Geomorphologic Analysis of Pravara River usingTopographical and Remote Sensing Database: A Case Study of Pravara River in Ahemadnagar District of Maharashtra

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Abstract

Remote Sensing (RS) and Geographical Information System (GIS) Technologies used in geomorphologic investigations give incredible advantages. One of the geomorphologic studies is designing and analysis of geomorphologic units of Pravara River basin in northern part of Ahemadnagar district in Maharashtra state. The aim of this study is to analysis geomorphologic units of Pravara River and its vicinity by using Remote Sensing and Geographical Information System. For this purpose verity of data sources used from topographical map to satellite images. This satellite image data collect based on spectral reflectance properties of land and 1/50000 scale topographic maps digitalized to consist of Geographical Information Systems database for morph metric analysis and also ERDAS 9.2, Arc View, Global Mapper software's were used.

The basic geomorphologic units such as mountainous areas, plateau, lowlands and metric properties of these units, etc. was not only dissected but also calculated and mapped in RS and GIS Technologies. The results of applying RS and GIS technique in Pravara River and its surrounding area were tested in field season. For instance, geomorphologic data produced by mapping, classifications based on data base and spectral reflectance of satellite image. Finally, Geomorphologic features of Pravara and its territory explained as units and types, drainage system, slope, quantitative results by digital mapping.

KEYWORDS: Remote Sensing, Topographical, GIS, Pravara River.

Introduction:

River is the important unit of environment which is determines all the biotic life. Here the Pravara River basin was considered as study area on account of showing a wholeness of it. Pravara River basin is an area attracting attention with geomorphologic diversity, rough morphology, and river system. These features of basin can easily notice if anybody looks through at the Digital Elevation Model (DEM) of Pravara River basin (Figure 2). Because of having physical environment properties, some geomorphologic actions sheetflood, flashflood and flood, mass movement, erosion, etc. causing important changes in regions. As we have thought of contributing to activities of preventative measure and mitigation, we target to geomorphologic analysis of Pravara River basin using Remote Sensing and Geographical Information System Technologies. Otherwise, result of this study not only can use natural disaster purpose but also applicable different aims with great advantages in management of environmental investigates, natural resources, planning, etc. It is important feature that RS and GIS technologies have been

used during all stages of study. The application of RS and GIS technologies provides advantages such as data collection, morphological analysis, designing of geomorphologic units, visualization and spatial modeling.

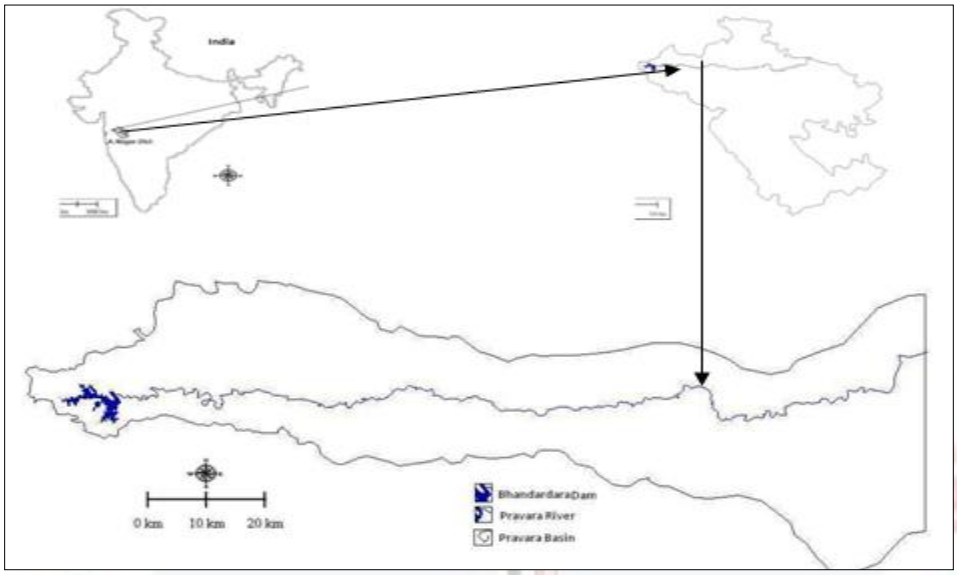

Fig 1: Study Area location Map

The total length of Pravara River near about 183.38 km and it is the one of the part of Godavari Basin. Out of to overall region some of the Basin is selected for the purpose of applying GIS and RS teachings to identify the morphological situation in River channel and vicinity for the further spatial point of view.

