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ORIGINAL ARTICLE

Morphometric Analysis for Sustainable Development of Watersheds Using Multisensor Satellite Data: A Case Study from Shiriya River Basin

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Abstract

Objectives: The goal of this research is to calculate, compare and analyze the morphometric drainage parameters of Shiriya River Basin (SRB), Kasaragod, Kerala, using DEMs acquired by different satellite sensors and topographic data (SOI toposheet) for sustainable watershed development. **Methods:** The Arc GIS 10.3.1 software was used to measure linear, relief, and areal aspects of morphometry. The input data used for deriving the drainage network of the SRB were SOI toposheet (1:50000 scale), SRTM DEM (90m), Cartosat, ASTER and ALOS PALSAR DEM of resolution 30 m each. The relative error percentage of basic parameters derived from DEMs concerning the toposheet is calculated. A groundwater potential map is prepared using weighted overlay analysis of thematic layers (geology, geomorphology, slope, drainage density, lineament density and depth to water level). **Findings:** Present study revealed that the parameters derived from SRTM DEM data are more similar to those derived from toposheet. Most of the parameters obtained from each input DEM are more or less equal, and the minor variation may be due to varied data collecting and processing methodologies used for DEM creation. SRB is characterized by 6 th order stream with a dendritic drainage pattern, which is elongated and less susceptible to soil erosion. SRB has an intermediate texture and is in a mature stage of geomorphic evolution. Inference from the ground water potential zonation map indicates that major portion of the SRB has moderate ground water potential. **Application/improvement:** The study would be a valuable source for identifying water recharge sites, basin modelling, and groundwater prospect mapping. **Novelty**:This research has attempted to compare and analyze the morphometric parameters' results from multisensor satellite data for sustainable watershed management. An attempt has been done to understand the relation between morphometric parameters and ground water potential of SRB using Groundwater potential zonation map.

Keywords: Drainage morphometry; Shiriya River basin; GIS; Karnataka; Kerala

1 Introduction

"The measuring and mathematical study of the shape of the earth's surface and the extents of its landforms is known as morphometry"[1]. Morphometric analysis has received much interest recently because of its application in different aspects like watershed delineation, Runoff modelling, soil erosion and flood susceptibility, groundwater map generation, natural resources management, and conservation[2]. In basin studies, numerous methodologies and techniques can be used to extract the Basin boundaries and drainage networks. While some researchers select traditional methods like topographical maps and field surveys to support their studies, others favour current approaches like GIS-produced digital elevation models (DEMs), digital surface models (DSMs), and remote-sensing techniques.

Several studies on morphometric analysis have been carried out in numerous basins of Kerala. Morphometric analysis of the Ithikkara river basin is studied using SRTM DEM by[3] using Basin-wise DEM-based Automated Morphometry (BaDAM) toolbox. Another study has been carried out in Kerala to identify the role of morphometric parameters in controlling the runoff efficiency of the ValakkayiTode watershed of the Valapattanam River[4]. Neotectonic evidence linked with the Achankovil shear zone is studied with the help of morphometric analysis and field investigations[5]. But the comparison of morphometric characteristics derived from two or more DEM datasets has only been made recently in Kerala in a few research.

There is a great demand for studying and assessing a drainage basin's physiographic features and hydrologic behaviour by utilizing geospatial datasets from various DEMs in recent years. As a result, there is a significant question about the accuracy and sensitivity of these datasets derived from various DEMs.The current study compares drainage features of the SRB derived from four different DEMs: ASTER 30 m, SRTM 90 m, CARTOSAT 30 m, and ALOS 30 m and Survey of India toposheet 1: 50000. and also calculate relative error percentages of DEM-derived morphometric parameters with toposheet.For the effective management of water resources of a basin, it is very crucial to know the water availability of that Basin. Hence groundwater potential zonation map was also created using the weighted overlay analysis. The reason for choosing this study location is that SRB is one of the minor river basins of the Kasaragod district, which has received less attention from other researchers. No literature regarding morphometry is available for reference in the SRB. So, it could be a primary guide for further study in the area to evaluate and manage the Basin's natural resources.

1.1 Study Area

SRB is one of the minor river basins of Northern Kerala. It is geographically located between latitudes 12°31'41.26" N - 12°45'15.98" N and longitude 74°55'26.73" E -75°20'55.74" E (Figure 1). The river's total length is about 65 km, 38 kilometers in the Kasaragod district of Kerala, and the remaining part is in the Dakshina Kannada district of Karnataka State. The river rises from the Anne Gundi Hills from the height of 270 m from the Mean Sea Level and joins the Kumbla backwaters. It finally empties into the Arabian sea. The total basin area of the river is 630 square kilometers; out of it, 290 square kilometers are in Kerala.

