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Embankment breaching and its management in Gosaba and Basanti blocks of Sundarbans, West Bengal

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Abstract

The Sundarban is frequently associated with natural disasters especially hydro meteorological hazards like cyclones and storm surges. The settlements in the Sundarbans face the risk of tidal inundation by the complex network of the tidal creeks in the region. Besides tropical cyclones in the pre monsoon and post monsoon period frequently strike the area . During storms the winds with high speed not only damage the households and vegetation but also cause tidal floods. Embankments in Sundarbans have been a result of the premature reclamation. These embankments are the lifelines of people there as these have been built to protect the agricultural land from the inundation of water. However, at most of the places the embankments are earthen and of dilapidated state. This paper takes into account the condition of embankments in Gosaba and Basanti during and after Aila. The paper shows the vulnerable mouzas, mouzas affected by Aila and the vulnerable sites particularly along with the response of the people regarding the change in last five years. It also takes into account the vulnerability analyses and management options.

Introduction

Indian Sundarbans with a shore length of 130 km covers the area of south eastern part of North and South 24 Parganas with an area of 9630 sq km bounded between estuaries of river Hughli on the west to Raimongal-Ichamati in the east.

Topographically the region is a low lying flat alluvial plain, intersected by a large number of tidal rivers, estuaries, creeks and saltwater courses (Bagchi, 1944). In West Bengal Sundarbans mangrove swamps are restricted under reserve forest within 4264 sq km areas and the rest of the areas (5366 sq km) of early Sundarban has been reclaimed and inhabited by about 35 lakh people with a density of 652 persons per sq. km. The wide funnel shaped mouth of the rivers are being maintained by sea waves and destructive tidal currents which have produced an erosive transgression over the sub-aerial part (Paul A.K, 1995).

The climate of the area is seasonably wet and dry with predominant monsoon season. Average annual rainfall is over 160 cm. The dry spell of hot and humid summer (March, April and May) has the temperature ranging from 29°C – 38°C. During the summer especially in the month of April and May the area experiences thunderstorms known as Norwesters. The rainy season comprises of June, July, August and September. The monsoon in this part consists of a series of cyclonic depressions. Temperature in winter season (Dec – Feb) comes down to 12°C in January. The average wind speed during the South west monsoon varies from 30 – 50 km per hour. Relative humidity is high throughout the year but it becomes highest during monsoon period.

The soils are mostly saline. The salinity is the result of upward capillary movement of water from brackish ground water table located at a shallow depth (Bandyopadhyay B.K, Maji et al 2003). Besides saline tide water ingression contributes to the salt accumulation in soil. Soils in Sundarban are classified into a) Saline, b)Saline alkali, c) Non saline alkali and d) Degraded saline alkaline soil.

Mangroves and mangrove associated plants from the flora of the Sundarbans. The species diversity of mangroves is relatively poor and they all show

similarity in general occurrence and physiological adaptations. Species include Dhani grass, Avicennia, Sonneratia, Ceriops, Bruguiera, Excoecaria etc. Salt tolerant mangroves are physiologically halophytes with specialized adaptations like vertical pneumatophores, buttresses,cables with salt glands etc.

Study Area

The study area includes two CD blocks named Gosaba and Basanti of South 24 Parganas. The area is within 21°-22°16´N and 88°40´-89°20´E.Basanti is a community development block of South 24 Parganas district. The location of Basanti town is marked by 22°11´21˝N and 88°40´14˝E. Basanti is bounded by Matla and Bidyadhari rivers and inland creeks. Gosaba is a community development block of South 24 Parganas district. Its location is marked by latitude 22°10´N, 88°48´E. The village panchayats under it are Amtali, Bali I and II, Bipradaspur, Chotomollakhali, Gosaba, Kachukhali, Kumirmari, Lahiripur, Pathankhali, Radhanagar- Taranagar, Rangabelia, Satjelia and Sambhunagar. For convenience, Gosaba has been divided into six island units-

- Sambhunagar island unit (containing both Sambhunagar, Pathankhali and Bipradaspur).
- Kachukhali island unit (containing both Radhanagar-Taranagar, Chotomollakhali, Kachukhali and Rangabelia).
- Kumirmari island unit(containing Amtali and Kumirmari).
- Gosaba island unit.
- Satjelia island unit (containing Satjelia and Lahiripur).
- Bali island unit (consisting of Bali I and Bali II).