Aims and Objective:

The biotic and a biotic life are directly and indirectly attached with river environment that's why a normal scale changes starting to modifies local environmental characteristics. For identifying these situations some aims and objective is settling here. Primitively put of the aims is to understanding overall river situations from source region to confluence region of Pravara River. To monitoring the river and digitized it for mapping. From the convectional to digital database analysis the morphological characteristic of river, such has meandering nature, stages of river, and verity of landform formations due to river cycles. Finally to discuss the human life developments around the river flowing.

Data Sources Used for Study:

Landsatsatellite images (2010) have been used as data resources for geomorphologiccharacteristics of study area. Ground resolutions of used satellite images have 30 m (band number 3, 4, 5,). Other data resources of investigate have been 1/50, 000 scale topographic maps (47 E and I series) used to find out of various locations in the study area. ASTER (Advanced Space borne Topographic Emission Reflectance Radio)

data also used to create data base for Digital Elevation Model (DEM) and another analysis.

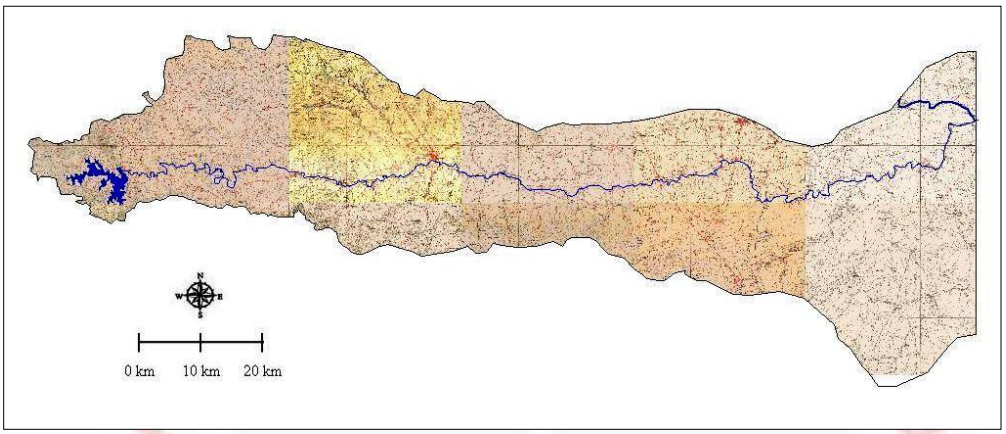

Fig 2:Topographical Map of Pravara River

Methodology:

Even though there are a lot of data resources for geomorphic diagnosis. It is clear that morph metric and river system information's of Pravara River basin contribute too basically both interpretation and designation on geomorphologic units within basin. Here the Topographic maps have been converted from analog environment to digital environment.Creating database which are consisting of graphic and attribute data have been depend on rectified digital maps.Dam and River Features are digitized and convert in the vector data base(Figure 2). Slope and aspect maps have been constituted with opportunity of "Surface Analysis" in same extension as 10*10 m cell size(Figure 4). Landsat Image drape over Aster data with river and dam shape file of Basin (Figure 4). Topographic profiles, directions as west -East of study area have been prepared (Fig 6). Finally, geomorphologic analysis of Pravara River basin has been finished by means of consideration in using all data collecting RS and GIS technologies.

Geological information of Pravara River Basin:

The present area belongs to 'Deccan plateau of peninsular India' which is the part of 'The western Deccan volcanic province'. Khadala and Poladpur formations situated close to the Western Ghats escarpment which has moderate relief and is drained by tributaries of the Pravara River. The basalt flows are nearly flat-lying and mainly belong to the Thakurvadi Formation of the Kalsubai Subgroup (Khadri et al. 1988; Subbarao and Hooper 1988). Extensive collusion-alluvial deposits (locally up to 30 m thick) of the late Quaternary Pravara Fm. (Bondre 1999) overlie the basalts along the Pravara River and its tributaries. Patches of these sediments are also found along the Pravara River. The basalt flows are classic compound pahoehoe, ranging in thickness from few tens of meters to well over 50 m, and are made up of individual flow lobes ranging in thickness from a few cm to 20 m (Bondre et al. 2000, 2004).

