CHAPTER 6

THREAT TO MANGROVE ECOSYSTEM

Mangrove ecosystem is a sustainable resource that provides large number of people with food, fuel wood, construction materials, chemicals and even medicines. In addition to benefitting the natural ecosystems of the surrounding area, mangroves are also extremely important to human communities as well. Many indigenous coastal residents rely on mangroves to sustain their traditional cultures.

About 80% coastal communities of the world depend largely on mangrove forest product to meet their subsistence needs. Mangrove resource use by local population can be sustainable as it forms an integral part of the ecology and functioning of the ecosystem. However, with population growth and increasing demand for space have resulted in most mangrove forests showing various level of degradation.

Land development for agriculture, aquaculture, industrial purpose, pollution, has contributed extensively resulting in damage to mangroves in many areas for the last so many years. This trend of degradation is continuing at greater extent in recent times along the many coastal states.

GLOBAL STATUS

In the beginning, mangrove forests were considered as the waste and unproductive regions along coastal areas. However, now it has been recognized as the most important ecosystem for local communities and also it is uniquely linked to many other systems that surround them. As a result, mangrove forests are now among the most threatened habitats in the world. Countries like Vietnam and Ecuador have already lost close to fifty percent of their mangrove forests; others, like Java and Thailand, have lost even more. Sadly, destruction in these countries continues even today.

Mangrove forests in Australia and the United States are protected from direct exploitation, yet are still damaged by nearby development, dumping and pollution. Mangrove forests are destroyed in order to provide places for residential, commercial, and industrial development. Many mangroves have been cut down to provide ocean-side land for local housing and tourist hotels. The most destructive process, however, has been the shrimp aquaculture industry.

In Thailand, the shrimp industry can account for 50% loss of mangrove forests since 1960, the Philippines 338,000 hectares loss between the 1920s and 1990, and Ecuador 20% loss of its mangrove coastline. In the Muisne region of Ecuador, approximately 90% of the mangrove forests have been lost. Overall, up to 50% of the world's mangrove destruction can be attributed to the shrimp farm activity.

NATIONAL STATUS

In India, mangroves in many places have been highly degraded. According to the Government of India (1987), India lost 40 percent of its mangrove area in the last century. The National Remote Sensing Agency (NRSA) recorded a decline of 7000 ha of mangroves in India within the six-year period from 1975 to 1981. In Andaman and Nicobar group of Islands about 22 400 ha of mangroves were lost between 1987 and 1997. The Government of India had set up the National Mangrove Committee at the Ministry of Environment and Forests in 1976 to advise the government about mangrove conservation and development.

This ecosystem is highly threatened with estimated loss of at least 50 % in the second half of the 20 th century that places this ecosystem under the “headed for extinction” category of the International Union for the Conservation of Nature and Natural Resource (IUCN). All of these "eco-services" that the mangroves provide, free of charge to the local communities, have a tremendous economic value for all who are dependent on

them.

In Sundarbans, largest deltaic region of the world that exist between India and Bangladesh, about 1, 50,000 ha of mangroves were destroyed during the past 100 years and reclaimed for agriculture and human settlement. A large scale destruction of mangroves for aquaculture purpose along the east coast of India in states like Tamil Nadu, Odisha, Kolkata and Andhra Pradesh was carried out two decades ago.

Mumbai is one of the best examples of mangrove destruction due to urbanization. Mumbai, once upon a time consisted of seven islands fringed with luxuriant mangroves. Today many mangrove areas in Mumbai are reclaimed for building new airport, bridges, housing and other infrastructure development. This process still continues and whatever mangroves have been left are under tremendous threat.

In Goa, mangrove areas have been reclaimed for building houses, bridges, industrial units, roads, jetties, infrastructure for tourism etc. Patto is a unique example where mangroves were cut down to accommodate to build government and private offices. Many private shipyards have flourished along the Goa estuaries by reclaiming mangrove areas. A small state like Goa where land is a scarce commodity is being utilized by cutting hills as well as coastal land for various developmental activities which needs to be restricted and conserved.

