*Parana Journal of Science and Education (PJSE) – v.4, n.7, (24-28) October 25, 2018*
*ISSN: 2447-6153* *https://sites.google.com/site/pjsciencea*
*24*

# The Changing Trends of Climate in Context to Indian Sundarbans

**Sufia Zaman[1♯], Utpal Pal[1∏], Ricardo Gobato[2☼], Alekssander Gobato[3Ξ], Abhijit Mitra[4◊]**

[1]Department of Oceanography, Techno India University, Salt Lake Campus, Sector V, Kolkata 700091,West Bengal, India.
[2]Laboratory of Biophysics and Molecular Modeling Genesis, State Secretariat for Education of Parana, St. Rocha Pombo, 953, Bela Vista do Paraíso, Parana, 86130-000, Brazil.
[3]Seedling Growth Laboratory, Green Land Landscaping and Gardening, Bela V. do Paraíso, Paraná, Brazil.
[4]Department of Marine Science, University of Calcutta, 35 B. C Road, Kolkata, 700019, West Bengal, India.

**To cite this article:**

Sufia Zaman, Utpal Pal, Ricardo Gobato, Alekssander Gobato, Abhijit Mitra**,** "The Changing Trends of Climate in Context to Indian Sundarbans", *Parana Journal of Science and Education*, Vol. 4, No. 7, **2018**, pp. 24-28.

**Received**: October 14, 2018; **Accepted**: October 21, 2018; **Published**: October 25, 2018.

## Abstract

The effects of climate change on estuarine system is reflected through the changing salinity level of the coastal and estuarine waters, the concentration of dissolved oxygen in water, the levels of pollution and turbidity due to increased rate of erosion etc. In order to get a holistic picture of the climate change we had collected data from two different sectors of Indian Sundarbans (namely western and central sectors) on surface water temperature, salinity and dissolved oxygen for three decades (1980-2009). Our investigation reflects the rising trend of surface water temperatures in both the sectors reflecting the alarming trend of global warming in this part of the Indian sub-continent at the apex of Bay of Bengal. The scenario of salinity profile is conceptualized in two different ways due to variation in geographical features. The *ex situ* effect of Himalayan deglaciation is confirmed not only by decreasing trend of salinity in the western sector, but also through gradual increase of dissolved oxygen.

**Keywords**: Climate change, Temperature, Salinity, Dissolved Oxygen, Indian Sundarbans.

♯ E-mail: zamansufia123@gmail.com
∏ E-mail: mutpalpaul@gmail.com
☼ E-mail: ricardogobato@seed.pr.gov.br
Ξ E-mail: alekssandergobato@hotmail.com
◊ E-mail: abhijit_mitra@hotmail.com

## 1. Introduction

In the present *era* climate change is one of the most burning issues across the globe. Sea level rise, floods, landslides, earthquakes, cyclones and tornadoes are some of the catastrophes which are associated with climate change. Climate change directly and indirectly affects 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 [1]. Climate change has intense effect on the aquatic ecosystem and is an inter-linked 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. Climate change is a composite story of several functionally parallel ecosystems which cannot be analyzed with sporadic data [2] in a piece-meal manner. In this article, we have attempted to inter-link the phenomenon of Himalayan glacier retreat in the northernmost part of India with the salinity alteration of the inshore region of Bay of Bengal.

The effect of climate change on estuarine system is reflected through the changing salinity level of the coastal and estuarine waters, the concentration of dissolved oxygen in water, the levels of pollution and turbidity due to increased rate of erosion caused by amplified tidal amplitude [3].

Climate change is being experienced intensely in the mangrove dominated deltaic complex of Indian Sundarbans. Deglaciation of Gangotri glacier in the Himalayan range and several anthropogenic influences has accelerated the phenomenon since last few decades [4].

