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HYDROLOGICAL LAND USE/VEGETAL COVER MAPPING AND CHANGE DETECTION THROUGH LANDSAT MSS IMAGERIES A CASE STUDY OF SAHARANPUR DISTRICT

ANIL KUMAR*

ABSTRACT

For an optimum and better planning and management of natural resources one of the first requirements is the Land Use/Vegetal cover map of the concerned area. Most obviously the hydrological land use map at an unit of district level is the pre-requisite for water resources management. As the area into consideration for such theme maps is usually of an order of several hundred square kilometers, the space technology of polar orbiting solar synchronous satellite-viz. Remote Sensing Satellites- plays a significant and vital role. Due to their capability of temporal, repetitive, multi-spectral synoptic coverage, the Image acquired by various sensors on-board these satellites become very good inputs for Land Use/Vegetal cover and change detection theme-maps. The present paper describes the theme maps of hydrological Land Use/Vegetal cover and change detection in such cover over a period of five years between 1972 and 1977, in the Saharanpur district of Western Uttar Pradesh The Multispectral Imageries of LANDSAT satellite of December 1972 and November 1977 have been used to prepare these theme-maps. Together with these theme-maps paper presents the percentage change in various classes of land cover over the period of study.

1. INTRODUCTION

Movement and storage of water in the land phase of hydrologic cycle vary with space and time. Prevailing land use/vegetal cover exerts considerable influence on various hydrologic processes such as infiltration, evapotranspiration interception and overland flow, (10,11,12,13). Thus, knowledge of land use/vegetal cover distribution in an area and its impact on various hydrologic processes needs to be investigated for optimal utilization of water resources.

While planning for irrigation facilities in an area a district is considered as an unit. Data on hydrologically significant land use may be required to assess the suitability of existing irrigation facilities and future requirements. This may also help in identifying areas which are over irrigated under current irrigation scheme . Land use information gives an indirect indication of increased salinity in excessively irrigated areas. Thus an integrated data base may be generated for the district which may be used for the developmental planning of the district. Remote sensing technique is an effective tool for mapping of hydro/-logically significant land use categories because of its capability to provide synoptic and repetitive view of the area in various bands of electromagnetic spectrum.

