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Identification Of Soil Erosion Prone Zones Using Geomatics Technology In Parts Of North Arcot And Dharmapuri District.

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ABSTRACT:
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. The average natural geologic rate of soil erosion is approximately 0.2 tons per acre per year. Erosion is the process were by the earth or rock is loosened or dissolved and removed from any part of earth's surface. Geological erosion is the rate at which the catchment or land would normally be eroded without any disturbance by human activity. If man alters the natural system by means of various land use practices that is caused accelerated erosion. The present study area is covering Parts of North Arcot The area is lies between E78°30'-E78°45' lattitudes N12°15'-N12°30'. The total aerial extent of the study area is 720 sq.km. It falls in the survey of India Toposheet 58 L11 on 1:50,000 scale. The IRS – 1D satellite imagery data were subjected to different types of image enhancement techniques and soil erosion areas were mapped out and GIS databases were generated showing the soil erosion areas using Arc Map 9.1 version. GIS overlay function was executed between soil erosion prone areas and the various controlling variables and the area has been fragmented into a number of polygons of land segments depending upon the controlling variables. Finally, the remedial measures were suggested for each land segment according to the controlling variables.

KEY WORDS: IRS - 1D LISS - III, Geomorphology, land use and Land cover, Geographical information system, drainage density, GIS Overlay, Digital elevation model, High pass filtering,

I INTRODUCTION

1.1GENERAL

Geological time scale has revealed the various geological and geomorphological factors factors evolved on our mother planet "The Earth", leading to lithological formation with various types of soil types forming the solid state outer bound to our planet. Soil as a three dimensional natural body of the earth's surface is a piece of 'landscape' with its own surface and landforms as well as soil profile and internal characteristics.

Erosion is the process were by the earth or rock is loosened or dissolved and removed from any part of earth's surface. Weathering both chemical and physical aspects involves only the degradation of the rocks, but the erosion is the detachment of particles, transports the same through drainage channels of a catchment and finally deposits in the reservoirs or rivers bank. The process of erosion and delivery of sediment to the reservoir is severe and spectrally uniform process. It is dependent on various geological, geomorphological and other terrain characters. Earth scientists are concerned with many types of soil erosion. There are distinctions between geological and accelerated erosion. Geological erosion is the rate at which the catchment or land would normally be eroded without any disturbance by human activity. If man alters the natural system by means of various land use practices that is caused accelerated erosion. These types of erosion may vary from place to place. Normally erosion is measured as sediment yield in tons/km^2/year (Cooke and Doormkamp, 1974).

1.1.1 ECOSYSTEMS AND GEOHAZARDS:

The natural disasters have become fast spreading epidemics around the world. These natural disasters/geohazards such as seism cities and soil erosion, earthquake, landslides, volcanic eruption, flooding, soil erosion and reservoir siltation, salt water intrusion, coastal erosion etc., are

1) Due to morph tectonic and processes of the planet earth.
2) Due to improper intervention of the human beings
3) Exclusively due to human improper land usage.

Several millions of hectares of land have been affected in the world by various soil limitations/hazards such as erosion salinity, alkalinity, water logging and high water table, excessive permeability, ravines, rockiness and rock out croups. However, due to phenomenal population, the humans who have started their civilization and settlements of the earth like hill, plain, revering, coastal etc., and amongst which the man's invasion of the hill ecosystems has started causing chains of environmental problems. The extensive deforestation and the modification in land use pattern in hilly areas cause intensive soil erosion. Which intern trigger off phenomenal siltation in the down ward reservoirs, cause storage loss of the reservoirs and haphazard flooding?

The geology and the terrain systems not only stand as a testimony for the palaeo geological processes but also for the ongoing morphotectonic and morphodynamic activities too.

1.1.2 SOIL EROSION

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. The average natural geologic rate of soil erosion is approximately 0.2 tons per acre per year. This is approximately equal to the average rate at which soil is being produced from parent rock and organic materials. Mans' utilization and disturbance of the land has increased the rate of soil loss significantly. Soil erosion seriously threatens agriculture and the nature environment. It is very distressing that at a time when soil degradation is increasing worldwide.

1.1.2.1 ENVIRONMENTAL PROBLEMS RELATED TO SOIL EROSION:

The soil erosion leads adverse effect over the catchments as well as command area and effects are interrelated. It reduces the forest growth due to removal of topsoil reduction in soil depth in the catchment. In command areas the erosion process leads to the heavy silting in lakes and ponds. Finally flooding in agricultural lands and also changes the quality. Hence, the harmful effects on gullies or channels should be undertaken for the assessment of erosion. The assessment involves the recognition of existing erosion prone areas susceptible for further erosion.

The economy of developing countries like lndia is mainly based on agriculture and natural resources. Agriculture activities are mainly controlled by the availability of water in the reservoirs and also other surface as well as subsurface water. As the above narrated problems have severely affected all the developmental activities such as crop production and other biological activities and finally lead to the loss of economy.

