

Bank Erosion and Channel Abandonment of the Sankosh River in India

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ABSTRACT

Bank erosion is an important process of channel abandonment of the Sankosh River. In alluvial river bank erosion is frequently occurred which caused by several factors i.e. high discharge, flow diversion, migration of bar, cohesiveness of the bank material and different anthropogenic activities viz. construction of embankments, excessive gravel and sand extraction from the river bed. At the same time, sufficient energy is also considered as an important factor for bank erosion. It is mentioned that bank erosion for channel migration demand available stream energy which occurred during bankful stage. Moreover, the combined effect of both the physical and anthropogenic processes causing bank erosion and formation of abandoned channel along the Sankosh River in India. Generally, the River erodes one bank as well as deposition occurred on the other bank and sometimes bank erosion may also be occurred in the both bank of the river channel. It is noticed that bank erosion is high during peak discharge period due to high current of water flow and excessive load of the river. In this way wetting of the bank materials lower the shear strength of the bank and the bank strength reduce remarkably and as a result create fissures and cracks over the surfaces. Moreover this condition generates tension within the bank soil which leads to slip failure. As a result the widening of valley occurs by this bank erosion process and the meandering of the river increases day by day and initiates the process of channel abandonment.

1. Introduction

Bank erosion is an important process that has both geomorphological and anthropogenic significance which varies over different time-scales. Geomorphologically, bank erosion is a main component of the formation of meander, lateral channel shifting and the movement of sediment throughout the drainage basin (Lawler, 1993) and required a long time for these occurrences. On the other hand, anthropogenically, bank erosion is occurred more readily over just a short period of time. This anthropogenic activity helps to eroding banks pose a threat riparian floodplain structure and to the fertile agrarian land of the flood plain. It is at this shorter time scale that the mechanisms which constitute bank erosion are often studied (Couper&Maddock, 2001)

Anyway, Bank erosion process is frequently found in the both bank of the Sankosh River. Researchers have observed different types of bank erosion and also investigate the rate of land loss by bank erosion along the channel of Sankosh River at the time of field work. Bank erosion of Sankosh River may also be considered as an important factor of meandering of channel and channel abandonment.

2. Objective

1. To analyse various type of bank erosion associated within the study area
2. To find out the extent of bank erosion in different reaches of the Sankosh River in the study area

3. Methodology

Empirical and quantitative techniques of geomorphology will be applied according to the requirement. Various relevant maps will be prepared by using geo-spatial techniques on the Remote Sensing and GIS platform. Quantitative and qualitative

conclusions will be derived from systematic compilation processing and classification of information (generated by sample survey) and data.

4. Study area

The geographical location of the study area is 26°44'24" N to 25°58'48" N latitude and 89°43'48" E to 89°55'12" E longitude. The study area is covered an area of 1012 sq.km. The present study area is located within the states of West Bengal and Assam of India.

5. Major findings

Types of Bank Erosion:

Different types of bank erosion along the Sankosh River have been identified in different reaches during the field work with consultation of technical documents. Throne (1991) had given a detail discussion on bank erosion and bank failure processes in this regard. River bank erosion includes three general geomorphic processes operating with various magnitude and frequencies depending on specific environment associate with the bank side. The first process is related to fluvial entrainment, The second process is bank failure and the last processes is associated with sub aerial erosion which entails a weakening of the bank face and subsequent fall of soil particles (Veihe, *et al.*, 2011). On the basis of these above processes, Bank erosion may be classified in various types that have been identified in the field discuss in below.

Parallel flow erosion: In the study area the parallel flow has been observed in relatively straight channel reaches of Sankosh River at upstream. It has been evidenced from the field study that parallel flow erosion occurs in the reaches at midstream due to high flow velocities close to the bank, ragged

appearance of the bank face and absence of surficial vegetation.

Impinging flow Erosion: Impinging flow Erosion is defined as the detachment and removal of grain or aggregates of grain by flow attacking the bank at a steep angle to the long stream direction. This type of flow has been found at braided reaches of the channel where braid bars direct the flow strongly against the bank. It is also found where the radius of curvature of the outer bank is less than that of the channel centreline. Moreover that type flow erosion also found where an in stream obstruction deflects and disturbs the orderly flow of water. For evidence, Impinging flow Erosion is found near at Sankosh River Bridge of the study where braid bars directing the flow forwards the bank and high flow velocities approaching the bank at an acute angle to the bank.

Piping or Crab-hole Erosion: Piping is occurred where ground water seeping out of the bank face. Grains are detached by seepage flow and removed away from the bank face by surface run-off caused by the seepage. This type of erosion is specially occurred in high banks or banks backed by the valley side or some other high ground. Evidence include some seepage home are found at near Sankosh side in the study area where pipe shaped cavities in the bank with the layer of sand.

