

Morphometric analysis of Upper Ghod Basin Using GIS Techniques

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Abstract

Ghod River is seventh order tributary. The number at stream gradually decreases in first order to higher order. Stream order and stream number negative Relationship. Morphometric analysis is any hydrological investigation and it is inevitable in development and management of drainage basin. Development of a drainage system and the flowing pattern of a river over space and time are influenced by several variables such as geology, geomorphology, structural components, soil, and vegetation of the area through which it flows. Geographical Information System (GIS) techniques have already been used for assessing various terrain and morphometric parameters of the drainage basins and watersheds as they provide a flexible environment. Morphometry is the measurement and mathematical analysis of the configuration of the earth's surface, shape and dimensions of its landforms. Drainage density and stream frequency measures at the dissection of the basin are important factors that control the speed of runoff.

KEYWORDS: Morphometric analysis, basin, techniques, GIS etc.

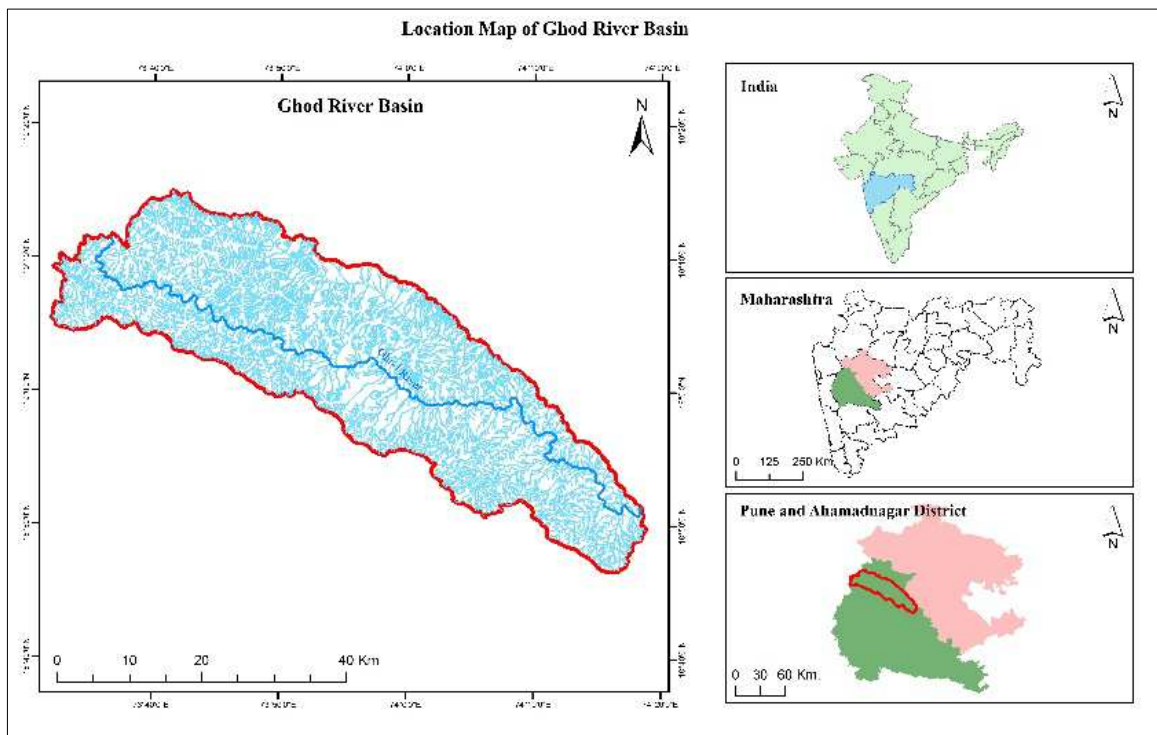
Introduction:

