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DIGITAL ELEVATION MODELS AND SLOPE ANALYSIS IN SOME PART OF PURNA RIVER SUBBASIN, CENTRAL INDIA

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Abstract: Slope is one of the important factor governing topography of the area. Slope governs many factors like drainage systems, drainage pattern and also affects soil cover of the area which ultimately leads to vegetation cover and vegetation density. Study area varies in elevation from 290 Mt. to 1147 Mt. With the help of SRTM-DEM and ArcMap 10.1 slope analysis is been carried out. Study area is been classified into 5 classes on the basis of slope in degree. Categories as Very gentle (0˚ to 3.39˚), Gentle (3.39˚to 9.80˚), moderate (9.80˚to17.89˚) and Moderate to steep (17.89˚ to 27.49˚) and Steep (27.49˚ to 48.01˚). Where northern part of study area is having steep slope and as going downwards in the southern parts of study area slope decreases up to very gentle.

Keywords: Slope, DEM, Purna River

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INTRODUCTION

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 (Bolstad , 1994, Welch, 1990). The satellite images are becoming useful and necessary in geomorphology, especially in obtaining quantitative measurements and performing geomorphic analyses (Hayden et al. 1986). Image analysis provide geologists an opportunity to enhance, manipulate, and combine remotely-sensed digital data with several types of geographic information that in turn increases the amount of extracted information related to topographic and geologic features (Horsby & Harris 1992). In the study area, how the IRS LISS III false colour composite and SRTM DEM has been used for deliation of the geomorphology of the upper Chandrabhaga River. It occupies an area of 308.29 km^2. The elevation varies in the study area from 1147 m to 290m. The stratum of the Northern Western part mainly of Deccan traps. The southern part of the Watersheds contains alluvium. The Shuttle Radar Topography Mission (SRTM) is an international research effort that obtained digital elevation models on a near-global scale from 56° S to 60° N, to generate the most complete high-resolution digital topographic database of Earth. This data is provided in an effort to promote the use of geospatial science and applications for sustainable development and resource conservation in the developing world. Digital elevation models (DEM) for the entire globe, covering all of the countries of the world, are available for download. The SRTM 90m DEM's have a resolution of 90m at the equator, and are provided in mosaic 5 deg x 5 deg tiles for easy download and use. All are produced from a seamless dataset to allow easy mosaicing. These are available in both ArcInfo ASCII and GeoTiff format to facilitate their ease of use in a variety of image processing and GIS applications. Data can be downloaded using a browser or accessed directly from the ftp site. In the Study Approach is made to analyse the slope with SRTM-DEM data. The slope information is useful in understanding the topography, geomorphology, soil types and their erodability, surface drainage etc (Manjare 2015). Slope Analysis provide information about the topography of the area and on the basis of slope analysis area is been classified into Very genital slope (0° to 3.39°); Gentle slope (3.39° to 9.80°); Moderately steep slope (3.39° to 17.89°); Moderately to steep slope (17.89° to 27.49°); Steep slope (27.49° to 48.01°). A map is been generated using the SRTM-DEM data and on the basis of above classification showing slope map of study area (Fig.2). The slope element dependent on stratigraphy, structure, climate and erosion activity of the river (Paunikar**,** 2015).

Study Area

The study area encompasses the part of the upper Watershed of the Chandrabhaga River, which is main tributary of Purna River. It extends between 77˚ 04' 23" E to 77˚ 25' 19" E and 21˚ 20'52" N to 20˚ 53'24" N, and administratively in Amravati districts of Maharashtra, India (Fig.1). The river Chandrabhaga originates from Satapura Hills (Chikaldhara) and flow in south direction. It occupies an area of 308.29 km^2. The elevation varies in the Watershed lies in around 1147 m to 290m. The stratum of the Northern Western part mainly of Deccan traps. The southern part of the Watersheds contains alluvium.

