Assessment Of Soil Erosion Using Remote Sensing And Gis In Kadana Nathi

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Abstract- *Soil erosion is the most environmental problem it cause reduced crop productivity in agriculture and also it reduce the surface water quality. Thus soil in erosion is a natural problem that occurs on a global scale and can lead to significant economic and environmental impacts. soil erosion involves the detachment of soil from the soil surface by rain drop, flowing water and wind. Run-off from eroding mountainous landscapes contains sediment and any nutrients, fertilizers that were present in the soil. This study narrates about assessment of soil erosion in Kadana Nathi river, using remote sensing and GIS techniques. Topographical map has been collected from survey of India and it has been digitized using Arc GIS version 9.3 software. Soil sample are collected from the study area, Kadana nathi and rainfall data are also collected from the study area. Satellite images are collected from the study area. Satellite images are collected from the study area. satellite images are collected from NRSA, the images are of IRS-P6.Based on which, spatial distribution maps of the erosion in the study area are prepared using spatial interpolation technique Arc GIS software.*

I. INTRODUCTION

A. General

Soil erosion is one of the most serious environmental problem in the world. Because it threatens agriculture as well as natural environment. Now a days large area suffers from soil erosion which in turn reduces productivity and losses in land resources. The prevention of soil erosion which means reducing the rate of soil to approximately that which would occur under natural conditions, relies on selecting appropriate strategies for soil conservation. The factors which influence the rate of erosion are rainfall, run-off, soil slope, and plant cover and the presence or absence of conservation measures.Erosion control requires a quantitative and qualitative evaluation of potential soil erosion considering these factors.

A=R*K*LS*C*P (tons/ha/year)

Where,

A=soil loss

R=rainfall erosivity factor

K=soil erodibility factor

LS=slope and slope length factor

C=vegetative cover factor

P=conservation practice factor

B. ROLE OF REMOTE SENSING AND GIS

Remote sensing is the acquisition of information about an object phenomenon without making physical contact with the object and thus in contact to on site observation. In modern usage the term generally refers to the use of aerial sensor technologies to detect and classify objects on earth by means of propogated signals.

A Geographic Information System (GIS) is a computer system capable of assembling, storing and manipulating, analyzing and displaying geographically referenced information. This system contains both data identified according to their location, geographic and non geographic data.

II. REVIEW OF LITERATURE

Nuket Benzer.,(2009)presented a paper by using the Geographical Information System and Remote Sensing Techniques for Soil Erosion assessment in Landscape Architecture Ankara,Turkey. The objective of this study to establish a geographical information system method for spatial assessment of soil erosion based on the universal soil loss equation (USLE). In this study, USLE factors including rainfall erosivity factor (R-factor),soil erodibilityfactor (K-factor),slope and slope length factor (LS-factor), vegetative cover factor (C-factor), and conservation practice factor (P-factor) were studied. A digital elevation modeling (DEM) interpolated from elevation contours was used to generate the slope and LS-factor. Soil loss calculated in tons/ha/year. These values are ranked into three classes as low, moderate and high. It indicates that highly eroded areas are bare lands and steep conditions, less eroded areas are low slope classes. As a conclusion this study confirms that the use of GIS and remotely sensed data can greatly enhance spatial modeling for soil erosion.

Wenfu Penga, Jieming Zhoub, Cun-Yanga., In this study they are using Remote Sensing and GIS for predicting soil erosion proscess in Ministerial Key Lab of Land and Resources Information and Applied Technology, Chengdu University of Technology.Soil erosion is a major threat to the land use of mountainous environment. RS and GIS technique is used to detecting land-use change. The objective of this study was to predicting the process of soil erosion in Yizi region based on RS and GIS.Soil erosion hazard in the study area with numerical values of the Soil Loss Equation (SLE) ranging between low hazard high hazard.The results indicate that RS and GIS for predicting soil erosion.

Kartic Kumar.M , Annadurai.R, Ravichandran P.T., In this Paper, Assessment of Soil Erosion Suscetibility in Kothagiri Taluk Using Revised Universal Soil Loss Equation (RULSE) and Geo-Spatial Technology. This research integrates the RULSE within a GIS environment to investigate the spatial distribution of annual soil loss potential. Both magnitude and spatial distribution of potential soil erosion in the catchment is determined GIS data layer. The topographic factor was developed from a Digital Elevation Model(DEM). The K factor was determined from a combination of soil map and geological map; and the land cover was generated from IRS LISS III images.The resultant map of annual soil erosion shows a maxmium soil loss of 27.11ton/hec/year.

