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Remote Sensing and GIS Based Geomorphological Mapping of Amravati District Maharashtra

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ABSTRACT: Geomorphological mapping is essential for understanding terrain characteristics, landform processes, natural resources, and environmental management. The present study employs Remote Sensing (RS) and Geographic Information System (GIS) techniques to prepare a detailed geomorphological map of Amravati District, Maharashtra. Satellite imagery, DEM (Digital Elevation Model), Survey of India toposheets, and secondary datasets were integrated to identify major landform classes. Various geomorphic units, such as structural hills, pediments, valley fills, alluvial plains, residual hills, escarpments, and floodplains, were delineated. The study highlights the spatial distribution of geomorphological features and their relationship with lithology, slope, elevation, and drainage. The results demonstrate the effectiveness of RS and GIS tools for terrain analysis and landform classification, useful for land-use planning, groundwater exploration, soil conservation, and watershed management in semi-arid regions like Amravati.

KEYWORDS: Remote Sensing, GIS, Geomorphology, Amravati District, DEM, Landform Mapping

I. INTRODUCTION

Geomorphology is fundamental to understanding the evolution of landscapes, the distribution of natural resources, and the functioning of environmental processes. It provides insights into terrain formation, surface stability, soil development, hydrological behaviour, and landform–process interactions. Traditionally, geomorphological mapping has relied heavily on field-based surveys, which, although detailed, are often time-consuming, labour-intensive, and limited in spatial extent. Advancements in Remote Sensing (RS) and Geographic Information Systems (GIS) have transformed this field by offering efficient, cost-effective, and spatially comprehensive tools for analysing terrain characteristics. These technologies allow researchers to classify landforms, assess surface processes, and generate accurate geomorphological maps across large regions with improved precision.

Amravati District, located in the Vidarbha region of Maharashtra, presents a diverse geomorphic environment shaped by Deccan Trap basaltic formations, fluvial dynamics, tectonic influences, and prolonged denudational activity. The district's landscape is strongly influenced by the Satpura mountain ranges to the north, the Wardha and Purna river systems, and extensive Pedi plains that dominate the central and southern parts. Variations in lithology, climate, and drainage patterns have contributed to the development of structural hills, dissected plateaus, pediments, alluvial plains, and associated fluvial features. While the broader Vidarbha region is known for its geomorphic diversity resulting from basaltic lava flows and climatic variability, systematic geomorphological mapping specifically for Amravati District remains scarce.

Given the need for detailed terrain assessment to support land-use planning, natural resource management, groundwater exploration, and environmental monitoring, an updated geomorphological analysis of Amravati District is essential. Integrating RS and GIS for this purpose provides a robust framework for identifying landforms, understanding terrain processes, and producing reliable geomorphological maps that can guide sustainable regional development.

II. STUDY AREA

The study area is situated between **20°45'0" N to 21°10'0" N latitude** and **77°35'0" E to 78°5'0" E longitude**, encompassing Amravati City and its surrounding regions in Amravati District, Maharashtra. The area is bounded by

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Bhatkuli Tehsil to the west, Morshi Tehsil to the north, Tiwsa Tehsil to the east, and **Nandgaon Khandeshwar Tehsil to the south**. Amravati serves as the administrative headquarters of the district and is commonly referred to as the *Gateway of Vidarbha* due to its strategic geographical and economic significance.

Agriculture forms the backbone of the regional economy. The district is a major producer of **cotton** and **pigeon pea (tur)**, particularly in Chandur Railway, Dhamangaon, Tiosa, and Nandgaon Khandeshwar. The region around Achalpur and Anjangaon Surji is known for the cultivation of **betel leaves, piper longum, oranges, and bananas**, while Warud, Morshi, Chandur Bazar, and Achalpur are especially recognized for their high-quality **Nagpuri oranges**. In recent decades, **soybean** has emerged as an important *kharif* crop in the district's agricultural landscape.

The hydrological framework of the area is dominated by the **Wardha River**, which forms the eastern boundary of the district. Much of the eastern region lies within the **Wardha–Purna river basin**, supported by several tributaries including the **Shahanoor** and **Chandrabhaga** rivers. The upland areas of the **Chikhaldara Hills** have also witnessed successful introduction and cultivation of temperate crops such as **musali** and **cherry**, reflecting the region's diverse agro-climatic potential.

