

Status of mangroves along the countries bordering the Arabian Sea

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Abstract- Distribution of mangroves in the countries bordering the Arabian Sea, including Gulf of Oman, Persian Gulf, Gulf of Aden and Red Sea, is reviewed and their present status is discussed.

The estimated area of mangrove vegetation is 1140 sq. km for west coast of India, 2494 sq. km for Pakistan, 30 sq. km for United Arab Emirates and 400 sq. km for Red Sea. There are total 17 genera and 34 exclusive mangrove species, among these the dominant species are *Rhizophora mucronata*, *Avicennia marina*, *A. officinalis*, *Sonneratia alba*, *Lumnitzera racemosa*, etc.

Historical account indicates that about 2000 years back, there were dense mangroves in Persian Gulf, however, due to extreme climatological conditions and over-exploitation for the fodder and firewood, the vegetation has been reduced completely.

Deforestation and reclamation of mangrove forests for agriculture, construction purposes, urban development and industrialization are mainly responsible for its degradation.

The present situation certainly calls for urgent measures of restoration, management, conservation, and awareness which are discussed in the paper.

INTRODUCTION

Mangroves must have come into existence with many other angiosperms during the process of evolution. There are fossil evidences proving the existence of mangroves in the geological ages. The earliest known reference on mangroves from the present world goes back to 3580-3536 B.C. An inscription from the time of an Egyptian king Assa, mentioned about mangroves in the Red Sea. Subsequently, the mangroves of Persian Gulf, Indus delta and Red Sea have been quoted in different ways by Theophrastus (305 B.C.), Pliny (A.D. 77) and Aboul Abbass-en-Nebaty (1230). Coastal mangroves are the fragile but ecologically and economically significant ecosystem of the tropical and subtropical regions of the world. These forests have been overexploited over the past several centuries to such an extent that they have become highly degraded, particularly in the countries bordering the Arabian Sea. It is, therefore, necessary to assess the status of mangroves and also the reasons for their degradation, usage and the efforts made for their restoration.

Geomorphological features

The study area includes the countries like Maldives, West coast of India, Pakistan, Iran, Iraq, Egypt, Sudan, Ethiopia, U.A.E., Oman, Democratic Yemen, Yemen, Saudi Arabia and Somalia. The coastline comprises of deep ocean coral atolls like Maldives and Lakshadweep, major and minor gulfs like Gulf of Oman, Persian Gulf, Gulf of Aden, and Red Sea. The shoreline consists of low lying areas, sandy beaches, rocky western ghats, estuarine deltas (ex. India) and bordering desert areas. A characteristic feature of the coasts bordering Yemen, Oman and Red Sea is the formation of frequently occurring 'Sharma' and 'Sebkhas' (hypersaline ponds).

The extreme conditions of the Rann of Kutch along the Indian Coast with very high soil salinity makes it virtually a desert area.

Climatological Characters

Various countries of this region experience medium to extreme climatic conditions. The rainfall is maximum (above 2000 mm) along the West Coast of India, however, from Saurashtra coast onwards the rainfall becomes scanty to rare to minimum (less than 50 mm) in the countries like Iran, Iraq, U.A.E., Oman, Yemen and Somalia.

The atmospheric temperature in this zone ranges from -5°C (along Arabian Gulf Coast) to about 50°C (along the Gulf of Aden, Rann of Kuchchh, U.A.E., etc.).

Environmental observations

Since the mangrove formation is generally found in the intertidal zone, the tidal amplitude of the Arabian Sea region is of great significance. It ranges from 0.9m at Cape Comorin to 9m (in Gulf of Kuchchh). The intertidal region extent depends generally on the profile gradient (low along the Western Ghat and high in low lying areas).

