A STUDY ON REMOTE SENSING & GIS APPLICATIONS IN WATERSHED MANAGEMENT

***Siddnagowda, Assistant Professor (Group A), Dept. of Civil Engineering. Govt. Engineering College, Raichur.**

Abstracts

Objectives of this paper are to Study Morphometric parameters such as Water Density, Stream Frequency, Texture Ratio, Valley Length, Elongation Ratio, Circulation Ratio and Form Factor Ratio. In addition to this calculate the run-off, sediment yield, vegetative cover factor, annual rainfall and mean temperature In this study, the Akeru river site of the Parvathagiri mandal in the Warangal region was selected for detailed morphometric analysis. The study performed manual and computer specifications as well as a drainage sample, which led to detailed morphological measures. Topographic maps combined with remote data, are used to determine the existing drainage system, thus accurately identifying water divisions. This was achieved using the Geographic Information System (GIS) to provide computer-generated data that can be converted to various calculations for morphometric analysis. The morphometric analysis obtained from this study addressed: 1) distribution behavior, 2) morphometric configuration of streams within the drainage system and 3) interactions between connected streams. Improved use of remote sensing techniques (RS) and Geographical Information System (GIS) has led to the measurement of morphometric analyzes based on different parameters. The location map and satellite image of IRS LISS-III is used to edit maps with different themes using ARCGIS9.2 and Erdas imagine 9.1 software.

1. **Keyword:** ***Remote Sensing, GIS, Watershed Management,*** **Thematic Maps.**

1. INTRODUCTION

Rain is a natural gift for man to live and to grow his food. It is an important source of income for the local life of Watershed. Each Watershed is a family in itself as the incoming and outgoing water can be measured and budgeted for. Therefore, rainfall, flow recharging, evaporation, respiration, hiding and retention occur in one unit. Watershed is a geo-hydrological unit that draws water out of a common area. It can be divided based on the back and gully lines. In other words, a watershed is a dividing area based on a

water dividing line that separates a drainage ditch from another. Micro-watershed is the basis of management and planning. Morphometry is defined as a measure of shape. Morph metric studies in the field of hydrology were initiated by Horton (1940) and Strahler (1950). The morphometric analysis of the drainage hole and the network of channels plays an important role in understanding the geo-hydrological behavior of the drainage basin and reveals the existing climate, geology, geomorphology, structural, etc. which precedes the pumping station. The Indian economy is largely rural, hence the development of rural areas depends upon the optimum management of natural resources particularly the Water resources. A Drainage basin (or) Watershed can be considered as a preferable unit for initiating water conservation and management practices .Watershed management is an integration of technology within the natural boundaries of a drainage basin for land, hydrological, biotic and vegetative resources development to fulfill the population needs on sustainable basis. The study deals with the Integrated watershed management of Parvathagiri mandal which is located in Warangal district of the Andhra Pradesh. The study area extends between 79o 30' E and 17o 30' N and 79o 50' E and 17o 50' N. Toposheets numbers are 56O/9SE, 56O/10NE, 56O/13SW & 56O/14NW on 1:25,000 scale provides the physiographic coverage of the study area. Total extent of the study area is 162 sq. kms.

In this study, the Akeru river basin area of Parvathagiri mandal in Warangal district having selected for detailed morphometric analysis. The study performed manual and computerized delineation and drainage sampling, which enables applying detailed morphological measures. Topographic maps in combination with remotely sensed data, were utilized to delineate the existing drainage system, thus to identify precisely water divides. This was achieved using Geographic Information System (GIS) to provide computerized data that can be manipulated for different calculations for morphometric analysis. The obtained morphometric analysis in this study tackled: 1) stream behavior, 2) morphometric setting of streams within the drainage system and 3) interrelation between connected streams. The advanced application of Remote Sensing (RS) and Geographical Information System (GIS) techniques has lead to estimation of morphometric analysis based on different parameters. Topographical map and IRS LISS-III satellite image are used for preparing different thematic maps using ARCGIS9.2 and Erdas imagine 9.1 software

