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# MORPHOMETRIC ANALYSIS OF RIVER PANZARA AND HER IMPORTANT TRIBUTARIES - A CASE STUDY

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ABSTRACT : The present paper is the case study of Panzara basin, visualised that in the homogenons lithological axes, the main river may differ in geomorphic character and stages of landform development, from her tributaries. An attempt is also made to trace the correlationships with the help of statistical analysis.

River Panzara is an obsequent tributary of river Tapi. Panzara basin occupies 2727.82 sq. kms. area of Deccan plateau. The basin lies towards the northern part of the plateau. Geologically the area is basaltic of the Eocene period, over which there is a thin layer of Recent period, hence the entire Panzara basin bears a homogenous lithological character.

River Panzara flowing from west to east, is having number of tributraies. A comparison between river Panzara and her major randomly selected tributaries is made.

## Introduction

Panzara basin is elongated in shape and is lying in the southern half of Dhule District in Maharashtra state. It occupies 2727.82 sq. kms. area. It is demarcated by a long dyke range from the northern side, and off -shoots of Sahyadri from the southern and western sides. The basin extends between 20° 30' N. and 21° 45' N. latitudes, and 73°75' E. and 76°15' E. longitudes. Panzara, the main west-east flowing river is having 180 kms. length. Place of her origin is lying in the vicinity of ' Mangi-Tungi ' peaks of northern Sahyadri. The course of the river appears to be controlled by the elongated dyke range. The river is flowing mostly parallel to the dyke range and turns abruptly to its left to the east of Dhule city, where there is a major gap in the dyke. Further it drains in to the westward flowing Tapi.

River Panzara receives number of tributaries from northern and southern sides. For this case - study following 10 tributaries are at randomly selected, five each are from right bank and left bank sides. They are Lovki, Anwar, Gaon-nala, Umral, Assydar, Jamkheii, Kan, Manduk, Sushi -nala and Bhad-nala.

Geologically, there are three formations 1) Bagh-Bed of the Upper Cretaceous, not exposed in the basin. 2) Deccan Basalt of the Eocene, exposed in the basin with some dykes 3) Alluvium deposits period, found in the lower parts of the basin.

The entire area of the basin in under semi-arid type of climate with Summer Monsoons. There is slight variation in rainfall

in this basin. The basin bears dry-decidous type of natural vegetation.

**Methodology**

The methodology of the study is based on quantitative analysis made by Horton, Strahler, Schumm, Melton and others. Stream order, numbers, bifurcation ratio, average length, average length ratio, elongation ratio, drainage density, drainage frequency, relief, and slope are the parameters considered. Percentage hypsometric curves are drawn for the stages of land-form development. From these curves percentage mass removed is worked out for 10 tributaries which are at-randomly selected.

Morphomctric investigations of these 10 sub-drainage basins are carried out with the help of one inch Topographical maps and subsequent field checks.

In the first attempt the comparison of salient geomorphic characteristics is made between main river and her tributaries with the help of different statistical measures. Secondly, percentage mass removed and geomorphic characters of each drainage basin is statistically analysed. Correlation coefficient, coefficient of determination ( $R^2$ ) and regression equations are worked out. The relationships are established between geomorphic characteristics and stages of land-form development.

**Analysis**

Amongst the various tributaries of river Panzara those 10 tributaries are randomly selected which enter directly into the main stream. Thus there are 10 sub-basins. The morphometric parameters for each basin are worked out separately (Table I).

The following statistical indices are applied for getting a better perspective of the variations in geomorphic characteristics ( Table II ).

The above table reveals the following important points:

1. The highest variations in geomorphic characteristics are found in case of parameters like total no. of streams ( 115.49 ), slope in degree (99.08), total stream length (93.58), area ( 81.12 ), and relief ( 57.89 ). Remaining parameters show variations in decreasing order. In case of average stream length, drainage density, and drainage frequency the variations between the tributaries and main river basin is very slight.

2. The variations in the values of bifurcation ratio among the tributaries selected above are less, but when the values are compared with that of main river ( 4.24 ) and ( 5.16 ), there appears grater difference.

