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# GEOMORPHOLOGICAL ANALYSIS FOR WATERSHED MANAGEMENT IN THE SELECTED OSMANABAD BASIN, MAHARASHTRA-PART OF INDIA.

**Devdatta K. Mokashi[#1], Vidula S. Sohoni[#2]**
[#1]Research Scholar, Bharati Vidyapeeth (Deemed to be University), College of Engineering Pune-411046,India
[#2]Principal, Bharati Vidyapeeth (Deemed to be University), College of Engineering Pune-411046,India
*Corresponding author Email: dev.mokashi@gmail.com

**Abstract:** The recent spurt in agricultural production, industrial and urban development by uneven distribution of rainfall in recent time, failure of monsoons has admired the irrecoverable stress on groundwater in the hard rock regions. Osmanbad district is having serious water scarity due to last several draughts as well as sometimes extensive flooding conditions due to unexpected dense rainfallthroughout the study region, this maybe due to climate change.Studies based on geomorphological analysis have shown vital results to enhance the new sites for water conservation both in surfacial and sub-surfacial form. The stream density, stream frequency and the bifurcation ratio has enhanced to go for detailing of the geomorphological studies. The investigated sites were not only referred with the geomorphological studies, but a prioritization of the sub-watersheds were determined. Groundwater prospects of the present study area depend on its geological structures, geomorphic features and their hydrological characters. Topographical map has been used to prepare the required thematic maps like geology, geomorphology, surface water bodies and drainage etc., eighteen geomorphic units have been derived from the integrated maps. Based on which the prioritization of the regions based on the classification of the drainage system has been made. In the present investigations of Osmanabad basin are coupled with the geo-spatial techniques with green potential zones of watershed for environmental management too. A huge data with individual unbiased are used for assigning the Weighted Sum Analysis (WSA) method was used to identify the critical, prioritized and green potential watershed in the Osmanabad basin.

**Keywords:** Drainage, Geomorphology, Groundwater, Watershed Prioritization, Weighted Sum Analysis etc.

## 1. Introduction

Groundwater is the primary source of fresh water in the Osmanabad study region. There has been a growing demand for fresh water in deomestic, agriculture and indutrial sectors of this region. In order to satisfy the demand, identification and delineation of potential zones are essential for which the various methods are available. The primary goal of this study is to calculate the basin morphometric characteristics of various parameters.The assessment of stream basins, the prioritisation of basins for soil and water conservation, and basin-level natural resource management are all found to benefit greatly from the quantitative study of morphometric parameters.

Osmanabad city as well as near by area is facing water scarity due to which industrial development is less as compare to others. The average rainfall in the study area is about is about 730 mm and temperature ranges between 20oC to 45oC. Inspite of encouraging rainfall the surface runoff is more in the area and this needs to be focused for storage in different type of structures to be constructed. From this area the small watershed of 728 sq.km area is selected for appropriate studies and the details are elaborated below.

## 2. Materials & Methods

The current research attempted to investigate the morphometric characteristics of the Osmanabad basin area.Three SOI OSM toposheets (E43J15, E43J16 and E43K4) of 1:50000 scales in paper format were usedas a reference and to prepare the basic map.. The order was given to each stream followed by (Strahler, 1957) stream ordering technique.The area falls between North 18°22'11.35"N, South 18°2'19.22"N, East 76°12'36.74"E and West 75°45'32.26"E as shown in Fig. 1.1.

The base of the present project was related to survey carried in study area. Geomorphological studies carried by digitization of the OSM maps will help in understanding the surface water flow and the sites for creation of new check dams or percolation tanks. It is done to analyse different drainage parameters, such as stream ordering, basin area, basin perimeter, drainage channel length, drainage density (Dd), drainage frequency, bifurcation ratio (Rb), texture ratio (T), circulating ratio (Rc), stream frequency (Fs), elongation ratio (Re), form factor (Rf), total basin relief (Rr), and relief ratio (Rh) of the basin.From the basin's beginning to the confluence with the Terna River, elevations in this area range from 560 metres to roughly 960 metres on the contour chart.The drainage map for the study region depicts parallel and dendritic drainage patterns. Parallel drainage patterns in basalts indicate the possibility of structural control, whereas gentle slopes, joints, and fractures control dendritic drainage patterns.

