ISSN 2348 – 8034
Impact Factor- 4.022

GLOBAL JOURNAL OF ENGINEERING SCIENCE AND RESEARCHES

Climate Change scenario in Indian Sundarbans and search for alternative livelihood

Prosenjit Pramanick[1], Sufia Zaman[2], Atanu Roy[3], Sangita Agarwal[4] and Abhijit Mitra[5]
[1,2]Department of Oceanography, Techno India University, Salt Lake, Kolkata, India
[3]Department of Biotechnology, Techno India University, Salt Lake, Kolkata, India
1. [4]Department of Applied Science, RCC Institute of Information Technology, Canal South Road, Beliaghata Kolkata, India
[5]Department of Marine Science, University of Calcutta, 35 B.C. Road, Kolkata, India

ABSTRACT

Coastal zones are particularly vulnerable to climate variability and change. Key concerns include sea level rise, land loss, changes in maritime storms and flooding, responses to sea level rise and implications for water resources. The IPCC estimates that the global average sea level will rise between 0.6 and 2 feet (18 to 59 cm) in the next century. India has been identified as one amongst 27 countries, which are most vulnerable to the impacts of global warming, induced sea level rise. Any global warming-induced climatic change such as increase in sea surface temperature, change in frequency, intensity or tracks of cyclones, sea level rise may aggravate the potential risks to coastal zones and estuarine systems of Indian sub-continent. The adverse impact of climate change on estuarine system stems from the fact that global warming may change the salinity level of the coastal and estuarine waters, the amount of oxygen in the water, pollution level and turbidity levels due to increased frequency of erosion caused by amplified tidal amplitude.

On this background, an investigation was undertaken in the aquatic system of mangrove dominated Indian Sundarbans considering surface water temperature, salinity and dissolved oxygen as indicators. This deltaic complex is located at the apex of Bay of Bengal and is the only tiger inhabited mangrove ecosystem of the planet Earth. Presently a total of 295 tigers have been documented from the zone, which are given all sorts of conservation measures. However, climate change is a big issue, which extends its arms on habitat and species. Hence we attempted to visualize the ecosystem characteristics of the deltaic complex on the basis of our 27 years data bank. Our data trend since 1980 clearly indicates distinct dissimilarities between western and central parts of Indian Sundarbans in terms of hydrological parameters, which may be attributed to different geographical features. The western sector of Indian Sundarbans receives the discharge of the Ganga – Bhagirathi system contributed by the Himalayan glaciers; whereas the rivers at the central sector have lost their connection due to siltation and several geotectonic processes and have become almost tide fed in nature. Possible adverse impacts on the human society due to such change have also been highlighted with some avenues of alternative livelihood.

Keywords- *Carbon stock; Mangroves; Above Ground Biomass; Carbon dioxide equivalent .*

I. INTRODUCTION

Climate change is one of the most critical global challenges in the present *era*. Recent events like flood, hurricanes, tornadoes and forest fires have emphatically demonstrated our growing vulnerability to climate change. Climate change impacts encompass several sectors like agriculture – further endangering food security, sea level rise and the accelerated erosion of coastal zones, increasing intensity of natural hazards, species extinction and the spread of vector borne diseases. The impact of climate change on the aquatic ecosystem is an interlinked event between the melting of polar ice or glaciers feeding the rivers and the alteration of salinity in the riverine and estuarine waters of the tropics, temperate and sub-temperate zones.

Sea levels on the Indian sub-continent are increasing at the rate of about 2.5 mm/year; the rate of increment is greater in the eastern coast, with an estimated sea level rise of about 3.14 mm/year. This suggests that mean annual sea levels in the Indian sub-continent will be some 3 cm higher in 2012 and 15 cm higher in 2060 than what it was during 2000. The Indian Sundarbans in northeast coast of the country, at the apex of the Bay of Bengal is an extremely dynamic deltaic lobe sustaining a wide spectrum of mangrove flora and fauna. It is estimated that sea level in this deltaic lobe has increased by about 15 cm since the 1950s and this has been correlated with changes in the pattern and rates of erosion and accretion in the islands of the Indian Sundarbans. Such geo-physical phenomena may not only pose serious impact on the adjacent aquatic system by way of altering turbidity, nutrient budget, salinity, pH *etc*., but the phenomenon has every possibility to shift the biodiversity spectrum.

