Published by :
http://www.ijert.org

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 10, October-2016

Geospatial Approach of Land Use/Land Cover Studies on Swarnamukhi River Basin, Andhra Pradesh

Vani Timmapuram[1]
Research Scholar, Department of Environmental Sciences, S.V.University, Tirupati, India[1]
Kalyan Yakkala[2],
Young Scientist, Department of Environmental Sciences, S.V.University, Tirupati, India[2]

Gangadhar Battala[3],
Post Doctoral Fellow, Department of Environmental Sciences, S.V.University, Tirupati, India[3]
Ramakrishna Naidu Gurijala[4]
Professor Emeritus, Department of Environmental Sciences, S.V.University, Tirupati, India[4]

***Abstract* - Spatial information on land use/land cover is a necessary prerequisite in planning, utilizing and management of natural resources. In the current days context of development planning, information on land use/land cover and the changes over a period of time attain prominence because of its primary requirement in all the planning activities. Information on land use/land cover in the form of maps and statistical data is very vital for spatial planning, management and utilization of land for agricultural, forestry, pasture, urban-industrial, Environmental studies, economic production, etc. Keeping this in view, land use categories are mapped by using on-screen visual interpretation techniques in Arc GIS environment. For detection of land use classes taken the multi dated satellite data of Land-sat has been used for the study. Change map has been generated for change analysis.**

Keywords- Land Use/Land Cover, Change matrix, Remote sensing and GIS, Arc GIS.

I. INTRODUCTION

The Land Use/Land Cover patterns of a region are an outcome of natural and socio-economic factors and their utilization by man in time and space. The terms "Land Use" and "Land Cover" are often used simultaneously to describe maps that provide information about the types of features found on the earth's surface is called as land cover and the human activity that is associates with them. Land cover is an important input parameter for a number of agricultural hydrological and ecological models, which constitute necessary tools for development planning and management of natural resources in the territory. [1, 2, 3] In order to use the land optimally and to provide as input data in modelling studies, it is not only necessary to have information on existing land use/land cover but also the capability to monitor the dynamics of land use resulting out of changing demands. [4,5,6] If the site is small and easily accessible a suitable land cover may be based on ground observation and surveys. However such methods are quickly become less feasible, if the site is large or difficult to access. Toposheets may be useful for reference but are generally outdated and too coarse for detailed analysis. With the improvement in software and decrease in the cost of imagery, satellite remote sensing is being used for more and more studies particularly at the landscape level [7,8,9]

Another important purpose of the analysis of land use change is impact assessment. The contemporary interest is not so much on land use change itself as is on its various environmental and socio-economic impacts at all spatial levels. In addition, as policies are designed to address several of the environmental and socio-economic problems in which land use change contributes in one way or another, policy impact assessment has emerged as a significant scientific activity. The recent policy interest, specifically, is on the broader issue of sustainability of development as it is impacted by land use change triggered by proposed or implemented policies. Land use changes with adverse impacts such as land degradation, desertification, population etc, contribute negatively to the achievement of long term sustainability as they reduce the natural, economic, human, and social capital available to future generation. [10, 11, 12, 13]

The rapidly developing technology of remote sensing offers an efficient and timely approach to the mapping and collection of basic land use/land cover data over large area. The remote sensing data is potentially more amenable to digital processing because the remote sensor output can be obtained in digital format as a more expedient means to map land use and land cover [14,15].

To understand how changes in climate and bio-chemistry affect both land use and land cover, in a region, it is important to differentiate between land cover and land use when measuring patterns of changes are dealt. Simple land use classification is not sufficient for analysis of changes but land use functions of a land cover type needs to be known to understand the changes in land cover. [16,17]

The present research work deals with the EIA (Environmental Impact Assessment) on Swarnamukhi River basin using Spatio multi-Temporal satellite data. Spatial means geographical distribution of features on the earth surface. Temporal means using different time period satellites data for this study. Land use and Land cover and changes between them over the years have been mapped and its impact has been studied.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 10, October-2016

II. STUDY AREA

Swarnamukhi River is one of the major 13 rivers flowing in Chittoor District, Andhra Pradesh, India. It is originated from Seshachalam Hills, Chandragiri mandal and passing nearly 83 Km length in the District. Whereas, the total length of the river is approximately 142 Km, in which the course of the river starts through a valley between Tirupati and Chandragiri towns and meets the Srikalahasti town, thereby the river finally joins into the Bay of Bengal at Siddavaram village in Nellore District.

