REMOTE SENSING AND GIS BASED WATERSHED STUDIES IN AKRAVATI WATERSHED IN KARNATAKA

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Abstract

The present study has been carried out to characterize the Akravati Watershed by studying various watershed parameters and Weighted overlay analysis to suggest suitable land & water resources management plans for the area. This study is undertaken The *Kanakapura watershed forms a part of the Arkavathi river basin which is one of the principal tributaries of the river Cauvery in Karnataka. The watershed is bounded between 12°16'N and 12°35'N latitudes, 77°15'E and 77° 38' E longitudes, covering an area of about 81550 ha. (Figure 1). The entire watershed is divided into nine sub-watersheds, namely, Bannimukudlu, Bennagodu, DoddaAlahalli, Gadasahalli, Horalagallu, Kodihalli, Madarahalli, Maralebbekupe, and Mudagod, area of each ranges from 3000 to 25100 ha (NRSA, 1995)this study found that The seven input layers considered for weighted overlay analysis are rainfall, lithology, drainage density, slope, hydrogeo- morphic units, lineament density, and LULC. In order to bring all the thematic layers, having diverse, dissimilar inputs, into an integrated analysis, a common scale of value is applied to each layer. Hence, the sub-watersheds were categorized into four levels of ranking, ranging from 1 to 4, on the basis of their infiltration potential, namely: very low, low, medium, and high, respectively.*

Keywords : *Remote Sensing, GIS, Akravati Watershed, Weighted overlay analysis*

1. INTRODUCTION

The Water reaches at the Earth's surface through precipitation. Some amount of water falling on land seeps into the soil or flows over the surface before entering streams and lakes. The area of land that supplies water to a particular river or lake is known as watershed. The whole world is divided into many watersheds/ subwatersheds to make it easier to study the conservation, management and utilization of natural resources. India is a country in which people are living at the banks of rivers since ancient times and major cities in North-India like Allahabad, Varanasi and Kolkata are surviving nearby river banks representing wet point civilization.

In India the watershed programs based on traditional water management approaches, which focus on micro-watersheds as the basis for planning and intervention are in force since the late 1980s. The Government of India have brought the Drought Prone Areas Programme (DPAP) and the Desert Development Programme (DDP) under the watershed scheme in 1987. The Integrated Wasteland Development Programme (IWDP) under the aegis of the National Wasteland Development Board of the government of India launched in 1989 also aimed at the development of wastelands on watershed basis. All these activities were brought under the Watershed Development Programme and the Guidelines for Watershed Development Projects became operational in 1995. These projects are based on rainfall and runoff harvesting schemes that involve rehabilitating, building small check dams and tanks, and groundwater recharge structures. These types of plans were started for rural development. However, it has been realized that these programs should be more focused on land and water resources conservation and management. In the present study an attempt has been made to make a suitable action plan for KoshalyaJhajhara watershed conservation and management.

2. OBJECTIVES OF STUDY

The present study has been carried out to characterize the Akravati Watershed by studying various watershed parameters and Weighted overlay analysis to suggest suitable land & water resources management plans for the area.

3. WATERSHED

A watershed is a natural geo-hydrological unit, which drains into a common point or represents an area from which surface runoff is through common outlet such as the reservoir, mouth of a bay, or any point along a stream channel. The word watershed is synonym with drainage basin or catchment area. The two watersheds can be separated by ridges and hills that are known as drainage divide. The watershed may consist of surface streams, water-lakes, reservoirs, forest, agriculture land and wetlands, and all the underlying ground water. Watersheds contain many smaller watersheds also called sub-watersheds.

Watershed is also an ideal unit for checking land degradation, water and silt losses and thereby improving the environment. Watershed has its own characteristics features and problems related to land and water resources. To obtain maximum benefits from these resources, the watershed should be treated like a single unit, especially for soil and water conservation, flood management, control of siltation and sedimentation and to enhance the productivity of land. More over the problem of the upper catchment & lower catchment are interrelated and interdependent also as the changes in the upper catchment directly affect the status/ activities in the lower catchment.

