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Morphometric Analysis of Drainage Basin of Parts of Adilabad, and Karimnagar, Telangana State, India.

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Abstract: Morphometry is the science of analyzing the shape, surface, and size of the Earth's landforms.Quantitative analysis of drainage networks in relation to lithology, geomorphology, climate, and tectonics provides significant data of an area's drainage development, hydro-geomorphic, and denudation features. The main focus of this research is to figure out how to get a holistic view of a stream by measuring various stream attributes. Aspects such as linear aspects and aerial aspects are considered in the quantitative drainage analysis. The linear aspects include stream number, stream length, stream order, and bifurcation ratio, mean length of stream orders, stream length ratio, mean stream length ratio, and form factor. Drainage density, stream frequency, and texture ratio, constant channel length, and overland flow maintenance length are all Areal aspects to consider. Morphometric analysis is conducted with the help of Arc GIS (10.2) software, which is a sophisticated tool for quickly measuring the drainage basin and the earth surface dimensions of landform and shape. The present study was carried out by using LISS-IV Satellite Images to study the drainage morphometry, Geomorphology and its influence on the hydrological characteristics of mine Areas in Adilabad District & Karimnagar District ,Telagana State, India. Results of the morphometric analysis reveal that the catchment of mine Areas in Adilabad District & Karimnagar District can be described as 1st to 7th order drainage basins, encompassing an area of 854km2, respectively. Area with a mean bifurcation ratio of 7.285, indicating greater structural control and a steeper gradient. The shape parameter shows that the basin is semicircular with dendritic drainage pattern. The Study Area's relief parameter indicates that the basin contains a steep slope and a high relief. These Morphometric parameters through GIS-based analysis indicate that drainage development of the study area shows well maturity stage, lithology and Geomorphology have a major impact on the drainage development in mining Area.

Keywords: Morphometric analysis of Mining Area Ramagundam, Mapping, Arc- GIS, Geomorphology, Ground water Prospects part of Adilabad Dist & Karimanagar Dist.

Introduction:

Morphometric study in the field of hydrology started In the year of 1940s and 1950s, Morphometry is the mathematical analysis study of measurement of the earth's surface, shape, and landforms. The flow of tributaries is controlled by structural and geomorphological features. Drainage Morphometric analysis provides an overall view of the terrain, including hydrological, lithological, relief, watershed variations, slope, ground water recharge, flood peak, rock resistant, porosity, soil characteristics, permeability, and runoff intensity, and is useful for civil engineering, hydrological, ground water prospects, geological, and environmental studies.

GIS allows the user to examine, analyze, interpret, and visualize data in a variety of ways, including maps, globes, reports, and charts, to reveal correlations, patterns, and trends.

By examining data in a form that is quickly understood and shared, GIS assists in answering questions and solving issues. More than ever before in history, it is necessary to manage, conserve, and restore natural resources, and decision-makers who must act need a comprehensive understanding of the concerns. The Arc GIS platform aids in gaining a better knowledge of the issues and providing more accurate data to the table with less guesswork. Arc GIS (10.8) software is the Most powerful tool that found a significant role in scientific applications (http://webhelp.esri.com/arcgisdesktop/10.8). The main purpose of this research work is to study holistic stream properties from Measurement of various stream attributes, and also groundwater investigation to know how to utilize them for farming purposes. Using Arc GIS (10.8) software techniques for mapping, analysis, and quantitative measurements are carried out with accurate results with less time and least cost and produced a practical approach for creating GIS data models for morphometric analysis Drainage morphology including slope maps is also investigated for purpose of build water storage facilities such as percolation tanks, ponds, and check dams. As a result, the main purpose of the research is to use GIS tools to analyze various morphometric characteristics of the study area.

Study Area

The Study area Ramagundam Mines located in the Northern part of Telangana State i.e Adilabad Dist & Karimnagar District is selected for morphometric analysis. The area is located in the Survey of India Toposheet No 56N/5 and bounded by latitudes 18° 35 to 18° 55′ N and Longitudes 79° 15′ to 45° 00′ E. The total area of drainage basin cover is 854km2, (Fig: 1). Study Area of drainage basin is a part of the Godavari Valley of formations consisting of Sandstone, Limestone, Coal, Quartzite and Granitic Gneiss. Major part is covered with Sandstone, Limestone and Granitic Gneiss. Major Activities such as Mining and Agriculture are notable in the study area.

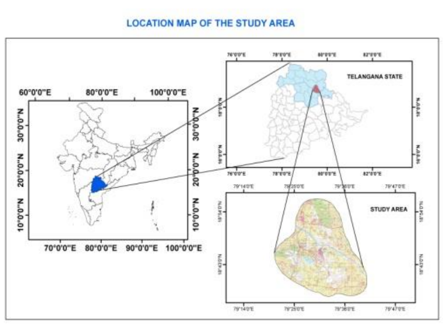

Figure 1: Location of the study Area

Methodology

Survey of India (SOI) toposheet No 56N/5 on 1:50,000 and RESOURCESAT-2 LISS IV data 8th Feb 2012 have been used for generation of DEM. SOI topographic map No 56N/5) on 1:50,000 scale was georeferenced using WGS 84 datum, Universal Transverse Mercator (UTM) zone 44N projection in ArcGIS desktop 10.8

For DEM and ortho-image generation from RESOURCESAT-2 LISS IV data, Eridas was used in the study. In LISS IV pair images, with both bands were added and automatically tie points were generated.

The study's main objective is to come up with a suitable approach for creating GIS data models for drainage morphometric analysis and discovering holistic stream characteristics from measurements of various stream parameters using Arc GIS 10.8 software.

. This study has following steps illustrated in Fig: 2.

