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# Deriving of Topographical Attributes using SRTM DEM for Tiruppur District, Tamil Nadu, India

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**ABSTRACT**

The earth's surface is covered in a variety of landforms that are generated as a result of natural geomorphologic processes. Our major goal is to create a landform classification map for Tamil Nadu's Tiruppur district, India. A digital elevation model (DEM) with a resolution of 30 meters is used as input data for categorization. With the advancement of computer technology and the advent of Geographical Information Systems (GIS), it is now possible to extract relevant information from topographical data in a simple and faster manner. Decision tree is a non- parametric tree structure and the algorithm given by Quinlan was used.

***Key words :*** *DEM,Quinlan algorithm, Topographical data*

## Introduction

Because of the great diversity and complexity of landforms that exist on the planet's surface, it's critical to classify and analyze each one, as each one has a wide range of applications. It is more difficult to classify an entire land surface than it is to isolate certain landforms from it. Specific geomorphometry deals with the topological and geometric characteristics of landforms (Evans, 1972). The earliest means of classifying and identifying landforms were field survey studies and aerial picture interpretation. Manual landform identification was initially a difficult and time-consuming operation. Because of the several computer-based methods have been created to calculate geomorphometric parameters of the earth's surface and their temporal change as a result of advances in computer technology (Horton, 1945). Several methods for modeling land surface features have been developed based on the essential principles of Digital Terrain Models (DTMs). For DEM processing and landform extraction, several automated techniques and algorithms have been developed. GIS plays an essential role in landform classification by utilizing numerous techniques mathematically to assess digital elevation data (Jacek, 1997). The purpose of this study is to create a landform classification map for the Tiruppur district of Tamil Nadu.

## Materials and Methods

The study was carried out inTiruppur district that is located in western part of Tamil Nadu, near the Western Ghats, and so has a temperate climate. The district is bordered on the west by Tiruppur district, on the north and northeast by Erode district, on the east by Karur district, and on the south east by Dindigul district. Kerala state surrounds the district to the south (Idukki district). The district covers 5187

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square kilometres. Due to the presence of the western ghats, the district's southern and south western areas receive the most rainfall. Except the extreme east half of the district, which is under the rain shadow of the Western Ghats, the rest of the district has a pleasant climate for the majority of the year. During the summer and winter, the mean maximum and minimum temperatures in Tiruppur range from 35 to 18 degrees Celsius. The average annual rainfall on the plains is approximately 700mm, with the North East and South West monsoons contributing about 47% and 28% of total rainfall, respectively.

The Noyyal and Amaravathi rivers are the two major rivers that flow through the district. The Amaravati River is the district's primary source of irrigation. Amaravathi Reservoir which was constructed for the Amaravathi Dam,is located in Amaravathinagar. This district is home to the Thirumurthy dam, which was built as part of the PAP project. The district's primary sources of irrigation are the Amaravathi and Thirumurthy dams, with the Uppaar dam receiving water from seasonal rains. The district's soil types include loamy, alluvial, and clay. The soil is mostly black, which is ideal for cotton farming, although there is also some red loamy soil.

### Study Area Map

### Environmental Covariates

The current study used a variety of ancillary data to depict land formation characteristics such as relief and parent material, with the details stated in the sub sections below. These datasets are valuable for picture categorization because they contain both spatial and non-spatial information. Satellite imagery alone may not be sufficient for good image classification. The listed covariates (Table 1) are also required to increase classification accuracy when predicting distinct

## Result and Discussion

In this present study, environmental covariates under organism, relief /topography and parent material are selected. Usage of such environmental covariates shows greater influence in predicting the digital soil maps (Samuel-Rosa *et al.*, 2015). Cavazzi *et al.* (2013) concluded that use of more number of environmental covariates would improve the accuracy of the predicted maps

