Photonirvachak
Journal of the Indian Society of Remote Sensing, Vol. 27, No. 2, 1999

Application of Remote Sensing Technology For Land Use/Land Cover Change Analysis

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ABSTRACT

Land use/land cover changes over a period of 30 years were studied using remote sensing technology in a part of Gohparu block, Shahdol district of Madhya Pradesh. Land use/land cover maps were prepared by visual interpretation of two period remotely sensed data. Post-classification comparison technique was adopted for this purpose. The loss of vegetation cover was estimated to be 22 percent and 14 percent of the land was found to have been tranformed into wasteland between 1967 and 1996. Overall rate of change was found to be 1.8 percent per year during this period.

Introduction

Since the beginning of human civilisation, mankind has lived in a close relationship with nature. While mankinds interdependence on environment is greater than that of any other organism; his restless pursuit of progress, comfort and security has resulted in increased stress on the environment which led to land use/land cover changes over a period of time. Information on existing land use/land cover, its spatial distribution and change are essential prerequisite for planning (Dhinwa *et al.*, 1992). Thus land use planning and land management strategies hold key for development of any region (Anon, 1992). The conventional methods of detecting land use/land cover changes are costly, low in accuracy and present a picture of only a small area. Remote sensing, because of its capability of synoptic viewing and repetitive coverage, provides useful information on land use/land cover dynamics (Sharma *et al.*, 1989). Detection of changes in the land use/land cover involves use of at least two period data sets

(Recd. 24 March '98; in final form 12 May '99)

(Jenson, 1986). The changes in land use/land cover due to natural and human activities can be observed using current and archived remotely sensed data (Luong, 1993). Land use or land cover change is critically linked to the intersection of natural and human influences on environmental change. The change in the state of the biosphere and bio-geochemical cycles are driven by heterogeneous changes in land use and continuation of those uses (Turner, 1995). The present study area is comprised of 12 microwatersheds of Son river. This area has been experiencing land cover changes as a consequence of increase of human and cattle population during the past 30 years. The present study was undertaken with the objectives of analysing land use/land cover changes in the area using remote sensing data.

Study Area

The study area forms the mid-western part of Gohparu Block, Shahdol district, Madhya Pradesh. It covers an area of about 101 sq.km, which falls between 23°33' to 23°40' N latitudes and 81°19' 81°29' E longitudes. As per forest administrative records, it forms the part of Khannaudhi range of North Shahdol Forest Division. The elevation ranges between 380 and 792 m above m.s.l.. The major rivers in the area are Chundi Nadi and Gulgul Nadi. The microwatersheds covered are 3e2A, 3e2B, 3e2C, 3e2D, 3e2E, 3e2F, 3f1A, 2f1B, 3f2A, 3f2B, 3f2C and 3f2D which have been taken from National Watershed Atlas. There are 27 villages within the watershed. The important villages are Khand, Ratehar, Nawagoch etc. in which Khannaudhi is the main city centre. Human population and number of occupied residential houses is increasing in this area at the rate of 700 and 350 per year respectively. The area is prone to drought and forest fires. Each village is connected with good road which is also responsible for the rapid changes in land cover during the past 30 years.

Materials and Methods

The Survey of India topographic Sheet No. 64 E/6 (scale 1:50,000) of 1967 was used for preparation of base map. The status of land use/land cover during 1967 was mapped from this sheet. IRS – 1C LISS III sensor image on 1:50,000 scale of 1996 was visually interpreted to map the land use/land cover status during 1996. Forest land was classified further on the basis of density as dense (greater than 40%), open (10-40%) and degraded (less than 10%). The map was finalised after ground verification. Demarcation of present forest boundary was done with the help of forest stock map of North Shahdol Forest Division. Demographic data was collected from Census of India Abstracts (Dubey, 1982). The land use/land cover map of 1967 and 1996 thus prepared were digitised and incorporated into GIS domain for change analysis (Intergraph MGE Software). Area statistics of each land use/land cover classes was found through MGE-Area Loader Module.