Sheet Erosion: Sheet erosion is occurred in the areas of exposed surface layer of soil with lack of vegetation. It has been generally found in the reaches where fresh appearance of soil surface that has been deposited in recent previous years. It is mentioned that sheet erosion caused by non-channelized surface run-off specially during the high storm period. Moreover, it is also mentioned that sheet erosion results from surface water drain over the bank vegetation has been deforested by human activities. Finally sheet erosion is defined as the removal of loosen material from the edges due to the draining of surface water down to the bank. Evidence includes:

Rilling and Gulling: Rills are small ephemeral channels that often form in sub parallel sets on sloping agricultural land in response to intense run-off events. It is uneven removal of surface soil by the formation of small scale rill channel. It is formed when overland flow down a slope specially flowing heavy rainfall concentrated into rills which merge and enlarge into the gully (Smith, 1984). These types of rilling and gulling are very common and dominant in the reaches of upstream to downstream.

Stream bank Failure: Serious bank retreat often involves geotechnical bank failures at the river bank as well as direct erosion by the flow. Generally during peak and high discharges accelerates the shear stress surpasses the shear resistance of the bank and the safety factor becomes negative and then collapsing in the form of mass failure, is called stream bank failure. Examples of different modes of geotechnical river bank failure like soil fall, rotational slip, slab failure, block slumping, Wet earth flow, block glide etc. may be included in this regard.

Rotational Slip: Rotational slip is the most widely recognised types of mass failure mode and commonly found in the riverbank slide. A deep seated failure along a curved surface results in back tilting of the failed mass towards the bank of the river. The sliding mass rotates with the bottom slipping further forward then the top (Smith, 1984). Such type of failures is common in high and strongly cohesive banks of

the river. These types of bank failure are found in the reaches of the study area.

Slab-type Bank failure: This type of failure is sliding and forwarded toppling of a deep seated mass into the channel during the low flow period. Slap failure occurs in the cohesive banks with steep bank angles. In the study area, this process observed in the reaches of midstream the study area.

Wet Earth flow failure: Wet earth flow failure is the loss of strength of a portion of bank due saturation caused by heavy and prolonged precipitation. Earth flows promoted by heavy rainfall as a result eroded materials are oversaturated. This type of failure is more common on valley sides where high alluvium and clay materials are available. Such type of failure is commonly found in the downstream of the study area.

Pop out failure: Pop out failure is occurred due to over saturation and strong seepage in the lower half of a steep and cohesive bank. A slab of material in the lower half of the steep bank face is fall out and leaving an alcove shaped cavity in the bank side. For example, such type of failure is found in the reaches of midstream of the study area.

Extent of Bank Erosion: The extent of bank erosion of the study area has been observed and calculated along the reaches. For the convenient of field survey and measurement of bank erosion here we select three reaches along the Sankosh River of the study area. So, the extent of bank erosion has been discussed reach-wise in detail in this chapter under the following heading:

Reach AB: Reach 1 of the study area is covered an area of 0.11sq.km from west to east. In this reach, bank erosion is occurred in the both left and right bank. An area of 1.37sq.km has been eroded away from the right bank where 0.11 sq.km area has been removed from the left bank in the year 1991 to 2016. On the other hand, the area eroded during the year 2016 has been found -1.37sq.km and 0.11sq.km in the right and left bank respectively of this reach.

Reach CD: Reach 2 of the study area there are no erosion or bank line shifting in the cleft bank. In this reach, bank erosion is occurred in the both left and right bank. An area of 0.27sq.km has been eroded away from the right bank in the year 1991 to 2016. On the other hand, the area eroded during the year 2016 has been found 0.27sq.kmin the right of this reach.

Reach EF: Reach 3 of the study area is covered an area of 0.36sq.km from west to east. In this reach, bank erosion is occurred in the both left and right bank. An area of 0.89sq.km has been eroded away from the right bank where 0.36sq.km area has been removed from the left bank in the year 1991 to 2016. On the other hand, the area eroded during the year 2016 has been found -0.89sq.km and 0.36sq.km in the right and left bank respectively of this reach.

Reach GH: Reach 4 of the study area there is no erosion or bank line shifting in the cleft bank. In this reach, bank erosion is occurred in the both left and right bank. An area of 0.70sq.km has been eroded away from the right bank in the year 1991 to 2016. On the other hand, the area eroded during the year 2016 has been found 0.70sq.kmin the right of this reach.

Reach IJ: Reach 5 of the study area is covered an area of 0.78sq.km from west to east. In this reach, bank erosion is occurred in the both left and right bank. An area of 0.78sq.km area has been removed from the left bank in the year 1991 to

2016. On the other hand, the area eroded during the year 2016 has been found 0.78sq.km in the left bank respectively of this reach.

Rates of Bank Erosion: The figure no.1 represents the rate of bank erosion of all five (5) reaches of the Sankosh River of the Study area. The rate of bank erosion varies from one reach to another. The highest bank erosion has been observed in the reach No.1 at upstream with 1.48 sq.km followed by the reach no.3 at midstream with 1.25sq.km. On the other hand, lowest rate of bank erosion has been observed in the reach no. downstream at 0.27sq.km.