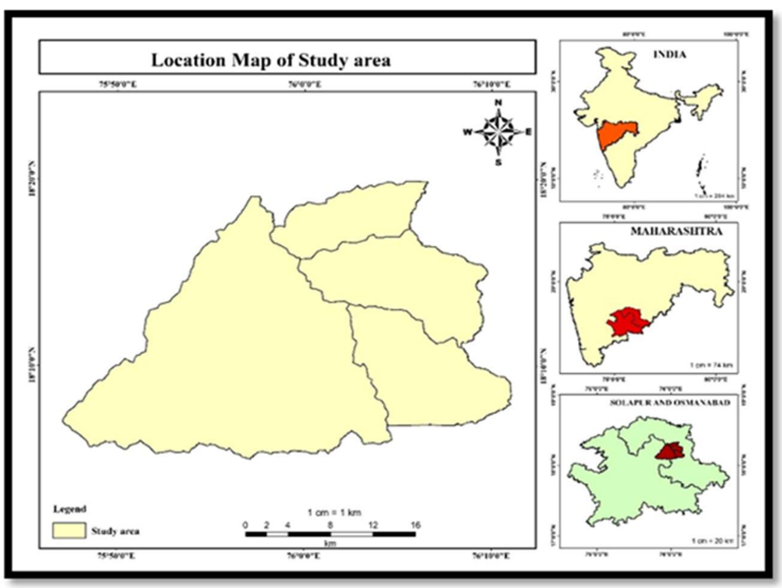


Fig. 1.1.: Map of Study area stating 4 distinctive basin form Osmanabad selected basin.

### 1.2 Geomorphological Studies:

Quantitative evaluation of the earth surface characteristics and any landform unit is the key role of morphometric analysis, for a basin analysis it is the most common technique adopted commonly. For open system of operation morphometry stands to be an ideal areal unit for interpretation and analysis of fluvially originated landforms from where they exhibits.

In contrast to aerial parameters, which have an inverse connection with soil erosion, linear and relief parameters directly affect it.Due to this, higher ranks are allocated to linear, relief parameters with lower ranks being given to aerial parameters.As a result, each sub-watershed is given a ranking based on the importance of morphometric parameters for erosion susceptibility, where a greater rank corresponds to a higher risk of soil erosion and vice versa.By calculating the mean of the ranks given to each of the sub-watershed's morphometric parameters, a compound value of rankings is then determined.Sub-watersheds are ranked from highest to lowest priority based on the obtained compound value, so a sub-watershed with a high value is given the greatest priority Watersheds are prioritised with the lowest compound value having the greatest priority and the opposite for the highest compound value.The approach taken in this research is depicted in Fig. 1.2.The current research area is defined using DEM data and the ArcGIS tool; this area is then divided into 4 sub-watersheds and given local names as shown in Figure 4.Drainage morphometry is a crucial parameter for comprehending any watershed's hydraulic behavior, including form, patterns, stream phase, permeability, stream health, and correlation with lithological features.Using the techniques and formulas listed in Table 1.2, the morphometric parameters of a particular Osmanabad basin were determined.

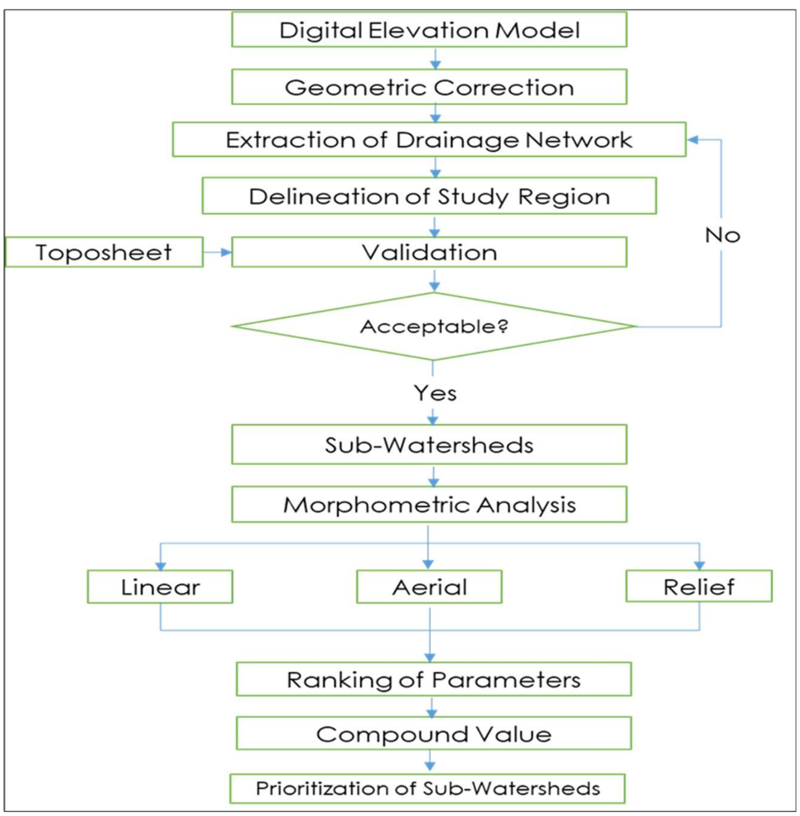


Fig. 1.2.: Flow chart of Methodology.

