

GEOSPATIAL TECHNIQUES FOR LAND USE LAND COVER CHANGE ANALYSIS IN CHIKKANAYAKANAHALLI, TUMKUR DISTRICT, KARNATAKA

Channabasappa, K and Lingadevaru, M*

Department of Geology, School of Earth Sciences

Central University of Karnataka, Kalaburagi-585 367, Karnataka

**Corresponding Author (mlingadevaru@cuk.ac.in)*

Abstract

The LU/LC changes of Chikkanayakanahalli area were mapped by using satellite data and suitable software for the years 2000, 2003 and 2012 in order to assess the mining induced land degradation. LU/LC maps were compared and it reveals that maximum area is occupied by crop land, followed by barren rocky, plantation, forest cover, and water body settlement and mining area. No significant changes were observed in LU/LC classes except, barren rocky, forest cover and mining areas. It is observed that there is significant raise in mining area from 0.50 to 2.9 Km² with decreasing in barren rocky land and forest cover from 2000 to 2012.

Key words: *satellite, Land use/Land cover (LU/LC), analysis, mining, barren land, forest,*

1. Introduction

Land Use/ Land Cover is a very important factor in any developing country for the economic planning of a region or nation which needs details information on element of natural resources. Land use means the area which is used by human being and land cover means by the naturally occupied area. The changing land-use patterns require a frequent updating of the existing land-use maps of the area. It is very crucial time to understanding the natural and socioeconomic factors which are continuously modifying the landscape (Sahu, and Dash, 2011; Basavarajappa et. al, 2016). Remote Sensing and Geographical Information System (GIS) has become very advanced tool for the proper utilization, equitable distribution and optimal management of natural resources (Kiran, 2013; Sanjith, et al., 2018) Therefore, attempts are required to produce data from the concerned source in the standardized formats and put in an appropriate database. Satellite remote sensing is a powerful tool for natural resources inventory at local, regional and global scales, because of its synoptic, repetitive area coverage and high spatial resolution with multispectral bands. Remote sensing has shown its superiority in data collection for natural resources management Remotely sensed data are used to obtain the necessary information on land under various crops, crop rotation and agricultural practices adopted, soil types, problems of land degradation, availability of water bodies etc., which are very useful for agricultural development. The remotely sensed data can be taken even of inaccessible land and applying the suitable technology and agricultural practices can do identification of unused land, wasteland, degraded land etc., (Prakash, and Gupta, 1998; Agele, 2000; Yacouba, 2009; Chitade and Katyar, 2010; Arendran et. al. 2013), the repetitive coverage of space remote sensing is useful in detecting changes/ degradation, unwanted happening in the same area and the impact of anthropogenic

activity on natural landscape (Rao, 2002), The dynamism of with which changes are occurring on the landscape can be understand very effectively and correct measures can be taken in advance.

The remote sensing data can be used for the preparation of a set of resource maps such as surface water bodies, ground water potential zones, ground water recharge sites, type of soil, existing land use patterns etc, and the combination of these data with other information like meteorological data, socio- economic factors etc., can be used to identify the priority areas for various land needs for the developmental activity without disturbing the ecology.

2. Study area

Chikkanayakanahalli is a town in Tumkur district and is located at 13.42°N 76.62°E. Chikkanayakanahalli (C N Halli) area considered as the potential area for Gold, Iron ore, Manganese, Dolomite, Limestone, Clay, Soap Stone, Manganese, Quartz and Steatite. This area is endowed with rich iron ore deposit, there are 24 iron ore mine leases in Chikkanayakanahalli sector and distributed in three taluks of Tumkur district such as C.N Halli, Gubbi and Tiptur (Fig. 1). The main aim of this paper is to assess the land land use/ land cover changes in the C N Halli area over the period of past 12 years (2000 -2012) as there was intensive mining activity during this period.