Today mangroves face constant threat because of the following reasons, in spite of its protection under various rules and regulations i.e. Forest Act, CRZ – Rules, Tree Act etc.

MAN MADE HAZARDS

· Urbanization

The urban development includes the construction of buildings, roads, bridges, canal systems as well as other infrastructure development. Coastal mangroves have been cleared for human habitation in many coastal states of India. In Goa many mangrove areas are being reclaimed for developmental purpose. Currently, millions of tourists visit Goa each year and large numbers of people move. Residents as well as tourists add to the increasing pressure to develop shorelines.

· Agriculture

The conversion of mangrove forests for


Agriculture

agricultural purposes initiated in 1770 and it continued till recent past. In the largest delta region of the world, the Sundarbans existing between India and Bangladesh, 1, 50,000 ha of mangroves were destroyed during the past 100 years and these were mainly reclaimed for agriculture. Converting mangroves into agricultural land involves the digging of narrow canal and piling up the diggings to form bunds on one or both banks of the canal. The bunds generally prevent seawater intrusion. Once the salt is leached to a sufficient level, the land is cultivated either with paddy or coconut plantation. This may lead to extensive loss of mangrove areas and their productivity. Karland development activities in Maharashtra has destroyed lot of mangrove areas.

· Aquaculture

Destruction of mangroves in the states like Tamil Nadu, Odisha, Kolkata and Andhra Pradesh on large extent and in smaller extent along Karnataka, Goa, Maharashtra and Gujarat coasts was for conversion to shrimp farm aquaculture. In 1986 aquaculture became very advanced because of the availability of wild brood stock, good infrastructure and pond construction, good support industries and unique culture techniques. Mangrove forests have been destroyed or surrounded with embankments to make shrimp ponds and after 2-3 years,


Aquaculture

production drops. Most ponds were completely abandoned due to effects of increasing acidity from mangrove soils, water quality, declining productivity, self-pollution and virus disease problems.

· **Sewage and industrial effluent.**

Mangrove habitats serve as a dumping ground for solid wastes and for discharging the effluents from various sources. Industrial wastewater and wastewater from municipal consumption is discharged untreated, directly into mangroves. Increased accumulation of pollutants in mangrove ecosystem, especially through the food chains, is likely to occur due to coastal development activities. In aquaculture, antibiotics and chemicals are widely used to disinfect and adjust the water quality.

· **Oil Pollution**

There have been more than 70 cases of large and small Oil spills along the Indian coast between Gujarat and Vishakhapatnam, since 1970. The spilled oil reaches mangroves causing defoliation of trees, mortality of all sessile and benthic organisms and contamination of many water fowls. Once the mangrove forest is affected by oil pollution, it will take a long time of at least 10 years for recovery of the forest. There are short term and long term effects on mangrove biota.

Cutting of mangroves

· **Cutting of Mangroves**

Mangroves are slow to recuperate from cutting. Several species do not re-sprout after being cut. So, once they have been cut down, they will never return unless replanted. When a large section of mangrove forest is cut, the roots can no longer oxygenate the oxygen-deficient soil, and the large amount of bacteria in the soil begins to churn out hydrogen sulphide. This makes the soil extremely acidic which may not support any mangroves, even if it is replanted. Deforestation of mangrove is a great threat in mega cities like Mumbai.

· **Reduction of ecosystem health**

Indian mangroves are generally not dense mangrove forests, except in three regions namely, Sundarbans (42 %), Andaman and Nicobar group of Islands (39 %) and Mahanadi (4%). Sparse mangrove forests range from 15 to 20 % in different states of the country. Their sparse occurrence may make the population with reduced genetic vigour, resilience and ability to respond to changing environment conditions. The plants also will lead to loss of reproductive potential and regenerative capability. Top dying disease of mangrove trees is an example leading to drying and death of foliage and branches from top to bottom with reduced wood productivity.

