Data Article

Prioritization of the micro-watersheds through morphometric analysis in the Vasishta Sub Basin of the Vellar River, Tamil Nadu using ASTER Digital Elevation Model (DEM) data

R. Poongodi *, S. Venkateswaran

Hydrogeology Lab, Department of Geology, Periyar University, Salem 636011, India

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A B S T R A C T

The dataset for this article includes morphological analysis of the level to which groundwater potential of the Vasishta River, Salem and Perambalur districts of Tamil Nadu. The method for the computation of morphometric parameters using data Digital Elevation Model (DEM) of the Vasishta River, is also prepared using SRTM (Shuttle Radar Topographic Mission) 90 m resolution data. Morphometric parameter linear, aerial and relief limits, such as a bifurcation ratio (Rb), Drainage density (Dd) Stream Frequency (Fs) Elongation ratio (Re), Length of overland flow (Lg), Relief ratio, ruggedness number (Rn) and Slope (sb) of Vasishta Sub Basin (VSB). The relief ratio indicates that the discharge should be considered high priority given to the following micro-watersheds numbers 9, 11, 15, 11 and 10. This data could be very useful to help with sustainable groundwater planning in any similar basins.

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Specification table

| Subject area                     | Earth Science                                      |
|---------------------------------|---------------------------------------------------|
| More specific subject area      | Environmental Science, morphometry                |

* Corresponding author.
E-mail address: poovijigeo@gmail.com (R. Poongodi).

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The morphometric parameters of all the sub basin were calculated using ArcGIS 9.3 Software. Determination of morphological factor that combines the Vasishta river.

The data includes morphometric analysis of the Vasishta River Salem and Perambalur districts of Tamil Nadu, The Survey of India toposheet (SOI) year 1973 and ASTER DEM data. Derived from mathematical formula, see Table 1 (the characteristic investigated are in Tables 2 and 3).

The quantitative morphometric analysis was carried out in seventeen micro-watersheds of VSB catchment using GIS technique for determining [1] the linear aspects, such as Stream order.