Fig.1. Location map of the study area

2. Materials and Methods

The survey of India (SOI) topographical map of 57 C/11 of scale 1:50,000 which cover the study area is used to prepare the base maps and LANDSAT (TM) 2000, 2003 and Google imagery of 2012 were used for land use/ land cover mapping. Visual interpretation techniques were adopted

to delineate the land use/ land cover classes such as built-up land, fallow land, plantation, forest, waste lands, water bodies, mining area and degraded land based on the image characteristics like tone, texture, shape, color, association, back ground etc.. During interpretation, where doubtful units were encountered for those areas the ground truth survey was done and corrected the misclassified features by using ERDAS Imagine and Arc GIS software.

3. RESULTS AND DISCUSSION

The satellite data provides a permanent and authentic record of the land-use patterns of a particular area at any given time which can be reused for verification and reassessment. Satellite data and GIS provide the facility to integrate multi-disciplinary data for dedicated interpretations in an easy and logical way. This integrated approach proves to be very effective method for assessing the mining induced land degradation over the period of time. Hence, Lu/Lc maps of the study area for the years 2000, 2003, and 2012 were prepared by visual interpretation of Landsat image

Fig. 2 depicts seven classes of Land use/ Land cover for study area for the years 2000,2003 and 2012. The area covered under each of these classes and the percentage of area changes is given in table 1.. Vegetation (crop land and plantation) cover is about 60.34% of the total area and there is no changes in vegetation covered area and even settlement is 0.81% and water body is about 2.92% also no changes were identified during the assessment period from 2000-2012. But forest area 12.21% and barren rocky area 23.58 is decreased to 12.09% and 23.03% respectively. Mining area is increased from 0.14% to 0.81% within the assessment period.

3.1. Land Use/Land Cover Map 2000

Lu/Lc map of study area for year 2000 (Fig.2)was prepared and various land Use/Land cover categories were identified and mapped. The area under study consist of Lu/Lc class viz;).

3.1.1. Settlements

It is an area of human settlements developed due to non-agricultural actives and has a cover of settlement. These settlements appear as steel grey tone with a molted structure on the imagery. The area under this category has been estimated as 2.9403Km² and occupying about 0.81% of the total area.

3.1.2 Agricultural lands

Most of the lands in this area are mainly used to take the Kharif crop land. The area under this category has been estimated as 158.2839 Km² and occupying about 43.61% of the study area (Table 1), and some percent of the land is mainly used as plantations growing coconut, Areca nut, and Banana etc. There also consist mixed crops and the area has been estimated as 60.7345 Km² and occupying about 16.73% of the study area.

3.1.3 Barren Rocky land

This is the area with limited ability to support life as there are rock exposures of barren land. These areas are covered with Iron and Manganese ore. The area under this category has been estimated as 85.6017 Km² and occupying about 23.58% of the study area.

3.1.4 Water body

The study area comprises of 20 major tanks which provide drinking water to the adjacent villages and most of them serve as source of irrigation and domestic use. The tanks occupying total geographic area 10.5905Km² and constitute about 2.92%.

6.1.5 Forest

In the study area major amount of the forest land is present in the hilly region, comprises of Tirtharampura North West extension reserved forest, Mattikere reserved forest and Harenahalli reserved forest. The total forest area has been estimated as 44.3115 Km² and occupying about 12.21% of the study area.

6.1.6 Mining area

In Chiknayakanalli mining area covers nearly 0.5 Km² of the total study area in the year 2000.