2. REMOTE SENSING AND GIS ADVANCES IN WATERSHED MANAGEMENT

Since the launch of the advanced installation of the remote sensor application we have seen the phase transition from the app map to decision-making. . High-intensity and near-infrared sensors such as those in the IRS can be used to measure surface water level due to the strong infrared contact between the water and the surrounding area. Informal land use information is important because the ground cover record can be used to measure the amount, quality and timing of water harvesting in response to a specific rain event or water purification. Physiographic observations as a hole and location, fine-tuning, water density and pattern and specific channel features can enable the researcher to estimate the annual flow rate and annual flow of wetlands, as well as to respond quickly to a river in a particular rain event. GIS is a computer program capable of capturing, storing, analyzing, and providing geographically identified information; that is, geographically identified data. Employees also define GIS as integration processes, operational personnel,

and system data entering the system. The power of GIS comes from the ability to integrate different information locally and to reach conclusions about these relationships. Therefore, GIS can reveal important new information that leads to better decisions. GIS can also convert existing digital information, which may not yet be in map form, into forms that researcher see and use.

3. OBJECTIVES OF THE STUDY

- To Study Morphometric parameters such as Water Density, Stream Frequency, Texture Ratio, Valley Length, Elongation Ratio, Circulation Ratio and Form Factor Ratio.
- To calculate the run-off, sediment yield, vegetative cover factor, annual rainfall and mean temperature

4. BRIEF PROFILE OF STUDY AREA

Parvathagiri Mandal is part of the Warangal Region, Telangana stretching between 79o 30 'E and 17o 30' N and 79o 50 'E and 17o 50' N latitude. It has a total area of 162 sq. M. km. Parvathagiri Has 13 Income Houses, 19 Gram Panchayats and 38 Residences. There are no cities in this Mandal. The Akeru River flows with the Parvathagiri mandal and forms almost a bare boundary except for a few mountain rocks in the North and West. These hills rise 213 to 350 feet above sea level. The general slope is from north to south, with a level almost visible to the basin.

.

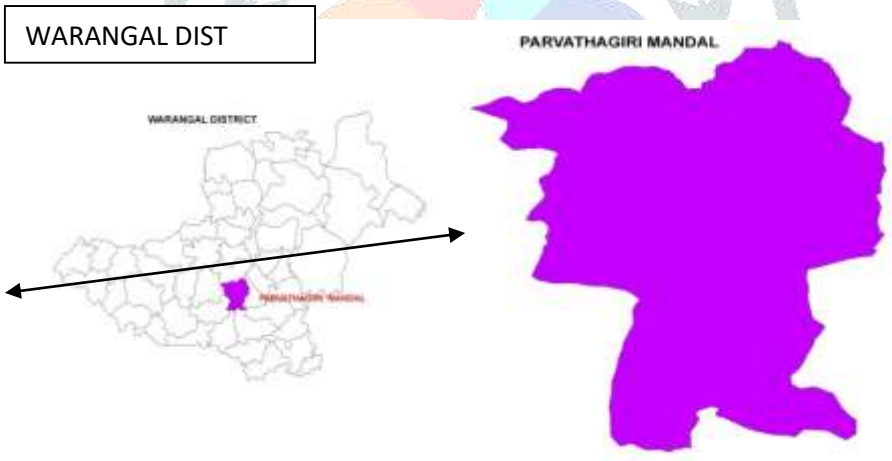

Fig 1.1. Location Map of the Study Area

4.1Rainfall

The rainfall is the source of all water in the form of rain. The study area mainly experiences the south west monsoon. The southwest monsoon sets by middle of June. The Area receives an average of 874 mm of rain fall for the year 2011-12.

4.2Cropping pattern

Farmers diversify their cropping pattern through number of crops through two seasons main rainy season (kharif), post rainy season (rabi).The main cropping of the study area is cotton, groundnuts, maize, fruits and vegetables in few hectares.

4.3Soils

The study area consists of red soil and light black soils having the fertility varying from good to poor.

4.4Demography

An increase of about 500 households (or 2500 people) has been recorded over the last 10 years in the mandal. SC/ST's make about 40% of the total population of the area. The main livelihood in the area is agriculture. The average per capita availability of land is 0.35 ha.

