

Land Use and Land Cover Mapping by using Remote Sensing and GIS Techniques – a Case Study of Kasaba Hobli, Hoskote Taluk, Bangalore Rural District, Karnataka, India.

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Abstract

The present study analyzes the dynamics of land use / land cover using modern geospatial techniques of Remote Sensing and GIS on Kasaba Hobli in Hoskote taluk of Bangalore District, India. The seasonal data of IRS-IC LISS-III images of the year 2005 and data collected from field visits were used to analyze the dynamics of land use / land cover of the above area. Erdas and Arc-GIS softwares were used for classification of land use/land cover. The area has been classified into five classes at Level I and fourteen sub classes at Level II. The major land use is Agricultural land 6798.93 Ha (77%), Built-up land 520.70 Ha (5.9 %), Forest cover 148.41 Ha (1.70%), Wasteland 118.30 Ha (1.35%) and Waterbodies 1160.76 Ha (13.27%). The study helps in identifying land use and land cover classes, and the data can be used for future environmental monitoring studies.

1. Introduction

The remote sensing techniques are used to measure the land cover, from which land use can be inferred particularly with ancillary data or priority knowledge. Land use/cover studies are multidisciplinary in nature. In addition, facilitating sustainable management of the land, land cover and use information may be used for planning, monitoring and evaluation of development, industrial activity or reclamation [1]. Detection of long term changes in land cover may reveal an idea for the shift in local or regional climatic conditions and analyzing the basis of terrestrial global monitoring. In order to improve the economic condition of the area without further deteriorating the ecosystem, every bit of the available land has to be used in the most rational way [2]. For this type of mapping it requires the present and the past land use/land cover data of the area. In this context, remote sensing technology plays an effective role in the sustainable development and

management of our environment and resources [3].

The unparalleled increase in population growth in Bangalore region has resulted in the increasing demands for land in Bangalore rural district. Hoskote area on the outskirts of Bangalore region has much of the land for agriculture and waterbodies, due to change in land use from agriculture to non-agricultural use resulting in, decrease in vegetation and waterbodies. This leads to depletion in ground water and much drier climate. This calls for rational utilization of the available land and hence the study of its characteristics is crucial in formulating the management and development plans. The conventional methods for the study of land use involves extensive field study which is time consuming and cumbersome. Land use changes are mostly due to more of human activities, which can be observed using current and archived remotely sensed data [4]. The information on land use / land cover patterns, their spatial distribution and changes over a time scale are prerequisite for making development plans [5].

Though many studies were undertaken to understand the land use and land cover in different parts of India, not much studies were carried out in Hoskote Taluk, Kasaba Hobli. So, a preliminary study was carried out to understand the present overlay of land use and land cover. The study focuses on the effectiveness of the satellite data for land use/land cover study and describes the various land use and land cover categories of the study area. It is observed that the multi-temporal images (Seasonal data) play an important role in the classification of land use and land cover [6][7].

2. Materials and Methods

2.1 Study Area

The study area is Kasaba Hobli in Hoskote Taluk in

Bangalore Rural district of Karnataka state in India with Latitude $12^{\circ}5'23''N$, Longitude $76^{\circ}19'47''E$ shown in Figure 1. Hoskote Taluk consists of 5 Hoblis - Anugondanahalli, Jadigenahalli, Kasaba, Nandagudi and Sulibete. It has many water tanks, large one being Hoskote tank. Agriculture, Apiculture and Horticulture are primary occupations of people here. Many industries have developed in the recent times. Kasaba Hobli has 36 villages. Kasaba Hobli geographical area is 8747.62 hectares.

