MORPHOMETRIC ANALYSIS OF A VRISHABHAVATHI SUB WATERSHED UPSTREAM SIDE OF GALI ANJANEYA TEMPLE USING GEOGRAPHICAL INFORMATION SYSTEM

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Abstract

The abrupt flood event at Gali Anjaneya Temple in Vrishabhavathi sub watershed disrupts the normal life and cause loss to economy. Main objective of the study is to characterize the morphometric parameters near the Gali Anjaneya Temple, based on toposheets 57/H 9 and 57/H/ 9/1(scale 1:25,000) used for morphometrical analysis. The morphometric parameters were delineated through STRM data using ArcGIS-10.1software. The sub watershed is covering about 34.4 Km^2 consists of valleys and plains mainly in urban area. The longest flow path is calculated and found to be 9.3 Km. The study reveals that Remote sensing technology can be employed for . watershed modeling for the study region. The paper highlights the key parameters of watershed such as morphometry and slope analysis by using GIS/RS data.

Keywords: *Gali Anjaneya Temple, Morphometry, Vrishabhavathi sub watershed, Drainage Characteristic, SOI: Survey of India, DEM: Digital Elevation Model, Advanced Space-borne, ArcGIS,: GIS, RS, Spatial analysis, hazards, River basin*

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1. INTRODUCTION

The morphometric analysis refers to quantitative evaluation of characteristics of earth surface and any landform unit. This is the most common technique in basin analysis, as morphometry form an ideal areal unit for interpretation and analysis of fluvially originated landforms where they exhibits and example of open systems of operation. The composition of the stream system of a drainage basin in expressed quantitatively with stream order, drainage density, bifurcation ration and stream length ratio (Horton, 1945). It incorporates quantitative study of the various components such as, stream segments, basin length, basin parameters, basin area, altitude, volume, slope, profiles of the land which indicates the nature of development of the basin. . Horton's laws were subsequently modified and developed by several geomorphologist, most notably by Strahler (1952, 1957, 1958, and 1964), Schumm (1956), and etc.

The study area Gali Anjaneya Temple sub watershed lies in the Southern part of the Bangalore city, Karnataka, India through which the Northern part of the Vrishabhavathi valley flows. Geographically, the study area is located at latitude $13^0$1'11" N and $70^0$32'6" E longitude, covering a total area of about 34.4.Km^2 (Figure1). The SOI Topo-sheet numbers are 57/H 9 and 57/H/ 9/1 arscale (1:25,000) are used to delineate the boundary and morphometric analysis.

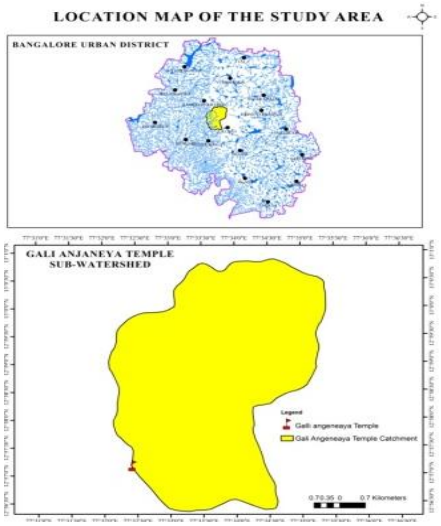

Fig1: Location Map of the Study Area

For the present study, Remote Sensing (Lillisand Thomas, 2002) and Geographical Information System (GIS) will be used as tools for managing and analyzing the spatially distributed information's. ArcGIS powerful software to analyze, visualize, update the geographical information, and create quality presentations that brings the power of interactive mapping and analysis. Many researchers have done morphometric analysis using Remote Sensing and GIS technique. (Shakil Ahmad et al., 2012) has used Geoinformatics for assessing the morphometric control on

hydrological response at watershed scale in the upper Indus Basin.

The urban flooding at Gali Anjaneya Temple during monsoon disrupt the normal life in southern Bangalore. The main objectives of the present study are morphometric analysis of Gali Anjaneya Temple sub watershed area to understand the hydrological process of the (DEM) catchment with the help of ArcGIS software.