A.Zotaj, N.Mecaj., In this study, application of Remote Sensing and GIS on assessment of soil erosion risk and mitigation in mountain areas at Dangellia highlands, Permet, Albania. The objective of this study to assess and map soil erosion. The method is based on analysis of temporal and spatial distribution of soil analysis. Assessment and inventory on soil erosion hazard are essential for effective soil conservations plans of a watershed. Morphographic and Morphometric analysis carried out at the values of erosion rate on the slopes ranges from 5 to 7.5 cm/year. DEM of Dangellia Highlands was created by digitizing contour lines and spot heights from the SOI toposheets at 1: 50,000 scale. The results indicate that remote sensing and GIS techniques are indeed valuable tools for soil erosion hazard assessment by integration of soil erosion controlling soils cape, terrain and climatic parameters.

III. DESCRIPTION OF STUDY AREA

Among the major tributaries of Thamiraparani river, we selected Kadana nathi as a study area because there is no lot of prevention of soil erosion.

Kadana nathi (or) Karunaiyar like the other rivers of the district,has its origin in the eastern slopes of western ghats,at an altitude of 1700m,in Ambasamudram Taluk.The following are the anaicuts across the Kadana nathi,Arasapattu anaicut,Alwarkurichi thenkal anaicut,Manjapalli anaicut,Kakkavallur anaicut and Kangeyan anaicut.

FIG:-Kadana nathi

District	Tirunelveli
Taluk	Ambasamudram
Village	Sivasilam Tharmapuram
Toposheet No.	C43X5 C43X6
Area in Hectare	64.61
Ownership	Government

The Kadana nathi area lies in

Latitude-N $8^{o}47^{'}57"$

Longitude-E $77^{o}18'38^{"}$

IV. GIS AND ITS APPLICATION

A **Geographical Information System (GIS)** is a system designed to capture,store to manipulate,analyse,manage and present all types of spatial and geographical data.The acronym GIS is sometimes used for geographical information science or geospatial science studies to refer to the academic discipline or career of working with geographic information system and is a large domain within the broader academic discipline of geo information.

A.SOFTWARE USED

The softwares we used in the paper to create thematic maps and to find slope factor

- ENVI GIS 4.7
- Arc GIS 9.3

1. ENVI GIS:

ENVI GIS is an Exelis Visual Information.It is for proceeding and analyzing geospatial imagery used by scientist,researchers image and analysis.It contains combined lateral spectral iamge processing and image analysis technology with an user friendly interface to help you get meaningful information from imagery.

2. ARC GIS:

General Information of ARC GIS	
Developers	ESRI
Initial release	Dec,7 1999
Stable Release	Dec,10 2014
Development status	Active
Type	Geographic Information System
License	Proprietary Commercial software
Website	http://www.esri.com/software/arcgis

It is used for creating and using maps; compiling geographic data ; analyzing mapped information.Using maps and eoraphic information in a range of application and managing geographic information in a range of application and managing geographic information in a database.

V. METHODOLOGY

1.Data collection

- Collection of toposheet
- Rainfall data collection
- Soil samples
- Collection of satellite images

2.Data Input

3.Database Creation

4.Data integration

5.Generation of DEM

6.Assessment of slope factor

7.Data analysis

8.Assessment of soil erosion

A.DATA COLLECTION

1) Collection of toposheet

A Toposheet is a shortened name of "TOPOGRAPHIC SHEET "It contains information about an area like roads ,railways, settlement canals,

rivers, electric poles,post office..,According to their usae they may be available at different scales (1:25000; 1:50000 etc…wher the former is a larger scale as compared to the later)They are made on a suitable projection for that area and contain lat-long information at corners.Thus any point on it can be identified with its corresponding lat-long depending upon the scale,if the scale is large more accurate lat-long.

2) Map scales

Maps are prepared correct to the scale.Scale is expressed as Representative Fraction,abbreviated as R.F. written as 1/25000 or in the form of ratio 1:25000.It means that 1metre on paper is equal to 25000metres on the ground.

