IOSR Journal of Applied Geology and Geophysics (IOSR-JAGG)
e-ISSN: 2321–0990, p-ISSN: 2321–0982.Volume 5, Issue 5 Ver. II (Sep. – Oct. 2017), PP 01-07
www.iosrjournals.org

Gis Based On Morphometric Analysis of Part of Manair River Basin in Karimnagar District, Telangana State.

B. Satheesh,
Department of Geology, Kakatiya University, Warangal-506009

Abstract: *The Manair River is an important tributary of river Godavari and forms part of Karimnagar district of Telangana State. The geomorphological studies have been carried out with a view to understand the impact of these parameters over the ground water occurrence in the area. The area is covered with hard rock's i.e., granites and granitic gneisses traversed by dykes and numerous veins of quartz, epidote and pegmatite. The morphometric analysis has been carried out in addition to the study of land forms. The structural features has strong bearing over the development of drainage pattern and it is mostly dendritic to sub-dendritic nature and the Manair river is designated as sixth order stream. The lower value of bifurcation ratio is mainly due to gentle slopes owing to hard rock terrain. The geomorphic features such as pediplains, shallow valley fills and palaeo channels are considered to be potential aquifer zones. It has been also observed that the increasing order of drainage has increased the ground water potential.*
Keywords: *Drainage Characteristics, Morphometric Analysis, Manair Basin, Karimnagar District.*

Date of Submission: 27-09-2017 Date of acceptance: 18-10-2017

I. Introduction

The morphometric analysis of a drainage basin and channel network play a significant role in understanding the hydrogeological behavior of the basin and express the prevailing climate, geology, geomorphology and structures etc. the relationship between various drainage parameters and the above factors are now almost well established (Horton, 1945;Strahler, 1957; Melton, 1958). Recently, several researchershave used remote sensing data and GIS on morphometric parameters and have concluded that remote sensing has emerged as a power full tool in analyzing the drainage morphometry(Agarwal, 1998; Nag, 1998; Das &Mukarji, 2005) the present study mainly aims to analyse the morphmetric attributes part of the Manair river basin around Karimnagar district.

II. Study area

Karimnagar District is part of the Telangana state, covering an area of 11,835 Km^2. Mighty Godavari is the northern boundary of the District separates from Adilabad District and Maharastra State. Another major River Manair is flowing in the middle of the District in W-E direction and it is a tributary of Godavari and merging at Damarakunta Village of Kataram Mandal. The study area forms part of the Lower Manair basin covering an area of 671 km^2. This basin is located on the North Eastern part of the Karimnagar district lying between $17^o\ 56'\ 18'' - 18^o\ 25'\ 38''$ and longitude $78^\circ 45' 30'' - 79^\circ 17' 10''$ of East latitude in Survey of India toposheet No. 56 N / 3, 56 N / 4, 56 N / 6& 56N/8 (Fig. 1) 1:50,000 Scale with an area of 671 Km^2 (Fig. 2). Investigation is intended to study the morphometric characteristic of the drainage basin with a special emphasis on ground water conditions on the area (Strahlar's 1957).

