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REMOTE SENSING AND GEOGRAPHIC INFORMATION SYSTEM (GIS) UTILIZATION FOR LAND RESOURCE ASSESSMENT AND TERRAIN EVALUATION IN THE BALTIRA RIVER BASIN

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Abstract
In emerging nations that are frequently under intense environmental and demographic pressure, land use planning and the supporting statistics are crucial. Spatial design must be guided by strategies and techniques for mapping the variability of natural resources. The purpose of this research is to employ a Geographic Information System (GIS) over remote sensing database to examine the terrain and significant land characteristics of the Baltira River Basin. The terrain is represented utilizing a DEM (digital elevation model). Information regarding the region's land-resource delineation (forest-vegetation cover, agricultural and residential areas water resources) was extracted from the LISS III and ETM+ photos taken in the research area through processing and interpretation. This study's material can be used for a variety of purposes, comprising analyses and modelling of hydrological watersheds, environmental management and planning, assessments of landforms and natural resources, and geological and geo-structural research.
Keywords: Remote Sensing, Terrain analysis, Digital elevation model

1. Introduction

Remote sensing provides us with an ongoing and continuous input of Earth-related information and geographic information systems (GIS) offer a mechanism for storing and managing these and other geographic information. The merging of the two disciplines has enabled us to conduct large-scale examinations of the Earth's surface while also providing increasingly precise knowledge on numerous planetary variables and improving our understanding of how they work. GIS with remote sensing facilitates the assessment and management of soil, water, and landform resources.

Terrain analysis refers to the use of geographic information systems for the analysis and interpretation of topographic features. Slope, aspect, viewshed, elevation, contour lines, flow, upslope flowlines, and dowslope flowlines are a few examples of these features. The most common data source for topography studies is survey of India topographical maps at different map scales. (Abhijit M Zende et al, 2012).

Burrough (1986) described a DEM as a consistent gridded matrix illustration of the ongoing variation in relief across space. One of the most important factors in its development as a model appropriate for landscapes was the appeal of a straightforward matrix of elevation values. Research in the early 1970s (Evans, 1972). Digital manipulation and database visualization become simpler as a result of the ease with which mathematical-statistical models may be constructed using well-defined methods.

The continuous and widespread use of DEM as a surface form model might be attributed to its simplicity of integration under a GIS system (Weibel and Heller, 1991). For terrain evaluation and landform studies, remote sensing data, particularly those produced from aerial images, are used (Thomas, 1999). Fluvial landforms, rock kinds, geological formations, water bodies, and stream networks are all studied using RS-images.

1.1 Objective

The goal of this study is to evaluate the terrain and land in the Baltira river basin.

2. Resources and Techniques

2.1 Brief Discussion of the Study Area – Baltira River Basin

Baltira is a tributary of the Man River, and its watershed includes the tehsils of Atpadi and Sangola in the Sangli and Sholapur districts, respectively. Atpadi is a large hamlet in the eastern section of Sangli district that also serves as the district's tehsil headquarters. The Baltira basin research area includes a variety of tributaries such as ShukraNala, DhandarNala, DabuchaNala, and KhavniNala. The Atpadi city at its center is part of the Baltira watershed, which also includes Deshmukhnagar, Jambhulni, Pujariwadi, Kharsundi, Nangremala, Valvan, Maptemala, Bhingevadi, Mitkiwadi, Kamath, Pandharevadi,Ghanand, Chinchale, Thoratwadi, Gham Along the course of various river tributaries, from east to west.

These adjacent communities encompass a significant agricultural, forest, revenue, and residential area. It is a one-of-a-kind watershed, with the village boundary coincident with the watershed's maximum extent. This is a severe, chronic drought-prone region in Maharashtra's Atpadi Taluka.

