Research Paper

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A Study On Temporal Change In Bank Line Of River Khowai At Alepsha, Khowai District, Tripura

GEOGRAPHY

KEYWORDS : Temporal change, channel shifting, bank material, Khowai River.

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ABSTRACT

Lateral shifting of channel is a type of change of immense importance which can be detected by its asymmetric position in the river valley and the evidences of its temporal shift. The lower reach of the Khowai River is flowing through the alluvial plain and its bank line is changing gradually. The present study aims to investigate the amount and nature of shift of the left bank of the Khowai River in Tripura, particularly at Alepsha between 1966 and 2010 and to ascertain the possible reasons behind such changes. Such changes of the river course are affecting the livelihood of the local people and also repeatedly damaging a part of the State Highway. People were forced to migrate permanently due to this hazard. Temporal change has also affected the land use pattern along the river bank at Alepsha.

INTRODUCTION: Riverbank erosion is an endemic and recurrent natural hazard, which creates enormous amount of land loss, population displacement and landless every year. Alluvial courses are very sensitive indicators of channel change and can readjust to variation in hydrology, sediment load and active tectonics (Schumm et al., 2000). Lateral shifting is a type of change of immense importance which can be detected by its asymmetric position in the river valley and the evidences of its spatio-temporal shift in one direction (Schumm et al., 2000). A 2 - year research effort has developed a practical methodology for predicting the rate and extent of channel migration near transportation facilities. The River Khowai is one of the major rivers of Tripura. It originates from the Longtarai Hill Range and after flowing over the plain land it meets with River Meghna in Bangladesh. The basin is located within $23^0 40'$ to $24^0 5'30''$ N. latitude and $91^0 30'$ to $91^0 55'50''$E. longitude covering an area of 1328 km2. The hills of Tripura are made up of semi-consolidated sedimentary rocks. Due to high precipitation (>2200 mm), steep slope, soft soil cover in the hills and alluvial formation in the valleys, there is high velocity and discharge of water laden with high silt charge. All these result into meandering nature of the river and causes severe erosion in the concave bends. An in depth study has been carried out at Alepsha as a vulnerable place, located at $23^0 59'$N. latitude and $91^0 36'$E.longitude, where bank line of the River Khowai is shifting towards west and damaging the transport system and cultivated lands .

OBJECTIVE: The objective is to study the temporal changes of the Khowai River bank and to analyse its impact on people in Alepsha.

METHODOLOGY: This paper has been prepared on the basis of intensive field work and modern technology. SOI topographical maps (1:63360) 78P/12 and 79M/9 of 1933-34 and satellite image of 1989 have been overlaid in GIS environment to show the temporal change of river course (Geomatica 10.1). Cadastral maps of 1966 and 1988 have been used to find out the sinuosity index, areas under erosion, deposition etc. Soil samples were collected from top to bottom of the affected bank at a vertical interval of 1m. These samples were mechanically analyzed (sieving) in the laboratory in order to determine their textural characteristics (Table 1).Textural class of soil has been determined by following standard methods (USDA, after Fitzpatrick, 1971). Present position of the channel was marked on the cadastral map after conducting field survey with the surveyor. Questionnaire survey has been carried out among the people suffering from shifting hazard.

RESULTS AND DISCUSSION: The River Khowai shows a narrow and highly sinuous course in 1932-33 with a length of 87.86 km. In 1989 it was wider and length was reduced to 59.71 km (28.15 km reduction in 56 years, i.e. 0.5 km per year). Fig. 1 shows its shifting towards west at Alepsha also.

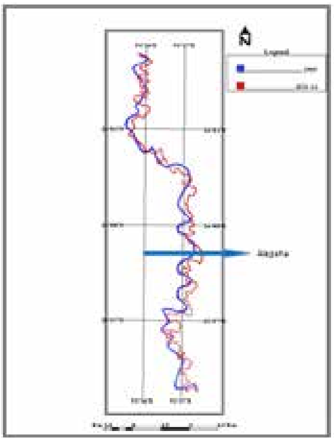

Fig. 1: Temporal change in the Khowai River bank line from 1934 to 1989 of the study area and its surroundings

Fig. 2: Highly vulnerable left bank of the River Khowai at Alepsha tracked by GPS along the State Highway.

