



## Physiographic study of eastern Ahmednagar area by using remote sensing data

Bhagwat G. Rashinkar<sup>1\*</sup>, Digambar S. Samarth<sup>2</sup> and Pramod A. Wadate<sup>3</sup>

<sup>1</sup>Department of Geography, Abasaheb Kakade College, Bodhegaon, Maharashtra, India

<sup>2</sup>Department of Geography, Taywade College, Koradi, Nagpur, Maharashtra, India

<sup>3</sup>Department of Geography, Bar. Sheshrao Wankhede Mahavidyalaya, Mohapa, Kalmeshwar, India  
bgrashinkar@gmail.com

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### Abstract

*The study of topography or physiography was based on visual interpretation of toposheet, aerial photographs, satellite images as well as doing by manually surveying, field visits and local observations. These study methods, somewhat called time consuming, required more human resources, and less accuracy oriented. Today, the trends of physiographic study have been changed and having a more scientific base due to Remote Sensing (RS) data and its incorporation in Geographical Information System (GIS) software. It is probably most used in spatial planning or surface planning with monitoring, mapping, and analysis of environmental parameters. The optical RS data help to generate the digital relief or digital elevation information of the earth surface at higher resolution with more scientific and visualize manner. On the earth surface, the presence of physiographical aspects can be noticed and could be possible to detect by automated or semi-automated techniques from the satellite derived ASTER DEM data. ASTER is Advanced Space borne Thermal Emission and Reflection Radiometer, which has a 30 M. spatial resolution which could be used in physiographic aspects micro level mapping and assessment. In the present study, the mapping of physiography along with slope, contour, aspects etc. parameters were carried out from ASTER DEM data and its incorporation in GIS software. It was proved and suggested that the ASTER data provide more accurate surface view of physiography than the traditional methods in the case of physiographic modelling and analysis. It is useful and resourceful for the earth scientists, researcher, regional planner, spatial planner in several decisions making and surface related planning process. Based on this physiographic analysis it was revealed that, the southern part of the study area is more undulating than the northern part.*

**Keywords:** Physiographic study, Remote Sensing, Geographical Information System.

### Introduction

Physiography is the significant part of our earth environment which study was based on field survey and analog data in last few years ago. It was quiet complicated and less accuracy oriented. Digital spatial data are essential to study, recognize dynamic process and to develop the environmental simulation models that are useful for scientific assessment of environmental problems and effects of human interactions on environmental quality<sup>1</sup>.

Identification and mapping of topographic situation and related natural and cultural environment is understand a significant exercises for the earth scientists who are interested in the fields of spatial planning, agricultural management, water resource management, engineering, groundwater exploration, flood hazard management etc. There is a continuous transformation of topographic landforms on the earth surface due to various atmospheric, morphological and anthropological agents<sup>2</sup>. Physiographic regime is one of the important units of environment<sup>3</sup> which determining the regional environment and allied socio-economic community.

Topographical arrangement, associated geological factors, structures like as lineaments, dyke, landforms and slope determines the water resources, direction of groundwater flow, groundwater recharge and discharge which influencing the socio-economic activities<sup>4,5</sup>. The slope of a region is seen to control the infiltration pattern and rate of groundwater and is also prospective groundwater suitability indicator. High surface runoff along a slope does not give ample residence time for rainwater to percolate into the ground, whereas along the gentle slope area the runoff is slow, allowing more time to percolate resulting into comparatively more infiltration<sup>6,7</sup>. Hydrologic phenomena can be correlated with topography, geology and climate that has a prominent impact on scale and quality of running water, soil erosion and soil nature at the scale of a basin<sup>8-10</sup>. Thus, the physiography and allied environment has a multidimensional correlation with other factors of the earth surface and sub-surface environment.

The role of space based input like satellite derived ASTER data is growing in the regional environmental and physiographic study. As compare to convectional data RS data is most useful for aerial mapping, monitoring and tracing the spatial entities

information at precise level. Similarly, it gives general Land Use and Land Cover (LULC) impression with and without image processing. RS data provide the aerial information at 2D and 3D form which is more appropriate for surface reality understanding, monitoring and could be used for decision support system<sup>11</sup>. It consists with spatial, spectral, radiometric and temporal characteristic with fine resolution. Satellite derived, satellite image, aerial photograph, ASTER DEM, World climate data, Synthetic Aperture Radar, etc. data<sup>11,10</sup> are commonly used in many regional applications. The hazard and disaster mapping can be performed from these types of RS data also. Few researchers<sup>12,13,5</sup> used the RS data in glacier retreating study, seismic hazard analysis and groundwater quality respectively. This paper informs the weight age of how to use high-resolution satellite RS products (ASTER GDEM) to attempt a regional-scale physiographic analysis with associated factors.