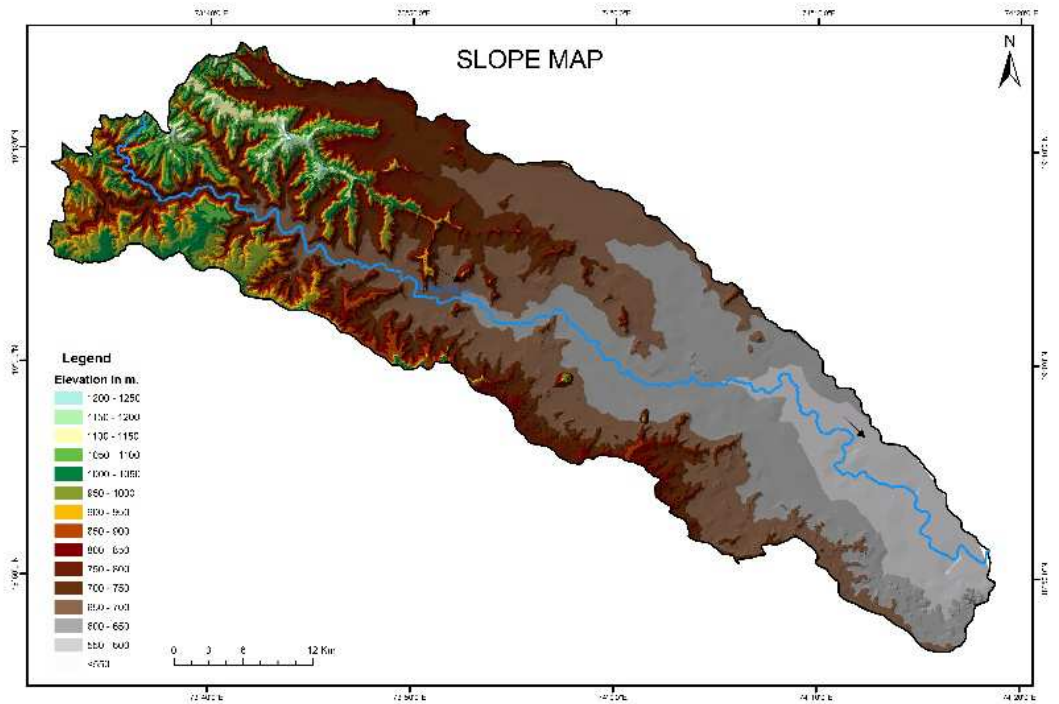
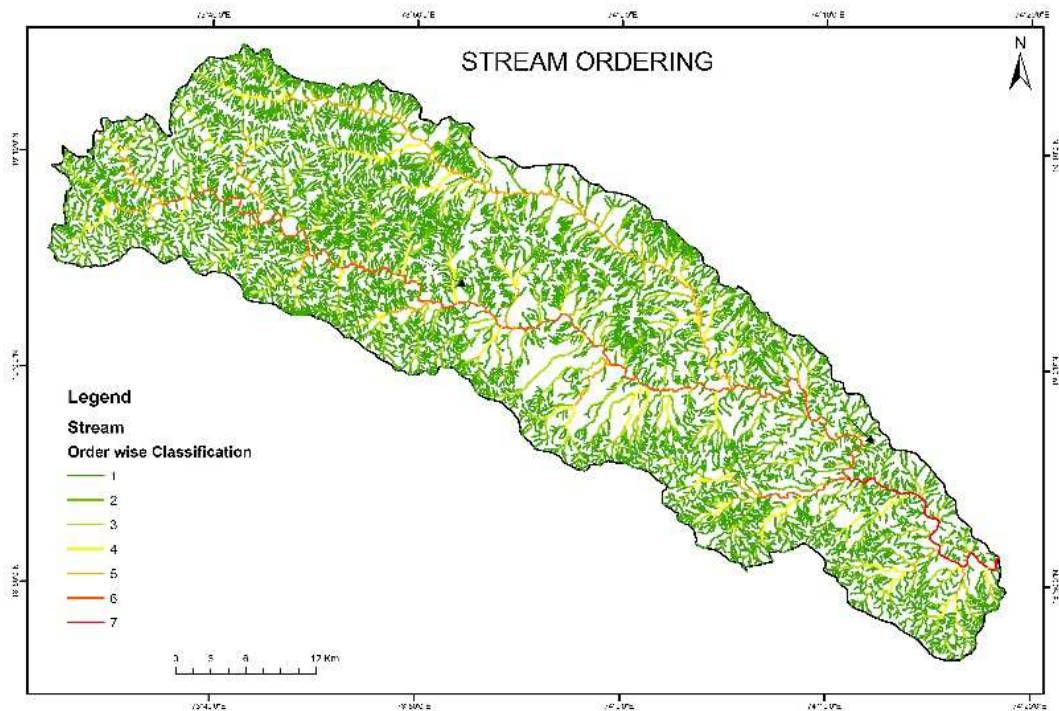
Morphometric analysis is important in any hydrological investigation and it is inevitable in development and management of drainage basin. A critical evaluation and assessment of morphometric parameters have been achieved through measurement of linear, aerial and relief aspects of basins by using GIS techniques, and it necessitates preparation of a detailed drainage map. Development of a drainage system and the flowing pattern of a river over space and time are influenced by several variables such as geology, geomorphology, structural components, soil, and vegetation of the area through which it flows. Geographical Information System (GIS) techniques have already been used for assessing various terrain and morphometric parameters of the drainage basins and watersheds as they provide a flexible environment and a powerful tool for the manipulation and analysis of the spatial information, particularly for the future identification and extraction of the information for better understanding (Vijith 2006).

