



**“GEOMORPHIC ASSESSMENT OF THE DEV RIVER BASIN IN PARNER TEHSIL DIST. AHMEDNAGAR, MAHARASHTRA: USING GEOGRAPHICAL INFORMATION SYSTEM”**

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**Abstract:**

Drainage basins, catchments and sub catchments are the fundamental units for the management of land and water resources (Moore, et.al., 1994). The drainage basin is the fundamental unit for collection and distribution of water, solutes, and sediment in fluvial landscape (Ritter al. 1995), Horton. R. E. (1945), the first proposed a quantitative description of the drainage network and basin characteristics. The total length of Dev river channel is 26.3432 kms from its origin to confluence. The total area of the basin is 110.0245 Sq. km. and it falls in the Survey of India (SOI) Toposheet No, (47I/8, 47 J/5) for watershed boundary.

**Keywords: Physiography, Morphometry, GIS.**

**Article History**

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**1. Introduction:**

Major part of Maharashtra consists from lava, in other words entire region rests on a basaltic base. The Balaghat plateau covers Parner tehsil (Ahmednagar district) in the west and Ambejogai in the east from the catchments area for a number of Plateau Rivers. The Kukadi is one of the main sub-streams of the Ghod River. Dev River is major sub-tributary of Kukadi River. The Dev river basin is one of the south flowing river and left bank tributary of Kukadi River.

**2. Study Area:**

The study area includes the plateau region of the central part of Deccan plateau in Parner Tehsil. Study area is located at a latitudinal extent between 18° 56',58''N to 19° 6',53''N and a longitudinal extent between 74° 15',4'' E to 74° 24',42''E. Dev river is originated at 913 meters mean above the sea level (ASL) near Vadagaon Darya village. Dev is a major left bank tributary of Kukadi River. The total length of Dev river channel is 26.3432 kms form its origin to confluence. The total area of the basin is 110.0245 Sq. km.

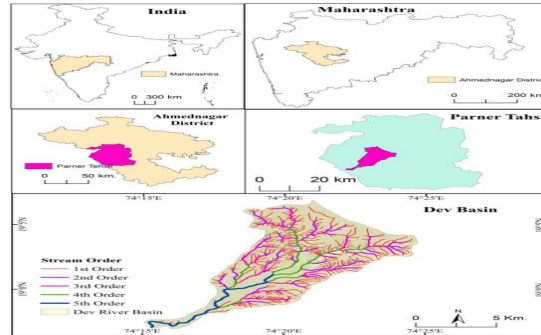


Fig.1. Location Map

### 3. Aim and objective:

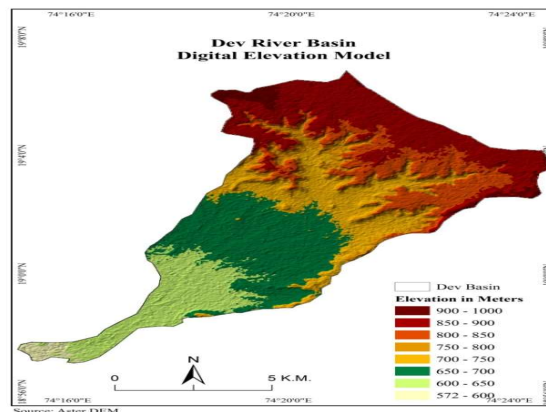
To analyze the physiographic and quantitative morphometric parameters (Linear, Areal, Relief aspects).

### 4. Data base and Methodology:

The present study is based on the survey of India Topo-sheets (47 I/8, 47J/5) at 1: 50000 scale map. It was scanned and georeferenced with appropriate projection parameters (Universal Transverse Mercator Projection, UTM, Zone 43 N and Datum GCS.WGS.1984). The survey of Indian Toposheet at the digitization work has been carried out for the entire analysis of the basin using GIS Software (ArcGIS 10.1). Stream, contour line, power line, road, forest, settlement, and well are digitized in Arc GIS (10.1) software and preparation of the physiographic map, DEM, contour map, slope map, aspect map. Contour interval of the Toposheet is 20 meters.

