CHANGE DETECTION MATRIX ANALYSIS OF LAND USE/LAND COVER MAPPING OF 11 MANDALS USING REMOTE SENSING AND GEOGRAPHICAL INFORMATION SYSTEMS IN COASTAL PART OF EAST GODAVARI DISTRICT, ANDHRA PRADESH, INDIA.

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ABSTRACT

*This paper has been made to study the change detection analysis of land use /land cover mapping for the years 2000 & 2014 in coastal part of East Godavari district, Andhra Pradesh India on 1: 50,000 scale. The district is also known as "The Rice Bowl of Andhra Pradesh" which is capable with fertile paddy field and coconut grove and is also rich in minerals like graphite, Bauxite, iron and variety of clays etc.. The study area bounded on north by Tuni, Sankavaram in the south by I Polavaram, Mummidivaram, in the West by Peddapuram, Rangampeta and in the east by Bay of Bengal. The Study area covers 1,452 sq km with 11 mandals of East Godavari District. Lithologically the area is classified into high lands, plains and Delta and it is made up of Gondwana sandstones. Climatic conditions are semi humid average annual rain fall 110m. In this study the data used is Landsat-8 for the year 2000 and 2014 for mapping of the Land use/Land cover and are classified into 12 classes viz. Built up land, Agriculture lands, Coastal sandy area, Plantations, Barren rock, Saltpans, Vegetation, Mangroves, Scrubs, Wastelands and Waterbodies. The identification of the change matrix is high on Built up lands increase to **14.65%** and agricultural lands decreasing to **-18.84%** are the surface features that had undergone changes over the period of selected time line.*

Keywords: Remote Sensing, GIS, Land use/Land cover, Classification, Change Detection

I. STUDY AREA

The study area extends from Tuni Mandal in the north bearing Longitude 82°32' E and Latitude 17°16' N to Mandal in the south bearing Longitude 81°41' E and Latitude 16°18' N of East Godavari district. The area comprises of 11 Mandal from north to south, shown in the **Fig**-2. The study area mainly covered by Gollaprolu, Karapa , Kajuluru, Kottapalli, Pedapudi, Pithapuram, Samalkota, Talleruvu, Thondangi, Kakinada Rural & Kakinada Urban mandals in coastal part of East Godavari   District.   The average annual rainfall is 115

centimeters and the climate is hot and humid for most of the year. The hottest part of the year late May to Early June with maximum temperature 38^0- 42^0.
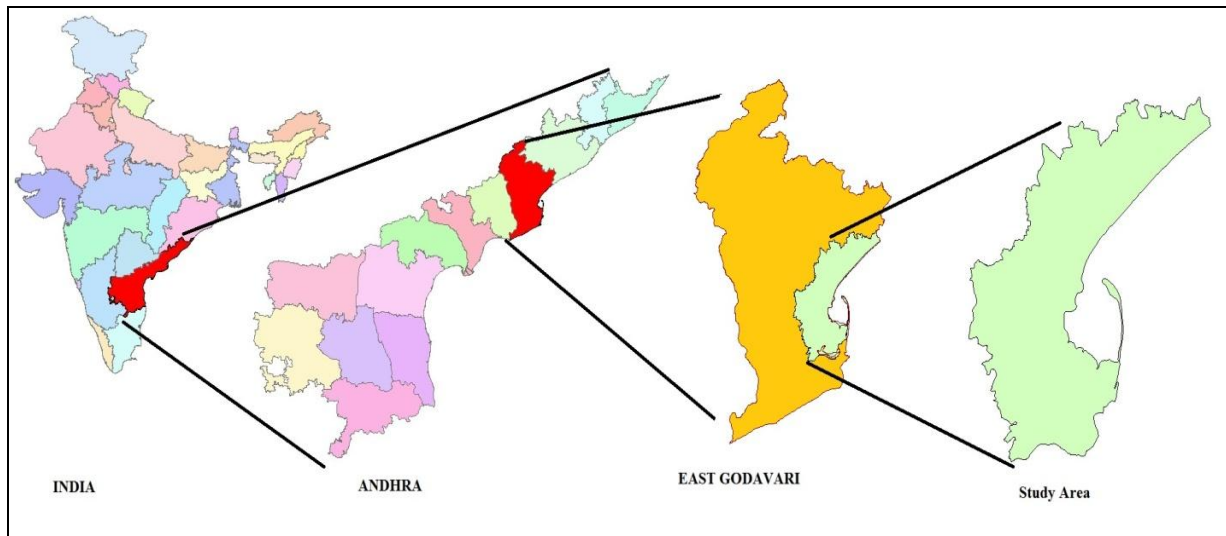

