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PRIORITIZATION OF WATERSHEDS OF SHETRUNJI RIVER BASIN BASED ON MORPHOMETRIC ANALYSIS USING REMOTE SENSING AND GIS

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Abstract- The study area i.e. Shetrunji basin falling in the district of Bhavanagar, Amreli and Junagadh, is a major one among 71 river basins of Saurashtra region of the Gujarat state, India. Using the remotely sensed images of the IRS P6 LISS III and Cartosat satellites, the maps for the theme of land use/land cover, soil, drainage, slope and contour were prepared adopting the PCI Geomatica 10.1 software. The GIS analysis was made for the said themes using the ArcMap V9.2. The Shetrunji basin was found as 7th order basin. The mean bifurcation ratio was found as 4.51 for the basin and it varied from 1.8 to 4 for the 17 watersheds which indicated that the geological structures did not amply disturbed the drainage pattern. The length of overland flow for watersheds of the basin was found varying from 0.1919 to 0.4419 km. while 0.3132 km for the basin. The drainage texture for watersheds of the basin varied from 3.3 to 10.7. The drainage density of the basin was found as 1.5965 km/km^2 while for its 17 watersheds it ranged between 1.14 to 2.60 km/km^2. The elongation ratio of the watersheds varied from 0.45 to 0.85. Similarly the form factor for basin was found 0.3023 and for basin watersheds it varied from 0.16 to 0.56. The circularity ratios for watersheds were found in the range of 0.37 to 0.77 and 0.3853 for basin as a whole, which all together reflects elongated shape, low runoff and high permeability of the subsoil. The compactness coefficient for watersheds was found in between 1.14 to 1.79 and 1.6106 for basin as a whole. The relief, relative relief and relief ratio for watersheds ranged from 0.095 to 0.445 km, 0.0915 to 0.5399 and 0.00273 to 0.019 and that of for the basin as 0.605 km, 0.1410 and 0.004427 respectively. The ground slope and channel slope for different watersheds of study basin were found varied from 0.00307 km/km to 0.0192 km/km and 0.001549 km/km to 0.01224 km/km; and for the basin 0.004427 km/km and 0.002820 km/km, respectively. According to severity ranking of each watershed the compound parameters were estimated by averaging the priorities. The final priority was allotted to the watersheds according to the values of compound parameters. The value of compound parameter for all 17 watersheds varied from 6 to 11.50. The watershed 5G2B5d (compound parameter value 6) receives the highest priority value and so it becomes potential and prioritized candidate for applying soil conservation measures, in contrast to the other watersheds with low priorities are subjected to lower degree of erosion. Such kind of watershed prioritization becomes helpful to overall watershed management planning. The morphometric properties determined for this basin as whole and for each watershed will be useful for the sound planning of water harvesting and groundwater recharge projects on watershed base.

Keywords- Morphometry, Shetrunji river basin, Watershed, thematic mapping, remote sensing and GIS, watershed prioritization

Introduction

India occupies 329 Mha geographical area, which forms 2.4 per cent of the world's land area. An estimated 175 Mha of land constituting about 66 percent [22] of total geographical area of the country suffers from deleterious effects of soil erosion and land degradation.The Khodiyar dam and Shetrunji dam are located on Shetrunji River having catchment area 384 km^2 and 4317 km^2, respectively. Morphometric analysis is the measurement of the three dimensional geometry of land forms and has traditionally been applied to watershed, drainages, hill slopes, and other group of terrain features. Morphometric analysis is a significant tool for prioritization of sub watersheds even without considering the soil map [4]. Morphometric analysis requires measurement of linear features, gradient of channel network and contributory ground slopes of the drainage basin [23]. The close relationship between hydrology and geomorphology play an important role in the drainage morphometric analysis [15]. The success of watershed development programme revolves around the conservation of soil and water resources in that watershed and hence, it is imperative to prioritize the watersheds on the basis of conservation and developmental needs. River basins comprise a distinct morphologic region and have special relevance to drainage pattern and geomorphology [10,26].

Study Area

The study area is Shetrunji river basin in Saurashtra region of Gujarat. It is located between 21° 00' to 21° 47' North latitude and 70° 50' to 72° 10' East longitude. The climate of the project area can be classified as tropical and sub-tropical. January is the coldest month with mean monthly temperature varying from 14.5°C to 20°C and maximum monthly temperature varies between 30°C to 44°C in the month of May. The river Shetrunji originates at Chchai hills in Gir forest of Junagadh district at 380 m.s.l. and flows towards east direction till it confluence with Gulf of Khambhat near Santrampur port. Its length is 227 km having 5646 km^2 catchment area with average annual rainfall of 604.52 mm on varied slope of basin (1:1000 to 1:5000) [Fig-1].