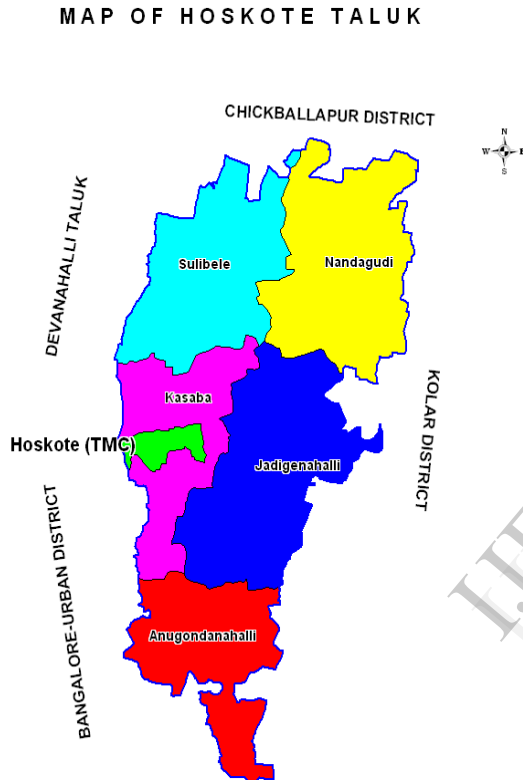


Figure 1. Map of Hoskote Taluk.

2.2 Satellite Image

The images used in this paper were extracted from IRS-ID LISS III scenes taken in the different seasons (summer, kharif and rabi) of the year 2005 with a spatial resolution of 23.5m. Figure 2, 3 and 4 are images of summer, kharif and rabi seasons respectively. The kharif season starts from June and ends in September. The rabi season is during October to February and the summer season is between March and May. False color composite (FCC) images were generated using the different bands of the satellite data and a great deal of information about land cover and land use could be displayed and analyzed.

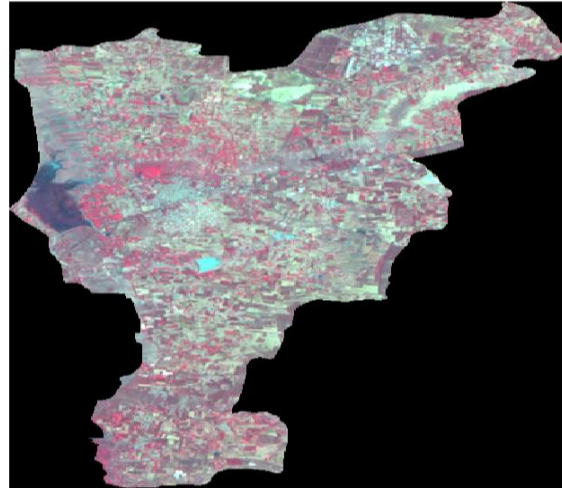


Figure 2. IRS IC LISS III image of Summer Season

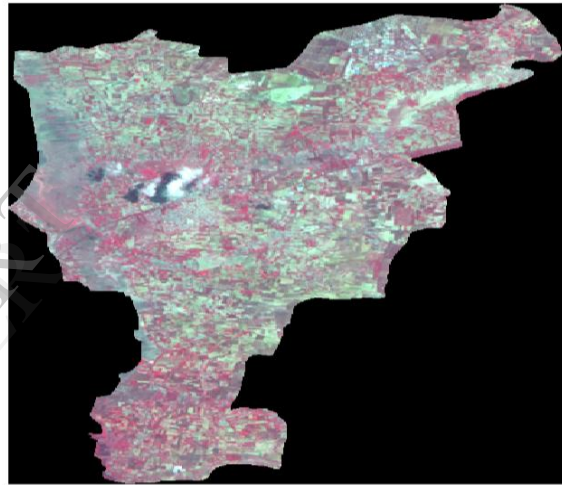


Figure 3. IRS IC LISS III image of Kharif Season

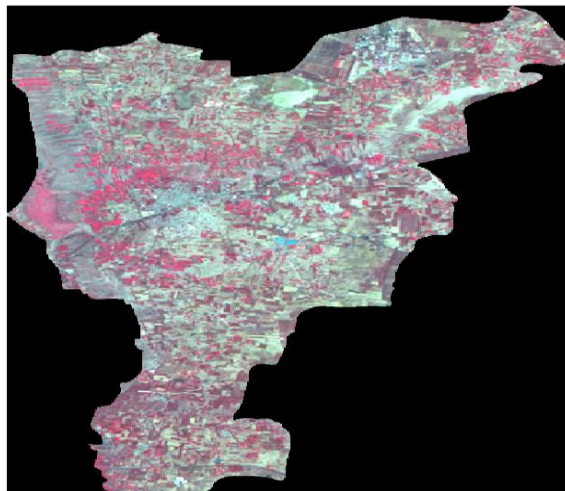


Figure 4. IRS IC LISS III image of Rabi Season

2.3 Survey of India Toposheets

The survey of India (SOI) toposheets 57G-16 and 57H-13 of 1:50000 scale, pertaining to the study area are used for the geo-referencing of satellite images and ground truth acquisition.