Considering surface water temperature, salinity and dissolved oxygen as indicators, a study was undertaken in the mangrove-dominated areas of Indian Sundarbans since 1980. This deltaic complex is located at the apex of Bay of Bengal and is the land of the Royal Bengal Tiger which is dominated by mangrove flora (some 34 true species in number). Our data trend since 1980 clearly indicates distinct dissimilarities between western and central sectors of Indian Sundarbans in terms of hydrological parameters [4]. Owing to varied geographical features in the western and central sectors of the deltaic complex, the foot prints of climate change were perceived in different pattern and scale. The western sector of Indian Sundarbans receives the discharge of Ganges through Farakka barrage - contributed by the Himalayan glaciers where as the rivers at the central sectors (like the Matla River) have lost their connection due to heavy siltation of the Bidyadhari River and several geotectonic phenomena [5].

## 2. Methodology

An integrated methodology is adopted to monitor the effect of climate change on the hydrological parameters of the deltaic and coastal Indian Sundarbans as it receives all the waters from the riverine sources and run-offs from adjacent landmasses. The salinity of the aquatic phase is governed by many physical, geographical, geological and even anthropogenic parameters. Salinity at the riverine outlets is often regulated by several factors like evapotranspiration, riverine discharge, siltation, discharges through barrages constructed in the upstream areas etc. The variation in salinity needs to be monitored by analyzing the parameters as stated above. The geographical scenario of the western and central parts of Indian Sundarbans is different as the rivers in the western part are connected to the Himalayan glaciers, whereas the rivers in the central sectors are all tide fed, Figure (1). In order to get a holistic picture of the climate change we had collected secondary data from two different sectors of the Indian Sundarbans (namely western and central sectors) in terms surface water temperature, salinity and dissolved oxygen [2, 4].