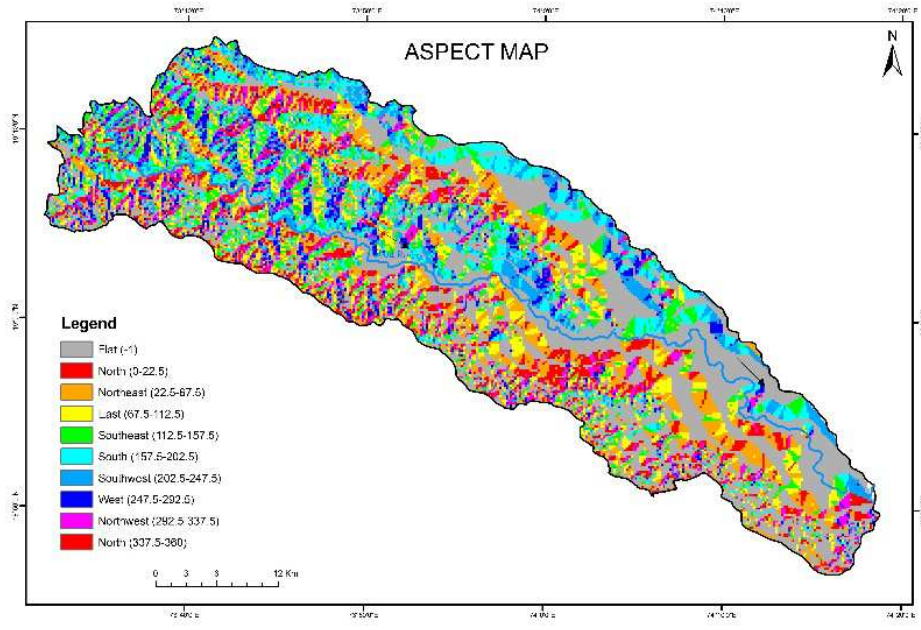
Morphometry is the measurement and mathematical analysis of the configuration of the earth's surface, shape and dimensions of its landforms (Clarke 1996). The present study is an attempt.

1. The Study Area:-

The study area located Ambegoan, Junner, Shirur tehsil in Pune district, Maharashtra. Ghod River is a tributary of Bhima River. The Ghod River originates on the eastern slope of the western Ghat at 1029 meters (3580ft) a above sea level. It flows in an east to southeast direction for approximately 200k.m. before the confluence of Bhima. The geographical location of the Study area can be expressed from $18^{\circ} 46' 36''$ to $19^{\circ} 15' 08''$ N latitude and $73^{\circ} 31' 58''$ to $74^{\circ} 18' 52''$ longitude. The study area selects to study origin of river to confluence with Kukadi River. The Kukadi river is one of the tributary of the Ghod. Inamgoan a post Harappa agrarian village located along the Ghod River .The River dammed by the Ghod Dam. The Shirur city located on the side of Ghod River therefore Shirur city known as the Ghodnadi city.







