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Change Dynamics Study in Land Use and Land Cover Using RS & GIS for Erramanchi Village in Ananthapuramu District

G Bhuvana[1], K Pavan Kumar[2], G Navya Tej[3], B Chaitanya Rao[4], Dr.K S Rama Rao[5]
[1] M.Tech Scholar, *School of Renewable Energy and Environment&JNTUK,*
[2] Assistant Professor, *School of Renewable Energy and Environment&JNTUK,*
[3] Senior Environmental Consultant, *L&T Infrastructure Engineering Ltd,*
[4] Assistant Professor, *School of Renewable Energy and Environment&JNTUK,*

Abstract— Land Use/Land Cover (LULC) data is essential for determination, arranging and implementation of management strategies to meet the increasing demands for essential human needs and welfare of the regularly developing population. This dissertation delinates the status of Land Use/Land Cover in the Ananthapuramu District in Andhra Pradesh utilizing an integrated approach of Remote Sensing and Geographical Information system (GIS). Land Use and Land Cover (LU/LC) changes were identified using the suitable sentinel-2 satellite imageries of temporal difference of three years i.e., 2015 to 2017 using Quantum GIS. The comparison of LU/LC from 2015 to 2017 derived from topo-sheet and satellite imagery interpretation indicates that there is a significant increase in Built-up area, water bodies, Fallow land and other lands. It is also noted that substantial amount of crop land, Plantation and forest area vanished during the period of study which may be due to rapid industrialization of the study area.

Keywords— Land Use, Land Cover, Remote Sensing, Geographical Information System, Satellite, Quantum GIS

I. INTRODUCTION

The land is the most vital regular asset which encapsulates soil, water, flora and fauna involving total environment. The term land use relates to the human action or economic function associated with a particular piece of land, while the term land cover relates to the kind of feature present on the surface of the earth. The study area is one of the quickest creating urban communities in Andhra Pradesh and has seen a considerable increment in population, economic growth, industrialization, and transportation exercises in recent years which demonstrate a critical effect on the environment. The main target of this study is to distinguish LU/LC changes in Erramanchi village, Penukonda Mandal, Ananthapuramu, by taking satellite imageries for the year 2015, 2016 and 2017 and by using topographic map.

II. OBJECTIVES

- To conduct a study of land use/ land cover change.
- To provide an assessment of the impacts from human-induced land use transformations.
- Change detection in cropland, industrial area and water bodies.
- To provide data for better planning.
- To map and provide a greater understanding of urban growth using satellite images.

III. DATA ACQUISITION

The study area lies between latitude $14^0$9’33.35”N to $14^0$10’19.50”Nand $77^0$36’37.88”E to $77^0$37’25.02”E. The present work has been taken up to study and assess some of the natural resources and environmental potential of the study area which is falling in the Survey of India Topo-sheets No: D43L12 (NEW), 57F/12 (OLD). In order to study LULC changes in Erramanchi, Ananthapuramu, three multispectral satellite images were acquired for three years; 2015, 2016 and 2017. 2015 images (Sentinel-2) were obtained for the month of only October, 2016 images (Sentinel-2) were obtained for the month of only December and 2017 images (Sentinel-2) were obtained for the month of only December from United States Geological Survey (USGS).

IV. METHODOLOGY

The present study involves the collection of Topographic sheets from the survey of India. The required satellite imagery for the study area is to be downloaded from the USGS Earth Explorer. Identifying the suitable satellite imagery and acquiring it (medium to high resolution) which is then Pre-Processed in Quantum GIS using Semi-Automatic Classification plug-in to do necessary atmospheric corrections. Data were pre-processed in QGIS for geo-referencing, mosaicking and sub-setting of the image on the basis of Region of Interest (ROI).

The Pre-Processed pictures are clipped and converged to the study area and running with the supervised method of Land Use classification the datasets are assigned. For each of the foreordained LU/LC compose, preparing tests were chosen by outlining polygons around representative sites. Spectral signatures for the separate LU/LC composes got from the satellite imagery were recorded by utilising the pixels encased by these polygons. Minimum Distance method with decision rule was used for supervised classification by taking training sites for five major LU/LC classes. The outlined LU/LC classes were; built up areas, water bodies, croplands, forests and wastelands. After running the automatic classifier the output imagery is verified using spectral histograms and recoding is done where important. Measurements are created after conclusive recoding and the output is analysed and tabulated class wise.

