

A STUDY OF MORPHOMETRIC ANALYSIS USING REMOTE SENSING TECHNIQUES OF UPPER NIRA DRAINAGE BASIN, MAHARASHTRA

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ABSTRACT

Nira is tributary of Bhima which covers 7,008 sq k.m. area and include in three district Pune – Satara – Solapur. Ghatghar, Devdhr and Vir this are the situated on Nira river. Total length of river Nira is 290 km. Upper Nira drainage basin is considered for present study. It covers 2381.2sq.km. Area. Morphometric analysis using remote sensing technique has emerged as a powerful tool in recent year. Remote sensing has the ability of obtaining synoptic view of large area and very useful in analyzing the drainage morphometry. The basin morphometry includes the analysis of the characteristics of linear, area land relief aspects of fluviially originated drainage basin. The present study aims to demonstrate the potential use of remotely sensed data and geographical information system in extracting and evaluating of linear, relief and areal morphometric parameters of Nira drainage basin. Drainage basin are the fundamental units to understand geometric characteristics of fluvial landscape such as topology of stream networks, and quantitative description of drainage texture pattern, shape and relief characteristics. SRTM data, topographic sheets (1: 50000) were used as the source data.

Keywords: Morphometry, Upper river basin, Remote sensing GIS, spatial information technology

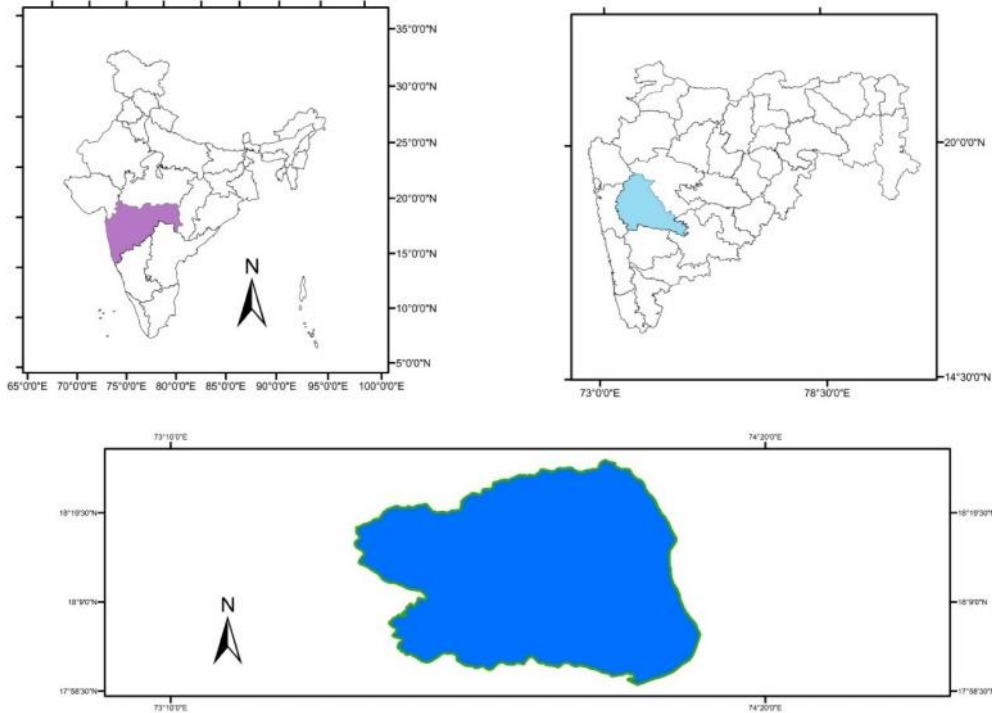
INTRODUCTION

Drainage basins or basins should be the study area for the better understanding of the hydrologic system. The drainage basin area is the area that collect the rainwater and contributes to particular channel. The study of stream order in drainage basin helps to identify the natural environment of a place. Morphometry is the measurement and mathematical analysis of the configuration of the earth's surface, shape and dimensions of its landforms(Clarke, 1966). Morphometric analysis is an important technique to evaluate and understand the behavior of hydrological system. The quantitative analysis of morphometric parameters is found to be of immense utility in river basin evolution and it is very significant in understanding the landform processes, soil physical properties and erosion characteristics. The main objective of the present study is to analyze the linear and areal morphometric characteristics of Upper Nira Drainage Basin.