Objectives

The major objectives are to identify the island units of Gosaba block, to identify the impact of coastal environment on the embankment, to identify the types of embankment and embankment structure, to identify the sites of embankment breaching, to suggest the management options for the embankments, and to assess the role of mangrove vegetation with respect to the protection of embankments.

Methodology

Primary data was collected from field survey in the study area in the year 2010. Household survey was done as well as field photographs were taken. Secondary data was collected from CD block maps, district census handbook and village panchayat statistics. In the post field stage the data collected were tabulated and thematic maps were prepared and analysed.

Mechanism of Breaching

Human interference in the deltaic plain of West Bengal is the most important factor influencing natural processes.The premature reclamation of Sundarbans by embankments has led to the reduction of spill area of the rivers which deposit the sediments carried on the riverbed. This increases the height of the riverbeds at the cost of settled land which doesnot get the riverborne sediments leaving them more prone to get flooded. The Sundarban delta experiences two flood tides and two ebb tides in 24 hours. The tidal range varies from3 to 5m and may rise upto 8 m during normal spring tide. On an average cyclonic depressions hit the area every two or three years. This is concluded on the basis of the analysis of the records of incidence of tropical cyclones in Sundarban from 1582 to 1994(Human Resource Development Report, 2009,pg 216). The flood tide takes less time to enter while the low tide takes much time to leave. This increases deposition of sediments as in most cases another high tide encroaches prior to the complete setting of the first low tide. As tides are the primary source of flow and the creeks are separated from their upland sources of sweet fresh water, Sundarban faces an unique hydrogeomorphic consequences.

During the colonial period the maintenance of the embankments was done by the zamindars. After the abolition of the zamindari system Department of Irrigation and waterways(DIW) of the government of West Bengal took the responsibility of maintaining the embankments. Technologically the earthen embankments are weak as they are built with uncohesive soil found locally which cannot resist tidal surges for a long period. Secondly, improper drainage through the sluice gates in the Sundarbans cause serious problem of damage of earthen embankment (Status Report on the Progress of “Urgent Repair works in Sundarbans” in 2006, Department of irrigation and waterways). Sluice gates are placed in this area to drain out excess rainwater to prevent the crops from rainwater flooding. During heavy rains, sluice gates frequently become out of order. The inhabitants of the area are compelled to cut the embankment for draining excess water. Generally the portions of the embankments are not repaired timely and partly or non repaired embankments become vulnerable to tidal surges and wave action. Again population growth has led to widespread conversion of lands to aquaculture . For example Sambhunagar, Kachukhali, Chunakhali of Gosaba and Mondalgheri, Bagmara, Napitkhali and Hogolduri of Basanti block experience transformation from agriculture land to aquaculture. This transformation is due to higher productivity in aquaculture and nearness to market. To maintain the supply of saltwater in the bheries the owner dig channels in embankment which increases the possibility of failure of embankments.

Condition of Embankments

1) Satjelia Island Unit

The site chosen for survey was Luxbagan. It can be seen from the field photographs of 2010 that the

dilapidated condition of the earthen embankment has led to the inundation at Bidhan colony near Kakmari Bazar. The temple at Kakmari bazaar had got submerged during Aila with no recovery further. The new embankment at the left has been constructed after Aila as the previous embankment had been damaged during Aila. Moreover the settlement to the south of Kakmari Bazar has been included in the river Garal. Birajnagar, at the confluence of Bidya and Durgaduani was considered for this study. A tubewell there is the only source of drinking water for 1800 people. The field photograph shows the temporary tents the only shelter of the people on the embankment of Bali II. The condition of the houses there is dilapidated mostly earthen huts on the embankment. Rice cultivation has been affected by saline water condition of November 2010.

