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Watershed Management of Purandar Taluka by Remote Sensing and GIS: A Review

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Abstract: ***Morphometric analysis by using RS and GIS has emerged as an effective technique for the investigation and management of the watershed. Morphometric analysis can solve various hydrological problems like flood, drought, soil erosion. In this analysis, linear, aerial, and relief aspects of the watershed are used. Toposheet of a survey of India (SOI), digital elevation model (DEM), software like ArcGIS, satellite data from IRS 1D LISS- 3 sensor are the key resources for measurement of various morphometric parameters.***
Keywords: Morphometric Analysis, GIS, Remote Sensing, RS, ArcGIS, Morphometry, Watershed Management, Purandar Taluka.

I. INTRODUCTION

With the abundant increase in population, it is noticed that water and soil resources need to be manage in an sustainable & effective manner. This can avoid any future problem regarding its qualitative & quantitative availability. A watershed is an ideal unit for management of natural resources like water, soil, land and for mitigation of the impact of natural disasters for achieving sustainable development. Morphometric analysis could be used for watershed development even without the availability of soil maps. Morphometric analysis involves quantitively measurement of the geographic parameters and also provide information related to formation of various processes occurring on the surface of land which can be linear, aerial and relief aspects. The fast-emerging spatial information technology, RS, GIS and global positioning System (GPS) are effective tools for soil & water resources planning and management rather than conventional method.

II. LITERATURE REVIEW

A. *Application of Remote Sensing & GIS Techniques for Comprehensive Geological & Geohydrological Study of GP-16 Watershed of Aurangabad District, Maharashtra.* **[1]**

From this paper, we understand that the basaltic terrain in the study area is hard, compact & it does not possess primary porosity & permeability. But the groundwater permits through secondary porosities i.e., joints & fractures formed due to weathering. The suitable zones for groundwater percolation in the GP-16 watershed are identified using Remote Sensing & Geographical Information Techniques. These techniques are used to prepare thematic maps like DEM, Contour, Drainage, Geomorphology maps & Litholog of the study area.

B. *Morphometric Analysis of Nagjhari Watershed of Pedhi River, Amravati District, Maharashtra.* **[2]**

In this paper based on drainage orders, the Nagjhari watershed has been classified as fourth-order having a maximum frequency of first-order streams. The total stream length segments are comparatively lesser in the case of the higher-order streams. The ratio between stream length and stream order is constant throughout the successive orders of a basin, revealing the preservation of geometrical similarity. The plotted logarithm of stream number versus stream order demonstrates an inverse relationship, a normal trend in the case of areas having gently sloping topography, low relief, and homogenous lithology. The plot of the logarithm of stream length (ordinate) as a function of stream order (abscissa) yields a set of points lying essentially along a straight line obeys Horton's law of stream length (1945). Except for second-order streams, the remaining do not show any structural control over them. The lower values of drainage density, stream frequency, and infiltration number also favor low relief conditions in the area. Such conditions provide a congenial set-up for high infiltration due to less runoff. Similarly, the parameters like coarse drainage texture, texture ratio, elongation ratio, relief ratio, low ruggedness value, and relative relief also favor the high infiltration capacity of the area. The pre-monsoon season situation, throughout the last fifteen years, however, implies a scope of artificial recharge to the groundwater. Hence, looking at the feasibility of the study area, it is advised to adopt such avenues to enhance the water level conditions. The overall studies have confirmed inter-relationships amongst various attributes of the morphometric aspects.

C. Watershed Development by using Remote Sensing and GIS for water budgeting. **[3]**

The objective of this paper is to demonstrate the capabilities of Remote Sensing (RS) and Geographic Information System (GIS) techniques for the morphometric analysis of any ungauged as well as a gauged watershed. Remote sensing and GIS have emerged as the most powerful tools for morphometric analysis for the development of the regional hydrological models for solving various hydrological problems of the ungauged watershed in inadequate data situations especially for developing countries like India. The study area is one of the sub-basins of the Dwarakeshwar River covering four blocks of the Bankura district of West Bengal. The Gandeshwari watershed expands approximately over 391.7624 Km2 and it has been divided into 24 micro-watersheds (MWS). The morphometric parameters are divided into four categories: basic parameter, relief characteristics, drainage network, and drainage texture analysis.