4.5 Methodology

The process includes mapping with themes such as basic map, Drainage and water boundary, concrete map, slope map, land use / land cover map and calculation Morphometric parameters such as Drainage Density, Stream Frequency, Texture Ratio, Basin Length, Elongation Ratio . , Circulation Ratio and Form Factor Ratio. To calculate runtime, sediment yield, vegetative cover factor, annual rainfall and average temperature.

4.6 Collection of Rainfall data

Year	Rain fall (cm)
2002	99.3
2003	65.0
2004	102.8
2005	69.6
2006	76.1
2007	72.3
2008	100.0
2009	102.8
2010	90.0
2011	96.0
Average	**87.39**

Table: Rainfall data of Study Area (2002-2011)

(Source: Warangal weather station)

5. THEMATIC MAPS

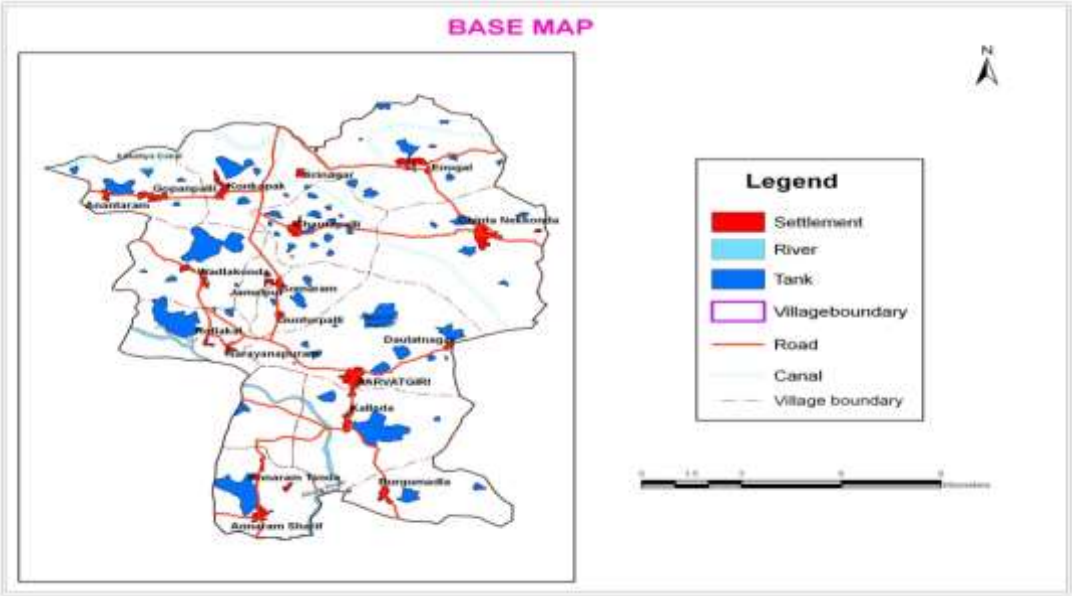

Figure 1. Base map of the Parvathagiri mandal

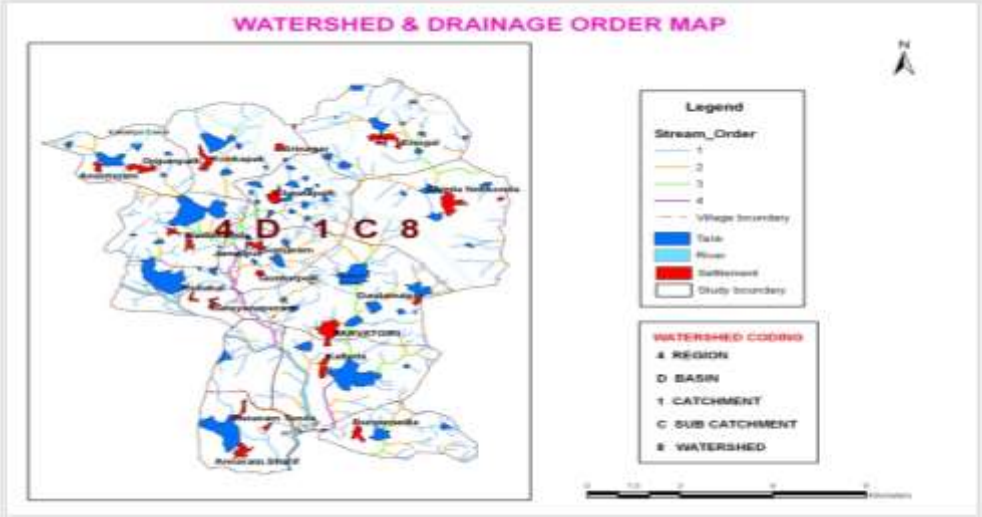

Figure 2. Drainage pattern and their order identified from the Parvathagiri mandal

