
WATERSHED PRESERVATION AND CONTROL USING GIS

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Abstract

Remote sensing (RS) and Geographical Information System (GIS) data provides timely, accurate and reliable information at definite intervals in a cost effective manner and these tools are helpful in mapping and monitoring of natural resources available for proper utilization. The Meghadrigedda watershed is selected for the present study and has a gross capacity of 1169 Mc. Ft. For the identification of morphological features and analyzing their properties of the Meghadrigedda basin various GIS and image processing techniques have been adopted. The linear and aerial aspects of the basin were calculated and computed. It is 7th order drainage basin and drainage pattern is dendritic type. The results obtained from watershed delineation and prioritization has wider application in preservation of the watershed.

Keywords:

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1.Introduction

Basin morphometry is the mathematical quantification of various drainage basin characteristics. Land is one of the important natural resource and it should be conserved to mitigate the increasing demand of land and water resources (Panhalkar S.S et al, 2012). In India 70% of the people depend on agriculture directly or indirectly. The analysis of the drainage basin is important in assessing the ground water potential and ground water management. The study on morphometric analysis using remote sensing and GIS techniques was carried out by (Sangita Mishra et al, (2010); Biswas et al. 1999; Panhalkar S.S et al, 2012; Subodh Chandra Pal and Gopal Chandra Debnath, 2012; Jagadeeswara Rao, Harikrishna P and Suryaprakasa Rao.B, 2006).

The Meghadrigedda watershed is the area enclosed between Northern latitude and Eastern longitude, covering an area of 453.40 sq. km falling in Survey of India (SOI) toposheet Nos: 65 O/1, O/2&O/3, O/5 and O/6 on 1:50,000 scale. Meghadrigedda reservoir was formed across Meghadrigedda and Naravagedda just 400 mts above their confluence to supply drinking water to the people of Visakhapatnam city at the rate of 8 Million gallons per day. The 8MGD of water is being drawn from the reservoir and distributed to various industries and industrial colonies by Visakhapatnam Municipal Corporation.

Meghadrigedda reservoir has a gross capacity of 1169 Mc.Ft and the flood bank was formed on the left side of the reservoir to protect the Howrah-Visakhapatnam railway line and the Chintalagraharam village. The average annual rainfall is around 110cm and occurs in the months of June to November. December and January are coldest months in this region and April and May are hottest months. The area enjoys sub tropical climate and the temperature ranges from 14 to 22° C in December and 33-45°C in May. Relative humidity is high in day time and varies between 70-80% throughout the year.

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Sujata Biswas, S. Sudhakar and V.R. Desai (1999) carried out prioritization of sub-watersheds based on morphometric analysis of drainage basin in Nayagram block located in Midnapore district, West Bengal and a small portion of Mayurbhanj district of Orissa using RS and GIS techniques. The study area is divided into 9 sub-watersheds and parameters like stream length, bifurcation ratio, drainage density, stream frequency, elongation ratio, circulatory ratio, texture ratio and form factor are considered for morphometric analysis and to prioritize the sub-watersheds. The analysis is done both by morphometric parameters and by using Sediment Yield Index (SYI) model. The results obtained in both cases are same and concluded that morphometric analysis is helpful in prioritization of sub-watersheds even without considering the soil map. The sub-watersheds are prioritized and ranking is given based on the soil erosion. Highest priority is observed in sub-watershed 8 because of high erosion in that basin and the ratio between total stream length and stream order is constant throughout the orders of a basin.

Chitra C et al (2011) studied watershed characteristics of Kundah sub-basin using remote sensing and GIS techniques. The study area is located in the Nilgiri hills covering a portion of the Nilgiri district, Tamilnadu. IRS P6 LISSIV FEB, 2006 satellite data is used for this study. It is noticed that stream frequency decreases as stream order increases. The basin is of 6th order and has dendritic drainage pattern. The entire area is divided into 25 sub-watersheds and characteristics are studied by considering stream order, stream length, bifurcation ratio, basin relief, elongation ratio, circulatory ratio, form factor, drainage density etc.

Subodh Chandra Pal and Gopal Chandra Debnath (2012) morphometric analysis and associated land use study of a part of the Dwarkeswar watershed is done. The study area looks like semi-elliptical shape located in Bankura and Puruliya district, West Bengal. 20 morphometric parameters are computed for the analysis and ASTERDEM data is used for the preparation of DEM. The watershed consists of 4th order streams and the pattern of drainage is dendritic. The watershed is less elongated and found that watershed experience moderate drainage texture. Land use/ land cover map is prepared by using LANDSAT ETM+ satellite image in which it is classified into 9 categories in the study area.