Basic parameter deals with basin area, basin perimeter, basin length, elongation ratio, form factor, and recirculatory ratio. Relief characteristics consist of maximum height of watershed, a minimum height of watershed, basin relief, relief ratio, bifurcation ratio, and ruggedness number. The third category which is drainage network deals with stream order, stream length, and mean stream length. The last category is drainage texture analysis which consists of stream frequency, drainage density, drainage intensity, the constant channel of maintenance, length of overland flow, and drainage intensity.

D. GIS for the assessment of the groundwater recharge potential zone. **[4]**

This study produced a groundwater recharge potential map of the Chih-Pen Creek basin in Taiwan. The results indicate that the most effective groundwater recharge potential zone is located downstream. In this region, the gravelly stratum and agricultural land have a high infiltration ability. Additionally, the concentration of drainage also indicates the ability of streamflow to recharge the groundwater system.

The upstream region is least effective for groundwater recharge, mainly due to its metamorphic limestone. This study has established the interrelationships between the groundwater recharge potential factors and the groundwater recharge potential scores from the general hydrology characteristics of Taiwan.

Since the groundwater recharge potential is directly correlated with percolation, the established scores may be more accurate and objective if the rate of percolation and hydraulic conductivity of each recharge potential factor can be measured in a laboratory or on-site. The groundwater recharge potential zones are demonstrated using the grid model, which can be partially modified to study groundwater recharge potential factors (such as changes in terrain and river courses caused by an earthquake, or changes in land utilization) in a small area in the future, thus avoiding extensive re-estimation, which requires a lot of time and labor. The isotopic tracer technique will be applied to verify the model results in future research.Additionally, the quantity of pumped groundwater should be considered in the groundwater recharge.

E. Check Dam positioning by prioritization of micro-watershed using SYI model and morphometric analysis, Remote Sensing and GIS perspective. **[5]**

The main objective of this paper was to explore how local people were involved in resolving water problems, rejuvenating rivers, Dallas (water streams), and construction of various types of dams, recharge shafts, tree plantation, etc. The study is carried out in the affected villages to check their motivation level, binding forces, and their commitment to take lead to transform the village from water scarcity to a place where water is now actually generating revenue. The study has also explored how de-siltation of the tanks and rivers was carried out– thereby increasing their water carrying capacity and ensuring that they remain with water for a larger portion of the year. The silt which was coming out through the de-siltation process, we also tried to find out how this silt, can use an efficient soil conditioner, as a fertilizer for their agricultural fields.

F. Morphometric Analysis using Remote Sensing and GIS. **[6]**

From this literature we understand that the aim of this project is to emphasize the importance of the water conservation to overcome from shortage of water.

The activities undertaken in this project include soil and water conservation measures like construction of Bandhara. We estimate the quantity of water about 0.74 TCM and work out the cost of construction about 9 lacks. By construction of Bandhara the stored water is use for agriculture purpose and to increase infiltration and to prevent soil erosion. Maharashtra has a large drought prone area (52%) and has faced recurrent drought and famines (1907, 1911, 1918, 1920, 1972, 2013 etc.) which generated attention on the improvement of agriculture in non-irrigated areas.

G. Morphometric analysis in basaltic Terrain of Central India using GIS techniques: a case study. **[7]**

This study demonstrates that remote Sensing and GIS have been proved to be efficient and effective tools over conventional methods in the delineation of drainage basins and updating drainage, which is used for morphometric analysis, geological and geomorphological studies. The quantitative analysis of drainage patterns was found to be of immense utility in delineating erosion-prone zones which can help to suggest soil and water conservation measures at the parcel level. The computation of linear, areal, and relief parameters of the watershed confirm that there is a linear correlation between hydrological behavior and landforms, which is helpful for water management activities. The study reveals that the Miniwada watershed is characterized by an elongated basin having fourth stream order, high drainage density, low relief ratio, and low infiltration with a high bifurcation ratio. The drainage network of the watershed is the dendritic type and the low value of the bifurcation ratio indicate that the watershed has suffered less structural disturbance. The high value of elongation ratio compared to circulatory ratio indicates the elongated shape of the watershed, which is mainly due to the guiding effect of thrusting and faulting. The elongated shape of the watershed indicates less prone to flood, lower erosion, and sediment transport capacities. The drainage density shows that the area has a less vegetative cover and moderate to high relief. Stream frequency and drainage density of the watershed play a vital role to control the runoff pattern and other hydrological parameters. The relief ratio reflects that the watershed is treated with soil and water conservation measures. The value of the ruggedness number is 0.25, which is low and shows that the region is less prone to soil erosion. The bifurcation ratio, circulatory ratio, and relief ratio have huge significance in deciding the pattern and changes in the shape and drainage of the watershed. The results observed from the analysis could be helpful for watershed prioritization concerning erosion. In the future, drainage morphology along with slope map needs to be explored for locating and selecting the water storage structures like percolation tank, pond, check dams, etc. This work shall prove beneficial to the planners and decision-makers for proper natural resource management at micro-level.

