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Land use land cover mapping using remote sensing & GIS Techniques: a case study of Jhajjar district, Haryana

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Abstract
Land Use Refers to Man's Activities on Earth, Which Are Directly Related to Land, Whereas Land Cover Denotes the Natural Features and Artificial Constructions Covering the Land Surface. Land Use Practices of A Region Are Influenced By A Number of Parameters Namely Physical and Chemical Environments, Socio-Economic Factors and Needs of the Masses. This study involved secondary data collection. Mainly Indian remote sensing satellite- IRS ID LISS III satellite data of FCC satellite imagery 2016.

Keywords: Land, GIS techniques, FCC satellite

Introduction

Land use/land cover (LULC) changes are critical challenges of the 21st century. The land is the basic platform on which all human functions are being conducted. The use of land resources gives rise to the concept of "land use" which varies with the requirement it serves, such as the use of land for food production, provision of shelter, extraction of minerals and manufacturing of goods, and the biophysical characteristics of the land itself. So, there are two sets of broad forces under which land use is being shaped human needs and natural phenomena i.e. temperature, rainfall, physical slope etc. The terms land use and land cover are not synonymous and the literature seeks attention to their differences so that they are used properly in studies of land use and land cover change. Land cover is the biophysical state of the earth's surface and immediate subsurface (Turner *et al*. 1995) [16]. It describes the physical state of the land surface; e.g., cropland, mountains or forests. Land cover deals with, for example, the quantity and type of surface vegetation, water, and earth materials (Meyer and Turner, 1994) [15].

Remotely sensed imageries provide an efficient means of obtaining information on temporal trends and spatial distribution of urban areas needed for understanding, modelling and projecting land changes (Elvidge *et al*. 2004) [3]

The term land cover originally referred to the type of vegetation that covered the land surface but has broadened subsequently to include other aspects of the physical environment also, such as soils, biodiversity and surfaces, and groundwater (Moser, 1996) [18].

Table 1.1: Differences between Land Cover and Land Use

S. No.	Land Cover	Land Use
1	Vegetation (Maple Trees)	Forestry Use (Timber)
2	Vegetation (Maple Trees)	Agricultural Use (Chestnut Production)
3	Vegetation (Maple Trees)	Agricultural Use (Grazing Area)
4	Vegetation (Maple Trees)	Forestry Use

Study Area

The state of Haryana is situated in the south of natural geographical boundaries of the Shivalik; the Yamuna River makes boundary in the east and the Ghaggar River in the west. The southwest boundary is surrounded by a range of Aravalli hills which runs through southern Delhi to Mt. Abu in Rajasthan. The geographical

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extension of Haryana is between 27° 39' to 30° 56' N latitude and 74° 27' to 77° 36'E longitude, covering an area of 44, 212 sq. km. It occupies 1.40 per cent of the total area of the country. The State is bounded by Uttar Pradesh on the east, Punjab on the west, Himachal Pradesh on the north and Rajasthan in the south. Administratively, the state has been divided into 22 districts. The State's landscape and soil fertility are noticeably diverse. The national capital Delhi is surrounded on three sides by Haryana. Nearly, half of the national capital region representing about 40 percent of its population falls within the State.

Table 1.2: Demographic Profiles

Description	Rural	Urban
Population (%)	74.61	25.39
Total Population	7,15,066	2,43,339
Male Population	3,84,219	1,30,448
Female Population	3,30,847	1,12,891
Sex Ratio	861	865
Child Sex Ratio (0-6)	778	794
Child Population (0-6)	89,704	30,347
Male Child (0-6)	50,465	16,915
Female Child (0-6)	39,239	13,492
Child Percentage (0-6)	12.54	12.47
Male Child Percentage	13.13	12.97
FemaleChildPercentage	11.86	11.90
Literates	4,96,455	1,79,636
Male Literates	2,96,833	1,02,647
Female Literates	1,99,622	76,989
Average Literacy	79.39	84.34
Male Literacy	88.94	90.41
Female Literacy	68.46	77.41

Source: Census of India, 2011

Database and Methodology
GIS technology can be integrated into any enterprise information system framework. The processing of geographically referenced data is the unique feature of GIS. Geographical data shows both the location and characteristics of spatial features on earth. Therefore two data components are involved in GIS.