2) Ramnagar Abad

The field photographs show that the settlement has been abandoned due to inundation of water during Aila. The agricultural plots have been totally submerged and the trees are seen to be left in worst condition.

3) Sambhunagar Island Unit

During Aila, the river Suryaberia of Sambhunagar had joined the Hatakhali river on its opposite side through a small creek inland. This situation had left about 5.56 sq km area totally inundated. Photo 5 Suryaberia river had joined the Hatakhali during Aila. This embankment was photographed in 2010. In the subsequent years, this embankment had got submerged and now the local people stand and walk on the submerged part to indicate its trace. New embankments have been built in subsequent years.

Breaching of Embankment during Cyclones

Cyclones of 1988, 1989 and 1985 were responsible for embankment breaching at Ghoramara island, Sagar island, Mahisani, Namkhana, Gosaba, Basanti and Patharpratima. In 2009, Aila cyclone on 25 May 12 km long embankment was damaged in Ramchandrakhali, 4 km of the embankment was completely washed out. 150 feet long embankment of Napitkhali in Ramchandrakhali of Basanti couldnot be repaired due to the nature of bank materials which are very loose and unconsolidated. The nature of the eddy current of the river is also responsible for damage. The total affected embankment in Basanti block is 98 km. In Gosaba block the embankment breaching took place in Bali II, Sonargaon, Dulki at Gosaba proper, Kochukhali of Ramnagar panchayat and Luxbagan in Satjelia panchayat.

Embankment Damage and Reconstruction (after Aila 2009)

Total damaged embankment in Jharkhali Anchal was 16 km in 2009. 10 km of embankment has been repaired. The embankment repaired by the panchayat has the width of 8ft, height of 9 ft, the riverward slope is 18 ft and landward slope is 13.5 ft. Total expenses for the construction of 10 km long embankment is 48 lakhs.

In Jharkhali no 1, 250 m of embankment along the Matla river near Jharkhali market has been maintained using bamboo piling. At Laskarpur, there is 500 m embankment with block pitching along Matla river. This embankment is meant for protecting Laskarpur, Mondalgheri and Parbatipur from Matla. There is a stretch of earthen embankment in between two stretches of concrete embankments. The earthen portion is highly damaged by the wave thrust of Matla during high tides. At Jharkhali 4, 1 km long embankment was totally washed out. Before Aila 2009, two parallel embankments were destroyed by the Herobhanga river in different storms. After Aila concrete embankments have been constructed.

Vulnerability Analysis

Vulnerability has been calculated according to Wisener's method of 2004 considering the poorest 33%, middle 33% and richest 33% of the population gauging the changes in the last five years whether it has been negative or positive. The parameters considered for the following resource types—

a) Material resources (Land, water, local resources, livestock, tools and equipments, capital and stock, food reserve, house/shelter, transport, sanitation)

b) Physiological and social resources (nutrition and health, education, technology, information, social links, livelihood, safety and security)

c) Financial resources(income,market,banking and credit)

d)Environmental resources(workplace environment, home environment, pollution, aesthetics).

Mostly the surveyed people have opined that land type, water quality, status of local resources, livestock quantity, capital and stock, sanitation conditions have undergone negative change in the last five years. Nutrition and health condition, livelihood, security, banking and credit have also recorded a negative change in last five years. Positive change has been recorded for connectivity through cellular phones and unity despite political disparity.The post Aila response in Gosaba for Bairagipara, Luxbagan, Kachukhali and Birajnagar have been shown and it is evident that in all the cases majority of the people have opined that in the last five years negative change has been recorded in all respects.

Vulnerable Sites

The District Disaster Management report of the year 2012 was taken into consideration to show the vulnerable sites of Gosaba and Basanti left vulnerable

due to breaching of embankments. For this lengths of damage more than 600m have been taken into account. Gosaba testifies 18 sites of damage while Basanti has 6 sites of damage with damaged length of more than 600 m. The rivers and the banks damaged have also been tabulated. Subsequently a map has also been prepared according to this data. In the map all the sites have been shown with lengths of damages ranging from 200 m to 7000 m.