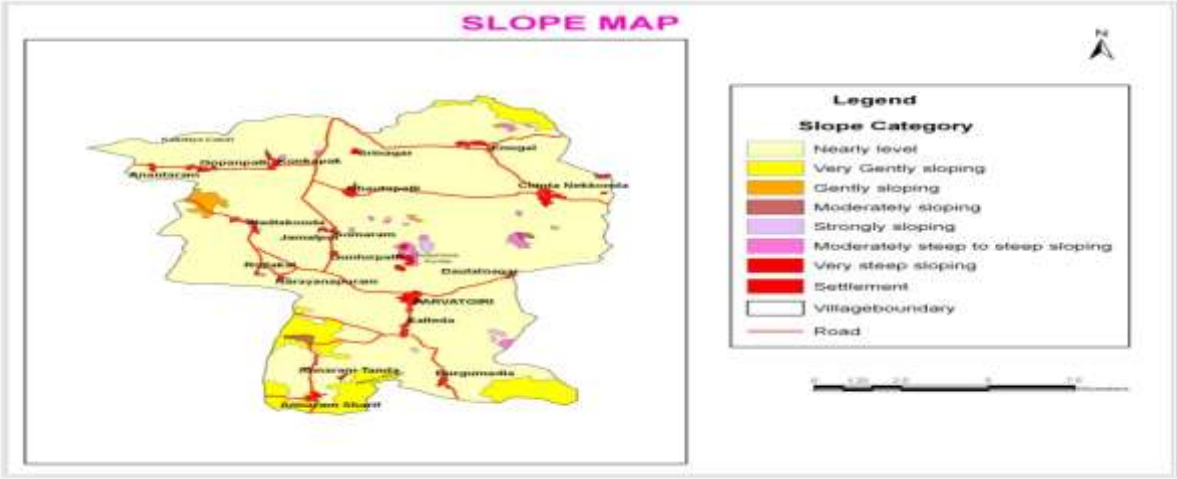

Figure 3. Slope map of Parvathagiri mandal

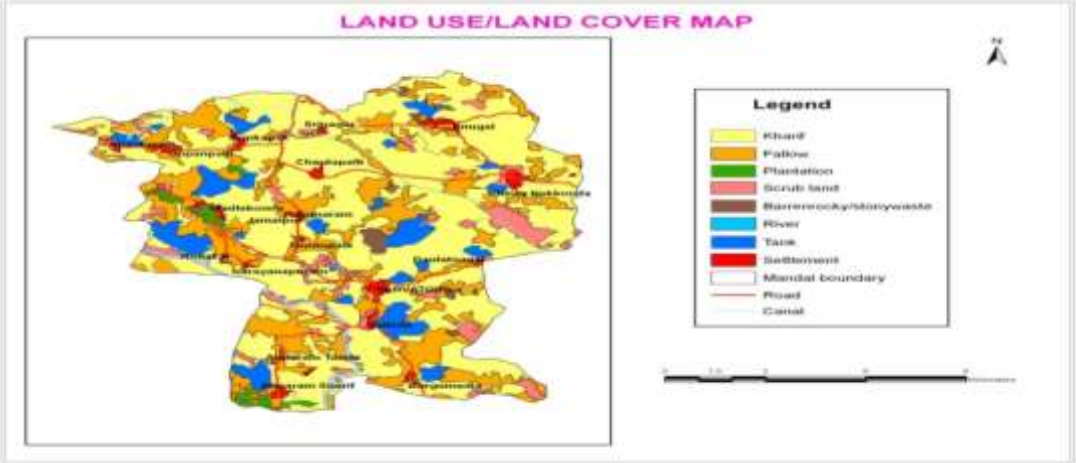

Figure 4. Land use/Land cover map of Parvathagiri mandal

6. RESULTS AND ANALYSIS:

An attempt has been made to use GIS translation techniques to determine the relationship between morphometric parameters at the canal level. Drainage was specified using IRS LISS-III satellite data at a scale of 1: 25,000 and SOI top sheets were used as reference. Based on the norms and standards of the All India Land Use organization. Related drainage networks are digitized using Arc GIS and stream orders are calculated using the method proposed by Strahler (1964). The morphometric parameters of the vessel are given in Tables 3.1 and 3.2. The linear parameters are analyzed including broadcast order, broadcast length, broadcast length and bifurcation rate. Based on the drainage rules, the current study area is divided into a fourth system and the drainage pattern is usually a dendritic type. The number of broadcast orders is calculated and the total length of each order stream is calculated at the whole level with the help of GIS software. All aerial parameters, a water pump with a study area have been developed with the help of ERDAS software and Arc GIS..

Table 3.1: Linear Aspects of the Drainage Network of the Study Area:

River Basin	Stream Order u	Number of streams	Total Length Of Stream in km	Log N_u	Log L_u
Akeru	1	328	159.180	2.515	2.202
	2	82	53.813	1.913	1.731
	3	19	16.893	1.278	1.228
	4	2	90.26	0.301	1.95

Bifurcation Ratio			Mean Bifurcation Ratio
1^{st} order / 2^{nd} order	2^{nd} order/ 3^{rd} order	3^{rd} order /4^{th} order	
4.0	4.316	9.5	5.94

Table 3.2: Aerial aspects of the study area

Morphometric Parameters	Symbol / Formula	
