

# Climate Change and Its Impact on Biological Diversity of Indian Sundarban

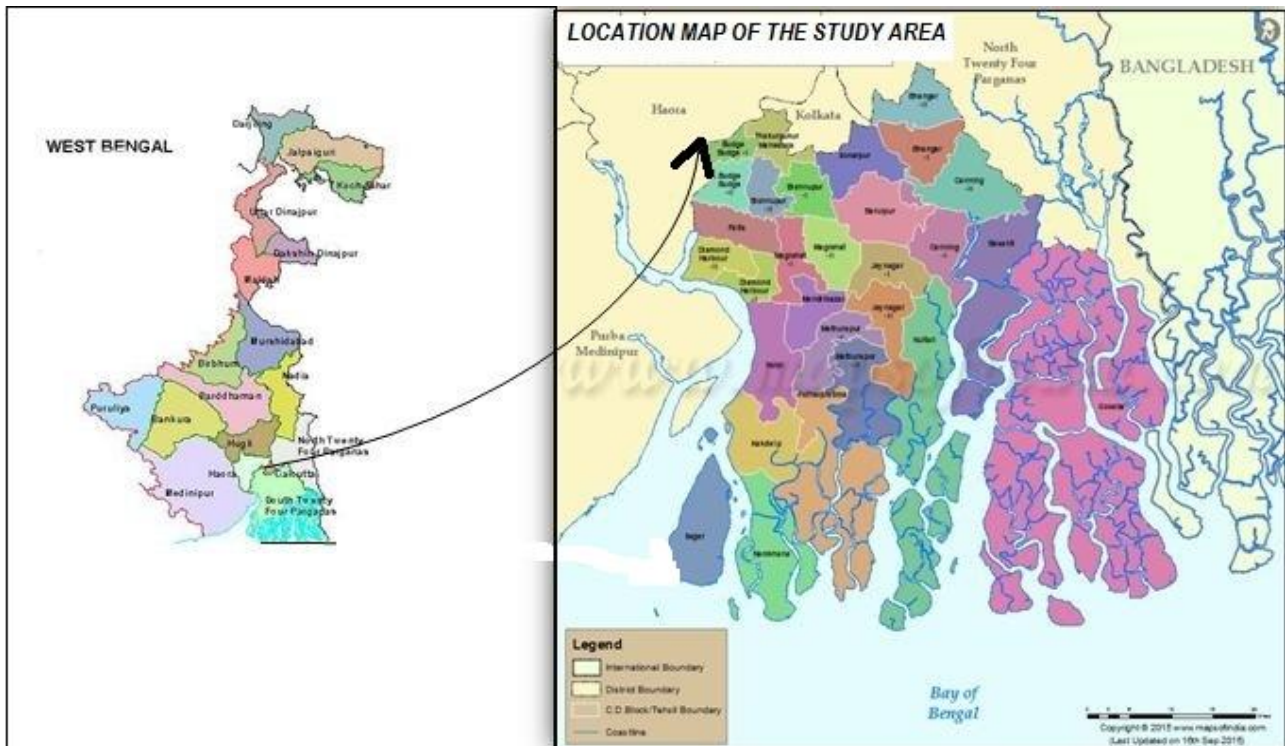
Srimanta Halder

Student Department of Geography, Calcutta University

**Abstract :** *The Sundarban is a vast forest in the coastal region of the Bay of Bengal which is one of the natural wonders of the world. The present paper is an attempt to analyse the climate change and its impact on biological diversity of Indian Sundarban. The total area of Indian Sundarban is about 9360 Sq.km comprising of 102 Island. In 1997, Sundarban was recognized as UNESCO world Heritage site. The highly specialized mangrove ecosystem supports rich biodiversity. Many floral and faunal species are highly endangered due to climatic changes and people activities. In terms of biodiversity, Sundarbans serves as an important refuge for several endangered and threatened mammals including the tiger, smooth coated otter, and great Indian Civet. The region also has several smaller predators such as jungle cat, fishing cat, and leopard. Continued emission of greenhouse gases will cause further warming and long lasting changes in all components of the climate system, increasing the likelihood of severe, pervasive and irreversible impacts for people and ecosystem.*

**Key words:** *Climate change, Biological diversity, Mangrove forest, Anthropogenic, Fauna.*

**[I] INTRODUCTION :** In the past century, the earth has warmed on an average by 0.76°C and the rate of warming is increasing. According to WMO, the year 2010, was the warmest year on record. The sea level is also rising, and it has almost doubled from 18 cm per century in 1961-2003 to 31 cm per century in 1993-2003. At India level, the annual mean temperature of the country for the period 1901-2009, as whole has risen by 0.56°C (IMD, 2010) and by 2050 the temperature may rise by 2° – 4°C (NAT Com, 2004). Climate change, as some of the studies suggest, may alter the distribution and quality of India’s natural resources, enhance water insecurity, enhance exposure to extreme weather events, and pose even biological diversity of India or Indian sundarban.



