IDENTIFICATION OF SOIL EROSION PRONE AREAS USING REMOTE SENSING AND GIS IN PART OF TIRUPPUR DISTRICT, TAMIL NADU, INDIA

M. PANDIAN*
P. PAVITHRA**
K. SRIMADHI**

Abstract

Soil erosion by water is a critical problem with terrain due to various anthropogenic pressures as well as natural factors. Its assessment and mapping of erosion prone areas is very essential for soil conservation. The present study is carried out to assess soil erosion using Remote Sensing and GIS techniques in Tiruppur district, TamilNadu state with the objective to identify soil erosion prone areas. The method used to assess soil erosion is the Rank and Weightage. The geocoded digital data of IRS P6, LISS-III and Survey of India toposheets are used for various interpretations and thematic maps such as drainages, lineaments, landuse/landcover, and slope maps have been prepared. Weightage factors are assigned for each of the parameters and are overlaid and integrated into one another by GIS technique using ArcGIS and soil erosion prone areas are identified. The results of interpretation and analysis show that the areas such as Karukutti, Madathukulam, and Sammedu are high prone, areas such as Salaiyur, Pukkulam, Vairappattamkovil, Udumalpet and Adivalli are moderately prone and areas such as Pedappampatti and Askurichchikkottai are low prone.

Key words: soil erosion, Remote Sensing, GIS and IRS

* M.Tech, Centre for Remote Sensing, Bharathidasan University,Khajamalai Campus, Tiruchirappalli – 620023, Tamil Nadu, India

** B.Tech, Centre for Remote Sensing, Bharathidasan University,Khajamalai Campus, Tiruchirappalli – 620023, Tamil Nadu, India

Introduction

The incarnation of Geomatics technology is a major technological breakthrough in understanding the mother earth, her morphotectonic and morphodynamic processes and the related natural resources, environmental, ecological system, disaster proneness. Among these technologies, remote sensing has acquired position owing synoptic photo coverage capability, multispectral possibility and temporal resolution. While the synoptivity aids in providing panoramic view of the earth, the multispectral photographs vividly and spectacularly display the different terrestrial objects, whereasuit's temporal resolution provides unique vistas in monitoring the changes that are taking place on the surface of the earth. The GIS technology is a versatile tool in storing, manipulating and preferentially retrieving all types of spatial and non-spatial data.So in the present study remote sensing and GIS technology have been used extensively for soil conservation in parts of southern TamilNadu. Soil erosion is the removal and subsequent loss of soil by the action of water, ice, wind and gravity. Soil erosion is a process that occurs naturally at a slow rate. Especially, remote sensing techniques offer a good means of monitoring the adoption of these conservation practices (Logan et al., 1982; Trolier and Philipson, 1986; Welch et al., 1984). The black- and-white aerial photographs, satellite remote sensing data and GIS techniques have been applied by several scholars for soil erosion assessment. Karale and Saini,1986; Stephens and Cihlar,1982; Biswas,1986; Karale and Das,1986; Sharma and Kalia, 1987; Manu Omakupt,1989; Saha and Singh,1991 and Petra Fritz,2004. Mitchell,1981 and Steglik,1982 have studied the extent and risk of soil erosion in North Africa and Middle East by visual interpretation of Landsat imagery. Louhichi, et. al (2010), EliasSymeonakis and Nick Drake (2010), Sergio Lo Curzio and Paolo Magliulo (2009), JasminIsmailandRavichandran (2008), Pankaj Mani et. al (2003) have also recently used the Geospatial technologies to assess the soil erosion. Hence, here an attempt has been made to develop soilerosion prone areas model for techniques studied from the potentiality of remote sensing and GIS.

Study area

The study area is Tiruppur district, lies on the western part of TamilNadu bordering Western Ghats. It comprises of major town such as Tiruppur, Udumalpet, Madathukulam and Pukkulam. The main rivers of the district are the Noyyal and Amaravathi, the tributaries of the Cauvery are flowing towards east. The Palar and Nallarriver flow towards the west. The study area covers an area of 1418.56sq.km and falls between north latitudes of 10^0 20' 00" and 10^0 40' 00", and east

longitudes 77^0 00' 00" and 77^0 20' 00"and covering the toposheets 58F/2, 58F/3, 58F/5, 58F/6, 58F/7and 58F/8. The study area experiences a general tropic – subtropical climate. The temperatures recorded in the past have shown the variation of maximumtemperature 34.9^0 and minimum temperature 18.4^0.The average rainfall recorded in the past shows 700mm with the North East and the South West monsoons.

