

## RESEARCH ARTICLE

# ENVIRONMENTAL CHANGE AND STRUGGLE FOR EXISTENCE: A CASE STUDY OF PAKHIRALAYA AND RANGABELIA VILLAGE, GOSABA IN SUNDERBAN AREA OF WEST BENGAL

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### ABSTRACT

Sunderban is the largest space of tidal halophytic mangrove forest in the globe. It is a delta of the rivers Ganga, Brahmaputra and Meghna and located in West Bengal state of India and neighboring country of Bangladesh. The present paper deals with the changing nature of agro-climatic condition in Indian Sunderban and its effect on the economy of that region. Economy is such an indicator which determines the status of living. So the present paper will examine the basic character of traditional economy of Sunderban region, as well as, it also looks into the recent changes that occur in the economic composition of Indian Sunderban region due to this reason. The paper will give emphasis on the relation between the climate change and its impact on regional economy with special reference to Pakhiralaya and Rangabelia. Thus the paper will try to find out the changes in economic sector as a part of adaptation with changing environment.

**Key Words:** Environment, Climate change, Struggle for existence, Economy.

### INTRODUCTION

Sunderban is one of the dynamic ecosystems of the world, formed by interactions between land and water, and is considered as one of the most productive wetlands on earth. The studied villages belong to the Gosaba CD block of South 24 Paraganas. Pakhiralaya is a well known tourist place of present Sunderban and Rangabelia has awarded by Government of India as one of the ideal villages of our nation.

### MATERIALS AND METHODS

The present paper deals with the climate change in Pakhiralaya and Rangabelia village of Indian part of entire Sunderban and the changing nature of economy of that region. Economy is such an indicator which determines the status of living. So the present paper will examine the basic character of traditional economy of Sunderban region, as well as, it also looks into the recent changes that occur in the economic composition of Pakhiralaya and Rangabelia. At the same time, the paper will give emphasis on the relation between the climate change and its impact on ground level economy. Not only that, it will try to find out the changes in economic sectors as a part of adaptation with the changing environment. The present paper is based on an intensive field survey in those two villages. Near about fifty households of each villages are taken into consideration to collect the raw data. At the same time it also to be said that it is not possible to prepare such a paper without getting secondary data from different official document which has created the database of this present analysis.

On the basis of available statistical data, an intensive analysis has been done to represent the relationship between climatic change and its response to the economy of Pakhiralaya and Rangabelia.

#### Trend of Climatic Change

The climate of the whole world is changing gradually and Sunderban region is not the exceptional one. If we give stress on the general climatic characteristics of Sunderban, we can observe that the average temperature of the water surrounding Sunderban, gradually increases over the time. The increase in this sea surface temperature (SST) has been much higher than the global average. The SST in the Bay has increased at the rate of 0.5 degree C per decade since 1980. While the globally observed SST warming rate is 0.06 degree C per decade between 1970 and 1999, that for the Indian Ocean for the same is 0.2 degree C per decade (Chand B.K., Trivedi R.K., Dubey S.K., Beg M.M., Aquaculture in changing environment in Sunderban, West Bengal University of Animal and Fishery Science, 2012). In according to Indian Meteorological Department (2001), an increase in SST of 0.5 degree C in the eastern part of Sunderban. MIT said that the average temperature to have increased from 31.0C to 32.6 degree C between 1980 and 2007 in the pre-monsoon periods. Higher SST affects the process of evaporation, condensation, cloud formation and rate of precipitation etc. The following table shows that the average decadal change in SST is greater than half a degree in recent time in Indian Sunderban. At the same time it has also been observed that the average maximum monthly land mass temperature also denotes a positive trend in last decade, particularly from the month of September to April.

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The range varies from 2.0 degree to 5.0 degree for the span of 2005 to 2009 (Gupta S. and Sarkar G., Climate Change and Economic Adaptability of Indian Sunderban, 2014).