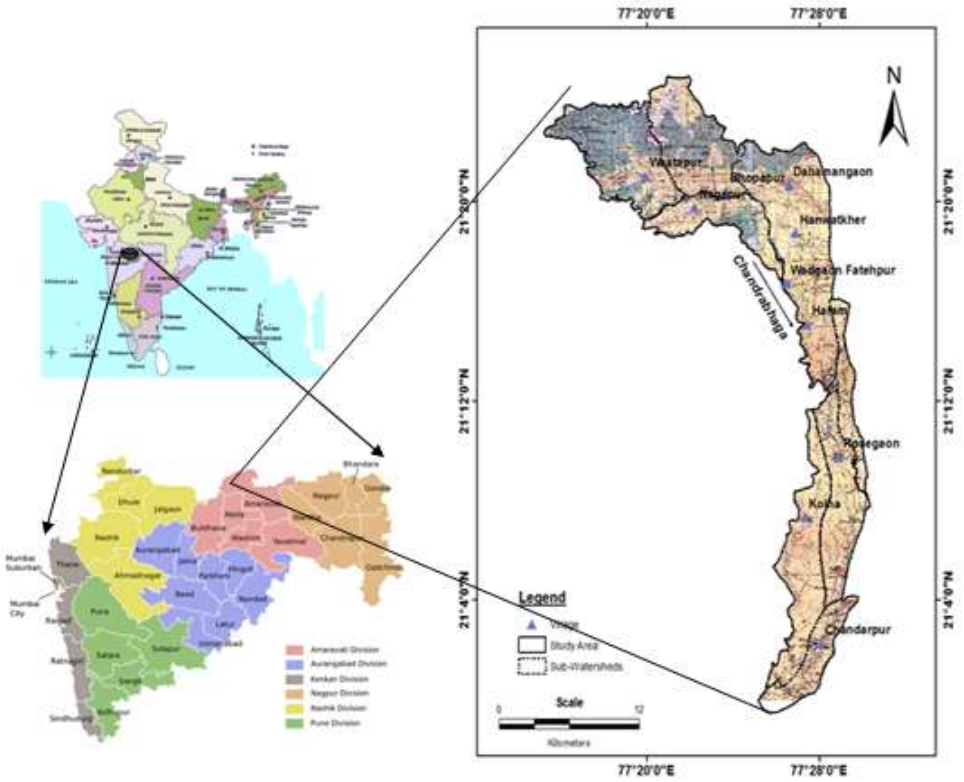

Fig.1: Location map of study area

Digital elevation models (DEMs)

The availability of digital elevation models (DEMs) is critical for performing geometric and radiometric corrections for terrain on remotely sensed imagery, and allows the generation of contour lines and terrain models, thus providing another source of information for analysis. Present day mapping programs are rarely implemented with only plan metric considerations. The demand for digital elevation models is growing with increasing use of GIS and with increasing evidence of improvement in information extracted using elevation data (for example, in discriminating wetlands, flood mapping, and forest management). The incorporation of elevation and terrain data is crucial to many applications, particularly if radar data is being used, to compensate for foreshortening and layover effects and slope induced radiometric effects. Elevation data is used in the production of popular topographic maps. Elevation data, integrated with imagery is also used for generating perspective views, useful for tourism, route planning, to optimize views for developments, to lessen visibility of forest clear cuts from major transportation routes, and even golf course planning and development. Elevation models are integrated into the programming of cruise missiles, to guide them over the terrain (Burrough, 1986).The digital elevation map of the study area were extracted from the SRTM DEM and analyze by using topomaps (Fig.2).