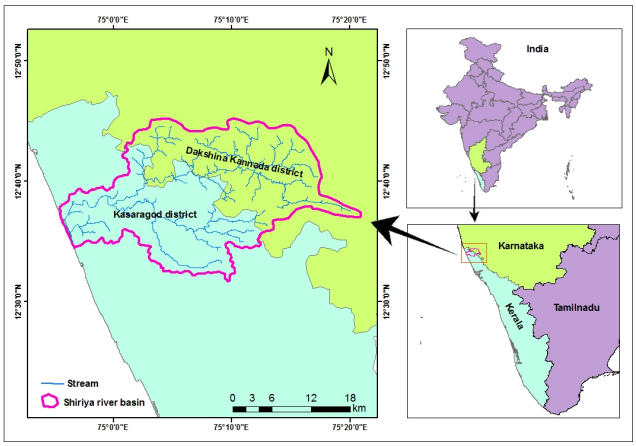

Fig 1. Study area's location map.

1.1.1 Geology

The major portion is enclosed by laterite overlying the peninsular gneiss in the study area. The laterite is a result of weathering of charnockite /Hornblende biotite gneiss. Small patches of syenite, dolerite, and recent tertiary/quarternary alluvial deposits like grit, sandstone, and clay with lignite intercalations are seen as part of the Warkalli formation at the mouth side of the river basin. Basic dykes are also present on the southeastern side of the study area. Some garnitiferous sillimanite gneiss/schist patches are located at the NW- SE side of the Basin. Granite intrusion is present on the southern side of the Basin. Patches of hornblende diopside granulite schist rocks are seen almost in the middle portion of the SRB.It has some lineaments, with NW-SE's primary trend (Figure 2).

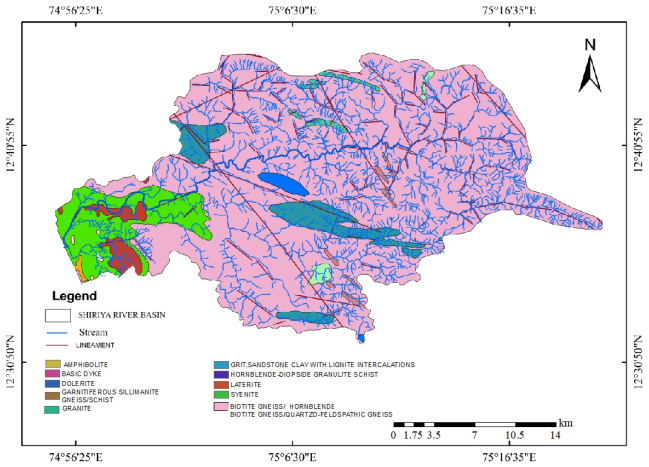

Fig 2. Study area's geology map.

2 Methodology

Morphometric analysis was carried out in this study using toposheet and GIS methodologies (Figure 3). The toposheets of the 1:50000 scale corresponding to the SRB were downloaded from the Nakshe portal (website) of the Survey of India (SOI). As a first step,georeferencing and the digitization of streams from the toposheets were done in Arc GIS 10.3.1 software. Each stream was digitized as a line feature with a unique Id and stream number. The method proposed by Strahler [6] is used to order the streams. The relief aspect of the Basin was assessed using contour values. The length of the digitized stream was calculated using Arc GIS 10.3.1 geometry calculation tool, and the attribute table was exported to Microsoft Excel for further calculations of morphometric parameters.

Initially, morphometric parameters are calculated from the toposheet. After that, digital elevation models were downloaded from Earth explorer (SRTM 90 m and ASTER 30 m), the Earth data portal of NASA (ALOS PALSAR 30 m) and the BHUVAN (CARTOSAT 30 m) web portal of ISRO, respectively (Table 1). Then, for a better comparison of morphometric parameters, each of the DEMs was resampled to the same resolution. Then, using the fill option of spatial analyst extension of the hydrology tool, all the four DEMs mentioned above were pre-processed to seal the voids. Then, each DEM was re-projected into Universal Transverse Mercator (zone 43N) projection for further analysis.

