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Morphological characteristics of Kanthatmakur vagu Watershed of Warangal District: Using Geographical Information System (GIS)

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Abstract

The present study relates to the morphometric analysis of Kanthatmakur vagu watershed using GIS. The GIS platform facilitates the analysis of various morphometric parameters. This watershed has higher order of 5th order. The present study has area of about 440.4 Km2 with total length of basin is 45.5 Km. Total number of streams in the basin is 635, ranging from 10 to 319. The basin area exhibits dendritic drainage pattern with bifurcation ratio ranges from 0.1 to 9.2, with mean bifurcation ration of 3.4. Length of stream of all orders are 481.8 km. Length of overland slow is 0.55 km and perimeter of the basin found to be 119.7 km. Areal aspects such as drainage density is calculated as 1.1, drainage frequency is 1.4 and drainage texture calculated as 5.3. Infiltration number of the watershed is 0.8. The watershed has 0.3 form factor ratio, 0.5 elongation ration and 0.4 circularity ratio. Relief of the watershed is 261m and ratio of relief is 6.3. The characteristics of morphological analysis of the Kanthatmakur vagu watershed has peak flow, is an elongated and less probable to flooding as well as moderate to slightly steep slope. In the watershed infiltration is high and run off will be low.

Keywords: Morphological characteristics; GIS; Warangal; Linear; Areal

1. Introduction

Morphometry is defined as the measurement and analysis of the earth's surface, dimensions and shape of landforms. Morphometric analysis of a drainage basin is a quantitative description and analysis of landforms, which is an important aspect to know the character of the basin (Rahel Hamad, 2020) [10]. Important characteristics of the drainage basin such as shape, length of tributaries, size, and slope are highly correlated with drainage basin hydrological process (Alemsha Bogale, 2021) [11]. Quantitative morphometric analysis of drainage basins was begun in the middle of the 20th century, based on manual analyses of printed topographic maps. The advantage of geographic information systems (GIS) allowed the digital extraction of morphometric parameters from digital elevation models (DEMs), for the quantitative characterization of landform (Ali P. Yunus, 2014) [12]. Morphometric analysis provides a quantitative description of the basin geometry to understand initial slopes or inequalities in the rock hardness, structural controls, recent diastrophism, geological and geomorphic history of the drainage basin (Strahler, 1964). Basin morphometry is a means of numerically analysing or mathematically quantifying various aspects of drainage channel and its characteristics (B.S. Manjare, M.A. Padhye, S. S. Girhe, 2014) [14]. A quantitative assessment of morphometric characteristics of a drainage basin has been found very useful in the determination of hydrological processes including runoff generation, peak flow, infiltration rate and length of overland flow for soil and water conservation and natural resources planning and management (Bismark Mensah-Brako1, Wilson Agyei Agyare1 , Ebenezer Mensah1 and Richard Kotei, 2018. The morphometric parameters of the watershed/drainage basin broadly divided into three categories, i.e., linear aspect, relief aspect, and aerial aspect (Udoka Ubong Paulinus et al., 2016) [17]. According to Clarke (1966),

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morphometry is the measurement and mathematical analysis of the configuration of the earth surface, shape and dimensions of its landforms.

1.1. Study area

Kanthatmakur vagu catchment area is lies between 79^0 24^I 14.50" E to 79^0 39^I 29.10" E and 17^0 53^I 17.79" N to 18^0 13^I 50.23"N (Fig.1). This area is covering 440.4 sq.km. Administratively, it covers 8 mandals (Blocks) of Warangal urban and Warangal rural. Kanthatmakur vagu is a tributary of Peddavagu, which is tributary of Godavari River.

