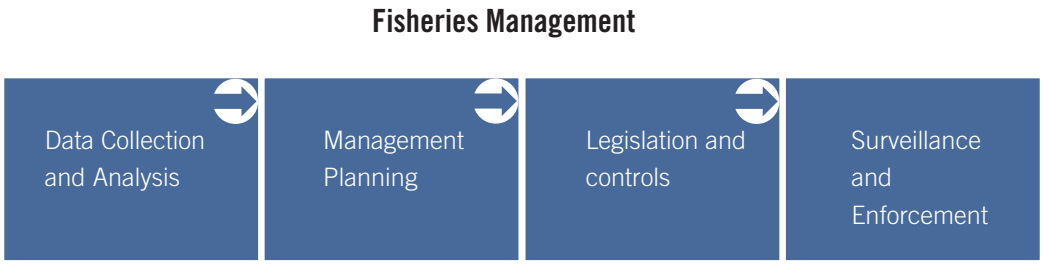
India has a vast potential for fisheries in view of our long coastline of about 8,000 kms apart from the inland water resources and India is the second largest producer of fish in the world contributing to about 5.43% of global fish production. Fisheries sector contributes significantly to the national economy while providing livelihood to about 14.5 million people in the country. The total fish production during 2011-12 is at 8.67 million tonnes with a contribution of 3.37 million tonnes from marine sector. It has been recognized as a powerful income generator and is a source of cheap protein besides being a source of foreign exchange earner. The main challenges facing marine fisheries development in the country include development of sustainable technologies for capture fisheries, yield optimization, infrastructure for harvest and post-harvest operations, landing and berthing facilities for fishing vessels and uniform registration of fishing vessels (Department of Animal Husbandry, Dairying & Fisheries, Annual Report, 2013).

4.7.2 What is fisheries management?

Historically, fishing has been a major source of food for humanity and a provider of employment for coastal population. As fish has been considered as renewable natural resources, the tendency of harvesting these resources has been intensified in recent days. As a results, over-exploitation of important fish stocks, modifications of ecosystems, significant economic losses, and international conflicts on management and fisheries economic trade threatened the long-term sustainability of fisheries. At the same time, with increased knowledge and the dynamic development of fishing technology, it was realized that living aquatic resources, although renewable, are not infinite and need to be properly managed. Then the concept of fisheries management emerged.

According to the Food and Agricultural Organization (FAO), the definition of fishery management is:

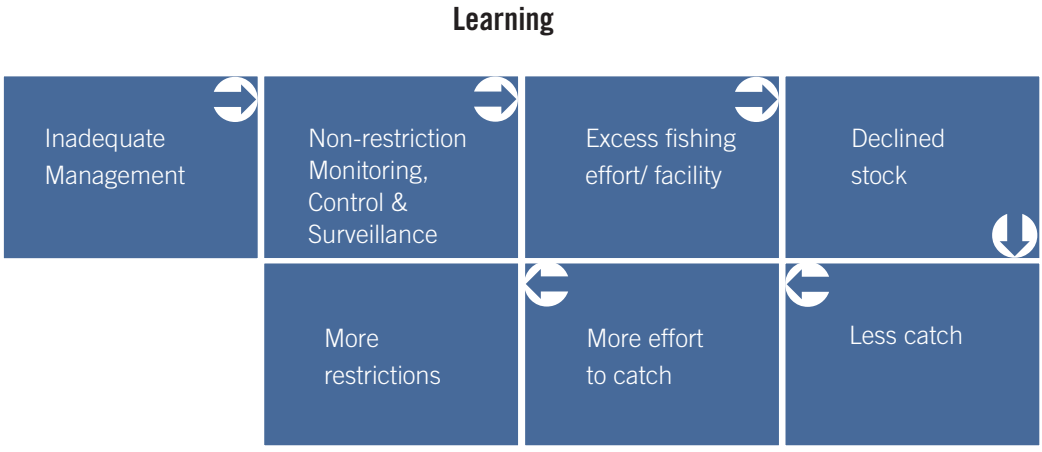
> *The integrated process of data gathering, analysis, planning, consultation, decision-making, allocation of resources and formulation and implementation, with enforcement as necessary, of regulations or rules which govern fisheries activities in order to ensure the continued productivity of the resources and the accomplishment of other fisheries objectives - FAO, 1997.*



4.7.3 Conventional fisheries management

Conventional fisheries management in which stakeholders are those directly or indirectly involved in fishing activities and the entire fisheries is managed by government fishery authorities. They generally operate through regulations and penalties for non-compliance. This approach is single species or economically important resource targeted and fishery industry focussed. It pays less attention to small scale fisheries.

(*Source: FAO 2009*)



4.7.4 Concept of Stock & Maximum Sustainable Yield (MSY)

4.7.4.1 Stock

The concept of stock is very commonly used term in exploiting the aquatic resources and more specifically in fisheries management.

A stock is a sub-set of one species having the same growth and mortality parameters and inhabiting a particular geographic area (FAO, 1991).

In general, the growth and mortality parameters differ significantly in various part of the area of distribution of species, which is called different stocks of a species, that case the stock assessment should be made for each stock separately. The 'growth parameters' are numerical values by which we can predict the body size of a fish when it reach a certain age. The mortality parameters reflect the rate at which the animal die i.e., the number of death per unit time (death may be natural or by fishing). The essential characteristic of a stock is that its growth and mortality parameters remain constant throughout its area of distribution (FAO, 1991).

4.7.4.2 Population dynamics

Population dynamics describes the growth and decline of a given fishery stock over time, as controlled by birth, death and migration. It is the basis for understanding the changing fishery patterns and issues such as habitat destruction, predation and optimal harvesting rates. The population dynamics of fisheries has been traditionally used by fisheries scientists to determine sustainable yields (Thamas and Chang, 1999; Zabel et al., 2003).

The basic accounting relation for population dynamics is the BIDE model (Birth, Immigration, Death and Emigration model, Caswell, 2001):

$N_1 = N_0 + B - D + I - E$

Where N_1 - is the number of individuals at time 1

N_0 - is the number of individuals at time 0

B - is the number of individuals born

D – is the number that died

I – is the number that immigrated and

E – is the number that emigrated between time 0 and time 1.

While immigration and emigration can be present in wild fisheries, they are usually not measured. Care is needed when applying population dynamics to real world fisheries. In the past, in many stock assessment studies many aspects of population dynamics such as size, age and reproductive status of the fish has been ignored. Similarly other factors such as targeted single species catch, by-catch and physical damage to the ecosystem may accelerate the stock collapses (Walter and Maguire, 1996). The basic purpose of fish stock assessment is to provide advice on the optimum exploitation of fishery resources. Fishery resources are limited but are renewable; and fish stock assessment is described as the search for the exploitation level, which in the long run gives the maximum yield in weight from the fishery.

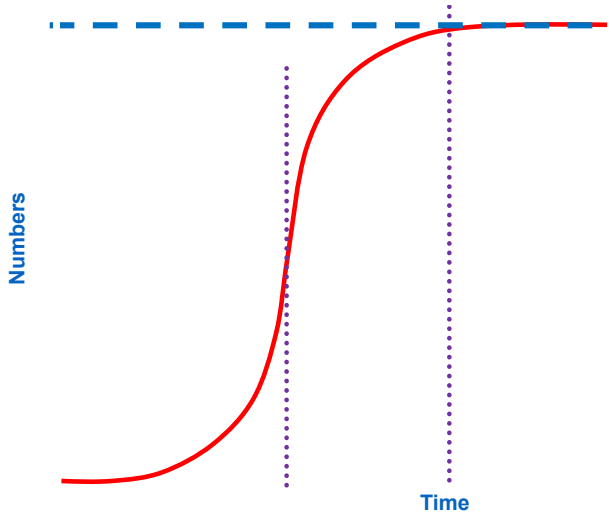


Figure: Population growth at different time interval [time 1 – slow growth stage (log phase); time 2 – growth acceleration phase (optimum sustainable yield); time 3 – Carrying capacity of the population (Maximum sustainable yield).

4.7.4.3 Maximum Sustainable Yield (MSY)

In fisheries management, the maximum sustainable yield or **MSY** is, theoretically, the highest catch that can be taken from a fishery stock over an indefinite period (Europa, 2006). Under the assumption of logistic growth, the MSY will be exactly at half the carrying capacity of a species, as this is the stage at when population growth is highest. The maximum sustainable yield is usually higher than the optimum sustainable yield. Any small population at initial stage going through a slow growth at first and some point the growth will accelerate and that will start to level off once the species approaches carrying capacity. The idea of maximum sustained yield is to decrease population density to the point of highest growth rate possible.