Post-classification comparison is the commonly reported technique for classification-based change detection (Weismiller and Momin, 1977; Rubee and Thie 1978; Wickware and Howarth 1981; Burns and Joyce 1982; Estes *et al.*, 1982; Likens and Maw 1982 and Singh, 1989).

Results and Discussion

Area under major land use/land cover categories was calculated for the year 1967 and 1996 (Fig. 1a, 1b & Table 1). Forest areas has been categorised into five classes, viz., dense forest, open forest, degraded forest, forest blank and forest plantation. Those areas having dense/open vegetation but outside the notified forest areas were classed as woodlands. This information was extracted from 1967 topographical map. Non-forest land include agricultural land, wasteland and settlement areas

Table 1. Area (sq.km.) for change in different land use/land cover classes.

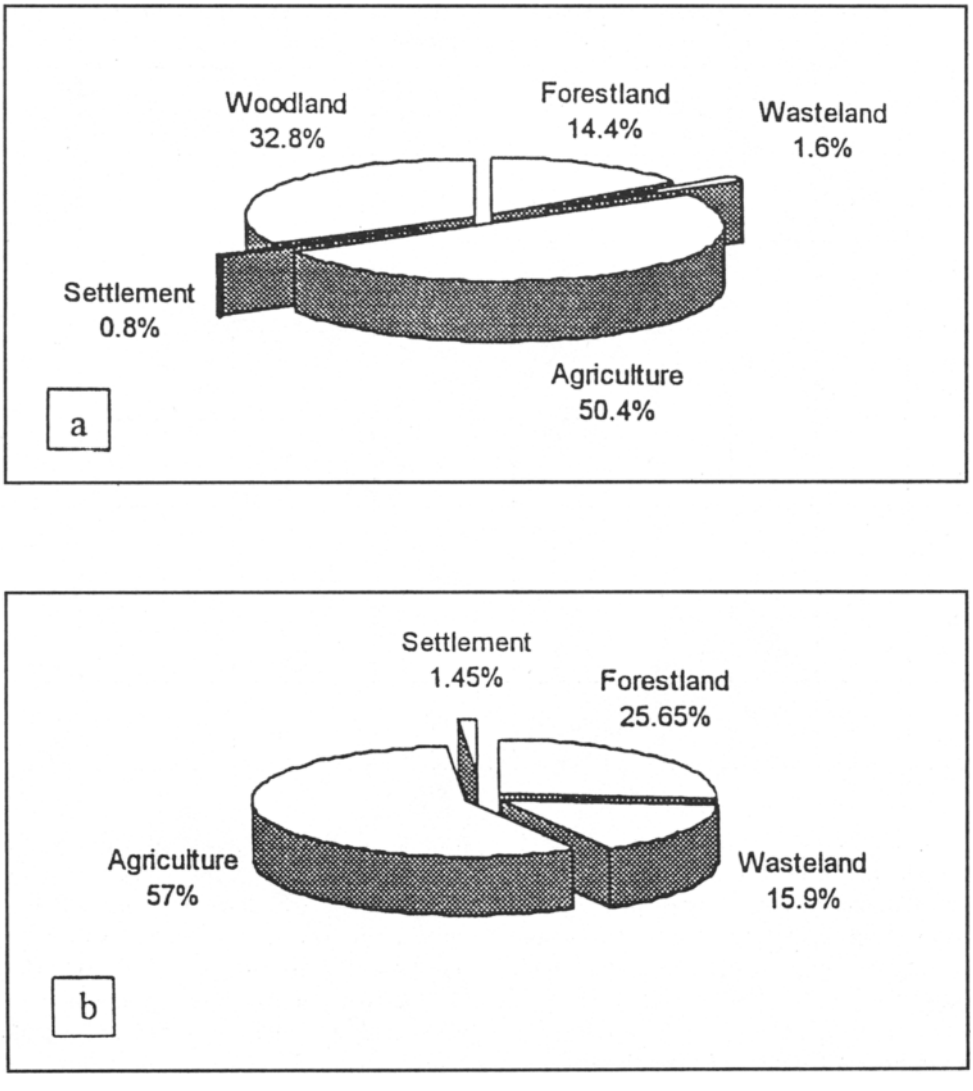
	Dense forest	*Open forest*	*Degraded forest*	*Forest blank*	*Forest plantation*	*Settlement area*	*Agricultural land*	*Wasteland*
Dense forest		2.45	1.66		2.72		0.94	
Open forest					0.97			
Forest blank	0.54		0.33					
Forest plantation		0.72	0.56				0.65	
Agricultural land		0.50	0.40		0.53	0.68		4.62
Wasteland				0.32			0.83	
Dense woodland				0.40			3.52	2.20
Open woodland	1.32	3.67	4.28	0.49	0.96		7.42	8.84

