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Geoinformatic Techniques For Morphometric Analysis of Tarapur Creek Catchment, India

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***Abstract*— Morphometric analysis as practiced in geomorphology that may be applied to a particular kind of landform or to drainage basins and large regions generally. Morphometric analysis of a watershed provides a quantitative description of a drainage system that is why morphometric analysis of drainage system is required as a prior condition to assessment of hydrological characteristics of surface water basin. It is an important aspect of the watershed characterization. In this present study attempt has been to study the morphometric characteristics of Tarapur creek catchment. The study region comprises 31.02 sq km.**

***Keywords*— Morphometric Analysis, Watershed, Geomorphology, Creek Catchment.**

I. Introduction

Morphometry is the measurement and mathematical analysis of the configuration of the earth's surface, shape and dimension of its landforms (Agarwal, 1998; Obi Reddy et.al, 2002). A major emphasis in geomorphology over the past several decades has been on the development of quantitative physiographic methods to describe the evolution and behavior of surface drainage networks (Horton, 1945; Leopold & Maddock, 1953; Abrahams, 1984). Morphometric studies involve evaluation of streams through the measurement of various stream properties.

A drainage basin is an area defined by a topographic boundary that diverts all runoff to a single outlet. The topographic boundary that separate runoff between two basins is the drainage divide. The delineation of drainage basin can be done manually using topographic information. On the other hand, the widespread availability of elevation data in digital format has bolstered the development of automated tools that can be used to delineate drainage basin and their associated stream network.

The creek is a body of water partially enclosed by land, and with a mouth opening to the sea (United Nations, 1983). It extends from the landward limit of tidal facies at its head to the seaward limit of coastal facies at its mouth, and covers the range of intertidal flat and some offshore water area (Buatois,L.A,et al.,2003).With ascendant natural resources, dominant geographic location and environment condition, the creek area has become a natural region which is not only the most active of the earth surface, but also a part of coastal zone. With highest intensity of human activities (Edition Committee of the Creek Chorography in China, 1999; Hugo,V.Z.et al.,2008).

According to the definition, an integrated creek includes three parts: backshore land area, tidal zone, and alongshore sea area. The creek mouth is the borderline of creek and sea, the mean low-tide line is the borderline of sea area and tidal zone, while the mean high-tide line is the borderline of tidal zone and coastline. Therefore, a creek can be seen as a systematic structure formed by four axes: creek mouth, mean low-tide line, coastline, land boundary, and three areas surrounded by these axes, namely alongshore land area, tidal zone, and alongshore sea area. Among these four axes, the up-boundary of land area can be established as the catchment boundary. Figure 1 is the sketch map of the conceptual model of the spatial morphological of creek.

II. Study Area

The region selected for present study Tarapur creek located in the Thane district of Maharashtra on the Arabian Sea coast near Dahanu. The distance of study area from Mumbai is near about 170km.The Study area is lies to the South of Dahanu. The extent of the area is 72°40'47.36"E to 72°44'45.20"E longitude and 19°50'30.38"N to 19°54'32.97"N latitude. The total catchment area is 31.02 s.q.k.m. The maximum north south stretch is 8.33 km. wide and the maximum east west wide is 6.70 km.

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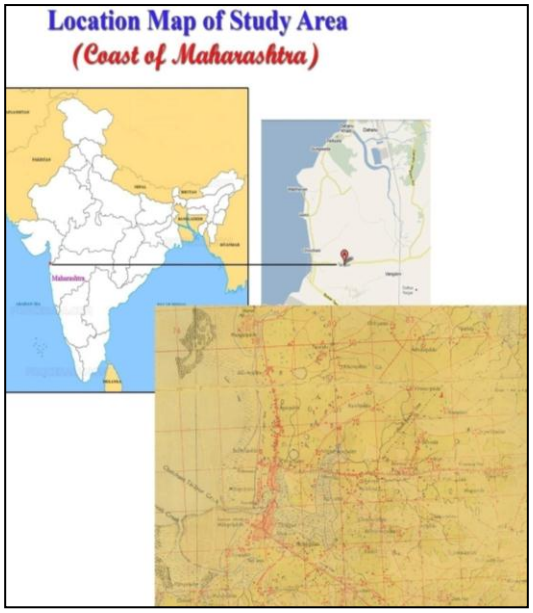

Figure1: Location Map

III. Data And Methodology

a) Field and analytical Procedure:-

This work is basically based on morphometric analysis of Tarapur creek catchment to study the Geomorphology of area. In order to study the morphology in the creek catchment the field & analytical procedures were adapted. This part of study therefore, required instruments for measuring like measuring tape & GPS to obtained elevations, location, length, width etc. of the study area.

b) Planning and Preparation:-

The creek area was selected in the thane district that is Tarapur the creek segment and the stream area was marked with the help of Toposheet no. 47 A/9 the area was marked from the starting point of the stream originating from, the confluence with the creek channel, up to the mouth of the creek in the Arabian Sea.