* Remote Sensing Division, National Institute of Hydrology, Roorkee

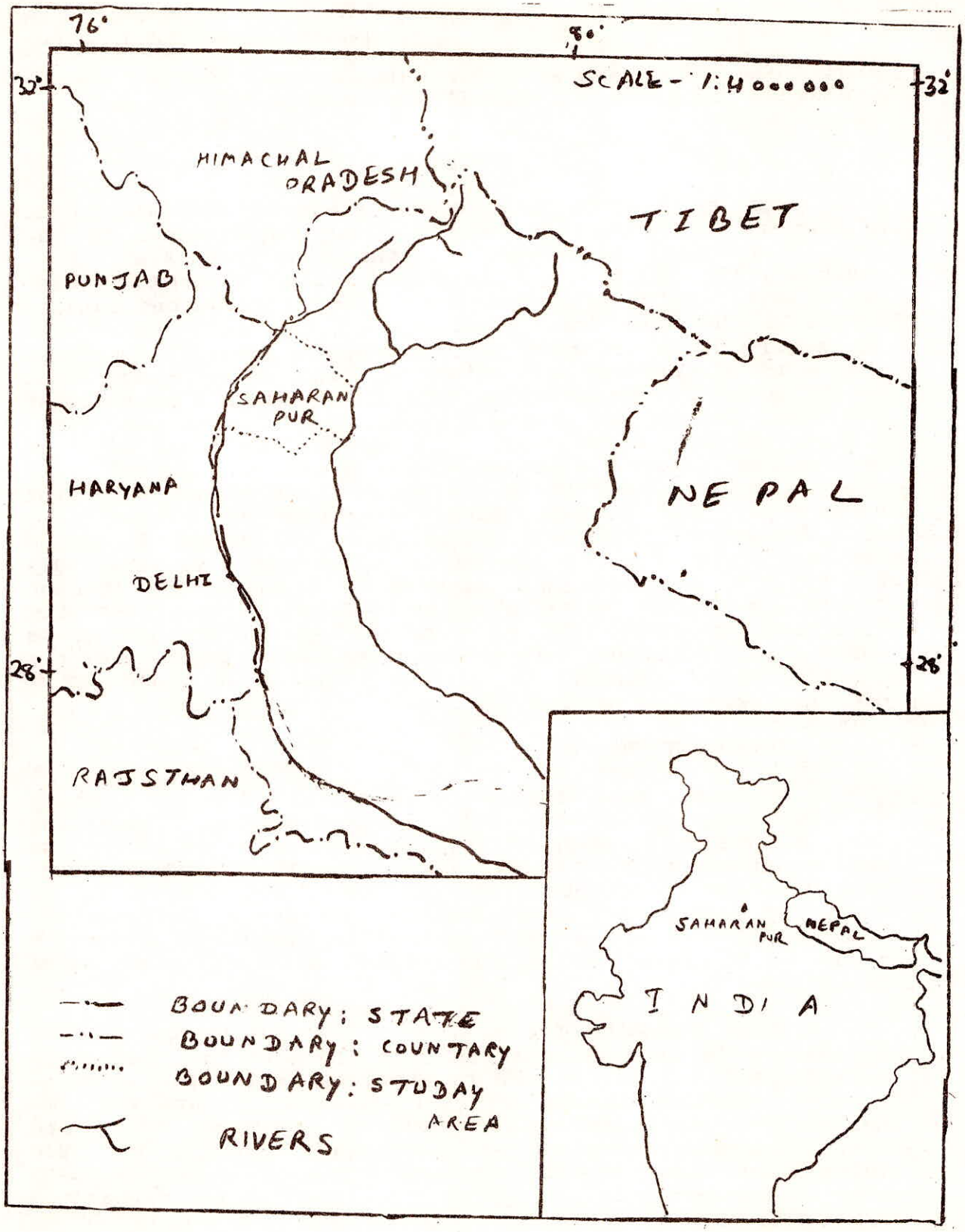

FIGURE-1 LOCATION OF STUDY AREA

The accuracy of theme map thus prepared is nearly 85% (1,2,3,4). Delineation of irrigable and non-irrigated areas can be done easily with these theme maps (5). Availability of multidate data can also be used for change detection and crop inventory for major crops and acreage estimates with fair accuracy (6,7,8). The differences in tonnes on imagery of two different seasons of the year are helpful in deciphering, phenological changes that have occured. Assessment of vegetal cover at regular intervals could be used as a tool for drought monitoring (9).

Input from such map could improve the performance of various hydrologic models assessing availability of runoff from watershed and ground water potential of an area.

Table 1

Interpretation Key for Identification of Land Use/ Vegetal Cover Features

Sl.No.	Category Name	Appearence on FCC
1.	Built-up land	Uniform bluish brown
2.	Dense Cultivation	Red with blue patches with rough texture
3.	Moderately dense cultivation	Light red wittled with blue with rough texture
4.	Sparse cultivation	Whitish red
5.	Plantation	Dark red surrounding built up areas
6.	Shrubs	White to pink with bluish tone
7.	Water bodies	Dark blue
8	Riverine land	White
9.	Swamp areas	Dark brown to black
10.	Forest	Dark red
11.	Barren land	White

2. STUDY AREA

The study area lies in Indo-Gangetic alluvial plains of Saharanpur District, which is situated between latitudes 29°35' to 30°24'N and longitudes 77°07' to 78°13' E. Lower Shiwalik series in the area forms northern boundary of the district while southern boundary of the districts joins district Muzaffarnagar. River Ganga seperates from district Bijnor in the east and the western boundary is marked by river Yamuna (Figure 1).

3. LAND USE CLASSIFICATION SCHEME

The purpose of a land use classification scheme is to provide a logical framework for presenting land use and vegetal cover information derived from remotely sensed data. A classification scheme was selected on the basis

of influence of various categories of land use/vegetal cover on hydrologic processes and other environmental factors. Limitations due to factors such as poor ground resolution of Landsat MSS, season of imagery, spectral separability etc. were adequately considered while arriving at a suitable land use classification scheme. The classification scheme comprises of following land use categories: (i) built-up land, (ii) dense cultivation, (iii) moderately dense cultivation, (iv) sparse cultivation, (v) plantation, (vi) shrubs, (vii) water bodies, (viii) riverine land, (ix) swamp areas, (x) forest and (xi) barren land.

