Thematics Journal of Geography

ISSN: 2277-2995
Vol-8-Issue-3-March-2019

A Study of Mangrove Ecosystem of Sundarbans, India.

Dr. Bharat Kumar
Assistant Professor in Geography
Agrasen Girls PG College, Bayana, Bharatpur (Raj.)

Abstract

Mangrove ecosystem, an unique, fragile, highly productive ecosystem in the sea- land interphase, is the conglomerations of plants, animals and microorganisms acclimatized in the fluctuating environment of tropical intertidal zone. This ecosystem is a highly valued ecosystem in terms of economy, environment and ecology. Mangrove ecosystem of Sundarbans, India, (between 210 32' – 220 40' north and between 880 85' – 890 00' east) a World Heritage Site, is a unique tidal wetland from the point of view of its biodiversity and ecology. This tidal dominated deltaic complex is the largest of its kind and covers an area of 1,000,000 ha of land and water, the major part (60%) of which is situated in Bangladesh while the remaining western portion (40%) lies within India. The mighty Indian river, the Ganges and its associated estuaries like Muriganga, Saptamukhi, Bidyadhari, Haribhanga, Matla, Thakuran etc open into the Bay of Bengal having a north – south direction of water flow. The silt and loam carried by these estuaries were deposited on the salt marsh eventually leading to the formation of mosaic of 102 deltaic islands of which 54 have been reclaimed for human habitation. A number of geomorphological and resultant hydrological changes have contributed for shapping and reshapping of this estuarine complex making it a very dynamic system. This ecosystem (representing worlds' one of the most productive ecosystem) harbours thousand of flora and fauna in its diversified habitats and niche. The biodiversity includes true mangrove plants (34 species) and their associate plant species (40), 150 species of algae,163 species of fungi, 32 species of lichen, 250 species of fishes, 7 species of amphibian, 59 species of reptiles, around 200 species of birds, 39 species of mammals, besides numerous species of phytoplankton, zooplankton, ichthyoplankton, benthos, soil inhabiting micro arthropods and mangrove plants dependant insects. Species composition, and their distributional pattern, population dynamics and community structure of different groups of fauna experience wide range of changes spatially and temporally because of the prevailing fluctuating environmental condition. Temperature, rainfall and tidal mixing mostly make this environment unstable with a wide range of variation of major ecological parameters like salinity, pH, dissolved oxygen, nutrients, turbidity etc. from east to west in different periods of year. This ecosystem maintains rural economy by providing timber, fuel wood, faunal resources like fishes, honey etc and protects coast from soil erosion, buffer cyclone, stormes etc, mitigates flood and maintain estuarine flow. However, the biodiversity and basic fabric of ecosystem functioning are being threatened because of several reasons like reclamation of deltaic island for human use, deforestation, erosion and unwanted accretion, salinity invasion, nonjudicious exploitation of fishes, floral and other faunal components, ecotourism, bioinvation and pollution. Further the impact of global climate change has aggreviated the problem. The

ISSN: 2277-2995
Vol-8-Issue-3-March-2019

paper discusses the biodiversity conservation strategies which are being adopted giving due importance to the success and failure of previous ones.

Key words: Mangrove Ecosystem, Sundarbans, Biodiversity, Deltaic Island, Conservation.

Introduction

The **Sundarbans** is a mangrove area in the delta formed by the confluence of Ganges, Brahmaputra and Meghna Rivers in the Bay of Bengal. It spans from the Hooghly River in India's state of West Bengal to the Baleswar River in Bangladesh. It comprises closed and open mangrove forests, agriculturally used land, mudflats and barren land, and is intersected by multiple tidal streams and channels. Four protected areas in the Sundarbans are enlisted as UNESCO World Heritage Sites, viz Sundarbans National Park, Sundarbans West, Sundarbans South and Sundarbans East Wildlife Sanctuaries.

The Sundarbans mangrove forest covers an area of about 10,000 km^2 (3,900 sq mi), of which forests in Bangladesh's Khulna Division extend over 6,017 km^2 (2,323 sq mi) and in West Bengal, they extend over 4,260 km^2 (1,640 sq mi) across the South 24 Parganas and North 24 Parganas districts. The most abundant tree species are sundri (*Heritiera fomes*) and gewa (*Excoecaria agallocha*). The forests provide habitat to 453 faunal wildlife, including 290 bird, 120 fish, 42 mammal, 35 reptile and eight amphibian species.

