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REVIEW ARTICLE

Physico – Chemical Properties of Mangrove Region: A Review

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ABSTRACT

Water pollution may be defined as the "alternation of physial and biological properties of water or any addition of foreign material and the natural water which may have harmful effect on living beings, human agricultural system and other biological aspects, either directly or indirectly or immediately or after sometimes or after a very long period". Among the several characteristics of water quality the most important factors such as temperature, pH, dissolved oxygen, electrical conductivity, total dissolved solids, biological oxygen demand, chemical oxygen demand and nutrients, like phosphate, silicate, nitrate and nitrites, ammonia etc., and heavy metals *viz*., copper, chromium, cadmium, lead, zinc, manganese and iron will play an important role in the life of aquatic organisms.

Key words: Water, Mangroves, Physico – chemical properties and Pollution.

1. INTRODUCTION

Water is the driver of nature and best of all things. Water is a "Cradle of Life" on which all organisms play. Next to air water is one of the natural resources for life and it is likely to become a critical scarce resource in further. The total life of the world depends on water and hence the hydrological study is very much essential to understand the relationship between its different tropic levels and food webs. Wetlands are one of the most useful natural resource systems, and are "essential life" support system. They play a vital role in controlling water cycles and cleaning the coastal environment and also they are open ecosystem which is sustained by the flow of energy and nutrients (e.g. fresh water delivery and tidal flow) from the neighboring marine and land systems and in turn influences them. The tidal forest is used as a synonym of mangroves [1]. Moreover, the mangrove forest provides to human resources such as fuel, building materials for house, boats and fishing equipment, food stuffs such as fish, mussels, leaf vegetables, honey, sugar, vintage and alcoholic drinks and traditional medical remedies [2].

Before using a resource, people usually ask what it is worth, and how its value can be determined. To come straight to the point, despite numerous attempts, so far nobody has succeeded in putting a financial value on mangrove forests which would be accepted by all who have vested interests in this system. This is not surprising when one considers the wide range of ecological, economical and cultural values provided by this habitat. However, with this anthropocentric way of viewing things we often run the risk of high handedly over estimating our role as users and consumers of a natural system. It is an extremely one-sided approach to evaluate natural goods solely on their marketability. All too often in our industrial culture, we tend to apply value scale to natural resources and products which do not take adequate account of their true importance in the country of their origin. There, market value is essentially determined by the users themselves, depending exclusively on the availability and cost of procuring these goods.

Environmental factors such as tidal range, soil and freshwater input, do influence the diversity and productivity of mangrove ecosystems. The mangrove environments provide living space for a dependent biota of more than two thousand species of flora and fauna of resident, semi resident or migratory mode of life. The uniqueness of the mangrove also lies with the low species diversity but richness of individual species. It is the concentration of individual species rather than their diversity, which characterizes the mangrove [3].

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Low diversity is attributed to the generally severe climatic and environmental conditions with the limited range of suitable habitats and niches. The primary food source for aquatic organisms occurs in the form of particulate organic matter (detritus) derived chiefly from the decomposition of mangrove litter fall. Dissolved organic compounds of mangrove origin are an additional source of nutrition. The predators feed on the detritus feeders, which in turn form an important food source for both aquatic as well as terrestrial animals. Faunal assemblage of mangrove includes insects, crustaceans, molluscs, fishes, snakes, crocodiles, birds and mammals. Temperature, salinity, tides, rainfall, winds etc. are the major environmental factors, which influences the functions and stability of the mangrove ecosystem [4].

India has a long coast line and exclusive economic zone (EEZ) with an area equivalent to two third of its land area [5]. The increasing demands of the growing population on the limited resources and the move towards heavy urbanization have lead to the exploitation of coastal and marine resources. Therefore it is necessary to keep abreast with the changing potential of the coastal zone due to the impact of human activities on the marine environment. Approximately major portion of the Tamil Nadu is broadly coastline. The 10,00km coast represents one sixth of the coast line of India. Marine fisheries are a significant source of income in this coast. Coastal environment is highly productive and economically important ecosystem. The oceans cover 71% of the earth's surface and provide maximum benefit to human beings [6]. Coastal zone region is an admixture of landmass, ocean and fresh aquatic environment. Coastal zone is considered to be highly productive through it constitutes a small surface (80%) of the marine realm of coastal water are largely governed by the seasonal and tidal cycles.