The other aspect such as the planning for data collection for sample and GPS location was done.

Digital analysis :-

This includes the digitization processes, querying and analytical procedure with the help of different software. There are mainly three basic element used for this analysis they are as follows –

- Inputs- Toposheet, Satellite image from the Google.

Software- The software are selected with consideration of their specification like ARC-GIS, because in this software tools and more options are given for making all type of the maps. Also using software's are Global Mapper, Surfer version 8 and 9 both are used in analysis, A Google Earth images was used for geocoding & digital mapping.

IV. Anaysis And Result

4.1 Relationship between stream order and number:-

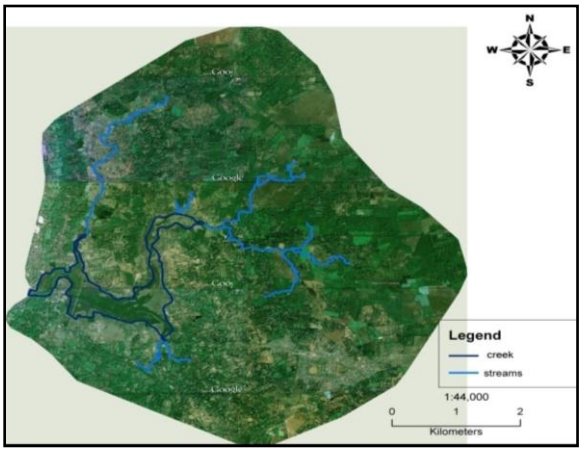

Figure 2 : Stream Network.

Table 1:
Stream Network Ordering

Order	No.	logY	XlogY	X^2
1	21	1.3222	1.3222	1
2	3	0.4771	0.9542	4
3	1	0.0000	0.0000	9
∑X=6		∑logY =1.7993	∑XlogY =2.2764	$\sum X^2=14$

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$\bar{X}$=2

log$\bar{Y}$= 0.5997

$$b = \frac{n\sum \times \log Y - \sum \times \sum \log Y}{n\sum X2 - (\sum x)2}$$

$$b = \frac{3 \times (2.2764) - 6(1.7993)}{3 \times 14 - (6)2}$$

$$b = \frac{6.8292 - 10.7958}{42 - 36}$$

$$b = \frac{-3.9666}{6}$$

b= - 0.6611

logY= a+b x

a=log$\bar{Y}$ - b$\bar{X}$

a= 0.5997 – (-0.6611×2)

a= 0.5997 + 1.3222

a= 1.9219

When, $x = 1$

logY = a+b log x

= 1.9219+(-0.6611×1)

= 1.9219 – 0.6611

= 1.260

Antilog = 18.20

When, $x = 2$

logY = a+b log x

=1.9219+ (-0.6611×2)

= 1.9219 – 1.3222

= 0.5997

Antilog = 3.978

logY = 1.9219 + (-0.6611) x

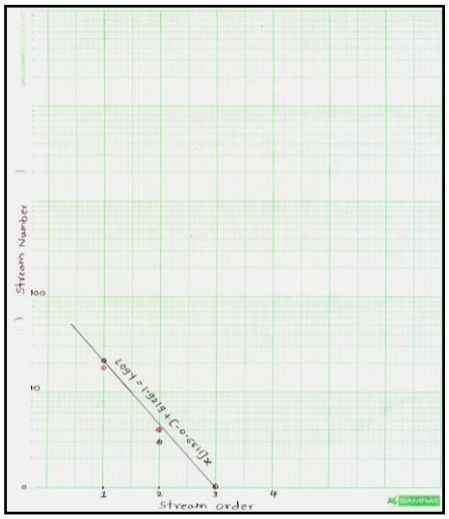

Figure 3: Relation in stream order and number

Bifurcation Ratio:

The bifurcation ratio is the ratio of the number of stream segments of given order to the number of segments of next higher order. Bifurcation ratio is an index of relief and dissection (Horton, 1945**).**

Table 2
Bifurcation Ratio

Order	No.	Bifurcation Ratio	Total Length (km)	Mean Length (km)
1	21	7	18.38	0.87
2	3	3	8	2.66
3	1	--	1.6	1.6

