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Terrain Analysis of Dongargan Hilly Area, Balaghat Range, Maharashtra

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Abstract

Terrain analysis is an important aspect in the study of physical geography branch geomorphology. The various aspects of the terrain such as slope, elevation, local drainage pattern, 3D view, cross profile etc. understand with the help of using GIS technique. Terrain is considered one of the most essential natural geographic features and is a key factor in physical processes; terrain analyses have provided a wealth of topographic data and corresponding tools, thus delivering insights in to geomorphology, hydrology, soil science, and geographic information systems (GIS) in general. Recent analysis methods, data-acquisition techniques and analysis platforms are impressive in their ability to interpret not only multi-scale and multi-aspect topographic characteristic. Terrain analysis helps understand and model natural processes, including hydrology and ecology, and supports applications in urban planning, natural resource management, and hazard assessment. Common terrain analysis tools derive information like drainage networks, potential water flow, and site suitability, making GIS an indispensable tool for diverse professionals. In the present paper the Balaghat range inner branch of western ghat of Maharashtra the Dongargan hilly area an important part in Ahilyanagar district where origin of Sina river which flowing through Ahilyanagar city area. The various aspect of the terrain is analysis with the help of digital model is studied in present research paper.

Keywords: terrain analysis, GIS technique, balaghat range, DEM, Hydrology, slope

Introduction

Dongargan is a small hilly region located within the Balaghat Range in Maharashtra. This area forms part of the larger Deccan Plateau and is characterized by its rugged topography, moderate to steep slopes, and mixed vegetation cover. The terrain significantly influences land use patterns, the drainage system, soil characteristics, and agricultural practices in the region. In physical geography, terrain refers to the layout of the land, involving both the vertical and horizontal dimensions. The terrain of a region plays a crucial role in determining the distribution and processes of flora, fauna, and human development. The present study area, Dongargan, is part of the Harishchandra-Balaghat mountain range, located in the Ahilyanagar district on the border of Rahuri and Nagar tahsil's. This region serves as a watershed divide between the Sina and Mula basins (origin of the Dev River).

Therefore, it is important to analyze terrain aspects such as altitude, slope, horizontal and vertical profiles, and watershed characteristics using GIS tools. This analysis helps in understanding the terrain and contributes to effective watershed planning and regional development.

Study Area

The Dongargan hilly region lies between 19°21'28"N to 19°23'31"N latitude and 74°67'37"E to 75°77'48"E longitude. Dongargan is known for its beautiful hilly landscape and rich, diverse flora. It is located on the northern side of Nagar Tehsil, approximately 13 km away, in Ahilyanagar district (M.S.), India.

Aims and Objectives of the Study:

The main aim of the present study is to analyze the Morphometric characteristics of the Dongargan area using a digital model with the help of GIS. The specific objectives include the analysis of:

- Altitude
- Slope
- Profile
- Watershed
- 3D Terrain Modelling

Database and Methodology

1. Scanning of S. O. I. Toposheet 47 I /12
2. Digitization of contour with help of in Software in Surfer.
3. Digital Analysis of Morphometric characteristics with the Global mapper 15.1.

Physiographic Features

- **Elevation:** The Dongargan hilly region ranges in elevation from approximately 400 to 750 meters above sea level.
- **Relief:** The area features an undulating terrain with a combination of ridges, slopes, and narrow valleys. The landscape is dissected by numerous seasonal streams.
- **Slope:** Slopes range from gentle (5–10%) at lower elevations to steep (more than 25%) along the ridges, which influences erosion and land stability.
- **Aspect:** The slopes face various directions, affecting microclimates, soil moisture retention, and vegetation distribution.

Geological Structure

- The terrain is underlain by basaltic rock formations typical of the Deccan Traps, with lateritic soils found in the upper hill regions.
- The region is geologically stable but prone to weathering, which results in shallow soil layers and exposed rock outcrops.