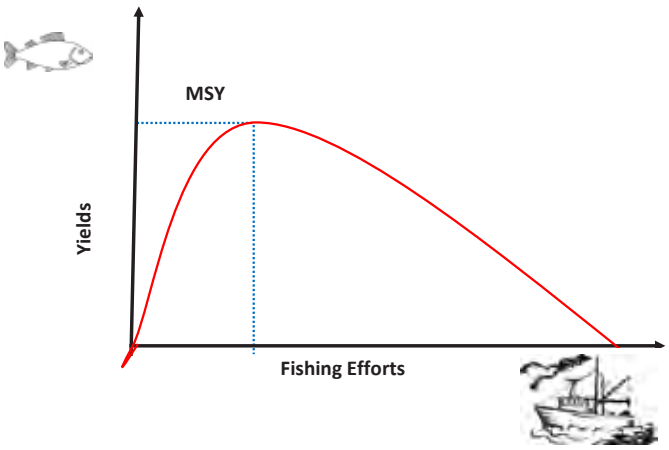


Figure : Relationship of fishing effort and yield

The horizontal axis is the fishing effort measure, for example number of fishing days. On the other axis is the yield i.e length and weight of target species. The graph shows that up to certain level we gain by increasing the fishing effort., but after that level the renewal of the resource (the reproduction and the body growth) cannot keep pace with the removal caused by fishing and a further increase in exploitation level leads to a reduction in yield (FAO 1991).

Application:

Based on MSY, harvest rate can be assessed and predicted. We get to understand species recruitment rate, especially predict the addition of young ones. Based on the population growth, harvest rate can be decided at the point in their population growth rate where it is highest (the exponential phase). **Fixed fishing quotas** will produce a constant harvesting rate (i.e. a constant number of individuals fished in a given period of time).

4.8 Challenges and trade-offs with the protection-oriented coastal management

- Major challenge in fisheries in worldwide is uncontrolled harvesting of targeted species– even if catch quota systems are imposed they need to be monitored
- Unrealistic and inflexible quotas
- Insufficient data on fish population characters and poor understanding on species ecology
- Intensive fishing, improved fishing technology and fishing industry

4.8.1 Overfishing

The worldwide depletion of major fish stocks through intensive industrial fishing is thought to have profoundly altered the trophic structure of marine ecosystems. Declining trophic levels in fisheries catches have occurred, with fish catches progressively being replaced by invertebrates and non commercially important fishes.

> Overfishing is a form of overexploitation where fish stocks are reduced to below acceptable levels. Overfishing can occur in water bodies of any size, and can result in resource depletion, reduced biological growth rates and low biomass levels (http://en.wikipedia.org).

Overfishing has significantly affected many fisheries around the world. As much as 85% of the world's fisheries may be over-exploited, depleted, fully exploited or in recovery from exploitation. Significant overfishing has been observed in pre-industrial times. In particular, the overfishing of the western Atlantic Ocean from the earliest days of European colonisation of the Americas has been well documented. Following World War Two, industrial fishing rapidly expanded with rapid increases in worldwide fishing catches. However, many fisheries have either collapsed or degraded to a point where increased catches are no longer possible (Jeffery 2012).

4.8.2 Artisanal fishing (small-scale) Vs Industrial fisheries (large-scale)

Artisanal fishing (often called small-scale fisheries), which uses small inshore vessels and/or fixed gear (e.g., coastal traps, gill nets and cast nets) and whose purpose is to catch fish and other organisms for their won consumption and sale (Pauly 2013).

Commercial fishing is the activity of catching fish and other seafood for commercial profit, mostly from wild fisheries. It provides a large quantity of food to many countries around the world, but those who practice it as an industry must often pursue fish far into the ocean under adverse conditions. Large-scale commercial fishing is also known as industrial fishing. Commercial fishermen harvest a wide variety of animals, ranging from tuna, cod, and salmon to shrimp, krill, lobster, clams, squid, and crab in various fisheries for those species (http://en.wikipedia.org).

	Artisanal fishing	Commercial fishing
1.	Uses small boats without any facility for fish processing	Large sized vessels with facility for fish processing
2.	Uses fixed gears	Used large sized commercial trawl nets
3.	Net with bigger mesh size for targeting adult individuals	Net with closed mesh size for targeting all species (small and large body size)
4.	Minimum by-catch and trash fish landing	Huge landing of trash fish, which is wanted for animal husbandry industries
5.	Operates in coastal area and shallow seas	Operates in EEZ and also deepwater
6.	No negative impact on fish stock and ecosystem	Overexploitation of stock and degradation in habitat quality

4.8.3 Principles and Criteria for Sustainable Fisheries (Source: MSC, 2002)

Principle 1: A fishery must be conducted in a manner that does not lead to over-fishing or depletion of the exploited stock and for those stocks that are depleted, the fishery must be conducted in a manner that demonstrably leads to their recovery.

Criteria

1. The fishery shall be conducted at catch levels that continually maintain the high productivity of the target population(s) and associated ecological community relative to its potential productivity.
2. Where the exploited populations are depleted, the fishery will be executed such that recovery and rebuilding is allowed to occur to a specified level consistent with the precautionary approach and the ability of the populations to produce long-term potential yields within a specified time frame.
3. Fishing is conducted in a manner that does not alter the age or genetic structure or sex composition to a degree that impairs reproductive capacity.

Principle 2: Fishing operations should allow for the maintenance of the structure, productivity, function and diversity of the ecosystem (including habitat and associated dependent and ecologically related species) on which the fishery depends.

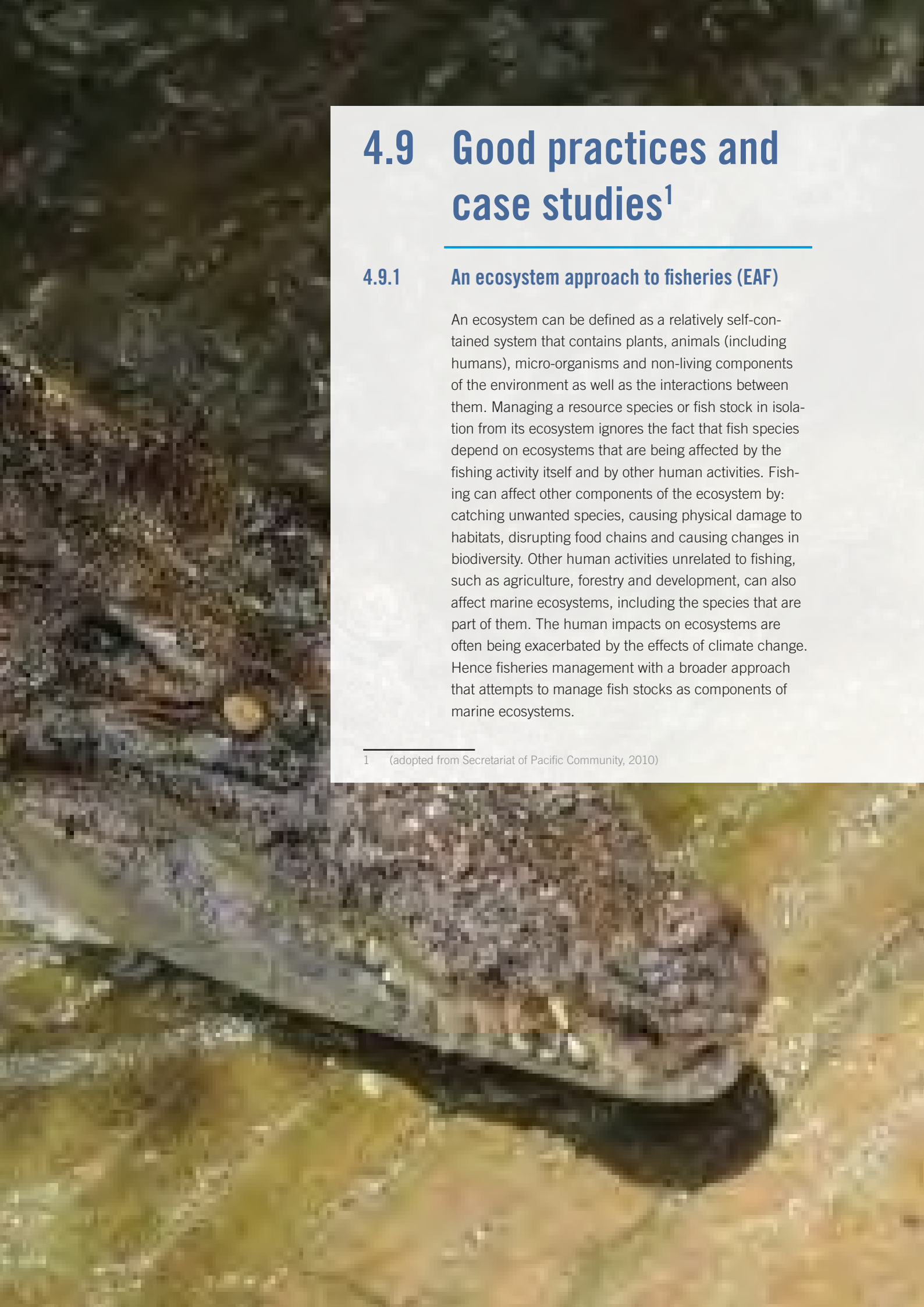
Criteria

1. The fishery is conducted in a way that maintains natural functional relationships among species and should not lead to trophic cascades or ecosystem state changes.
2. The fishery is conducted in a manner that does not threaten biological diversity at the genetic, species or population levels and avoids or minimises mortality of, or injuries to endangered, threatened or protected species.
3. Where exploited populations are depleted, the fishery will be executed such that recovery and rebuilding is allowed to occur to a specified level within specified time frames, consistent with the precautionary approach and considering the ability of the population to produce long-term potential yields.