River Swarnamukhi, an ephemeral river, is the east flowing river between Pennar and Cauvery Rivers. The basin is bounded by North Latitude 13^0 25’ 30” and 14^0 28’ 30” and East Longitude 79^0 08’ 39” and 80^0 11’ 00”, in Chittoor and Nellore Districts in. One hydrological observation station in the Swarnamukhi River basin is located in Naidupet and an average rainfall is 1,000 mm. The basin covers 5 watersheds and each watershed covers 5000 Ha. The river basin is occupied by rocks of granite and granitic gneisses. Swarnamukhi River basin location map is showing in figure1.

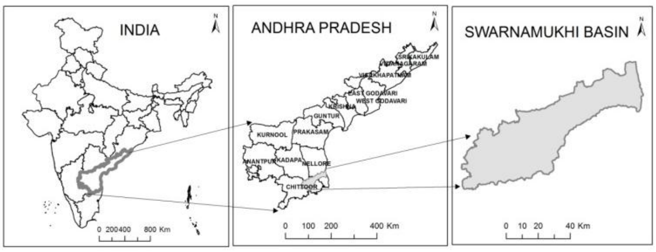


Fig 1: Location map of Swarnamukhi River basin

III. METHODOLOGY

Mainly the methodology follows using of geo referenced Landsat data (Landsat-4,5,7,8) 2000-01, 2005-06, 2011-12 and 2014-15 respectively. The spatial resolution of Landsat data is 30 meters. The above satellite data has taken for both Kharif and Rabi seasons for generate of LU/LC map. The scale of mapping is 1:50,000 for the study area. ERDAS 2015 software is used for satellite data rectification and mosaicking. ARC GIS 10.3 software is used for creating of LU/LC vector data. The detailed methodology is given in Figure2.

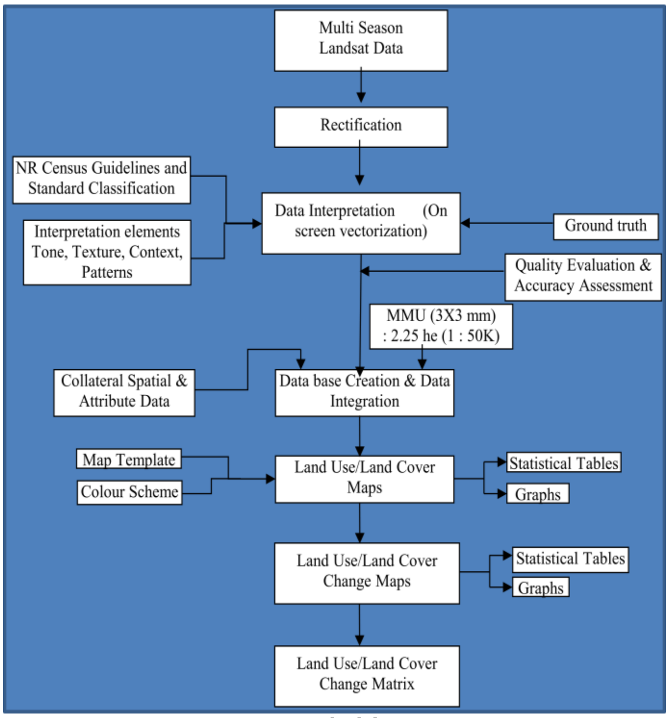


Fig 2: Methodology

IV. RESULTS AND DISCUSSONS

Land use/Land cover maps from using of four different years with two seasons of 2000-01, 2005-06, 2011-12 and 2014-15 of satellite remote sensing data has been prepared based on onscreen digitization of visual interpretation with ground truth. Preparation of past and present LULC inventories and changes using multi-periods satellite data and to studied the impact of Swarnamukhi River basin. The rainfall map is showing in figure 3. The Land Use/Land Cover map of Swarnamukhi River is for the 2000, 2005, 2011 and 2014 are showing in figure 4,5, 6 and 7. The area statistics are given in table 1.

