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Bank Erosion and Bankline Shifting of Dhansiri River In Golaghat District, Assam (1999-2019)

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ABSTRACT

The Dhansiri River is the main river of the Golaghat District of Assam. However, unpredictable shifts of the river, serve erosion and frequent flooding have major adverse effect on the economy and ecology, affecting and threatening key villages, agricultural lands, school, and natural heritage sites. Erosion displaces a large number of the population often rendering them poor and landless. This study is aimed to investigate the flood erosion and bed aggradations scenarios of the Dhansiri River in the Golaghat district, Assam. Most of the villages in Golaghat district have been submerged by flood water and people and animal are taking shelter on the roadside and on the highlands. Golaghat in upper Assam has been most flood affected, where over 1, 19,179 people of 109 villages under Khumtai, Dergaon, Golaghat and Bokakhat revenue circle in Golaghat district have been affected by floods due to rise water of Brahmaputra and Dhansiri rivers. There are many problems being faced by this flood affected are due to river bank erosion: social, economic, health, education and political. The major impact of erosion is social, i.e., homelessness due to land erosion which compels people to migrate. After forced migration they suffer economic crisis, namely loss of occupation and loss of property.

Key words: *Bank Erosion, Flood, Dhansiri River, Bankline Shifting*

Introduction

A river is a natural flowing water course, usually freshwater, flowing towards an ocean, Sea or another river. Small River can be referred to using name such as stream, creek, brook, rivulet and rill (Alam, 1993). River erosion means the river eroding away the banks and its beds vertically and laterally. Vertical erosion is the downward erosion which deepens the river channel, and lateral erosion is sideward erosion which widens the river channel (Bathurst *et al.,* 1979). River bank erosion is one of the natural disasters that cause displacement of inhabitations who previously lived near river banks (Bishop *et al.,* 1965). Flood and river bank erosion are almost regular phenomena throughout the world. Between these two types of disaster, the loss due to flood is temporary, but the loss of land due to river bank is permanent and has a long-term impact on the economy (Bhattacharjee, 2009). This area is mostly suitable for agriculture productivity and is highly populated. Therefore the reason behind selecting this area for present study to examine the effects of bank erosion on land use and settlement near the river and level of adjustment of the people to the danger situation of erosion in this area and

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also it is important to know why erosion is more in those areas and how it can control for saving people life from this situation and through this study we can know the area which will be affected by flood more in future, for this we can help the people life by moving them to save place in flood season (Goswami, 1985). The main aim of this paper is to study bank line shifting of Dhansiri river in the study area in different periods and also to know the causes and consequences of erosion in the study area.

Materials and Methods

Data source as shown in Table 1, Satellite imageries were used to extract Dhansiri river boundary with the help of NDWI method in the three different periods. January and December month is taken for getting clear satellite image of three different periods. In Dhansiri river 19 cross-sections were taken during 1999-2010. Four reaches were considered for measuring bankline migration. Similarly, 13 cross sections were taken during 2010-2019. In Dhansiri river 22 cross-sections were taken during 1999-2019. From the shifting of river along the cross sections direction and distance of shifting were measured and by overlapping the Dhansiri river erosion and deposition area were measured.

Location of Study Area

The Golaghat district located between 26°41′N and 27°17′N latitude and 93°18′E and 95°26′E longitude (Figure 1). The district covers an area of 3502 sq.km and lies 100 m above mean sea level. The urban area of the district is 36.45 sq. km and the rural area is 3465.55 sq. km. According to 2011 census the total population of Golaghat district is 1,066,888 of which males (543,161) and females (523,727). The district has a population density of 305 inhabitants per square kilometer. Its population growth rate over the decade 2001-2011 was 11.88%. Golaghat has a sex ratio of 961 females for every 1000 males and a literacy rate of 78.31% (Gogoi, 1999).