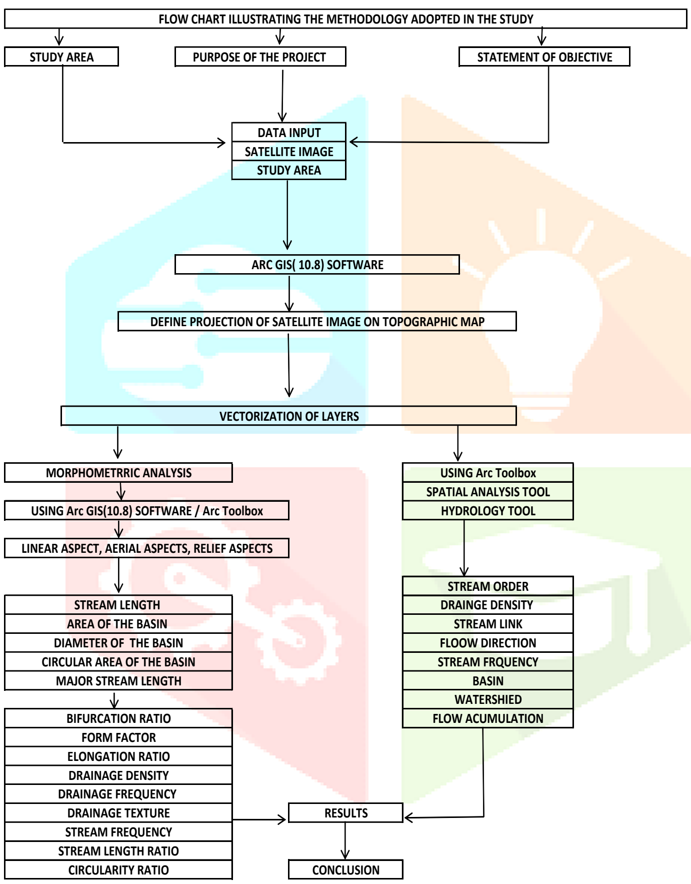

Figure 2: The Drainage Basin Analysis

The quantitatively analysis of drainage basin by help of Arc GIS 10.8. Using the vectorization of study area base map and Geomorphological map and drainage network map all measurements in the Arc GIS 10.8 like linear aspects and aerial aspects are considered in the quantitative drainage analysis. The linear aspects include stream number, stream length, stream order, and bifurcation ratio, mean length of stream orders, stream length ratio, mean stream length ratio, and form factor. Drainage density, stream frequency, and texture ratio, constant channel length, overland flow maintenance length, Texture ratio Basin length, Elongation ratio, Circularity ratio and Form factor ratio were calculated. By the help of arc Conversion tools box the data is converted in to raster to vector form.

Personal Geodatabase tools and Coverage-tool were used in the area to estimate stream length. For accuracy, the topology tool was used to edit line errors such as polygons, point and node of overlapping, dangles, and gaps.

By registering a raster image with a satellite image and a topographical map, projection and transformation were performed using data management techniques.

For drainage basin creation, sub-watershed delineation, flow direction, stream order, and stream intersection points, hydrology tools were utilised. Bifurcation ratio, form factor, elongation ration, drainage density, drainage frequency, stream frequency, and drainage texture were all analyzed after this process.

The study area of drainage basin analysis done quantitatively aspect wise such as aerial aspects and linear aspects. In the linear aspects, bifurcation ratio, mean length, stream order, stream length, stream length ratio, and mean length ratio were analyzed.

In the basin geometry factors like stream frequency, drainage density, texture ratio, constant of channel maintenance and the length of the overland flow and Geomorphology were carried out. Each parameter's method of calculation and procedure to estimate were briefly mentioned.

Results and Discussion

Morphometric analysis of the Study area drainage Basin

Stream Order (U)

There are four different system of ordering streams that are available (Gravelius(1914), Horton (1945), Strahler (1952) and Schideggar (1970)].

Strahler's system, which is a slightly modified of Hortons system, has been followed because of its simplicity, where the smallest, un-branched fingertip streams are designated as 1st order, the confluence of two 1st order channels give a channels segments of 2nd order, two 2nd order streams join to form a segment of 3rd order and so on. For maintaining Higher Order Stream the two channel of different order joined together.

The trunk stream is the stream segment of highest order. It is found that Godavari river tributaries are of 7th order. In all 5664 streams were identified of which 2807 are first order, 1341 are second order, 713 are third order, 430 are fourth order, 262 are fifth order, 6 are Sixth order and 105 in Seventh Order. Drainage patterns of stream network from the basin have been observed as mainly of dendritic type. The properties of the stream networks are very important to study basin characteristics (Strahler, 2002).

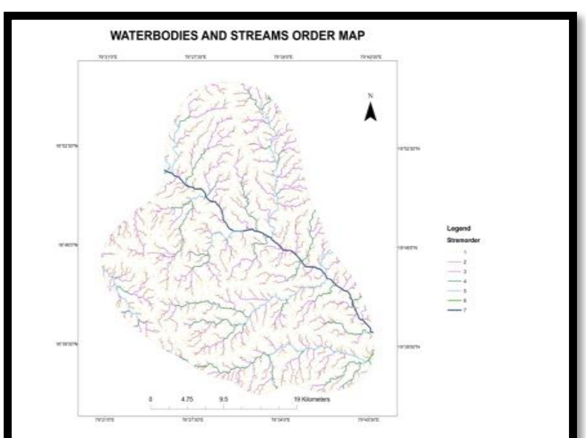

Figure 3 : Water bodies and Stream

Stream Number (Nu)

Stream number refers to the number of stream channels in a certain order. As the order increases, the number of stream segments decreases. The higher the stream order which means the lower the permeability and infiltration.

The number of streams is proportional to the size of the contributing watershed as well as the channel dimensions. The number of streams in any given order will obviously be less than in the next lower level, but larger than in the next higher order. As the stream order increases, the number of streams decreases. The order-wise stream numbers were estimated in this study are given in the

Stream order (U)	Stream number(Nu)
1	2807
2	1341
3	713
4	430
5	262
6	6
7	105

Table 1: Order wise Stream Numbers

Bifurcation Ratio (Rb)

It is defined as the number of stream segments ratio of given order to the next higher order of number of segments (Schumn 1956).

Horton (1945) Consider the bifurcation ratio is a measuring of dissections and relief.

Strahler (1957) stated that the bifurcation ratio shows a small range of variation for different environmental conditions and different regions except where the geology dominates.it also found that Rb is not same from one order to another order.

In the study area mean Rb varies from 0.057 to 43.66; the mean Rb of the entire basin is 7.28.

when the streams number is plotted against stream order, almost drainage network sows a liner pattern however it contains small deviation from straight line.

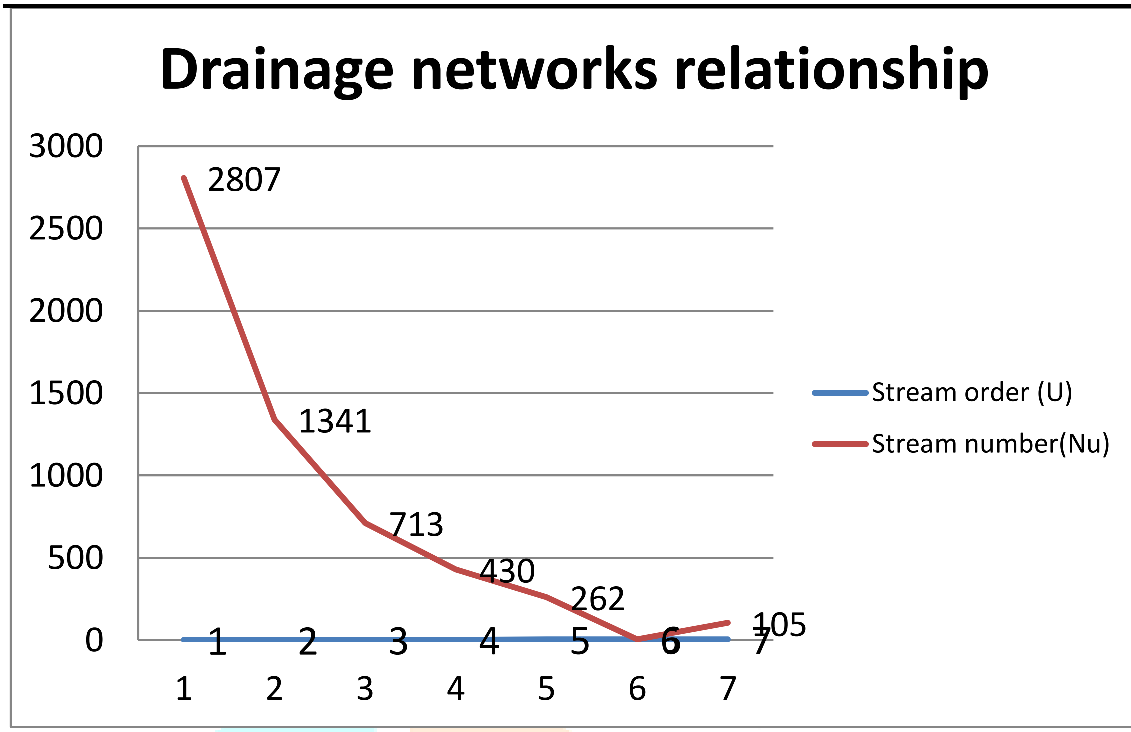

Figure 4 : Relation Between Stream Order & Stream Number

Stream Length Ratio (RL)

