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Spatio temporal analysis of Land use Land cover change in Chamarajanara district

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Abstract: *In the few decades the methods used to study LULC have undergone a huge transformation. Early LULC studies were more complex involved the use of ground surveying, GPS markers, tabulating the surveys extensively, statistical records for each type of land use in each area and finally validating these results. The LULC changes has been identified in nine classes for the two decades by using different satellite images in GIS software. To identify the LULC by using the two different years of satellite imagers. The overall result shows that there is a marginal increase of area by forest, lake, fallow land, villages and mining and decrease of aera in agriculture cropland and agriculture plantation etc.*

Key words*; LULC, Chamarajanagara district, Change detection, Agriculture crop land, Plantation land etc*

1.1. LULC Change Detection Using Remote Sensing and GIS: In the last few decades, the methods used to study LULC have undergone a huge transformation. Early LULC studies were more complex involved the use of ground surveying, GPS markers, tabulating the surveys extensively, statistical records for each type of land use in each area and finally validating these results. By the time a study was completed, the land use would have already changed. The results of such studies were usually used as a historical reference and only for major policy decisions. Thus, the need for updated and current land use change detection came up. The U.S. Geological Survey (USGS) began such studies with the use of aerial photography, the predecessor of satellite imaging. They prepared LULC maps from photographs for the period of1970-80 at an impressive scale of 1:250,000. With the advent of satellite imaging and GIS applications, LULC studies have been far more detailed, current

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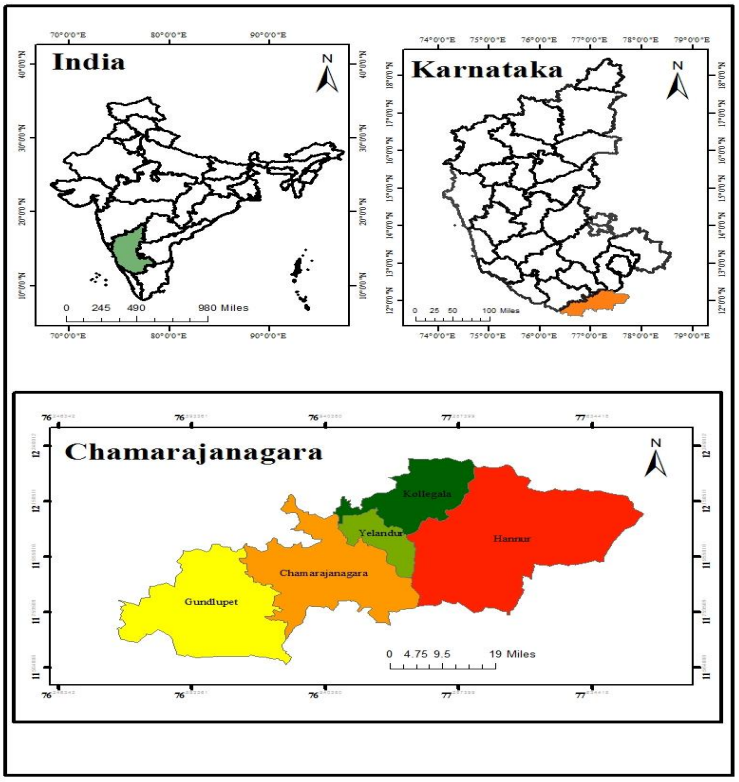
and reliable. Remote Sensing and GIS allows us to study and manipulate geographic information for large areas easily and effectively. The process also takes up very little time as compared to manual studies.

1.2. LULC Change Detection: The process of land use and land cover change LULC is very complex and takes different forms, with differences in magnitude and rate. LULC change detection studies are usually not conducted alone; it is generally connected to a larger problem based on the purpose of the study.

1.3. Study Area: Chamarajanagara district is the southern-most district in the state of Karnataka. Chamarajanagara district is consisting of 5 taluks, Namely Chamarajanagara, Hanur, Gundlupet, Kollegala and Yelandur. The geographical area of Chamarajanagar district is about 5,101 Km^2. The district is located in the southern tip of Karnataka state and lies between the North latitude 11^0 40'and 12^0 06'and East longitude 76^0 24' and 77^0 46'. It falls in the southern dry zone. Chamarajanagar lies in the southern dry zone having an average rainfall of 811.75mm. The temperature typically varies from 64°F to 94°F and is rarely below 59°F or above 99°F.