3.1.1 Data Source
The data for the present study has been taken from both primary and secondary sources. A brief description of data used in present study is given below:

Secondary Data Source
▪ IRS LISS- III Map (1:50,000)
▪ Administrative Map of Jhajjar District

3.1.2 Spatial Data
It gives the location of the geographic feature and is related to the geometry of a spatial feature. The data used in this present work is a toposheet (1:50,000) of Jhajjar district.

LISS-III
The LISS-III (Linear Imaging Self-Scanning Sensor) sensor is an optical sensor working in four spectral bands (green, red, near infrared and shortwave infrared). It covers a 141km-wide swath with a resolution of 23 meters in all spectral bands. In the present study image processing and visual interpretation, the technique was employed to carry out Land use/Land cover classification using digital data and standard False Colour Composite (FCC) paper print of Indian Remote Sensing satellite

Result and Analysis
Urban Land Use/Land Cover
Remote sensing and GIS are highly capable in urban studies, particularly in urban management and planning. The present study "mapping of urban land use/land cover" clearly demonstrates the importance and role of GIS-based information system and potentialities of satellite remote sensing technique for preparation of more updated and reliable information.

The first objective of the study, e.g. to prepare LULC map of Jhajjar District using map prepared by IRS based on LISS-III data (2016), has been obtained for this chapter. This map shows the features of the first level as depicted the classification scheme. It includes the features of built-up urban, wasteland, agriculture land, water bodies, transportation, vacant land, wetland features.
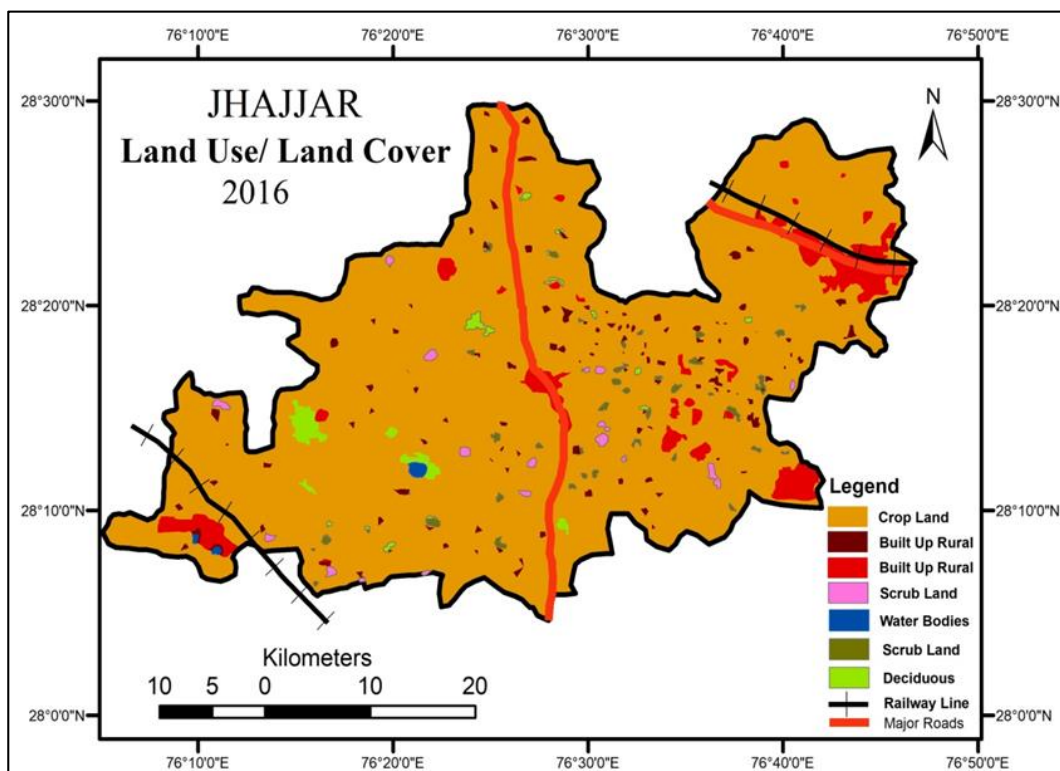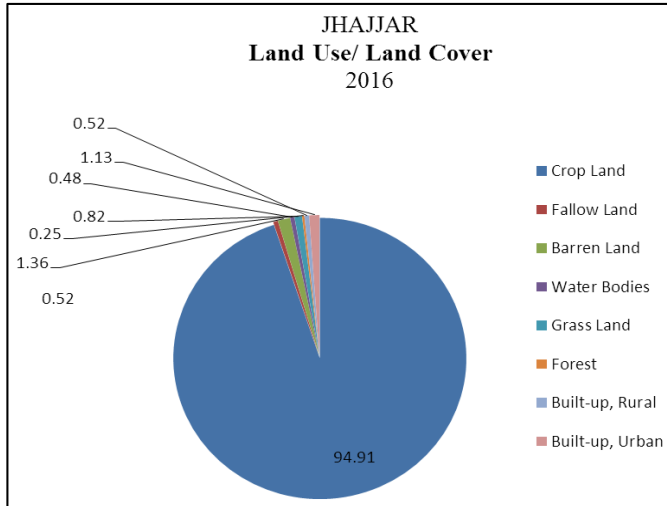