(Plate 1a & 1b). Around 52 percent of the total area have changed showing overall increase in open forest, degraded forest, forest plantations, agricultural land and wasteland. This was occurred at the cost of dense forest and woodlands.

Changes in Forest Cover and Woodland

Though forest area has increased by 11 percent of the study area but deforestation has resulted in decrease in forest density. Deforestation has arisen due four principal causes, often in relationship with each other; excessive felling of trees for timber, overgrazing, fire and clearance of land for cultivation. The total forestland and woodland has decreased from almost 48 percent in 1967 to 26 percent of total geographical area of watershed in 1996, regardless of changes in forest quality (density of crown cover, composition etc.). Woodlands have totally disappeared during this period and this is the major change noticed in this area. Woodlands are mainly shifted towards agricultural land and wasteland. Almost 11 percent of woodland area

Fig. 1 Land use/ land cover in the watershed in 1967 (a) and 1996 (b)



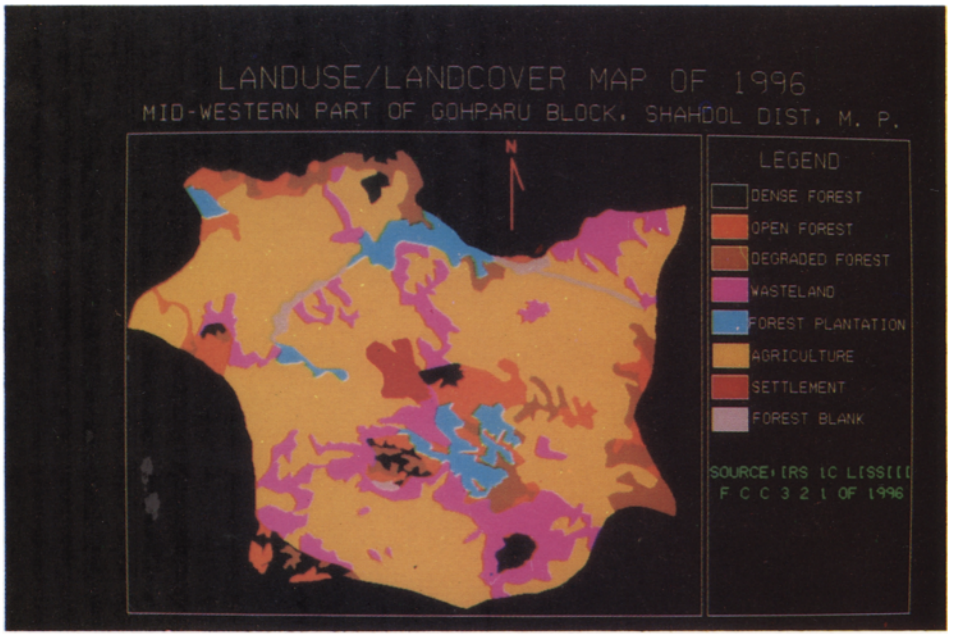


Plate 1a: Showing land use/land cover map (1996) of a part of Shahdol district M.P.