Major Findings

In Gosaba block the embankment breaching took place in Bali II, Sonargaon, Dulki, Kachukhali and Luxbagan. The embankments repaired by the Panchayat have width of 8 ft and height of 9 ft.Total length of embankment in Gosaba block is 372 km out of this 210 km was badly damaged during Aila cyclone. Concrete breaching along the main rivers like Matla, Bidya, Gomor and Hogol is needed. Settlement and agricultural activities should be avoided in the areas which are frequently flooded during high tide and storm surges. Height of the embankment should be increased on the basis of level of high tide and the height of storm water. Embankments should be constructed and repaired by trained workers under government initiative and mangroves must be preserved.

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Table – 1: Factors and Elements of Breaching of Embankments

Factors	Elements
1. Nature of currents	Nature and extent of discharge Velocity and shear stress Presence of eddy currents
2. Embankment materials	Texture and cohesiveness of materials
3. Climate	Nature of rainfall Duration of rainfall Dry and wet cycle
4. Geology	Permeability Nature of soil moisture Presence of capillary water
5. Geometry of the channel	Slope, breadth and depth of the valley Height of the bank Sinuosity of meanders
6. Biodiversity	Nature and density of natural vegetation Biological activities
7. Man	Urbanization, transport and drainage system Artificial device for protecting channel bank

Source: Compiled from ***Knighton, 1998)***

Table – 2: Impacts of Breaching of Embankments

Direct impact	Indirect impact
Loss of agricultural land	Depopulation
Loss of wetlands	Survival problem of the people
Loss of settlements	Occupational change
Loss of fisheries	Environmental refugee
Shift of bank line	

Source: Compiled by the authors

Table – 3: Vulnerable Sites of Gosaba

Location	River / Khal	Bank	Length of Damage (m)
Dayapur	Gomor	Left	800
Lahiripur	Rangabeliagunj	Right & Left	800
Rangabelia	Gomor	Right & Left	1000
Pakhiralaya	Gomor	Right	1000
Kachukhali	Bidya	Right	800
Sambhunagar	Hana	Right & Left	700
Mathurakhanda	Bidya/ Gomor	Left	1000
Bali	Bidya	Right	1000
Bijoynagar	Durgaduani/ Gomor/ Bidya	Right	1000
Dulki	Durgaduani/ Gomor	Right	700
Manmathanagar	Bidya/ Pathankhali	Right/Left	1000
Kumirmari	Sarsa/ Bagna/ Puinjali/ Raimongal	Right/Left	7000
Hetalbari	Melmel/Kapura	Right/Left	2000
Kalidashpur	Kapura	Right	2500
Chotomollakhali	Sarsa	Right/Left	1500
Dakshin Radhanagar	Bali	Left	1000
Amtoli	Puinjali	Right	2000
Puinjali	Puinjali/Raimongal	Right	1500

Source: Field Observations by authors

Table – 4: Vulnerable Sites of Basanti

Location	River/Khal	Bank	Length of Damage (m)
Parbatipur	Matla		900
Jharkhali	Matla/Herobhanga	Left/Right	1000
Sonakhali	Hogol	Left/Right	1100
Chunakhali	Hana/Hatakhali	Left/Right	800
Birinchibari	Bidya	Left/Right	700
Jharkhali/Tridibnagar	Bidya/Herobhanga	Left/Right	1000