### 5. Physiography:

The topography of this region is rugged and highly dissected. Its altitude varies from the lowest height at 595 mts observed in confluence and highest of 913 m observed in the extreme northern part of the area.



### Fig.2. Physiographic Map

(Source: Based on Survey of India Toposheet)

#### 6. Geology:-

Geologically the entire area is covered by basaltic lava flows which is commonly referred to as the Deccan traps (Geological survey of India, 1970). Dev River is a part of Maharashtra Deccan Basaltic plateau with an average height of 913 meters above the sea level (ASL). The Basaltic lava of the Deccan traps is the only major geological formation here.

#### 7. Drainage:

Dev River is the sub-stream of the Kukadi River, from the point of view of peninsular drainage. The Dev River originates at vadagaon Darya 913 m from (ASL) and confluence to Kukadi near Devanwadi. The river basin comes in the rain shadow areas. The pattern of Dev River basin is tree shape drainage Patten.

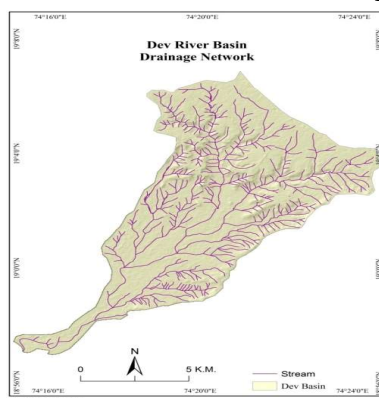


Fig.3. Drainage Network

(Source: Based on Survey of India Toposheet)

#### 8. Morphometry:

The quantitative expressions of various properties of the basin have been attempted by Horton's as well as Strahler method of stream ordering has been widely accepted:

1. The linear aspects were studied by using the methods of Horton (1945), Strahler (1953), Chorley (1957), (Schumm 1956).
2. The areal aspects were studied using the methods of Schumm (1956), Strahler (1956, 1968), Miller (1953) Chorley (1957), and Horton (1932).
3. The relief aspects were studied using the methods of Horton (1945), Broscoe (1959), Melton (1957), Schumm (1945), Strahler (1952) and Pareta (2004).

##### 8.1. Linear Aspects:

The network analysis is the most important basin parameter for changing the geomorphic environment of the region.

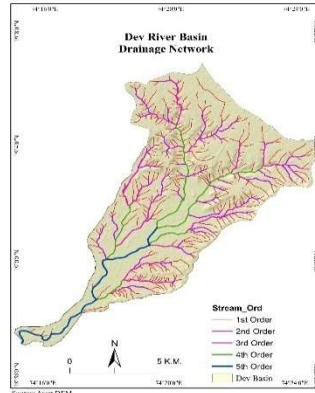
##### 8.1.1. Stream ordering (Su):

The present drainage network of the Dev river basin is classified into stream order as followed by Strahler (1952) stream ordering system.

The total numbers of streams (423) were identified in the present drainage basin, which are first, second, third, fourth, fifth order streams.

**8.1.2. Stream Number (Nu) :**

“The order wise total number of stream segments is known as the stream number”. The total number of the stream identified in this river basin is 423 out of which 326 in first order, 73 in second order, 18 in third order, 5 in fourth order.



**Fig. 4. Stream Orders of Dev River Basin**

**8.1.3. Bifurcation Ratio : (Rb):-**

The bifurcation ratio (Rb) is the ratio of number of stream segment of the given order 'Nu' to the number of the stream in the next higher order (Schumm, 1957).

Mathematical Formula:-

$$Rb = Nu / N(N+1)$$

Where,

Rb= Bifurcation Ratio

Nu=Number of the stream order in given order

Nu+1=Number of streams segment of the next higher order

The mean bifurcation ratio of the Dev River basin is 4.27 which indicates that bifurcation is normal in region. This is because of uniform climate, rock types and uniform history of geological development.

