Morphometric Relief Investigations of Sulur Block at Coimbatore Districts, Tamil Nadu (India)

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Abstract: ***The Sulur block is located at 11°02'N 77°08'E11.03°N 77.13°E. It has an average elevation of 340 metres (1115 feet).Study area is in the extreme western part of Tamil Nadu. It is surrounded by the Western Ghats mountain range on the west and north, with reserve forests on the northern side. The Noyyalriver runs through Coimbatore and forms the southern boundary of the study area. The study area sits amidst Noyyal basin. The study area has a pleasant, salubrious climate due to its proximity to thickly forested mountain ranges and the cool breeze blowing through the Palghat Gap which makes the consistently hot temperatures pleasant. The study area exhibits the mountain profile, high relative relief variation, the average slope is both sides moderate and high central part is low, high frequency stream order categories, central region low drainage density, the coarse and intermediate drainage texture, roughness index and ruggedness. These parameters prove that study area. This features main reason for this topography.***

Keywords: Sulur Block, Noyyal River, Delta, Drainage, Mountain, Relif

1. Introduction

Morphometric studies can be used to quantify a trait of evolutionary significance, and by detecting changes in the shape, deduce something of their ontogeny, function or evolutionary relationships. Morphometric methods are applied and measurements from the topographical maps provide us detailed information about the landform. Then, morphometric parameters also used to describe and compare basins of different sizes. Such parameters include profiles (superimposed profile, composite and projected profile), height frequency histograms, hypsometric curve, Relative Relief Map (Smith), Average Slop Map (Wentworth), Stream Order, Bifurcation Ratio, Drainage Density, Drainage Texture, Roughness Index And Ruggedness numbers. It describes relationship between drainage basin and topography morphometric parameters. For instance, it has been discovered that the higher the drainage density, the faster the runoff and the more significant the degree of channel abrasion is likely to be for a given quantity of rainfall. Drainage density also provides a link between the form attributes (morphometry) of the basin and its erosional process. Such conditions would result in greater probability of flash floods. The measurement of drainage density also provides information to Geomorphologists about the numerical measure of landscape dissection and runoff potential. In homogeneous bedrock, bifurcation ratio influences the landscape morphometry and plays an important role.

2. Study Area

It is a suburb of the Coimbatore city. Sulur is regarded as a pleasant town situated very close to the cities of Coimbatore (19 km) and Tirupur (35 km). Thus it is a popular location for various textile mills and weaving slots. Sulur is located at 11°02′N 77°08′E11.03°N 77.13°E. It has an average elevation of 340 metres (1115 feet). The Sulur Bloke extent upto 28,922 Sq.ha..It is surrounded by the Western Ghats mountain range on the west and north, with reserve forests on the northern side. Upland plateau region with hill ranges, hillocks and undulating plain. The study area physical relief features, topology structure, climatic condition very nice. These area wonderful natural tourists place in Tamil Nadu. (Figure: 1)

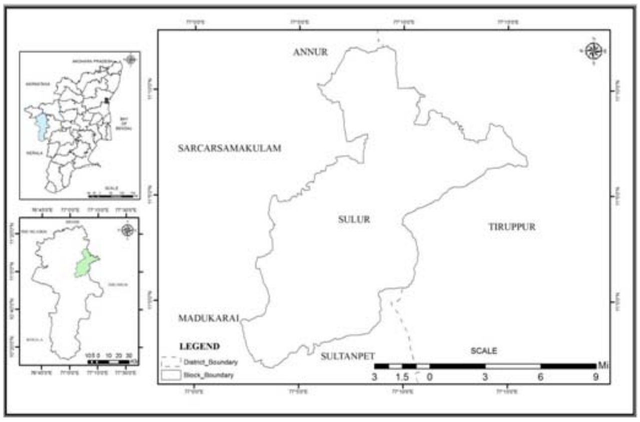

Figure 1: Study Area

3. Material and Methods

The aim of the present study is to evaluate the relief of the Study area by morphometric analysis. The major objectives is analyse the spatial distribution of relief, analyse the drainage basin and roughness structure and to find out the significance of relief and their evolution of topology at study area.