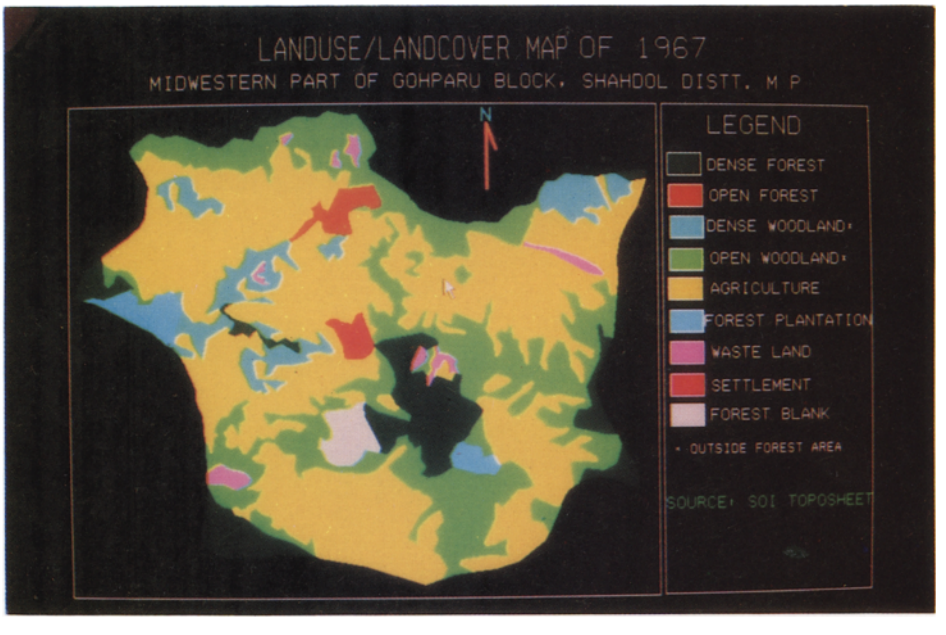


Plate 1b: Showing land use/land cover map (1967) of a part of Shahdol district M.P.

has converted into wasteland due to drought and non-survival of plantation. Another 11 percent of the woodland changed into agricultural land due to increase in population and far fulfilling ever-increasing demand for food, fiber, fodder and shelter. Rest of woodland has come under forestland as forest department has increased the forest boundary. The degraded forests now exist on the periphery of agricultural lands indicating human encroachment.

Change in Agricultural Land

A major factor responsible for the disappearance of forests has been the search of new agricultural land due to increasing population pressure and need to generate more income. The agricultural land has increased from 50 percent in 1967 to 57 percent in 1996 at the cost of surrounding woodlands.

Change in Settlement Areas

Rapid growth in population and number of occupied residential houses have been reported from each village of the study area. This has inevitably caused changes in its main city centre Khannaudhi. The urban sprawl area is found to be 0.68 sq. km. (i.e. from 08 % to 1.48%) in last 30 years.

Changes in Wasteland Areas

Significant (14%) increase was noticed in the area under wasteland. With increasing human and animal pressure on land, the intensive cultivation has extended even to areas under ecological stress leading to accelerated soil erosion and excessive land degradation.

Conclusions

Changes in land use/land cover were inferred from the differences between 1967 and 1996 status. Forest land has increased significantly due to land acquisition (woodland) by Forest department. Density of vegetation has decreased due to human interference and improper management by forest department. Agricultural land and wasteland have also increased at the expense of woodlands and forestland. Study has revealed that synergistic use of Survey of India toposheets and remote sensing data could be conveniently used to detect the changes in land use/land cover. However, the accuracy of results depends on the individual accuracy level of the two different data sources and interpretation.

Acknowledgements

The authors are grateful to Dr. P.S. Roy, Dean, Indian Institute of Remote Sensing, Dehradun and Scientists of M.P. Council. of Science & Technology, Bhopal for providing valuable support during data collection and analysis of the present work.

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