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ASTER DEM Based Studies for Geological and Geomorphological Investigation in and around Salbardi Fault of Betul District (M.P.) and Amaravati District (M.S.), India

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Abstract The Salbardi and adjoining area are one of the important elements of the Son Narmada Tapti Lineament. Digital elevation models (DEMs) are more and more 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 software ARC GIS 9.3. The analysis of the remote sensing data with conventional studies and sufficient ground truth information makes probable to recognize and delineate the various ground features such as geology, structures, geomorphological features and their characters. This study is an attempt to delineate the geomorphology in and around Salbardi and adjoining area of Madhya Pradesh and Maharashtra states, using 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, Geomorphology, Remote Sensing*

1. Introduction

Digital elevation models (DEMs) is a digital representation of the topographical surface. 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 in various purposes such as evaluation of surface features for geological and geomorphological studies. The modern 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 play important role in preparation of the base map as well as various surficial thematic maps (S., 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).

2. Study Area

The study area lies in the Survey of India toposheets no. 55k/2, 55/k3, 55G/14, 55G/15 and bounded by latitude and longitude 21^0 20' to 21^0 35' E and 77^0 45' to 78^0 10' N respectively. The area from the present study divided in to two parts i.e. one part comes under the state of Maharashtra and other falls under the state of Madhya Pradesh. The proposed study area is one of the important elements of the Tapti-Purna lineament which in turn is a major component of SONATA (Son-Narmada-Tapti Lineament), straddling across the Indian shield in ENE-WSW direction (Acharyya et al., 1998). The fault at the junction of Tapti Grabben and Satpura Horst is termed as Satpura foot hill fault and is the most active element of the system (Ravi Shankar, 1995).

Auden (1949) had guessed the through of this fault to be anywhere between 1800-1400 m in Gawilgrah region. This is a regional feature which can be traced throughout the proposed area and extend in either direction for considerable distance. It was variously described as Gawilgrah fault, Ellitchpur fault and Salbardi fault in different stretches (Rajurkar, 1992; Saxena, 1984). The vertical through or displacement across the fault junction of the Tapti grabben and Satpura horst was measured to about 1000mt at Salbardi of this 425 meters appears to be quaternary component (Ravi Shankar, 1992). The northern contacts of Proterozoic rock with Upper Gondwana with that of Deccan trap and with Gondwana are faulted. It is an ENE-WSW trending fault and known as Salbardi fault (Ravi Shankar, 1994).This fault is most probably the eastern continuation of well known Gavilgrah/Elichpur fault (Rajurkar 1981).