India was perhaps the first developing country to formally recognize the danger of soil erosion and land degradation vis-à-vis food securing and prosperity of the nation (das, 1994). The average sedimentation rates of most of the reservoirs of our country range between 2.5 and 18 ha.m/yr. which is considerably higher than that of anticipated at the time of dams projects were conceived. The average annual percent loss of storage capacity of various dams estimated in 1975 was as high as 1.4%. This further reduces the lifespan of most of the multipurpose dams. Also flooding is another serious disaster every year in the country and causes damage to an average 6.7 million hectares. So, it becomes rather essential to delineate and map such areas affected by soil limitations/hazards and the information on extent and geographical distribution of these `declarative or conservation measures.

1.1.2.2 POSSIBLE MITIGATIONS:

Twenty eight river valley projects have been taken for various perennial Indian rivers for the detailed investigation on erosion and land degradation studies. The priority has been given for the high soil erosion and silt depositing catchments and remedial measures has been suggested in different aspects. The existing work on such aspects includes conventional field measurements for the zonation of soil erosion. Analysis of space borne and airborne, data, detailed surveys on various aspects of land use and land cover, geomorphology etc.,

Hence, proper soil conservation measures are thus urgently required to resolve the above said problems all over the world. While remote sensing technology provide excellent information in understanding the geology and the terrain systems, The geographic information system has unique potentials in collecting, collating and modeling the various terrain system data for geohazards appraisals.

The present study was aimed to give the soil conservation measures to arrest the silt or soil erosion in hill ecosystem using geospatial technology.

1.2 ROLE OF REMOTE SENSING AND GEOSPATIAL TECHNOLOGY:

Remote sensing is an art and science of obtaining information about an object without being in contact with the object under consideration. Remote sensing has emerged as a powerful tool in planning natural resources development programmes, an ability of space technology for obtaining systematic, synoptic, rapid and repetitives coverage in different windows of electromagnetic spectrum.

In addition to multi-spectral photo capabilities, availability of digital data has provided the possibility of various digital enhancement techniques through which the objects of our interest can be preferentially highlighted and interpreted according to the form. On

the contrary the temporal resolution or the repetivity is something special in satellite remote sensing in which the satellite capture the photographs of the earth once in 18 days, by these we can monitor the changes, that are taking place on the vegetation pattern, coastal and revering pattern etc., By using satellite images, collected prior and after a natural disaster such as soil erosion, earthquake, landslide, flood etc., we can precisely monitor and map its devastations.

India has also started playing a pioneer role in space research under the banner of ISRO (department of space). India after lunching several experimental satellites invented IRS series of satellites for remote sensing with finer spectral, spatial and temporal resolutions. Finer spatial resolution (1m) namely IKNOS and satellite with few centimeter spatial resolution namely Quick bird are now in orbit. Recently SRTM also play a vital role in the soil erosion studies.

Such satellite technology has found unique position in various of natural resource management environmental management and natural disaster mitigation programmes.

Application of remote sensing

- Geology and mineral exploration
- Geomorphology and modern geomorphic process modeling
- Ecosystems studies in hills plain, revering, coastal, marine and volcanic ecosystems
- Natural resource management
- Land use/land cover mapping, development and planning etc.,

GIS is a particular form of information system applied to geographical data is mainly a system of hardware, software and procedures designated to support the capture, management, analysis, modeling and display of spatially referenced data for solving complex planning and management problems.

GEOGRAPHY: May be defined in terms of its constituent's part geo and graphy, geo refers to the earth and graphy indicates a process of writing so geography means writing about the earth. The systems is concerned with data relating to geographic scales of measurement and which the referenced by some coordinate system to location on the surface of the earth. Other types of information system may contain details about location, but have spatial objects and their locations are the very building blocks of the systems.

INFORMATION: Refers to well arranged data of particular object for decision making. This represents the extraction of specific and meaningful information from a diverse collection of data, and is only possible because of the way in which the data are organized in to a 'model' of the world.

1.3 PREVIOUS WORK

The work on soil erosion have been carried out by many geoscientists, aviation engineers, soil scientists and environments from all over the world for many decades. The significant amongst them are discussed below.

1.4 THE PRESENT AREA

The present study area is covering Parts of North Arcot The area is lies between E78°30'-E78°45' lattitudes N12°15'-N12°30'. The total aerial extent of the study area is 720 sq.km. It falls in the survey of India Toposheet 58 L11 on 1:50,000 scale.

1.4.1. Temperature.

The observation done by the meteorological stations show that the study river receives high temp in the summer to the tune of 34° to 40°c in valley/plain areas and 11° to 26°in the hills/hills ranges. In general the maximum temperature is in the months between April and May and minimum temperature is in between June and February.

1.4.2. Rainfall:

Analysis or existing rainfall data shows that the mean annual rain fall varies between 1569m and 700 m. The monsoon period includes the summer showers, northeast and southwest monsoons. The summer showers are very less.

1.4.3. Geomorphology

The southern part of the study area cover by structural hill and all other area are morphologically very shallow slope and pediplain.

