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"An Integrated Approach To Exploring The Warana River Basin Using Thematic Maps"

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ABSTRACT
Thematic maps are used to graphically illustrate the distribution, density, and fluctuation of a certain phenomenon across a geographical region. They are a vital tool for analyzing spatial patterns and interactions between diverse aspects of the environment, with applications in a variety of domains such as geography, geology, ecology, environmental science, and urban planning, among others. In this article, we will look at several types of thematic maps, their characteristics, and uses, with an emphasis on drainage maps, slope maps, land use land cover maps, soil maps, and hydrological soil group maps. The hydrological soil group maps are especially important for water resource management, flood control, erosion control, detecting flood and erosion-prone locations, and evaluating the influence of land use changes on soil hydrology. As the demand for sustainable development and natural resource management develops, the usage of themed maps will become increasingly important in the future.

KEYWORDS *- Thematic maps, Spatial patterns, Geographic area, Environmental conservation, Hydrological soil group maps, Land use planning*

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I. INTRODUCTION

Thematic maps are specialized maps that include extensive information on a certain theme or subject. They are intended to depict the distribution, density, and fluctuation of a certain occurrence throughout a geographical area. Thematic maps are vital for analyzing spatial patterns and interactions between various environmental variables, such as natural characteristics, cultural features, and socioeconomic aspects. Their applications are diverse and span many domains, including geography, geology, ecology, environmental science, and urban planning. The purpose of this article is to investigate the numerous forms of thematic maps, their distinguishing traits, and their specialized uses. Drainage maps, slope maps, land use land cover maps, soil maps, and hydrological soil group maps will be our primary emphasis. These themed maps are crucial in natural resource management and environmental protection. They give useful information to decision-makers and planners sothey to make educated decisions that encourage sustainable development and natural resource management.

Drainage Map:

A drainage map is an essential tool for visualizing and grasping the flow of water in a given area. It depicts the distribution of water bodies such as rivers, lakes, and streams and illustrates the direction of water flow. This data is essential for comprehending the hydrological cycle and anticipating potential water-related calamities such as droughts and floods. Drainage maps have a wide range of uses, including environmental research, urban planning, agriculture, and forestry. Various colors and thicknesses are used to differentiate the sizes and significance of water bodies. Additionally, the arrows indicate the direction of water flow, and the grade of the slope is depicted with distinct colors. Drainage basins are drawn and labeled, and the boundaries of many river systems are shown, making it a comprehensive map.

Slope Map:

A slope map is a sort of thematic map that depicts the slope of the ground surface in a specific geographic location. The map is useful for detecting locations that are vulnerable to landslides, erosion, and other geomorphological hazards. Slope maps are essential for planning building operations, monitoring land use, and analyzing environmental effects. The degree of slope is expressed by different color tones, with darker colors representing steeper slopes. Contours are used to depict elevation variations, with contour spacing

reflecting the steepness of the slope. The direction of the slope is shown by arrows, and the aspect of the slope, whether it is facing north, south, east, or west, is also shown.

Land Use Land Cover Map:

Land Use Land Cover Map: A land use land cover map is a themed map that gives information about the many forms of land use and land cover in a certain area. These maps are used to indicate the distribution of forests, agricultural land, urban areas, and other forms of land use. They are required for proper land use planning, environmental management, and natural resource management. distinct colorssymbolize distinct land uses and land coverings, such as green for forests, yellow for agricultural land, and grey for urban regions. Each land use type's size and borders are identified and labeled. Furthermore, time-series maps are used to display changes in land use and land cover over time, making it easier to understand.

Soil Map :

A soil map is a sort of themed map that depicts the distribution of different soil types in a certain region. It is used to identify agricultural potential and land use management plans by evaluating soil qualities such as texture, fertility, and drainage. Soil maps are crucial tools for soil protection, land use planning, and natural resource management. Different colors are used on the map to distinguish between soil types, such as red for clay soils, yellow for sandy soils, and brown for loamy soils. The borders of different soil types are identified and labeled, as well as the size of each soil type. To facilitate comprehension, soil qualities such as texture, fertility, and drainage are illustrated using symbols and codes.