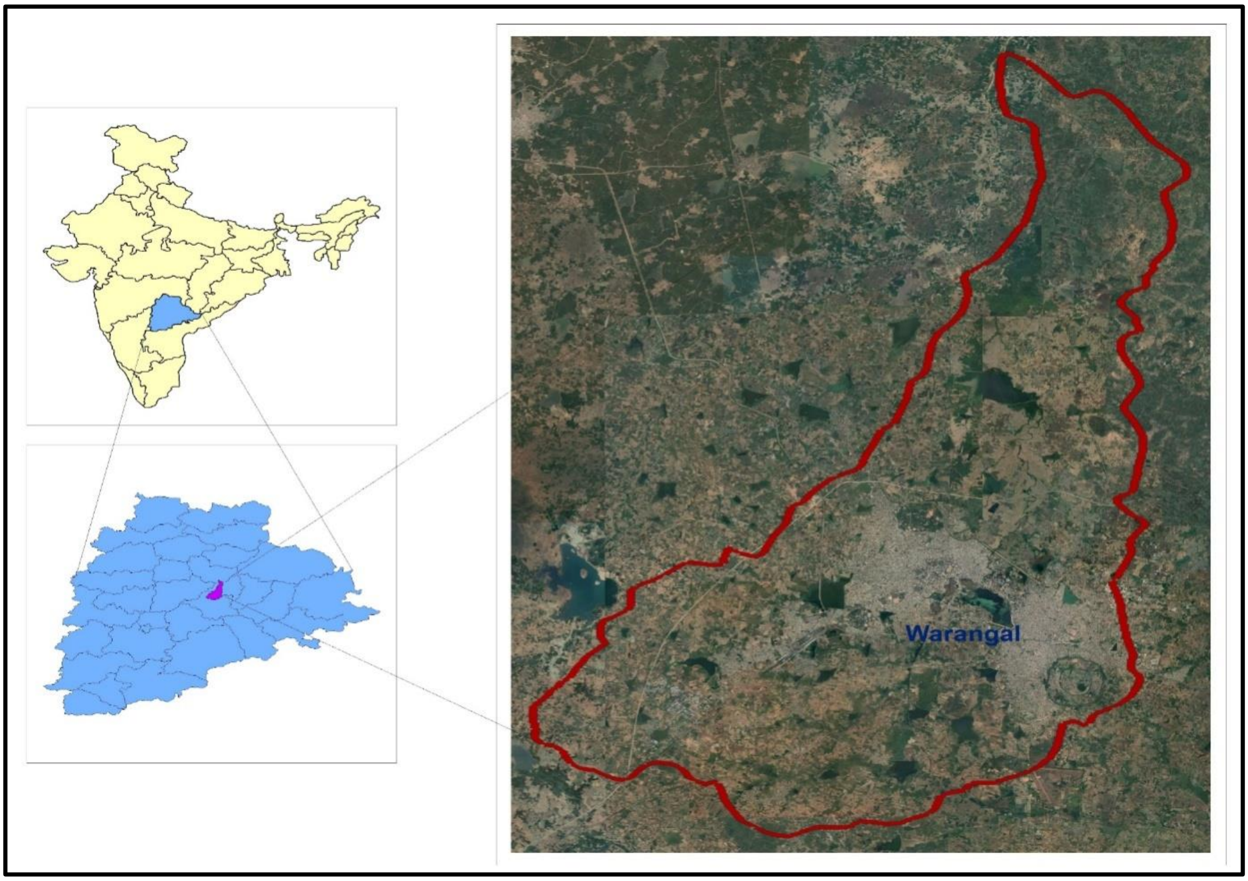

Figure 1 Location map of Kanthatmakur vagu watershed

2. Methodology

Topographical maps of Geological Survey of India (GIS) of 1:50,000 scale were utilised to prepare base maps and watershed drainage map of Kanthatmakur vagu watershed. These maps were scanned and geo referenced and converted into digital format using ArcGIS 10.2. Satellite data of 30 m resolution of the basin extracted from the Shuttle Radar Topographic Mission (SRTM), which is downloaded from the US Geological Survey Website. The standard and formulae adopted for the analysis of different parameters are listed in Table 1.

