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Identification of Morphometric Relief Aspects case study of Kottur Block at Tiruvarur Districts, Tamil Nadu, India

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ABSTRACT

Morphometric analysis is part of geomorphological studies. It can provide vital clues concerning the landscape evolution. The present paper examines the implications different morphometric parameters. This parameters using find out the relationship proves its significance of relief development in this study area. The study area is extends between 10°94 ′N, 79° 55′ E to / 11°7′N, 79.62°E / 11.03; 77.13. It has an average elevation of below 5 meters. The study area locates in Thiruturaipoondítaluk, Thiruvarur district at Tamil Nadu, India. The study area has a plain terrain of alluvial soil, consisting of sand, silt and clay. The study Area located between Delta of Cauvery River and near to coast of Bay of Bengal. These study analysis of various drainage parameters namely ordering of the various streams and measurement of area of basin, perimeter of basin, length of drainage channels, drainage density (Dd), drainage frequency, bifurcation ratio (Rb), drainage texture (T), Roughness index and ruggedness was determined. The total parameter analysis of this study area, overlays each and every parameter.

Keywords: Morphometric, Kottur block, drainage density, cauvery river, stream order, delta

Morphometric analysis is refers as the quantitative evaluation of form characteristics and shape of the earth surface and any landform. This is the simple technique inbasin analysis, as morphometric form an ideal areal unit for interpretation and analysis of fluvial originated landforms where they exhibits and example of open systems of operation. The composition of the stream system of a drainage basin in expressed quantitatively with stream order, drainage density, bifurcation ration and stream length ratio (Horton, 1945). It incorporates quantitative study of the various components such as, stream segments, basin length, basin parameters, basin area, altitude, volume, slope, profiles of the land which indicates the nature of development of the basin.

This modern approach of quantitative analysis of drainage basin morphology was given inputs by Horton (1945) the first pioneer in this field. Horton's law of stream lengths suggested that a geometric relationship existed between the numbers of stream segments in successive stream orders. The law of basin areas indicated that the mean basin area of successive ordered streams formed a linear relationship when graphed. Horton's laws were subsequently modified and developed by several geomorphologist, most notably by Strahler (1952, 1957, 1958, and 1964), Schumm (1956).

Stream profile analysis and stream gradient index by Hack (1973) is another milestonein morphometric analysis. Many workers have used the principles developed by these pioneers to quantitatively study the drainage basin as a tool for landscape analysis (Sharma, 1987; Raj *et. al.* 1999; Awasthi and Prakash, 2001, Phukon, 2001; Sinha-Roy 2002). Morphometry is the measurement of the shape or geometry, of any natural form-plant, animal or relief features (Strahler, 1969). This mainly indebted to three fundamental reasons; recognition of drainage basin as a basic geomorphic unit in the land form evolution studies, high demand for quantitative data to accompany the processes in process-response models and finally a general philosophical and methodological shift of geomorphology from subjective and deductive science based upon observations to an objective and inductive science based up on measurements. (Sharma, 1981)

Geographical Information system (GIS) and Remote sensing techniques using satellite images are used as a convenient tool for Morphometric analysis. Many workers have carried out morphometric analysis using these new techniques. Digital Elevation Model (DEM) and Shuttle Radar Topography Mission (SRTM) widely used in drainage basin analysis. Srivastava, 1997; Nag, 1998; Duarah *et al.* 2011, carried out morphometric analysis, while Nag and Chakraborty (2003) deciphered the influence of rock types and structures in the development of drainage network in hard rock area.

