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APPRAISAL OF LAND USE CHANGE USING REMOTE SENSING TECHNIQUE

AGRICULTURAL SCIENCE

KEYWORDS : Altitude, Land use, Increment, MAI

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ABSTRACT

The present investigation entitled, "Appraisal of land use change using Remote Sensing technique" were carried out in Nauni campus of Dr .Y.S. Parmar University, Nauni, Solan located at 300 51′ N and 760 11′ E with an altitude of 1250m above mean sea level in Himachal Pradesh to study land use change from 1998 to 2008 in the university campus. The area was classified into main six land use categories such as Culturable, Unculturable, Ban oak, Broadleaved, Chirpine and Habitation with overall classification accuracy of 65 and 71 % for 1998 and 2008, respectively. The area under Culturable, Banoak and Habitation has been found to increase by 183.33 %, 440 % and 215 %, respectively from 1998 to 2008 whereas Unculturable, Broadleaved and Chirpine categories reported decrease in area by 25.29 %, 16.51 % and 7.41 %, respectively from 1998 to 2008.

Introduction:
Land use/ Land-cover change information has an important role to play at local and regional as well as at macro level planning. The planning and management task is hampered due to insufficient information on rates of land-cover/land-use change. The land-cover changes occur naturally in a progressive and gradual way, however sometimes it may be rapid and abrupt due to anthropogenic activities. Land-use change can be a factor in CO_2 atmospheric concentration, and is thus a contributor to climate change. Forests have a critical role to play in addressing climate change. Recognizing the importance and providing incentives for conserving, restoring and better managing forests provides an effective way to mitigate climate change while offering a cost-effective and near-term option to ease the transition to low carbon economies (Stern, 2006). Slowing deforestation, combined with changes in forest management as well as reforestation, could curb a significant portion of the emissions that contribute to climate change.

Materials and methods:
Study area:
The study was carried out in Nauni campus of Dr. Y.S. Parmar University, Nauni, Solan which is located in the mid hill zone of Himachal Pradesh with an elevation of about 900-1300m. The area lies about 13 kilometers from Solan between 30°50′ 30″ to 30° 52′ 0″ N latitude and 77° 08′ 30″ and 77°11′ 30″ E longitude (Survey of India Toposheet No. 53F/1). The climate of the study area is sub-tropical type. There is a considerable variation in the seasonal and diurnal temperature at experimental site. The monthly mean temperature ranges from 11.7°C to 26.3°C and the annual rainfall ranges between 850-1300 mm of which 60-70 per cent is received during mid June to mid September.

Source of basic data:
To create GIS base map for the study area, topographic toposheets comprising of 32 sheets (Figure 1) acquired from Estate Office of Dr. Y. S. Parmar University were digitized on screen for land features such as basic roads, stream network, towns and infrastructure in CartaLinx (GIS data builder software developed by Clark's Labs, Clark University,Worcester,USA).

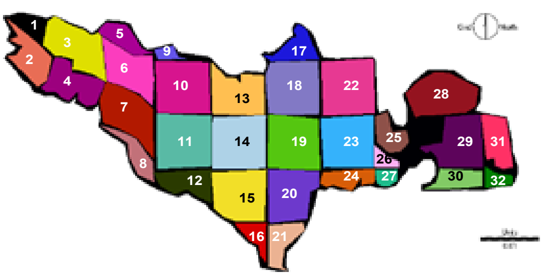


Figure 1. Arrangement of toposheets numbers covering area of Dr. Y. S. Parmar University

The IRS 1D (LISS-III) satellite data for two dates (1998 and 2008) were purchased from National Remote Sensing Agency (NRSA), Department of Space, Hyderabad, Govt. of India.

Image Processing
Image processing was done using the package IDRISI developed by Clark Labs, Clark University Worcester, USA. IDRISI-32 has the capability to display images in a 24-bit colour, which offers a superior image display and interpretation.