Table 1 Description of Morphometric Parameters

S. No	Parameter	Symbol	Formula	Description	Reference
1	*Linear aspects*				
1.1	Stream order	Sμ	Hierarchical rank		Strahler (1964)
1.2	Stream length	Lμ		Length of the stream (Km)	Horton (1945)

S. No	Parameter	Symbol	Formula	Description	Reference
1.3	Stream length ratio	R_L	$R_L = L_{sm} / L_{sm}-1$	Where, L_{sm}= Mean stream length of a given order; L_{sm}-1 = Mean stream length of next lower order	Horton (1945)
1.4	Mean stream length	L_{sm}	$L_{sm} = L\mu/N\mu$	Where, Lμ = Total stream length of order μ; Nμ = Total no. of stream segments of order μ	Strahler (1964)
1.5	Bifurcation ratio	R_b	$R_b = N\mu/N\mu+1$	Where, Nμ = No. of stream segments of a given order; Nμ+1 = no. of stream segments of next higher order	Schumm (1956) [5]
1.6	Mean bifurcation ratio	R_{bm}		Average of bifurcation ratios of all orders	Strahler (1957) [6]
1.7	Length of overland flow	L_o	$L_o = 1/2D$ km	Where D = Drainage density (Km/Km^2)	Horton (1945)
1.8	Basin perimeter	P		Outer boundary of the drainage basin measured in kilometers	Schumm (1956)
1.9	Basin length	L_b	$L_b = 1.312 \times A^{0.568}$	Where A = Basin area	Schumm (1956)
2	*Areal aspects*				
2.1	Basin area	A		Area from which water drains to a common stream and boundary determined by opposite ridges (Km^2)	Schumm (1956)
2.2	Drainage density	D_d	$D_d = L\mu/A$	Where Lμ = Total stream length of all orders; A = Area of the basin (Km^2)	Horton (1932) [1]
2.3	Drainage frequency	F_s	$F_s = N\mu/A$	Where Nμ = Total number of streams of all orders; A = Area of the basin (Km^2)	Horton (1932)
2.4	Drainage texture	D_t	$D_t = N\mu/P$	Where Nμ = Total no. of streams of all order; P = Perimeter (Kms)	Horton (1945) [2]
2.5	Infiltration number	l_t	$l_t = D_d \times F_s$	Where D_d= Drainage density (Km/Km^2); F_s = Drainage frequency	Faniran (1968)
2.6	Form factor ratio	R_f	$R_f = A/L_b^2$	Where A = Area of the basin (Km^2); L_b = Maximum basin length	Horton (1932)
2.7	Elongation ratio	R_e	$R_e = 2\sqrt{A/\pi}/L_b$	Where A = Area of the basin (Km^2); L_b = Maximum basin length	Schumn (1956)
2.8	Circularity ratio	R_c	$R_c = 4\pi A/P^2$	Where A = Area of the basin (Km^2); P = Perimeter (Kms)	Miller (1953)
3	*Relief Aspects*				
3.1	Basin relief	H	H = Z - z	Where Z = Maximum elevation of the basin (m); z = Minimum elevation of the basin (m)	Strahler (1952)
3.2	Relief ratio	R_r	$R_r = H/L_b$	Where H = Basin relief (m); L_b = Basin length (m)	Schumm (1956)

S. No	Parameter	Symbol	Formula	Description	Reference
3.3	Dissection index	D_i	$D_i = H/R_a$	Where H = Basin relief (m); R_a = Absolute relief (m)	Horton (1945)

3. Results and discussion

3.1. Linear aspects

Linear aspects includes stream order (S_μ), number of stream with respect to order (N), stream length (L_μ), mean stream length (L_{sm}), length of overland flow (L_g), bifurcation ratio (R_b), mean bifurcation ration (R_{bm}), basin perimeter (P) and basin length (L_b) as shown in Table 2.

3.2. Stream order (Sμ)

Determination of stream order (Sμ) is the first step in drainage basin analysis. It is a positive whole number. This concept which was introduced by Horton (1945). He stated that the order of a drainage basin or its stream system generally increases with size of the drainage area and later modified (Strahler, 1957). The channel/stream network map includes all intermittent and permanent flow lines. The designation of stream orders is based on a hierarchic ranking of streams (Nag, S.K. and Chakraborth, S., 2003) [22]. The smallest finger-tip tributaries/channel are designated order 1. Where two first-order channels join, a channel segment of order 2 is formed; where two of order 2 join, a segment of order 3 is formed; and so forth. Order number is directly proportional to relative watershed dimensions, channel size, and stream discharge at that place in the system. The order of a drainage basin or its stream system generally increases with size of the drainage area (Strahler, 1957). The following steps involved in delineate and generate stream networks.