H. Integrated Watershed Management using Remote Sensing & GIS. **[8]**

In this Literature, we get the idea that a watershed is a geo-hydrological unit draining at a common point by a system of streams. Watershed management is the rational utilization of land and water resources for optimum production with minimum hazard to natural resources. Remote sensing (RS) and Geographical Information Systems (GIS) techniques can be utilized for the effective management of land and water resources in a watershed. Even the Government of Andhra Pradesh is implementing watershed development programs on a priority basis for sustainable development of land and water resources on a holistic approach. The activities of watershed management mainly include rainwater harvesting structures, soil conservation measures, and environmental protection measures. The study area was Boothpur Mandal, which is one of the 64 manuals of Mahaboobnagar district. These areas have been identified as chronically drought-affected areas in the State because of scanty and erratic rainfall. Collection of source data like satellite data of two seasons, SOI toposheets, and village maps was carried out. Secondary data like groundwater levels, agriculture, population, and socioeconomic data were collected. Various thematic maps like base map, contour map, drainage map, soil map, geomorphology map, slope map, and land use/land cover map were prepared by using SOI toposheets and satellite imageries. After analyzing all maps, an action plan map was generated for the soil and water conservation in the study area.

I. Morphometric Analysis of River Drainage Basin /Watershed Using GIS And RS: A Review **[9]**

This paper is based on the reference of 28 other research papers to conclude the effectiveness of morphometric analysis or parameters in watershed management. Morphometry is the measurement and mathematical analysis of the earth's surface, shape, dimensions of landforms. In this paper, the watershed is classified into Mini watershed (1 to 100 ha), Micro watershed (100 to 1000 ha), Milli watershed (1000 to 10000 ha), Subwatershed (10000 to 50000), Macro watershed (>50000 ha). In this paper, various parameters like stream order, stream length, mean stream length, Bifurcation ratio, stream density, circulation ratio are calculated by using ArcGIS software and correlate values of this parameter with the standard one.

J. Morphometric Analysis and Prioritization of Vashishthi Watershed. **[10]**

From this paper, we can say that RS & GIS technique is useful to study the hydrological aspect of every watershed effectively and it can be related to morphometric parameters. Aerial aspect; Area of basin and perimeter are important in the watershed. Basin area directly affects the size of storm hydrograph, the magnitude of a peak, and mean runoff. Drainage density indicates the closeness of spacing of channel and stream eroded topography. The texture ratio shows a very coarser drainage texture. If the form factor has a low value it indicates the peak flows of longer duration.

K. Watershed Planning and Development Plan by Using RS and GIS of Khultabad Taluka of Aurangabad District. ***[11]***

From the study of this literature, it is recommended that water harvesting should be given importance to avoid the wastage of rainwater from the watershed. This will also increase the groundwater recharge besides providing supplementary irrigation during the Rabi season. Farmers should be encouraged about making farm ponds and soil conservation measures.

L. Management of watershed with Remote Sensing and GIS: A case study of river Niger delta region in Nigeria. **[12]**

rom this paper, we have analyzed the applications of GIS and remote sensing tools in watershed management with emphasis on the need to provide baseline data about the change in the ecology and forest cover that forms the basis of future management of the Niger Delta watershed of Southern Nigeria. The paper presented a concise overview of the attributes and benefits of the watershed approach in general, issues in the literature, a review of the major environmental effects and factors associated with the problem, and a series of suggestions to mitigate the problems. Notwithstandingthe gravity of these trends, there has not been any major effort by resource managers aimed at examining these issues in watershed management within the Niger Delta Region of Southern.