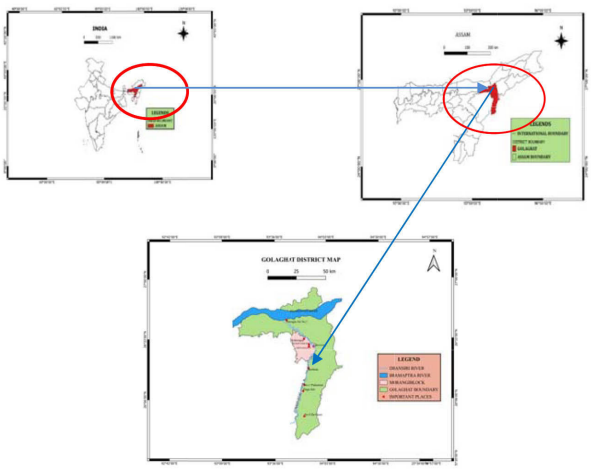

Fig. 1. Location of the Study Area

Results

The major portion of the river course is within the originating state Nagaland and terminating state Assam. In Nagaland, the river passes through a hilly course in the upper catchment and causes flood only in the foot hill areas of Kohima district, round Dimapur town. But the inundation stays only for a day or two at the most. In its course in Assam also no major inundation generally takes place upto Bokajan. The problem of flooding becomes more complicated in the lower reach. Sarupathar, golaghat, Khomtai and Bokakhat circles are affected by the flood of Dhansiri River. Meandering nature, flooding, flow direction and fast flow velocity of the Dhansiri River are main cause of bank erosion. The earthquake of 1950 may be said to be a threshold point after which the bank erosion problem has become severe and intensive throughout the Brahmaputra valley of Assam (Kotoky, *et al.*, 2003).

The problem of bank erosion is more pronounced in the downstream of NH-37 crossing at Numaligarh.

The villages affected due to erosion by river Dhansiri are Dukhutimukh, No.1 Koiborta, Halmoratup, Mainmapara, Parghat Gaon, Leteku Chapori and Aborghat.

Table 1. Data used and Data Source

Sl.No.	Satellites and Sensors	Description	Source
1	Landsat TM, 20/12/1999	P135/R42	www.glovis.usgs.gov.in
2	Landsat TM, 21/012/2010	P135/R42	www.earthexplorer.usgs.gov.in
3	Landsat 8 OLI/TRIS, 25/01/2019	P135/R42	www.earthexplorer.usgs.gov.in

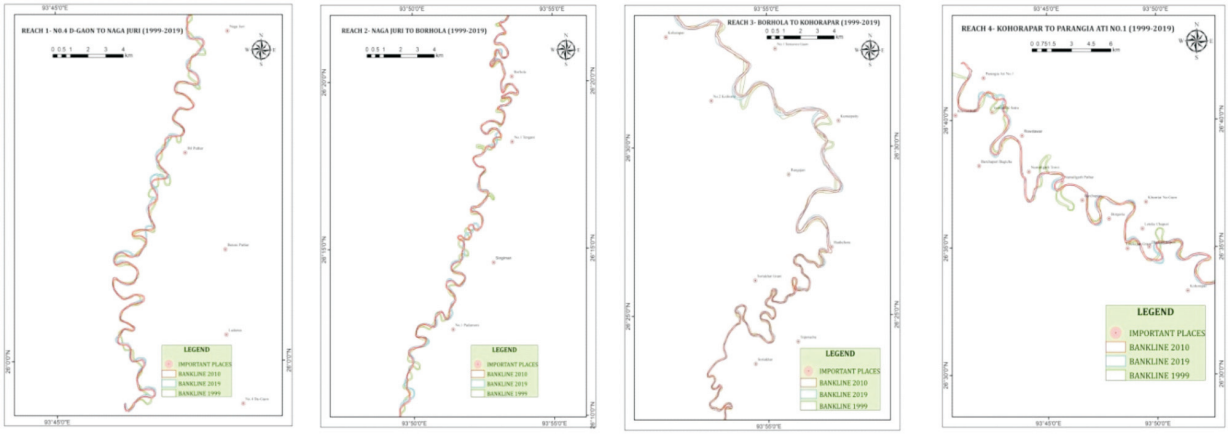

Fig. 2. Meandering channels and sinuosity indices of Dhansiri River in Reach 1- Reach 4

The river parameters like channel length, mean width, water surface area, sinuosity, erosion and deposition areas in different periods were measured reach wise to know the river migration processes. The reach wise river parameters were measured with the help of GIS. Sinuosity is the ratio between channel length and valley length. The channel length is determined along the channel between two points on a river and valley length is the straight-line distance between the same two points (*Leopold, et al.*, 1957). The detailed of the different parameters of the Dhansiri River were shown in Table 2 & Figure 2.