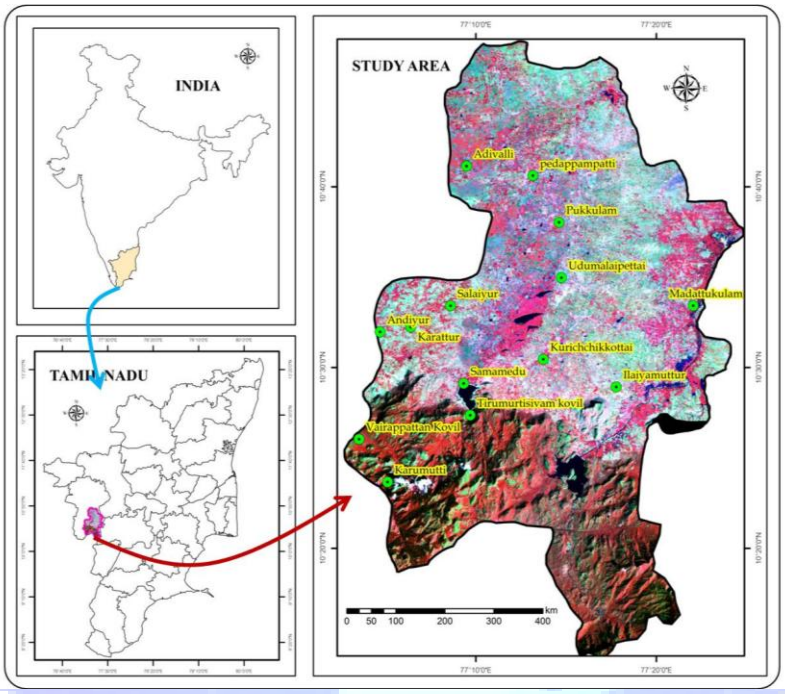

Fig1. Location map of the study area

Methods and Materials

The parameters considered for the soil erosion are slope, Land use/land cover, soil and rainfall. The soil erosion hazard zones have been prepared using the above parameters based on the followingmethodology. The detailed methodology was accordingly carved out to fulfill the above aim and objectives as given in the flow chart (fig.2).The Landsat ETM data were subjected to the different types of image enhancement techniques and soil erosion areas were mapped out and GIS database was generated showing the soil erosion areas using Arc GIS 10.1 version. Same enhanced satellite data were used for preparing different thematic data on various geological / terrain variables which obviously control soil erosion prone areas and the various

controlled variables and the area has been fragmented into a number of polygons of land segments depending upon the controlling variables. The Slope has been generated from the Survey of India topographic map in the scale of 1:50000 (1971) and the contours have been digitized using Arc -GIS software (Fig.4).Soil map has been generated using the existing data available to the Soil Survey Department and the limited field check has been performed (Fig.5).Monthly rainfall data from State government departments have been collected and isohyets map is constructed using Arc GIS – Spatial analyst software (Fig.6). Suitable ranks and weightage have been given to interpret the erosion prone areas with reference to the given thematic layer's parameters.Finally, the remedial measures were suggested for each land segment according to the controlling variables. For the identification of soil erosion prone areas the various methodologies adopted in the previous studies, in this present study the weightage based methodology is adopted in the identification of soil erosion prone areas.

