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Drainage Characteristics of Arunavati River Basin Dhule District (M.S.)
And Badwani District (M.P)

Girase B.N.
Arts college Bamkhed Tal: Shahada District: - Nandurbar (M.S.)
Patil Y.V.
Principal, Kisan College Parola. District: - Jalgoan (M.S.)

Abstract:
The study presented here was undertaken to determine the drainage characteristics of Arunavati basin using the topographical maps on a scale of 1:50000. The total area of Arunavati basin is 738.11 Sq. kms and it is divided into 7 sub basin for the analysis. The drainage pattern of the basin is dendritic type and it is a VII order stream. The drainage density of the basin 2.59 Sq Kms mean bifurcation ratio of Arunavati basin is 3.73. The Length ratio range from 3.8 to 4.8. The elongation ratio of the basin is 0.311 means that the basin is an irregular shape. The study reveals that the drainage area of the basin is passing through early mature stage of the fluvial geomorphic cycle.

Keywords: Stream Number, Stream Length, Length Ratio, Drainage Density, Texture, Bifurcation ratio of Arunavati Basin.

Introduction:
Arunavati basin being a land area of geohydrological importance. It suffers from water problem, soil erosion, and vegetation loss and land degradation. In order to prepare a comprehensive watershed development plan it becomes imperatively necessary to understand the topography, erosion status and drainage pattern of the region. The Arunavati basin lies in the Dhule District (M.S) and Badwani District (M.P) The topography of the basin is undulating and slope is moderate to steep. The area suffers from the absence of perennial surface water resources in rainy season, rendering the ground water potential limited in the basin area. In this paper an attempt has been made to study the drainage characteristics of Arunavati basin using the topographical maps and field visits.
Study Area:

The Arunavati River is north bank tributary of the river Tapi that rises from satpuda ranges in the slopes of inner satpuda ranges at height of 650 meters from the sea level near Jhirpan village in Madhya Pradesh. It flows in southwesterly it covers area of 738.11 sq.kms which lies between 21°18' N to 21°37'N latitude and 74°49' E to 75°13' E longitude. It travels about 69.5 kms from its source to mouth. It begins at Sendwa Tahasil in Madhya Pradesh and meets the river Tapi at Vanaval Village in Shirpur Tahasil of Dhule district. The survey of Indian Toposheets number 46 0/2, 46 0/3, 46 K/14, 46 K/15 are used for present study.(fig no-1)

Geology:

The geological formations met within the district are alluvium (Recent Period) and Deccan basalt (Eocene period). The close to Mesozoic Era was marked by out pouring of voluminous lava which spread over vast area. The flows are called 'Trap' because of step like appearance of their out crops a major part of district is occupied by these traps flows. These volcanic rocks have considerable thickness of several meters. They are compact and hard which are grouped into vasicular and nonvasicular varieties. A belt of alluvium covered land found on the bank of Tapi River throughout the district. The alluvium thins out west world. The alluvium layers are composed of radish and brownish clay with interaction of gravel and Kankar. Geologically the region is homogenous Deccan trap covers almost the study region. The Tapi Valley proper and the Valley of her tributaries are covered by the alluvium. The alluvium layers are much thicker and wider on the west while they thin out on the east.

Climate:

The general climate of Arunavati basin is semi-arid in nature. The Temperature reaches high in the month of May and it is low in the month of December after reaching maximum in the month of
May it decreases gradually from July and reaches minimum in the month of December. The relative humidity shows seasonal variations generally fluctuating with rainfall and temperature apart from the diurnal variations. The relative humidity is more during monsoon and winter period due to increase in rainfall and decrease in temperature. The relative humidity is less in summer due to combined effect of high temperature and low rainfall. The Arunavati basin receives an average annual rainfall with significant seasonal variations usually the region receives its first spell of rainfall from the pre monsoonal convectional showers in the month of October and November.

**Database and Methodology:**

The morphometric analysis of Arunavati basin has been based on the SOI topographical maps on 1: 50000 scale. The quantitative analysis of the morphometric characteristics of the basin include stream orders, stream numbers, stream lengths, bifurcation ratio, basin circularity, drainage density, drainage frequency, relief ratio etc. The geomorphic stage of development of the area was determined on the basis of hypsometric integrals.