The dominant land use / land cover categories in 2000-01 were built-up land occupied 78 sq.km (2.35%), agricultural land occupied 1308 sq.km (39.59%), forest area 1027 sq.km (31,08%), wastelands area 554 sq.km (16.78%), waterbodies area 319 sq.km (9.68%) and wetlands area 16 sq.km (0.49%).

The land use / land cover categories in 2005-06 were built-up land occupied 93 sq.km (2.84%), agricultural land occupied 1297 sq.km (39.25%), forest area 1026 sq.km (31.06%), wastelands area 558 sq.km (16.88%), waterbodies area 320 sq.km (9.70%) and wetlands area 8 sq.km (0.24%).

The land use / land cover categories in 2011-12 were built-up land occupied 127 sq.km (3.85%), agricultural land occupied 1303 sq.km (39.44%), forest area 1026 sq.km (31.04%), wastelands area 517 sq.km (15.65%), waterbodies area 305 sq.km (9.24%) and wetlands area 25 sq.km (0.75%).

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 10, October-2016

The dominant land use / land cover categories in 2014-15 were built-up land occupied 142 sq.km (4.31%), agricultural land occupied 1320 sq.km (39.93%), forest area 1024 sq.km (30.99%), wastelands area 489 sq.km (14.81%), waterbodies area 319 sq.km (9.65%) and wetlands area 9 sq.km (0.28%). The land use/land cover maps of the study area for 2000-01, 2005-06, 2011-12 and 2014-15 respectively given below.

The two crop area has been decreased from 24.20% to 10.89% for 2000-01 to 2014-15. Kharif crop has been decreased from 6.91% to 7.56%, Rabi crop has been increased 2.91% to 12.11%, and agricultural plantation increased from 0.99% to 2.63%, fallow land has been increased 4.14% to 5.53%, aquaculture land increased from 0.44% to 1.21%.

There has been increased the built up compact 0.62% to 0.93%, built up sparse increased from 0.53% to 0.99%, rural area has been increased from 1.09% to 1.57% and the development area for built up it has been increased to0.07% . Under the quarry area increased from 0.04% to 0.09% and the active mining area has not been seen in the 2000-01 it has observed on 2011-12 satellite data and it is increased 0.10% to0.12% under silica mining near the coast area of the study area. Under the development activities in the study area it has been increased from 0.08% to 0.51%.

There has been decreased the deciduous forest from 22.14% to 21.99% and increased the scrub forest area from 7.83% to 7.91%.

Under the waste land category salt affected land has been decreased for developmental activities from 2.62% to 2.10%. Scrub land has been decreased from 12.30% to 11.21%. The sandy area has been decreased from 1.22% to 0.86%.

There has been decreased the tank areas from 7.38% to 7.22%, canal area has been increased from 0.13% to 0.19%. Under the wetland areas it is decreased from 0.49% to 0.28%.

The study successfully shows that the change detection technique can be applied for land use / land cover using remote sensing data. Based on the land use / land cover analysis, along with the change detection matrix analysis of the study area, it is found that the land use /land cover change trend varied during the period of 15 years of study.

This research has brought out that the land use which spatially reflects the Swarnamukhi River basin can be done on a rational and scientific basis by evolving land use.

Remote Sensing is not an end in itself for any resources study. It is only an effective tool for acquiring authentic comprehensive timely data, especially for land use study. But field checks are most essential for confirming the result derived from Remote Sensing data products.

Thus, this study concludes that the remote sensing and GIS have a pivotal role in assessing the various parameters of land use / land cover analysis.