- Extract Kanthatmakur vagu watershed area from the geo-referenced SRTM DEM image.
- Fill the depressions in the DEM using fill tool under Spatial Analyst tools of Hydrology tool.
- The flow direction and flow accumulation map of the watershed was created using flow direction and accumulation tools of the same spatial analyst tools of hydrology tool.
- Raster calculation operation was carried out using the threshold value of 5000 to generate the stream networks.
- The watershed boundary was plotted, and the area of the watershed stream length and order of the streams were calculated.

Kanthatmakur vagu watershed is formed with 5th order stream. The drainage patterns of stream network indicate dendritic type that develop where the river channel follows the slope of the terrain. Map of different stream order is shown in Fig. 1.

Table 2 Results of linear aspects of Kanthatmakur vagu watershed

Stream order (Sμ)	No. of streams (Nμ)	Bifurcation ration (R_b)	Mean bifurcation ratio (R_{bm})	Stream length (Lμ) in km	Mean stream length (L_{sm})	Stream length ratio (R_L)	Length of overland flow (Lo) km	Basin perimeter (P) in km	Basin length (L_b) in km
1st	319	2.2	3.4	236.3	0.74		0.55	119.7	45.5
2nd	146	1.6		119.4	0.82	1.10			
3rd	92	9.2		78.1	0.85	1.04			
4th	10	0.1		7.4	0.74	0.87			
5th	68			40.6	0.60	0.81			
Total	635			481.8		1.0			

3.3. Number of streams (Nμ)

Total number of streams are 635 in the study area. The number of streams are decreasing from the 1st order to 4th order and increased 5th order from the 4th order stream. In the study area, number of highest order streams i.e. 5th are 68. Number of 1st, 2nd, 3rd and 4th order streams are 319, 146, 92 and 10 respectively as shown in the Fig. 2. The higher amount of first order streams indicates the intensity of permeability and infiltration (Praveen Kumar Rai, 2019) [20].