**Table No. 1 Morphometric Parameters of Arunavati Basin.**

<table>
<thead>
<tr>
<th>No.</th>
<th>Nala</th>
<th>Length (km)</th>
<th>Width (km)</th>
<th>Bifurcation Ratio</th>
<th>Circularty</th>
<th>Drainage Density</th>
<th>Drainage Frequency</th>
<th>Relief Ratio</th>
<th>Area (sq. km)</th>
</tr>
</thead>
<tbody>
<tr>
<td>01</td>
<td>Ambad nala</td>
<td>128</td>
<td>3.98</td>
<td>40.5</td>
<td>0.0780</td>
<td>0.22</td>
<td>0.32830</td>
<td></td>
<td></td>
</tr>
<tr>
<td>02</td>
<td>Chondi nala</td>
<td>90</td>
<td>3.76</td>
<td>18</td>
<td>0.2777</td>
<td>0.42</td>
<td>0.55857</td>
<td></td>
<td></td>
</tr>
<tr>
<td>03</td>
<td>Chul nala</td>
<td>118</td>
<td>2.51</td>
<td>18.5</td>
<td>0.3447</td>
<td>0.46</td>
<td>0.5484</td>
<td></td>
<td></td>
</tr>
<tr>
<td>04</td>
<td>Kunjal nala</td>
<td>74</td>
<td>2.89</td>
<td>14.5</td>
<td>0.3519</td>
<td>0.47</td>
<td>0.5272</td>
<td></td>
<td></td>
</tr>
<tr>
<td>05</td>
<td>Asrapani</td>
<td>26</td>
<td>4.26</td>
<td>9.0</td>
<td>0.3209</td>
<td>0.45</td>
<td>0.5673</td>
<td></td>
<td></td>
</tr>
<tr>
<td>06</td>
<td>Khambale</td>
<td>29</td>
<td>3.75</td>
<td>9.5</td>
<td>0.3213</td>
<td>0.45</td>
<td>0.7530</td>
<td></td>
<td></td>
</tr>
<tr>
<td>07</td>
<td>Jhirbavi nala</td>
<td>114</td>
<td>4.78</td>
<td>22.5</td>
<td>0.2251</td>
<td>0.37</td>
<td>0.5508</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Arunavati Basin(Total)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>08</td>
<td></td>
<td>738.11</td>
<td>3.41</td>
<td>69.5</td>
<td>0.1528</td>
<td>0.311</td>
<td>0.33159</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Result and Discussion:**

The total area of arunavati basin is 738.11 Sq.Kms and it is divided into seven sub basin for analysis. The area of these seven sub basins are 128, 90, 118, 74, 26, 29, 114 and 159 sq km. The drainage pattern of Arunavati river basin is dendritic in nature which is commonly found in Deccan basalt area. (Fig No.2)

**Stream Order (u)**

The streams of the Arunavati river basin have been ranked according to the strahler (1964) stream ordering system and the number of streams of each segment (Nu) of the order (u) is given in the Table no. 2. It is obvious that the total number of stream gradually decreases as the stream order increases for the stream order analysis of 7 sub basin is designated as 1st to 6th order stream covering an area of 97.2 km². From the stream order analysis Chul nadi & Jibhavi nala Sub basin are designated as 6th orders stream covering an area of 118 sq. km. and Jirbhavi nala covering an area of 114 sq.km. Whereas Ambad nala , Chondi nala , Kunjal nala , Khambale nala etc are designated as 5th order streams covering an area of about 398, 256, 162, 80 sq. km. respectively. Whereas Asrapani sub basin are identified as 4th order sub basin with an area covering 84 sq. km. The variation in order and size of the tributaries basin is largely due to physiographic and structural condition of the region.
Stream Length (Lu)

The total stream length of the 7th sub basin of various order have been computed with the help of rotameter from topographical sheets. Horton’s law of stream length supports the theory that geometrical similarly is present generally in the basins of increasing order (Strahler 1964). It is clear that the total length of streams segment is maximum in case of first order stream. In all most all cases, the basin length decreases as the order increases and it is lowest in case of the highest order streams. This geometric relationship is shown graphically in the form of a straight line when the log values of these variables are plotted on an ordinary graph. Using the log values of stream number and the order of streams the regression line are fitted for the 7th sub basin according to Horton’s principles the number of streams are negatively correlated with the order. (Fig No.3)

Fig.No.3 Geometric Relationship between Stream order, Stream length & Stream numbers.
Stream Length Ratio:

\[ RL = \frac{Lu}{Lu-1} \]

The Stream Length of the drainage basin of the study region has been calculated by applying the following formula.

