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Geomorphological Analysis of Two Mini-Watersheds in Raichur City Karnataka

Mohammed Badiuddin Parvez1, Chalapathi k[2], M .Inayathulla3

[1,2]Research Scholar, Department of Civil Engineering, UVCE, Bangalore University, Bangalore, Karnataka, India.
[3]Professor, Department of Civil Engineering, UVCE, Bangalore University, Bangalore, Karnataka, India.

ABSTRACT:- *Morphometric analysis of the Watershed is considered to be the most satisfactory method because it enables in understanding of the relationship of various aspects within a drainage basin. In the present study two mini watersheds in Raichur city have been considered Mini-watershed 1 with an area of 519.32 km² with highest order stream of 6 it flows through north of city and it joins the streams of Krishna, Mini –Watershed 2 with an area of 360.97 km² with highest order stream of 5 it flows through south of city and joins Tungabhadra streams. The values of Stream frequency is 1.07 and 1.03, Form factor 0.35and 0.53, Shape factor 2.84 and 1.90, Elongation Ratio 0.67 and 0.82, Circularity Ratio 0.27 and 0.42, Drainage density 1.26 and 1.30, Length of overland flow 0.40 and 0.38 for Mini-watershed 1 and Mini-watershed 2 respectively.*

Key words: Mini –watershed, GIS, Drainage density, Stream Frequency, Length of overland flow.

I INTRODUCTION

Watershed is a natural hydrological entity from which runoff resulting from precipitation flows past a single point into large stream, river, lake or ocean. Thus, a watershed is the surface area drained by a part or the totality of one or several given water courses and can be taken as a basic erosional landscape element where land and water resources interact in a perceptible manner. Morphometric analysis provides quantitative description of the basin geometry to understand initial slope or inequalities in the rock hardness, structural controls, recent diastrophism, geological and geomorphic history of drainage basin (Strahler, 1964). Morphometric analysis requires measurement of linear features, gradient of channel network and contributing ground slopes of the drainage basin. . A major emphasis in geomorphology over the past several decades has been on the development of quantitative physiographic methods to describe the evolution and behavior of surface drainage networks (Horton, 1945). The influence of drainage morphometry is very significant in understanding the landform processes, soil physical properties and erosional characteristics. Drainage characteristics of many river basins and sub basins in different parts of the globe have been studied using conventional methods (Horton, 1945; Strahler, 1964). Geographical Information System (GIS) techniques are now a days used for assessing various terrain and morphometric parameters of the drainage basins and watersheds, as they provide a flexible environment and a powerful tool for the manipulation and analysis of spatial information.

II MATERIALS AND METHODS

A Study Area

In this Study two Mini-watersheds have been considered Mini-watershed 1 is located between Latitude 16º9′52′′ N to 16º22′24′′ N Latitude and 77º2′59′′ E to77º28′50′′ E Longitude and an area of 519.32 km², having maximum length of 38.42 km. The maximum and minimum elevation of the basin is 492 m and 335 m above MSL, respectively. And Mini-watershed 2 is located between Latitude 15º57′58′′ N to 16º11′25.6′′ N Latitude and 77º18′1′′ E to77º32′5.3′′ E Longitude and an area of 360.97 km², having maximum length of 26.17 km. The maximum and minimum elevation of the basin is 533 m and 323 m above MSL respectively. Location of the study area is shown in figure 1.