Figure 1: Location map of Study area

II. INTRODUCTION

The applications of remote sensing and GIS techniques help for extensive and detailed ground information for mapping of land use and land covers of 2000 & 2014 in the study area of coastal part of East Godavari district, Andhra Pradesh, India. The classification of Land use /land cover mapping is extremely valuable especially for water quantity, quality and assessing the hydrological effects. Main rivers of the district are Godavari, Gauthami, Vasistha, Pampa, Thandava and Yeluru. This district has 5 revenue divisions comprising of 60 revenue mandals. The entire East Godavari districts broadly classified into the natural divisions like plains, deltas, hill tracts and uplands. The general elevation of the east Godavari varies from a few meters near to the coast to about 1400 meters up hills in the agency. Average annual rain fall is 1280 mm. Cyclones occur frequently in the Bay of Bengal and hit the town. About 10 Km from Kakinada coast is a small island called Hope Island which makes Kakinada a natural harbor and also protects the city from Storm Surges. The total geographical area of East Godavari district is 10,807 sq km of which the study area covers 1,415 sq km.
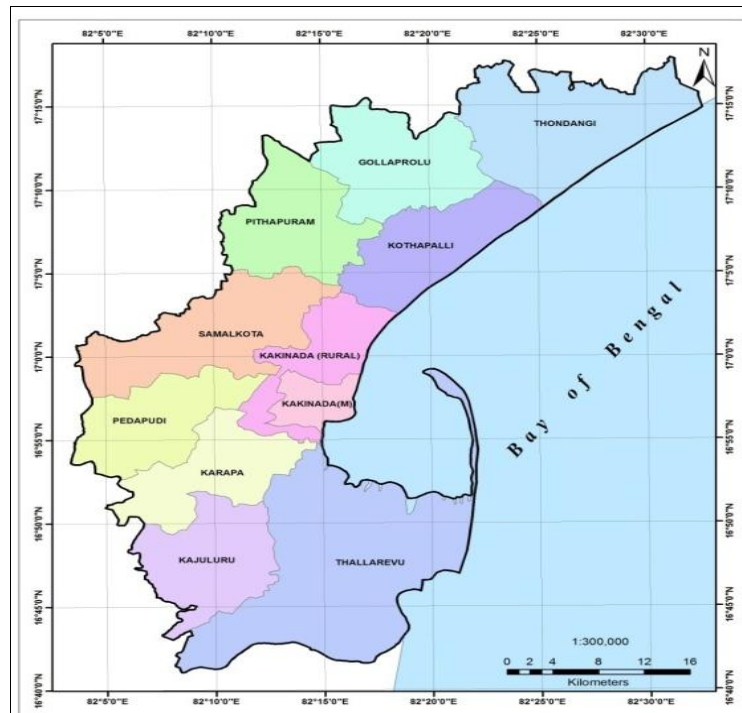
Figure 2. Study area

III. LITERATURE REVIEW

Numerous schoolwork encompass be conduct on mapping of land use and land cover of India and others (Anderson, James., 1971, Justus RWETABULA 2005)[1]. Remote Sensing data and GIS techniques are integrated to specifically study and describe Land use/Land cover classes and change detection mapping of coastal part of East Godavari district is described. The studies of Land use /Land cover mapping information gives for useful in many applications like agriculture, forests, industry, residential & commercial selection of site for construction of huge structures are buildings, dams, reservoirs, etc.. The level of classification also gives in micro level identification like assessment of tax, commercial site selection, development of zoning, environmental planning and population estimation,. (Culling-Worth, 1997 [2] Green et al., 1994[3]). Mapping the land use information can be used for monitoring ecological processes and ecosystem health and also to take necessary steps to stop unwanted changes that can affect ecological processes in future (Sudeesh et al., 2012)[4]. Land cover is referred to as artificial cover, natural vegetation, rock/soil, water bodies and others resulting due to land transformation (Roy and Giriraj, 2008)[5]. The increase in the wetland extent is mainly due to the large-scale vegetation cover as well as aquaculture practices in the coastal part of the delta (V.V.L.N. Sarma etal 2003)[6]. This data will help in estimating the area under different crops more accurately which forms base line information for crop production estimation on an operational basis (D.P.Rao et al., 1996)[7]. Applications of Remote Sensing Data and GIS Techniques on Land use, Land cover and Wetland mapping of the coastal part of East Godavari District, Andhra Pradesh. (Padma Kumari et al., 2012)[8]