Where

- \( RL \) = Stream Length Ratio
- \( Lu \) = Mean Stream length order \( u \)
- \( Lu-1 \) = mean stream length of segment of the next lower order.

The stream length ratio is changing haphazardly both at the basin and sub basin levels. The values of stream length ratios vary from 1.14 to 4.17 for sub basin it ranges from 1.80 to 4.15 for whole basin the stream length ratio has an important relation with the surface flow discharge and erosional stage of the basin.
<table>
<thead>
<tr>
<th>Sr. No</th>
<th>Basin / Sub Basin</th>
<th>Stream Number</th>
<th>Order wise Total Stream Length</th>
<th>Stream Length Ratio</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>I</td>
<td>II</td>
<td>III</td>
</tr>
<tr>
<td>1</td>
<td>Ambad Nala</td>
<td>398</td>
<td>37</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>Chondi Nala</td>
<td>256</td>
<td>53</td>
<td>16</td>
</tr>
<tr>
<td>3</td>
<td>Chul Nadi</td>
<td>216</td>
<td>59</td>
<td>14</td>
</tr>
<tr>
<td>4</td>
<td>Kusjal Nala</td>
<td>162</td>
<td>38</td>
<td>10</td>
</tr>
<tr>
<td>5</td>
<td>Asarapani</td>
<td>84</td>
<td>20</td>
<td>6</td>
</tr>
<tr>
<td>6</td>
<td>Khambale Nala</td>
<td>80</td>
<td>22</td>
<td>4</td>
</tr>
<tr>
<td>7</td>
<td>Jhirbavi Nala</td>
<td>424</td>
<td>94</td>
<td>19</td>
</tr>
<tr>
<td>(Total)</td>
<td></td>
<td>1620</td>
<td>383</td>
<td>89</td>
</tr>
</tbody>
</table>
Stream Frequency (Fs):

The stream frequency of a basin may be defined as the ratio between the total number of segment cumulated for all orders with a basin and the basin area (Harton 1945)

\[ Fs = \frac{Nu}{A} \]

Where \( Fs \) = Stream Frequency

\( Nu = \) Total Number of stream segment of all orders

\( A = \) Total area of the Basin

The stream frequency of the whole basin is 3.41 km²/km². While the stream frequency of 1 to 7 sub Basins are 3.98, 3.76, 2.51, 2.89, 4.26, 3.75, 4.78 km²/km² respectively. The development of the stream segment in the basin area is affected by rainfall & temperature.

Basin Length (L):

Basin length has been given different meaning by different workers (Schumm, 1956) Gregory and Walling (1973); Gardiner and Cannon, (1976). According to Gregory (1973). The Basin length (L) is the longest length of the Basin and end being the mouth. The length of the Arunavati Basin is 69.5 Sq.Kms. While the length of the seven sub Basins are 40.5, 18, 18.5, 14.5, 9, 9.5 and 22.5 kms. respectively (Table No.1)

Dimensionless Factor:

Form Factor (Ff):

Form factor of a drainage basin is expressed as the ratio of average width of basin where axial length is the distances along the longest basin dimension parlayed to the main drainage line. So the form factor is expressed as

\[ Ff = \frac{Au}{Lb^2} \]

Length of basin is the longest dimension from mouth to the farthest point on the perimeter of the basin, and width is measured normal to the length. The form factor of the Arunavati River drainage basin is 0.1528. While the form factor of seventh sub basin are 0.0780, 0.2777, 0.3447, 0.3519, 0.3209, 0.3213 and 0.2251 respectively (Table No. 1).

Elongation Ratio (Re):

The elongation ratio (Re) is calculated by using the following formula

\[ Re = \frac{2A/\pi}{L} \]

Where \( Re \) is the elongation ratio, 2 is Constant, \( A = \) Area and \( L \) is the maximum length of the basin.