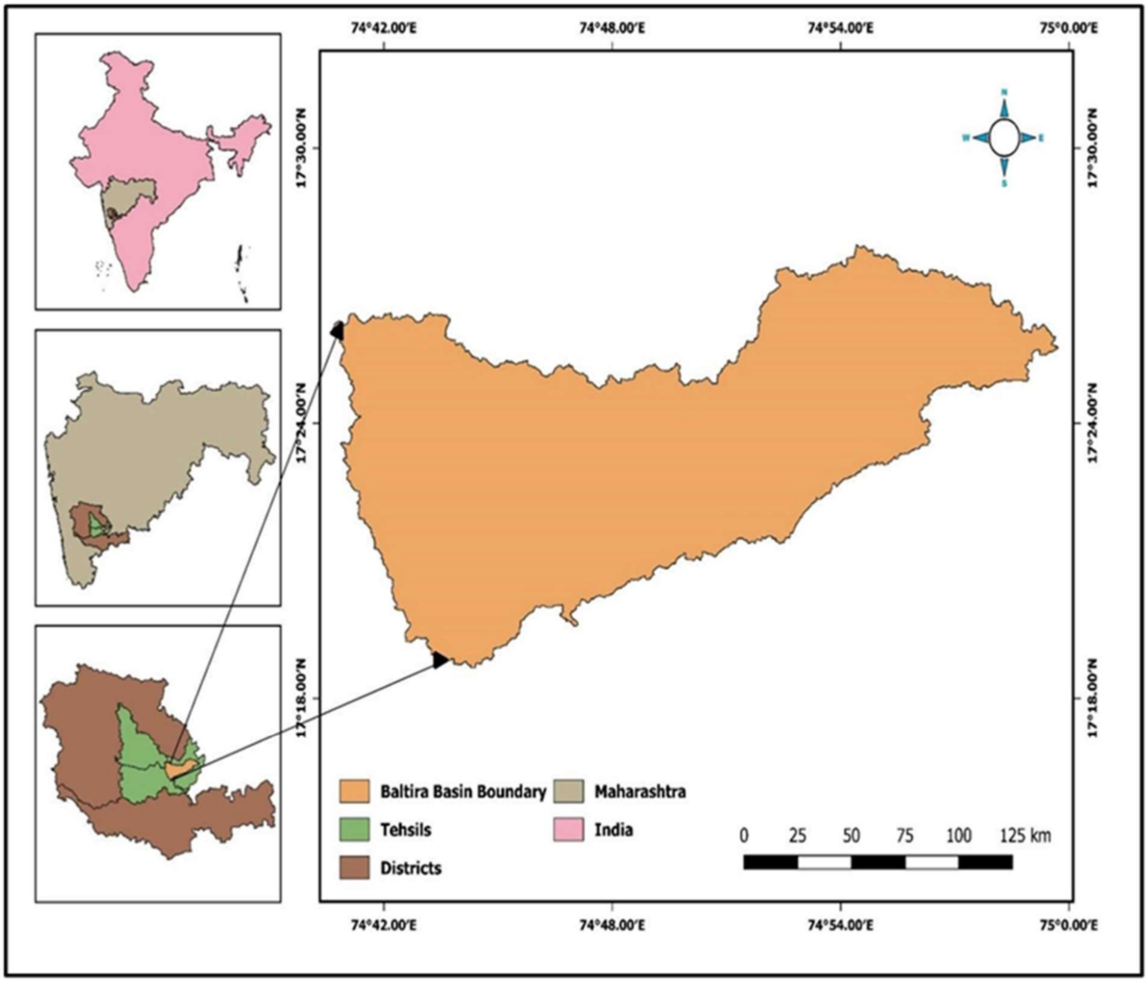

Fig. 1 Location Map of Baltira River Basin

2.2 Drainage

The assessment of any drainage basin's characteristics using quantitative morphometric analysis gives useful information about the geological characteristics of the exposed rocks and the hydrological nature of the drainage basin. A proper drainage map always offers a trustworthy index of the permeability of the hosting rocks as well as a more accurate indication of the basin yield.

There has been a huge increase in recent years. Growth in the level of interest in watershed management, for which we need to understand the morphology of the catchment. Only the topography of the physical structures of land that make up the drainage basin, and also the shape and size of the stream system or drainage net inside it, dictate the morphology aspects. (Horton, 1932). Remote sensing offers an overview picture of a vast area and is highly beneficial in assessing drainage morphometric parameters (Rabu and Askaran2013). Many studies on morphometric analysis using RS and GIS have been conducted.