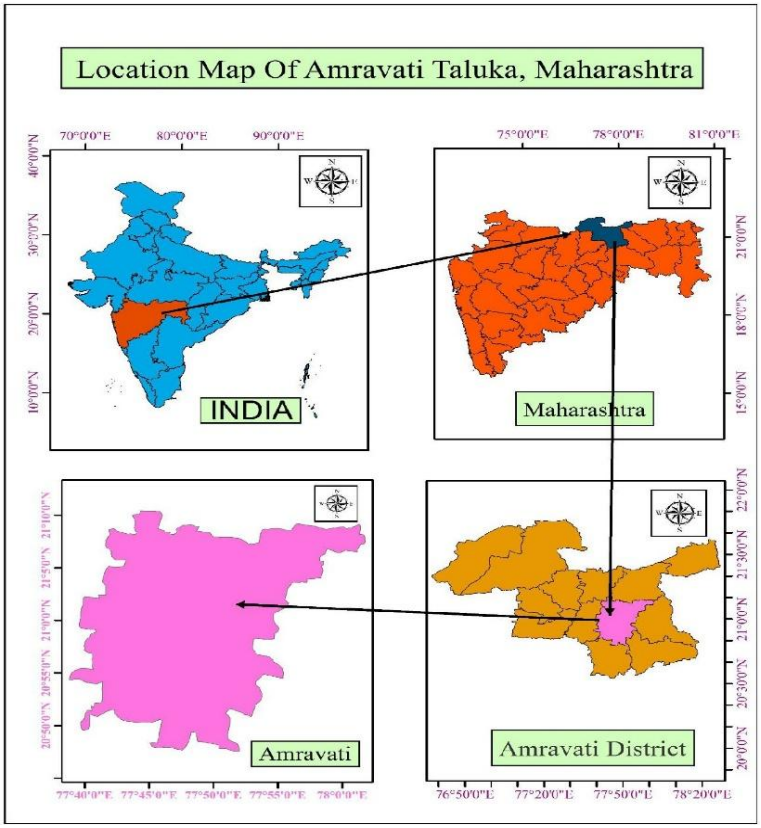

Fig.1: Study Area

III. METHODOLOGY

ArcGIS software was used to generate feature datasets, attribute tables, topology, geometric networks, and other database elements required for spatial analysis. The platform provides a wide range of tools for preparing, managing, and analyzing geospatial information. The creation of thematic maps was carried out through the following procedures:

- Digitization of scanned toposheets and maps, followed by editing to remove spatial and attribute errors.
- Assigning an appropriate map projection system to all spatial datasets.
- Extracting various feature classes for each thematic layer.
- Assigning and managing attributes for each layer and integrating all datasets within the GIS environment.

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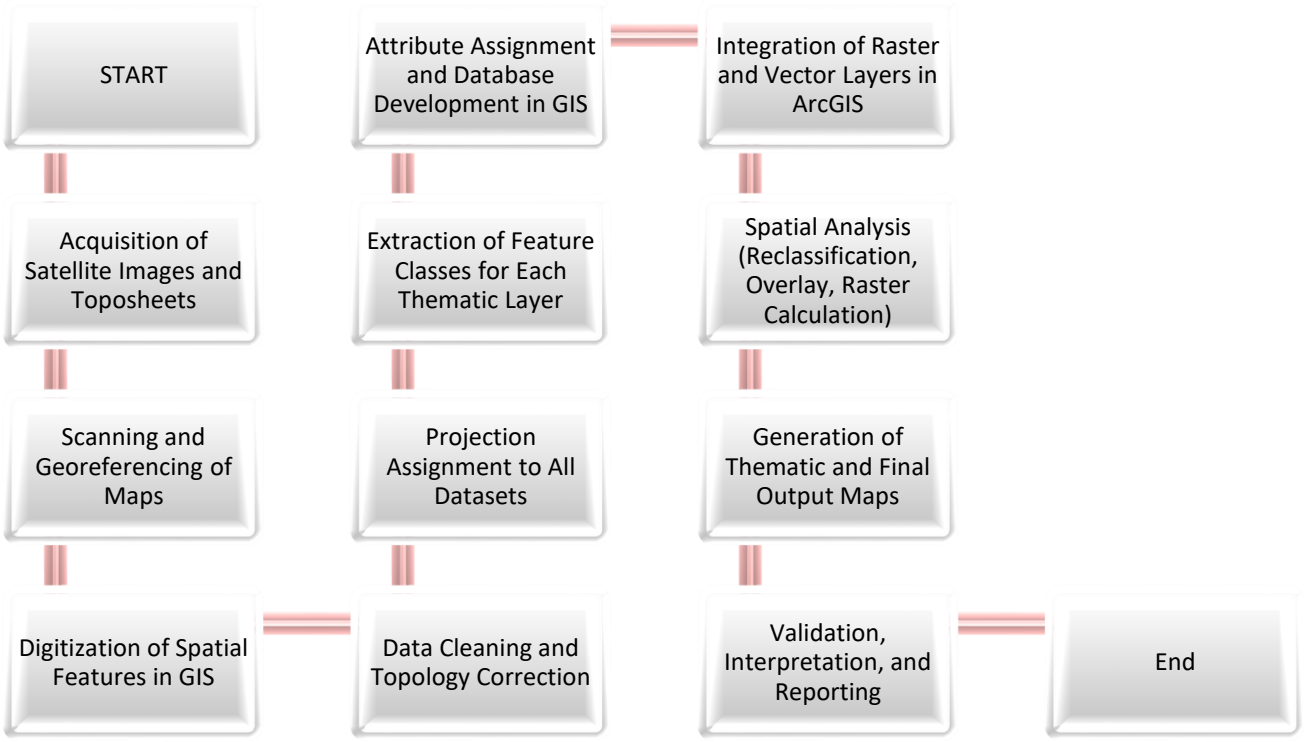
A) SOFTWARE USED:

1.ArcGIS
Developed by ESRI Inc., ArcGIS is one of the leading software platforms for desktop GIS and spatial analysis. In this study, ArcGIS was used to visualize raster datasets, digitize features, and query attribute information. The Spatial Analyst extension supported terrain and raster-based analysis. Tools such as *Reclassify* and *Raster Calculator* were employed to generate classified maps, perform overlay analysis, and derive final analytical outputs.

2.GoogleEarth
Google Earth is a widely used visualization tool that provides high-resolution satellite imagery, aerial photographs, and GIS layers draped over a 3D globe. It was utilized to cross-verify spatial features, identify landforms, and extract coordinate-based information through its interactive interface.

3.MS-Word
Microsoft Word, a widely used word-processing software, was employed for preparing descriptions, documentation, and formatting report sections.

4.MS-Excel
Microsoft Excel is a versatile spreadsheet application used for data entry, tabulation, computation, statistical analysis, and chart preparation. It supports advanced tools such as pivot tables and Visual Basic for Applications (VBA) for automated processing.



Flow Chart 1: Methodology

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IV. RESULT AND DISCUSSION: -

The geomorphology of Amravati District exhibits a variety of landforms, including plateaus, buttes, and alluvial plains, each represented with distinct colour indices in the map. The results of the present study highlight the distribution of multiple hydro-geomorphological zones, reflecting groundwater potential that ranges from moderate to poor across the district. These findings confirm the effectiveness of Remote Sensing and GIS techniques in delineating potential aquifer zones, which is crucial for the sustainable management of water resources in the Amravati region.

Geomorphology as a scientific discipline evolved later than geology, although many of its concepts are rooted in geological processes. It focuses on the origin, evolution, and characteristics of landforms that shape the Earth's surface. Geomorphological mapping, supported by relevant spatial datasets, is particularly important for developing regions that experience intense environmental pressure and population growth. Modern approaches and geospatial methods that capture the spatial variability of natural resources serve as vital tools for informed land-use planning and sustainable resource management.

