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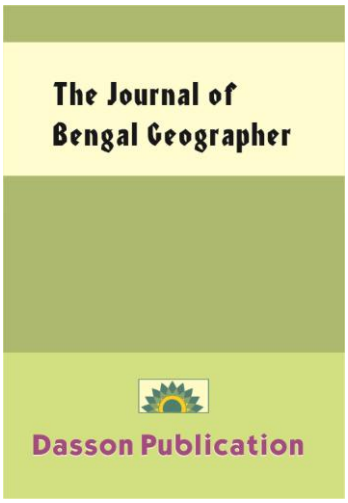

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Impacts of riverbank erosion of floodplain areas of Torsa river at Cooch Behar-II

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Abstract

Cooch Behar district is a land of many perennial rivers. The Torsa River flows through Tibet, Bhutan, India and Bangladesh. Cooch Behar district is mainly formed of the processes of alluvial deposits. Only seven mauzas I have selected for my research work. This paper provides an overview of coochbehar block II residence displaced by river bank erosion. This research work describes the socio-economic as well as environmental conditions of the study area with a special attention to natural hazards. Riverbank erosion of a considerable proportion of the victims are compelled to leave the original homestead plot and take shelter by the left embankment, cultivated land, neighbors land, Government and relative lands. The health and economic conditions of the victims are extremely low. In fact, riverbank erosion causes every year unemployment, landlessness and poverty is increasing which results from unstable condition of this area. This physical process affects the economic and socio-cultural aspects and creates drastic change over the period. Continuous monitoring and maintenance of these floods induces river bank management which is necessary for the beneficial result. The distressed people demand a holistic and positive approach to tackle the problem. The information on losses of livelihoods, generated vulnerabilities, social destructions, impacts on agriculture, impacts on environment, relief and benefit for erosion victims and livelihood dependence on the river is collected through semi-structured questionnaire survey.

Keywards: *1. Bank erosion, 2. Objectives, 3. Methodology, 4. Causes of bank erosion, 5. Socio-Economic impacts, 6. Remedial measures, 7. Recommendations and 8. Findings.*

Introduction

The "Torsa" is an important river in the foothills of North Bengal. This is the western most right bank tributary of the Brahmaputra. The Torsa rises in the Chumbi valley of the eastern Himalayas in southern Tibet at an elevation of 7065 meters. Known as the Machu, in Tibet and Ammo Chu in Bhutan, the Torsa flows southwards in south Tibet, before turning south to cross the east-west trending ranges of the Himalayas. The river breaks through these ranges via a series of deep, narrow gorges before entering the Indian State of West Bengal. The total length of the Torsa from its origin to its confluence with the Jamuna at Nageshwar in Bangladesh is 295 km, of which 99 km lies in Alipurduar and Cooch Behar districts (India). The catchment area of the Torsa is about 6407 sq km, out of which about 37 % area is in India. The river draws a number of tributaries such as Kaljani, Kharkhari, Gadadhar and Raidak-I. The floodplain of Cooch Behar is an aggradational plain built up by the depositional work of the Torsa and its tributaries. After travelling 99 km in a southerly direction through the Duars (Babar) region, the river again turns south easterly to enter Bangladesh. This river is known as 'Toyrosa' (meaning "sorrow of river") in the Tibet because Torsa changes its own course many times from last two centuries and it shifted its course substantially in the bank erosion of 1887.

Most of the studies on bank erosion of Torsa River at Cooch Behar have been aimed at identifying factors causing erosion and assessment of eroded geographical area. Such studies are important for taking erosion control measures and restoration. However, little effort has been made to quantify the loss due to this erosion though it is often reported that bank erosion of Torsa River causes poverty which has a long term impact and there is no compensation mechanism. It has already been mentioned that bank erosion has wiped out a large area including human settlements, productive crop land and embankment area. One of such affected areas consists of some villages of Cooch Behar-ll.

Problems

On the basis of field investigation it has been found that the river Torsa is shifted towards left bank and eroded gradually from Shalmara to Kachuban mauza. This research work will deal particularly with one of the current issues of river bank erosion as well as socio-economic problem related with enormous erosion and bank failure.