V. CHANGE DYNAMIC ANALYSIS

Change detection analysis describes and quantifies the difference between images of the same scene at different times. This analysis is very much helpful to identify various changes occurring in different classes of land use like increase in urban built-up area or decrease in agricultural land and so on.

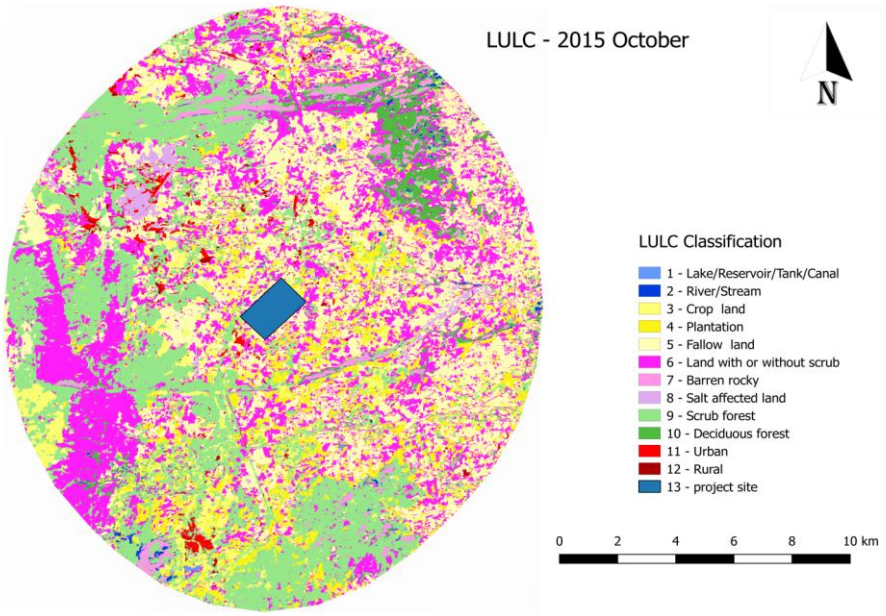


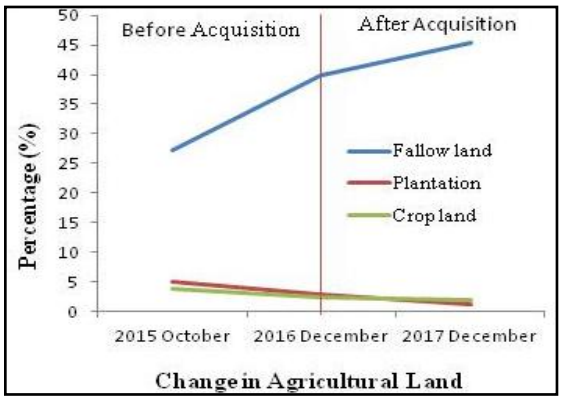
Fig. 1 **Land Use Land Cover map in October 2015**

5.1 Agricultural land

Agricultural land is described as the land primarily utilized for cultivating and for the generation of food, fibre and other commercial and horticultural crops.

5.1.1 Agricultural Plantation – Agricultural plantation is defined as an zone under farming tree crops planted adopting certain horticulture administration techniques. In the present study plantation covers about 1593.28 ha (5.06%) for October 2015 and it is decreased to 940.19 ha (2.99%) and 364.23 ha (1.16%) in December 2016 and December 2017 respectively.

5.1.2 Agricultural Croplands- Cropland include those lands with standing crop as on the date of satellite overpass. The main crops in the study area are paddy, Jowar, groundnut, onions, ragi and chillies. Crop land covers about 1234.7 ha (3.92%) for October 2015 and it is decreased to 721.34 ha (2.29%) and 579.38 ha (1.84%) in December 2016 and December 2017 respectively.