Soil Characteristics

- **Soil Type:** Predominantly lateritic and shallow black soils are found on slopes, while deeper black cotton soils occur in flatter valley areas.
- **Soil Erosion:** Due to steep gradients and sparse vegetation in some zones, the area is vulnerable to surface erosion, especially during the monsoon season.

Drainage Pattern

- The region exhibits a dendritic drainage pattern, typical of basaltic terrains.
- Seasonal nalas and rivulets drain the area and feed into tributaries of larger river systems such as the Wainganga and its sub-streams.
- Water retention is generally low due to rapid runoff on steep slopes.

Land Use and Vegetation

- **Forest Cover:** Mixed deciduous forests dominate the higher elevations, with species such as teak, bamboo, and other native varieties.
- **Agriculture:** Cultivation is mostly practiced in valleys and on gentler slopes, with crops such as millets, pulses, and rice in flatter areas.
- **Human Settlements:** Settlements are scattered and sparse, primarily located on lower slopes and in valleys where soil and water conditions are more favourable.

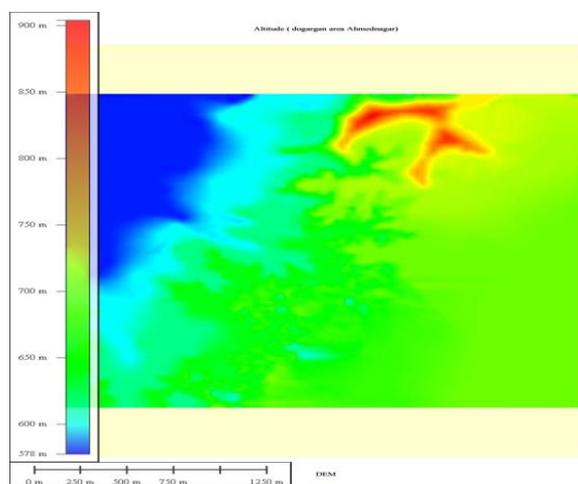
Challenges

- **Soil Erosion:** Unchecked runoff and deforestation have accelerated soil degradation.
- **Limited Accessibility:** The steep terrain presents challenges for infrastructure development.
- **Water Scarcity:** Poor percolation and seasonal water availability lead to water scarcity during the dry months.

Discussion of Results

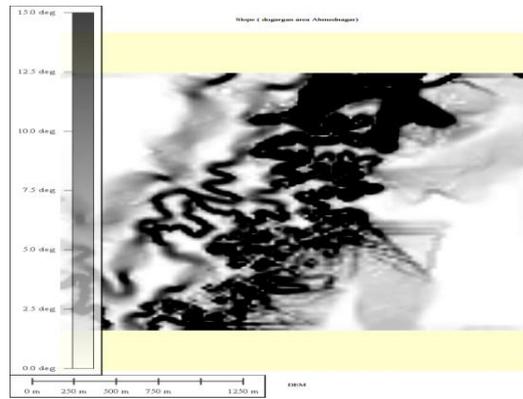
1. Digital Elevation Model (DEM)

The maximum altitude recorded in the north-western part of the study area is 960 meters. Altitude gradually decreases on both sides of the study area. Elevation significantly influences the local climate and vegetation. The minimum elevation, 560 meters, is observed on the eastern side of the image. In the hilly regions of the study area, thorny vegetation types are commonly observed.