Sr. No.	Talukas Average Rainfall	Annual Rainfall (mm)
1	Junner	761.2
2	Ambegaon	806.79
3	Shirur	512.4

Source: Socio-economic Abstract, Pune District, 2009-10.

2. Objectives:-

- To understand the general Morphometric characteristics of Ghod River Upper basin.
- Morphometry analysis in GIS environment.
- To prepare drainage map, Ordering Map, Slope Map, Slope aspect map etc.

3. Results and Discussion

The various morphometric parameters of the upper Ghod river basin area were determined and are summarized in tables.

5.1 Linear Aspects

The linear aspects of drainage network such as stream order (Nu), bifurcation ratio (Rb), Stream length (Lu)

5.1.1

Stream Order	No of Stream	No of Stream In %
1	4955	76.4
2	1186	18.3
3	266	4.10
4	58	0.89
5	14	0.21
6	2	0.03
7	1	0.015
Total	6482.00	100

(Table no.1)

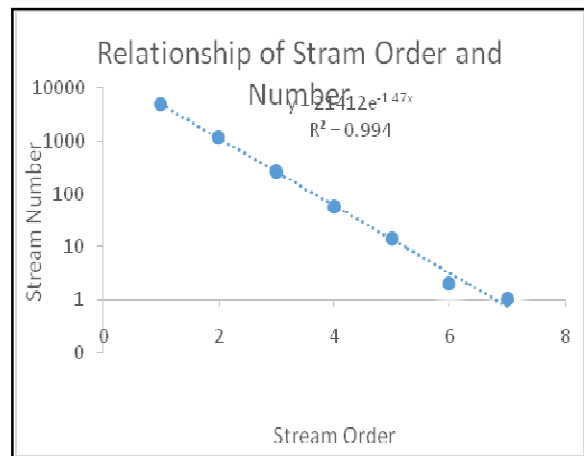
Stream order:

There are four different system of ordering streams that are available Gravelius (1914), Horton (1945), Strahler (1952) and Schideggar (1970). Strahler’s system, which is a slightly modified of Horton’s system, has been followed because of its simplicity. The stream step in the morphometry analysis of a basin is designation of stream orders. The stream order (u) is a dimensionless number, which can be used for comparison of geometry for drainage networks on different linear scales. The drainage network of the Ghod river basin is classified into stream orders, as followed by Strahler (1952). In this analysis, the smallest fingertip tributaries are designated as first-order streams; where the two first order streams join, a second-order stream is formed; where the two second-order streams join, a third-order stream is developed . It is obvious that the total number of streams gradually decreases as the stream order increases.

5.1.2 Stream Number:

The total number of stream segments present in each order is the stream number (Nu). Nu is number of streams of order u. The total number of stream segments is found to decrease as the stream order increases in the basin.

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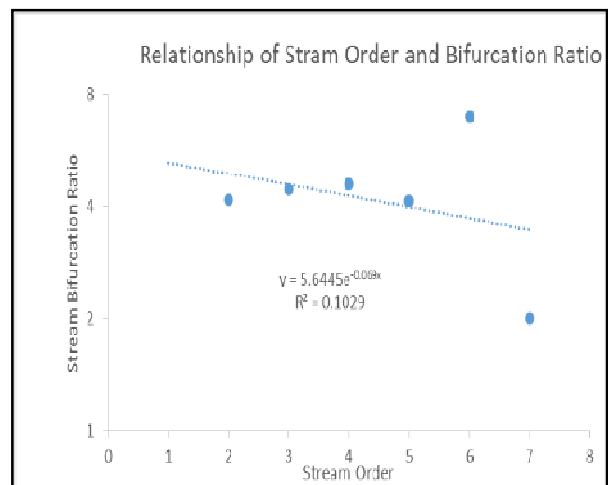
5.1.3 Stream length:

The stream length has been an important relationship with the surface flow discharges longer the length the appearance of flood and the surface flow. It is observe that mean stream length is decreases in increasing stream order.

The Ghod river total stream length is 4687.48.