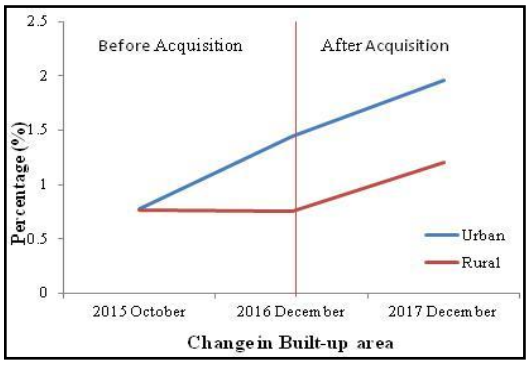


5.1.3 Fallow land – These lands are associated both irrigated and un-irrigated agricultural lands or cropped areas which are allowed to rest un-cropped for one or more seasons. It covers about 8566.4 ha (27.21%) for October 2015 and it is increased to 12586.3 ha (39.99%) and 14158.08 ha (45.3%) in December 2016 and December 2017 respectively.

The area which falls under cropland and plantation is decreased because of less rainfall and infiltration capacity. From graph we can observe that there is an increasing trend in fallow land percentage may be because of land acquisition, less rainfall and high runoff.

5.2 Built-up land

5.2.1 Built-up land Urban– In this study, an urban area is characterized by high human population density and vast human built features in contrast to the areas surrounding it. It covers an area of about 244.5 ha (0.78%) for October 2015 and it is increased to 451.9 ha (1.44%) and 763.15 ha (1.96%) in December 2016 and December 2017 respectively.

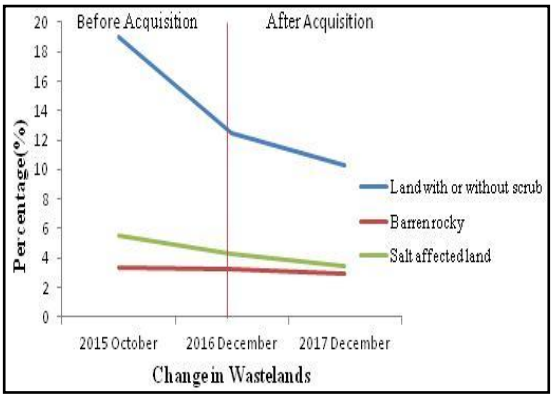


5.2.2 Built-up land rural – The rural area is characterized by agricultural and allied sectors and non- commercial activities with low density population (less than 5000) generally lack of supporting facilities. The area covered under village/hamlet/dispersed household categories are about 238.32 ha (0.76%) for October 2015 and it is increased to 234.68 ha (0.75%) and 330.25 ha (1.2%) in December 2016 and December 2017 respectively.

The Built-up area is increased because the area which is allocated for industrial park is zoned for different activities based on their requirements, which includes industrial plots, support services, open space/green buffers and parking, space for utilities which include water supply system, sewage network and waste water treatment facility, waste management facility and power supply etc.

5.3Wastelands

53.1 Land with or without scrub – The land which is prone to deterioration due to erosion is termed as scrubland. Land with or without scrub usually associated with shallow, stony, rocky otherwise non arable lands. Land with or without scrub occupies about 5973.17 ha (18.98%) for October 2015 and it is decreased to 3919.26 ha (12.45%) and 3246.09 ha (10.31%) in December 2016 and December 2017 respectively.



5.3.2 Barren rocky – Barren rocky is often barren and devoid of soil cover with limited capacity to support life and having less than 5 percent vegetative cover. In the present study barren rocky occupies 1059.24 ha (3.37%) for October 2015 and it is increased to 1035.44 ha (3.29%) and 914.15 ha (2.9%) in December 2016 and December 2017 respectively.

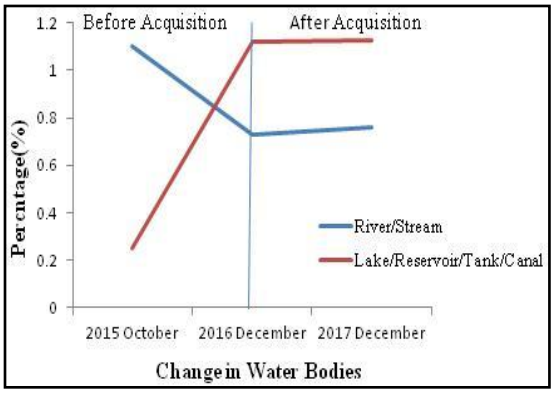
5.3.3 Salt affected–The salt affected land is generally characterized as the land that has adverse effects on the growth of most of the plants due to the action or presence of excess soluble or excess exchangeable sodium. It covers about 1755.59 ha (5.58%) for October 2015 and it is decreased to 1335.02 ha (4.24%) and 1081.2 ha (3.44%) in December 2016 and December 2017 respectively.