The mangroves have also significant roles in the maintenance of coastal water quality, reduction of the severity of coastal storms, waves and flood damage and as nursery and feeding grounds for fishery resources [7]. The water quality problems of the coastal environment are significantly different from those of the freshwater environment. The coastal water has undergone varying severity of the chemical changes due to human activities like terrestrial drainage, atmospheric deposition and urban discharges [8]. Coastal pollution has seriously affected the exploitable living resources reduction in coastal biological diversity, recreational and commercial uses and overall integrity of coastal ecosystem. Human activities have not only affected the exploitable living resources but have also caused a reduction in coastal biological diversity. These conditions imply, at present, that the coastal zone are either misused or overused.

Water quality monitoring is an important aspect of the overall water quality management and water resources development. A well planned and well managed water quality monitoring system is required to predict changes or trends of changes in the quality of a particular water body, so that creative and preventive measures can be taken to restore and maintain ecological balance in the water body [9]. However the objectives of water quality monitoring under different hydrological situation may be different.

Environmental pollution monitoring is essential at strategic point in natural water bodies, as well as in commercial and industrial locations [10]. In general, there are two types of monitoring (a) Biological monitoring and (b) Physico– chemical monitoring. Biological monitoring is based on the assessment of population of critical species that are sensitive to pollution; while physico – chemical monitoring is based on the actual measurement of physical parameters e.g pH, temp, rainfall, turbidly. Chemical parameters such as pesticides, insecticides and heavy metals, viz copper, zinc, cadmium, chromium, lead, iron, cobalt mercury etc [11]. Biological monitoring directly provides qualitative information with regards to the health chemical monitoring provides quantative information about the presence of pollutants in the natural water bodies. Physico – chemical monitoring is also provides stable information with regards to incoming undesirable effluents, which eventually indicate the possible source of such effluents. Biological monitoring does not provide any such hints.

2. TAXONOMY OF MANGROVES

Mangrove are not a single genetic group but representing a large variety of plant families that are adapted to tropical intertidal environments recognized three groups of mangrove sp. i) major mangrove species ii) minor mangrove species iii) mangrove associates. According to [12] the mangrove includes 34 species in 9 genera and 5 families. The minor species contribute 20 species in 11 genera and 11 families. Thus total of 54 mangrove species in 20 genera and 16 families are present globally. [13] on the other hand identified 69 mangrove species belonging to 26 genera in 20 families. One family fall in the fern division (polypodiophyla) the remainders are in the

magoliophyla (angiosperms). Families containing only mangroves are the *Agialitidaceace, Avicenniceae, Nypaceae and pellicieraceae*. Two orders (*Myrtales and Rhizophorales*) contain 25% of all mangrove families and 50% of all species by reconciling common features from [14] were recognized 65 species in 22 genera and 16 families.

Diversity of mangroves is extremely low as compared to that of tropical rainforest. Almost 40 species exist in Southeast Asia, 15 in Africa and 10 occur in America. There are 65 species of mangroves globeally, where as the rainforests of the mainly peninsula alone have about 800 flora species of vascular plants that include 2500 tree species. The east coast of India has a smooth and gradual slope which provides larger are 60% (2685 Km^2) for colonization of mangroves, where as th west coast has a steep and vatical slope that provides less area 25% (1123Km^2) for mangrove establishment, however, the extent of mangrove keeps on changing over a period in different states of the east coast and the Bay of Islands. The satellite data between 2003 and 2005 revealed considerable increase in mangrove cover in west Bengal and in Andaman and Nicobar Island (FSI, 2005).

3. DISTRIBUTION OF MANGROVES

Mangrove is the unique ecosystem with highly specialized, adapted vegetation types, distributed in the intertidal areas along tropical and Subtropical coastlines. In India the total area covered by mangroves is estimated as 6, 81,976 ha. Mangroves in India are distributed along east and west coasts of the mainland and in the Andaman and Nicobar Island. Mangroves in India account for 3% of the world's mangrove vegetation and they spread over an area of about 4500Km^2 along the coastal states/UTs of the country. Sundarbans in West Bengal accounts for a little less than half of the total area under mangroves in India. The FSI is assessing the mangroves using remote sensing since 1987 and the first assessment report showed the over an area of 4,046 Km^2. In 2003 assessment, the total mangrove area was 4,448 Sq.km. Only 26% of the total mangrove had very dense forests 37% had moderately dense forest and the remaining 37% was open areas with poor stand of mangroves (FSI, 2003).