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 data have been collected toposheet No.58E/4, 58E/8 and 58F/1. The scale is 1:50,000. The toposheet reduced to 1:60000 scales, using various parameters, the spatial distribution of relief (contour lines) and drainage basin (stream area) were 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 were determined.

4. Results and Discussion

Profiles

Serial Profile: A set of samples 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..

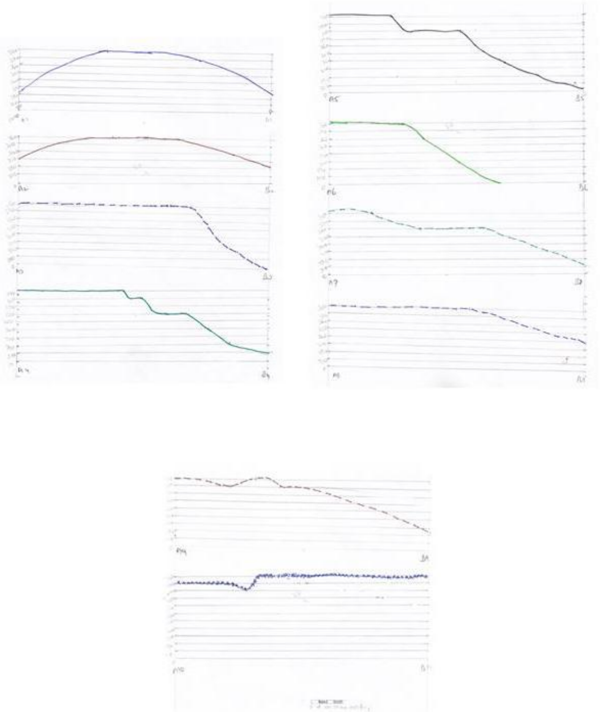

Figure 2: Serial Profiles

In figure: 2 the serial profile from A1 to B1 exhibits hill topography, A2 to B2 represents hill. The A3 to B3 determines the table land, A4 to B4 represents the steep like gentle slope, A6 to B6 represent the gentle slope, A7 to B7/step like gentle slope, A8 to B8 represents upland, A9 to B10 represents upland at centre part the valley is seen.

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, the major break of slope and amount of lowering etc.

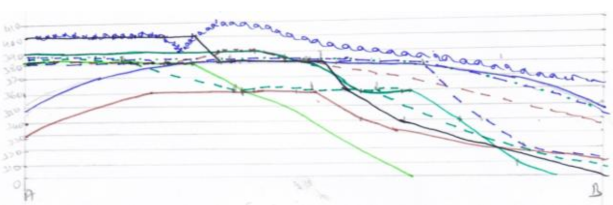

Figure 3: Super Imposed Profiles

In Figure: 3 the super imposed profile determines the continuous mountain a range, the ranges is seen from the west to east. The superimposed is seen 20 meter contour interval. The study area is completely surrounded with mountain which is known as Western Ghats.

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.

Figure 3: Composite Profiles

In figure no.: 3 the composite profile determine that 10th and 9th profile has continued ranges at highest altitude.

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.

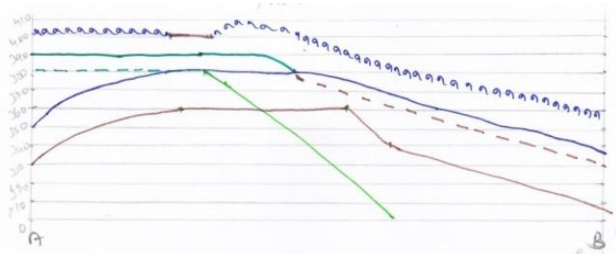

Figure 3: Projected Profiles

In figure no.: 3 the projected profile explains that the highest altitude in the 10th serial profile, which is followed 4th serial profile, 1st, 9th, and 7th serial profile followed by 8th and 6th serial profile. The projected profile exhibits continuous mountain range. The project profile is also seen from west to eastern region of study area.