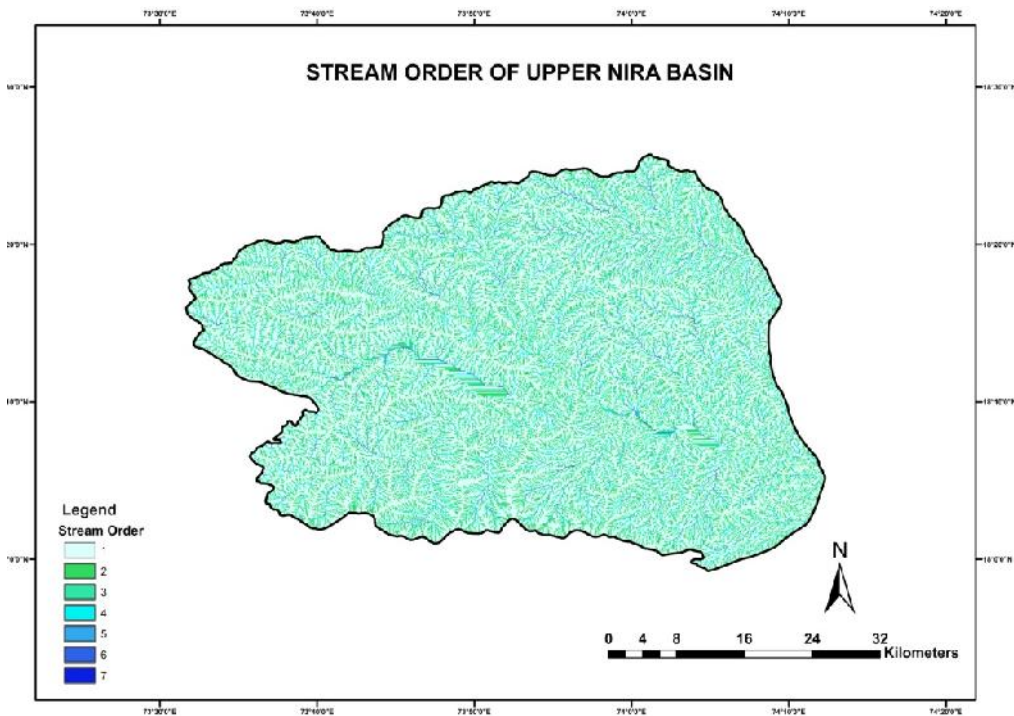
STUDY AREA

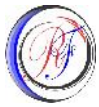
Nira is a river flowing through the Indian state of Maharashtra. The study area lies in between 17°58' North to 18°13' North latitude and 73°33' East to 75°11' East longitude. It is a tributary of Bhima river and flows through Satara, Pune and Solapur districts of Maharashtra. Karha is a tributary of Nira. This river flows from Shirwal (taluka Khandala) Satara District to

Pune District and then meets Bhima basin at Nira Narsingpur near Akluj. Then flows with Bhima water to Solapur District. The dams built on Nira river are Bhatghar, Devdhar and Veer in Satara District. For present study Upper Nira Drainage Basin is selected and it covers 2381.2 sq.km area.



Location of Study Area



**METHODOLOGY**

The study is based on secondary data. The Shuttle Radar Topographic Mission data has been downloaded. The ArcGIS software has been used to analysis the stream order of drainage basin.

The Survey of India (SOI) toposheets no. 47 F/11, 47 F/12, 47 F/15, 47 F/16,47 J/3,47 J/4,47 J/7,47 J/8,47 J/11,47 J/12,47 J/15,47 J/16,47 G/9,47 G/13,47 K/1, 47 K/5,47 K/9,47 K/13,47 O/1,47 O/2 which are on a scale 1:50.000. Digitization work was carried out for analysis of drainage morphometry. Stream order, Stream length (Lu), Mean stream length (Lsm), Stream length ratio (RI),Elongation ratio(Re), Form factor(Ff)this parameters have been considered. The slope map was prepared by the SRTM 90 resolutions data. Number of stream order has been calculated using raster file itself and length of each stream have been calculated using the feature file in ArcGIS. The length , perimeter and area of drainage basin have been calculated using suitable tools in software. Flow direction , Flow Accumulation ,Stream Order tool in Strahler method and Stream to feature tools have been used to find out pattern of stream in study area.