In the year 2005 FSI assessment mangrove cover has been categorized into very dense mangrove (Canopy density of more than 70%), moderately dense mangroves (Canopy density between 40 and 70%) and open mangrove (canopy density between 10 and 40%). The assessment done in 2005 showed the mangrove cover in the country as 4445 Km^2, which was 0.14% of the country's total geographic area. The very dense mangrove was 1,629 Km^2 (3.6%) while open mangrove covered in an area of 1,669 Km^2 (37.6%). Compared with 2003 assessment, there was a marginal decrease of the Tsunami that hits Andaman and Nicobar Islands on 26 December 2004. Gujarat showed an increase in mangrove cover mainly because of plantation and protection. The deltaic mangrove on the east coast was about 60% (2605 Km^2), estuarine mangrove on the west coast 25% (1123 Km^2) and the insular mangrove in the Bay of Island (Andaman and Nicobar) an many tidal, estuaries, small rivers, Neritic islets and lagoons, accounting for 14% (637 Km^2) of the country's total area of mangroves. The sundarbans in west Bengal forms the largest block of mangroves of the world taken together with Bangladesh. It covers an area of 2110 sq Km^2. The Sundarbans is familiar for its richness and diversity of mangrove vegetation with dominant species *Avicennia sp. Rhizophora apticulata, R. mucronate* etc [15]. Andaman and Nicobar islands harbour a rich diversity of mangroves. It is located in the northeast Indian Ocean, occupay 637sq Km^2 of mangrove cover.

In Tamil Nadu mangrove exists on the Cauvery deltaic area. The total mangrove area available in the state is around 35 sq Km. A Pichavaram mangrove that extends between the Vellar and Coleroon estuaries spreads over an area of 7 sq Km. Pichavaram is well developed mangrove forest the dominant species here are *Rhizophora* species. *Avicennia marina, Exocecuari agallocha, Ceriops decandra*. Mangrove also occurs in Muthupet, Vedaranyam point calimere, Chatram and Tuticorin area the dominant species here in *Avicennia marina* and a good mangroves is available in the Gulf of Mannar where the dominant species in *Rhizophora sp.* In the impact of restoration of the degradation of Pichavaram wetland has been analyzed by comparing T. M digital data of 1986 (before restoration) and Liss-3.digital of 2002 (after restoration) the analysis indicated that the mangrove cover has increased by about 90% [16].

4. CONSERVATION AND MANAGEMENT OF MANGROVES

Mangrove ecosystem are under threat due to various factors such as Urbanization, industrial development, aquaculture, extraction of fuel wood, over exploitation of fishery resource, tourism, diversion, of freshwater flow and natural

calamities. An urgent and well planned programme, like mass awareness programme an eco-development and campaign for the protection of the mangrove species of Achara creek are needed for the conservation and protection of the natural resources for the sustained utilization. Rural people should be educated about Conservation activities. In the north stands of mangroves had 5 associated villages, 2 on the coast and 3 behind the mangrove. The villages on the coast were completely destroyed, where those behind the mangrove, suffered no destruction even through the waves damaged area unshielded by vegetation north and south of these villages. Large scale destruction of mangroves for fuel and development activities, deforestation along the coastal region and its consequent soil erosion, sand mining, encroachment, tourism, trawlers increase use of pesticides for agriculture and extensive bleaching have affected the island ecosystem [17].

Impact of Indian Ocean Tsunami 2004 it has been suggested, that suitable plant species for use of bioshaild between human inhabitation and the sea [18]. Nearly 80% at the coastal wetlands has been destroyed due to the industrial revolution; these impacts are likely to continue and worsen as human populations expand further into the coastal areas. Dredging for private port activities oil and chemical spillage from existing ports and industries, illegal traveling and grazing are the few threats faced by the mangrove revering timely intervention. Solid waste pollution by tourists and felling of trees by villagers are the likely thread to the mangroves in Davbagh creek at Kali estuary near, Karnataka. In view at its closeness to the town, presence at Jungle resort that attracts tourists from India and abroad due to the presence at scenically unique creek, the area has to declare as mangroves Bio-Reserve [19].