1.5 AIMS AND OBJECTIVES

The Main of the study is

To Identify the soil erosion prone zones with help of advance Geomatics Technology

To achieve the above aim the following objectives are adopted:

- Preparation of various thematic maps using high resolution satellite images, survey of india topographic sheets, field data etc.,
- Demarcation of soil erosion areas (by analyzing above thematic maps using GIS technology)
- Prioritization of soil erosion areas.
- Identification of controlling parameters.
- Suggestion/remedial measure to the soil prone areas to restore/ preserve such sensitive hill eco system.

1.6 POSSIBLE OUT PUTS

- Preparing the map showing soil erosion areas
- Identification of controlling parameters
- Site suitable remedial measures to control soil erosion in the form of Gully Plugging, Check

dam, Silt trap, A forestation, Gully Vegetation, Grassed water ways

II METHODOLOGY

The detailed methodology was accordingly carved out to fulfill the above ail and objective as given in flow chart (Fig 1.1). The IRS – 1D satellite imagery data were subjected to different types of image enhancement techniques and soil erosion areas were mapped out and GIS databases were generated showing the soil erosion areas using Arc Map 9.1 version. Same enhanced satellite data were used for preparing different thematic data on various geological / terrain variables which obviously control soil erosion and GIS databases were generated. GIS overlay function was executed between soil erosion prone areas and the various controlling variables and the area has been fragmented into a number of polygons of land segments depending upon the controlling variables. Finally, the remedial measures were suggested for each land segment according to the controlling variables.

2.1 DIGITAL IMAGE PROCESSING:

After the preparation of all the thematic layers by visual interpretation, using the image processing techniques the updation of the features have been made for each and every layers like lithology updation, lineament updation, geomorphology updation and land use/land cover updation are performed.

2.2 GENERAL PROCESSING:

Raw data:

The data used for digital image process of the present study area is (IRS-1D) FCC of path 101 and row 65 data. There are three bands have been used to get the FCC are as follows.

- Green band (0.52-0.60µm)
- Red band(0.63-0.69µm)
- Infrared band(0.77-0.86µm)

The IRS 1D data which has been used for this study has the dramatic improvement. The advantage of using the IRS 1D imagery is the features such as agricultural field pattern that indistinct on the LISS III imagery are clearly seen on this imagery. The green-red band water of the lake, river and ponds in the scene has moderate reflection in the bands 1 and 2(green and red), a high amount of reflection in band 3(NIR) from the agricultural crops.

Beyond that there are different enhancements techniques have been adopted to get additional features compared to the IRS 1D data.

The following image processing techniques are applied to the IRS 1D data to emphasize the features distinctly.

2.3 SINGLE BAND ENHANCEMENT TECHNIQUES

In this analysis, three individual bands are used. First the green band which shows the brighter signature of water land areas. Second the red band shows the difference between the lithology and specifically designed to demarcate the peak of vegetations. Finally the NIR band to differentiate between vegetation based on the chlorophyll content. Hence it is very much useful in identifying the plantations.

2.3.1 FILTERING TECHNIQUES

Usually filtering techniques are used to emphasize of deemphasize image data of various spatial frequencies (“roughness”-tonal variations) following filtering techniques have been used to enhance the roughness and smooth textural features.

2.3.2 HIGH PASS FILTERING

Using this techniques the lithological features such as hornblende biotite gneiss, charnockite are clearly seen, using high pass-red band. In the imagery water bodies, drainage and tanks are clearly visible after applying this technique.

2.3.3 BAND RATIONING

The band rationing generally applied to convey the spectral or color characteristics of the image features. The formula used to calculate band ratios is

B.R=BAND 1/BAND2

For IRS 1D six combinations are possible. Generally out of six combination, some of the selected combination only gives better result. Based on the feature extraction the combinations were utilized and it is similar to the trial and error method. The following are the combinations which yield better result in identifying the features.

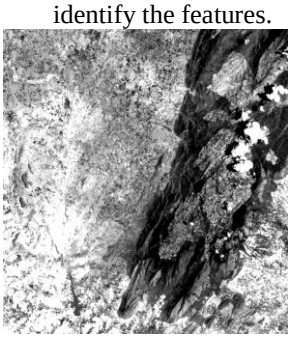
Band1/band2 combination result in identifying the water bearing formations, band2/band3 giving the contrast between plain and hill vegetation stress are clearly seen by applying this ratio, since the red band has the capability to enhance the vegetation. Hence, by using this combination water bearing and water barren tanks get differentiated, and also vegetation is discriminated from other features.

2.3.4 PRINCIPAL COMPONENT ANALYSIS (PCA)

In data mining often encounted situations where are a large number of variables in the data base. In such situations it is very likely that sub sets of variables are highly correlated with each other. The accuracy and reliability of a classification or prediction model will suffer if we include correlated variables or variables that are unrelated to the out come of interest. Different image processing techniques enhance the particular features in the digital image. In the study area different geographic features have identified by using the principal

component analysis under different band combinations.