IV. OBJECTIVES

The main objective of this paper is to prepare and analyses the changes in land use/ land cover for the years 2000 & 2014 by mapping the area of 11 mandals of coastal part of East Godavari district Andhra Pradesh. Landsat data based on Remote Sensing and GIS applications on 1:50,000 scale was used for identification and change matrix analyses of land use/land cover along with built up land, agriculture land, forest, and river areas etc., calculated and mapped.

V. DATA USED & METHODOLOGY

Literature review & map interpretation was followed by ground truth. The relationship of remote sensing data and field observations can carry out land cover level of classification on 1st level. All data was transformed into digital data using supervised classification and prepared the maps of 2000 & 2014. The methodology used in this study is to utilise Geographic Information System and integration of the same with Remote Sensing data so as to yield good results in classification and quantification of land use units for the study area. National Remote Sensing Center has classified Landuse & Landcover for the whole country. The classes mentioned in this paper are source from NRSC.

Toposheets from Survey of India on 1:50,000 scale were used to prepare the Base Map.

Table 1: Specifications of Landsat-7 and Landsat-8

| Feature	Landsat-7 (ETM+) 8th Dec'2000			Landsat-8 (OLI/TIRS) 26th Mar'2014		
	Bands	Wavelength (μm)	Resolution (m)	Bands	Wavelength (μm)	Resolution (m)
Spectral Resolution	Band1	0.45-0.52	30	Band 1	0.43 - 0.45	30
	Band 2	0.52-0.60	30	Band 2	0.45 - 0.51	30
	Band 3	0.63-0.69	30	Band 3	0.53 - 0.59	30
	Band 4	0.77-0.90	30	Band 4	0.64 - 0.67	30
	Band 5	1.55-1.75	30	Band 5	0.85 - 0.88	30
	Band 6	10.40-12.50	60	Band 6	1.57 - 1.65	30
	Band 7	2.09-2.35	30	Band 7	2.11 - 2.29	30
	Band 8	0.52-0.90	15	Band 8	0.50 - 0.68	15
				Band 9	1.36 - 1.38	30
				Band 10	10.60 - 11.19	100
				Band 11	11.50 - 12.51	100
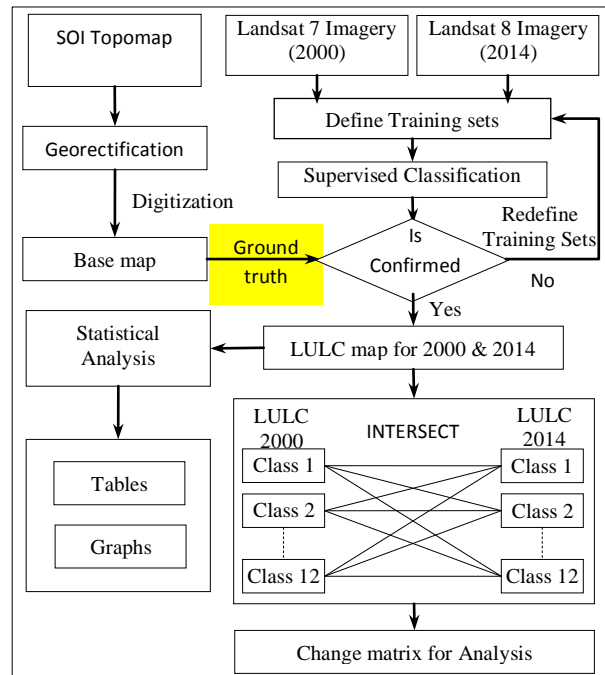
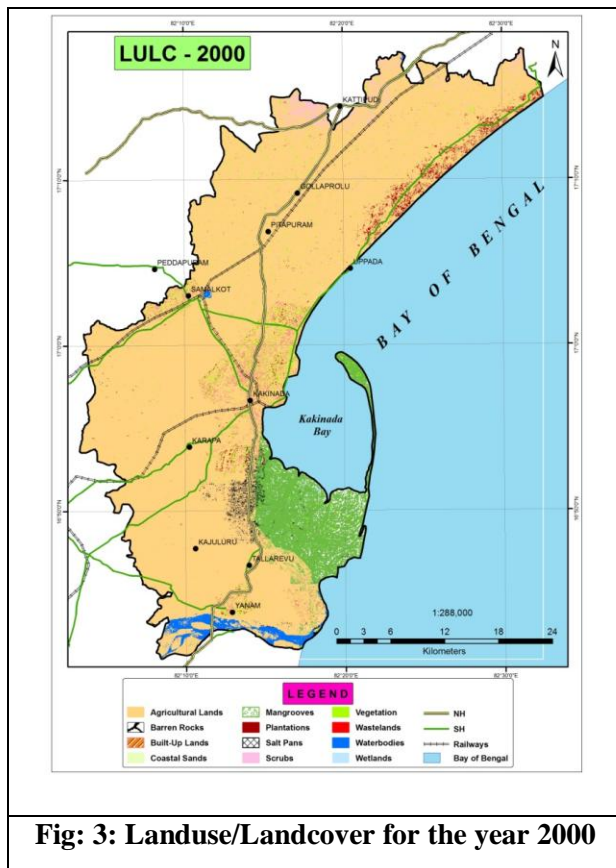**Chart-1 : Flowchart of the Methodology**