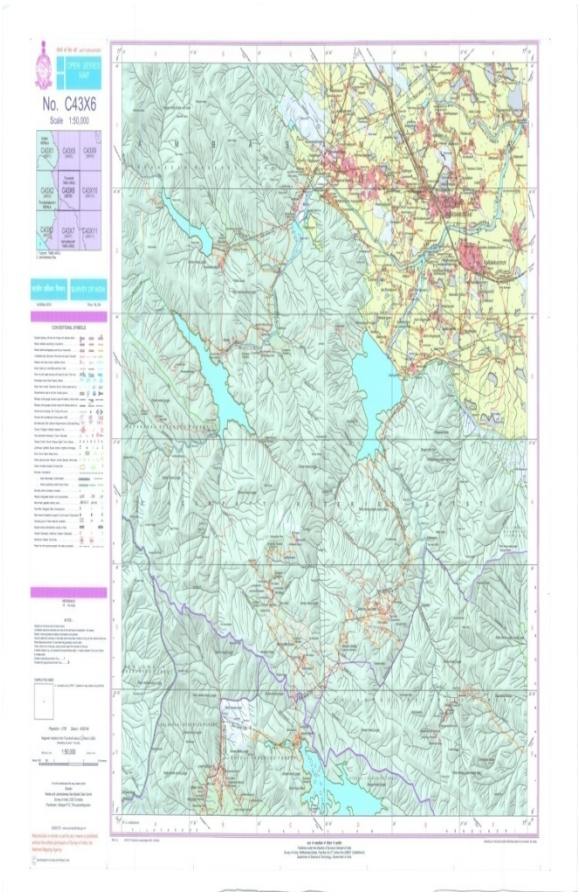


FIG:TOPOGRAPHIC MAP OF KADANA NATHI

(C43 X6)

B.DATA COLLECTIONS IN FIELD

- Rainfall data
- Soil samples

1) Rainfall data

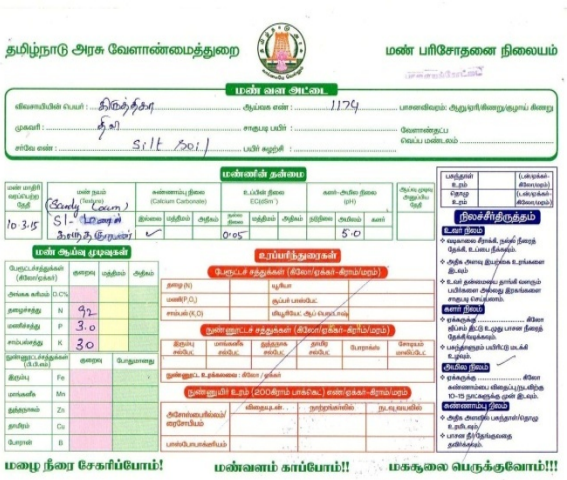
Rainfall data for theyear 2011 to 2012 were collected from field visit in Kadana nathi.The district receives the rain under the influence of both southwest monsoon and northwest monsoon it contribute the rainfall to the district.

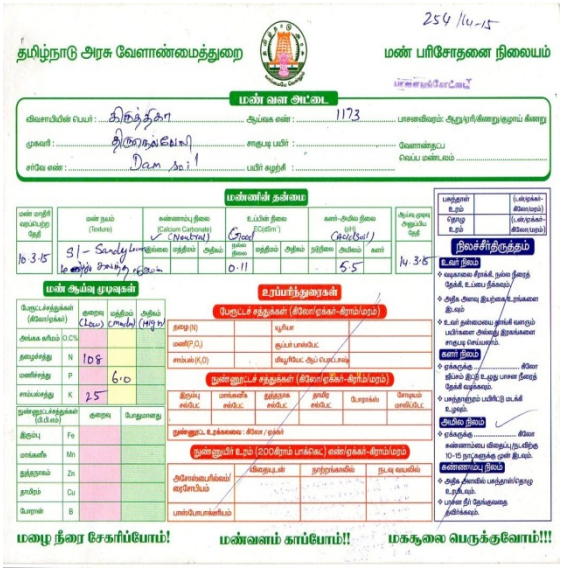
MONTH	2011 (mm)	2012 (mm)
January	6.2	36.8
Febrauary	28.8	15.04
March	80	9.60
April	Nil	Nil
May	2	204
June	110.4	8
July	62.8	46.5
August	17	32
September	36	16
October	10	199
November	170	123
December	44.2	32

2) Collection of soil sample in field

In field, We collect the soil samples for testing the nature of soil and its characteristics to find the erodibility factor based on its pH value of soil.After testing the soil in soil test laboratory they classified the soil samples as sandy loam and silt soil.The basic characteristics of these soils are,it holds moisture content.They also concludes that the soil sample we collected in Kadana nathi dam has pH range of 5.5 hence it is classified as **acidic soil.**