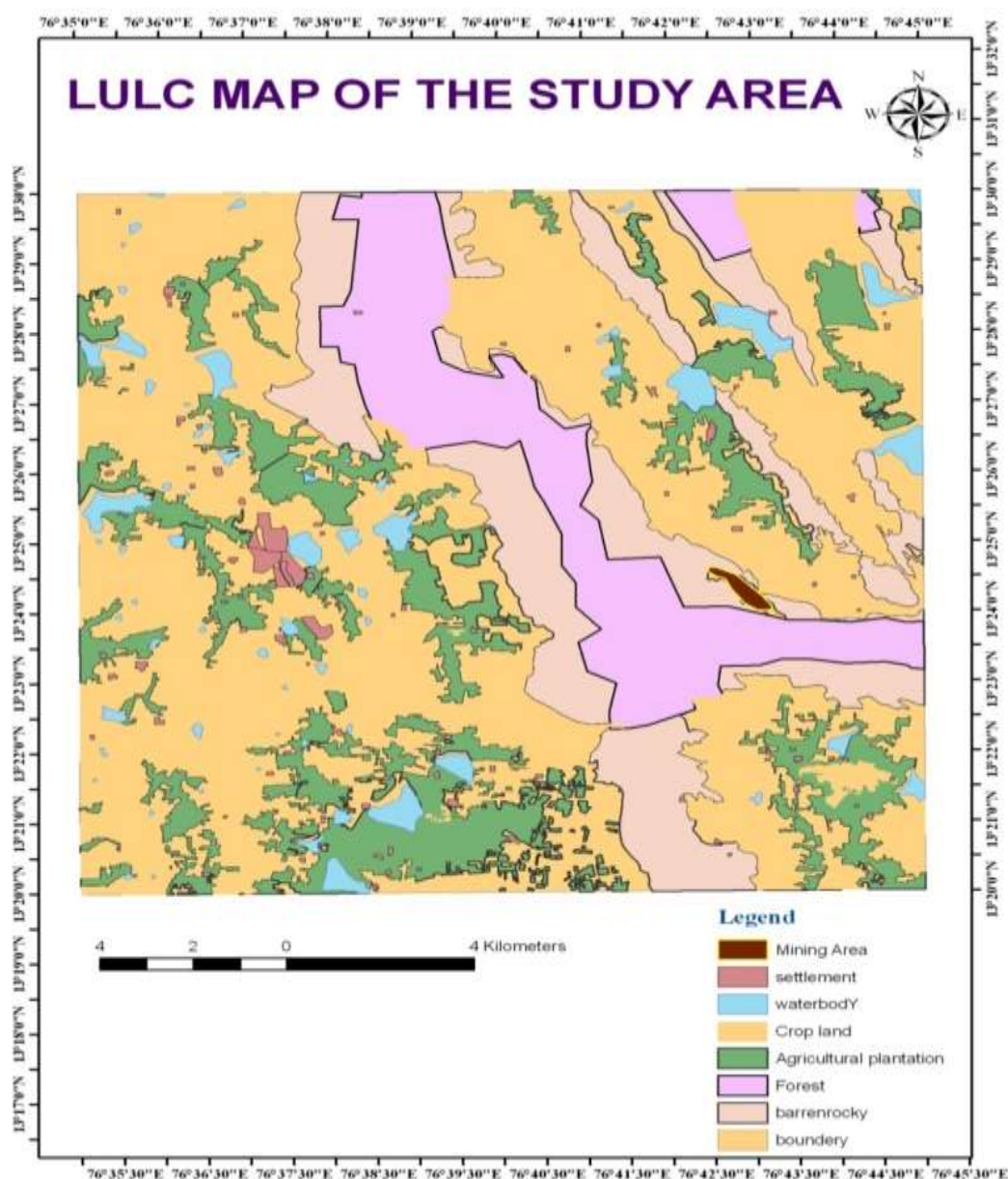
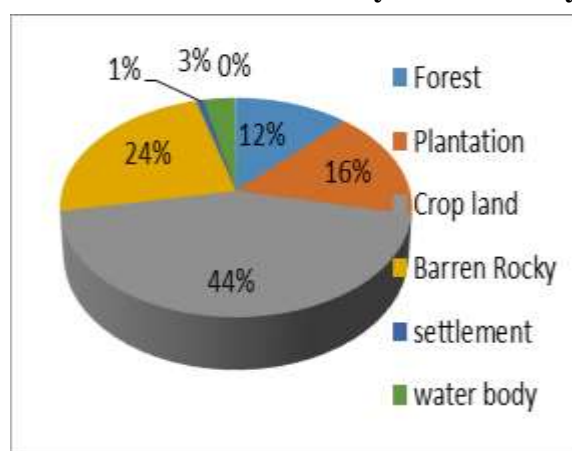


Fig. 2. Lu/Lc map of the study area for the year 2000

Sl no.	Lu/Lc class	Area in Sq Km	Area in %
1	Forest	44.3115	12.21
2	Plantation	60.7345	16.73
3	Crop land	158.2839	43.61
4	Barren Rocky	85.6017	23.58
5	Settlement	2.9403	0.81
6	Water body	10.5905	2.92
7	Mining area	0.50832	0.14
	Total	362.97072	100