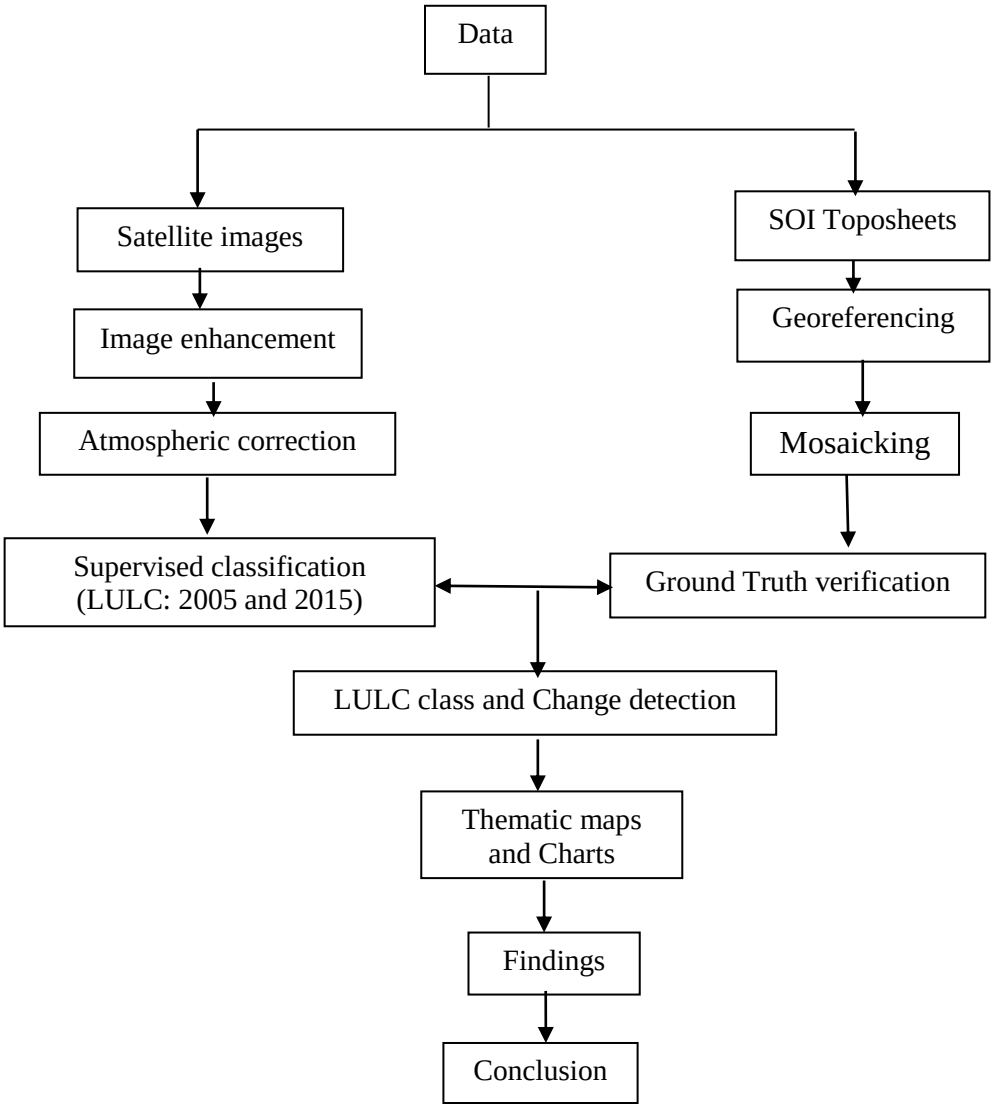
Location Map of study area



1.4. Objective and Methodology

This study aims to articulate the pattern of LULC changes in Chmarajanagara district. The change detection of general land use is first identified and then the agricultural land to horticultural crops of the study area. The base map for the study region for the georeferencing will be done by using the survey of India toposheets numbering 57D/12, 57D/16, 57H/12, 57H/16, 57H/3, 57H/4, 57H/8, 58A/10, 58A/13, 58A/14, 58A/5, 58A/6, 58A/7, 58A/9, 58E/1, 58E/2, 58E/5 and 58E/9 of 1:50000 scale.

METHODOLOGY FLOW CHART



This study by using the satellite images of two different years i.e., 2005 and 2015. The supervise classification method has been used for identifying the LULC classes. GIS

software has been used for the analysis, classification of satellite images, preparing thematic maps and other area calculations. Microsoft Excel has been used for preparing tables and graphs of the land cover changes. The workflow of this study is shown below on the flowchart to easily understand the process. Nine major classes of land use and land cover (table1.1) have been chosen for the study for a period of 2005-06 and 2015-16 are according to hierarchy dense forest, agriculture or crop land, agricultural plantation, land with scrub, lake/tank, fallow land, towns/villages, sand desertic land and miming/ Industrial wasteland comprised of 5639.10 Sq.km.