The PC analysis is done of IRS 1D data using ENVI and different band combinations have applied to identify the features.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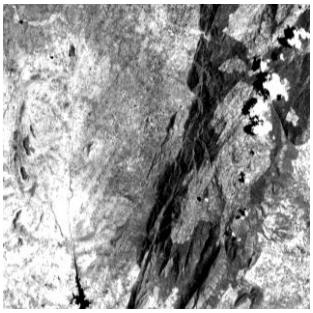
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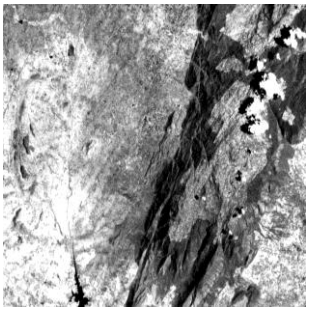
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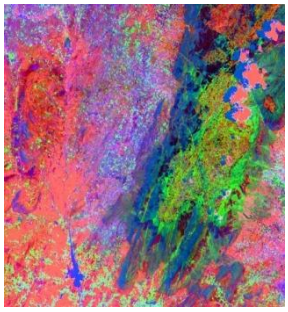
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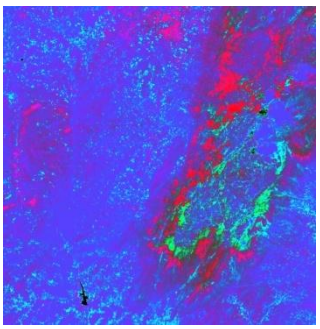
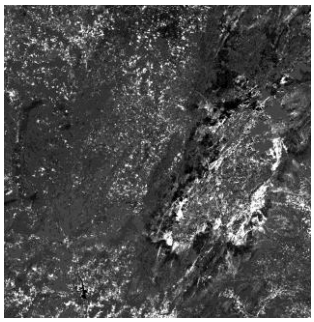

BAND RATIO (R/G)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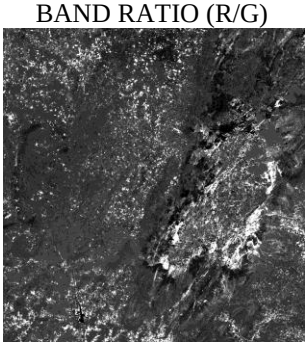
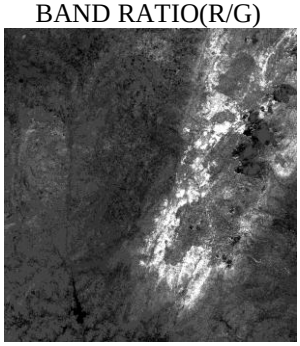
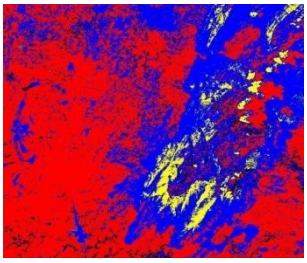

BAND RATIO (B/G)


SUPERVISED CLASSIFICATION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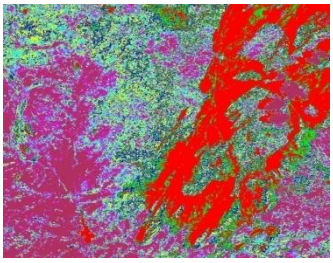
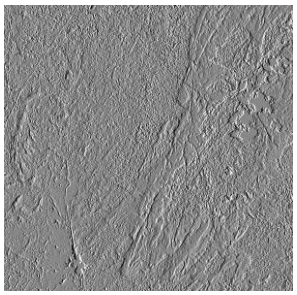
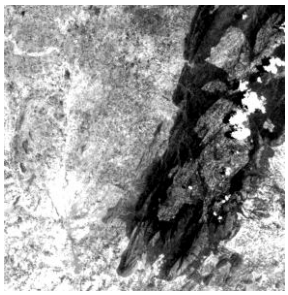

CLASSIFICATION




DIRECTIONAL FILTERININLOWPASS FILTERING

III GENERATION OF GIS DATABASE

3.1 GENERAL:

The Study area is one of the soil erosion prone area among the catchments of Tamil Nadu and supporting forest, irrigation and agricultural systems with and aerial extend of about 720 sq. km. The earlier studies were concentrated mostly on quantification of soil erosion with less importance of influencing or controlling or inducing variables. The pre preliminary field observation in the area shows that the soil erosion in influenced not only one be parameters but instead various parameters seen to act in different permutations and combinations. So, the present study has been undertaken to identify the area prone soil erosion using digitally processed satellite data and interrelate the same with GIS output on various geological / terrain parameter data so as to understand the actual controlling parameters of soil erosion and to finally suggest the remedial model to minimize the soil erosion.