RESULT & DISCUSSION:-

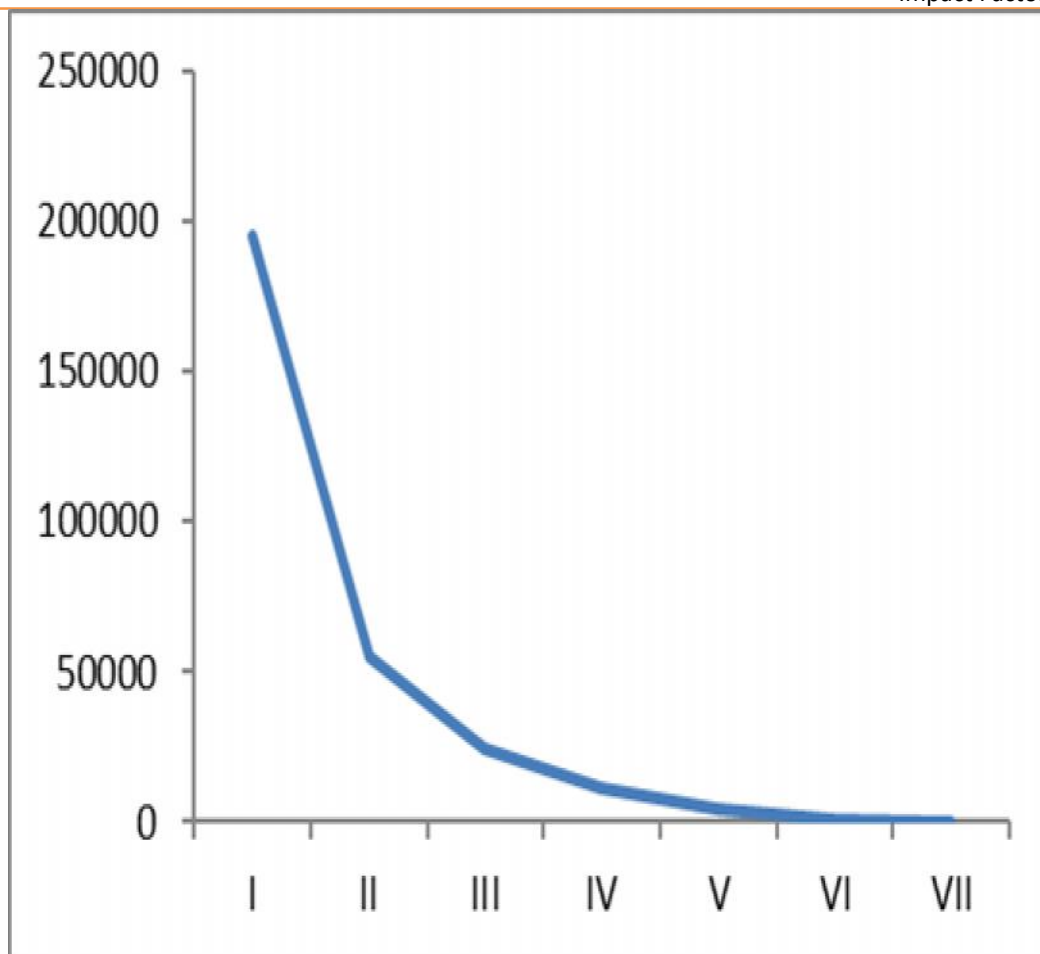
The result of the Linear, Relief and Arial properties of Upper Nira Drainage Basin are given below:

Results of Morphometric Analysis		
Sr.No	Morphometric Parameters	Result
01	Basin Area sq. km	2381.2 sq.Km.
02	Basin Order	7.00

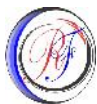
1. Linear Aspects of Nira River :**1.1 Stream order (U) :**

Differentiate the stream orders in basin the first step in drainage basin analysis and expresses the hierarchical relationship between stream segments, their connectivity and the discharge arising from contributing catchments. The highest order in study area is seven. The total numbers of streams are 291208, out of which 194944 are first orders, 55313 are second orders, 24373 are third orders , 11644are fourth orders , where 4307 are fifth orders , 626 are sixth orders and 1are seventh orders. The stream have been formed in dendritic drainage pattern. The number of stream segments are decrease as the stream order increase.

Horton (1945) laws of stream numbers states that the number of stream of each order forms an inverse geometric sequence against plotted order. Plotting the logarithm of number of streams against stream's order shows a straight line which shows the streams usually decreases as the stream order increases.



Sr. No.	Parameters	Stream Orders								References
		I	II	III	IV	V	VI	VII	Total	
1	Number of streams (Nu)	194944	55313	24373	11644	4307	626	1	291208	Strahler, 1964
	Number of streams (%)	66.94	19	8.36	4	1.47	0.21			
2	Bifurcation ratios (Rb)		I/II	II/III	III/IV	IV/V	V/VI			Schumm, 1956
			3.52	2.26	2.09	2.7	6.88			
3	Mean Bifurcation ratios	3.49								Strahler, 1964
4	Basin length in sq.km	75 sq.km								Arc GIS tool
5	Basin area in km ²	2381.2 sq.km.								Arc GIS tool
6	Stream frequency	122.37								Horton, 1945



1.2 Bifurcation Ratios (Rb):

Bifurcation ratio is related to the branching pattern of a drainage network and is defined as the ratio between the total numbers of stream segment of one order to that of the next higher order in a drainage basin (Schumm, 1956). It is a dimensionless property and shows only a small variation for different regions with different environment except where powerful geological control dominates (Strahler, 1964). In study area bifurcation ratio is vary from 2.09 to 6.88 with the mean bifurcation ratio of 3.49. The highest Rb (6.88) is found between fifth and sixth order.

2. Areal Aspects of the Drainage Basin:

2.1 Stream frequency (Fs):

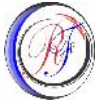
The stream frequency of a basin may be defined as the total number of stream segments within the basin per unit area (Horton, 1945). The stream frequency of the whole basin is 122.37/ sq. km. Greater the drainage density and stream frequency in a basin, the runoff is faster.

CONCLUSIONS

With the above morphometric analysis, drainage system and drainage characteristics of Upper Nira drainage basin examined by using GIS technique. GIS helps to analyze the drainage basin accurately. The study of linear aspects of drainage basin result shows that, the basin has been formed in dendritic pattern with seventh order stream. Plotting the logarithm of number of streams against stream's order shows a straight line which shows the streams usually decreases as the stream order increases. The result of relief aspect shows the study area is high relief and high stream density. The quantitative analysis of immense utility in river basin evaluation, watershed prioritization for soil and water conservations, and natural resources management at micro level.

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