Table-1: The area eroded from different reaches along Sankosh River of the study area.

Reach No.	Erosion (Sq.km)		
	Bank		Total (RB+LB)
	RB	LB	
AB	1.37	0.11	1.48
CD	0.27	0.00	0.27
EF	0.89	0.36	1.25
GH	0.70	00	0.70
IJ	00	0.78	0.78

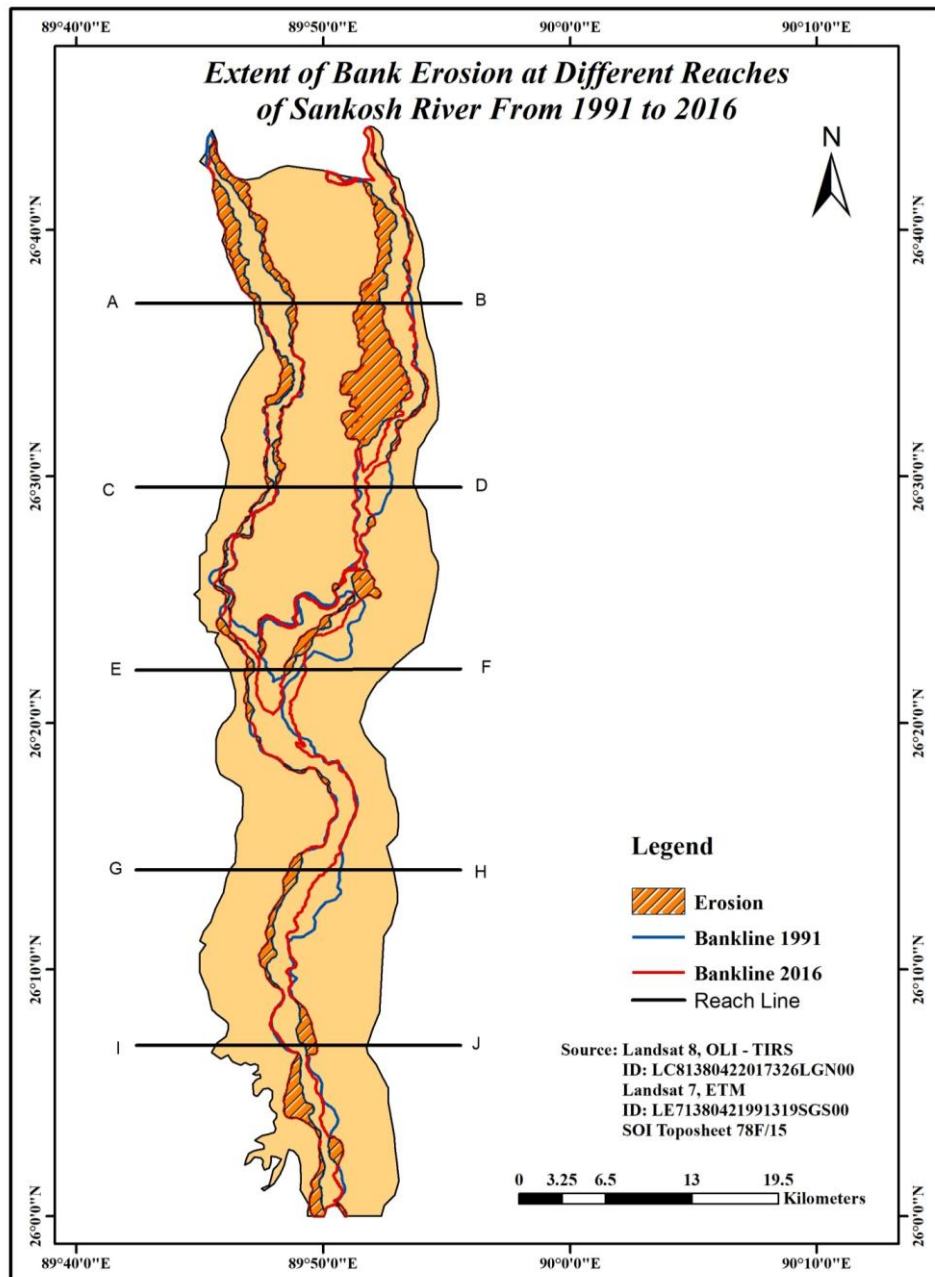


Fig. no.1: Extent of bank erosion at different reaches of Sankosh River from 1991 to 2016

6. Conclusion

Bank erosion is an important process of the formation of the abandon channel in the study area. It is noticed that bank erosion is high during peak discharge period due to high current of water flow and excessive load of the river. In this way

wetting of the bank materials lower the shear strength of the bank and the bank strength reduce remarkably and as a result create fissures and cracks over the surfaces. Moreover this condition generates tension within the bank soil which leads to slip failure. As a result the widening of valley occurs by this

bank erosion process and the meandering of the river abandonment in the study area.
increases day by day and initiates the process of channel

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