International Journal for Environmental Rehabilitation and Conservation
Volume IV No. 2 2013 [81 – 86] [ISSN 0975 - 6272]

Ecological Analysis of vegetation of Phakot watershed by remote sensing in Uttarakhand, Central Himalaya

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Received: March 17, 2013 | **Accepted**: July 30, 2013 | **Online**: October 15, 2013

Abstract

The Phakot watershed is a part of Phakot beat of Saklana range of Garhwal Himalaya. It lies between 78^0 19' 53" to 78^0 22' 16" East and 30^0 14' 29" to 30^0 13' 17" North with elevation ranging from 650m to1900m. The study area comprises of 17 villages. IRS-1C LISS III digital data were used for the present study. Prefield visual interpretation of imagery was carried out on false colour composites using image elements such as tone, texture, pattern, location, association, shadow. The mapping was done on 1: 50,000 scale. Two forest and six non-forest classes viz., agriculture, barren land, forest blank, scrub land, river and settlements were mapped.

Keywords: Watershed | Phakot | Saklana Range | Garhwal | Remote Sensing

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Introduction

Remote sensing derives the earth's surface from space by making use of the properties of electromagnetic wave emitted, reflected or diffracted by the sensed objects, for the purpose of improving natural resource management, land use and the protection of the environment. Remote sensing data (the image) has been used to derive thematic information on various natural resources and environment. The remote sensing image of land can be used to derive information on vegetative cover, water bodies, land use pattern, geological features, soil, etc.

In order to use land optimally, it is necessary to have information on existing land cover/land use, and the capability to monitor the dynamics of land use resulting out of newer demands of increasing population and changed lifestyles. Both visual and digital analysis techniques are employed for preparation of land cover/land use maps using satellite data.

Geographical Information Systems are

computer based systems that efficiently store, retrieve, manipulate, analyse and display spatial data according to user specification (Arnoff, 1991; Maguiri, 1991). Burrough (1986) defines GIS as a powerful set of tools for collecting, storing, retrieving at will, transforming and displaying spatial data from the real world. One of the most powerful aspects of GIS is the ability to examine spatially referenced objects over time. Storing, analyzing ecological data by geographic coordinates and by using spatial data structures are powerful basis for establishing a GIS for multiscale studies of ecosystems (Marble *et al*., 1984).

GIS forms an integral part in any biodiversity information management system. Such systems are designed to harness the data that are available, and extract the information that creates the kind of knowledge needed to truly address conservation challenges and made the needs of the users (Salem, 2003).

Visual interpretation was extensively used in different fields such as forest inventory before the 1970s when digital satellite data were not available and the capability of computer techniques and image processing in handling a large amount of data were poor.

Methods

Satellite data

- IRS-1C LISS III digital data were used for the present study. Data having least cloud cover was selected. The detailed of satellite data used are given in Table -1.

S. No.	Satellite	Sensor	Path/Row	Date of Pass
1	IRS-P6	LISS III	097/050	19-01-07

Table: 1: Satellite data used for vegetation mapping

Image processing and GIS systems:

Following software's were used for image processing and GIS analysis

1 ERDAS IMAGINE software for image processing

2 ARC/INFO for GIS analysis

3 MS Office 2000: MS Excel, MS Word for word processing and vegetation analysis.

Preliminary interpretation

Prefield visual interpretation of imagery was carried out on false colour composites using image elements such as tone, texture, pattern, location, association, shadow.

Field visit

A reconnaissance survey was carried out to recognize and relate vegetation types found on the ground to their respective tonal variations on satellite image. Various observations were noted on vegetation types, their physiognomy and floristic composition. Major vegetation types and a few prime localities of characteristic types were recorded. The variation and tonal patterns were observed on existing maps/images. All roads, major drainage, and hilltops were traversed for collecting ground truth. The literature survey and interactions with forest department and local institutions were also made for collecting the past/present status of forest, land use changes, etc.

Ground truth is essential in remote sensing study. Areas with unique image tone and texture were visited and verified on the ground. During ground truth all forest types were covered and sampling data was collected in nested quadrats.

Satellite image analysis

Digital data pertaining to Phakot watershed was subjected to digital classification for stratifying various forest types. The digital Satellite data of IRS P6 LISS –III acquired from NRSA was evaluated on ERDAS Imagine Software. The Standard False Colour Composite (FCC) was generated by assigning blue, green and red colours to visible green, visible red and near infrared bands respectively. Expressing image pixel addresses in terms of map coordinate base is often referred to as geo-coding. As various thematic layers were to be overlaid for this work, all the layers were geo-referenced to real world coordinates. The 1:50,000 scale toposheets of the area were used for the purpose of geo-referencing.