STUDY AREA

Kottur bloke is located at 10°94′N 79° 55′ E / 11°7′N 79.62°E / 11.03; 77.13. It has an average elevation of below 5 meters. The study area locates in Thiruturaipoonditaluk, Thiruvarur district at Tamil Nadu, India. The study area experiences tropical climate during summer; from March to May. The proximity to sea results in high humidity throughout the year and peaks 70% from August to May. The town experiences tropical climate during summer; from March to May. The proximity to sea results in high humidity throughout the year and peaks 70% from August to May. The mean maximum and minimum temperature varies between 26.39°C. Highest temperature ever recorded is 35.19 °C. The tributaries of river Cauvery are the major water bodies around the study area. Surface water and canals contribute 89% to irrigation, while the rest 11% is accounted by dug wells and tube wells. Paddy is the major crop while the others being Black gram, Green gram, Ground nut and Gingely. The study area has a plain terrain of alluvial soil, consisting of sand, silt and clay. Vennar and Vettar the tributaries of river Cauvery are the major water bodies around the study area. In Cauvery basin Kovilkalappal area have abundant natural gas. But, as because of strong communist party presence & labour issue, this one yet to take-off. The study area is coastal plain of the Bay of Bengal. The study region is part of Delta in Cauvery River.

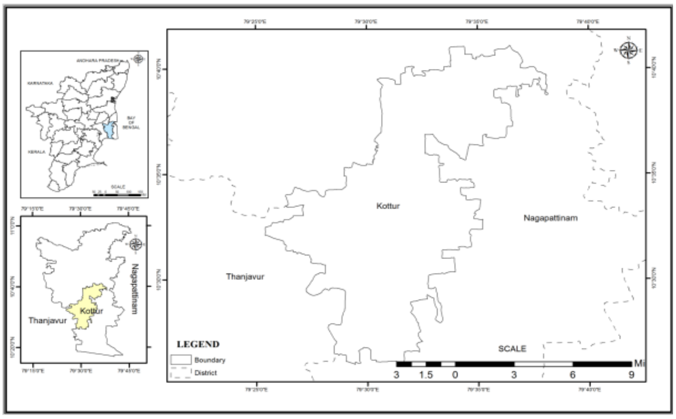

Fig. 1: Study Area

MATERIALS AND METHODS

Aim and objective

The aim of present study is to analyses evaluation of relief by morphometric studies at Kottur block using from different parameter.

As the main objectives of this work was to discover to analyse the spatial character of relief in study area, analyse the structure of drainage basin in study area and find out the significance of relief and drainage basin and their evolution of topology in the study area.

Data base and Methodology

To complete these various objectives, secondary data have been collected from concerned departments. The basic raw data have been taken from toposheet of survey of India, Guindy, chennai-32. The Kottur block administrative maps have been collected from Thiruvarur District Collector office. The data have been collected from survey of India toposheet or topoplan No.58E/4, 58E/8 and 58F/1. The scale is 1:50,000 or 2 Centimetre represents 1km. The Toposheet reduced 1:60000 scales, using various parameters, the spatial distribution of relief (contour lines) and drainage basin

(Stream area) was determined. Morphometric studies involve evaluation of measurement of various profiles (superimposed, composite and projected profile), height histogram, hypsometric curve, relative relief map, average slope map. Analysis of various drainage parameters namely ordering of the various streams and measurement of area of basin, perimeter of basin, length of drainage channels, drainage density (Dd), drainage frequency, bifurcation ratio (Rb), drainage texture (T), Roughness index and ruggedness was determined.

RESULTS AND DISCUSSION

Morphological Studies of rivers are very important to study the behaviour of a river, its aggradations/degradation, shifting of the river course, erosion of river bank etc. and to plan remedial measure for erosion and other related problems. Most of the streams appear to be in conformity with the geological and structural setup of the area. Morphometric analysis in following heads:

- ❖ Linear Aspects – One dimension
- ❖ Areal Aspects – Two dimensions
- ❖ Relief Aspects – Three dimensions

(i) Linear aspects

Profile

Serial profile: A set of simple when arranged serially, is known as serial profile. When closely spaced, they give visual impression about the characteristics of the landform. Raised beaches, terraces, spur etc..

The superimposed profile: plotting of a set of serial profiles covering an area on a single frame is known as superimposed profiles. Grouping of lines help in identifying plateau top, high level erosion remnants, major break of slope and amount of lowering etc.

