CHAPTER 1

INTRODUCTION

If you ever happen to visit a coastal area in the tropics, you will notice between the interface of land and sea a group of trees that rise from a cluster of roots emerging out of the substrate. These are called mangroves or coastal wood lands or tidal forests. The Shorter Oxford Dictionary describes the word "mangrove" as obscurely connected with the Portuguese word "*mangue*", the Spanish word "mangle" and the English word "grove". Dr Marta Vannucci in her book "The Mangrove and US" mentioned that the word "*mangue*" was derived from the national language of Senegal and it probably was adapted by the Portuguese and later modified by the Spanish.

Mangroves were evolved around 114 million years ago in the Indo-Malaysian area and later spread to the other regions of the tropics. Due to their unique reproductive strategy of viviparous germination, propagules dropped from the mother plant floated in the water and swayed by the ocean currents to India and East Africa, eastward to the America, arriving in Central and South America during upper Cretaceous period and lower Miocene epoch between 66 and 23 million years ago.

During that period, mangroves spread throughout the Caribbean Sea across an open sea which once existed where Panama lies today. Later, they spread to the western coast of Africa and as far south as New Zealand. At present, the Indo-Pacific region is known for its luxuriant mangroves. Especially, the mangrove forests are most

Fig. 1 Map of Sundarbans

luxuriantly present in Southeast Asia. The Sundarbans of India and Bangladesh put together form the single largest block of mangroves of the world.

Mangrove - the term has been applied to any and all species of trees which occupy the zone between land and sea. All are able to tolerate partial submersion in high salinity water and in anoxic condition in the ground where their roots penetrate. Different kinds of mangrove trees have evolved different adaptations to deal with these two limiting factors to survive in this environment. Mangroves occur only in the tropics where the daytime temperature is greater than 24° C and the annual rainfall exceeds 40 inches.

Various functional types of mangrove forest can be briefly described as:

1) Over wash mangrove forests: These are small islands covered with mangroves that are frequently washed by the tides. The dominant species is Rhizophora spp.

2) Fringing mangrove forests: These strips of mangrove are found along the borders of the waterways and influenced by daily tidal activities. These are sensitive to erosion and mostly exposed to marine environment. The dominant species is Rhizophora spp.

3) Riverine mangrove forests: These are luxuriant stands of mangroves found along the tidal areas and creeks with a good input of fresh water and fluvial nutrients. Often composed of Rhizophora, Avicennia spp.

4) Basin mangrove forests: These are stunted mangroves located in the interior of swamps and in drainage depressions. Often dominated by Avicennia spp.

5) Scrub mangrove forests: A dwarf stand of mangroves found on flat coastal fringes due to high salinity.

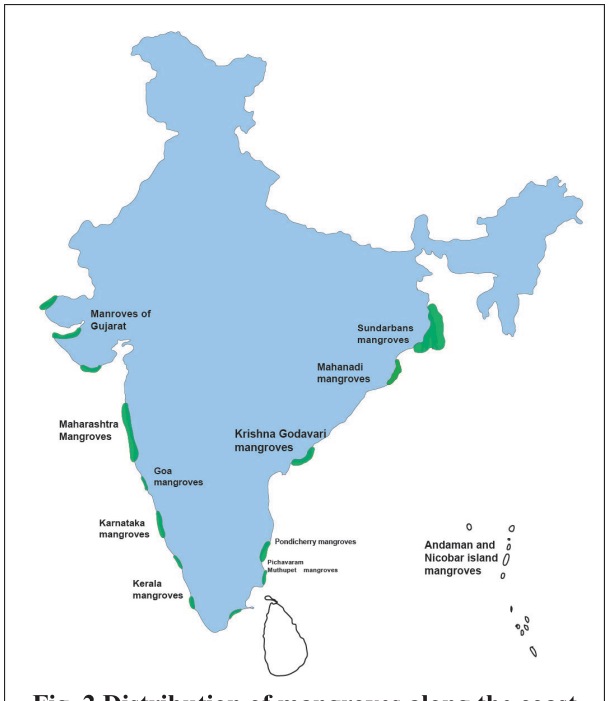

Fig. 2 Distribution of mangroves along the coast

Mangroves grow on waterlogged soils that are often devoid of oxygen. These are known as anaerobic soils, literally means, soil without air. The lack of oxygen in the soil is due to the slow rate of diffusion of oxygen in water as well as the biological activity of microorganisms that is taking place, consumes oxygen present in soil and water. The amount of oxygen in the soil varies according to how often and for how long tides cover the mud, how well drained the areas are, and whether there are chemicals in the soil that absorb oxygen. Extreme lack of oxygen in the soil can lead to the formation of gas, hydrogen sulphide, which has rotten egg smell often associated with mangrove swamps.

India has a long coastline of about 7800 km associated with continental shelf of 0.5 million sq. km and an Exclusive Economic Zone of 2.02 million sq. km. There are 13 maritime mainland states and Union territories (UTs). The coastal zone of the country comprises of wetlands, lagoons, mangroves, sea-grass beds, coral reefs, shallow bays, creeks and estuaries that are storehouses for variety of rich biodiversity. From the economic perspectives, these coastal and marine ecosystems are of great importance in that they provide wide range of ecosystem services and goods to the coastal inhabitants.

