

Conservation and Sustainable Use of Gulf of Mannar Biosphere Reserve

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Abstract: *This study provides guidelines for the sustainable use and conservation of biological diversity and for the improvement of the relation between people and their environment globally. Sanctuaries, National parks and Biosphere Reserves are considered as protected areas. There are 13 Biosphere Reserves in India. The program of Biosphere Reserve was initiated under "The man and Biosphere (MAB) "program by UNESCO in 1971. Biosphere Reserves are areas of terrestrial and coastal or marine ecosystem, or a combination thereof, which are internationally recognized for promoting and demonstrating a balanced relationship between people and nature. This paper focuses on environmental planning of Gulf of Mannar Biosphere Reserve which extends from Rameswaram Island to Tuticorin. There are 21 islands running almost parallel to the coastline of Gulf of Mannar. It spreads over an area of 10500 sq. km having 3600 species of flora and fauna. 130 species of corals are found here. This study provides a guideline for sustainable use of resources, activities to be permitted along coastal stretch, coastal highways, and mangroves, reclamation of saline and alkaline soil, coastal pollution, sedimentation, avifauna, settlements, tourism and recommended vegetation.*

Keywords: Sustainability, Conservation, Biosphere, Marine, Resources

1. Introduction

The coastal environment is very dynamic with many cyclic and random processes owing to a variety of resources and habitats. Further the coastal ecosystems are one of the most productive ecosystems on earth. About 60 percent of the world population lives near the coast and in one way or other depends directly or indirectly on the coastal zone and its resources. Thus the coastal zone plays a vital role on the nation's economy. As a result of increasing human population and the trend for a greater proportion of people to live close to the sea, the economic activities on coastal environment are also increasing. Hence there is an urgent need to protect the coastal environment and ensure its sustainable production and development.

Gulf of Mannar:

Gulf of Mannar, inlet of the Indian Ocean, between southeastern India and western Sri Lanka. It is the first biosphere reserve established on 18th February 1989. It is bounded to the northeast by Rameswaram (island), Adam's (Rama's) Bridge (a chain of shoals), and Mannar Island. The gulf is 80–170 miles (130–275 km) wide and 100 miles (160 km) long. It receives several rivers, including the Tambraparni (India) and the Aruvi (Sri Lanka). The port of Tuticorin is on the Indian coast. The gulf is noted for its pearl banks and sacred chank (a gastropod mollusk). It comprises a chain of 21 islands along a stretch of 140 km between Rameshwaram and Tuticorin, which are small and presently uninhabited. These islands and their surrounding waters measuring a total of 560 sq km. has been notified as a National Park on 10th September 1986 under the Indian Wild Life (Protection) Act, 1972.¹

Composition of Gulf of Mannar:

Coral reef:

Coral reefs are a distinctive shoreline habitat of stunning visual appeal found only between latitudes 30°N and 30°S. They grow only where sea surface temperatures are above 20°C. Most living coral communities do not grow at depths of more than 50m although some grow at depths of 100m. They are considered the most productive marine ecosystem, supporting as many as 3,000 species². Coral reefs form the most dynamic ecosystem providing shelter and nourishment to thousands of marine flora and fauna. Coral reefs acts as a critical resource for various environmental and economical activities. Coral reefs provide an ideal habitat and feeding ground for various marine animals. Coral reefs act as a bulwark against cyclone, erosion, protects coastal installation and beaches. It provides a feeding ground and habitat for various marine animals. Coral reefs absorb CO₂ and convert it to CaCO₂ and reduce the CO₂ in the atmosphere. Coral reefs and sea grasses are interconnected ecosystems. Sea grasses provide feeding ground for babyish marine species while coral reefs feeds adult species .

Core zone:

Core zone is a chain of 21 uninhabited islands which is a Strictly prohibited area, conservation and monitoring are the functions allowed. Buffer Zone is a strictly delineated area, which is comprised of Gulf waters to the south and an inhabited coastline to the north. The allowable functions are research, education and tourism and activities that are managed to protect the core zone. The Transition Area is the Outer area of the buffer zone; functions allowable are human settlements, research station, traditional

¹ www.in.undp.org

² <https://www.researchgate.net>

use, education, training, tourism, recreation rehabilitation, facilities for research.