Hydrological Soil Group Map:

A hydrological soil group map is an essential thematic map that depicts the infiltration capacity and runoff potential of various soil types in a certain location. This map is essential for identifying places prone to floods and erosion, as well as examining the hydrological behavior of various soils. It is commonly used in the management of water resources, land use planning, and natural resource management. To designate the four hydrological soil categories, including A, B, C, and D, different colors are used. The boundaries of each group are delineated and labeled, and the map illustrates the size of each group. The infiltration capacity and runoff potential of various soil types are represented by symbols and codes. This data is essential for making educated judgments.

Thomas *et al*.,(2017) offer an overview of thematic maps, including a discussion of the various types of thematic maps and their design principles. Additionally, they provide recommendations on selecting the most suitable map type based on the dataset at hand.

Liu *et al*., (2020) examine a range of techniques for thematic mapping in geographic information visualization, evaluating their respective advantages and disadvantages while also highlighting recent developments in the field of thematic mapping technology.

Kraak *et al*.,(2010) present a comprehensive introduction to cartography and map design, which includes various thematic mapping techniques. The authors discuss the fundamental principles of map design, the significance of maps in data visualization, and the use of diverse mapping techniques for representing various spatial data types.

Krygier *et al*.,(2011) offer a guide to map design for GIS, which includes a focus on thematic maps. They cover principles of map design, color and symbology, and provide instruction on creating various thematic maps such as choropleth, dot density, and proportional symbol maps.

de Hoop *et al*., (2013) discuss the various sources of uncertainty in thematic mapping and offer guidance on how to integrate uncertainty into thematic maps. Furthermore, they provide a case study on the propagation of uncertainty in land-use change modeling.

Study Area –

The Warana river basin in the Maharashtra districts of Ratnagiri, Kolhapur, and Sangli has been chosen as the research area. The research region is located between latitude 16º0'47" " N and longitude 73º30'15" E. The Warana River basin is located in a tropical and subtropical climatic zone, hence it has pleasant temperatures all year. The temperature in the basin can fluctuate between 30°C and 40°C. The Warana River basin has an area of 1,965 square km. Figure 1 depicts the research area's location map.

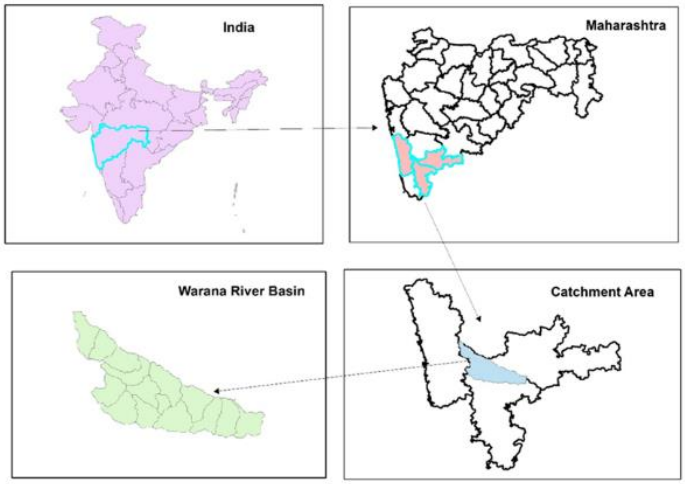

Figure 1Location map of the study area

II. MATERIAL AND METHODS

The study's diverse information was gathered from a variety of sources.
The following is an overview of the data to be collected:
1. Land Use and Land Cover (LULC): Data on the physical and biological properties of the Earth's surface derived via supervised classification of Bhuvan and MODIS sentinel 2 images.
2. Soil: Open Land Map, a free and open-source global soil information system, provides data on soil qualities such as texture.
3. Digital Elevation Model (DEM): SRTM data on the topography and elevation of the Earth's surface.
4. Boundaries: WWF HydroSHEDS data on watershed boundaries for spatial analysis and mapping.
Software Used
ArcGIS 10.5 is software that processes remotely sensed data and generates themed maps.

III. RESULTS AND DISCUSSION

Drainage pattern

The drainage pattern of the Warana River Basin, which is a depiction of the river system's design and offers information about the geology and main slope of the drainage basin, was studied. The drainage pattern is formed by the arrangement of streams in a drainage system, which might reflect primarily structural or lithological restrictions of the underlying rocks. The researchers discovered that the Warana River Basin has a dendritic drainage system, which is distinguished by homogeneous and uniform soil and rocks. This sort of drainage pattern suggests that the subsurface geology is resistant to weathering and that there is no discernible control over the course of the tributaries. A drainage density map for the Warana River Basin was generated.