III.CONCLUSIONS

A. The study demonstrates that remote sensing and GIS have been proved to be efficient tools over conventional methods in the delineation of the drainage basin and updating drainage which is used for morphometric analysis.

B. The computation of linear, areal, and relief parameters of watershed confirm that there is a linear correlation between hydrological behavior and landform which is useful for water management activities.

C. From Morphometric analysis using GIS we get to know the watershed problems easily.

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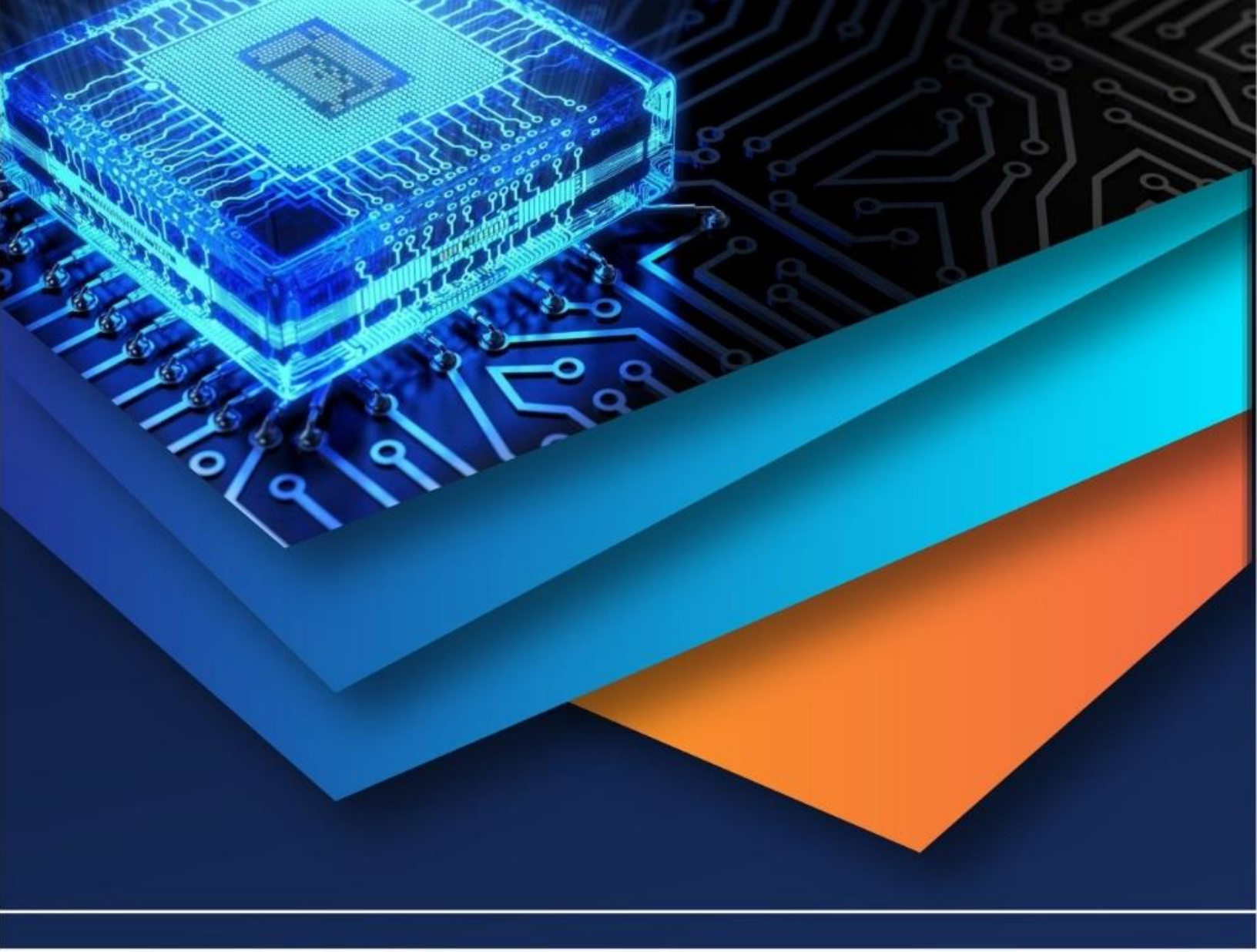

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