Geo-Spatial approach to Geomorphology mapping for Thandava Reservoir Catchment of Visakhapatnam district,

Andhra Pradesh

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Abstract-Geomorphological mapping is regarded as the preliminary tool for land management and geomorphological risk management that providesbaseline data for other sectors of environmental research. The present study delineates the geomorphological features for Thandava Reservoir Catchment in Visakhapatnam based on visual interpretation strategies. The study area mainly comprises Structural hill covering 276.59 km^2 followed by Inter mountain valley covering 97.16 km^2 and then Alluvial plain covering 48.66 km^{2}of the total geographical area. These maps can be further used for natural Earth resources planning, management and decision making. Thematic maps of geomorphology have been generated on satellite dataIRS-ID-LISS III. Standard interpretation methods according to the norms given by NRSA (1996)are followed to portray on-screen digitations of features.

Keywords:Geomorphological mapping, risk management, Thandava Reservoir, Earth resources planning.

1. INTRODUCTION

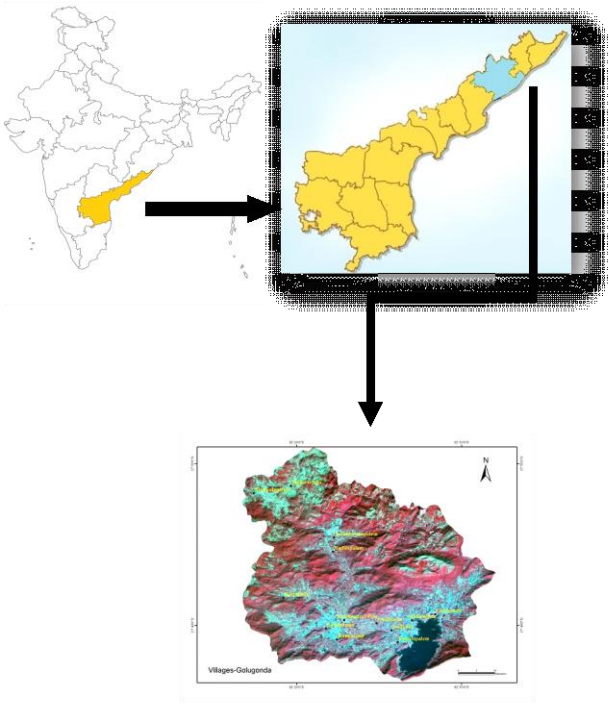
The term ‘Geomorphology’ is the combination of three Greek words; i.e. geo(earth), Morpho(form) and logos(discourse) which means the study of forms of the earth’s surface. Geomorphology is the science where geology, seismology, hydrology, geochemistry, geomorphology, atmospheric dynamics, biology, human dynamics, interact and develop a dynamic system (Murray, 2009). Landforms, according to Bishop and Shroder, (2004) carry two geomorphic meanings. Therefore, the task of geomorphology is twofold: Quantification of landforms to derive information about historical processes, and determination of parameters expressing recent evolutionary processes. Basically, it aims at extracting surface characteristics (drainage network channels, basins, plantation surfaces, valley side slopes etc.) using a set of numerical measures derived from digital elevation models (DEMs)that permit the analysis of even more extended areas and regions. These measures include slope steepness, profile and plan curvature, cross-sectional curvature as well minimum and maximum curvature, (Wood, 1996; Pike, 2000; Fischer et al., 2004). Numerical characterizations are used to quantify morphometric features such as point based features

(peaks, pits and passes), line-based features (stream channels, ridges, and crests), and area based features (planner) according to Evans (1972) and Wood (1996).

The landforms of the area have been visually delineated on satellite image following the guidelines RGNDWM of NRSC, (1996). Geomorphological landforms are dominated by highly structural hill and intermountain valley. The other geomorphological features such as pediment inselberg complex, pediplain weathered, alluvial plain and residual hill as also present in the study area (Table 1).

2. STUDY AREA

The Thandava reservoir catchment area is located in the hilly terrain of the Eastern Ghats region of Visakhapatnam district, Andhra Pradesh with catchment area of 467 km² and is constructed with the gross storage capacity of 4960Mcft. Thandava reservoir is located between 17°45'50" North latitude and 82°15'20" East longitude.(Figure 1). The study area is covered in the survey of India toposheets 65 K/5, 65K/6, 65K/9, 65K/10 on 1:50,000 scaleand IRS-1D-LISS-III digital data of 2011 have been used for extraction of thematic information on geomorphology. Thandava Reservoir Catchment (TRC) is characterized by undulating topography, with hill ranges (320m-540m above M.S.L) on Northern, Southern and Western sides, and Bay of Bengal on the eastern side.



