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Morphometric analysis of Sankosh River based on Linear aspect

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ABSTRACT

Morphometry is the measurement and mathematical analysis of the configuration of the Earth surface, shape and dimensions of its landforms. The morphometric analysis does, therefore include different aspects like erosional development of drainage network, the intensity of landform contrast, the phase of the development of lands through various fluvial processes etc. In the study area, the measurement of various morphometric parameters such as stream order, stream length (Lu), mean stream length (Lsm), stream length ratio (Rl), bifurcation ratio (Rb), mean bifurcation ratio (Rbm) etc. has been carried out.

Introduction

The Mo-Chu or Sankosh River also known as Puna Tsang Chhu in its upper reaches which located in the northern part of Bhutan. The River Sankosh rises in the great Himalayan region of Bhutan and it starts to flow towards the south, following the regional slope of Bhutan Himalaya and find its confluence at the river Brahmaputra in Bangladesh. It is mentioned that total Basin area of Sankosh River is about 9734 sq.km in Bhutan. At Punakha, the Sankosh River is joined by a tributary named the Pho Chu and 20 km further downstream at Wangdi Phodrang by the Tang Chu. Many mountain streams join the Sankosh River on both sides. At its exit into the Duar plain, it is a deep river flowing mainly over a bed of boulders. Moreover, the portion of this river basin falling within West Bengal and Assam is constituted of lower alluvial courses having significant dynamic fluvial characteristics for which frequent changes and abandonment of courses are manifested in the channel system which counts for adequate academic significant.

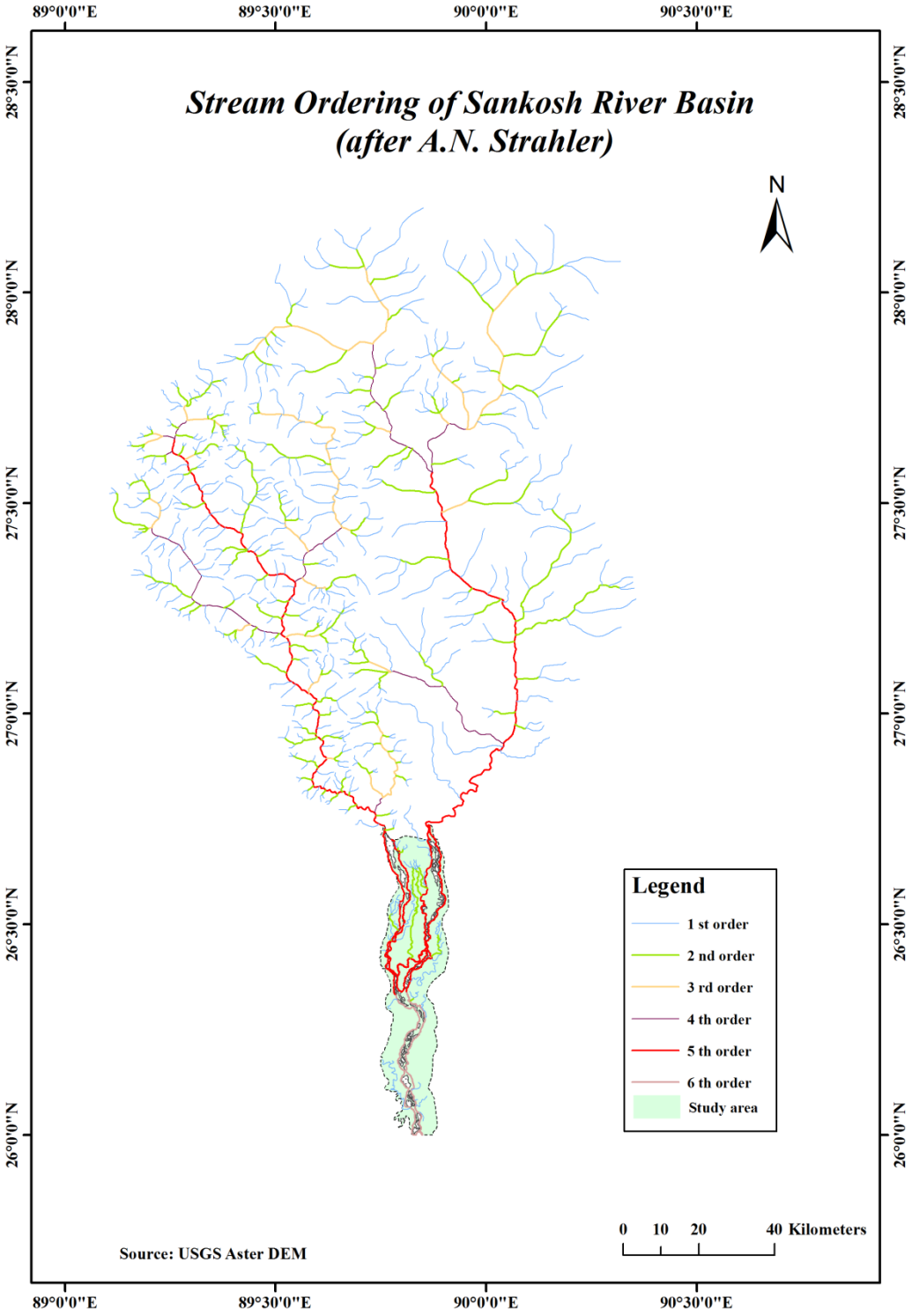
Methods:

According to Clark (1966), morphometry is the measurement and mathematical analysis of the configuration of the Earth surface, shape and dimensions of its landforms. The morphometric analysis does, therefore include different aspects like erosional development of drainage network, the intensity of landform contrast, the phase of the development of lands through various fluvial processes etc. It is mentioned that morphometric analysis of the studied basin includes the measurement of linear, areal and relief aspects of the basin and slope configuration (Nag & Chakraborty, 2003). In the study area, the measurement of various morphometric parameters such as stream order, stream length (Lu), mean stream length (Lsm), stream length ratio (Rl), bifurcation ratio (Rb), mean bifurcation ratio (Rbm), Elongation ratio (Re), etc. has been carried out.

Stream ordering:

The drainage basin is considered as an important geomorphic unit on the surface of the Earth. The drainage basin area is considered as an area which contributes water for a particular channel or a set of channels within the drainage basin. A drainage basin provides a limited unit of the surface of the Earth within which basic climate quantize can be measured and characteristics landforms described and a system within which a balance can be struck in terms of inflow and outflow of energy (Luna B. Leopold, Wolman, Miller, 1964). River Sankosh contributes a drainage basin in Bhutan and India with a number of tributaries and reveals various morphometric characteristics and associated erosional and depositional landforms in the Sankosh River basin.

In a drainage basin, Stream ordering is considered the process of identification of links in a drainage network. The Strahler's method (1952, 1964) of stream ordering system has been adopted in determining stream order in the Sankosh river basin. The Stream order analysis reveals that the Sankosh river basin belongs to 6^{th} order basin. It is mentioned that the whole basin area of Sankosh River has formed in different run-off zone on the basis of stream order. In the Sankosh River basin it is observed that the total number of 1^{st} order River is 510 and 148, 26, 10, 2, 1 are 2^{nd}, 3^{rd}, 4^{th}, 5^{th} and 6^{th} order respectively.



Map: Stream Ordering of Sankosh River Basin (after A.N. Strahler, 1952)

Drainage Network Composition:

Bifurcation ratio is a unit less number indicating the ratio between the number of streams of one order and those of the next-higher order in a drainage network. The relationship between streams of different orders has calculated by Bifurcation ratio. (Table) The Bifurcation Ratio has deep significance to analysis a drainage basin as it is the leading parameter for linking the hydrological regime within a watershed under any topological and climatic conditions. The shape of the basin and run off behaviour of a drainage basin has also be calculated by bifurcation ratio. Bifurcation ratio may be a useful measure of flood frequency and discharge where the higher the ratio value, the shorter will be the time taken for discharge to reach the passage, and higher will be indicate the peak discharge which leading to a greater possibility to flooding. Bifurcation ratio (Table) correlates

positively with drainage density i.e. a high bifurcation ratio indicates a high drainage density. Higher bifurcation ratio also suggests that the area is tectonically active and prone to extreme events. The value of bifurcation ratio can also explain which parts of a drainage basin are more likely to extreme event i.e. flood, comparatively, by looking at the separate ratios.

Bifurcation ratio (Rb):

$$Rb = \frac{Nu}{Nu + 1}$$

Where, ***Rb*** = Bifurcation ratio,
Nu= Number of segments of a given number,
Nu+1 = Number of segments of the next higher order.

Stream length ratio (Rl):

$$Rl = \frac{Mean\ Lu}{Mean\ Lu - 1}$$

Where, ***Rl*** = Stream length ratio,
Lu = the total stream length of order,
Lu − 1 = the stream length of next lower order.

Table: Linear properties of Sankosh River basin

Stream order *(u)*	Stream numbers *(Nu)*	Total length of stream of order u *(Lu km)*	Mean Stream length in km *(Mean Lu = Lu/Nu)*	Bifurcation Ratio $Rb = \frac{Nu}{Nu+1}$	AV Rb= Reg. Coefficient b^{-1}	Stream length ratio *Rl = Mean Lu/Mean Lu-1*
1st	**510**	**2321.64**	**4.55**			
2nd	**148**	**821.03**	**5.55**	**10.63**		**1.21**
3rd	**26**	**299.72**	**11.52**	**5.70**		**2.07**
4th	**10**	**183.06**	**18.31**	**2.6**		**1.58**
5th	**2**	**325.16**	**162.58**	**5.0**	**4.23**	**8.87**
6th	**1**	**51.29**	**51.29**	**1**		**0.09**
Total	**697**	**4001.9**	**253.8**			**13.82**
Mean	**116.17**	**666.99**	**42.3**			**2.764**

Source: Data compiled by researcher.

Result and Discussions:

1. It is observed that Sankosh River basin shows an average bifurcation ratio 4.23 which is within the normal value ranges 3 to 5 and this indicates that higher concentration of water from lower stream order to higher stream order.

2. The lower basin of Sankosh River influenced by fluvial geomorphology and lithology.

3. The evolution of drainage network in the lower reaches of the study area decreased and at the same time the length of 6th order stream increased due to high bifurcation ratio.

4. The basin width decreases in the lower reaches which promote elongation of basin shape of Sankosh River.

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