We observed that in reach 3 meandering nature of the Dhansiri River is more, so we can say that erosion and flood is more during 1999-2019. Reach3 is in the lower catchment of the Dhansiri River, so erosion and flood are more in the north of this river.

In reach 1 (Table 3) from No.4 Da-Gaon to Naga Juri five cross sections was taken from AA2 to EE2. Along cross-section AA2, BB2, CC2 and DD2 the river shifted towards eastward and cross-section EE2 the river shifted towards west.

In reach 2 (Table 3) from Naga Juri to Borhola four cross-sections was taken from FF2 to II2. Along cross-sections FF2, GG2 and HH2 the river shifted towards west and cross-section II2 the river shifted towards east direction.

In reach 3 (Table 3) from Borhola to No.1 Sensowa Gaon four cross-sections were taken from JJ2 to MM2. Along cross-section JJ2 the river shifted eastward and cross-section KK2, LL2 and MM2 the river shifted towards west direction.

In reach 4 (Table 3) from No.1 Sensowa Gaon to

Table 2. Measure of parameters on Dhansiri River in

Reach	Year	Length (km) C. L.	V.L. (km)	Width (km)	Area (km)	SSI
Reach 1: -No.4 Da-Gaon to Naga Juri	1999	43.71	22.35	0.16	2.74	1.95
	2010	43.64	22.69	0.13	2.2	1.92
	2019	43.59	21.64	0.16	2.64	2.01
Reach 2: -Naga Juri to Borhola	1999	51.18	23.68	0.15	3.18	2.16
	2010	49	23.72	0.12	2.47	2.06
	2019	47.88	22.81	0.15	2.82	2.09
Reach 3: -Borhola to No.1 Sensowa Gaon	1999	61.23	23.19	0.25	5	2.64
	2010	62.9	23.27	0.16	4	2.7
	2019	60.57	22.01	0.24	5.14	2.75
Reach 4: -No.1 Sensowa Gaon to ParangiaAti No.1	1999	66.67	27.2	0.26	5.31	2.45
	2010	59.28	27.17	0.23	4.57	2.18
	2019	57.13	24.27	0.25	5.49	2.35

C.L- Channel Length, V. L- Valley Length, S.S.SI- Standard Sinuosity Index

Table 3. Changing course of Dhansiri River during 1999-2010

Reaches	Cross Sections	Distance of migration (m) 1999-2010		
		Right Bank	Left Bank	Shifting Direction
Reach 1	AA′	-552.7	519.35	EAST
	BB′	-402.79	458.49	EAST
	CC′	-514.2	497.06	EAST
	DD′	-518.56	509.91	EAST
	EE′	458.51	-415.95	EAST
Reach 2	FF′	329.42	-348.18	WEST
	GG′	381.54	-431.58	WEST
	HH′	364.86	-396.16	WEST
	II′	-350.26	381.54	WEST
Reach 3	JJ′	-341.21	384.54	EAST
	KK′	495.58	-530.78	WEST
	LL′	836.79	-809.71	WEST
	MM′	373.71	-509.11	WEST
Reach 4	NN′	-321.31	388.43	EAST
	OO′	522.99	-556.63	WEST
	PP′	354.78	-357.83	WEST
	QQ′	-367.01	382.3	EAST
	RR′	-755.44	804.37	EAST
	SS′	351.72	-382.3	WEST

Source: Satellite Imageries- Landsat 4-5 TM

Parangia Ati No. 1 six cross-sections was taken from NN2 to SS2. Along cross section NN2, QQ2 and RR2 the river shifted eastward and cross section OO2, PP2 and SS2 the river shifted west direction.