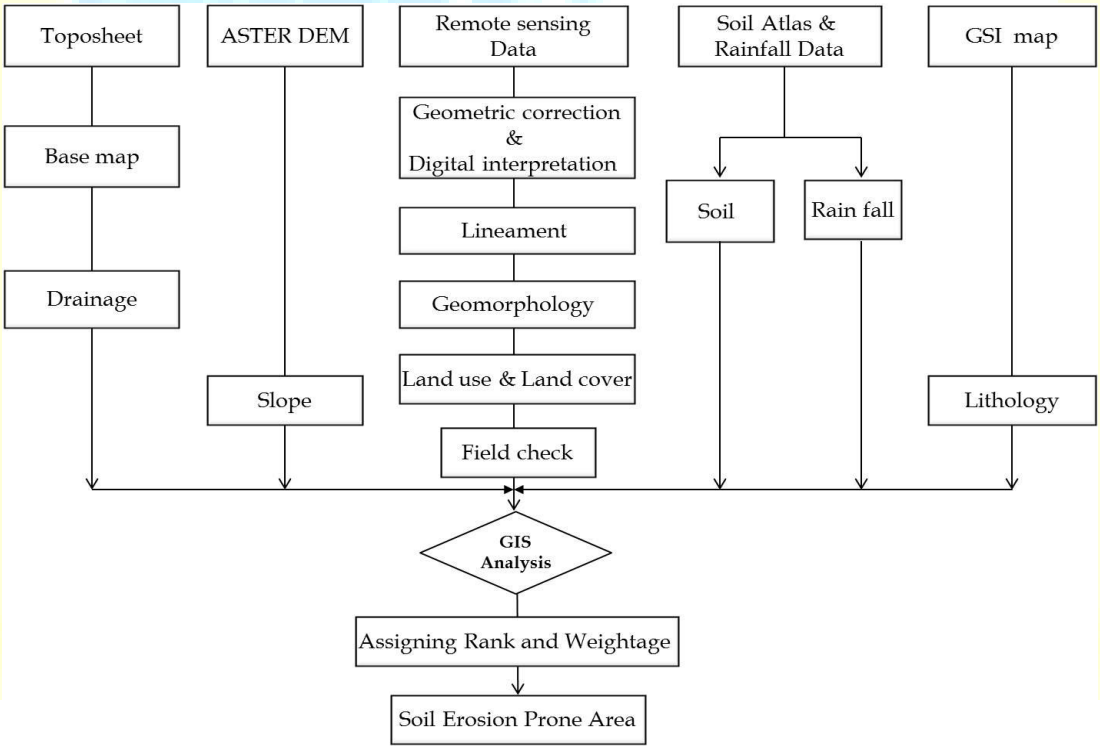

Fig2. The Flow chart showing the methodology for soil erosion using Remote Sensing & GIS

Landuse / Landcover map

Landuse refers to various activities of human beings which carried on land. Land cover refers to the natural vegetation, water bodies, rock / soil artificial cover and another resulted due to land transformation. Landuse classification of the specified area using remotely sensed data can provide valuable information on the interrelationship between land use and landcover. In the present study the standard land use / land cover classification developed by NRSA (National Remote Sensing Agency).

Slope

The Slope is an important factor / parameter in the terrain systems having direct contribution over various Geo-hazards especially soil erosion, landslides, flooding etc., so detailed satellite imagery interpretation was carried out in the study area and categorizes into nearly level, gentle slope, moderate slope, steep slope and strongly steep slope. They are classified on the basis of the degree of slope. The steep slope area is (>35^0) and nearly level (<5^0).