Table 1. Data sources used for the present study

Data	Resolution	Source
Toposheet	1:50000 scale	Nakshe portal of SOI
ALOS PALSAR DEM	30m	Earth data portal of NASA
SRTM DEM	90m	USGS earth explorer
CARTOSAT DEM	30m	Bhuvan web portal of ISRO
ASTER DEM	30m	USGS earth explorer

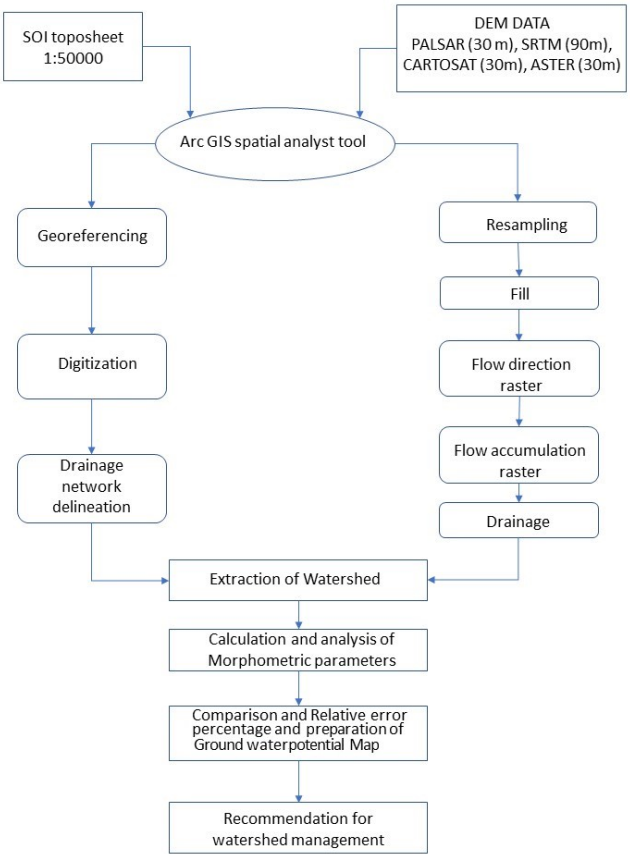

Fig 3. Methodology flow chart.

For generating a stream network from any DEM, specific steps must be followed in Arc GIS software. The initial step is finding the flow direction corresponding to individual cells. The next step is to determine the accumulated number of cells upstream, denoting watershed derived from fill DEM. The selection of threshold values is essential. Because of drainage density and stream frequency change with a threshold value. Then, stream identification was made based on the cells with a higher accumulation value than the threshold value. Stream order was measured using the hydrology option after generating streams using a typical threshold value for different DEMs (SRTM, ASTER, ALOS PALSAR and Cartosat). Finally, the generated stream was converted into a vector for further calculation with the help of the stream to feature option in the hydrology tool.

The drainage layer calculates fundamental aspects like the number and length of streams, area, perimeter and length of the Basin. Then, the remaining parameters of morphometry were calculated with the help of formulas (Table 2) in Microsoft excel.

Table 2. Morphometric parameters

Morphometric Parameters		Formula	
Linear	Stream order (u)	Hierarchical rank	Strahler [6]
	Stream length (Lu)	Total Length of Stream	Horton [7]
	Mean stream length (Lsm)	Lsm = Lu ÷ Nu	Horton, [7]
	Stream length ratio (RL)	Rl= Lu ÷ (Lu-1)	Horton [7]
	Bifurcation ratio (Rb)	Rb=Nu ÷ (Nu+ I)	Schumm [8]
	Rho coefficient (ρ)	ρ = RL ÷Rb	Horton [7]
Relief	Relief ratio (Rh)	Rh = Bh ÷Lb	Schumm [8]

Continued on next page

Table 2 continued

Areal	Ruggedness number (Rn)	Rn = Bh X Dd	Strahler [9]
	Drainage density (Dd)	Dd = L ÷ A	Horton [7]
	Stream frequency (Fs)	Fs = N÷ A	Horton [7]
	Drainage texture (T)	T = Dd x Fs	Smith [10]
	Form factor (Ff)	Ff = A÷Lb2	Horton [7]
	Circulatory ratio (Rc)	Rc=4×πA/P^2	Miller [11]
	Elongation ratio (Re)	Re = $\sqrt[1.128]{A/Lb}$	Schumm [8]
	Length of overland flow (Lg)	Lg=1÷(2Dd)	Horton [7]

