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"Drainage Morphometry of Yerla River Basin Using Geoinformatics Techniques"

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Abstract
Drainage morphometry analysis of Yerla river basin was carried out to study the drainage pattern and morphometric characteristics of basin using SoI toposheet and geoinformatic techniques. The Yerla river basin is one of the sub-basin of Krishna river basins in Satara and Sangli district of Maharashtra and it covers 3029 sq. km area. Morphometric parameters like stream order, stream length, bifurcation ratio, drainage density, stream frequency, relief ratio, elongation ratio, circularity ratio and compactness constant are calculated using various techniques.
Keywords: Drainage Morphometry, Geoinformatics, Yerla River Basin

Introduction

Morphometry is defined as the measurement of the shape and mathematical analysis of drainage (Clarke, 1966). Morphometric studies in the field of hydrology were first initiated by Horton (1940) and Strahler (1950). Geoinformatic technologies, such as Geographic Information Systems (GIS) and Remote Sensing (RS), are efficient tools and techniques in watershed delineation and digitization of drainage network for planning of water resource in the river basin.The drainage morphometric analysis is play a important role for understanding the hydrological behavior of drainage basin and to analyze flood condition, soil erosion, geological and geomorphological processes.

Study Area

The Yerla Basin lies in western part of Maharashtra state and bounded by 16^0 55' to 17^0 28' N Latitude and 74^0 20' to 74^0 40' E Longitude in survey of India toposheet no 47 K – 5, 6, 7, 8, 10, 11, 12, 47 L - 9 on the scale 1:50,000 and it covers total area of 3029 km^2. Geologically yerla basin is covered by basaltic rock (Fig.1).

Objective:

The main objective of the research work is to apply geoinformatic techniques to study the drainage morphometry of the Yerla river basin.

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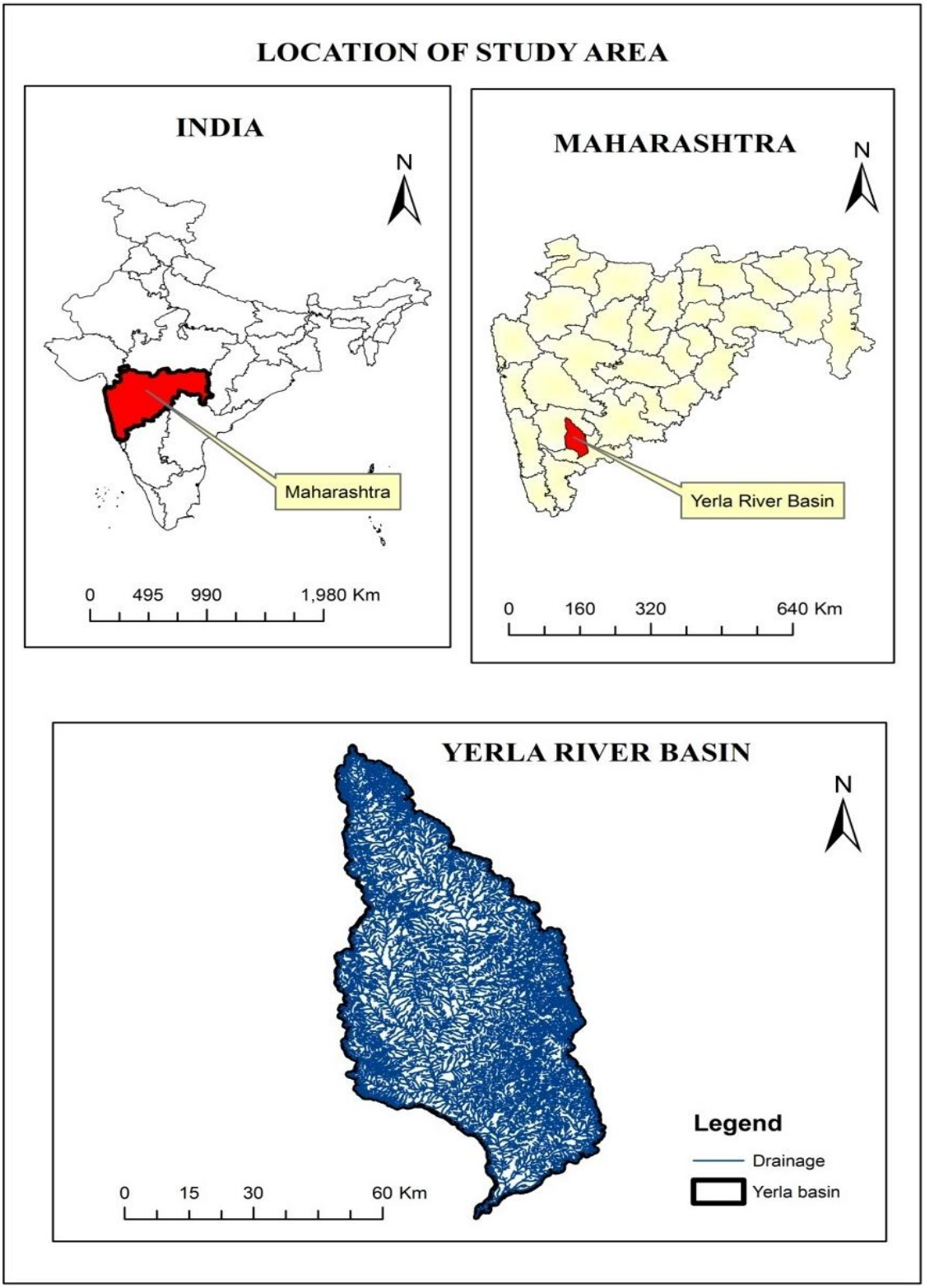