Table 1.1. Land use and Land cover Description for the period of 2005-06 and 2015-16

Land use classes	2005 (area in sq km)	2015 (area in sq km)	Change in sq km
Dense Forest	2802.28 (49.69%)	2803.66 (49.71%)	+1.38 (0.049%)
Agriculture, Crop land	2205.19 (39.10%)	2194.51 (38.91%)	-10.68 (-0.48%)
Agricultural Plantation	193.60 (3.43%)	191.55 (3.39%)	-2.05 (-1.07%)
Land with scrub	188.54 (3.34%)	185.97 (3.39%)	-2.57 (-1.38%)
Lake / Tanks	97.00 (1.72%)	108.32 (1.92%)	11.32 (10.45%)
Fallow land	82.06 (1.45%)	83.87 (1.48%)	+1.81 (2.15%)
Towns/Villages (Rural)	57.17 (1.00%)	58.20 (1.03%)	+1.03 (1.71%)
Sandy-desertic Land/ Salt Affected Land	13.16 (0.23%)	13.04 (0.02%)	-0.12 (-0.92%)
Mining/Industrial waste	0.10 (0.001%)	0.12 (0.002%)	+0.02 16.66
Total	**5639.1 (99.9%)**	**5639.2 (99.8%)**	

Source: computed by author

1.5. LULC Change Detection of the study area:

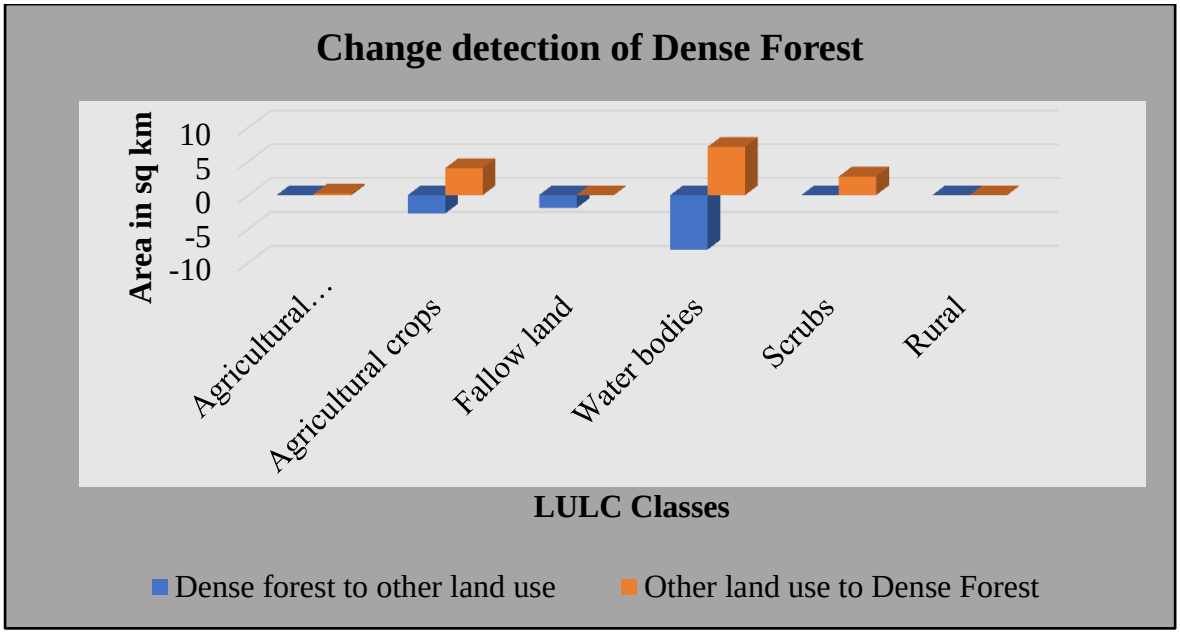
1.5.a. Dense Forest: Land with tree canopy density more than 40%. It is used to refer to land with a tree canopy cover of more than 10 percent and area of more than 0.5 ha.

Table.1.2. Change detection of Dense Forest

Change Over			
LULC classes	**Dense forest to other land use (area in sq km)**	**Other land use to Dense Forest (area in sq km)**	**Area increased (in sq km)**
Agricultural plantation	-0.003	0.20	
Agricultural crops	-2.7	4.00	
Fallow land	-1.92	0.01	
Water bodies	-8.04	7.13	
Scrubs	-0.01	2.74	
Rural	-0.008	0.00	
Total	**12.70**	**14.08**	**1.38**

Source: computed by author

Chart.1.1. Change detection of Dense Forest



The area of dense forest has been moved to other land use type; secondly the area from other land use has been arrived to the area of dense forest resulting in an increase of 1.38 sq km for a span of one decade. The area was 2803.66 sq.km. in 2015-16 as against to 2802.28 sq km. in 2005-06.