**8.1.4. Stream Length (Lu):**

The number of streams of various orders in sub watershed was counted and their lengths were measured with the help of GIS Software.

**Table No. 1.**

**Stream Order, Number of Stream, Stream Length, Percentage of stream Length.**

Su	Nu	Lu (Kms)	Lu (%)
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1	326	166.7101	<b>54.9445</b>
2	73	53.1178	<b>17.5066</b>
3	18	45.1028	<b>14.8650</b>
4	5	24.6253	<b>8.1160</b>
5	1	13.8592	<b>4.5677</b>

**Source:** Computed by Researcher.

### **8.1.6 Mean stream length (Lum):**

Mean stream length mean is the total length of stream of order divided by total numbers of segment in the order.

Mathematical Formula:

$$Lum = Lu / Nu$$

Where,

Lum=Mean stream Length.

Lu=Total stream length of order ‘u’.

Nu=Total number of stream segment of order ‘u’.

**Table No. 2.**

<b>Su</b>	<b>Nu</b>	<b>Lu(kms)</b>	<b>Lum (kms)</b>
1	326	166.7101	<b>0.5113</b>
2	73	53.1178	<b>0.7276</b>
3	18	45.1028	<b>2.5057</b>
4	5	24.6253	<b>4.9250</b>
5	1	13.8592	<b>13.8592</b>

**Source: Computed By Researcher.**

Where, Su-Stream Order, Nu-Number of Stream, Lu= Stream Length , Lum=Mean Stream Length. The positive relationship between the stream order and mean stream length as order increases the mean stream length also increase.

### **8.1.6. Stream Length Ratio: (Lur):-**

Horton’s (1945) states that the stream length ratio is the ratio of mean (Lu) of segment of order (su) to mean length of segment of the next lower order (Lu-1) which trends to be constant throughout the successive order of a basin.

**Table No: 3**

Su	Nu	Lu(Kms)	Lum	Lur	Lurm
1	326	166.7101	0.5113	-	2.41
2	73	53.1178	0.7276	1.4230	
3	18	45.1028	2.5057	3.4437	
4	5	24.6253	4.9250	1.9655	
5	1	13.8592	13.8592	2.8140	

Source: Computed by Researcher.

Where, Su-Stream Order, Nu-Number of Stream, Lu = Stream Length, Lum = Mean Stream Length, Lur = Stream length ratio, Lurm = Mean stream length ratio.

The mean stream length ratio is 2.41 and comparing with the first, second and fourth order is observed to be indicating that water flow in the source region is limited. Stream length ratio of the 3<sup>rd</sup> and 5<sup>th</sup> order stream is 3.4437 and 2.8140 which indicated moderate surface flow.

### 8. 1. 7. Length of main channel (C1):

Main channel length is computed by using ArcGIS software 10.1 versions is 26.3432 Kms.

### 8. 1. 8 Length of overland flow (Lg):

According to the Chorley (1969) the length of overland flow is considered as dominant hydrological and morphometric factor and is the mean horizontal length of flow path from the divided path to the stream in a first order basin.

Mathematical Formula:

$$LG=A/2Lu$$

Where,

Lg=Length of the overland flow in Km.

A= Area of the basin in sq.km.

Lu= Total Length of stream in Km.

The value of length of over land flow of Dev River is **0.1813 km** which represents the moderate relief in the basin.

## 8. 2. Areal aspects:

**8. 2. 1. Basin Perimeter (P):**The basin perimeter (p) is the total length of the drainage basin boundary enclosing its area. The basin perimeter of the Dev basin is 60.1306 km measured by the topographical map.

**8. 2. 2. Stream Frequency (Fs):**Horton (1932), Stream Frequency or channel frequency (Fs) is the total number of stream segments of all order per unit area.

Mathematical Formula:

$$Fs=Nu/A$$

Where,

Fs= Stream Frequency.

Nu= Number of stream Segment.