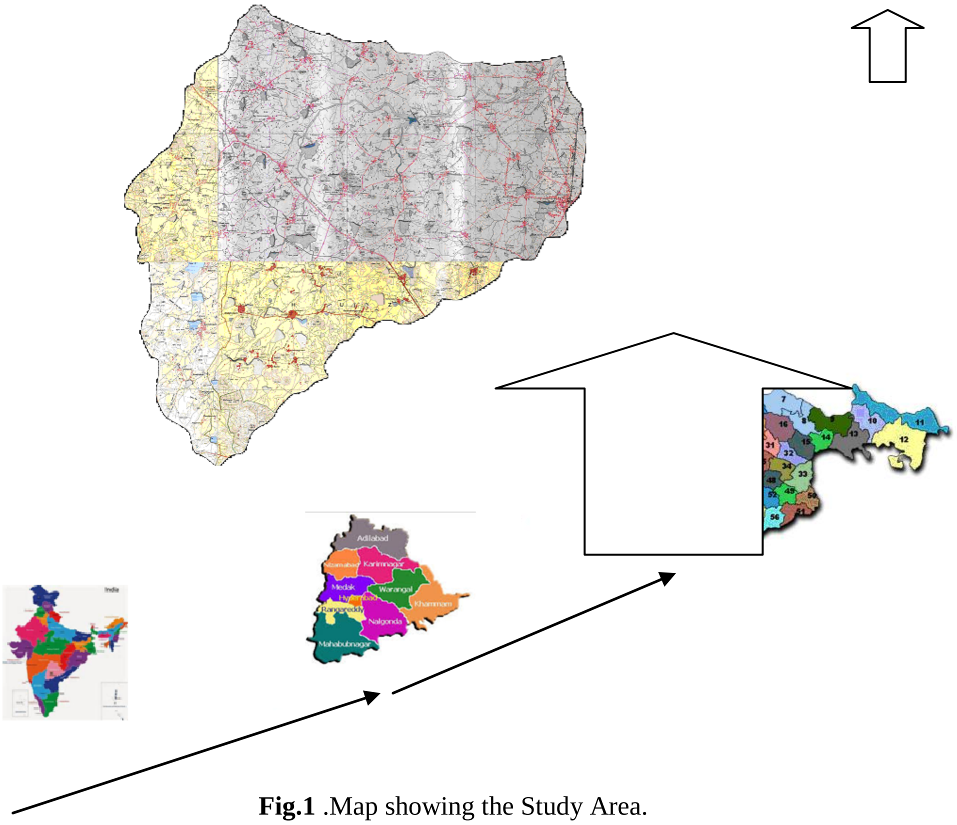

Fig.1 .Map showing the Study Area.