The rivers situated along the West coast of India, bring the fresh water and influence the salinity, particularly during the rainy season. The major delta formation is observed at the confluence region of the Indus river in Pakistan. However, the countries bordering the arid regions have minimum fresh water flow. The seawater salinity ranges 0 to 60×10^{-3} . The extreme conditions in the Rann of Kuchchh show the maximum salinity of 120×10^{-3} . Lower water and soil salinity help better mangrove growth. The surface water temperature shows the average constant range from 15 to 32°C .

Phytogeographical distribution

The formation of mangroves is influenced by the nature of coast, physical nature of the substrate and estuarine environment.

Mangroves tend to be extensive in the stable and subsiding coast. The rising coast along the West coast of India supports the fringing mangroves along drowned estuaries, whereas in the countries with arid zone like coast of Persian Gulf i.e. northern east coast of Saudi Arabia, northern coast of U.A.E., Gulf of Aden (Northern Somalia) as well as the east and west coasts of Red Sea, there are very few mangrove species. The details of species distribution in the above mentioned countries is shown in Table 1.

In India, along the west coast, mangrove cover is estimated to be 1140 sq. km. having 34 species. *Rhizophora mucronata*, *R. apiculata*, *Sonneratia alba*, *Avicennia officinalis*, *A. marina*, *Bruguiera gymnorhiza* and *B. cylindrica* are the dominant species. In Pakistan, mangroves occur along coastal belt in Sind and Baluchistan, covering 0.4 million acres (Ansari, 1988). *A. marina*, reaching upto 8-9 metres height is the dominant species of Pakistan. In Iran, though there are not many mangroves, about 8900 ha. of mangroves have been estimated in Khoran Straits (Ormond *et al.*, 1988).

Towards and within the Gulf of Oman and in the Persian Gulf, mangroves occur within large bays or small embayment. In U.A.E., few patches of mangroves occur at Straits of Hormuz, which is the opening of Gulf of Oman into Persian Gulf (Ormond *et al.*, 1988). The shores of Persian Gulf are fringed by *R. mucronata* and *A. marina*. In Kuwait and Iraq, there are no mangroves, probably for climatic and biotic reasons. In Oman the densest mangroves are found at Liwa. At the northern coast of Gulf of Aden i.e. southern half of Democratic Republic of Yemen, is devoid of creeks and bays, and hence there are no mangroves (Ormond *et al.*, 1988).

The shoreline morphology and climatic condition of Red Sea coast favour the mangroves like *R. mucronata*, *A. marina*, *B. gymnorhiza* in form of scattered bushes of 1-2 metres in height. At Egypt border of Red Sea, pure stands of *A. marina* and *R.*

Table 1. Phytogeographical distribution of mangroves and their associate species along the countries bordering the Arabian Sea

	Maldives	West Coast	Pakistan	Iran	Iraq	Kuwait	Saudi Arabia	Oman	Yemen	Somalia	Egypt	Ethiopia	Sudan
1. <i>Rhizophora mucronata</i>	+												
2. <i>R. apiculata</i>	-	+											+
3. <i>R. stylosa</i>	-	+											-
4. <i>Avicennia marina</i>	-	+	+										+
5. <i>A. officinalis</i>	-	+	+										-
6. <i>A. alba</i>	-	+	+										-
7. <i>Ceriops tagal</i>	-	+	+										+
8. <i>C. decandra</i>	-	-	-										-
9. <i>C. roxburghiana</i>	-	-	-										-
10. <i>Kandelia candel</i>	-	+											-
11. <i>Bruguiera parviflora</i>	-	+											-
12. <i>B. gymnorhiza</i>	-	+											-
13. <i>B. cylindrica</i>	+												+
14. <i>Sonneratia alba</i>	-	+											-
15. <i>S. caseolaris</i>	-	+											-
16. <i>S. acida</i>	-	+											-
17. <i>S. apetala</i>	-	+											-
18. <i>Lumnitzera racemosa</i>	+												-
19. <i>Excoecaria agallocha</i>	-	+											-
20. <i>Xylocarpus granatum</i>	-	+											-
21. <i>Acanthus ilicifolius</i>	-	+											-
22. <i>Aegiceras corniculatum</i>	-	+											-
23. <i>Acrostichum aurcum</i>	-	+											-
24. <i>Derris heterophylla</i>	-	+											-
25. <i>Suaeda maritima</i>	-	+											-
26. <i>S. vermiculata</i>	-	-											-
27. <i>S. fruticosa</i>	-	-											-
28. <i>Salicornia brachiata</i>	-	+											-
29. <i>S. europaea</i>	-	+											-
30. <i>Porteresia coarctata</i>	-	+											-
31. <i>Cyperus</i> sp.	-	+											-
32. <i>Cynometra ramiflora</i>	-	+											-
33. <i>Scyphiphora hydrophyllacea</i>	-	+											-
34. <i>Urochorda setulosa</i>	-	+											-
35. <i>Cerbera manghas</i>	-	+											-
36. <i>Aeluropus lagopoides</i>	-	+											-
37. <i>Genchurus</i> sp.	-	+											-
38. <i>Sporobolus</i> sp.	-	+											-
39. <i>Myriostachya wightiana</i>	-	+											-
40. <i>Sesuvium portulacastrum</i>	-	+											-