(Study area as viewed on IRS-ID-LISS III, dated on 11th Jan 2011)

Figure 1: Location map of the Thandava Reservoir catchment

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3. Methodology

The base map of the study area is prepared from the Survey of India (SOI) topographic maps numbered 65 K/5, 65K/6, 65K/9, 65K/10 on 1:50,000 scale. The methodology carried out for further processes is provided in Figure 2.

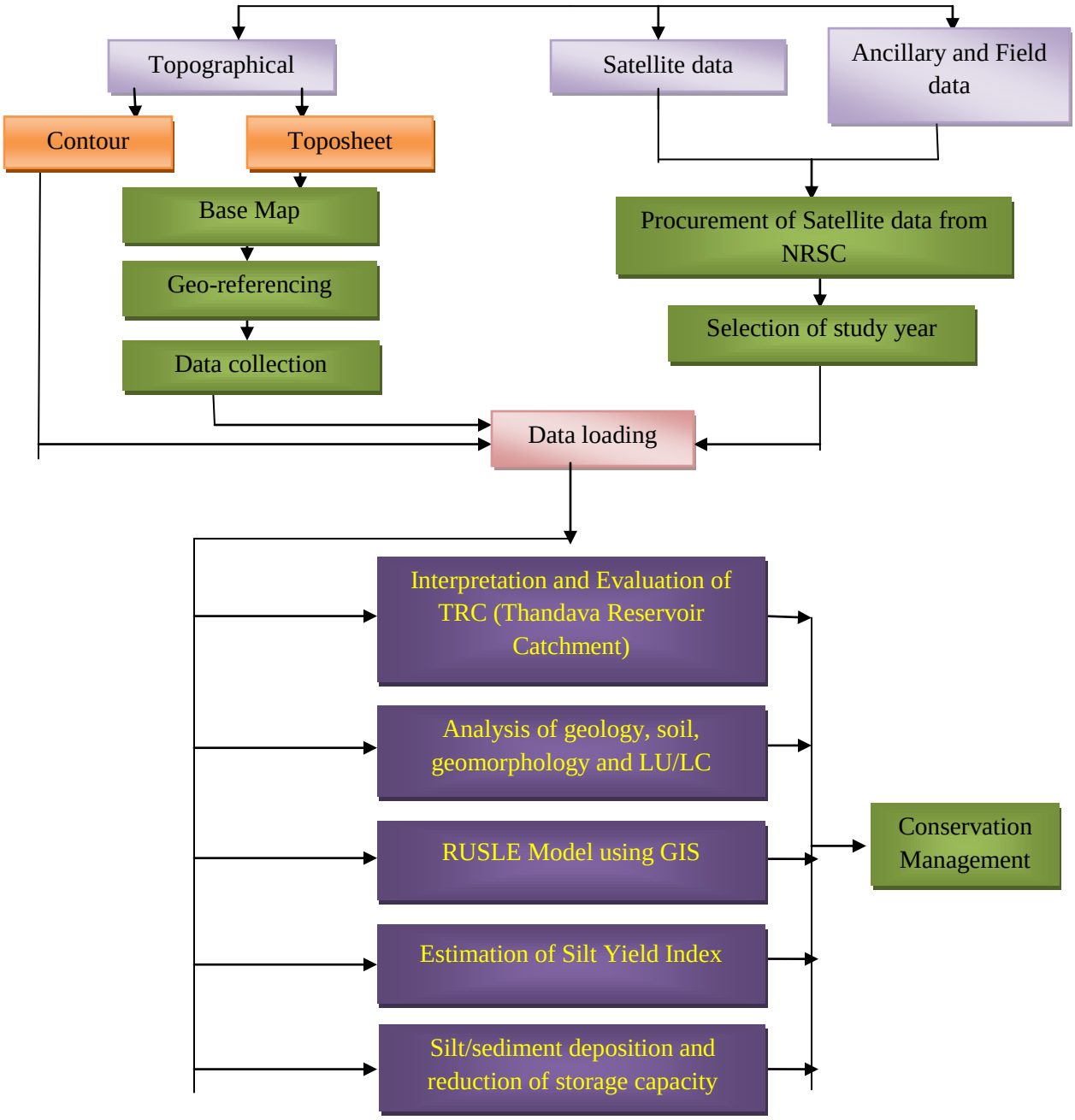

Figure 2: Methodology (flow chart)

