

EVALUATION OF WESTERN GHATS REGION USING REMOTE SENSING

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1.Introduction

Now a day the land resources planning needs large types of data and planning should be done in a shortest possible time. In the case of hilly and forest terrains it is impossible to use the normal surveying methods to arrive at a quick result. The dependence on Remote sensing data and the Geographic Information Systems Software is increasing day by day to have a realistic, reasonably correct plan document. In this paper the capacity of Remote sensing data and the Geographic Information software is demonstrated so that these facility can be availed by all users. The Arc View 3.2 software, Erdas Imagine 8.4 were used to analys the Indian Remote Sensing Satellite data to draw the land use map so that most of the land use information has been extracted to draw the land use map. Using the Silt Yield Index Methodology the soil erosion priority has been done for each micro watershed in the study area. The soil erosion prioritization has been done for each physiographic unit of the satellite data because it is possible to extract all land use information by the two soft wares used in this study. Let us now see the use of the software in land use planning and soil erosion estimation.

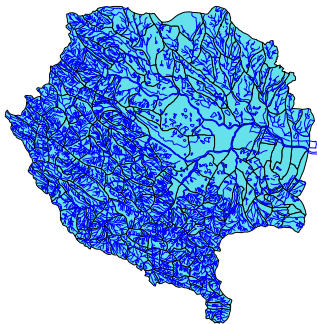
2.Study Area

The study area is Manimuttar watershed in the Western Ghats region of Tirunelveli district in Tamil Nadu State in India. The Manimuttar river originating in the watershed is one of the main tributary of Tambrabarani River in Tirunelveli District. The Manimuttar Reservoir located at foot hills collects the run off from the hills in the catchments and the water is used for irrigation purpose in Tirunelveli District. The catchment area in the hills also has the three small reservoirs which joins with Manimuttar . The hills are covered with the dense forest, which is also known as Kalakkadu - Mundanthurai Tiger Reserve. This region is also one of the finest natural rain forest area around equator which support variety of flora and fauna. The hill slopes of Manimuttar and Karayar have Tai shola tea estate and Coffee Plantations. The area and the use of lands for other non-forest purpose, induce soil erosion. The Manimuttar and other reservoirs are being affected by siltation.

3.Remote sensing data

As explained earlier we had no option but to use the Remote sensing satellite data to study the land use of this undulated forest terrain. The Indian Remote sensing satellite data of IRS 1C taken on December 1998 was used for this study. This is LISS III (Linar Image Self Scanning Sensor III) data of 23 m resolution in CD format.

Base map Fig 1: Drainage map (Shape file)



The base map was prepared using 1:50000 scale topographic sheets. The 20 m Contours, the drainage, Roads, Infrastructures, Forest boundary, Railway network etc were digitized from the topographic maps after importing the scanned Tiff image as imagine file in the Arc View 3.2 software. These file were kept as

Shape files. The watersheds have been delineated into micro watersheds. The attribute tables have been created for each shape file.



Fig 2. Micro Watershed Map. Shp file

4. Image Analysis

The Satellite data has been imported as binary data in Imagine Erdas software. The image analysis has been done for 25 Classes based on ground truth verification. After the supervised classification the resultant land use map was saved as Manimuttar.img file as detailed in fig 3.

5. Importing the Imagine file in Arc View

The Manimuttar.img file has been opened as a layer in Arc View software using the Command Add theme in the layer menu of Arc view software. The layer has the attribute table of Erdas imagine as it's Attribute table in Arc View Software too. The Manimuttar.img file is now converted as shape file using the convert shape file in the Theme Command in the menu bar.

Now the Manimuttar.shp file appears in the menu bar which can be seen by clicking it. This shape file has defined polygons of 25 classes identified in the imagine software. The class names and other details as in Imagine software appears in the Attribute file of the Arc View software. This is the main advantage of importing the img file as shape file.

The Land use map of the Arc View Manimuttar .shp file is given in Fig 2.