From the above cross section measurement, we observed that during 1999-2010 periods the river Dhansiri erosion is more in the lower and upper catchment in the opposite bank.

Similarly, 13 cross sections were taken during 2010-2019; bank line shifting is more in AA2 cross-section and shifted towards east. Right bank eroded 805.88 meters and left bank deposited 793.78 meters along the cross-section. Four reaches were considered for measuring bankline migration.

In reach 1(Table 4) from No.4 Da-Gaon to Naga Juri three cross sections was taken from AA2 to CC2. Along the cross-section AA2 and CC2 the river shifted towards east and cross section BB2 the river shifted towards west direction.

In reach 2 (Table 4) from Naga Juri to Borhola five cross-sections was taken from DD2 to HH2. Along the cross-section DD2, EE2, FF2 and GG2 the river shifted towards east and cross section HH2 the river shifted towards west direction.

In reach 3 (Table 4) from Borhola to No.1 Sensowa Gaon two cross-sections were taken from II2 to JJ2. Along the cross section II2 and JJ2 the river sifted towards west direction.

In reach 4 (Table 4) from No.1 Sensowa Gaon to ParangiaAti No.1 three cross-sections was taken from KK2 to MM2. Along the cross-section KK2, LL2 and MM2 the river shifted towards west direction.

Table 4. Changing Course of Dhansiri River during 2010-2019

Reach	Cross Section	Distance of migration (m), 2010-2019		
		Right Bank	Left Bank	Shifting Direction
Reach 1	AA′	-805.88	793.78	East
	BB′	337.22	-355.49	West
	CC′	-209.25	204.06	East
Reach 2	DD′	-346.02	371.79	East
	EE′	-452.77	434.38	East
	FF′	-312.89	320.25	East
	GG′	-301.82	213.5	East
	HH′	360.75	-360.75	West
Reach 3	II′	704.44	-654.12	West
	JJ′	452.85	-488.79	West
Reach 4	KK′	383.59	-407.56	West
	LL′	311.66	-311.66	West
	MM′	323.68	-395.76	West

Source: Satellite Imageries-2010 Landsat 45 TM, Landsat 8 OLI/TRIS

From the above cross-section measurement, we observed that during 2010-2019 periods the Dhansiri river erosion is more in the lower reach in the opposite side.

In Dhansiri river 22 cross-sections were taken during 1999-2019. Four reaches were considered for measuring bankline migration.

In reach 1 (Table 5) from No.4 Da-Gaon to Naga Juri eight cross sections was taken from AA2 to HH2. Along cross-section AA2, BB2, DD2, GG2 and HH2 the river shifted towards east and cross-section CC2, EE2 and FF2 the river shifted towards west.

In reach 2 (Table 5) from Naga Juri to Borhola four cross-sections was taken from II2 to LL2. Along the cross-section II2 and LL2 the river shifted towards east and cross section JJ2 and KK2 the river shifted towards west direction.

In reach 3 (Table 5) from Borhola to No.1 Sensowa Gaon five cross-sections were taken from MM2 to QQ2. Along cross-section MM2 and NN2

the river shifted eastward and cross-section OO2, PP2 and QQ2 the river shifted towards west direction.

In reach 4 (Table 5) from No.1 Sensowa Gaon to ParangiaAti No.1 five cross-sections was taken from RR2 to VV2. Along the cross-sectionRR2 and TT2 the river shifted towards south direction, the cross-section SS2 and VV2 the river shifted towards west direction and the cross-section UU2 the river shifted towards north direction.

From the above cross section measurement, we observed that during 1999-2019 periods the river Dhansiri erosion is more in the upper catchment.

During the period 1999-2010 and 2010-2019 (Figure 3) the rate of lateral erosion is less than deposition. The erosion is about 0.273km^2 and 0.288km^2 and deposition is about 0.643km^2 and 0.392km^2 ,but during 1999-2019 erosion is more than deposition. The erosion is about 0.3901 km^2 and deposition is about 0.77km^2.

