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RESEARCH ARTICLE

A STUDY OF GEOMORPHOLOGICAL ANALYSIS AND FLUVIAL LANDFORMS ON THE COURSE OF RIVER TISTA IN SIKKIM

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ABSTRACT

Geomorphology sub-fields of physical geography which studies landforms on the earth's surface. Geomorphic processes and its landforms are the major domain of the subject. Although, various types of landforms glacial, arid, aeolian, fluvial, etc have its own processes and system. Fluvial processes are conscientious for the frequently change the earth landscape compared to other processes. The fluvial landscape is dynamic in nature, river affects a land in three ways i.e. erosion, transportation, and deposition, with the help of fine to coarse-grained erosional tools viz. sand, pebbles, boulders, etc, these three activities of the river are inter-related. Study of fluvial landforms is out most important owing to major human activities are found on the river bank. Nonetheless, river valley of Tista has numerous urban settlement, rural settlement, transport, and industries. Being the valleys lies in the IV Zone of seismic zonation map of India, valleys are more vulnerable to natural extreme events.

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INTRODUCTION

Sikkim is the 22nd State of India that lies in the North-Eastern part of the country. It is the second smallest and the least populous state in the country (2011 census). It extends between 27^0 04' 46" N to 28^0 07' 48" N latitudes and 88^0 00' 58" E to 88^0 55' 25" E longitudes with elevations ranging from 280-8586m above mean sea level. Although the total geographical area is only 7096 km^2 the state is very diverse in terms of its flora and fauna. The state is separated from Nepal in the West by the Singalila Range, from China in the North by the Chola Range, Bhutan in the East and the State of West Bengal in the South. The landforms refer to the morphological and character of land surface resulting from the interaction of physical processes and crustal movements with the geology of surface layers (Singh, Svindra). Fluvial landforms are those landforms which are formed by river and streams. Since, from the source to the Rangpo valley of the river Tista, the river developed numerous erosional and depositional features. The formation of the river channel is a result of the erosional capacity of the stream. The erosional capacity of the stream depends mainly on its volume and velocity. The river Tista starts its journey from the Chholamu Lake, Lungna, Ochha, Ookra, Kombe areas in the north eastern parts of Sikkim in the north district of the state. It flows from the north-south direction. River Tasha Chhu, Lasha Chuu join the upper course of the river. Similarly, Lachung Chhu, Ong Chuu, Ramam Chhu, Rangphap Chhu join as a left and right bank tributaries in the middle course of the river. Pabong Khola, Rongli Chhu, Rangpo Chhu are major the tributaries join the river Tista, in the southern part of the state. The river Tista performs three types of work viz. Erosion, transportation and deposition processes and landforms.

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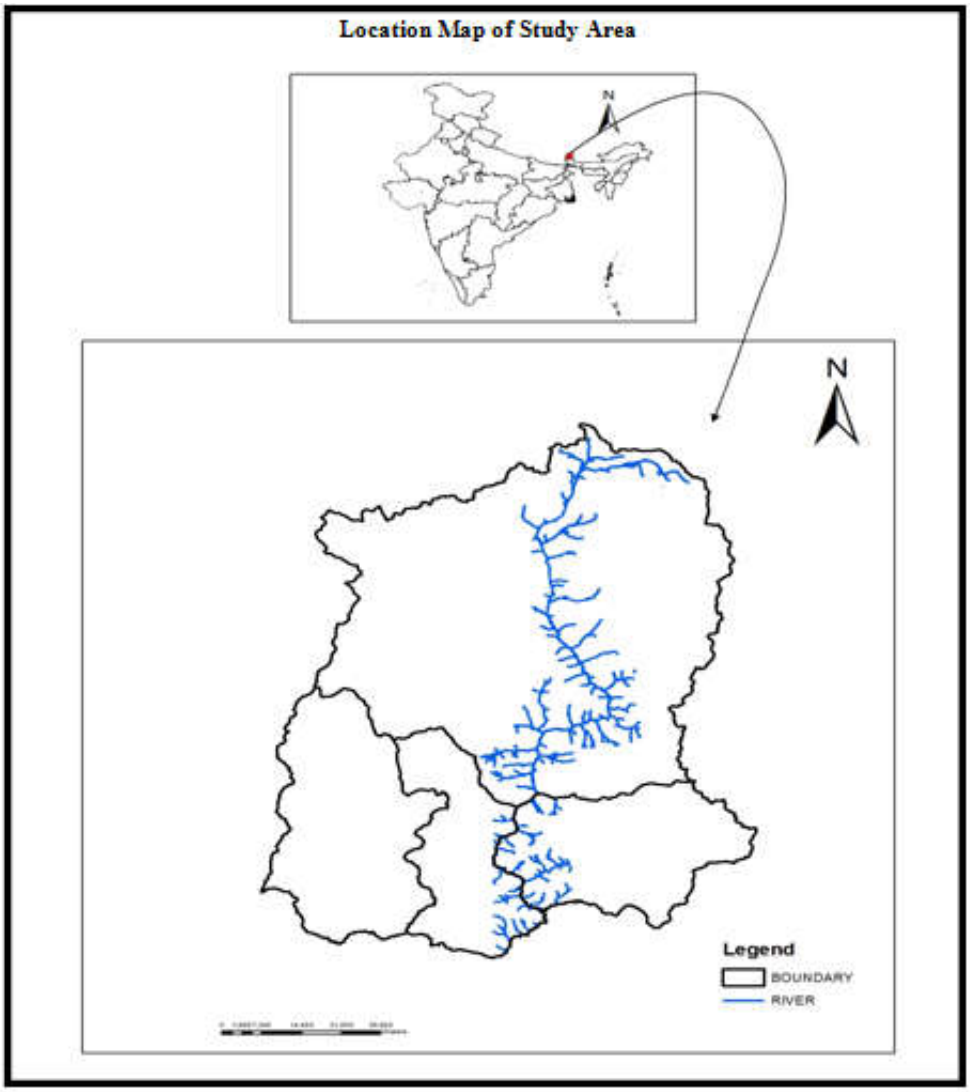
METHODS AND MATERIALS