Principle 3: The fishery is subject to an effective management system that respects local, national and international laws and standards and incorporates institutional and operational frameworks that require use of the resource to be responsible and sustainable.

Criteria

1. The fishery shall not be conducted under a controversial unilateral exemption to an international agreement.
2. The management system shall demonstrate clear long-term objectives consistent with MSC Principles and Criteria and contain a consultative process that is transparent and involves all interested and affected parties so as to consider all relevant information, including local knowledge. The impact of fishery management decisions on all those who depend on the fishery for their livelihoods, including, but not confined to subsistence, artisanal, and fishing-dependent communities shall be addressed as part of this process.
3. The management system shall be appropriate to the cultural context, scale and intensity of the fishery – reflecting specific objectives, incorporating operational criteria, containing procedures for implementation and a process for monitoring and evaluating performance and acting on findings.
4. The management system shall observe the legal and customary rights and long term interests of people dependent on fishing for food and livelihood, in a manner consistent with ecological sustainability.



4.9 Good practices and case studies[1]

4.9.1 An ecosystem approach to fisheries (EAF)

An ecosystem can be defined as a relatively self-contained system that contains plants, animals (including humans), micro-organisms and non-living components of the environment as well as the interactions between them. Managing a resource species or fish stock in isolation from its ecosystem ignores the fact that fish species depend on ecosystems that are being affected by the fishing activity itself and by other human activities. Fishing can affect other components of the ecosystem by: catching unwanted species, causing physical damage to habitats, disrupting food chains and causing changes in biodiversity. Other human activities unrelated to fishing, such as agriculture, forestry and development, can also affect marine ecosystems, including the species that are part of them. The human impacts on ecosystems are often being exacerbated by the effects of climate change. Hence fisheries management with a broader approach that attempts to manage fish stocks as components of marine ecosystems.

1 (adopted from Secretariat of Pacific Community, 2010)

Under an Ecosystem Approach to Fisheries, the usual concern of fisheries managers – the sustainability of targeted species – is extended to address the sustainability of ecosystems upon which the fisheries depend, which include people and fish stocks. Ecosystem Approach addresses both human and ecological well-being and merges two paradigms: protecting and conserving ecosystem structure and functioning; and fisheries management that focuses on providing food, income and livelihoods for humans.

As the objective of Ecosystem Approach to Fisheries is the sustainable use of entire ecosystems as well as targeted species, it implies that non-fisheries activities that impact marine ecosystems must also be managed, even though these activities may be outside of the responsibilities of fisheries authorities. In addition to fishing, target stocks are affected by non-fishing issues including climate change, coastal development, pollution and the loss of critical habitats by reclamation. Because of the broad issues involved, the full implementation of EAF requires collaboration and cooperation between communities and a range of government agencies responsible for managing activities that impact on marine ecosystems.

Ecosystem Approach to Fisheries involves making decisions to achieve objectives based on the best available knowledge, whether it is scientific or traditional. Urgent actions are required now and there is no time to wait to collect extensive scientific information. In any case, local communities are repositories of much information on local ecosystems.

4.9.2 Community-based fisheries management (CBFM)

Community Based Fisheries Management refers to a management system under which communities take a leading role in managing fisheries and adjacent coastal areas in partnership with, or with support from, a promoting agency.

Example for CBFM

Communities in the Pacific Islands have been involved in managing and protecting their coastal ecosystems and fish stocks for many hundreds of years. And now, many government and NGOs are actively encouraging communities to take on more management responsibilities under CBFM projects. Many Pacific Island Communities have been assisted in establishing CBFM by Secretariat of Pacific Community – a regional organisation based in New Caledonia, as well as several NGOs.

Status of the Fisheries in India

The west coast of India is by far the most important area so far as fisheries production is concerned, accounting for over 70 percent of national production.

Gujarat State in the northwest has, for some years, been the major fish producer in India, and, in 2001, accounted for around 37 percent of west coast production and 26 percent of national production. Gujarat is closely followed by Kerala in the southwest which, in 2001, contributed around 30 percent of national production. The other west coast states of Maharashtra and Karnataka, in addition to offshore Islands contribute the remaining 33 percent of west coast production.

The Saurashtra coast in the northwest experiences winter cooling of oceanic waters during November-February with no significant upwelling and consequently the fisheries in this area are dominated by demersal species (57.2 percent of landings) such as sciaenids, flatfish, ribbonfish etc.

The fisheries of the west coast of India can be conveniently divided into both artisanal and industrial sectors as well as inshore (<50 meters) and offshore fisheries. Artisanal fisheries dominate the inshore areas while industrial fishing dominates the offshore area, usually operating under the provisions of the Deep Sea Fishing Policy.

Managing fisheries in accordance with sustainability guidelines is not required by legislation either at the State or National/Union level. As a result, many stocks both in the inshore and offshore area are either fully or overexploited although it is generally agreed that offshore areas are more lightly exploited and may, for some species, be underexploited.

Offshore species which are considered to have the greatest potential for increases in exploitation rates are various species of tuna, threadfin bream, carangids and deepwater shrimp (Vivekanandan, 2002).

Marine pollution and coastal degradation has impacted on resources in the coastal areas (including estuaries) and has degraded the marine resource potential and marine biodiversity of these areas. As a result, the issues of overexploitation of many coastal fisheries resources have been becoming more important, even in areas where the number of fishermen and vessels has remained stable. However, within the context of marine and coastal ecosystem destruction in the Indian Ocean area, overexploitation of fisheries resources and coastal habitat destruction is not as much a problem in India as it is in other countries of the region.

Total fish production from the west coast area of India in 2001 was 1.996 million tonnes with this level of production having been maintained for some years. Table 2 provides data on the catches, by species group, for the period 1998-2001 for the west coast area of India in addition to similar data for 1980.

First, most fisheries statistics in India are collected at landing places although species that are destined for export are recorded at the point of sale or export. Hence aquaculture production is sometimes incorporated into landings statistics, particularly for those species that are exported. In addition, consumption at home, which may be significant, is often not included in statistics collection.

The reason for this increase in production is almost exclusively an increase in fishing effort, both in inshore areas and offshore. For example, in Gujarat, the fishing fleet has increased to 29506 vessels in 2002, 19092 of which are mechanized.

Methods of exploitation of marine fisheries resources vary from simple traps to large trawlers and from handlines to modern purseseiners.

There are also regional variation in fishing vessels and gear. Traditional catamarans, common on the east coast are not used on the west coast to any great extent, with dugout canoes being the more common traditional fishing craft.

Mechanized vessels include stern and outrigger trawlers, gillnetters, purseseiners, longliners and dolnetters (bag nets, mainly for Bombay duck) whereas traditional nonmechanized craft use handlines, gillnets and fish traps. There is a program in place to upgrade dugout canoes in the area by the addition of small outboard motors and, since 1977, 50 922 motors have been fitted to these traditional craft (Vivekanandan, 2002)

The fishery, which in 2001 landed 288 000 t from the west coast is a mixed artisanal/industrial fishery and utilizes dugout canoes (Kerala coast), outrigger vessels (Maharashtra and Karnataka coasts) and purse seiners (offshore areas) to take the fish.

Most of the catch is locally consumed as fresh product although canning, freezing, drying, and production of sardine oil is also undertaken. The fishery fluctuates significantly from year to year in response to oceanic conditions and particularly the abundance of phytoplankton blooms (*Fragillaria oceanica, Coscinodiscus* spp and *Pleurosigma* spp).

