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MORPHOMETRIC ANALYSIS OF MOTHKURI WATERSHED USING REMOTE SENSING AND GIS TECHNIQUES NALGONDA DISTRICT TELANGANA STATE

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ABSTRACT

Morphometry represents the topographical expression of land by way of area, slope, shape, length, etc. These parameters affect catchment stream flow pattern through their influence on concentration time (Jones, 1999). The significance of these landscape parameters was earlier pointed out by, who observed that stream flow can be expressed as a general function of geomorphology of a watershed. Morphometric analysis of drainage basins thus provides not only an elegant description of the landscape, but also serves as a powerful means of comparing the form and process of drainage basins that may be widely separated in space and time (Easterbrook, 1993). Morphometric analysis is important in any hydrological investigation and it is inevitable in development and management of drainage basin. Geographical information system (GIS) has emerged as an efficient tool in delineation of drainage pattern and ground water potential and its planning GIS and image processing techniques. Morphometry is essentially quantitative, involving numerical variables whose values may be recovered from topographic maps. The importance of morphometric variables is their usefulness for comparisons and statistical analyses. This study involves evaluation of streams through the measurement of various stream properties, analysis of various drainage parameters namely ordering of the various streams and measurement of area of basin, perimeter of basin and length of drainage channels, Drainage Density (Dd), Drainage frequency, Bifurcation Ratio (Rb), Texture Ratio(T) and Circulatory Ratio (RC). Quantitative description of the basin morphometry also requires the characterization of linear and areal features, detailed analysis of drainage parameters is of great help in understanding the influence of drainage morphometry on landforms and their characteristics.

Key Words: ***Remote sensing, GIS techniques, Morphometric, Drainage, Basin, Stream order***

INTRODUCTION

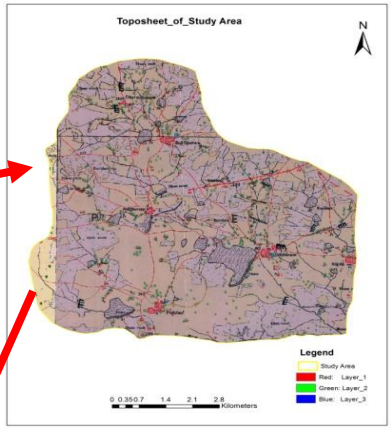
Morphometry represents the topographical expression of land by way of area, slope, shape, length, etc. These parameters affect catchment stream flow pattern through their influence on concentration time (Jones, 1999). The significance of these landscape parameters was earlier pointed out by, who observed that stream flow can be expressed as a general function of geomorphology of a watershed. Morphometric analysis of drainage basins thus provides not only an elegant description of the landscape, but also serves as a powerful means of comparing the form and process of drainage basins that may be widely separated in space and time (Easterbrook, 1993).Various important hydrologic phenomena can be correlated with the physiographic characteristics of drainage basins such as size, shape, slope of drainage area, drainage density, size and length of the contributories. The quantitative analysis of drainage system is an important aspect of characteristics of watershed region. Drainage pattern refers to spatial relationship among streams or rivers, which may be influenced in their erosion by inequalities of slope, soils, rock resistance, structure and geological history of a region. Morphometry is the measurement and mathematical analysis of the configuration of the earth's surface, shape and dimension of its landforms (Clarke, 1966). The present study is aimed to understand the drainage water bodies dynamics and their usefulness in Mothkuri watershed.