Mangroves:

Mangroves are termed as tropical tidal wetlands with typical vegetations distributed along the border of the sea and lagoons reaching upon the edges of the rivers to the point where the water is saline and growing in swampy soils covered by the saline water during high tides. They play a role in preventing soil erosion even during tsunamis. They are salt tolerant forest ecosystem found in the inner tidal regions. The major threats for mangroves are hyper salinity, siltation, tree felling for timber and firewood, human inhabitation and pollution, embankment construction, aquaculture, grazing by cattle/goat, over exploitation of juvenile fishes, disease, natural calamities (cyclone, storm and flood). The factors that influence mangroves are temperature, tides, salinity, rainfall and winds. Mangroves are under pressure due to salt pan conversions, development of ports, aquaculture, increase in population, dumping of industrial waste and their effluents leading to loss of mangrove ecosystem.

Sea shells:

Sea shells are the marine living organisms which belong to the family called Mollusca. Commercially many ornamental items are made from these shells. Collection, possession and trading of these marine living organisms and their products are happening in this coastal stretch.

Sea weeds:

Seaweeds are marine algae. They occur in the inter-tidal and sub-tidal regions of the sea. They are very important marine living resources. They are the only source for the production of photo chemicals which are used in food industry, textile industry, paint industry etc. Over exploitation of seaweeds indirectly affects the coral reef ecosystem, as a result of increasing siltation in sea water. Seaweeds act as a protective barrier against the wave action. Reduction in seaweeds leads to coastal erosion and removal of coral reefs.

Sea turtles:

The gulf of Mannar is the only ecosystem in India where all 5 sea turtle species have been reported. Four of the seven species of sea turtles found worldwide are reported to occur in the Gulf of Mannar.

Sea cow:

Dugong dugon is commonly known as sea cow. They are marine mammals with grey colour and a streamlined body orientation. They swim slowly and propel themselves using a crescent shaped tail and a pair of flippers. They grow up to a maximum size of 3 meters and 500 kg weight. The

endangered dugongs are protected under Schedule-I of the Indian Wild Life Protection Act 1972.³

Ship wreck:

Ship wreck is regarded as an artificial reef that harbours corals, fishes and other fauna. Artificial reefs are beneficial in reef conservation and rehabilitation efforts.

The Offshore Islands:⁴

1. Mandapam Group (7 islands): Shingle, Krusadai, Pullivasal, Poomarichan, Manoliputti, Manoli, Hare.
2. Keezhakkarai group (7 islands): Mulli, Valai, Thalaiyari, Appa, Poovarasampatti (submerged), Valaimunai and Anaipar.
3. Vembar Group (3 islands): Nallathanni, Pulivinichalli and Upputhanni.
4. Tuticorin Group (4 islands): Kariyachalli, Vilanguchalli (submerged), Koswari and
5. Vaan.

Legal Provisions:

I. International Conventions:

1. Convention on International Trade in Endangered Species of Wild Fauna and Flora:⁵

CITES recognised that species were driven to extinction because of unsustainable exploitation, combined with other factors such as habitat loss. It ensures that international trade in specimens of wild animals and plants does not threaten their survival by means of regulating and monitoring commercial international trade of the same.

2. United Nations Convention on Law of the Sea:⁶

The UNCLOS was convened with the intention of establishing a legal order for the seas and oceans in order to facilitate international communication, and promote the peaceful uses of the seas and oceans, the equitable and efficient utilization of their resources, the conservation of their living resources, and the study, protection and preservation of the marine environment.

3. Convention on Biological Diversity, 1992 (CBD):

CBD was convened to provide for the conservation of biological diversity, the sustainable use of its components and the fair and equitable sharing of the benefits arising out of the utilization of genetic resources. The CBD redefined biological diversity as relating to people and the need for food security, medicines, fresh air and water, shelter, and a clean and healthy environment in which to live.

³ www.oceanconservancy.org

⁴ www.shodhganga.inflibnet.ac.in

⁵ also known as Washington convention came into force on 1st July, 1975.

⁶ came into force in 1982.

2. Indian Acts

1. The Wild Life Protection Act (WLPA) 1972:

This Act provides for protection to listed species of flora and fauna and establishes a network of ecologically-important protected areas. It empowers the central and state governments to impose a blanket ban on carrying out any industrial activity inside any area that has been identified and declared a wildlife sanctuary, national park or closed area. It is probably one of the most important laws in operation in the Gulf of Mannar. There are provisions under the Wildlife Protection Act that prohibit the hunting or fishing and trading of species listed in Schedules I, II, III and IV of the Act.