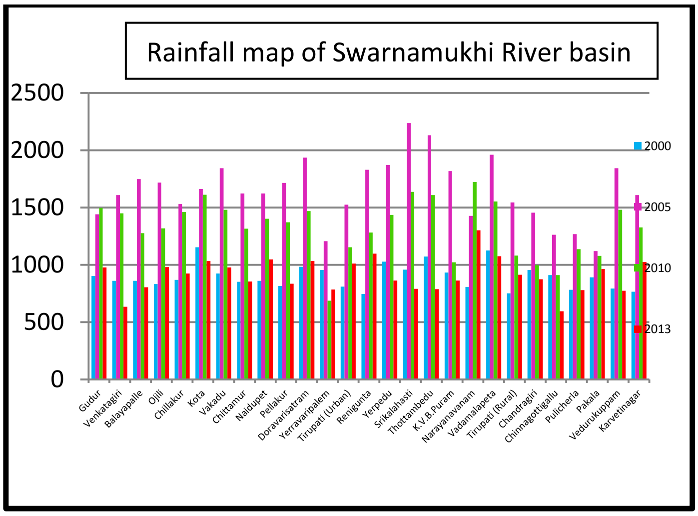


Fig 3 : Map showing the rainfall distribution in Swarnamukhi River basin

Last 15 years (2000-2015) significant changes in various LULC are observed in the studied in Swarnamukhi River basin and this information would provide useful inputs to LULC planners for effective management of the basin. Remarkable increase in built up area, industrial area from fallow land, salt affected land and scrub land in the basin. Aquaculture area ha s been increased from agricultural crop land besides the river channel at the coast of the basin.

The major causes of negative LULC changes are deforestation activities, due to built up land has been identified, soil erosion in sloping mountainous areas, rapid urbanization, unplanned infrastructure development such as road and building etc and population pressure.

The other important limitation of this study was that the social and economic drivers of land use land cover change like population pressure and economic status etc. were not considered in the LULC change and impact assessment. Figure 8 is showing the land use change between 2000-01 and 2014-15. Table 2 is showing the error matrix or change matrix for 2000-01 to 2014-15. Areas are showing in hectares.

V. CONCLUSIONS:

Land is the most vulnerable natural resource for production of food, fibre, fuel and many other essential goods to meet human and animal needs. However, it is facing serious threats of deterioration due to simmering human pressure and utilization incompatible with its capacity. The success of any impact assessment study depends mainly on two factors. One is the assessment of the environmental condition and the second one is estimation of impact from proposed project on the environment. Both are key factors to arrive at the post project scenario.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 10, October-2016

Remote Sensing study indicates the various land Use/Land Cover patterns. In this paper the methodology followed by detailed results derived from medium resolution satellite data. This analysis shows that the LULC in Swarnamukhi River basin has undergone medium changes between 2000 and 2015.

Urban area in the present research area has been increased from 77 sq.kms to 94 sq kms. During the 15 years period from 2000-2015 was observed. This increase is mainly due to increase in population especially urban population in the research area, it is observed that urban area increased from Tirupati town to Tiruchanur village at a 4 Kilometres distance. Tirupati Town is a change in the central place activity from pilgrim cum educational cum industrial sector.

Cultivation and aquaculture are the major activities in this region. Between 2000 and 2015 of the 22 major LULC classes, considerable changes has been observed in agriculture (39.5% to 40%) and built-up areas (2.32% to 4.10%), area under forest (31.09% to 30%) marginally changed. Other LULC classes including barren land (0.43% to 0.41%), sandy area (1.22% to 0.86%) and scrub land (12.30 to 11.21%) also recorded marginal changes in this basin. Mining or quarry has been occurred in coastal sandy areas (0.04% to 0.21%).

It is observed that, due to not proper rainfall in the research area the tanks are dried up in over the year. Canal has been 430 ha in 2000-01 in the study area, it is observed the canal has been increased in 2014-15 nearly 612 ha.

Using of above data it will be investigate the Environmental Impact Assessment of Land Use/Land Cover in Swarnamukhi River Basin. Furthermore, these maps will enable identification of vulnerable areas of land degradation process, changing patterns of precipitation and temperature.