| S.No | Parameter                  | Formula                                      | Previous Work |
|------|----------------------------|----------------------------------------------|---------------|
| 1    | Area (A)                   | Area of the watershed                        | [2]           |
| 2    | Perimeter (P)              | The perimeter is the total length of the watershed boundary. | [7]           |
| 3    | Length (L_b)               | Maximum length of the watershed              | [2]           |
| 4    | Stream Order (N_u)         | Hierarchical rank                            | [3]           |
| 5    | Stream Length (L_u)        | Length of the stream                         | [2]           |
| 6    | Stream length ratio (RL)   | RL = L_u / L_u - 1                           | [4]           |
| 7    | Mean Stream Length Ratio (Lsm) | Lsm = L_u/N_u                          | [2]           |
| 8    | Bifurcation ratio (R_b)    | R_b = N_u/N (u + 1)                          | [5]           |
| 9    | Drainage density (D_d)     | D_d = \sum L_u / A                          | [2]           |
| 10   | Stream frequency (F_s)     | F_s = \sum N_u / A                          | [2]           |
| 11   | Elongation ratio (R_e)     | R_e = 1.128 \sqrt{A/L}                      | [5]           |
| 12   | Length of overflow (L_a)   | L_a = 1/2/2d                                | [2]           |
| 13   | Compactness coefficient (C_c) | C_c = 0.282P/\sqrt{A^{0.5}}              | [6]           |
| 14   | Basin relief (R)           | R = H - h                                   | [5]           |
| 15   | Ruggedness number (Rn)     | Rn = R x D_d                                | [5]           |
| Micro Watershed. No | A (km²) | P km | L | N | N1 | Lb (km) | Rₚ | Dₛ (Km/km²) | Fₛ | D₁ | Lₛ | R₁ | Rₑ | Bₑ | Cₑ |
|-------------------|---------|------|---|---|---|--------|----|------------|----|----|----|----|----|----|----|
| 1                 | 84.36   | 51.39| 693.01| 428 | 343 | 12.08 | 3.54 | 8.21 | 5.07 | 8.33 | 4.11 | 0.58 | 0.60 | 1.73 | 0.40 | 1.58 |
| 2                 | 84.36   | 46.95| 393.02| 203 | 159 | 12.38 | 3.31 | 4.66 | 2.41 | 4.32 | 2.33 | 0.55 | 0.60 | 1.82 | 0.48 | 1.44 |
| 3                 | 122.78  | 59.56| 623.75| 348 | 256 | 23.15 | 2.76 | 5.08 | 2.83 | 5.84 | 2.54 | 0.23 | 0.73 | 4.36 | 0.43 | 1.52 |
| 4                 | 144.53  | 70.75| 692.89| 380 | 284 | 20.99 | 3.32 | 4.79 | 2.63 | 5.37 | 2.40 | 0.33 | 0.79 | 3.05 | 0.36 | 1.66 |
| 5                 | 125.15  | 58.02| 394.09| 156 | 111 | 21.91 | 2.63 | 3.15 | 1.25 | 2.69 | 1.57 | 0.26 | 0.74 | 3.84 | 0.47 | 1.46 |
| 6                 | 133.59  | 63.82| 618.11| 321 | 241 | 23.09 | 2.76 | 4.63 | 2.40 | 5.03 | 2.31 | 0.25 | 0.76 | 3.99 | 0.41 | 1.56 |
| 7                 | 136.45  | 67.41| 412.63| 189 | 142 | 29.04 | 3.09 | 3.02 | 1.39 | 2.80 | 1.51 | 0.16 | 0.77 | 6.18 | 0.38 | 1.63 |
| 8                 | 107.77  | 61.09| 236.04| 116 | 92  | 25.86 | 3.38 | 2.19 | 1.08 | 1.90 | 1.10 | 0.16 | 0.68 | 6.21 | 0.36 | 1.66 |
| 9                 | 58.7    | 37.28| 493.32| 313 | 248 | 15.23 | 3.26 | 8.40 | 5.33 | 8.40 | 4.20 | 0.25 | 0.50 | 3.95 | 0.53 | 1.37 |
| 10                | 88.42   | 41.72| 543.61| 316 | 230 | 13.06 | 3.12 | 6.15 | 3.57 | 7.57 | 3.07 | 0.52 | 0.62 | 1.93 | 0.64 | 1.25 |
| 11                | 97.71   | 48.1 | 663.29| 396 | 307 | 15.88 | 3.35 | 6.79 | 4.05 | 8.23 | 3.39 | 0.39 | 0.65 | 2.58 | 0.53 | 1.37 |
| 12                | 83.03   | 41.28| 498.65| 275 | 211 | 11.31 | 3.09 | 6.01 | 3.31 | 6.66 | 3.00 | 0.65 | 0.60 | 1.54 | 0.61 | 1.28 |
| 13                | 74.57   | 42.72| 445.99| 248 | 195 | 12.8  | 3.08 | 5.98 | 3.33 | 5.81 | 2.99 | 0.46 | 0.57 | 2.20 | 0.51 | 1.40 |
| 14                | 32.27   | 32.97| 205.38| 115 | 89  | 11.8  | 2.09 | 6.36 | 3.56 | 3.49 | 3.18 | 0.23 | 0.37 | 4.31 | 0.37 | 1.64 |
| 15                | 36.26   | 30.63| 309.63| 185 | 144 | 11.74 | 2.97 | 8.54 | 5.10 | 5.62 | 4.27 | 0.26 | 0.40 | 3.80 | 0.42 | 1.54 |
| 16                | 40.95   | 33.77| 252.48| 139 | 107 | 11.12 | 2.30 | 6.17 | 3.39 | 4.12 | 3.08 | 0.33 | 0.42 | 3.02 | 0.45 | 1.49 |
| 17                | 319.88  | 198.3| 946.03| 426 | 319 | 65.21 | 2.59 | 2.96 | 1.33 | 2.15 | 1.48 | 0.08 | 1.18 | 13.29 | 0.10 | 3.13 |
Table 3
Micro Watersheds parameter of the VSB.

| Micro watershed No | No of stream orders | Total stream Numbers |
|---------------------|---------------------|----------------------|
|                     | 1st order           | 2nd order           | 3rd order           | 4th order           | 5th order           | 6th order           | 7th order           |                     |
| 1                   | 343                 | 68                  | 12                 | 4                  | 1                  | 0                  | 0                  | 428                 |
| 2                   | 159                 | 34                  | 7                  | 1                  | 0                  | 2                  | 0                  | 203                 |
| 3                   | 256                 | 69                  | 15                 | 5                  | 2                  | 1                  | 0                  | 348                 |
| 4                   | 284                 | 73                  | 17                 | 5                  | 1                  | 0                  | 0                  | 380                 |
| 5                   | 111                 | 33                  | 8                  | 3                  | 1                  | 0                  | 0                  | 156                 |
| 6                   | 241                 | 58                  | 16                 | 4                  | 2                  | 0                  | 0                  | 321                 |
| 7                   | 142                 | 36                  | 6                  | 4                  | 1                  | 0                  | 0                  | 189                 |
| 8                   | 92                  | 21                  | 2                  | 1                  | 0                  | 0                  | 0                  | 116                 |
| 9                   | 248                 | 51                  | 10                 | 3                  | 1                  | 0                  | 0                  | 313                 |
| 10                  | 230                 | 65                  | 16                 | 4                  | 1                  | 0                  | 0                  | 316                 |
| 11                  | 307                 | 68                  | 16                 | 4                  | 1                  | 0                  | 0                  | 396                 |
| 12                  | 211                 | 46                  | 13                 | 3                  | 1                  | 1                  | 0                  | 275                 |
| 13                  | 195                 | 36                  | 12                 | 4                  | 1                  | 0                  | 0                  | 248                 |
| 14                  | 89                  | 18                  | 4                  | 4                  | 0                  | 0                  | 0                  | 115                 |
| 15                  | 144                 | 32                  | 6                  | 2                  | 1                  | 1                  | 0                  | 185                 |
| 16                  | 107                 | 23                  | 6                  | 2                  | 0                  | 0                  | 0                  | 139                 |
| 17                  | 319                 | 75                  | 19                 | 4                  | 0                  | 0                  | 1                  | 426                 |