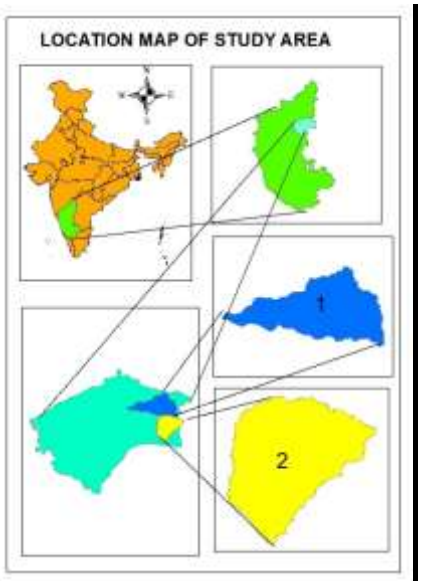

Fig 1 Location Map of Study Area

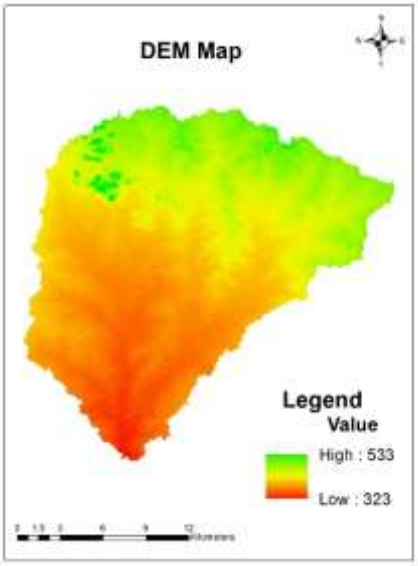

Fig 2 DEM of Mini-Watershed1

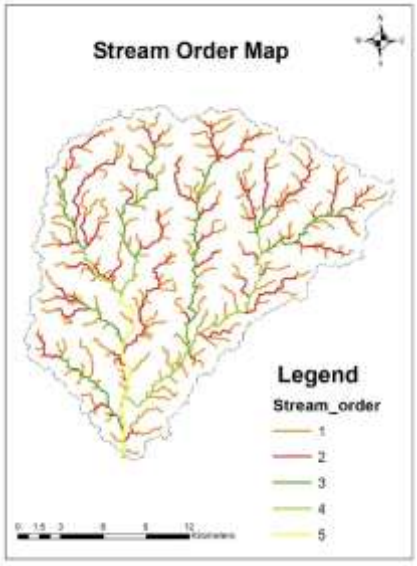

Fig 3 Stream order of Mini-watershed1

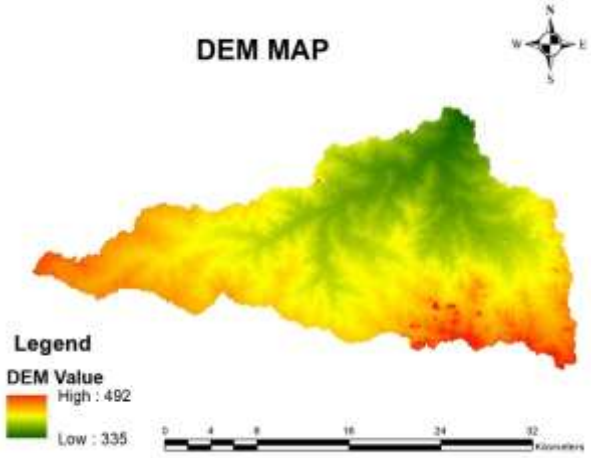

Fig 4 DEM of Mini-Watershed2

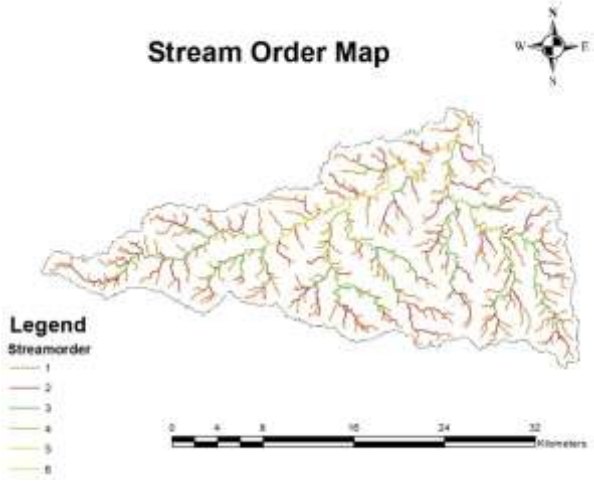

Fig 5 Stream order of Mini-watershed2

B Methodology

DEM data is used to calculate the flow direction a staple for determining many important hydrologic parameters stream network is determined by using Arc GIS tools. Quantitative morphometric analysis was carried out for different mini watersheds for linear aspects, areal aspects and relief aspects. The analysis was carried out using Arc GIS. The detailed list of various morphological characteristics derived for Table 1 is used for calculating the morphometric parameters of the mini watersheds.

Table 1 Formulae adopted for computation of Morphometric parameters

Sl no	Morphometric parameters	Formula	Refrence
1	Stream order	Hierarchial rank	Strahler (1964)
2	Stream length (Lu)	Length of the stream	Horton (1945
3	Mean stream length (Lsm)	Lsm = ? Lu / Nu	Strahler (1964)