Height Frequency Curve

The contour interval or spot height shown in the toposheet and maps are classed into groups and 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.

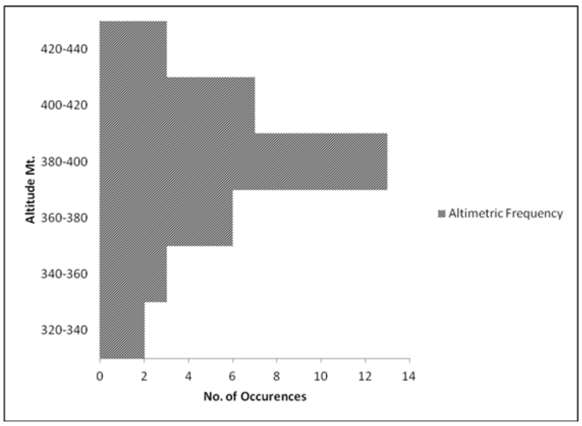

Figure 4: Height Frequency Curve

Figure no.: 4 represents the method in which bar diagram is drawn between contours captured area sq. miles its height in meters. The distance between them also describes topographic land height. In this study area, the landscape is of height about 380-400mt.Is mostly seen which followed by 400-420m.which is followed by 360-380mt., 340-360mt, 420-440mt and 320-340mt. is seen which explains the contour topographic line. This height frequency curve explains that very higher altitude containing contour line is seen at higher frequency with gentle slope mountain topographic is seen.

Percentage Hypsometric Curve (Strahler, 1956)

In this Percentage of hypsometric curve with enclosed by each contour are plotted against height as proportion to total area and proportion of total height.

$$\frac{\text{Total area} - \text{Area any particular contour}}{\text{Total Area}}$$

The formula of gives a hypsometric integral curve. This is defined as the proportion lying below the curve to the total square graph.

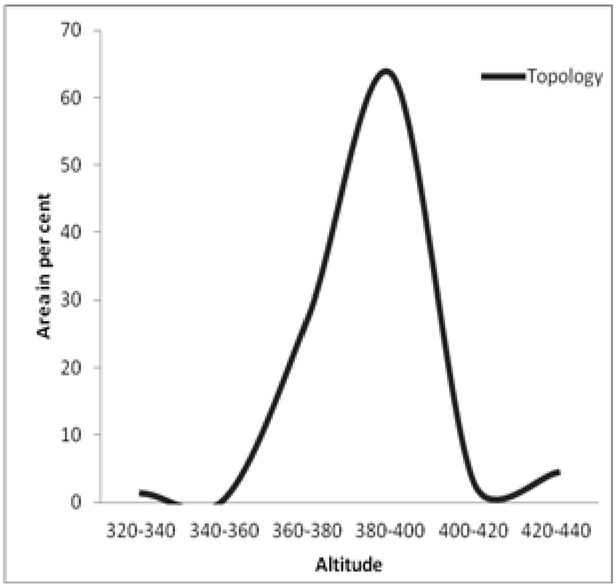

Figure 5: Percentage Hypsometric Curve

The figure no. 5 describes the topographic slope of the region. It is the easiest method. Mostly, topographic land of youthful stage is seen which due to Noyyal river nearer to Study Area This region has mountain ranges with high altitude landscape is seen.

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 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. In arithmetic lines, are then drawn by joining places of same difference to get a cloropleth map showing relative relief.