2. Maritime Zones Act, 1976:

This act establishes a comprehensive legal framework to regulate all ocean space, its uses and resources. It contains, among other things, provisions relating to the territorial sea, the contiguous zone, the continental shelf, the exclusive economic zone and the high seas. One of the most important parts of the act concerns the exploration for and exploitation of the resources of the seabed and ocean floor and subsoil thereof, beyond the limits of national jurisdiction (the Area).

3. Biological Diversity Act, 2002:

The salient features of this Act include the (i) the regulation of access to biological resources of the country with the purpose of securing equitable share in benefits arising out of the use of biological resources; and associated knowledge relating to biological resources; (ii) conservation and sustainable use biological diversity; (iii) Protection of knowledge of local communities related to biodiversity; (iv) sharing of benefits with local people as conservers of biological resources and holders of knowledge and information relating to the use of biological resources; (v) conservation and development of areas of important from the standpoint of biological diversity by declaring them as biological diversity heritage sites; (vi) protection and rehabilitation for threatened species; (vii) involvement of institutions of state government in the broad scheme of the implementation of the Biological Diversity Act through constitution of committees.

4. Forest (Conservation) Act, 1980:

This act aimed at conservation of biological resources and associated knowledge as well as facilitating access to them in a sustainable manner and through a just process. Biological resources also include resources at Sea.

5. The Water (Prevention and Control of Pollution) Act, 1975:

The Water (Prevention and Control of Pollution) is a Central Act enacted by the Parliament in pursuance of powers given under Articles 249, 250 and 252 of the Constitution of India. The basic scheme of this Act is to ensure the prevention and control of water pollution and to maintain

and restore the wholesomeness of water. The Central and State Pollution Control Boards (PCBs) are the implementing bodies under the Water Act.

6. The Arms Act, 1959:

The Arms Act was legislated to control the possession of the arms and ammunitions recognizing its potential to disrupt public peace and tranquillity.

The Act is significant in the GoM region since the marine environment and the biosphere reserve zones in this region come under threat due to the usage and the possession of arms and ammunitions in this region.

7. The Coastal Aquaculture Authority Act 2005:

The Coastal Aquaculture Authority Act and Rules were enacted to establish a Coastal Aquaculture Authority and to regularize aquaculture activities. The Authority has been constituted [Section 4] to make regulations for the construction and operation of aquaculture farms within the coastal areas [Section 11(1)(a)]; to inspect coastal aquaculture farms with a view to ascertaining their environmental impact caused by coastal aquaculture [Section 11(1) (b)]; to register coastal aquaculture farms [Section 11(1) (c)]; to order removal or demolition of any coastal aquaculture farms which is causing pollution after hearing the occupier of the farm [Section 11(1) (e)].

8. Tamil Nadu Marine Fisheries Regulation Act, 1983:

This Act also provides for the protection and preservation of the marine environment, for marine scientific research and for the development and transfer of marine technology. This Act also permits the innocent passage of all the foreign ships, other than warships, sub-marines and other under water vehicles in the territorial waters.

Threats to Biodiversity:

1. Fishing:

Traditional fishers who form the majority population have increased in numbers during the last decades. Crowded fishing grounds, increasing demand for fisheries products, and declining catch deprive artisanal fisher families of livelihoods and food security. In general, the fisher communities are characterized by low literacy rate, lack of awareness of environmental issues, low income and a resulting reluctance among fisher folk to take up livelihood options other than fishing and this lead them to involve in more effective but illegal, destructive and unsustainable fishing practices, such as shore seine, purse seine and push net fishing, dynamite fishing and cyanide fishing.

2. Population Growth:

The Gulf of Mannar Reserve Trust initiated research survey during 2008- 2009 revealed that the population growth between 1989 and 2009 along the coast of Gulf of

Mannar increased about 34%⁷. Accordingly, the numbers of crafts have also been increased. However, the fisher folk use the same fishing ground and is over exploiting the resources using destructive fishing methods.

3. Coral mining:

The corals were collected from the seabed earlier days for use in construction or as raw material for the lime industry. In addition, corals have always been collected for ornamental purposes. For a long time the collection of corals did not pose an obvious threat to the resource as there were large reef areas in good condition in the Gulf of Mannar. However, gradually the extraction of coral became too intensive and the deterioration of the reefs was obvious to anyone.

4. Pollution and other hazards:

The southern part of the Gulf of Mannar region has occupied with many industries, factories and power plants. Tuticorin for example is the city which harbors a major Port, thermal power plants, Heavy water plant (HWP), many chemical industries, chain of salt pans and pollution from untreated sewage. The northern region of Gulf of Mannar basically suffers from domestic sewage let out directly into the sea.