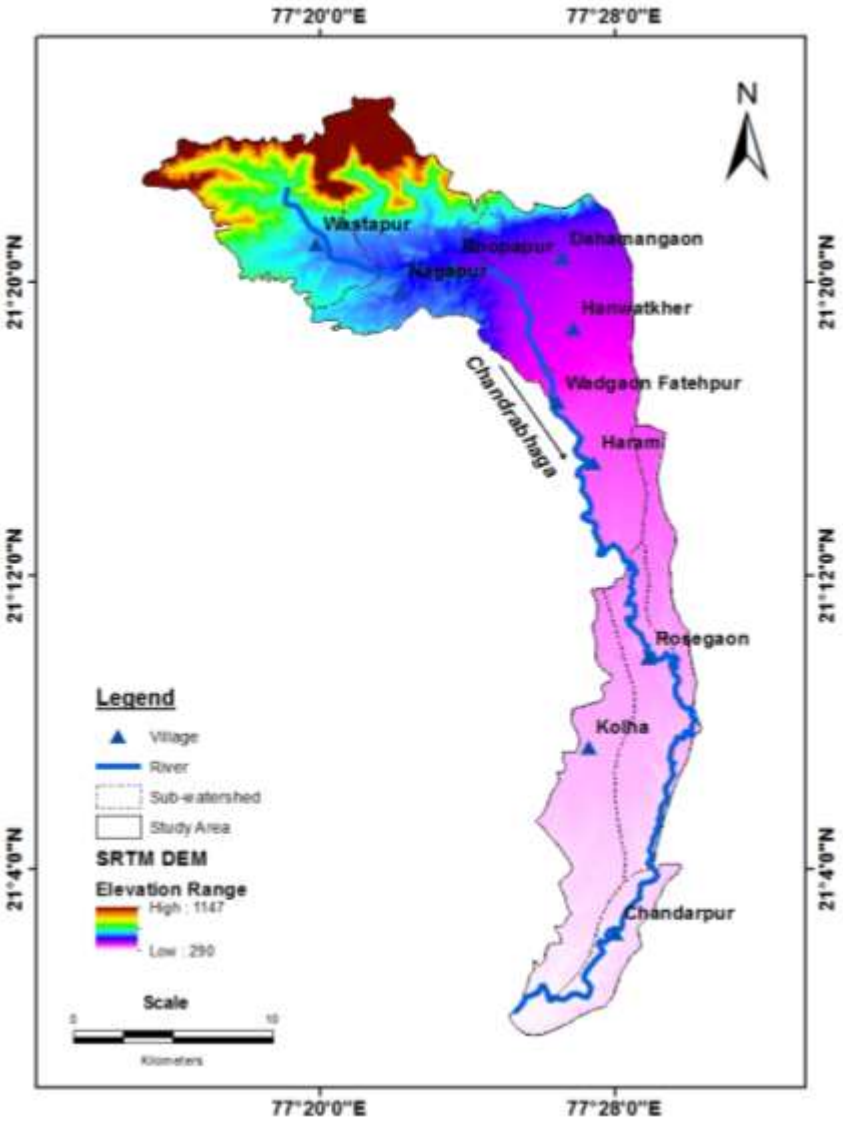

Fig. 2: Digital elevation map of the study area

SLOPE

Slope is the basic elements visualizing landform characteristics. They are important in studies of watershed units, landscape units, and morphometric measures (Moore et al., 1991). For other variables slope can assist in runoff calculation, forest inventory estimates, soil erosion, wild life habitat suitability and site analysis (Wilson and Gallant, 2000). A slope map shows the degree (steepness) of slope for a terrain. Degree of slope classes are mapped with saturation (or brilliance of colour) so that the steeper slopes are brighter. A high degree of slope is noticed in the north-western parts of the basin (Fig. 2). The elevation in the study area ranges from 290 to 1147 mt. which extracted from the SRTM DEM data (Fig. 1). The terrain is occupied by high degree of slopes resulting from complex geological structures. The slopes of the study area are represented in terms of degrees and are classified into five categories such as Very gentle (0˚ to 3.39˚), Gentle (3.39˚to 9.80˚), moderate (9.80˚to17.89˚) and Moderate to steep (17.89˚ to 27.49˚) and Steep (27.49˚ to 48.01˚). From the slope map (Fig. 1), it can be seen that major part of the study area falls under Very Gentle slope category covers an area of 2.19.32 sq.km (71.14 %) and 14.90 % of the study area is characterized by Gentle slope category occupies an area of 45.95 sq.km. About 20.30 sq.km of the study area (6.54 %) comes under moderate slope category while the small proportion 16.09 sq.km

(5.22 %) of the study area has moderately to steep sloping areas and only 7.14 sq.km (2.20) areas is of very steep slope which are mainly along the master streams. Low relief is present in the gentle slope class, moderate relief is belongs to moderate slope category and high relief is extant in the steep categories.

SLOPE CLASSIFICATION

Slope study classified on the basis of the guideline mentioned in Integrated Mission for Sustainable Development (IMSD) document. The varying degree of slope leads to severe erosion of land soil. The effect of slope on geomorphology, soil and land used was studied. Variation of slope and relief, drainage networks and typical landforms are the result of erosion and tectonic activity (Ghosh, 2011). The slope for the Chandrabhaga sub-basin of Purna River varies from. It is evident from the slope map which has been extracted from the SRTM DEM (90m) resolution in which five slope category have observed in the given study area (Fig. 2).

a) Very genital slope (0° to 3.39°): This is the lowest category of slope in this region and is associated with extremely flat part of area. This class provides ideal conditions for any type of farming, other agronomic condition favorable. Almost erodible land falls in this category which is drained by river and stream and represents an erosional surface of the current cycle. This covers Villages Chandarpur, Bargao, Rosegaon, Chamak Khurd, Petehpur, Wadgaon Fatehpur, Aregaon, Hanwatkher, Dhamangaon, Pimpalkhuta (Fig. 3).

b) Gentle slope (3.39° to 9.80°): This category of slope class covers an area having gently sloping terrain and do not have irregularities in the form of small mounds or some undulation, which can be remove by leveling process. This slope region cover villages Deogaon, Nimdari, Bhopapur, Manjarkapdi, Nagapur, Somwarkheda, Malkapur, Dobanballa, Baglinga, Wastapur, Kulangna budruk (Fig. 3).