it is defined as the ratio of given order of mean stream length to the lower order and its has significant relationship with discharge and surface flow (Horton, 1945). The RL values of the basin shows different order of streams that there are variations in topography and slope. In the study area It indicates that the stream lengths are decreasing with increasing the order of stream as shown in Fig: 4

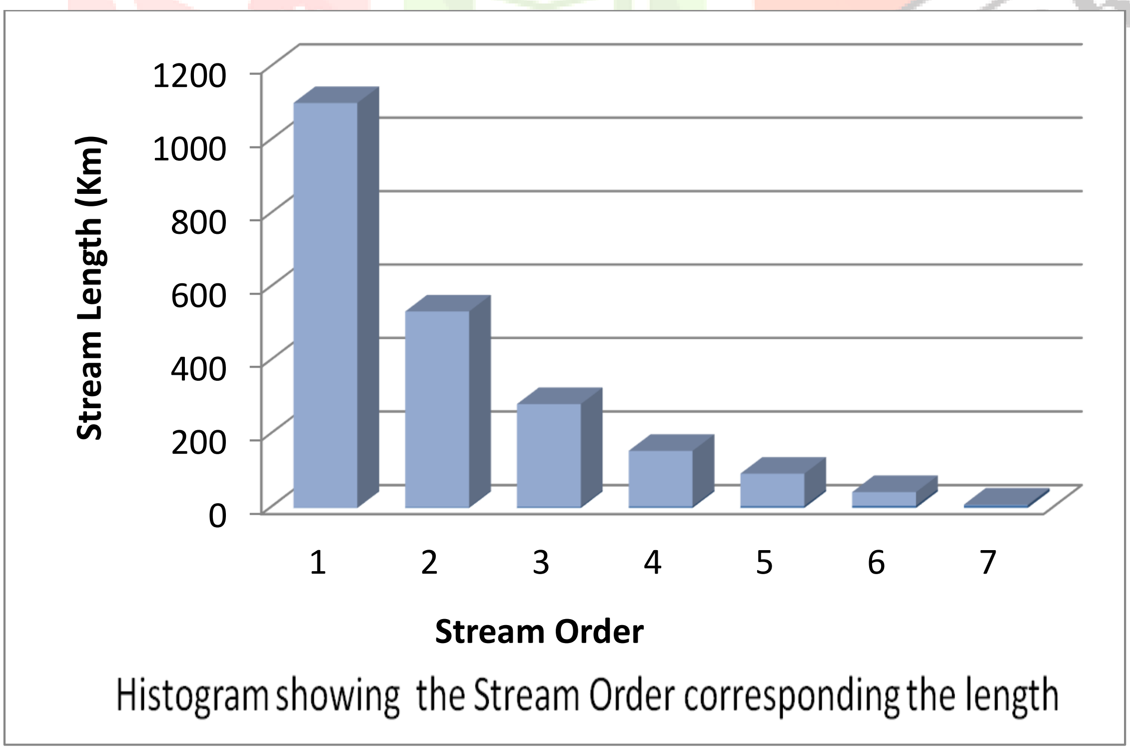

Figure 5: Histogram Showing stream Order Corresponding the Length.

Stream length of overland flow (Lf)

Flows of surface runoff the drainage divide (basin perimeter) to the nearest channel is formed by a system of down slope flow.

Depending on the location of the basin, this flow net, which is made up of a group of orthogonal curves with regard to the topographic contours, converges or diverges from parallelism locally.

The length of overland flow Lf as the length of flow, Non-channel flow from a point on the drainage divide to a point on the adjacent stream channel, projected to the horizontal. One of the most important independent variables influencing the hydrologic and physiographic development of drainage basins is the length of overland.

Basin area (Au)

The drainage basin area, like the length of draining - the basin, is an important parameter. The area of a given order is defined as the entire area of contribution overland flow to the channel segments of the given order, which includes all tributaries of the lower order, projected on a horizontal plane.

The Study area of drainage basin is = 854km2.

Stream Frequency (FU)

The number of streams segments per unit area is referred to as stream frequency, and it is related to the relevance of ground water recharge features in a river basin. It's computed by dividing the number of streams by the drainage basin's entire area.

The stream frequency for the study area is 6.632318501.

Fu= Nu/A Where A = Area of the basin (854 km2) Nu = Stream number (5664 sq.km)

Form factor (Rf)

It is define as the Square of basin length and the ratio of the basin area is known as form factor and also it is used as a quantitative to express the shape of the basin.

R f = A/L2 Where A = Area of the basin (854 sq. km) L2 = Basin length (816) and Rf is 29.89598.

<5 high values – have flattered and flow for longer durations

>5 high values – have high peaks and flows shorter duration

Circulatory ratio (RC

Circulatory ratio (RC) is Basin area Ration Au, and AC is the Area Circle having the same perimeter as the Basin. RC= Au /Ac

Where Au = Total basin area (854sq. km) Where Au = Total basin area (854sq. km)

Ac = Circle area with the same perimeter (115 km2)

Circulatory ratio (RC) is Basin area is 7.426087.

Elongation Ratio (Re)

These values can be grouped into three categories namely (a) circular (>0.9), (b) oval (0.9-0.8), (c) less elongated (<0.7).

$$R_e = (2/L_b)\sqrt{(A/\pi)}$$

2/854 X √854/3.14 = 0.038622

The Re value in the study area is 0.038622 indicating less elongated.

Drainage density (Dd)

Defined as channel length per unit watershed area (km km-2), reveals the amount (or density) of channels in a watershed.

Drainage density is controlled by the type of formations in the basin areas with impervious formations will have higher drainage density than those with pervious formations (Gokhale, 2005)

D d=∑ Lu /Au Where ∑ LU = Mean channel length Au = Unit area 854 Sq.km

Drainage density (km/sq.km) = 2.564403

Low drainage density is preferred in areas with high resistive or highly permeable subsurface materials, dense plant cover, and low relief. In areas with weak or impermeable surface materials, scant vegetation, and hilly terrain, high drainage density is preferred. Factors such as rock type, run-off intensity soil type, infiltration capacity and percentage of rocky area influence drainage density.