		Where, Lsm = Mean stream length Lu = Total stream length of order 'u' Nu = Total no. of stream segments of order 'u'	
4	Stream length ratio (RL	RL = Lu / Lu – 1 Where, RL = Stream length ratio Lu = The total stream length of the order 'u' Lu – 1 = The total stream length of its next lower order	Horton (1945)
5	Bifurcation ratio (Rb)	Rb = Nu / Nu + 1 Where, Rb = Bifurcation ratio Nu = Total no. of stream segments of order 'u' Nu + 1 = Number of segments of the next higher order	Schumn (1956)
6	Relief ratio (Rh)	Rh = H / Lb Where, Rh = Relief ratio H = Total relief (Relative relief) of the basin (km) Lb = Basin length	Schumn (1956)
7	Drainage density (D)	D = Lu / A Where, D = Drainage density Lu = Total stream len gth of all orders A = Area of the basin (Sq km)	Horton (1932)
8	Stream frequency (Fs)	Fs = Nu / A Where, Fs = Stream frequency Ns = Total no. of streams segments A = Area of the basin (Sq km)	Horton (1932)
9	Form factor (Rf)	Rf = A / Lb Where, Rf = Form factor A = Area of the basin (Sq km) Lb = basin length	Horton (1932)
10	Circularity ratio (Rc)	$Rc = (4 * Pi * A)^{1/2} / P^2$ Where, Rc = Circularity ratio Pi = 'Pi' value i.e., 3.14 A = Area of the basin (Sq km) P^2 = Square of the perimeter (km)	Miller (1953)

11	Elongation ratio (Re)	Re = 2 (A/Pi)½ / Lb Where, Re = Elongation ratio A = Area of the basin (Sq km) Pi = 'Pi' value i.e., 3.14 and Lb = Basin length	Schumn (1956)

Results and Discussion

Quantitative Morphometric analysis were carried out for two Mini-watershed. The results of Morphometric characteristics are presented in Tables 2 and 3.

Table 2 Morphometric Parameters

Sl No	Watershed Parameters	Units	Watershed 1	Watershed 2
1	Watershed Area	Sq.Km	519.32	360.97
2	Perimeter of the Watershed	Km	155.83	104.57
3	Watershed Stream Highest Order	No.	6	5
4	Maximum Length of watershed	Km	38.42	26.17
5	Maximum width of Watershed	Km	14.14	19.14
6	Cumulative Stream Segment	Km	557	370
7	Cumulative Stream Length	Km	651.75	469.82
8	Drainage Density	Km /Sq.km	1.26	1.3
9	Constant of Channel Maintenance	Sq.Km/Km	0.8	0.77
10	Stream Frequency	No/Sq.Km	1.07	1.03
11	Form Factor		0.35	0.53
12	Shape Factor		2.84	1.9
13	Circularity Ratio		0.27	0.42
14	Elongation Ratio		0.67	0.82
15	Compactness Coefficient		1.93	1.53
16	Total Watershed Relief	m	157	210
17	Relief Ratio		0.004	0.008
18	Relative Relief		0.001	0.002
19	Ruggedness Number		0.0001	0.0002
20	Texture Ratio		2.75	2.88
21	Length Of overland flow		0.40	0.38

Table 3 Morphometric Characteristics

Name	Stream order	No. Of streams	Total length of streams (km)	Cumulative length (km)	Mean stream length (km)	Bifurcation ratio (km)	Length ratio
Mini Watershed 1	1	429	339.04	339.04	0.79		
	2	100	148.98	488.02	1.49	4.29	1.89
	3	20	93.35	581.37	4.67	5	3.13
	4	5	40.87	622.24	8.17	4	1.75
	5	2	10.52	632.76	5.26	2.5	0.64
	6	1	18.99	651.75	18.99	2	3.61
	1	302	248.24	248.24	0.82		

Mini Watershed 2	2	54	117.91	366.15	2.18	5.59	2.66
	3	10	61.62	427.77	6.16	5.4	2.82
	4	3	28.27	456.04	9.42	3.333333333	1.53
	5	1	13.78	469.82	13.78	3	1.46