Here Nu denotes total number of stream segments of order u, Nu+1is used for number of stream segments of next higher order, Lu-1 corresponds to length of stream segments of previous lower order, Lb, A and P is used for length, area and perimeter of the basin, value of π is 3.14

After calculating all the parameters of morphometry relative error percentage of basic parameters with respect to the toposheet was assessed.To manage the water resources of SRB, it is crucial to know water availability. Hence the groundwater potential map is generated using weightage overlay analysisin Arc GIS 10.3.1 software using different thematic layers(geology, geomorphology, drainage density, slope, lineament density and water level). The critical aspects of these thematic maps are described below. The ranks and weightages of parameters assigned for various classes of different layers are given in Table 3.The weightage and rank are given to a factor based on their influence rate on groundwater occurrence. The highest weightage is assigned for the factor that dominantly influences the groundwater occurrence and vice versa.

Table 3. Ranks and weightages of parameters assigned for various classes of different layers.

Theme	Source	Weight	Identified factors	Rank	Ground water potential	Overall weightage
Geomorphology	Toposheet SOI,1:50000	6	Denudational hills, Lower plateau	2	Poor	12
			Flood Plain,Valley,Islands	5	Very good	15
			Young coastal plain	4	Good	24
Lineament density (km/sq.km)	Bhukosh web portal	5	0-0.64	1	Very Poor	5
			0.65-1.3	3	Moderate	15
			1.4-1.9	4	Good	20
			2-2.5	5	Very good	25
Slope (Degree)	Prepared from SRTM DEM	3	0-5.38	5	Very good	15
			5.38-10.75	4	Good	12
			10.76-16.13	3	Moderate	9
			16.14-21.5	2	Poor	6
Geology	Toposheet SOI,1:50000	4	Laterite, Grit, Sandstone with clay intercalations	5	Very good	20
			Dolerite, Granite, Amphibolite, Basic dyke, Syenite	1	Very Poor	4
			Garnitiferous sillimanite gneiss/schist, Hornblende diopside granulite schist	2	Poor	8
			Biotite gneiss/Hornblende biotite gneiss	3	Moderate	12
Drainage density (km/sq.km)	Prepared from SRTM DEM	2	1.13-1.87	4	Good	8
			1.87-2.60	3	Moderate	6
			2.60-3.33	2	Poor	4
			3.33-4.07	1	Very poor	2
Depth to water level (m)	Collected from district ground water department, Kasaragod and Mangalore	1	4.66-8.58	4	Good	4
			8.58-12.49	3	Moderate	3
			12.49-16.4	2	Poor	2
			16.4-20.32	1	Very poor	1

3 Results

The outcome of the drainage basin analysis of the Shiriya river is discussed below.

3.1 Stream Order (u)

The present study revealed that the Shiriya river is a sixth-order stream with a chiefly dendritic drainage pattern (Figure 4) in which tributaries join the main stream in many directions resembling tree branches. This drainage pattern is typical in homogeneous terrain.

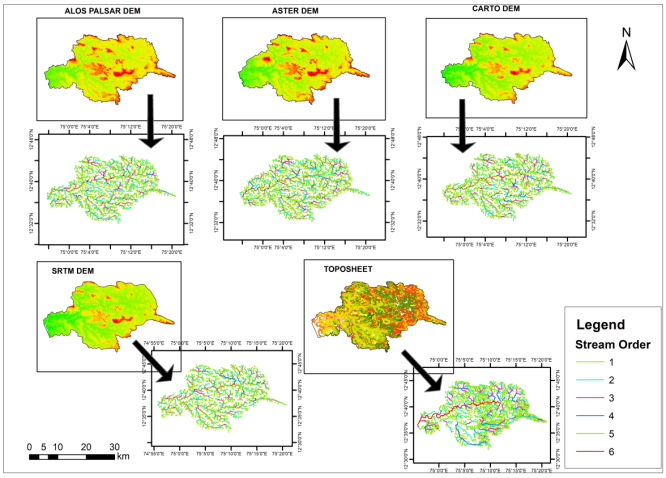

Fig 4. Drainage network map derived from ALOS PALSAR, ASTER, CARTO. SAT, SRTM, and Toposheet (SOI)DEMs.

3.2 Stream Number (Nu)

The total number of streams obtained from toposheet, PALSAR, SRTM, CARTO and ASTER DEM are 1759, 1723, 1730, 1722 and 1807, respectively (Table 4). Slight variation in a number of streams derived from different sources may be due to spatial change of elevation, vertical accuracy and raster grid size of the digital elevation model.