Drainage frequency

It is a measure of the number of stream segments per unit area and hence it is dependent on the stream order, whereas drainage density is independent.

Drainage pattern

It describes the spatial arrangement of geologic, topography, or vegetative features in a systematic manner. In geologic interpretation of satellite images, the drainage pattern is important.

The study area shows dendritic type of drainage pattern. It is described by a tree like branching system in which tributaries make acute angles by joining the gently curving main stream. The occurrence of this drainage system indicates homogeneous, uniform soil and rock material (GSI, 2002).

Drainage Texture

The density of dissection or texture is another way of categorizing drainage texture. The product of drainage density and stream frequency is drainage texture. It is expressed in the same way as drainage and is classified as follows. A high relief ratio causes a large amount of surface water to be discharged in a short period of time. The drainage basin's erosional development is indicated by a low relief ratio.

Texture ratio (/Km) T = N_1/P 49.25217

Topography Land form

The most significant distinguishing features of a landform are its size and shape. As may be observed in numerous images, there is often a significant topographic change at the boundary between two land forms. The interpretation of the underlying geology can be aided by identifying land formations.

Slope

The rise or fall of the ground surface is referred to as a slope. It is essential for the farmer or irrigator to recognise the land's slopes. Slopes are expressed in this way.

Method of expressing slopes.

A ratio is used to indicate the slope of a field.

It's the vertical distance (or height difference) between two points in a field divided by the horizontal distance between them.

The formula is as follows:

$$\text{Slope} = \frac{\text{height difference(m) between A and B}}{\text{horizontal distance (m) between A and B}} =$$

Contour

Contours are lines drawn on a map that connect points of similar elevation above sea level. Contours create patterns that represent land relief or shape.

A contour line for a two-variable function is a curve that links points of equal value and has a constant value for the function. It's a plane portion of the function's three-dimensional graph that's parallel to the plane.

Geomorphology

Geomorphological maps are graphical inventories of a landscape that show landforms, as well as surface and subsurface materials. Geomorphological mapping is a preliminary tool for land management and risk management, as well as providing baseline data for other areas of environmental research such as landscape ecology, forestry, Geology and soil science.

Geomorphology is the study of forms and process of landform, which are the products of various exogentic and endogenetic forces. landforms play a vital role in land resource mapping, Terrain evaluation and soil classification in addition to groundwater studies the groundwater condition vary from terrain to terrain. For the present study IRS Resources sat-2 Liss-4 satellite imagery and SOI Toposheet 1:50,000 scale have been used to map various Geomorphic features. The hydrogeomorphic units have been defined based on the interpretation of satellite imagery and the SOI toposheet.

Peneplain moderately weathered (PPM)

It is almost flat to gently undulating plain formed by the coalescence of several pediments with varying thickness from 10 to 20 meters of weathered material. it is a red light to the dark red with medium course texture. aquifer material shows weathering and weathering is not uniform in fracture rock. success rate is good. recharge rate is good. Suggested depth range of wells is 25 to 40 mts with an expected deal of 200 to 250 LPM.+

Pediplain Shallow Weathered (PPS)

This is a gently sloping surface of weathered pediplain. The landscape unit is defined by its characteristic white to yellowish to light red tone, medium to coarse texture with irregular shape on the satellite image. Aquifer material is weathered ,fractured and fissured rock. The thickness of the weathered material is 0-5 m. Recharge is moderate. Water quality is generally good for drinking and irrigation purpose. The groundwater prospects are moderate to good with an expected yield of wells between 150 to 200 lpm. Along the fractures and lineaments, and also close to their intersections, good yields are expected. Suggested well depth range is 35 to 50 mts.

Pediment (PD)

Pediment is gently sloping surface landform or rock cut surface resting against the land relief with thin veneer of deposit over the parent rock, mostly derived from sheet erosion. It can be also explained as broad flat or generally sloped rock floor having very low relief in an arid or semi-arid region. It shows moderate elevation of undulating land at places, and complexes with lightly elevated hillocks and rock out crops. The pediments are bearing a thin veneer of shallow weathering at places.

Residual hills (RH)

these are the denudational hills, resulted from prolonged denudation and isolated from the main masses. These isolated hills are comprised of inselburgs and tors invervened by pediments. Denudational hills are generally topographic highs without any geological structure and surrounded by pediplain with thinning out crops of residual hills, inselbergs and pediment areas

Denudational-residual-inselberg-tors-pediment area constitutes the gradational phase of pediplanation developed in the Archaean terrain Residual hills form large to medium relief left over after prolonged denudation. The inselburgs and tors are not much in height and as well as aerial extent. Residual hills occupied South-eastern part of the study area Some hills attained heights above 700 meters. 4.6.5. Fractures/Lineaments The various lithological units in the study area are traversed by lineaments occurring as vertical to sub vertical and horizontal to sub horizontal deep seated fractures. The fractures in the study area are generally associated with topographical depressions and controlling drainage network. These fractures play a vital role in the development of groundwater in the study area.

Inselbergs

This landform is generally the characteristic of arid and semi-arid region that develops at a late stage of erosion cycle. This is prominent isolated steep sided, mostly smoothened rounded hill rising abruptly from the surrounding area. Unlike tors it preserves wide areas of regolith between rock outcrops. These are noticed in the southern and southeastern part of the area as part of the residual hills.

Tors

Tors, Sheet rocks, rocky knolls are common features in granitic terrains, These are found at higher contour levels. Tor, though not marked separately in the map, forms part of Isenberg. Tors are isolated pinnacled like rocks. These are much jointed and usually reflect peculiar or fantastic shapes. During the course of erosion, the basal surface of weathering may be exhumed and the core stones left behind as 'tor complex'. These are observed in the pediment area and residual hills in the southern and south western part of the area.

By virtue of the topography the all above denudational forms, largely form the runoff areas with less infiltration along joints and fractures.

These hills are forested. Groundwater occurrence is restricted to joints and fracture planes and storage capacity is very meager due to the absence of weathered zone.

Groundwater prospects

Because of the increased demand for water, groundwater resource mapping has become more prominent in recent years. The combination of remote sensing and geographic information systems (GIS) is a useful tool for water resource management.

It plays important role in integrating all the data to generate various thematic maps in the study area such as geomorphology, geology, lineament density, drainage density, slope and land use/land cover for preparing groundwater prospective map.

The geomorphic units viz. valley and valley fill are excellent, pediplain moderate weathered is good, pediplain shallow weathered is moderate to good, pediment is poor, Residual hill, Denudational hill, and Structural hill poor prospective zones for groundwater exploration. The presence of groundwater is indicated by high lineament density, low drainage density, and a low slope.

Hydrogeomorphology

The hydrogeomorphological map of the study area is prepared by demarcating the geomorphic units and landforms. The following types of features are identified and are discussed in detail. The pediment is a geomorphic unit, which are smooth times fractures controlled. It is characterized by gently sloping, smooth surface of erosion bedrock between hills and plain with a veneer of detritus Le, it is the zone of varying lithology, which is moderate to poor in underground water prospects. The availability water depends on underlying lithology, presence of fracture and lineaments. The inselbergs are the elevated structure stand above the earth surface and Surrounded by pediplain (Flat Surface). It will be normally barren and rocky with poor ground water prospects. The piedmont is a geomorphic unit, which is characterized by boulders. pebbles, gravel, sand and silt of varying lithology. It is formed at the foothills with gentle slope.