**Table 1.2: Formulae for computing morphometric parameters.**

| Sr. No. | Parameter | Formula | Reference |
|---|---|---|---|
| **Basic Parameters** | | | |
| | | | |
| 1 | Area (A) in $Km^2$ | GIS analysis / DEM | |
| 2 | Perimeter (P) in Km | GIS analysis / DEM | |
| 3 | Basin length ($L_b$) in Km | $L_b = 1.312A^{0.568}$ | Schumm |
| 4 | Mean basin width ($W_b$) in Km | $W_b = A/L_b$ | Horton |
| 5 | Stream order (U) | Hierarchical rank of streams using Strahler method | Strahler |
| 6 | Stream number ($N_u$) | $N_u = N_1+N_2+...+N_n$ | Horton |
| **Linear parameters** | | | |
| 7 | Stream length ($L_u$) | Length of the stream | Strahler |
| 8 | Mean stream length ($L_{sm}$ ) | $L_{sm} = L_u/N_u$ | Strahler |
| 9 | Stream length ratio ($L_{ur}$)<br>$L_u$ – Total stream length of order ‘u’<br>$L_u$-1 – Total stream length of next lower order | $L_{ur} = L_u/L_u-1$ | Strahler |
| 10 | Bifurcation ratio ($R_b$)<br>$N_u$= Total number stream segments of order ‘u’<br>$N_u$+1 = Total number stream segments of next higher order | $R_b = N_u/N_u+1$ | Strahler |
| 11 | Mean stream length ratio ($R_{slm}$) | $R_{slm} = \Sigma L_{ur}/n$ | Schumm |
| 12 | Mean bifurcation ratio ($R_{bm}$) | $R_{bm} = \Sigma R_b/n$ | Schumm |
| 13 | Rho coefficient ($\rho$) | $\rho = R_{slm}/R_{bm}$ | Horton |
| 14 | Drainage density ($D_d$) | $D_d = L_u/A$ | Horton |
| 15 | Stream frequency ($F_s$) | $F_s = \Sigma N_u/A$ | Horton |
| 16 | Drainage texture ($D_t$) | $Dt = N_u/P$ | Horton |
| 17 | Infiltration number ($I_f$ ) | $I_f = F_s * D_d$ | Faniran |
| 18 | Length of overland flow ($L_{of}$) | $L_{of} = 1/(2D_d)$ | Horton |
| 19 | Drainage intensity ($D_i$) | $D_i = F_s/D_d$ | Faniran |
| **Areal Parameters** | | | |
| 20 | Form factor ratio ($F_f$) | $F_f = A/L_b^2$ | Horton |
| 21 | Elongation ratio ($R_e$) | $R_e = (1.128A^{0.5})/L_b$ | Schumm |
| 22 | Circularity ratio ($R_c$) | $R_c = 12.57\ (A/P^2)$ | Miller |
| 23 | Compactness constant ($C_c$) | $C_c = 0.282\ P/A^{0.5}$ | Horton |
| 24 | Shape factor ($S_f$) | $S_f = L_b^2/A$ | Nooka Ratnam |
| **Relief parameters** | | | |
| 25 | Elevation of basin outlet (z) | GIS analysis / DEM | |
| 26 | Maximum elevation of the basin (Z) | GIS analysis / DEM | |
| 27 | Total basin relief (H) | $H = Z – z$ | Strahler |
| 28 | Relief ratio ($R_h$) | $R_h = H/L_b$ | Schumm |
| 29 | Relative relief ($R_r$) | $R_r = H/P$ | Schumm |
| 30 | Ruggedness number ($R_n$) | $R_n = H * D_d$ | Strahler |