The elongation ratio of the Arunavati river basin is 0.311 and seventh sub basin are 0.222, 0.420, 0.468, 0.473, 0.451, 0.452, and 0.378 showing extremely elongated nature (Table No. 1). The varieties of the elongated shape of the basin are due to the guiding effect of thrusting and faulting and geomorphological variation of the study region.
Circularity Ratio (Rc):

The circularity ratio has been used as a quantitative measure and is expressed as the ratio of the basin area (Au) to the area of a circle (Ac) having the same perimeter as the basin (Strahler, 1964 and Miller, 1953). It is affected by the lithological character of the basin. It is expressed as

\[
Rc = \frac{4\pi A}{P^2}
\]

Where Rc is the basin circularity
P is basin perimeter
4 are constant and A is the area of the basin.

The ratio is more influenced by length, frequency and gradient of streams of various orders besides slope condition and drainage pattern of the basin. It is significant ratio which indicates the stage of dissection in any region. Its low, medium and high values are indicative of the youth, mature and old stages of the cycle of the tributary basins of the study region. The circularity ratio of the Arunavati Basin is 0.33159 while that of the seventh sub basin are 0.32830, 0.55857, 0.5484, .05272, 0.5673, 0.7530 and 0.5508 respectively (Table No. 1).

The high value of circularity ratio for Asarapani Nala and Kambale Nala sub basin indicate the late maturity stage of topography and other sub basins reveal nearly mature stage of topography. This anomaly is due to diversity of slope, relief and structural condition prevailing in the basin.

Table No.3: Drainage Density, Texture and Bifurcation Ratios of Arunavati River Basin.

<table>
<thead>
<tr>
<th>Basin/Sub Basin</th>
<th>Drainage</th>
<th>Drainage Texture</th>
<th>Bifurcation Ratio</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Density</td>
<td>Rb1</td>
<td>Rb2</td>
<td>Rb3</td>
</tr>
<tr>
<td>Ambad</td>
<td>2.93</td>
<td>4.57</td>
<td>4.35</td>
<td>5</td>
</tr>
<tr>
<td>Chondi</td>
<td>4.65</td>
<td>4.06</td>
<td>3.93</td>
<td>5.33</td>
</tr>
<tr>
<td>Chul</td>
<td>2.68</td>
<td>3.66</td>
<td>4.21</td>
<td>3.5</td>
</tr>
<tr>
<td>Kunjal</td>
<td>2.48</td>
<td>4.26</td>
<td>3.8</td>
<td>3.33</td>
</tr>
<tr>
<td>Asarapani</td>
<td>3.34</td>
<td>4.2</td>
<td>3.33</td>
<td>6</td>
</tr>
<tr>
<td>Kambale</td>
<td>3.58</td>
<td>3.63</td>
<td>5.5</td>
<td>2</td>
</tr>
<tr>
<td>Jhirbhavi</td>
<td>3.73</td>
<td>4.51</td>
<td>5.52</td>
<td>3.4</td>
</tr>
<tr>
<td>Arunavati</td>
<td>2.63</td>
<td>4.18</td>
<td>4.28</td>
<td>4.45</td>
</tr>
</tbody>
</table>

Measure Involving Height

Relief:

Basin relief is an important factor understanding the denudational characteristics of the basin. Relief is the different the maximum and minimum contour level. The maximum height of the Arunavati River basin is 650 mts. And minimum height is 130 meters. Therefore the relief of the basin is 520 mts.
### Table No. 4 Relief and Gradient Aspects of Arunavati River Basin.

<table>
<thead>
<tr>
<th>Basin/ Sub Basin</th>
<th>Relief</th>
<th>Gradient</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Elevation in Meter</td>
<td>Source ‘a’</td>
</tr>
<tr>
<td></td>
<td>Max. Height</td>
<td>Min. Height</td>
</tr>
<tr>
<td>Ambad</td>
<td>640</td>
<td>200</td>
</tr>
<tr>
<td>Chondi</td>
<td>660</td>
<td>260</td>
</tr>
<tr>
<td>Chul</td>
<td>640</td>
<td>240</td>
</tr>
<tr>
<td>Kunjal</td>
<td>640</td>
<td>220</td>
</tr>
<tr>
<td>Asarapalli</td>
<td>420</td>
<td>280</td>
</tr>
<tr>
<td>Khambale</td>
<td>400</td>
<td>240</td>
</tr>
<tr>
<td>Jhurbhavi</td>
<td>480</td>
<td>180</td>
</tr>
<tr>
<td>Arunavati</td>
<td>650</td>
<td>130</td>
</tr>
</tbody>
</table>
Relief Ratio:

The relief ratio is calculated by using the following formula

\[
\frac{H-h}{L}
\]

Where

- \( H \) = Highest elevation in the basin
- \( h \) = Lowest elevation in the basin
- \( L \) = Longest axis of the basin

The relief ratio of the Arunavati basin is 0.0748 while that of seven sub basin are 0.01086, 0.02222, 0.02162, 0.02896, 0.01555, 0.01684 and 0.01333 respectively (Table No.4) generally the relief ratio of the basin as well as the sub basin are moderate which is characteristics feature of the basalt rock of the area.