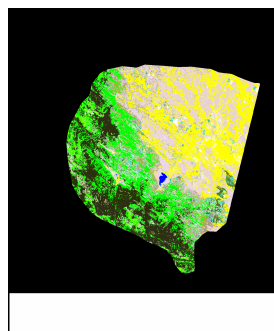


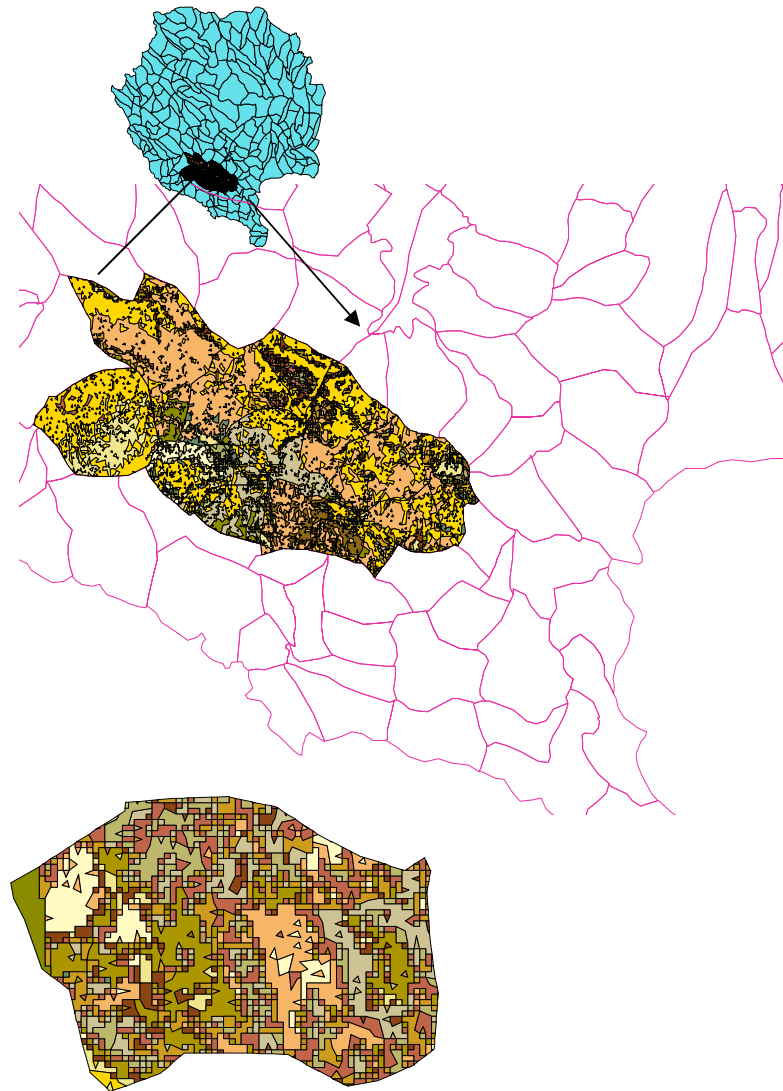
Fig 3. IRS IC Supervised Classified image of Manimuttar Area .(img .file)

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As the maps are so large it is difficult to explain the methodology from the total watershed map. Hence the land use map of one micro watershed as img file and shp file are given in Fig 3 and Fig 4.

The Attribute table of the micro watershed is given in Fig 5

Fig .4 The location map and Sub Watershed Land Use Map from IRS Data in Shape File



Land use map of 4A1B3b3c2b2 Micro Watershed shp.file

With these Attribute tables and land use maps we can take full advantage of the calculator module in the GIS software to work out the area of land class and also arriving at Soil erosion priority. For working out the soil erosion priority we use the All India Soil and Land Use Survey Organization's Silt yield equation. The equation is as follows

$$\text{Silt Yield Index} = \frac{\sum A_1 \times W_1 \times D_1}{\sum A_1}$$

Where A1= Area of Physiographic Units in ha

W1= Weightage of the physiographic unit with respect to land class , soil and slope

D1= Delivery ratio with respect to drainage pattern, distance of the physiographic unit to drainage pattern, slope.
 The Weightage and the Delivery Ratio for each type of physiographic unit is drawn by All India Soil and land use rganization.

The Silt Yield Index is a dimensionless number.

Soil Erosion priority is based on the values of silt yield index as detailed below.

Less than 1000	Very Low
1000 - 1099	Low
1100 - 1199	Medium
1200 - 1249	High
1250 and above	Very High

6.Application of Silt Yield Index values in Attribute tables

The facility of calculator and adding the columns to Attribute table editor is used to work out the Silt Yield Index. The five columns viz Delivery Ratio of the Physiographic Unit , The Weightage of the Physiographic Unit , The Result of $A1 \times W1 \times D1$, are added to the existing attribute table of manimuttar shape file as shown in Fig 6.

7.Attribute table of sub watershed

The sum of A1 and Sum of $A1 \times W1 \times D1$ are given in Column 4 and Column5. The Result of dividing Column Sum of $A1 \times W1 \times D1$ and Sum of A1 are given in Columns 6 which is the Silt Yield Index of the watershed. Now based on silt yield index values the manimuttar.shp file can be classified into five classes as detailed above. This Soil Erosion Priority is worked out for this micro watershed.

