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Identification of Soil Erosion Prone Zones in Parts of Nichabanadhi Sub Basin Tamilnadu, India - Using Remote Sensing and GIS

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A B S T R A C T

A comprehensive methodology that rank and weightage method and Geographic Information System (GIS) techniques was adopted to Identification of soil erosion prone zones in parts of Nichabanadhi Sub Basin Tamilnadu. Using satellite data, various thematic maps on soil erosion such as slope, geological, geomorphological, slope aspect, drainage density, lineament density, soil types and land use/land cover maps were prepared and GIS analyses method to understand the situation of soil erosion.

Keywords: Landsat ETM Satellite imagery, Remote Sensing and GIS technique, Geomorphology and LULC Mapping.

1. Introduction

Soil erosion is one of the most serious environmental problems in the world today because it threatens agriculture and also the natural environment. Since soil erosion affects the productivity of land and while adversely affecting downstream areas, soil conservation takes a lead role in today's development programs. Soil erosion is a major land degradation process in the mountain and hilly regions (Dabral *et al.* 2008). It has increased due to inappropriate LU/LC and unscientific management practices followed in the hilly regions. Worldwide, each year, about 75 billion tons of soil is eroded from the land, a rate that is about 13-40 times as fast as the natural rate of erosion, Zuazo et al. (2009).

In India, the soil erosion is more severe in the Himalayan ranges, Northeastern states, and the Western Ghats, together constitute 45% (130M ha) of the total geographic area, which is affected by serious soil erosion through ravines, gullies, shifting cultivation, cultivated wastelands, sandy areas, deserts, and water logging. Among this 93.68M ha of land is influenced by hydrologically controlled soil erosion (Narayan and Babu 1983; Anon 2008, 2009; Singh et al. 1992; Pandey et al.2007). Geographic information systems are becoming a popular tool when seeking solutions to issues of these kinds, which are spread over large spatial extends and require equation. The present study deals with the identification of soil erosion along the study area using geographic information system.

2. STUDY AREA

The study area lies between Vaippar river basin and the geographic co-ordinates north latitudes 9° 0' 00" to 09° 20' 00'' and east longitudes 77° 20' 00" to 77° 40' 00" Total study area covered by 565 sq.km (Fig.1). The Nichabanadhi sub basin sprawls in sivagiri, Sankarankoil and Sattur taluks of Tirunelveli district of Tamilnadu. The important towns in this sub basin are puliyankudi, Karivalamvanthanallur, Nelkattumseval and Thiruvengadam. There are 3 Block in the sub basin, such as Vasudevanallur, Sankarankoil, Kurivikulam. The basin can be broadly divided in to hills and plains.

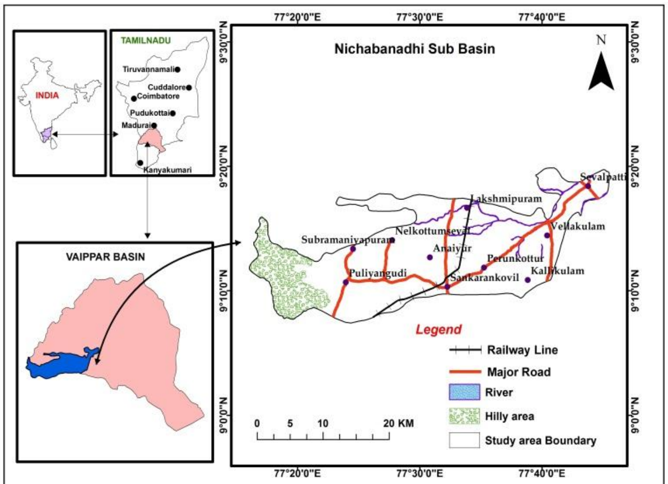

Figure.1 Location map of the Study Area

3. DATA PREPARATION

Landsat 7 ETM$^+$ was acquired on 27 June 2002. This image was also geometrically rectified using control points collected from topographic maps so that the image can be accurately linked to ground reference data with Visual interpretation technique was followed for preparing geomorphological and landuse landcover map using ARC/INFO GIS software and other ancillary data, such as soil type and soil depth maps prepare from NBSS (National Bureau of Soil Survey, Bangalore), Lithology map was prepared from District Resource Map published by Geological Survey of India in 1995. The study area has three types of lithologies such as Quartzite, Charnockite and Hornblende biotite gneiss. The Slope analysis map prepares using ASTER DEM data. The range of slope aspect is classified as North and North East, South, South East and South West and west and North West. Rainfall data collected from PWD, Tirunelveli (Public Work Department). Base map was prepared using Survey of India (SOl) toposheets (1: 50,000 scale) 58/G7, G8, G11 and 58/G12.

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4. METHODOLOGY

Present study is based on both primary and secondary data sources. Primary data involved sample survey of geomorphic features sites (erosion, deposition) using handheld Global Position System (GPS) instrument. Secondary data is collected from concerned public department, published report and internet. The sequence of procedures followed for the assessment of vulnerable areas to soil erosion is schematically shown in Fig.2.