Fluvial Process of Pravara River:

Realization of morphological analysis of Pravara River basin has been used to R.S. and G.I.S. technologies. Components of analysis concept have been classified into two groups. Data and material is the first component of this study. Other component of investigation is method and extends of elements. The rivers also carry a huge amount of sediment from the upstream reaches. These factors combined with seasonal change of flow discharge have contributed to the morphological characteristics of the rivers. Shifting of channel, excessive scour of fine bed materials, meander development and migration intensify bank erosion.

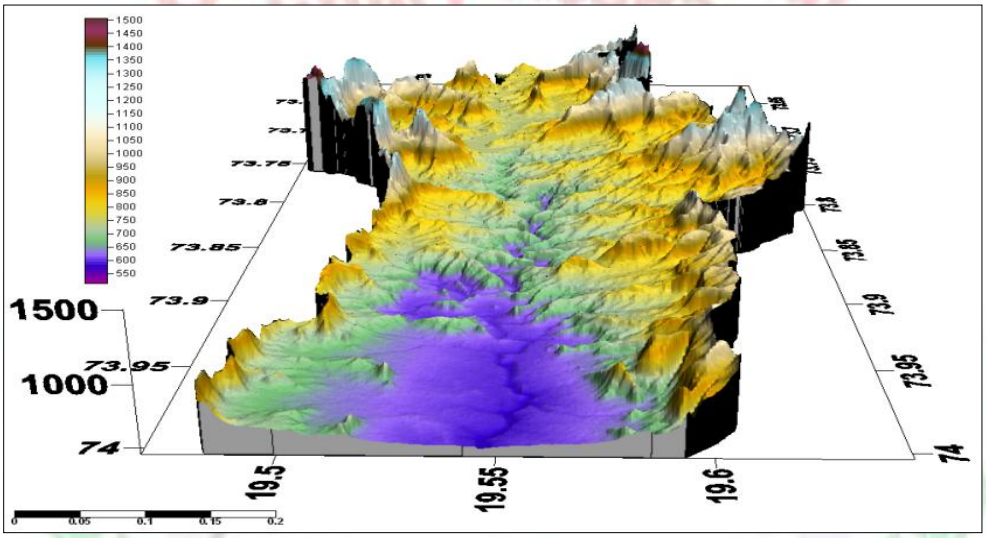

Fig 3: Digital Elevation Model of Upper Pravara Basin.

Aster Data of Pravara River:

There is opening the innovative and powerful research gateway in the spatial planning on 29 June 2009, the Global Digital Elevation Model (GDEM) was released to the public **(**Recently release of ASTER GDEM Version-2, on 3 October, 2011). ASTER (Advanced Spaceborne Thermal Emission and Reflection Radiometer) is an imaging instrument flying on Terra, a satellite launched in December 1999 as part of NASA's Earth Observing System (EOS). It was a joint operation between NASA and Japan's Ministry of Economy, Trade and Industry (METI), and Japan's Earth Remote Sensing Data Analysis Center (ERSDAC). The GDEM covers the planet from 83° N to 83° S becoming the first earth mapping system that provides comprehensive coverage of the Polar Regions as well as easy-to-use topographic information of the global terrainwith at 30 meter (98 ft) intervals resolution.

This data has acquired from website, which is strongly represent the physiography of basin region. Generally slope from western to eastern direction. Maximum height recorded in the NW direction of basin near Kalsubai (1646 m.) and lower most height observed toward the eastern direction near ‘PravaraSangam. Slop has represented by slope map (Figure 3) in degrees which is 350 deg. Is maximum and 0 deg. is minimum in selected basin. Most of convex slop find in the upper basin which also represent the divers situation of mountain.