Fig 1.1

Table 1.3: Land Use/Land Cover Profile of Jhajjar District

Sr. No.	Category	Area (in km^2)	Area (in %)
1	Crop Land	1730.20	94.92
2	Fallow Land	9.40	0.52
3	Wasteland	24.86	1.36
4	Water Bodies	8.80	0.48
5	Grass Land	15.10	0.82
6	Forest	4.47	0.25
7	Built-up, Rural	9.30	0.52
8	Built-up, Urban	20.70	1.13
7	Total	1822.83	100

***Source*:** Computed by Author

Table 1.4: Land use/ Land cover Pattern of Jhajjar District, 2016

Description of Land Use and Land Cover Classes
LULC classification scheme and a brief description of classes are as given:
Land Cover is defined as observed physical features on the Earth's Surface. When an economic function is added to it, it becomes Land Use (FAO, 2005).

Built-Up Land
It is an area of human habitation developed due to non-agricultural use and that has a cover of buildings and transport and utilities in association with water, vegetation, and vacant lands. The study area LULC map consists of 3 classes under built-up viz., urban, rural and transportation.

Urban Area
Urban areas are non-linear built up areas covered by impervious structures adjacent to or connected by streets. This cover is related to centers of population. This class usually occurs in combination with, vegetated areas that are connected to buildings that show a regular pattern, such as vegetated areas, gardens etc. and industrial and/or other areas (FAO, 2005).
It includes residential areas, mixed built-up, recreational places, public / semi-public utilities, communications, public utilizes/facility, commercial areas, reclaimed areas, vegetated areas, transportation, industrial areas and their dumps, and ash/cooling ponds. The urban built-up area of Jhajjar district has been analyzed with the help of remote sensing and GIS. The Urban built-up area alone covers 20.70 km^2 out of 1822.83 km^2 of the total area of Jhajjar district (1.13%). It is an area of human settlements comprising the residential area, transportation and communication lines, industrial and commercial complexes, utility and services etc. collectively cities, towns, and habitations are included under this category.

Rural Area
These are the lands used for the human settlement of size comparatively less than the urban settlements of which the majority of the population is involved in the primary activity of agriculture (more than 25 per cent of workers are engaged in agricultural activities). These are the built-up areas, smaller in size, mainly associated with agriculture and allied sectors and non-commercial activities. They can be seen in clusters non-contiguous or scattered. Rural built up area alone covers 9.30 km^2 out of 1822.83 km^2 of the total area of Jhajjar district (0.52 per cent).
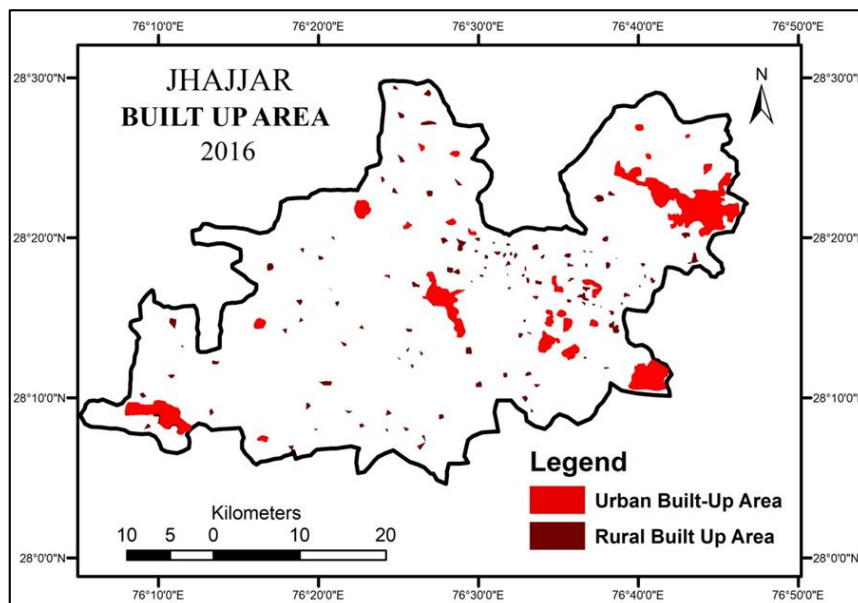
Fig 1.2