Table 1. Lu/Lc class units of the study area for the year 2000



Pie chart showing percentage of classes of Lu/Lc for the year 2000

3.2 Land Use/Land Cover Map 2003

Fig. 3, is the Lu/Lc map of study area for the year 2003 prepared by using Landsat image. The map shows that study area comprises of forest land, barren rocky land, agricultural land (Crop land, Plantation), Forest, Settlement, mining area and water bodies as Lu/Lc units

3.2.1. Settlements

The area under this category has been estimated as 2.9403 Km² and occupying about 0.81% of the study area in the year 2003.

3.2.2 Agricultural lands

The area under this category has been estimated as 158.2839 Km² and occupying about 43.61% of the study area in the year 2003 and some percent of the land is mainly used as plantations growing Areca nut, coconut and Banana etc (Table 2). These area also consist mixed crop has been estimated as 60.7345Km² and occupying about 16.73% of the study area.

3.2.3 Barren Rocky land

These are the areas with limited ability to support life as they are rock exposures of barren land. These areas are covered with Iron and Manganese ore deposits. The area under this category has been estimated as 85.6017Km² and occupying about 23.58% of the study area. There is a slit

decrease in the area under this category compared to the year the 2000

3.2.4 Water body

The study area comprises of 20 major tanks which provide drinking water to the adjacent villages. The tanks occupying total geographic area 10.5905Km^2 and occupying about 2.92%. No change is recognized in the geographical area this category compared to year 2000

3.2.5 Forest

In the study area major amount of the forest land is present in the hilly region, it comprises of Tirthampura North West extension reserved forest, Mattikere reserved forest and Harenahalli reserved forest. The total forest area has been estimated as 43.912Km^2 and occupying about 12.10% of the study area for the year 2003. Compared to year 2000 there is slight decrease in forest cover.

3.2.6 Mining area

The mining activity gradually increases from the year 2000 to 2003 as it is evident from increase in area coverage of mining area 0.5Km^2 to 0.907Km^2 respectively.