1.5.b. Agricultural Crop land: As shown in the following table, there is an inflow and out flow of area from agricultural crop land. The area was 2205.19 sq km in 2005-06 but

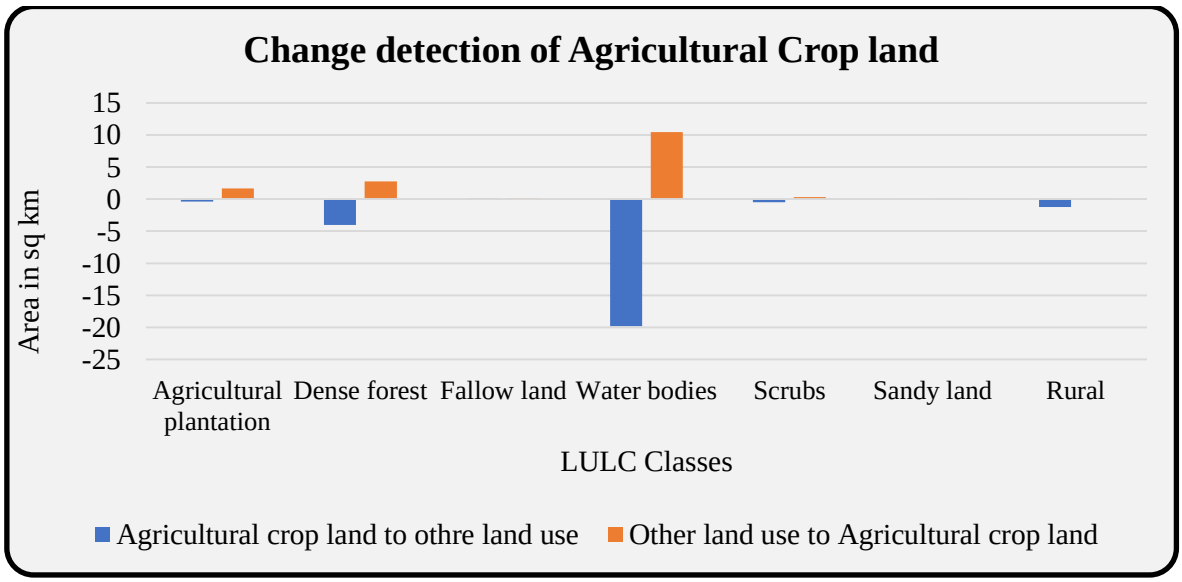
decreased to 2194.51 sq km for the next decade of 2015-16 with a decrease of area of 10.68 sq km which has moved to other land use.

Table.1.3. Change detection of Agricultural Crop land

Change Over			
LULC	**Agricultural Crop land To other land use area in sq km**	**Other land use to Agricultural Crop land area in sq km**	**Area Decreased in sq km**
Agricultural Plantation	-0.39	1.66	
Dense Forest	-4.01	2.77	
Fallow land	0.11	0.18	
Water bodies	-19.82	10.44	
Scrubs	-0.48	0.32	
Sandy Land	-0.02	0.02	
Rural	-1.26	0.02	
Total	**25.87**	**15.41**	**10.68**

Source: computed by author

Chart.1.2. Change Detection of Agricultural Cropland



The change that has occurred between 2005-06 and 2015-16. Totally the area of agricultural crop land of about 26.09 sq km has been converted various other land use, such as 0.39 sq km to agricultural plantation, 4.01 sq km to dense forest, fallow land amounts 0.11sq km, highest to water bodies 19.82 sq km, scrubs- 0.48 sq km, least of 0.02 to sandy land and lastly 1.26 sq km of area to rural. At the same time an area of 15.41 sq km from

other land use is converted as agricultural crop land and they are 1.66 sq km of agricultural plantation, 2.77 sq km of dense forest, fallow land amounts to 0.18 sq km water body records highest of 10.44 sq km, scrubs 0.32 and least of 0.02 sq km sandy land and rural.

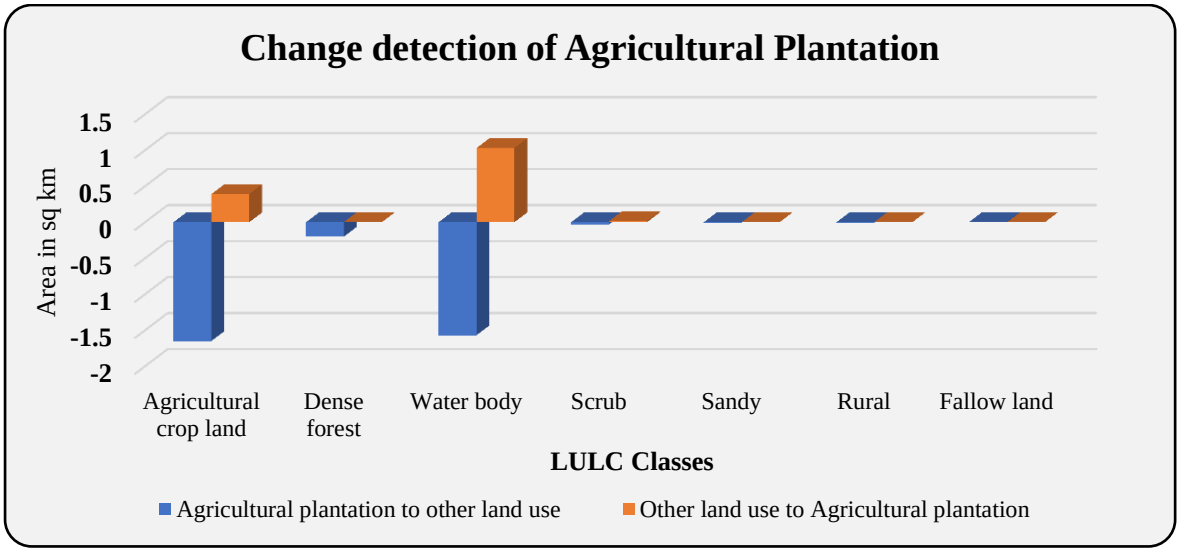
1.5.c. Agricultural Plantation: Change detection of agricultural plantation has been represented in the following table and chart. The area of agricultural plantation was 193.60 sq km in 2005-06 decreased to 191.55 sq km for the period of 2015-16 due to shift of area of agricultural plantation to other land use resulting in decrease of an area of 2.05 sq km.