4. Results and Discussions

The landforms of the area have been delineated on satellite image and the geomorphology map has been prepared on 1:50000 scale. The features encountered in the study area: Alluvial Plain, Inter Mountain Valley, Structural Hill, Residual Hill, Pediment Inselberg Complex, Pediplain Weathered, Valley Fill Shallow and Pedimont Slope are produced in the geomorphological map (Figure 3.). Further, the percentage covered by each geomorphic class in the study area is given in Figure 4.

a)Pediplain weathered:

Pediplain is a gently undulating to flat topography feature spreading over the granites, gneisses and schistose formations. It is mostly covered with reddish-brown, medium to coarse-gravel.The chance to form apediplain weathered is very low in the study areas it is surrounded by structural hill and intermountain valley. This zone is confined over the plains, which are suitable for sediment deposition. Thandava colony is the only pediplain weather village in the study area which is under sugar cane agricultural activity. Pediplain occupies 16.84 km^2 of the study area.

b)Pediment InselbergComplex:

Pediment inselberg complex observed down to the agency area where high sediment delivery has been released from hill due to valley fill. Inselberg is an isolated mountain that rises abruptly from a gently sloping or virtually level surrounding plain.During the field visit,inselberg formation is observed in the center of the reservoir which contains high amount of sediments with full of nutrients which dictates high infiltration rate of the reservoir. Pediment inselberg occupies 2.51 km^2 of the study area.

c)Residual Hill:

Residual hills are basically hard rocks that are left behind after occurrence of erosion. Some parts are covered by forest, and some are even without shrubs. The Residualhills are inthe villagesof Donkada,Mallavanipalem, Rajannapalem, Dukkuvanipalem and Chintalapalem covering about 3.68km^2.

d)Structural Hill:

A complex erosion process occurring by denudation, weathering and mass-wasting havebeen playing a major role in order to shape structural hills. The denudation processes in the structural hills are controlled by dip of strata. They consist of archaean and migmatite group of rocks which are controlled with complex folding.Most of the study area is enclosed by structural hills. The structural hill of the study area includes Bointi reserved forest, Dharakonda Reserved forest and Sarugudu reserved forest that occupies 276.59 km^2 of the study area.

e) Intermountain Valley:

Intermountain valley contains a tremendous volume of unconsolidated rock material derived by erosion/flow from bordering mountains. This forms a big piedmont plain resembling the same alluvial plain

characters. Many of these form individual sub basins where sand and gravel bed can yield large quantities of water.Intermountain valley occupies 97.16 km^2 of the study area.

f) Alluvial Plain:

Alluvial fans are predominent depositional landforms created where steep high power channels center a zone of reduced stream power and act as a transitional feature between a degrading upland area and adjacent lowland (Harvey, 1997). The analysis of the main controlling factors on past and presentfan processes is also of major concern in order to distinguish between the two dominant sedimentary processes on alluvial fan formation and evolution: debris flows and stream flows (Crosta and Frattini, 2004). The alluvial plain of the study area is mainly covered by water bodies such as reservoir water, tanks, springs and river water. The alluvial nature of the landforms helps extensive agricultural activities for the local farmers. Alluvial plain occupies 48.66 km^2 of the study area.

g) Valley Fill Shallow:

The Valley Fill Shallow covers 14.74km^2 in the villages of Kommarapalli, Dingiraya, Chitimamidi, Nimmalapalem, Singanapalli etc.

h)Pedimont Slope:

This Pedimont slope covers an area of 7.63 km^2 in the village of Ramoulu and very less part of Bointi Reserved Forest. In this terrain element, more erosion is taking place owing to steep to moderate slopes. Most of the pedimont slope areas are reckoned as gullied/ravinous land in land use/land cover analysis.