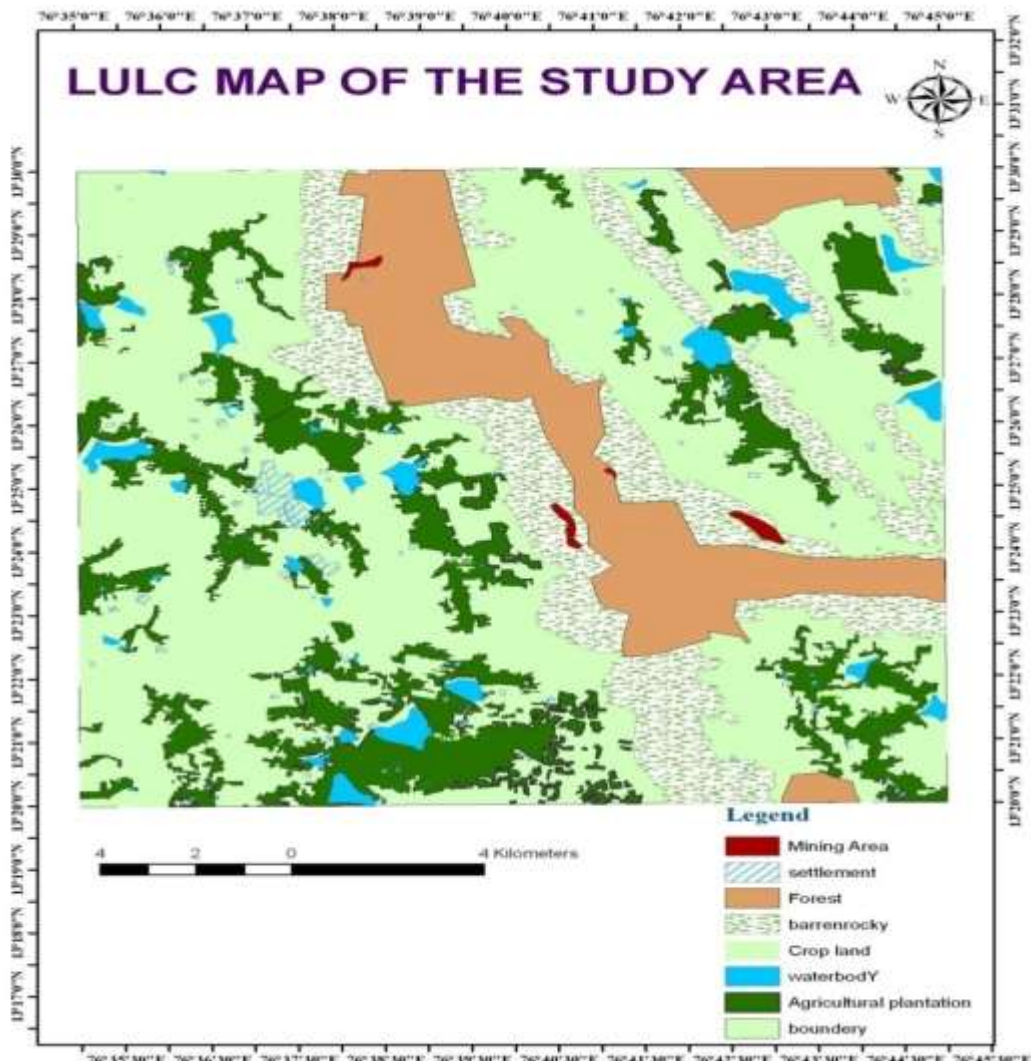
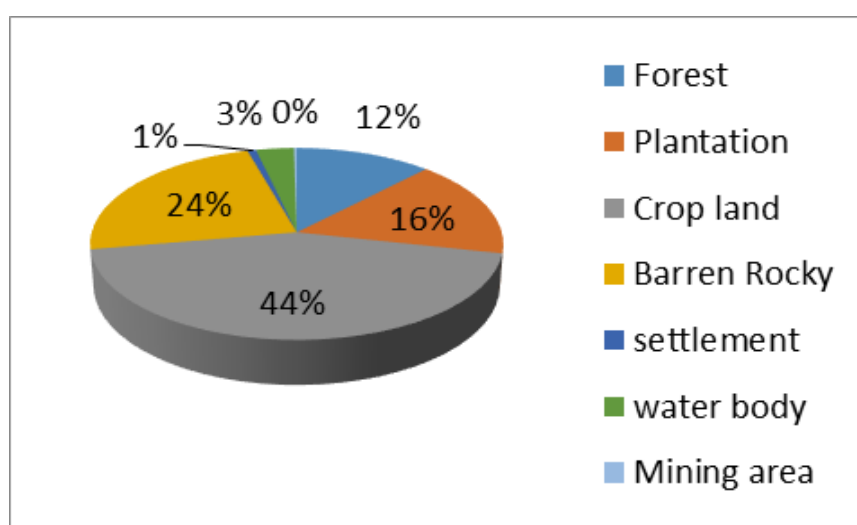


Fig. 3. Lu/Lc map of the study area for the year 2003

Sl no.	Lu/Lc class	Area in Sq Km	Area in %
1	Forest	43.912	12.10
2	Plantation	60.7345	16.73
3	Crop land	158.2839	43.61
4	Barren Rocky	85.6017	23.58
5	Settlement	2.9403	0.81
6	Water body	10.5905	2.92
7	Mining area	0.9078	0.25
	Total	362.9707	100

Table 2. Lu/Lc class units of the study area for the year 2003



Pie chart showing percentage of Lu/Lc classes for the year 2003

3.3 Land Use/Land Cover Map 2012

Fig. 4 is Land use and land cover map of the study area for the year 2012 prepared by using Google image and showing distribution of Lu/Lc classes viz., forest land, barren rocky land, agricultural land (Crop land, Plantation), Forest, Settlement, mining area and water body

3.3.1 Settlements

These settlements appear as steel grey tone with a molted structure on the imagery. The area under this category has been estimated as 2.9403 Km² no change is recognized in the areal extent of this Lu/Lc unit from 2003 to 2012.