Figure 1: Location of Yerla RiverBasin

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Database and Methodology

The database is created using various techniques for the morphometric analysis. Yerla Basin is delineated from rectified and mosaiced SOI toposheet no. 47 K / 5, 6, 7, 8, 10, 11, 12, 47 L / 9 on the scale 1:50,000 on UTM projection system with the help of ArcGIS 9.3 software. Drainage network is digitized from the toposheet and stream order was calculated using Strahler method (1964).

Result and Discussion

The linear aspect of the drainage morphometry includes stream order, stream length, drainage density, drainage frequency and bifurcation ratio etc. The aerial aspect of the drainage morphometry includes basin area, stream frequency, constant of channel maintenance, texture ratio, elongation ratio, circulatory ratio and form factor etc.

Linear Aspects of the Basin

The linear aspects of drainage network such as Stream Order (Nu), Bifurcation Ratio (Rb), Stream Length (Wu), and stream length ratio.

Stream Order

In the present study, first step is to determine the stream orders for the drainage analysis .The channel segment of the drainage basin has been ranked according to Strahler stream ordering method (Fig.2).

Stream length (Lu)

Stream length is one of the most significant hydrological features of the basin as it levels surface run off characteristics streams of relatively smaller length are characteristic of areas with larger sloped & finer textures longer length of streams are generally indicative of flatter gradients generally the total length of streams segment is maximum in first order stream and decreases as the number of stream of various order in the basin are counted & there length from mouth to drainage divide are measured with the help of GIS software.

Stream Length Ratio (RL)

The ratio in between the average lengths of successive orders is stream length ratio (Horton 1945).

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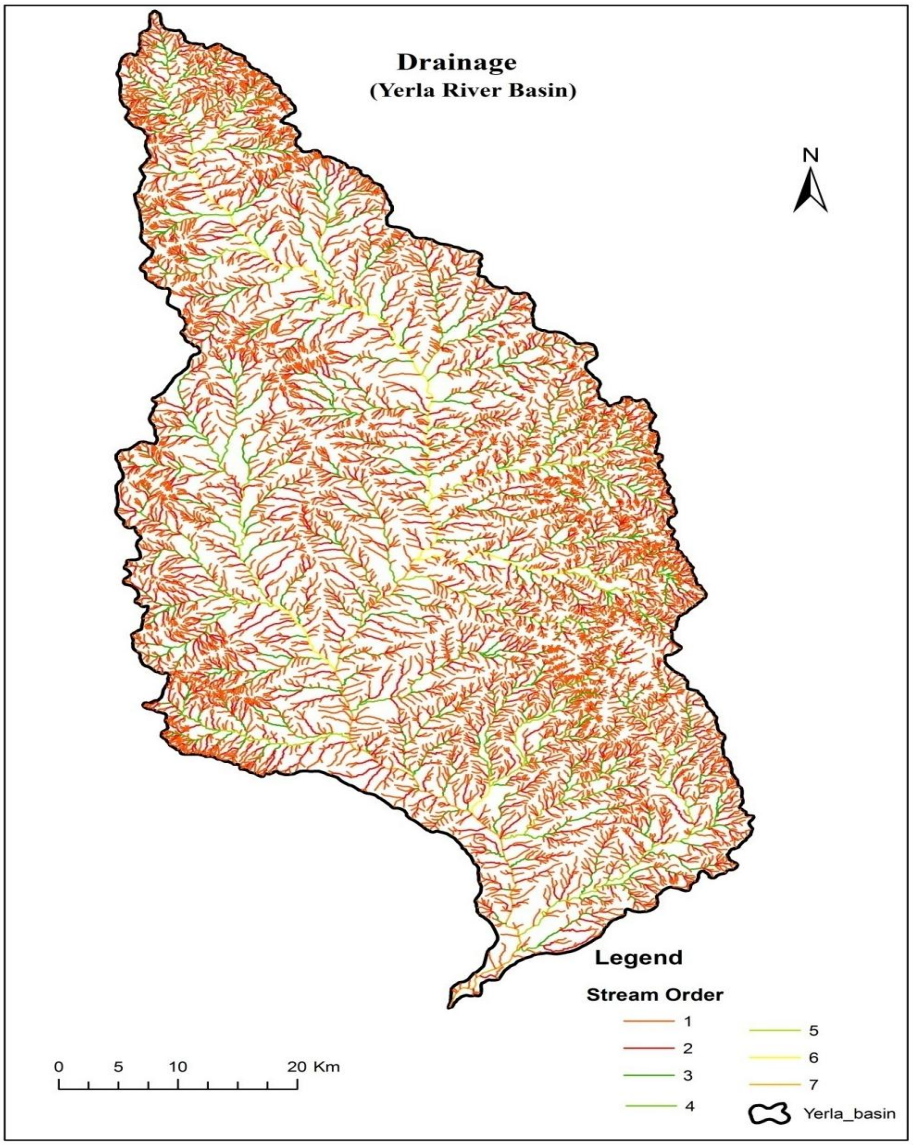