A=Area of basin in sq.km. The stream frequency of Dev River basin is 3.84 Sq. Km. The value of stream frequency indicates a moderate relief and less run off basin.

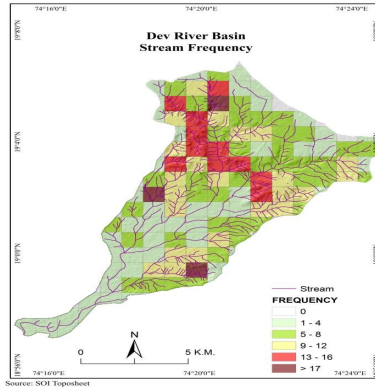


Fig. 4. Stream frequency Map

**8.2.3. Drainage Density (Dd):**According to Horton (1932) drainage density gives mean length of stream within a basin per unit area and it is obtained by dividing the total stream length (L) by the total basin area (A).

Mathematical Formula: Drainage Density (Dd)

$$Dd= Lu/A$$

Where,

Dd= Drainage Density in Km /km<sup>2</sup>

Lu= the total length cumulated for each stream order in km.

A= The total area of the basin in sq. km.

The drainage density of Dev river basin is 2.7577 Km/Km<sup>2</sup> which indicates a low numbers of streams per unit area, dense vegetation, high soil infiltration and permeability.

**8. 2. 4. Length of the basin (Lb):**-According to Schumm (1956) the basin length (Lb) is defined as the longest dimension of the basin parallel to the principal drainage line. The length of the basin is 19. 6642 kms of the Dev basin from source to mouth.

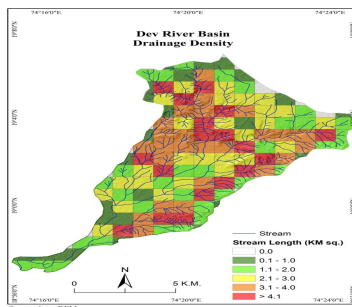


Fig. 6 Drainage Density Map

**8.2.5. Area of basin (A):**The drainage basin is one of the important parameter like stream number, length of stream etc. the drainage basin is computed with the help of ArcGIS 10.1 software is 110.0245 sq.km

**8.2.6. Form Factor (Rf):** According to Horton (1945) is the ratio between the basin area and square of the basin length form factor represents the erosional potential of the catchment area.

Mathematical Formula:

Where,

$$Rf = A / Lb^2$$

Rf = Form factor

A = Area of the drainage basin in sq.km

Lb = length of basin in km.

The form factor value of Dev river basin is .2845 which indicated the drainage basin less elongated shape.

**8.2.7. Circulatory Ratio (Rc):** Circulatory ratio is defined by Miller (1953), the ratio of the area of a basin to the area of a circle having the same circumference as the perimeter of the basin. The sub watersheds have an index of less than 0.50 indicating that the basin is more elongated shape.

Mathematical Formula:-

$$Rc = 4IA/P^2$$

Where,

Rc = Circulatory Ratio.

A = Area of the basin in sq.km.

P = perimeter of the basin in km.

$\Pi = 3.14$

The circulatory ratio of Dev river basin is 0.3820

**8.2.8. Infiltration Number (If):** Infiltration ratio (If) of watershed is defined as the product of drainage density and stream frequency. It is given as idea about the infiltration characteristics of the watershed. The higher infiltration number (If) the lower will be the infiltration and higher the run-off of the basin. The lower the infiltration number (If) the higher will be infiltration and lower the runoff of the basin.

Mathematical Formula: (Faniran, 1968)

$$If = Fs * Dd$$

Where,

If = Infiltration Number.

Fs = Stream Frequency.

Dd = Drainage Density.

Infiltration Number of Dev river basin is =10.6019

### 8.3. Relief Aspects:

**8.3.1. Relative Relief (Rhp)** "The relative relief has shown the difference between the maximum elevation and minimum elevation of the area".