Projected profile: A sketch of profile with a complete shape of the nearest one and peeping of the other profile behind the former one is known as projected profile gives a panoramic view.

Composite profile: Drawing of the upper most line from the diagram of superimposed and projected profile produces a composite profile. It is a line of greatest height across the strip. It illustrates the ruggedness of the skyline.

The study area is a plain region which is located nearer to the sea coast. The region is plain because of altitude below 5 meter of mean sea level and due to its presence at mouth of Cauvery River and at peniplain region of south India. Hence, the contour lines are not found in this region.

Height frequency curve

The contour interval or spot height shown in the toposheet and maps are classed into groups and then frequency as well as frequency percentage or values are determined for each group. Then a histogram is constructed. The height frequency group will indicate the most important erosional surface. The study area is below 5 meter mean sea level it is plain region. The contour line was not found in this region plain region,

Stream Order (Stahler's Method)

Horton formulated a system of ordering to arrange the streams of a drainage basin in a hierarchical order. According to this scheme, a stream without any tributary is a first order stream. Two first orders when joins form a second order, two second orders joins to form a third order and so on. He then extended the highest value of order towards the head. (Hortons, Stahler's, Shreve's, Sacheidegger's).

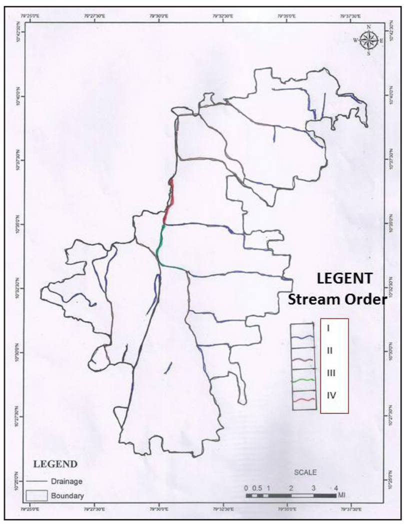

Fig. 2: Stream Ordering

Staler modified the scheme by increasing the number of order segment-wise towards the downstream direction. It can avoid Horton renumbering and loss of tributaries, but at the same time the higher order segments may decrease in length than the lower ones. Shreve observed that any addition of a new stream to the main channel will enhance its energy and therefore, amalgamation of any number of streams will increase the order.

The map 3 explains the drainage basin in the study area, mostly first order small streams channel was seen which was followed by second order which was followed by third order and fourth order streamline. The streamline is based on rock hardness and topographical structure of the study area.

Stream Frequency

It is defined as number of streams per unit order of a drainage basin on percentage. It is independent of the drainage density for the same basin.

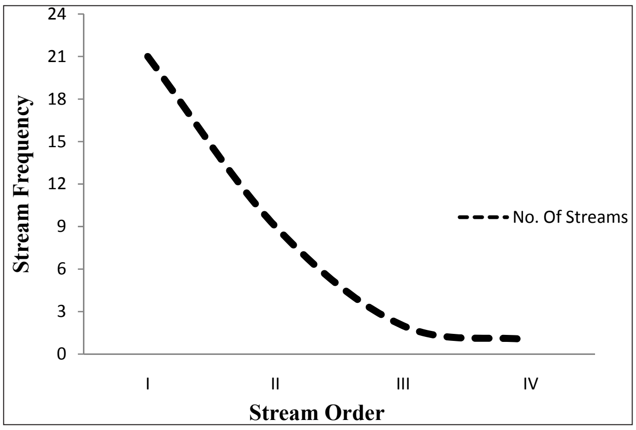

Fig. 3: Stream Frequencies

The Fig. 3 explains the stream frequency occupied by study area, mostly first order (small streams channel) captured higher frequency, followed by second order which is followed by third order and fourth order in streamline.

Bifurcation Ratio

It is defined as the ratio of the number of stream segments of any order to the number stream segments of the next higher order. It gives the idea about the rate of bifurcation towards the water divide.