Despite a total ban on all killing or capture of wildlife other than fish and some invertebrates, it appears that there is a consistent pattern of depleted biodiversity or loss of species in the 20th century, and that the ecological quality of the forest is declining. The Directorate of Forest is responsible for the administration and management of Sundarban National Park in West Bengal. In Bangladesh, a Forest Circle was created in 1993 to preserve the forest, and Chief Conservators of Forests have been posted since. Despite preservation commitments from both Governments, the Sunderbans are under threat from both natural and human-made causes. In 2007, the landfall of Cyclone Sidr damaged around 40% of the Sundarbans. The forest is also suffering from increased salinity due to rising sea levels and reduced freshwater supply. Again in May 2009 Cyclone Aila devastated Sundarban with massive casualties. At least 100,000 people were affected by this cyclone. The proposed coal-fired Rampal power station situated 14 km (8.7 mi) north of the Sundarbans at Rampal Upazila of Bagerhat District in Khulna, Bangladesh, is anticipated to further damage this unique mangrove forest according to a 2016 report by UNESCO.

Sundarban is the single largest chunk of mangrove forest in the world. Formed at estuarine phase of the Ganges - Brahmaputra river system, the Sundarban ecosystem is unique in many respects. The area experiences a subtropical monsoon climate with the annual rainfall of about 1600-1800 mm and several cyclonic storms. This mangrove ecosystem of Indian subcontinent is well known not only for the aerial extent, but also for the species diversity. The biodiversity of Sundarban includes numerous species of phytoplankton, zooplankton, micro-organisms, benthic invertebrates, mollusks, amphibians and mammals. It is the only mangrove tiger land on the earth. It has been declared as a world heritage site by International Union for Conservation of Nature (1987). However, the landscape of the Sundarbans have changed remarkably due to neo-tectonic movement compounded with

ISSN: 2277-2995
Vol-8-Issue-3-March-2019

large scale human intervention from the beginning of last centaury, as a result several species have become extinct or are in very much threatened or degraded state. But any systematic approach towards studying the ecosystem dynamics of Sundarban has not been attempted so far.

Our work attempts to explore and understand the correlation between different components of Sundarban ecosystem. The study area is located in the reserved mangrove forest of Sundarbans within the 24-Parganas Forest Division. Herobhanga Forest Block, the northern-most block out of seven forest blocks covers over an area of about 200 km^2. Out of this, about 16 square kilometers of mangroves were lost due to encroachment and human intervention over a period of about last fifteen years. Total mangrove coverage in this block was 73.05 km^2 as per Survey of India topographic sheet (Surveyed in 1988-89) which was dwindled to 57.53 km^2 as deciphered through land use land cover study using remote sensing data of the year 2006 (IRS P-6, LISS-IV data). The entire loss of mangrove coverage was recorded on the northern side of the Bara Herobhanga Khal adjacent to the inhabited Jharkhali Island. In fact, out of nine Forest compartments present in Herobhanga Forest Block, compartment numbers 1 (one), 2 (two) and 3(three) have been completely reclaimed and converted into either aquaculture ponds or agricultural land. Effluents from these aquaculture ponds are disposed through another small creek into this Bara Hero Bhanga Khal (creek), thus acting as a point source contaminant into this mangrove ecosystem; while rain washings from the agriculture fields mix up with this Bara Hero Bhanga Khal as a non-point source of impure water. At the same time, this particular creek separates inhabited Jharkhali Island from the Herobhanga Forest, which is a dense mangrove forest having hardly any human intervention.