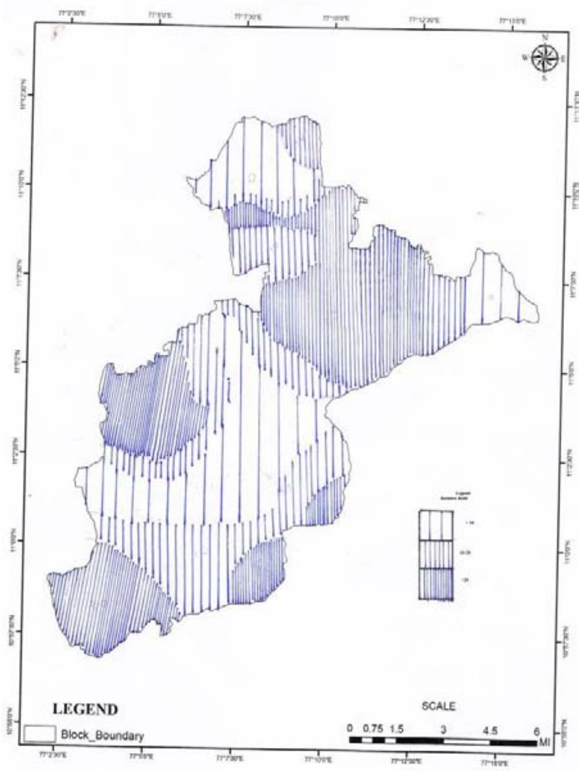

Figure 6: Relative Relief Map

The relative relief map describes about the relief of the Study Area figure no. 6 represents that north, east, centre and the western region has low or few relative relief topography. The moderate relief is seen at north east, central and east region of Study Area In this study area, high relative relief is seen at north east, west, south west part of the block. The study area has relative relief change in broad level, only in few places only. It is due to the presence of Western Ghats (broad mountain ranges) around topography.

Average Slope Map (Wentworth, 1930)

In 1930 C.K. Wentworth developed a simplified method for determining the average slope of land surface. According to this method, the contour map of the area is covered with an east-west, north-south grid; 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 of the same area and the average number of contour crossings per mile was determined. He then applied the formula to determine the tangent of the average angle of slope of the land surface.

The Average Angle of Slope (TANÕ)

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

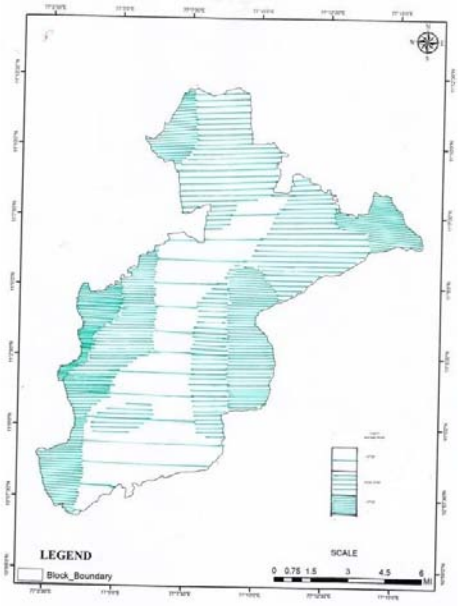

Figure 7: Average Slope Map

The figure no.: 7represent the slope in degree. In that, the low slope is found in central and eastern region of Study area. The moderate slope has been seen at northern, eastern, south central region. The high degree is found in north, east, West and south east part of study area. The low degree was found in southern part of study area. The slope flowing direction is from east to central, west to central and North West to Central East part of study area. It is due to presence of Noyyal River aside to this region, the slope is towards central part of study area.

Stream Ordering (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 join to form a second order; two second order joins to form a third order and so on. He then extended the highest value of order towards the head.