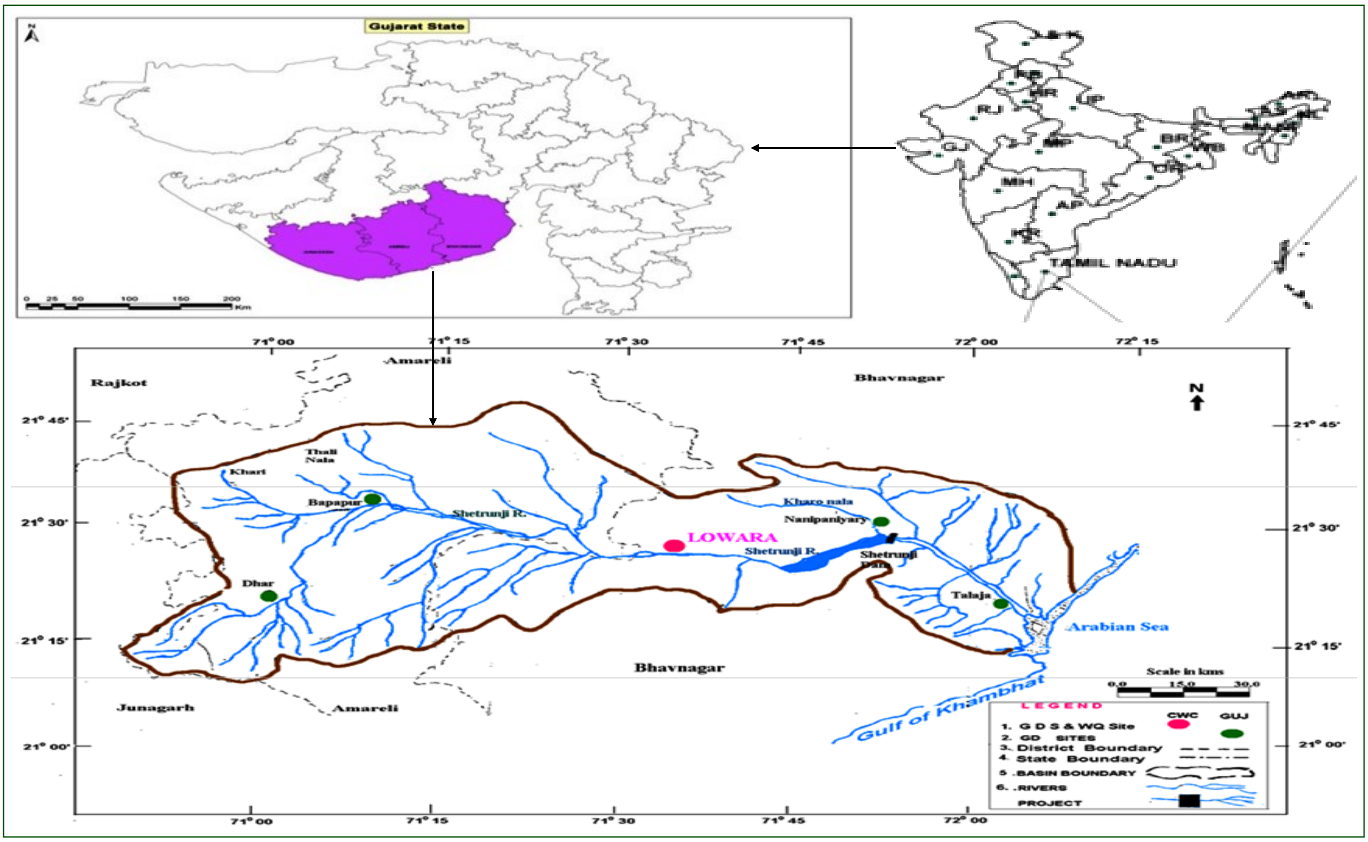

Fig 1- Location map of study area (Shetrunji river basin)

Methodology

The remote sensing and GIS software used for the study is PCI Geomatica V10.1 and ArcGIS-ArcMap 9.2. The satellite images of IRS P6 LISS III captured in Oct 2005 and Feb 2008 having resolution of 23.5 m x 23.5 m and images from Google Earth Pro of study area were used. Map of India with Scale 1:15, 00,000, Gujarat with Scale 1:37,50,000 and Watershed map of Gujarat (Scale 1:37, 50,000) and Soil maps of India were used for the experimental study. The order was given to each stream by following Strahler, [27] stream ordering technique. The map showing drainage pattern in the study area [Fig-2] was prepared.