3.2 GENERATION OF GEOSPATIAL DATABASES ON GEO VARIABLES.

The soil erosion is the function of rock types, degree of deformation, drainage, lineament, geomorphology, slope, land cover etc., of the area. As the main function of the study is to suggest the soil conservation measures, it is necessary to understand the different controlling variables such as landforms and their characteristics, drainage pattern, watershed, Lithology, lineament, geomorphology, land use and land cover. So various thematic maps were generated using toposheet and satellite image and GIS data bases were generated accordingly. The GIS databases were integrated and functional models for soil erosion were developed. These different thematic maps prepared include Base Map,Lithology, Drainage Map, Drainage Density Map, Lineament Map, Lineament Density

Map, Geomorphology Map, Land use / Land cover Map, Structural Trend line Map

3.2.1 LITHOLOGY MAP:

The Lithology map was prepared by using already existing geology map which is prepared by geological survey of India. The following are the different Lithology classes of the present study area are Charnockite, Pyroxene granite, Hornblende granite,Basic dykes, Carbonatite, Syenite, Epidote-horn blende.

3.2.2DRAINAGE MAP

Drainage refers to the area whose rainfall being drained into the rivers. Drainage network helps in the delineation of soil erosion areas and suggesting various soil conservation measures. Detailed drainage map was prepared with the help of toposheet on 1:50,000 scale. Drainage map was prepared .

3.2.2.1DRAINAGE DENSITY MAP

The entire study area was girded with 1cm value of each. The drainage map was superimposed over the grid plotted in the corresponding grid center and contoured using Surfer software. These contours were designated as drainage density diagram. After removing the anomalous values, the low, medium high and very high zones were demarcated and GIS image was generated in ARC GIS environment.

3.2.3 LINEAMENT MAP

The degree of fracturing is one of the important parameters in controlling soil erosion. Lineaments are the linear, rectilinear and curvilinear features of tectonic origin observed in satellite data. These lineament normally show tonal, textural, soil tonal, relief, drainage

And vegetative linearities and curvilinearities in satellite data. All these linear features were interpreted from the satellite imagery of IRS- P6-LISS-III on 1:50,000 scale and the lineament map were prepared for the present study area.

3.2.3.1 LINEAMENT DENSITY MAP

The lineament map was superimposed over the grid map and the total length of the lineaments was counted for each grid, lineament density lineament frequency lineament intersection zones were demarcated and GIS image was generated in ENVI environment.

.2.4 GEOMORPHOLOGY MAP

Geomorphology, the sculpture of earth is an important parameter in soil erosion study. Each and every landform has their own physical characters and hence these landforms express distinct soil erosion expression of their own in the satellite images. So, in the present study an attempt was made to prepare a detailed geomorphologic map on 1:50,000 scale using IRS-1D data. Photo recognition elements like tone, texture, shape, size, associated features etc., have been utilized in delineating the different landforms present in the study area (Fig. 3.7).

3.2.5 LAND USE / LAND COVER MAP Land use refers to "man's activities and various uses which carried on land" land cover refers to "natural vegetation, water bodies, rock/soil, artificial cover and other resulted due to land transformation. Land use classification of the specified area using remotely sensed data can provide valuable information on the interrelationship between land use and land cover.

Systematic and comprehensive compilation of land use / land cover maps data is necessary for the planners for various development activities. As the land use/land cover have direct or indirect influence over soil erosion it is necessary that one should know about the land use/land cover of the area under investigation. The role of remote sensing data in providing such information has been well established because of its synaptic view and temporal data capability.

In the present study the standard land use/ land cover classification developed by NRSA (national remote sensing agency) has been followed.

In the present study area in order to understand the relation between soil erosion and land use/land cover map has been prepared on 1:50,000 scale using IRS 1-D. The following are the different land use and land cover classes of the present study area Crop land ,Scrub forest,Land with scrub,Settlements, Plantation,Open forest, Land without scrub,Tanks,Dense forest, Dense scrub,Open scrub

3.3 SYNTHESIS:

The density and degree of soil erosion was found to vary from place to place in the study area. They are in general controlled by various geological, geomorphological, land use and land cover etc., and these parameters are influencing the soil erosion independently as well as in various permutations and combinations. Hence, in order to find out the influence of various parameters namely gully/ lineaments, Drainage, slope, Lithology, geomorphology, land use /land cover these databases were prepared using toposheet and satellite imagery data. The database was further analyzed to predict the soil erosion zones along their controlling parameters.The above thematic maps were directly or indirectly related with the site selection of soil erosion. In the present study main thrust was given to surface characters such as drainages, Lithology, lineaments, slope, geomorphology, land use and land cover. All the thematic maps were prepared from the IRS 1D LISS-III geocoded data, SOI topographic sheets. These were, digitized and GIS databases were generated.

IV GEO SPATIAL MODELING FOR SOIL EROSION.

4.1 GENERAL:

Subsequent to the generation of factor controlled soil erosion domains for the area, an attempt was made to carry out soil erosion hazard zonation along with

causative factors using geospatial technology. In the said modeling assigned weightages to the geovariables and superposed one over the other by map overlaying techniques and combinations of land variables which influence soil erosion were identified. Based on that remedial measures are recommended.