STUDY AREA

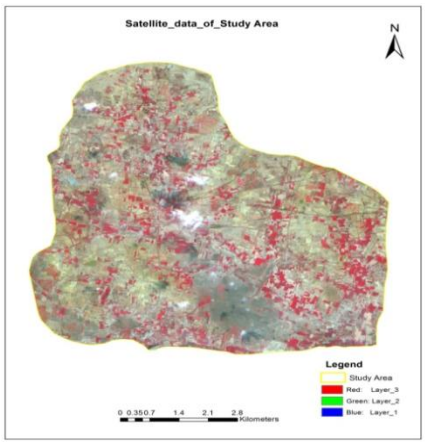
Mothkuri is located in Nalagonda District of Telanagana. The Mothkuri watershed is situated It lies between 17°28'51.14° and 17°25'58.53°N latitude and 79°17'3.63° and 79°14'2.69°E longitude and the total area is 5541.82 ha. The population of Mothkuri Mandal as per 2001 census is 55638 and 2011 census is 55699 with a very less growth of 0.11%. Tobaccos, Paddy, Sugarcane, and Groundnut are the major crops that are cultivated mostly in the area. It is located on the banks of Bikkeru a tributary of Musi River which itself is a tributary of river Krishna.

LOCATION MAP OF STUDY AREA

India with Telangana



Study Area Toposheet



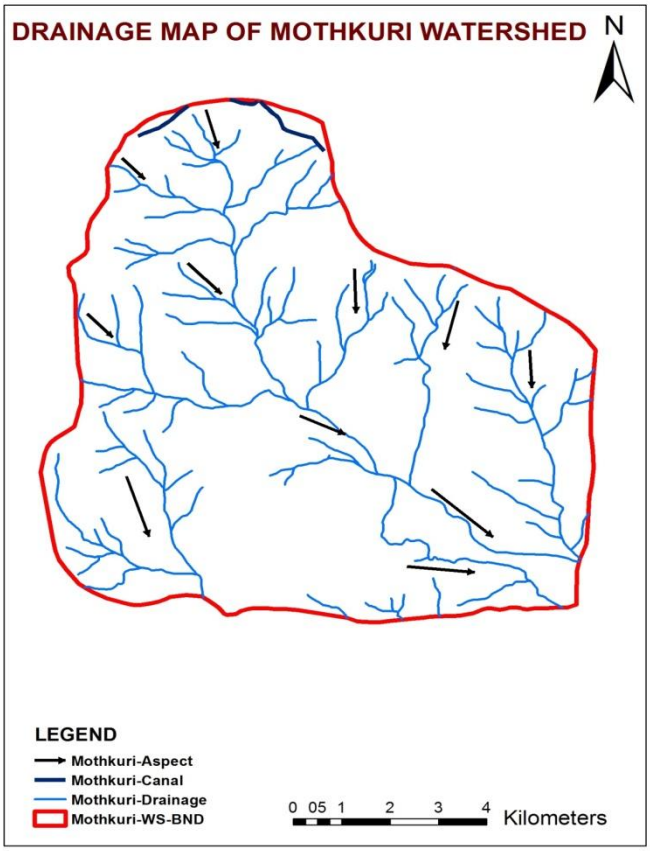
Study Area Satellite image

DATA SOURCE AND METHODOLOGY

The morphometric analysis of the Mothkuri Watershed was based on topographical map on 1:50,000 scale. The various GIS software is used such as ERDAS 9.2, Arc GIS 10.2.2 in the preparation of digital layers of various morphometric maps. The current data source of Telangana State Remote Sensing Centre (TRAC), Hyderabad Telangana.IRS P6 LISS III data was prepared the base map and drainage map of Mothkuri Watershed. The morphometric parameters were divided in three categories: Basic parameter, Derived parameters and Shaper parameters. Area, Perimeters, Basin Length, Stream Order, Stream Length, Maximum and Minimum Heights and Slope come under first categories. Those of the second categories are Bifurcation Ratio, Stream Length Ratio, Stream Frequency, Drainage Density. The drainage network of the basin was analysed as per Horton S and laws and the stream ordering was made after Strahler.