| **Fig: 3: Landuse/Landcover for the year 2000** | **Fig: 4: Landuse/Landcover for the year 2014** |
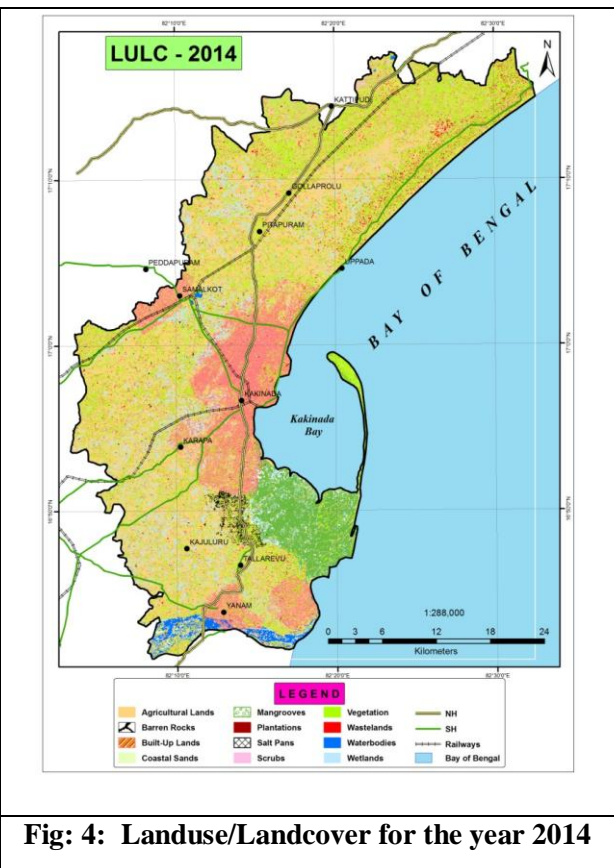
TABLE 2 : Land Use/Land Cover 2000

SL. NO.	CATEGORY	AREA (sq km)	% of Area
	LU/LC - 2000		
1	AGRICULTURAL LANDS	1,028.88	72.69%
2	BARREN ROCKY	0.52	0.04%
3	BUILT-UP LANDS	71.92	5.08%
4	COASTAL SANDS	2.44	0.17%
5	MANGROOVES	120.82	8.54%
6	PLANTATIONS	42.22	2.98%
7	SALT PANS	14.05	0.99%
8	SCRUBS	27.97	1.98%
9	VEGETATION	63.09	4.46%
10	WASTELANDS	2.54	0.18%
11	WATERBODIES	27.84	1.97%
12	WETLANDS	13.24	0.94%