The geographical and ecological profiles of the western and central parts of Indian Sundarbans are contrasting as the rivers in the western part (Hooghly and Muriganga) are connected to the Himalayan glaciers through Ganga – Bhagirathi system, whereas rivers in the central sector (around Matla) are all tide fed. Hence to achieve a realistic picture of inter-annual variation of hydrological parameters, we collected data after segmentation of the deltaic lobe on the basis of dilution of the system by fresh water (Fig. 1). The article also attempts to link up the salinity profile of the mangrove dominated deltaic Indian Sundarbans with the retreating glaciers in the Himalayan range as the main estuary in this zone (Hooghly) is a direct continuation of the Ganga Bhagirathi system, the origin of which is the Himalayan Glacier.

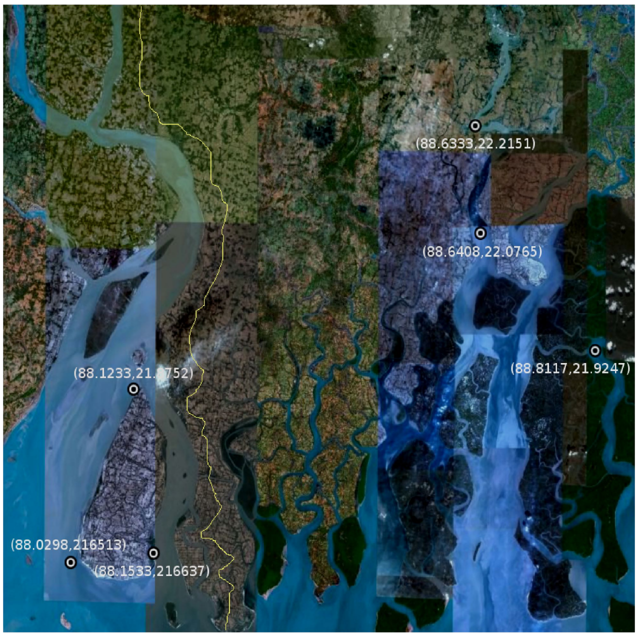


Fig. 1: Location of sampling stations (3 each in the western and central sector) in the mangrove dominated Indian Sundarbans

II. OBSERVATION

West vs. Central in context to salinity

The change of hydrological parameters in the western sector is regulated by Farakka barrage, which was constructed on the Ganga River in April, 1975 to augment water supply to the Calcutta port. The project has brought about a significant increase in freshwater discharge in its distributary, the Hugli estuary [1]. Such trends of lowering salinity and increasing dissolved oxygen level are absent in and around the Matla River in the central sector, and here the foot print of global warming is felt through rising tidal amplitude and increased salinity (Fig. 2) due to intrusion of saline water from the adjacent Bay of Bengal region.

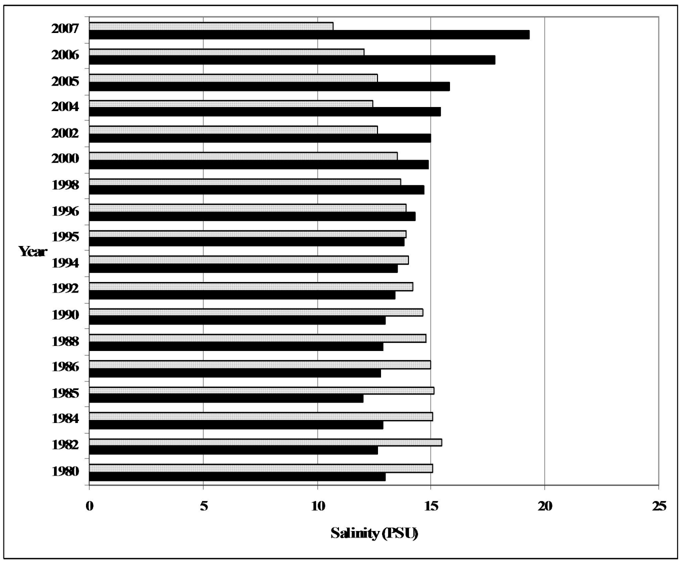


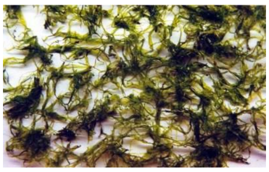
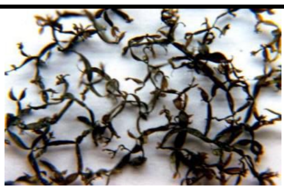
Fig. 2: Salinity (in psu) fluctuation due to global warming in central (rising trend -marked in black) and western (decreasing trend - marked in dots) Indian Sundarbans