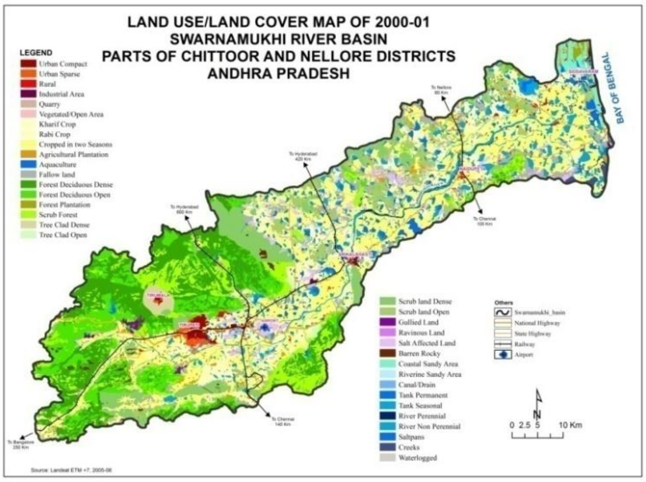


Fig 4:Map showing the LULC in 2000-01

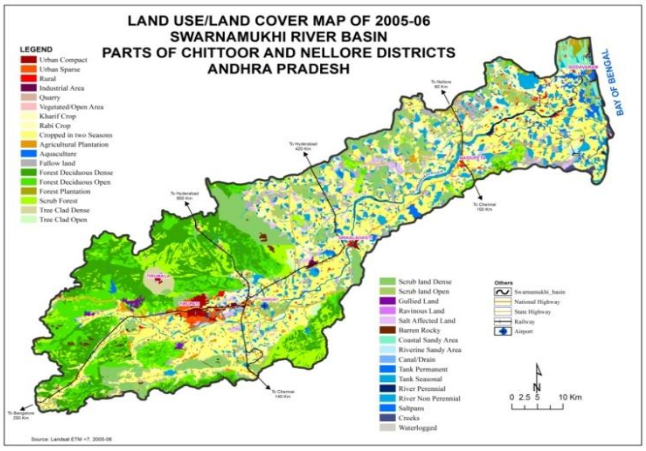


Fig 5:Map showing the LULC in 2005-06

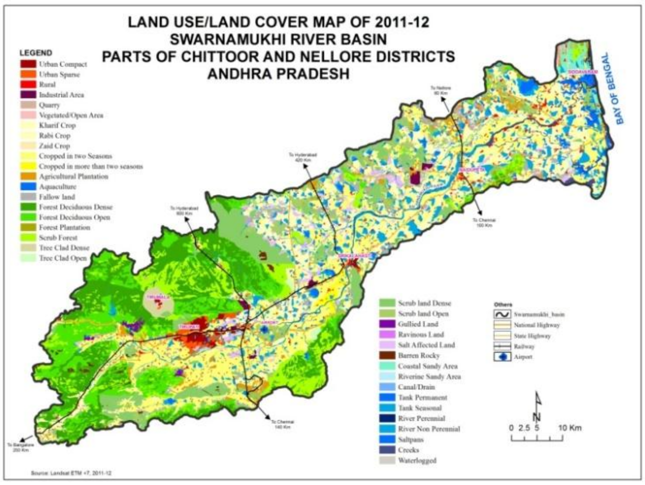


Fig 6:Map showing the LULC in 2011-12

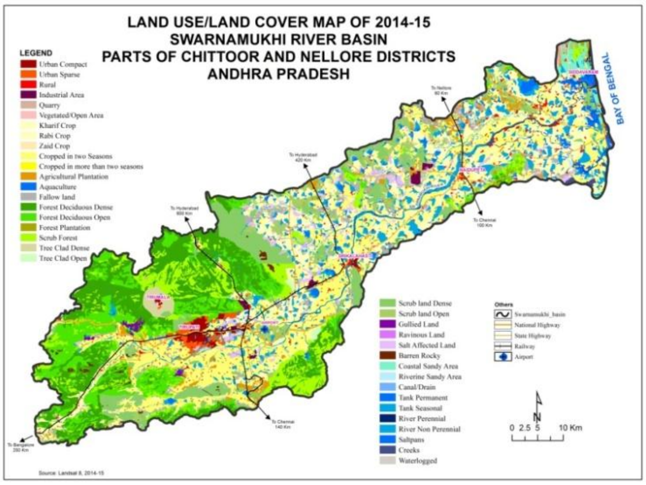


Fig 7:Map showing the LULC in 2014-15

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 10, October-2016

REFERNCES

[1] E.R. Lambin, M.D.A. Rounsevell and H.J.Geist, "Are agricultural land-use Models able to predict changes in land use intensity?" *Agriculture, Ecosystems and Environment*, Vol. 82, 2000, pp.321-331.
[2] G.D. Squires, "Urban Sprawl and the Uneven Development of Metropolitan America", Urban Responses, Urban Institute Press, Washington, D.C. 2002, pp.1-22.
[3] Fei Yuan, Kali E. Sawaya, Brian C. Loeffelholz and Marvin E. Batter "Land cover classification and Change analysis of the Twin Cities (Minnesota) Metropolitan Area" by multitemporal Landsat remote sensing, Remote Sensing of Envoronment, Vol.99, August 2005, pp.317-327.
[4] Lillesand, T M and Kiefer, R.W. (2000) "Remote Sensing and Image Interpretation".
[5] "National Land Use/Land Cover classification" by N C Gautam, "Centre for Land Use Management", 2004
[6] Priyanka Patel N. Janardhana Raju. B. C. Sundara Raja Reddy. U. Suresh, Wolfgang Gossel, Peter Wycisk, "Geochemical processes and multivariate statistical analysis for the assessment of groundwater quality in the Swarnamukhi River basin, Andhra Pradesh, India" Environ Earth Scince (2016) 75:611, pp. 610-611, December 2015.
[7] Verburg, P.H., Paul, S., Yaqui Chen, Soepboer, W., and Veldkamp, T.A. 2000. GIS-Based Modeling of Human-Environment Interactions for Natural Resource Management Applications in Asia. In 4th International Conference on Integrating GIS and Environmental modeling (GIS/EM4): Problems , Prospects and Research Needs, Banff, Alberta, Canada. Boulder: Cooperative Institute for Research in Environmental Sciences (CIRES), University of Colorado. http://www.colorado.edu/research/cires/banff/upload/337/.