Source: Field Observations by authors

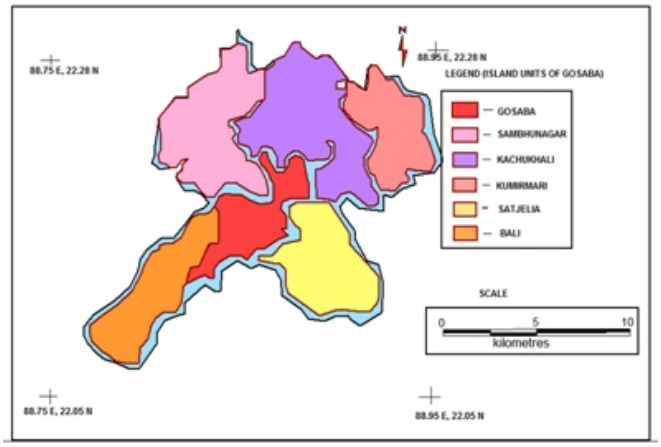

Fig. 1: Island Groups of Gosaba

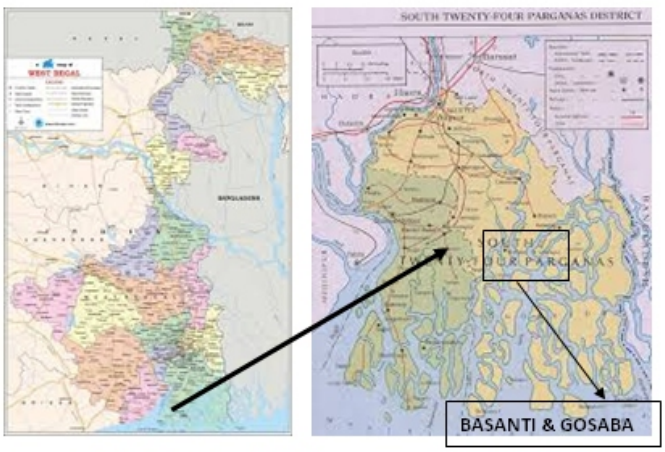

Fig. 2: Location of Study Area

Fig. 1: Temple near Kakmari Bazaar.

Fig. 2: Bidhan colony near Kakmari Bazaar

Fig. 3: Tents on the Embankment - Bali 2

Fig. 4: Ramnagar Abad after Aila

Fig. 5: Suryaberia river had joined the Hatakhali during Aila.

Fig. 6: Damaged embankmentat Mondalgheri, Laskarpur (14th June, 2011)

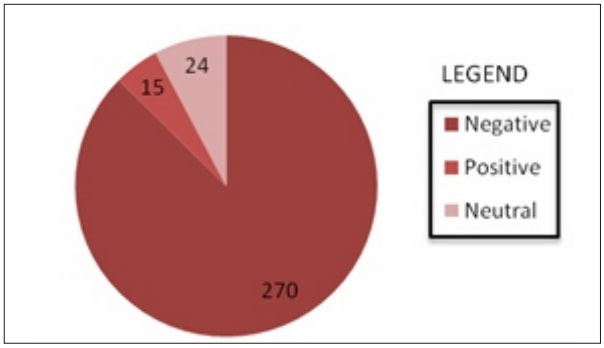

Fig. 7: People's Perception about Change in the last 5 Years (Birajanagar)

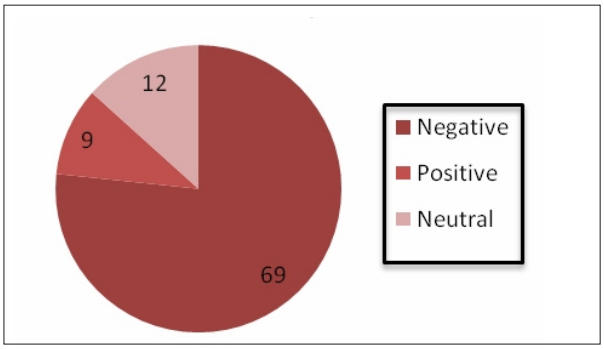

Fig. 8: People's Perception about Change in the last 5 Years (Kachukhali)