Here the Highway has been captured by the river and the tracking points are on the existing road. Another road has been constructed by the government on the land of the villagers. Temporary protective measures adopted by means of local wood/bamboo permeable spurs have failed to protect river bank from erosion. As a result, the river course is gradually shifting towards the cultivated land, homesteads, various plantations etc. From 1966 to 1988 (22 years) the rate of shifting was 10m/year towards west. Again from 1988 to 2010 (22 years) the rate of shifting was 8.7 and 1.37m/year towards west and east respectively within Alepsha (Fig. 3).

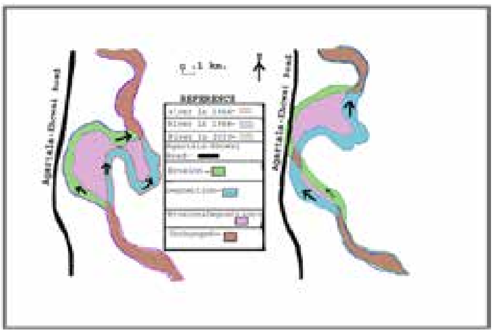

Fig. 3: Westward shifting of the channel has captured the State Highway during 1988-2010 period at Alepsha.

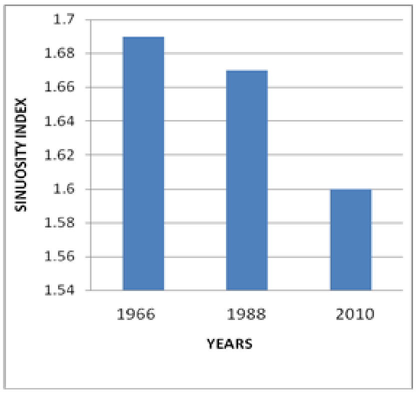

Fig. 4 : Change in Sinuosity Index of the River Khowai within Alepsha from 1.69 -- 1.60 .

Fig. 3 indicates that the river is becoming less sinuous leaving a number of cut offs and paleo- channels and thereby shortening its length (Fig.4). Due to this large scale shifting, area under erosion-deposition is more (Fig. 5).

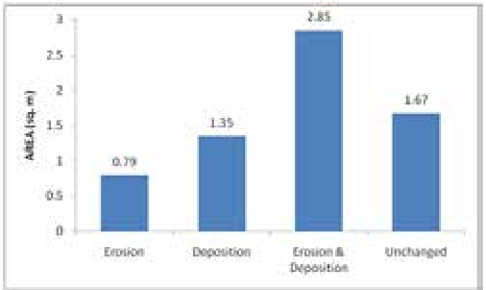

Fig. 5: Amount of area under past and present channel positions at Alepsha during 1966-2010

It is revealed from the above figure that the channel has a long history of shifting (45 years under study) as total area under erosion and deposition occupies maximum area 92.85 m2, paleo channel covers 1.35 m2, present channel occupies 0.79 m2 and for 1.67 m2 area the channel maintains its course for last 44 years (Fig.3).

Erosivity depends on the nature and amount of flow. The study area experiences average annual rainfall of 2487.77 mm, most of which (78%) falls during the monsoon season (June to September) when southwest monsoon fully establishes. During rainy season, heavy rainfall accelerates water velocity and discharge which again increase the energy of the river to erode its bank (Fig. 6 & 7). About 76% of the total discharge is reported during the monsoon months and maximum velocity was 1.6 m/s. Suspended solid estimates 6421607MT (74.66%) during monsoon. Therefore with increase in discharge, channel width increases which leads to increase in sediment load. The avg. depth and width of the channel is 1.35m. and 61.75m respectively.

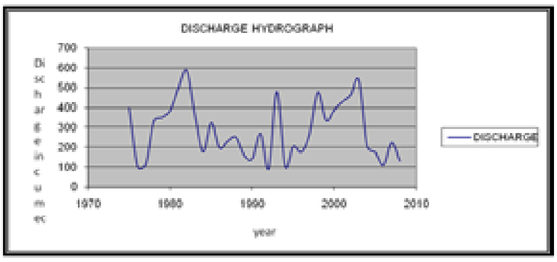

Fig. 6: Discharge hydrograph of the Khowai River

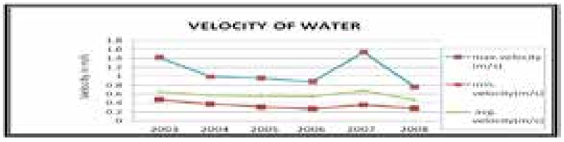

Fig. 7: Maximum, Minimum and Average Velocity of the Khowai River

Bank erosion is related with the erodibility of the bank material. Soil texture is an important physical characteristic of soil which may be defined as the degree of coarseness or fineness of soils resulting from the relative proportions of the particle size fractions – sand, silt and clay (Goswami et al., 1999).