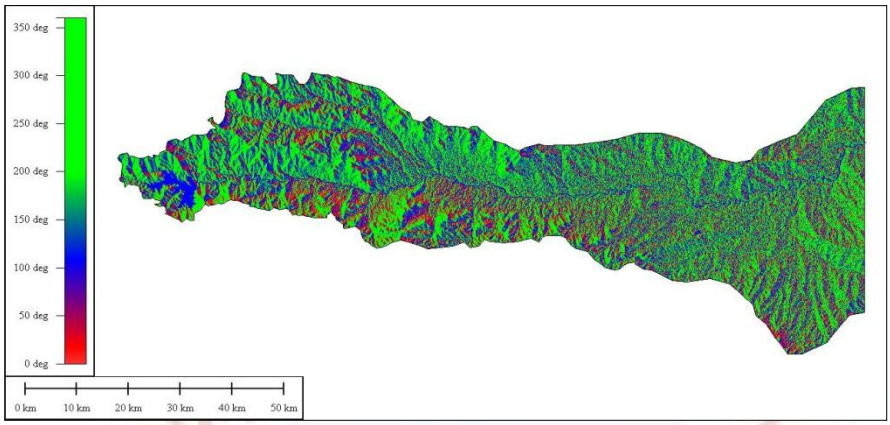

Fig 4: Slope map of Pravara River basin

Simulation of landscape processes is more sensitive to noise and artifacts in landscape characterization data than the more traditional uses of GIS such as automatic map production or spatial analysis. Efficiency of simulations depends on digital data representation where the traditional representation by polygons, commonly used for mapping, is not always the best approach for simulations. Therefore, there is a continuing effort to extend the GIS capabilities to support modeling and simulation of processes (both within commercial products and research tools) by implementing new, advanced methods and data structures. Our effort has focused on improving methods for multivariate spatial interpolation, topographic analysis and visualization and extending the data structures to support multivariate point and raster format.

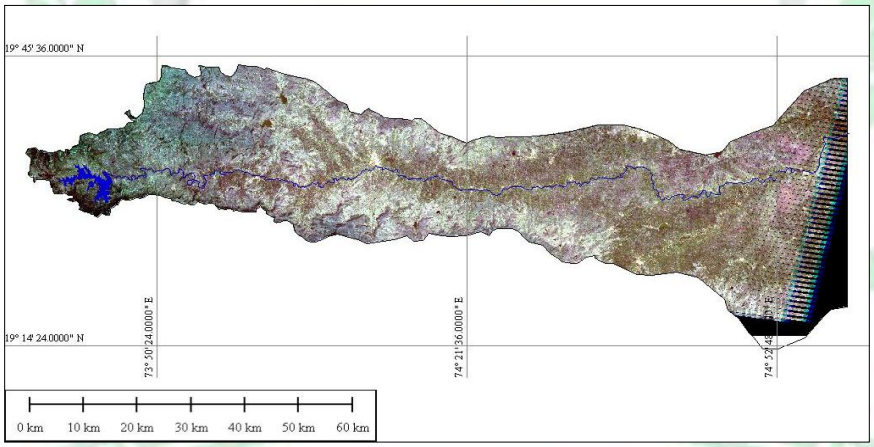

Fig 5: Landsat satellite Image Thematic Mapper (2010) Basin croppedimage

Remote Sensing Data for Morphologic Analysis:

To illustrate the issues of resolution, noise and systematic errors in standard elevation data we analyzed the 30m DEM available for Pravara Basin with more detailed analysis performed for the subareas. Globar Mapper 11 allows us to compute several important topographic parameters describing various geometrical properties of terrain, as illustrated for an area for the original 30m DEM. Tangential curvature for 30m DEM shows acceptable structure in mountainous area while significant noise and systematic

errors (stripes) are present in lowland because of UTM zone 43 limitations. (PravaraSangam). These images clearly demonstrate that the need for precision and accuracy is spatially variable, with flatter areas much more sensitive than mountains.The results are significantly influenced by flow tracing algorithm and resolution as well as quality of the DEM as illustrated by the following example, which compares the steady state water flow maps based on the original Topographical Map.

Landsat Image is also cropped of river basin which is sensed in 2010 by thematic mapper sensor. It is shows the general land cover with the central river main channel and the normal variable sinuosity in youthful, mature and old stages. Upper part consists with hilly region and lower part belongs to plain region because of confluence with main Godavari River near PravaraSangam in Nevasetahsil (Ahemadnagar).Longitudinal profile also extracted from the ASTER data and topographic map from Bhandardara to confluence spot near PravaraSangam. Nearby, 200 k.m profile (Figure 6) extracted from ASTER data. The differentiation in height is found from 650 m (top) to 450 m (bottom), it means 200 m differentiation in total slop of River main channel. Normally, half part of basin covered by hilly region, which is observed from ASTER data height shade.

