



## Channel Pattern Variability and Stream Characteristics: A Study of Tulsi and Bhogawati River using Geoinformatics

### KEYWORDS

Sinuosity Index, Meandering channel, Braiding, variation in river discharge, river energy, GIS.

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### ABSTRACT

*In the present research work, an attempt has been made to study the plan view of Tulsi and Bhogawati River. The study area forms a part of Tulsi channel from its dam to its confluence near Bid and a channel of Bhogawati from Radhanagari Dam to Prayag Chikhali of Kolhapur District. Channel in plan means, the various channel patterns of river i.e. straight, sinuous, meandering and braided. The study of river plan-form is significantly essential for river restoration and river conservation. Apart from hydrological events, unplanned agricultural activities and deforestation in the basin is extremely responsible in channel erosion and shifts in channel locations that is one of the causes for the variation in sinuosity index of the channel. River is generally controlled by geological characteristics of basin and its plan form, which equally influence on channel slope and shows the erosional or depositional signs of the river. Geomorphic characteristics and within channel variations are also influenced by the variability in river basin and its hydrology. The study of channel in section and channel in plan also predicts the future channel deposition and erosion. Therefore an attempt has been made to study the channel patterns and channel variability of Tulsi and Bhogawati River.*

### INTRODUCTION



Figure 1 : Study Area ( Source : SRTM data)

In the studies of river basin and watershed management it is important to understand the plan view of the river. The channel pattern considered to be a 'plan view' of a river reach and comprises meandering, braided, and straight channels (Leopold and Wolman, 1957). The channel pattern of a river usually differs from place to place and shows variations in the river characteristics. Leopold and Wolman (1957) calculated the sinuosity of a reach considering the ratio of thalweg length to valley length. The sinuosity index is the ratio of length of channel to length of meander-belt axis also. That means the sinuosity index can be computed as the ratio of the length of channel to length of valley axis (Brice, 1964). According to the Brice, if the sinuosity index of a reach is 1.3 or greater, the reach is considered as meandering, a straight reach has a sinuosity index of 1 and reaches which is having sinuosity indices between 1.05 and 1.3 are defined as sinuous. Toy in 1987 described that in addition to changes that occur in stream channel cross section and slope; channels also have characteristic patterns in a down-stream direction when observed in plan view. The most easily recognized are braided and meandering pattern; long straight reaches are not common in natural streams. All of these patterns are a reflection of the water discharge, sediment load, channel slope and cross section. According to Schumm (1972) an in-

crease in sinuosity of river generally occurs with an increase in Valley slope and channel gradient. Alluvium excavations from river banks are also extremely responsible in channel erosion and shifts in channel locations that is one of the causes for the variation in sinuosity index of the channel (Sapkale, 2014). Therefore in view of variability and changing pattern of Tulsi and Bhogawati River, the present research has attempted.

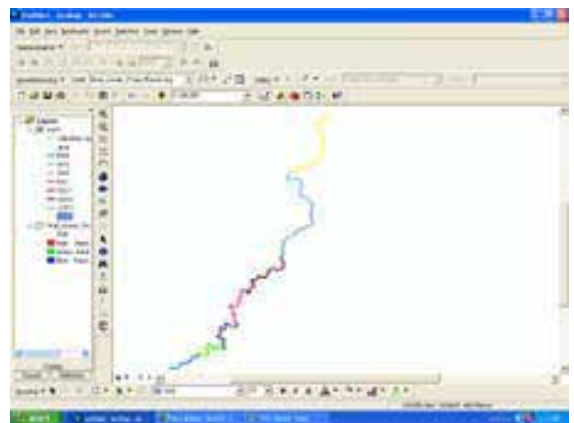


Figure 2 : Analysis using Arc-map, Arc-info

### METHODOLOGY

The main aim of the present research work is to identify the channel pattern and causes of sinuosity of Tulsi and Bhogawati River (Fig.1). Therefore, Tulsi channel for a length of 31 km from its downstream to the dam and Bhogawati channel (approximate length of 75 km) from Radhanagari Dam to Prayag Chikhali has considered. The Tulsi stream has divided into 10 stretches, more or less equally for a distance of 3-3 kms each (Fig. 3). Simultaneously, the Bhogawati channel has divided into 08 stretches (Fig 4). For these stretches sinuosity index has been calculated. Field visits have been conducted in the study area. S.O.I. Toposheets at a scale of 1: 50,000, T.M. and Google images were used for the observation of channel patterns and calculation of Sinuosity Index. The analysis, measurements of channel length, basin length were car-

ried out using GIS software i.e. Arc-Info/Arc-Map (Fig 2). The data for river characteristics were generated using Remote Sensing images with ERDAS and Global Mapper software.

