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CONSERVING A CRUCIAL WETLAND ECOSYSTEM -A NOTE

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ABSTRACT: Mangroves occur almost exclusively in the tropics. Mangroves are found in a relatively small area of originally 17 to 20 million hectares. A few years ago environmental care given to mangroves ecosystem was negligible and it was subjected to destruction. Hence, there has been massive destruction of mangrove forests all over the world. To approach the mangrove forest, with a narrow, utilitarian and restricted point of view, may lead to the exploitation of this resource. It has pushed the system to its highest possible level at the cost of breaking the equilibrium of the whole system. The intensive aquaculture practice in mangrove areas will collapse the system ecologically and economically in a few years, as has it happened in Thailand and Philippines. In the past, about 80% of the mangrove forests have been devastated or have been subjected to degradation due to land deposits, construction of sanitary land fills, setting up of aquaculture, industrial logging, and discharge of water pollutant, mining and other human impact. The application of scientific knowledge, coupled with socio-economic considerations may provide the planners with a solid basis for a proper management of the coastal wetland systems where the mangroves are one of the important life-sustaining ecosystems. Based on these different viewpoints mangrove should be conserved for the future with an effective eco-balance.

Keywords: Mangroves, distribution, destruction, conservation and management

INTRODUCTION

Mangrove is one of the good examples for the wetland ecosystem. Recently it is emphasized as one of the most useful natural resource systems, and essential life support systems that plays a vital role in controlling water cycles and cleaning the coastal environment. Mangroves usually bring to mind only the mangrove forest excluding the other important elements that integrate this complex ecosystem [1]. This ecosystem, however, is dependent on the whole for survival. Unfortunately, these mangroves are fast disappearing all over the world [2] including India, and the time has come to make a coordinated effort to halt this trend and optimise the use of mangroves. Until a few years ago, the care afforded to conserve mangroves was less and they were considered to be a destroyable wasteland and hence bearing to massive destruction of mangrove forests is Southeast Asia and the Pacific (mainly parts of Indonesia and Papuna New Guinea) for wood chips used by rayon and other industries [3]. Thus, a mention of mangrove leads one to think in terms of timber, poles, wood for charcoal, fuel wood and forgetting, unfortunately, the dependent animals and microbial colony for land in the soil of the mangrove ecosystem. Such is the case because the constituent plants, animals and microbial species that live in close association are interdependent in the mangrove ecosystem would not survive in isolation i.e, if the forest were totally felled.

Mangrove related plants and animals depend on the ebb and flow of the tides and live in the inter-tidal belt that is alternately covered and uncovered by coastal seawater. It is also a region where seawater mixes with the water from the land runoff. With regards to plants, no other association of plants can live and grow well above or below such a widely fluctuating ecological regime. This, however, is not the only characteristic of the mangrove forest. Another important factor is that of the 70 or 80 exclusive mangrove species that are sustained on a permanently or temporarily associated fauna is dependent on the vegetation in one way or another. Frequently the dependence is not species - specific, but ecosystem - specific and is linked to the mangrove soils, waters and trees as habitat [4]. Same is true of the micro-organisms fauna (bacteria and fungi) of soils and water that serve the useful purposes of controlling the pH, leaching metals, recycling nutrients; some of them are also chemosynthesisers and are capable of living in extreme environmental conditions. Unfortunately, very little attention has been paid to this important ecosystem in the past. In respect of global warming, mangroves play a major role in controlling the concomitant sea level rise, coastal erosion and long- term community stability. It also acts as a barrier to protect the direct force of storms and tsunamis [5]. Based on these different viewpoints, major ecological aspects of mangroves such as distribution, diversity, importance, destruction and managements are discussed in this paper.

DISTRIBUTION AND DIVERSITY

Mangroves occur almost exclusively in the tropics. Mangroves are found in a relatively small area of originally 17 to 20 million hectares [6]. Based on the climate, the mangroves either merge with the inland into terra firma vegetation or they are visibly separated from the mainland by an almost vegetation-free strip of land. Mastaller [2] reported that the largest mangrove area occur in Indonesia (30%), Brazil (10%), Australia (8%) and Nigeria (7%), but in India having only 3% of mangroves (Table 1).