Area (sq. km)	A	162
Perimeter (km)	P	72.667
Drainage Density (km/sq.km)	$D=\frac{Lu}{A}$	320.146/162 = 1.976
Stream frequency (sq. km)	$F_s=\frac{NU}{A}$	431/162 =2.66
Texture ratio	$T=\frac{N1}{p}$	8.36
Basin length (km)	L_b	72.67
Elongation ratio	$R_e=\frac{2\sqrt{A/\pi}}{Lb}$	0.197
Circularity ratio	$R_c=\frac{4\Pi A}{p2}$	0.385
Form factor ratio	$R_f= A/L^2_b$	0.031

7. Vegetative cover factor

Vegetative cover factor is determined from the land use/land cover map. It is one of the parameters used for the computation of sediment yield. Vegetative cover factor is inversely proportional to the sediment yield. The vegetative cover factor is given by

$$FC = \frac{0.2F1+0.2F2+0.6F3+0.8F4+F5}{F1+F2+F3+F4+F5}$$

Where

F1 = Reserve & protected forest area = nil

F2 =Unclassified forest area = nil

F3 =Cultivated area = 97.65 sq.km

F4 = Grass &pasture land = nil

F5 = waste land = 32.182 sq km

$$FC = \frac{0.2(0) + 0.2(0) + 0.6(97.65) + 0.8(0)+32.182}{0+0+97.65+0+32.182} = 0.69$$

8. Computation of Runoff

The runoff formula developed by Garde et al (1985) is used in the present thesis. Runoff obtained by this formula is accurate and reliable for estimation of sediment yield using remote sensing techniques. The parameters involved in the computation of runoff are annual rainfall, mean temperature and vegetative cover factor. The Garde formula for runoff is

$$\text{Run off } (Q) = \frac{Fc^{0.49} \times (Pm - 0.5\,Tm)^{1.59}}{26.5}$$

Where

FC => Vegetative cover factor

Pm=> Annual Precipitation

Tm=> Mean temperature (°C)

Q=> Runoff in Mm^3

9. Annual rainfall

Monthly normal rainfall data at Warangal weather station for a period of 10 years (2002-2011) is collected and calculated. The average annual rainfall of Parvathagiri mandal is 87.39cm.