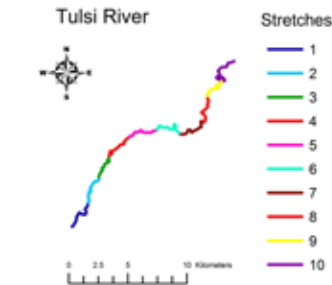


Figure 3 : Stretches of Tulsi River

**RESULTS AND DISCUSSIONS**

The channel pattern means the appearance of river, whether it is straight, meandering or braided. The various channel patterns i.e. straight, meandering or braided are observed in Tulsi channel under consideration (Mugade et.al, 2012). In the present research work it has seen that channel stretches are rarely straight in Tulsi River and numerous sinuous patterns have been identified. Moreover, sinuous and meandering pattern of the river appears in lower course of the river which is more confined to flood plain area. The sinuosity index of Tulsi have ranges from 1.34 to 2.07 which also indicates that meandering channels are controlled by fluvial processes and its dominant variable i.e. river discharge (Table 1). Sinuosity Index value i.e. 1.33 and 1.29 of Stretch 01 and 02 indicates that the river is more or less sinuous in its upstream part for a distance of 06 km (Fig 5a). But next to 06 km the length of river Tulsi, the channel becomes meander with and sinuosity index value of 1.52. Sinuosity index varies from 1.29 to 2.07, shows the inconsistency in its channel pattern. The Variability in river discharge and availability of alluvium deposits in middle and lower reaches are the causes for sinuous and meandering pattern of the river. It has also observed, that the riparian vegetation along the bank has also influenced on the sinuosity of the stretches, because in some stretches it has identified that, the shift in channel and shifts in meandering bends is more or less affected by riparian vegetation. Besides this, it has also observed that the Sinuosity and meandering of channel has influenced due to the occurrence of K.T Weirs across the river channel. Tulsi River is supplied with large load of pebbles, gravels and sand, which are transported as bed load. Meandering patterns is responsible for the formation of bars (Fig. 5b) and shows erosion on convex side of the meander and deposition on the concave side of the meander.

Table No. 1 : Sinuosity Index

Bhogawati River		Tulsi River	
Stretch No.	Sinuosity Index	Stretch No.	Sinuosity Index
1	1.139	1	1.339
2	1.909	2	1.292
3	2.624	3	1.522
4	1.625	4	1.311
5	1.559	5	1.309
6	1.351	6	1.529
7	1.534	7	1.488
8	1.316	8	1.479
		9	1.647
		10	2.074
Average	1.633		1.487

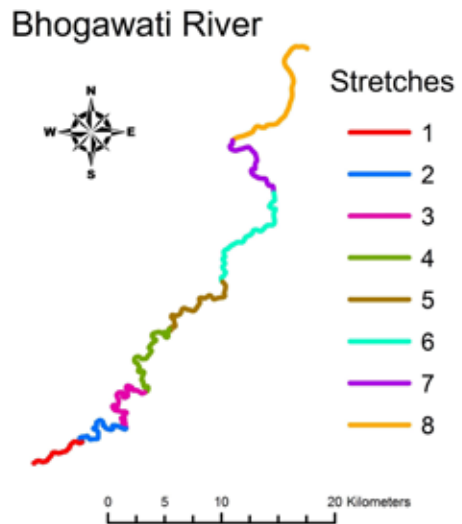


Figure 4 : Stretches of Bhogawati River

Table No. 2 : Gradient of Bhogawati River

Stretch No.	Gradient (Ratio)
1	0.0785
2	0.0130
3	0.0285
4	0.0481
5	0.0274
6	0.0167
7	0.0390
8	0.0078
Average	0.0324

The present study also reveals that, Bhogawati River is generally controlled by geological characteristics of basin and its platform is equally influenced by channel slope and shows the erosional or depositional signs of the river. Sinuosity index of Bhogawati channel varies of from 1.139 to 2.624 that show the inconsistency in its channel pattern.



Figure 5 : a) River Tulsi - Straight channel down to its dam; b) Braided channel of Tulsi and Central bar; c) River Bhogawati- deep and straight channel; d) Confluence of Tulsi and Bhogawati river.

it also indicates that, the river is more or less near to straight in its upper stream part in stretch no.1; however stretch no. 3 shows well-developed meandering pattern. Slope and sinuosity relationship has also studied. In stretch 2 and 6 the slope and the channel gradient is 0.0130 and 0.0167 respectively which is steeper than the other stretches (Table 2). It occurs in straight channel and causing vertical erosion of the bed (Fig 5c). A gentle slope with a gradient of 0.0070 occurs in stretch no. 08 that is associated with meander channel leads to lateral erosion. Besides this, it has also observed that, similar to Tulsi, the Sinuosity and meandering of Bhogawati channel has also influenced due to K.T Weirs across the river channel.

## CONCLUSIONS

The both river channels are mostly confined with sinuous channel with large meanders. The meandering pattern is more consistent in lower part of Tulsi River. This lower part of the river comes under flood plain area. The average sinuosity index of Tulsi channel from its dam to confluence is 1.48; this also shows that the channel bank contains higher percentage of silt and clay. The Bhogawati channel has a maximum sinuosity index of 2.624 in stretch no. 3. It has also observed that out of 08 sections of the river, 05 sections indicate the meandering pattern. The meandering pattern is more consistent in Stretch No. 2, 4, 5 & 7 of Bhogawati River. The confluence of River Tulsi–Bhogawati (Fig 5d), Kumbhi-Bhogawati and Kasari-Bhogawati are the sensitive and probable zones for flooding during monsoon. Meanders near Prayag Chikhali, Hanumantwadi, Gadegondwadi, and Haldi are the locations for flood risk.

## REFERENCE

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