Research Paper Geography

Human Interferences and Variations in Sinuosity Index of Tarali Channel, Maharashtra, India

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ABSTRACT

The present research work attempted to study the variations in Sinuosity Index of Tarali Channel of Maharashtra, as a result of human interferences. It has observed that extensive silt excavation is carried along the banks of Tarali and Krishna rivers at Umbraj of Satara district. This activity along the banks and in agricultural fields has resulted in positive and negative impacts in the region and reveals that human intervention has resulted for the increase in width of the channel and influenced on the channel form and plan.

KEYWORDS Sinuosity Index, Meandering channel, excavation of river bank, variation in river discharge.

INTRODUCTION

It may be considered that, the channel morphology is a product of continuous adjustment of variables related to hydraulic geometry. Variations in discharge of the river brings about the changes in the form of river cross section, particularly in width and depth and the channel patterns in terms of its sinuosity characteristics. The changes in the discharges are generally controlled by climatic conditions, and the channel, in order to accommodate the incoming discharges, tries to adjust itself to a certain extent. There has been considerable amount of discussion of the human intervention in catchment area of Tarali river basin, particularly in the form of deforestation and silting up of the channel. However, if such intervention occurs close to the channel, the adjustments are different in type and order. In last two-three decades or so, such interventions are being studied by research scholar. Moreover, in recent decades, an effect of human intervention has been observed in playing a significant function in governing the changes in the channel form.Umbraj, located on the Bombay - Bangalore highway, in Satara district of Maharashtra, isa major large scale brick making centre. One finds 60 -70 brick kilns dotted all over the settlement. All these brick kilns derive their raw material, alluvium, from the deposits in the lower reaches of river Tarali that passes through Umbraj. A stretch of River Tarali, extending for about 4.325 km in direction upstream from its confluence with River Krishna also forms the part of the study area for the present research work. (Sapkale,2008, 2010).

DATA BASE AND METHODOLOGY

In the study area the monsoon period, being the period of high rainfall, generates heavy discharges. It is supposed to be the period during which one can expect the large scale variations in the channel morphology and in its plan form, mostly due to high magnitude flood occurrences. For most of the river gauging stations cross sections surveyed in per monsoon period are used for the subsequent monsoon season for estimation of discharge. In order to get the idea about the details of the channel cross sections, measurements at 90 locations (Fig. 1) were taken that forms the core of the data base for the present study. In all 7 field survey sessions were conducted for generating the required data. Of these 6 were carried out in the period from April 94 to January 97. The last field session was conducted in October 2002, after a gap of 5 years. The field surveying was carried out with the help of transit theodolite using tacheometric method in Nov/Dec and April/ May and block contour maps for the entire stretch of 4.3 km of the river channel were prepared.The river channel is divided into five stretches for its detailed study for cross sectional changes and variation in sinuosity form.



Figure1 :Five Stretches of Tarali channel.
Source : Field Surveying and Google Earth

The following table gives the details of length and fall of height in each stretch identified above.

TABLE – 1 MEAN GRADIENT OF THE STRETCHES

Stretch	Length (in m) from to	Length of the stretch (in m)	Fall (in m)	Mean gradient (ratio)
1	0 - 910	910	1.689	0.0018
2	910 - 1700	790	0.449	0.0006
3	1700 - 2485	785	1.110	0.0014
4	2485 - 3250	765	0.630	0.0008
5	3250 - 4325	1075	1.925	0.0018
Total length	0 - 4325	4325	5.800	0.001341

Source: Field Surveying

RESULTS AND DISCUSSIONS

Channel in plan : 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. These patterns have been divided into three groups: braided, meandering, and straight. The most easily recognized are braided and meandering; long straight reaches are not common in naturalstreams. All of these patternsare areflection of the water discharge, sediment load that the channel is transporting, channel slope and cross section. Schumm (1977) also observed that the proportion of bed load to total load has a major influence on the nature of alluvial channels. Those transporting large quantities

of suspended sediment are relatively sinuous and have a low width-depth ratio, whereas those, in which the bed load sediment discharge is large, tend to be relatively wide, shallow, and less sinuous. Both the total sediment load and its particle size distribution influences channel shape.In general, the channel pattern or map view of a river is almost considered as straight, meandering or braided. These various channel patterns are observed in Tarali channel under consideration. It may be noted that sinuosity for Tarali channel has been calculated for low flow conditions. It is the low flow line of post monsoon period that keeps on shifting its location as a result of reworking of the sediments as well as fresh sediment load passing through the channel during the monsoon period.

TABLE - 2 SINUOSITY INDEX

Stretch No.	Apr-95	Apr-96	Jun-97	Average
1	1.57	1.685	1.685	1.646
2	1.13	1.282	1.196	1.202
3	1.126	1.144	1.213	1.161
4	1.134	1.194	1.119	1.149
5	1.419	1.456	1.468	1.447

Source: Field Surveying

While from the table no. 2 it revealed that the values of sinuosity range between 1.13 and 1.68 for different stretches, the channel observed between specific cross sections display considerable variations. The stretch 3 and 4 records very low sinuosity and can be considered to be straight. The value of sinuosity for stretch 1 is highest in all the three periods. However, this higher value is mainly due to a single turn in the course of river rather than the meandering tendency on part of the channel. The specific sections having straight, sinuous / meandering and braided channel are as follows.



Plate -1:Braided pattern, next to Highway Bridge

Straight channel: In Stretch I, the course of river between C S 5 to 10 the channel stretch is slightly straight with near vertical banks on either side. Stretches 3 and 4 as noted above show characteristics of being straight. These stretches have maximum width.

Sinuous channel: The line of low flow in post-monsoon period in stretch III and IV generally gets confined to one of the banks and swings towards other bank,In next four of Tarali channel under consideration, the channel is sinuous in nature. The degree of sinuosity increases in IV and V stretches in case of the post monsoonal flow conditions.

Braided channel: It is only in stretch V, near the highway bridge, braided characteristics can be observed (Plate 1). Just a few hundred metres upstream the confluence the channel of post monsoon conditions gets bifurcated due to the large central bar that is developed. This give rise to 2 to 3 flow lines.

Overall, Tarali River is supplied with large load of pebbles, gravels and sand, which are transported as bed load. Locations of braided pattern becomes wide in relation to its depth due to deposition and such type of deposition with vegetation allows to slow transport of bed material, and deposition leading to formation bars and islands which separate water into smaller and multiple flow line.

CONCLUSIONS

It is important that, any resource has to be utilised rationally to increase its sustainability. The alluvium excavation should not be done over the annual yield. There should be a balance between input and output of alluvium. If such a balance is not maintained, the situation can be hazardous for the area. Floods can become more frequent and will lead to intensification of the problem. Thus it has concluded that, the channel of river Tarali for a stretch of 4.325 km characterizes the human interferences on the channel patterns, forms and its morphology. The study also shows the effects of river discharges and energy dissipation in the channel during different flow conditions of the river. Alluvium excavations from river banks are 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.

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