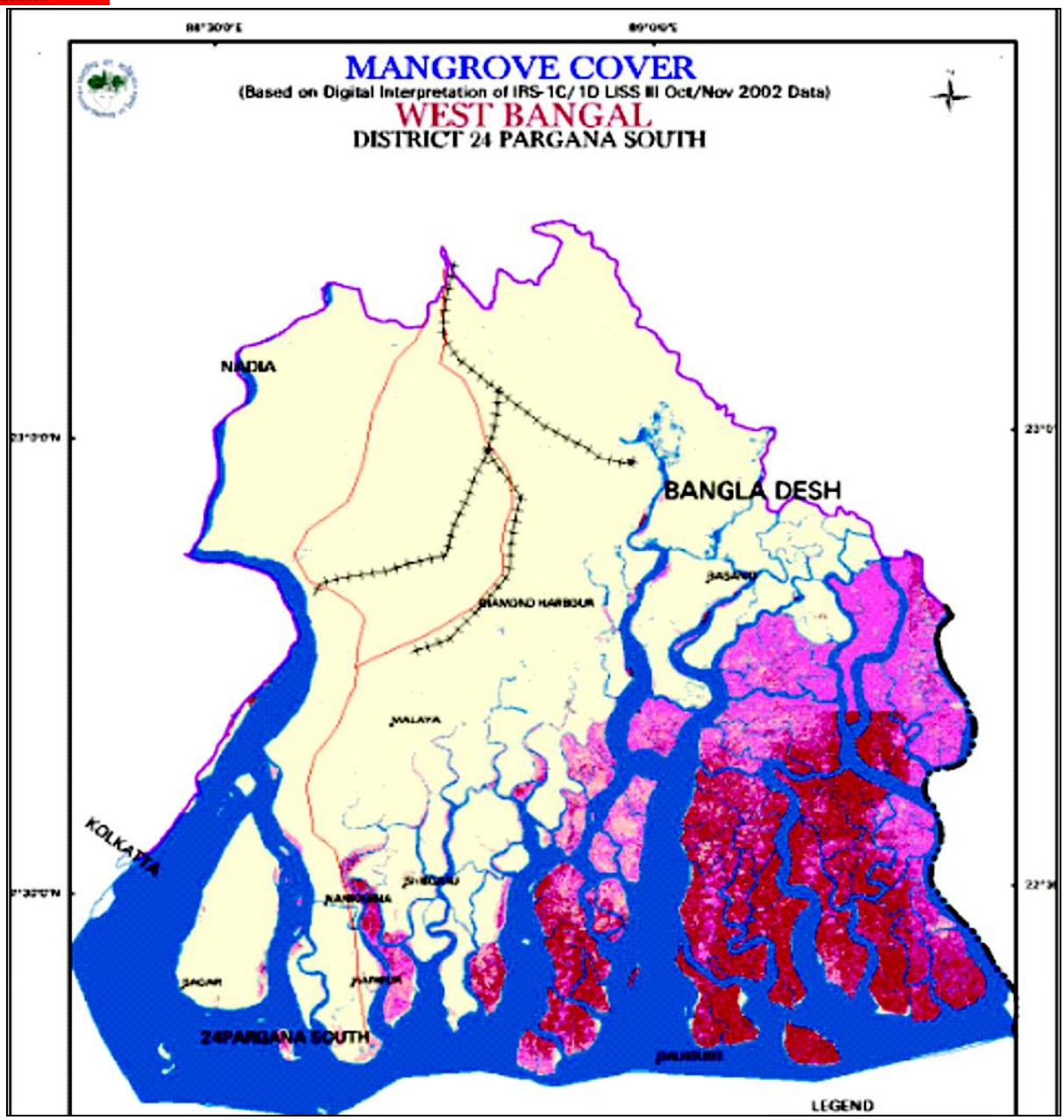


**Figure 1**. Indian Sundarbans. [6]

## 3. Results and Discussion

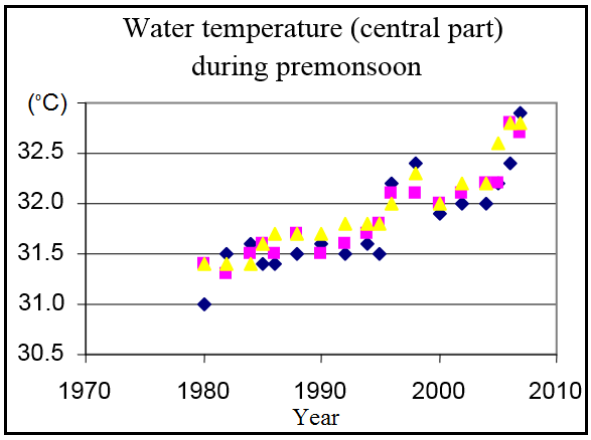


**Figure 2a**. Water temperature (ºC) × Year.

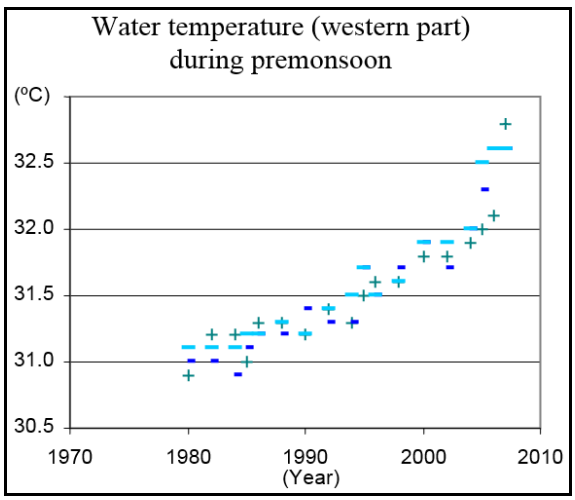


**Figure 2b**. Water temperature (ºC) × Year.

Figures (2a) and (2b) reflect the rising trends of surface water temperatures in both the sectors reflecting the alarming trend of global warming in this part of the Indian sub-continent at the apex of Bay of Bengal.