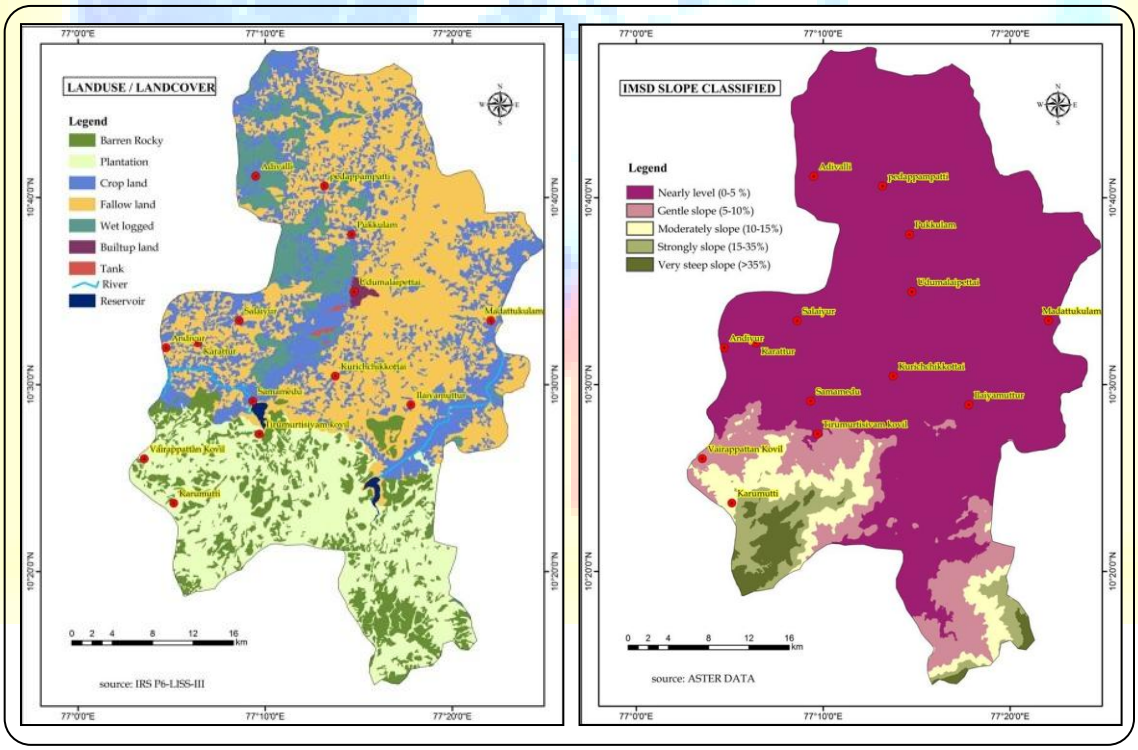

Fig3. Land use / land cover map of the study area

Fig4. Slope map of the study area

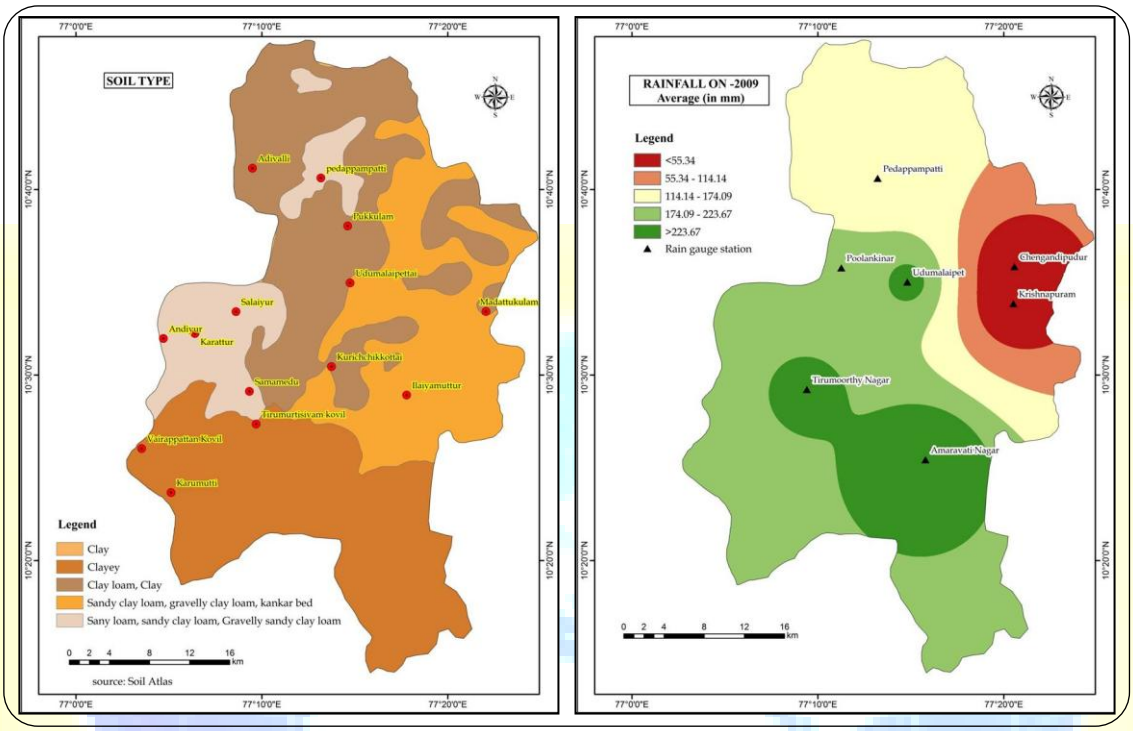

Fig5. Soil map of the study area

Fig6. Rainfall map of the study area

Table.1. weightage of the parameters

Parameters	Weightages		Parameters	Weightages
Land use / land cover			Soil type	
Crop land fallow land	5		Gravelly clay loam	5
River	4		Sandy loam	4
Reservoir	4		Sandy clay loam	3
Wet logged	3		Clay loam	2
Plantation	3		Clay	1
Barren rocky	2			
Built-up-land	1			
Tank	1			