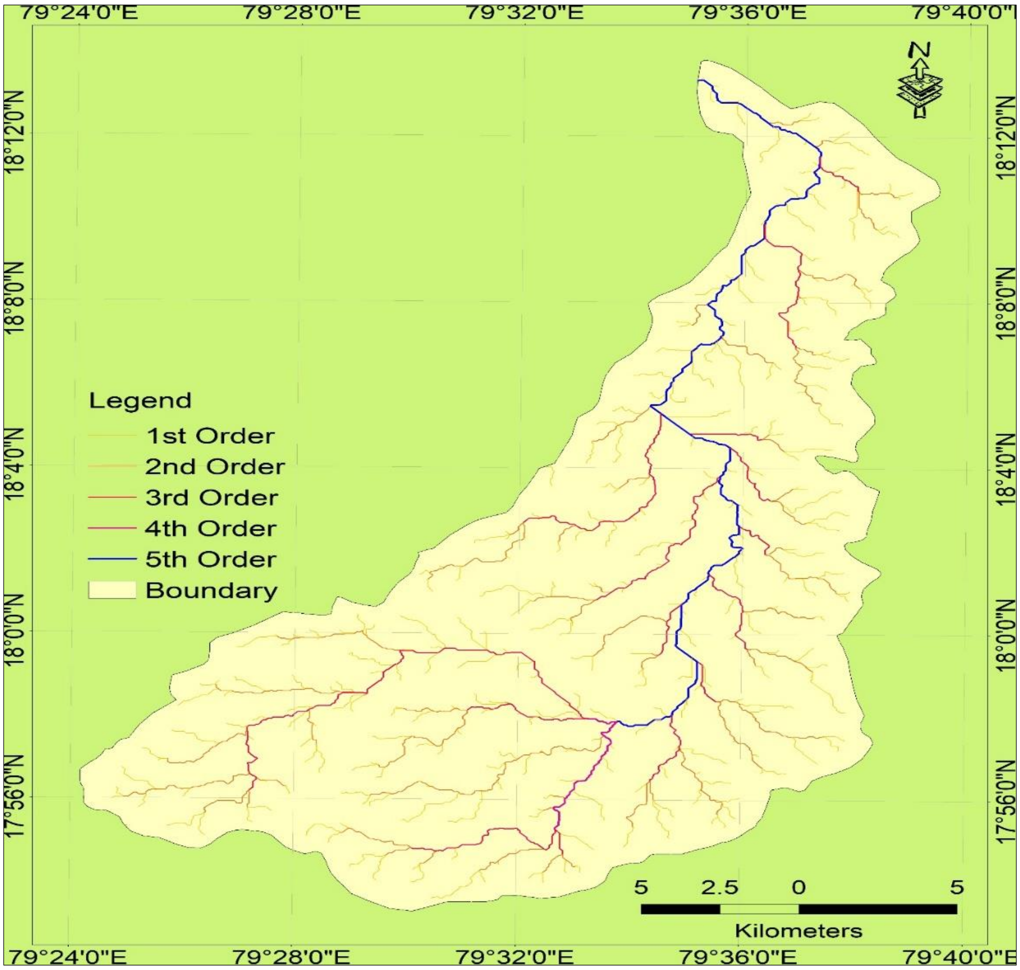

Figure 2 Distribution of Order of streams of Kanthatmakur vagu watershed

3.4. Bifurcation ratio (R_b)

The bifurcation ratio R_b, or ratio of the number N_i of channels of order i to the number N_{i+1} of channels of order i+1 is relatively constant from one order to another. This is Horton's Law of Stream Numbers. It is usually constant for all orders of streams in a given basin (Horten, 1945; Strahler, 1957).

The number is usually between 2 and 4, and indicates the peakedness of runoff. Low ratios are associated with high flood peaks for a small watershed (Vijay P. Singh, 2017) [8]. The bifurcation ratio ranges from about 2 for flat or rolling drainage basins, up to 3 or 4 for mountainous or highly dissected drainage basins. Long narrow basins with high bifurcation ratios would be expected to have drawn out flood-discharge periods, whereas rotund basins of low bifurcation ratio would tend to peak sharply (Ziemer, 1973). The bifurcation ratio is generally higher for hilly, well-dissected drainage basins than for rolling basins (Horten, 1945). The highest value of R_b will suggest a strong structural control in the drainage pattern whereas lower value of R_b less affected by structural disturbances (Strahler, 1964).

Bifurcation ratio of the Kanthatmakur vagu watershed for first order to second order is 2.2, second order to third order is 1.6, third order to forth order be 9.2, and forth order to fifth order is 0.1. In the watershed third order and forth order are has structural control and hilly area. First, second and fifth order drainage area has flat area and less structural disturbance.

3.5. Mean bifurcation ratio

It is an average of bifurcation ratios of all orders. In the present study area, mean bifurcation ratio found to be 3.3, which shows small structural control and elongated shape of the watershed mountainous or highly dissected drainage.

3.6. Stream length

Stream length measured along stream from outlet and extended to watershed line. The total length of stream segments are maximum/highest in first order streams and decrease as the stream order increases (Horten, 1945). The average lengths of streams of each of the different orders in a drainage basin tend closely to approximate a direct geometric series in which the first term is the average length of streams of the 1st order (Horten, 1945; Chorley. R.J.,) [9].

In the study area, total length of the first order is highest i.e., 236.3 km, followed by second order by 119.4 km, third order is 78.1 km, fifth order is 40.6 km and forth order is 7.4 km. Total stream lengths of watershed of all first orders are 481.80 Km.

3.7. Mean stream length

It is defined as the total stream length of order (Nμ) is divided by the number of streams segments in the order (μ). It is described as property related to the drainage network components, and its associated basin surfaces, changes in topographic elevation and slope of the area (Strahler, 1964).

In the present area the mean stream length increases from lower order to the next lower order for 3rd order and increases for 5th order. The first, second, third, fourth and fifth order streams are 0.74, 0.82, 0.85, 0.74 and 0.60 km respectively. Hence the mean stream length is about 3.74.