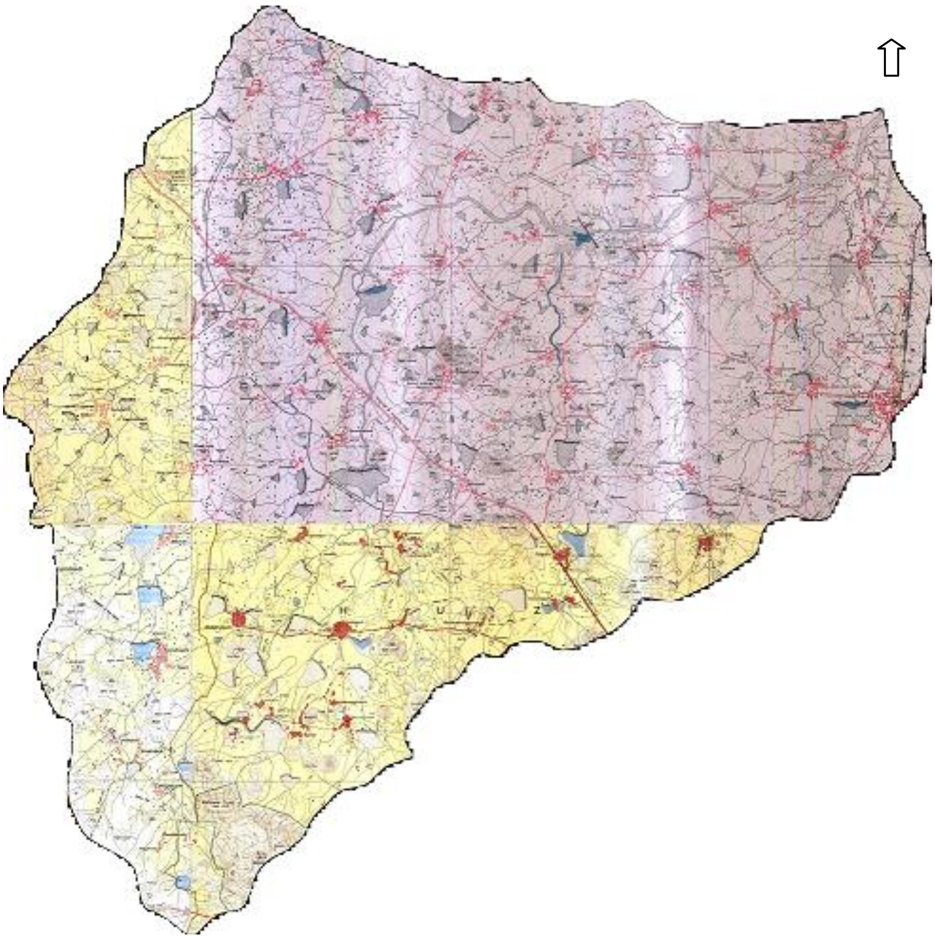

Fig. 2. Map Showing Toposheet of the Study Area.

Topography and Climate: The highest and lowest elevation from above Mean Sea Level (MSL) in the study area is 634 meters towards western side and 200 meters on southern side of the basin. The highest elevated area is observed at Saidapur with an elevation of 634 m above MSL which is located on the South-Western part of the basin. On the Northern side of the basin the Veenavankagutta with an elevation of 400 m, the eastern part of the basin near Jammikunta with an elevation of 450m, and on the Western side of the basin nearby Manakondur with an elevation of 400 m. Climate is the more important natural phenomenon which controls the growth at living organism's development of soil, surface and sub surface water resources, etc. The climate of the area is generally hot and dry with the temperature varying between 13 to 46° C and occasionally touches 49°C and it is considered to be semi-arid tropics.

Rainfall is the major source of groundwater recharge in the study area. The distribution, duration, intensity and frequency of occurrence of rainfall are some of the primary factors that govern the distribution of water in the land surface and sub-surface. Protected open forest, which covers 8% percent of the total area of the study area, is covered with limited flora and fauna. Many plant species have disappeared due to deforestation. However Teak, Bamboo, Buruf, etc., are some of the dominating varieties of plant species which are present in the forest area. This flora plays vital role in recharging the water in the study area. The remarkable hills with an average elevation of 632 m are observed on the West to Northern parts of the area and also at southern part with an elevation of 620 mts.There are two types of soils are found in the area, they are Red soils and Black cotton soils.

Geology of the Area: The area forms part of the peninsular shield represented by the Granites, Granitic gneisses and schist's which are traversed by dolerite dykes and numerous veins of quartz, pegmatite and epidote. The granites and granitic gneisses are massive and fractured created the secondary porosity. At places, granodiorites and charnokites occur as small patches within the granitic terrain (Fig.3).