Figure 2: Drainage Network of Yerla River Basin

Bifurcation Ratio (Rb)

Bifurcation Ratio (Rb) is defined as ratio of the number of stream of a given order (Nu) to the number of streams of the next higher order (Table 1).

Table 1: Bifurcation Ratio (Rb)

1st order /2nd order	2nd order/3rd order	3rd order/4th order	4th order/5th order	5th order/6th order	6th order/7th order	Mean Bifurcation Ratio
4.40	4.44	4.37	4.81	4	4	-

Aerial Aspect of Drainage Basin

Basin area (A)

Basin area is the direct outcome of the drainage

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development in a particular basin. The area of Yerla basin is 3029 sq. km.

Table 2: Aerial Aspects of the Drainage Basin

Morphometric Parameters	Calculated Value
Perimeter (P) (km)	320
Basin Area (A)	3029 sq.km
Drainage Density (Dd)	6.90
Constant of Channel Maintenance (C)	0.44
Texture Ratio (Rt)	18.61
Circulatory Ratio (Rc)	0.37
From Factor Ratio	0.19

Drainage Density (Dd)

Drainage density is defined as a ratio of total length of all streams to the total area of the basin (Horton, 1932). Drainage density of Yerla Basin is 6.90 km/sq km

Constant of Channel Maintenance (C)

The Constant of channel Maintenance is the inverse of the drainage density (Schumm, 1956) Therefore higher the drainage density lowers the constant of channel maintenance and vice versa. Regarding the Yerla basin, the average constant of channel maintenance is 0.44 (Table.2).

Texture Ratio (Rt)

It is the ratio of total stream numbers to the total perimeter of the basin (Horton, 1945). Texture ratio of the Yerla river basin is 18.61, which indicate fine texture and area under high relied & steep slopes (Table.2).

Elongation Ratio (Re)

Elongation ratio is defined as the ratio of diameter of a circle of the same area as the basin to the maximum basin length (Schumm, 1956).

Circulatory Ratio (Rc)

Circulatory ratio is the ratio of basin area to the area of circle having to some perimeter as the basin (Miller, 1953). It is influenced more by the length, frequency and gradient of streams of various orders than slope condition and drainage pattern of the basin (Strahler, 1957) Circulatory ratio of Yerla basin is 0.37.

Form Factor Ratio (Rf)

From Factor ratio is the dimensionless ratio of the basin area to the square of basin length (Horton, 1932). The form Factor ratio value of the Yerla basin is 0.19.

Conclusion:

The morphometric analysis is effective technique in basin management, watershed management, watershed prioritization, and soil and water resource conservation at different levels. The morphometric parameters analyzed using geoinformatic techniques to understand various parameters such as terrain analysis, runoff rate and problem soil erosion etc. The morphometric analysis carried out in the Yerla basin shows that the basin is having basaltic rock and exhibits dendritic to sub dendritic drainage pattern. Drainage network of the basin shows dendritic pattern which indicates the homogeneity in the rock structure.

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