3.8. Stream length ratio

The stream length ratio r_i can therefore be obtained by dividing the average stream length of any order (L_u) by the average stream length of the next lower ($L_{\mu-1}$) order (Horten, 1945). It is controlled by the slop and regional topography, and thus controls the discharge and erosional activity of the particular watershed or basin (Singh, S., et al., 2019) [24]. R_L of stream orders different due to diversity in slope and topographic conditions, and has a positive relationship with the surface flow discharge and erosional stage of the sub-basin (Resmi MR, 2019) [21].

The mean values of stream length ratio for the study area is 1. Stream length ration of first order to second order is 1.10, whereas second order to third order is 1.01, third order to forth order is 0.87 and forth order to fifth order is 0.81. The R_L values between streams of different order in the watershed reveal that there are variations in slope and topography.

3.9. Length of overland flow

Length of overland flow (L_o) is length of flow of water over the ground before it becomes concentrated in definite stream channels, which affect both the hydrological and physiographic characteristics of the basin. Infiltration is high if greater the length of overland flow, and less the direct surface run-off (Horton (1945).

In the present study watershed, the length of overland flow value is 0.55 showing relatively mature stage of the drainage development.

3.10. Basin perimeter

It is the outer boundary of the watershed that encloses its area. It is dimension along the divides between watersheds and may be used as an indicator of watershed dimension or size and shape. The perimeter of the Kanthatmakur vagu watershed is 119.7 Km.

3.11. Basin length

According to Schumn (1956) who defined the basin length as the lengthiest dimension/ (size) of the basin parallel to the standard drainage line. The basin length determines the shape of the basin. High basin length indicates elongated basin. The watershed length of the study area is 45.5 km.

3.12. Relief aspects

Relief aspects are basin area (A), drainage density (D_d), Drainage frequency (F_a), Drainage texture (D_t), Form factor ratio (R_f), Elongation ratio (R_e), Circularity ratio (R_c) and infiltration number (I_t). Results of relief aspects are shown on Table 3.

3.13. Basin area

Drainage area measures the average drainage area of streams in each order; it increases exponentially with increasing order (Bhavana N. Umrikar, 2016) [15]. Schumm (1956) established an interesting relation between the total watershed area and the total stream length, which are supported by the contributing areas (Praveen Kumar Rai, et al, 2019).

Area of Kanthatmakur vagu watershed is 440.4 sq.km, which is measured using geometry calculation of ArcGIS.

3.14. Drainage density

Drainage density (D_d) is defined as the length of streams (L) per unit of drainage area (A) and measured by dividing the total length of stream by the area of a drainage basin (Horton, 1945; Schumm, 1956). The drainage density indicates the closeness of spacing of channels (Horton, 1932). Higher this number means closer together are the channels. Slope gradient and relative relief are the main morphological factor of drainage density. There is a high correlation among drainage density, precipitation, and evaporation (Horton, 1932). Low drainage density is favoured in regions of highly resistant or highly permeable subsoil materials, under dense vegetative cover. High drainage density is favoured in regions of weak or impermeable subsurface materials, sparse vegetation, and mountainous relief (Ziemer, 1973). For soft, incoherent materials such as silt or fine sand, this factor will be high; for hard rock surfaces or heavily vegetated soil surfaces, this factor will be low. It is well known that drainage density is high in bad- lands, where the rock is weak and unprotected by vegetative cover; low in regions of massive, strong bedrock and in heavily forested regions. Drainage density reaches a maximum in the early mature stage when relief is greatest but diminishes to lower values in late maturity and old age. Coarse drainage density occurs in regions of highly permeable subsoil material, under dense vegetative cover, and where relief is low. Low density leads to coarse drainage texture while high drainage density leads to fine drainage texture (Strahler, 1958) [7].

High drainage density implies increase in flood peaks, whereas there is decrease in food level in low drainage density. It is because long concentration time allows more opportunities to infiltrate and distributing through time the flow. Generally drainage density and flood volume have direct relation (Alemsha Bogale, 2021).

The drainage density of the study area is 1.1 km/Km^2, indicating low drainage density. It is reveals this area has a characteristics highly resistant subsoil materials, under dense vegetative cover, low relief, very coarse drainage and flood levels will be decreased.

