Morphometric parameters of micro watershed in Paravanar Sub-Basin, Cuddalore District

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ABSTRACT

Morphometric parameters of micro watershed of Paravanar sub-basin is extracted from digital elevation data using D8 algorithm available within *r.watershed* module in GRASS GIS and Quantum GIS environment. The basis for assuming the limiting threshold value is discussed by using ASTER data and the results are computed. The number of micro-watersheds resulting for limiting threshold value is obtained and presented. *r.water.outlet* module was used to obtain a watershed basin with a set of coordinates representing the outlet point of watershed. Subsequently *r.basin* module was used to determined the linear, areal and relief aspects of the micro watershed. The total area of micro watershed is 100Km^2 with the main channel extend of about 21Km. The Bifurcation Ratio is about 3.2 and the maximum order based on Strahler method is about 4 with 37 total numbers of streams.

KEY WORDS: Paravanar sub-basin, Cuddalore, ASTER, GRASS GIS

1. INTRODUCTION

Geographic Resources Analysis Support System (GRASS GIS) is an open source project (Neteler and Mitasova, 2002; GRASS Development Team, 2002), freely available on the internet, which offers an integrated environment for raster and vector analysis, image processing and map creation. Numerous studies were carried out on morphometric analysis by using Shuttle Radar Topography Mission (SRTM), Advance Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data. In which Geographic Information System (GIS) practice is a widely used because it is speed, accuracy, fast and inexpensive way for calculating morphometric analysis (Grohmann, 2007). According to Mesa, (2006) the primary components which determine a basin are such as geology, climate and relief. According to Grohmann (2007), surface roughness is a useful parameter for morphological compartimention. Franco-Plata (2013), implemented a geomatic module to extract the physiographic parameters of a basin. The present study is mainly undertaken to delineate the morphometric parameters for micro watershed in Paravanar sub basin by using Advance Spaceborne Thermal Emission and Reflection Radiometer (ASTER) data using open source GRASS GIS and Quantum GIS.

Study Area: Paravanar sub basin is taken as the study area which lies between 340018.28 Easting Centroid of Basin and between 1282425.29 Northing Centroid of Basin in UTM degrees covered in part of Cuddalore district of Tamil Nadu. The basin area is onscreen digitized from the survey of India toposheet, which covers an area about 882 km² (Figure 1). The study area includes three largest open cast lignite mines which are operated by Neyveli Lignite Corporation Ltd. The Cuddalore sandstones are exposed found interlocked with parts of clay patch and fully enclosed by lateritic formation (Selvaraj and Ramasamy, 1998).

2. MATERIALS AND METHODS

The Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER global DEM has been downloaded from the http://earthexplorer.usgs.gov. The obtained raster has a resolution of 30m for the study area (Figure 2). GRASS GIS and QGIS were used in demarcate the linear, areal and relief aspects like stream order, stream number for various orders, bifurcation ratio, stream lengths for various stream orders and length ratio, drainage density, Elongation Ratio (Re) and slope etc., will be derived by using the *r.basin* module.
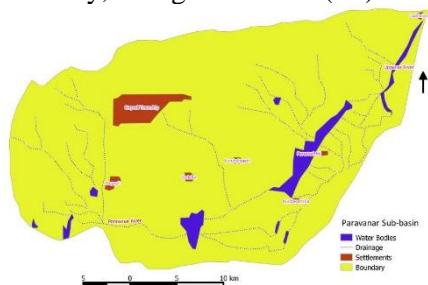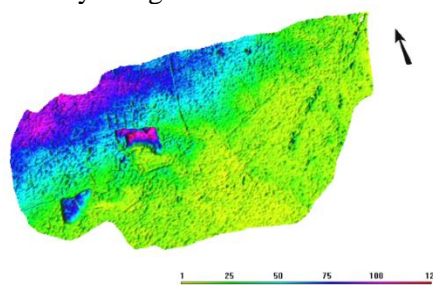

Figure.1.Study area Paravanar sub-basin   **Figure.2.3D view of the study area Paravanar sub-basin**

3. RESULTS AND DISCUSSION

Morphometric parameters of micro watershed of Paravanar sub-basin is extracted by with ASTER digital elevation data of 30m using D8 algorithm available within r.watershed module in GRASS GIS and Quantum GIS environment. The basis for assuming the limiting threshold value of 500 was used and the results are computed. The