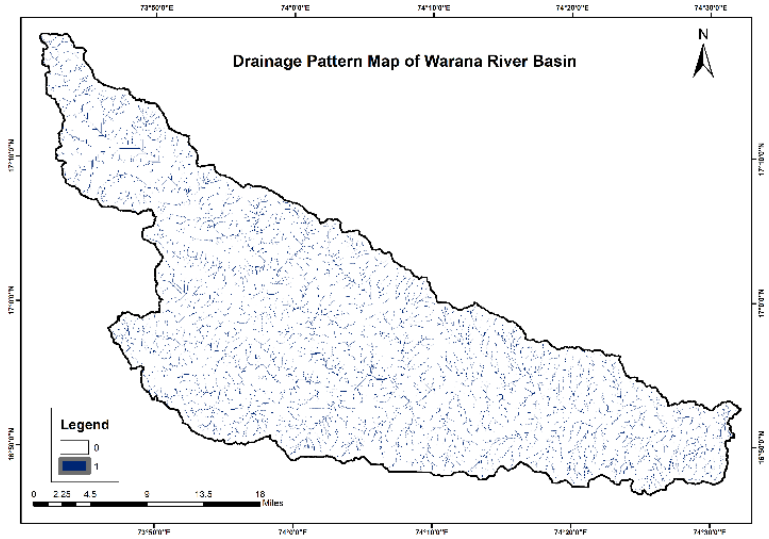

Figure 2Drainage pattern map of warana river basin

SlopeofWatershed

The slope map of the Warana River Basin was generated using ArcGIS and is presented in Figure 3. This map depicts the gradient of the terrain in the basin, which ranges from 0% to more than 33% slope. The majority of the region, however, has a slope of less than 10%. It is worth noting that the basin's hilly parts, which are mostly covered by forests, have slopes that surpass 25%. These places have higher slopes, which can have a substantial influence on the basin's hydrological regime, as well as the plant cover and animals. Overall, the slope map created with ArcGIS is a vital tool for comprehending Warana's terrain and landscape.

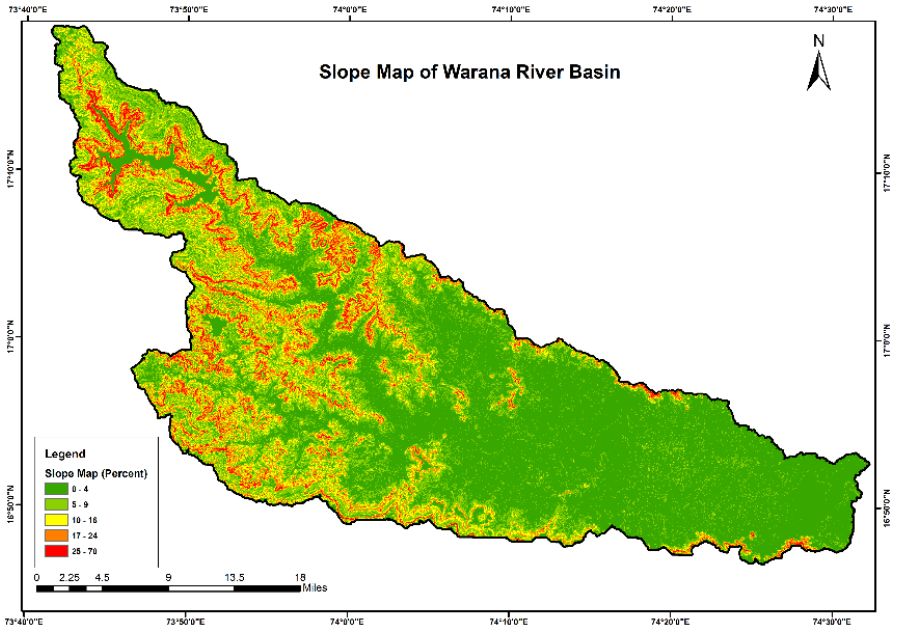

Figure 3Slope map of warana river basin

Soil Map

The Warana River Basin is mostly made up of clay and clay loam soils, which cover 64,873 and 127,339 hectares, respectively. This suggests that the area is ideal for agriculture. The least prevalent soil types, on the other side, are loam and waterbody, which cover 222 and 4,197 hectares, respectively. The basin's rarest soil type is sandy clay loam, which covers only 30 hectares. It is vital to highlight that the existence of water bodies in the region is noteworthy since they play a key part in the area's ecological and economic elements. Overall, the table contains useful information regarding the soil types in the Warana River Basin and their potential consequences for the region.