Gradient Ratio:

It is an indication of channel slope the basin has gradient ratio of 0.0748 while that of the seven sub basin are 0.0103, 0.0211, 0.0216, 0.0289, 0.0155, 0.0168 and 0.0133 respectively (Table No. 4)

Conclusion:

The quantitative analysis of various aspects of the drainage network characteristics of river basin reveals some complex morphometric attributes. The streams of lower order mostly dominate the Basin. They play important role in the work of erosion and landform development. The development of stream segments in the basin area is affected by rainfall. The study reveals that the drainage area of the basin is passing through early mature stage of the fluvial geomorphic cycle. The analysis also indicates some relations among the length, area and number of the stream of the basin and helps to understand their role development of various landforms in the region.

Acknowledgement:

The present work has been carried out in the department of Geography Kisan College, Parola. The author is thankful to the Principal and Head of Department of Geography for his valuable suggestion at various stages.

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Geomorphic Study of the Arunavati Basin- A Case Study

Girase B. N., Patil Y. V. and Dr. Prdnya Jangale

Abstract

The Arunavati basin covers an area of 738 sq.km. The Arunavati river rises in the slopes of inner Saipuda ranges at height of 650 mts from sea level Jhirpan village (Madiya Pradesh). It flows in south westerly direction average bifurcation ratio is 3.65 indicating a mature stages of development. The length ratio is 3.8 to 4.8. The mean drainage density is 1.78 sq.km. The stream Frequency of the basin is 3.04 per sq.km. The slope and hypsometric analysis been carried out for the basin. The hypsometric analysis indicates the mature stages of development of the basin.

Key word- Linear aspect, Areal aspects, Relief aspects.

Introduction:-

The Arunavati river is tributary to the river Tapi. This basin covers an area of 738.11 sq.km. and lies in Maharashtra and Madhya Pradesh. It flows in a general south westerly direction over a length of 69.5 km and joins the Tapi river at Vanaval villages. It lies between 21° 18' N to 31° 37' latitude and 74° 49'E to 75° 13'E Longitude. The north and north east part of the study area is occupied by the hill tracts. While the southern part of the study area is plain. The highest point of the hill ranges is Jhirpan Village (650muts) toward north eastern part of basin. In the present paper, the geomorphological parameters are studied in detail for the quantitative as well as qualitative investigation of the river basin.

A) Arunavati Basin-Linear Aspects

<table>
<thead>
<tr>
<th>Stream Order</th>
<th>1st</th>
<th>2nd</th>
<th>3rd</th>
<th>4th</th>
<th>5th</th>
<th>6th</th>
<th>7th</th>
<th>8th</th>
<th>9th</th>
<th>10th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total No. of Streams (N)</td>
<td>613</td>
<td>394</td>
<td>250</td>
<td>214</td>
<td>173</td>
<td>181</td>
<td>192</td>
<td>200</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total Length (Km)</td>
<td>390</td>
<td>238</td>
<td>184</td>
<td>92</td>
<td>83</td>
<td>102</td>
<td>255</td>
<td>55</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Basin (Km²)</td>
<td>49.5</td>
<td>18</td>
<td>18.5</td>
<td>18.5</td>
<td>18.5</td>
<td>9</td>
<td>9.5</td>
<td>7.5</td>
<td>0.5</td>
<td></td>
</tr>
<tr>
<td>Relief Ratio (Rd)</td>
<td>4.67</td>
<td>4.28</td>
<td>3.14</td>
<td>3.39</td>
<td>5.36</td>
<td>3.39</td>
<td>3.61</td>
<td>3.65</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

