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Application of Remote Sensing and Geographic Information System Techniques in the Analysis of the Decadal Change Variation in the Forest Cover in and Around Sagang Village Under Bishnupur District, North East, India

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Abstract: The main task of this study is to detect the forest cover changes to find out the tree diversity in and around Sagang village of Bishnupur district, North East India (area, 260.90 ha.) during three decades (1988 - 2008) using Normalized Difference Vegetation Index (NDVI). For the study of tree diversity index the Shannon-Wiener information function (H') was used and twenty six quadrat size of $31.62 \times 31.62 \text{ m}^2$ were sampled. From each quadrat fifty-six tree sample species were collected as well as identified. The value shows that the study site has high species diversity.

Keywords: Forest cover, NDVI, diversity index, Shannon-wiener information function, species diversity

I. Introduction

Forest may be defined as “land spanning more than 0.5 hectares with trees higher than 5 metres and a canopy cover of more than 10 percent, or trees able to reach these thresholds in situ”. It does not include land that is predominantly under agricultural or urban land use. It is determined both by the presence of trees and the absence of other predominant land uses (FRA-2010). According to Forest and Agricultural Organization (FAO-2005), forest may be defined as land with a tree canopy density of 10 percent and area of more than 0.5 hectare. Forest Type may be defined as “a unit of vegetation which possesses broad characteristics in physiognomy and structure sufficiently pronounced to permit of its differentiation from other such units” (Champion and Seth, 1968). The forest cover may be defined as all lands more than 1 ha in area having tree canopy density of 10 percent and above (SFR-1988-2011).

In the present analysis the land cover classification was mainly done by NDVI and calculation of tree species diversity by using Shannon-Wiener information function (H'). The NDVI is a measurement of the balance between energy received and energy emitted by objects on Earth. When applied to plant communities, this index establishes a value for how green the area is, that is, the quantity of vegetation present in a given area and its state of health or vigour of growth. The NDVI is a dimensionless index, so its values range from -1 to $+1$. In a practical sense, the values that are below 0.1 correspond to bodies of water and bare ground, while higher values are indicators of high photosynthetic activity linked to scrub land, temperate forest, rain forest and agricultural activity (www.fao.org, NDVI as indicator of degradation - FAO). More specifically, the specific objectives were i) To assess the forest in and around the study site using remote sensing and GIS technique, ii) To generate a composite map, iii) To find out the species diversity using quadrat method.

II. Study site

The study area is located in the Bishnupur district of Manipur and Southern Forest division of Churachandpur district Manipur under the control of Sagang range under the Khuga subwatershed. It has an area of 260.90 hectare (ha) having the latitude of 24.36°N to 24.41°N and the longitude of 93.8°E to 93.83°E . It is 58.8 km from

proper Imphal, the capital of Manipur. It covers the hill near the Terakhong village, hills of Sagang village, hills of Lukhumbi and nearby hills and hills of Lulambung. The altitude varies from 780 mean sea level (msl) upto 900 msl (SOI toposheet and working plan of Bishnupur and Churachandpur 2010-11 to 2019-20).

III. Materials and Methods

A. Literature Survey

Existing baseline data are collected from various departments of Manipur Government mainly from Manipur Forest Department, Loktak Development Authority, Manipur Remote Sensing Application Centre and University itself. Collected data were analysed statistically.

B. Field Survey

The study was visited on seasonally during 2008 to 2012. Informations were collected from the local people. Some plants and twigs were collected from the study sites for identification. The identification is done in the Botany Lab of Life Sciences Department, Manipur University.

C. Measurement of tree diversity

The tree diversity measurement was done after the classification using NDVI. Depending on the topography and altitude the study site was divided roughly into twenty-six parts. Each part was sampled using 31.62x 31.62 m² i.e. 0.1 ha randomly laid quadrats. From each quadrat fifty-six tree sample species were collected as well as identified. The analysis was conducted during August and September. Then the quadrat data were used for computation of analytical features such as Density (D), Relative Density (RD), Frequency (F), Relative Frequency (RF), Relative Dominance (R Dom), basal area, basal cover and importance value index (IVI), etc. following standard phytosociological methods as given by Curtis & McIntosh (1950). Diameter at breast height (dbh at 1.37 m from the ground) of all the trees with greater than 30 cm circumference in each quadrat was measured and recorded for each species. The importance value index (IVI) for the tree species was determined as the sum of the relative density, relative frequency and relative dominance (Curtis 1959). The tree species diversity was determined by using Shannon-Wiener information function (H') (Shannon & Wiener 1963) and further analysis is going on.