### Organism

Soils interact with biotic forces in the form of flora and wildlife, promoting soil development. They are important in the decomposition, weathering, and evolution of soil. Humans also have an impact on soil changes in natural landscapes and soil physico-chemical characteristics. (Matano *et. al,* 2015). Remote sensing satellites can efficiently monitor these land use and land cover changes, allowing for better classification and identification of landform features. The figure depicts the land use and land cover map and the area occupied by various land use groups. Fallow land, Crop land, Plantation make up the majority of the district (3951.29sq.km), followed by Deciduous, Evergreen forest, grass lands, scrub, rural and urban land, scrub forest, evergreen, salt affected land, sandy area, waterbodies, rivers, mining, forest plantations, gullied lands, barren rocky areas of 1244.09 sq.km. (Table 2 and Figure 1)

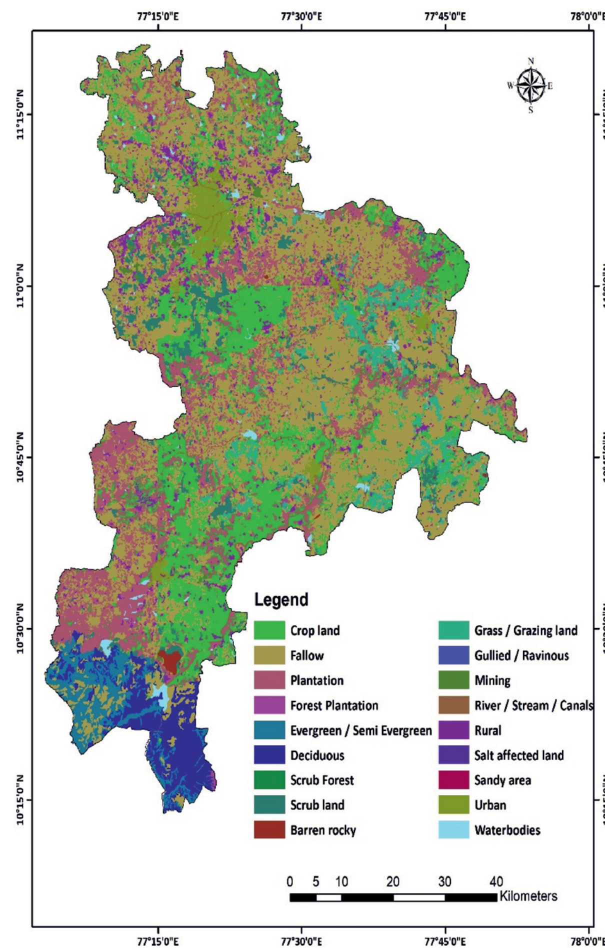


**Fig. 1.** Land use and land cover map

**Table 1.** List of Covariates used

| Type of Covariate | Covariate | Description | Resolution |
|---|---|---|---|
| **Relief(R)** | Elevation | Derived from a SRTM digitalelevation model (DEM); elevation is represented as acontinuous terrain reliefsurface. | 30 m |
| **R** | Slope Gradient | The maximum rate ofchange in elevation calculated from a DEM to represent thehydraulicgradientactingupon overland and subsurface water flow through theinfluenceofgravity. | 30 m |
| **R** | Slope Aspect | Direction of slope gradientdepictingflowdirection. | 30 m |
| **R** | Profile Curvature | Curvature of slope gradient(direction of the steepestslope) depicting flowacceleration. | 30 m |
| **R** | Tangential Curvature | Curvature perpendicular toslope gradient depicting flowconvergence. | 30 m |
| **R** | Convergence Index | Convergence index is used to determine whether waterflow from neighboring cellsdivergesorconverges. Convergence is calculatedusing flow direction between adjacent cells based on theaspectsof neighboring cells. | 30 m |
| **R** | Slope Height | The relative height abovethe closest modeled drainage accumulation. | 30 m |
| **R** | Normalized Height | The normalized differencebetween slope height and valley depth. Also referred toasrelative position. | 30 m |
| **Parent Material** | | | |
| **P** | Geology | A kind of geologic map showing the rock types of a particular area | 1:50,000 |
| **P** | Geomorphology | Study of physical features of the earth's surface | 1:50,000 |

## Relief / Topography

Because topography has such a large impact on soil distribution and vegetation, it is sometimes considered as a passive element in soil formation. These values were calculated using the SRTM (Shuttle Radar Topography Mission) Digital Elevation Model (DEM). The key factors are elevation and slope. The digital depiction of a physical surface with varied topography is called elevation. For DSM projections, a more precise elevation is required. The height of the Tiruppur district ranged from 153 metres to 2343 metres above sea level. The Western Ghats region of Udumalpet block has higher elevation values.