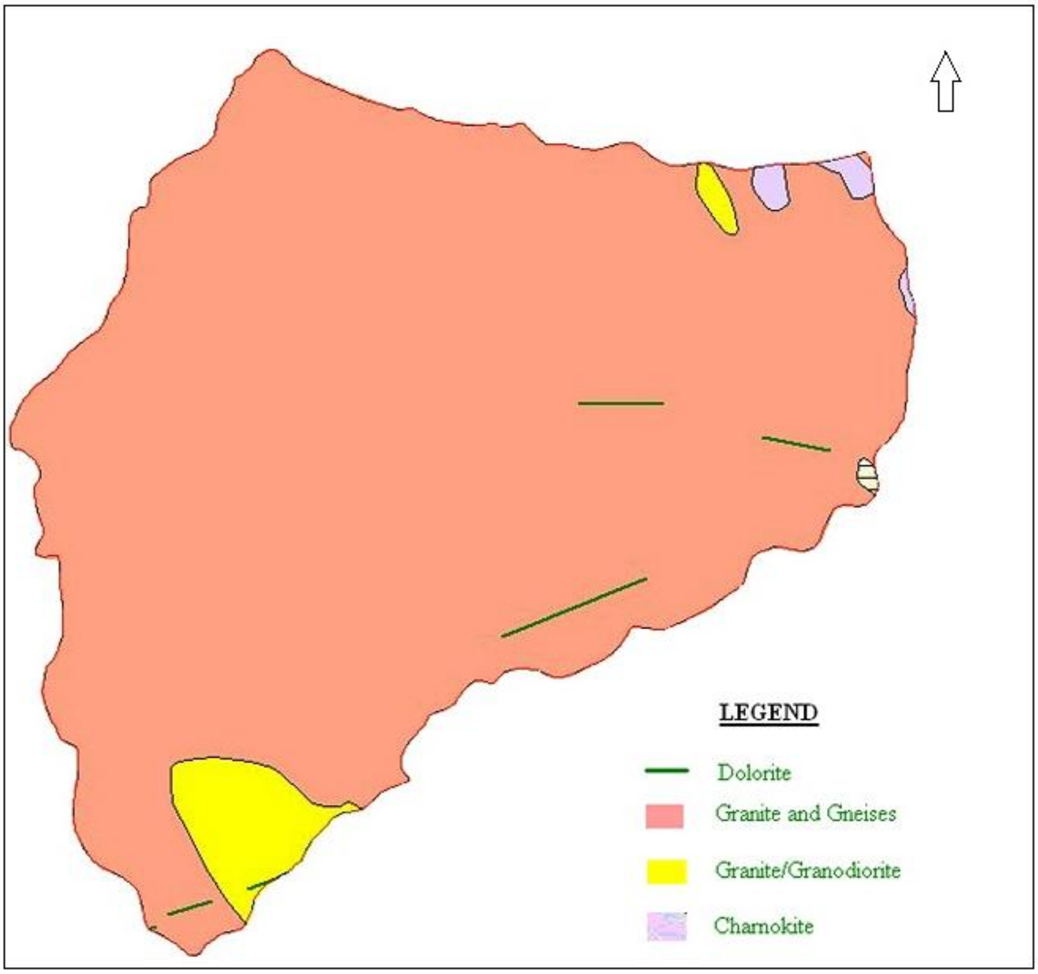

Fig.3. Geology of the Study Area

Basin Morphometry: The drainage system constitutes the main stream and its tributary network. The study of drainage basin gives a detailed account of runoff, infiltration, sediments lodes carried by streams etc., which are suitable for tapping groundwater. The size of the drainage basin influences the yield of the basin. The analysis includes stream order, streams length, stream length ratio, and length of overland flow, elongation ratio, circularity ratio, bifurcation ratio, drainage density, drainage frequency and drainage texture. The drainage network of the basin has been analysed following the procedures of Horton (1945) and Strahler (1964, 1968).

Stream Order: The effectiveness of a drainage development is related to stream magnitude so that the stream order is considered as an important parameter in a linear aspect of drainage basin. The designation of various stream orders was first introduced by Horton (1945), and was later modified by Strahler (1952, 1958). The first order streams have no tributaries (Strahler 1964). The second order streams have the tributaries of only first order channels. A segment of third order is formed, where two-second channels join when two third order segments join, a fourth order channels is formed. When third, fourth order segments join a fifth order channels is formed, when fourth, fifth order segments join a six order channel is formed. Accordingly the Manair basin is designated as six order basin. The stream order is generally designated by the letter 'U' and the total numbers of streams are indicated by 'Nu' (Table - 1). There are as many as 1159 first order streams, 298 second order streams, 77 third order streams, 18 fourth order streams and 5 fifth order streams, with a single sixth order stream. Hence it is designated as part of sixth order basin.