**Table 1. Decadal change in SST of Indian Sunderban**

Year	Sea Surface Temperature (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

\*data from IMD & calculated by authors

Sea level rise has also been higher than the global average in Sunderban. In according to School of Oceanographic Studies, JU, Kolkata an increase at 17.8 mm/year in sea level between 2000 and 2009. National Institute of Oceanography (2006) indicates an increase of 5.7 mm/year between the year 2000 and 2004. Earlier, during 1991 and 1999, sea level rise in that area was 3.14 mm/year. The current rate of sea level increase in Indian Sunderban is far higher than the global average rise in sea level which was in the range of 1.7 mm/year between 1870 and 2000 and 3.27 mm/year between 1993 and 2010. In according to the report of IMD, rate of rainfall has marked a sharp increase in rainy days as well as intensity of rain that enhance the risk of more frequent and disastrous cyclones in that region. At the same time it can also be observed that most of the severe cyclones take place in the span of April to June in recent years.

Severe cyclonic storms over the Bay of Bengal have registered a 26 per cent increase over the last 120 years, intensifying in the post-monsoon period. The intensity of storm has been increasing time to time. The decadal frequency of storms in the Bay of Bengal from 1891 to 1961 as per the 1964 records of the IMD indicates that 56 cyclones occurred during 1921-1930, while 32 storms were reported for the period 1951-1960.

**Table 3. Frequency of Cyclone in Recent Past in Studied Area**

Frequency of severe cyclone				
2000	2003	2007	2008	2009
1	1	3	2	2

\*data from IMD & calculated by authors

**Population growth of Study Area**

Before 19th century, Indian Sunderbans had no human population or habitation. In 1771, British collector general Clod Russell initiated a plan to divide the forest land into plots and lease them out to prospective landlords. At stake were timber and the collection of land revenue. These lease-holding landowners encouraged poor farming communities from other parts of Bengal as well as from neighbouring states to come and settle in the Sunderban. These people were put to work on clearing the forests and developing the land (Human development report, South 24 Parganas, 2009). The following table shows that the mean population density of the studied region is 906.4 persons/sq. km.

**Table 2. Changing Nature of Climatic Condition in Study Area**

Month	Mean maximum Tem.(in degree) 2005	Mean maximum Tem. (in degree) 2009	Difference in degree C from 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

\*data from IMD & calculated by authors

**Table 4. Population pressure on Indian Sunderban**

Name of block	Population 2001	% of population of Indian Sunderban	Area (in sq. km.)	Population density (Population/sq.km.)
Gosaba	222822	5.93	296.7	751
Total	3757356	100	4574.8	906.4

\*data from Census report 2001 & calculated by authors

**Table 5. Role of agriculture in economy of Indian Sunderban**

Name of block	Agricultural Labour 2009	Agricultural labour as % of total worker	Per capita cultivable land (hector)
Gosaba	63277	46.7	0.08
Pakhiralaya		48.45	
Rangabelia		39.74	

\*data from Human development report, South 24 Pgs, 2009 and Primary survey data

The studied villages belong to Gosaba block which holds the population density of 751 persons/sq. km.

### Economic Characteristics of Study Area

Most of the people of Indian Sunderban traditionally engaged themselves with the paddy cultivation. Aman cultivation is the mainstay of economy of the inhabitants of that region for a long span of time. There is a favourable condition of rice farming prevails in that region, that is why the local people choose this traditional option and have been enlisted themselves as the main worker of that region. If we give stress on the economic structure of that region, it has been found that agriculture plays as dominant economic feature for most of the development blocks. Basanti, Kultali, Sagar and Canning II are so significant in this case, as they hold more than 70% share as agricultural labour. So, it can be concluded that Indian Sunderban has been dominated by agriculture. 46.7 % of population are engaged with agriculture in case of studied Gosaba block and per capita land available for agriculture is 0.08 hector in Gosaba. The percentage of worker engaged with agriculture in villages Pakhiralaya and Rangabelia are 48.45 and 39.74 % in the year of 2012.

The following table represents the overall picture of paddy production of different blocks of Indian Sunderban. It can be observed that Gosaba is most productive block in this context.