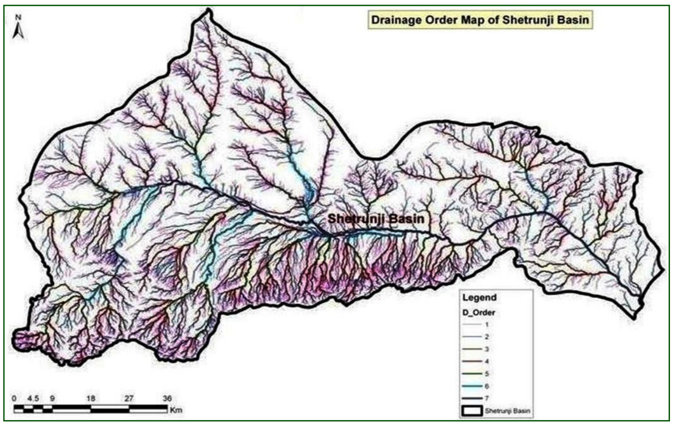

Fig. 2- Drainage order map of Shetrunji river basin

The linear parameters like stream order, stream length, bifurcation ratio, stream length ratio and length of overland flow stream frequency, areal parameters like stream frequency, drainage density, texture ratio, elongation ratio, circularity ratio, form factor and compactness coefficient and relief parameters relief, relative relief, relief ratio, channel slope and ground slope or watershed average slope were determined using GIS. Prioritization rating of all the seventeen watersheds of Shetrunji river basin is carried out by calculating the compound parameter values. The watershed with the lowest compound parameter value is given the highest priority and the final priority map was prepared [Fig-3].

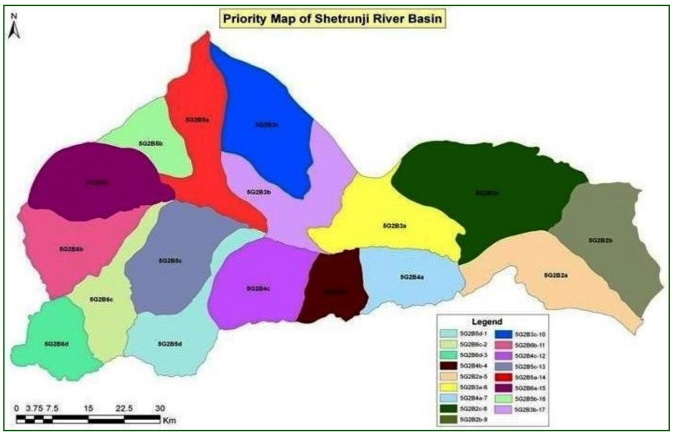

Fig. 3- Final priority map of Shetrunji river basin

Result and Discussion

Drainage patterns of stream network from the basin have been observed as mainly dendritic type which indicates the homogeneity in texture and lack of structural control. The basin is divided into 17 watersheds with codes viz. 5G2B2a, 5G2B2b, 5G2B2c, 5G2B3a, 5G2B3b, 5G2B3c, 5G2B4a, 5G2B4b, 5G2B4c, 5G2B5a, 5G2B5b, 5G2B5c, 5G2B5d, 5G2B6a, 5G2B6b, 5G2B6c and 5G2B6d.

Linear Aspects of the Watershed

Linear aspects of the 17 watersheds, related to the channel patterns of drainage network where in the topological characteristics of the stream segments in terms of open links of the stream network system are analyzed. The parameters such as stream order, number of streams, stream length, bifurcation ratio, length of overland flow and stream length ratio are taken into account for the present study and the results have been tabulated in the [Table-1] as a whole to [Table-2] as sub watersheds.