There is not much change was observed in Barren rocky but there is a change in percentage was observed in Land with or without scrub and salt affected land because these land was used as built-up area in project site.

5.4 Water bodies

5.4.1 River/Stream – It covers an area of about 345 ha (1.1%) for October 2015 and it is decreased to 230.69 ha (0.73%) in December 2016 and again increased to 240.27 ha (0.76%) and December 2017 respectively.

5.4.2 Lake/Reservoir/Tank/Canal – It covers an area of about 78.96 ha (0.25%) for October 2015 and it is increased to 352.81 ha (1.12%) and 355.7 ha (1.13%) in December 2016 and December 2017 respectively.



Water bodies are increased due to the construction of Gollapalli reservoir that formed part of the Handri Neeva Sujala Sravanthi (HNSS) project, which can hold a maximum of 1.6 tmcft (thousand million cubic feet) of water. There is a less amount of water flow observed in near-by river/stream because of construction of the Gollapalli reservoir.

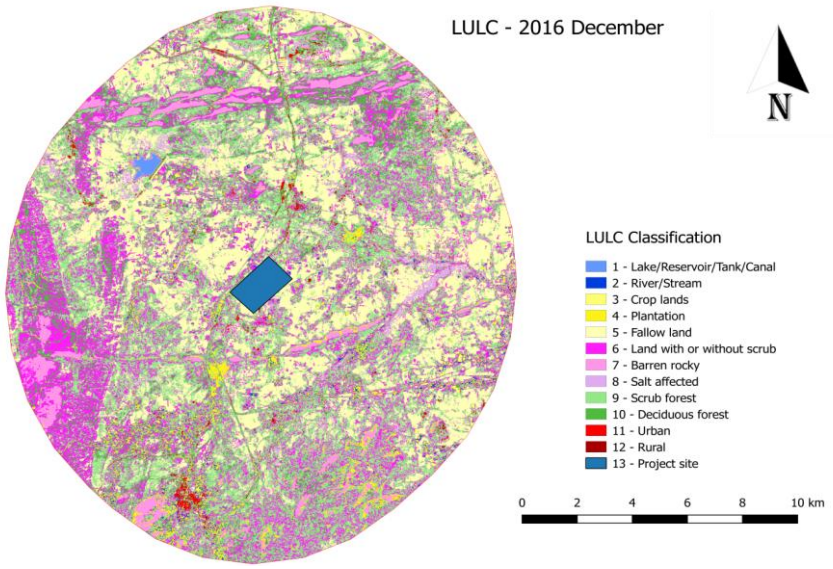
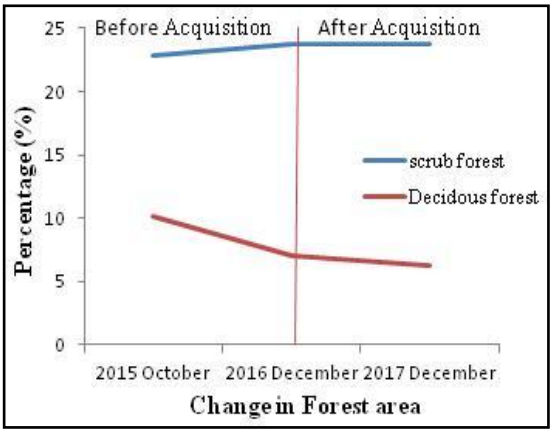


Fig.2 **Land Use/Land Cover map in December 2016**

5.5 Forest

5.5.1 Scrub forest – Land as notified under forest act and those lands with vegetation cover less than 10% to 40% of canopy covers are classified as scrub forest. It covers 7190.05 ha (22.84%) for October 2015 and it is increased to 7465.44 ha (23.72%) and 7461.78 ha (23.71%) in December 2016 and December 2017 respectively.



5.5.2 Deciduous forest –This associated with at least more than 40% of canopy land occupied by trees capable of producing timber or other wood products. It covers an area of about 3194 ha (10.15%) for October 2015 and it is decreased to 2200.09 ha (6.99%) and 1978.92 ha (6.29%) in December 2016 and December 2017 respectively.