The fishery for Bombay Duck (*Harpodon nehereus*) contributes around ten percent of the average national landings and, in 2001, 143 000 t were landed in the west coast States.

The species has a wide, and discontinuous, distribution along both east and west coasts of India although the north west coastal States of Gujarat and Maharashtra contribute the greatest catches. Given the discontinuous distribution, a priority for management and research has been to determine whether the east and west coasts stocks are separate or consist of a single stock. Fishing methods used to take Bombay duck vary between regions. In Saurashtra, about 400500 vessels operate 'dol' nets in coastal waters 612 miles offshore whereas in Gujarat the majority of the catch is taken by gillnets (30 ft long with a mesh size of 1 inch) operated in inshore coastal waters between June and September. Most of the catch is sundried although a small quantity is sold fresh or is 'laminated' by pressing and drying.

Nonpenaeid prawn fisheries dominate the more northern areas of the west coast with Gujarat and Maharashtra States accounting for the bulk of the annual landings of around 125000 t in 2001[301]. *Acetes* spp account for 74 percent of the landings; while *Nematopalaemon tenuipes* account for a further 25 percent. *Exhippolysmata ensirostris* made up the remainder of the landings. These landings have shown a steady increase from about 1961, rising from approximately 20 000 t per annum at that time to 80100 000 t per annum during the 1990s to the current levels of around 120 000 t. Most prawn fisheries on the west coast are subject to exploitation throughout their lifecycle, with large, traditional fisheries for juveniles occurring in the backwaters and estuaries of Kerala and other States and both traditional and large mechanized trawl fisheries for adults in offshore waters.

Fisheries in the backwaters and estuaries tend to be undertaken throughout the year whereas the marine coastal fishery is seasonal with a regulated, variable closed season during the monsoon period (Kurup, 2001). Assessments of the stocks of the major species comprising the prawn fisheries of the west coast have been undertaken periodically with the general conclusion that stocks generally are overexploited with fishing capacity being too high and prawns being taken at suboptimal sizes, mainly as a result of the fishery for juveniles in the backwaters. However, the small prawns that are taken in the backwater fisheries provide much of the local supply of prawns to the market since the larger sizes (often taken by offshore trawling) are increasingly being packed and exported. Kurup (2001) showed the beneficial effect on landings and catch rates of the closed season for trawling that was introduced in 1988.

Source: Morgan, G (2015). Country review: India (West coast) Review of the state of world marine capture fisheries management. FAO.

4.10 Participatory planning of MPAs:

4.10.1 Why participatory planning?

While it is generally acknowledged that stakeholder participation is an essential component of effective management of natural resources, perceptions of what participation entails vary widely. In the context of MPA planning and management, participation can be defined as a process that facilitates dialogue among all actors, mobilizes and validates popular knowledge and skills, supports communities and their institutions to manage and control resources, and seeks to achieve sustainability, economic equity, and social justice while maintaining cultural integrity.

Participation is relevant to all aspects of development and environmental management. The challenge for policy-makers, planners and managers is to define the form of participation which is the most appropriate to a given situation.

The arguments in favour of participation in planning and managing MPAs include the following:

- It contributes to improved management by incorporating popular knowledge and practices;
- It increases the likelihood of stakeholder compliance and support through participation in decision-making;
- It incorporates a wide range of perspectives and ideas, resulting in improved management decisions and actions;
- It provides a forum for identifying conflicts between users and negotiating solutions to them;
- It can contribute to community empowerment and local institutional development, especially when the sharing of management responsibility is involved.

4.10.2 What does it includes?

Planning processes can be described as participatory when they also include:

- The identification and involvement of all stakeholders, early in the process;
- The incorporation of the diverse views and opinions of the individuals within these groups;
- The sensitization of stakeholders to the issues being addressed;
- Provision of information needed to shape opinions and make decisions, in forms that are accessible to all participants;
- The recognition of and accommodation for the inequities among stakeholder groups and among individuals, in order to assure that those that are more powerful do not dominate or manipulate processes;
- Respect for the process and the decisions that are reached: participatory planning cannot manipulate participation to arrive at a predetermined conclusion or even to start from a predetermined point.

Ideally, participation in the context of MPAs will start at the earliest planning stages for the protected area. However, any stakeholder (management agency, non-governmental organization, community, researcher, external agency) can take the initiative for a participatory planning exercise. The initiative can come from the manifestation of a conflict or a crisis resulting from resource utilization, or from the realization by the initiator that there are management issues requiring attention. It is at this early stage that the initiator must decide that the planning process will be participatory and make arrangements for the facilitation of the process.

The **next steps in a participatory planning process** involve the following:

- **Identification of the groups, sectors, communities, and individuals who have a stake in the resource or issue** which is the object of the planning initiative. This activity is generally not participatory, as its purpose is to identify those who should participate in the process;
- **Analysis of the expectations, rights and responsibilities of these various stakeholders.** This step is ideally conducted in a participatory manner, and can be an excellent mechanism for conflict management, because it provides a forum for each party to hear and understand the perspectives of others, and to make its own perspectives heard and understood;
- **Analysis of needs, issues, causes and options.** This is the first main step in a classical planning process. In a participatory process, these analyses follow the identification and analysis of stakeholders, and must therefore involve all these stakeholders. A wide range of tools is available and used to conduct such analyses, including those described in the literature as participatory rural appraisal and rapid rural appraisal techniques, as well as scientific methods such as biological and socio-economic surveys, impact assessment studies, and literature reviews;
- **The identification of options.** This is a critical step in a participatory process, as this is where all participants use the results of the various analyses to define priorities and to identify the various options available to them, with an appreciation of the costs and benefits associated with each.

One of the added benefits of these participatory appraisals and assessments is that they build the confidence and ability of all participants, notably the powerless, to become involved in decision-making and management. On the basis of information gathered, partners in the planning process must be in a position to define objectives, formulate action and management plans, design monitoring and evaluation procedures, and begin implementation.

Because the purpose of a participatory planning process is change (in perceptions, relations, practices and outcomes), it is not linear, but creates change at every step along the way. Inherent in the concept of participatory planning, therefore, is the idea that change is constant and that action can take place at any stage in the process. Participatory planning processes do not require the completion of a plan to witness changes on the ground. Their purpose is to change conditions, and thus to provoke action. In the participatory approach to planning, implementation does not follow planning. It is a part of the planning process.

4.10.3 Constraints and Obstacles

- A major constraint to participatory planning processes is the general lack of enabling policies and the prevalence of centralized systems of management. While there are a few countries in the region where participatory planning is encouraged through policy, legislation, or institutional cultures, this is far from the norm.
- Participatory approaches require radical changes within the culture of organizations, notably those of the state. From a culture of enforcement and control, they need to move to the new attitudes that are required of facilitators and supporters.
- A great challenge to participatory planning is making the process legitimate to those who have the power to influence decisions through other means. These stakeholders may feel they have little to gain from their involvement in a participatory planning process and may seek to coopt or circumvent it. The issue is further complicated by the inherently political nature of participatory processes and the high likelihood of political interference.
- Involving all the agencies that have jurisdiction or responsibility over the area and its surroundings can be extremely difficult, but if any are not included, it may prove impossible to implement the decisions that are reached.
- Effective participation requires that participants all have a good grounding in the issues being addressed. The process of awareness-building that is required to assure this can be time-consuming and expensive.
- Facilitation is key to effective participation, and facilitators must be skilled and appear to be impartial, while assuring that stakeholder participation is fair and equitable. Many participatory planning processes are spoiled by poor or biased facilitation.
- Finally, participatory planning requires high investments of time as well as human and financial resources. There are no cheap and easy shortcuts.