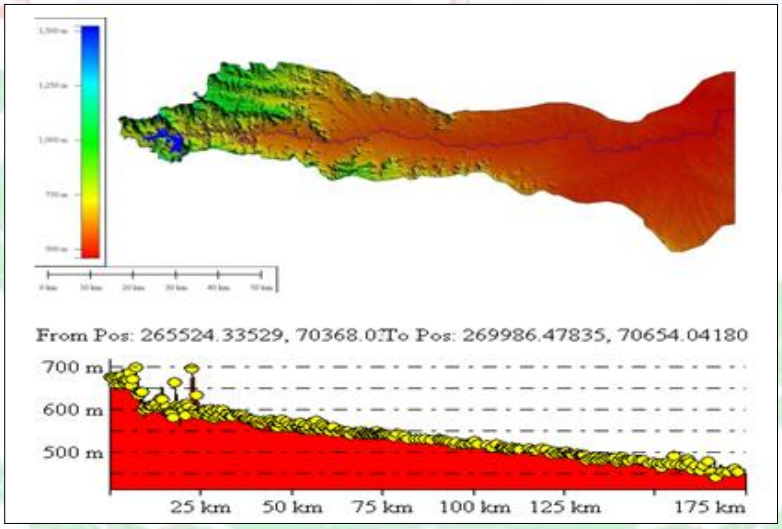

Fig 6: Topographic Longitudinalprofiles from West to East

Morphological Analysis:

Stream is a spatial hydrological model that allows for assessing hydrological impacts due to changes in climate and socio economic drivers. The fact that composed satellite images as analyzed in GIS, shaded relief images, slope and aspect analyses, Analyses of Pravara river system have been commented on geomorphologic determination purpose, It has been described to River extent, size shape and height of morphologic units, and also drainage pattern (Near Sangamner), dispersal and displacements of riverbeds into basin. Spectral reflections, hill shades, slope;DEM images infer both visual and numerical interpretation for basin. Some quantitiesinformation's such as elevation of long profiles (Figure 5), numerical value of

flats taking place different elevations,areas having different slope degree have contributed to visual interpretation.