[8] Raskin, P., Banuri. T., Gallopin, Gutman, P., Hammond, A. et al. 2002. Great transition: the promise and lure of the times ahead. Glob. Scenar. Group, SEI Pole Star Ser. Rep. 10, Stockholm Environ. Inst. Boston.
[9] Martens. P, and Rotman, J. (Ed). 2002. Transition in a Globalizing World. Lisse, Neth: Swets and Zeitlinger, 135 pp.
[10] Manual LULC 50K 2005 (write complete name)
[11] "National Land Use/Land Cover classification" by N C Gautam, "Centre for Land Use Management", 2004.
[12] R. Nagaraja, "Appraisal and evaluation of land and water resources for integrated land use planning-A Remote Sensing approach", Ph.D Thesis, 1989.
[13] Anderson, J.R., Hardy, E.E., Roach, J.T. and Witmer, R.E. 1976. A land use and land cover classification system for use with remote sensor data. *U.S. Geological Survey Professional Paper*, No. 964. USGS, Washington, D.C.
[14] Darwin, R., Tsigas, M., Lewandrowski, J. & Raneses, A. 1996. Land use and cover in ecological economics. *Ecological Economics*, 17: 157–181.
[15] Meyer, W.B. & Turner II, B.L. 1992. Human population growth and global land use/land cover change. pp. 39–61, *in: Annual Review of Ecology and Systematics*, No. 23.
[16] Di Gregorio, A. 1991. Technical report on the land cover mapping of Lebanon. FAO Project NECP/LEB/001/SAU.
[17] Di Gregorio, A. 1995. FAO land use statistics: A case study for three countries using remote sensing and GIS technology. Consultancy Report for FAO Statistics Division, Rome.

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 10, October-2016

Table 1: Overall extent of land use and land cover classes in Swarnamukhi river basin