Government of Goa has already banned felling of 15 species of mangroves for a period of ten years under the Goa, Daman and Diu Preservation of Trees Act, 1984. This protection is desirable for all mangrove species, but the need for a total ban on mangrove felling or lopping may be periodically reviewed.

· **Over fishing**

Fishery activities, as traditional sources of livelihoods and incomes for the local fishing communities, result in overfishing in mangrove ecosystem. Presently, the demands and consumption of marine catch have significantly increased, which ultimately reflects in the increase of market prizes.

Innovations in fishing gears, scouring of top benthic layers by push nets and traditional drag nets, trawls, harvesting of small-size individuals, and harvesting of new target species for consumers have resulted in over fishing. Industrial development also induce environmental changes and the rapid decline of natural stock. Certain forms of fishery practices results into negative effects on the mangrove ecosystem.

· **Sand and iron ore Mining**

Movement of barges (used in Goa for carrying iron ore) which give rise to strong waves that sometimes damage the young mangrove seedlings. The sand mining which is going on in almost all the estuaries of Goa, in spite of the sand mining ban imposed by Govt. of Goa is a great hazard that needs immediate strict action. Similarly,


Sand mining

mining rejects flowing from the mining belt of upstream region also changes the water quality and the topography of the estuaries resulting in the formation of mud flats. These mud flats ultimately, form into a mangrove island as in case of island formed near Chorao and Divar heads.

NATURAL HAZARDS

· Flooding

Mangroves are specially adapted to high salinities and temperatures, tidal changes, and anaerobic sediments. These ecological and morphological adaptations make them somewhat vulnerable to natural stresses. The aerial roots are especially sensitive to long periods of flooding. If these specialized roots are covered for extended periods of time by sediments or water, the mangroves may die due to lack of oxygen to the plant tissues.

· Grazing

a) Browsing and trampling by domestic livestock such as camels, goats, buffaloes and cows, which are often left to graze freely, especially in areas close to human habitation in Gujarat, Middle Andaman, Sundarbans etc. create large scale damage to mangrove seedlings and fauna.

b) Mangrove plants are grazed up on by the insects, wood borers etc. during the certain stages of life cycle. *Avicennia* species is attacked by the insect *Pablia* sp. during September to November every year to complete its life cycle. When in caterpillar stage this insect becomes voracious eater and consumes large quantities of leaves. Once this stage is complete it leaves the tree as a full-fledged insect. Once this insect leaves, the tree regenerates its foliage. This phenomenon is very common along the Indian coast.

c) Mangrove mud crabs, feed on young seedlings, eat young leaves and flowers of mangroves. Crabs girdle the root collars and eat the fleshy tissues of the propagules - a serious problem in the Middle Andaman and lesser extent in other mangrove areas.

· Poor natural regeneration

Propagules are abundantly produced in most of the mangrove forests but their dispersal, survival and establishment are of serious concern. Dispersal of the propagules is restricted by both land barriers blocking current flow and wide expanse of water. Therefore, it is necessary to assess natural regeneration for its constraints like terms of hydrological changes from upstream to downstream areas and to implement correction measures for facilitating the dispersal and establishment of mangrove propagules.

· Biofouling

a) Biofouling simply refers to the undesired settlement of an organisms like microbes, plants and animals on a surface of natural or any artificial structures in contact with water for a period of time in the aquatic environments. As fouling impacts the gaseous exchange ability of mangroves, fouled plants could obtain less carbon dioxide and water for photosynthesis, resulting in reduced food and chloroplasts production.

b) Gastropods graze on the mangrove young foliage, particularly the young seedlings. The propagules, prop and stilt roots are infested with barnacles, oysters and gastropods during the younger period. The grazing interferes with overall performance of the species such as, interfering with respiration and photosynthesis and delaying seedling growth.

c) Seaweeds growing on the roots, stems and other submerged object compete for CO_2 and nutrients. They are the main food source for a variety of fishes and invertebrates. They play an important role in the energy flux of this environment as a regulatory source of dissolved oxygen in water and provide organic and inorganic nutrients to maintain estuarine fauna.