Fig. 1. The Base Map of the Vasishta Sub Basin.
Bifurcation ratio, Stream length and aerial aspects such as Stream order \((U)\), Stream length \((L_u)\), Mean Stream length \((L_{sm})\), Stream length ratio \((R_l)\), Bifurcation ratio \((R_b)\), Length of overland flow \((L_g)\), drainage density \((D_d)\), stream frequency \((F_s)\), Compactness coefficient \((C_c)\), form factor \((R_f)\), circulatory ratio \((R_c)\), and elongation ratio \((R_e)\), Relief ratio \((R_h)\), Ruggedness Number. The prioritization based on different morphometric factor is time-consuming.

2. Experimental design, methods and materials

Manual extraction of drainage network, assigning the stream order from a published Survey of India \((SOI)\) topographic map and from georeferenced satellite data for a large area is a time-consuming and tedious exercise. To overcome this problem, automatic extraction techniques were used for evaluating the morphometric factor of a basin. Extraction of River basin/watershed boundary and extraction of drainage/stream the Vasistha River basin using ASTER DEM in conjunction with geocodes standard false colour composite remote sensing satellite data.

A multi criteria assessment was used to assimilate all the thematic layers. Individual themes and their consistent groups allocated a knowledge base weightages given depending on their suitability to grip groundwater and their weightages calculated. The process of visually interpreting digitally enhanced imagery attempts to optimize the complementary abilities of the human mind and the computer.

**Fig. 2.** The Priority Map of the Vasistha Sub Basin.
2.1. Study area

The Vasistha River lies between 11° 24’0.347” and 11° 53’0.26496” N latitudes and 78° 13’55.211”E to 78° 58’9.969”E longitudes. The area was bounded by Toposheet numbers (58 I/5, 6, 7, 9, 10, 11, 12, 14, and 15) survey of India. Having scale of 1:50000. Toposheet published the year 1973. The Vasistha River study area lies in the Salem and Perambalur districts of Tamil Nadu comprises the part of Vellar River. The main river Vasishta originates from the southern slope of the Kalrayan hills and flows through kurchi, Belur, Pethanaickenpalayam, Attur, Pattuthurai, Thalaivasal, Aragalur, Sitheri, Villages of Salem and Perambalur districts of Tamil Nadu.

It covers an area of 1770.78 km², consisting of the Vasistha Nadi and Sweata Nadi, which drain two parallel valleys running east and west in Attur taluk. Vasistha River runs for a distance of 73 km in Salem, Perambalur and Cuddalore districts and drains into the Bay of Bengal. The climate of the Vasistha River area is mainly sub-tropical climate with moderate humidity and temperature. The VSB is underlaid by the Archaean crystalline rocks surrounded by denudation hills and structural hills. The Base map of the VSB is given in the Fig. 1.

3. Compound factor and ranking

Compound factor is calculated by summing all the ranks of linear, aerial and relief parameter, the shape parameter and then dividing by the number of parameter. From the group of these micro watersheds, highest rank was assigned to the micro watershed having the lowest compound factor and so on. Depending upon the value of compound factor, ranking to each micro watershed assigned in the micro-watershed no. 9 is given as a rank 1 with least compound factor value at 5.2 and it is followed by micro-watersheds no. 1 and 15 as second and third respectively. The values of compound factor and respective rank of all micro- watersheds. The Priority value of the VSB is given in the Fig. 2 and Table 4.

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Transparency document. Supplementary material

Transparency data associated with this article can be found in the online version at http://dx.doi.org/10.1016/j.dib.2018.08.197.

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