4. REMOTE SENSING

Remote Sensing is defined as the science and art of gathering information about an object, body, phenomenon or the surface of the earth without making any physical contact with the object. In remote sensing

Electromagnetic Radiation (EMR) are used for taking observations. EMR refers to all forms of energy, which moves in a harmonic wave pattern with the velocity of light. The principle of remote sensing is based on the solar radiation reflected or emitted from the surface of the earth. The remote sensing image is formed of many small pictures elements called pixels. Pixel is the smallest part of a picture (the area being scanned) with a single value. The remote sensing method can be considered of comprising two parts: data acquisition and data analysis. The data acquisition is done either by space borne or air borne sensors. The device in which the solar radiation reflected or emitted by the earth surface is recorded is termed as passive remote sensing (here sun is the source of energy) such as optical remote sensing satellites and aircrafts. The other device in which the energy is first generated and directed towards the surface of the earth and the reflected energy is gathered is called active remote sensing (or microwave remote sensing) and the examples of such type of devices are RADAR or Radar Imaging Satellites (Indian RISAT satellite series) and work particularly in microwave region. The important remote sensing regions which are employed for data gathering are visible, infrared and microwave. The atmosphere of the earth absorbs most of the UV, X-ray and gamma rays and therefore these are not used for remote sensing.

5. APPLICATIONS OF RS & GIS

Remote Sensing (RS) and Geographic Information System (GIS) together can play an important role in mapping and management of natural resources. Remote Sensing can be used to characterize upto micro level and can depict slope direction, extent of cultivated area, wasteland, drainage density, soil erosion, decline in soil productivity, decline in forest cover and change in ecological equilibrium etc. Remotely Sensed Data (e.g. aerial photographs and satellite images) can be used to obtain information on geology, geomorphology, soils, land use, vegetation, slope gradient, runoff, erosion, groundwater prospects, recharge areas etc. GIS is an important tool for tracking spatial data. GIS can support many database queries tied to spatially referenced objects and their associated attributes. This is exclusively designed to store information about the location, topology and attributes of spatially referenced objects such as rivers, wells, wetlands, waste lands, land features, sub surface features and also non spatial data in the form of attributes etc. The use of GIS is to draw the composite maps by superimposing the data and image files obtained from traditional methods and satellite images (Shanwal and Singh 2006).

Remote Sensing and GIS collectively play a key role in natural resources mapping and management like: land and water resources planning, conservation and management. These are very useful tools in watershed conservation and management. Remote Sensing and GIS play a vital role in decision support system for various activities related with development and management of land and water resources in an environmentally sound and sustainable manner.

6. STUDY AREA

The Kanakapura watershed forms a part of the Arkavathi river basin which is one of the principal tributaries of the river Cauvery in Karnataka. The watershed is bounded between 12°16′N and 12°35′N latitudes, 77°15′E and 77° 38′ E longitudes, covering an area of about 81550 ha. (Figure 1). The entire watershed is divided into nine sub-watersheds, namely, Bannimukudlu, Bennagodu, DoddaAlahalli, Gadasahalli, Horalagallu, Kodihalli, Madarahalli, Maralebbekupe, and Mudagod, area of each ranges from 3000 to 25100 ha (NRSA, 1995). It has an average elevation of 638 m. The drainage pattern of the study area is dendritic to sub-dendritic in nature. The climatic characteristic is generally salubrious, tempera- ture ranges from 28.4°C to 35.8°C, the lowest temperature being recorded during the month of January and the driest season is April–May. The average annual rainfall is 741 mm. Lithologic characteristics of this terrain are Granite and Peninsular Gneisses, and Charnockite is present in some places. In general, soil characteristics in this region are shallow to deep, drained to well-drained, yellowish to reddish-brown with moderate to high infil- tration potential. Land-use patterns are predominantly agriculture and forest.