The mangroves are wide spread along the Indian coast line. The Gangetic Sundarbans of West Bengal is the largest mangroves formation occupying an area of 2067 sq. km. Mangroves of the Andaman &Nicobar Group of Islands are the second largest and other prominent mangrove formations are found in the deltaic areas of Mahanadi, Godavari, Krishna, Pichavaram and Muthupet on the east coast, while, the coastal areas of Gujarat, Maharashtra, Goa, Karnataka and Kerala on the west coast have limited areas of mangroves (Fig. 2).

The total area under mangroves along the Indian coast was estimated at 4460 sq. km. The values shown by satellite data revealed a decrease in the mangrove area, which may be due to several reasons such as:

a) Grazing by domestic cattle and exploitation of mangrove wood for fuel and timber.

b) The neo-tectonic movement of river courses.

c) Abatement of upstream freshwater discharges due to construction of dams and reservoirs.

d) Rapid trend of reclamation of mangrove forests for habitations.

e) Pollutant discharges from cities and industries.

Recent data from State of Forest Report 2011 of the Forest Survey of India, Dehra Dun showed that mangrove cover in the country is 4,662.56 sq. km, which is 0.14 percent of the country's total geographical area. Compared with 2009 assessment, there has been a net increase of 23.34 sq.km in the mangrove cover of the country. This can be attributed to plantations undertaken, particularly in Gujarat state and by natural regeneration in mangrove areas.

There are around 82 described species of mangroves in the world, 60 of which exist exclusively on coasts between high and low tide lines. Mangroves grow from small bushes to the 40 to 60 m high trees found in Ecuador. Mangroves are remarkably very sturdy species, growing in muddy soil, but some also grow on sand, peat and coral rocks. They grow in water up to 100 times saltier than most other plants.

Mangroves form very important part of the marine food chain. Mangrove ecosystem being a detritus based ecosystem, supports variety of organisms that inhabit mangroves or at least spend some part of their life span. Mangroves provide a variety of food for microorganisms, crustaceans, mollusks and provide a refuge from predators for many species. Many commercial and non-commercial fish such as Liza, Lactes, Polynemes, Sciana, Hilsa, Atroplus and prawn species like *Metapenaeus* and *Penaeus* feed and breed in mangroves. The estimated fishery yield from mangrove is found to be around 30,000 m tones, 13,000 m tones of crabs and prawns per annum. About 10 % of the India's coastal marine fisheries depend on the estuarine complex.

Number of terrestrial animals such as monitor lizards, flying foxes, wild cats, several species of snakes, wild boars, crab eating macaques, cattle, camels etc. visit mangroves for food, feed, breeding and shelter. Mangrove provides diverse structural habitats for several species of avifauna. About 121 bird species belonging to 82 genera and 39 families have been recorded from mangroves. Birds visit mangrove for feeding, roosting and transit purpose and very few for breeding and other activities. It has been found that the resident and local migrant birds dominate avifaunal composition.

In the past few decades, mangroves in India have been subject to a wide variety of threats. Unregulated urban development, increased pollution, altered distribution and use of water and with increased tourism into tropical regions over recent decades resulted in the most destructive human impact on mangrove forests. Approximately, 35 % of the mangrove area of the world was lost during last several decades of the 20 th Century. The United Nations Environmental Programme estimated that shrimp farming caused quarter of destruction of mangrove forest. Recent updates of World Mangrove Atlas indicated a fifth of the world's mangrove ecosystems have been lost since 1980. Intensive shrimp farming had resulted in the devastation of large mangrove areas. It had not only cleared large areas of coastal habitat including mangrove forests, it also polluted nearby coastal waters and marine habitats such as coral reefs with waste matter from the shrimp ponds.

Mangroves have been reported to be able to help buffer against tsunami, cyclones, and other storms. One village in Tamil Nadu was protected from tsunami destruction. The villagers in Naluvedapathy, planted 80,244 saplings to get into the Guinness Book of World Records. This created a kilometer-wide belt of trees of various varieties. When the tsunami struck in 2004, much of the land around the village was flooded, but the village itself suffered minimal damage.

Mangroves for the Future (MFF) in India has a primary focus on improving the scientific knowledge base to feed into national policies for enhanced management of coastal and marine ecosystems. National and regional symposia supported by MFF have greatly contributed to this by establishing baseline database for coastal and marine ecosystems (specifically mangroves and coral reefs). Information sharing with civil societies is also helping to raise awareness about India's valuable coastal resources.

Rapidly increasing development has put numerous direct and indirect pressures on coastal ecosystems in the form of degradation and destruction. Climate Change is likely to further exasperate the loss of biodiversity. With increase in extreme weather events, sea-level rise, warming of the sea surface temperatures and ocean acidification, socio- economic and environmental problems will be faced by the people of India. Similarly, the increased uses of coastal resources call for the

conservation of the genetic resources and maintenance of genetic diversity within the ecosystem.

There is an urgent need to conserve and protect the biological diversity of mangroves. Recently, as a result of increasing awareness and understanding of the importance of mangrove, its components and coastal processes that maintains this unique ecosystem, several steps have been taken to conserve and protect mangroves at various levels. The Government of India has recognized that the long-term solution to coastal and marine ecosystem degradation requires a holistic and integrated approach. Similarly, ensuring compliance with existing laws and regulations requires a coordinated response from a number of sectors.