Histogram of the scene under study was generated to check the range of spectral values present in the scene. In order to use total grey level range and to optimize the contrast, the actual grey level ranges of three bands were linearly stretched independently. The zoomed images were studied wherever necessary. The interpretation key necessary for identifying different features were developed systematically on the basis of image characteristics and associated elements viz. shape, size, shadow, pattern, colour/tone, texture, association, location and available ground truth. Among these characteristics shape, size, shadow and pattern are basically dependent on the scale of the image whereas the color/tone and texture depends upon the brightness, contrast and resolution of the image. The data was generated for landuse/landcover classification.

Landuse/landcover classification

1 Prior to ground truthing, the satellite data was classified using **unsupervised classification** technique. Further after collecting ground truth details maximum likelihood classification based **supervised classification** method was used with remote sensing image data.

2 After the supervised classification procedure, landuse map was prepared which was verified, and any error or omissions were identified and corrected.

3 A reclassification of the land-use categories implementing the details and corrections was done. The reclassification output was used for the preparation of the final landuse classification map.

Results

The forest/vegetation cover map and classification prepared from digital classification of IRS-P6 LISS III data is shown in table. 5.2. The mapping was done on 1:

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[ISSN 0975 - 6272]

50,000 scale. Two forest and six non-forest classes viz., agriculture, barren land, forest blank, scrub land, river and settlements were mapped. The area under various categories is shown in Table – 2.

Class	Vegetation/Land Use Types	Area in Ha	Area in %
	Himalayan Moist Temperate Forest	16.67036 ± 5.474166	1.34
	Sub Tropical Dry Deciduous Forest	204.25 ±39.67671	15.97
	Agriculture	428.14 ± 31.41186	33.49
	Scrub Land	203.71 ± 17.51645	15.93
	Barren Land	152.44 ± 10.50322	11.92
	River	8.88 ± 1.42363	0.69
	Settlements	256.97 ± 42.95564	20.10
	Forest Blank	7.26 ± 1.12019	0.56
	Total	1278.36 (±150.0819)	

Table: 2: Area under different vegetation/ landcover type in Phakot watershed.

Description of Forest Types

(a) Sub tropical dry deciduous forest: The major tree species in this forest were *Anogeissus latifolius*, *Mallotus philippensis*, *Lannea coromandelica*, *Shorea robusta*, *Acacia catechu*, *Macaranga pustulata* and M*adhuca longifolia*. This class occupies of 15.97% area of the watershed. (Plate 1).

(b) Himalayan Moist Termperate Forest: The major forest vegetation in this forest consisted of namely *Quercus leucotrichophora*, *Rhododendron arboretum*, *Lyonia ovalifolia*, *Myrica esculenta* and *Bauhinia semla*. This class occupies an area of 1.34% area of the watershed. (Plate.1).

Non-forest Classes

(a) Scrub Land: This class occurs in the forest area and consists of heterogeneous bushy vegetation comprising of different plant species and occupies an area of 203.71 ha, which is about 15.93 per cent of the total geographical area of the watershed.

(b) Barren Land: These are degraded lands outside the forest area which are lying unutilized. A total of 152.44 ha area is under barren land. *Lantana camara*, *Murraya koenigi Adhatoda zeylanica*, *Cassia tora*, *Eupatorium adenophorum* and *Berberis asiatica* were observed to be the major vegetation of this class.

(c) Agriculture: This is the largest class covering a total of 428.14 ha, which is about 33.49 per cent of the area. The major crops grown are wheat, maize, mustard, Barley, ginger, potato, pea etc.

(d) Forest Blank: These areas inside the forest are completely devoid of vegetation. It was found that such forest blanks occur mostly in the areas where Shepard's used to reside. This class covers 0.56 per cent of the total geographical area of the watershed.

(e) Settlements: The extent of habitation in each village has been mapped using the satellite data. The total area under this class

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[ISSN 0975 - 6272]

is 256.97 ha (20.10 %).

(f) River: Water bodies include river. Hiul is the main river that runs across the study area. The main tributary is Bhirnu khala which meets with Hiul inside the watershed. 8.88 ha (0.69%) of the total area form the river course.