Mathematical Formula:

$$(Rhp) = Z - z$$

Where,



Z= Highest Elevation in the Basin.

z= Lowest Elevation in the Basin.

Rhp= 913m -595m

The relative relief of Dev river basin is 318 m which indicated as the moderate relative relief.

**8. 3. 2. Absolute Relief:** Absolute relief means the highest point on the basin mean above the sea level (MSL).

The absolute relief of Dev river basin is 913 m in height.

**8. 3. 3. Ruggedness Number (Rn):**Ruggedness number is the product of the basin relief and the drainage density and usefully combines slope steepness with its length (Strahler, 1968).

Mathematical Formula,

$$Rn= H *Dd$$

Where,

Rn = Ruggedness Number.

H = Total Basin Relief.

Dd= Drainage Density

The Ruggedness Number of Dev River Basin is = 876.9486 which is indicated the relief and drainage density is low.

**8. 3. 5. Slope analysis :-**The contributions made by Rich (1916),Wentworth (1930),Robinson (1948), Miller (1960), Pity (1969), Smith (1939), Elves (1965) have a remarkable impact on slope geomorphology and various methods of representing the slope.

The present study based on the Wentworth (1930) method to analyse slope geomorphology of Dev River Basin.

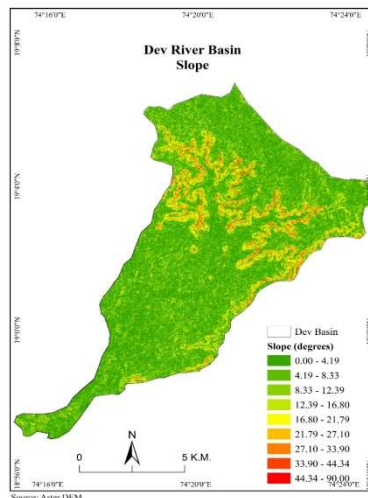


Fig. 7. Slope Map

**8. 3. 6. Drainage pattern (D<sub>p</sub>):**Drainage pattern means the 'Form' (Geometrical Forms) of the drainage systems and the spatial arrangement of streams in a particular locality or region. The Drainage Patterns of Dev basins are

included in fifth order stream. The dendritic pattern of drainage in general is typical of homogeneous crystalline rocks.

**8. 3. 8 Dissection Index (Dis)**Dissection Index (Dis) is a parameter implying the degree of dissection or vertical erosion and expounds the stage of terrain or landscape development in any given physiographic region or watershed (Singh and Dubey 1994).

Mathematical Formula,

$$Di = \frac{H}{Ra}$$

Where,

Di= Dissection Index

H = Relative Relief.

Ra= Absolut Relief.

The Dissection Index value of Dev river basin is 0.34 which indicates that the watershed is moderately dissected.

#### **Result and Discussion: -**

The total length of Dev river channel is 26.3432 kms from its origin to confluence. The total area of the basin is 110.0245 Sq. km. and it falls in the Survey of India (SOI) Toposheet No, (47I/8, 47 J/5) for watershed boundary. The total numbers of streams (423) were identified in the present drainage basin, which are first, second, third, fourth, fifth order streams. The mean bifurcation ratio of the Dev River basin is 4.27 which indicates that bifurcation is normal in region. The drainage density of Dev river basin is 2.7577 Km/Km<sup>2</sup> which indicates a low numbers of streams per unit area, dense vegetation, high soil infiltration and permeability. The relative relief of Dev river basin is 318 m which indicated as the moderate relative relief.

#### **Conclusion:**

The present paper attempt the geomorphic assessment of dev river basin using geographical information system. The study area includes the plateau region of the central part of the Deccan plateau in parner tehsil .The geologically the entire area is covered by basaltic lava flows which is commonly referred as the Deccan traps. The dev river is the sub-stream of the kukadi river. The quantitative morphometric analysis of dev river basin. In dev river basin characterized uniform climate, rock types, and uniform history of geological development. The geomorphic analysis of dev river using GIS Technique.

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