4.2 ASSIGNNING OF WEIGHTAGE FACTORS TO GEOVARIABLES:

An understanding of spatial relation of soil erosion with the dependent parameters is essential is before assigning the weightage to geovariables. However, assigning of weightage for each and every class present in the layer was based on the expert's opinion. For each layer, attribute tables were modified and assigned values (weightages) were stored as a different field for further analysis. The assigned values (weightage factors) are shown in table.

Table: 1 weightage table for lithology

S.NO	LITHOLOGY CLASS	WEIGHTAGES
1	carbonatite	1
2	charnockite	1
3	Epidote hornblende	3
4	Hornblende biotite gneiss	2
5	Pyroxene granite	3
6	syenite	3

Table2: weightage table for lineament density

S.NO	LINEAMENT DENSITY CLASS	WEIGHTAGES
1	High lineament	3
2	Moderate lineament	2
3	Low lineament	1

Table: 3 weightage table for geomorphology

S.NO	GEOMORPHOLOGY CLASS	WEIGHTAGES
1	Dissected plateau	3
2	Undissected plateau	2
3	Residual hills	1
4	Composite slope	3
5	Bajada	3
6	Deep pediments	1
7	Moderate pediments	2
8	Shallow pediments	3
9	Alluvial plain	2
10	Deep Pediplain	1
11	Shallow Pediplain	2
12	Water bodies	1

Table: 4 weightage for drainage density

S.NO	DRAINAGE DENSITY CLASS	WIEGHTAGES
1	High	3
2	Moderate	2
3	Low	1

Table: 5 weightage table for land use &land cover

S.NO	LU/LC CLASS	WIEGHTAGES
1	Crop land	1
2	Scrub forest	2
3	Land with scrub	2
4	Settlements	1
5	Plantation	1
6	Open forest	
7	Land without scrub	3
8	Tanks	1
9	Dense forest	1
10	Dense scrub	1
11	Open scrub	3

4.3 GIS OVERLAYING:

Using the integrated function in ARC all the following images are integrated Lithology map, Geomorphology map, Lineament density map,Land use and land cover, Drainage density map.

4.3.1 Level 1 (Lithology +geomorphology map)

Firstly, the GIS image having drainage density was kept as thematic image (lithology) and the image having geomorphology was both image were overlayed and integrated into a single image. Which shown in (4.1).

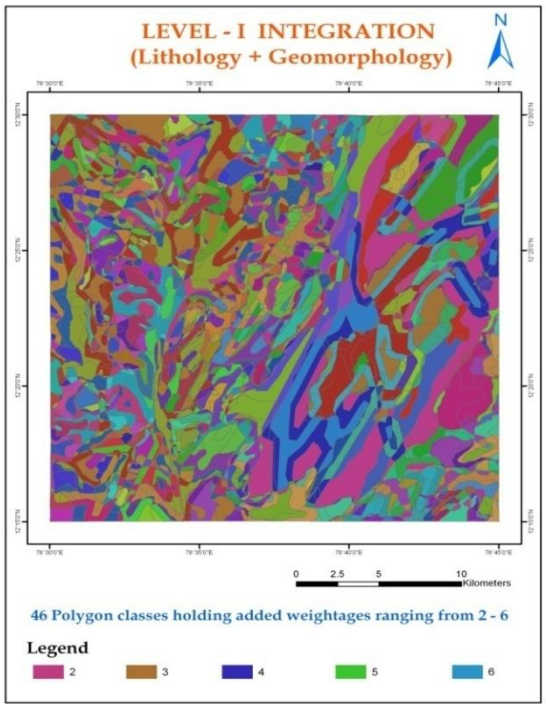


Figure 4.1

4.3.2 Level 2 (level 1 & lineament density)

The above integrated map was kept as image 1 and the image having lineament density was kept as image 2 and both images were integrated into a single image which shown in (fig.4.2).

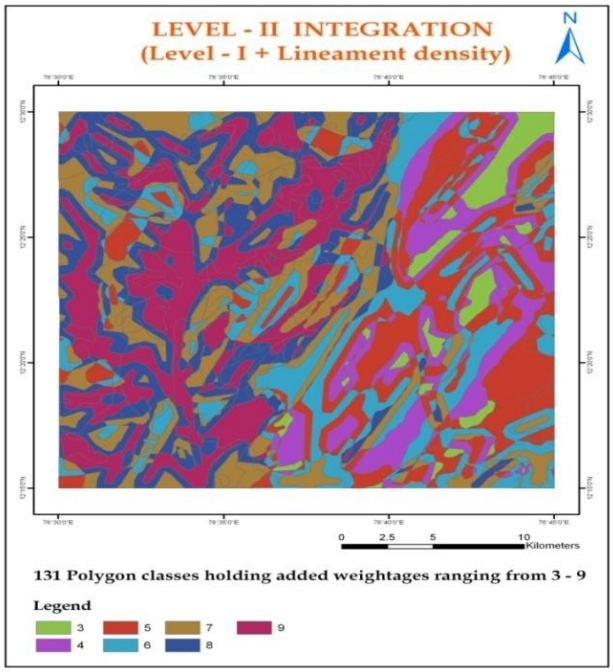


Fig 4.2.