YangchanJ, Jain A.K, Tiwari A.K and Sood A (2015) had done a case study on Morphometric analysis of Sukhana lake watershed using GIS in the lower Shiwalik, India. The analysis is done by considering linear, areal and relief aspects. The Sukhana lake watershed has a dendritic drainage pattern with fifth order streams. GIS tools are helpful in analyzing the data accurately in short period of time. Based on the drainage density, drainage texture, elongation ratio, relief ratio values it is noted that the area is underlined by impermeable subsurface. The area is prone to soil erosion due to steep slopes with very fine texture.

2. Research Method

As reference and base map preparation, five toposheets on 1:50000 scale were used. The SOI toposheets are rectified and geo-referenced using digital image processing software (ERDAS IMAGINE ver: 9.1). Geo-referencing was performed using the nearest neighbour resampling algorithm with first order polynomial transformation. The toposheets have been assigned to Geographic (Lat/Lon) projection with WGS 84 datum is used for standard geographic coordinate system. Using GIS software (QGIS) digitization has been carried out for the entire analysis of basin. By following Strahler stream order method, ordering was given to each stream for the entire area. Various morphometric parameters such as linear and areal aspects of the drainage basin were computed. Based on the obtained values average compound parameter weightage value is calculated and rating is given to each sub-watershed. Finally prioritization is carried out and relative control measures are adopted in each sub-watershed.

3. Results and Analysis

Some of the control measures are adopted for the preservation of watershed such as contour bunding, construction of earthen embankments, check dams, construction of farm ponds etc.

The applications involved in watershed management include prevention of soil erosion, increasing water holding capacity, to reduce the effect of sediment yield on the watershed etc.

4. Conclusion

GIS provides friendly interface for the user and reliable information at definite intervals and pliability in preservation and control of watershed.

References

- [1] Biswas S., Sudhakar S., and Desai V.R, (1999), "Prioritization of subwatersheds based on morphometric analysis of drainage basin: a remote sensing and GIS approach", Journal of Indian Society of Remote Sensing, 27(3), pp 155-166
- [2] Biswas S., Sudhakar S., and Desai V.R, "Remote Sensing and Geographical Information System Based Approach for Watershed Conservation", Journal of Surveying Engineering, 128(3), pp. 108-124, 2002.
- [3] Bahuguna I.M., Nayak S., Tamilsan V et al, "Ground water prospective zones in basaltic terrain using remote sensing", Journal of Indian Society of Remote Sensing 31(2), pp. 107-118, 2003.
- [4] Horton R.E, (1967), "Erosional development of streams and their drainage basin: Hydrophysical approach to quantitative morphology", Bulletin of Geological Society of America, 56, pp 275-370

- [5] Miller, V.C, “A quantitative geomorphic study on drainage basin characteristics in the Clinch Mountain area, Virginia and Tennessee”, Columbia University, pp. 271-300,1953.
- [6] Panhalkar S.S., and Mali S.P., Pawar C.T, “Morphometric analysis and watershed development prioritization of Hiranyakeshi Basin in Maharashtra, India”, International Journal of Environmental Sciences, 3(1), pp. 525-534,2012.
- [7] Strahler A.N, “Quantitative analysis of watershed geomorphology”, Transactions of American Geophysical Union, 38(6), pp 913-920,1957.
- [8] Sangita Mishra S., and Nagarajan R, “Morphometric analysis and prioritization of subwatersheds using GIS and Remote Sensing techniques: a case study of Odisha”, International Journal of Geomatics and Geosciences, 1(3), pp 501-510,2010.
- [9] Sethupathi A.S., Lakshmi Narasimhan C., Vasanthamohan V and Mohan S.P, “Prioritization of microwatersheds based on Morphometric Analysis using Remote Sensing and GIS techniques in a draught prone Bargur-Mathur subwatersheds, Ponnaiyar River basin, India”, International Journal of Geomatics and Geosciences, 2(2), pp 403-414,2011.
- [10] Subodh Chandra Pal., and Gopal Chandra Debnath “Morphometric analysis and associated land use study of a part of the Dwarkeswar watershed”, International Journal of Geomatics and Geosciences 3(2), pp 351-363., 2012.
- [11] YangchanJ., Jain A.K., Tiwari A.K., and Sood A, “Morphometric Analysis of Drainage Basin through GIS: A Case study of Sukhna Lake Watershed in Lower Shiwalik, India”, International Journal of Scientific and Engineering Research, 6(2), pp 1015-1023, 2015.