B) Arunavati Basin – Areal Aspects

<table>
<thead>
<tr>
<th>Basin (Km²)</th>
<th>174</th>
<th>94</th>
<th>128</th>
<th>78</th>
<th>44</th>
<th>69</th>
<th>160</th>
<th>738</th>
</tr>
</thead>
<tbody>
<tr>
<td>Base Extinction</td>
<td>60</td>
<td>43</td>
<td>31</td>
<td>20</td>
<td>15</td>
<td>36</td>
<td>78</td>
<td>147</td>
</tr>
<tr>
<td>Hill factor</td>
<td>0.060</td>
<td>0.260</td>
<td>0.370</td>
<td>0.320</td>
<td>0.510</td>
<td>0.464</td>
<td>0.316</td>
<td>0.152</td>
</tr>
<tr>
<td>Coefficient of Rank</td>
<td>0.269</td>
<td>0.509</td>
<td>0.452</td>
<td>0.653</td>
<td>0.329</td>
<td>0.395</td>
<td>0.413</td>
<td>0.331</td>
</tr>
<tr>
<td>Coefficient of Length</td>
<td>0.300</td>
<td>0.197</td>
<td>0.347</td>
<td>0.423</td>
<td>0.265</td>
<td>0.294</td>
<td>0.313</td>
<td>0.296</td>
</tr>
<tr>
<td>Coefficient of Area</td>
<td>0.255</td>
<td>0.429</td>
<td>0.485</td>
<td>0.455</td>
<td>0.587</td>
<td>0.600</td>
<td>0.481</td>
<td>0.311</td>
</tr>
<tr>
<td>Coefficient of Frequency</td>
<td>3.52</td>
<td>3.19</td>
<td>2.73</td>
<td>2.74</td>
<td>3.03</td>
<td>3.61</td>
<td>3.71</td>
<td>3.41</td>
</tr>
<tr>
<td>Drainage Density</td>
<td>1.66</td>
<td>3.33</td>
<td>1.43</td>
<td>1.17</td>
<td>1.88</td>
<td>1.70</td>
<td>1.60</td>
<td>1.70</td>
</tr>
</tbody>
</table>

(Source: Computed From S.O.I Topographical Map)

Methodology:

Toposheets on scale 1:50000 are used for the morphometric analysis of the Arunavati basin. The linear measurements are carried out with the help of rotometer. Areal measurement are carried out with graph paper and elevation within the basin area picked up from the toposheets for hypsometric analysis. For convenience the fluvial morphometric analysis of the basin is divided into three aspect linear, areal, relief.

Geology:

The geological formation met with in the Arunavati basin are alluvium and deccan basalt. The close to Mesozoic Era marked by out pouring of voluminous lava which spread over vast area. The flows are tarts because of step like appearance of their out crops. A major part of basin is occupied by these trap flows. The basin has volcanic rocks with considerable thickness of several meters. They are compact and hard which are grouped into vascular and non-vascular varieties. A belt alluvium covered land found on the banks of Tapi river through the
district. The alluvium thins out west world. The Arunavati river rises in the slope of inner satpuda ranges height of 650 mts from mean sea level near Jhurpan village (Madhya Pradesh). It flows in south westerly direction after passing by Shrirpur, it joins Tapi river near Vanavali village. Arunavati has important left bank tributaries like Jhirmahi, Arunavati received a number right bank tributaries such as Ambad nala, Chondi nala, Chul nadi. The drainage segments in the southern part of the basin are long and widely spaced.

C) Linear Aspects

I) Stream Order and Stream Number:

The relationship between stream order and stream number is inverse geometric proportion for all sub basins. According to Strahler (1957) system of stream ordering, Arunavati basin is 7th ordered stream, covers, and area of 738 sq. km. The drainage pattern of the Arunavati river is mostly dendritic. The drainage pattern over the deccan trap, almost dendritic in nature like Arunavati basin for convenience the entire basin is further classified in to main seven sub basins namely,

1) Ambad nala 2) Chondi nala 3) Chul nadi
4) Kunjal nala 5) Asarpani nala 6) Khamhale nala
7) Jhirmahi nala. The given drainage map of the Arunavati basin shows the network of stream of different orders are length. The entire network is composed of 2521 streams in which is near about 90% Stream are lower order i.e. first and second order, the higher order stream successively reduced to until finally.

II) Stream Order:

The modified method of Strahler (1952) is adopted for the designating the stream order in present analysis. The number of stream segments in each order are shown in the table. The Arunavati basin is 7th order basin with 1920, 459, 107, 24, 08, 02, 01, in channels in a particular order than next higher order.