**STUDY AREA :** The Indian Sunderban at the apex of the Bay of Bengal (Between 21°13’ N to 22°40’ N latitude and 88°03’ to 89°07’ E longitude) is located on the southern fringe of the state of West Bengal. The Indian Sundarban Delta is part of active delta of the Ganga-Brahmaputra – Meghna Basin.

Sundarbans, shared between India and Bangladesh is home to one of the largest Mangrove forest in the world. The total area of Indian Sundarban is about 9360 sq.km comprising of 102 island of which the forest area is about 4263 Sq.km (Hazra, 2015). The region is bordered by Bangladesh in the east, Hooghly river in the west, Dampier and Hodges line in the north and bay of Bengal in the south. The forest area is further subdivided into two parts, a core area and a buffer area. The habitation area is subdivided into 19 community development blocks, in which 13 blocks area in south 24 parganas and 6 blocks in north 24 parganas district of West Bengal.

**[II] OBJECTIVE OF THE STUDY :** On account of a large number of inter related factors operating at the local, regional and global scales the anthropogenic pressures in Indian Sundarban are increasing. The present study has been under taken with the specific objectives which as following:

- a. To identify major anthropogenic pressures on the natural eco-system on Indian Sundarban.
- b. To determine nature and change of climate and its impact on biodiversity of Indian Sundarban.
- c. To know the major flora and fauna of Indian Sundarban.
- d. To suggest appropriate management of the study area.

**[III] METHODOLOGY :** This study is based on secondary data. Map and others data collected from the office Govt. of West Bengal. Literature review done by searching internet and from of the govt. of West Bengal and WWF. Indian Sundarban Delta, A Vision 2011 by WWF collected from the internet.

**[IV] RESULTS AND DISCUSSION :**

- **Physical Background of the study area :** The landscape is characterized by a web of tidal water system. The Indian Sundarban is criss – crossed by innumerable tidal rivers and creeks forming 102 Island.
- **Physiography and relief :** Indian Sundarban delta is a active portion of Gangetic Delta. The average tidal amplitude is between 3.5 – 5 metres with the highest amplitudes in July – August and the lowest in December – January. Topography is more or less flat.
- **Hydrology :** Hydrologically this area is very important to us. Many creeks which are locally known canal are developed in this region. Most of the river of Sundarban region carries enormous loads of sediment which is deposit at the confluence of river and sea also river bed. Important tidal rivers of Indian Sundarban is Hooghly, Muriganga, Spatamukhi etc. The following table gives an idea about important tidal rivers of Indian Sundarban.

**Table – 1 :** Important tidal rivers of Indian Sundarban

River	Description
Hooghly	It is the main river of West Bengal and is a direct continuation of the river Ganges.
Muriganga	It is a branch of Hooghly River.
Saptamukhi	It has origin at Sultanpur.
Thakuran	It begins near Joynagar in south 24 Parganas.
Matla	This river originates at the Bidyadhari, Khuratya and the Rampur Khal.
Bidyadhari	This was flourishing branch of the Bhagirathi during 15 <sup>th</sup> and 16 <sup>th</sup> Century.
Gosaba	It is another important river of Sundarban delta.
Harinbhanga	It is extreme eastern most river in the Indian Sundarban deltaic complex.

- **Climate :** The climate of the study area can be classified as hot and humid (AM). The climate of Indian Sundarban is generally smoothing and pleasant. The average mean monthly temperature of 19.3°C in January rises very rapidly to 31.5°C in the month of May.  
The highest maximum rainfall as well as maximum number of rainy days occurred in the month of July.
- **Soil :** The saline soils of Sundarban area are recognized by high plant mortality and often by white salt crust on the soil surface. Salinity of the soil varies with the season. The following table give an idea regarding the soil characteristics of the study area.

**Table – 2 :** Soil Characteristics

Soil Texture	: Silty clay (sand 10%, silt 51.2% and clay 38%)
Available potash	: 450 kg/ha
Available Phosphorus	: 22.5 Kg/nm
Organic Carbon	: 0.98%
Zinc	: 1.0 ppm
Boron	: 0.5 ppm

**Source :** central soil salinity research institute, Canning town.

The soil of this region is slightly acidic to slightly alkaline in reaction, the pH range varies in between 5.4 to 7.8. The parent deposit is rich in magnesium and calcium. The soil is mainly saline which is less productive.