3.3.2 Agricultural lands

The area under this category has been estimated as 158.2839 Km² and occupying about 43.61% of the study area, and some percent of the land are mainly used as plantations growing Areca nut, coconut and Banana etc. This Lu/Lc class also consist mixed crop and has been estimated as 60.7345Km² and occupying about 16.73% of the study area. No change is recognizable in the areal extent of this unit from the year 2003 to 2012.

3.3.3 Barren Rocky land

These are areas with limited ability to support life as they are rock exposures of barren land. These areas are covered with Iron and Manganese ore deposits in the study area. The area under this category has been estimated as 83.6017Km² and occupying about 23.03% of the study area for the year 2012. It is observed that in year 2012 there is decrease in the areal extent of this unit compared the year 2003

3.3.4 Water body

The study area comprises of 20 major tanks which provide drinking water to the adjacent villages and occupying total geographic area 10.5905Km²and occupying about 2.92%. There no change in the areal extent of this unit compared to year 2003.

6.3.5 Forest

In the study area major amount of the forest land is present in the hilly region, it consists of Tirtharampura North West extension reserved forest, Mattikere reserved forest and Harenahalli reserved forest. The total forest area has been estimated as 43.88Km²and occupying about 12.09% of the study area for the year 2012. There slight decrease in the forest cover compared to 2003 Lu/Lc map

6.3.6 Mining area

Mining area covers nearly 2.907 Km²and occupying about 1% of the total study area in the year 2012. It is a substantial increase from 2003 to 2012 and evidencing intensive mining activity in the area.

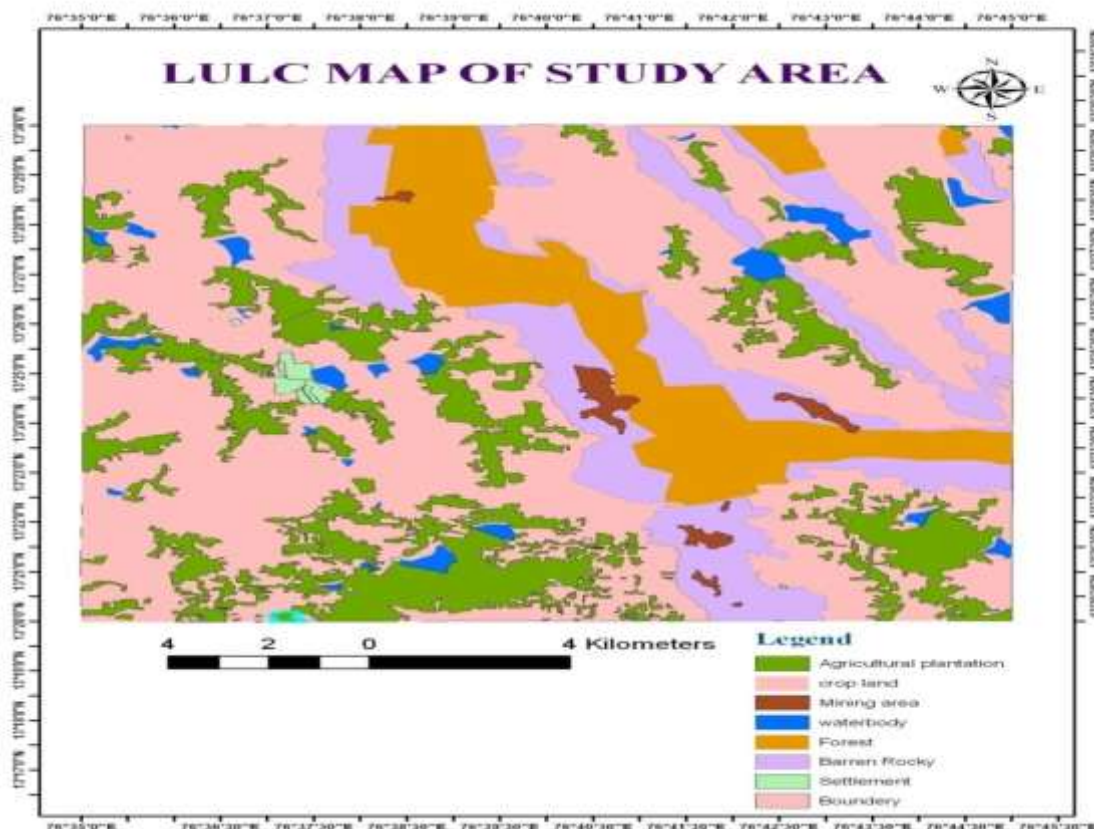
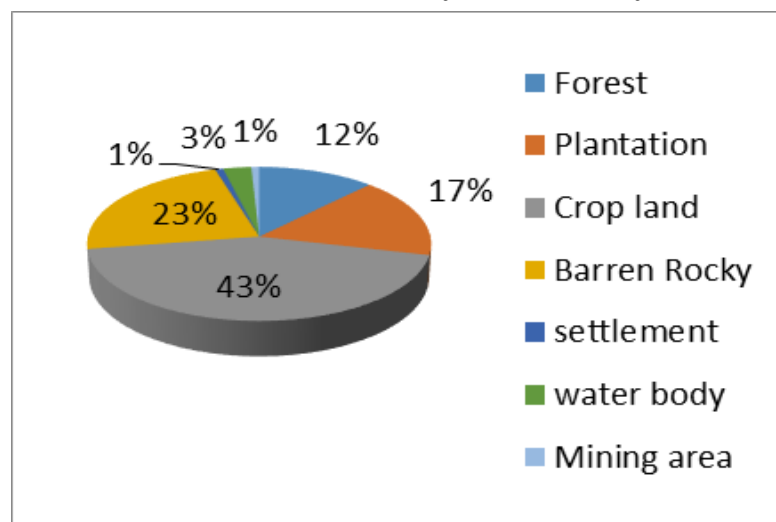