4.11 Case studies

4.11.1 Case study: MPAs secure fish supply in the Philippines

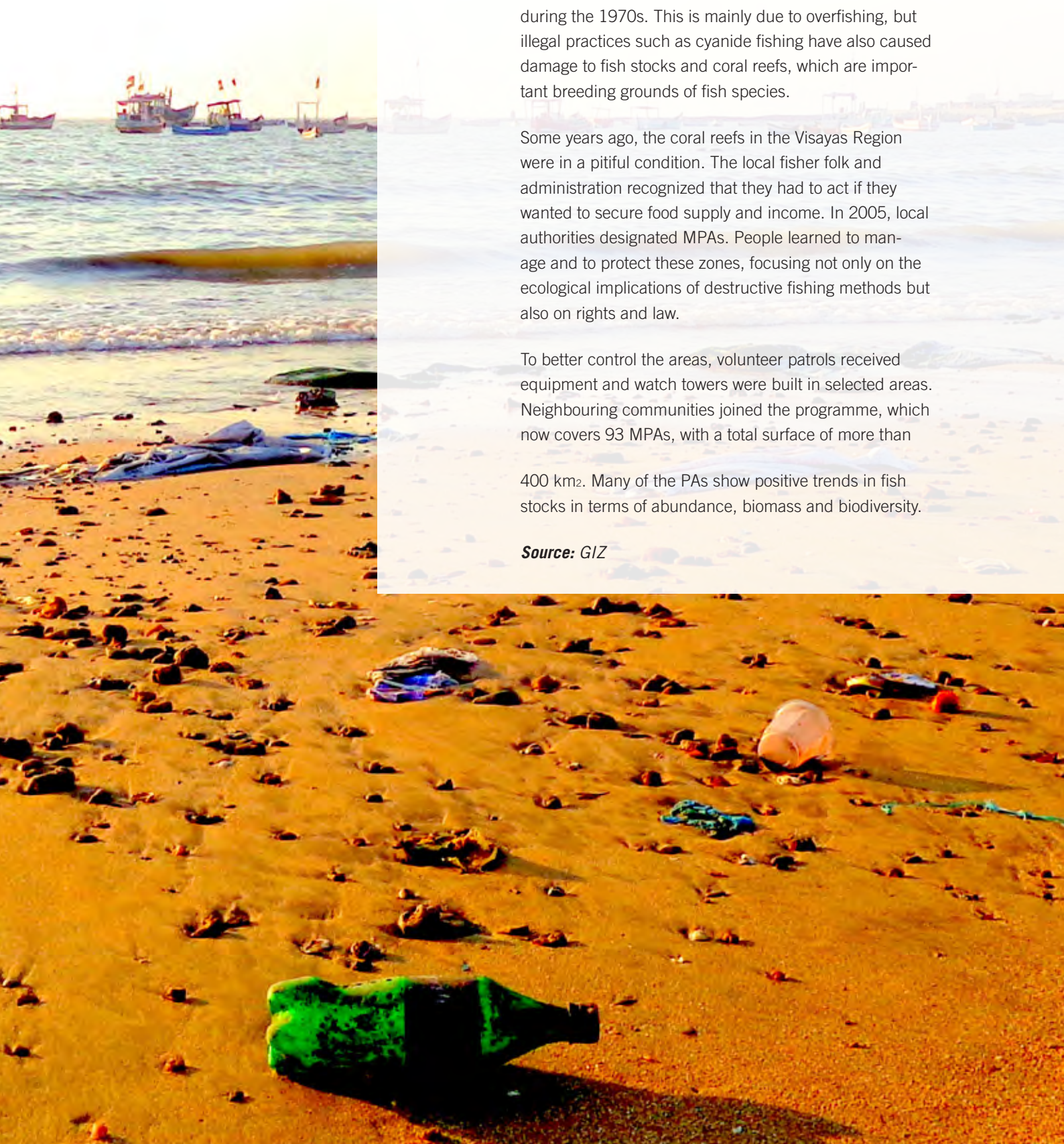
The current nationwide productivity of fishing grounds in the Philippines is only ten per cent of what it used to be during the 1970s. This is mainly due to overfishing, but illegal practices such as cyanide fishing have also caused damage to fish stocks and coral reefs, which are important breeding grounds of fish species.

Some years ago, the coral reefs in the Visayas Region were in a pitiful condition. The local fisher folk and administration recognized that they had to act if they wanted to secure food supply and income. In 2005, local authorities designated MPAs. People learned to manage and to protect these zones, focusing not only on the ecological implications of destructive fishing methods but also on rights and law.

To better control the areas, volunteer patrols received equipment and watch towers were built in selected areas. Neighbouring communities joined the programme, which now covers 93 MPAs, with a total surface of more than

400 km_2. Many of the PAs show positive trends in fish stocks in terms of abundance, biomass and biodiversity.

Source: *GIZ*



4.11.2 Case study: Fishermen ride sustainability wave

Colourful boats bob on the waves, children play their breathless games along the sandy tracks and fishermen and their families chat in the village's small pine-clad bar. But some here fear the future is less than bright for the sea and the catches it brings; they fear the sun is about to go down on an entire way of life. 'Since the 1990s, there has been a big depletion of species in this area,' says Juan Manuel Gomez Leis, over a glass of brown beer. 'In general, all of them have been depleted; here in Lira, octopus, squid, brown crab and turbot have virtually disappeared. We think overexploitation and overfishing is a large part of this, and we as fishermen have a responsibility.' The Lira fishermen, led by Mr. Gomez Leis, have embarked on a radical plan to safeguard their fishery–they are asking fishers to catch less. They want to establish a marine reserve along their stretch of coast, which lies between La Coruna and Vigo, two major ports in the province of Galicia. Within the reserve, fishing will be prohibited at certain places and in certain seasons of the year. They hope this will allow the stocks of brown crab, octopus and turbot to recover, so the grounds where they do fish will regain their former bountiful condition. They hope that catching less now will enable them, at some point in the future, to catch more.

Precautionary principle

The Lira marine reserve will by no means be the first in the world, of course, or even the first in Spain; though it is a Spanish first in the sense that the fishermen themselves are demanding the restrictions. And with global stocks in such stark decline that there may be no commercially viable marine fisheries within half a century, the logic behind them appears irrefutable. 'Marine reserves are a new, different and additional idea to marine management generally,' says Bill Ballantine, a New Zealand marine biologist who has spent three decades campaigning for the issue. 'Ordinary marine management doesn't do anything until there's some sort of problem. But marine reserves are precautionary, they say "we're going to leave some bits alone so they can and will continue in their natural state, or that they will restore themselves, revert towards a more natural state."'

The price of fish

Across the globe you can find various types of reserves, ranging from places where all fishing is banned—the so-called no-take zones—to those where, like Lira, certain species can be caught at certain times of the year. The key, usually, is to protect the grounds where creatures spawn and reproduce, and the nurseries which shelter and feed the young. 'Reserves give incredible results,' asserts Ricardo Aguilar, Research Director of the campaign group Oceana. 'In some areas they are multiplying the catch by a factor of 25, because destructive fishing gear is not there. In an area of Sicily, for example, they decided to ban trawling for mullet; and the catches by local fishermen using gillnets multiplied by 27, in only five years.' Such tales are becoming more commonplace as coastal waters gain protection. Britain has one no-take reserve, established in 2003 around the Isle of Lundy off the north Devon coast, historically fertile ground for lobsters and other shellfish. 'Initially we were somewhat sceptical of the marine nature reserve, as we weren't quite sure what was being asked of us,' recalls John Butterwith, head of the North Devon Fishermen's Association. 'The wardens and different people such as the divers who look after the area report a huge increase in the stocks of shellfish and also the sizes; so yes, an MPA is a very good thing.' Evidence such as this was one of the factors persuading the community in Lira to push for their own PA. They were helped by a local academic, Antonio Garcia Allut, from the University of La Coruna, for whom making fisheries sustainable is a grail-like quest.

He believes that establishing the reserve is just one link in the chain. Another is to make sure that fishermen are properly rewarded for their efforts. If they receive a higher price per fish, there is less pressure to catch more. Currently, he says, a big slice of the final market price is commanded by middlemen who may not care where the fish comes from or how it is caught. 'I found that some products, for example shrimp, you could buy firsthand from the fishermen at 15 euros, and then finally the product

would be sold in the market for 50 or 60 euros,' he tells me. Hence the establishment of Lonxanet, a cooperative venture which aims to change the paradigm and remove the financial reason to overfish.

Premium rates

The price of fish in the early morning markets where newly returned Galician skippers sell their catch is set by the market. Lonxanet buyers pay a premium over that market price. Fish are transported to the depot in La Coruna. A small sales team contacts potential buyers all over Spain, and products are despatched the same afternoon. 'In general, buyers want something that's certified as authentic Galician produce,' says Javier Vitancourt, Lonxanet's manager. 'On top of that, they want to buy a good fish caught by traditional means, and more and more restaurateurs favour the philosophy of protecting artisanal fishermen; and there are 'ecological' restaurants which look for our products.' By cutting out the traditional network of middlemen, Lonxanet says it will return about 90 per cent of the final price to the fisherman. On the face of it, it is a win–win situation. By certifying their wares, fishermen are able to enter the relatively new and lucrative marketplace of the discerning gourmand who demands fish produced to social and ecological standards. By making sustainability part of the certifying process, Lonxanet ensures that if fishermen want to continue reaping the rewards, they must harvest the shrimps, crab and hake with techniques that leave stocks healthy.