Table 1- Morphometric parameters of Shetrunji River basin

Linear aspects of basin Stream orders, numbers and length						
Stream order	No of streams	Total length of streams, km	Mean stream length, km	Length of overland flow km		
1	6285	4861.8	0.77			
2	1512	1961.02	1.3			
3	351	1113.67	3.17			
4	100	552.47	5.53	0.3132		
5	27	266.12	9.86			
6	8	135.89	16.99			
7	1	123.9	123.9			
Bifurcation ratio (N_u/N_{u+1})						
1st /2nd	2nd/3rd	3rd/4th	4th/5th	5th/6th	6th/7th	Mean
4.16	4.31	3.51	3.7	3.38	8	4.51
Stream length ratio (L_{u+1}/L_u)						
2nd/1st	3rd/2nd	4th/3rd	5th/4th	6th/5th	7th/6th	Mean
1.68	2.45	1.74	1.78	1.72	7.29	2.78
Aerial aspects of basin						
Drainage density (km/km2)	Stream frequency (1/km)	Circularity ratio	Compactness coefficient	Form factor	Elongation ratio	Drainage texture (1/km)
1.5965	1.4671	0.3853	1.6106	0.3023	0.6206	19.3095
Relief parameters of basin						
Relief, km	Relief ratio	Relative relief	Channel slope km/km	Ground slope, km/km		
0.605	0.004427	0.1410	0.002820	0.004427		

The present study has adopted the widely used method of Strahler. The study area is a 7th order drainage basin covering an area of 5646.54 km^2. The total number of 8284 streams were identified of which 6285, 1512, 351, 100, 27, 8 and 1 nos. were 1st , 2nd, 3rd, 4th, 5th, 6th and 7th order streams respectively. The total length of the 1st order streams is highest i.e. 4861.80 km, and that of 2nd order is 1961.02 km, 3rd order is 1113.67 km, 4th order is 552.47 km, 5th order is 266.12 km, 6th order is 135.89 km and the lowest is of 7th order of 123.90 km respectively. Lower stream lengths are likely to have lower runoff [8].

Bifurcation Ratio

Horton, [17] and Strahler, [26] defined bifurcation ratio as the ratio of the number of streams of one order to the number of streams of the next higher order. The analysis of bifurcation value shows that the basin and its watersheds possesses well developed drainage network as the bifurcation ratio ranges between 2.8 to 4.7 i.e. low value.

Stream Length Ratio

Stream length ratio may be defined as the ratio of the mean length of the one order to the next lower order of the stream segment [17]. The value of stream length ratio ranges widely between 1.35 to 176 which shows the early stage of maturity of the watershed.

Length of Overland Flow

A larger value of length of overland flow indicates longer flow path and thus, gentler slopes. The Length of overland flow for basin 0.3132 km and for watersheds ranges from 0.2026- 0.4419 km. The watersheds 5G2B4b, 5G2B4c, 5G2B5d, 5G2B6c and 5G2B6d are having lower values of length of overland flow comes under the influence of high structural disturbance, low permeability, steep to very steep slopes and high surface runoff. Other remaining watersheds having length of overland flow greater than 0.25 are under very less structural disturbance, less runoff conditions and having higher overland flow. For basin it is greater than 0.25 it comes under very less structural disturbance, less runoff conditions and having higher overland flow.

Aerial Aspects of the Watershed

The parameters which are governed by the area of the drainage basin are classed as areal aspects of the basin. The aerial parameters include drainage density, stream frequency, elongation ratio, form factor, circularity ratio, compactness coefficient and drainage texture have been identified and results have been given in [Table-2].

Drainage Density

Drainage density the ratio of total channel segment lengths cumulated for all orders within a basin to the basin area, which is expressed in terms of mi/sq. mi or km/sq. km. The drainage density of the basin is 1.5965 km/km^2 comes under low drainage density. The drainage density for watersheds varies from 0.1314 to 3.0857. The watersheds 5G2B4a, 5G2B4b, 5G2B5a, 5G2B5d, 5G2B6c and 5G2B6d show high drainage density (greater than 2 km/km^2) due to the presence of impermeable sub surface material, sparse vegetation and high relief. Whereas remaining watersheds fall under low drainage density indicate the region has highly permeable subsoil and dense vegetation cover.

Stream Frequency

The stream frequency for watersheds varies from 0.9393 to

3.50931 and for basin 1.4671 it is low due to permeable rocks the surface runoff is low and infiltration capacity is high within in the study area [8]. The stream frequency for all 17 watersheds of the study area shows positive correlation with the drainage density which indicate that the stream population increases with the increase of drainage density.