Every watershed assessment uses the stream order (U) criterion, which is founded on the conventional practise of channel hierarchy.The first stream in the current investigations is one that has no tributaries, then two streams where first-order streams combine to create second-order streams, and so on. This is done in accordance with Strahler's method.The variations in stream order are primarily caused by the geographic and structural characteristics of the sub-watersheds in the particular Osmanabad basin.The watershed's greatest stream order is used to determine stream order.The study region in the current investigation has a maximum stream order of sixth order.Only the Hingoli sub-watershed contains the greatest order (6th order) stream.The total number of stream segments for each sequence is known as the stream number (Nu).According to Horton, the number of stream units of every other order from that of a reciprocal geometric sequence with the order unit.A greater number of first-order streams indicates higher permeability and erodible topography, and the stream number classifies the surface run-off features.In the present study region, Alni (166) has the lowest stream numbers showing less permeability and erodibility topographic nature and Hingoli (1085) has the highest number of streams showing erodible topographyin this present study area.

**Table 1.3: Stream orders and stream numbers of sub-watersheds.**

| Stream Order | Code of Watershed | | | |
|---|---|---|---|---|
| | Alni | Wagholi | Raibhur | Hingoli |
| Stream Number (Nu) | 166 | 221 | 401 | 1085 |
| 1st order (Nu1) | 135 | 186 | 279 | 824 |
| 2nd Order (Nu2) | 27 | 31 | 93 | 200 |
| 3rd Order (Nu3) | 3 | 3 | 24 | 46 |
| 4th Order (Nu4) | 1 | 1 | 4 | 12 |
| 5th Order (Nu5) | - | - | 1 | 2 |
| 6th Order (Nu6) | - | - | - | 1 |
| Stream Length (Lu) | 92.12 | 126.3 | 175.54 | 474.8 |
| 1st order (Lu1) | 40.2 | 66.4 | 87.72 | 187.5 |
| 2nd Order (Lu2) | 24.12 | 34.7 | 44.01 | 142.4 |
| 3rd Order (Lu3) | 17.1 | 16.3 | 20.71 | 87.1 |
| 4th Order (Lu4) | 10.7 | 8.9 | 14.2 | 32 |
| 5th Order (Lu5) | - | - | 8.9 | 18.1 |
| 6th Order (Lu6) | - | - | - | 7.7 |
| Bifurcation Ratio (Rb) | 17 | 19.33 | 16.88 | 20.30 |
| Nu1/Nu2 (Rb1) | 5 | 6 | 3 | 4.12 |
| Nu2/Nu3 (Rb2) | 9 | 10.33 | 3.88 | 4.35 |
| Nu3/Nu4 (Rb3) | 3 | 3 | 6 | 3.83 |
| Nu4/Nu5 (Rb4) | - | - | 4 | 6 |
| Nu5/Nu6 (Rb5) | - | - | - | 2 |
| Stream length ratio (Rl) | 1.93 | 1.54 | 2.28 | 2.73 |
| Lu2/Lu1 (Lb1) | 0.60 | 0.52 | 0.50 | 0.76 |
| Lu3/Lu2 (Lb2) | 0.71 | 0.47 | 0.47 | 0.61 |
| Lu4/Lu3 (Lb3) | 0.63 | 0.55 | 0.69 | 0.37 |
| Lu5/Lu4 (Lb4) | - | - | 0.63 | 0.57 |
| Lu6/Lu5 (Lb5) | - | - | - | 0.43 |

## 1.3Linear Parameters:

The length of all the stream segments in a basin, in a given sequence, is known as the stream length (Lu).Stream length, which reveals the runoff and sediment characteristics of the region, is among the most significant drainage characteristics.Calculating the total stream lengths of various orders makes use of the watershed geometry provided by GIS software.It shows the rivers' chronological progression and is extracted from their beginning to their conclusion.Table 1.8 highlights each stream order's stream duration.The findings show that the stream lengths in Hingoli (474.8 km) and Alni (92.12 km) are the highest and lowest, respectively.Stream length ratio (Lur) is the proportion of overall stream length to previous.In Table 1.4, the stream length ratios are emphasised.The differences in the sub-watersheds' stream segment ratios may have been impacted by topological restrictions and elevation variations.The ratio of the total number of streams of one order to the total number of streams of the next higher order is known as the bifurcation ratio (Rb).

The degree of convergence between rivers with various stream orders within a watershed is, in fact, a dimensionless feature.Low Rb values suggest a flat region with a working drainage system.The mean bifurcation ratios in this research were found to be highest in Wagholi (4.83) and lowest in Ruibhar and Hingoli (3.38).The ratio of the stream length to the bifurcation ratio is known as the rho parameter ().It is a crucial factor that determines the stream network's storage capability and the extent of drainage development. Here, Alni has higher Rho coefficient values than the remaining two sub-watersheds, Ruibhar and Hingoli, which have lesser values.This suggests that Wagholi has the largest storage capability which is useful for conservation of water.

