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ASTER DEM BASED GEOLOGICAL AND GEOMORPHOLOGICAL INVESTIGATION USING GIS TECHNOLOGY IN KOLLI HILL, SOUTH INDIA

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Abstract

Digital elevation models (DEMs) are increasingly used for visual analysis of topography, landforms, as well as modeling of surface processes. DEM of study area is generated from ASTER DEM data of 30m resolution with using ArcGIS software. The analysis of the remote sensing data with conventional studies and sufficient ground truth information makes it easy to distinguish and demarcate the various ground features such as geology, structures, geomorphological features and their characteristics. This study is an attempt to delineate the geology and geomorphology interpretation in Kolli hill, South India. The present study is done using an integrated approach of Remote Sensing and GIS techniques, especially ASTER DEM, by observing the elevation, aspect, slope, lineament, and shaded relief of images. DEM has been an excellent supplementary information database for interpretations in the present study area along with other data.

Keywords: ASTER DEM, GIS, Slope, Aspect

Introduction

Digital elevation models (DEMs) is a digital representation of the topographical surface (Gurugnanam and Kalaivanan, 2014).It is used for visual interpretation, analysis of topography, landforms, lithology, as well as modeling of surface processes. In the present scenario, GIS is being used for various purposes such as evaluation of surface features for geological and geomorphological studies. The current computer technologies may provide additional tools for geological and geomorphological mapping which may improve better agreement of determined geological units with the terrain topography. One of such tools of GIS is the Digital Elevation Model (DEM) which can serve both as information source for finding geological boundaries, controlling elevations, and at the same time playing an important role in preparation of the base map as well as various surficial thematic maps (Ostaficzuk,2005). It is also used for many purposes like providing flood and landslide risk zone, highways and corridor selection including cut and fill estimation etc. These data are also good for geological interpretation particularly in terms of geomorphology, rock type and structure (Sarapirome et al., 2002).

Study area

The proposed study is taken up in Kolli Hill, Tamil Nadu. The study area lies between 11°11' - 11°30' north latitude and 78°15'00" - 78°30'00" east longitude in Namakkal District of Tamil Nadu. The study area lies north of the river Cauvery, covering an area of about 485 km2 (Fig.1). Physiographically; it is a hilly region with an altitude ranging from 180 to 1415 m at the foothill and plateau respectively. Slope of this region varies from gentle to very steep. Geologically, the study area is occupied by acid charnockite with minor bands of pyroxene granulite and magnetite quartzite (Mani, 1976).

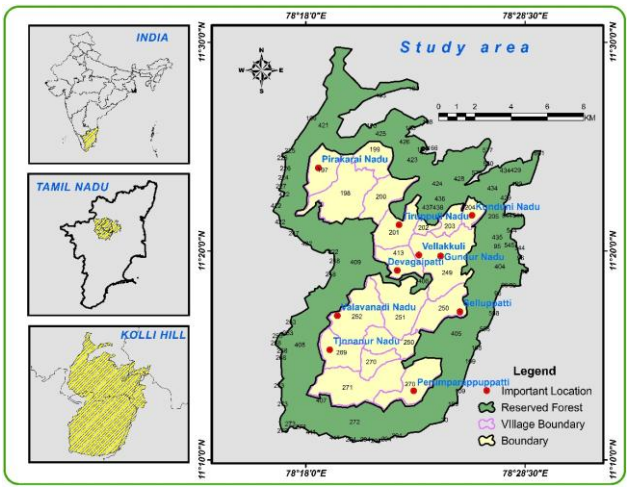

Fig.1. Location map of the study area.

Methodology

For the present study, Advanced Spacebourne Thermal Emission and Reflection Radiometer (ASTER) DEM data of 30m resolution is used as input data. The DEM map is representing the elevation of the study area, ranging from 160 to 1400m elevation. The slope and aspect map, which aids in interpretation of topographical and geological features, is generated from the DEM in ArcGIS software. A number of shaded relief images are also generated from the DEM having different azimuth, sun angle and vertical exaggera-

tion using surface analysis tool. It is seen that different sun angle and azimuth help in enhancing different features. On these parameters, the various interpretations are made based on the shaded relief images, aspect and slope map with reference to the existing geomorphological and lithological maps. The present study methodology flow chart is shown in (Fig.2.).