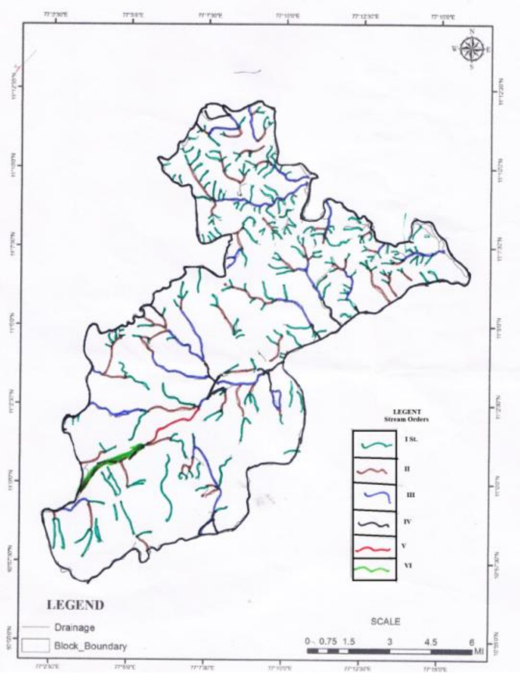

Figure 8: Stream Ordering

The figure no.: 8 represent the drainage basin in the study area, mostly first order small streams channels was seen which is followed by second order, third order, fourth order, fifth order and sixth order streamline. The streamline is based on rock hardness and topographical structure of the study area. The whole study area is seen with drainage streams due to flow of Noyyal River at centre region.

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.

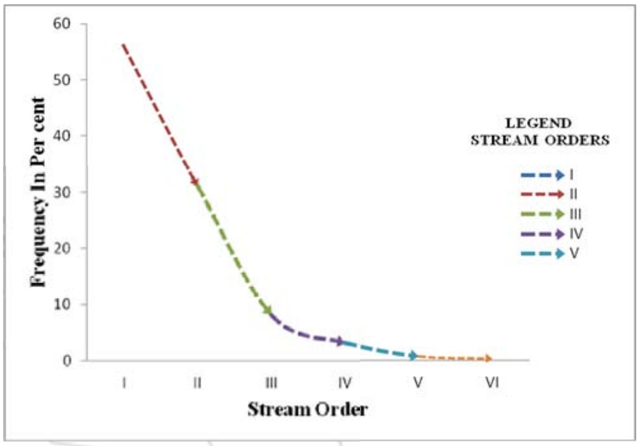

Figure 9: Stream Frequency

The figure no 9 represents the stream frequency in percentage at study area, mostly first order (small streams channel) captured high percentage was seen followed by second order, third order, fourth order, fifth order and sixth order 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	137	
2	II	76	1.8
3	III	20	3.8
4	IV	8	2.5
5	V	2	4
6	VI	1	2

The table no 1 describes about the bifurcation ratio value in the study area. The first and second order bf value is 1.8, second order and third order Bf value is 3.8,the third and fourth order Value is 2.5, fourth order and fifth order Bf value is 4. This method also describes the water utilization in each area and their level to be understood. First bifurcation ratio value is not greater than second bifurcation value, the second to third order, the third order to fourth order, the fourth order to fifth order is greater than the study area, hence, drainage basin and water sharing is well satisfactory.

Drainage Density

According to Horton (1945), as the total length of stream channels per unit area represents a geomorphometric parameter. It is independent of order and varies inversely with the size of the basin.

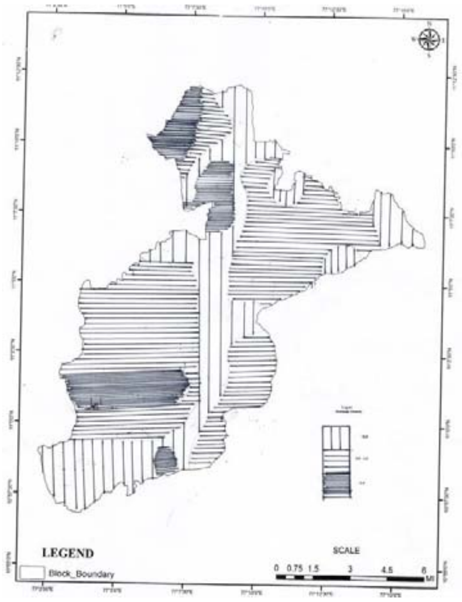

Figure10: Drainage Density

This figure no 10 represent the high drainage density at north, North West, south east part of the Study Area The moderate drainage density level is seen at eastern, central west and south east part of the study area. The low drainage density is seen central, northern, southern and eastern region of study area. The density level at north and south west 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 stream is measured. This region has river density flow at this region from other regions which reaches central part where Noyyalriver flows. The river flows on the valley section of Western Ghats which is located at 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.