The satellite data for two dates (1998 and 2008) received from National Remote Sensing Agency, Hyderabad were imported into IDRISI using the TIFF module to create multi-spectral images. The 8-bit digital satellite data, as supplied, were already corrected for major geometric and radiometric errors. To geocode the satellite data to the topographic map coordinate system, first order polynomials warping based on precisely selected Ground Control Points (GCPs) was carried out. Twenty control points common to two date satellite images and Survey of India topographic sheets (1:1,000 scale) were selected. The GCPs included permanent features such as road intersections and curvature, vegetation boundaries, and other well-defined features. After the allocation of GCP's, a root mean square error (RMSE) was calculated in IDRISI, which computed the RMSE for each GCP relative to other GCP's. GCP's having higher values of RMSE were deleted and finally 15 GCP's were retained which were found in the acceptable limit of RMSE of less than 0.3 pixels. The rectified datasets were visually examined by overlaying a GIS layer of roads and streams, created for the study area to validate the accuracy of the geo-rectification. This proved acceptable and the resampled images were used for further analysis. Image to image normalization was performed by registering images of 1998 to the images of 2008 as reference image. This helped us to proceed further in using satellite data of both the dates simultaneously in the process.

Land Use Classification:
Delineation of Training Areas
Homogeneous training areas to represent the variety of land use types within the study area were delineated with the aid of a False Colour Composite (FCC) image. The FCC image for the year of 1998 and 2008 was created by displaying NIR in red band, RED in green band, and GREEN in blue band, respectively (Figure 2). The training areas were selected with criteria that they represent the area of each class throughout the image.

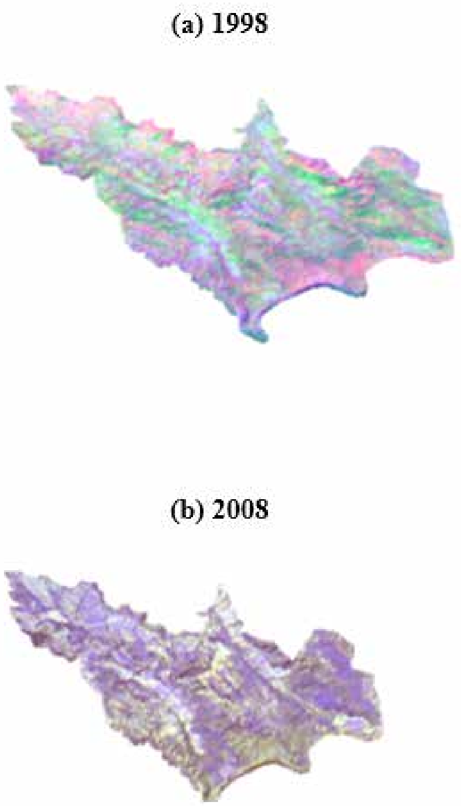


Figure 2. False colour composite images for the year of 1998 and 2008.

Classification Method
Wide ranges of supervised classifiers are available but they share a common objective to allocate each pixel of unknown class membership to a pre-defined class on the basis of its spectral properties. From these minimum distance classifier was selected. Apart from being one of the used procedures in the classification of digital remotely sensed data, the Minimum distance classification was performed using the MINDIST module in IDRISI.

Accuracy Assessment of Classification
Accuracy assessment of classification is an essential component of the classification process. Therefore, a complete accuracy assessment was performed on classified images of two dates generated during this study. A sample of points distributed randomly on the classified image was laid using the SAMPLE command in IDRISI. Total 31 points were overlaid randomly over the classified image to assign to each point an identifier of the land cover type. The sample points vector file (31 points) was then rasterised using the POINTRAS module and thereafter, each sample point was assigned an identifier by visiting the reference data to create a "ground truthing image". This served as reference image for testing the accuracy of all six-land use classes in the classification. The ERRMAT module in IDRISI was run on the reference data points and the final classified images. This generated an error matrix between the reference data points and the classified image.

Land use change Analysis
Land use change was estimated using formula as given below for the classified images of 1998 and 2008.