Transportation
The act of carrying or conveying a thing or person is called transport communication and transport system is one of the major aspects of the development of any region. Majorly of the population uses road network because most of the places are linked with the road only. Hence proper connectivity of roads with other places is a good indicator of development. The roadways include major and minor roads/streets, bridges/flyovers, expressway. There are numbers of National Highways such as N.H 9, NH-15A, NH352, NH 334B and NH 22), in Jhajjar district.

Another mode of the transportation network is a railway. There is two railway line one from Delhi to Rohtak via Bahadurgarh and second is Rewari to Bhiwani via Kosli railway station having broad gauge line in Jhajjar district
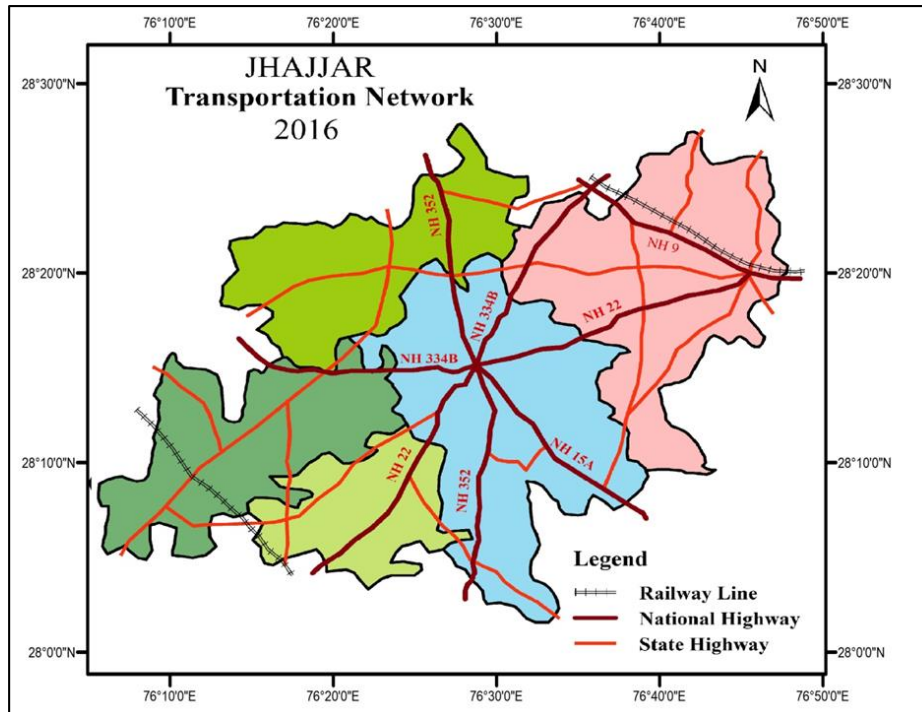

Fig 1.3

Agricultural Land
These are the lands primarily used for farming and for production of food grains, fiber, and other commercial and horticultural crops. It consists of:

Cropland
The crop area covers 94.92 per cent of the total area of the Jhajjar district. These are the areas with the standing crop as on the date of Satellite overpass. Cropped areas appear in bright red to red in color with varying shape and size in a contiguous to non- contiguous pattern. They are widely distributed in different terrains; prominently appear in the irrigated areas irrespective of the source of irrigation. It includes kharif, rabi, and zaid crop lands along with areas under double or triple crops.