This geomorphic unit has well to moderate underground water prospects The geomorphic unit like valley fill is associated with valleys, which are mostly fracture controlled.

The material of valley fills includes boulders, cobbles, pebbles, gravel, sand and silt.

The groundwater prospects in general are good but vary depending on the depth or thickness of the hill.

Pediplain is a geomorphic unit controlled some times by joints, fractures, lineaments, etc. The study area in general has well to moderate underground water prospects excepting in few locales where it is poor like inselberg complex zone.

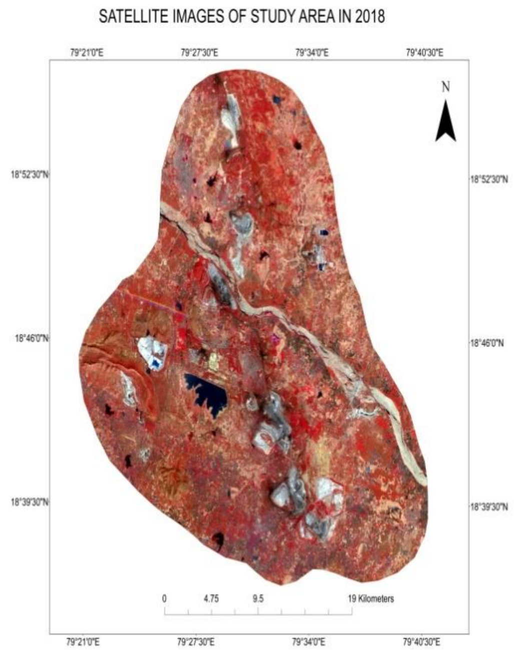

Figure 6: Satellite image of Study area (**IRS P6 LISS-IV 2018**)