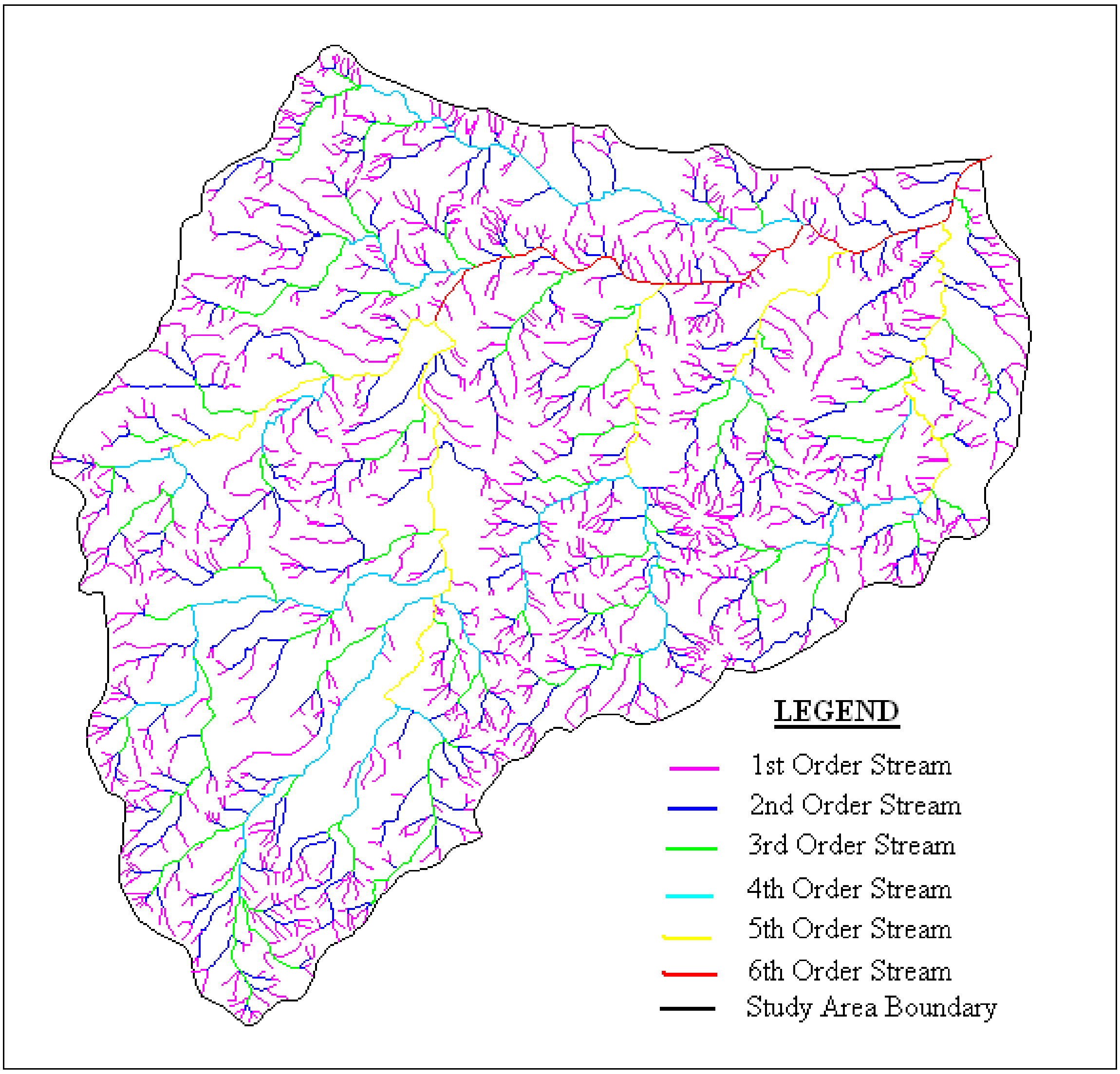

Fig.4. Map Showing Study the Drainage Pattern of the area

Table –1: Drainage parameters of Manair basin

S.No.	Stream order	No. of streams of given (Nu)	Stream length (Lu)
1	1	1159	841.19
2	2	298	401.00
3	3	77	260.00
4	4	18	95.40
5	5	05	55.08
6	6	01	22.40