**Table 1.4: Formulae for computing morphometric parameters for sub-watersheds.**

| Sr. No. | Parameter | Readings | | | |
|---|---|---|---|---|---|
| Basic Parameters | | | | | |
| | | Alni | Wagholi | Ruibhar | Hingoli |
| 1 | Area (A) in $Km^2$ | 63.59 | 116 | 115 | 433 |
| 2 | Perimeter (P) in Km | 38.9 | 52.7 | 49.4 | 105 |
| 3 | Basin length ($L_b$) in Km | 47.39 | 86.45 | 85.70 | 322.68 |
| 4 | Mean basin width ($W_b$) in Km | 1.34 | 1.34 | 1.34 | 1.34 |
| 5 | Stream order (U) | | | | |
| 6 | Stream number ($N_u$) | 166 | 221 | 401 | 1085 |
| Linear Parameters | | | | | |
| 7 | Stream length ($L_u$) | 92.12 | 126.3 | 175.54 | 474.8 |
| 8 | Mean stream length ($L_{sm}$ ) | 0.55 | 0.57 | 0.44 | 0.44 |
| 9 | Stream length ratio ($L_{ur}$) | | | | |
| 10 | Bifurcation ratio ($R_b$) | 5.7 | 6.4 | 4.3 | 4.1 |
| 11 | Mean stream length ratio ($R_{slm}$) | 4.40 | 3.95 | 2.82 | 3.71 |
| 12 | Mean bifurcation ratio ($R_{bm}$) | 4.25 | 4.83 | 3.38 | 3.38 |
| 13 | Rho coefficient ($\rho$) | 1.03 | 0.82 | 0.83 | 1.10 |
| 14 | Drainage density ($D_d$) | 1.45 | 1.09 | 1.53 | 1.10 |
| 15 | Stream frequency ($F_s$) | 2.61 | 1.91 | 3.49 | 2.51 |
| 16 | Drainage texture ($D_t$) | 4.27 | 4.19 | 8.12 | 10.33 |
| 17 | Infiltration number ($I_f$ ) | 3.78 | 2.07 | 5.32 | 2.75 |
| 18 | Length of overland flow ($L_{of}$) | 0.35 | 0.46 | 0.33 | 0.46 |
| 19 | Drainage intensity ($D_i$) | 1.80 | 1.75 | 2.28 | 2.29 |
| Areal Parameters | | | | | |
| 20 | Form factor ratio ($F_f$) | 0.03 | 0.02 | 0.02 | 0.00 |
| 21 | Elongation ratio ($R_e$) | 0.19 | 0.14 | 0.14 | 0.07 |
| 22 | Circularity ratio ($R_c$) | 0.53 | 0.53 | 0.59 | 0.49 |

| | | | | | |
|---|---|---|---|---|---|
| 23 | Compactness constant ($C_c$) | 1.38 | 1.38 | 1.30 | 1.42 |
| 24 | Shape factor ($S_f$) | 35.31 | 64.42 | 63.86 | 240.47 |
| Relief Parameters | | | | | |
| 25 | Elevation of basin outlet (z) | 646 | 634 | 622 | 485 |
| 26 | Maximum elevation of the basin (Z) | 713 | 714 | 707 | 713 |
| 27 | Total basin relief (H) | 67 | 80 | 85 | 228 |
| 28 | Relief ratio ($R_h$) | 1.41 | 0.93 | 0.99 | 0.71 |
| 29 | Relative relief ($R_r$) | 1.72 | 1.52 | 1.72 | 2.17 |
| 30 | Ruggedness number ($R_n$) | 97.06 | 87.10 | 129.75 | 250.01 |