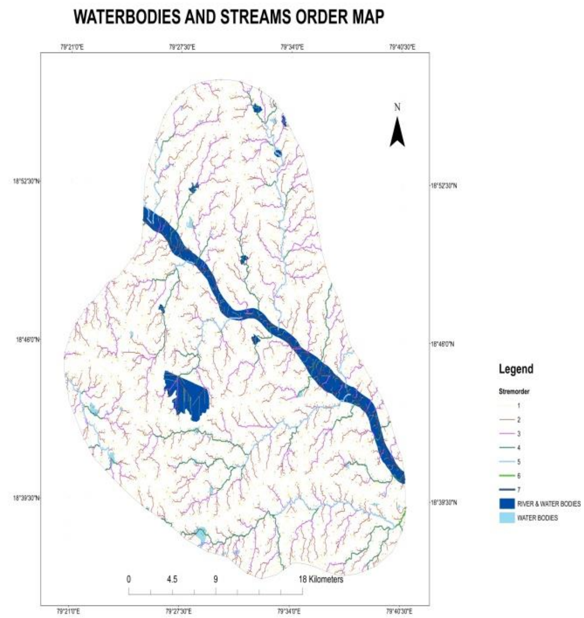

Figure 7: Water Bodies & Stream Order Map of Study area

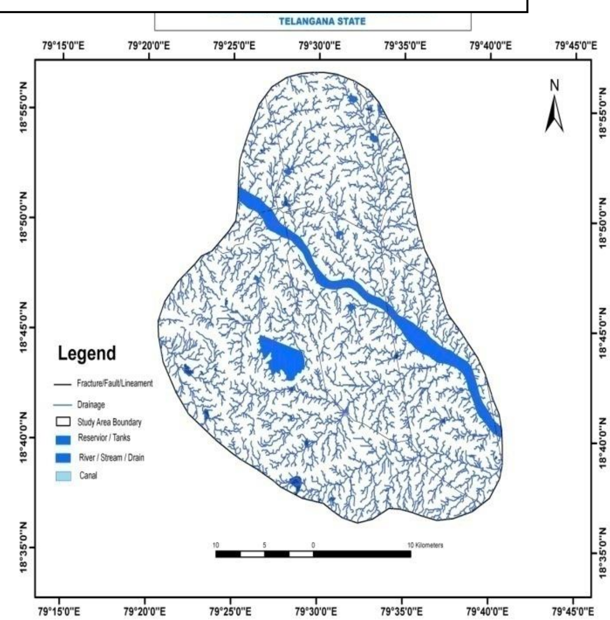

Figure 8: Drainage & Lineament Map of Study area

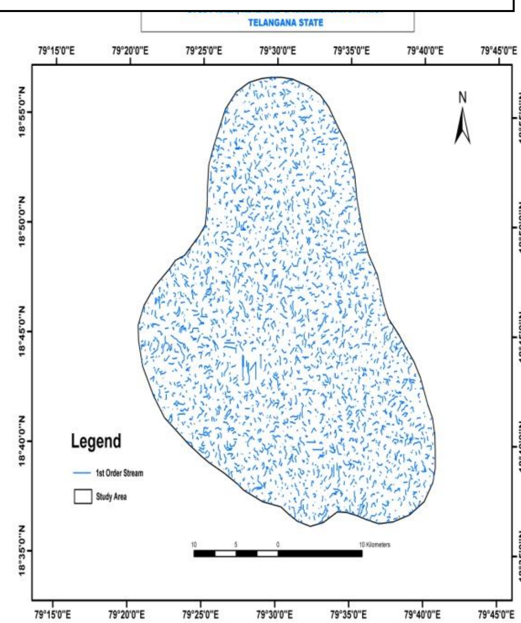

Figure 9: 1st Stream Order Map of the Study Area

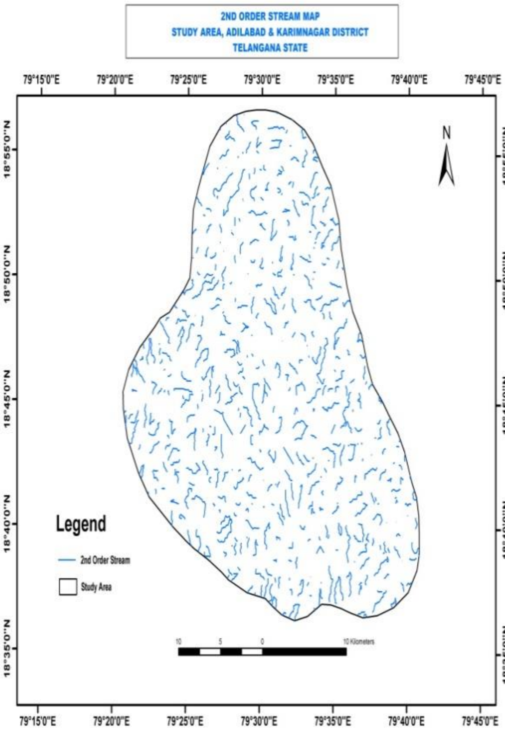

Figure 10: 2nd Stream Order Map of the Study Area

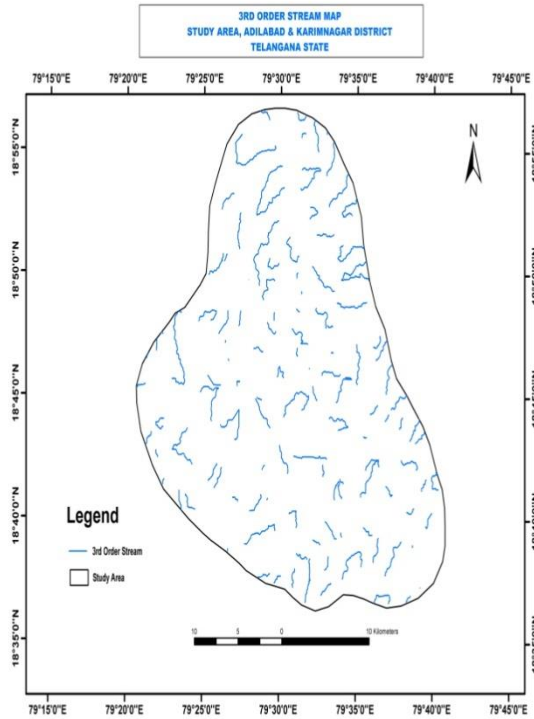

Figure 11: 3rd Stream Order Map of the Study Area

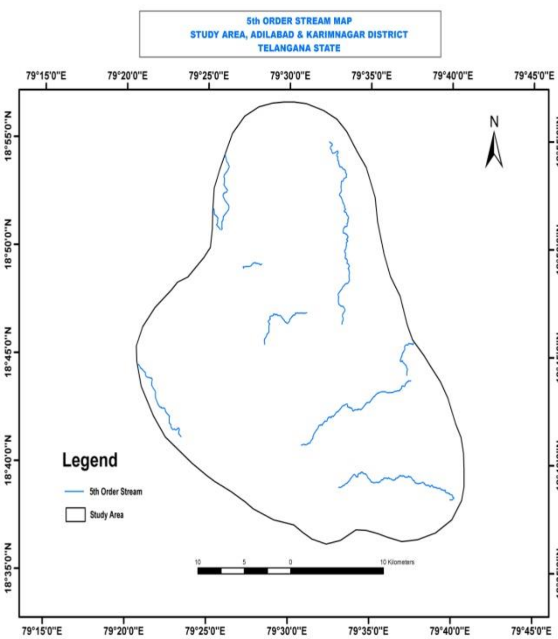

Figure 12: 4th Stream Order Map of the Study Area

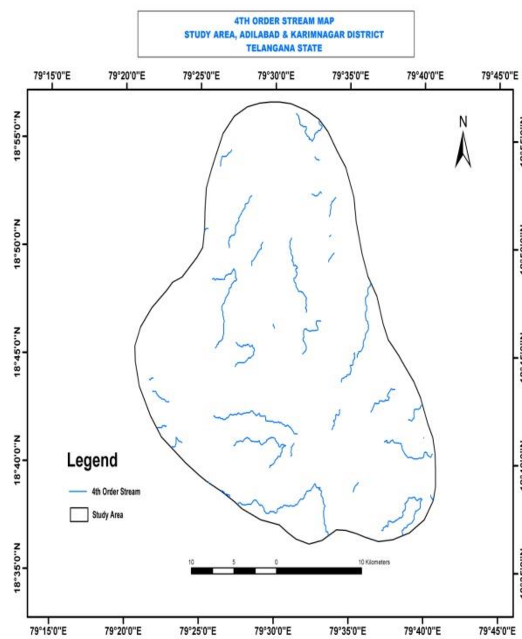

Figure 13: 5th Stream Order Map of the Study Area

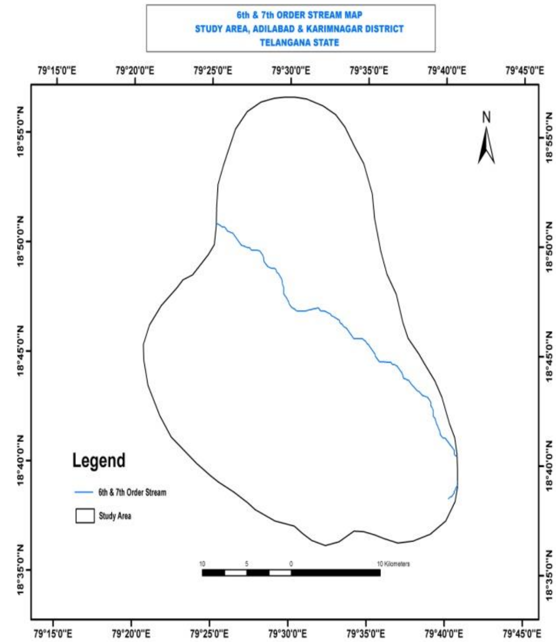

Figure 14: 6th & 7th Stream Order Map of the Study Area

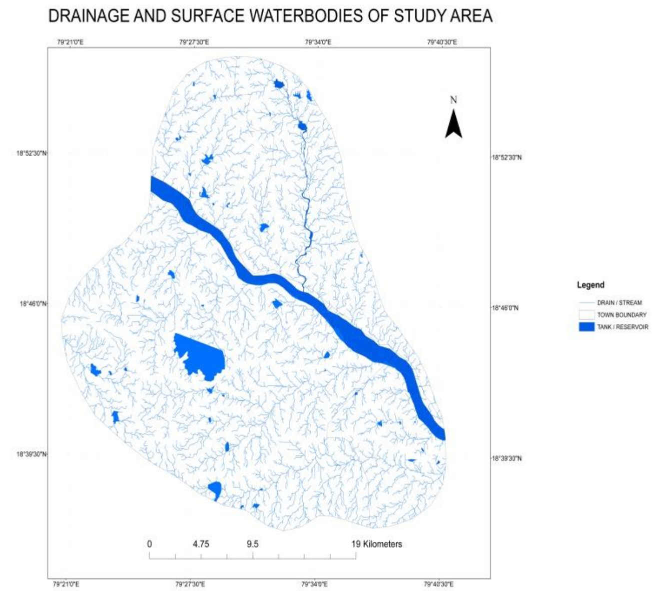

Figure 15: Drainage & Surface water bodies Map of the Study Area

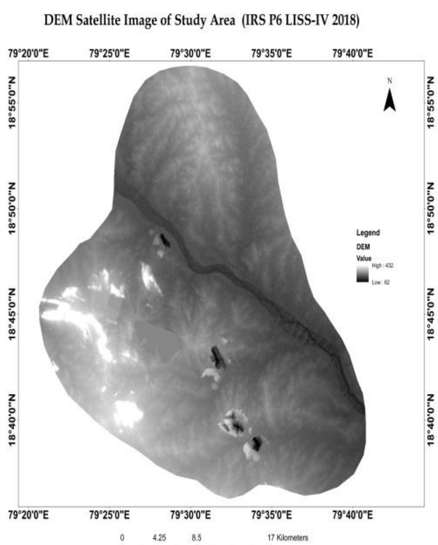

Figure 16: DEM of the Study Area

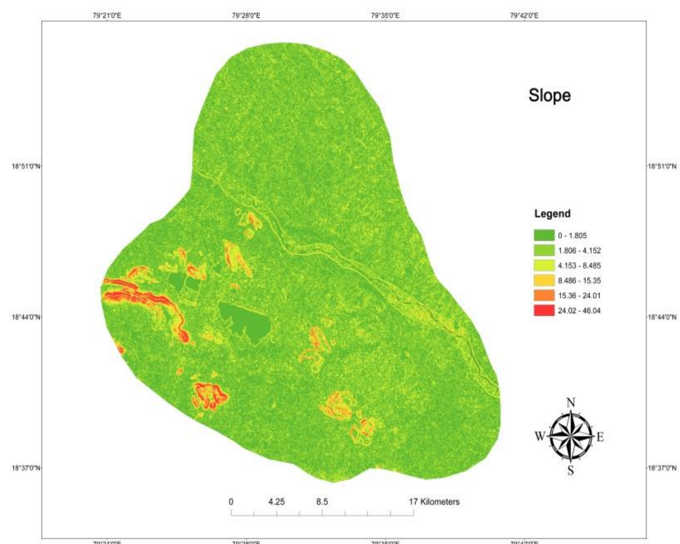

Figure 17: Slope Map of the Study Area

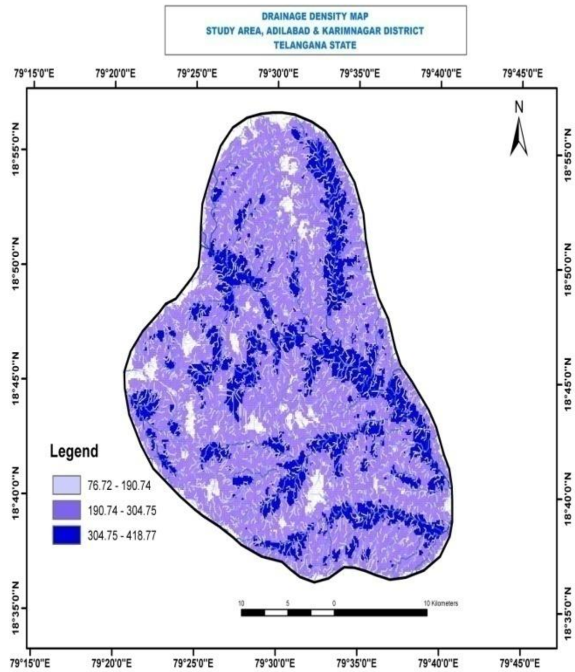

Figure 18: Drainage Density Map of the Study Area

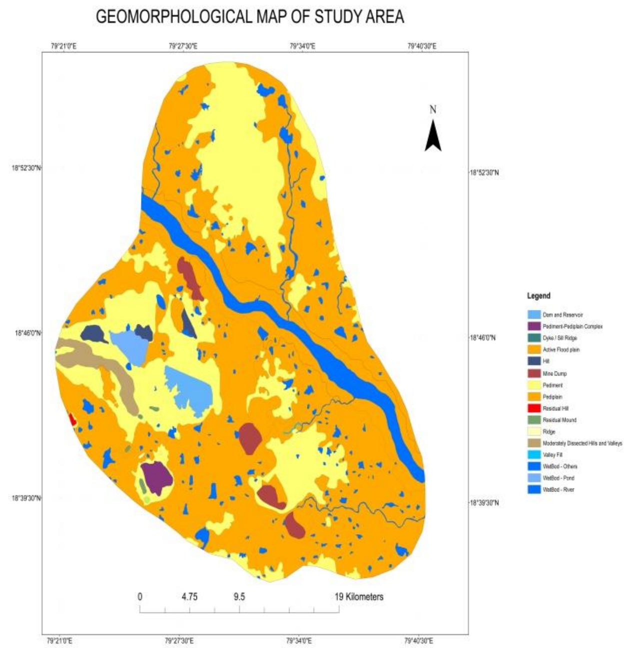

Figure 19: Geomorphological Map of the Study Area

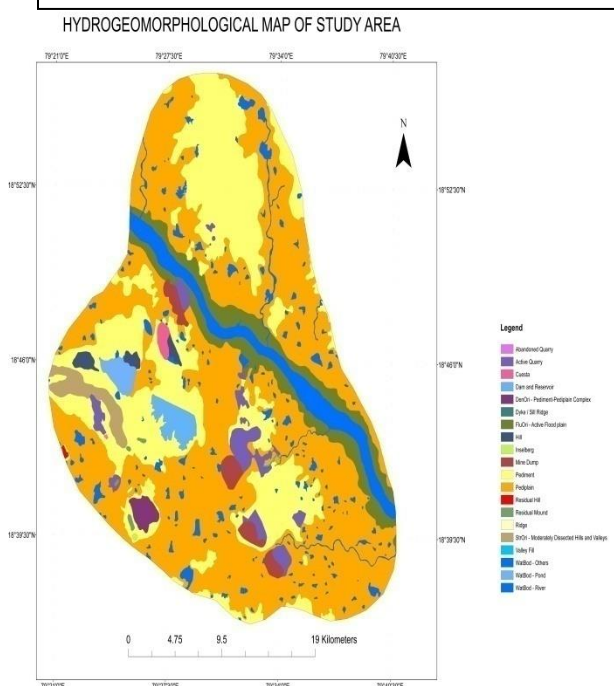

Figure 20: Hydrogeomorphological Map of the Study

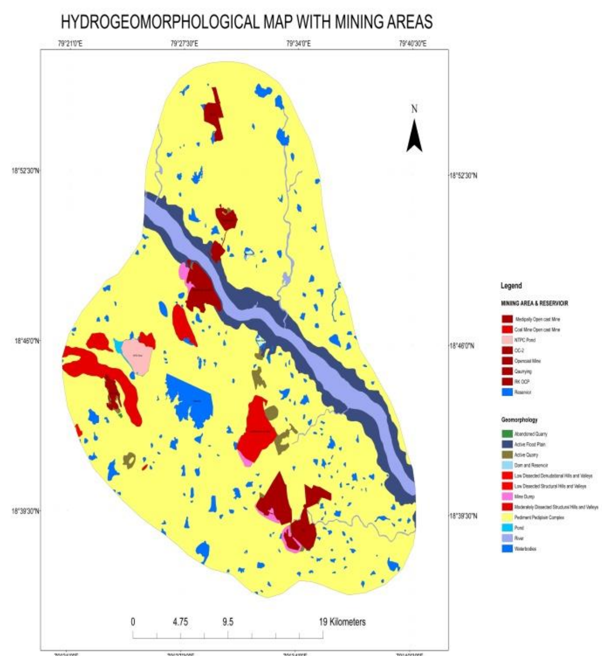

Figure 21: Hydrogeomorphological Map with Mining Area

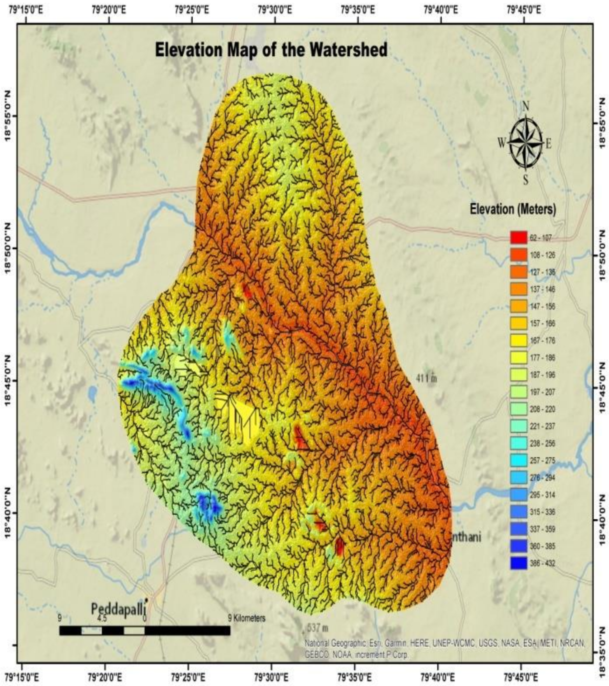

Figure 22: Elevation Map of the Study Area

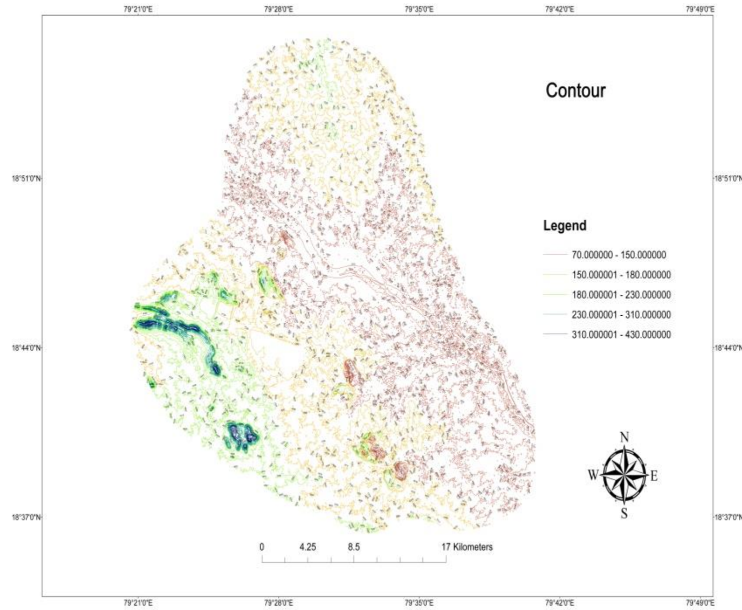

Figure 23: Contour Map of the Study Area

Above all, the quantitative Morphometric analysis performed in the Arc GIS (10.8) software is a powerful and advanced tool for measuring basin length, basin area, computerized drainage network creation, stream order, stream link, basin circular area, and so on.