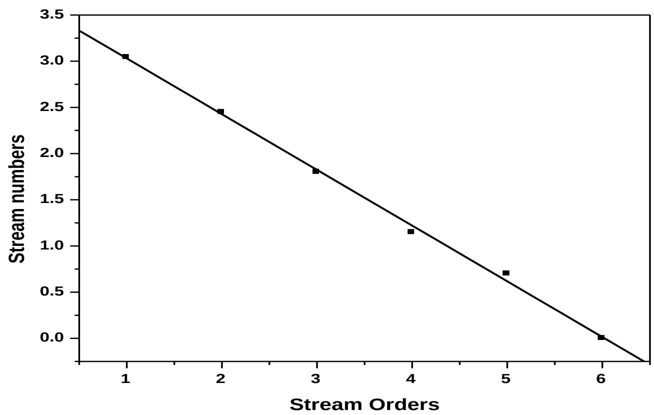

Fig.5. Geometric relationship between stream orders and number of streams

Stream Length: Stream length is a dimensional property to understand the characteristic size of components of a drainage network. Total length of stream segments maximum is 846.19 km. In the case of first order streams (Table 1) and almost in all cases, the basin length decreases, as the stream order increases the length decrease.

Stream Length Ratio: Stream length ratio has an important relationship with surface flow discharge and erosional stage of the basin. Streams flow smaller in number and greater in length in more permeable areas. The length of the various stream segments were measured order wise and the total length as well as the mean length for each order were computed. The stream length ratio which is the ratio of the mean length of the steams of a given order to the mean length of the streams of the next lower order has been calculated for each pair of orders as shown below. The mean length of the streams increases with the order in direct proportion and brings out this exponential relation clearly. The best-fit regression equations were obtained as in the semi-logarithm plot of mean length against order is more or less straight lines satisfying (Fig.6). Horton's second law of stream lengths which states that the average length of streams of each of the different order in a drainage basin tends closely to approximate a direct geometric series in which the first term is the average length of the streams of the first order.

RL = Lu / Lu-1

Where RL is the stream length ratio, Lu is the mean stream length order (u) and Lu-1 is the mean stream length of segments of the next lower order.

The stream length ratios of the Manair basin range from 1.547 to 2.72 (Table-2). The mean length ratio obtained from the regression co-efficient is 1. 23 and mean length ratio is 2.180. The variation in the stream length ratios may be caused by the difference in slope and topographical conditions.

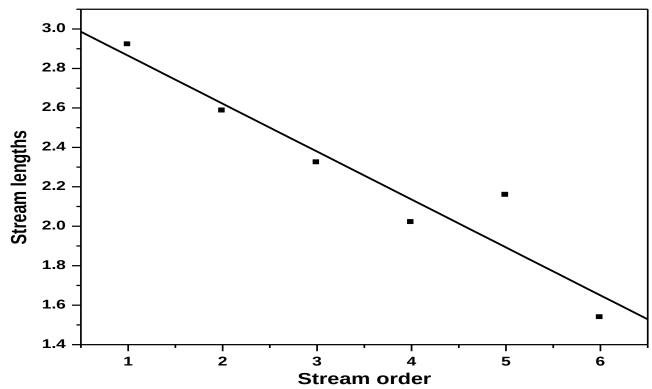

Fig.6. Geometric relationship between stream orders and stream length (Km)

Table -2: Stream length ratio

S.No.	Length of each stream order	Stream length ratio	Mean stream length ratio
1 2 3 4 5 6	841.19 401.00 260.00 95.40 55.08 22.4	2.109 1.541 2.72 1.732 2.458	2.180

Circularity Ratio: Circularity ratio is a quantitative expression of the shape of a basin. It is defined as the ratio of basin area to the area of a circle having the same perimeters as the basin (Strahler, 1964: Miller, 1953) and is expressed as

$$RC = 4\Pi A / P^2$$

Where RC = is the circularity ratio, A is the area of a basin and P is the basin perimeter.