The scenario of salinity profile is conceptualized in two different ways due to variation in geographical features. The rivers in the western sector of Indian Sundarbans (Hugli and Mooriganga), connected to the River Ganges receives the snowmelt water of Himalaya after being regulated by the Farakka barrage. The impact of temperature rise has considerably affected the Himalayas. The 30.2 km-long Gangotri Glacier is receding very quickly: the rate of retreat in the last three decades has been found to be more than three times the rate during the earlier 200 years or so [7]. The average rate of recession has been evaluated by comparing the snout position on 1985 topo-sheet map and the 2001 satellite panchromatic satellite imagery and the results show the average recession for this period is about 23 m/year [8-10]. The pictorial plot based on historical evidences and data on Gangotri Glacier retreat in a research by Jeff Kargel, Geologist of USGS also supports the increased rate of retreat of the Gangotri [7].

The *ex situ* effect of Himalayan deglaciation is confirmed not only by decreasing trend of salinity in the western sector, but also through gradual increase of dissolved oxygen, as fresh water input accelerates the dissolved oxygen status of brackish water system. [3]

## 4. Conclusion

Biodiversity and livelihood of the present study area may be crucially affected by the changing foot prints of climate change. Increased rate of flooding in the adjoining cities and towns of western Sundarbans is already observed since last few decades. The gradual vanishing of the fresh water loving Sundari (*Heritiera fomes*) trees, loss of agricultural land due to salinization and the increase in the catch of trash fishes with loss of commercial fishes has affected the livelihood of the local people of the central sector of Indian Sundarbans. The island dwellers of the central sector of the Indian Sundarbans will be suffering from the adverse effect of deglaciation and subsequent change in hydrology as their livelihood will be greatly hampered. Pressure on livelihoods may force poor landless island dwellers of the central sector to migrate in the western part or adjacent cities like Kolkata, Howrah and the newly developing Haldia industrial complex. This will definitely intensify the magnitude of vulnerability as some 25 – 40 percent of the urban population in developing countries already live in impoverished slums, with little or no access to water and sanitation [11, 12]. It is, therefore, the need of the hour to incorporate the climate change related variables in the policy frame of the nation to develop a comprehensive management action plan to fight the battle against the changing climate.

## References

[1] H. T. Pandve, “India’s National Action Plan on Climate Change”, *Ind J of Occup and Environ Med.* April, 13(1):17-9. doi: 10.4103/0019-5278.50718, (**2009**).

[2] A. Mitra, S. Zaman, “Blue carbon reservoir of the blue planet”, published by *Springer*, ISBN 978-81-322-2106-7 (Springer DOI 10.1007/978-81-322-2107-4) (**2015**).

[3] A. Mitra, S. Zaman, “Basics of Marine and Estuarine Ecology”, *Springer*, ISBN 978-81-322-2705-2 (**2016**).

[4] S. Trivedi, S. Zaman, T. Ray Chaudhuri, P. Pramanick, P. Fazli, G. Amin, A. Mitra. “Inter-annual variation of salinity in Indian Sundarbans”, **2016**. *Ind J of Geo-Mar Sci*. 45(3), pp. 410-415, (March 2016).

[5] A. Mitra, S. Zaman, “Carbon Sequestration by Coastal Floral Community”, published by *The Energy and Resources Institute (TERI)* TERI Press, India, (**2014**).

[6] A. Mitra, “In: Sensitivity of Mangrove ecosystem to changing Climate”. *Springer* DOI: 10.1007/978-81-322-1509-7, pp. 323, (**2013**).

[7] J. Kargel, *USG*. URL. http://www.gsfc.nasa.gov/topstory/2002/20020530glaciers.html, **2002**.

[8] S. I. Hasnain, “Himalayan Glaciers: Hydrology and Hydrochemistry”, *Allied Publ*., Ltd., New Delhi (**1999**).

[9] S. I. Hasnain, "Status of the Glacier Research in the HKH region", *ICIMOD*, Kathmandu, Nepal, (**2001**).

[10] S. I. Hasnain, "Himalayan glaciers meltdown: impact on South Asian Rivers", *IAHS Pub*., No. 274, pp 1-7, (**2002**).

[11] World Bank, "World Development Indicators". *World Bank*, Washington DC, USA, 231 pp., (**1997**).

[12] IPCC, 2001b. "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., **2001**.