Fallow Land
An agricultural land, which is left for periods of time in between cropping several periods (Ruthenberg, 1980). In another term, these are the lands, which are taken up for cultivation but are temporarily allowed to rest, un-cropped for one or more season, but not less than one year.

Forest
The forest area refers to the land with a tree canopy cover of more than 10 percent and area of more than 0.5 ha. Forests are determined both by the presence of trees and the absence of other predominant land uses. The trees should be able to reach a minimum height of 5 m (MOEF, 2011). Only 0.25 per cent of the total area is covered by forest. It consists of:

Deciduous Forest
It consists of the phenology of perennial plants that are leafless for a certain period of the year (Ford-Robertson, 1971). The leaf shedding usually takes place simultaneously in connection with the unfavorable season (UNESCO, 1973). These kinds of forest are predominantly composed of species, which shed their leaves once a year, especially during summer. It also includes tree clad area with tree cover lying outside the notified forest boundary areas that are herbaceous with a woody appearance e.g. bamboos, palms, tree ferns etc.

Scrub Forest
These are the forest areas which are generally seen at the fringes of dense forest cover and settlements, where there is biotic and abiotic interference. Most times they are located closer to habitations. Forest blanks which are the openings amidst forest areas, devoid of tree cover, observed as openings of assorted size and shapes as manifested on the imagery are also included in this category.
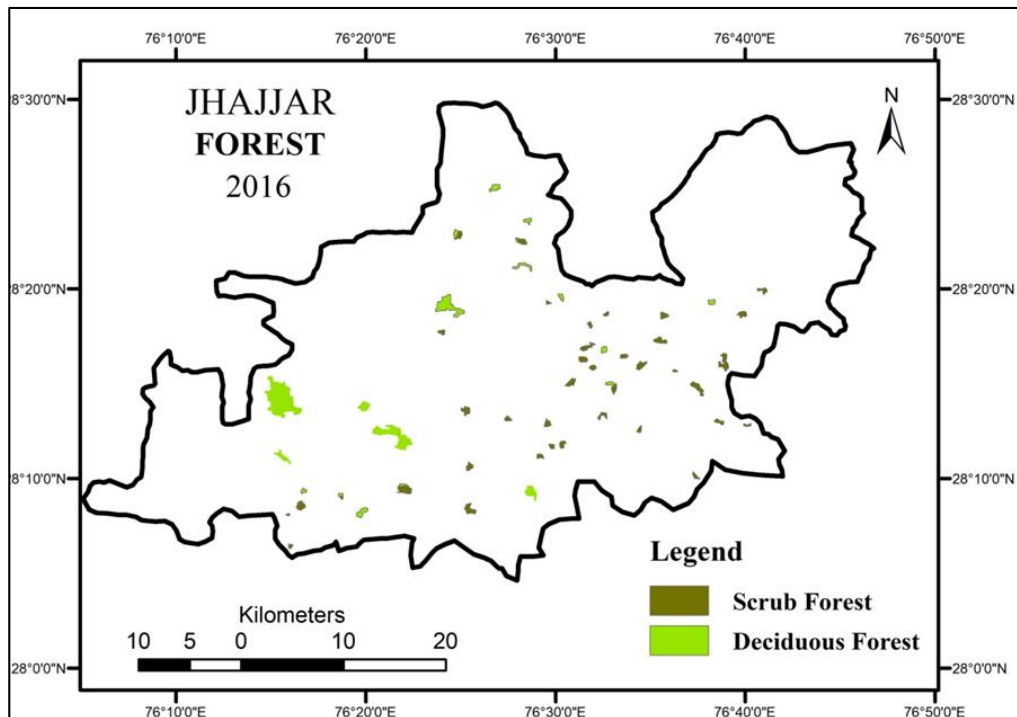
Fig.1.4

Scrub Land
These areas possess shallow and skeletal soils, at times chemically degraded extremes of slopes, severely eroded or subjected to excessive aridity with scrubs dominating the landscape.

Wasteland / Water Bodies
All submerged or water-saturated lands, natural or man-made, inland or coastal, permanent or temporary, static or dynamic, vegetated or non-vegetated, which necessarily have a land-water interface, are defined as wetlands. It consists of:

Wasteland
Degradation of land is caused by biotic and abiotic pressures. An increasing population places enormous demands on land resources. The wasteland has only 1.36 per cent of the Jhajjar district geographical area. It has 24.86 km^2 area out of 1830 km^2.

