FOREST COVER AND LAND USE MAPPING OF A REGION OF BARAK VALLEY OF ASSAM, INDIA USING IRS LISS-II IMAGERY.

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ABSTRACT

The Barak Valley of Assam alongwith the hills around are endowed with rich and diverse vegetation resources. Deforestation and raw materials extraction for industrial purposes are heavily altering the forested landscape. The present study deals with mapping of forest cover and land use in the region covered by imagery 15-50 (B2 segment) having scene centre 24°47'20" North Latitude and 92°55'22"East Longitude of Indian Remote Sensing (IRS) Satellite Linear Imaging Self-scanning Sensor (LISS) II sensor. The study was undertaken by placing the imageries (bands 2,3,4 and F.C.C) on light table using a hand magnifying lens. The elements of visual interpretation elements like tone, texture etc. are used as keys. The map thus delineated shows the spatial distribution of bio-climatic vegetation concentration and the land use patterns.

KEY WORDS : IRS-imagery, visual interpretation, mapping, land use, forest cover.

INTRODUCTION

Mapping and monitoring of land cover is one of the foremost requirement for planning, management and conservation of land and forest. Remote Sensing plays a vital role in mapping the existing resource information at particular period of time. Detailed forest cover type and land use mapping have been successfully done in various parts of country and abroad using aerial photointerpretation techniques (Report Forest Survey of India and National Remote Sensing Agency,India) Mapping of forest cover and land use have also been done using satellite imageries viz. LANDSAT Multispectral Scanner (MSS) False Colour Composite (FCCs') (Gupta,D. M. et al, 1983), Thematic Mapper FCCs' (Ghosh, R et al, 1990). Lots of work is also reported relating to land cover classification using LANDSAT Thematic Mapper data through digital classification techniques (Mikihiro, et al, 1986). However, in the present study authors have attempted to map land cover including forest using Indian Remote Sensing (IRS) satellite Linear Imaging Self-scanning (LISS)II data using visual interpretation techniques.

STUDY AREA

The study area lies approximately between 24°30' to 25°15' North Latitude and 92°30' to 93°15' East Longitude covering an area of about 25,000 square kilometers The location of the area is most pronounced by presence of the Barak River, which traverses through the middle of the scene. Physiographically, the Barak River Valley, having very gentle slope of average height 20 metersabove mean sea level lies in the middle of the scene surrounded by successive ranges of hills on three sides. The heights of above hills varies upto 1500 meters and endowed with rich forest cover mainly bamboo. The hill ranges mainly comprise relatively compact and resistant older rock units exposed in the anti-clinal crests, whereas the valleys are composed of younger and softer formation exposed in the synclinal trough. The geology consists of alternate Surma and Tipam series of rocks with bedding plane along the North-South direction. The Barak Valley is usually characterised by exposures of younger rock formation of alluvium folded into narrow box like anclines separated by wide flat synclines. The other rocks present in the scene are (i) Dihing and Dupitila series, (ii) Barail series, (iii) Jaintia and Dishang series. There are numbers of tributaries on both sides of the river Barak. The individual rivers and streams are of anastomatic pattern and the overall drainage pattern of the scene is dendritic pattern.

MATERIAL USED

For the present study, Indian Remote Sensing (IRS) satellite Linear Imaging Self-scanning sensor (LISS)II imageries (scene number 15-50, B2 segment) of scale

1:1 million were used in conjunction with the topographical map of scale 1:50,000 prepared by Survey of India (SOI). The imageries used were panchromatic black and white Band 2 (0.52-0.59 μm), Band 3 (0.62-0.68 μm), Band 4 (0.77-0.86 μm) and False Colour Composite (Band 2,3,4) having scene centre 24°47'20"North Latitude and 92°55'22"East Longitude. The date of acquisition of the imageries was 8 November, 1989 at 09 hr- 49 min- 16 sec. The details of topographic sheets used for the purpose are given in Table 1. The imageries and FCC were studied by placing them on light tracing table and viewing through a hand magnifying (X4) lens.