Open verdict

Combining the concepts of certification and marine reserves may be a model for the truly sustainable fishery. But there are limits. Clearly, not every consumer is willing to spend time selecting the supplier, or spend extra funds for the clean bill of ecological health that comes with these selected products. It is also doubtful whether the Lonxanet approach could work on large-scale open-water fisheries, though bodies such as the Marine Stewardship Council are doing their best to extend certification into these areas. The notion of marine reserves is probably more generally accepted than certification, but out on the water there is a long way to go. The CBD recommends that about 10 per cent of the oceans should be protected from fishing; currently the total stands at about 0.5 per cent. There is some doubt, too, whether protecting 10 per cent would be enough. 'I've been recommending 10 per cent of everything for a quarter of a century now,' notes Bill Ballantine, 'and that is what we'd need for science and recreation and education. But if you wanted to be serious about conservation, keeping the options open for our grandchildren, you'd need at least 20 per cent of everything. If your primary concern was fishing, what you'd be recommending is 30 per cent.' After four years of preparatory work, the Lira fishermen hope to have their reserve established soon. They will regulate and police it themselves; and perhaps, in time, add to the evidence that in fisheries, less can be more. 'Many people who were against the project are now in favour, and we hope others will join us,' says Mr. Gomez Leis.

'We think that with the project of a marine reserve we can earn a living while allowing the next generation to continue fishing.'

Source: BBC NEWS, http://news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/7067795.stm

4.11.3 Integrated Management Plan for the Gulf of Mannar Marine National Park and Biosphere Reserve (2007-2016): Process and Methodology

The Wildlife Institute of India was given the responsibility by GOMBRT in July 2005 for developing a 10 year Management Plan for the Gulf of Mannar National Park and Biosphere Reserve. The Plan was to specially address the issues of:

- Conservation of Biodiversity and ecological integrity of the National Park and Biosphere Reserve through protection, restoration and management of the coral reef systems in the Gulf of Mannar region.
- Sustainable development in the Biosphere region to ensure the wise use of common ecological goods and services for the benefit of the local community.
- Develop a model plan and mechanism for multi-sectoral involvement in managing a globally important but fragile coastal and marine ecosystem in India.

Since the management plans of terrestrial PAs are different from the Marine Protected Areas, a modified management plan development guidelines was adopted using the IUCN-Marine PAs Management Plan Guidelines and the WII's Management Plan Preparation Guidelines. The Wildlife Institute of India initiated the integrated management plan development exercise during January 2006 and through a team of field researchers inventoried the ecological, socio-economic and developmental settings in the region. Based on this information, a draft management plan was prepared and shared with the GOMBRT and GOMMNP authorities. Analyzing the feedback from these two agencies, a Management Plan sharing exercise was organized with the other stakeholders before finalizing the plan and submitting to the Tamilnadu Government through the GOMBRT and the State Department of Environment & Forest. The whole exercise was completed by March 2007 and the Management Plan was submitted in September 2007.

The process adopted for the preparation of the Management plan, the methodology followed, the challenges encountered and the key recommendations are elaborated in the paper

Introduction

The Gulf of Mannar, the first Marine Biosphere Reserve in the South and South East Asia, running down south from Rameswaram to Kanyakumari in Tamilnadu, India is situated between Longitudes $78^0$08'E to $79^0$30'E and along Latitudes from $8^0$35'N to $9^0$25'N with a total area of 10,500 Km^2. This marine Biosphere Reserve encompasses a chain of 19 islands and adjoining coral reefs off the coasts of the Ramanathapuram and the Tuticorin districts forming the core zone; the Marine National Park. The surrounding seascape of the Marine National Park and a 10 km strip of the coastal landscape covering a total area 10,500 sq. km., in the Ramanathapuram, Tuticorin, Tirunelveli and Kanyakumari Districts form the Gulf of Mannar Biosphere Reserve. The importance of the Gulf of Mannar region dates back to the 2^{nd} Century AD because of its highly productive pearl banks and other religious significance.

The South and South-east Asia region in the southern hemisphere is one of the richest coastal and marine biodiversity areas in the World with the maximum diversity of coral reef systems. In India, in addition to the Gulf of Mannar region in Tamilnadu, the Gulf of Kutch in Gujarat, the Lakhsadweep and Andaman & Nicobar Islands are the other important coral reef regions. With its rich biodiversity of 3600 species of various flora and fauna, part of the Gulf of Mannar was declared as a Marine National Park in 1986 by the Government of Tamil Nadu and later as the first Marine Biosphere Reserve of India in 1989 by the Government of India.

Organizations like Central Marine Fisheries Research Institute (CMFRI), Zoological Survey of India (ZSI), Tuticorin Fisheries and Research College, ICMAM project of Department of Ocean Development, Government of India, Anna University, Madurai Kamaraj University, Annamalai University, Suganthi Devadasan Marine Research Institute (SDMRI), Wildlife Institute of India (WII) and others have conducted biodiversity assessment studies in the Gulf of Mannar Protected Areas and their studies have confirmed the richness of the marine biodiversity in the Gulf of Mannar region with 104 species of hard corals, more than 450 species of fishes, 4 species of sea turtles, 38 species of crabs, 2 species of lobsters, 12 species of sea grasses, 147 species of marine algae, 160 species of birds, 79 species of crustaceans, 108 species of sponges, 260 species of molluscs, 99 species of echinoderms, 5 species of sea horses, 12 species of sea snakes besides the critically endangered Dugong (sea cow) and the endemic balanoglosses. The Gulf of Mannar Marine National Park also supports 12 mangrove species.

For centuries, the exploitation of fishery resources in the in-shore waters has been the sole occupation for several thousand families living along the coast of Mannar. They have been in such close intimacy with the coastal and marine environment that their life-style, culture and social life all centre around the sea. In this background, it was considered important to develop an adaptive management plan for the Gulf of Mannar Marine National Park and Biosphere Reserve with community based participatory approaches for sustainable use and management of coastal and marine resources of this region.

The Thrust Areas of the Management Plan

The primary objective of the Management plan is to safeguard and manage the biodiversity of the Gulf regions in general and the declared Marine National Park in particular, so that the Protected Marine Park will serve as a marine resource generation area and the renewable marine resources will spread out in to the Biosphere Reserve Landscape, where controlled and sustainable utilization by coastal communities can be worked out. If this plan is followed properly then this will serve as a model for other marine parks in the country.

The key thrust Areas visualized in the Management Plan are:

A) Protection of the islands and the Associated Marine Environment.

B) Restoration of the Protected Ecosystem

C) Development of Protection and Restoration infrastructure.

D) Monitoring of the Protected and Restored Ecosystems health functions.

E) Development of Recovery Plans for the threatened Species

F) Development of an 'Education and Awareness' programme for Stakeholders on the function and role of the Marine Protected Area as a resource generation base.

Methods

The Wildlife Institute of India (WII), after setting in place a process for Management Plan Development, initiated the management plan development exercise during January 2006. A team of field researchers lead by experienced WII faculty inventoried the ecological, socio-economic, developmental and threat assessment settings for the region. Based on this information, the management plan has been developed through a consultative process. This has been shared with the GOMBRT, GOMMNP and other stakeholder agencies. Analyzing the feed back from these agencies, the WII has finalized the Integrated Management Plan and presented it to the Management Plan Development Steering/Advisory Committee on 20th April 2007. After incorporating the final suggestions, the WII has submitted the Plan to the Gulf of Mannar Biosphere Reserve Trust in the month of September 2007 for obtaining the approval of the Concerned Competent Authority for its implementation.

Management Plan Development Framework and Guidelines

The Wildlife Institute of India has followed the IUCN-WCPA, Marine Protected Area Planning Process and Planning Guidelines for the broad general principles in developing the Marine Protected Area Management Plan. The Management Plan Development Guidelines for Protected Areas (Sawarkar, 2005) developed by the Wildlife Institute of India provided the general guidelines for developing the plan for the Marine National Park. The Biosphere Reserve Management Plan Development Guidelines by the Man and Biosphere Programme of the UNESCO and the new guidelines for regulatory regimes in the Biosphere Reserve by the Ministry of Environment and Forests, Government of India have also been followed in developing the Integrated Management Plan for the Gulf of Mannar Biosphere Reserve and Marine National Park.

