

Livelihood changes due to climate changes in Sunderban, India-A case study

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1. Introduction

Sundarbans, the world's largest contiguous mangrove forest of India lies in the north-eastern shores. The area of Indian Sundarbans is about 9630 sq. km, of which 5,363 square kilometers is reclaimed area and the 4,267 square kilometers are protected mangrove forests. It comprises of 19 Community Development blocks of which 6 in North 24-Parganas and 13 in South 24-Parganas districts. Sandeshkhali I, Sandeshkhali II, Hingalgunj, Hasnabad, Haroa, Minakhan belong to North 24 Parganas Sagar, Namkhana, Kakdwip, Patharpratima, Kultali, Mathurapur I, Mathurapur II, Jaynagar I, Jaynagar II, Canning I, Canning II, Basanti and Gosaba belong to the South 24-Parganas. Out of 102 islands, 48 islands of the Indian Sundarbans are fostered while the remaining 54 are inhabited with varied population densities. The Sundarbans ecosystem is one of the most biologically protective and taxonomically diverse ecosystems of the Indian Sub-continent. This is the fact that reckless and random economic development affected the ecological balance which implies that the human activity at random with complete disregard to ecosystem hampers the ecological balance.

The risk to change the climate and frequency and severity of occurrence of extreme climate events pose. They might include a rise in sea level, salt water contamination, more storms and flood, and draught. In the past 35 years, sea level rose at a rate almost double the global average due to a combination of factors including land subsistence patterns. Besides, continuous submergence in higher water is the important reason for rise in sea level which affects the plants as these are shorter and narrower with fewer branches and leaves. This is also due to lower rates of photosynthesis (Mahadevia and Vikash, 2008). Thus the livelihood pattern of the people in Sundarbans has changed. In this study the livelihood pattern of the people will be discussed.

2. Objectives of the study

The objectives of the study are

- i) to look into the matter of climate change in this areas
- ii) to analyse the livelihood pattern of the people in Sunderban areas.

3. Methodology

The secondary data will be used to analyse the objectives. Sea level, temperature, severe of cyclone will be analysed. The census data (Census of India, 2001, Census of India, 2011) will also be used to analysed the livelihood pattern of the people in Sundarbans.

4. Analysis and Results

The analysis part of this study will be discussed into four sections. Section 4.1 analyses the change in temperature. The issue of sea level change will be discussed in section 4.2. Again, severity of cyclone in Sundarbans areas will be discussed in section 4.3. Section 4.4 analyses the livelihood pattern of the people in Sundarbans areas of 24 Pargana (North) and 24 Pargana (South) of West Bengal in India.

4.1 Change of Temperature

The temperature is an important indicator of the climate change. In Indian Sundarbans, the temperature changes in a regular basis. In the table below the change in temperature is shown during 2005-2009. The study found that the change in temperature during 2005-2009 varies from +1 to + 5. In fact, it varies during the year.

Table 1 Changing climate of Indian Sunderban

Month	Mean maximum Tem. (in degree) 2005	Mean maximum Tem. (in degree) 2009	Difference in degree during 2005-2009
January	26	28	+2
February	29	31	+2
March	32	34	+2
April	34	36	+2
May	35	35	0
June	35	35	0
July	32	32	0
August	33	33	0
September	28	33	+5
October	30	33	+3
November	30	31	+1
December	27	28	+1

Source: Environmental Information System. Department of Environment, Government of West Bengal, Government of India

The study found that the temperature of the waters in the Sundarbans has increased at an accelerated rate of 0.5°C per decade compared to the observed global sea surface temperature warming at the rate of 0.06°C per decade during 1980 to 2007. This accelerated increase in temperature of the sea has severe implications on aquatic life. This change greatly impacts the Sundarbans area as it is an estuarine delta.

Table 2 Decadal change in SST of Indian Sunderban

Year	SST (in degree C)	Decadal difference (in degree C)
1980	31.0	
1990	31.3	0.3
2000	31.8	0.5
2007	32.6	0.8

Source: Environmental Information System. Department of Environment, Government of West Bengal, Government of India

4.2 Sea level change

The sea level of Sundarbans changes in a continuous process. This is due to submergence in higher water. Again, the sea level rise is affecting the availability of sediment, directly impeding

the establishment of new groves. Studies suggest that in the last two decades, the run off in the eastern rivers of Sundarbans has decreased resulting in ever increasing salinity and sea water-sulfate concentrations. The decrease in fresh water run off has affected mangrove growth. Further, agriculture is being affected because of the high levels of salinity of the soils due to high tides, cyclones and storm surges, and problems of water stagnation, sometimes even beyond monsoon seasons. Human life and health could be threatened as well.

The relative mean sea level is rising 8 mm/year that was 3.14mm/year in the last decade. This is due to warming. Again, the result for the change in climate was net land area decreased by 5.9% during 1975-2006. Besides, mangrove forest area decreased by 19.3% and dense forest area is decreased by 50%.

4.3 Severity of Cyclones

Cyclones and super-Cyclones are quite a regular phenomenon along the eastern coast of India. It has been observed that there has been an increase in the intensity of cyclonic storms hitting the Sundarbans between 1951 and 2010. Recent research suggests that such increase in intensity may be attributed to an increase in sea surface temperature.

Table 3 Frequency of severe cyclone

Month	Year				
	2000	2003	2007	2008	2009
January					
February					
March					1
April				1	1
May		1	1		
June			1		
July					
August					
September					
October	1			1	
November			1		
December					

Source: Environmental Information System. Department of Environment, Government of West Bengal, Government of India

During the occurrence of Cyclone Aila in 2009, a 400 km stretch of embankment was breached and the waves crossed over the height of the embankment and entered the flood plains. Its effect on livelihood, more specifically on agriculture, is not quite the same in Sundarbans delta region compared to its other mainland counterparts.