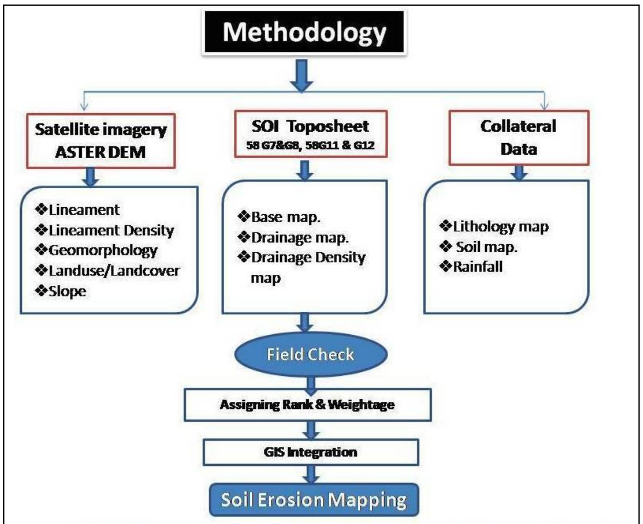

Fig.2 Flow chart – methodology in estimation of soil erosion mapping

5. MAPPING OF SOIL EROSION PRONE AREAS

For assessing the Soil Erosion prone zones in the study area, various thematic layers like Mean Annual Rainfall, Slope, Geomorphology, Lineament Density, Land use, and Drainage density, soil thickness and lithology are considered. Each theme has different importance in the context of determining the susceptible zones. Choudhury (1999) states that, the consideration of relative importance factors often leads to a better representation of the actual ground situation. A weight represents the relative importance of a parameter with respect to the objective. The ranks are assigned to each category of the thematic layer.

All themes by adding the total weightages and dividing them into different soil erosion prone zones (Table.1). Digitised vector maps pertaining to chosen parameters, viz. Rainfall, geomorphology, landuse landcover, slope, geology, lineament density, drainage density and Soil depth were converted to raster data using 23m × 23m grid cell size. The raster maps of these parameters were assigned respective theme weight and their class weights. The individual theme weight was multiplied by its respective class weight and then all the raster thematic layers were aggregated in a linear combination equation in ArcMap GIS Raster Calculator module as given here: Rain fall * 8 + Slope * 7 + Landuse Landcover * 6 + Geomorphology * 5 + lineament density * 4 + Drainage density* 3+ Soil depth* 2+ Lithology* 1. The final cumulative map generated by applying the above equation had weight values ranging from 92 to 35. The cumulative map was further reclassified into five categories of soil erosion zone, viz. Severe Erosion, Very High Erosion, High Erosion, Moderate Erosion, and Slight Erosion in terms of their importance with respect to soil Erosion mapping (Fig.3). Moderate erosion dominates in the area. Serve Erosion 05% of the total area. Very high erosion category has about 48%, High Erosion 13% whereas about 49% comprised of Moderate Erosion. Areas with Slight Erosion constitute 25% of the total study area.

Rainfall Weightage – 08		
Class	**Rank**	**Score**
Structural hill & Residual Hill	3	24
Pediments	2	16
Water bodies	1	08
Slope Weightage - 07		
Very steep	3	21
Steep slope	3	21
Moderate slope	2	14
Nearly	1	7
Gently	1	7
Land Use/ Land Cover Weightage - 06		
Forest Covered area	3	18
Fallow land	2	12
Plantation	2	12
Land with scrub	2	12
Crop land	1	06
Geomorphology Weightage - 05		
Bazada Zone	3	15
Weathered Pediplain mode.	3	15
Weathered Pediplain Shallow	3	15
Burried pediment	2	10
Flood plain.	2	10
Structural hill	1	05
Pediment	1	05
Residual hill	1	05
Lineament Density Weightage - 04		
High	3	12
Moderate	2	08
Low	1	04
Drainage Density – Weightagee – 03		
High	3	09
Moderate	2	06
Very low	1	03
Low	1	03
Soil Depth Weightage - 02		
Rock land	3	06
Moderately deep	2	04
Very deep	1	02
Deep	1	02
Lithology Weightage - 01		
Quartzite	3	3
Hornblende-Biotite Gneiss	2	2
Charnockite	1	1

Table.1: Assignment of ranks and weightages to various themes and units.

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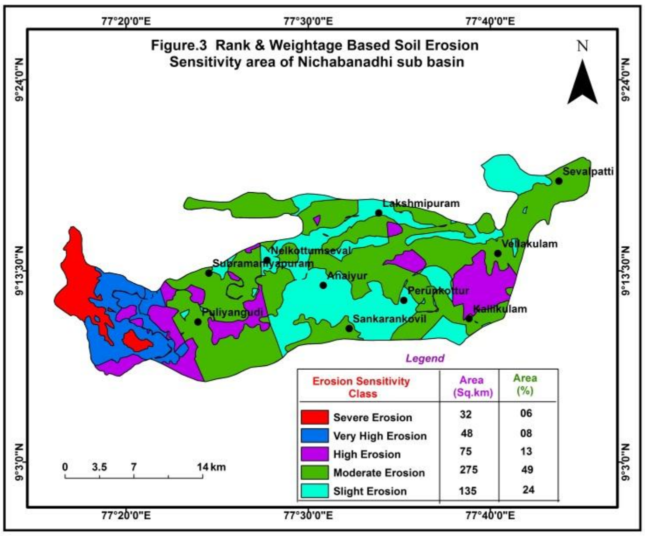

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