4.3.3 LEVEL III (level 2 & land use & land cover)

The above integrated map (4.2) was kept as image 1 and the image having land use & land cover map was kept as image '2' and both images were integrated into a single image which shown in (fig 4.3).

4.3.4 LEVEL IV (level 3 & drainage density)

The above integrated map (4.3) was kept as image '1' and the image having drainage density map was kept as image '2' and both images were integrated into a single image which shown in (4.4). like above all the above images, which are said above, are integrated one after the others.

4.3.5 ZONES OF SOIL EROSION:

Finally after integrating all the above maps using ARC GIS 9.2 versions the zones which shows the soil erosion prone areas are identified (Figure. 4.5). These zones are categorized as three zones, those zones are.

- ❖ Highly vulnerable soil erosion zone
- ❖ Moderately vulnerable soil erosion zone
- ❖ Least vulnerable soil erosion zone

4.4 REMEDIAL MEASURES:

The GIS analysis has not only shown the area prone for soil erosion but also the controlling parameters of soil erosion, such as drainage density, lineament density, lithology, geomorphology, land use and land cover. These controlling parameters are observed to either independently control the soil erosion or in various combinations. So according to the controlling parameters, various remedial measures were suggested. Those are as follows.

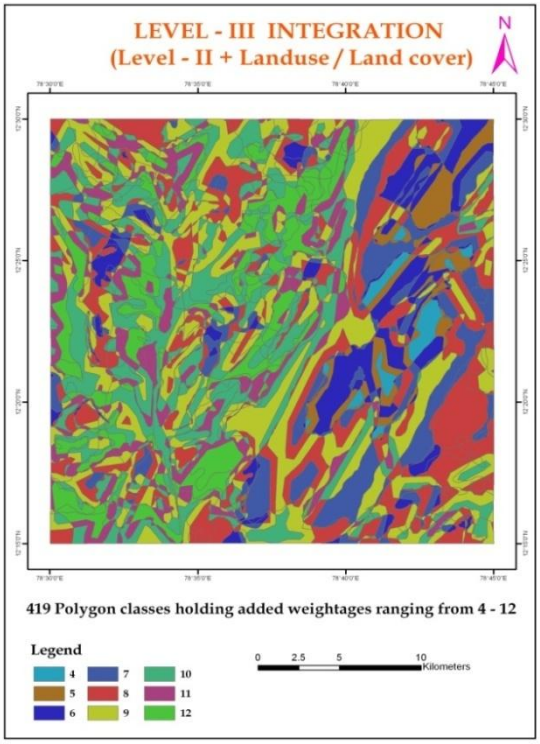


Fig 4.3

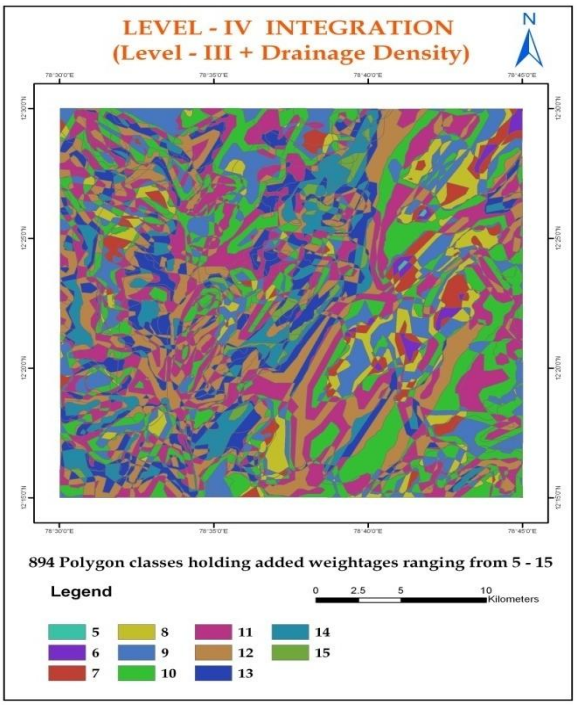


Fig 4.4

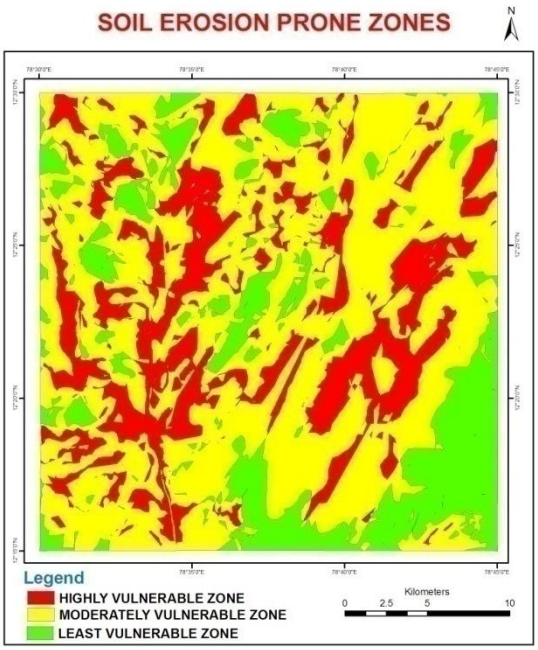


Fig 4.5

4.4 SYNTHESIS:

Subsequent to the generation of GIS image on soil erosion and the generation of GIS image on various geological variables GIS function was executed and area of soil erosion controlled by drainage density, lineament density , lithology, geomorphology, land use and land cover and multicombinations were identified.