METHODOLOGY

The primary objective of the study was to delineate the land use and forest cover of the study area on the basis of the data available from the topographical maps and remotely sensed data of the area. The ground truth for analysis of IRS imageries was essentially derived from topographical maps on the basis of 'Convergence of Evidence' principle. The broad methodology adopted for the study is outlined as below:

1. Collation of data of the study area in the form of maps and IRS imageries.
2. Analysis of the available topographical maps (a portion of the whole scene) and development of forest cover and land use maps in the scale of 1:50,000 on the basis of the same.
3. Analysis of the imageries of the study area in relation to the 1:50,000 maps and development of interpretation keys for the land use and forest cover classes adopted for the study area.
4. Analysis of the whole scene on the basis of the above data.
5. Cartographic presentation of the analysed land use data.

INTERPRETATION

The assessment of the imagery and its interpretation involved the comparison of spectral response of each type of imagery with the respective areas of land use which were easily identified from collateral materials. The key characteristics are listed in Table 2. Imageries used for visual interpretation are thus divided into three broad class I categories. The level I categories are divided into a number of level II classes using the interpretation elements tone, texture, colour, size, association and patterns. These interpretation keys are designed to facilitate the rapid and accurate identification of features as imaged in IRS imageries. It is also used as a record to correct interpretation of land use in less obvious areas.

OBSERVATION

The land cover of the scene is classified into three broad level I classes as water bodies, forest cover and built up areas. Water bodies are divided into level II classes as : river, stream, lake, dry river. The forest cover is divided into three level II classes : dense forest, medium forest and tea garden. Lastly, the built-up areas are divided into habitat, paddy field, tea garden, road and railway. The following observations were made on different classes and subclasses.

Water bodies

Water bodies are very prominant in band 4 and FCC imageries. The delineation of river and stream of high order can be done most easily from band 4 due to the distinct dark black tone and pattern. However, in some cases especially near heavily built-up areas the FCC coupled with Band 3 imageries helped in exact delineation of the feature. In some cases band 2 imagery supplemented the delineation. However, lakes are best delineated from FCC due to the distinct colour with respect to adjoining features. The intensity of tone and colour found to be depended on the depth of water. The larger the depth the greater is the intensity. In case of perfectly dry river/stream or meanderings, the intensity of tone is very low distinguishing it from adjoining water bodies.

Forest cover

The forest cover of the scene could readily be distinguished and tentative delineation could be done easily from FCC

TABLE 1. Details of Topographic Sheets (prepared by SOI) Used.

Sl.No.	Map Sheet No.	Scale	Centre Coordinates North	Centre Coordinates East	Year of survey	Edition and year
1	83 D 9	1:50,000	24°52'30"	92°37'30"	1972-73	1st/1977
2	83 D 10	1:50,000	24°37'30"	92°37'30"	1972-73	1st/1975
3	83 H 1	1:50,000	24°52'30"	93°7'30"	1971-72	1st/1974
4	83 H 4	1:50,000	25°07'30"	93°07'30"	1971-72	1st/1974

TABLE 2. Interpretation Keys for Land Use and Forestry.

2.1 For Level I Classes.

Class	Tone				Texture	Remarks
	Band 2	Band 3	Band 4	FCC		
Water bodies	Light black to white	Dark to medium black	Dark to medium black	Very dark to light bluish black	Smooth	Linear or patch in shape
Forest cover	Medium to dark black	Light white to light black	Light black to white	Light red to dark brick red	Smooth to rough	Roughness appears to be spotted
Built up areas	Light medium black	Dark to light black	Medium to light black	Bluish black with light red	Very rough	Associated with water bodies

2.2 For Level II Classes.

2.2.1 Water bodies.

Class	Tone				Remarks
	Band 2	Band 3	Band 4	FCC	
River	Light black	Dark black	Dark black	Dark bluish black	Linear in shape. Anastomatic pattern.
Dry river stream	White	Medium black	Medium black	Light bluish black	Associated with river/ stream.
Stream	Light black	Dark black	Dark black	Medium bluish black	Linear in shape. Anastomatic pattern.
Lake	White to light black	Dark to medium black	Dark to medium black	Dark to light blue	Irregular patch shape. Associated with built-up areas.