TABLE 3: Land Use/Land Cover 2014

SL. NO.	CATEGORY	AREA (sq km)	% of Area
	LU/LC - 2014		
1	AGRICULTURAL LANDS	762.26	53.85%
2	BARREN ROCKS	5.14	0.36%
3	BUILT-UP LANDS	279.34	19.73%
4	COASTAL SANDS	5.41	0.38%
5	MANGROOVES	101.47	7.17%
6	PLANTATIONS	19.70	1.39%
7	SALT PANS	4.11	0.29%
8	SCRUBS	10.76	0.76%
9	VEGETATION	131.02	9.26%
10	WASTELANDS	8.07	0.57%
11	WATERBODIES	29.21	2.06%
12	WETLANDS	59.02	4.17%

TABLE 4: Land Use/Land Cover DIFFERENCE

SL. NO.	CATEGORY	AREA (sq km)	% of Area
	LU/LC Difference (2000 - 2014)		
1	AGRICULTURAL LANDS	(266.62)	-18.84%
2	BARREN ROCKS	4.62	0.33%
3	BUILT-UP LANDS	207.43	14.65%
4	COASTAL SANDS	2.98	0.21%
5	MANGROOVES	(19.34)	-1.37%
6	PLANTATIONS	(22.52)	-1.59%
7	SALT PANS	(9.94)	-0.70%
8	SCRUBS	(17.21)	-1.22%
9	VEGETATION	67.93	4.80%
10	WASTELANDS	5.53	0.39%
11	WATERBODIES	1.37	0.10%
12	WETLANDS	45.78	3.23%

TABLE 5: Land Use/Land Cover - Confusion Matrix Method

Sl. No.	2000 | 2014	AGRI	BARR	BULS	CSTL	MNGR	PLNT	SALT	SCRUBS	VEGE	WSTL	WTRB	WETL
1	AGRICULTURAL LANDS	NA	5.010	192.941	1.701	0.423	1.332	2.228	5.861	91.779	6.465	7.184	48.392
2	BARREN ROCKY	0.297	NA	0.107	0.003	- NA -	0.021	- NA -	0.003	0.047	0.032	- NA -	0.012
3	BUILT-UP LANDS	0.185	0.048	NA	0.062	0.524	1.382	0.068	0.165	6.578	0.146	0.534	2.098
4	COASTAL SANDS	0.785	- NA -	0.205	NA	0.267	0.027	- NA -	- NA -	0.677	0.014	0.004	0.023
5	MANGROOVES	0.000	- NA -	7.438	0.429	NA	0.219	0.316	- NA -	4.830	0.063	0.638	2.021
6	PLANTATIONS	16.341	0.003	10.702	0.835	0.002	NA	0.003	- NA -	8.615	0.532	0.003	1.086
7	SALT PANS	6.323	0.015	4.005	0.002	0.384	0.091	NA	- NA -	1.143	0.002	0.068	0.683
8	SCRUBS	12.382	- NA -	4.455	0.002	- NA -	1.056	- NA -	NA	4.941	0.124	0.010	0.674
9	VEGETATION	31.490	0.112	13.651	0.688	1.813	1.195	0.199	0.531	NA	0.466	0.650	2.775
10	WASTELANDS	1.682	0.014	0.325	0.023	0.024	0.023	- NA -	0.009	0.162	NA	0.128	0.064
11	WATERBODIES	3.303	0.000	1.656	1.023	0.024	0.108	- NA -	0.036	0.925	0.058	NA	0.659
12	WETLANDS	6.029	0.012	2.286	0.245	1.869	0.218	0.037	0.067	1.599	0.149	0.209	NA

(Units in sq km)   ** NA – Not Applicable*

Abbreviation Used :