4. METHODS OF ANALYSIS

Standard false colour composite (scale, 1:250,000) of Landsat frame No.157-039 of Dec.1972 and diazo colour composite (scale 1:1M) of the same frame of Nov.1977 were used in the study. Diazo colour composite was projected with enlargement of four times through Large Format Optical Enlarger. These data products were visually interpreted for land use/vegetal cover mapping. An interpretation key based on tone-texture, which was used in the interpretation is presented in Table 1.

Selected regions of the study area were also interpreted on black & white panchromatic aerial photographs for selection and identification of ground truth points in the field. Ground truth data was collected for twenty points and suitable corrections were also applied for geometric distortions using optical projection techniques and these maps were brought to exact scale of Survey of India topographic sheets(figures 2 and 3).

5. RESULTS AND CONCLUSIONS

Areal extents and percentage distribution of various land use categories as determined from the land use/vegetal cover maps prepared for the year 1972 and 1977 are shown in Table 2. A pictorial representation of aerial distribution of various land use categories is given in figure 4.

A close examination of the table reveals that there has been an increase of built-up land by 4.375 sqm which is about 0.078 per cent of total geographical area of the district. This increase in built-up land reflects urbanisation of cultivated areas surrounding the cities like Saharanpur and Roorkee. A reduction in forested area (1.093 per cent) has taken place due to natural and man made deforestation activities. Cultivated area has shown an overall increase of 0.506 per cent during the period 1972-77. This may be attributed mainly to the improved methods of farming, increased irrigation facilities and proper utilization of ground water potential during the period. A marked increased by 6.680 percent in area under dense cultivation clearly indicates that many parts of the district which were sparsely and moderately cultivated due to lack of irrigation facilities are now intensively cultivated. Subsequently, areas under moderately dense cultivation