2.2.2 Forest cover.

Class	Tone				Remarks
	Band 2	Band 3	Band 4	FCC	
Dense jungle	Dark black	Light white	White	Dark brick red	Associated with shadow.
Medium jungle	Medium black	Light black	Light black	Medium brick red	Shadow leads to some misclassification.
Tea garden	Medium black	Light black	Light white	Pinkish red	Appears at the edge of forest.

2.2.3 Built-up areas:

Class	Tone				Remarks
	Band 2	Band 3	Band 4	FCC	
Habitat	Light medium black	Medium to dark black	Light to medium black	Light bluish black	Associated with linear features.
Paddy field	Light black	Light black	Light white	Reddish pink	Associated with water bodies and/or habitat.
Road/ Railway	Light white	Medium black	Light black	Light white	Linear shape.

by its distinguishing colour. The exact delineation can better be done with the help of band 2 imagery due to the distinct separable tone. The intensity of tone/ colour depends on the intensity of vegetation concentration. Thus, depending on the intensity of tone/colour, the density of forest cover was classified into dense and medium types. The lighter tone indicates the presence of other vegetation like tea gardens etc. The tea-gardens are mostly associated with forest and are found at the edge of forest cover.

Built-up areas

This is clearly distinguishable in FCC by its specific colour and texture. Band2

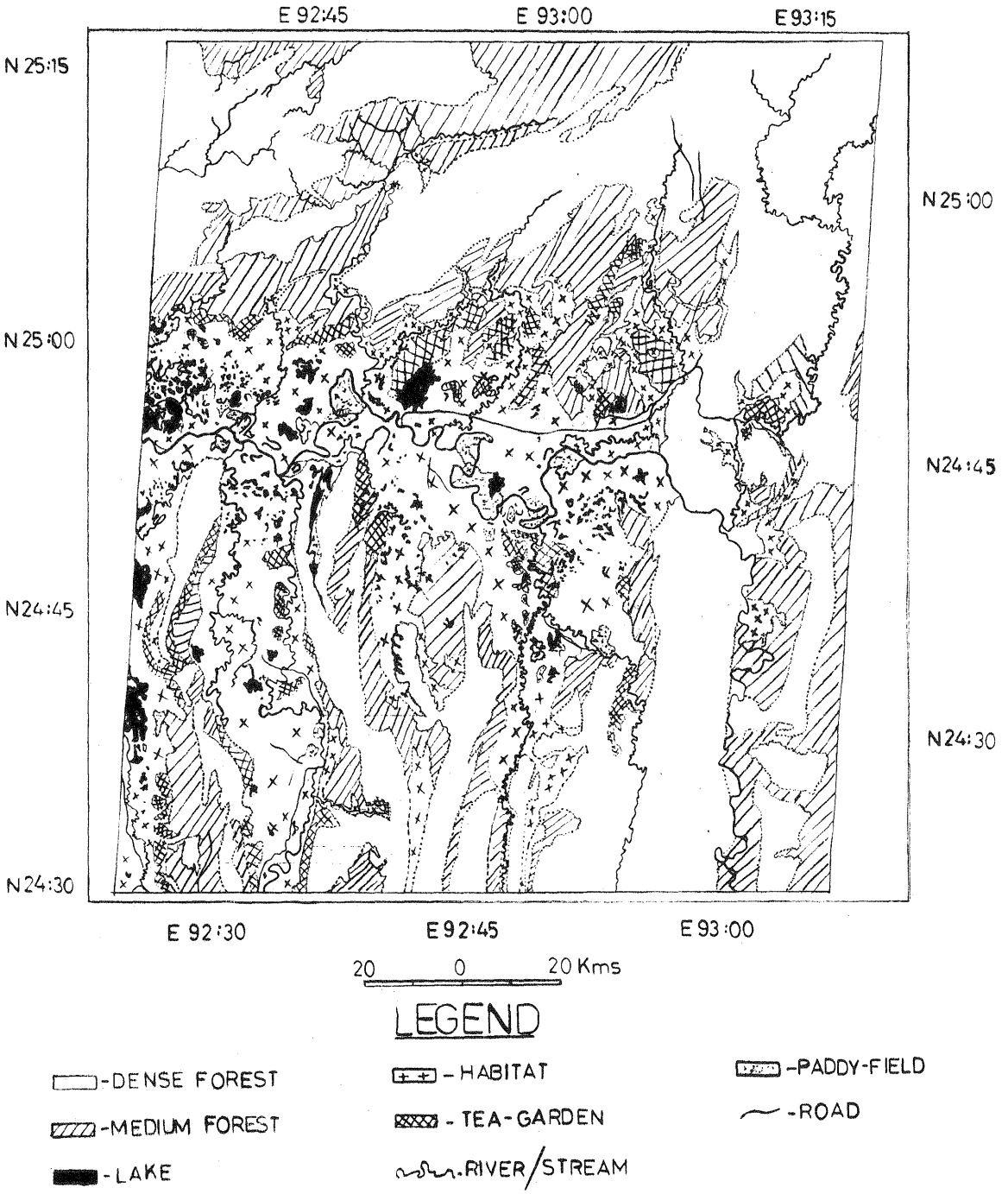

Fig.1. Forest Cover and Land-use map from IRS (15-50, B2 segment) Imagery.

imagery also supplements the level II data by specific tone and association. Built-up areas where concentration is less, are found to be having reddish pink background due to its association with vegetation. The habitats are easily distinguishable in FCC by the particular colour and rough texture. Also, habitats are found to be associated with river/stream or other linear features presumed to be roads and/or railways. The roads and railways are mostly distinguishable in Band 2 imagery. Though, tea-gardens are found at the edge of forest, they are found near habitats in some places.

RESULT AND DISCUSSION

The land cover classes which could be identified and mapped are shown in fig 1. In preparing the map, we referred to the topographical sheets (Table 1) as needed. But there is a time lapse of about 18 years between the survey conducted for topographical sheet and the date of acquisition of the imagery, 1989 which might result to some misclassification. But due care and attention