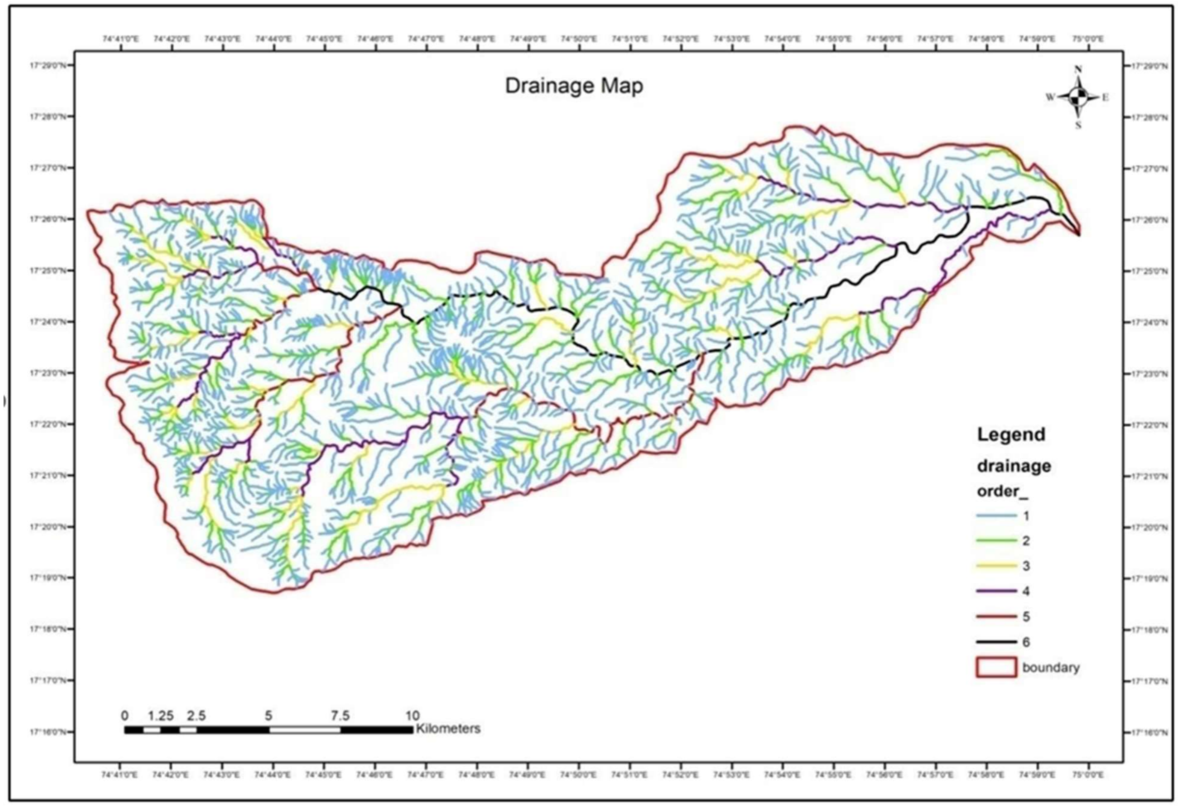

Fig. 2 Drainage map of Baltira River Basin

2.3 Geomorphology

The current study is being conducted in the Baltira Nala basin in Atpadi taluka, Sangli district, Maharashtra, India. The study location is located approximately 90 kilometers north-east of Sangli. The research region is located between North Latitudes 17o 18' and 17o 28', and East Longitudes 74o 42' and 75o0'. The entirety of the field of study is indicated by Survey of India topographic illustrations no. 47 K/15 & 47 K/11, having a maximum height of 834 m and a minimum height of 540 m.