Figures (6,7,8,9,10,11,12,13,14,&15) show how to use in the creation of basin, delineation of drainage network, stream link, flow direction and stream order and figures (16,17,18) show DEM(Digital Elevation Model), Slope, and Drainage Density of Study Area, and figures (19,20,21,22,23) Geomorphology, Hydrogeomorphology, Hydrogeomorphology with mining Area, Elevation and Contour, Morphometric analysis quantitatively using with Arc toolbox. Within the short time by using Arc GIS techniques the work of mapping, analysis, statistics, displaying the data and output is done.

In the process of Morphometric analysis conversion tools, analysis tools, data management tools, geostatistical tools, spatial analysis tools, and others used.

By Using all these tools, Morphometric analysis of drainage basin of the Study area done mathematically using Arc GIS (10.8) software.Vectorization of the study area base map layers like settlement, drainage network, Mining Area, tank,basin shape etc.

By using (Arc GIS 10.8) with editor tool bar and preparing layout for all layers.

Sl. No.	Parameters	Formula	Type of parameters
1	Area	A	Geometric
2	Perimeter	P	Geometric
3	Basin length	L_b	Geometric
4	Stream length	L	Stream
5	No of streams of order U	N_u	Stream
6	Bifurcation ratio (R_b)	$R_b = Nu/N(u+1)$	Morphometric
7	Drainage density (D_d)	$D_d = L/A$	Morphometric
8	Stream frequency (Fs)	$F_s = \Sigma N/A$	Morphometric
9	Drainage texture (T)	$T = D_d X Fs$	Morphometric
10	From factor (R_f)	$R_f = A/(L_b)^2$	Morphometric (basin shape)
11	Circularity Ratio (R_c)	$R_c = 4\pi A/P^2$	Morphometric (basin shape)
12	Elongation ratio (R_e)	$R_e = (2/L_b)\sqrt{(A/\pi)}$	Morphometric (basin shape)

Table 2: Formula for Morphometric Analysis

Aerial Aspect of Study Area

Morphometric Parameters	**Symbol/Formula**	**Results**
Area (sq.km)	A	854
Perimeter (km)	P	115
Drainage density (km/sq.km)	$D = Lu/A$	2.564403
Stream frequency(/Km)	$Fs = Nu / A$	6.632319
Texture ratio(/Km)	$T = N_1/P$	49.25217
Basin length (km)	L_b	816