The present study, soil erosion areas, their controlling parameters were demarcated and accordingly suitable remedial measures are suggested.

V CONCLUSION AND RECOMMENDATION

In this present study, the soil erosion measures in hill ecosystem have been carried out. For this type of evaluation pambar river catchment area was identified as study area. Both Remote sensing and GIS technologies have been effectively used.

The present study area represents mainly seven litho units namely charnockite, pyroxene granite, hornblende-biotitegniess, basic dykes, Carbonatite, syenite, Epidote-hornblende. The Lithology map was prepared from geological survey of India map. Through raw and digital analysis of IRS 1D LISS-III geocoded data and toposheet, various thematic maps such as drainage map, lineament map, geomorphology map, land use and land cover map, have been prepared.Lineament and drainage density maps were generated by measuring the total length of lineament subsequent to the preparation of GIS image on soil erosion and other controlling geological variables. GIS integration was carried out using ARC GIS of 9.2 version and buffered GIS images were generated bringing out of soil erosion controlled by lineament density, drainage density, geomorphology, land use and land cover. These were further integrated which has given huge number of polygons of and of soil erosion along with various combination of above geologic variables. From where same suitable remedial measures are suggested in the form of Gully plugging, Afforestation,,Check dam,Gully vegetation,Silt trap,Grassed water ways.The detailed site suitable remedial measures are given in Table 5.1

Table 5.1 Site suitable remedial measures

S.NO	SOIL EROSION CONTROLLED BY	REMEDIAL MEASURES
1.	Drainage density	Gully plugging, check daming
2.	Geomorphology	Gully plugging, afforestation, silt trapping
3.	Land use and land cover	Aforestation in forest blank/open forest
4.	Lineament density	Gully filled vegetation, check daming
5	Drainage density very high+lineament density very high+Bajada.	Afforestation, gully plugging, gully filled vegetation and check daming
6	Drainage density very high+lineament density very high+valley fill	Afforestation gully filled vegetation, gully plugging, check dam, silt trap
7.	Drainage density very higy+lineament density very higy+steep slope	Placement of netting, gully filled vegetations, geotextilling, drainage diversion, surface and subsurface drains
8	Drainage density very high+lineament density very high+moderate slope	Afforestation, gully filled vegetation, gully plugging,check dam,silt trap and grassed water ways.
9	Drainage density very high+lineament density high+convex slope	Grassed water ways, affoestation

REFERENCES

[1]. M.Omakupt. Soil erosion mapping using Remote Sensing data and Geographic Information System, URL: http://www.gisdevelopment.netAsian GIS journal. (1989)

[2]. Subramani.T, Manikandan.T, "Analysis Of Urban Growth And Its Impact On Groundwater Tanneries By Using Gis", International Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 2), pp.274-282, 2014.

[3]. Subramani, T "Assessment Of Potential Impacts On NH7 – 4 Laning From Salem To Karur", International Journal of Modern Engineering Research, Vol.2, No.3,pp 707-715, 2012.

[4]. Subramani.T , Someswari.P, "Identification And Analysis Of Pollution In Thirumani Muthar River Using Remote Sensing", International Journal of Engineering Research and Applications, Vol. 4, Issue 6(Version 2), pp.198-207, 2014.

[5]. Subramani.T, Krishnamurthi.P, "Geostatical Modelling For Ground Water Pollution in Salem by Using Gis", International Journal of Engineering Research and Applications ,Vol. 4, Issue 6(Version 2), pp.165-172, 2014.

[6]. Subramani,T, Krishnan.S. And Kumaresan.P.K., Study on Existing Traffic condition in Salem City and Identify the transport facility improvement projects, International Journal of Applied Engineering Research IJAER, Vol.7,No.7, Pp 717 – 726, 2012.

[7] K. Kadavul and N. Parthasarathy. International Journal of Ecology and Environmental Sciences, 27,(2001) 51-54.

[8] R.L.Karele and S.N.Das. Aerial photo-interpretation for detailed soil survey in part of Ajoy Catchment, Bihar, India. Proceedings of International Seminar on Photogrammetry and Remote Sensing for developing countries, Vol.1, (1986).

[9] R.L.Karele and K M. Saini. Resources inventory in parts of Rajasthan using Remote Sensing Technology. Remote Sensing Applications seminar, Jodhpur, (1986).