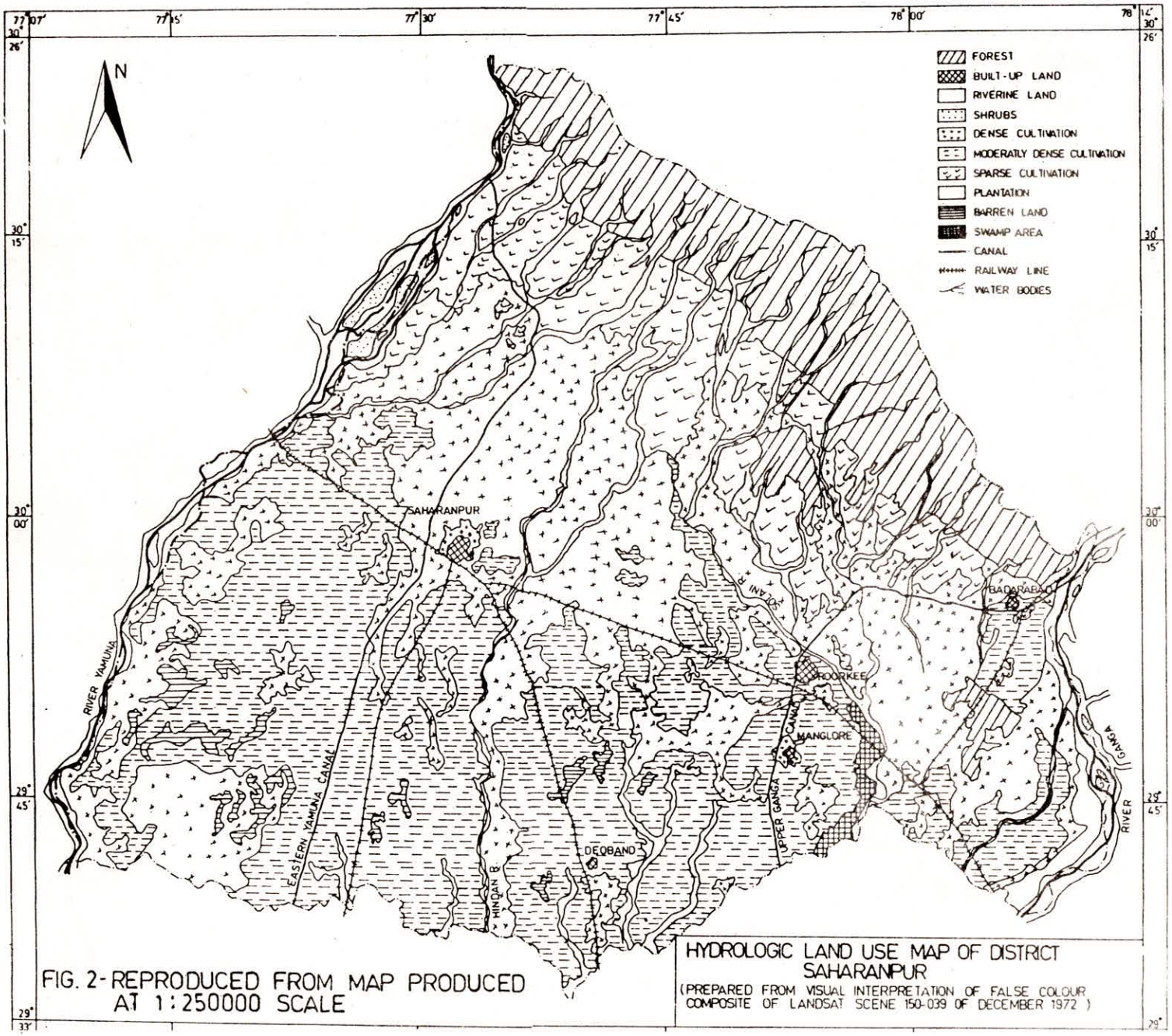

FIG. 2- REPRODUCED FROM MAP PRODUCED AT 1:250000 SCALE

HYDROLOGIC LAND USE MAP OF DISTRICT SAHARANPUR

(PREPARED FROM VISUAL INTERPRETATION OF FALSE COLOUR COMPOSITE OF LANDSAT SCENE 150-039 OF DECEMBER 1972)