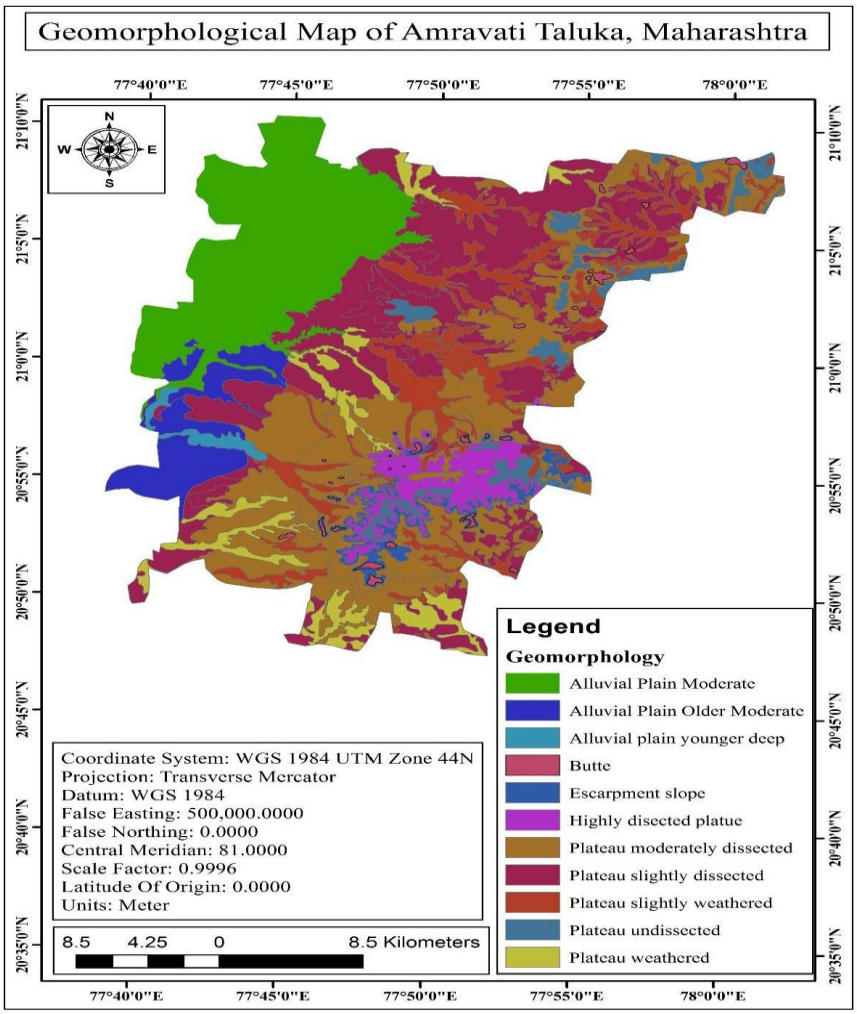

Fig2: Geomorphological Map of the Study Area

The geomorphic framework of Amravati Taluka comprises several distinct land-surface units, which can be summarized as follows:

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- **Alluvial Plains (Moderate & Older).** In the northwestern sector of the study area, the *moderate alluvial plain* consists of relatively recent fluvial deposits forming gently undulating to planar surfaces. These zones likely support well-developed soils and exhibit high agronomic potential due to favorable moisture retention and fertility. In contrast, the older alluvial plain represents a more stabilized depositional surface. Over extended periods, this terrain has undergone pedogenesis and possibly compaction or cementation, resulting in reduced permeability relative to younger alluvial deposits, which may modulate groundwater recharge dynamics.
- **Plateaus.** The southern portion of the map is dominated by a *moderately dissected plateau*, characterized by pronounced incision by fluvial channels, yielding a complex network of valleys and ridges—a clear indication of active geomorphic evolution and efficient drainage. In the northeastern region, a slightly dissected plateau persists, where erosion has been comparatively subdued, allowing the primary plateau surface morphology to remain largely intact. Scattered patches of undissected plateau are also present; these areas are marked by elevated, planar surfaces that have experienced minimal erosional modification, indicating relative geomorphic stability. Centrally and toward the southern boundary, a *weathered plateau* is mapped. This unit exhibits signs of prolonged chemical or physical weathering, which has likely degraded rock strength, influenced soil formation processes, and altered surface hydrology and slope stability.
- **Buttes.** The landscape also includes isolated, steep-sided hills (buttes) with relatively flat summits. These geomorphic relics likely consist of erosion-resistant lithologies and represent remnants left behind by differential erosion, where more erodible material has been selectively removed.
- **Escarpment Slopes.** Finally, pronounced escarpment slopes delineate abrupt topographic transitions between geomorphic units. These cliffs or steep slopes probably reflect structural or lithologic contrasts—such as uplifted blocks or harder strata—that define the boundaries of plateau surfaces

V. CONCLUSION

The study demonstrates the effectiveness of Remote Sensing and Geographic Information System (GIS) techniques in generating accurate and comprehensive geomorphological information for Amravati District. By analyzing satellite imagery and applying GIS-based spatial analysis, key landforms—including structural hills, plateaus, alluvial plains, and other geomorphic units—were successfully identified and mapped with high spatial precision. The resulting geomorphological map serves as a valuable scientific resource for land-use planning, groundwater assessment, environmental monitoring, and natural resource management.

The use of Remote Sensing enabled the rapid acquisition of large, reliable datasets, while GIS facilitated the integration, interpretation, and visualization of complex terrain information. Together, these technologies proved to be powerful tools for understanding the geomorphic framework of the region.

To further enhance the accuracy and applicability of such studies, future research may incorporate higher-resolution satellite data, advanced geospatial modelling techniques, and detailed field validation. Such integrated approaches will contribute significantly to sustainable landscape management and informed decision-making in Amravati District.

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2. Dr. M. M. Deshmukh is an Assistant Professor and Head with five years of teaching and research experience. She holds an M.Sc. and a Ph.D. in Geology. Her areas of research include Petrology, Geochemistry, Geomorphology, and Paleo-magnetism. She is actively engaged in academic teaching,

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