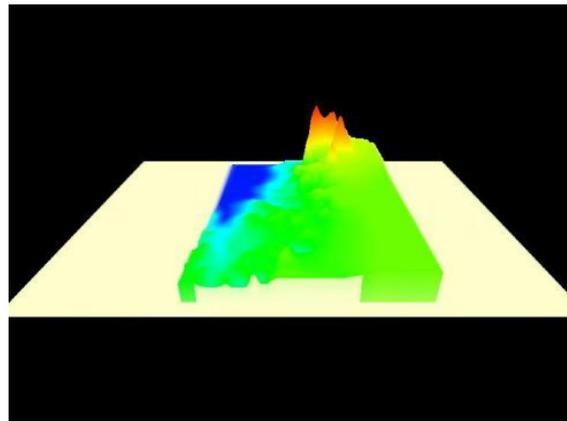
2. Digital Slope Model

The maximum slope is located at the center of the study area and declines toward both sides. This central high-slope area acts as a watershed divide between the Sina and Dev River basins. The eastern part of the image exhibits steep slopes, while the western side shows gentler slopes. The western region represents part of the Dev River basin, which flows through Rahuri as a tributary of the Mula River. The eastern side corresponds to the Sina basin.



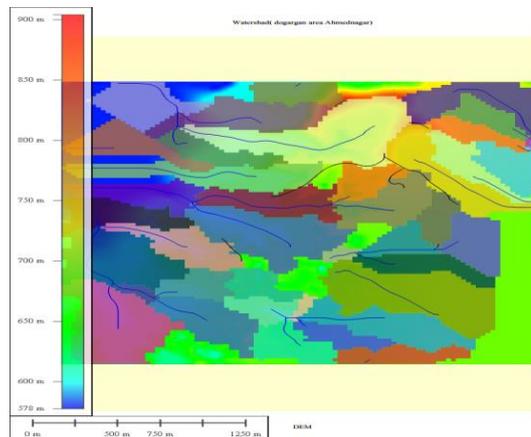
3. Digital 3D Model

The current 3D digital model provides a three-dimensional visualization of the terrain using Global Mapper software. This model allows for terrain analysis from a 360-degree perspective and helps in understanding elevation variation and landscape features in detail.



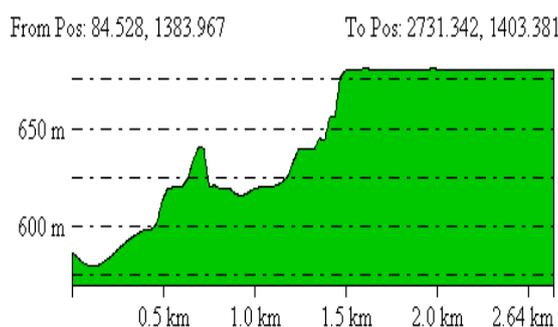
4. Digital Watershed Model

Blue lines in the image represent the tributaries in the study area. The Dongargan hilly region extends from southeast to northwest, serving as a watershed divide. Most of the flow is directed westward, while some tributaries flow eastward, contributing to the Dev River system.



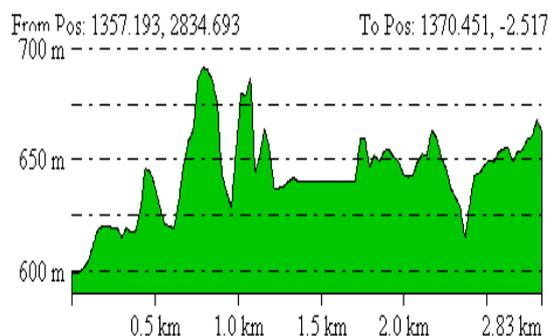
5. Digital Vertical Cross-Profile Model

The vertical cross-profile, taken from north to south, highlights the variation in elevation and terrain features. A noticeable cliff is observed on the northern-facing slope, representing the actual structure of the terrain in the study area.



6. Digital Horizontal Cross-Profile Model

The horizontal cross-section, taken from west to east, shows topographical undulations and elevation changes across the study area, indicating a rugged terrain pattern.



Conclusion

Based on GIS analysis, the digital models effectively support terrain analysis of the Dongargan region. Elevation, slope, 3D modelling, and cross-profile data help in understanding the area's topography. These findings are valuable for planning regional development activities such as contour plantations, check dams, water bunding, and other conservation and land management strategies suited to the area's physiographic characteristics.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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