10.Mean temperature

The temperature data recorded at warangal weather station. The average of mean monthly max-min temperature for 10 years is collected. The normal mean annual max-min temperature of Parvathagiri mandal for the last 10 years as shown in the following Table 3.3.

Table: 3.3 Temperature data of study Area (2002-2011)

Year	Max.temp °C)	Min.temp (°C)	Mean emp (°C)
2002	40.28	20.26	30.27
2003	42.10	20.50	31.30
2004	43.03	20.39	31.71
2005	44.11	20.19	32.15
2006	42.58	20.84	31.71
2007	42.33	19.88	31.11
2008	41.76	20.85	31.30
2009	41.38	20.65	31.02
2010	42.00	19.83	30.92
2011	44.98	19.99	32.49

Mean Annual temperature of Parvathagiri mandal = 31.398(°C)

$$\text{Run off } (Q) = \frac{Fc^{0.49} \times (Pm - 0.5\,Tm)^{1.59}}{26.5}$$

Where,

FC => Vegetative cover factor = 0.69

Pm=> Annual Precipitation = 87.39cm

Tm=> Mean temperature (°C) = 31.398°C

Q=> Runoff in Mm^3 = ……

$$\text{Annual Runoff (Q)} = \frac{0.64^{0.49}\,(87.39 - 0.5 \times 31.398)^{1.59}}{26.5} = 27.03\ Mm^2$$

11. SUMMARY AND CONCLUSIONS:

The current study focuses mainly on an integrated approach, where the problem of soil erosion is a highly focused subject. To implement this approach, the input data is considered as a satellite image of the P6 IRS 1C, the flow rate and yield of sedimentation and socio-economic data analysis. The combination of false colors IRS 1C, Indian Toposheets Survey, Socio-Economic Survey, recorded data from the weather station are the main sources of data used. The result is based on a topical map in the form of different land use / land cover, a sloping map, a water source map of the study area as well as a soil yield measure in line with socio-economic data using the ARC / GIS package 9.2.

1. Parvatigiri Mandal, located at Warangal Dist. It contains up to 209 ha (1.29%) Hills. 4415 ha (27.25%) plains, 1110 hectares of flood plains (6.85%).

2. Local rainfall has not changed but is found to vary between 99.3cm to 102.8 cm in parvathi girimandal for 10 years. The average annual rainwater harvesting is operating at 87.39cm.

3. The agricultural area accounts for 97.65% of the total Parvathagiri mandal. The most widely used plants in the water are cotton, nuts, corn, greengram, fresh fruit, mangoes, vegetables, etc.

4. The annual output of the study area is 27.03mm2. In this study, sediment yield figures are 0.0778 calculated by the number of distances. Therefore, the soil level is estimated at 4.8x10-

5. Based on a land use / cover map of an area covered by 325ha lands, agricultural area occupies 13265 hectares, agricultural area occupying 198 hectares, 1099ha waste land area, and 1313 ha water areas.

12. REFERNCES

- All India Soil and Land Use Survey (1990). Watershed Atlas of India. Department of Agriculture and Co-operation. IARI Campus, New Delhi.
- Arakeri H.R , Roy Donahue, “soil conservation and water management”. 1984, Oxford and IBH

- Bhagavan, S.V.B.K and Raghu, V. (2000). "Integrated Remote Sensing based Study of National Watershed Development Project for Rain fed Area in A.P". Abstract Volume of National Symposium on Remote Sensing for Natural Resources with Special Emphasis on Watershed Management, Bhubaneswar, and pp.15.
- Biswas.T.D. Mukharjee.S.K. "Soil erosion and conservation" 1989 Central Research Institute for Dry land Agriculture, (1990). Field Manual on Watershed management, CRIDA, Hyderabad.
- Department of Space/ ISRO (1988). Manual for Hydrogeomorphological mapping for drinking water mission.