Coringa mangrove region in Andhra prasadash is a complex estuarine system, which has been adversely affected by urbanization and industrialization. The circulation pattern showed that the pollulated released to the canals are not flushed out completely, but tend to accumulate in the southern part at the bay where mangroves are located [20]. Rising population pressure has related in serious environmental and socio-economic crises in Indian coastal cities. The impact anthropogenic activities on coastal resources, such as mangroves coral reefs, sea grasses and fishery resources have been illustrated.

Considered as a region where mangrove ecosystems have been under serious threat due to both biotic and abiotic factors. However in many places in and around Mumbai, habitat Conditions are still capable of supporting mangroves. Present status and conservation strategies of mangroves in Mahanadi and Godavari- Krishna Delta in the eastern ghat regions have been studied [21]. A total of 97 major estuaries, 34 major lagoons, 31 mangroves areas and 5 Coral reef areas have been mapped and identified in India for conservation and sustainable use [22]. Conservation and preservation of bioresources at Bhitarkanika mangroves ecosystem in Orissa have been discussed.

The need to educate the fisherwomen and youth of fishing community is regarding the importance of Corals and mangroves are imperative. Eco-tourism potential of mangrove swamps of Goa has been analyzed by [23]. Mangrove of Thane district has been destroyed due to lack of awareness and poor political will. It was felt necessary to educate common man and to convince them about the importance of mangroves. Further replantation of mangroves was felt necessary which can be achieved through collaborative efforts of Govt. and non-Govt. organizations [24]. The tremendous pressure on the mangrove ecosystem- of Sundarbans due to collection of firewood during dry fish trade in winter as well as by the crab catchers round the year was investigated and analyzed.

The Sundarbans is inhabited largely by poor people. About 50% of people survive below poverty level described the status of the mangroves ecosystem a lay the inclusion Ocean region in terms of climatology and biodiversity. Application of GIS and remote sensing in management of mangrove ecosystem has been documented [25]. Such as Liss-II, Liss-III, SPOT-MLA and ERS-SAR. It was concluded the IRS IC/ID data used as merged product can be used for preparation of CRZ maps with desired accuracy [26].

5. PHYSICO-CHEMICAL AND NUTRIENTS IN WATER

Hydrobiological investigations in the Bay of Bengal along the Tamil Nadu Coast were made extensively by several earlier workers. [27] studied the distribution and seasonal variation of temperature and salinity in Cochin back waters. [28] studied the physico-chemical characteristics in the coastal environment of visakhapattinam and form their study the concluded that the harbor water and polluted with nutrients and organic matter. [29] studied the diurnal variation in physico-chemical and primary production in

Kakinada Coast of Andhra Pradesh. [30] studied the distribution of phytoplankton in relation to physico-chemical parameters in the west coast of India. Seasonal variation of certain hydrographical parameters like temperature, salinity, transparency and nutrients was studied in the Visakhapattinam Coast. [31] made some observation on the seasonal variation of different physico-chemical parameters of the South East of India.

The environment conditions such as topography, water movement and stratification, salinity, oxygen, temperature and nutrients, with several rivers draining a total catchment of $3.02x10^6$km and their estuarine, have water spread area of $2.7x10^4$km with 80% of mangroves recorded on the east coast and 20% on the west coast [32]. Mangrove forests are considered to be highly productive tropical ecosystem. It is a fact that the mangrove forests represent an important carbon and nutrient source to the adjacent lagoon and coastal systems. These mangroves have received considerable attention for floristic and faunal diversity [33].

Studied seasonal variation in physico chemical parameters of Kadalur coastal zone, Tamil Nadu. [34]worked on the physico-chemical characteristics of the fishing grounds on the West Coast of India. [35] studied the physico-chemical characteristics of the Vellore estuary, Southeast Coast of India. [36] studied the seasonal variation in salinity of Korapuzha estuary Kerala.