Land Use/Land Cover Classes	Area							
	2000_01		2005_06		2011_12		2014_15	
	Area	%	Area	%	Area	%	Area	%
Urban	3799.38	1.15	4661.42	1.41	5610.38	1.70	6589.14	1.99
Rural	3596.99	1.09	4103.75	1.24	5065.59	1.53	5190.31	1.57
Industrial	264.46	0.08	431.35	0.13	1433.28	0.43	1767.46	0.53
Mining/Quarry	133.51	0.04	195.45	0.06	631.38	0.19	699.06	0.21
Cropland	112448.34	34.02	109583.21	33.16	109571.48	33.15	101004.09	30.56
Fallow land	13685.17	4.14	13591.22	4.11	10762.61	3.26	18278.72	5.53
Agricultural Plantation	3281.29	0.99	3528.47	1.07	6710.05	2.03	8706.15	2.63
Aquaculture	1445.63	0.44	3051.17	0.92	3319.51	1.00	4012.99	1.21
Deciduous forest	73184.10	22.14	73166.60	22.14	72979.27	22.08	72691.56	21.99
Forest Plantation	770.85	0.23	770.85	0.23	719.50	0.22	781.29	0.24
Scrub Forest	25893.70	7.83	25835.26	7.82	26047.41	7.88	26158.97	7.91
Tree Clad Area	2895.09	0.88	2895.09	0.88	2863.40	0.87	2798.92	0.85
Salt Affected land	8657.34	2.62	7309.28	2.21	7112.81	2.15	6945.24	2.10
Gullied /Ravinous land	739.82	0.22	777.63	0.24	751.97	0.23	751.97	0.23
Scrub land	40636.33	12.30	42370.71	12.82	39284.11	11.89	37052.31	11.21
Sandy area	4021.73	1.22	3995.95	1.21	3233.39	0.98	2853.43	0.86
Barren rocky	1408.80	0.43	1357.94	0.41	1357.94	0.41	1347.44	0.41
River	7171.48	2.17	7264.99	2.20	5605.92	1.70	7438.78	2.25
Canal	429.91	0.13	429.91	0.13	612.34	0.19	612.34	0.19
Tank	24392.98	7.38	24370.74	7.37	24324.93	7.36	23867.33	7.22
Coastal Inland	1628.05	0.49	793.95	0.24	2487.67	0.75	931.39	0.28
Inland	19.87	0.01	19.87	0.01	19.87	0.01	25.92	0.01
Grand Total	330504.83	100.00	330504.83	100.00	330504.83	100.00	330504.83	100.00

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 10, October-2016

Table 2: Showing the error matrix or change matrix for 2000-01 to 2014-15

	In_2014_II																						
In_2000_II	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	Grand Total
1	3799																						3799
2	172	3425																					3597
3			219																		45		264
4			29	92			3								10								134
5	1801	1582	208	27	93302	9630	3640	1396					177		447	80		47	56	49		6	112448
6	264	45	31	9	4556	7950	766	168					4		179	26			24				13685
7	29	11	138	4	263	69	2388	77					2		204	70		1	7		17		3281
8					355	26	17	1048															1445
9	20	14		4			51		72619	173	248							1	1				73184
10										378	393												771
11	2			5		10	23		62	230	25518								1	41			25894
12	40	10			5							2799			41								2895
13	90	10	296		510	81	10	27					6737	38	581				5	12			8657
14				26										740									740
15	339	65	788	72	1607	298	1665	289					14		35380	6			85	2	27		40636
16		15	13	414	63	142	117	442							159	2626		10					4022
17				5	6	8			11						33		1347						1409
18		2			38	5	16	75					7		6	11		6921			91		7171
19																			430				430
20	34	10	46	43	75	57	1	12					4					351	3	23742	15		24393
21		2			225	1	9	481							11	34		108		21	736		1628
22																						20	20
Grand Total	6589	5191	1767	699	101004	18278	8706	4013	72692	781	26159	2799	6945	752	37052	2854	1347	7439	612	23867	931	26	330499

International Journal of Engineering Research & Technology (IJERT)
ISSN: 2278-0181
Vol. 5 Issue 10, October-2016