The circularity ratio is generally influenced by length, frequency and gradient of streams of various orders rather than slope and drainage conditions of basin. Low, medium and high circularity ratio values are indicative of youth, mature and old stages respectively of the basins. For this basin the circularity ratio is found to be 0.1

Bifurcation Ratio: Bifurcation Ratio is used to express the ratio of a number of streams of any given order to a number in the next lower stream order (Horton, 1932). The ratio of a number of streams of a given order to the number of segments of the higher stream order is termed as the bifurcation ratio, as shown in the following formula

$$Rb = Nu / Nu + 1$$

Where Rb is the bifurcation ratio, Nu is the number of stream segments and Nu+1 is the number of stream segments of the highs orders.

The bifurcation ratio varies from 2.57 to 5 (Table. 3) with mean of *4.1352* as a whole for the Manair basin. The higher bifurcation ratio for V and III order streams in the basin respectively, may be attributed to the development of streams in steeply dipping rock strata. The values of bifurcation ratio less than 5 suggest that the geological structures do not show any dominant influence on a drainage pattern. Such values denote a mature development of the basin.

Table.3. Bifurcation ratio

S.No.	No. of streams of each order	Bifurcation ratio	Mean Bifurcation ratio
1 2 3 4 5 6	1155 298 77 18 05 01	3.89 3.87 4.27 2.57 5	3.92

Elongation Ratio: Schumm's (1956) elongation ratio is the ratio between the diameter of a circle of the same area of a drainage basin and the maximum length of the basin. Higher the elongation ratio lesser will be the flood peak. For this basin the elongation ratio is 0.74. The shape of a drainage basin is significant since it affects the stream drainage characteristics (Strahler, 1958). The low form factor, circularity ratio and higher elongation ratio suggests the basin is more elongated.

Stream Frequency: Stream frequency (Horton, 1945) refers to the number of the streams per unit area and is obtained by dividing the total number of streams by the total drainage basin area. This basin has a stream frequency of 2.371. Stream frequency helps in distinguishing the groundwater recharge characteristics in a river basin.

$$Fs = Lu / Au = 1558 / 671 = 2.371$$

Where Fs Lu is total number of streams, Au is Total area of the drainage basin

Drainage Density: Drainage density is a measure of degree of drainage development within a basin. It reflects closeness of spacing of channels, attributing due to differential weathering of various formations, relief and rainfall in an area. According to Horton (1932), the drainage density is defined as the length of streams per unit of a drainage area divided by the area of the drainage basin. It is expressed as

$$Dd = Lu / A = 1680 / 671 = 2.504 \text{ km/km}^2$$

Where Dd is the drainage density, Lu is the length of all the other streams and A is the area of the basin, Smith (1950) and Strahler (1957) have described drainage density values less than 5 as coarse, between 5 to 13.7 as medium, between 13.7 to 155.3 as fine, and greater than 155.3 as ultra fine. Chow (1964) is of the opinion that the low drainage density is favored in regions of highly resistant or highly permeable sub-soil materials under dense vegetation and low relief, while the high drainage density is favored in regions of weak or impermeable sub-soil materials, sparse vegetation and mountain relief.

The drainage density computed according to Horton's formula in the manair basin is 2.504 km/km². It suggests that the drainage density is low, reflecting a permeable sub-surface stratum with dense vegetation and low relief, which is a characteristic feature of coarse drainage density.