The methodology of conceptualized and analyzing the major aspects related to Geomorphology of Tista river has been adopted for the present study. The study area is from upper course of river Tista to Melli (Sikkim –West Bengal border) The paper is based on the primary and secondary data, primary data generated through field observations along the river Tista and Secondary data through satellite imagery interpretation, google earth imagery interpretation and from other publish and unpublished books, reports, dissertation, etc.

Erosional Processes and Landforms: Erosion work of the stream is performed both mechanically and chemically. Some of the rocks over which the stream flows, are soluble.



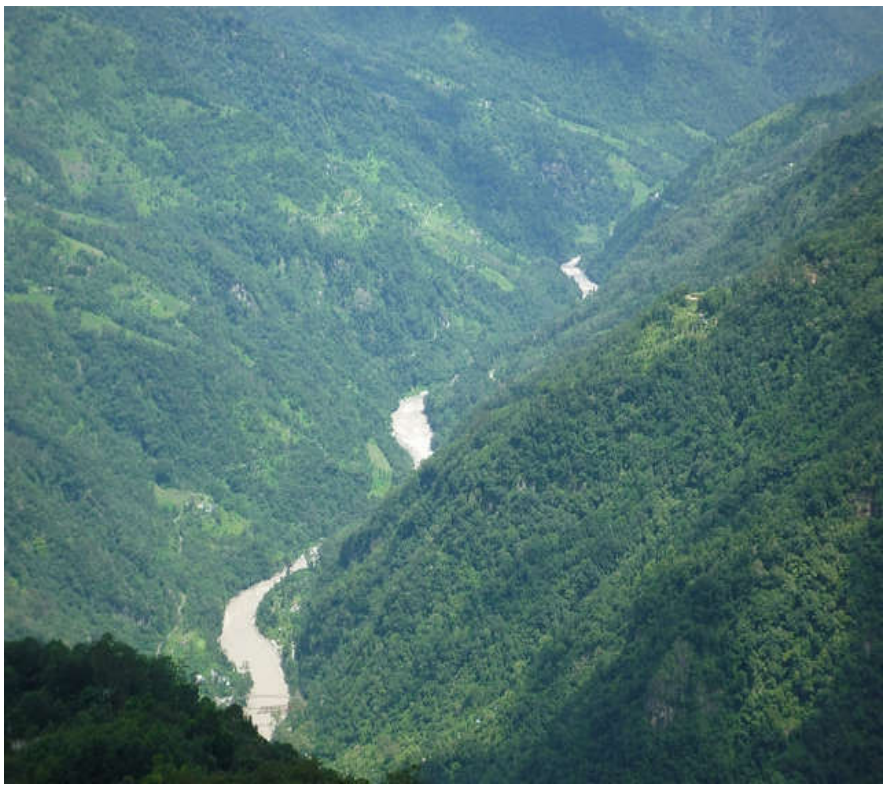


Plate 1. V-Shape valley, Tista River

The water the rocks along their joints and makes cavities through solution action. Mechanical erosion is caused by three chief processes viz. hydraulic action, Corrosion, and attrition. Hydraulic action refers to the physical force of the moving water. The force of the running water mechanically breaks and removes the rocks in its course. The broken rocks fragments being carried by the water increases the erosional capacity of the running water several times. Rock fragments moving downstream strike against the rock along the bed and side if the river channels thus abrading and breaking them. The corration may be a vertical leading deepening of the valley of the stream, or lateral leading to a widening of the valley. The rock fragmented transported may thus be converted into fine sand and silt through the process of attrition. The chief landforms made through this action of the stream such as V-Shaped valley, river capture pot holes waterfalls plunge holes or plunge pools, rapids, meander, incised and entrenched meander river terraces, structural benches, etc. which are common landforms on the upper course of river Tista. The above plate depicts the V-shape valley formed by the river Tista.