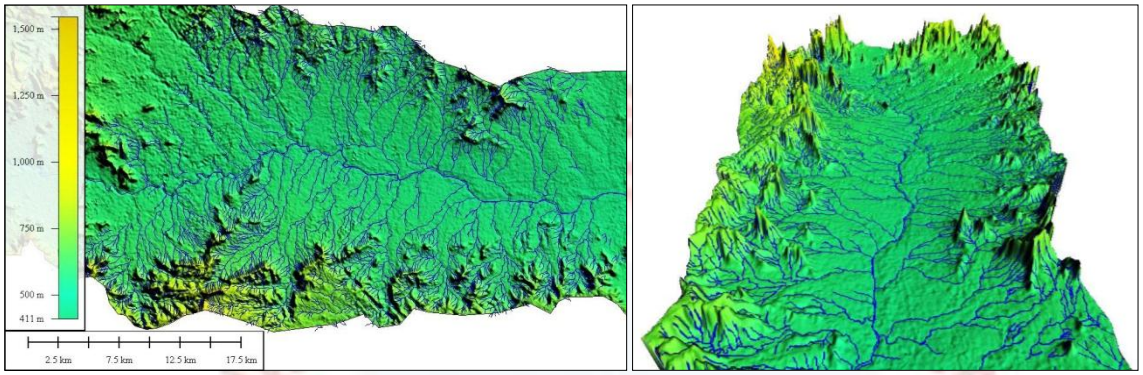

Fig7: Drainage network in River basin in SangamnerTahsil

This geomorphologic unit generally represented with over 1,500 m elevation in study area. Mountains environment classified by using ASTER data and satellite image in RS and its analysis in GIS techniques. In this Basin absence of plateaus surface because of mains streams flow. In middle part small, small plateaus (850-1000 m) have been classified to use slope breaks calculated topographic profiles, stream long profiles within study area Low plateau surface is largest in area with 32,85 % in basin. Highest Plateau surface is smaller than other plateau surfaces. Plateau surfaces are usually formed by lineaments which are probable fault traces in study area. Other information about making a decision for lowland forms has been used as GIS analysis methods. Especially, river system features such as meandering drainage directly refer to lowland in Pravara River basin. Alluvial terraces, normally deposited in channel of River which is identify on satellite images, topographic map. Floodplain, situated on the both bank in lower basin of Pravara River,floodplains have the relatively broad and smooth valley floors constructed by Pravara River and periodically covered with floodwater during periods of overbank flow becoming frequent year by year. The fluvial activities of Pravara River are both active horizontal erosion and depositional activity in floodplain which consist of a great variety of depositional materials, including colluviums (debris from valley sides), channel deposits (sand and gravel), and vertical accretion deposits (clay and silt deposited by overbank flows). Spectral reflection features of lowlands have helped to understand of landforms. Ground features such as texture, pattern, and size are important basic elements for interpretation of satellite images.

Observations and Results:

In this study, geomorphologic analysis had been aimed using Remote Sensing and Geographical Information System Technologies. DEM, slope map, aspect map, shaded relief, topographic profiles, basin satellite superimpose map, geomorphologic map of Pravara River basin was created by means of these methodologies. These maps were prepared not only according to result of analysis in office but also testing and surveying in field. Using of these technologies show that obtained data and created images are able to share with all scientific branches and different purposes. In addition, obtained data and created images which are numerical, reliable for truthful of its and able to convert to

different using demonstrated that RS and GIS Technologies have been making sure integrate with all scientific branches of geography science and geographical data.

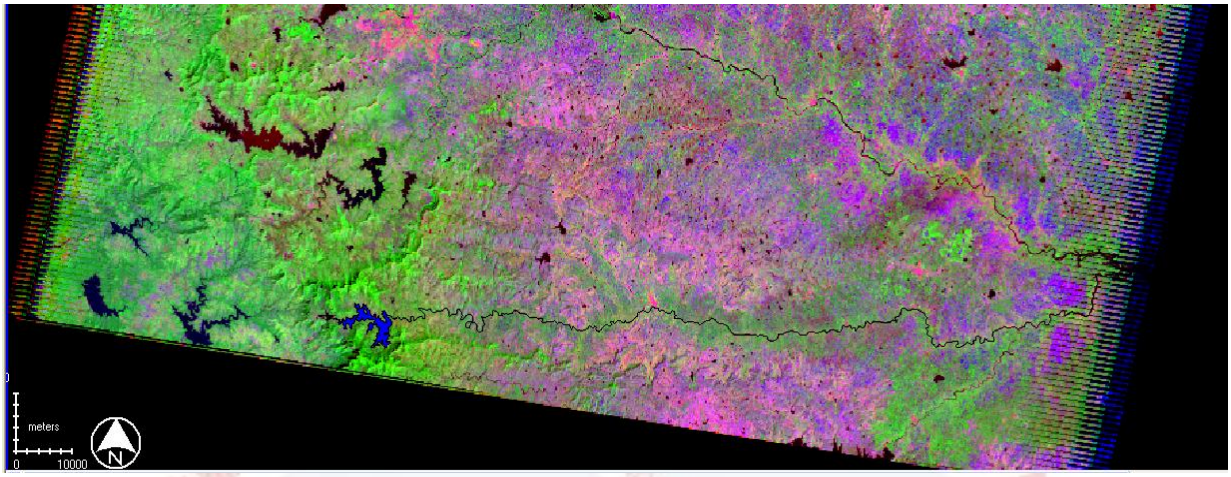

Fig 7: Landsat TM (2010) Composed image, (Band number 3:4:5).

Conclusion:

The incomings trends in RS and GIS are useful for the verity of applications in rivers study and supplementary another multiple fields. The data of RS provide the high accuracy and for analysis it saves time, money and resources. River is the important component of environment, since the gradual change in its own environment can also largely impact in surrounded environment. Present study belongs to morphological analysis of Pravara River, where the multiple types of database are produced. This database will useful for researcher, educations purpose, spatial planner, administration decision, and related environmental planning.

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