Table 1: Bifurcation Ratio Index

Sl. No.	Stream Order	Number of Segments	Bifurcation Ratio
1	I	21	
2	II	9	2.3
3	III	2	4.5
4	IV	1	2

The Table 1 represents bifurcation value in the study area. The first and second order bf value is 2.3, second order and third order Bf value is 4.5, third and fourth order Bf. value is 2. This method also describes about the water utilization and their level in the study area. First bifurcation ratio value is not greater than second bifurcation value, the second is greater than third order, the third order is not greater than fourth order , hence the drainage basin is satisfactory in this study area.

Drainage Frequency

It is defined as number of streams per unit area of a drainage basin. It is useful for the study of texture of drainage. It is independent of the drainage density for the same basin.

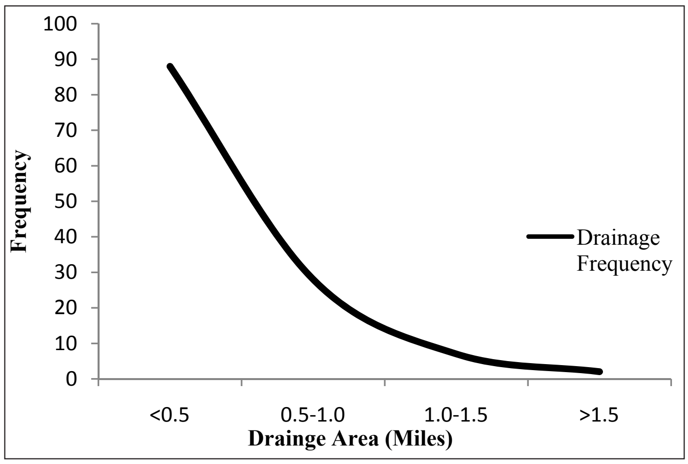

Fig. 4: Drainage Frequency

The Fig. 4 explains the drainage frequency at study area, mostly below 0.5 sq. miles (small streams channel) captured higher frequency was seen which is followed by 0.5 to 1.0 sq. miles, which is followed by 1.0 to 1.5 sq. miles and above 1.5 sq. miles of area of streamline captured. It is due to its presence at mouth of Cauvery River.

(ii) Areal Aspects

Relative Relief map

To prepare a relative relief map, the differences between the highest and the lowest elevations within a limited map area have to be determined first. To start with, a topographical sheet is divided into squares of per mile of longitude and latitude. Differences between the highest and the lowest points within each of the squares are marked and plotted on a small-scale base map. Isolines are then drawn by joining places of same difference to get a choropleth map showing relative relief.

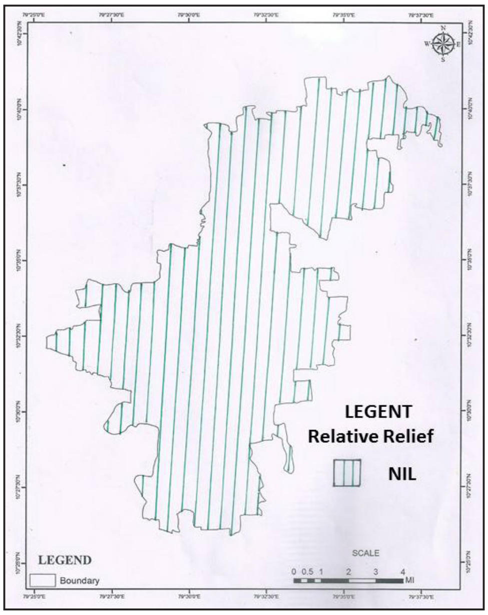

Fig. 5: Relative Relief Map

The relative relief map describes about the relief of the Kottur block. The Fig. 5 represents that no variation is seen in the relief of regions. The study has no relative relief change. It is due to presence of plain topography at mouth of the Cauvery river.