Elongation ratio	Re	0.038622
Circularity ratio	Re-4A/P2	0.811058
Form factor ratio	$R_1 = A/L_1 2$	29.89598

Table 3: Aerial Aspect of Study Area

Results of Morphometric Analysis

Stream Order	Number of Streams	Length Stream	Mean stream length	Stream length ratio	Bifurcation ratio	Mean Bifurcation ratio	Total Stream No	Total Stream lengeth
1	2807	1101	1.989100817	0	2.093214019	7.285309981	5664	2190
2	1341	532	4.116541353	2.069548872	1.880785414			
3	713	279	7.849462366	1.906810036	1.658139535			
4	430	151	14.50331126	1.847682119	1.641221374			
5	262	88	24.88636364	1.715909091	43.66666667			
6	6	37	59.18918919	2.378378378	0.057142857			
7	105	2	1095	18.5	0			

Table 4: Results of Morphometric Analysis

Conclusions

The direction of the drainage basin of the drainage area is NNW to SSE. The study area is underlined by a part of Godavari river which rocks consisting of Sandstone, Limestone, Coal, Quartzite and Granitic Gneiss.

The elongation ratio of the entire basin (0.038622) suggests that the basin has an elongated shape and is less likely to overflow. The basin bifurcation ratio is 7.285, indicating that the drainage system is dendritic. The area is inferred to be characterized by Sandstone based on the findings.

the drainage basin of study area is having good ground water prospects. Arc GIS 10.8 software tools like Data management, Hydrology, Geo statistical, Analysis tools etc. are very useful for mapping, analysis, and quantitative measurements are carried out with accurate results with less time and least cost

Drainage morphometric analysis includes the analysis of the terrain, including hydrological, lithological, slope, relief, watershed changes, ground water recharge, porosity, soil properties, flood peak, rock resistance, permeability, and runoff intensity.

This information can be used in geological, hydrological, and groundwater studies.

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