c) Moderately steep slope (3.39° to 17.89°): This type of slope does not have any problem for cultivation unless there are irregularities on the surface. This slope region covers villages Tarabanda, Mojhri (Fig. 3).

d) Moderately to steep slope (17.89° to 27.49°): It covers an area in patches mostly in foot hills of Satpura hills, part of basin. These parts are of reserved forest of Chikhaldara (Fig.3).

e) Steep slope (27.49° to 48.01°): It also covers the area in patches in different parts. This slope zone is prominent along the contacts of hill ridges and flat grounds. The strongly sloping area, the land use utilized for specific purpose. These parts are of reserved forest of Chikhaldara (Fig. 3).

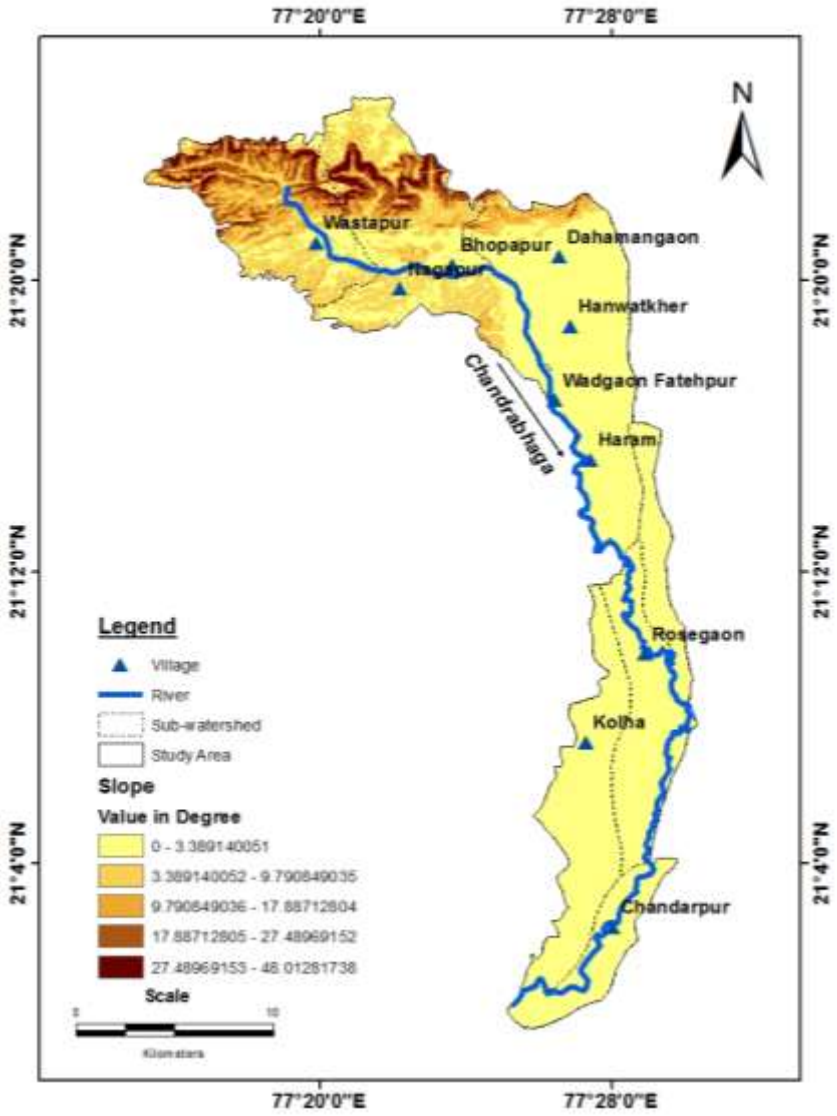

Fig.3: Slope map of study area

DISCUSSION AND CONCLUSION

Study area is been classified into five categories slope such as Very gentle, gentle, moderate, Moderate to steep and Steep. From the slope map it can be seen that major part of the study area falls under Very Gentle slope category covers an area of 2.19.32 sq.km (71.14 %) and 14.90 % of the study area is characterized by Gentle slope category occupies an area of 45.95 sq.km. About 20.30 sq.km of the study area (6.54 %) comes under moderate slope category while the small proportion 16.09 sq.km (5.22 %) of the study area has moderately to steep sloping areas and only 7.14 sq.km (2.20) areas is of very steep slope. It can be concluded from above studies that north parts of study area covering majority of Deccan traps show very steep slope and slope decreases almost become flat with very gentle in the south parts consisting of Purna alluvium.

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