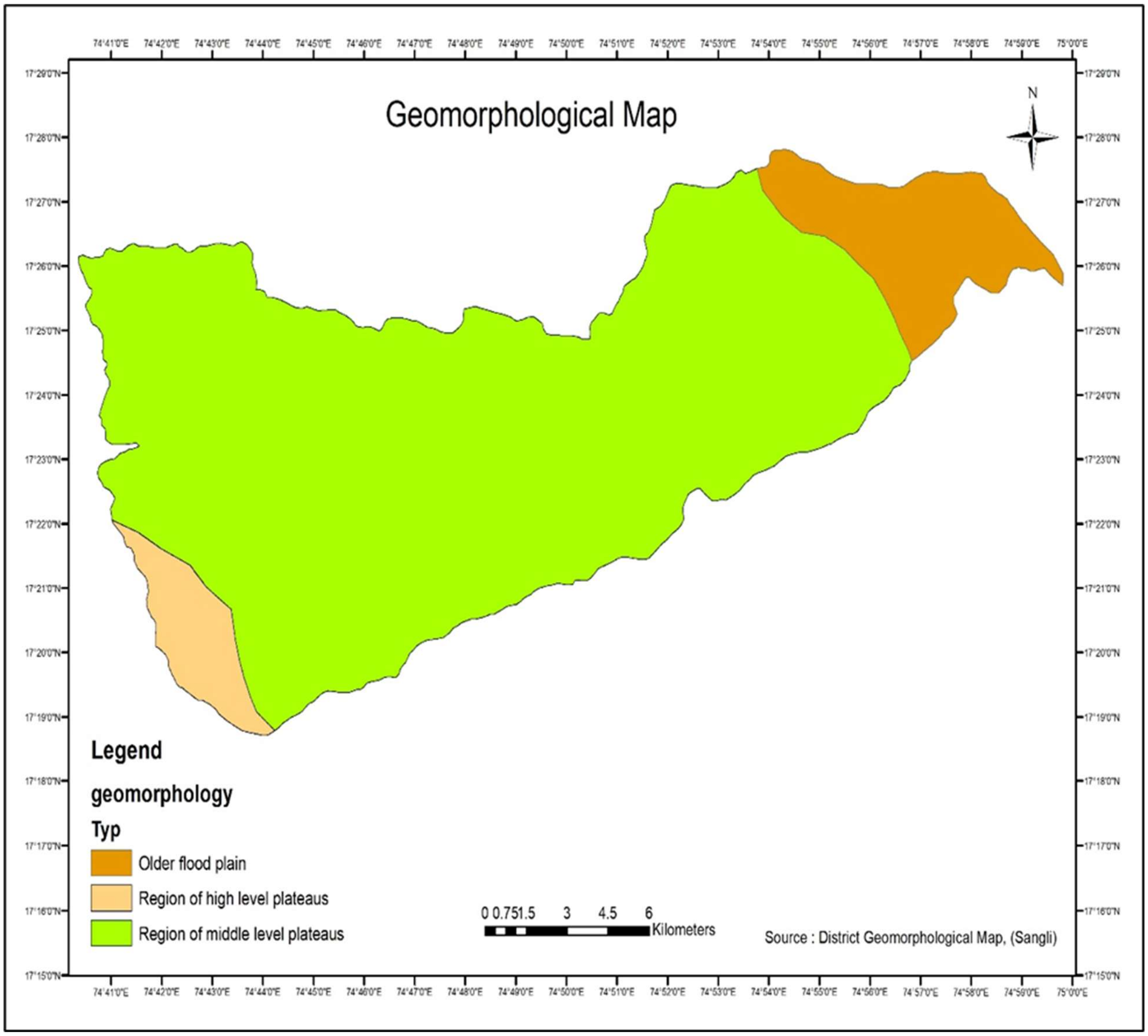

Fig. 3 Geomorphological map of Baltira River Basin

2.4 DEM (Digital Elevation Model)

DEMs are computerized records of ground elevations at regularly spaced horizontal intervals. To create the Digital Elevation Model (DEM), the Advanced Spaceborne Thermal Emission and Reflection Radiometer (ASTER) was utilized. (Figure 3). Topographic sheets yielded the greatest and lowest point elevation readings of 888 m and 521 m, respectively. The research area's western and northern periphery have higher elevation ranges, whereas the eastern half in the centre has the lowest slop, forming a level surface. The DEM was utilized to calculate slope, aspect, flow direction and accumulation, and stream network data.