7. DATA SOURCES

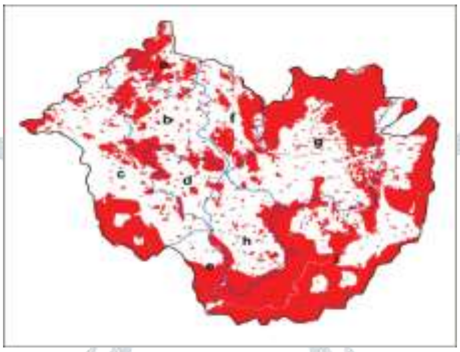
The study area, Kanakapura watershed is delineated using Survey of India (SOI) topographic sheets bearing survey numbers 57 H/6, 57 H/7, 57 H/10, and 57 H/11 in a 1:50000 scale. Various thematic maps-rainfall, drainage, geology, slope, hydro-geomorphology, lineaments, land- use, and land-cover (LULC) characteristics were pre-pared from topographic sheets, satellite images, and other reference maps, obtained from Karnataka State Remote- Sensing Center. Rainfall data from different rain gauge stations of the study area were collected from the statis- tical department, Government of Karnataka. Lithological information was extracted from the Geological Survey of India (GSI) map. Drainage density and hydro-geomorphic units were derived from LISS III + PAN (Figure 3) merged dataset and topographic sheet. The drainage map of the study area was generated from vectorization of the topographic sheet as well as satellite imagery, representing the network of streams and assign- ing stream orders (up to sixth order). LULC information was extracted from Landsat TM (Figure 4). The hydro- geomorphological map, generated for the Kanakapura watershed is based on a combination of visual interpreta- tion of satellite image, topographic map, and on-site verification. LULC classification is based on the classifica- tion scheme developed by the National Remote-Sensing Agency (NRSA, 1995). The LULC maps were prepared and classified into built-up land, agricultural land, fallow land, plantation, forest, wasteland, and waterbodies, based on visual image interpretation from Landsat TM (https://earthexplorer.usgs.gov/), path 144, and row 51. This is done in combination with IRS-1D LISS III FCC of band 2,3,4 and SOI topographic sheets, Cartosat-1 digital platform. Slope and lineament density were derived from Digital Elevation Model (DEM).

It is evident from (Figure 9) that NE, NW, and SW parts of the area showed maximum relief (upto 1001 m above MSL), while the rest of the area is undulating and plain in the central part. Minimum relief is observed in the southern part, from 276 m above MSL

8. Weighted overlay analysis

The present study is an effort to studying the Weighted overlay analysis of the Kanakapura watershed. The Kanakapura watershed was delineated into nine sub-watersheds based on various morphometric parameters.

The seven input layers considered for weighted overlay analysis are rainfall, lithology, drainage density, slope, hydrogeo- morphic units, lineament density, and LULC. In order to bring all the thematic layers, having diverse, dissimilar inputs, into an integrated analysis, a common scale of value is applied to each layer. Hence, the sub-watersheds were categorized into four levels of ranking, ranging from 1 to 4, on the basis of their infiltration potential, namely: very low, low, medium, and high, respectively. Each layer is assigned a weightage based on its importance in con- tribution towards the groundwater recharge process. Lithology and hydrogeomorphic units were assigned the highest weightage, 20 each, drainage density, slope, and LULC were given 15 each, lineament density was assigned a weightage of 10, and rainfall was given the least (Figure 12. Priority zones based on land-use land covershowm as below)



Bibliography

- Altaf, S., Meraj, G., & Romshoo, S. A. (2014). Morphometry and land cover based multi-criteria analysis for assessing the soil erosion susceptibility of the western Himalayan watershed. *Environmental Monitoring and Assessment*, *186*(12), 8391–8412. https://doi.org/10.1007/s10661-014-4012-2
- Bhattacharya, R. K., Chatterjee, N. D., & Das, K. (2019). Multi-criteria-based sub-basin prioritization and its risk assessment of erosion susceptibility in Kansai–Kumari catchment area, India. *Applied Water Science*, *9*(4), 76. https://doi.org/10.1007/s13201-019-0954-4
- Biswas, S., Sudhakar, S., & Desai, V. R. (1999). Prioritisation of subwatersheds based on morphometric analysis of drainage basin: A remote sensing and GIS approach. *Journal of the Indian Society of Remote Sensing*, *27*(3), 155. https://doi.org/10.1007/BF02991569
- Chowdhury, A., Jha, M. K., Chowdary, V. M., & Mal, B. C. (2009). Integrated remote sensing and GIS-based approach for assessing groundwater potential in West Medinipur district, West Bengal, India. *International Journal of Remote Sensing*, *30*(1), 231–250. https://doi.org/10.1080/01431160802270131
- Clarke, J. I. (1966). *Morphometry from maps. Essays in geomorphology*. Heinmann.
- Deepa, S., Venkateswaran, S., Ayyandurai, R., Kannan, R., & Prabhu, M. V. (2016). Groundwater recharge potential zones mapping in upper Manimuktha Sub basin Vellar river Tamil Nadu India using GIS and remote sensing techniques. *Modeling Earth Systems and Environment*, *2* (3), 137. https://doi.org/10.1007/s40808-016-0192-9

- Dinesh Kumar, P. K., Gopinath, G., & Seralathan, P. (2007). Application of remote sensing and GIS for the demarca- tion of groundwater potential zones of a river basin in Kerala, southwest coast of India. *International Journal of Remote Sensing*, *28*(24), 5583–5601. https://doi.org/10.1080/01431160601086050