**The study area:** Present study area is the part of the eastern Ahmednagar district which is located in Maharashtra state of India (Figure-1). This study tract is selected as a study area to understanding the physiographic situations and its correlations with climatic, geographic, hydrologic and socio-economic environment. The extent of the selected study area is 18° 56' 42.05" to 19° 42' 49.31" N latitude and 74° 45' 3.35" to 75° 34' 5.97" E longitude. It covers around 3,589.38 km<sup>2</sup> area with diverse hilly, plateau and plain area. The mean temperature of the area recorded around the 25 to 29 degree in the area.

The maximum elevation of the study area is 906 M which is observed in the southern part of the study area (Pathardi Tahsil) while minimum elevation is 423 m which is observed in the northern direction of the study area (Shevgaon Tahsil). There is uneven distribution of physiography, population and agriculture and water resources in the area. This diverse environment determines the socio-economic situation of the present area. Brander and Schuyt stated that, rivers and streams hold enormous ecological values that provide very essential ecological services<sup>14</sup>. The intensity of precipitation, temperature, evapo transpiration, soil moisture, groundwater, vegetation canopy, cropping pattern etc. drought parameters are determine the drought nature<sup>15</sup>.

Present area suffering the drought characteristic as an influence of drought parameters<sup>16</sup>. Present areas ecological values based on Indian monsoon which is the main water source of associated tributaries and rivers. The Godavari is the significant east flowing river which is flowing from the northern part of the study area. The average rainfall of the study area is around 400-550 mm which has great spatial and temporal variations. The Southern part of the area facing the intense water scarcity problem, especially in summer seasons from last many decades, thus, the frequency of protest for water in this area has been rising. As a conclusion, regional physiography of the area is influencing the water resources and associated physical and cultural environment.

## Methodology

In this study, satellite derived ASTER GDEM (Global Digital Elevation Model) was downloaded from United State Geological Survey (USGS) website by selecting Area of Interest (AOI). ASTER data is used to create detailed maps of land surface and surface elevation. Digital representation of the surface or terrain through DEM is one of the main parts of the mapping process. DEM<sup>17</sup> represents a continuous variation of topography over space that helps in assessing landscape characteristics like slope, flow directions, areas, boundaries and outlets of drainage basins<sup>18</sup>.

In view of this ASTER GDEM, data used to monitor the topography, relief, associated landforms of the study area. Administrative map of Maharashtra consisted with tahsils boundary was georeferenced in Global mapper software. From this georeferenced administrative map, the Pathardi, Newasa and Shevgaon tahsils boundary shapes were extracted. Downloaded ASTER DEM was processed in ArcGIS software to create the physiographic, slope and aspect maps (Figures-2, 3). Moreover, contour was also generated from same DEM data in ArcGIS software (Figure-3). Selected tahsils shape file were superimposed over ASTER DEM data and prepared the physiographic, slope, aspects map along with contour lines of the study area. The integration of orthorectified ASTER DEM and georeferenced administrative maps with the GIS software were performed real world visualization in output maps of the study area.

## Results and discussion

**Topographical analysis:** The physiographic situation of the study area is determined by two main rivers system passing through middle part of the study area. The southern part of the study area is consisted with the hilly regime with a more than 900 meter height from mean sea level.

At the same time northern part of the study area is less than the 400 meter from mean sea level (Figure-2). Therefore, the main slope direction is from south to north in the stud area. The almost hilly tracts in the study area are located in the Pathardi tahsil. The main Balnath, Garbhagiri hill, Mohata Garh etc. are the significant hills ranges in this area.

The part of Shevgaon tahsil and Newasa tahsil is consisted with plain area. According to topographic situation it can hypothesized that the agricultural and other economic development is strongly associated with the Newasa and Shevgaon Tahsil area as compared to the Pathardi area.