Average slope map (Wentworth, 1930)

In 1930 C.K. Wentworth developed a simplified method for determining the average slope of land surface. He devised a 'general and random' method of determining average slope over an area from the map. According to this method, firstly, the contour map of the area is covered with an east-west, north-south gird, and then contour crossings are counted and then tabulated for determining the average number of contour crossing per mile. The procedure was repeated using an oblique grid over the same area and the average number of contour crossings per mile was determined. He then applied the following formula to determine the tangent of the average angle of slope of the land surface.

The average angle of slope (tanÕ) =

$$\frac{\text{Average no. of contour crossing per mile (A)} \times \text{contour interval (I)}}{\text{3361 (constant)}}$$

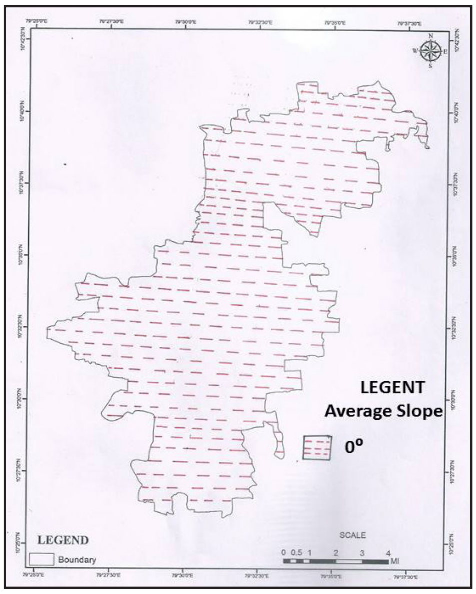

Fig. 6: Average slope map (Wentworth, 1930)

The Fig. 6 represent the slope in degree. In that, no slope variation of study area. Therefore, it is a plain region which is seen at regions. No slope is found in the part of study area. It is due to presence at mouth of Cauvery Rriver and near to the coastline.

Drainage Density

According to Horton, the total length of stream channels per unit area represents a very important geo morphometric parameter. It is independent of order and varies inversely with the size of the basin. The rock character and the influence of vegetation cover may be revealed from the study of drainage density.

Drainage density depends upon both climate and physical characteristics of the drainage basin. Rugged regions or those with high relief will also have a higher drainage density than other drainage basins if the other characteristics of the basin are the same. Drainage density can affect the shape of a river's hydrograph during a rain storm. Rivers that have a high drainage density will often have a more 'flashy' hydrograph with a steep falling limb. High densities can also indicate a greater flood risk.

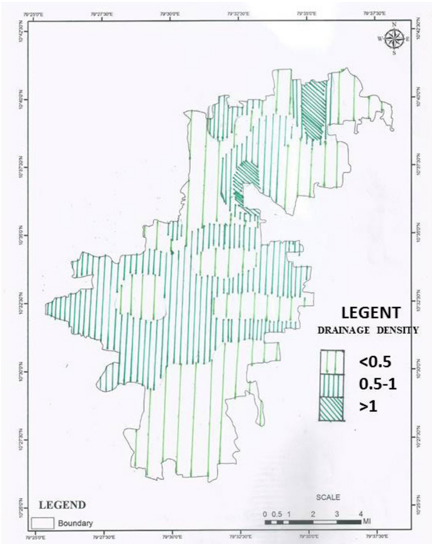

Fig. 7: Drainage Density

The Fig. 7 represent the high drainage density at north and north Eastern part of the study area. The moderate drainage density level is at centre and northern part of the study area. The low drainage density is seen at southern and North West part of the study area. The density level at Northern region is high, which is due to nature of topography which is based on rock hardness. A slight variation in density is seen in this study area. From this, drainage of a stream is measured. The variation is seen at 0.5 densities.

Drainage Texture

It is defined as the product of drainage density and drainage frequency. The scale of drainage texture is as follow below 4.0 coarse grains, 4.0-10.0 =intermediate grains, 10.0 - 15.0 = fine grains and above 15.0= ultra-fine and bad land topography.