Parameters	Weightages		Parameters	Weightages
Slope			Rainfall	
Strongly steep slope	5		>223.67	5
Steep slope	4		174.09-223.67	4
Moderately slope	3		114.14-174.09	3
Gentle slope	2		55.34-114.14	2
Nearly level	1		<55.34	1

Field verification

Fig8. Field verification of the study area

Results and Discussion

The weightage are given to the parameters considered. For the rainfall parameters, higher weighted values were assigned to the areas of very high rainfall and the values were progressively reduced to the lower rainfall categories. As far as theslope is concerned, the highest weighted value was assigned to the very steep slopes followed steep categories and the weighted values were progressively reduced for the lower steep slope. In soil type the highest value is given to gravelly clay loam followed by sandy loamy, sandy clay and clay.The value to soil type is based on the soil present in the slope area i.e., the soil present in the steep slope given greater value than the gentle. As far as the land use / land cover is concerned, the higher values were assigned to agriculture and human habitation category. Lower values were assigned for scrubs and for forest least value was assigned. After assigning the weightage factors for each of the parameters they were overlaid andintegrated it one another and various soil erosion prone areas were demarcated as shown in fig.7.

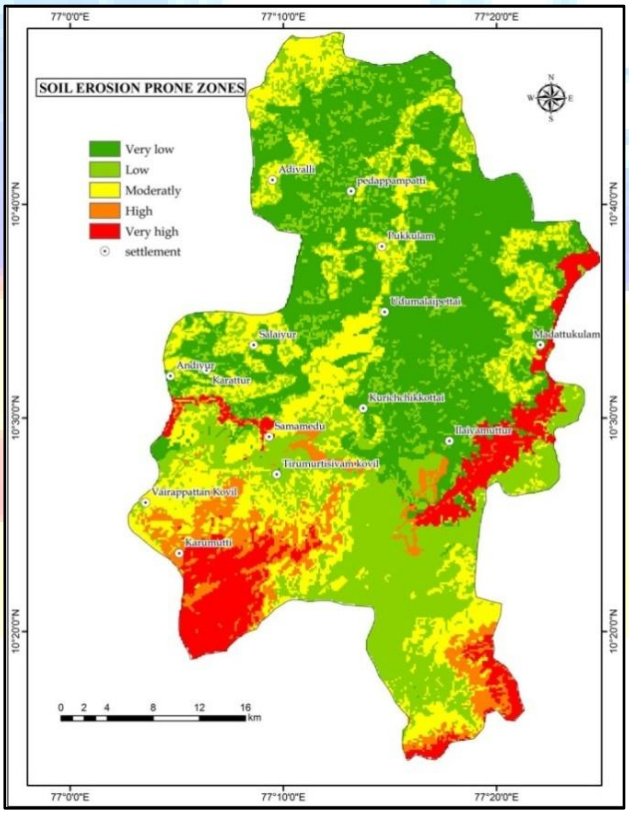

Fig7. Soil erosion prone zones map of the study area

Conclusion

For the present study Tiruppur district is selected and evaluated as both hill ecosystem and plain area, can be studied for the soil erosion process. Through raw and digital analysis of IRS P6 LISS-III data and SOI toposheets, various thematic maps such as drainage map, lineament map, geomorphology, Landuse / Landcover map, soil map and slope map have been prepared. Subsequent to the preparation of GIS image on soil erosion and other controlling geological variables, GIS integration was carried out using Arc GIs 10.1 version and buffered GIS images were generated bringing out of soil erosion controlled by lithology, lineament density, drainage density, slope and Landuse / Landcover. These were further integrated to give a number of polygons of land having different levels of soil erosion along with various combinations of above geologic variables.The results of interpretation and analysis show that the areas such as Karukutti, Madathukulam and Sammedu are highly prone, areas such as Salaiyur, Pukkulam, Vairappattamkovil, Udumalpet and Adivalli are moderately prone and areas such as Pedappampatti are less prone to soil erosion.

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Biography

M. Pandian, the author doinghisM.Tech in Geo-Technology & Geo-Informatics in Centre for Remote Sensing, Bharathidasan University, Khajamalai Campus, Tiruchirappalli – 620 023, Tamil Nadu, India. His paper won cash award at national conference held at IRS Anna University, Chennai. Three of his papers were published in international journals. His is interested to do research in the areas Remote Sensing and GIS.