was given on this point all throughout during the preparation of map from imagery. Again, due to very low scale (1:1 million) of the imagery, delineation was not that perfect as could be achieved by use of imagery of higher scale. Also, the higher level of discrimination of features could not be done due to this reason. The forest cover could only be classified into dense and medium types, not the tree species. It is observed that density of vegetation is largely controlled by altitude. Although altitude details have been taken from topographical maps, this aspect can be solved by classifying vegetation using digital satellite data overlayed with Digital Terrain Modelling (Andrew, 1989).

CONCLUSION

The IRS imageries can be used effectively for mapping different land cover types to be used for macro level planning, management and conservation. The False Colour Composite synthesised by combining bands 2,3,4 provides an added advantage in carrying out this work. However, multi-date multi-seasonal imageries of higher scale would make this a very important tool for quick mapping and updating the land cover of vast area.

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REFERENCES

o Andrew K. Skidmore, 1989. An expert system classifies eucalyptus forest types using Thematic Mapper data and a digital terrain model, Photogrammetric Engineering and Remote Sensing, Vol.55(10) Oct 1989 (pp 1449-1464).

o Bowden L.W and Pruitt E.L, 1983 Editor. Manual of Remote Sensing. American Society of Photogrammetry. Falls Church, Virginia Vol.2 (pp 882-891).

o Ghosh, Rekha and Ghosh, Dipen N, 1990. Land use Map of Jharia Coal-field Eastern India Aided by Remote Sensing. Journal of Indian Society of Remote Sensing, Vol.18, No.1 and 2 (pp 23-28).

o Gupta, D.M. Bgd and Munshi, M.K, 1983. Land use and Forestry studies of Himachal Pradesh. National Natural Resources Management, National Seminar proceeding, Hyderabad.

o Mikihiro, Ioke and Masatd Koda, 1986. Performance of Landsat-5 Thematic Mapper data in Land cover classification. International Journal of Remote Sensing, Vol.7, No.12 (pp 1715-1728).

o Pant, D.N. and Roy, P.S. 1990, Vegetation and Land use Analysis of Aglar Watershed using satellite Remote Sensing Technique Journal of the Indian Society of Remote Sensing. Vol.18, No.4.

o Welch, R, H.C. Lo and C.W. Pannel, 1979. Mapping China's New Agricultural Lands. Photogrammetric Engineering and Remote Sensing, Vol.XLIV, No.9.