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2. METHODOLOGY

The Topographic map of the study area is digitized with the help of topo-sheet number 57H/9 and 57H/9/1 with the scale of 1:25,000 obtained from Survey of India. Strahler's, Horton's and Schumm's methods have been employed to assess the fluvial characteristics of the study region . The maps were georeferenced and digitized in ArcGIS-10.1 and Erdas Imagine-10 software's and attributes were assigned to create the digital database (0.0001). The map showing drainage pattern in the study area (Figure 2) is draped over STRM to prepare DEM with 10m resolution

(Figure 3). The drainage pattern in the study area is mainly urban and hence the management of flood during the rainy season poses a challenge to control and manage the flood at Gali Anjaneya Temple.

Drainage net work of Vrishabhavathi sub basin is prepared with DEM model. The characteristics of drainage network is identified by stream ordering in the study area. Direction of flow (Figure 4) and flow accumulation (Figure 5) maps are prepared with the help of slope characteristics of the catchment.

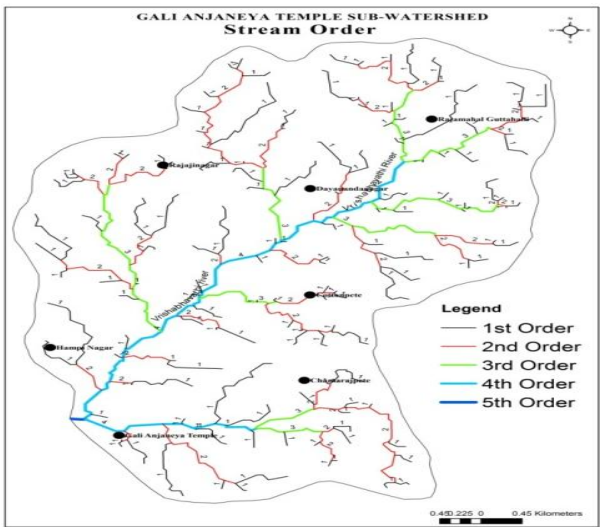

Fig2: Drainage Network of Vrishabhavathi sub Basin

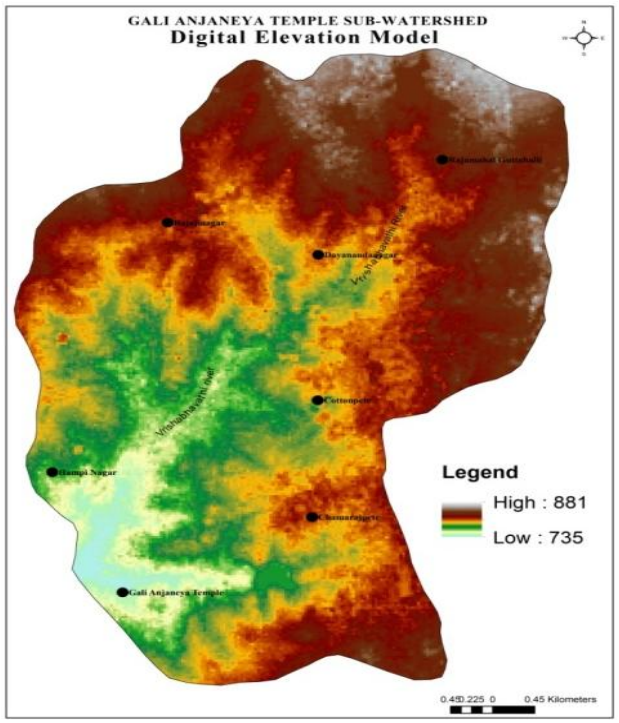

Fig3: DEM of study area

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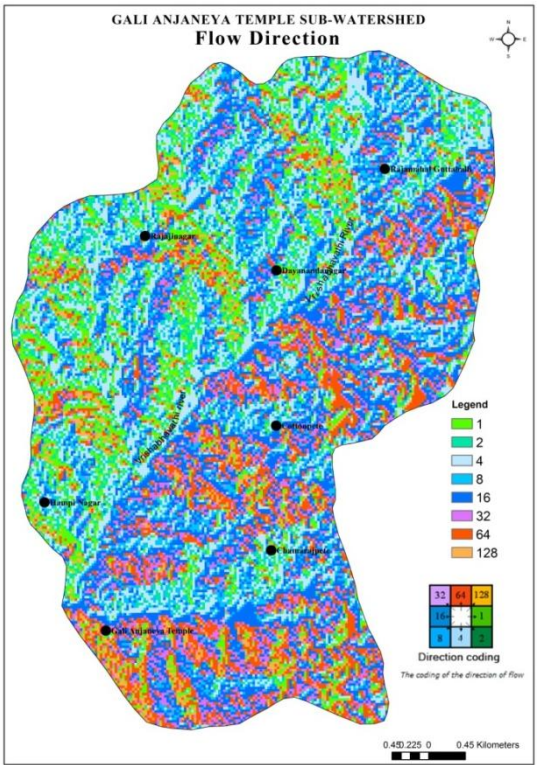

Fig-4: Flow direction map of the study area

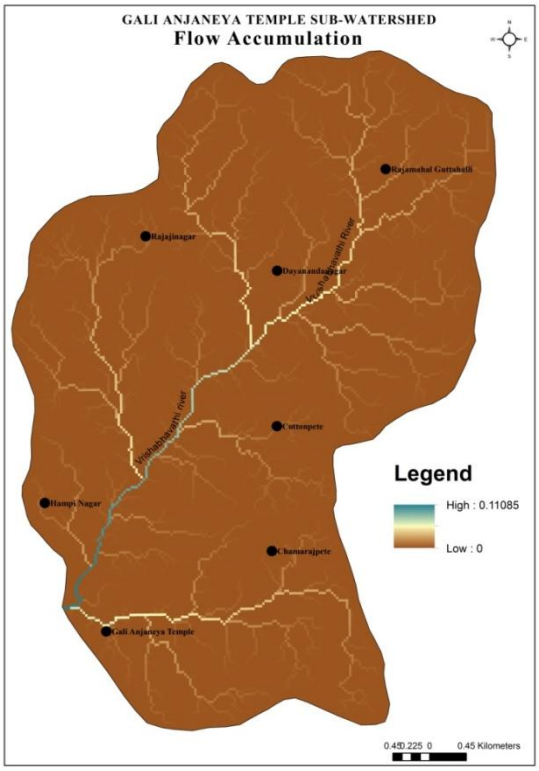

Fig-5: Flow accumulation map of the study area

The morphometric analysis was carried out at sub-basin level in the GIS System (ArcGIS-10.1). Based on the drainage order, the drainage channels were classified into different orders. In GIS, drainage channel segments , Strahler's system, has been followed because of its simplicity, where the smallest, un-branched fingertip streams are designated as 1st order, the confluence of two 1st order channels give a channels segments of 2nd order, two 2nd order streams join to form a segment of 3rd order and so on. When two channel of different order join then the higher order is maintained. The trunk stream is the stream segment of highest order.