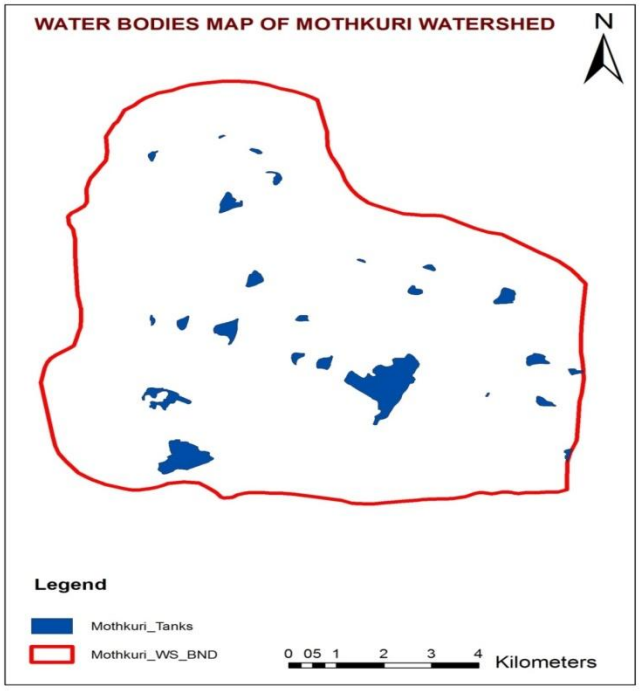
DRAINAGE PATTERN OF STUDY AREA

Generally, the drainage pattern in the study area is dendritic (i.e., irregular branching of streams in many directions and at almost any angle usually at less than a right angle) to sub-dendritic and trellis. The drainage density in this study area. Bikkeru a tributary of Musi River is flowing this Mothkuri watershed. These are the major water bodies, are flowing and many small streams also flowing in this catchment area. The drainage pattern in the study area is dendritic.



SURFACE WATER BODIES OF STUDY AREA

In the Mothkuri watershed is the area occupied by surface water bodies. These surface water bodies are in the form of rivers, streams, tanks, ponds, canals, etc.. A part from the Mothkuri Bikkeru a tributary of Musi River is flowing this Mothkuri water shed. These are the major water bodies are flowing and many small streams also flowing in this catchment area. The Surface water bodies captured from high resolution images are shown:



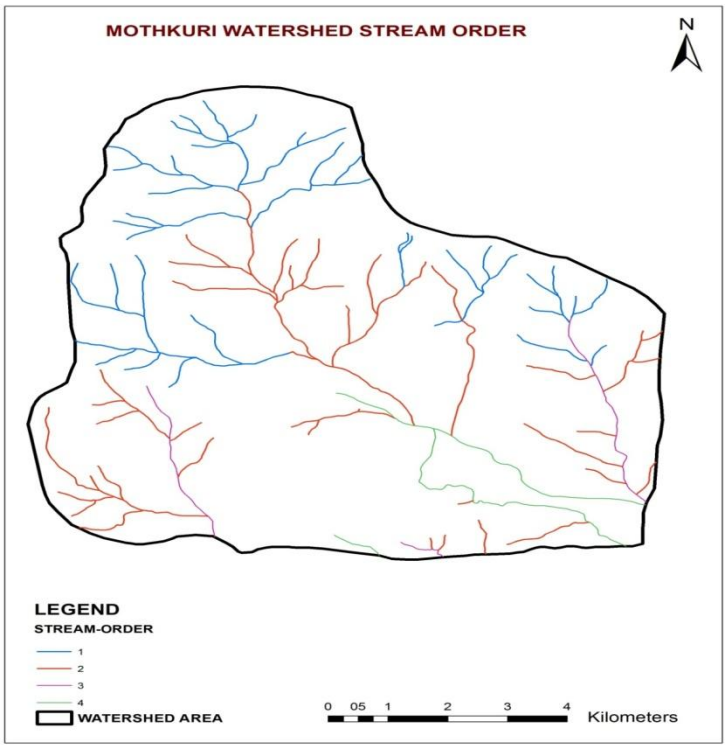
STREAM ORDER IN STUDY AREA

Strahler's system of streams analysis is probably the simplest and most used system. His stream ordering method is, each finger tip channel is designated as a segment of the first order. At the junction of any two first order segment, a channel of the second order channel, whereupon a segment of third order results and so forth. The study area has totally 4 order streams in Mothkuri drainage basin.