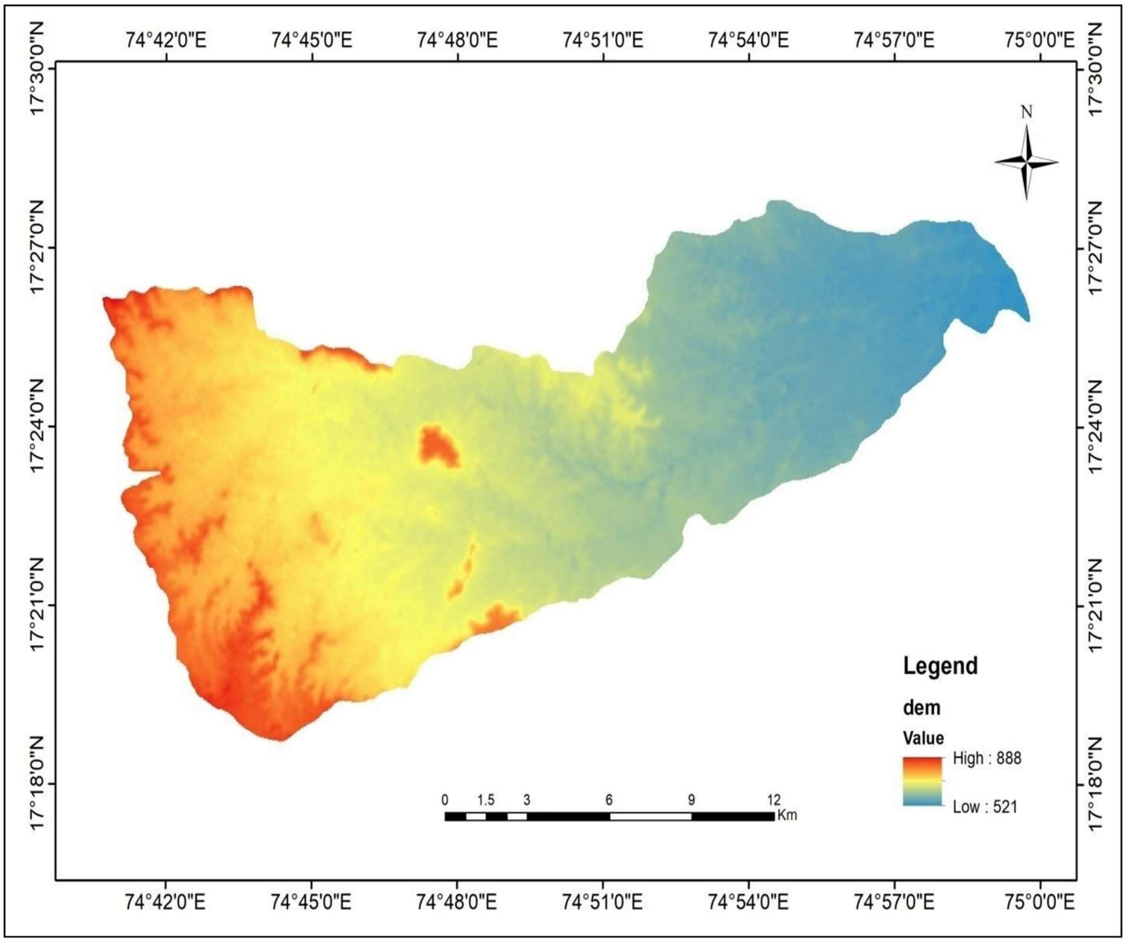

Fig.4 DEM of Balitra River Basin

2.5 Slope

Basaltic rock dominates the geology of the area, as illustrated in Figure 6. Tectonic action has historically caused extensive damage to the area, as demonstrated by various fold, fault, and lineament relationships with hills on the study area's western side. Basaltic flows cover the terrain associated with Cretaceous to Eocene Deccan Volcanic activity. They are referred to as the Deccan Trap because to its step-like topology. Individual flows have thicknesses ranging from a few metres to 40 metres. They go on for a long time. Throughout the study area, the mineralogical and chemical composition of basaltic lava flows is nearly uniform.

3. Methodology

After selecting the co-ordinates of GCPs, the boundary map, drainage map, and contour map of the sub-Watershed area were scanned and uploaded into Arc-GIS software as image files, digitized, geo-referenced, and then overlaid with imagery. The current study employs the following approach and procedure to achieve the aforementioned aims (Fig. 3).