There is no large variation in forests because the district is very poor in forests both in terms of area and richness of flora

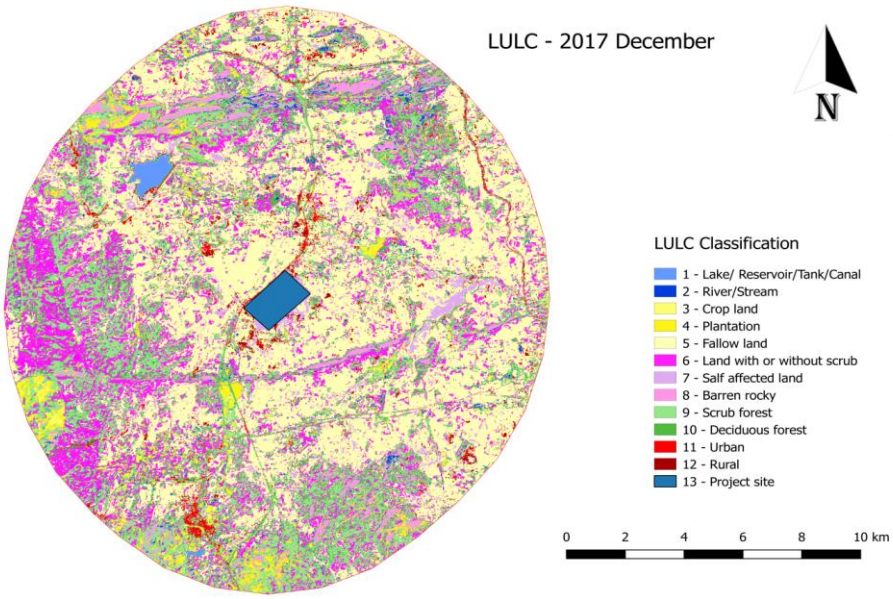


Fig.3 **Land Use/Land Cover map in December 2017**

TABLE I
LAND USE LAND DISTRIBUTION (2015, 2016, 2017)

Macro classes	Classification	Oct-15		Dec-16		Dec-17	
		Area in ha	percentage	Area in ha	percentage	Area in ha	percentage
Agricultural land	Fallow land	8566.4	27.21	12586.3	39.99	14158.1	45.3
	Plantation	1593.28	5.06	940.19	2.99	364.23	1.16
	Crop land	1234.7	3.92	721.34	2.29	579.38	1.84
wastelands	Land with or without scrub	5973.17	18.98	3919.26	12.45	3246.09	10.31
	Barren rocky	1059.24	3.37	1035.44	3.29	914.15	2.9
	Salt affected land	1755.59	5.58	1335.02	4.24	1081.2	3.44
Built-up	Urban	244.5	0.78	451.9	1.44	763.15	1.96
	Rural	238.32	0.76	234.68	0.75	330.25	1.2
Water bodies	River/Stream	345	1.1	230.69	0.73	240.27	0.76
	Lake/Reservoir/Tank/Canal	78.96	0.25	352.81	1.12	355.7	1.13
Forest	scrub forest	7190.05	22.84	7465.44	23.72	7461.78	23.71
	Decidous forest	3194	10.15	2200.09	6.99	1978.92	6.3
Total		31473.2	100	31473.2	100.00	31473.2	100

TABLE III
LAND USE LAND COVER CHANGES FROM 2015 TO 2017

Level- 1 LULC Classification	Level -2 LULC Classificatior	2015		2017		Change in hectares	Rate of change in hectare/year (2015-2017)	Percentage change
		Area (ha)	percentage (%)	Area (ha)	Percentage (%)			
Agricultural land	Fallow land	8566.4	27.21	14158.1	45.3	5591.7	2795.85	18.09
	Plantation	1593.28	5.06	364.23	1.16	-1229.1	614.525	-3.9
	Crop land	1234.7	3.92	579.38	1.84	-655.32	327.66	-2.08
Wastelands	Land with or without scrub	5973.17	18.98	3246.09	10.31	-2727.1	1363.54	-8.67
	Barren rocky	1059.24	3.37	914.15	2.9	-145.09	72.545	-0.47
	Salt affected land	1755.59	5.58	1081.2	3.44	-674.39	337.195	-2.14
Built-up	Urban	244.5	0.78	763.15	1.96	518.65	259.325	1.18
	Rural	238.32	0.76	330.25	1.2	91.93	45.965	0.44
Water bodies	River/Stream	345	1.1	240.27	0.76	-104.73	52.365	-0.34
	Lake/Reservoir/Tank/Canal	78.96	0.25	355.7	1.13	276.74	138.37	0.88
Forest	scrub forest	7190.05	22.84	7461.78	23.71	271.75	271.75	0.87
	Decidous forest	3194	10.15	1978.92	6.3	-1215.1	607.54	-3.9
Total		31473.2	100	31473.2	100			