Study area

Cooch Behar ll (Pundibari block), the study area is located at the left bank of the Torsa River and north-eastern part of the Cooch Behar city of West Bengal. The coochbehar district (25° 57' 40" North to 26° 32' 20" North and 88° 47' 40" East to 88° 54' 35" East) covering an area of 3387 sq. km is divided into 12 blocks. It is situated on the northern plain of north Bengal. Present study includes Shalmara, Aratguri, and Deutibari, Petbhata chandanchaura, chandanchaura, Kachuban and Hokakura mauzas. It extends between latitude 26° 23'55.7" N to 26° 22'52" N and longitude 89° 20'41.1" E to 89°21'43" E. It is covered by the survey of India (SOI) topographical sheet numbered 78F/7.

Methodology

This research work is based on the empirical study of river bank erosion. A systematic methodological principle was followed in this research work. The entire work can be represented in the following manner :

1. Pre field study

At the beginning intensive literature review from related books, journals, articles, government publication, direct investigation etc. has been done to specify the research problem and selecting the study area and topic of this research work. The spatial information have been collected from different govt. office like Water and Irrigation Department, Cooch Behar; B.L. and L.R.O Office, Pundibari, Cooch Behar; Disaster management Office of Cooch Behar were also taken in to consideration.

2. Field study

Primary data have been obtained through intensive field survey in selected mauzas of Cooch Behar block-ll. Household surveys using structured socio-economic questionnaires have been done very scientifically. Photographic records of the related features have also been collected. The study of

imperial observation has been done very carefully through measurement and analysis process to know the bank erosion of Torsa River and existing management structure.

3. Post field study

Data and others information made available and generating on the field were compiled using appropriate modern techniques on computer and satellite images, topographical map and cadastral maps. The collected data have been quantified, analyzed and synthesized by using standard statistical methods like regression, co- relation etc.

Objectives

Severe, precise and rational Objectives have been chosen for the scientific study of the above mentioned problem of the study area, which are as following:-

1. To highlight the problem of river bank erosion of study area.
2. To emphasize the causes of bank erosion of the river Torsa.
3. To examine the nature and extent of this devastating hazards.
4. To assume the present socio-economic status of study area.
5. To evaluate the impact of bank erosion of study area.
6. To suggest suitable prevention measures.

Literature review

Before 20th century DR. Anvil (1752), James Rennell (1781), Tossin (1840) and Hunter (1874) prepared ancient river maps of West Bengal. Here are few articles and books mentioned in the following which are published in the twentieth century- 'Bangladeshi Nod-nodi o Parikalpana'-(1959) by Kapil Bhattacharyya; 'Banglar Nadi Kotha' (2008) by DR. Kalyan Rudra; 'Banglar NAD Nadi' (2007) by Dilip Kumar Bandhyapadhya; 'Paschim Banger Nod Nadi' (2002) by Ashok Kumar Basu. According to the official report by Water and Irrigation Department and Disaster Management Office, Govt. of West Bengal, Cooch Behar, there could be number of reasons for the left bank erosion of River Torsa as well as bank failure of main channel.

Causes of erosion

Riverbank erosion is a widespread and recurrent natural hazards in the left bank of river Torsa at Cooch Behar blocks ll. When rivers enter the mature stage, they become sluggish and meander or braided. These oscillations cause enormous bank erosion. Every year, many people are affected by erosion that destroys standing crops, cultivated land, homestead land and others. The bank erosion of river Torsa has been occurred in following manners-

1. In many places of study area the rate of river bank erosion has increased rapidly. This is a result of the extensive clearing of deep-rooted natural vegetation across the catchments for agricultural developments.

2. Structures like bridges at Sajher par villages (NH-31) causes bank erosion, although bridges ensure and facilitate the communication across the rivers conveniently, but, these structures may have unfavorable effects on the hydraulic parameters, discharge and morphology of the river channel.