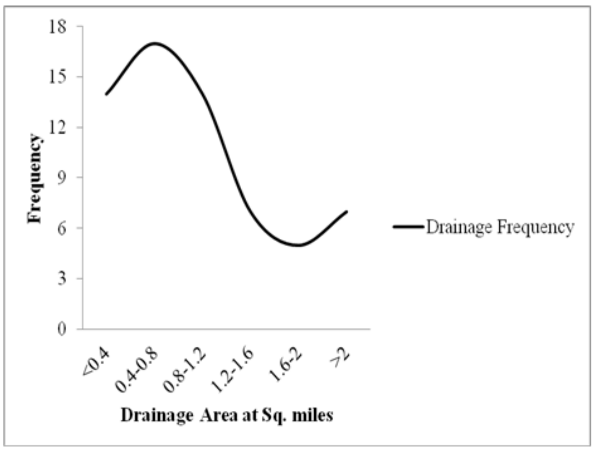

Figure 11: Drainage Frequency in Percentage

The figure no 11 explain the drainage frequency in percentage at study area, mostly 0.4 to 0.8 sq. miles captures high per cent was seen which is followed by 0.8 to 1.2 sq. miles, which is followed by 1.2 to 1.6 sq. miles, 1.6 to 2 sq. miles and above 2sq miles order per cent at streamline captured. It is due to high relief and well know drainage basin.

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.

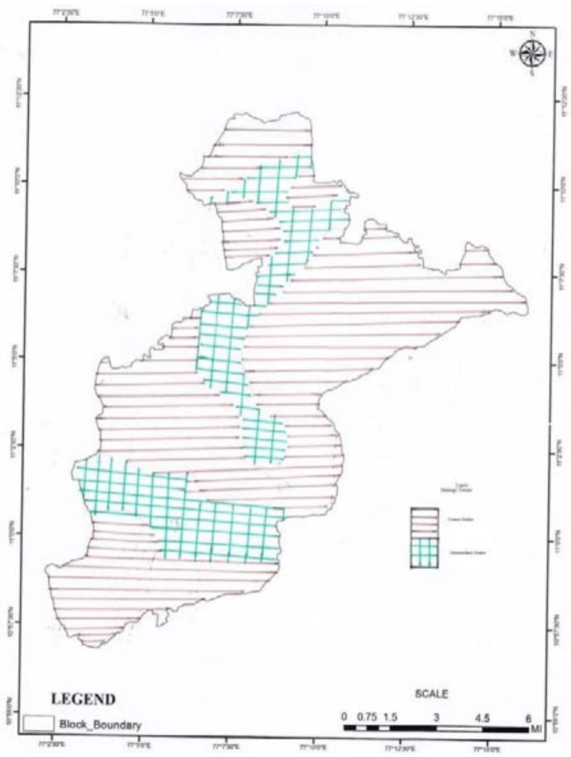

Figure 12: Drainage Texture

The figure no. 12 determines the drainage texture at Study area. In that, the south east, west, east, and north region Study area has coarse grains texture. The intermediate grains are found in west and east side of the study area. From this study area, drainage texture of few regions has intermediate grains. Other areas are covered by igneous rock formation which is not easily eroded in fluvial process. It is due to formation of intermediate coarse grain texture.

Roughness Index

Relief roughness or smoothness, inspections are performed to monitor the pavement conditions in order to evaluate the ride quality of new and rehabilitated basin development. Both manual and automatic multi- function profiling systems are continuously being developed and topographic for improved performance. The roughness index formula:

$$N \quad \frac{M}{4} \quad 10$$

N= total no. intersection of contour lines with to sets of perpendicular girds, set at 45^0 to each other. 4 and 10 are constant.