The Process of Management Plan Development

After having discussion with Park Authorities, the format and the process of the Management Plan of GOMMNP were as under:

1. First formed a management plan development team with representatives of the GOMMNP, GOMBRT and WII as a Core Team.
2. Formed a GOMMNP&BR Management Plan development Steering/Advisory Body.
3. Set up of a GOMMNP Management Plan development cell by WII at the NICMB, Kanayakumari with Project Personnel and logistic support.
4. Collected all available information through literature search and visited to several organizations who have worked in the GOMMNP region and landscape.
5. Conducted a Management Plan development launch workshop with all stakeholders and organizations and found out gap areas in research.
6. Rapid fieldwork for collection of information for the identified gap areas was carried out for the period of one year.
7. Meeting of the Advisory/Steering Committee to review the suggested thrust areas of the Management Plan and adoption of guidelines were conducted.
8. Development of a Management Plan as per the guidelines of the a) IUCN-Marine Park Management, b) GOI-MOEF wetland Division guidelines c) MAB Biosphere Reserve Guidelines and d) A Guide for Planning wildlife management in Protected Areas and Managed landscape (Sawarkar, 2005) – keeping in mind the close linkages and relationship of the National Park and the Biosphere Reserve.

Management Plan Development Core Team and Steering/Advisory Committee met several times during the period of the Management Plan development exercise. Apart from the input provided by the committee, various stakeholders meetings also contributed a lot for preparation of this Integrated Management Plan. We also consulted other well known organizations/Experts in India and abroad and also reviewed global model case studies from Marine Protected Areas for this plan.

The present Management Plan has two important parts, one is addressing the need and importance of the Management Plan and the second is management prescriptions for both the Gulf of Mannar National Park and the Biosphere Reserve.

Geographic scope of the Management Plan

The geographic scope of the Management Plan encompasses the Gulf of Mannar Biosphere Reserve (GOMBR) as buffer area and the Marine National Park as the core area within the GOMBR. The

GOMBR also encompasses terrestrial area up to 10 km from the coast line from Dhanuskodi Island on the north-east (Ramanathapuram District) to Cape Comorin in South (Kanyakumari District) covering all along the four coastal districts of Ramanathapuram, Tuticorin, Tirunelveli and Kanyakumari of Tamilnadu, India.

Administrative structure

The Management Plan prescribes that the GOMBRT to be made into Gulf of Mannar Biosphere Reserve Management Authority' (GOMBRA) not only for unified control and management of all activities of the core area of the Biosphere Reserve i.e. the Marine National Park and the buffer and multiple use area i.e. Biosphere Reserve but also for better coordination and synergy with all other stakeholders agencies who will play an important role in the management of Reserve. The new Authority in such a situation will have better co-ordination between the management of the Marine National Park as well as the Biosphere Reserve through its own staff i.e. the Wildlife Warden, the Eco-development Officers and the suggested sociologist, biologist, fisheries and tourism officials to deal with human dimensions, research and monitoring unit, fisheries and eco-tourism aspects as well as eco-compatible and sustainable marine resource utilization activities.

Zonation

Selective control of activities at different zones is proposed here, including both strict protection and various levels of use.

The Core zone (Gulf of Mannar Marine National Park)

All the 19 islands and 2 submerged island and the sea portions surrounding the islands up to 6.405 m (3.5 fathoms) on the bayside and 9.5m (5 fathoms) depth toward the seaward side, which is the National Park area is the Core Zone and the rest of the area of the seascape i.e. up to 20 m depth and the coastal terrestrial areas (10 km from the high tide mark to landward side) will be the Biosphere Reserve and forms the buffer zone for the Marine National Park.

It is observed that by hindsight, the boundary of the Tuticorin cluster of islands based on quadrates mentioned in the Notification has omitted Karaichalli Island, which has been included into the Marine National Park, accordingly the boundary line was redrawn. Except research, monitoring and restoration of biodiversity, no other activities are proposed to be permitted in the core zone. The strict protection given to the core zone will result in spillover and migration of the faunal wealth to the buffer zone and will be available and can be harvested in sustainable manner by people who directly depend on these resources for their livelihood especially those who live in the buffer zone. It will also help in the economic development and a source of revenue to these coastal districts.

The Buffer zone - Gulf of Mannar Biosphere Reserve (The Utilization / Manipulation/ Experimental zone)

This zone is proposed to be permitted for local people's use such as fishing and fisheries related activities. The seascape surroundings and the islands beyond the limits of the National Park will form the buffer zone of the biosphere reserve i.e. up to 20 m depth in seascape around the National Park and the coastal areas (10 km from the high tide mark to landward side). As per the Notification of the Gulf of Mannar Biosphere Reserve, the total area of the Reserve is reported to be 10500 sq. km which extends from Dhanuskodi Island to Cape Comorin. However, based on the 20 m depth south-eastern boundary of the Biosphere Reserve the actual size of the Reserve is to be calculated.

Eco-developmental Zone (Terrestrial)

10 km stretch of coastal land starts from sea shore all along the Biosphere Reserve are identified as the Eco-developmental (terrestrial) zone. This zone is also utilised for multiple use like the Utilization zone.

Restoration zone

Restoration zone will enable damaged areas to be set aside for recovery. Both core zone and buffer zone can be used for restoration of habitat/species. All the islands are infested with invasive species. These islands need to be restored to their original state by eradicating invasive species from these islands. Northern group of islands such as Mandapam and Kilakarai groups are proposed to be used for restortation of mangrove habitat during this Management Plan period. Coral reefs in the Southern group of islands need to be restored. Detailed prescriptions are available in the concerned chapters.

Tourism zone

Tourism zone is proposed to be used for various recreational activities (bird watching, snorkeling, coral watching etc) to increase the enjoyment and safety of each pursuit. Eco-tourism is proposed to be allowed in the Biosphere Reserve. As a part of the value addition to the Eco-tourism in the Gulf of Mannar Biosphere Reserve, around 50 km stretches of land and sea areas around the Biosphere Reserve has also been identified and proposed as 'Tourism Zone for Value Addition' with community participation. All the tourist centers in this area have been assessed and included as potential tourism resources in the Eco-tourism sub plan in this Management Plan.

Delineation of boundaries

The boundary demarcation of the Biosphere Reserve, especially the seascape side needs to be reviewed at five years intervals as the bathymetry of the sea tends to change. The boundaries of the National Park and of the different zones will have to be suitably demarcated with different colour buoys or markers so as to be easily visible to the users of the coastal waters as per the Notification. Coloured buoys in every 250 m to 500 m distance for the National Park boundary and buoys with automatic illumination system to alert the vessels along the boundary of Biosphere Reserve needs to be installed in every five kilometers may be considered. Registered fishermen who use trawlers and are not supposed to fish inside the Biosphere Reserve need to be assisted by the Government to install required equipments such as GPS etc to receive the alarm signal if they approach the Biosphere Reserve boundary.

Protection measures

The core zone of the Biosphere Reserve i.e. the Marine National Park and its biodiversity need to be protected strictly from any kind of anthropogenic activities except the activities related to habitat & species restoration, and research & monitoring. Therefore, it is important to strengthen the protection force of the Biosphere Authority by having 'Forest Watchers Hut' in each island, which is in addition to existing protection force. A minimum of two forest watchers should be posted in each island with a motorboat and communication systems. People who are posted on the island need to be paid special incentives and their stay on the islands should not harm the biodiversity at any level. Minimum accommodation facilities (eco-friendly patrolling hut) may be created in each larger island. Responsibilities of the proposed protection force under the control of the Wildlife Warden need to be extended to other zones of the Biosphere Reserve too. Any violation of the Indian Wildlife (Protection) Act, 1972 and the Management Plan of GOMBR, any where in the Biosphere Reserve should not be allowed and this would be the responsibility of the protection force under the WLW and also of the other staff of the Biosphere Authority.

Restoration of habitat and recovery of certain species

Gulf of Mannar harbours diverse life forms. If not all, most creatures still experience severe threats. Illegal extraction, poaching, hunting were found as the culprits. Dugongs, Dolphins, Turtles, Hard Coral species, and several other organisms require significant conservation measures. A list of fauna and flora of Gulf of Mannar Marine Biosphere Reserve has been given in the Management Plan. This list in detail depicts their scheduled status under the Indian Wildlife (Protection) Act 1972.. Their status as per the IUCN Red Data Book and CITES Appendix is also given in the Plan.

Stock enhancement of certain commercially important marine fauna within the National Park is prescribed in the Plan. Spill-over of the enhanced stock from core zone to the buffer zone of the Biosphere Reserve will be harvested rationally and in a sustainable manner, which ultimately will improve the livelihood of coastal fishermen and the economy of the coastal districts of the Gulf of Mannar Biosphere Reserve. During current Management Plan period, the following species of conservation importance and sustainable utilization are required to be given special management attention.