Fig. 4. Lu/Lc map of the study area for the year 2012

Sl no.	Lu/Lc class	Area in Sq Km	Area in %
1	Forest	43.88	12.09
2	Plantation	60.7345	16.73
3	Crop land	158.2839	43.61
4	Barren Rocky	83.6017	23.03
5	settlement	2.9403	0.81
6	water body	10.5905	2.92
7	Mining area	2.9398	0.81
	Total	362.9707	100

Table 3. Lu/Lc class units of the study area for the year 2012**Pie chart showing percentage of Lu/Lc classes for the year 2012**

4. Comparison of Lu/Lc of 2000, 2003 and 2012 of the study area

In order to assess the mining induced land degradation Lu/Lc maps of 2000, 2003 and 2012 (Fig. 2, 3 & 4) were compared and it reveals that maximum area is occupied by crop land, followed by barren rocky, plantation, forest cover, water body settlement and mining area. No significant changes were observed in Lu/Lc classes except, barren rocky, forest cover and mining. It is observed that there is significant raise in mining area from 0.50 to 2.9 Km² with decreasing in barren rocky land and forest cover from 2000 to 2012. As per the records of the Department of Mines and Geology, Tumkur there are 56 mining leases in Tumkur district. Out of the 56 mine leases 24 are engaged in iron ore production in CN halli sector and are distributed in three taluks of Tumkur district such as C.N Halli, Gubbi and Tiptur. The extent of mine lease sanctioned in Tumkur district cover a land area of 2678.97 ha. Of which the iron ore mine lease land area consist of 1148.38 Ha which include Forest (513.32 ha) and revenue land (635.06ha).

Further, statics from the records of State department of Mines and Geology indicates that there is substantial increase in production of iron over the years in CN Halli sector of Tumkur. The total iron ore produced during 2002-03 was merely 0.174 million tones which increased to more than

six fold to 1.113 million tonnes in 2003-04. The peak iron ore production was recorded during 2006-07 with 3.023 million tonnes. The total production from 1999 to March, 2011 has been recorded to be 18.33 million tonnes and the dispatch to be 15.23 million tonnes.

Following line graph (FIG.5) indicate that there is spurt in mining activity from 2003 onwards which coincides with peak period of iron ore production (2003, 04, 05, 07, 08, 09). The table given below and the bar graph (Fig.6) indicates exponential increase of mining area Lu/Lc class in CN Halli area.