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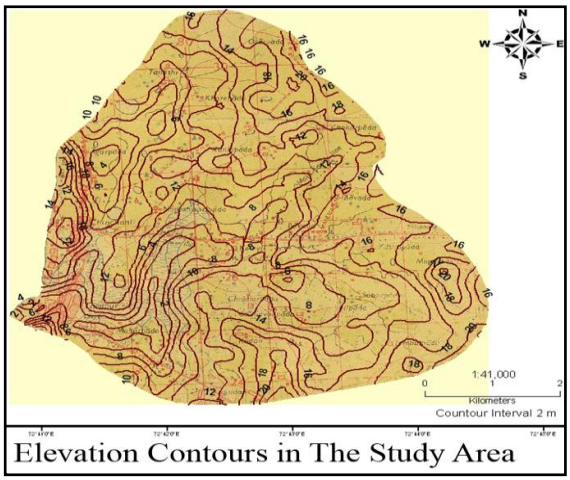

Figure 4: Contour Map of Study Area

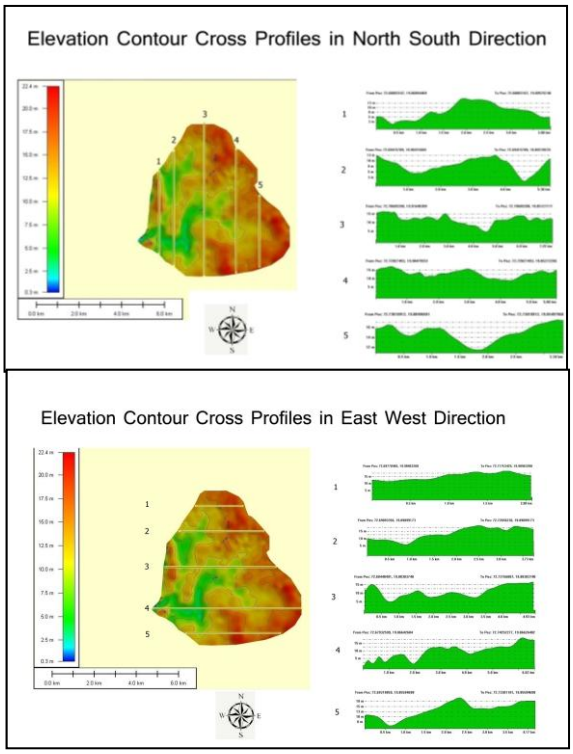

Figure 5: Cross Section

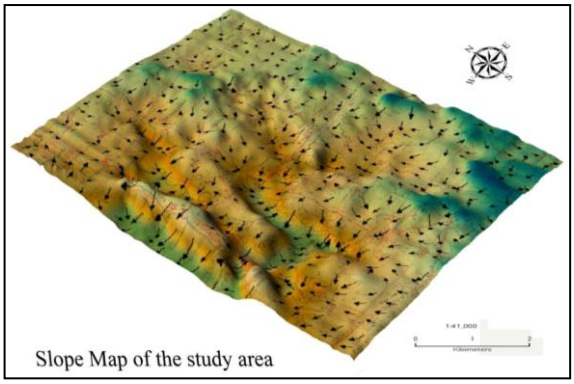

Figure 6: Slope Map

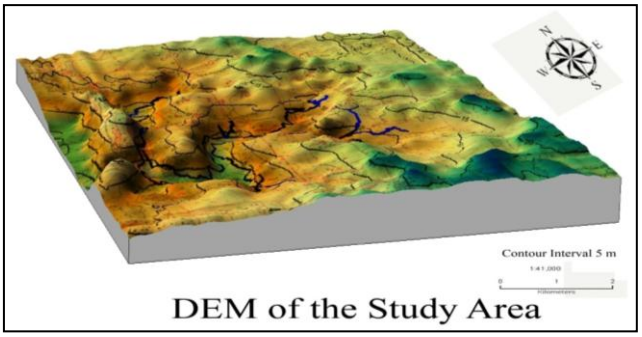

Figure 7: Digital Elevation Model

V. Observation And Conclusion

Preceding discussion helps in identifying major trends in the morphodynamic nature of Tarapur creek Catchment. By using above study of creek catchment, some of the important observations, findings & conclusions are given below.

1) Nature of slope increases from eastern side to western side towards the Arabian Sea.
2) Southern side of the study region has deep as compare to the Northern side.
3) The catchment area is more rugged in the southern part and to the northern bank of the creek.
4) The nature of terrain parallel to the coast. The eastern part of the catchment shows the valley like appearance of terrain.

5) Highest elevations counter in the study area is 20m.
6) There are 3 sub basin develop by streams in the region.
7) Due to siltation and deposition, there is 1st order streams are mostly buried.

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