III) Stream Number:

The total number of streams 2521 of Arunavati basin, the total number of stream found in a drainage basin as whole is important. No doubt, but greater importance is their number per unit area. The entire network is composed of 2884 streams in which 1920+459=2379 near about 94.3% streams are lower order i.e. first and second order.

IV) Bifurcation Ratio:

Bifurcation ratio is number of streams of given order to the number of streams of next highly order. It is expressed as Rb= Nu/(Nu+1), bifurcation ratio is related to the branching pattern of the drainage network. According to Horton (1945) bifurcation ratio ranges between 2.0 to 5.0 under normal environment circumstances in case of Arunavati basin bifurcation ratio varies from 2.0 to 4.45 and mean bifurcation ratio is 3.65.

The mean bifurcation ratio from stream number 1 to 5 is 3.90 which indicates the upon 5th order the stream are following thoroughly the mountainous region. The mean bifurcation ratio for the streams order 6 and 7th is 3.0 which indicates it flows thoroughly the plain region.

B) Areal Aspects:

I) Drainage Basin Area:

Drainage basin area represents the area includes within the boundary of water shade divide. It reflects the quantity of water that can be generated from rainfall. The total drainage basin area of the Arunavati basin is 738 sq.kms.

II) Basin Perimeter:

Basin Perimeter is total length of basin boundary or the length measured along the drainage divide of basin. It is an indicate for of basin size and shape. Arunavati basin perimeter is 167.25 Km.

III) Form Factor:

Form factor is the ratio of the basin area to the square. Value of basin length F= A/L² it is dimension less properties that expresses the basin shape. The shape of drainage basin influences the discharge of a basin. 'F' values calculate for the Arunavati basin is 0.1528 indicating that is elongated shape.

IV) Circularity Ratio:

Circulatory ratio is the ratio of basin area to the basin perimeter the value of area divided by length square i.e Arunavati basin is 0.3316 which indicate it is not a circular shape.

V) Elongation Ratio:

Elongation is the ratio of diameter of the circle with the same area as basin and length of basin. The value for elongation ratio of the Arunavati basin is 0.3118. It means that the basin is of irregular shape or not elongated in shape.

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VI) Stream Frequency:
Stream Frequency is measured number of streams per unit area (Horton 1945). The Value to stream frequency for Arunavati basin is 3.41 sq.kms.

VII) Drainage Density:
Area to Horton drainage density is ratio of total channel length of all orders to the area of drainage basin. Drainage density of Arunavati Basin is 1 78 km/sq km

VIII) Constant Channel Maintenance:
Schumm (1965) defined constant channel maintenance is the ratio between the area of drainage basin and the total length of all channels. It is expresses in sq.kms. It is equal to the reciprocal of the drainage density. The value of constant channel maintenance of the Arunavati basin comes to 0.593 per sq. kms. It means that 0.593 sq.km surface is required to maintenance stream length of 1 km.

C) Relief Aspect:
Relief aspect of the river basin describes the elevation of the surface from surrounding surface 1 is measured in terms of difference between the elevation of highest and lowest point. Some parameters of relief aspects of the Arunavati basin are discussed below.

1) Total Basin Relief:
Total basin relief is the deference in elevation between the highest point on the source and the mouth of in the basin. The highest elevation and lowest point in the study area are 650 mtrs within 138 mts respectively. The value of total relief is 512 mts within the difference of 69.5 Kms. It indicates moderate potential energy with medium velocity and average important on along with rare flashy discharge in the basin.

I. Length Ratio and law of Stream length:
The Term length of ratio indicate the ratio of mean length of the stream of the given order to the mean length of the next order. Average stream length ratio of the Arunavati basin is 2.89 total stream length in the Arunavati basin decreases with increasing stream order.

Conclusion:-
Arunavati basin exhibits dendritic pattern of drainage with a number of segment controlled by geomorphic process. The basin obeys the laws of the stream number of, the stream lengths the stream area of Horton. Arunavati is the seventh order basin with a drainage density of 2.59 km/sq km which is a course textured basin.

The overall slope of Arunavati basin is in a east-westerly direction and the low slope regions are potential zone of ground water accumulation. The average bifurcation ratio of Arunavati basin is 3.77 and the hypsometric analysis indicate that the basin has reached a mature stage of erosion.

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References:-

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