Mangrove ecosystems are diverse communities growing in the intertidal zones of tropical to subtropical coastal rivers, estuaries and bays. In mangroves coastal waters, factors related to water quality such as temperature, salinity, pH, dissolved oxygen, Total organic carbon and nutrients are particularly important for determining the biota and ecosystem functions [37]. The Coastal region microbial population higher due to the input of organic matter and nutrients from the continent. In the regions qualitative and quantitative changes in the environmental characteristics may occur and consequently due to anthropogenic influence the bacteria also changes. High levels of faecal indicator bacteria are a major cause of impairment of water bodies by [38]. Mangrove ecosystem provides an ideal nursery and breeding grounds to most of the marine and brackish water fish and shell fish [39]. The interstitial water chemistry and nutrients change in sediment of Gorai Creek in Mumbai. [40] studied the geochemistry of the Pichavaram mangrove sediments. [41] has explicated that the nutrients in sediments of Pichavaram Mangrove.

Nutrients Measurements in the German Bright and the Kettgat had studied by [42]. Seasonal distribution and behavior of nutrients in the Greek and coastal water of Gopalpur East coast of India was studied by [43]. Nutrients and heavy metals in the Coastal Water of Madras and Cuddlore were reported by [44]. [45] reported the release of soluble orthophosphate the most biologically available form of phosphate for aquatic microorganisms. [46] revealed that estuarine in China act as a source of nutrients and trace species to the ecosystems of adjacent shelf. Suspended Particulate Matter (SPM) is one of the main form in which various materials including nutrients, hydrophobic organic micro-pollutants and heavy metals are transferred from land to marine environment were reported by [47].

[48] observed that the nitrate variability along the oregan coast. [49] assessed the nutrients loading reduction in Danish streams, lakes and Coastal waters. [50] reported that the mineralization of organic matter in Coastal sediments of different frequency and duration of resuspension. [51] point out the increased utility of the secchi disc to assess eutrophication in Coastal waters with fresh water run-off. [52] analysed the characteristic of chlorophyll in the Sula Sea. [53] studies the nitrogen uptake by bacteria and phytoplankton in arctic maters. That the pH may coastal dinoflagellate bloom. The large portion of total organic carbon and dissolved organic carbon in the coastal and estuarine waters of Goa, might serve as an estuarine nutrients supplements for the phytoplankton at time of nitrate deficiency.

Mangrove ecosystem acts as a buffer between transitional nearshore and lagoon or estuarine environments with respect to their influence or freshwater discharge, salinity regime and adjustment aquatic system in general. Distributional of nutrients determines the fertility of potential water mass [54]. The seational variations of biotic and abiotic process affect the nutrient cycle of different coastal environments. Assessment of water resource quality from any region in an important aspect of the developmental activities of the region, because the rivers, lakes, and reservoirs are used for water supply to domestic, industrial, agricultural and fish culture.

The significance of mangrove in the estuarine and marine ecosystem are well established due to their Biological, ecological, socioeconomic values. The mangrove ecosystem perform many functions such as nutrients export, protection of coastal areas and as exporters of rich dissolved organic

matters, humic acids etc. They reduce the impact of cyclone storms by acting as an abstraction to sea advancements the high rates of productivity leads to the sustenance of coastal population act as a reservoir for salt tolerance halophytic plants besides inhabiting innumerable vertebrate and invertebrate fauna of diverse groups and there serve as the breeding, swamping and nursery grounds for wide array of both esturine and marine fauna [55].

The study of mangrove regions is necessary as they are highly productive and play an important role as breeding and nursery grounds for many commercially important fishes especially shrimps [56]. Good quality of water resource depends on a large number of physico-chemical parameters and magnitude and source of any pollution load and to assess that monitoring of these parameters is essential. Due to their inherent physical and chemical parameters, mangrove muds have an extraordinary capability to accumulate materials discharged to the shore environment.

Mangrove ecosystem exchange organic matter and energy with the adjustment marine and terrestrial ecosystem. However, they are found in different in their "energy Signature" or the sum of all forces, which ultimately dictate the types of organisms that will survive and the speed of ecological processes [57]. The magnitude and periodicities of forces such as tides, nutrients, hydro-period and stress such as cyclone, drough, salt accumulation and forest may largely determine the energy signature in mangrove realm and in its floristic and faunistic composition [58].

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