The degree of steepness or inclination of a surface is defined as slope. The slope of a topomap is computed using contour lines. The Reserve forest areas of Amaravathi and Manjampatti of Udumalpet region have a steeper slope (Figure 2).

The convergence index is a topography metric that depicts the relief structure as a series of converging (channels) and diverging areas (ridges). The ridge value spans from -100 to 100, with values above -100 and up to 100 indicating the study area's

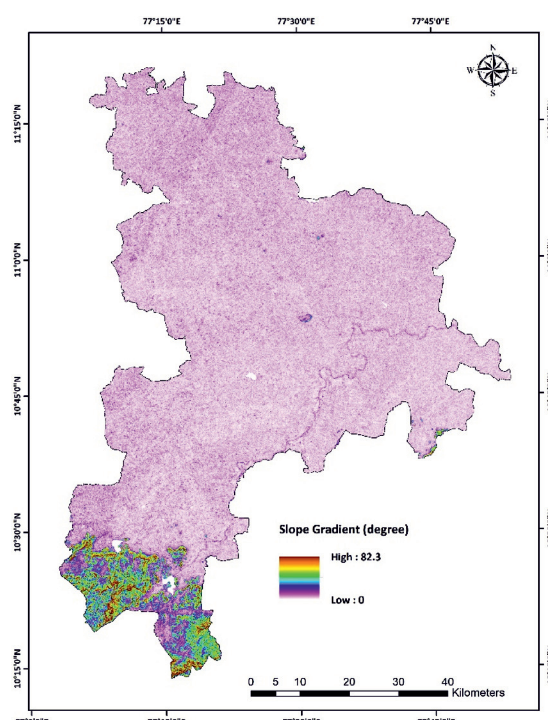


**Fig. 2.** Slope Gradient

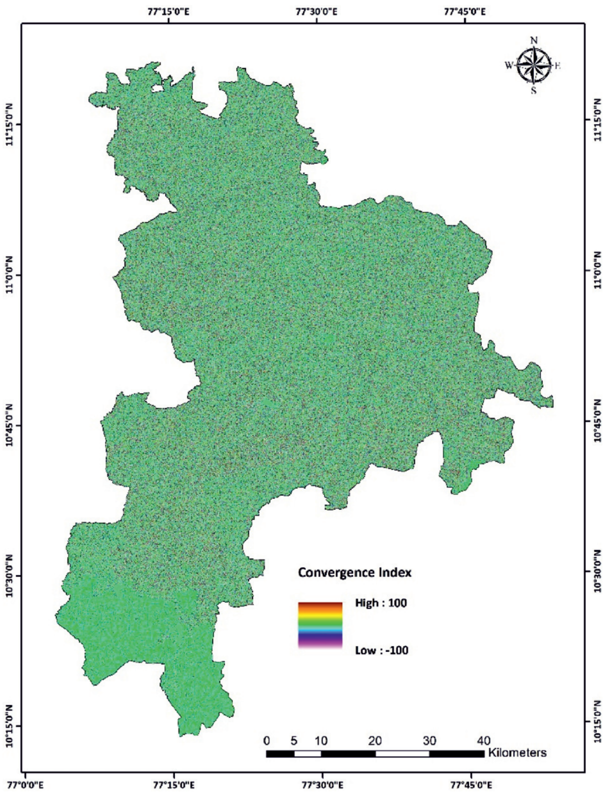


**Fig. 3.** Convergence Index

channel. (Figure 3)

The Topographic Wetness Index (TWI) is a useful tool for predicting where water will collect in a region with varying elevations. It is determined by the slope and the area contributing upstream. TWI (Figure 4) is used to determine how much moisture is present in the soil. This makes it easier to adapt agricultural operations and crop choices to the current water level. It also aids in the integration of soil water holding capacity with soil pH, moisture regimes, and soil textural classes (Sørensen *et al.*, 2006). It was created by (Beven and Kirkby, 1979) and is utilized as a static soil moisture content indicator, as well as the TWI map.