3. Methodology

The study has made use of various primary and secondary data. False Colour Composite images of the Kasaba hobli was generated with the band combinations of 3, 2, 1 in Red, Green and Blue LISS III data from different seasons data. The displayed images were spectrally enhanced by histogram equalization method. Land use/land cover map was then prepared by on-screen visual interpretation method using ERDAS IMAGINE 8.5 [8]. The primary LULC classification scheme used for this study was derived from the Anderson classification system for a level one classification [9] [10]. The classification scheme utilized five LULC classes representing built-up areas, agriculture land, forest, wasteland and waterbodies. The level one classes were then used to derive level two classes as shown in Table 1.

Different land use/land cover classes as shown in Table 1 were then identified using visual interpretation keys such as colour, tone, texture, pattern, size and shape. Land use/land cover map with the above classes was then transferred to base map of 1:50,000 scale, which was used for ground truth collection. Based on the ground truth data, land use/land cover map of Kasaba hobli were corrected and finalized using ArcGIS software. Adequate field checks were made before the finalization of the thematic maps. The main goal of this study is to extract the land use/land cover classes and changes of the study area.

Table 1. Level 1 and II LULC classification classes.

Level 1	Level II
Agricultural land	Includes Agricultural Plantation, Single crop land, Double crop land and Fallow land
Built-up land	Includes all town/city, industrial area and villages.
Forest	Includes Forest plantation, scrub forest and degraded forest
Wasteland	Includes land with scrub, Gullied/Revinous land and Barren Rocky/Stony waste/Sheet Rock Area
Waterbodies	All water bodies including tanks and ponds.

4. Analysis and Results

Land cover and land use mapping serves as a basic inventory of land resources for all levels of government, environmental agencies and industries in the world. Land use classes can be effectively delineated from the digital remote sensing data. The various land use and land cover classes interpreted in the study area include, built-up land(industrial area, village, town and cities), agricultural land (single crop land, double cropland, fallow land and agricultural plantation), forest (forest plantation, scrub forest and degraded forest), waste lands, (land with scrub, Gullied/Revinous land and Barren Rocky/Stony waste/Sheet Rock Area) and water bodies, which are shown in Figure 5. The study revealed that nearly 6798.93 Ha of the area was covered by agriculture, 520.70 Ha of the area covered by built-up area and water bodies is 1160.76 Ha. Wasteland covering 118.30 Ha and Forest area covers 148.41 Ha to limited extents as shown in Table 2. Detailed information of these land use /land cover classes of the study area are described in the following section and seen in Figure 5.