4.4 Livelihood pattern

Sundarbans is a source of living for millions of people of the south western coastal region. The forest supplies timber, fuel, wood, pulpwood etc. The forest also supplies the thatching materials, honey, fish, crustacean and mollusk resources regularly. Most of the collectors were engaged in fish and fuel wood collection followed by crab, honey and golpata. Fuel wood collection becomes secondary occupation along with fishing or other activities. Poor access to energy services and the consequent lack of opportunities of the people living in the more remote islands is further magnified by a very high density of population. Land use policies prevailing in Sundarbans delta drives the socio-economic activity pattern and resultant impacts. In human civilization example of land use pattern changes, shift away from one activity (e.g forest to agriculture) to the other is so common that we often forget all the anthropogenic interventions those have happened so far to the natural systems.

According to the West Bengal Government, in 2009, the agricultural area had shrunk between 2002 and 2009 from 2,149.615 square kilometers to 1,691.246 square kilometers. The area suffers from a low intensity of cropping because mono cropping of rice is practiced seasonally, and horticultural crops are rarely grown. Further, only 12% of the cropped area in the Sundarbans is irrigated through rainfed ponds, tanks and canals; majority of the agricultural land is rain fed. It has been observed that rainfall has become erratic and its intensity has increased causing further damage to the agricultural yield. With continuous increase in population, agriculture production in the region is not able to meet demand. Historically, the main economic activity of rain-fed paddy agriculture was made possible by the construction of earthen embankments to keep brackish tidal water at bay and by cultivating salt-tolerant paddy varieties such as *Matla* and *Hamilton*. Such varieties could be cultivated on raised sections.

Table 4 Role of agriculture in economy of Indian Sundarbans

Name of block	Agricultural Labour 2009	Agricultural labour as % of total worker	Per capita cultivable land (hector)
Canning I	29369	37.1	0.07
Canning II	43863	73.9	0.08
Mathurapur I	22209	46.3	0.07
Mathurapur II	36698	62.5	0.09
Jaynagar I	42135	33.8	0.04
Jaynagar II	66004	54.1	0.07
Gosaba	63277	46.7	0.08
Basanti	21303	74.0	0.09
Kultali	40558	71.6	0.11
Kakdwip	44487	53.2	0.07
Namkhana	55683	63.8	0.11
Patharpratima	43895	65.8	0.13
Sagar	80887	73.9	0.09

Source: Rural and Panchayet Department, Government of West Bengal

Sundarbans is one of the most densely populated parts of India with a population density of about 929 persons/square kilometers in 2001, which has increased to 1,082 persons per square kilometers in 2011. With about 44 per cent of the population living below the poverty line and only one degree/technical college in every 250 square kilometers area, creation of alternate job opportunities to remove some of the biotic pressure off the Sundarbans is a distant dream. The economic profile of the local population dismally lags behind the national average. The per capita electricity consumption of the Sundarbans inhabiting Indian is one-fourteenth of the national average, majority of households do not have access to electricity and about 60 per cent of the households do not have access to clean drinking water. Only about 30 per cent of the families in live in *pucca or partially pucca* houses. About 87 per cent people in the area live with some sort of food shortage and healthcare infrastructure is in shambles. Approximately 33 percent of the population does not even have access to a primary health care. Coverage of institutional banking and insurance facility in Sundarbans is very low. Only about 10 per cent of the population avails institutional banking and there is no agriculture insurance. Absence of marketing and value addition infrastructure do not allow better price for whatever the agriculture, fishery and forest yield. This is especially important in light of the fact that 78 per cent of the

economy and 65 per cent of local workers are dependent on agriculture and there is an abject lack of any local industry.

During 1992 and 2001, the number of marginal labour jumped from 49,429 to 4.15lakh, an increase of almost 739% or over eight-folds. However, the number of main workers in these 10 years remained almost constant, or hardly changed from about 15.27 lakh in 1991 to 15.30 lakh in 2001. Besides, Sundarban is an important place for tourism and thus a large income generated from this areas are percolated among the rural people of Sundarbans (Hussain, 2014).

Table 5 Decadal transformation of worker in Indian Sundarbans (%) increase or decrease (2001-2011)

Block	Main worker		Marginal worker	
	Male	Female	Male	Female
Canning I	-7.5	3.7	9.4	4.2
Canning II	-9.2	1.3	7.8	6.1
Basanti	-10.0	1.2	10.4	2.9
Gosaba	-10.5	-0.9	13.3	3.8
Joynagar I	-4.7	4.1	7.1	3.1
Joynagar II	-5.2	3.2	8.5	8.0
Mathurapur I	-11.0	0.9	1.4	0.7
Mathurapur II	-6.5	1.7	3.2	3.2
Kultali	-6.4	1.6	2.1	4.4
Patharpratima	-4.7	5.6	5.9	11.0
Kakdwip	-7.0	2.0	3.2	6.2
Namkhana	-5.0	0.8	0.8	-5.22
Sagar	-5.8	2.9	3.4	19.3

Source: Census of India, 2001, Census of India, 2011

5. Conclusion

The study found that the people of Sundarbans are severely affected by climate change. They try to get job other way with the change of climate. However, they have no option to go with their earlier choice of agriculture in recent times. Besides, the landless people have chosen an alternate economic system for their livelihood. Again, collection of wood, honey, wax, and crab may be considered as a good option for survival.

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