**Table. 2** Land use and land cover in Tiruppur district

| Land use and land cover of Tiruppur district | Area_ha | Area_ sq_km |
|---|---|---|
| Barren rocky | 1319.26 | 13.19 |
| Crop land | 103954.66 | 1039.54 |
| Deciduous | 20006.04 | 200.06 |
| Evergreen / Semi Evergreen | 14960.45 | 149.60 |
| Fallow | 208120.93 | 2081.20 |
| Forest Plantation | 338.22 | 3.38 |
| Grass / Grazing land | 18575.98 | 185.75 |
| Gullied / Ravinous | 1.89 | 0.01 |
| Mining | 2942.56 | 29.42 |
| Plantation | 83055.31 | 830.55 |
| River / Stream / Canals | 4380.20 | 43.80 |
| Rural | 21817.13 | 218.17 |
| Salt affected land | 202.11 | 2.02 |
| Sandy area | 2.02 | 0.02 |
| Scrub Forest | 55.37 | 0.55 |
| Scrub land | 19479.46 | 194.79 |
| Urban | 15905.50 | 159.05 |
| Waterbodies | 4420.84 | 44.20 |

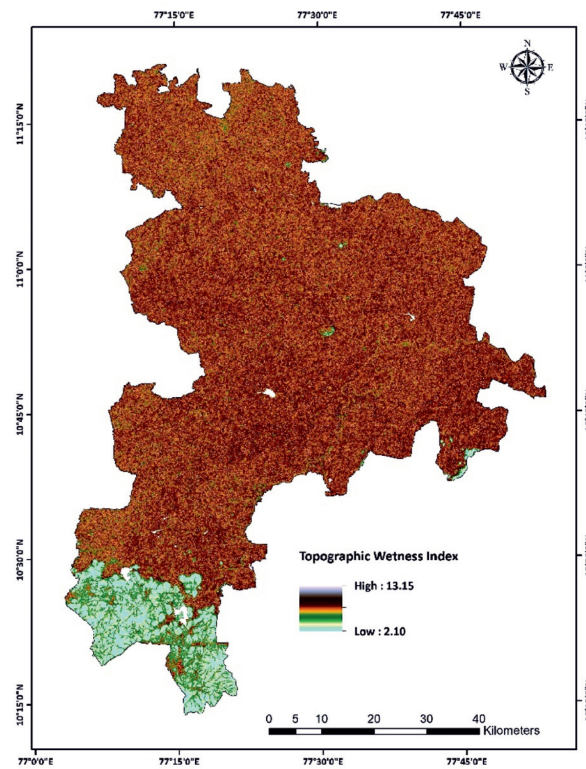


**Fig. 4.** Topographic Wetness Index (TWI)

Curvature is described as "the rate of change of slope" by Evans (1980), and it is a continuous phenomena. Different curvatures have an impact on the slope of a region. Curvatures in the horizontal and vertical planes are called Plan and Profile curvatures, and their values range from -0.05 to 0.05. The number for the study region ranges from -0.88 to 0.97 for general curvature, which is a combination of plan and profile curvature. The value of tangential curvature, which is perpendicular to the slope, ranges from -0.064 to 0.056. The study area's total curvature value ranges between 0 and 0.12. (Figure 5 a & b)

## Parent material

Bedrock and sediments are examples of parent material. Geology is the study of the earth's physical structures and the materials that make up its surface. It is clear that slope and parent material are interrelated and have an impact on the soil's physical, chemical, and morphological features. Fissile hornblende biotite gneiss and Hornblende-biotite gneiss make up the district. The main minerals found in this area are Charnokites, Granites, Syenite/ Nephelene syenite corrundun syenite, Sand and silt. The Avinashi region has a higher concentration of Fissile hornblende biotite gneiss. The final product clearly demonstrates that Hornblende-biotite gneiss has a total area of 3962.96 square kilometers, followed by Fissile Hornblende-biotite gneiss with a total area of 499.82 square kilometers (Figure 6)