Elongation Ratio

The elongation ratio (Re) is the ratio of diameter of a circle of the same area as the basin to the maximum basin length (Schumm 1956). The elongation ratio of the basin watersheds is varies from 0.45 to 0.85. The watersheds 5G2B2b, 5G2B2c, 5G2B4a, 5G2B4b, 5G2B4c, 5G2B5b, 5G2B5c, 5G2B6a and 5G2B2d are elongated in nature. While remaining are less elongated in nature. For the basin it is 0.6206 indicating less elongated in nature.

Form Factor

According to Horton, [15] Form Factor is defined as the ratio of the basin area to the square of the basin length. The form factor for basin is 0.3023 and for basin watersheds varying from 0.16 to 0.56. Theses low value of form factor indicates that they have a flatter peak flow for longer duration. The watershed 5G2B5a, 5G2B5d and 5G2B6c are circular in shape showing less side flow for shorter duration and high main flow for longer duration [8]. The remaining watersheds are elongated watershed, indicating that they will have a flatter peak flow for longer duration.

Circularity Ratio

The basin shape itself largely controlled by geological structure and it is an important control factor over the geometry of the stream work. A dimensionless circularity ratio (Rc) is the ratio of basin area to the area of circle having the same perimeter as the basin. For the out-line form of watershed [20,27] used a dimensionless circularity ratio as a quantitative method The circularity ratio for watersheds varies from 0.37 to 0.77 and for basin it is 0.3853 indicating elongated in shape, low discharge of runoff and highly permeability of the subsoil condition.

Compactness Coefficient

The compactness coefficient is the ratio of catchment perimeter to that of equivalent circle having area as that of the basin [12]. The compactness coefficient for watersheds ranges from 1.14 to 1.79 and for basin is 1.6106. They have elongated shape so they have enough time for discharge.

Drainage Texture

The drainage texture depends upon a number of natural factors such as climate, rainfall, vegetation, rock and soil type, infiltration capacity, relief and stage of development. It is the total no. of stream segments of all orders per perimeter of the area. The texture ratio for watersheds varies from 3.3 to 10.7. For watershed 5G2B4a, 5G2B4b 5G2B4c and 5G2B6c it is greater than 8 indicating very fine texture i.e. higher runoff potential while 5G2B5d, 5G2B5c, 5G2B6a and 5G2B6d is moderate in nature. The rest watersheds are coarser in nature i.e. having less runoff potential. For basin it is 19.3095 showing very fine nature [25].

Relief Aspects of the Watershed

The relief aspects of drainage basin are also important in water resources studies. The character of the distribution of slope, angles sampled over the whole basin depends on the height distribution within it. Relief aspects like relief, relative relief, relief ratio, channel slope and ground slope were measured.

Relief

It is defined as the elevation difference between the reference points located in the drainage basin. The relief of basin is 0.605 km. The study area is of high relief region as it is greater than 0.3 km. The high relief value indicates low gravity of water flow as well as infiltration and high runoff conditions. The relief for watersheds varies from 0.095 to 0.445 km. The watersheds 5G2B5b and 5G2B6d are of low relief region, 5G2B2c, 5G2B3a, 5G2B5d and 5G2B6a are of high relief region and remaining are of moderate relief region.

Relief Ratio

It is the ratio of relief to the horizontal distance on which relief was measured. The relief ratio for watersheds varies from 0.00273 to 0.019 and for basin it is 0.004427. It was noticed that the higher values of relief ratio indicated steep slope and high relief (5G2B6d watershed), while the lower values in case of watershed 5G2B5a indicated the presence of basement rocks that are exposed in the form of small ridges and mounds with lower degree of slope [11].

Relative Relief

It is the ratio of relief to the perimeter of basin. It is an important morphometric variable used for the overall assessment of morphological characteristics of terrain. The relative relief for watersheds varies from 0.0915 to 0.5399 and for basin it is obtained as 0.1410. The watersheds having higher relative relief have higher runoff potential than others. Therefore, the watershed 5G2B5a and 5G2B5d are having the lowest and highest runoff potential.

Channel Slope

Horton, [17] expressed the relationship in form of law called as laws of stream slopes, which is an inverse geometric series law. For watersheds it is varies between 0.001549 km/km to 0.01224 km/km and for basin it is 0.002820 km/km. The higher channel slopes in 5G2B6d watershed indicated less time of concentration i.e. peak flow occurs in short time while lower slope in 5G2B5a watershed indicated less peaked flow for longer duration. Therefore, while constructing the water harvesting structures on channel of watershed 5G2B6d, the outlet should be designed of higher discharge capacity and the rest components like headwall, sidewall and wing wall should also be of higher height for the designed storage capacity [28]. The drop structures in series in the channels of this watershed are recommended.