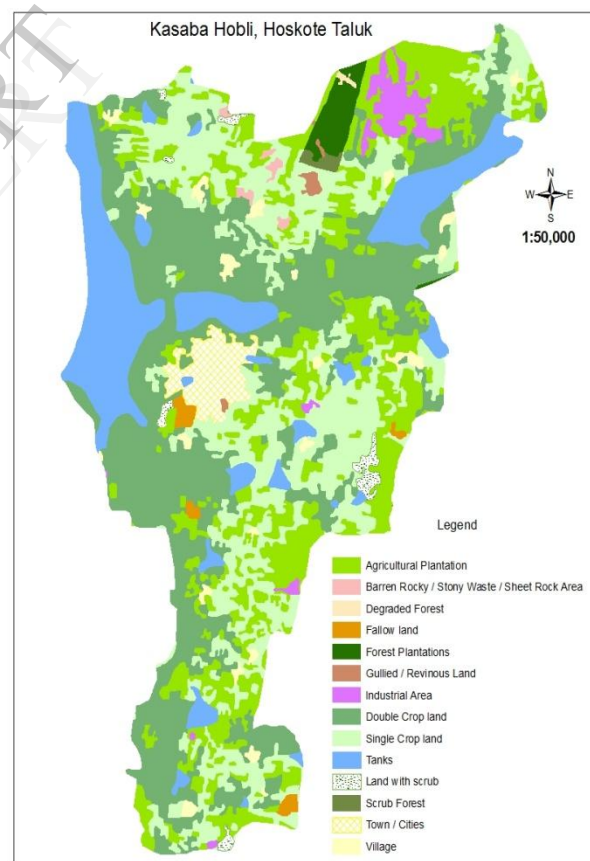


Figure 5. Land Cover and Land use map of Kasaba Hobli, Hoskote Taluk

Table 2. Area Estimates of Different Land Use and Land Cover Features

Name of the feature	Area in Hectares	% of area
Agricultural Plantation	1799.89	20.58
Double Crop land	2831.10	32.37
Single Crop land	2116.15	24.19
Fallow land	51.78	0.59
Industrial Area	160.18	1.83
Town / Cities	214.83	2.46
Village	145.69	1.67
Degraded Forest	5.91	0.07
Forest Plantations	119.90	1.37
Scrub Forest	22.60	0.26
Barren Rocky / Stony Waste / Sheet Rock Area	28.83	0.33
Gullied / Revinous Land	21.84	0.25
Land with scrub	67.63	0.77
Lake / Tanks	1160.76	13.27
Total area	8747.62	100.0

4.1 Agriculture Land

This encompasses both cultivated (Single crop land) and irrigated lands (double crop land). These are the lands mainly used for farming and for production of food and other commercial and horticultural crops. With the help of satellite data, it is possible to identify various agricultural land uses up to level III. The different types of agriculture lands are identified in the study area and described below in detail. These include the agricultural areas identified by their characteristic red tone, regular shaped agricultural fields and in associated with settlements, water bodies, etc. Crop lands are found in and around the water bodies. The agricultural lands occupy 77% of the area, the major land use is under agriculture. The percentage of agricultural area may decrease in the coming years due to urbanization and industrialization.

4.1.1 Single Crop land

The kharif crops (paddy, ragi, jowar, cereals, maize and pulses) are cultivated in the months of June, July and August. It is interested to note that such crops are totally distributed in the northern part and eastern part of the study area. These kharif crops occupy 2116.15 Ha (24.19 per cent) of the area. These area being second highest.

4.1.2 Double Crop land

The rabi crops mostly paddy, ragi, maize and vegetables are cultivated in the months of October, November and December. The above crops are well distributed in the area and found in level plain lands, around the water bodies. A double crop land occupies an area of 2831.10 Ha (32.37 per cent) of the total area and is the largest area among the other classes.

4.1.3 Agricultural Plantation

Plantations appear in dark-red to red tone of different sizes with regular and angled shapes. Depending on the location, they are dispersed or contiguous pattern. Plantation area includes coconut, grapes, sapota mango orchards, mulberry, and vegetables mostly under irrigated conditions. Agricultural plantations occupy 1799.89 Ha (20.58 percent) of the Kasaba Hobli.

4.1.4 Fallow land

These are the lands presently not cultivated and are identified by their dark greenish tone, smaller sized rectangular parcels and medium texture. These lands evenly distributed all over the study area and cover very limited area of 51.78 Ha (0.59 per cent).

4.2 Built up area

This is an area of human habitation developed due to non-agricultural use and has a cover of buildings, transport and communication, utilities in association with water, vegetation and vacant lands.

4.2.1 Towns/Cities

It is an area essentially used for human habitation and has both residential and commercial. It includes permanent buildings of single, double or high rise buildings. It also includes temporary establishments. This class was identified with their dark bluish green tone in the center and bluish tone on the periphery, and shows a coarse texture. Major settlement is Hoskote Town covering an area of 214.83 Ha (2.46 percent).

4.2.2 Industrial Area

Land used mainly for various kinds of industries. They are identified with dark bluish green tone and white patches in between and have coarse texture. Major industrial area is located in the northern part of the hobli (KIADB), in Hoskote hobli small scale industries including poultry are in small patches and distributed

all over. Total Industrial area is 160.18 Ha (1.83 percent).