Geomorphology refers to the various landforms or physical characteristics of the earth, as well as the sediments that inhabit the planet's surface as a result of physical, chemical, and biological processes. Dome type Denudational Hills, Dome type Residual Hills, Fracture Valley, Inselberg, Linear Ridge/ Dyke, Moderately weathered/moderately buried

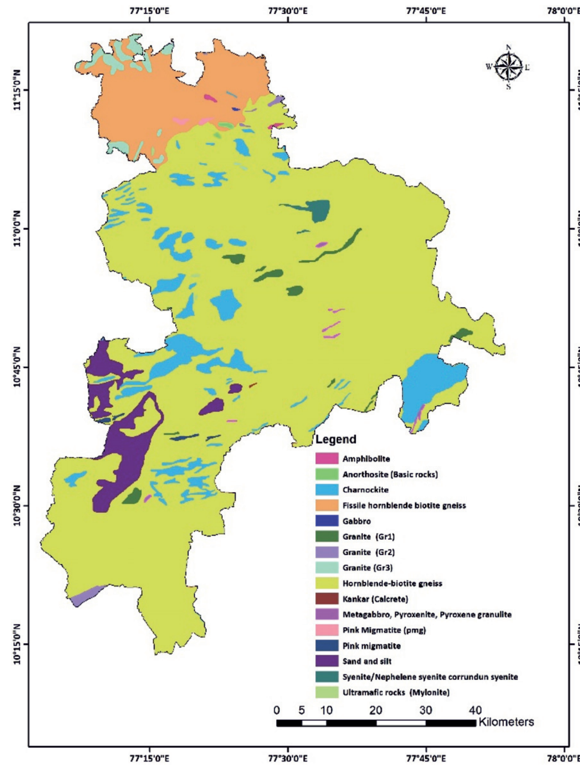


**Fig. 6.** Geology map of Tiruppur District

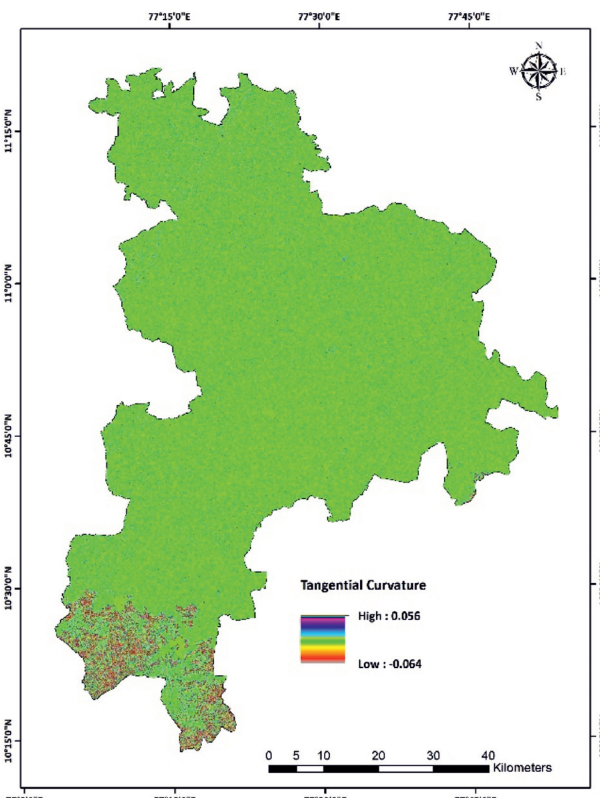


**Fig. 5a.** Tangential Curvature

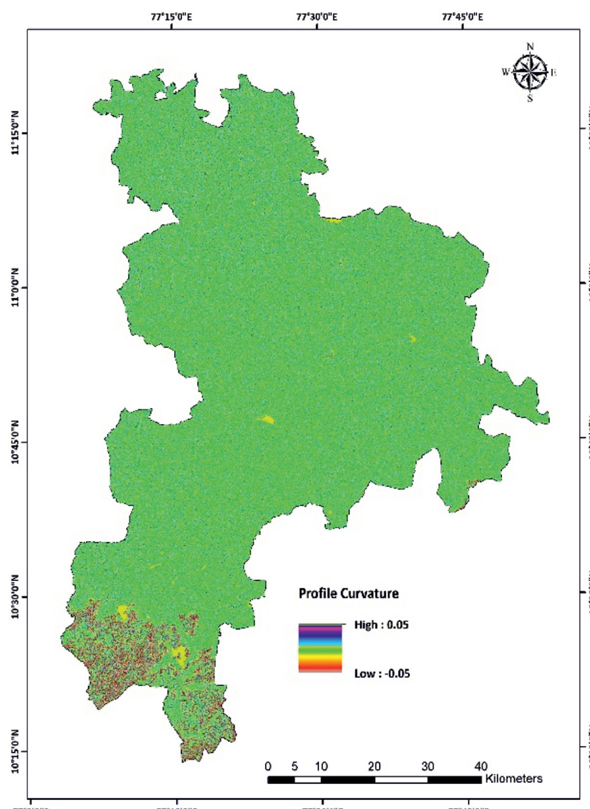


**Fig. 5b.** Profile Curvature

Pedipla, Pediment/ Valley Floor, Pediplain Canal Command, Ridge type Structural Hills (Large), Shallow weathered/shallow buried Pediplain, Valley Fill/ filled-in valley, Water Body Mask are found in the district. The Shallow weathered/shallow buried Pediplain takes up approximately 3044.24 square kilometers, followed by Pediplain Canal Command (1229.38 sq.km) (Figure 7)