D. Material Used

The materials that used in this analysis are given below

i) Instruments: Theodolite for quadrat, 4 red handkerchiefs, knife, etc.

ii) Data: In this analysis of different types of land cover the hard copy of Survey of India toposheet, 83 H/15 refers as scale, 1:50,000, first edition and the Satellite data of 1988, 1998 and 2008.

E. Data Preparation

The data preparation comprises of the following functions like, geometric correction, reprojection to reproject or transform raster image data from one map projection to another, mosaicking images to join georeferenced images together to form a larger image or a set of images, Image enhancement, subsetting images to copy a selected portion of an input data file into an output data file, etc. will be performed in this dialog. Before the actual Digital Image Processing (DIP) the satellite data will be preprocessed using the ERDAS Imagine software, 8.5 version. In this step all the satellite data will be checked for errors using appropriate techniques available with the DIP software.

In the present study the satellite data are imported then geometric corrections using Ground Control Points will be adopted to rectify the images with the help of already rectified data. Geometric correction includes the correction for geometric distortion due to sensor-earth geometric variations and conversion of the data to real world co-ordinates, eg. longitude and latitude on the earth surface. In this analysis it is carried out with the help

of Survey of India (SOI) top sheets extent 83H/15, of 1970-74 at 1:50000 scale using UTM, Zone 46 projections, Datum and Spheroid WGS 84.

F. Image Enhancement

This is done by using simple brightness & contrast tool to adjust the brightness and contrast of the currently displayed image, break point editor to rescale the histograms and lookup table graphs for red, green and blue colours, band rationing, etc. to enhance the colour of the imagery. Though many enhancement techniques are available in the enhancement functions the spectral enhancement is mainly used for this study to access functions for enhancing images by transforming the values of each pixel on a multiband basis. The input data i.e.1998 and 2008 are multispectral (IRS-1C/1D/P6-LISS III) so noise, haze, etc. are removed by the satellite itself but in case of 1988 data as the sensor is LANDSAT there will be some noise, haze or unwanted scenes on the satellite data. Hence some removal techniques are going on in this case of 1988 satellite data.

G. Mosaic Images

After the enhancement mosaiking is done to join together to form a larger image or a set of images.

H. Study Area Extraction

This function is done by Subset images. This dialog enables to copy a selected area using area of interest (AOI) in the image. After Subsetting the satellite data to be used will be again enhanced.

I. Resized

The pixel of the study site: The extracted data are then resized that can be found out the decadal changes of the three decades.

J. Indices

The analysis of forest cover of Bishnupur district is carried out by using remote sensing data and GIS techniques especially NDVI, the Normalised Difference Vegetation Index. Normalized difference vegetation index (NDVI) transformation is normally used for density classification of the forest covered or green vegetation covered. It may be defined by the following formula, $NDVI = \frac{\text{Infrared} - \text{Red}}{\text{Infrared} + \text{Red}}$

The values of NDVI ranges from -1 to 1. If the value of NDVI is nearer to the positive value there will be good vegetation and if the value of NDVI of each pixel is nearer to the negative value there will be no vegetation i.e. it may be water, snow, ice barren land, etc. Likewise, the colour of most of the pixels of NDVI is also different from each other. Darker the pixel colour, lesser amount of vegetation likewise lighter the pixel colour, higher the vegetation cover. That means the light grey colour of pixel or nearer to the positive value of pixel i.e.1 will have good vegetation. NDVI of each satellite imagery are produced using ERDAS IMAGINE. The result of this process might be a triplicate set of 8 bit i.e. 0-255 classes of pixel representing the amount of vegetation, and conversely, dark areas show regions of low vegetation.

K. Image Classification

It is used to digitally identify and classify pixel in the data classification usually performed on multi channel data set and this process assigned each pixel in an image to a particular class or theme. Then the classified imageries are transformed to vector and then rescale to signed 8 bit images. Finalisation of classification is done using MapInfo software version 11. Interpretation of remote sensing imagery involves the identification and measurement of various targets in an image in order to extract useful information about them. Target in remote sensing may be distinguishable and contrast with other feature around it in the image.