Table: 1- Textural analysis of soil samples of left bank at Alepsha

Soil depth (m)	Sand (%)	Silt (%)	Clay (%)	Soil type
Top	70	30	00	Sandy loam
1	60	40	00	Sandy loam
2	60	39	1	Sandy loam
3	50	49	1	Sandy loam

Source: Soil sample tested by the researcher in the laboratory

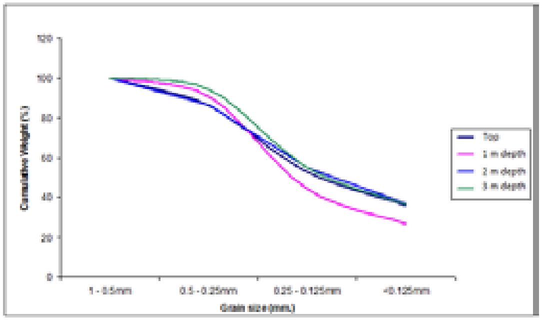

Fig. 8: Grain size analysis curve of left bank materials of the River Khowai at Alepsha

When a river bank consists of high amount of sand but lesser amount of clay that means the bank material is less cohesive and more susceptible to erosion. During heavy discharge, water penetrates through the interstitial spaces of sandy beds. After recession of high water level, lateral flow of sand and silt into the channel takes place which leads to disequilibrium condition in the bank itself and the bank failure takes place (Plate 1).

Plate 1: After recession of flood water the bank is ready to

collapse at Alepsha.
Moreover, the site lacks vegatation root depth and density which is another cause of bank failure. Bank sediment with a root volume of 16-18% and a 5 cm root mat can afford 20000 times more protection from erosion than comparable sediment without vegetation (Smith, 1976). Steep bank angle also indicates the high risk of bank erosion hazard in this portion. Presence of all these factors at Alepsha indicates its vulnerability to bank erosion.

Effects on people: Due to bank line change a large number of family have lost their homes and / or valuable agricultural lands. Some have migrated to far areas and facing the problem of their servival.

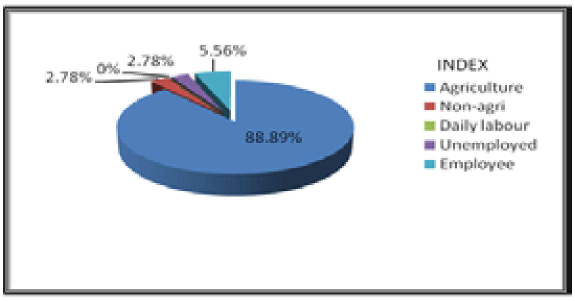

Fig. 9: Occcupational structure of the people of Alepsha
The above fig. shows that 88.89% people of the study area depend on agriculture, most of which had double-cropped land. Therefore their occupation is badly affected by this hazard.

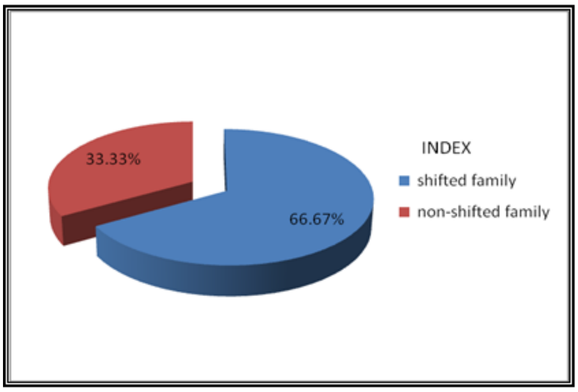

Fig.10: Status of the affected families of Alepsha.
People permanently migrated in their present location have been interviewed for understanding the problems faced by them . Among the total affected family, 66.67% have already shifted due to bankline change. Another 33.33% family have not shifted but they have to shift in future if this rate of change continues. They have already lost their agricultural lands.