5. Climate Change and Coral:

In 1998, severe coral bleaching was reported in Gulf of Mannar due to elevated sea surface temperature (SST). The reef areas of Gulf of Mannar have faced annual elevated sea surface temperature and resultant coral bleaching during summer since 2005, significant coral mortality was only recorded in 2010 when elevated temperatures (32.2 to 33.20C) persisted for four months (April to July). Estimated amounts of 9.99% live coral colonies bleached and more than 50% mortality among the bleached colonies. The live coral cover during 2003-2005 was 36.98% and increased gradually to 42.85% in 2009. During 2010, coral cover decreased to 33.2% due to severe bleaching and mortality; however it started to recover and was 37.31% in 2011⁸.

Other threats to Biodiversity include:

1. Global warming is causing sea levels to rise, threatening coastal population centres.
2. Many pesticides and nutrients used in agriculture end up in the coastal waters, resulting in oxygen depletion that kills marine plants and shellfish.
3. Factories and industrial plants discharge sewage and other runoff into the oceans.

4. Oil spills pollute the oceans, though U.S. water-sewage treatment plants discharge twice as much oil each year as tanker spills.
5. Air pollution is responsible for almost one-third of the toxic contaminants and nutrients that enter coastal areas and oceans.
6. Invasive species such as poisonous algae, cholera, and countless plants and animals have entered harbour waters and disrupted the ecological balance.
7. The United Nations Food and Agriculture Organization estimates that 31.4 percent of fish stocks are either fished to capacity or overfished.

Conservation and Management of Gulf Of Mannar:

1. Conservation of marine biodiversity through coastal zone management:⁹

Some coastal ecosystems are particularly at risk, including saltwater marshes, coastal wetlands, coral reefs, coral atolls and river deltas. Changes in these ecosystems could have major negative effects on tourism, freshwater supplies, fisheries and biodiversities that could make coastal impacts on important economic concern. Coastal zones comprise a continuum of aquatic systems including the network of rivers, the estuaries, the coastal fringes of sea and continental shelf and its slope. The functional value of diversity concept encourages analysis to take such a wider perspective and examine changes in large-scale ecological processes, together with the relevant environmental and socio-economic driving forces. At the global scale, while climate has fluctuated through out time, a global warming scenario could lead to accelerated sea level rise, changes in rainfall patterns and storm frequency or intensity and increased siltation. The consequences may include shoreline erosion and associated loss of habitats, such as salt marshes, mangroves and mud flats. An economic multiplier effect would then be generated leading to, for example, loss in tourism income and fisheries productivity, together with the increased cost of water supply and biodiversity conservation. In principle, the core objective of coastal zone management is the production of a socially desirable mix of coastal environmental system states, products and services. A future, more integrated coastal zone management process should include:

1. Integration of programmes and plans for economic development, environment quality management and ICZM.
2. Integration of ICZM with programmes for such sectors as, fisheries, energy, transportation, water resources management, disposal of waste, tourism and natural hazards management.
3. Integration of responsibilities for various tasks of ICZM among the level of government- local state/provincial, regional, national, international and between the public and private sectors.

⁷Mahadevan S. and Nayar K.N. (1972), „Distribution of coral reefs in Gulf of Mannar and Palk Bay and their exploitation and utilization“, In: Proceedings of Symposium on Coral Reef, Mandapam, 181-190.

⁸ Morgan Miller, Alexandra Scott - Biosphere Reserve.

⁹Tamilnadu Forest Department, 2007, Integrated Management Plan for the Gulf of Mannar Marine National Park and Biosphere Reserve (2007-2016). Published by the Gulf of Mannar Biosphere Reserve Trust, Ramanathapuram. p. 647.

4. Integration of all elements of management, from planning and design to implementation, that is, construction and installation, operation and maintenance, monitoring and feedback and evaluation over time.
5. Integration among the disciplines; for example, ecology, geomorphology, marine biology, economics, engineering, political science and law. Integration of management resources of the agencies and entities involved.

The Integrated Coastal Zone Management process should aim to unite government and the community science and management and sectoral and public interest. It should inter alia improve the quality of life human communities who depend upon the coastal resources while maintaining the biological diversity and productivity of coastal ecosystems. The rapid industrialization along the coast especially in the areas along the metropolitan cities has caused enormous damage to the coastal ecosystem. Hence, the laws governing the coastal land use should be framed with a view to promoting the economic development designed in tune with the coastal ecosystem.