5.1.6 Bifurcation Ratio (Rb)

Order No	Order Count	Stream length in km	Bifurcation Ratio
1	4955	2935.52	
2	1186	861.09	4.1779
3	266	487.17	4.4586
4	58	168.95	4.5862
5	14	113.73	4.1429
6	2	99.39	7
7	1	21.64	2
Total	6482	4687.48	26.366
Mean Bifurcation Ratio			4.3942



The ratio between the number of streams of an order (Nu) to that of the next highest order (Nu+1) is known as a bifurcation ratio (Rb). Horton (1932) introduced the term 'bifurcation ratio' (Rb) to express the ratio of the number of streams of any given order to the number in the next lower order.

According to Strahler (1964) The Rb reflects the complexity and degree of dissection of a drainage basin. Strahler (1964) has stated that where the Rb is between 3 and 5, geological structures do not seem to exercise a dominant control over the drainage pattern for the

Bifurcation Ratio of the Ghod River is **4.39** that means Bifurcation Ratio is normal in this region. Since ratio between 3 to 5 there is no geological structural Control in the drainage network pattern. That in the region of uniform climate, rock type and uniform history of geologic development.

5.2 Areal Aspect:

The areal aspect is the two dimensional properties of a basin. It is possible to delineate the area of the basin which contributes water to each stream segment..

Sr.No	Parameter	Formula	Result
1	Drainage Density (Avg. Density)	Total Length of Stream in Basin/ Area of the basin	3.03sq.km ²
2	Stream Frequency	Total No Of Stream /Total Area of the Basin	4.19/km
3	Elongation Ratio	$Re = 2 (\sqrt{(A/\pi)}) / Lb$ (Dia. of the basin/Max. Basin Length)	0.25
5	Highest Elevation (m)		1280.00m
6	Lowest Elevation (m)		560.00m
7	Relative Relief (m)	H-h (H-Highest Elevation (m)- Lowest Elevation (m))	720.00m
8	Circulatory ratio	Area of basin(Sq.km)/Perimeter of basin (Km)	
9	Form Factor	Area of Basin(Sq.km)/ Basin Length	0.19
10	Bifurcation Ratio		4.39
11	Constant of Channel maintenance	1/Drainage Density	0.33km ²
12	Relief Ratio	$Rh = bh/ld$ (bh- Basin Relief/Basin Length)	8.07

Conclusion:-

- There are following characteristics of Ghod River. In between the study area, Ghod River is seventh order tributary. The number at stream gradually decreases in first order to higher order. Stream order and stream number negative Relationship.
- The length of River decreases with increasing of with order number. The length of the Ghod river is 126.0 km between Origen to Ghod and Kukadi river confluence. The total area of the basin is 1546.0km sq. The total length of Mutha river and its tributaries is 4687.48 km in the study area
- The Bifurcation ratio of river is 4.39. If is in between 3 to 5 that means here no geological control, river flowing the natural condition.
- The river Drainage Density is 3.0 sq.km². Means high drainage density. High drainage that means high relief. The greater drainage Density faster runoff,

increases Drainage density with increasing size of mean annual flood. Rainfall intensity high greater therefore Drainage Density high because little vegetation and low permeability in region high intensity rainfall occur in area. Underlain by difficult basalt rock and all streams require the large area to maintain a channel of given length.

- In the Ghod River has constant channel maintenance is 0.3297 km² that means the Ghod river has low of constant channel maintains in the river bed is mostly made up of basalt hard rock present low Erosibility and low permeability etc.
- In the Ghod river Stream frequency is high, a higher frequency its greater surface ran off and steeper ground surface. Drainage density and stream frequency measures at the dissection of the basin are important factors that control the speed of runoff. In the right bank of river high frequency of steam and left bank low stream frequency because differences in relief.
- Ghod river and their tributaries are highly seasonal or ephemeral in nature and carry under during the monsoon
- Maximum river depth increases and the form ratio decreases downstream

As the main objectives of this work was to discover holistic stream properties from the measurement of various stream attributes, detailed morphometric analysis is carried out river catchment and discusses their feature and characteristic and also attempt to find out the stages of geomorphic development with the help of different morphometric parameter.

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