Water Bodies
This category comprises areas with surface water in the form of ponds, lakes, tanks, and reservoirs. 8.80 km^2 area out of 1822.83 km^2 lies under water bodies which consist 0.48 per cent area.
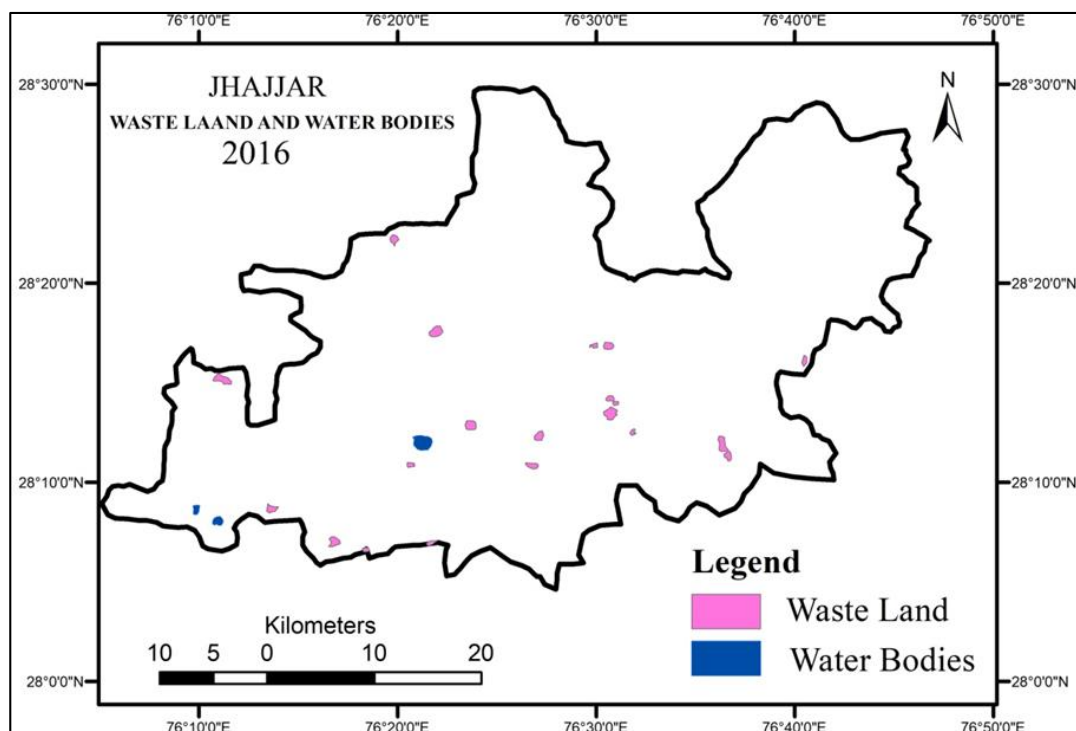

Fig 1.5

Conclusion

The study demonstrates the importance and potentiality of Satellite Remote Sensing and Arc GIS technique for preparation land use/land cover for future planning, management, and development of any area. Present study is based on interpretation of map of land use/land cover mapping prepared by IRS based on LISS-III data

This Study revealed eight major land use/land cover categories in the study area which are - built-up, agricultural land, wasteland, water bodies, grassland, scrubland etc. Out of study total area 94.92 per cent is come under cropland whereas 1.13 per cent is used for urban built-up land and 0.52 per cent in rural built-up area. Residential and Industrial are the major land use in the built-up area. There are numbers of National Highways such as N.H 9, NH-15A, NH352, NH 334B and NH 22), in Jhajjar district. The district is well connected by road and railways with the important cities of Haryana and Delhi. Some other category in the study area like a forest, water body and grassland which occupied 0.25, 0.48, and 0.82 per cent respectively of the study area.

This Study emphasized that district has crop dominant over land use. Central core areas Land use/land cover mapping and analysis show here may not provide the ultimate explanation for all problems related to land use/land cover pattern but it serves as a base to understanding the patterns and possible causes and consequences of land use/land cover in the study area.

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