**Table 6. Net cultivated land & Paddy productivity of Sunderban Blocks of Indian Sunderban**

Name of block	Paddy productivity (in tones/hector) 2009	Net cultivated area (in hector)2009	Name of block	Paddy productivity (in tones/hector) 2009	Net cultivated area (in hector) 2009
Canning I	1.72	15862	Gosaba	2.7	17000
Canning II	1.71	15847	Basanti	1.7	26151
Mathurapur I	1.6	11980	Kultali	1.9	19923
Mathurapur II	2.3	17878	Kakdwip	2.1	15973
Jaynagar I	2.0	9402	Namkhana	2.5	16910
Jaynagar II	1.6	15539	Patharpratima	2.3	36429
Sagar	2.2	17436			

\*Statistical handbook 2009, Human development report, N&S 24 pgs, 2009

The following table shows that the agriculture and agriculture related job is the mainstay of the people of Pakhiralaya and Rangabelia villages still now. Most of the population of Pakhiralaya and Rangabelia associated with agricultural land. A significant number of people have been lost their own productive land after Aila, 2009 due to higher salinity. But still now they are closely associated with the land for their livelihood. The people, who have lost their own land, work at paddy field as the land less daily agricultural labour. They have no option to choose any other alternative job for their livelihood. A few numbers of inhabitants have managed to shift from agriculture to the segment of fishing, which is also an important economic sector of that region. But at the same time it has also to be said that the sector of fishing has already been facing a problem due to high salinity of sweet water pond after Aila. The salinity level of those ponds has rose up by the storm surge during that time. Even the intensity of salinity has not yet under control after five years of Aila.

**Table 7. Economic structure of Pakhiralaya and Rangabelia, 2012**

Type of worker	Agricultural	Land less labour	Associated with fishing	Labour engaged with other activities
Pakhiralaya	48.45	15.46	7.23	28.86
Rangabelia	39.74	24.36	12.82	23.08

\*Primary data & calculated by authors

The production of food grain and fiber of the studied area has been decreasing gradually with time. If we give stress on paddy production, then it can be observed that there are three main type of paddy have been cultivated in that area, such as- Aus, Aman and Boro in which production rate of Boro paddy has been improved with time. At the same time the production of Aus and Aman paddy has been decreasing particularly in last decade.

### Climate Change and Effect on Local Inhabitants

Population increase with an uncontrolled manner in the studied region creates a complex situation day- by- days. It is not possible for a region to provide proper opportunity for such a growing population with sharp increase. At the same time it should take under consideration that the changing nature of climate creates more complex condition and creates challenge for the inhabitants to live. As we know that the sea level of the studied area gradually rises, it has been found that a number of islands are being disappeared and the others being degraded regularly with the rise of sea level. As example Jambudwip, Dhanchi, Dalhousie, Ghoramara, Mousuni exhibits the trend of gradual erosion and subsidence in the part of Indian Sunderban. Lohachara has completely been disappeared (Gupta S. and Sarkar G., Climate Change and Economic Adaptability of Indian Sunderban, 2014).

Thus a real difference has been made in landuse of Indian Sunderban. It has already been detected that the amount of agricultural land gradually decreasing as a result of landmass sinking and subsidence. The local inhabitants have been facing a real problem as most of the people are engaged with agricultural based economy. They have lost their land and became helpless. If we concentrate on the figure of the people who has no land, we can observe that a significant number of people have been lost their own land of agriculture due to sea level rise. Not only but also a significant number of farmers are unable to plough their agricultural field due to over salinity. The saline water of sea often enters into the agricultural field by overtopping the embankment in the time of severe cyclones. As a result, the productivity of land decreases sharply and paddy production of Indian Sunderban has been threaten by such climatic phenomena (Gupta S. and Sarkar G., Climate Change and Economic Adaptability of Indian Sunderban, 2014).