The two categories of species requiring conservation and management actions are:

A. Species recovery/restoration programme to improve their threat status.

Even though, several species of invertebrates and vertebrates within the Gulf of Mannar Biosphere Reserve and Marine National Park are in the Red Data Book of the IUCN and schedules of the Indian Wildlife (Protection) Act, 1972, it is proposed to initiate active species recovery and restoration of a few prioritized species. It is important to realize that such species recovery programmes require highly specialized and professional help. The small number of species recovery programme suggested below will also provide opportunities for capacity building of GOMMNP and GOMBR staff, educated youth, local NGOs and other institutions to formulate and initiate similar actions for range of other species, a range of which has been listed here: (Dugong, Sea turtles, Sea horses & pipe fishes, Holothurians, Balanoglossus, Reef fishes, Lobsters, Economically important crabs)

B. Stock enhancement of species important to dependent communities for subsistence and commercial reasons.

Commensurate with the traditional dietary spectrum of the local inhabitants and the increasing evidence of a large number of marine fauna entering into the local, regional and global commercial market, there has been an over exploitation of many such resources. The current status of many marine resources is vulnerable and an increasing number of species are being considered to be taken into the threatened and endangered category and provided strict protection. In a situation like this there is drastic decline in the number of species that can be harvested without any legal hindrance. It is, therefore, important that the 'stock enhancement option' for select group of harvestable resources are initiated. Such programmes are proposed to be taken up in the National Park limits where no fishing is permitted. This will provide the replenished stock to grow in a sheltered and protected situation and spill over into the Biosphere Reserve limits where controlled and sustainable harvest by users is permitted. The community at large will view this activity as a positive and supportive effort by the Biosphere Reserve Authority rather than as a ban on resource use. Fortunately, for a range of economically important and subsistence level use resources, the technology has been developed with fair degree of extension and technology transfer mechanisms in place. A few species suggested to be included under this programme can be enhanced after the success of the pilot programmes. A range of species for which such programmes can be initiated is appended in the plan. A similar approach of creating livelihood opportunities involving propagation of indigenous marine flora and fauna that are not in the threatened and endangered category have also been suggested in the Eco-development plan chapter.

Eco-tourism Plan

The coastal landscape and seascape in the Gulf of Mannar Biosphere Reserve historically has been a major tourist destination in South India in general and in Tamilnadu in particular. Of the four coastal districts in which the Biosphere Reserve is located, the northern district of Ramanathapuram and southern district of Kanyakumari attract the largest number of tourists, the majority being religious tourist. Most of the tourists visiting Kanyakumari are interested in the 'tri-sea confluence' at the Cape Comorin. And, the tourists who visit Rameswaram are interested in the Ramanathaswamy Temple and nearby temples.

The coastal and marine habitats of the Gulf of Mannar and Palk Bay have also been favourite visiting sites for academic purposes by students, researchers and scientists studying biology, marine sciences, ecology, oceanography, geography and coastal geomorphology. After the creation of the GOMMNP which encompasses the offshore islands and surroundings coral reef systems, there has been a restriction on tourism. However, all eco-tourism prospect assessments have recommended reef based tourism as the highest opportunity in the Gulf of Mannar (MSSRF-UNDP-GEF study, 1988).

It is in this context, that a **World Class State of Art Aquarium** is suggested to be established in the Rameswaram Island perhaps in Pamban. This way the new aquarium will not pose any competition with the Heritage Museum and aquarium of the CMFRI and the new small scale aquarium of the TNFDC. It is suggested that the Tamilnadu Government through a Global Tender seek 'Expression of Interest' of interested and experienced corporate sectors and or global consortium to invest and construct a world class aquarium on a 'Build, Operate and Transfer (BOT)' basis.

As a part of the value addition to the Eco-tourism in the Gulf of Mannar Biosphere Reserve, around 50 km stretch of land and sea area around the Biosphere Reserve has been identified as 'Value added tourism zone'. All the tourist centers in this area have been assessed and included in the Management Plan for visitors to benefit more. Visitors/Tourists need to be guided to all the available tourism resources in the Biosphere Reserve as well as in the 'Value added tourism zone' of the Biosphere Reserve.

The proposed state of the art **Marine Conservation Interpretation cum Education Center (MARCONI)** and small information centers are required to be established at important entry points as well as at urban sites that will provide the visitors and other users a safe, visually coherent, appropriately sequenced and enjoyable experience with a focus on conservation education through exhibits and self guided activities

Eco-development Plan

The term „eco-development" seeks to reflect the interdependency between environmental problems and those connected with economic growth, demography and poverty. This leads to the principle of a trade-off between development and ecology or „eco-swap", according to which the project undertakes to support activities meeting the community's immediate needs in exchange for the latter's commitment to environmental restoration or conservation activities, in the spirit of a „social contract for long term concerted development" (Michel & Lazarev, 1997). The notion of participation brings the human development dimension into the eco-development concept, by introducing the idea of local control over decision-making (Michel & Lazarev, 1997).

With the setting up of Gulf of Mannar Marine National Park in Tamil Nadu, under the provisions of Wildlife (Protection) Act 1972, covering the 21 offshore islands along the Ramanathapuram and Tuticorin Districts, fisherfolks have lost livelihood access to the common property resources from the coral reef-based fisheries operations. However, to seek out a subsistence of livelihood option, they still resort to some level of marine resource harvesting from the protected area. By setting up the Gulf of Mannar Biosphere, a large buffer zone of seascape surrounding the Marine National Park as well as

a coastal terrestrial landscape have been earmarked as a multiple-user area where a diversity of alternate livelihood options are to be facilitated by the Gulf of Mannar Biosphere Reserve management agencies in an attempt to wean away the dependency of coastal communities from a multitude of marine resources. This major marine protected area management objective has been met with only to some extent by initiating some "eco-development measures" by the GOMBRT in the year 2002 following the India Eco-development Program (IEP) model. In this present plan, it is proposed to enhance the eco-developmental activity in a planned manner within the GOMBR limits following the guidelines set forth by Wildlife Institute of India (WII, 2004). This is proposed to be achieved by a proper assessment of the socio-economic dependency levels of dependent communities on coastal and marine biodiversity, identifying alternate livelihood options, enhancing community empowerment and setting in place proper inter-sectoral institutional mechanisms for the sustainability of such eco-developmental initiatives. The plan therefore examines the cultural, socio-economic and the socio-political situation to suggest a practical eco-development plan.

After a review of the existing eco-development programs implemented by the GOMBRT under the supervision of the Eco-Development Officer (EDO), the present eco-development plan proposes the need to continue and enhance the eco-developmental activities with certain modifications in all the identified villages during the 10 year plan period.

The objective of the eco-development plan is to combine guaranteed ecological balance with economic and socio-political dynamism at local level. More specifically, the Eco-development plan of the Gulf of Mannar Biosphere Reserve aims:

1. To ameliorate the hardships faced by the fishing villagers living in Biosphere Reserve, due to the curtailment of their access to fishing in the National Park, with a view to reducing their dependence on the protected area
2. Planning for resource substitution
3. Socio-economic upliftment of the target population especially fisherfolk
4. Involving local communities in conservation by adopting a "Community participatory" system of management, so as to elicit public support for conservation
5. Creating organised community institutions at the village level, and assuring benefits and rights to usufruct by developing viable partnerships with the village communities, subject to successful protection and conditions laid by the park management
6. Developing micro-institutional and technical functions in the community management organisations, so as to make them self-sustaining in the long run with minimum dependence on the Park Management
7. Formulation of utilisation rules and their enforcement, so that the contemplated welfare actions are not nipped in their infancy

The planned activities of eco-development program forms an integral part of the Buffer Zone (Biosphere Reserve) Management objectives, for it is this Zone that is expected to absorb the biotic pressures and insulate the Core Zone (Marine National Park). Community activities of "Social buffering" are expected to support "Extension buffering" that involves providing a habitat for the spillover population of fish and other marine resources for sustainable use. The eco-development activities area not restricted only to the presently prioritized 222 Buffer villages of the Gulf of Mannar Biosphere Reserve region but are expected to be carried out in other coastal villages in Tirunelveli and Kanyakumari districts during the plan period of 2007-2016.

Conclusion

The Integrated Management Plan of the Gulf of Mannar National Park and Biosphere Reserve is an adaptive management plan, which will undergoes periodic review based on evaluation of management activities and its outputs. This plan is also prescribed various policy level decisions which need to be taken up by the Government of Tamilnadu. These policy level decisions are important for the successful implementation of the Management Plan. This adaptive management plan for the Gulf of Mannar Marine National Park and Biosphere Reserve strongly emphasizes the importance of community based participatory approaches for sustainable use and management of coastal and marine resources of this region.

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