Table.1.4. Change detection of Agricultural Plantation

Change Over			
LULC	**Agricultural Plantation to other land use area in sq km**	**Other land use to Agricultural Plantation area in sq km**	**Area Decreased in sq km**
Agricultural Crop land	-1.65	0.39	
Dense Forest	-0.20	0.003	
Water body	-1.57	1.03	
Scrub	-0.03	0.015	
Sandy	-0.005	0.001	
Rural	-0.007	0.003	
Fallow Land	0.003	0.00	
Total	**3.49**	**1.44**	**2.05**

Source: computed by author

Chart.1.3. Change Detection of Agricultural Plantation



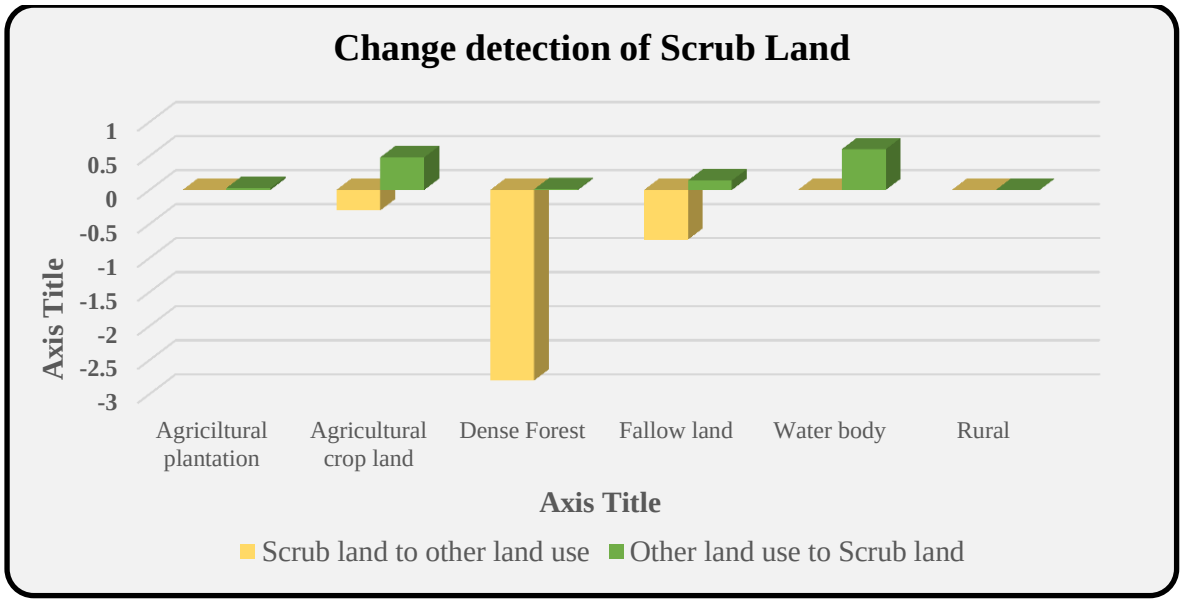
1.5.d. Land with Scrub: Areas possess shallow and skeletal soils, at times chemically degraded extremes of slopes, severely eroded or subjected to excessive aridity with scrubs dominating the landscape.

Table.1.5. Change detection of Scrub land

Change Over			
LULC	**Scrub land to other land use area in sq km**	**Other land use to Scrub land area in sq km**	**Area Decreased in sq km**
Agricultural Plantation	-0.005	0.03	
Agricultural Crop land	-0.3	0.48	
Dense Forest	-2.80	0.01	
Fallow land	-0.73	0.14	
Water body	-0.0001	0.60	
Rural	-0.0001	0.00	
Total	3.82	1.26	2.56

Source: Source: computed by author

Chart.1.4. Change Detection of Scrub Land.



The area of scrub land was 188.54 sq km in 2005-06 as against to 185.97 sq km resulting in the decrease of 2.56 for the period of 2015-16. Following table & chart. clearly shows how the area has been decreased.