3.2 Stream Length (Lu)

Stream length and number of streams are directly proportional. A shorter stream indicates that the area has greater slopes and finer textures. Conversely, larger streams are characterized by flat or nearly flat areas[12]. The total length of streams derived from toposheet, PALSAR, SRTM, Cartosat and ASTER DEMs is 1289.53km.,1184.2km.,1118.86km.,1172.44km., and 1267.24km,respectively (Table 4).

Table 4. Linear parameters of SRB

Parameter	Toposheet	PALSAR	SRTM	Carto sat	ASTER
Basin area A (Sq. km)	620	623	614	614	634
Perimeter P (km)	157	176	145	175	176
Basin length Lb (km)	43.98	45.1	44.17	44.43	41.31
stream order (u)	Stream Number (Nu)				
1	1305	1338	1340	1327	1372
2	351	292	300	289	322
3	75	68	65	74	85
4	21	19	19	25	21
5	6	5	5	6	6

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Table 4 continued

6	1	1	1	1	1
Total	1759	1723	1730	1722	1807
	Stream Length (Lu) (km)				
1	726.95	614.54	579.01	617.52	655.89
2	250.51	263.2	251.15	243.27	290.82
3	126.6	155.8	143.3	155.1	170.4
4	82.44	64.06	62.87	77.92	72.31
5	58.37	45.42	46.05	40.99	39.65
6	44.66	41.14	36.81	37.62	38.21
Total	1289.53	1184.2	1118.86	1172.44	1267.24
Mean stream length (Lsm)	0.73	0.69	0.65	0.69	0.7
	Stream Length Ratio (RL)				
2nd/1st	0.34	0.43	0.43	0.39	0.44
3 rd/2nd	0.5	0.59	0.57	0.64	0.58
4th/3rd	0.65	0.41	0.44	0.5	0.42
5th/4th	0.71	0.71	0.73	0.53	0.54
5 th/6th	0.76	0.9	0.79	0.92	0.96
Mean stream length Ratio	0.59	0.61	0.59	0.59	0.59
	Bifurcation Ratio (Rb)				
1st/2nd	3.72	4.58	4.47	4.59	4.26
2nd/3rd	4.68	4.29	4.61	3.9	3.79
3rd/4th	3.57	3.58	3.42	2.96	4.05
4th/5th	3.5	3.8	3.8	4.17	3.5
5th/6th	6	5	5	6	6
Mean Bifurcation	4.29	4.25	4.26	4.32	4.32
Rho coefficient (ρ)	0.14	0.14	0.14	0.14	0.14

3.4 Mean Stream Length (Lsm)

It is the ratio between the overall length of a stream of a particular order (Lu) and the stream number (Nu) for that order. Lsm is a distinctive property of drainage networks and their components. Table 4 shows the average mean stream length derived from different sources.

3.5 Stream Length Ratio (RL

RL is the same for streams of all orders within a watershed. Any deviations from the constant value of the RL can be traced to differences in slope and topographical conditions[13]. Table 4 displays the RL values of the SRB.

3.6 Bifurcation Ratio (Rb)

The geology and lithology control the Rb of a basin. Usually, it falls between 3.0 to 5.0. The watershed that had undergone less structural disturbance has lower values of Rb (less than 3), and the one that had undergone high structural disturbance has higher Rb values[6,14]. Mean Rb values obtained from toposheet, PALSAR, SRTM, CARTO, and ASTER DEMs are 4.29, 4.25, 4.26, 4.32, and 4.32, respectively (Table 4). Mean Rb derived from CARTOSAT, ASTER is equal. These values indicate the elongated nature of the SRB, where geologic structures present in the Basin has a moderate impact on the drainage network development.

3.7 Rho Coefficient (ρ)

The Rho values of the study area calculated from different sources (toposheet, PALSAR, SRTM, Cartosat and ASTER DEM) are similar (0.14). This value indicates that the SRB has less storage capacity during a flood.

3.8 Relief (H)

H of the SRB obtained from SRTM DEM is 0.38 km, ASTER DEM has 0.39 km, PALSAR DEM shows 0.37 km, Cartosat DEM has 0.23km and 0.37 km from toposheet (Table 5).

3.9 Relief Ratio (Rh)

Rh depends upon the slope and geology of the Basin. Higher values of Rh link to the hilly region of the Basin, whereas lower values indicate the plain region. The Basin's relief ratio was obtained from toposheet-0.008, SRTM-0.009, PALSAR-0.008, Cartosat-0.005 and ASTER DEM-0.009 (Table 5).