**[B] Biodiversity of Indian Sundarban :** Biodiversity generally refers to the variety and variability of life on earth. According to the united nations Environment programe (UNEP), biodiversity typically measures variation at the genetic, the species, and the ecosystem level. Sundarban is very rich in biodiversity value, which is not yet fully explored. A total of over 96 species of mangroves and its associates have been recorded in Indian Sundarban of which 34 are true mangroves. A total over 1692



species has been recorded as faunal diversity of Sundarban of which 481 species belong to vertebrates and 1104 belong to invertebrates.

- Mangrove forests :** Mangroves and Mangrove associates constitute the dominant vegetation type of the area. These salt loving plants which are found throughout the tropical and subtropical regions of the world. Prain (1903) divided the entire Sunderban into three zones, namely [i] Southern coastal strip and south-western part consisting of mangrove species, [ii] central zones of *Heritiera fomes*; and [iii] north-eastern part of Savannah type vegetation. The Indian Sundarban falls in the first category.



The Sundarban flora is characterized by the abundance of Sundari, gewa, goran and keora all of which occur prominently throughout the area. There is abundance of dhundul or passur and kankra through distribution is discontinuous. Among palms, *Poreia*, *Coarctata*, *Myriostachya wightiana* and *Golpata*, and among grasses spear grass and *Khagra* are well distributed. As per Naskar and Mondal (1999) there are 40 species of major mangroves, 32 species of minor mangroves and 30 species of back mangroves and associates.

- Fauna :** Sundarbans forests, locally known as badabon, are one of the richest biodiversity hotspots in India. Kailash Chandra, Director of the zoological survey of India, Kolkata, says that “the information about the faunal diversity of Sundarbans was scattered, therefore, we took the initiative of documenting the organisms of Sundarban Biosphere reserve, which we have accomplished in this compendium”.



In addition to the famous tigers of these island, the compendium is full of hundreds of picture of the 50 mammalian species found in the region, including the Asian small clawed otter, civet, leopard cat, jackal, and Indian fox. Also included are 356

species of birds, including raptors like osprey, Brahminy Kite, and white bellied sea eagle, that occupy the highest canopies of the forest. The forest also harbors 11 species of turtles, 13 lizards, 37 snakes, 10 toads, more than 350 species of fishes, and 173 mollusks, which have adapted themselves to harsh environment.

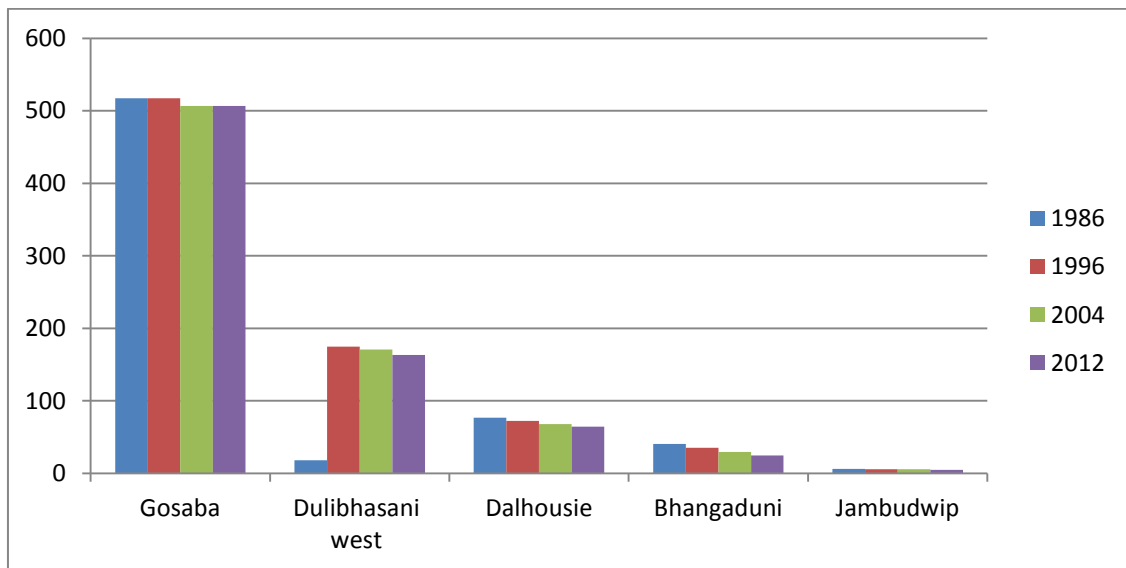
**[C] CLIMATE CHANGE :** Climate change will amplify risks and create new risks for natural and human system. Risks are unevenly distributed and are generally greater for disadvantaged people and communities in countries at all levels of development. Continued high emissions would lead to mostly negative impacts for biodiversity, ecosystem etc.