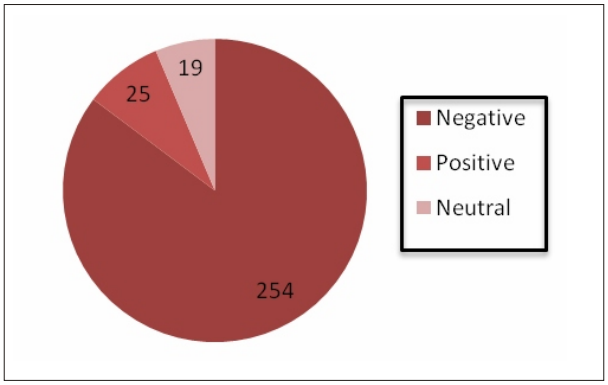

Fig. 9: People's Perception about Change in the last 5 Years (Luxbagan)

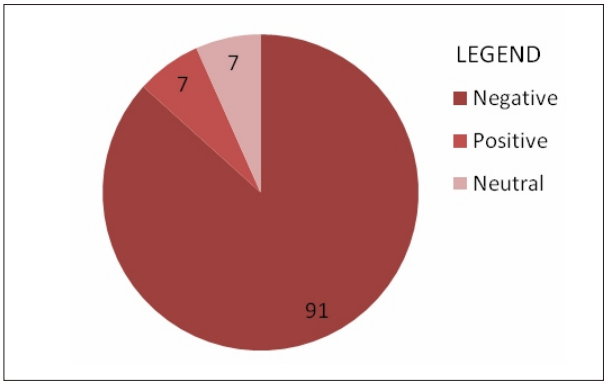

Fig. 10: People's Perception about Change in the last 5 Years (Bairagyaparai)

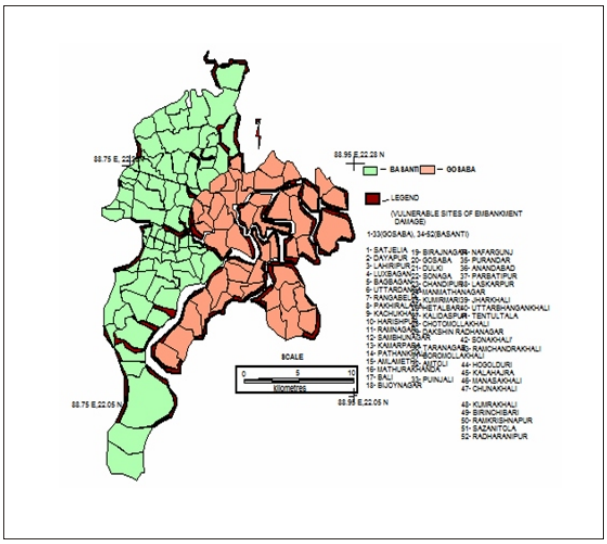

Fig. 11: Vulnerable Sites of Gosaba, and Basanti due to Embankment Breaching

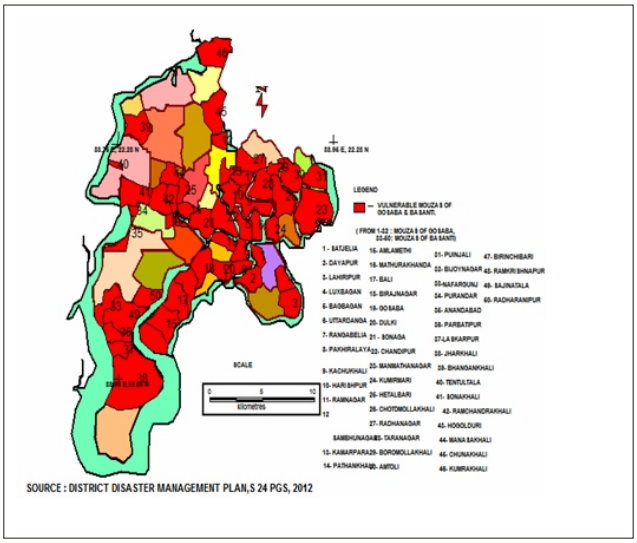

Fig. 11: Vulnerable Mouzas of Gosaba, and Basanti

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