flow accumulation, number of micro-watersheds and basins resulting for limiting threshold value is obtained and presented in the Figure 3, 4 and 5 respectively. r.water. outlet module was used to obtain a watershed basin with a set of coordinates representing the outlet point of watershed. Subsequently r.basin module was used to determine the linear, areal and relief aspects of the watershed. Therefore r.basin module with a threshold=500 was used were the outlet point lies at easing=345487.427382 and northing=1279579.591542. The A* Search method with accumulating Surface Flow with MFD method was used to calculate the parameters. The result is with respect to only positive flow accumulation values in which cells with a likely underestimate for flow accumulation can no longer be identified. Thus the morphometric parameters such as the linear, areal and relief aspects of the micro watershed basin were given in the table 1. The characteristic features stream and its order were calculated and listed on the table 2&3 respectively.
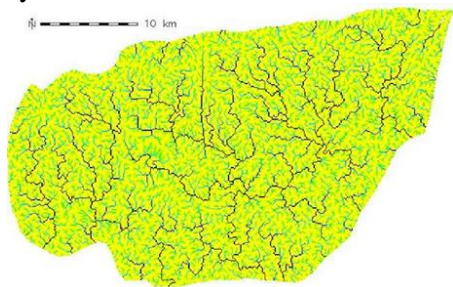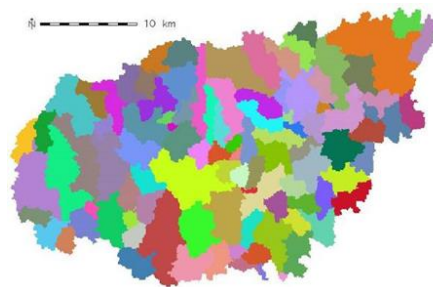

Figure.3 Flow accumulation of the Paravanar sub-basin
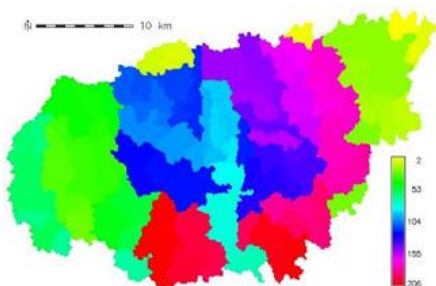

Figure.4 Micro watersheds of the Paravanar sub-basin

Figure.5.Watersheds of the Paravanar sub-basin

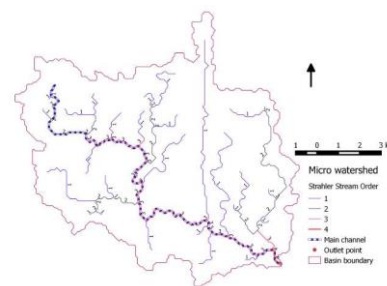**Figure.6.Calculated Micro-watersheds draped over flow accumulation**

Figure.7.Strahler's stream order of Micro-watersheds

Table.1.Morphometric parameters details of the micro watershed basin

Parameters	Results
Easting Centroid of basin	340018.28
Northing Centroid of Basin	1284444.96
Rectangle containing basin N-W	333036.6838569 , 1291376.10061366
Rectangle containing basin S-E	346361.02901452, 1278523.65970635
Area of basin [km^2]	100.30
Perimeter of basin [km]	60.17
Max Elevation [m s.l.m.]	128.0
Min Elevation [m s.l.m.]	6.0
Elevation Difference [m]	122.0
Mean Elevation [m s.l.m.]	54.35
Mean Slope	1.54
Length of Directing Vector [km]	7.32
Prevalent Orientation [degree from north, Counter clockwise]	0.72
Compactness Coefficient	5.32
Circularity Ratio	0.34
Topological Diameter	23.0
Elongation Ratio	0.52
Shape Factor	4.66
Concentration Time (Giandotti, 1934) [hr]	8.18
Length of Mainchannel [km]	21.48

Mean slope of mainchannel [percent]	0.58
Mean hillslope length [m]	100.15
Max order (Strahler)	4
Number of streams	37
Total Stream Length [km]	93.58
First order stream frequency	0.25
Drainage Density [km/km^2]	0.93
Bifurcation Ratio (Horton)	3.22
Length Ratio (Horton)	1.45
Area ratio (Horton)	3.13
Slope ratio (Horton)	1.29

Table.2.The stream statistics of the micro watershed

Max order	Total No. Streams	Total Stream Length	Total Area.	Drainage Density	Stream freq.
(num)	(num)	(km)	(km^2)	(km/km^2)	(num/km^2)
4	37	93.76	100	0. 94	0.37

Table.3.The Strahler stream order of the micro watershed

Order	No. of Streams	Total Length (km)	Total Area (km^2)
1	28	54.29	66.72
2	6	21.07	50.19
3	2	17.28	98.78
4	1	0.94	100

4. CONCLUSION

An attempt has been made to study the micro level watershed and its morphometric character pertains to the Paravanar sub basin watershed. This study was mainly based on the free available data ASTER data for preparing the surface digital elevation model, aspect maps and slope maps. GRASS GIS and Quantum GIS were used in estimate the linear, areal and relief aspects of morphometric parameters. The total area of micro watershed is 100Km^2 with the main channel extend of about 21Km. The Bifurcation Ratio is about 3.2 which indicate there are no structural controls on the drainage pattern and the maximum order based on Strahler method is about 4 with 37 total numbers of streams.

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