Table 3 Results of the areal aspect of the study area

S. No	Parameter	Value
1	Basin area (A), Sq.km	440.4
2	Drainage density (D_d) (Km/Km^2)	1.1
3	Drainage frequency (F_s)	1.4
4	Infiltration number (l_t)	0.8
5	Drainage texture(D_t)	5.3
6	Form factor ratio (R_f)	0.3
7	Elongation ratio (R_e)	0.5
8	Circularity ratio (R_c)	0.4

3.15. Drainage frequency or stream frequency

The ratio between total number of streams (N) and area of a basin (A) is known as stream frequency (F_s) as given by Horton (1945). The stream frequency is the total number of stream segments of all order per unit area. Stream frequency primarily depends on the lithology of the basin and reflects the drainage texture of the drainage network

(Bismark Mensah-Brako, 2018) [16]. Drainage frequency mainly depends on the lithology of the basin, high drainage frequency will lead to a more surface runoff, while low drainage frequency leads to more percolation and therefore more groundwater potential (Resmi MR et al., 2019).

According to the Imran Malik et al., 2011, stream frequency classified in to 4 categories. The ratio <2.5 km^2 categorised as poor frequency, between 2.5 to 3.5 km^2 grouped as moderate, between 3.5 to 4.5 km^2 high and ranges from above 4.5 km^2 categorised as very high frequency (V. Anantha Rama, 2014) [13].

The calculated value of stream frequency (F_s) is 1.1 which is less than <2.5 km^2 showing poor drainage frequency and exhibits presence of a permeable subsurface material.

3.16. Drainage texture

According to Horton, 1945, drainage texture (D_t) is defined as the total number of stream fragments of all orders per perimeter of that watershed area. The drainage texture is chiefly be depending upon a number of consistent factors like rainfall, vegetation, climate, rock and soil type, infiltration capacity, relief and stage of development (Smith, 1950) [3].

According to Smith, 1939 has classified drainage texture into five different texture, they are, very coarse, moderate (4-6), fine (6-8), very fine (>8). In the study area, 5.3, which come under the class moderate drainage texture.

The Kanthatmakur vagu watershed has 5.3, which is characteristics of moderate texture.

3.17. Form factor ratio (R_f)

This is the ratio of the width to the length of the drainage-basin. The length to be used is not necessarily the maximum length but is to be measured from a point on the watershed-line opposite the head of the main stream. In the case of long, narrow drainage-basins such as basins occupying synclinal valleys and rift valleys, the form factor is indicative of the flood regimen of the stream. For drainage-basins of irregular form, especially those with permeable soils, form factor is not a sensitive indicator of hydrologic characteristics (Horten, 1932).

Low form factor ratio will be for basins of flatter peak flow for longer duration with less side flow for shorter duration and main flow for longer and vice versa for high ratio. The calculated value for the studied watershed catchments is 0.3 which confirms flatter peak flow for longer duration in moderately elongated shape (Alemsha Bogale, 2021).

3.18. Elongation ratio (R_e)

The shape of any drainage basin is expressed by an elongation ratio. It is the ratio between the diameters of a circle with the same area as the basin (Schumn, 1956). According to Singh and Singh (1997), the varying index of elongation ratio can be classified as; circular (> 0.9), oval (0.8- 0.9), less elongated (0.7-0.8), elongated (0.5-0.7), and more elongated (< 0.5) (Shruti Verma et al., 2020). According to Strahler (1964) [4], $R_{e,}$ values close to 1.0 are typical of regions of very low relief, whereas values in the range of 0.6-0.8 are usually associated with high relief and steep ground slope (Ramaiah, S.N. et al) [23]. The value of elongation ratio varies from "0" which indicates elongated shape to unity i.e., 1, which shows circular shape of a drainage basin. As elongation ratio is index of the overall shape of river basin and it depends on various geological as well as climatic factors (Satish V. Kulkarni, 2021) [27].

The observed value of the elongation ratio form the Kanthatmakur vagu watershed is 0.5, which indicating the watershed is an elongated and less probable to flooding as well as moderate to slightly steep slope (Alemsha Bogale, 2021).