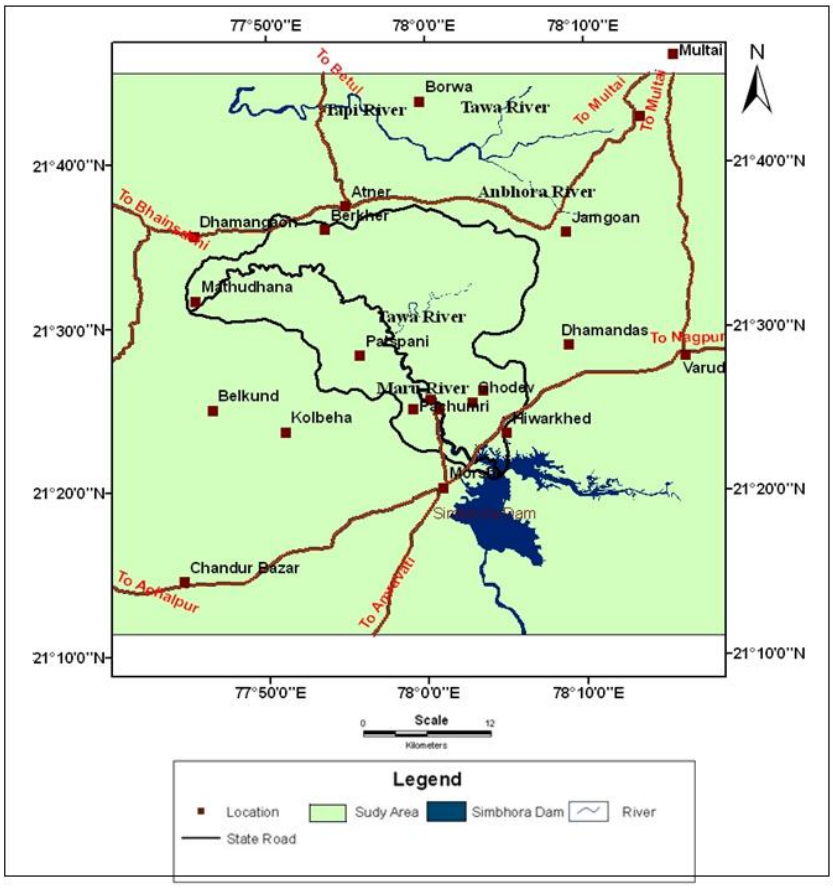

Figure 1: *Location Map of the Study Area*

3. Materials and Methodology

3.1. Data Used

a. ASTER DEM 30m (USGS/NASA ASTER DEM data), available from
http://www.gdem.aster.ersdac.or.jp
b. ERDAS IMAGINE 9.2
c. ARC GIS 9.3

3.2. Methodology

The input data is used as ASTER DEM 30m with resolution for the present study area. DEM map is representing the altitude of the study area ranging from 282 to 1138 mt amsl. Aspect map which is generated in ARC GIS 9.3 software from the input data to know the topographical slope direction and geological features of the area. Slope map is also generated to know the intensity of slope. Slope of the study area has been classified into seven classes as per the IMSD guidelines (NRSA, 1995). The area constitutes 0 to more than 35% slope. Most of the area falls into 0-1% i.e. nearly level and 1-3%. High slope is observed in the northern part, western part and southwestern part of the study area (Figure 4).

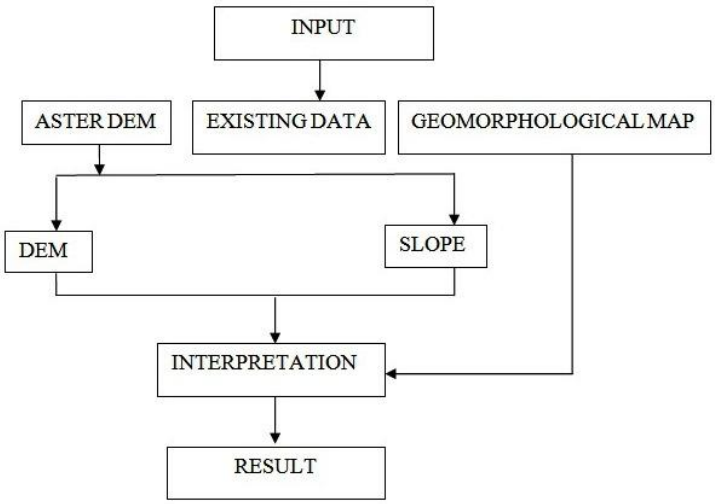

Figure 2: *Flow Chart Showing Methodology*

4. Interpretation

Digital elevation models suggest the most widespread 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 Digital elevation models (DEMs) is considered as the main resource for the extraction of various geomorphologic 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) or Digital Terrain Model (DTM) 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 and Stowe 1994, Welch 1990). They composed of samples array of elevations for a number of ground locations at equally spaced intervals (USGS 1990).

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. From the shaded relief images, the geomorphometric features which is described as extent, tone, textures, size, shape, height, variation of slope and aspect on the surface can be identified (Figure 3). Geological structures look like a series of curvilinear features from southwest to northeast alternate banded appearance of soft and hard rocks. The data deciphers that in the southwestern part of the study area constitute hills like structures as identified, which may be of hard rocks like felspathic gneiss, etc. Tributaries are following the soft rocks, merging and making a form of river. A river flowing from north to south direction is totally structural controlled (a clear view of the river can be seen in (Figure 1). In northwest part of the study area another river has been identified with the help of the generated data. Northern part of study area has a sudden change in the topography is rugged (Figure 3).