The generated contours are in NW-SE directions which also represent the slope angle and directions in the present area. In the northern part contours are close to each other because of steep slope nature as compared to the other region while in southern directions maximum spacing is seen which the

indication of gentle slope of the area. The area from 540 to 480 meter height was to be seen large as compare to other region. Based on contour interpretation in the Newasa tahsil area maximum area is dominated by the plain topography. The

direction of contours lines are parallel to the river flow located in the northern direction of the study area or the northern boundary of the Newasa and Shevgaon tahsils (Figure-3).

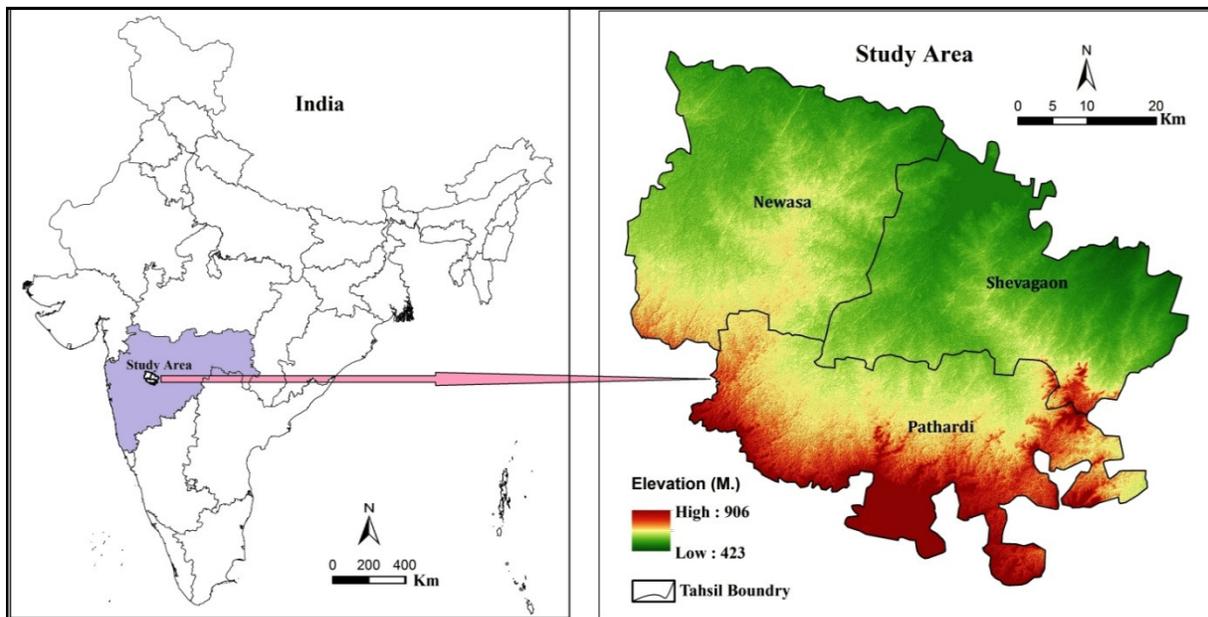


Figure-1: Location map of the study area.