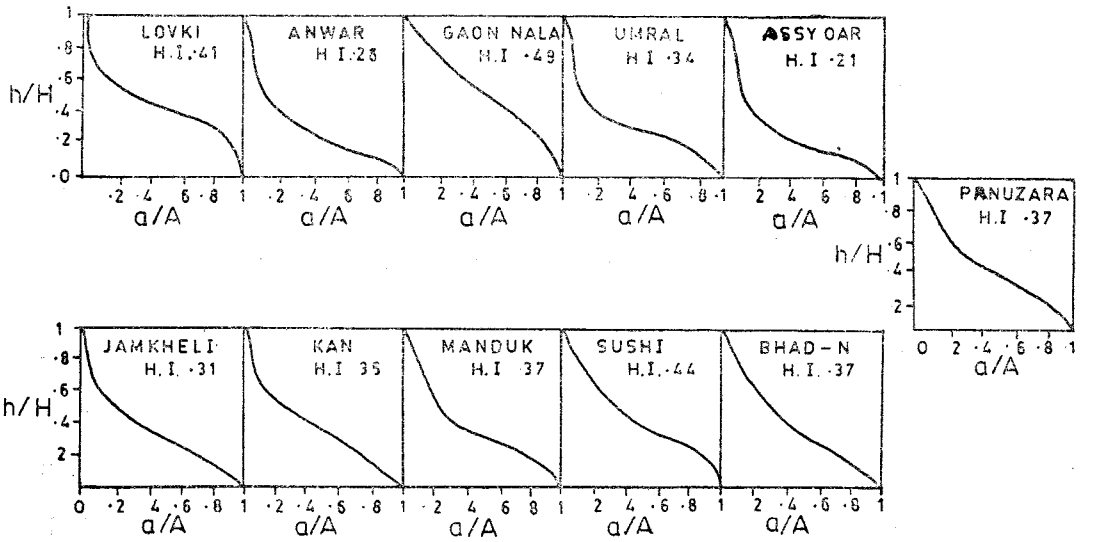
3. The main basin is structurally controlled because the bifurcation ratio is more that 5 ( 5.16 ).

4. The mean elongation ratio is 0.679 which indicates nearly oval shape of the sub-basins where as 0.22 for the main river shows elongated shape proving the structural control.

5. The mean values ( 64.68 per cent ) of persentage mass removed suggest that the tributaries selected above have crossed the mature stage, but the main river (63 per cent) is in the river mature stage.

**Stages of landform development**

The hypsometric curves are drawn for all the selected 10 tributaries and also for the entire basin ( Fig. ). These curves indicate the stages of land-form development. From these curves percentage mass removed is worked out, ( Table I ) which ranges between 51 per cent and 79 per cent. These percentages clearly indicate that none of the above 10 selected tributaries nor the main river Panzara itself is in youthful stage. The noteworthy feature of the Panzara basin is that the following 5 tributaries among the sample are in old stage. They are Assydar 79 per cent, Anwar 74 per cent, Jamkhei 69 per cent, Kan 66 per cent and Umral 66 per cent, the Panzara as a whole is in late mature stage 63 per cent mass removed. Remaining 5 tributaries are in mature stage. Such variations in the percentage mass removed means in the stages of landform development may be due to the fact that some of the parameters are more effective.




PERCENTAGE HYPSOMETRIC CURVES

Fig. 1

**Table I**

**Morphometric Characteristics of Selected Tributaries of River Panzara.**

| S. N. | Basin | Area sq. kms. | Relief Meters | Final order | Total No of Streams | Total Stream Length in kms | Aevage Length in kms. |
|---|---|---|---|---|---|---|---|
| 1 | LOVKI | 112.30 | 78.3 | 5 | 245 | 235.90 | 0.96 |
| 2 | ANWAR | 33.35 | 442.34 | 5 | 205 | 191.50 | 0,93 |
| 3 | GAON-N | 32.80 | 128.90 | 4 | 83 | 78.89 | 9.95 |
| 4 | UMRAL-N. | 111.80 | 512.60 | 6 | 551 | 373.60 | 0.67 |
| 5 | ASSYDAR | 18.20 | 555.10 | 4 | 111 | 79.80 | 0,69 |
| 6 | JAMKHELI | 148.20 | 364.10 | 5 | 645 | 404.00 | 0.62 |
| 7 | KAN | 358.40 | 454.50 | 6 | 1815 | 1073.6 | 0,59 |
| 8 | MANDUK | J2.75 | 134.40 | 5 | 209 | 188,00 | 0.90 |
| 9 | SUSHI-N. | 81.90 | 140.50 | 4 | 194 | 146.20 | 0.95 |
| 10 | BHAD-N. | 84.73 | 191.40 | 5 | 216 | 209.60 | 0,97 |
| PANZARA River | | 2727.82 | 903.30 | 7 | 9184 | 7222.6 | 0.78 |