4.2.3 Villages

These are the built-up areas, smaller in size, mainly associated with agriculture and allied sectors. They appear as dark bluish green tone, the size varies from small to big, irregular and discontinuous in appearance and scattered. Village settlements cover an area of 145.69 ha (1.67 percent).

4.3 Forest

Forest, which comprises of thick and dense canopy of tall trees, which predominantly remain green throughout the year. These lands are discerned by their red to dark red tone and varying in sizes. Based on the tonal and textural variations, the forests of the Kasaba Hobli were divided into three categories as forest plantation, degraded forest and scrub forest.

4.3.1 Degraded Forest

It includes land with degraded scrubs, bushes and smaller trees and are identified by greenish tone. It occupies limited area of 5.91 ha (0.07 per cent).

4.3.2 Forest Plantation

Notified forest plantations belonging to forest department which include tree species. Forest, comprises of thick and dense canopy of trees. They are identified by their red to dark red tone regular shape and size, have smooth texture. This includes Eucalyptus plantation also. Area covered is 119.90 ha (1.37 percent).

4.3.3 Scrub Forest

These are the forest areas where the crown density is less than ten percent of the canopy cover, generally seen at the fringes of dense forest cover and settlements. They appear light red to dark brown depending on canopy cover. size varies from small to big, irregular in shape. Occurs to limited extent in northern forest plantation area and covers 22.60 Ha (0.26 percent).

4.4 Wasteland

Wasteland is a degraded land which is not used for any purpose. The wasteland of the Kasaba Hobli were classified into three categories as Land with scrub, Gullied/Revinous land and Barren Rocky / Stony

Waste / Sheet Rock Area.

4.4.1 Land with scrub

These lands are subject to degradation, due to erosion or thorny bushes. Such areas are identified from their yellowish tone to brown to greenish blue depending on the open ground and vegetation cover. Land with scrub are found scattered in the hobli covering an area of 67.63 Ha (1.99 per cent).

4.4.2 Gullied/Revinous land

Gullies are formed as a result of localized surface runoff affecting the unconsolidated material resulting in formation of perceptible channels causing undulating terrain. They are commonly found in sloping lands, developed as a result of concentrated runoff. They appear in light yellow to bluish green in tone depending depth of erosion and exposure of parent material. They vary in width and appear streak like. They are found in northern part of the hobli covering an area of 21.84 Ha (0.25 percent).

4.4.3 Barren Rocky/Stony waste/Sheet Rock Area

These areas are bare rock exposures devoid of soil and vegetation cover. They can easily discriminated from other classes because of their characteristic spectral response. They appear white and bluish white tone depending on the rock type. Found in northern part of the hobli and cover an area of 28.83 Ha (0.33 percent).

4.4 Water bodies

This comprises of surface water bodies of tanks and ponds. These are identified on satellite image in blue to dark blue or cyan in tone depending on the depth of water and bunds. Tanks are the source of water for agriculture and domestic purpose in Kasaba Hobli and are also source for ground water recharge. Depending on the monsoon rainfall and utilization of water, both wet and dry tanks are seen. Hoskote tank covers large area, followed by Hallur tank and Dodammanni tank. A total of 13 tanks are found in Kasaba hobli. Some tank beds are cultivated in rabi season. Tanks cover an area of 1160.76 Ha (13.76 percent).

5. Conclusion

In the Hoskote hobli (Kasaba) area the following land use and land cover categories were identified using RS and GIS techniques. Agricultural lands cover the largest area with single and double cropped areas, agricultural plantation and fallow lands. Major crops

grown are ragi, paddy, mulberry, grapes, mango and vegetables. The built-up lands forms the second largest land category which includes town, villages and industrial areas. Water bodies are third largest category. Forest plantations and wasteland occur to limited extent. Multi-temporal images of three different seasons help in analyzing the land cover and land use features of the area. The present study emphasizes that remote sensing coupled with GIS can be effectively used for real time and long term monitoring of the environment. This baseline information on land use/land cover of the Kasaba hobli will immensely help in the formulation of policies and the benefits in the developmental planning.

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