Table 1. Estimated mangrove coverage areas of the 15 countries with the largest mangrove areas. After [7, 8, 9, 10]

Country	Mangroves (x1000 ha)	Global share (%)
Indonesia	4,250	30
Brazil	1,376	10
Australia	1,150	8
Nigeria	970	7
Malaysia	641	5
Bangladesh	611	4
Myanmar	570	4
Vietnam	540	4
Cuba	530	4
Mexico	525	4
Senegal	440	3
India	360	3
Colombia	358	3
Cameroon	350	2
Madagascar	327	2
Total	14200	100

Mangroves, as tropical rainforest, saline tolerant tidal forest, represent an open ecosystem. The mangroves create an ecosystem where an extremely large number of small and big plants, animals and microbes find their suitable ecological niche [11]. The plants, animals and microbes are the major forces that keep the wheel to energy turning and they ensure a healthy forest to thrive, with it shrubs, herbs, mosses, lichens, algae, corals, seagrasses, insects, nematodes, crabs, amphipods, fish and shrimps, reptiles, birds, fungi, bacteria and mammals including man, but is a fallacy to believe that disturbed mangroves regenerate spontaneously [4]. For example, with regards to species distribution, more than 2145 species of plants and animals have been identified on a world wide basis. Of these 2145 species, there are 93 plants, 397 fishes, 259 crabs, 256 mollusks, 450 insects and 250 species of mammals and other associated plants and animal species. In India, a total of 65 mangrove plant species, belonging to 41 genera, 29 families and 26 species have been recorded. Of these 62 are found in Sundarbans, 63 in west and east coast regions and 30 in the Andaman and Nicobar Islands [12, 13]. Further, many animal species of economic importance depend exclusively or partly, directly or indirectly, on the mangrove ecosystem, throughout their life or a part of it. Most of them have economic importance. For example, the *Penalid* shrimp or prawns, they are one of the economically most important resources from the tropical coastal zone [14]. The coastal zone, as in all ecosystems, plants and animals interactions are not only complex and poorly known, but have been recognized as an indispensable element for the understanding [15]. The scope is to maintain the structure and the dynamics for a sustainable production of valuable resources. To enhance the productivity of the system, it is necessary to evaluate how each member functions and how far the production of each can be pushed without inhibiting the production of the useful species of plants and animals and without disturbing the balance of the ecosystem.

Therefore, it is clear that the fauna of the mangroves are not only important in itself but also for the role there plays in the food web, in the processing and transfer of nutrients and energy, in the transmission of plants, animals and human [16]. Particulate organic matter (POM) is produced in a large measure by mangrove plants as litter fall and by the herbivorous fauna. The tiny planktons feed on the litter fall and also find shelter under roots upstream with the incoming tides and making some foothold during the ebb to avoid being washed back to sea.

DESTRUCTION OF MANGROVE WETLANDS

Mangroves, on a global scale, are exposed to many destructive agents. But the cumulative effect of natural disasters, clear cutting, over logging, fish and shrimp farming, industrial and domestic pollution, dredging and industrial and agricultural land reclamation as well as fragmentation threaten their continued existence [17]. The loss of mangrove forests can have drastic effect on the local inhabitants for many years to come. Increased flooding and coastal erosion lead to loss of crops, lives and properties. Local subsistence fisheries may also decrease or collapse altogether and many coastal communities may undergo severe social changes relating to loss in incomes through loss of resources [2]. Without doubt most of the recent mangrove destruction around the world has been due to man. As a consequence, a decline in mangrove resources has reached alarmingly high rates all over the world, as illustrated by the figures in Table 2.

Table 2: Example of the (estimated) world- wide decline of mangrove forest in recent times [2].

Country/ Region	Period of Recorded	Original mangrove area (ha)	Present mangrove area (ha)	Existing (%)
Cuba	1969-1989	4,76,000	4,48,000	94
Bangladesh	1963-1990	6,85,000	5,87,000	86
Guatemala	1965-1978	58,000	50,000	86
Malaysia	1979-1986	1,13,000	89,000	79
Ecuador	1966-1989	2,35,000	1,77,500	76
Thailand	1961-1993	3,00,000	2,19,200	73
Vietnam	1969-1990	4,25,000	2,86,400	67
U.S.A.	1958-1983	2,60,000	1,75,000	67
Colombia	1976-1989	4,80,000	3,07,000	64
Indonesia	1969-1986	42,20,000	21,76,000	52
Philippines	1968-1995	4,48,000	1,40,000	31
Singapore	1922-1989	700	180	26
Puerto Rico	1930-1985	26,300	3,000	11
India (Kerala)	1911-1989	70,000	250	4

Human interactions such as natural enemies, land reclamation for settlements, conventions of mangrove are into agricultural lands are mainly responsible for the degradation of mangrove wetlands [13]. For example, if the mangrove forests are cut, its associated fauna will perish; streamline or fill in or divert the mangrove creeks and channels and the habitat area for the prawn larvae will shrink. Thus, by a single stroke the forest and the shrimp and finfish fisheries are destroyed in the brackish and coastal areas, a well-known and documented fact in the tropics.