AGRI   : Agricultural Land

BARR   : Barren Rocky

BULS   : Built-up Lands

CSTL   : Coastal Sands

MNGR   : Mangroves

PLNT   : Plantations

SALT   : Saltpans

SCRUBS   : Scrubs

VEGE   : Vegetation

WSTL   : Wasteland

WTRB   : Waterbodies

WETL   : Wetlands

VI. RESULTS AND DISCUSSION

East Godavari district is major Educational society hub and lush paddy field in the state of Andhra Pradesh, India. The aim of study is to analyze of change matrix for land use /land cover mapping of 11 mandals of coastal part of the district. The maps were prepared on 1:50,000 scale using the Landsat-7 for the year 2000 & Landsat-8 for the year 2014 using supervised classification. Classified into 12 classes are Agriculture lands, Barren rock, Built up land, coastal sands, Mangroves, Plantations, Saltpans, Scrubs, Vegetation, Wastelands, Water bodies and Wetlands. (Padmakumari et al.,2012) [9]

In this study Remote Sensing and GIS gives detailed ground information of land use /land cover mapping of coastal part of East Godavari district using the software of ArcGIS 10.1 and ERDAS 9.2. Land use /land cover

analysis gives extremely valuable information especially for water quantity, quality and assessing the hydrological effects of land uses (source: Anderson et al., 1976)[10]. A land use / land cover classification system for use with remote sensor data (**Table-1**) has been adopted for present study with reference to Ground truth 12 classes are identified the results are given **Table-2, Table-3 & Table- 4.**

Land use /land cover mapping is helpful in assess and quantify the land cover information (Sudeesh etal, 2012)[4]. Total area of land use/ land cover is 1,452 Sq km. In this study from 2000 Landsat-7 (**Fig 2**) & 2014 Landsat-8 (**Fig 3**) satellite data shows land use/ land cover in 2000 & 2014 **Tables 1&2**. The change matrix of the LU/LC (**Table 5**) shows the decrease in the Agricultural land by 18%. In the area human habitation developed due to non agriculture use of banana trees cover of building, transport, and communications utility in association with water vegetation & vacant land. Cropped areas appear in golden 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. Mangroves reduced by 1.37% between 2000 & 2014**.** Mangrove forest appear in patches of green, small to medium in size, irregular and discontinuous creeks in the coast area covered by 8.54%. There was also decrease in Plantations by 1.59%, Salt Pans by 0.70 %, and Scrubs by 1.22%. Scrubland appears in light pinkish, associated with moderate slope in plain and dense scrub dominating the landscape tendency for intermixing with cropped areas covered by 1.98 %. There was also some increases of the landforms like Barren Rocks by 0.33%, Built-Up Lands by 14.65%, Coastal Sands by 0.21%. Sands areas appear as white to light yellow/bluish depending on moisture content appear light red. Coastal sand appears high reflectance exhibited by this category especially in the NIR region of this spectrum enable their separation with the salt affected land. Identification of canals, tanks, small ponds of impounded water ways constructed on land surface for irregular. Bay is inlet in the sea & beach is gently sloping zone concave profile of unconsolidated material that extends landward from the low line to the place. Spit structure is found on the irregular coast line where sediment availability and wave action is very prominent. Heavy metallurgical industries are thermal, oil, cement, petro chemicals. (NFCL, Coromandal, IOL etc.). Plantation appears dark red to maroon tone of different size with regular and sharp edges. Paddy growing areas are being converted to brackish water. This practice is resulting in pollution of shallow potable water resources with vegetation 4.80%. The developments of vegetation depend on the environmental factors, topography, background soil also with forest management practices (Shamsuddeen et al., 2005)[10]. Wastelands 0.39%, water bodies 0.10%. The water levels in ponds are usually maintained by rainfall. Land is predominantly used for production of food and fish farms and other commercial and horticulture crops. Wet lands 3.23% (Padma kumari et al., 2012) [12]

VII. CONCLUSIONS

Land use/Land cover data shows in 2000 & 2014 **Tables 1&2**. The change matrix of the LU/LC (**Table 3**) shows the decreases of the classes are Agricultural land18%, Mangroves 1.37%, Plantations 1.59%, Salt Pans 0.70%, Scrubs-1.22%. Increases of the landforms are Barren Rocks 0.33%, Built-Up Lands 14.65,% Coastal Sands 0.21% and Vegetation 4.80 %Wastelands 0.39% water bodies 0.10%, wet lands 3.23%.

VII. ACKNOWLEDGEMENTS

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