Ground Slope

It is the ratio of relief and horizontal distance. It is the product of drainage density and relief of the basin. For watersheds it is obtained as 0.00307 km/km to 0.0192 km/km and for basin 0.004427 km/km. The higher ground slopes in case of 5G2B6d lying in upper reach of the basin indicates lower time of concentration of overland flow. Also, the possibilities of soil erosion will be higher in this watershed.

Watershed Prioritization

The watershed prioritization is done on the basis of linear parameters consisting of bifurcation ratio, stream frequency, length of overland flow, drainage density, texture ratio, relief, relative relief and relief ratio. The higher the values of these parameters, higher will be the degree of hazardous. The shape parameters like elongation ratio, circularity ratio, form factor and compactness coefficient varying inversely with the same [21]. The prioritization ranking was given based on the degree of hazardous and the final prioritization was done on the basis of compound parameter obtained from averaging the values of the rankings of the linear and shape parameters allotted to the watersheds. The compound parameter values of all seventeen watersheds are calculated and prioritization rating is shown in [Table-3]. The final prioritized map of the study area and prioritization ranks of watersheds is shown in [Fig-3].

Table 2- Morphometric parameters of watersheds of Shetrunji River basin

watershed	Stream order	No of streams	Total length of streams, km	Mean stream length, km	Length of overland flow, km	Bifurcation ratio	Stream length ratio
	1	251	227.42	0.9			
	2	68	94.3	1.39			
	3	19	80.46	4.23			
5G2B2a	4	6	21.12	3.52	0.4778	4.1092	1.3586
	5	1	0.068	0.068			
	6	0	0	0			
	7	1	22.19	22.19			
	1	274	207.48	0.76			
	2	62	120.16	1.94			
	3	16	53.98	3.37			
5G2B2b	4	4	28.9	7.23	0.438	4.0736	2.0111
	5	1	11.58	11.58			
	6	0	0	0			
	7	1	12.97	12.97			
	1	580	478.75	0.81			
	2	148	166.67	1.13			
	3	35	118.44	3.38			
5G2B2c	4	10	43.12	4.31	0.3872	3.1635	1.7125
	5	3	20.24	6.75			
	6	1	11.4	11.4			
	7	1	15.37	15.37			
	1	312	231.67	0.74			
	2	78	135.53	1.74			
	3	17	54.28	3.19			
5G2B3a	4	5	14.19	2.84	0.3844	3.1647	175.54
	5	1	8.62	8.62			
	6	1	0.019	0.019			
	7	1	20.83	20.83			
	1	249	209.82	0.84			
	2	63	96.83	1.54			
	3	13	31.6	2.43			
5G2B3b	4	5	26.76	5.35	0.4202	2.864	1.5789
	5	2	13.85	6.93			
	6	2	17.39	8.7			
	7	1	11.45	11.45			
	1	335	273.83	0.82			
	2	76	96.54	1.27			
	3	16	41.99	2.62			
5G2B3c	4	5	37.88	7.58	0.4419	3.3716	1.8697
	5	2	9.56	4.78			
	6	1	10.57	10.57			
	7	0	0	0			
	1	474	316.08	0.67			
	2	113	124.11	1.1			
	3	31	103.2	3.33			
5G3B4a	4	12	64.73	5.39	0.1921	3.071	2.0303
	5	3	8.34	2.78			
	6	1	12.16	12.16			
	7	1	12.12	12.12			
	1	448	275.72	0.62			
	2	113	98.02	0.87			
	3	30	59.05	1.97			
5G2B4b	4	13	68.68	5.28	0.162	2.8815	1.5036
	5	4	28.2	7.05			
	6	2	5.11	2.56			
	7	1	2.46	2.46			