L. Ground Truth Corrections

Once the data are digitized the doubtful classes or areas in the database are verified on ground for interpretation.

M. Data integration

It involves the combination or merger of data from multiple sources in an effort to extract better and more information. The data may be multi-temporal, multisolution, or multidata type in nature. In the present study, multi-temporal satellite data with different sensors (i.e. LANDSAT TM, IRS LISS III) are expected to be used to assess, evaluate and monitor the various forest cover of the study area.

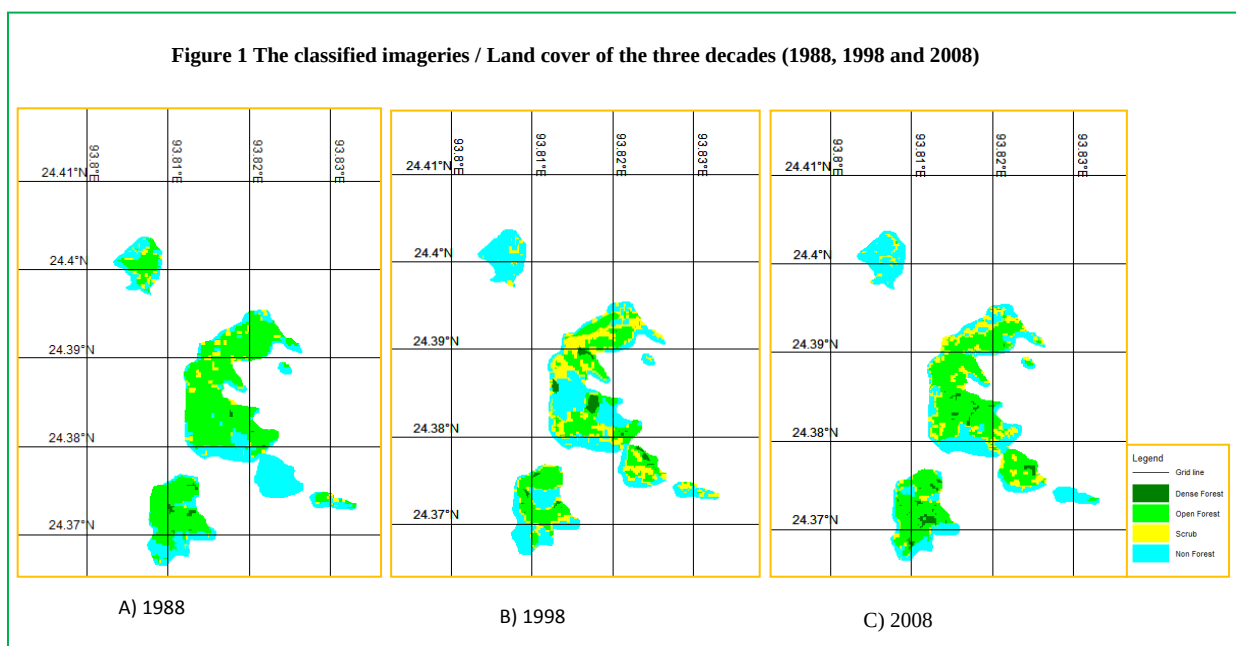
N. GIS-Data creation

The present study envisages creating a good GIS land cover type especially forest and other associate information database using the ERDAS IMAGINE, ARCGIS, MapInfo software.

Table 1: Decadal Change During 1988 to 1998 and 1988 to 2008		
Landuse change	Year(Area in ha)	
	1988-1998	1998-2008
Dense Forest (No Change)	0.77	1.38
Open Forest (No Change)	73.90	60.85
Scrub (No Change)	3.37	9.96
Non Forest (No Change)	42.34	51.64
Dense Forest to Open Forest	1.57	6.66
Dense Forest to Scrub	0.29	0.80
Dense Forest to Non Forest	1.05	0.78
Open Forest to Dense Forest	6.96	6.73
Open Forest to Scrub	37.52	12.20
Open Forest to Non Forest	53.51	12.94
Scrub to Dense Forest	0.25	0.66
Scrub to Open Forest	2.76	31.26
Scrub to Non Forest	5.78	14.01
Non Forest to Dense Forest	1.63	2.18
Non Forest to Open Forest	14.48	36.68
Non Forest to Scrub	14.71	12.18