- **Increasing temperature :** Between 1980 and 2007, it has been observed that surface water temperature of Indian Sundarban has increased at an accelerated rate of .5°C per decade. Now, surface water temperature increase around 1.5°C and levels of salinity have posed a problem for the survival.
- **Precipitation :** A recent report of the IMD (2010, IMD) indicates that there is distinctive changes in observed pattern of rainfall between 1901 and 2003. West Bengal district handbooks indicate that there is an overall decrease in the total rain in 2008.
- **Climate change and its impact:** Sundarbans steadily losing its famed mangroves. Mangrove forest cover change in India Sundarban (1986-2012) issuing remote sensing and GIS, a publication by the school of oceanographic studies, Jadavpur University, reveals that from 1986 to 2012, 124.418 sq.km mangrove forest cover has been lost. The total forest cover of the Indian Sundarbans as assessed by remote sensing studies for the year 1986 was about 2246.839 Sq.km which gradually declined by 2201.41 sq.km in 1996, then down to 2168.914 sq.km in 2001 and to 2122.421 sq.km in 2012. The loss in the mangrove forest in the Indian Sundarbans is about 5.5%

**Table 3 :** Loss of forest cover over the years

Island	1986	1996	2004	2012
Gosaba	517.47	517.44	506.71	506.69
Dulibhasani west	180.03	174.78	170.90	163.47
Dalhousie	76.60	72.39	68.09	64.24
Bhangaduni	40.44	35.15	29.55	24.91
Jambudwip	6.09	5.91	5.68	5.003

**Loss of forest cover from 1986 to 2012**



**Source :** Mangrove forest cover changes in Indian Sundarban (1986-2012) using remote sensing and GIS, School of Oceanographic Studies, Jadavpur University.

**[D] Impacts on Biodiversity :** The Sundarbans ecosystem contains numerous species of microbes, algae, and lichens. A brief assessment of the biodiversity in the Indian Sundarbans is given in table. The matrix takes into account the ecosystem services provided by biodiversity groups. It also lists the role that each of the biodiversity groups play in the dynamics of the sundarbans ecosystem and the threats to each of these biodiversity groups.

**Table 4 :** Assessment of Biodiversity in Sundarbans

Sl. No.	Biodiversity Group	No. of Species	Threats
01.	Microbes	Bacteria : 34 genera Fungi : 5 genera Virus : 1 genera	[i] change in habitat
02.	Algae	270	[i] increase sea surface temperature and pollution
03.	Phyto-plankons	Diatoms : 76 Copepods : 52	[i] Rise in atmospheric CO <sub>2</sub> concentration
04.	Lichens	167	[i] impact of climate change
05.	Mangrove and Associated Flora	180	[i] sea level rise
06.	Protozoa	67	[i] change in sea surface temperature
07.	Mollusca	177	[ii] pollution
08.	Poly Chaetes	57	[i] Anthropogenic and climate change
09.	Xipho-surans	2	[i] change in shore line
10.	Crustacea	329	[i] destruction of habitat
11.	Spiders	114	[i] changes in the habitat structure
12.	Mites	121	[i] climate change
13.	Insects	497	[i] climatic variability
14.	Fish	364	[i] oil pollution
15.	Herpeto-fauna	Amphibia : 11 Reptiles : 71	[i] salinity increase
16.	Aves	234	[i] sea level rise [ii] climatic variability
17.	Mammals	47	[i] urbanisation [ii] Breaches in embankments due to flood.

Source : WWF report, IND, 2017

**Conclusion :** Understanding the historical records of sea level rise, sediment runoff, tectonic movement and anthropogenic factors are extremely important to analyse the pulse of climate change. A 2015 ethnographic study conducted by a team of researchers from Heiderberg University in Germany, found a crisis brewing in the Sunderbans. The study contended that poor planning on the part of the India government coupled with natural ecological changes were forcing the flight of human capital from the region.

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**Srimanta Halder**

Student, Department of Geography, Calcutta University  
Email ID : srimanta.harder5@gmail.com