Table 2- Continues

watershed	Stream order	No of streams	Total length of streams, km	Mean stream length, km	Length of overland flow, km	Bifurcation ratio	Stream length ratio
	1	534	477.76	0.89			
	2	136	185.59	1.37			
	3	39	115.56	2.96			
5G2B4c	4	12	59.61	4.97	0.1919	2.6554	1.6702
	5	3	39.89	13.3			
	6	1	4.01	4.01			
	7	0	0	0			
	1	346	277.81	0.8			
	2	78	82.21	1.05			
	3	18	43.63	2.42			
5G2B5a	4	2	26.79	13.4	0.4115	1.8461	2.2711
	5	3	12.12	4.04			
	6	2	9.2	4.6			
	7	1	14.02	14.02			
	1	172	140.3	0.82			
	2	36	49.48	1.37			
	3	6	13.65	2.27			
5G2B5b	4	2	13.05	6.52	0.3798	3.94	0.5643
	5	1	9.18	9.18			
	6	0	0	0			
	7	0	0	0			
	1	328	318.76	0.97			
	2	77	140.28	1.82			
	3	20	77.56	3.88			
5G2B5c	4	4	29.1	7.28	0.3127	3.185	20.052
	5	1	19.39	19.39			
	6	1	0.073	0.073			
	7	1	8.16	8.16			
	1	608	374	0.62			
	2	133	165.4	1.24			
	3	27	89.07	3.3			
5G2B5d	4	7	31.12	4.45	0.2026	3.7709	2.1779
	5	2	29.44	14.72			
	6	1	22.92	22.92			
	7	0	0	0			
	1	341	293.11	0.86			
	2	81	91	1.12			
	3	21	47.55	2.26			
5G2B6a	4	4	12.82	3.21	0.41	3.0528	1.249
	5	2	9.05	4.53			
	6	2	8.01	4			
	7	1	1.84	1.84			
	1	222	226.75	1.02			
	2	56	85.7	1.53			
	3	14	61.91	4.42			
5G2G6b	4	3	17.52	5.84	0.379	3.3262	1.7262
	5	1	16.68	16.68			
	6	1	1.09	1.09			
	7	0	0	0			
	1	410	275.31	0.67			
	2	99	116.7	1.18			
	3	24	57.59	2.4			
5G2B6c	4	6	18.15	3.03	0.2494	3.3778	2.0648
	5	1	6.69	6.69			
	6	1	33.79	33.79			
	7	1	2.5	2.5			
5G2B6d	1	530	267.57	0.51	0.2116	3.6403	1.7670
	2	122	112.46	0.92			
	3	28	64.15	2.29			
	4	8	38.93	4.87			
	5	2	23.23	11.61			
	6	1	0.15	0.15			
	7	0	0	0			

Table 2- Continues

Aerial Aspects of Watersheds of Shetrunji River Basin							
Watershed	Drainage density (km/km^2)	Stream frequency ($1/km^2$)	Elongation ratio	Circularity ratio	Form factor	Compactness coefficient	Drainage texture (1/km)
5G2B2a	1.2262	0.9522	0.606	0.3709	0.2883	1.6416	3.1191
5G2B2b	1.1416	0.9393	0.7362	0.5981	0.4254	1.2927	4.0018
5G2B2c	1.2915	1.1905	0.8031	0.5744	0.5063	1.3191	6.5082
5G2B3a	1.3007	1.1605	0.6505	0.4242	0.3219	1.5349	4.0333
5G2B3b	1.1899	0.9777	0.6314	0.2807	0.3129	1.887	2.7056
5G2B3c	1.1314	1.0463	0.5702	0.5839	0.2553	1.3083	4.6002
5G2B4a	2.6025	2.5792	0.7456	0.6002	0.4365	1.2905	8.8469
5G2B4b	3.0857	3.5093	0.7043	0.6727	0.3894	1.219	10.716
5G2B4c	2.605	2.1403	0.7681	0.7752	0.4631	1.1354	9.7871
5G2B5a	1.215	1.1738	0.4672	0.3047	0.1714	1.8112	3.5797
5G2B5b	1.3164	1.266	0.7748	0.5669	0.4712	1.3279	3.5212
5G2B5c	1.5991	1.1643	0.7646	0.6475	0.4589	1.2425	5.092
5G2B5d	2.4678	2.6968	0.4882	0.3125	0.1871	1.7885	7.2247
5G2B6a	1.2195	1.1895	0.7119	0.7575	0.3978	1.1487	5.6945
5G2B6b	1.3191	0.9564	0.6956	0.5097	0.3798	1.4003	3.3952
5G2B6c	2.0047	2.1275	0.4503	0.3087	0.1592	1.7994	5.3236
5G2B6d	2.3628	3.2235	0.8467	0.5582	0.5628	1.3382	9.9494