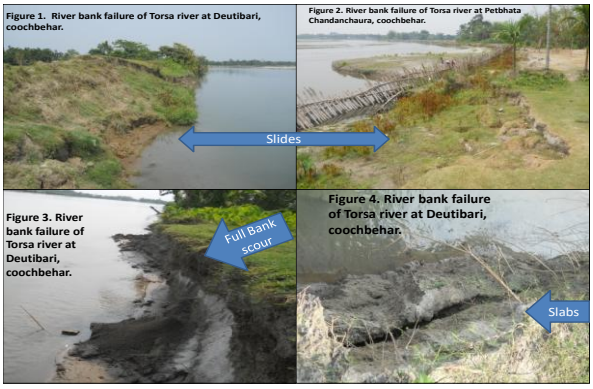
3. On the study area, the left bank of river Torsa has been eroded very quickly, because agricultural fields and practice has been done enormously in the catchment area.

4. Deforestation, land slide and constructions of unplanned embankment, road and bridges and extensive practice of agriculture carried huge amount of silt in the river beneath by the tributaries of Torsa. As a result, accumulation of silt and reduction of the water holding capacity of the Torsa enormously change the direction of the river and erode the left bank of river.

5. The helical flow of Torsa river water may also favour left bank erosion, as this flow scours the thalweg line which is situated beside the left bank and may cause collapse of channel walls of Deutibari and Petbhata Chandanchaura mauzas.

6. The left bank of Torsa River is composed of less resistant soils, erosion becomes so easier. Sand and alluviums composing the river bank may be weathered and eroded away very easily by the hydraulic action of river. In the downstream of river Torsa, excessive siltation problem may prove inadequate to hold water. This initiates too bank erosion.

Types of bank erosion



Effects of bank erosion

All sub-divisions of coochbehar district are more or less affected by river bank erosion. Torsa river bank erosion has disastrous socioeconomic effects and also affected significantly the socio economic spheres of the people of the locality. This erosion is a perennial and one of the most intensive problems at coochbehar Pundibari block.

The majority of the affected people perceive riverbank erosion as a natural phenomenon but in many cases the people believe erosion to be the 'will of God'. The degree of economic loss and vulnerability of population due to bank erosion has dramatically increased after 1993.

The effects of bank erosion are devastating. Many times bank erosion can destroy everything. During bank erosion, humans can lose so much. One of the most dangerous things a person could lose would be life. This causes lots of people suffering from unemployed, which in effect, creates no way of paying his daily needs. The environment and economy are destroyed; lands are washed away, houses are destroyed, and people live are distorted forever.

The impact of land loss involves primarily the loss of homestead land, housing structures, cultivated crops, livestock, trees and household utensils. About hundreds of people are directly affected each

year by bank erosion in the study area. The total land loss is estimated to be approximately 4.77 sq. km. An estimated 550 houses or 12 slum areas displaced usually take shelter on neighbor villages, new and old embankments, newly formed island, bare land and government-requisitioned lands. The first immediate relief after bank erosion is provided by the nearby primary schools and Kachuban embankment.

Table 1. Stable shelters area after bank erosion (No. Of families)

Category / Mauza	Primary schools	On embankment	Land of their relatives	Agricultural lands	Island	Govt. land	Outside of the village
Kachuban to Haripur	–	–	–	–	–	–	–
Deutibari and Chandanchaura	15	00	23	115	35	00	25
Aratguri	02	01	05	27	13	00	12
Hokakura	00	00	09	00	311	00	17
Shalmara- 1,2	03	00	12	69	61	25	33

Source: Primary survey, 2011-2015

River bank erosion has great impact on agriculture. Bank erosion causes setback for village agriculture. Along with homestead settlements, it erodes cultivated land, infrastructure and the communication system. The giant farmers are the most horribly affected, followed by marginal groups or nothing. As a result, every year, bank erosion has decreased the agricultural land at study area. The affected people lose their assets and are forced to draw on savings and often fall into further debt. The lost of land is much more than the land that rises out of riverbed through accretion. This has hampered their everyday food and nutritions and also has affected their economy. This erosion-accretion phenomenon is a characteristic feature of the middle courses of Torsa River in study area and gives rise to a lot of tension in local people. Hokakura and part of Aratguri mauzas of Cooch Behar block-ll are riverain area, so there is no use of any modern technique in agriculture due to some risk which cannot be enabled to invest on the agricultural field. So, agricultural productions are not satisfactory and adequate. Bank erosion destroyes the agricultural crops like paddy, jute, etc in eroded areas which create the economic problems of the farmers because of their miserable economic condition.