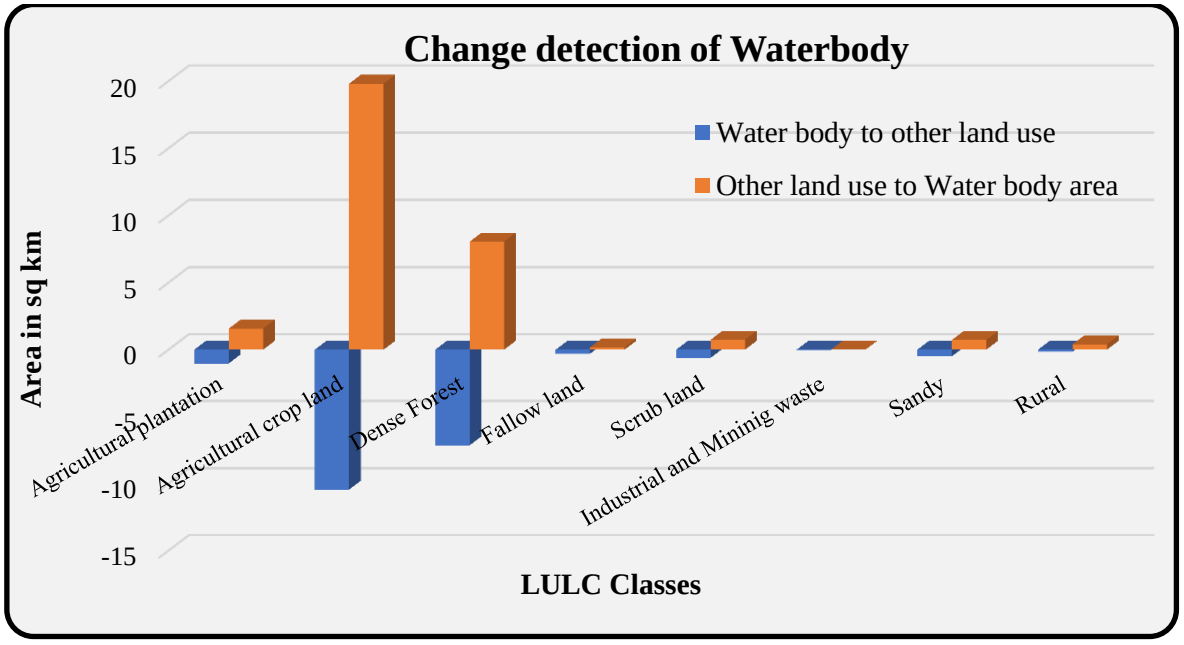
1.5.e. Lake and Tank: It comprises areas with surface water in the form of ponds, lakes, tanks and reservoirs. The table 1.6. and Cart 1.5. shows the changeover of land use and land cover of the water body. The area was 97.00 sq km in 2005-06 and has increased by 11.30 resulting in the total are of 108.30 sq km for the year of 2015-16.

Table.1.6. Change detection of water body

Change Over			
LULC	**Water body to other land use area in sq km**	**Other land use to water body area in sq km**	**Area increased in sq km**
Agricultural Plantation	-1.03	1.57	
Agricultural Crop land	-10.44	19.82	
Dense Forest	-7.14	8.05	
Fallow Land	-0.30	0.18	
Scrub	-0.61	0.74	
Industrial and Mining Waste	-0.02	0.01	
Sandy	-0.50	0.72	
Rural	-0.15	0.40	
Total	**20.19**	**31.49**	**11.30**

Source: computed by author

Chart.1.5. Change Detection of Waterbody.



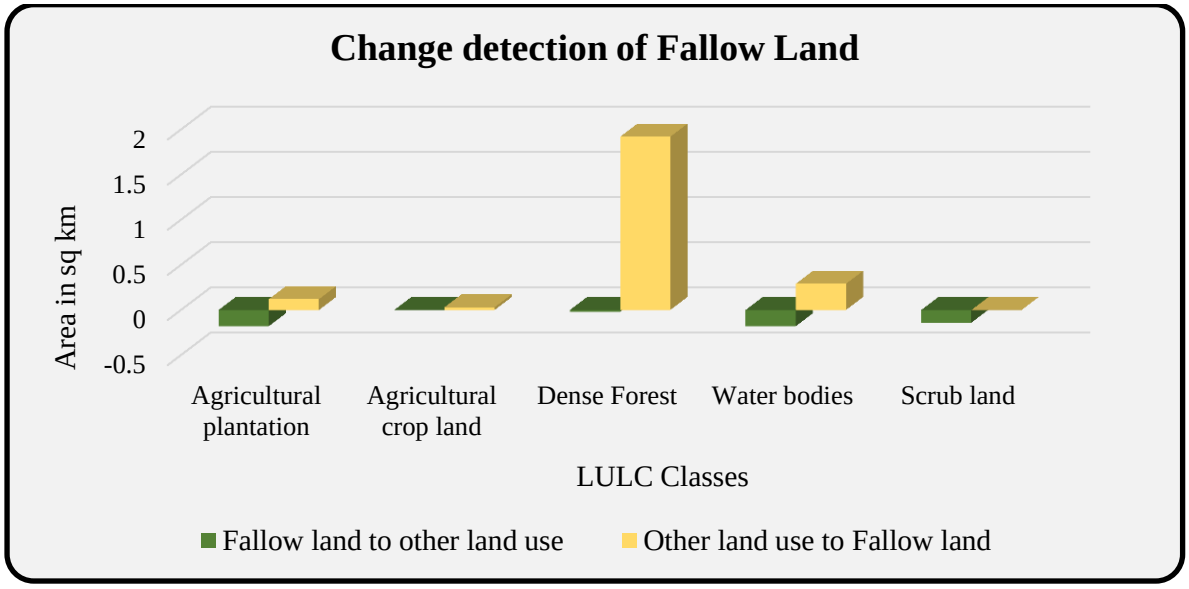
1.5.f. Fallow Land: The area of fallow land was 82.06 sq.km in 2005-06 as against to 83.87 sq km. in 2015-16. Due to inter change of land use, the area of fallow land has increased by 1.81 sq km.