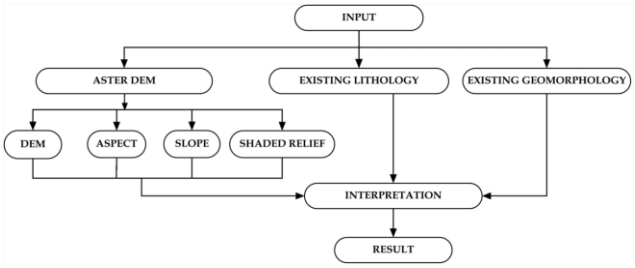

Fig.2. Flow chart showing methodology.

Results and discussion

Digital Elevation Model (DEM) suggest the most common methods for extracting important elevation and topographic information. DEMs are used for visual analysis of topography, landscapes and landforms other than modeling of surface processes (Welch 1990). Currently DEM is considered as the main resource for the extraction of various geomorphologic (Gurugnanam, et.al. 2008) and topographic features depending on their elevation, spatial distribution and deviations (Felicisimo 1994). Digital Elevation Model (DEM), Digital Elevation Data (DED), Digital Terrain Data (DTD) (Campbell 2002) all consists of different arrangements of individual points of x (east-west direction) and y (north-south direction) coordinates of horizontal geographic positions. Z is the vertical elevation value that is relative to a given datum for a set of x, y points (Bernhardsen 1999, Bolstad, Stowe 1994, Welch 1990). They composed of samples array of elevations for a number of ground locations at equally spaced intervals (USGS 1990).

ASTER DEM of the study area indicates that the slope trends towards north from south. Shaded relief images can help to identify the information about geomorphometric features, rock types and structures of an area. The geomorphometric features are described as extent, tone, textures, size, shape, height, variation of slope and aspect on the surface. From the shaded relief images, the geomorphometric features can be identified (Fig. 3, 4 and 5).

- Geological structures look like a longer linear feature from southwest to northeast appearance of hard rocks. The data deciphers that in the central part of the study area high elevation structures as identified, which may be of hard rocks like charnokite etc.(Fig.6& 7).

- The NE-SW flowing water body on the NE side of the images indicates presence of lineaments (Fig. 6, 7 & 8).

- The intermountain areas images with scattered hills indicate slope of the area (Figure 8, 9&10

In the process of identifying the geology of the study area from the shaded relief images, an already existing lithological map of the same area has also been referred. Hilly range is found across the central portion of the study area, and with comparison to the lithology and geomorphology map, it is identified as Charnokite. To the NE portion of the hilly area lies a rocky topography deprived of much drainage and without much change in slope and elevation. These are made up of metamorphic lithotypes of Charnokite and Hornblende Biotite Gneiss. Intrusive rocks like dolerites dyke are present in the NW and southern part of the study area.