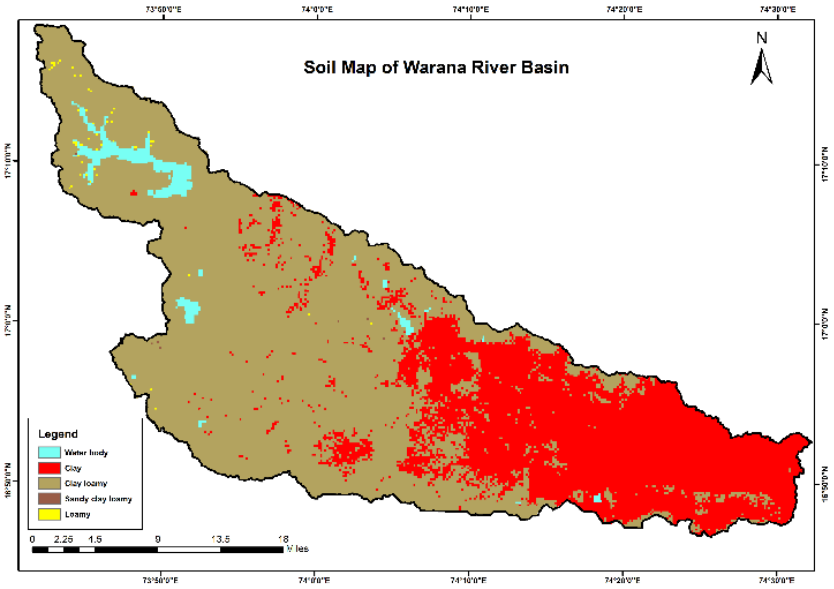

Figure 4 Soil map of warana river basin

Hydrologic Soil Group

Table 1Area covered by each hydrological soil group

HSG	TexturalClass	Area(ha)
Group A	Deep,well-drainedsands andgravel	4264.294
GroupB	Moderatelydeep,well-drained withmoderate	65277.88
GroupC	Clayloams,shallow sandyloam, soilswith moderatetofinetextures	126765.3
GroupD	Claysoilsthat swell significantlywhenwet	299.88
TotalArea		196604.3

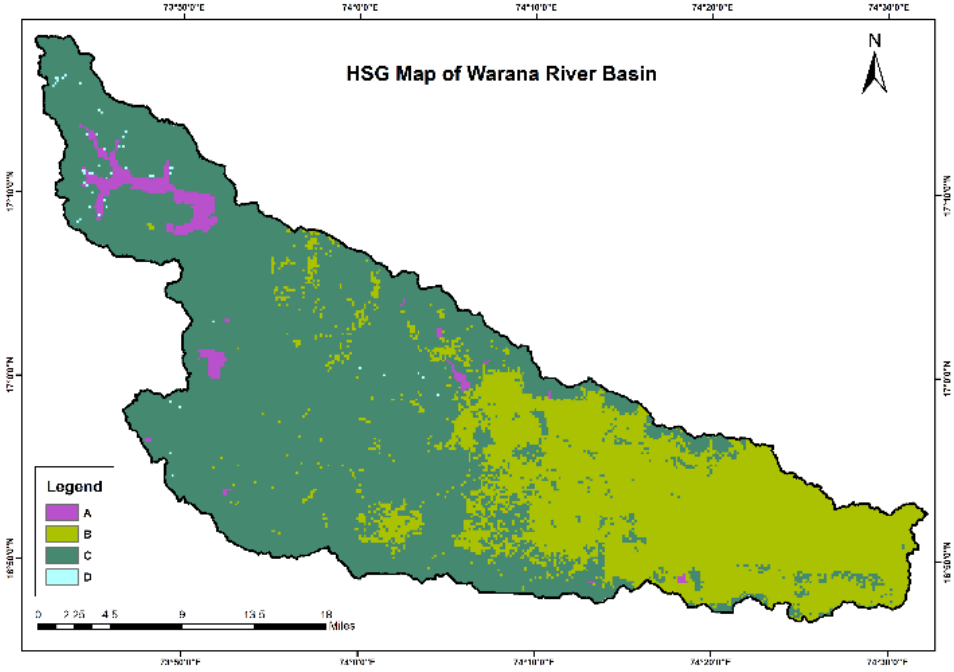

Figure 5 HSG map of warana river basin

Land Use Land Cover of the Watershed

The Warana River Basin land use land cover map was made using ArcGIS software and Landsat 8 satellite images downloaded from the USGS earth explorer. To categorize the watershed, the map was separated into five distinct categories: agricultural land, forest land, barren land, urban regions, and water bodies. The majority of the land was designated as barren land, accounting for approximately 54% of the entire area of the watershed. Forest land accounted for 8% of the total, followed by agricultural land (34%), urban areas (2%), and aquatic bodies (2%). The resultant land use land cover map of the Warana River Basin is depicted in Figure 5, and Table 2 shows the particular regions covered by each class of land use and land cover.