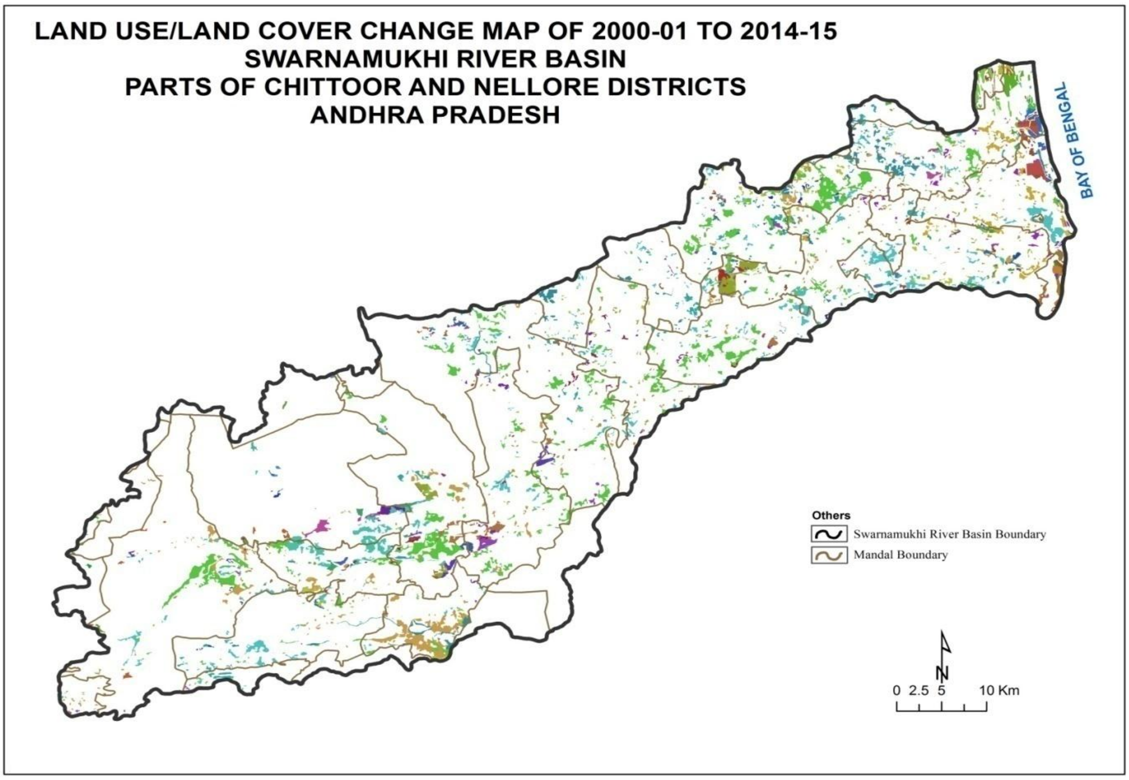
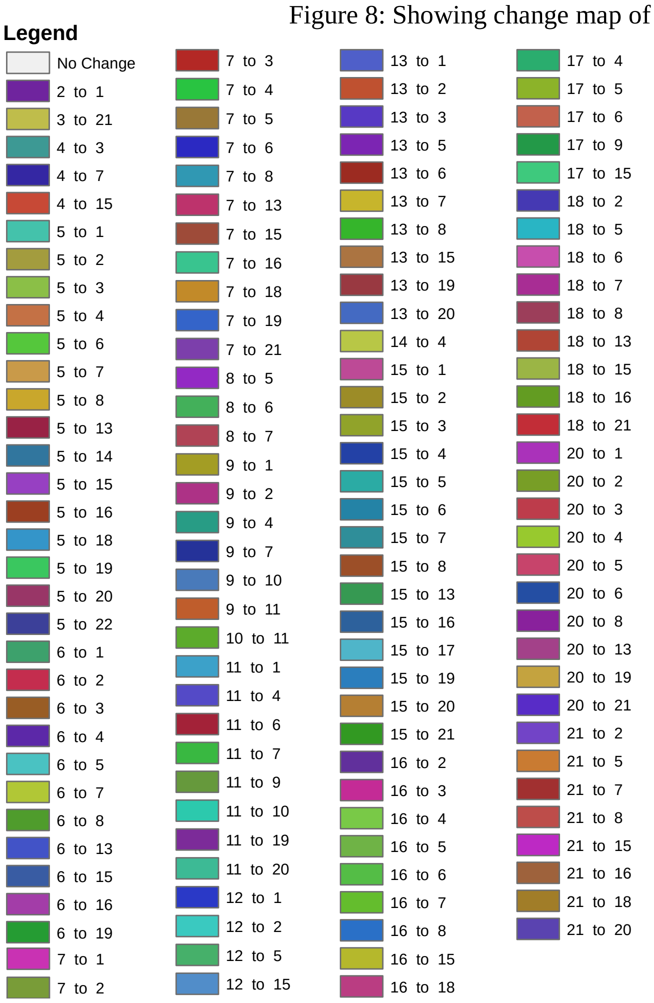


Figure 8: Showing change map of 2000-01 to 2014-15



1	Urban
2	Rural
3	Industrial
4	Mining/Quarry
5	Cropland
6	Fallow land
7	Agricultural Plantation
8	Aquaculture
9	Deciduous forest
10	Forest Plantation
11	Scrub Forest
12	Tree Clad Area
13	Salt Affected land
14	Gullied /Ravinous land
15	Scrub land
16	Sandy area
17	Barren rocky
18	River
19	Canal
20	Tank
21	Coastal Inland
22	Inland