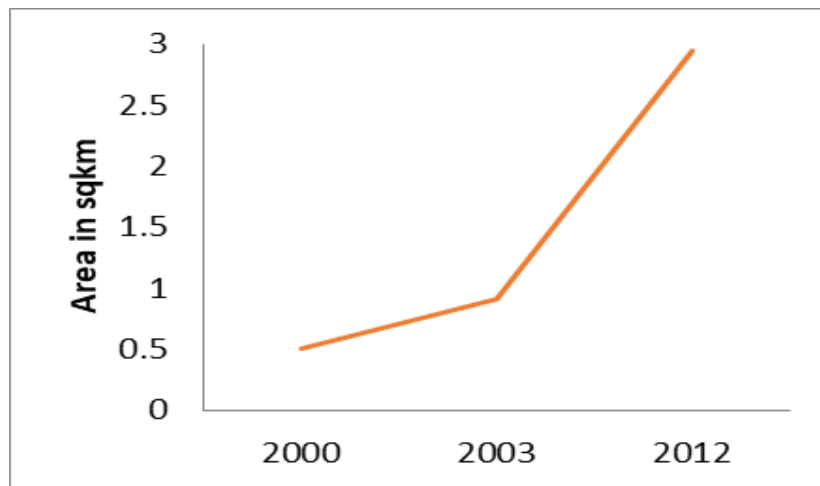


Fig.5. Line graph showing percentage of increase mining area for the years 2000, 2003 & 2012

SL no.	Lu/Lc class	Area in Km ²		
		Year 2000	Year 2003	Year 2012
1	Forest	44.3115	43.912	43.88
2	Plantation	60.7345	60.7345	60.7345
3	Crop land	158.2839	158.2839	158.2839
4	Barren Rocky	85.6017	85.6017	83.6017
5	Settlement	2.9403	2.9403	2.9403
6	Water body	10.5905	10.5905	10.5905
7	Mining area	0.50832	0.9078	2.9398

Table 4. Lu/Lc class units of the study area for the years 2000, 2003 & 2012

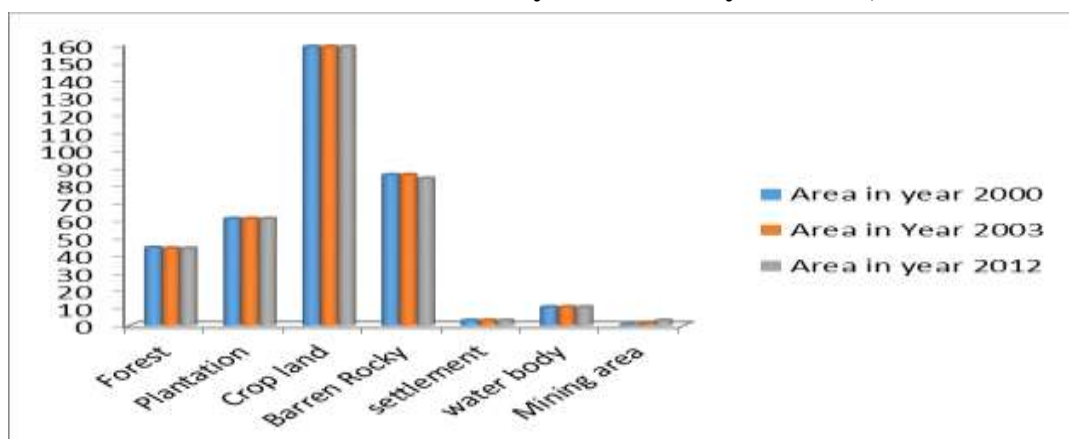


Fig.6. Bar graph showing Lu/Lc classes of CN halli area for the years 2000, 2003 & 2012

5. CONCLUSION

Preparation of LULC maps are very important document for monitoring, better planning and management of available resources for future usages. This study analysed for the distributions of different Lu/Lc classes in Chikkanayakanahalli area over a period from 2000 to 2012. The results of the study indicate that there is gradual increase in mining activity by converting barren rocky and forest land from 2000 to 2012.

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