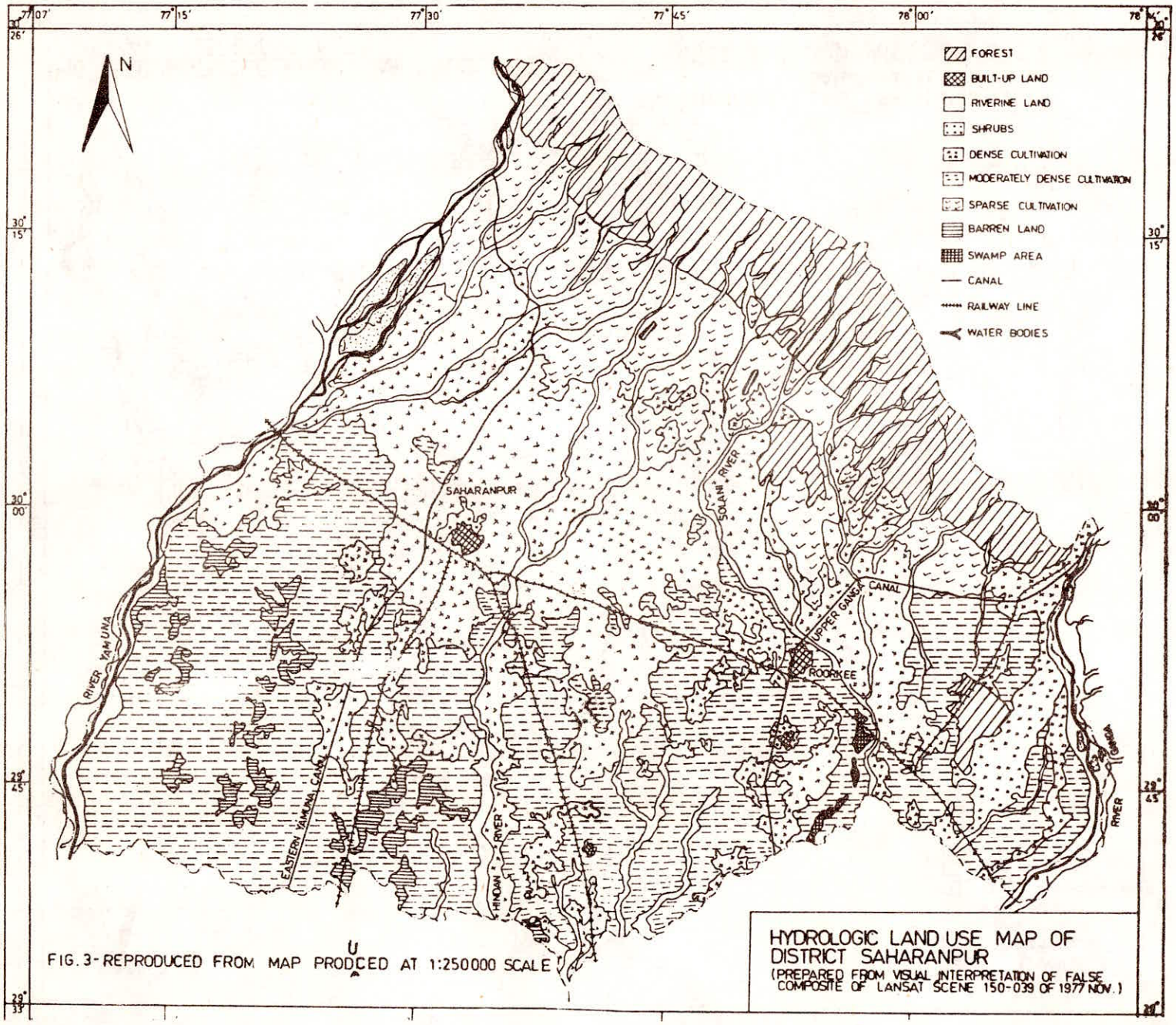

FIG. 3 - REPRODUCED FROM MAP PRODUCED AT 1:250000 SCALE

HYDROLOGIC LAND USE MAP OF DISTRICT SAHARANPUR

(PREPARED FROM VISUAL INTERPRETATION OF FALSE COMPOSITE OF LANSAT SCENE 150-039 OF 1977 NOV.)