	Classified image of 2008 – Classified image of 1998	
Land use change	=	x 100
	Classified image of 1998	

Results and discussion:
Land use change
A minimum distance (MINDIST) classification was run including three bands i.e., Green, Red and Near-infrared each for date 1998 and 2008 as a first step in studying land use change of the study area. MINDIST undertakes a minimum distance to means classification of remotely sensed data based on the information contained in a set of signature files. The minimum distance to means classification is based on the mean reflectance on each band for a signature. Pixels are assigned to the class with mean closest to the value of that pixel.

Spectral signatures of land use categories varied between 1998 and 2008. The Culturable land use category showed lowest DN value in 1998 whereas, in 2008 it showed highest DN value among land use categories. However, spectral signature of Ban oak showed higher DN value in 1998 among land use categories, whereas, for 2008 it reported lowest DN value.

The 2008 classification resulted in higher overall accuracy of 71 per cent followed by 1998 classification with an accuracy of 65 per cent. However, KHAT accuracy was lower at 65 per cent and 56 per cent for 2008 and 1998 land use classification, respectively (Table 1). Working on the same line, Brandt and Townsend (2006) were able to map land cover into six classes with an overall accuracy of 88% using traditional classification techniques and limited field data. Lower accuracy reported by 1998 classification was due to more mixing of spectral signatures between land use categories than 2008 classification. Cent per cent user's accuracy by Culturable, Habitation and Ban oak land use categories in 1998 may be attributed to conspicuous tonal variation by these features at the time of passing sensors.

Table 1. Comparison of two classification accuracy measures for two dates:

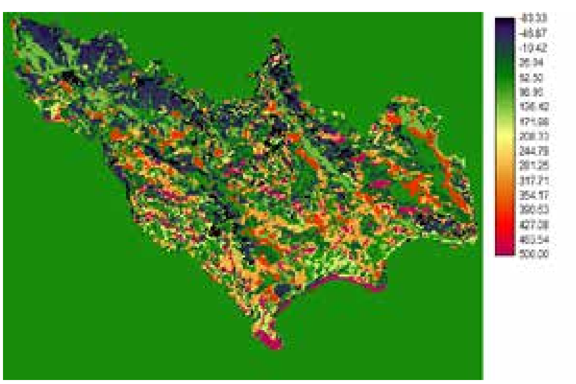
Classification	Overall accuracy (%)	Khat accuracy (%)
1998	65	56
2008	71	65

Figure 3 shows the land use change from the year 1998 to 2008. The figures of area falling under different land use categories on 1998 and 2008 and its per cent change over the period (1998-2008) is given in Table 2. The Culturable land use has shown increase in area (183.33%) during the period due to allocation of more area for agricultural production and decrease in area (25.29%) under Unculturable land use category may be due to the extension of agriculture production area in this land use category. Increase in area under Ban oak may be attributed to the increase in plantation area in the last decade under this species. Decrease in area (16.51%) under Broadleaved category is because of felling of species such as *Acacia catechu* and *Toona ciliata*, etc carried out during 2006. Similarly 7% decrease in Chirpine land use was reported during the period. During last 4-5 years lot of infrastructure activities took place in the campus such as extension of roads, erection of polyhouses in experimental areas of various departments, student hostels, student's centre and construction activities in the Pandah village by local inhabitant etc. leading to an increase of 215% area under Habitation category.

Table 2. Change in Land use area (1998-2008)

Land Use Category	Area Under Land Use (ha)		Per cent Change in Land Use Area
	1998	2008	(1998-2008)
Culturable	12	34	183.33 (+)
Unculturable	174	130	25.29 (-)
Ban oak	5	27	440 (+)
Broadleaved	212	177	16.51 (-)
Chirpine	108	100	7.41 (-)
Habitation	20	63	215 (+)
Total	531		

(+) (-)



Conclusion:

Overall Classification accuracy was 65 and 71% and KHAT accuracy was 56 and 65%for land use classification of 1998 and 2008, respectively. Among all the land uses, Unculturable, Broadleaved and Chirpine reported 25.29%, 16.51% and 7.41% decrease in area, respectively from 1998 to 2008. whereas Culturable, Banoak and Habitation reported increase in area as 183.33%, 440% and 215%, respectively from 1998 to 2008.

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