mucronata are present (Zahran, 1965). In Bahrain, a few stands of *A. marina* and *Suaeda maritima* are reported at Sanad (Price *et al.*, 1983).

It is estimated that the total mangrove area in Saudi Arabian Red Sea coast is about 20,000 hectares and for the whole Red Sea coast, mangrove cover may be about 40,000-50,000 hectares (Ormond *et al.*, 1988). The species like *B. gymnorhiza*, *C. tagal*, *R. mucronata*, *A. marina* occur along the bay of Massawa in Ethiopia. Sudan is fringed with *B. gymnorhiza* (Kassas & Zahran, 1967). The vegetation of Somalia is fringed by the growth of *A. marina* (Verdcourt, 1968; Hemming, 1961).

Ecobiology

The Gulf countries exhibit typical arid conditions like scanty rainfall (40-200 mm yr⁻¹), extreme temperature (-5 to 50°C), less humidity and hypersaline conditions. Similarly, the substratum is mainly sandy and rocky, which is not suitable for the establishment of mangrove seedlings. In such areas, very few species like *A. marina* and *R. mucronata* having tolerance for high salinity and wide fluctuations in temperature have been recorded. Along the coasts of Pakistan and northernmost part of West coast (Gujarat) of India, the arid conditions are slightly improved having more rainfall and higher humidity. The Indus delta in Pakistan and delta regions along Gujarat coast have large intertidal swamps silt and clay areas which are suitable for the establishment of mangrove seedlings. Therefore, in these areas more number (eight) of mangrove species occur compared to Gulf coast, dominated by *A. marina* and *R. mucronata*. Along the central and southern west coast of India, the climate is more humid (69-95%) and warm. Rainfall reaches upto 3000 mm yr⁻¹. The intertidal mudflats are more in this region. Climatic conditions are ideal for the establishment and growth of mangroves. Therefore, maximum abundance occurs along the central west coast of India. The poor extent and species diversity along the Kerala (south west) coast in India could be attributed to the degradation of mangroves due to biotic influence.

Usage

1. *Fuel* - In India and Pakistan, wood of *R. mucronata* and *B. gymnorhiza* is used as a fuel because of its high caloric values and cheaper price.

2. *Fodder* - *Avicennia* species is used as a cheaper and nutritive means of fodder for cattle and camels in Pakistan and in West Coast of India, especially in Gujarat and Maharashtra. In Persian Gulf, mangrove foliage is used as fodder for camels.

3. *Medicinal uses* - In India, few mangroves are used for different medicinal purposes. Leaves of *B. gymnorhiza* are used in reducing blood pressure. The root and stem of *Derris heterophylla* (contains weak poison) are used for narcotizing the fishes, *Acanthus ilicifolius* for rheumatic disorders.