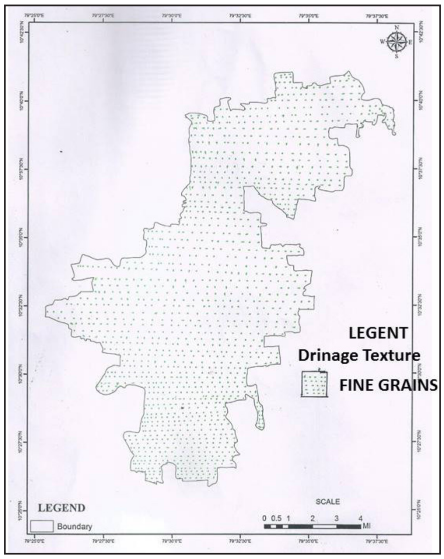

Fig. 8: Drainage Texture

The Fig. 8 explain that the drainage texture at study area. In that, vast and entire study area covers the fine grains soil (Alluvial soil). From the study area, drainage texture is found in fine grains. Other vast areas are covered with soft rock formation such as easily eroded in fluvial process.

(iii) Relief Aspects

Roughness Index

Relief roughness, or smoothness, inspections are performed to monitor the pavement conditions and to evaluate the relief quality and rehabilitated pavements. Roughness was closely related to terrain, water dynamics and drainage basin development. The American Society for Testing and Materials (ASTM) E 867 defines the roughness as the deviations of a pavement surface from a true planer surface with characteristic dimensions. A pavement profile represents the vertical elevations of the pavement surface as a function of longitudinal distance. Both manual and automatic multi- function profiling systems are continuously being developed and to determine the improved performance of this topography. The roughness index formula:

$$N \times \frac{M}{4} / 4 \times 10$$

N= total no. intersection of contour lines with sets of perpendicular grids, set at 45^0 to each other.

4 and 10 are constant.

M= distance in miles between grit lines

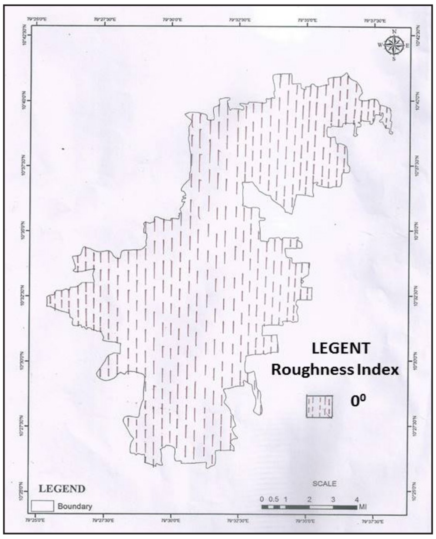

Fig. 9: Roughness Index

Fig. 9 represents that the roughness index in due at study area. The smooth topography is at study area. The roughness index of this area depends upon the nature of topography, relief and drainage basin. Low roughness or smoothness is more susceptible to erosion which results in plain. While comparing this with other sites, the topography nature of this has smooth surface. This study area has found at mouth of Cauvery river and nearer to coast which is major reason for low roughness and smoothness topography.

Ruggedness

It is defined as the product of relative relief and drainage density. It is combined expression of relief, texture and slope steepness, although a precise index is yet to be worked out.

Fig. 10 determine the ruggedness index of the relief. The map indicates, the less strong relief topography found in study area. The strangeness depends upon the nature of topography and drainage basin. Ruggedness at different sites of this area is low, no extent variations is seen.