Table 2Area covered by each land use land cover class

LandUseLandCover	**Area(ha)**	**Area(%)**
UrbanArea	3827	2
AgricultureLand	106568	34
BarrenLand	4443	54
ForestLand	66657	8
Waterbody	15006	2
Total	196501	100

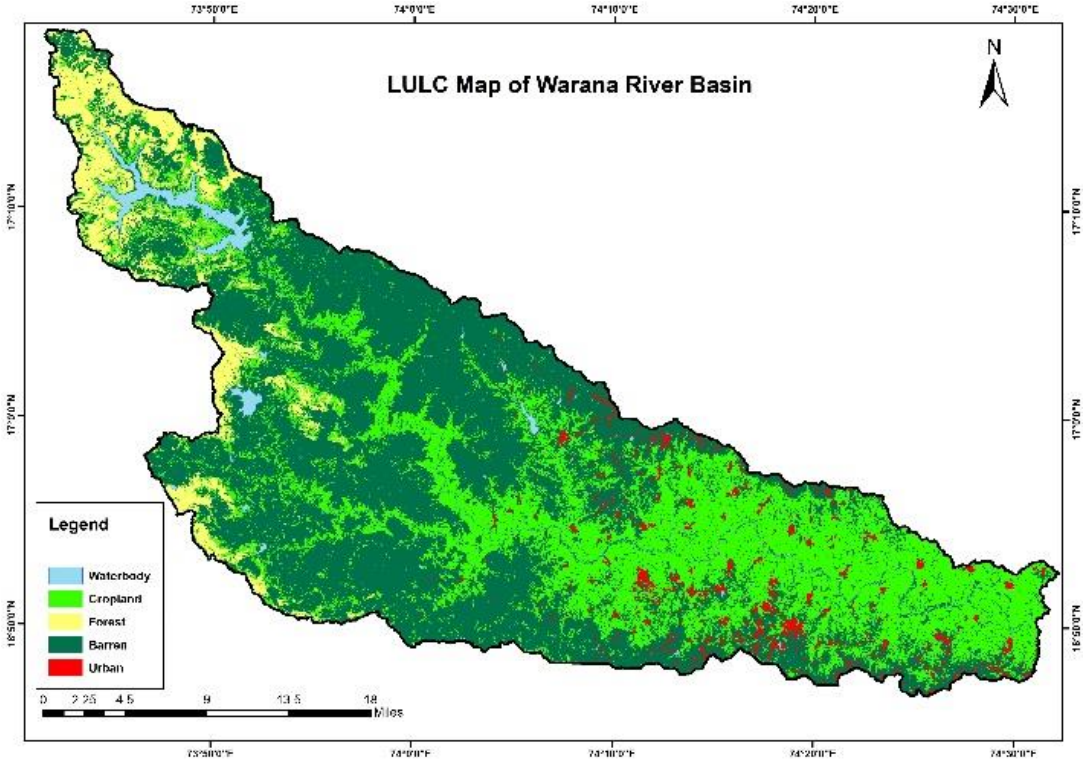

Figure 6 LULC map of warana river basin

IV. CONCLUSION

- Thematic maps are intended to graphically portray specific information about a certain subject or theme, such as watercourses, land use, or the gradient of the ground surface.
- Natural characteristics, cultural aspects, and socioeconomic features are all represented on thematic maps, which are essential tools for analyzing spatial patterns and interactions in the environment. They are used in a variety of domains such as geography, geology, ecology, environmental science, and urban planning.
- Land usage land cover maps, slope maps, drainage maps, hydrological soil group maps, and soil maps are examples of themed maps, each with its own set of characteristics and uses.
- Water resource management, flood control, hazard detection, sustainable land use, measuring environmental effects, and agricultural production, among other things, rely heavily on thematic maps.

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