**Table I** (contd)

**Morphometric Characteristics of Selected Tributaries of River Panzara.**

| Average Length Ratio | Average Bifurcation Ratio | Elongation Ratio | Slope in Degree | Drainage Frequency No/sq. km | Drainage Density km/sq. kms | % Mass Removed | Stages of Landform |
|---|---|---|---|---|---|---|---|
| 2.57 | 3.74 | 0.59 | 0.22 | 2.76 | 1.99 | 59 | Mature |
| 2.10 | 3.70 | 0,62 | 0.99 | 2.47 | 2.29 | 74 | Olh |
| 2.10 | 4.14 | 0.88 | 2.94 | 2.60 | 2.40 | 51 | Mature |
| 2.24 | 3.50 | 0.73 | 1.47 | 4.96 | 3.34 | 66 | Old |
| 1.57 | 4.7a | 0.70 | 4.10 | 6.16 | 4.26 | 79 | Old |
| 2.96 | 4.60 | 0.62 | 0.67 | 4.30 | 2.70 | 69 | Old |
| 2.72 | 4.60 | 0.43 | 0.59 | 5.25 | 3.00 | 66 | Old |
| 1.93 | 3.60 | 0.90 | 0.45 | 2.68 | 2.60 | 63 | Mature |
| 3.46 | 6.10 | 0.61 | 0.41 | 2.64 | 1.78 | 56 | Mature |
| 1.80 | 3.80 | 0.71 | 0.47 | 2.56 | 2.48 | 63 | Mature |
| 2.30 | 5.16 | 0.22 | 0.2978 | 3.15 | 8.65 | 63 | Mature |

**Statistical Analysis**

Regression equations, correlation coefficient and co-efficient of determination is also worked out, mainly with a view to examine as to what extent, the stages of landform development are correlated with morphometric parameters. The correlation table (Table III) reveals high values of correlation coefficient between relief ($r = +0.8859$), drainage density ($r = +0.6848$), average length ($r = -0.4$), and drainage frequency ($r = +0.3198$). Slope, elongation ratio, bifurcation ratio and area however, exhibit insignificant correlation with stages of land form development.

An attempt in determining the relationship between stages of landform development and significant correlating morphometric parameters is made the with help of linear regression equation. The linear regression models which are worked out express that the stages of landform development is a function of total basin relief, drainage density and average length in the form

$$Y = 18.2115X - 876.0489 \text{------(1)}$$

where Y = total basin relief, X = % mass removed.

$$Y = 0.0592X - 1.1403 \text{----(2)}$$

where Y = drainage density, X = % mass removed.

Table II

| Geomorphic characters | Mean $\overline{X}$ | Standard deviation 6 | Variation V | Co-effi. of Varia. V (%) | Value for Panzara |
|---|---|---|---|---|---|
| 1. Area sq. kms | 111.04 | 90.075 | 0.8122 | 81.12 | 27278 |
| 2. Relief in Mts. | 300.41 | 173.91 | 0.5789 | 57.89 | 903.3 |
| 3. Final order | 4.9 | 0.7 | 0.1429 | 14.29 | 7 |
| 4. Total no. steam | 427.4 | 493.59 | 1.1549 | 115.49 | 9184 |
| 5. Total stream length in kms. | 297.72 | 278.6 | 0.9358 | 93.58 | 7222 |
| 6. Average length in kms. | 0.803 | 0.1442 | 0.1468 | 17.68 | 0.78 |
| 7. Average length ratio | 2.34 | 0.559 | 0.2384 | 23.84 | 2.3 |
| 8. Average bifurcation ratio | 4.248 | 0.75 | 0.1765 | 17.65 | 5.16 |
| 9. Elongation ratio | 0.679 | 0.1333 | 0.1963 | 19.63 | 0.22 |
| 10. Slope in degree | 1.231 | 1.2196 | 0.9908 | 99.08 | 1.9 |
| 11. Drainage frequency | 3.638 | 1.3204 | 0.3629 | 36 29 | 3.15 |
| 12. Drainage density | 2.684 | 0.6775 | 0.2524 | 25.24 | 2.15 |
| 13. Percentage mass removed | 64.68 (old) | 7.793 | 0.1206 | 12.06 | 63 (Mature) |

$Y = 07956 - 0.0045X$---(3)

where Y = average length, X = % mass removed.

**Conclusion**

We can conclude from foregoing analysis that, 1) In the homogeneous lithological area the main river may differ in the geomorphic characteristics and stages of landform development from its important tributaries.

2) The co-relation between stages of land-from development and various morpho. metric attributes show as there is significant impact of total basin relief, average length and drainage density on stages of land-form development. In this way the stages of land-form development is a function of total basin relief, drainage density and average length which can be expressed with the help of regression models.

**Table III**

**Correlation Coefficient with Mass Removed**

| S No. | Morphometric parameters | r | $r^2$ | Mass Removed % |
|---|---|---|---|---|
| 1. | Total basin relief | +0.8859 | 0.7848 | 78.48 |
| 2. | Drainage density | +0.6848 | 0.4689 | 46.89 |
| 3. | Average length | −0.4 | 0.16 | 16.00 |
| 4. | Drainage frequency | +0.3193 | 0.1019 | 10.19 |
| 5. | Average length ratio | −0.3223 | 0.0961 | 9.61 |
| 6. | Area | +0.28 | 0.0784 | 7.44 |
| 7. | Elongation ratio | −0.2722 | 0.0729 | 7.29 |
| 8. | Slope | +0.2 | 0.04 | 4·00 |
| 9. | Bifurcation ratio | +0.037 | 0.001369 | 0.1369 |

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