Table 5. Relief and areal parameters of SRB, Kasaragod, Kerala.

Morphometric parameters	Toposheet	PALSAR	SRTM	CARTO	ASTER
Total relief (H) (km)	0.37	0.44	0.35	0.33	0.39
Relief ratio (Rh)	0.008	0.008	0.009	0.005	0.009
Ruggedness number (Rn)	0.82	0.70	0.69	0.44	0.78
Drainage density (Dd) (kms/km^2)	2.23	1.9	1.82	1.91	1.99
Stream frequency (Fs)	2.84	2.76	2.82	2.8	2.85
Drainage texture (Rt)	6.33	5.24	5.13	5.35	5.67
Form factor (Rf)	0.32	0.31	0.31	0.31	0.37
Circularity ratio (Rc)	0.31	0.25	0.37	0.25	0.25
Elongation ratio (Re)	0.60	0.62	0.63	0.63	0.68
Length of overland flow (Lg)	0.22	0.26	0.27	0.26	0.25

3.10 Ruggedness Number (Rn)

The ruggedness number of the SRB derived from the different DEMs shows slight variation. The obtained values are 0.82, 0.70, 0.69, 0.44, 0.78 for toposheet, PALSAR, SRTM, CARTO, ASTER DEMS respectively. These results show that the region is less vulnerable to soil erosion.

3.11 Drainage Density (Dd)

Dd is an indirect indicator of groundwater potential associated with surface overflow and permeability. The region with high surface runoff will have a higher drainage density; thus, infiltration will be lower. Dd of the SRB is 2.23 km/km^2 (Toposheet), 1.9 km/km^2 (ALOS PALSAR), 1.82 km/km^2 (SRTM), 1.91 km/km^2 (Cartosat) and 1.99 km/km^2 (ASTER). Drainage density less than 2 is grouped as low, 2-4 as moderate,4-6 as high and greater than 6 is treated as very high drainage density[15]. SRB belongs to a low to moderate drainage density category, which infers the presence of permeable subsoil with good vegetation cover[16].

3.12 Stream Frequency (Fs)

The lithology, as well as texture, influences it. The Fs for the Basin derived from different sources (Toposheet, PALSAR, SRTM, Cartosat and ASTER DEM) are 2.84, 2.76, 2.82, 2.80 and 2.85 individually. The low Fs values of the SRB may be credited to moderate infiltration capacity and small relief.

3.13 Drainage Texture (T)

T is controlled by the region's base rock, relief, and infiltration capability. Smith[10] divided drainage texture into five groups that are very coarse when the T is less than 2, coarse when T is between 2 and 4, moderate when the texture ranges from 4 - 6, fine when the texture ranges from 6 - 8, and very fine when it is greater than 8. Drainage texture of the watershed derived from Toposheet -6.33, PALSAR- 5.24, SRTM -5.13, CARTOSAT- 5.35 and ASTER DEM -5.67. It indicates that the Basin belongs to a moderate to fine drainage texture category.

3.14 Form Factor (Ff)

An exactly circular basin has an Ff value of 0.7854. For elongated basins, Ff values will be smaller, and it experiences longer duration flows with lower peaks. The higher value of the Ff indicates shorter duration flows of the more prominent peak. The Ff of the study area varies around 0.32 (Toposheet) and 0.31(PALSAR, SRTM and Cartosat DEM). ASTER DEM shows a slightly higher value (0.37). This result specifies the elongated nature of the SRB with a smaller peak flow that lasts longer.

3.15 Circularity Ratio (Rc)

Range[11] of Rc is 0.4 to 0.5. The Rc value of the SRB is tabulated in Table 5, which shows the Basin as elongated and made of permeable homogenous geologic materials.

3.16 Elongation Ratio (Re)

Re fluctuates from 0.6 to 1.0 along with the climate and geology of the region. Using the elongation ratio, it is possible to classify watersheds as most elongated if the value is less than 0.5, elongated when the value is between 0.5 and 0.7, least elongated if Re is 0.7-0.8, oval when Re is 0.8-0.9 and circular if the value is between 0.9 and 1.0. The studied Basin has a range of Re value (0.60 to 0.68), indicating that the SRB is elongated (Table 5).