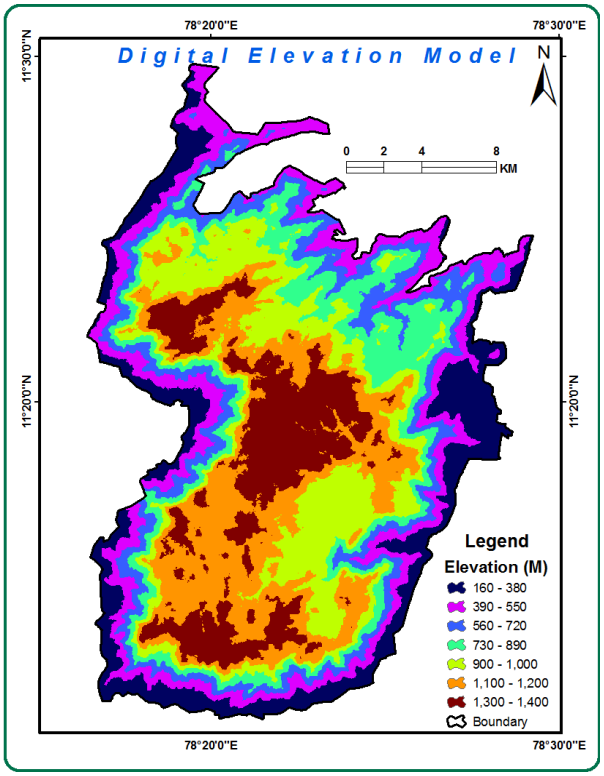

Fig.3. Digital Elevation Model in Kolli hill.

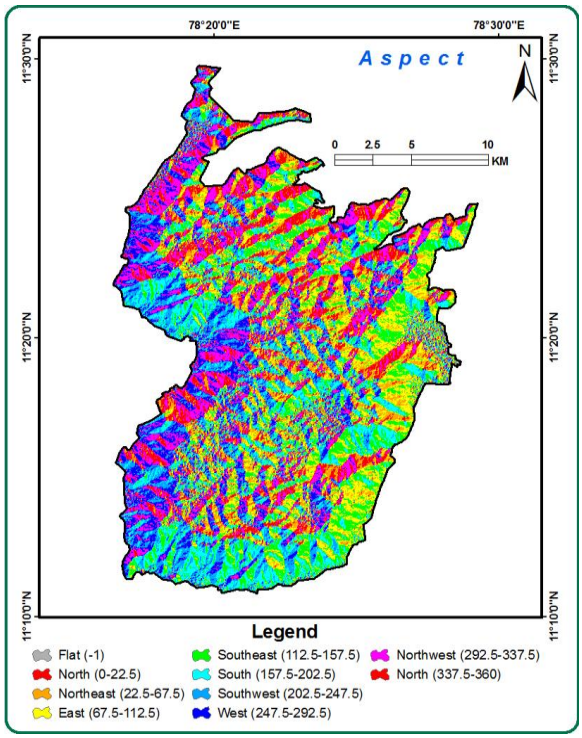

Fig.4. Aspect map of Kolli hill.

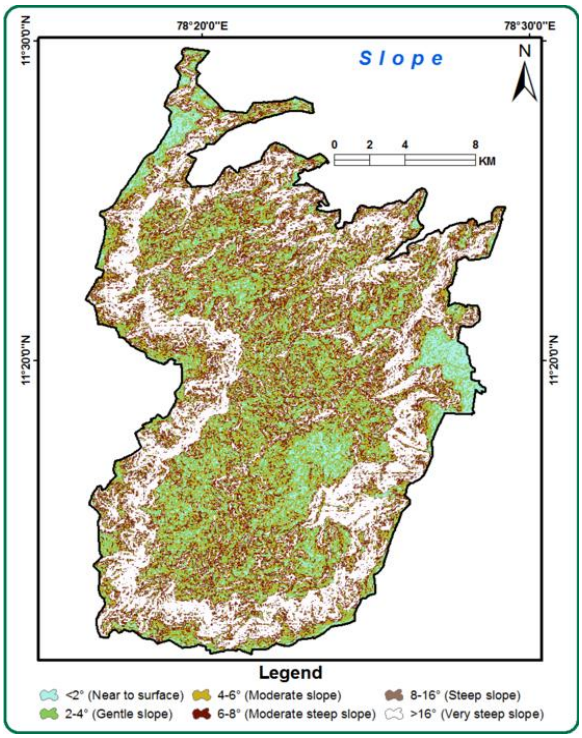

Fig.5. Aspect map of Kolli hill.

Fig.6. Shaded Relief Image (Azimuth315, Sun angle 75).