3.19. Circularity ratio (R_c)

The circularity ratio, which is the ratio of circumference of a circle of same area as the basin to the basin perimeter (Schumn, 1956). It is influenced by the length and frequency of streams, geological structures, land use/ land cover, climate and slope of the basin (M.L.Waikar, 2014) [18]. A significant circulatory ratio indicates the dendritic stage of a watershed. Low, medium and high values of R_c indicate the young, mature, and old stages of the life cycle of the tributary watershed (Mangesh Deepak Kulkarni, 2015) [19]. Miller (1953) has described the basin of the circularity ratios range from 0.40 to 0.50, which indicates strongly elongated and highly permeable homogenous geologic materials (Praveen Kumar Rai, 2019).

The calculated value of the circulatory ratio is 0.40, which indicates elongated shape and highly permeable homogenous geologic materials of the studied area.

3.20. Infiltration Number (I_t)

The infiltration number of a watershed is defined as the product of drainage density and stream frequency and given an idea about the infiltration characteristics of the watershed. The higher the infiltration number the lower will be the infiltration and consequently the higher will be the run off. This leads to the development of higher drainage density. It gives an idea about the rate of infiltration and reveals impermeable lithology and high relief areas in the watershed.

The infiltration ratio of the study area is 0.8, therefore infiltration will be high and run off will be low.

3.21. Relief aspects

Areal aspects are Basin relief (B_r), Relief ratio (R_r) and Disection index (D_i). Results of the relief aspects are presented in Table 4.

3.22. Basin relief

The relief of catchment is different between highest (H) and lowest (h) elevation of the watershed (Sahidul Karim, 2020) [25]. It is an important factor in understanding the denudational characteristics of the basin and plays a significant role in landform development, drainage development, surface and subsurface water flow, permeability, and erosional properties of the terrain (Sandeep Adhikari, 2020) [26].

The height elevation of the watershed is 461 m and lowest at the mouth of the catchment is 200 m from the sea level. The calculate relief of the Kanthatmakur vagu watershed is 261 m.

Table 4 Results relief aspects of the study area

S. No	Parameter	Formula	Value
1	Basin relief (H)	H = Z - z	261
2	Relief ratio (R_r)	$R_r = H/L_b$	6.3
3	Dissection index (D_i)	$D_i = H/R_a$	0.6

3.23. Relief ratio (R_r)

Relief ratio is defined as the ratio between the total relief of a basin, i.e. elevation difference of lowest and highest points of a basin, and the longest dimension of the basin parallel to the principal drainage line (Schumn 1956). The high values of R_r indicate steep slope and high relief and vice versa. Run-off is generally faster in steeper basins, producing more peaked basin discharge and greater erosive power. (Bhavana N. Umrikar, 2016). According to the Gottaschalk (1964) relief ratio normally increases with decreasing drainage area and size of the watersheds of a given drainage basin. The relief ratio for Kanthatmakur vagu watershed is 6.3 m/km.

4. Conclusion

The concluded that Kanthatmakur vagu watershed has maximum 5th order stream. Area and perimeter of the watershed is 440.4 sq.km and 119.7 km respectively. The length of the watershed is 45.5 km. The higher amount of first order streams indicates the intensity of permeability and infiltration. Bifurcation ratio indicates that in the watershed third order and forth order are has structural control and hilly area. First, second and fifth order drainage basin area has flat area and less structural disturbance. Total length of the all orders are 481.8 km and mean stream length is 3.74 km. Stream length ratio revealed that watershed has variations in slope and topography. Length of overland flow value (0.55) showing relatively mature stage of the drainage development.

The study calculated that the drainage density of the study area is 1.1 km/Km^2, It is reveals this area has highly resistant subsoil materials, under dense vegetative cover, low relief, very coarse drainage basin and flood levels will be decreased. The watershed has poor drainage frequency, permeable subsurface material and moderate texture. The calculated values of farm factor ratio, elongation ratio and circularity ration indicating the basin has peak flow, is an elongated and less probable to flooding as well as moderate to slightly steep slope. In the watershed infiltration is high and run off will be low.

Compliance with ethical standards

Disclosure of conflict of interest

There is no conflict nor any competing interests from all the authors. The authors Swethamber Cheruku, Prof. G. Prabhakar and Umamaheswara Rao Boddu and their institutions do not have any conflict with the content of the manuscript.

Statement of informed consent

Informed consent was obtained from all individual participants included in the study.

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