The quantity used to measure stream frequency (Fs) is the sum of the number of streams present in a given region.To identify the indicators of various stages of landscape growth, it is categorised according to the type and quantity of precipitation, the composition of the rocks, and the penetrability of the soil in the region.The stream frequency in this area varies between 3.49 and 1.91, with Ruibhar having the greatest frequency and Wagholi having the lowest.Total stream length divided by basin size is known as drainage density (Dd).It displays the spacing and stream growth.It is affected by the rock, soil, climate, relief, channel head, density of the valley, source region, and the evolution of the landscape.In this research, drainage density ranges from 1.09 to 1.53 km 1, with the highest values in Wagholi and lowest at Ruibhar.The ratio of the number of tributaries to the basin's edge is known as the drainage texture (Dt).It represents the proportional distance between streams.The drainage texture in this research ranges from 4.19 to 10.33, with Hingoli having the highest value and Wagholi having the lowest.In relation to river systems, length of overland flow (Lof) is roughly equal to half of the inverse of drainage density.It is arguably one of the most important individual factors influencing a watershed's geographic and hydrological development.In this research, the length of the overland flow varied from 0.33 to 0.46, with Ruibhar having the shortest length and Wagholi and Hingoli having the longest.Stream velocity to drainage density is referred to as drainage intensity (Di).

Soil erosion is more likely to occur in a watershed with lower drainage density, drainage texture, and drainage intensity numbers.Ruibhar has the lowest drainage intensity value, ranging from 1.75 to 2.29, and Hingoli has the greatest value.An essential measure that shows infiltration rate and surface run-off is the infiltration number (If).It is calculated by increasing the drainage density by the stream frequency.The infiltration rate in this research ranges from 2.07 (Wagholi) to 5.32. (Ruibhar). Higher infiltration number values correspond to reduced infiltration rates and higher surface run-off.The circularity ratio (Rc) measures the proportion of a watershed's area to a circle whose circumference is equivalent to that of the basin's perimeter.Circularity ratio values can be used to determine the stage at which a watershed is developing; a lower value denotes a younger stage, a medium value, a mature stage, and a larger value, an older stage.The area of a circle whose width is equal to the watershed's area divided by the length of the basin is the elongation ratio (Re).Inversely, if the values are greater, it means the watershed is less elongated.According to this investigation's elongation ratio, which ranges from 0.07 to 0.19, the sub-watersheds are extended.

**1.4 Aerial Parameters:**

Watershed area to cube of basin length is expressed as the form factor ratio (Ff).The form factor typically falls between zero (extremely long curve) and unity. (round shape). All of the sub-watersheds in this research have more rounded shapes because the form factor ranges from 0.00 to 0.03 in this study.The ratio of a circle's perimeter and radius to a basin's area is known as the compactness coefficient (Cc). (Potter, 1957). It is unaffected by basin size and contingent on basin slope.The compactness coefficient varies from 1.30 to 1.42 in this study, with Hingoli having the highest and Ruibhar having the lowest value.The ratio of the square of the basin's length to the watershed's size is known as the shape factor (Sf).The amount of run-off and sediment is significantly influenced by this feature.Greater erosion susceptibility is indicated by lower numbers, and vice versa.Alni has a lower risk of erosion than Hingoli, which has a higher risk of erosion, according to the shape factor, which in the selective Osmanabad basin varies from 35.31 to 240.47.Drainage density is inversely proportional to the constant of channel upkeep (C).It describes the drainage region necessary to preserve a unit length of the waterway and is influenced by relief, geological, and climatic factors.Higher permeability and maturation to the old stage of the watershed are indicated by larger values of channel upkeep, and vice versa.

**1.5 Relief Parameters :**

The disparity between the highest and lowest elevations of the watershed is what is commonly referred to as total relief (H), also known as basin relief.It significantly alters the basin's slope, which in turn affects how susceptible the soil is to soil runoff.In this research, the basin relief varies between 67 and 228 metres.The watershed is said to be more vulnerable to erosion the higher the elevation of the basin.The relief ratio (Rh) measures how much relief there is relative to a basin's extent.The relief ratio, as opposed to total relief, provides a more accurate image of the relief aspects.The study's relief ratio varies from 0.71 m/km (Hingoli) to 1.41 m/km. (Alni). The basin is said to be larger if the relief ratio is higher.If the relief ratio is greater, the basin is considered to be larger.The ratio of a basin's relief to its circumference is called relative relief (Rr).The study's proportional relief varies from 1.52 m/km (Wagholi) to 2.17 m/km. (Hingoli). Higher relative elevation means more erosion, which suggests Hingoli is more prone to erosion.Basin elevation and drainage density combine to form the ruggedness number (Rn).More rugged topography will result from a higher rating for ruggedness, and vice versa.This study's ruggedness score varies from 87.10 (Wagholi) to 250.01. (Hingoli). Hingoli has a high chance of erosion because more rugged terrain leads to more erosion.