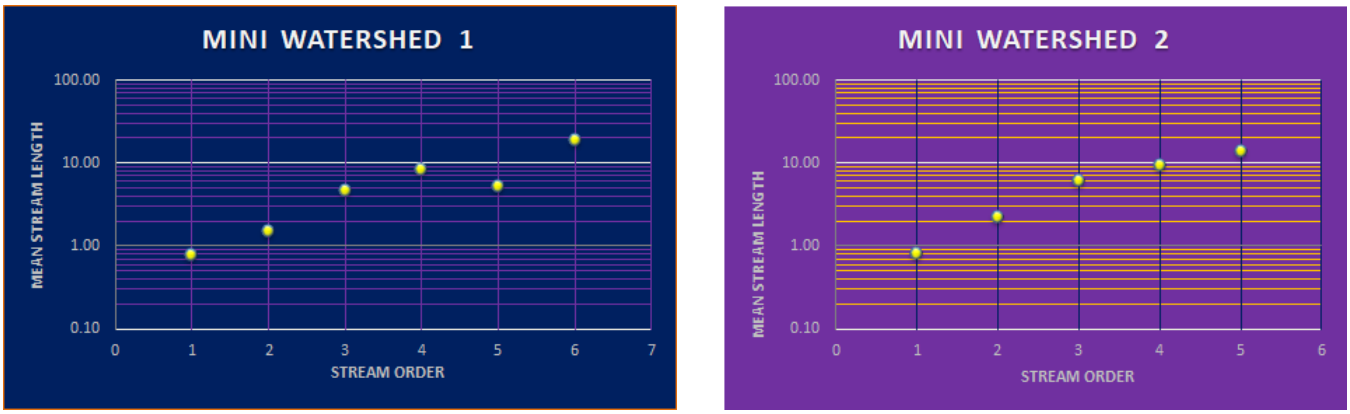

Fig 6 Regression of stream order on mean stream length

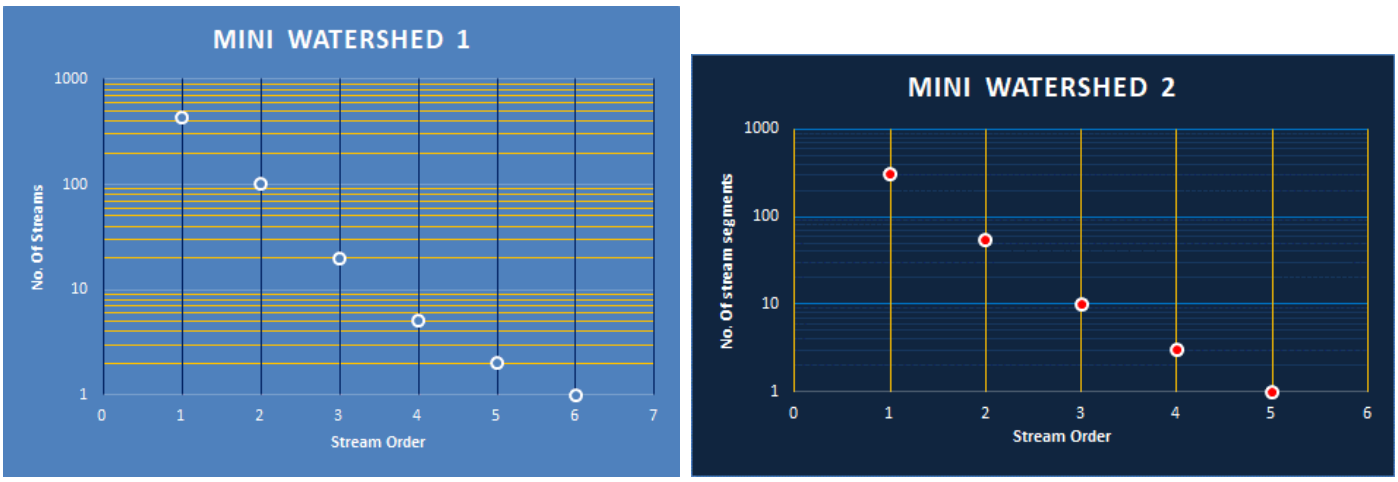

Fig 7 Regression of stream order on number of streams

IV CONCLUSION

The length of overland flow in both the Mini Watershed in the present study is more than 0.3. Hence, the Watersheds selected for study have longer flow paths associated with more infiltration and reduced runoff. The Drainage density ranges between 1.24-2.49 hence both the mini watersheds have coarse texture. The shape ratio shows the watersheds are elongated to oval shape. Stream frequency is less in both the mini watersheds

References

1. Agarwal. C.S (1998). Study of drainage pattern through aerial data in Naugarhareao of Varnasi district, U.P.Jour.Indian Soc. Remote Sensing 26:169-175
2. HortonR. E.(1945). Erosional Development of streams and their drainage basins, Hydro physical approach to quantitative morphology. Geological Society of American Bulletin. 56: 275-370.
3. Mohammed Badiuddin Parvez, M Inayathulla "Prioritization Of Subwatersheds of Cauvery Region Based on Morphometric Analysis Using GIS", International Journal for Research in Engineering Application & Management (IJREAM), Volume: 05 Issue: 01, April -2019.
4. Mohammed Badiuddin Parvez, M Inayathulla "Modelling of Short Duration Isopluvial Map For Raichur District Karnataka", International Journal for Science and Advance Research in Technology (IJSART), Volume: 05 Issue: 4, April -2019.

5. Mohammed Badiuddin Parvez, and M .Inayathulla. "Morphometry, Hypsometry Analysis and Runoff Estimation of Aam Talab Watershed Raichur, Karnataka" International Journal Of Advance Research And Innovative Ideas In Education Volume 5 Issue 3 2019 Page 1713-1727

6. Vijith, H and Sateesh, R. (2006). GIS based morphometric analysis of two major upland Sub-watershed of Meenachil river in Kerala. Jour