Drainage Texture: Drainage texture is a measure of closeness of the channel spacing. It depends on climate, rainfall, vegetation, rock and soil type, infiltration capacity, relief and stage of development of drainage (Smith, 1950). Weak rocks produce fine texture, while hard rock's develop coarse texture. Sparse vegetation of an arid climate causes develop on similar rocks in a humid climate. The texture of a rock depends upon vegetation and climate causes development of fine texture than those developed on similar rocks in a humid climate. The texture of a rock depends upon vegetation and climate conditions (Dornkamp and King, 1971). The drainage texture is computed, using the formula

$T = Dd \times Fs = 2.504 \times 2.321 = 5.81\ D^2$

Where T is the drainage texture, Dd is the drainage density and Fs is the stream frequency

The drainage texture of the Manair basin is 5.81 D . The basin obeys the loss of stream numbers and stream lengths. The mean bifurcation ratio indicates the drainage pattern of this basin is not distorted by the geological structures. The circularity ratio reveals early to late mature topography due to differences in slope, relief and structural conditions. The drainage density reveals that the subsurface strata are permeable with coarse drainage density. The river basin originates from the steep slopes. Most of the streams occur in comparatively plain lands and the sub-surface stratum is permeable. Therefore, the plain lands are important locations for constructing of artificial recharge zones for augmenting the groundwater conditions.

References

[1] Agarwal,C.S.(1998) Study of drainage pattern through aerial data in Nahagarh area of Varanasi District .U.P. Jour .Indian Soc. Remote Sensing V.26(4),pp.169-175.

[2] Das,A.K. and Mukharajee,S.(2005) Drainage morphometry using satellite data GIS in Raigad district. Maharastra.Jour.Geol. Soc. India , v.65.pp,.577-586

[3] Melton,M.A (1958a) A derivation of Strahlers 's Channel-ordering system, Jour., Geol,. V. 67,pp 345-346

[4] NAG,.S.K (1998) Morhometric Analysis using remote sensing techniques imn the Chuka, Sub-basin, Perulia district, West Bengal Jour,. Indian Remote Sensimg, v,.26(*1&2).pp., 69 -76

[5] Chow,V.T., 1964.Handbook of Applied hydrology.McGraw Hill Inc., U.S.A.

[6] Dornkamp, J.C. and King, C.A.M., 1971. Numerical analysis in geomorphology- an introduction. Ward Arnold Pub. Ltd., London, 372p.

[7] Horton, R.E., 1932. Drainage characteristic Trans. Ame.Geophys.Union,vol.13,pp 350-361

[8] Horton, R.E., 1945. Erosional development of steams and their drainage basins-hydrophysical approach to quantitative morphology.Geol.Soc.Ame.Bull,vol56,pp275-370

[9] Satheesh, B., (2011) Hydrogeological Studies of Peddavagu sub-basin in Warangal & Karimnagar Districts, Andhra Pradesh. Unpublished Ph.D. Thesis submitted to Kakatiya University.

[10] Schumm, S.A., 1956, Evolution of drainage systems and slopes in badlands at Perth Amboy, New Jersey, Geol.Soc.Ame.Bull,vol67,pp597-646.

[11] Smith, K.G., 1950. Standards for grading texture of erosional topography. Ame. Jour. Sci, vol.248, pp.655-668.

[12] Strahler, A.N., 1957. Quantitative analysis of watershed geomorphology, Ame. Geophys. Unioun. Trans., vol. 38, pp 913-920.

[13] Strahler, A.N., 1964. Quantitative geomorphology of drainage basins is channel networks. In: Hand Book of Applied Hydrology, Vent Te Chow (ed), pp39-79.

[14] Strahler, A.N. (1958) Dimensional analysis applied to fluvially eroded land forms. Bull. Geol. Soc.Amer. Vol 69, pp.279-300.

IOSR Journal of Applied Geology and Geophysics (IOSR-JAGG) is UGC approved Journal with Sl. No. 5021, Journal no. 49115.

B. Satheesh. "Gis Based On Morphometric Analysis of Part of Manair River Basin in Karimnagar District, Telangana State." IOSR Journal of Applied Geology and Geophysics (IOSR-JAGG) , vol. 5, no. 5, 2017, pp. 01–07.