## 3. Result and Discussion

### 3.1 Prioritization of sub-watersheds

Prioritization is the process by which the sub-watersheds are organised in a hierarchy according to the need for treatment for watershed conservation; the watershed that requires more upkeep is given top priority ranking, and vice versa.In order to prioritise the sub-watersheds of the chosen Osmanabad basin based on their vulnerability to erosion, 18 morphometric parameters are taken into account based on the literature review.While there is an inverse connection with aerial parameters, there is a direct link between soil erosion and the linear and relief parameters.Higher values of the linear and relief parameters, such as mean stream length ratio, mean bifurcation ratio, drainage density, drainage texture, stream frequency, drainage intensity, length of overland flow, infiltration number, rho coefficient, basin relief, relief ratio, relative relief, and ruggedness number, will therefore increase the risk of soil erosion.The sub-watershed with the largest value of these parameters is therefore given the first rank, followed by the sub-watershed with the next largest value as the second rank, and so on, with the smallest value being assigned the last rank.

Higher soil erosion risk is associated with lesser values of the aerial factors, including the elongation ratio, circularity ratio, form factor, and compactness coefficient.As a result, the sub-watershed with the smallest value of these parameters is given the first rank, followed by the next lowest value and so on until the largest value is given the last rank.The compound number is calculated for each sub-watershed by averaging the ranks assigned to each parameter.The sub-watershed with the lowest compound value has the greatest priority, followed by the sub-watershed with the next-lowest value, and the sub-watershed with the largest compound value has the lowest priority of all.From the results, the highest priority regions indicate a greater quantity of runoffand soil erosion risks and hence it is critical to plan and execute watershed management practices for these regions.The findings of the prioritisation of the sub-watersheds using 18 morphometric parameters are displayed in Table 1.5, and Fig. 1.2 shows a map of the sub-watersheds along with their priority rankings.The Hingoli is comparatively more vulnerable to soil erosion and ground degradation, as shown in Table 1.5.The execution of soil and water conservation practises in these sub-watersheds needs more focus in order to guarantee sustainability.

While Wagholi and Alni are low priority and the Ruibhar are middle priority, they both show high compound values.The embraces for conserving soil and water ought to occur after the most important task for efficient watershed management.

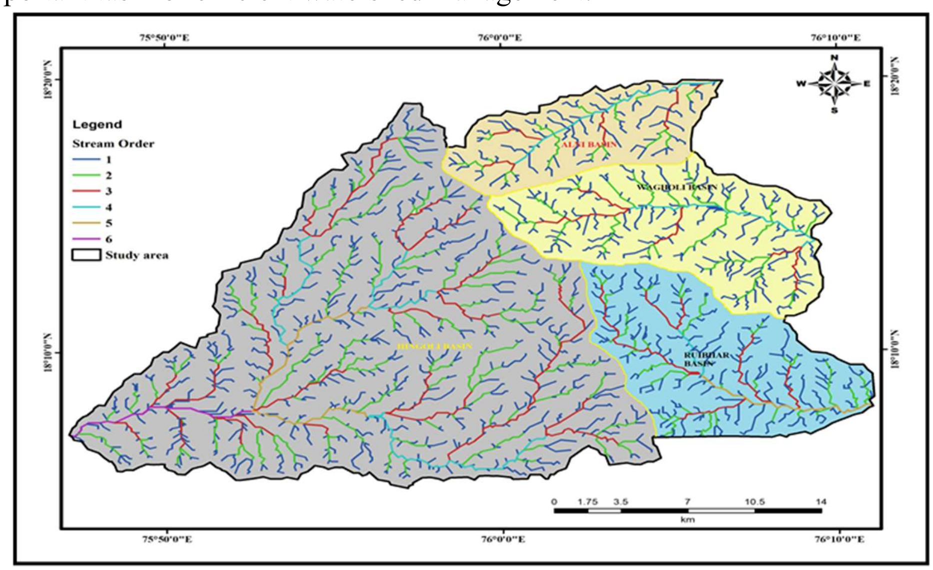


Fig. 1.3.:Prioritized sub-watershed map of selectivebasin.