According to this table length of Mothkuri watershed 1st order stream is 37.52 km, 2nd order is 43.08km, 3rd and 4th order is 7.55km and 10.34 km. The total stream length is 98.50kms.

MOTHKURI WATERSHED STREAM ORDER

River Basin	Stream Order	Number of Streams	Stream Length (km)
Mothkuri Watershed	1	47	37.52
	2	41	43.08
	3	3	7.55
	4	3	10.34
	Total	**94**	**98.50**



MORPHOMETRIC ANALYSIS PARAMETERS OF STUDY AREA

First and foremost analysis in morphometric is basic parameters. Some of the basic parameters are area of the study region, perimeter, basin length, streams order, stream number, stream length and slope. Further studies are a concentration of all these parameters.

Area (A)

Drainage area is defined as collecting area from which water would go to stream or river. The boundary of area is delineated by ridge separating water flowing in opposite direction. The parameters which are governed by the area of drainage basin are classed as aerial aspects of basin. Aerial aspects include different morphometric parameters like drainage area, drainage density. Mothkuri watershed located between 17°28' N to 17°25' N and 79°17' E to 79°14'E. The total drainage area of Mothkuri Watershed is 5541.82 km2. Measured and verified through digitized map.

Perimeter (P)

The perimeter of a drainage basin is defined as the horizontal projection of its water divide. It delimits the area of the drainage basin on the map and is always smaller than the true length of the water divide. However, being determined more easily than the later, it is always used for topographical purposes. The water divide is the

line linking the points of greatest height between two drainage basins and separating their surface run off. Perimeter length is the linear length of a drainage basin. One can measure this length with string, map wheel or digitizer. Perimeter is the total length of the drainage basin boundary. The perimeter of Mothkuri watershed is 450 km.

Basin Length

The length in a straight line from the mouth of the stream to the farthest point on the drainage divides of its basin. The basin length corresponds to the maximum length of the basin. The basin length of the study area is 230 Kms. The total stream length in Mothkuri watershed is 98.50kms.

Stream Order (Nu)

Strahler's system of streams analysis is probably the simplest and most used system. His stream ordering method is, each finger tip channel is designated as a segment of the first order. At the junction of any two first order segment, a channel of the second order channel, whereupon a segment of third order results and so forth. The study area has totally 4 order streams in Mothkuri drainage basin.

Stream Numbers

The counts of stream channel in its order are known as stream number. The number of the stream segments decreases as the order increases, the higher amount streams order indicates lesser permeability and infiltration. The number of streams had high influence, on slope character of that region. The Mothkuri watershed study area total number of streams are 94, in that 1st order streams are 47, 2^{nd} order streams are 41, 3^{rd} order streams are 3, 4^{th} order streams are 3.

Stream Length(Lu)

Stream length is the total length of streams in a particular order. Stream length is measured from confluence region of the river Mothkuri to drainage divide with the help of Arc GIS software. This has been computed based on the law proposed by Horton (1945) for all sub basins of the study area. Horton's law of stream length states that the total length of stream segments of a given order in a basin length is inversely related to stream order.

CONCLUSIONS

The drainage morphometric analysis of Mothkuri watershed reveals some complex morphometric characteristics of the Mothkuri stream. The Mothkuri watershed is a 4th order stream with dendritic pattern of drainage, which is the characteristic nature of granitic and gneissic formations occupied predominantly in the watershed area In almost all the cases the watershed and micro watersheds stream lengths decrease as the stream order increases and they are lowest in case of highest stream orders supporting Horton's law of stream numbers and stream length ratios. The quantitative analysis of morphometric parameters is found to be immense utility in river basin evaluation, watershed prioritization for soil and water conservation and natural resources management at micro level. The morphometric analysis carried out in the Mothkuri watershed.

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