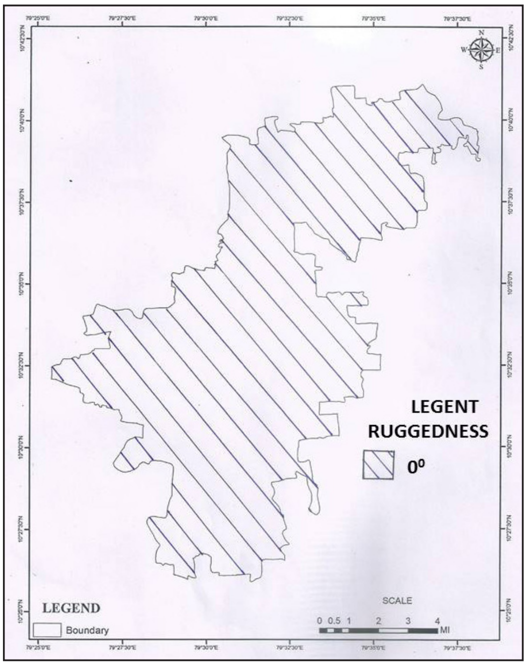

Fig. 10: Ruggedness

CONCLUSION

The total parameter analysis of this study area, overlays each and every parameter. It concludes that no contour lines area found (plain region), it is found very low altitude, average slope is not found in this region. Relative relief value is zero which is the major reason for dominated fluvial processing and the region located in near to coastal region (Delta Region) of study area. The stream ordering arranging and drainage density to as found to be good (Delta). The end part of the river is deposited with eroded materials of rocks which were found to be fine grain soils (Alluvial Soil). The Roughness and Ruggedness has smooth plain surface. The ruggedness of this region was found to be weak topographic feature at this study area. The fluvial processing is occupied captured in this whole region which is the major reason for the unique topography. These different parameters relationship proves its significance of relief development in this study area.

REFERENCES

Chorley, R.J. 1969. Introduction to Fluvial Processes. Methuan and Co Ltd. London, pp. 40-41.

Dayalan, N. 2016. "Morphometric analysis of relief on Jayankondam block, Ariyalur district, Tamil Nadu, India *Research*, **8**(05): 32088-32096.

Dayalan1, N. and Pavendar, T. 2016. Morphometric Relief Investigations of Sulur Block at Coimbatore Districts, Tamil Nadu (India) International Journal of Science and Research (IJSR) ISSN (Online): 2319-7064.

Horton, R.E. 1945. Erosional Development of streams and drainage basin: Hydrological Approach to Quantitative Geomorphology. Bulletin of Geo. Society of America, pp. 276-369.

Horton, R.E. 1945. Erosinal development of streams and their drainage basins: hydrophysical approach to quantitative morphology. *Bull. Geol. Soc. Am.*

Horton, R.E. 1932. Drainage basin characteristics. Trans. Am. Geophys. Unions.

Miller, V.C. 1953. A quantitative geomorphic study of drainage basin characteristics in the Clinch mountain area. *Tech. Report,* **3**: 2-25.

Misra. R.P. and Ramesh, A. 1969,"Fundamental of Cartography", Vidyaprientary, Mysore.

Monkhouse, F.J. and Wikinson, H.R. 1952. Maps and Diagrams, London; Methuen.

Schumm, S.A. 1956. The evolution of drainage system and slopes in badlands at Perth Amboy-Newjercy. Bulletin of Geo. Society of America, pp. 597-640.

Smith 1950. "The quantitative assessment as well as morphometric method".

Siddhartha Kumar Lahiri 2013, explained temporal variability in morphometric analysis of different geomorphic features like river dynamics and evolution of river islands.

Shrama, H.S. 1981. Perspectives in geomorphology. Concept publishing company. New Delhi, pp. 107-108.

Strahler, A.N. 1952. Hypsometric (area-attitude) analysis of erosional topography. *Geol. Soc. Am. Bull.*

Strahler, A.N. 1964. Quantitative geomorphology of drainage basins and channel networks.

Strahler,1969. Physical Geography. 3^{ed} edition. Newyork. Paper.

Wentworth 1930. "Morphometry is the measurement of geometry, Germany".

www.surveyofindia.gov.in

www.fundamentalsofphysicalgeography.net