**Table 1.5: Sub-Watershed prioritization of selected Osmanabad basin.**

| Sr. No. | Parameters | Morphometric Parameters Values and Ranks | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Alni | | Wagholi | | Ruibhar | | Hingoli | |
| 1 | Rslm | 4.4 | 4 | 3.95 | 3 | 2.82 | 1 | 3.71 | 2 |
| 2 | Rbm | 4.25 | 2 | 4.83 | 1 | 3.38 | 3 | 3.38 | 4 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 3 | P | 1.03 | 2 | 0.82 | 4 | 0.83 | 3 | 1.1 | 1 |
| 4 | Dd | 1.45 | 3 | 1.09 | 1 | 1.53 | 4 | 1.1 | 2 |
| 5 | Fs | 2.61 | 2 | 1.91 | 4 | 3.49 | 1 | 2.51 | 3 |
| 6 | Dt | 4.27 | 3 | 4.19 | 4 | 8.12 | 2 | 10.33 | 1 |
| 7 | If | 3.78 | 2 | 2.07 | 4 | 5.32 | 1 | 2.75 | 3 |
| 8 | Lof | 0.35 | 3 | 0.46 | 2 | 0.33 | 4 | 0.46 | 1 |
| 9 | Di | 1.8 | 1 | 1.75 | 2 | 2.28 | 4 | 2.29 | 3 |
| 10 | Ff | 0.03 | 2 | 0.02 | 4 | 0.02 | 3 | 0 | 1 |
| 11 | Re | 0.19 | 4 | 0.14 | 3 | 0.14 | 2 | 0.07 | 1 |
| 12 | Rc | 0.53 | 3 | 0.53 | 2 | 0.59 | 4 | 0.49 | 1 |
| 13 | Cc | 1.38 | 3 | 1.38 | 2 | 1.3 | 1 | 1.42 | 4 |
| 14 | Sf | 35.31 | 1 | 64.42 | 3 | 63.86 | 2 | 240.47 | 4 |
| 15 | H | 67 | 4 | 80 | 3 | 85 | 2 | 228 | 1 |
| 16 | Rh | 1.41 | 1 | 0.93 | 3 | 0.99 | 2 | 0.71 | 4 |
| 17 | Rr | 1.72 | 3 | 1.52 | 4 | 1.72 | 2 | 2.17 | 1 |
| 18 | Rn | 97.06 | 3 | 87.1 | 4 | 129.75 | 2 | 250.01 | 1 |
| 19 | Compound Value | 2.6 | | 2.9 | | 2.4 | | 2.1 | |
| | **Ranking =** | **2** | | **1** | | **3** | | **4** | |

The statistical analysis of the configuration of the earth's surface and shape with dimensions of landform provides the basefor investigation of maps for a geomorphological survey.The area, altitude, volume, slope, profile and texture of landforms comprise principal parameters of investigation. Dury (1952), Christian (1957) adopted different methods for landform analysis, theresults of the same are presented in the form of graphs, maps or statistical indices.

Groundwater prospects of the present study area depends on its geological structures, geomorphic features and their hydrological characters. Topographical map has been used to prepare the required thematic maps like geology, geomorphology, surface water bodies and drainage etc., eighteen geomorphic units have been derived from the integrated maps. Based on which the prioritization of the regions based on the classification of the drainage system has been made.

## 4. Conclusion

A basic method for depicting the physiological and quantitative characteristics of a watershed is morphometric analysis.Prioritizing sub-watersheds has previously been employed to protect natural resources.Instead of using conventional methods, GIS and remote sensing techniques can be used to assess morphometric characteristics.Thus, a quantitative morphometric analysis for the Osmanabad basin's sub-basins was carried out using geospatial technology.This research highlights the importance of promoting sub-watersheds based on watershed morphometric factors and their effect on soil erosion susceptibility.For each of the Osmanabad basin's eighteen morphometric characteristics, a sub-watershed, an evaluation is conducted.Using these parameters as a basis, the compound values technique is used to rank the sub-watersheds according to how susceptible they are to soil erosion, identifying the erosion-prone zones.According to the findings, there is a high risk of soil runoff in Alni and Wagholi, a medium risk in Ruibhar, and a low risk in Hingoli.The planning and implementation of soil and water conservation measures for efficient watershed management can be done in accordance with the last goal.Overall, the research shows that understanding drainage morphological characteristics is an important way to comprehend a watershed's characteristics and that it can be used to successfully designate sub-watersheds.The decision-making authorities can use the findings to allocate resources in the best possible ways to guarantee sustainability while lowering costs.The current study's findings and conclusions indicate that the area under investigation has undergone significant deformations in the past.According to geomorphological studies, stream channels from the area have important information to develop, so attention should be paid to them.According to the findings of the current studies, the regional watershed must be divided into sub-watersheds to promote the best possible management of the watershed.

## 5. Conflicts of Interest:

The authors declares that there is no conflict of interest regarding the publication of this paper.

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