Transportation Processes and landforms

Rivers are important agents of transportation it carries rock fragments of various sizes from its upper course to the lower reaches. Generally, transportation landforms are formed when the river velocity and the gradient decrease, the transportation capacity of the river also decrease simultaneously the river started deposition of its sediments along the river, as a result, it forms different types of depositional landforms such as deposition of boulders, pebbles, and sand along the river. The stage of river represents in the above plate depict that the transportation capacity of the river is high because the velocity of the river is high as compare to silt deposited in the lower course of the river Tista. huge amount of big boulders and pebbles has been carry by the river which represents that the more the velocity of a river, the more load can carry, the main processes for the formation of this landform includes attrition, abrasion or corrosion are active as a result which transport gravels, pebbles, and large particles move as bed load close to the channel floor by rolling or sliding. Therefore, we can state that the stage of the river depicted in the plate is a transportational stage.

Depositional Processes and Landforms

A river starts depositing its load when its velocity is reduced and it is incapable of transformation the entire material being carried by it. A river depositing its load which the amount of load being carried exceeds its transportation capacity. Reduction in its capacity generally a result of a reduction in its velocity and the river is incapable of carrying its present load at the lower velocity, so its start depositing.

Plate 2. Transportation of Sediments, Tista River

Plate 3. Formation of Natural Levee

Plate 4. Alluvial Fans along the River Tista

The largest particles of the debris are deposited first of all and the finest particles are deposited the last. Some of the important topographical features of the depositional landforms river are alluvial fans, ox-bow lakes, Delta, Flood plain natural levees, alluvial island, and sandbars. In Mangan river deposited silts and forms the depositional landforms natural levee and then the lateral erosion relatively increased and hence river starts widening. Below Ralep reserved forest near Papung Khola, there is around 276 meters widening of the river, where huge deposition of sandbars, and silt deposition. Maximum depositions of boulders are found from the Brum Khola where sand bar, lateral deposition of boulders is predominated, between Brum Khola and Khamdong there is huge deposition of boulders and pebbles are found., where there is the huge formation of natural levee formed by the confluence of river Rongli chhu or Rani Khola with Tista. The plate 3 depict that there is huge deposition of sediments in Rangpo which has around 1km length and 260 meters breath. In the middle of this depositional features, natural levee formed around 260 meters of length and 133 meters of breath. The plate 4 depicts the new formation of an alluvial fan near Rangpo areas. In between Donak reserve forest and Ramphuk reserve forest, there are wide depositional flood plains formed by the river. Majitar is a huge flatly plain is considered as largest depositional river valley. Along the bank of the river.

RESULTS

The total length of river Tista from the source areas to Melli is around 315 km. The river valley is endowed with numerous erosional, transportation and depositional processes and features. Maximum erosional features are found in the upper course of river Tista while transportation and depositional features are found in the middle and lower course of river respectively. The river low laying valleys are found well developed human settlements, industries, and urban centers. Therefore, the further systematic study is much needed for detail natural hazards and disaster assessment to minimize the potential disasters.

Conclusion

The study mainly focused on the Geomorphological analysis of Tista River and its processes and landforms in Sikkim. Various type of fluvial landforms made by the river along both the bank of the river Tista has been critically analyzed. The Sikkim Himalaya uplifted and tilted mountainous terrain which has been divided into several large elongate sub-parallel tributary valleys like the Rangpo chu, Rongni chu, Lachung Chu, Ranikhola, Rora chu, Takchom chu, Geilkhola, etc. An important feature of the Tista drainage basin is the remarkable way in which geological structure and the character of the underlying rocks are expressed in the landforms. Applying fluvial geomorphology to river channel management background for progress towards a palaeohydrology by (K.J. Gregory, G. Benito P.W. Downs, 2008) study revel that the fluvial geomorphology has wider application in river channel management. Applications of fluvial geomorphology research can arise where results or new facts may be applicable to environmental problems (applicable research) or where results are related to environmental problems in a specific area (applied research). In addition planning research, management research and sustainability research can be identified (Gregory, 1998, 2000). The upper course of river Tista is dominated by the erosional landforms wherein V-shape valleys are most common, Glacial fluvial landforms are predominant in the higher altitude areas such as braided streams, eskers, flood plains in the Yumthang valleys. The course of river Teesta from Dikchu to Singtam depicts that, from the Mangzing area the velocity of the river decreases up to Singtam, wherein heavy amount of deposition of sand and silt have been found. The erosional landforms are dominated in the upper course of the river while the depositional landforms are found in the middle and lower course of the river. The river Tista starts from its journey from the Chholamu Lake, Lungna, Ochha, Ookra, Kombe areas in the north eastern parts of Sikkim in the north district of the state. It flows from the north-south direction. River Tasha Chhu, Lasha Chuu join the upper course of the river. Similarly, Lachung Chhu, Ong Chuu, Ramam Chhu, Rangphap Chhu join as a left and right bank tributaries in the middle course of the river. Pabong Khola, Rongli Chhu, Rangpo Chhu are major the tributaries join the river Tista, in the southern part of the state. Well, define river channel do not develop in areas of low rainfall, for instance, arid and semi-arid regions, sometimes reason of floods develop seasonally.

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