During the past three decades about 1, 96,000 ha of the Philippine coastal lands have been converted into fish and shrimp ponds. Between 1968 and 1983, some 2, 37,000 ha of mangrove forests have been lost [2]. The Indian subcontinent renders an impressive example of how mangrove areas have always suffered from conversion due to colonisation, migration and population explosion. The history of the Sundarbans too has been characterised by continuous land reclamation since the beginning of British colonial time. In the largest delta region of the world extending between India and Bangladesh some 1, 50,000 ha of mangrove forests have disappeared during the past 100 years, as they were reclaimed for agriculture, settlement sites and road networks for an ever-increasing coastal population. Further, southernmost state of Kerala, where the rate of population increases is the highest in the country some 70,000 ha of mangrove were cleared at the turn of the century. Kerala had about 1.5 million inhabitants in the beginning of the twentieth centuries, to day some 22 million people crowd the coastal belt of 600 km by 25 km resulting in 1500 people per square kilometer. It is no surprise that only 3.5% of the former mangrove vegetation survives [2].

All ecosystems function (dynamics) successfully when there is equilibrium among the parts as well as equilibrium in the interdependence of the system as a whole with the adjoining ecosystem. For instance mangroves are highly productive because they receive nutrients from land runoff and from tidal seawaters [14]. Mangroves function at high temperatures and most species have their highest photosynthetic rate of carbon fixation under partly cloudy conditions, as is often the case in the humid tropics.

Further, all these movements evident by the tides are the lifeline that sustains the biological productivity of the coastal zone, through a constant transfer of matter and energy among interdependent ecosystems. It is this transfer that sustains life. Thus, the mangroves and coastal systems are not only highly productive in them selves, but also sustain basic life. This requires wise management beginning with the zoning of the coastal area for the highest possible production on a sustained yield basis. Some of the most important mangrove related ecosystems are the coastal water fisheries where detritus and plankton - grazing fish such as sardines or anchovies play a leading role of massive production [18].

CONSERVATION AND MANAGEMENT OF WETLAND ECOSYSTEM

It is indispensable that India evolves a coastal management plan, beginning with zoning of the coastal area. Because of its magnitude this can take years to be completed and implemented. The Department of Environment's publication "Mangroves in India" shows the extent and distribution of mangroves Gujarat and the Sundarbans mangroves are alike as both are subjected to high tidal amplitude fluctuations (9m and more), but are different in that the former is exposed to highly saline waters, arid conditions and a rather steep coastal gradient, while in the Sundarbans the salinity is low and the coastal gradient is gentle enabling the mangrove forest to extend over hundreds of kilometers in land up to the high reaches of the higher tides. The Kerala or the Tamilnadu mangroves, exposed to small amplitude tidal fluctuations, would probably have been similar in the past, and would have remained so had they not been exposed to a totally different type of human impact. In Kerala mangroves were converted to a large extent to a mixed silvi-agri-aquacultural complex system and used as waterways, but were either felled or used for firewood, building material or for tannin.

Throughout India, including the islands, mangroves should be managed as high productive ecosystems and should be regarded as life sustaining silvi - agri - aquacultural complexe as has been empirically done and practiced for many centuries in most parts of the world. The details of management and practices, however, should vary from place to place according to the local ecological constraints. Except for the traditional methods exemplified by the Cochin backwater system where the mangroves were almost totally converted into a multiple use system and only pockets were kept for their other useful roles, interference since the last century has been mainly of a destructive nature [2]. Thus, much has been lost. This should be recuperated by artificial replanting of mangroves, using the right species at the right places.

The application of scientific knowledge, coupled with socio-economic considerations, provides planners with a solid basis for the management of the coastal systems where the mangroves are one of the important life-sustaining ecosystems. The international scientific community can play an important role in the efforts to contain global mangrove destruction. When compared with other research sectors, brackish water wetlands receive only modest scientific interest, and it was only two decades ago that research into the ecological functions and food webs in the mangle began. To summarize, stringent management plans are needed. Such plans, devised as integrated approaches and able to tackle the issues from deferent angles, are seen as the basis for re-establishing or sustainable using mangrove wetlands [2]. To meet these ends, eleven practical elements have been identified: stop all deforestation of mangroves; provide alternatives to mangrove fuel wood for cooking needs (for instance, kerosene or gobargas); proper land-use planning; comprehensive inventory of the natural resources; innovative research programmes; public education (awareness building) and training; creation of an adequate legislative base and institutional arrangements; restoration of damaged mangrove forest areas; introduction of social forestry schemes; appropriate technical assistance (particularly in brackish water aquaculture) and creation of nature reserves.

There will be a higher level of production on a sustained yield basis without causing ecological degradation it above strategies are followed. The aim is, of course, an ecologically sustainable economic development or eco -economic -development. Further, a long-term utilization of mangrove is only possible if one takes the ecological, economic and socio-cultural functions of these systems into consideration.

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