4. *Salt production* - In India and Pakistan, reclaimed mangrove areas are used for salt extraction.

5. *Agriculture* - The reclaimed or denuded mangrove areas are used for paddy cultivation and coconut production in Kerala, Karnataka and Goa.

6. *Fisheries* - In India, mangrove estuarine waterways are used for exploitation of various species of fishes, crustaceans and shell fishes in traditional ways.

Captive Fisheries - Mangrove swamps and other low lying areas along the estuaries of West Coast of India are used as brackish water fish farms. Kerala is known for brackish water fish and prawn farming known as Pokkali i.e. alternate paddy and prawn cultivation. In Pakistan 23 different species of Penaeid prawns are reported from mangrove waters (Ansari, 1986).

Impacts on the mangrove environments

1. Human induced stresses

Overexploitation - Mangroves in the countries in arid climates have been over-exploited for fuel and fodder. In recent years, there is a marked acceleration in the rate of destruction of mangroves in Arabian Gulf as well as Indian Penninsula for which the main cause is construction work (Vousdan & Price, 1985). The mangroves along the west coast of India are mainly reclaimed for agriculture and urbanization purposes. Illegal exploitation of mangroves is still continuing on large scale.

Damming and Impoldering - Embankments are constructed of the mangrove mud to protect agricultural fields, fishfarms and human habitations from flooding or inundation. These bunds are also utilized for coconut plantation. The economy of the local people depends mostly on these impolderings. The height of the embankments depends mainly on the tidal amplitude. Impolderings have resulted in the reduction of mangrove forests and poor establishment of mangrove seedlings. Construction of dams, barrages, and bunds across the rivers, in the upstream regions has become a regular practice lately, particularly along the west coast of India. This affects the entire mangrove ecosystem as a result of very reduced flow of fresh water, and also nutrients.

Pollution - Mangrove environments were generally chosen for dumping various effluents, domestic garbage and sewage, which has affected the basic food cycle in the coastal environment. The mangrove ecosystems along the Bombay (central west coast of India), have worsely contaminated with toxic and nontoxic pollutants, resulting into severe degradation of mangroves and very low productivity of mangrove in and nearby coastal waters. The mangroves in the Gulf countries have been largely affected by contamination of petroleum products and even in the other countries oil has become serious threat to mangrove environments.

In recent years, major oil spills have resulted in serious oiling of mangrove stands in the northern Egyptian coast (Barratt, 1982). Various insecticides and pesticides applied in the agriculture find their way into the mangroves and are very toxic to the mangroves at high concentration and have accumulatory effect at low concentration.

Erosion - Extensive deforestation of mangroves have caused severe erosion in the Gulf of Kuchchh (Gujarat) along the West Coast of India.

Effects on the adjacent ecosystem

Deforestation of mangroves and other activities in the mangrove areas have affected the estuarine and coastal fisheries. In the Gulf of Kuchchh, deforestation of mangroves has increased the siltation rate causing mortality of the adjacent coral reef. Similarly, construction of Thanneermukkam dam near Cochin in India have resulted in the infestation of backwaters with *Salvinia* sp. and other aquatic weeds adversely affecting the prawn fisheries.

2. Natural stresses

Physico-chemical stress - Tropical cyclones and storms inundate the shore with tidal waves destroying and disturbing coastal life. Heavy rains during cyclone result in large scale flooding, causing heavy damage to the mangroves. In the Arabian Sea, total 82 cyclonic storms occured during 1891 to 1960, of which 48 were of severe nature (West Coast of India - Pilot 1975).