3.17 Length of overland flow (Lg)

Lg impacts the hydrologic and physiographic evolution of a watershed. Lg of the Shiriya river basin obtained from toposheet, PALSAR, SRTM, Cartosat, and ASTER DEMs are 0.22, 0.26, 0.27, 0.26 and 0.25, respectively. It shows that the SRB has a gentle slope that is less susceptible to erosion and is in a mature stage of geomorphic evolution.

3.18 Ground water potential zonation map

Ground water potential map of SRB is shown in Figure 5. The area is classified into 5 zones based on ground water availability as very poor, poor, moderate, high and very high. Factors that facilitates the infiltration rate of the regions are characterised by valleys, low drainage density, high lineament density and low slope. Those regions characterised by these factors are the very high potential zone of the ground water.

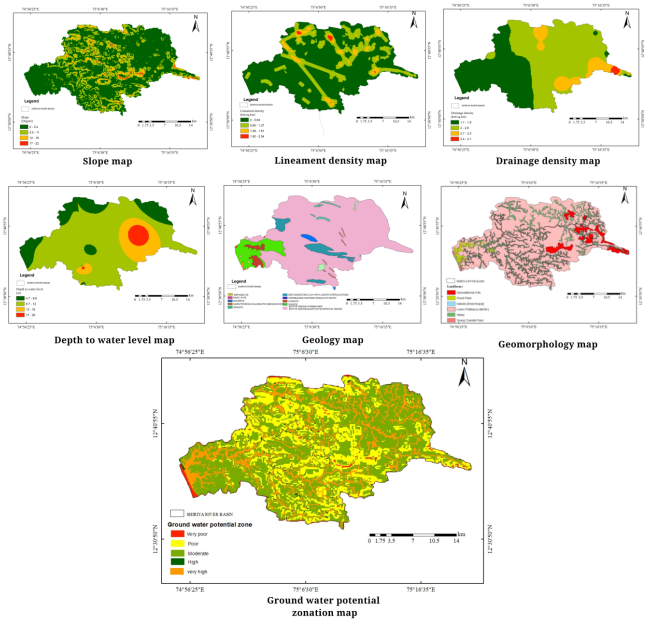

Fig 5. Ground water potential zones of SRB.

4 Discussion

The significant findings of the study are discussed below. The Basin is characterized by 6th order stream with a dendritic drainage pattern, which is elongated and less susceptible to soil erosion. The SRB has an intermediate texture and permeable homogenous geologic materials. The Basin has a gentle slope that is less susceptible to erosion and is in a mature stage of geomorphic evolution.

Many studies have been conducted in various basins regarding morphometric analysis from various data sources[17–19]. While comparing the results of parameters derived from different sources of DEMs with that of toposheet, in some of the research[18], it is observed that morphometric parameters derived from SRTM DEM data match with the toposheet and are suitable for drainage basin analysis. But in some research, when considering the vegetation cover along with different data sets, Basin with high vegetation, a morphometric parameter derived from SRTM DEM matches with that of toposheet and Basin with Low vegetation cover, parameters derived from AlOS DEM are more similar to that of toposheet[19].

This study also revealed that parameters derived from SRTM DEM match with the toposheet. Different DEMs used in the present study are more or less matched with the toposheet. Minor variation in drainage networks results because the flow direction grid is the primary determinant of drainage network derivation from DEMs. Variations in elevation and spatial resolution of the data may also impact the resultant networks.

To compare the five sets of data relative error percentage relative to the toposheet is calculated (Figure 6). Relative error percentage is the percentage of the difference between parameters derived from toposheet (X_{REF}) and corresponding parameters (X_{DEM}) derived from DEMs[20]. Here sign of the value is not considered.Additionally, morphometric attributes derived from the DEM were standardized to TOPO to understand the variability of distinct morphometric attributes (Figure 7).