Table.1.7. Change detection of Fallow land

Change Over			
LULC	**Fallow land to other land use area in sq km**	**Other land use to fallow land area in sq km**	**Area increased in sq km**
Agricultural Crop land	-0.18	0.12	
Dense Forest	-0.02	1.92	
Agricultural Plantation	0.00	0.03	
Water bodies	-0.18	0.29	
Scrubs	-0.14	0.00	
Total	**0.52**	**2.33**	**1.81**

Source: computed by author

Chart.1.6. Change Detection of Fallow land.



Only a very marginal of 0.52 sq km of area of fallow land as mentioned in the table-3 has been shifted to other land use type. Highest of 0.18 sq km of area from fallow land has been moved to agricultural crop land followed by least of 0.02 sq km to dense forest, 0.18 sq km to water bodies and 0.14 sq km to scrubs. Simultaneously 2.33 sq km of area from other land use has been moved to fallow land. 0.12 sq km of area from agricultural crop land has

been shifted to fallow land, highest of 1.92 sq km of area from dense forest and least of 0.03 sq km from agricultural land and 0.29 sq km from water bodies

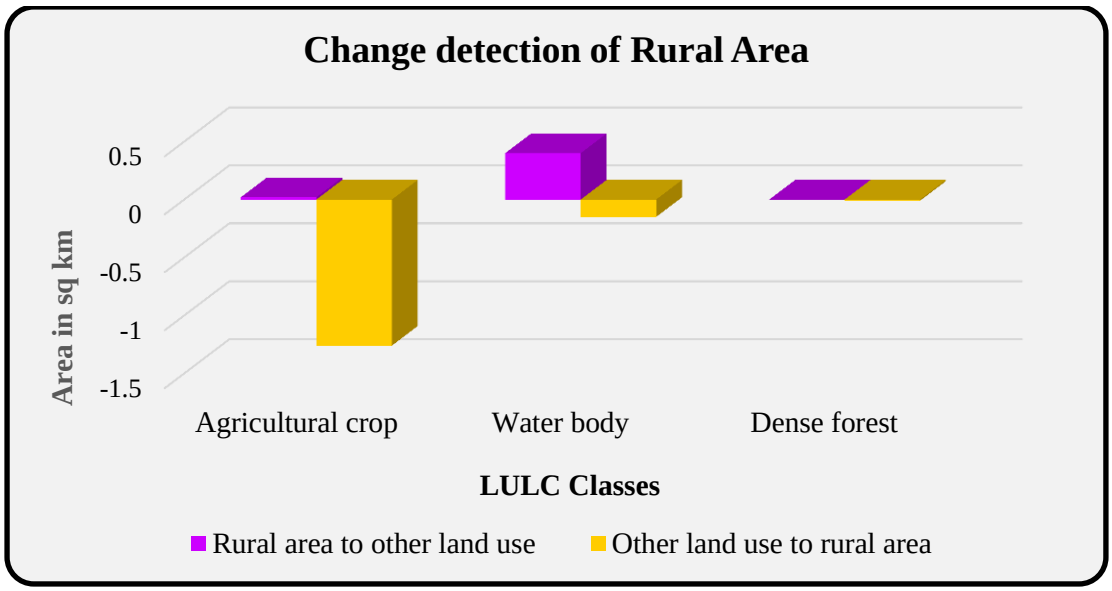
1.5.g. Rural Area: Towns and Villages: The total usage of the area for rural was 57.17 sq km in 2005-06 and has increased to 58.20 sq km for the next decade, with an increase of 1.42 sq km. which clearly indicates only 0.42 sq km of area from rural usage has converted in to agricultural crop land (0.02 sq km) and a very margin of (0.40 sq km) of area to water body. Same way 1.42 sq km of area of other land use such as agricultural crop land (1.26 sq km), water body (0.15sq km) and (0.01 sq km) dense forest has been converted for rural usage.