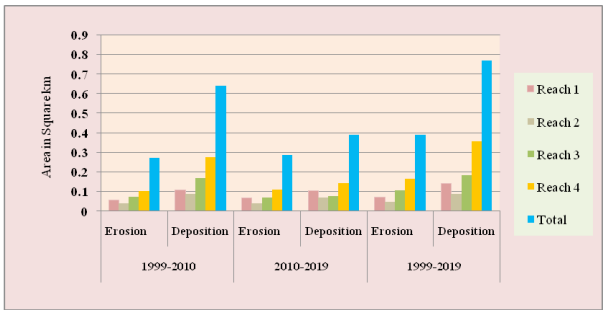

Fig. 3. Erosion and deposition of Dhansiri River in different period

In reach 1 and reach 2 erosion is gradually increasing but deposition is gradually decreasing. In reach 3 erosion and deposition is more in 1999-2010, but decreasing in 2010-2019, but again increasing during the period 1999-2019. Inreach 4 erosion is gradually increasing but deposition is more in 1999-2010, but decreasing during 2010-2019, but again start increasing during the period 1999-2019. Then from the total of erosion and deposition, we observed that the highest erosion and deposition is during the period 1999-2019 than the other two periods and the lowest erosion is during 1999-2010, but lowest deposition is during the period 2010-2019.

Discussion

From the above study it is clear that because of continuous erosion a dynamic change take place in the study area.With the help of multi-dated satellite images, we can make a conceptual prediction on the river's future trend and thus vulnerable areas can be identified. Erosion is quite intensive and more people become homeless. Bank line migration of the Dhansiri River has created an acute socio-economic problem in the study area. During the field survey it is clear that situation is vulnerable in surveyed villages, if government didn't take any step, then this people face lots of problem in next monsoon season.As we observed that reach and year wise SSI (Standard Sinuosity Index) was measured, so the highest SSI was in the reach 3 which is about 2.75km (2019) and lowest SSI was found in reach 1 which is about 1.92km (2010) .During the period 1999-2010 and 2010-2019 the rate of lateral erosion is less than deposition. The erosion is about 0.273km^2 (1999-2010) and 0.288km^2 (2010-2019) and deposition is about 0.643km^2 (1999-2010) and 0.392km^2 (2010-2019) but during 1999-2019 erosion is more than deposition. The erosion is about 0.3901 km^2 and deposition is about 0.77km^2.

Some suggestions like organizing some awareness programmers in the flood and river bank ero-

Table 5. Changing Course of Dhansiri River during 1999-2019

Reach	Cross Section	Distance of migration (m), 1999-2010		
		Right Bank	Left Bank	Shifting Direction
Reach 1	AA′	-675.46	738.79	EAST
	BB′	-508.47	633.24	EAST
	CC′	395.78	-364.11	WEST
	DD′	-759.89	786.28	EAST
	EE′	353.56	-379.49	WEST
	FF′	453.82	480.24	WEST
	GG′	-580.47	564.64	EAST
	HH′	-395.78	390.5	EAST
Reach 2	II′	256.12	279.06	EAST
	JJ′	412.87	-428.14	WEST
	KK′	435.79	-466.37	WEST
	LL′	-317.28	340.22	EAST
Reach 3	MM′	-251.77	247.19	WEST
	NN′	-416.57	462.34	EAST
	OO′	544.74	-476.08	WEST
	PP′	1089.49	-1126.11	WEST
	QQ′	508.12	-599.69	WEST
Reach 4	RR′	-1132.22	1112.14	SOUTH
	SS′	761.33	-834.41	WEST
	TT′	-1144.13	1095.06	SOUTH
	UU′	1438.98	-1481.57	NOTH
	VV′	470.27	-484.31	WEST

sion area about the importance of trees near to river or in any place, afforestation and reforestation. Afforestation reduces the soil erosion and as a result accumulation of sediment on the river bed reduce, which lessens the effects of flood and bank erosion.

Conflict of Interest- None

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