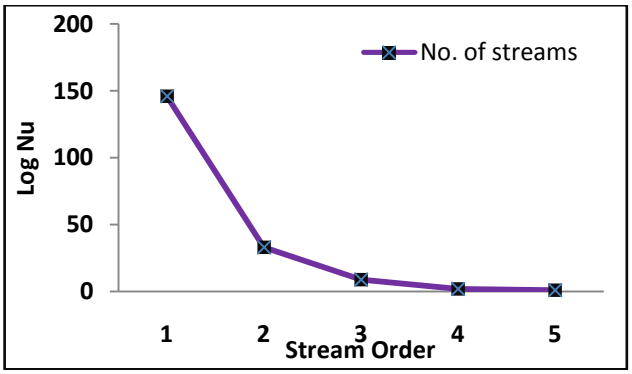

Fig-6a: Regression of Stream order on Number of Stream segments

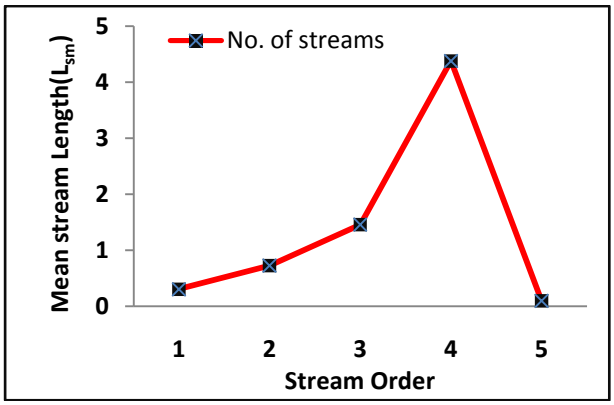

Fig-6b: Regression of Stream order on Mean Stream Length

3. GALI ANJANEYA TEMPLE SUB WATERSHED

The Basic Parameters of Vrishabhavathi sub watershed upstream of Gali Anjaneya Temple are tabulated in Table-1. The computed study drainage area is computed as 34.4 Km^2.

Table-1: Basic Parameters of Vrishabhavathi Catchment

Stream order (U)	No. of stream	Total length of streams (Km)	Cum u-lative length (Km)	Mean stream length (Lsm) (Km)	Bifurcation ratio (Rb) (Km)	Length ratio, (Rl)
1	146	45	45	0.3084		
2	33	24	69	0.7284	4.424	0.8633
3	9	13.2	82	1.46	3.666	0.922
4	2	8.8	91	4.382	4.5	0.0701
5	1	0.1	91	0.1	2	43.685
Total	191					

Mean of Bifurcation ratio: 2.94

Stream Order	1	2	3	4
Log Nu	2.164	1.518	0.954	0.3
Log Lu	1.654	1.381	1.119	0.943

Table 2: Summary of morphometric Parameter of Vrishabhavathi sub watershed upstream of Gali Anjaneya Temple

SL. NO.	Detail	DEM
1	Area of the catchment,(km2)	34.4
2	Total no. of Stream	191
3	Total length of the Stream(Km)	91.078

4	Perimeter of the Catchment(Km)	26
5	Length of the Catchment(Km)	9.311
6	Width of the Catchment(Km)	4.269
7	Catchment Relief(m)	150
8	Drainage density(Km/Km2)	2.6476
9	Length of overland flow(Km)	1.3238
AREAL ASPECTS		
10	Compactness coefficient	0.00619
11	Circularity ratio	0.639
12	Constant channel maintenance	0.3777
13	Stream frequency	5.552
14	Form factor	0.396
15	Elongation ratio	0.711
16	Drainage Texture	14.70
RELIEF ASPECTS		
17	Relief ratio	5.615
18	Relative relief	0.005769
19	Ruggedness number	2.3325

4. CONCLUSIONS

The morphometric analysis of Vrishabhavathi sub watershed upstream of Gali Anjaneya Temple has been carried out to understand the flooding scenario at the temple. The Vrishabhavathi sub watershed upstream of the temple is analyzed and morphometric parameters are estimated. Following is a summary of the results and a discussion of the inferences from the results.

- Study area satisfies Horton's law of stream length. States that "streams of smaller lengths are characteristics of areas with larger slopes", it seems to be in geometric progression.
- The relationship between stream order with log of number of stream and log of total length was examined (Figures 6a & 6b), it seems to be in geometric progression and agree with Horton's law of stream length. The study shows the total length of stream decreases with increasing order of stream.
- Drainage density worked out to be **2.64 Km/km^2** which lies in coarse region. It is a reflection of magnitude of surface runoff which leads to formation trellis drainage pattern.
- The Horton's law of stream orders holds good for the catchmentunder study
- The catchment is largely circular (Rc = 0.639) and largely coarse in texture (Drainage density D_d = 2.6476 Km/Km^2) with high Stream frequency (Fs = 5.52). The Circularity ratio is s 0.639 indicating that basin largely circular in shape.
- As reflected by the values of relief ratio, the catchment consists of land area with moderate to high slope (Rr = 5.615) charactersistics.
- The morphometric values of Vrishabhavathi sub watershed upstream of Gali Anjaneya Temple shows a higher value of stream density, slope and relief ratio. These parameters can be used to predict the peak flood values at Gali Anjaneya Temple during the monsoon season in Bangalore.

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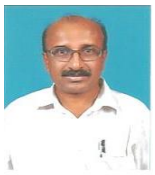
BIOGRAPHIES



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