M= distance in miles between grit lines.

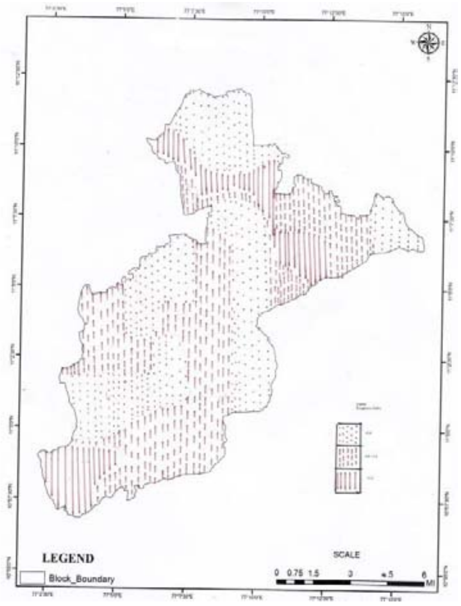

Figure 13: Roughness Index

Figure no.: 13 represent the roughness index of Study area. The high ridge and undulating topography is at scattered few part of the study area. The average undulating topography is seen at south and Eastern part of the study area. Low roughness surface is seen northern part of study area. The roughness index of this area depends upon the nature of topography, relief and drainage basin. Roughness areas are more susceptible to erosion which results in ranges (centre valley section). While comparing this with other sites, the topography nature of this has smooth surface at centre of the study area. The central region of this study area has Noyyal River which is the main 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.

Figure no.: 14 determine the ruggedness index of the relief. The map indicates the strong relief and hard rock topography found in Northern part of the Sulur block Average strong or moderate ruggedness is seen at southeast of topography. Low ruggedness is found in north part of topography. The strangeness depends upon the nature of topographic and drainage basin. Ruggedness at different sites of this area is strong, no extent variations is seen.

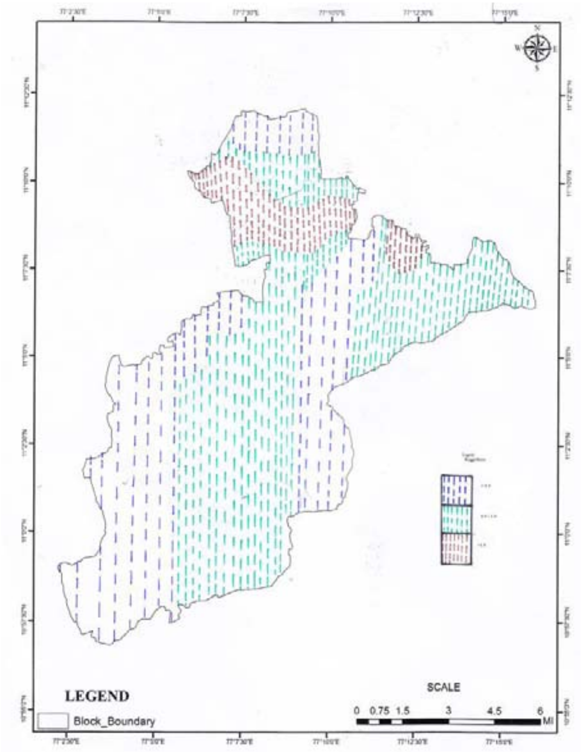

Figure 14: Ruggedness

5. Conclusion

The morphometric investigations of study area it exhibits the mountain profile, high relative relief variation, the average slope is both sides moderate and high central part is low, high frequency stream order categories, central region low drainage density, the coarse and intermediate drainage texture, roughness index and ruggedness. These parameters prove that study area has mountain ranges and valleys section flow via Noyyal River. It is due to mountain ranges topology, structure which is due high roughness, high ruggedness, relative relief is high and average slope. This all parameter features main reason for this topography. These all the parameter creates this relief feature in the study area.

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