**Table 8. Temporal Variation of Paddy, Food Grain and Fiber production of Sunderban Blocks of South 24 Parganas**

Crop	2003-2004 (in tones)	2004-2005 (in tones)	2005-2006 (in tones)	2006-2007 (in tones)	2007-2008 (in tones)
Aus	34200	7100	6300	18200	1800
Aman	715500	721000	682000	662900	569100
Boro	219900	184200	157000	230000	225900
Paddy	969600	912300	845300	911100	796800
Food grains	981500	924500	856700	921400	812800
Fibers	53000	15800	22800	18200	10300

\*source-WBSMB

**Table 9. Transformation from Main to Marginal Labour in Gosaba**

Name of block	Year 1991				Year 2001			
	Main worker (in %)		Marginal worker (in%)		Main worker (in %)		Marginal worker (in %)	
	M	F	M	F	M	F	M	F
Gosaba	51.55	4.91	1.73	12.59	41.03	3.99	15.01	16.41

\*data from Human development report, South 24 Pgs, 2009

**Table 10. Decadal transformation of worker in Study Area**

Name of block	Increase or Decrease(1991-2001)			
	Main worker (in %)		Marginal worker (in %)	
	M	F	M	F
Gosaba	-10.5	-0.9	13.3	3.8

\*calculation done by authors

**Table 11. Poverty level of Study Area**

Name of block	% of BPL Household	Less than one Square meal a day (%)
Gosaba	38.0	15.42

\*data from Human development report, S 24 Pgs, 2009

Now people of Indian Sunderban have no option to go with their earlier choice of agriculture. They have to find some other way to get their job in their changing environment. So, a significant change should be observed in occupational pattern of those people. Sharp declines in the number of main workers signify that the poor inhabitants find no way to stay with their tradition of agriculture based economy and they have to shift to other economic sector for their survival. A parallel increase of marginal workers refer that the landless people have chosen an alternate economic system for their livelihood. Thus the main workers of Indian Sunderban have been converted into marginal workers with the changing nature of climate. The transformation from main to marginal worker is taken under consideration for the span of 1991 to 2001. The negative increase has been detected for the male main workers. It has been clearly noticed in case of Gosaba.

It is the only block for which main worker decreases for both section (male and female). At the same time it is also to be said that the percentage share has quickly been raised for the marginal workers for all the blocks of southern part of Indian Sunderban. Gosaba and Basanti are such two blocks in which the positive increase take place most rapidly for the segment of male marginal worker. At the same time the point also to be noted that the percentage share of female main workers slowly increases for the studied block, which means the local female population has been engaged themselves with the agricultural field and the male people leave their traditional occupation in the adverse situation and try to engage themselves with some other economic activity. In short, it can be concluded that the inhabitants of Indian Sunderban has been facing great difficulties to live with the identity of a farmer and has been experiencing the curse of poverty and insecurity (Gupta S. and Sarkar G., Climate Change and Economic Adaptability of Indian Sunderban, 2014).

The above table shows the spatial distribution of poverty or BPL percentage in studied block Gosaba of Indian Sunderban. It has been found that Gosaba has been suffering by poverty. 38 % of population of Gosaba block belongs to BPL category. It has also to be found that more than 15% of the poor people of Gosaba even to take their both end meals daily.

## Conclusion

The future existence of Pakhralaya and Rangabelia is completely depended by the changing climate of that region. Climate change is a dynamic and complex process which has been changing the basic economical structure of this mangrove kingdom. The paper gives stress on the relationship between the changing climate and change take place in economical composition. It has been observed by the primary survey and secondary information that the major portion of population of that two studied villages are still depending on their traditional agricultural based economic sector. They have to depend on that sector due to absence of other alternative job in that less developed region. As we all know that the level of development is not so satisfactory in the southern most part of West Bengal.

The unskilled people have to stay with vulnerable agriculture based economy in the form of disguised labour. Even some of them have already lost their small piece of land to make plough and converted themselves as landless agricultural labour in against of very small daily wage. So, the time has come for the inhabitants of Sunderban to take some adaptive measures to defend the challenge of changing environment. The second alternative option for which they have shown their preference in the adaptive environment is aquaculture. But now-a-days they have really been tested as the aquaculture farms have been affected by salinization.

The pH level of water has been changed and the commercial fish production also been disrupted by the severe cyclones or tidal boars. They have to go for something else, which is suitable and sustained in changing environment of Sunderban region. Collection of wood, honey, wax, and crab may be considered as a good alternative option. They should give stress on the indigenous species of paddy as well as fishes which are able to maintain their life cycle in such a changing environment where salinity is such a problem. Thus the monoculture of rice has been threatened in the Pakhiralaya and Rangabelia, as well as Gosaba now-a-days.

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