ID	GRIDCODE	CLASS_NAME	HISTOGRAM	OPACITY	AREA	W	D	$A \times W \times D$
60446		4 Class 1	7191.00	1.00	0.0000000335	14.00	80.00	0.00003752
60447		1 Class 1	7191.00	1.00	0.0000004624	14.00	80.00	0.000517888
60623		4 Class 1 Tea	8425.00	1.00	0.0000000421	13.00	75.00	4.10475E-05
60624		16 Class 1 Tea	8425.00	1.00	0.0000001067	13.00	75.00	0.000104033
60625		3 Class 1 Tea	8425.00	1.00	0.0000000009	13.00	75.00	8.775E-07
60626		4 Class 1 Tea	8425.00	1.00	0.0000001376	13.00	75.00	0.00013416
60627		1 Class 1 Tea	8425.00	1.00	0.0000002618	13.00	75.00	0.000255255
60628		14 Class 1 Tea	8425.00	1.00	0.0000000001	13.00	75.00	9.75E-08
60629		4 Class 1 Tea	8425.00	1.00	0.0000001047	13.00	75.00	0.000102083
60630		3 Class 1 Tea	8425.00	1.00	0.0000006472	13.00	75.00	0.00063102
60631		1 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
60632		4 Class 1 Tea	8425.00	1.00	0.0000001047	13.00	75.00	0.000102083
60633		1 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
60809		14 Class 1 Tea	8425.00	1.00	0.0000001571	13.00	75.00	0.000153173
60810		1 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
60811		14 Class 1 Tea	8425.00	1.00	0.0000001571	13.00	75.00	0.000153173
60966		16 Class 1 Tea	8425.00	1.00	0.0000010747	13.00	75.00	0.001047833
60967		4 Class 1 Tea	8425.00	1.00	0.0000001047	13.00	75.00	0.000102083
60968		14 Class 1 Tea	8425.00	1.00	0.0000003232	13.00	75.00	0.00031512
60969		1 Class 1 Tea	8425.00	1.00	0.0000001047	13.00	75.00	0.000102083
60970		16 Class 1 Tea	8425.00	1.00	0.0000000167	13.00	75.00	1.62825E-05
60971		4 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
60972		3 Class 1 Tea	8425.00	1.00	0.0000001047	13.00	75.00	0.000102083
60973		3 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109

60974	9 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
60975	4 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
60976	16 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
61130	16 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
61131	14 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
61132	16 Class 1 Tea	8425.00	1.00	0.0000001571	13.00	75.00	0.000153173
61133	4 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
61134	4 Class 1 Tea	8425.00	1.00	0.0000001514	13.00	75.00	0.000147615
61135	14 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109
61136	9 Class 1 Tea	8425.00	1.00	0.0000000524	13.00	75.00	0.00005109

Table continues in 27 pages .The above is the first page of the table

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68893	1 tea estate	119024.00	1.00	0.0000001047	13.00	70.00	0.000095277
68895	9 tea estate	119024.00	1.00	0.0000003665	13.00	70.00	0.000333515
68896	3 tea estate	119024.00	1.00	0.0000000524	13.00	70.00	0.000047684
68897	14 tea estate	119024.00	1.00	0.0000001813	13.00	70.00	0.000164983
68898	1 tea estate	119024.00	1.00	0.0000000524	13.00	70.00	0.000047684
68899	3 tea estate	119024.00	1.00	0.0000000524	13.00	70.00	0.000047684
68900	14 tea estate	119024.00	1.00	0.0000000308	13.00	70.00	0.000028028
68901	3 tea estate	119024.00	1.00	0.0000001047	13.00	70.00	0.000095277
68902	4 tea estate	119024.00	1.00	0.0000000013	13.00	70.00	0.000001183
68903	1 tea estate	119024.00	1.00	0.0000001047	13.00	70.00	0.000095277
69042	16 tea estate	119024.00	1.00	0.0000000524	13.00	70.00	0.000047684
69043	7 tea estate	119024.00	1.00	0.0000001174	13.00	70.00	0.000106834
69053	3 tea estate	119024.00	1.00	0.0000005084	13.00	70.00	0.000462644
69054	3 tea estate	119024.00	1.00	0.0000000524	13.00	70.00	0.000047684
69055	14 tea estate	119024.00	1.00	0.0000000524	13.00	70.00	0.000047684
69195	8 tea estate	119024.00	1.00	0.0000004077	13.00	70.00	0.000371007
69207	1 tea estate	119024.00	1.00	0.0000000452	13.00	70.00	0.000041132
69537	8 tea estate	119024.00	1.00	0.0000002310	13.00	70.00	0.00021021
69544	16 tea estate	119024.00	1.00	0.0000000524	13.00	70.00	0.000047684
69548	14 tea estate	119024.00	1.00	0.0000006647	13.00	70.00	0.000604877
69837	6 tea estate	119024.00	1.00	0.0000000524	13.00	70.00	0.000047684
70333	9 tea estate	119024.00	1.00	0.0000001721	13.00	70.00	0.000156611
70333	9 tea estate	119024.00	1.00	0.0000001142	13.00	70.00	0.000103922
				0.0001449832			0.1540470410
							1062.5164915659

The Silt Yield Index is 1062. This Micro Watershed is in low priority. Similarly Silt Yield Priority of each micro watershed can be worked out by using the softwares.

8.Result

By application of the GIS and Image Analysis software like Arc View and Erdas Imagine softwares it is possible to extract the land use of the each class from satellite data accurately. It is also possible to estimate the Soil erosion using the capability of the calculator, table editor modules of Arc View attribute table editor . Because of using the GIS and Image analysis software it is possible to have an accurate estimation as on the date of satellite pass. The run off and other hydrological data can also be worked out using the attribute table editor facility available in the GIS and Image analysis softwares. These facilities enable the land use planner to have latest information and maps on the current land use condition for Manimuttar watershed of Western Ghats Development Programme region in TamilNadu state of India in a shortest possible time.