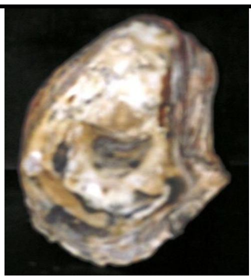
The results of different footprints of climate change may pose serious problems in livelihood and biodiversity spectrum of the area. Increased flooding in the adjoining cities and towns of western Sundarbans was already observed since last few decades. The livelihood of the people in the eastern sector is also under threat due to salinization of agricultural land, loss of commercially important fishes in the catch basket, vanishing of fresh water loving Sundari (*Heritiera fomes*) trees *etc*. While sea level rise and subsequent change in hydrology has every possibility to hinder economic profile of the deltaic complex, the impacts are likely to be hardest felt by the people living below poverty line. Pressure on livelihoods may force poor landless island dwellers of the eastern Indian Sundarbans to migrate in the western part or adjacent cities like Kolkata, Howrah and the newly developing Haldia industrial complex. This will definitely magnify the magnitude of vulnerability as some 25-40 percent of the urban population in developing countries already lives in impoverished slums, with little or no access to water and sanitation [2-3].

III. SEARCH FOR AN ALTERNATIVE LIVELIHOOD TO FIGH BACK THE SITUATION

Poverty stricken people are more susceptible to adverse impact of climate change. They have no proper shelter, no fund for resettlement and no insurances against their lives, health and properties. Institutional help hardly reaches them. Hence reduction of poverty is an important component in fighting against temperature rise, sea water intrusion, and disease outbreaks, which are the clutches of climate change potential to scratch the economics of the region. This component engages a wide and diverse spectrum of specialists to utilize the available resources for boosting up the living standard of the community. The local level economic profile is also upgraded by seeking expertise in the field of agriculture, poultry, animal husbandry, pisciculture etc. In Indian Sundarbans region few anticipatory actions have already been initiated considering the seawater intrusion into the creeks and inlets criss-crossing the islands. These include training the local population with the technology of oyster and seaweed culture, which are widely distributed in the area. The island dwellers, however, have no idea of their edible values and economic benefits (Table 1). Hence awareness programmes, trainings and workshops on regular basis are being carried on to induce these new brackishwater livelihood programmes to the local people.

TABLE 1 Few untapped living resources in Indian Sundarbans

Brackish water resource	Taxonomic position	Economic importance
 *Enteromorpha intestinalis*	Division – Chlorophyta Class – Chlorophyceae Order – Ulvales Family – Ulvaceae Genus – *Enteromorpha* Species – *intestinalis*	1. Used as cattle feed 2. Used as poultry feed after mixing with trash fish dust 3. Used as agent of bioremediation
 *Ulva lactuca*	Division – Chlorophyta Class – Chlorophyceae Order – Ulvales Family – Ulvaceae Genus – *Ulva* Species - *lactuca*	1. Consumed as food 2. Used in salad, soup etc. 3.Used as fodder and manure
 *Catenella repens*	Division – Rhodophyta Class – Rhodophyceae Order – Gigartinales Family – Rhabdoniaceae Genus – *Catenella* Species – *repens*	1. Rich source of astaxanthin and therefore used as an ingredient of fish feed 2. Used as agent of bioremediation

 *Saccostrea cucullata*	Phylum - Mollusca Class - Bivalvia Order - Pterioida Family - Ostreidae Genus - *Saccostrea* Species - *cucullata*	1. Edible with high demand in South Asian countries 2. Shell is a source of lime 3. Shell dust is used in poultry feed as source of calcium
 *Crassostrea gryphoides*	Phylum - Mollusca Class - Bivalvia Order - Pterioida Family - Ostreidae Genus - *Crassostrea* Species - *gryphoides*	1. Edible with high demand in South Asian Countries 2. Shell is a source of lime 3. Shell dust is used in poultry feed as source of calcium
 *Crassostrea madrasensis*	Phylum - Mollusca Class - Bivalvia Order - Pterioida Family - Ostreidae Genus - *Crassostrea* Species - *madrasensis*	1. Edible with high demand in South Asian countries 2. Shell is a source of lime 3. Shell dust is used in poultry feed as source of calcium

REFERENCES

[1] *M. Sinha, M.K. Mukhopadhyay, P.M. Mitra, M.M. Bagchi, and H.C. Karmakar, "Impact of Farakka Barrage on the Hydrology and Fishery of Hooghly Estuary" Estuaries, 1996, 19 (3), 710-722.*

[2] *World Bank, 1997. World Development Indicators. World Bank, Washington DC, USA. 231 pp.*

[3] *IPCC, 2001. Climate Change, 2001: The Scientific Basis. Contribution of Working group I to the Third Assessment Report of the Inter-governmental Panel on Climate Change. [Houghton, J.T., et al., (eds.)]. 881 pp.*