FIGURE-4 CHANGE IN LAND USE/VEGITA COVER

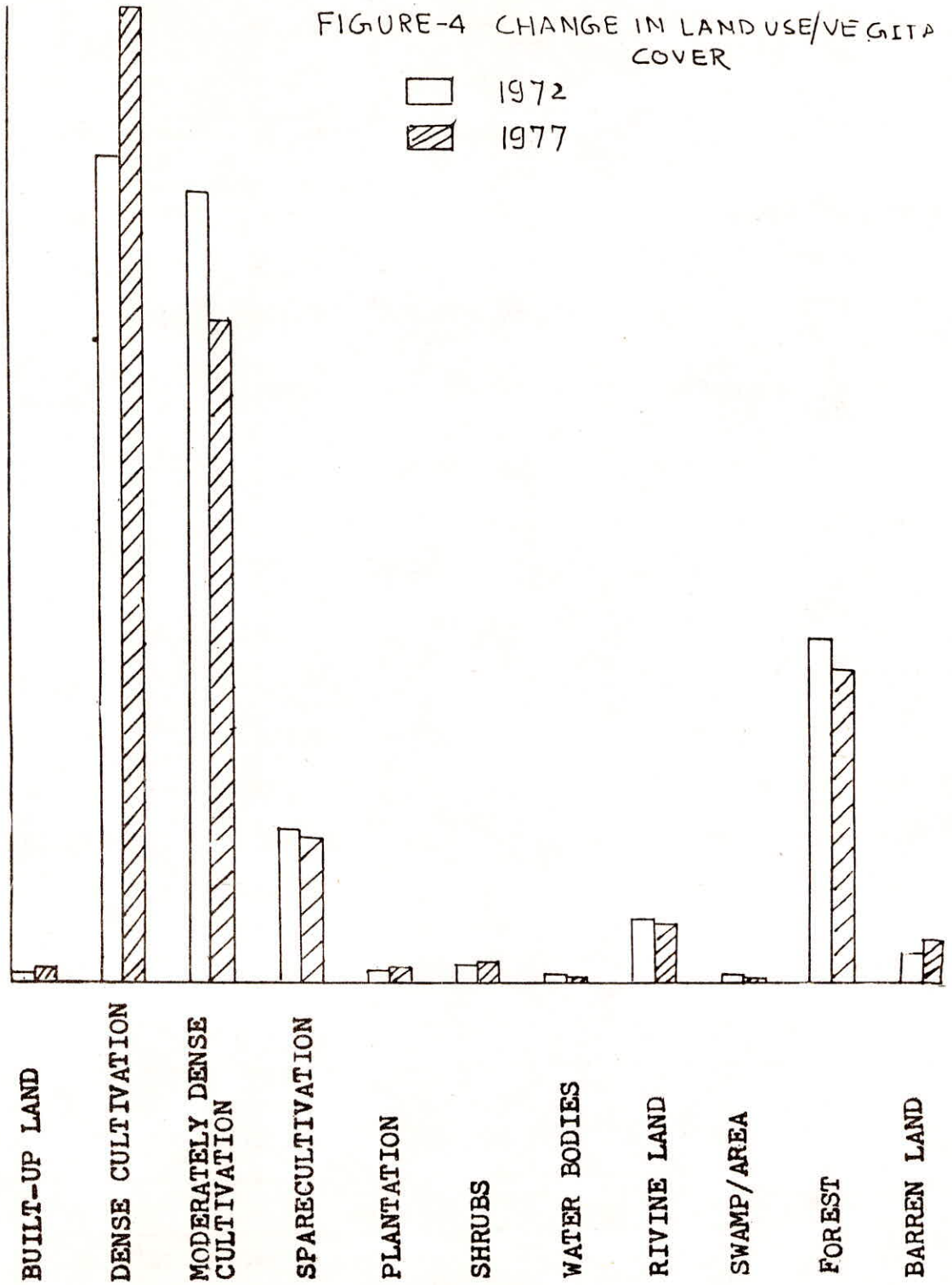

Table 2

Areal Extents of Landuse Categories in Dec.1972 and Nov.1979

Land use category	Areal extent		Percentage of total area		Change in Percentage area extent during seven years	
					+ve	-ve
Built-up land	13.750	18.125	0.246	0.324	0.078	-
Dense cultivation	2047.50	2421.250	36.595	43.275	6.680	-
Moderately dense cultivation	1962.625	1637.875	35.078	29.274	-	5.804
Sparse cultivation	379.375	358.120	6.781	6.400	-	0.381
Plantation	16.875	17.500	0.302	0.313	0.011	-
Shrubs	43.00	47.500	0.768	0.849	0.081	-
Water bodies	13.125	10.00	0.235	0.179	-	0.056
Riverine land	154.375	148.250	2.758	2.650	-	0.108
Swamp/area	18.750	14.375	0.335	0.257	-	0.108
Forest	866.875	805.755	15.494	14.401	-	0.078
Barren land	78.750	116.250	1.408	2.078	0.670	-
Total	5595.000	5595.000	100.000	100.000	7.520	7.520

Table 3

COST ANALYSIS

S.No.	Item	Cost
1.	Material	Rs. 6,690/-
2.	Hire charges of instrument	Rs. 500/-
3.	Technical Supervision	Rs. 20,000/-
4.	Contingency	Rs. 200/-
5.	Final Report	Rs. 200/-
Total cost of mapping for an area of 5595 sq km.		Rs. 27,590/- i.e. 4.9 paise/hectare

and sparse cultivation have reduced by 5.804 percent and 0.381 percent respectively. There has been a marginal increase of 0.011 percent in planted areas which incidentally lie around built-up areas. Although there has been no marked change in the course of rivers however, shifting nature of river courses may be held responsible for change in areal extent of water bodies, riverine land and swamp areas.

A cost analysis of the study indicates that land use mapping from remotely sensed data costs about 5.0 paise per hectare (Table 3). Thus it may be concluded that remote sensing technique could provide a viable tool for monitoring land use/vegetal cover changes with reasonable accuracy and relatively low cost.

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