2.1 Result of soil test samples





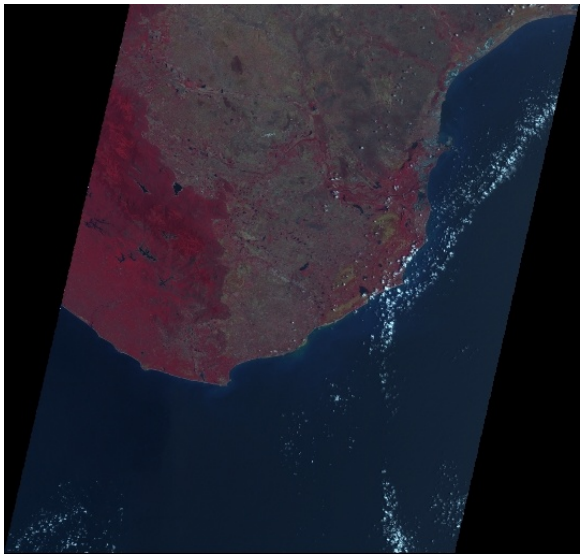


FIG:Satellite image

3) Collection of satellite images

The satellite images are collected from NRSC (**N**ational **R**emote **S**ensing **C**entre).NRSC is a department of space sponsored oranisation devoted to the acquitision,processing, and dissemination of remote sensing data.Data is acquired primarily via India's own IRS 1-A and 1-B as well as satellite belonging to other countries,such as USA's Landsat.

We collected the satellite imaes of IRS-P6 LISS III from the NRSC.

Specifications of IRS-P6

Temporal coverage - 2003-12-31 to current day

Spatial Coverage - 90 N ,90 S ,180 W ,180 E

Data type - Optical/Multi spectral Radiometry High Resolution

ESRIN - HORIZONTAL RESOLUTION RANGE – The spatial Resolution is23.5 metres

More data types On –IRS –P6,LISS III,Agriculture, land, water, solid earth.

Satellites – IRS-P6

Instruments – LISS III

C. DEM-Digital Elevation Model

DEM investigates and demonstrates the state of remote sensing techniques for detailed landslide hazard assessment applicable to large areas. Since the most common methods of landslide susceptibility assessment using weighted overlay are heavily dependent on three dimensional terrain visualisation. Digital photogrammetric and GIS used in terrain mapping purpose .Increased the demand of maps in various sectors such resource management, engineering sectors in planning and developmental purposes.

A.Generation of DEM

The DEM file does not contain civil information such as roads or buildings. It is not a planned image of the paper map. It is not a bit map. The DEM does not contain elevation contours, only the specific elevation values at specific grid point location.

The following are the procedure to create DEM

- First download and open arcgis software & click Add data and load the tif data
- Then right click the image, data-> export data-> and change tif picture format to img format

- After this tools select data management tool-> click -> projections and transform-> raster-> click-> project raster
- Then include the img file, and click output co-ordinate system icon
- Then click > projected co-ordinate system in this click > UTM > WGS 1984
- CLICK THIS COORDINATE SYSTEM ADD 49S FOR TIRUNELVELI
- Then apply and click ok
- Then click surface-> slope-> select the projected image -> you will get the slope details.

D.GEO-REFERENCING

To georeference something means to define its existence in physical space. That is, establishing its location in terms of map projections or coordinate systems. The term is used both when determining the spatial location of other geographical features. Examples would include establishing the correct position of an aerial photograph within a map or finding the geographical coordinates of a place name or sheet address. This procedure is thus imperative to data modelling in the field of Geographic Information Systems (GIS) and other cartographic methods. When data from different sources need to be combined and then used in a GIS application, it becomes essential to have a common referencing system. This is brought about by using various geo-referencing techniques. The study area was geo-referenced using the geo-coordinates (lat, log) by keeping topographic map as a reference.

A. Procedure For Georeferencing

- To perform georeferencing for a given map, first indicate ARCGIS software.
- Open Arc catalog module.
- Create a new folder say GIS; under which a personal geodatabase, a geodataset and feature classes are created.
- To create a new personal geodatabase, say database1, make a right-click on the concerned folder and select the option new-personal geodatabase.
- A new geodatabase can be created underneath the personal geodatabase say database 1, by selecting the option new dataset.
- For creating a dataset, on clicking the above option, a dialog box opens. The dataset is given a name, say dataset 1 and then click next.
- Then, set the geographical co-ordinate system for the map, by selecting the option, geographical co-ordinate system world WGS1984 and click next.
- Set the vertical co-ordinate system of the map, by clicking vertical co-ordinate system world ⟶ WGS1984 and click finish button.
- Create necessary feature classes with the option “New-Feature Class”. Common features like point, line and polygon are created with names such as location, road and boundary respectively.
- Click “Launch Arc Map” icon and create an empty map.
- Click “Add Data” icon and include the given map.
- Fix control points in the map (atleast four points) by clicking the “Control Points” icon.
- Locate the control point tool anywhere in the map and make a right click on the control points and select the option “Input x,y”.
- Input the latitude and longitude values and x and y co-ordinates in the input x,y dialog box. then, click ok.
- Then the control points get fixed.
- After, fixing the control points, select the option Georeferencing Rectify. As dialog box opens, input the name and format of the map to be stored.
- Rectify the image and save the modified map say TAMILNADU in “.tiff” image format.