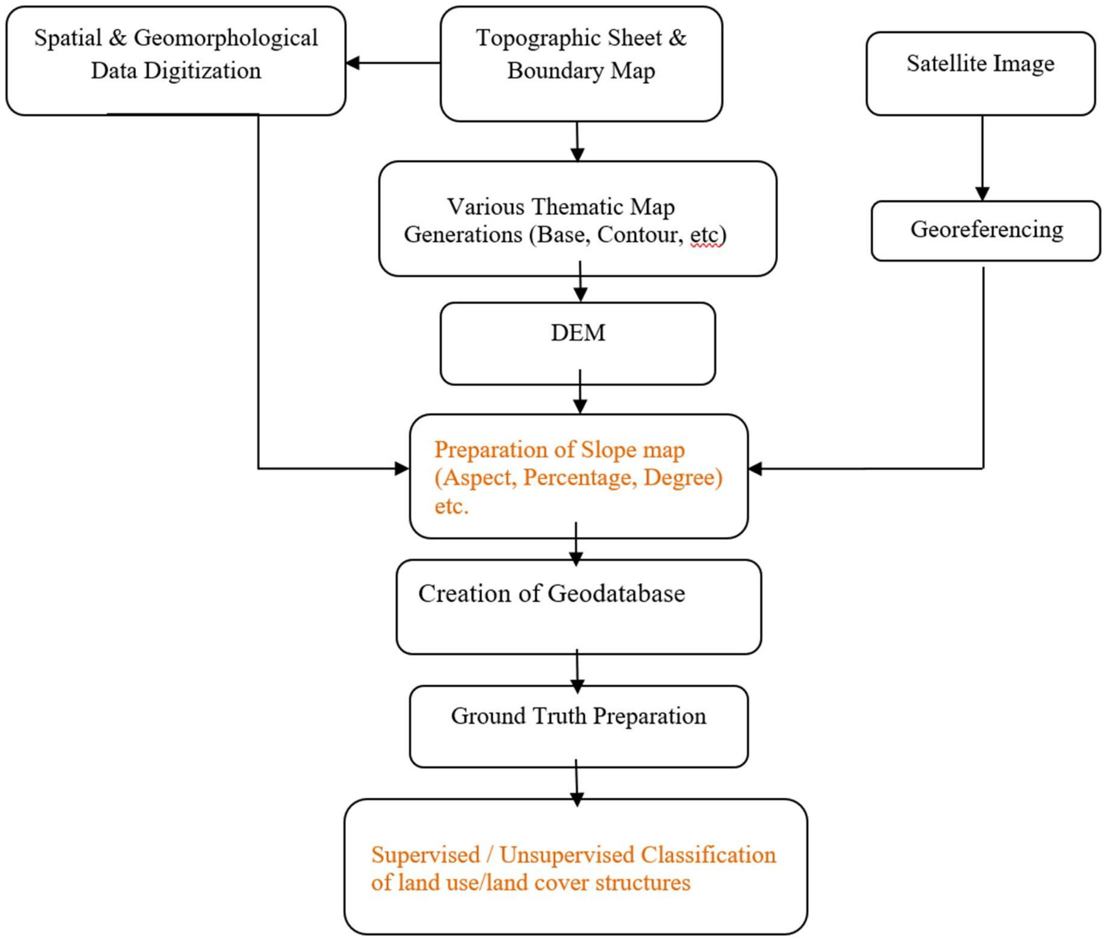

Fig. 5 Flow chart of methodology

The satellite data received for free from the Bhuvan.nrsc.govr.in website were digitized, geo-coded, and geo-referenced for the study. For the LISS III satellite picture, Arc-GIS 10 was utilized for GIS and evaluation, including supervised and unsupervised categorization.

4. Results and Discussions

Several thematic representations (geology, geomorphology, drainage network, drainage density) are available and slope were used to evaluate the area's terrain. It was created using field data, analysis of SOI remote sensing data and topographic sheets. The watershed region was assessed to be 278 square kilometres. The area under study has a dendritic drainage system, and the stream is sixth stream order. It is well known that the stream head location and drainage concentration will gradually change over time. The valley gradient initially rises with an increasing stream order before falling. Second to fifth order streams have the best grading. The primary explanation for such relationships to slope length increases with stream direction is known as gradient and steam order. When a drainage network is expanded, the slope length and drainage density generally increase. In reaction to changes in the local terrain, drainage basin slopes shift. The slope and aspect of a surface are essential aspects in creating its geometry.