Table 2: Impact on agriculture

Sl. No.	Category	Kachuban to Haripur	Deutibari and Chandanchaura	Aratguri	Hokakura	Shalmara-1,2
1.	Loss of agricultural land	2%	19%	5.7%	33.27%	54.3%
2.	Vita land	0.7%	11.3%	16.1%	66.73%	45.7%

Source: Primary survey, 2011-2015

Displacement is the instant impact of riverbank erosion. In erosion-prone areas, most families have witnessed a displacement in their lifetime. Loss of homesteads forces people to migrate to new places without any option and puts them in disastrous situations. The displaced people usually move to nearby areas but migrations to distant places are not uncommon. A survey conducted in study area has revealed that they consist of migrants who mostly originated from the villages of Salmara I, II, II; Hokakura and Deutibari. A closer examination of this distribution further revealed that most of the

migrants came from an area around the Torsa and its basin area. Almost 100% affected people are totally displaced at Salmara I and II mauzas. Now, they are resettled at sajher par Kathalbari mauza beside the new embankment, which was formed in 2009-2011, before the Bidhanshabha Election. They also resettled in newly accreted bar and govt. Lands, nearby villages and Pundibari market area and many of them took shelters in Cooch Behar City and other places e.g. Dinhata, Siliguri, Rajasthan, etc. Some people now live in mid channel bar or newly accreted island at Hokakura; they are totally deprived of any services especially medical service in the emergency period.

Most of the environment-induced refugees turn mainly into daily laborers or rickshaw pullers. A large proportion of the sufferers remain unemployed due to lack of job opportunities. Fortunately, at present, social workers are focusing on these problems and also are suggesting strategies of survival to these people.

Losses due to bank erosion

Figure 5. Resident crops at Deutibari

Figure 6. Loss of vegetation at Aratguri.

Figure 7. Loss of cultivate land at Deutibari.

River bank erosion has deprived also the local people of education. Most of the school and college going pupils have stopped their education abruptly for financial and agricultural work supports to their families and also they are going to Rajasthan, Gujarat, Delhi and Haryana for search a new jobs for better standard of livings.

The social destruction has been created as a result of bank erosion. Many people have changed their occupation for the bank erosion and they also have shifted themselves from small farmers to daily laborers.

Table 3: Social destruction

Sl. No.	Category	Kachuban to Haripur	Deutibari and Chandanchaura	Aratguri	Hokakura	Salmara-1,2
1.	Broken family relation	-	18.5%	39.2%	44.8%	83.0%
2.	Occupation change (from farmer to daily worker)	0.9%	53.9%	29.7%	59.0%	96.5%
3.	Ambition change (Students to worker)	-	31.3%	22.1%	77.6%	33.3%

Source: Primary survey, 2011-2015

Thus, river erodes villages and then leaves adverse effect on the occupation of the people of eroded areas. People who had sound economic condition before the erosion, are now a day bankrupt. Through agriculture has once a principal occupation in the study areas of Cooch Behar, of late it is seasonal in nature. The people of the affected area cannot find job throughout the year. In the absence of multiple cropping system and subsidiary occupation in this area a huge number of villagers have to sit idle for 4-5 months in a year. Permanent unemployment in agriculture is also suffering from due to excessive pressure in agriculture and allied activities. In the eroded areas people feel heavy pressure in agriculture due to continuous bank erosion.

Due to enormous bank erosion roads and bridge construction are not possible in those areas. Therefore, society faces the social problems in eroded areas.

Erosion is also reduces the housing land for people. Increasing population makes it more difficult to nourish them and arises further economic problems in society.

Due to enormous bank erosion of study area of Pundibari Block the number of land losers cum laborers increases by 72% which is much higher compared to the district of Cooch Behar. Hence, bank erosion also increases the rate of deforestation of the study areas.

Division of every joint family creates land problems for their shelter and also agricultural land fragmentation of herding creates the social and economic problems of the eroded area.