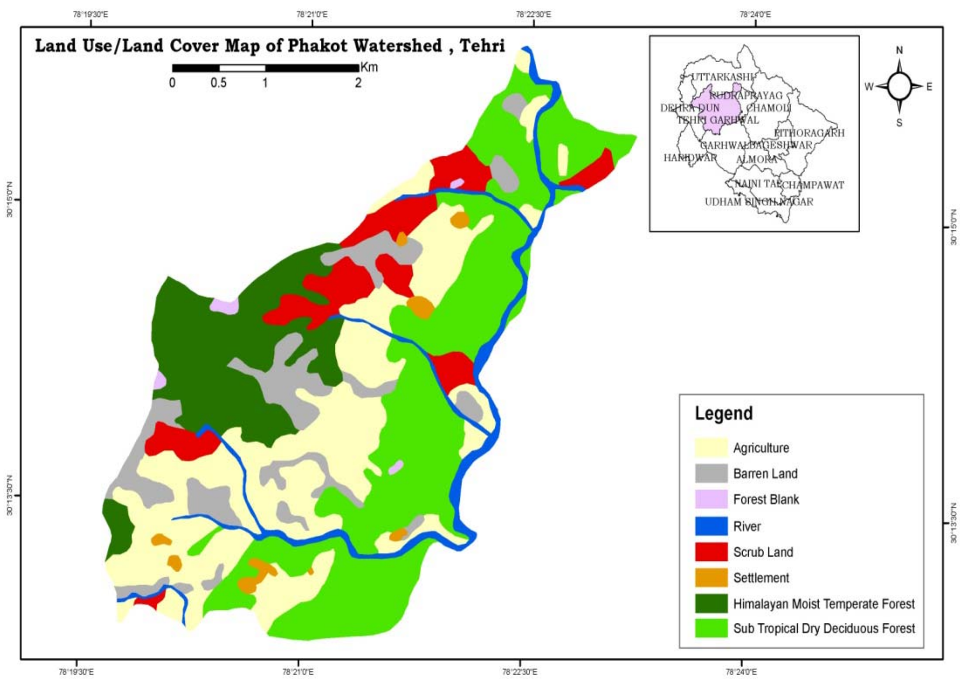

Plate 1

Discussion

IRS-P6 scene was used to classify the forested landscape of the study area. The various classes were identified and mapped digitally on the satellite image. The classification resulted into twelve forest types and eight non forest classes. Vegetation mapping of study area was done on 1: 50,000 scale using Landsat MSS data under "Natioanl Wide land Use/ land cover mapping (NRSA, 1983). The vegetation of Phakot watershed was classified into two forest types. The land-use classes identified in Phakot watershed were agricultural land, forest, barren land, river body, settlements, forest blank and scrub land. The study divided the forests into two forest types: Himalayan moist temperate and sub tropical dry deciduous forest.

Visual interpretation approaches do have certain advantages in terms of infusing the ancillary knowledge, like elevation, context etc. whereas computer assisted pattern recognition methods inherently have limitations in mapping forests. Vegetation distribution pattern is governed by topography and climatic conditions therefore it was thought appropriate to use elevation as an ancillary variable.

The landscape units in the area are clearly discernable and are distinct. Dominant land use in the area is agriculture (33.49%) followed by settlements (20.10%). Total forest lands come about 33.80% but 15.93% is scrubland and 0.56% forest area is blank. Thus 16.49% forest land needs proper management and is available for afforestation, plantations and silvicultural treatment in the watershed.

Conclusion

Remote sensing has emerged a valuable tool for conservation and development planning as it is an unbiased source of information. The current state of the art sensors provide repetitive and synoptic coverage of any part of the earth. Remotely sensed data also provide an opportunity to look back in time for any comparison of the resources positioned between past and present. Remote sensing and GIS together assist in preparing a spatial database of the study area and proper integration of this data with socio- economic and user need information can provide a framework for devising a scientific and sustainable land and water resources conservation strategy. The potential utility of remotely sensed data in the forms of satellite imagery and GIS have been widely used in mapping and assessing landscape attributes such as physiographic, soil, land use/ land cover, relief, soil erosion pattern etc. and making database of the watershed.

References

Arnoff, S. (1991): Geographical Information System: A management perspective. *WDC publication*, Ottawa.

Burrough, A.P. (1986): Principles of Geographic Information System. for Land Resources Assessment. Monograph on Soils and Resources, Survey No. 12. Oxford science. Publications 193, Calerendon Press, Oxford, U.K.

Maguire, D.J. (1991): An overview and definition of Geographic Information System. In: *Geographic Information System* (Maguire, D.J., Goodchild, M.F., Rhind, D.W. eds). Longman, Harlow, 9-20.

Marble, D.F., Peuquet, D.J., Boyle, A.R., Bryant, N., Calkin, H.W. and Johnson, T. (1983): Geographic information system and remote sensing. In: *Manual of Remote Sensing*, (R.N. Colwell eds), American Society of Photogrammetry, Falls Church, USA.

Salem, B.B. (2003): Application of Geographic Information System to biodiversity monitoring. *Journal of Arid Environments*, 54: 91-114.