IV. Results and Discussion

In present study the image analysis was started from the year 1988 to 2008. The classification of the study site was divided into four classes, viz. Dense Forest, Open Forest, Scrub, and Nonforest. There was no Very Dense Forest in this study site in the image analysis as well as in the ground verification during the months, August and September. During three decades i.e. 1988, 1998 and 2008, the dense forest is increased by 3.7 ha to 10.94ha, the open forest is decreased by 171.9ha to 135.45 ha whereas the scrub and the non forest are increased by 12.15ha to 35.14 ha and 73.16 ha to 79.37ha respectively (Figure 1). The decadal change during 1988-1998 and 1998-2008 of the present analysis was shown in table 1.



In the further field investigation some trees are collected to find out the Tree Species diversity index using the randomly laid quadrat size of 31.62 X 31.62 m². The site collection shows three types of land cover i.e., Dense, Open and Scrub. Altogether, 26 sites/ plots, table 4 belonging to scrub (10), open (9) and dense (7) as well as fifty six trees were also recorded (table 5). The study sites shows a high species diversity of $H' = 3.834230192$. The most abundant species are the *Quercus serrata*, *Quercus dealbata*, *Castanopsis hystrix*, *Chukrassia tabularis*, *Wedelia pendula*, *Microcos elengi* and *Emblia officinalis* species. The Open forests are dominated by *Quercus serrata*, *Quercus dealbata* species, and are much less diverse. The Dense forest had a greater species richness followed by open and scrub. The reasons for these differences could be as follows: anthropogenic activities, landscape and sunlight exposure. Further analysis is going on.

V. Conclusion

Nowadays, the forest management activities are expanding, so that looking at forest cover changes of in and around Sagang village of Bishnupur district, North East India will be extremely useful for management purposes. From the above analysis it is found that during three decades i.e.1988, 1998 and 2008, the dense forest is increased by 3.7 ha to 10.94ha, the open forest is decreased by 171.9ha to 135.45 ha whereas the scrub and the non forest is increased by 12.15ha to 35.14 ha and 73.16 ha to 79.37ha respectively. It can be concluded that except the open forest the rest of the classes are increased. It could be the plantation and maintenance of trees by villagers and Manipur forest Department. The Survey site collection shows three types of land cover scrub, open and dense. Altogether, 26 sites belonging to scrub (10), open (9) and dense (7) were recorded from the study sites. The study sites shows a high species diversity of $H' = 3.834230192$. The most abundant species were the *Quercus serrata*, *Quercus dealbata*, *Castanopsis hystrix*, *Chukrassia tabularis*, *Wedelia pendula*, *Microcos elengi* and *Emblia officinalis* species. The Open forests were dominated by *Quercus serrata*, *Quercus dealbata* species, and was much less diverse. The Dense forest had a greater species richness followed by open and scrub. The reasons for these differences could be as follows: anthropogenic activities, landscape and sunlight exposure. Further study is going on.

References

- [1] Champion, H.G. & S.K. Seth. 1968."A Revised Survey of the Forest Type of India". Govt. of India Publications, New Delhi.
- [2] Curtis, J.T. & R.P. McIntosh. 1950. "The interrelations of certain analytic and synthetic phytosociological characters". Ecology 31: 434-455.
- [3] Curtis, J.T. 1959." The Vegetation of Wisconsin, An Ordination of Plant Communities". University Wisconsin Press, Madison. Wisconsin.
- [4] Forest Survey of India, "The State of forest reports (1988-2011)". Ministry of Environment and Forests, Government of India: New Delhi.
- [5] Food and Agriculture Organisation (FAO)-2005.Shannon, C.E. & W. Wiener. 1963." The Mathematical Theory of Communication". University of Illinois Press, Urbana.
- [6] Survey of India toposheet 1970-1974.
- [7] "The Global Forest Resources Assessments (FRA)"-2010.
- [8] www.fao.org/docrep/015/i2560e/i2560e07.pdf,"NDVI as indicator of degradation - FAO".
- [9] "Working plan of Bishnupur, Central and Thoubal Forest Divisions", Manipur. (2010-11 to 2019-20).
- [10] "Working plan of Suthern Forets Division Churachandpur District, Manipur".(2010-11 to 2019-20).

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