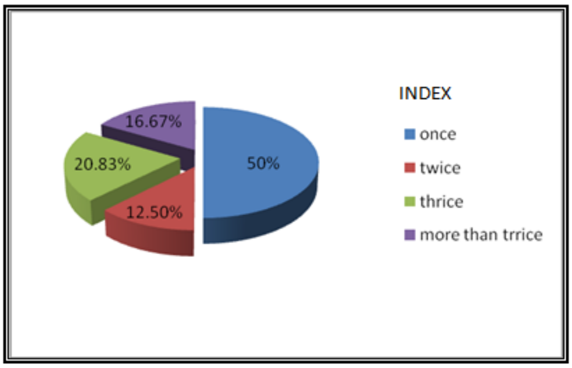

Fig. 11: Number of shifting of the shifted families
Above figure shows that about 20.83% and 16.67% people have to shift thrice and more times respectively for recurrence of this hazard. 12.50% and 50% families have migrated twice and once respectively. Due to shiftiing people had to spend extra money to build their houses again and again. For this the economic status becoming lower day by day.

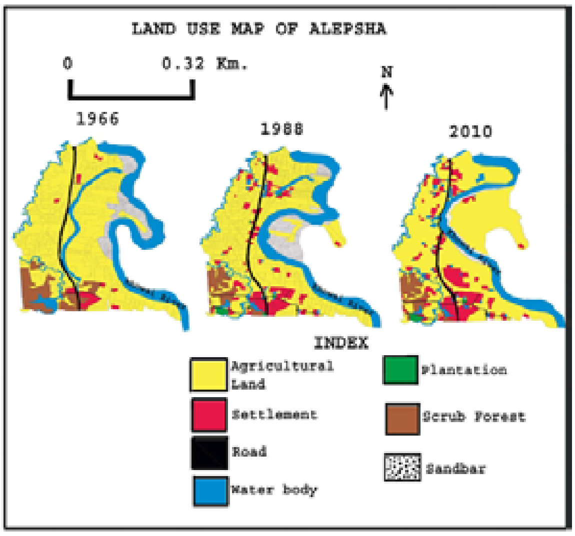

Fig. 12: Area under different land use in Alepsha from 1966 to 2010.
Latitudinal Extension: 23^{0} 59' N. - 24^{0} N., Longitudinal Extension: 91^{0} 36' E. - 91^{0} 37' E.

Table 3: Changing pattern of land use in Alepsha due to channel shifting (1966-2010)

Land Use Category	1966		1988		Change in %	2010		Change in %
	Area (acre)	%	Area (acre)	%		Area (acre)	%	
Agricultural land	240.60	67.84	201.45	56.93	10.91	214.96	61.38	- 4.45
Settlement	6.09	1.72	29.74	8.41	-6.69	39.95	11.41	- 3
Water bodies	26.8	7.56	32.04	9.06	-1.5	44.45	12.69	- 3.36
Plantation	Nil	Nil	3.56	1.01	-1.01	3.48	0.99	0.02
Scrub forest	43.78	12.34	36.43	10.30	2.04	24.58	7.02	3.28
Road	9.07	2.56	21.99	6.21	-3.65	12.37	3.53	2.68
Sand bar	28.32	7.99	28.62	8.09	-0.1	10.42	2.98	5.11
Total	354.66	100	353.83	100		350.21	100	

Source: Calculated by the researcher
The above table clearly explains the changes in area under different land uses during 1966-1988 and 1888-2010 periods. In 1966, agricultural land area was large which has been decreased in 1988. In 2010, it has been increased in comparison to 1988 because of the transformation of land by nature or by people .The people of the bank are compelled to replace their houses in the safer place. From Table 3 it is clear that the area under settlement is increasing significantly. People are transforming land from one category to another according to their needs. In 2010 area under sand bar has decreased because people have used it as agricultural land. In Alepsha the State Highway (Agartala-Khowai Road) was totally destroyed by the river, at least twice during this period. In the previous years' area under plantation was nil but in recent years people are planting trees according to their purpose. Thus vast changes have been found between the land use maps of 1966 and 2010.

Conclusion: Presence of high percentage of sand (50% – 70%) compared to silt and clay and high amount of monsoon rainfall leads to high erodibility and erosivity of flow and ultimately bank erosion takes place. Absence of vegetation root depth and density also found responsible for it. The study reveals that this is a recurrence fluvial hazard faced by the people of this area which needs immediate attention. Proper management to be taken to restrict it within its buffer zone. Considering the rate of shifting (8-10m/year) green belt may be planted to a distance of about 20m along the left bank, bamboo may be considered suitable. The Highway may be constructed beyond this green belt to avoid its recurrence damage.

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