This creek also joins two mighty tidal rivers of Sundarbans, namely Matla River in the west and Bidya River in the east and plays an important agent for hydrodynamic set up of this area. Thus, this creek along which sampling and analysis of water was carried out in pre and post-monsoon time for one-year period represents both pristine environment along its south bank (the border with dense mangrove forest) and human interfered environment along its north bank (the border with inhabited Jharkhali Island). During different seasons of the year water quality was studied and the concentrations of the nutrients like ammonia, nitrite, silicate and phosphate was quantitated. Primary producers in this estuarine ecosystem was characterized and the dominant species was identified. Phytoplankton is good indicator of trophic states and many species of this community are sensitive to environmental changes. Their presence or absence from the community indicates changes in physio-chemical environment of the estuary. Seasonal distribution patterns of phytoplanktons and primary producers were investigated thoroughly accompanied with the bacterial abundance in the estuarine water. It was envisaged that analysis of different physico-chemical as well as microbial parameters of water samples along different points on both sides of this river might throw some light on the effect of human intervention on the Sundarban eco-system to make the study significant.

Physiography of Sundarbans Mangrove Ecosystem

ISSN: 2277-2995
Vol-8-Issue-3-March-2019

The Mangrove dominated estuarine networks represent the major feature of coastal environment of West Bengal. The Indian Sundarban having 102 deltaic islands, (42 virgin and 54 reclaimed) is located between 21^0 30' - 22^0 15'N & between 880 10' - 890 10' E mostly within South 24- Parganas Districts of the state of West Bengal (Fig.-1). This largest tidal wetland and only mangrove tiger land on the earth, declared by IUCN, 1997 as 'World's Heritage Site', represents a highly valued ecosystem in terms of economy, ecology and environment. It includes a Tiger Reserve (2585 km2 , 1970), 3 wild life sanctuaries (Lothian, 3,800 ha; 1948; Sojnekhali, 35,240 ha; 1960 and Holiday Island, 595 ha; 1976) and one National Park (1330 km2 ; 1972). However, the landscape of the Indian Sundarban has changed remarkably because of several natural and anthropological activities like land reclamation, drainage control, sediment control, protective measures against tidal flooding, neotectonic movement, international treaty on sharing of fresh water etc over past centuries. The cumulative effect of all those changes led to alter physicochemical properties of this ecosystem (salinity invasion, massive 4 shoreline erosion coupled with unwanted accretion, shifting of mudfats and sand dunes, increased turbidity, temperature, tidal amplitude and decreased transparency, nutrients, pH etc). Such changes have resulted to modification of species composition of biotic communities leading to the decline and loss of mangrove dependant detritivores, herbivores and other carnivores.

Global distribution of Mangroves

Mangrove has a world wide circumtropical distribution, the highest concentration being located in the IndoPacific region. The mangrove dominate almost 1/4th of worlds tropical coastline. The total mangrove area which spans 30 countries including varius islands nations is about 1,00,000 km2 (Annon, 2003). Global distribution of mangroves are determined by an array of interlinked and interdependent factors like edaphic factors (soil texture, nutrients and microbial load), geomorphologic factors (rate of sedimentation, stabilization of deposited sediments by flora and fauna in the process of deltaic island formation), physical factors (amplitude and intensity of tides, micro and macrotidal cycles, current of water , salinity and other water parameters) climatological conditions (rainfall, temperature etc) and biological factors (flora, fauna, and microbs). So far 69 vascular plant species of mangroves having several specific adaptations to thrive well in the rigorous and dynamic coastal marineestuarine environment have been documented (Blasco, 1975; Chapman, 1976; Kathiresen and Bingham,2001) These mangroves and their associated plant species support the life of a diversified form of other faunal components (crustacean, molluscs, polychaetes, finfishes etc), algal (benthic and planktons) and microbial diversities (Chaudhuri and Choudhury, 1994; Annon, 2003). Another 80 species of plants, both herbaceous, and woody, being recognized as mangrove associates have been recorded (Cannolly and Lee, 2007) and they do not have special adaptations for living in the intertidal environment. More than 41% of the world's mangrove occur in South and South east Asia of which Indonesia alone accounts for 23% (Gopal and Chauhan, 2006). A further 20% of the total mangrove area lies in Brazil,Australia and Nigeria (Spalding et al 1997). However, largest chunk of the world's mangrove occur in Ganga- Brahmaputra-Meghna Deltaic system of Sunderbans jointly shared by two countries - Bangladesh and India.