2. Enforcement mechanism:¹⁰

We have adequate laws to protect the reef ecosystem and its resources from illegal practices, however implementation part need to be strengthened. It is also essential that the coastal people should be made aware of various aspects of laws and the need for implementation, also the stakeholders must be convinced that the regulations are only for their benefit. If the regulations are explained / provided in local language, it would reach the people more easily.

3. Alternative / additional livelihood:

Majority of the fisher folk who live on the coasts of reef areas know only fishing as their sole occupation for daily livelihood. Due to the increase of population growth, they need to share the fishing ground and resources which ultimately force them into illegal destructive practices. Hence, viable alternative / additional livelihood options are introduced among the coastal folk to reduce the pressure on the marine ecosystem.

4. Community participation:

If the communities realize that they are the custodians of the ecosystem and it is their duty to protect the resources from destruction, then the process is very simple and viable. The traditional knowledge coupled with scientific management would definitely bear good results. Village Marine Conservation and Eco-development Committees (VMC&EDCs) formed through GOMBRT is playing key role in community based management practices.

5. Artificial reefs:¹¹

¹⁰ Coral reefs of Gulf of Mannar, India - signs of resilience - J.K.P. Edward, G. Mathews, K.D. Raj, T. Thinesh, J. Patterson, J. Tamelander, D. Wilhelmsson.

Artificial reefs are deployed in the degraded coastal areas to restore the degraded marine habitat; to increase the biological diversity, in particular fishery production in the degraded coastal area; to protect the marine ecosystem from destruction; and to help improvement of livelihood to the small scale local fisher folk. In Gulf of Mannar, pilot scale artificial reef programme was initiated to address these issues.

6. Sea ranching for enhancement of stock:

Nowadays many species of marine organisms are included in the endangered list. Hence, the endangered and commercially important species may be cultured in laboratory and released into sea in order to protect them from extinction and to maintain natural stock. GOMMNP has been doing pilot scale sea ranching activities of sea horses cultured in the laboratory.

Gulf of Mannar Biosphere Reserve Trust:

The GOMBRT was established by the Government of Tamil Nadu in 18.12.2000. The trust is registered under Tamil Nadu Society Registration Act 1975. The Trust has been established as a special purpose vehicle to coordinate project implementation in order to ensure effective inter-sector co-ordination and facilitate main streaming of biodiversity conservation issues into the productive sector and policy development. The Trust allows project methodologies and result to be replicated in the rest of the coastal area so Tamil Nadu and serve as an institutional model for India as a whole. The Trust has statutory authority to play a focal role in the implementation of the project, providing the institutional frame work.

The five important areas where the project initiatives have been concentrated are as follows¹² :-

1. Managing the affairs of the Trust, developing a Long Term Funding for related activities after the project close and facilitating co-ordination among various stake holders.
2. Strengthening the capacity and infrastructure of the Gulf of Mannar Marine National Park for enhanced conservation and management functions.
3. Base line research and monitoring on key ecological, biological, environmental and management issues of Gulf of Mannar Biosphere Reserve.
4. Building capacity of various groups of stakeholders
5. Eliciting local community's participation in conservation and sustainable marine resource use through use through building awareness, capacity & skill, at the grass root level, empowering them and to facilitate provision and adoption of alternate/enhanced livelihood.

¹¹ Tamilnadu Forest Department, 2007, Integrated Management Plan for the Gulf of Mannar Marine National Park and Biosphere Reserve (2007-2016). Published by the Gulf of Mannar Biosphere Reserve Trust, Ramanathapuram. p. 634.

¹² www.tnenvs.nic.in

ood options and to bring down the pressure on the fisheries resources.

3. Conclusion

Coastal ecosystem is one of the important ecosystems and its importance is increasing in India because many people are depending on it. Gulf of Mannar is an important biosphere reserve with diversity of flora and fauna which are of economical importance. There is also increase in threat that the biosphere reserve faces. The threats are due to the development activities along the coast, increasing human population along the coastal and natural disasters. In India many studies are carried out on commercially important coastal resources. The central and state government of our nation took special steps to plan and coordinate the various activities in maintaining the resources. The project management system maintained by the government needs adequate monitoring and independent evaluation at the mid-term. The study helped to obtain zones of sustainability for preservation, conservation and development and areas of immediate action. It also leads to framing requirements the will create awareness and educate public about the coastal marine ecosystem.

Reference

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