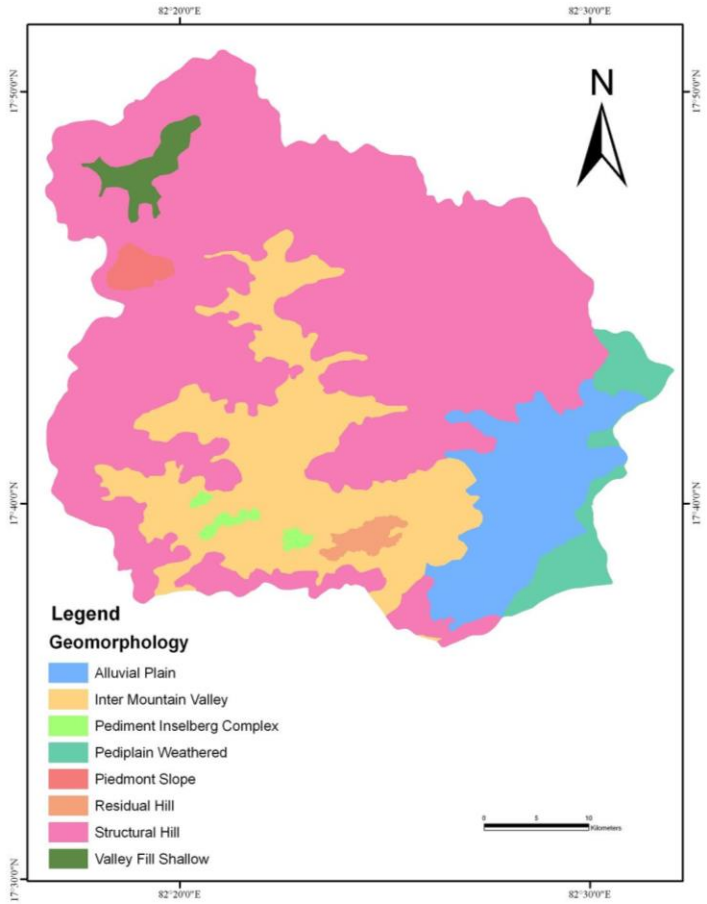

Figure 3: Geomorphology map of the study area

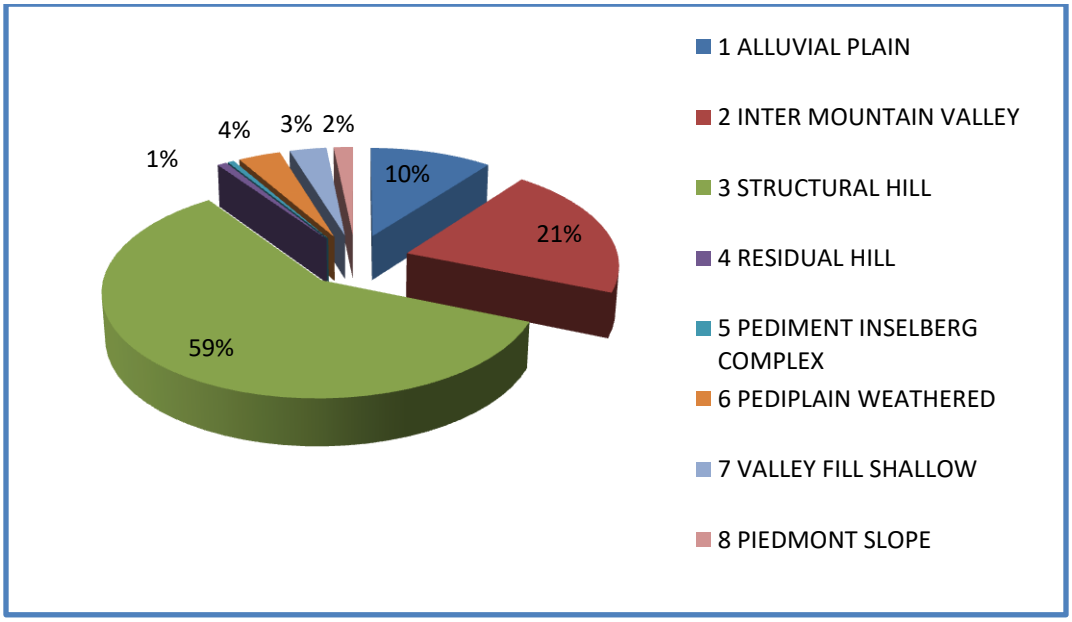

Figure 4: Percentile distribution of Geomorphological classes

Table 1: Area under different geomorphic classes

S.NO	Landform Classes	Area in Km²
1	Alluvial Plain	48.66
2	Inter Mountain Valley	97.16
3	Structural Hill	276.59
4	Residual Hill	3.68
5	Pediment Inselberg Complex	2.51
6	Pediplain Weathered	16.84
7	Valley Fill Shallow	14.74
8	Pedimont Slope	7.63

5. Conclusion

In this study,the area reveals that usingthesatellite imagery and GIS technique has a profound importance in the identification of geomorphic landforms. Remote sensing data (Landsat TM and IRS-ID), topographic maps and conventional data were used to prepare the thematic layers of geomorphology. The geomorphic classes such as PediplainInselberg Complex, Residual hills and Structural hills, Intermountain Valley, Pediplainweathered; Alluvial plain, Valley Fill Shallow and Pedimont Slope are grouped into run-off zones and infiltration zones on the basis of quantity of run-off and recharge of rainfall.Geomorphological landforms are dominated by structural hill (59%), intermountain valleys (21%) andresidual hill (10%) others being the pediment inselberg complex, pediplain weathered, alluvial plain etc. Hills act as run-off zones whereas plains are the deposition areas.

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