Relief aspects of watersheds of Shetrunji river basin					
watershed	Relief km	Relative relief km/km	Relief ratio	Channel slope km/km	Ground slope, km/km
5G2B2a	0.34	0.3065	0.00958	0.0061	0.00958
5G2B2b	0.2	0.2236	0.00668	0.004256	0.00668
5G2B2c	0.315	0.2635	0.00876	0.005584	0.00876
5G2B3a	0.445	0.4325	0.01356	0.008639	0.01356
5G2B3b	0.13	0.105	0.00393	0.002502	0.00393
5G2B3c	0.11	0.1163	0.00273	0.001736	0.00273
5G2B4a	0.22	0.3065	0.00926	0.0059	0.00926
5G2B4b	0.175	0.3069	0.00828	0.005271	0.00828
5G2B4c	0.14	0.1889	0.00517	0.003297	0.00517
5G2B5a	0.115	0.0915	0.00243	0.001549	0.00243
5G2B5b	0.075	0.1217	0.00393	0.002505	0.00393
5G2B5c	0.15	0.1768	0.00528	0.00336	0.00528
5G2B5d	0.315	0.2925	0.00802	0.005109	0.00802
5G2B6a	0.095	0.1197	0.00307	0.001958	0.00307
5G2B6b	0.16	0.1829	0.0056	0.003564	0.0056
5G2B6c	0.275	0.2701	0.00687	0.004379	0.00687
5G2B6d	0.375	0.5399	0.0192	0.01224	0.0192

Table 3- Final priority of watersheds based on compound

watershed	Linear parameters								Shape parameters				C_p	Final Priority
	R_b	F_s	L_g	T	D_d	H	R_{hp}	R_h	R_e	R_f	R_c	C_c		
5G2B2a	2	16	6	16	11	3	3	6	5	5	5	13	7.58	5
5G2B2b	1	17	2	12	16	8	9	9	11	11	12	6	9.5	9
5G2B2c	11	8	7	6	10	5	5	3	16	16	10	8	8.75	8
5G2B3a	10	12	8	11	14	1	2	2	7	7	6	12	7.67	6
5G2B3b	17	14	3	17	15	12	14	16	6	6	1	17	11.5	17
5G2B3c	7	13	1	10	17	15	16	15	4	4	11	7	10	10
5G2B4a	13	4	15	4	3	7	4	5	12	12	13	5	8.08	7
5G2B4b	14	1	17	1	1	9	6	4	9	9	15	3	7.42	4
5G2B4c	15	5	16	3	2	13	12	10	14	14	17	1	10.17	12
5G2B5a	16	10	4	13	13	14	17	17	2	2	2	16	10.5	14
5G2B5b	3	7	9	14	9	17	13	13	15	15	9	9	11.08	16
5G2B5c	9	11	11	9	7	11	11	12	13	13	14	4	10.42	13
5G2B5d	4	3	14	5	4	4	7	7	3	3	4	14	6	1
5G2B6a	12	9	5	7	12	16	15	14	10	10	16	2	10.67	15
5G2B6b	8	15	10	15	8	10	10	11	8	8	7	11	10.08	11
5G2B6c	6	6	12	8	6	6	8	8	1	1	3	15	6.67	2
5G2B6d	5	2	13	2	5	2	1	1	17	17	8	10	6.92	3

Conclusion

One of the purposes of fluvial Morphometry is to derive information in quantitative form about the geometry of the fluvial system that can be correlated with hydrologic information. Usually, morphometric analysis of drainage system is prerequisite to any hydrological study. The watersheds 5G2B4a, 5G2B4b, 5G2B5a, 5G2B5d, 5G2B6c and 5G2B6d show high drainage density due to the presence of impermeable sub surface material, sparse vegetation and high relief. Whereas remaining watersheds fall under low drainage density indicate the region has highly permeable subsoil and dense vegetation cover. The present study demonstrates the usefulness of GIS for morphometric analysis and prioritization of the watersheds of Shetrunji river basin, Gujarat. The ascending order of priority of watersheds according to compound parameter is 5G2B5d, 5G2B6c, 5G2B6d, 5G2B4b, 5G2B2a, 5G2B3a, 5G2B4a, 5G2B2c, 5G2B2b, 5G2B3c, 5G2B6b, 5G2B4c, 5G2B5c, 5G2B5a, 5G2B6a, 5G2B5b and 5G2B3b. The watershed 5G2B5d possess highest priority 1 which indicate greater degree of erosion and it becomes potential candidate for applying soil conservation measures, while the other watersheds with lower priorities are subjected to lower degree of erosion. Thus the morphometric properties determined for this basin as whole and for each watershed will be useful for the sound planning of water harvesting and groundwater recharge projects on watershed base.

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