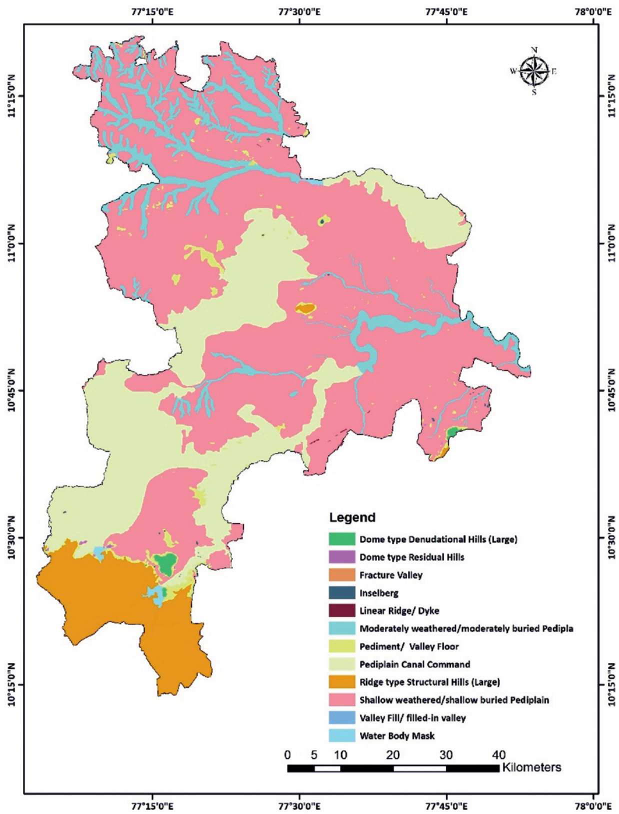


**Fig. 7.** Geomorphology of Tiruppur district

## Conclusion

From the above study it is evident that landform classification is based on digital elevation models (DEM).Organism, relief, and parent material were all employed as environmental covariates in this study to reflect soil formation parameters. Landforms are the geomorphic structures that make up the earth's surface. Landform classification is based on digital elevation models (DEM). The Quinlan's algorithm is the most promising and straightforward method for landform classification. For digital soil mapping, layers of environmental variables were created and layer stacked that can be used along with decision tree which is a non-parametric tree structure, and Quinlan's technique.

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