Table.1.8. Change detection of Rural area

Change Over			
LULC	**From rural area to other Land use**	**other Land use to rural area**	**Area increased in sq km**
Agricultural crop	– 0.02	1.26 0.15	
Water body	– 0.40		
Dense forest		-0.01	
Total	**0.42**	**1.42**	**1.0**

Source: computed by author

Chart.1.7. Change detection of Rural area.



1.5.h. Sandy and Desrtic land: There is no much difference between the period of Land use and land cover of the sandy and desrtic land. It was 13.16 sq km in 2005-06 and reduced to 13.04 sq km for the period of 2015-16, with decrease of very marginal area of 0.12 sq km.

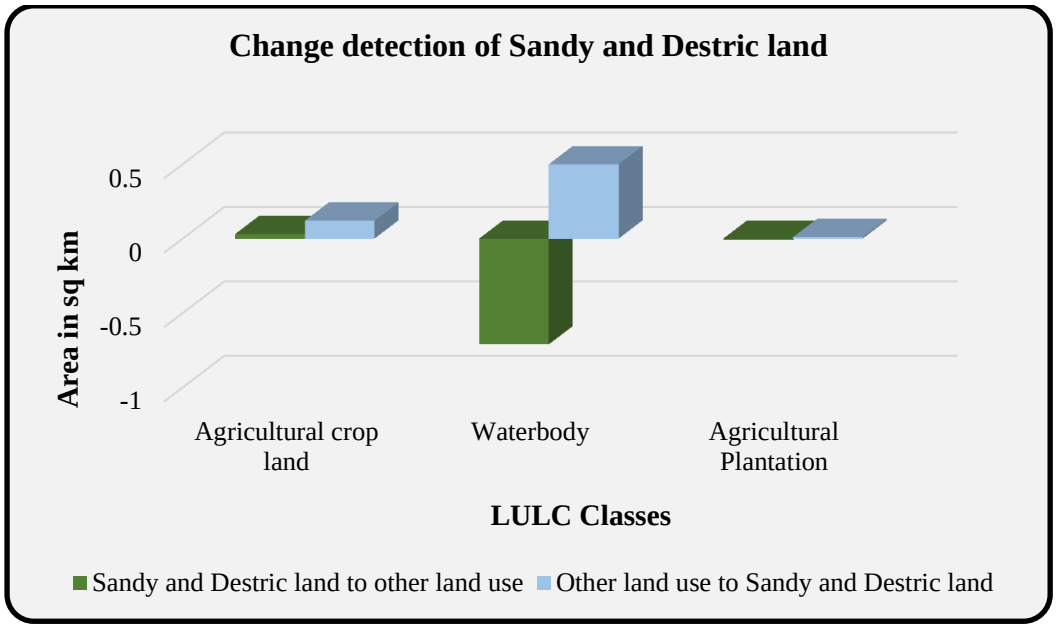
The change of land use of sandy and desrtic land was 0.75 sq, out of that 0.03 sq km has been converted to agricultural crop land, 0.71 sq km to water body and lest of 0.01 to agricultural plantation.The area of other land use such as agricultural crop land 0.12 sq km, water body 0.50 sq km and an area of 0.01 sq km of agricultural plantation have changed in to sandy and desrtic land.

Table.1.9. Change detection of Sandy and Desrtic land

Change Over			
LULC	**Sandy and Desrtic land to Other land use area in sq km**	**Other land use to Sandy and Desrtic land area in sq km**	**Area Decreased in sq km**
Agricultural Crop land	0.03	0.12	
Water body	-0.71	0.50	
Agricultural plantation	-0.01	0.01	
Total	**0.75**	**0.63**	**0.12**

Source: computed by author

Chart.1.8. Change detection of Sandy and Destric land



1.5.i. Mining and Industrial waste: The area devoted for mining and industrial activity as shown in the table-6 for the period of 2005-06 was about 0.10 sq km and a marginal increase of 0.02 has resulted to 0.12 sq km for the next decade of 2015-16. The increase of area is

attributed to coming of new industrial suburbs near to Chamarajanagara town by acquiring a marshy land or some patches of water body amounting to 0.02 sq km.

Table.1.10. Change detection of Mining and industrial waste.

2005	2015	Increase	From Ming to other LU	Ming to other LU
0.10	0.12	+0.02	Water 0.01	Water 0.03

Source: computed by author

1.6.Conclusion: this article to study the identification of changes accord in different land use land cover in Chamarajanagara district. Forest remains the largest land cover class nearly half of the region i.e., 49.7%. Agriculture land was decline, 2.05 and 2.57 sq km of plantation and scrub land was decline respectively. Water body, urban/Buit up and Industrial waste land was extended. This region shows an overall stability in its forest region. There is major lost in the agriculture crop and plantation land and significant increase in surface water bodies and expanding human settlement and industrial waste.

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