(-ve) sign indicates decrease in Land cover

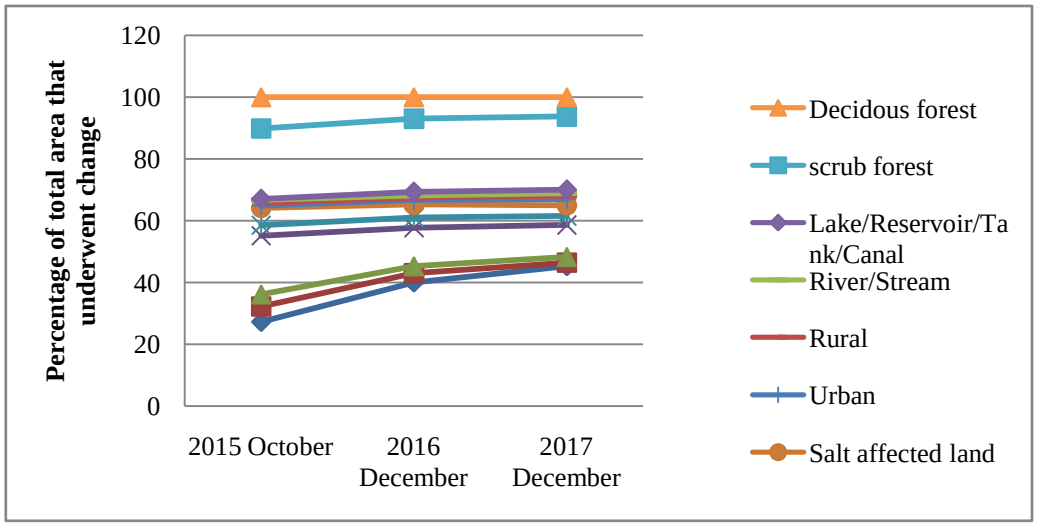


Fig.4 **Percentage of total area that underwent change with respect to time**

VI. CONCLUSION

Being a very fast growing area Erramanchi village in Ananthapuramu was chosen as a study area to quantify the LU/LC pattern for the years of 2015, 2016 and 2017. The National LU/LC classification developed by National Remote Sensing Centre (NRSC) and Indian Space Research Organization (ISRO) divides the land in the study area into 5 kinds of Level I class land type and 12 kinds of level II class land type.

Fallow land is increased by 5591.7ha (18.09%) from 2015 to 2017 because most of the land is turned into industrial area and some portion of land is left empty without cropping for certain period to increase the fertility, followed by cropland and plantation. Plantation is decreased by 1229.1 ha (3.9%) and crop land is decreased by 655.32 ha (2.08%) from 2015 to 2017 because of less rainfall and more runoff in that area. Built-up land urban is increased by 518.65 ha (1.18%) and rural is increased by 91.93 ha (0.44%) from 2015 to 2017 because of industrialization.

In wastelands, Land with or without scrub is increased by 2727.1 ha (8.37%), followed by salt affected and barren rocky. Salt affected land is decreased by 674.39 ha (2.14%) and barren land is decreased by 145.09 ha (0.47%) from 2015 to 2017. There is no much change in Barren rocky but there is a change in percentage was observed in salt affected land and Land with or without scrub because some part these land was used as built-up area in project site. Water bodies are increased by 276.74 ha (0.88%) from 2015 to 2017 due to the construction of Gollapalli reservoir which can hold a maximum of 1.6 tmcft of water. River/Stream is decreased there is a less amount of water flow in near-by river/stream because of construction of the reservoir. There is no large variation in forests because the district is very poor in forests both in terms of area and richness of flora.

The study revealed that there is a severe change in land cover usage has been taken place as a result of the industrial development. Establishment of Industries will enhance the Socio-Economic status of local people by creating direct or in-direct employment. This analysis will be used as reference for comparing further changes in Land Use/ Land Cover due to industrialization of that area.

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