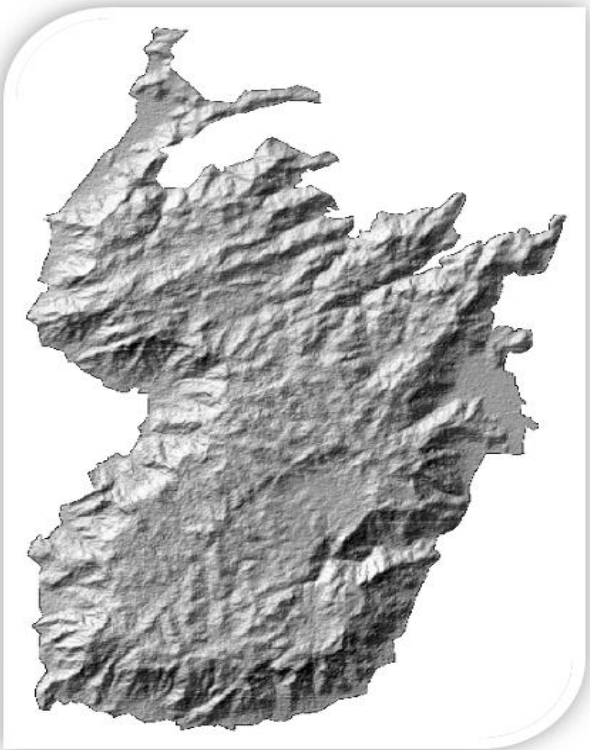

Fig.7. Shaded Relief Image (Azimuth315, Sun angle 45).

Fig.8. Shaded Relief Image (Azimuth 45, Sun angle 45).

Fig.9. Shaded Relief Image (Azimuth315, Sun angle 10).

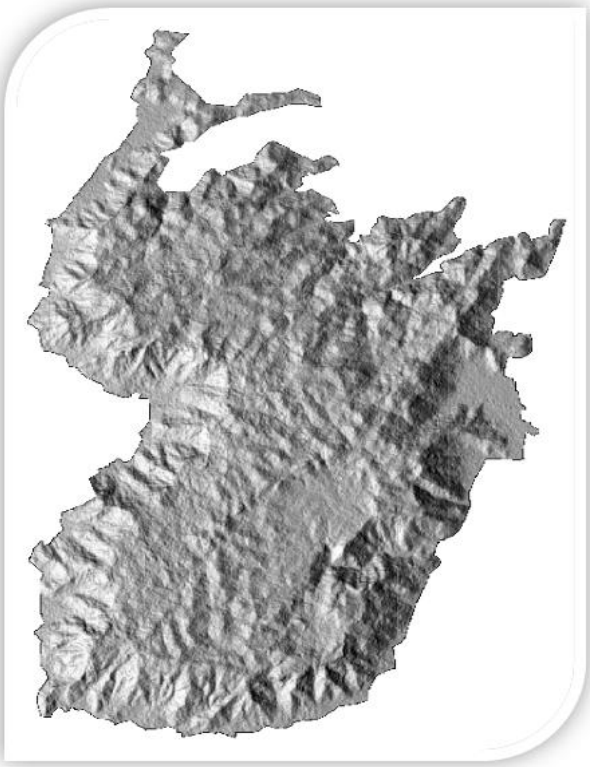

Fig.10. Shaded Relief Image (Azimuth 225, Sun angle 10).

Conclusion

According to Drury (1987), it is seen that DEM data can be used for geological interpretation in terms of geomorphology, structure and lineaments recognition but not to a very detailed level. ASTER DEM and satellite data can be used for visualization and interpretation of the area in terms of geology and geomorphology. In geological investigation we can delineate the changes in structures of the area and in the geomorphological features. We can identify the geomorphological features like lineaments, faults, fractures but not in detail. DEM data, however cannot be ignored altogether as it can be very useful in giving an overview of the geology and geomorphology of any area especially where any other data. Slope is the most important and specific feature of the earth's surface form. The Kolli hill region has fully developed slope profile that includes slope classification and slope elements. The slope elements in a complete sequence, from the crests to pediments, have been observed in the fully developed hilly slope.

Acknowledgement

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