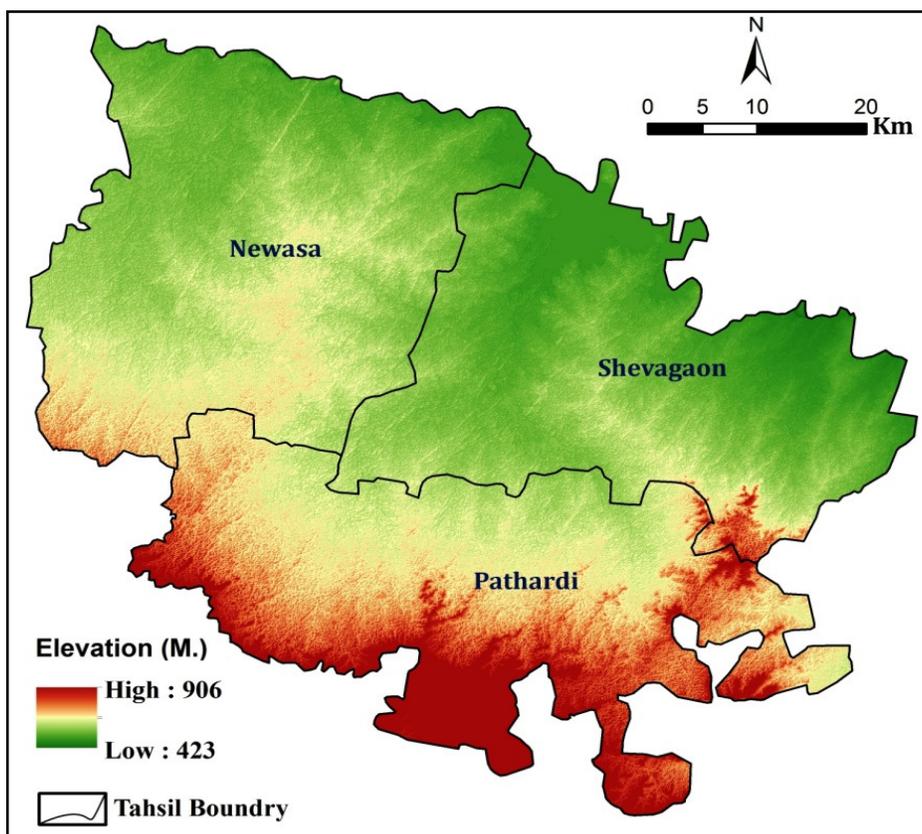


Figure-2: Topographic situation of the study area.

**Slope situation:** In this study area maximum slope were observed in the southern area and minimum in the northern area. Maximum slope is approximately 57 % which was recorded in the southern ranges of the study area. The Pathardi tahsil is located in the southern part which covered with large proportion of hilly area. Almost 37 % area of the tahsil is under hilly tracts, thus, in this area appeared maximum slope as compared to the Newasa and Shevgaon tahsil. The part of Shevgaon tahsil is connected with the Jayakwadi reservoir water body therefore, observed the minimum slope in this area which is around 0 %. Figure 4 showing the slope situation of the study area which is frequently showing the NE and SW facing slope in the area. Moreover, it is observed that from the generated slope map, the minor SW to NE facing linear ridges in the middle part of the

study area (Figure-4). The overall situation of the slope in the area is fluctuated and determined by the local topography.

**Aspect situation:** The aspect is the direction wise arrangement of the slope in particular area. The range of aspect is from  $0^{\circ}$  to  $360^{\circ}$  in the area (Figure-5). The maximum range of aspect in the area were observed in south west part and minimum in the north east part of the study area which is also affected by the local topography in the area. The hilly nature of the southern part of the area is determined the aspect of the study area. This area is connected with the hilly and water bodies from southern and northern direction sites respectively, thus, the aspect range were found  $0^{\circ}$  to  $360^{\circ}$  in the study area which encompass the diverse physiographic nature of the study area.

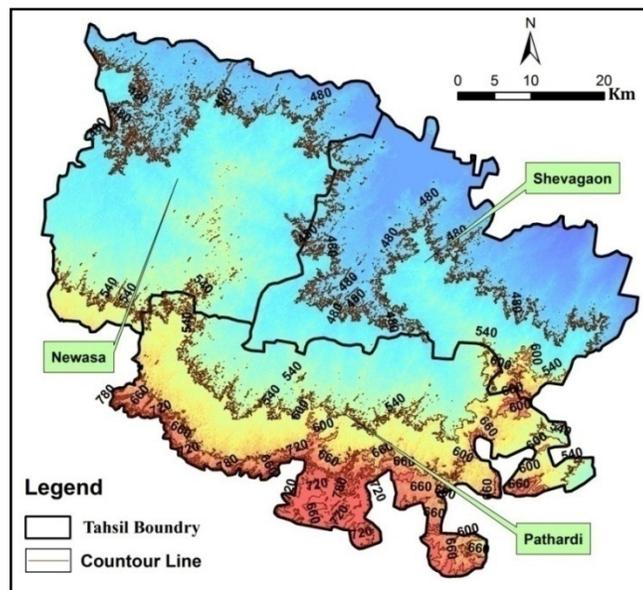


Figure-3: Contour line draped over the ASTER DEM of the study area.