Tidal waves - The mangrove formations are subjected to the tidal fluctuations. The tidal amplitude along the West coast of India keeps increasing from 0.9m along the southernmost coast (Cape Comorin) to 9m in the northernmost region (Gulf of

Kuchchh). Arabian Gulf coast is subjected to the tidal amplitude of 0.9 to 4m and Pakistan to 0.9 to 2.7m. Although there is no direct impact of this factor, it gives rise to fast currents affecting the mangrove establishment.

High and low temperatures, hypersaline conditions : In the arid coastal zone, higher temperature causes excessive evaporation resulting into hypersaline condition. Hypersaline conditions are generally observed in the supralittoral zone along the west coast of India. However, along the coasts of Gulf countries, Pakistan and part of northern west coast (Gulf of Kuchchh and Rann of Kuchchh), most of the lagoons and intertidal mudflats are hypersaline. Hypersaline soils are impregnated with salts and excess of clay and are therefore unsuitable for the cultivation or to grow any vegetation. Such areas support few species like *Avicennia marina* (shrubs) and shrubs like *Salicornia brachiata*.

The temperature below 20°C does not favour the growth of all mangrove species, however, it seems that *A. marina* could tolerate the lower temperature up to -5°C in the Gulf countries. There are no reports available on the effect of high and low temperature on the mangroves along the West Coast of India.

3. Geomorphological alterations

Geomorphological changes are caused due to accretion or erosion, tectonic movements, constructions of dams in the upstream regions and changes in the river courses. These types of alterations reduce or totally cut off freshwater supply to the mangroves in lowlying areas, causing water logging, anoxic and hypersaline conditions, and finally kill mangrove in the area.

4. Biological stresses

Pests, diseases, wood borers, grazing by cattle and associate competitors, cause damage especially to the young mangroves. Teredinids (wood borer) bore the mangrove wood. The leaves of *Avicennia* spp are extensively grazed by cattle and insects. Constant grazing results into stunted mangroves and damaging young seedlings. Associate marine algae and seagrasses, compete with mangroves for nutrients and space, resulting into poor establishment of the mangrove seedlings. The extensive growth of marine algae mainly of *Enteromorpha clathrata*, *Chaetomorpha* spp, *Ulva* spp and *Monostroma* sp. cover and finally kill the established mangrove seedlings. Similarly, pneumatophores of the mangroves also get covered with the growth of algae, reducing their efficiency.

Management and conservation

The present status of mangroves in the countries bordering the Arabian Sea, certainly calls for urgent measures of management and conservation.

Management options are various including legislation for water and land use, regulating deforestation, restricting on reclamation, preventing the release of pollutants, maintaining the mangroves as reserves and afforestation of new areas and reforestation of denuded areas. The most important is creating an awareness about the importance of mangroves among the local people. In India, National Mangrove Committee has been responsible to coordinate various activities in the field of mangroves. State Forest Departments are also involved in the protection and afforestation of mangroves. Afforestation in different states of India is under progress by both direct planting and by planting nursery grown seedlings in the open mudflats. About one lakh seedlings of *R. mucronata*, *A. marina*, *S. alba* and *K. candel* have been raised and about 115 ha. of area of Chorao Island in Goa have been afforested so far (Untawale, 1987). Mangrove afforestation is also being experimented at even arid and dry places. Kogo (1986) has

tried the mangrove afforestation of *A. marina* and *R. stylosa* at Mubbaral Island in Abu Dhabi, at Khafji in Saudi Arabia and *R. stylosa* was planted near Karachi.

A perspective conservation measure has to be taken by establishing reserves and wildlife sanctuaries in mangrove zones. This would help to protect the ecosystem, flora and fauna and also to generate income for local population by way of tourism. It needs nondestructive use of mangroves and vigorous promotion at all levels. Along the West coast of India, Pirotan Island (Gujarat) and Chorao Island (Goa) are being developed as recreation and education centres and been declared as bird sanctuaries. A vast region in Gulf of Kutch has been declared as National Park. Recently, the Arab countries have started thinking to grow mangroves along the coast for various reasons.

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