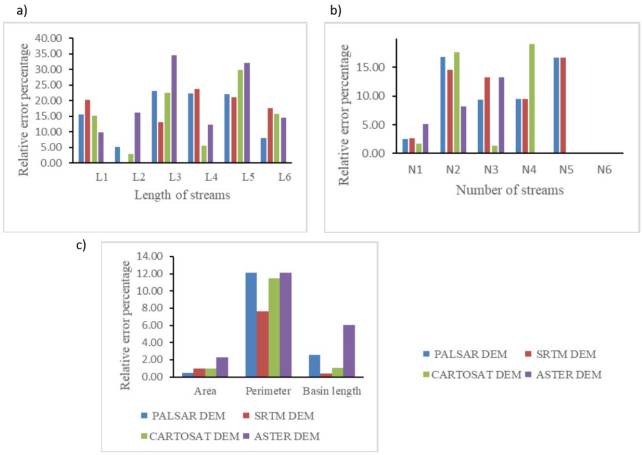

Fig 6. Relative error percentage of basic morphometric parameters

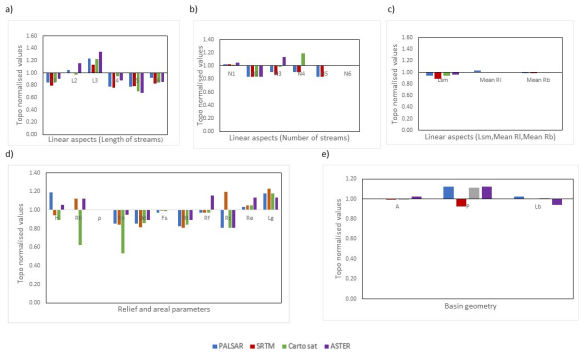

Fig 7. Morphometric attributes standardized to TOPO

Figure 6 clearly shows that among the basic parameters, the relative error percentage in the L2, L3, L5, perimeter and basin length is less in SRTM DEM data than in the other DEMs used in the study. Stream length shows relatively higher error in most data sets than stream numbers of individual streams. Among stream numbers, 5^{th} order shows significantly less error from reference data (toposheet). There is no relative error since the number of sixth-order streams is equal in all data sets. Among various parameters defining basin size (Area, Perimeter and Basin length), Perimeter displays a more significant error due to the irregularities of the basin boundary. From Figure 6, it is clear that SRTM DEM data shows a relatively less error percentage, and PALSAR DEM shows a higher error percentage than other sets of DEMs. Due to varied data collecting and processing methodologies for DEM creation, DEMs with equal spatial resolution can have distinct morphometry derivatives [21].

The SRB ground water potential zonation map is designed to the analysis of water resources of the region. It is evident from the map that there is a considerable water potential in the area of the basin where lineament density is high and drainage density is low. The spatial distribution map of depth to water level confirms it as well. Low depth to water level is seen in regions with high lineament density and vice versa. Average of ten years depth to waterlevel is considered in the present study.

5 Conclusion

This study aims to compare the morphometric parameters of the SRB based on the DEM type. This is an indirect method of determining the relative vertical accuracy of DEMs. Due to varied data collecting and processing methodologies for DEM creation, DEMs with identical spatial resolution can have distinct morphometric derivatives,which is understood from the study. The present investigation proposes that morphometric parameters(L2, L3, L5, Perimeter and Basin length) can be efficiently retrieved from SRTM DEM. The study concluded that the value of parameters derived from SRTM data is almost equal to that of parameters derived from the toposheet. SRTM DEM shows less relative error percentage with respect to toposheet. Hence, SRTM DEM data can be considered more suitable for the Shiriya River Basin morphometric analysis than other open-source DEMs employed in the present study. The SRB is morphometrically identified as sixth order, with a dendritic stream pattern. It is common in homogeneous terrain. Some structural or tectonic control in the SRB is clearly understood by the presence of lineaments and structural discontinuity. Elevation from different DEMs of the SRB indicates that it has low to moderate relief;as a result, there isn't much surface runoff. The Rn values of the SRB are 0.82, 0.70, 0.69, 0.44 and 0.78 for toposheet, PALSAR, SRTM, CARTO and ASTER DEMS respectively. The Rn values indicate the Basin's little runoff and high infiltration capacity. Dd of the SRB is 2.23 km/km^2 (Toposheet), 1.9 km/km^2 (ALOS PALSAR), 1.82 km/km^2(SRTM), 1.91 km/km^2 (Cartosat) and 1.99 km/km^2 (ASTER). Drainage texture (T) of the watershed derived from Toposheet -6.33, PALSAR-5.24, SRTM -5.13, CARTOSAT- 5.35 and ASTER DEM -5.67 are individually. The studied Basin has a Circularity ratio (Re) (0.60 to 0.68). All three parameters (Dd,T,Re) specify that the SRB is elongated with intermediate texture and permeable homogenous geologic materials. Hence the Basin has moderate infiltration capability, which has moderate groundwater potential. This result is also supported by the ground water potential zonation map. The output of the study can be very well used for the sustainable development of the SRB. Since no studies were available on the morphometry of the SRB, this work could be a primary guide for further study in the area.

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