E.PREPARATION OF THEMATIC MAP

A thematic map is a type of map especially designed to show a particular theme connected with a specific geographic area. These maps “can portray physical, social, political, cultural, economic, sociological, agricultural or any other aspects of a city, state, region, nation or continent”. Thematic maps are an important source of GIS information. These are tools to communicate geographical concepts such as climate, forests, land use pattern, soil type, roads and political boundaries etc. Thematic map displays the spatial pattern of a theme or series of attributes.

The following are the general procedure to create DEM

- Open Arc GIS software & click Add data and load the image in tiff format

- Then right click the image, data-> export data-> and change tiff picture format to image format

- After this tools select data management tool-> click -> projections and transform-> raster-> click-> project raster
- Then include the image file, and click output co-ordinate system icon
- Then click > projected co-ordinate system in this click > UTM > WGS 1984
- Click this co-ordinate system add 49S for Tirunelveli
- Then apply and click ok
- Then click surface-> slope-> select the projected image -> slope details will be generated.

Fig:Catchment Area Boundary From Google Earth

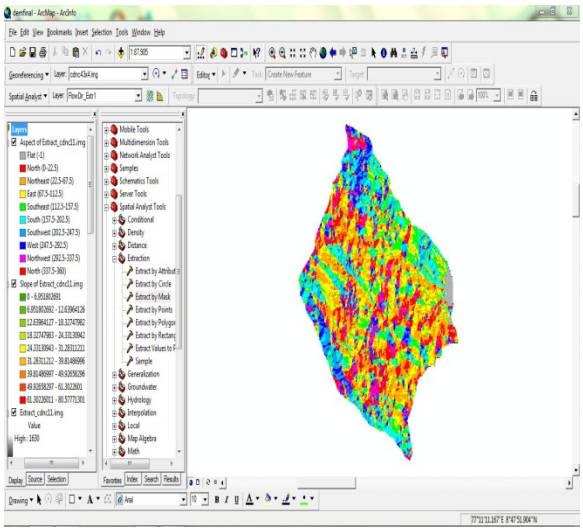


Fig:Slope Aspect of Kadana Reservoir Area

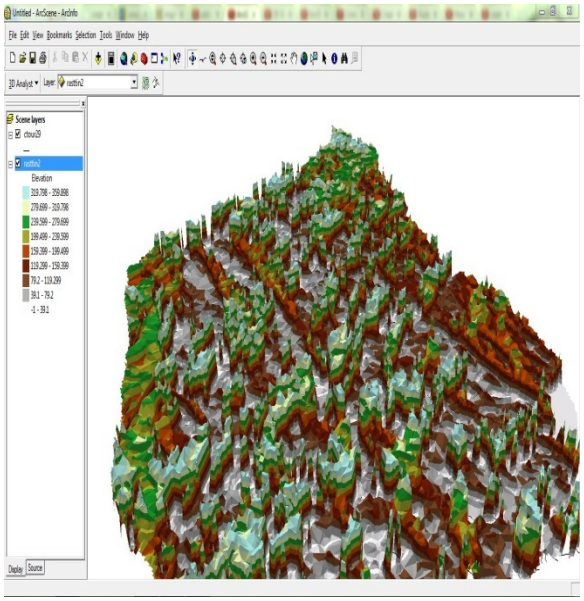


Fig: DEM Creation Of Kadana Catchment Area

VI. RESULT

From the study, the result of soil samples taken from Kadana nathi shows,it has low pH of 5-5.5 .Hence it is considered to be acid soils.The major drawback of acid soil is, it easily get eroded.And also the soil samples are classified as sandy loam soils,it has a major chance of getting erosion.

VII. CONCLUSION

Soil erosion is a major environmental problem. The present study has been undertaken to assess the soil erosion and its slope using remote sensing and GIS applications. For the study we selected Kadana nathi as a study area. The integrated map has been generated from the acquired datas.The study also shows the erosion assessment based on the soil samples.

From the study, I get knowledge about basic remote sensing and GIS .Also I learnt GIS softwares for interpretation and integration.It might be helpful for my future carriers too.Remote sensing and GIS is an excellent tools to study about any areas in the universe.

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