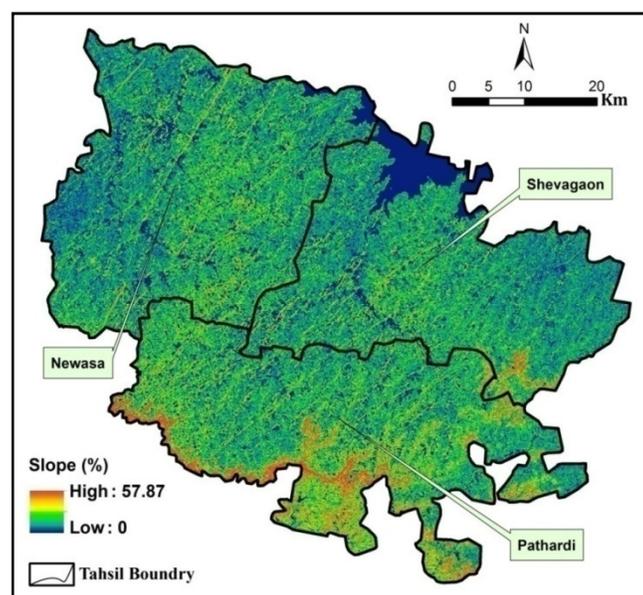


Figure-4: Slope situation of the study area.

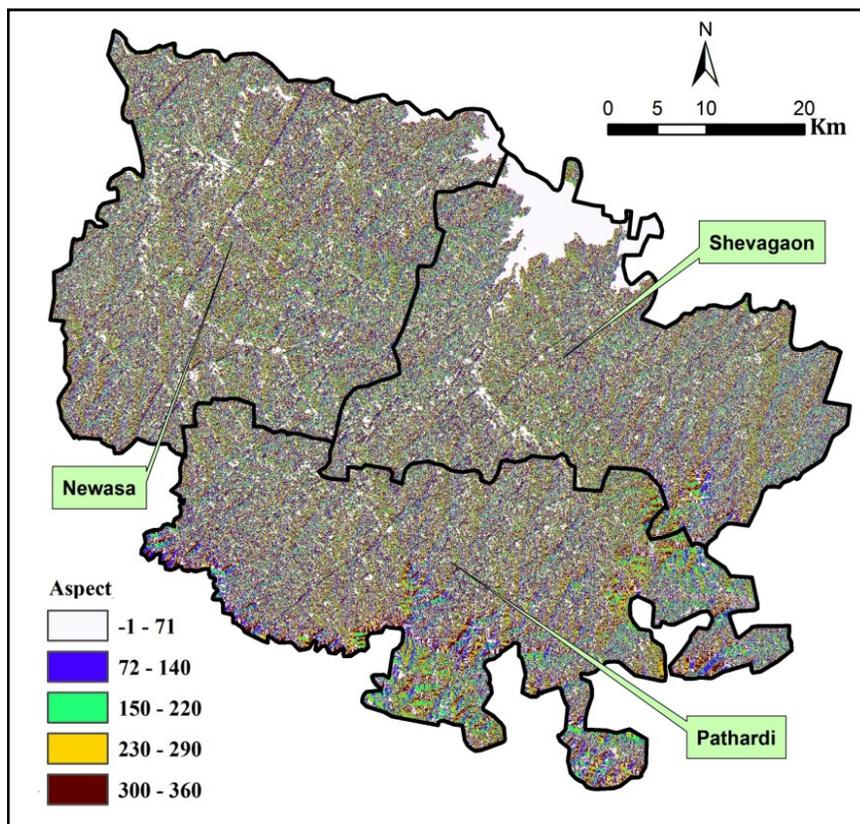


Figure-5: Aspect situation of the study area.

## Conclusion

The conventional techniques of physiographic analysis were time consuming and less accuracy oriented. The development of RS technology and its data capturing capabilities emerged the new gateway of knowledge<sup>19,20</sup>. It gives more precise level of regional topographic analysis within minimum time and resources. According to the revealed results overall area is showing the uneven characteristic of the physiographic situation. The southern part of the area is highly uneven in hilly situation as compared to the northern part. The hilly tracts are arranged in the NW to the SE directions thus the contours are parallel to the same arrangement. This arrangement also affects the slope and aspect situation of the study area. The optical RS data helps to generate the digital elevation information of earth surface at higher resolution with more scientific and visualize manner.

ASTER could be used in physiographic aspects micro level mapping and assessment. It was observed that the ASTER data provide more accurate surface physiography than the traditional methods in case of physiographic modelling and analysis. Based on this physiographic analysis it was revealed that, the southern part of the study area is more undulating than the northern part. As a conclusion the physiographic study of any regions with specified parameters based on RS data is more capable and high accuracy oriented. It can be used prior to any topographic planning and decision making process.

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