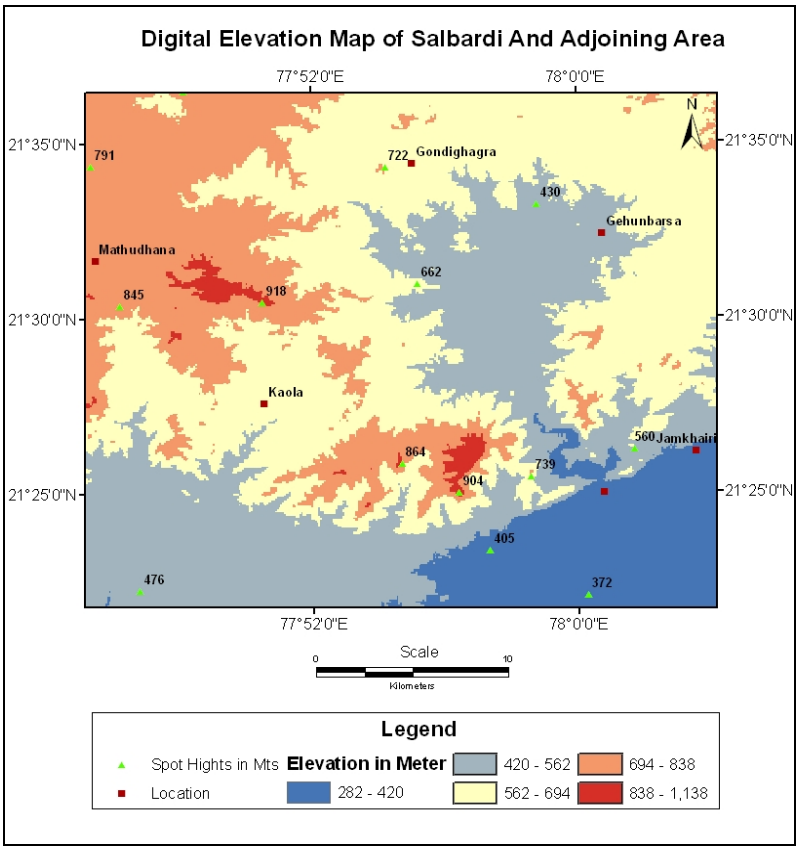

Figure 3: *DEM Map of Study Area*

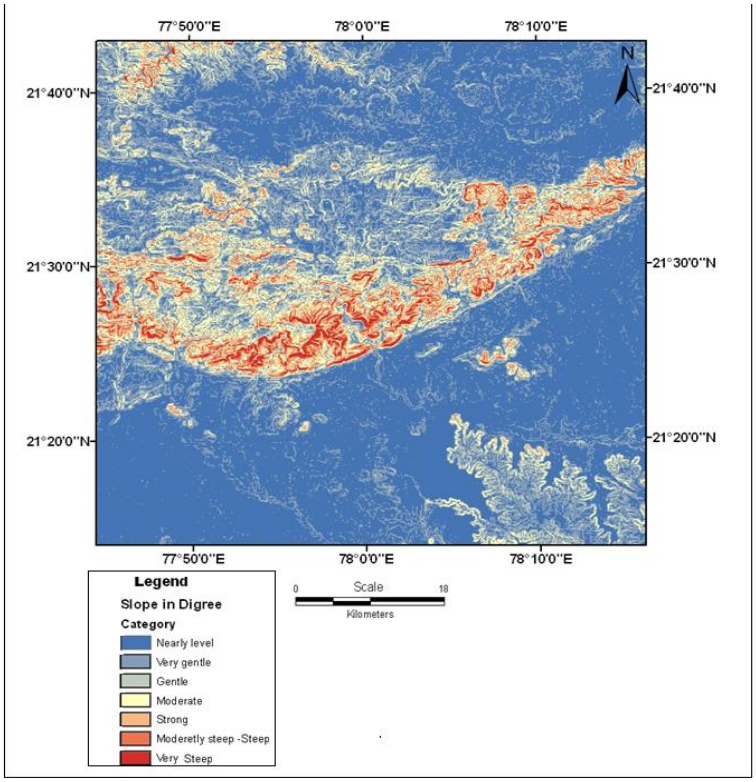

Figure 4: *Slope Map of the Study Area*

In the study area, the slope values vary from 0 to 42º. The slope values have been categorized in to seven groups like 0-1, 1-3, 3-5-10, 5-10, 10-15, 15-35 and above 35º with slope class namely nearly level, very gently, gentle, moderate, strong moderate, steep to steep, very steep respectively (Figure 4). Steep slopes to moderately steep slope are observed in hill top plain/dissected plateau and valley fill zones covering 15% of the total area and rest are nearly level, very gently, gentle to moderate category out of 4572 sq Km. Topography relates to the local and regional and gives an idea about general direction of the slope and direction of the study area that influence the whole topography of the area.

5. Conclusion

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 details. 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 Salbardi and adjoining region experiences a fully developed slope profile that includes slope classification and slope elements. The slope classification was adopted by NRSA, 1995 which is more convenient for the better interpretation and analysis of the slope for the study area. The slope elements in a complete sequence i.e. from the crests to pediments have been observed in the fully developed hilly slope near Salbardi and Jamkhari village. The slope map papered in degree form with their elements. In the study area the different slope elements have been observed.

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