· Cyclones

Cyclones, typhoons and strong wave action devastate vast coastal areas by destroying properties, killing human beings, erosion and disturbing over all settings of the coast. Mangroves are more efficient at attenuating surface waves and wind as well as providing protection against erosion. The wave energy is attenuated

by a factor of two within 50 m in front of the mangrove forest at normal sea level. The obstruction density caused by the mangrove wood structure decreases rapidly with height and therefore, as the water level increases because of the storm surge, there is proportionally less flow resistance and less reduction of wave energy.

Along the Indian coastline there are many vulnerable areas that are prone to cyclones, especially in the geographically vulnerable Andaman and Nicobar group of Islands; Gangetric Sundarbans, Andhra Pradesh, Tamil Nadu, Gujarat coast etc. In 2004 Tsunami has shown that where ever there were mangroves the impact of Tsunami waves was reduced with less death, less property damage etc. This effect was visible and hence it has been decided to plant mangroves and other trees as shield or create natural barrier to protect the coastline.

· **Effect of climate Change**

A growing threat to global mangrove ecosystem is the climate change, associated with increasing temperature, changing hydrologic regime, rising sea level and increasing magnitude and frequency of tropical storms and natural calamities. To these changes, mangroves are likely to be one of the first ecosystems to be affected, especially in low lying areas, because of their location at the interface between land and sea. In Indian Sundarbans, two islands namely, Suparibhanga and Lohacharra have recently submerged and dozen other islands on the western end of the inner estuary delta are under the threat of submergence.

It is predicted that a rise in mean sea-level may be the most important factor influencing the future distribution of mangroves. However, this effect will vary depending on the local rate of sea-level rise and the availabilityof sediment to support re-establishment of the mangroves. As the sea level rises, mangroves would tend to shift landward. Human encroachment at the landward boundary, however, makes this impossible. Consequently, the width of mangrove system would be likely to decrease with the sea level rise.

The loss of mangroves may cause a gradual depletion of the rich biodiversity of mangrove forests flora. However, a few genetically superior plants species that will exist in the mangrove habitats need to be identified, propagated and introduced in the areas that are vulnerable to natural calamities and sea level rise. Further research is required to record plant species with details of their flowering, germination, propagation, growth as related to changing climatic to determine the climate change induced effect on mangrove species.

· **Effect of change in Carbon dioxide**

Increase in CO_2 is also not likely to cause any increase in mangrove canopy photosynthesis but it may increase the rate of net photosynthesis and growth rate of mangroves when the soil salinity is low. The advantage is the water use efficiency by mangroves by reducing the water loss via transpiration. This advantage will be lost when the salinity increases in arid regions.

GLOBALLY THREATENED MANGROVES IN INDIA

Mangrove habitat loss has put up at least 40 % of the animal species that are restricted to mangrove habitat at an elevated risk of extinction under the International Union for Conservation of Nature (IUCN) categories and criteria. However, none of the mangrove plant species have been entered in IUCN Red List. Very recently, assessment of mangrove species were made by 24 global mangrove workers in two workshops, one in 2007 in Dominica and other in 2008 in the Philippines.

The results published revealed that 11 out of 80 mangrove species in the world are at an elevated threat of extinction, out of which only two species namely, *Sonneratia griffithii* (critically endangered) and *Heritiera fomes* (endangered) exist in India. All other mangrove species in India are in IUCN category of least concern and only one species *Brownlowia tersa* is in the category of near threatened species.

Kandelia candel is also considered to be on the verge of extinction. However, Goa estuaries have this species in plenty. There is a positive indication of discontinuous distribution along the east and west coast of India. There are several parameters which are affecting mangrove distribution.