ISSN: 2277-2995
Vol-8-Issue-3-March-2019

Climate

Seasons are well defined in this coastal environment each with four months duration-premonsoon (March to June) with highest temperature (42oC) and almost no rainfall; monsoon (July to October) with high rainfall (2000 ml) and moderate temperature; and postmonsoon having lowest temperature (10 oC) with occasional rainfall. Winds blow with higher intensity diving May to September from south –east to south-west directions. During early phases of premonsoon (February to April), winds blow from the south and south-west. The postmonsoon (late October to January) experiences mainly clam period having winds flowing from north-west (Annon, 2003).

Soil quality

Most of the soils derived from alluvial deposits are a zonal with little or no profile development (Chaudhuri and Choudhury, 1994; Sarkar et al., 1999). Clay loam is the predominating soil type in the Sundarban, though silty and sandy loams also occur in many areas. Numerous tidal flats have been formed after the headwater flow through the deltaic distributaries of the River Ganga was silted up. The parent deposits are either rich in calcium or magnesium, or consist of half decomposed organic matter. The coastal soils are usually classified as saline, non-saline and alkali soils (Annon, 2003). Texture analysis of Sundarbans mangrove soils (Gupta, 1987) revealed that the soil was mainly silty-clay. The percentage of sand particles varied from 3.81% in Prentice island to 42.62% in Sagar island while that of silt-clay percentage varied from 57.65% in Sagar island to 94.96% in Prentice island. Water holding capacity on silt-clay soil is more (59.03% in Lothian island) than comparatively higher sandy soil (43.16% in Sagar island).regarding mangrove soil nutrient status, both the percentage of organic carbon (0.45% to 1.86%) and human carbon (0.04% to 0.24%) in surface layer were higher than those in subsurface due to the confinement of organic residues in this layer. Available N (85 ppm to 116.4ppm). P (10 ppm to 42 ppm) and K (331 ppm to 630 ppm), were present in appreciable amounts (Sahoo et al, 1985). pH of the mangrove soil varied from 6.5 to 8.1 (Gupta, 1987). Soil temperature, salinity, organic carbon and sand content were found to be higher during premonsoon, while available potassium, available nitrogen and available phosphorous were maximum during monsoon. The postmonsoon season was characterized in having lowest temperature, available phosphorous, available potassium, available nitrogen and moderate level of other parameters.

Conclusion

Although, significant measures have been taken up for the conservation of biodiversity of Sundarbans, an integrated action plan is required incorporating the outcome and recommendations of multidimensional researches undertaken during the last four decades. Based on these, proper guidelines are to be framed for future researchers on this globally important environmental sector so that Time Series Analysis and Long Trend Analysis on the natural and anthropogenic stress factors become possible. These will facilitate the process of pointing out problems more distinctly and remedial measures more effectively.

References

ISSN: 2277-2995
Vol-8-Issue-3-March-2019

1. Abele, L. G (1974) Species diversity of decapod crustaceans in marine habitats.

Ecology 55: 156-161

2. Alongi, D.M. (1990). Effect of mangrove detrital outwelling of nutrient regeneration and oxygen fluxes in coastal sediments of the Central Barrier Ruf Lagoon. Estuarine Coastal Shelf Science. 31 : 581-598.

3. Annon, (2013). Mangrove ecosystem: Biodiversity and its influence on the natural recruitment of selected commercially important finfish and shellfish species in fisheries. National Agricultural Technology Project (NATP). Indian Council of Agriculture Research (ICAR). Principal Investigator: George, J.P.; Co-PI: Chakraborty, S.K. and Damroy, S.N.: 1 – 514.

4. Banerjee, A. and Santra, S. C, 1999. Plankton composition and population density of the Sunderbans mangrove estuary of West Bengal (India). In: D.N.Guha Bakshi, P. Sanyal and K.R. Naskar (cds). Sunderbans Mangal. Naya Prokash Publication, Calcutta : 340-349.

5. Chakraborty S.K., Chaudhury ,A (2012 A) . Population ecology of fiddler crabs(Uca spp) of the mangrove estuarine complex of Sundarbans. India. Tropical Ecology 33(1) : 78-88

6. Chakraborty, S.K. (2015). Aquaculture potential of mangrove ecosystem of Sundarbans, India. Proceedings of Seminar on Fisheries - a multimillion dollar industry. AFI, Madras: 72-83.