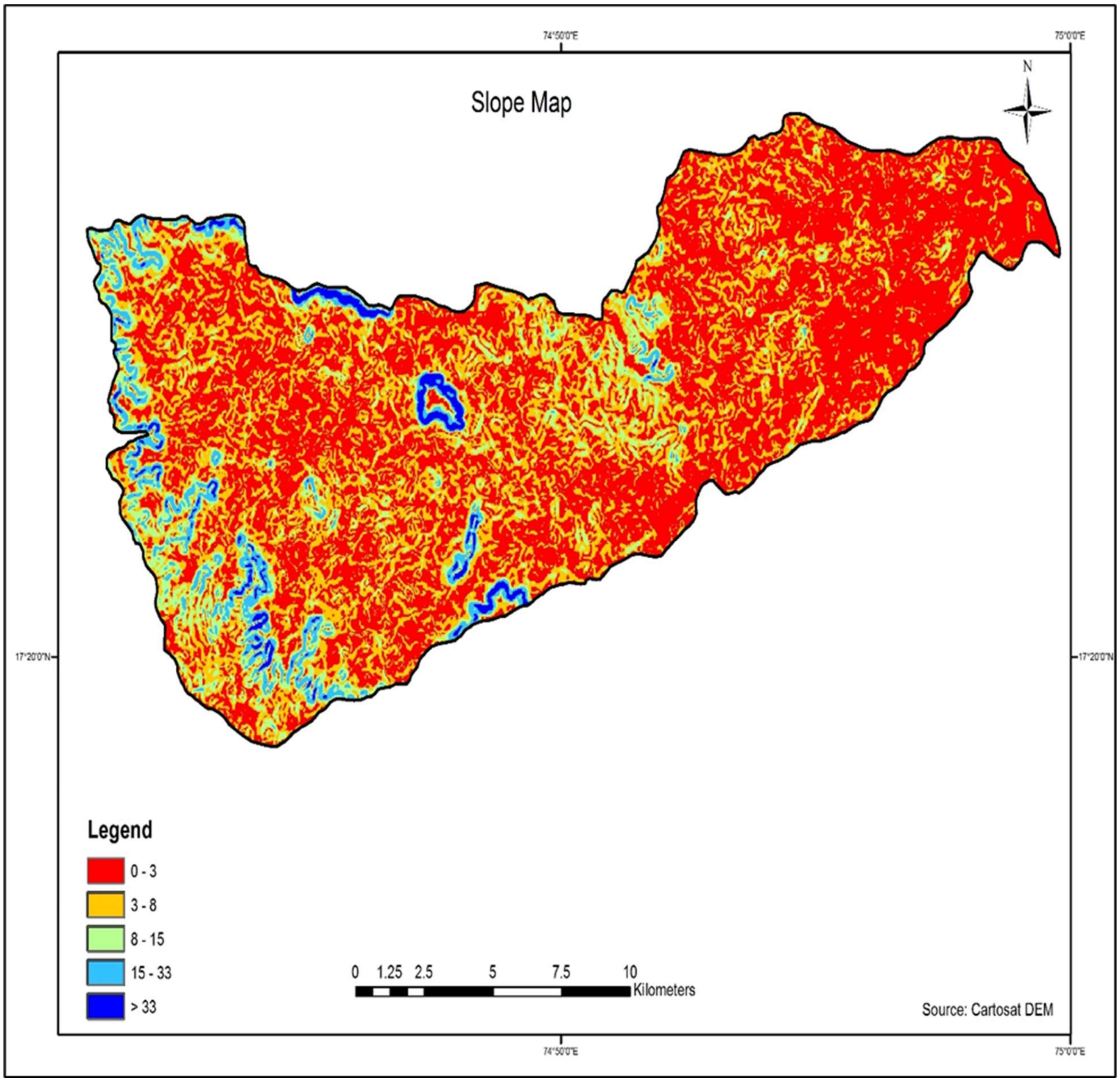

Fig. 6 Slope Map of Balitra River Basin

5. Conclusions

Terrain analysis is still an important part in delivering expected data pertaining to the geography and environment. A vast amount of data was collated, and additional layers, maps, and a relational database were created. Based on the above-mentioned map, a qualitative and quantitative terrain analysis of the region was conducted. Land use decisions have always been a part of the growth of human civilisation. Land use changes in the past were frequently the result of gradual progression. To effectively use for watershed development, a multidirectional approach is required.

It can also help with water conservation by identifying and implementing schemes in streams, for example, tiny check dams, percolation tanks, subsurface dykes, contour canals, properly plugging/ Nala bunds, and so on, as well as vegetative assistance (afforestation), terracing, geotextile application, and so on, wherever applicable or necessary. To recommend the design and scale of a particular sort of intervention plan, site-specific and extensive field investigations are necessary.

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