Controlling measures

There are several techniques to control or minimize bank erosion hazards, which are as follows-

1. To make the river flow along a more or less straight course between Shalmara and Haripur.
2. Bank stabilization by planting deep rooted trees can be implemented to minimize the erosion.
3. Bio-engineering is very low cost river bank protection and easy to construct, using natural and local materials.
4. A combination of bamboo and other local materials has been used to protect river bank erosion.
5. Woody stems woven into a vertical fence provide physical protection against fast flowing water.
6. Untreated timber or vertical timber posts or piles and other green materials placed or anchored at the foot of the bank below the normal low- flow water level to protect against toe scour.
7. Bundles of untreated brushwood are bound together and used to stabilize river banks.
8. To construct gravity walls and Cantilever walls along the river bank that help to stabilize river banks.
9. Large fragments of quarried rocks placed on riverbanks and Proper catchment area treatments to protect bank erosion.

Recommendations

Riverbank erosion is a threatening problem for the people of study area and for the economy of the region as well. It also breaks the environmental and ecological balance. The losses of bank erosion are irreparable. As our country, the study area is densely populated and most of them are directly or indirectly dependent on agriculture with appropriate measures for erosion control that are badly needed. The following recommendations are prepared on the basis of the analysis of this research-

1. Riverbank erosion is a regular and common phenomenon at Cooch Behar district. Every year, some areas on the left bank of the Torsa River are getting affected by riverbank erosion. So, a Comprehensive National Riverbank Erosion Management Policy should be made.
2. Proper steps for relief and rehabilitation for affected areas should be taken. Development Program for resettlement of erosion which induces displacement can be introduced. Newly created land should be given to the original owners of land. Also, an emergency fund for the erosion-induced can be created by the government.
3. Affected people should be consulted before taking any type of erosion control measures.
4. Many affected inhabitants become landless as a result of bank erosion. Minimum amount of govt. land should be allotted to them for shelter if possible at the time of these hazards occurred.
5. Many erosion-induced displaced people are compelled to change their profession like daily labour and they migrate to other regions for better jobs. As a result, they suffer from the source of income. At this time, they should be given micro-credit.
6. Proper planning for erosion protection is badly required. Political motivation and interest driven plan for erosion control must be avoided.
7. No development plan like built up embankments, bridges, etc that hampers the natural flow of the river should be taken. Appropriate and effective erosion control measures should be important consideration while making plan.

Findings

From the above comprehensive study i have assembled several important aspects, Which are follows :

1. According to my research, after 2010, excessive left bank erosion has taken place at Chandanchaura, Petbhata Chandanchaura, Deutibari and Shalmara mauzas.
2. After rainy season, in river Torsa is seen enormous bank erosion which also damages lots of production every year; moreover, loss live stocks, cultivated land, housing land and vegetation cover of this area.
3. The river thalweg line is situated on the left side of the river channel in study area.
4. In 2009-2011, a 2600 metres long new embankment is built up from Sajher par Bridge to Armature mauza by the irrigation departments.
5. In 2012, river Torsa has eroded some portion of kachuban embankments.
6. In study area displacement problems arises more and more due to river bank erosion, for which, people are searching for the better jobs and better residence for their livelihood. Due to bank erosion displaced people resettle at nearest areas.
7. Moreover, the transport facilities are not satisfactory found in the eroded area due to lack of metalled Road, Bridge and other means for communication of the study area. People are living in the Mid Channel bar and govt. land that are mostly seen in the villages like Hokakura and Ichhamari Chapaguri etc.
8. Both sides of river banks, villagers are communicated by the shako and boats.
9. 96% victims have got no help at the time of resettlement.
10. 73% people have left through negative change of social status in term of financial ability of the family.


Figure 8. New embankment at Shalmara village along the left bank of Torsa River.


Figure 9. Ending point of new embankments at Aratguri

11. Many of them have got separated from their society; as a result, still they miss the societies. Social damages have taken place among the families. A number of joint families have been splitted into nuclear families.

Conclutions

From above discussion it is clear that the erosion has great impact on people's livelihood along with the river Torsa of seven mauzas. Natural occurrence such as river bank erosion cannot be completely stopped from happening but its frequency can be reduced through the success of full management planning and commitment from the policy planners. Thus proper policy planning is possible consulting with stakeholders, and together with people it is easy to overcome these types of hazards.

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