

Land Use/Land Cover Change Detection in Swarnamukhi River Basin Using Remote Sensing and GIS Techniques

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ABSTRACT: Natural resources play an important role in the economic growth and development of the region, more so, the degree of development is a function of natural resource occurrence and its utilization and sustenance for future population needs and demands. 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.

KEYWORDS: Land Use/Land Cover, Change detection, Remote Sensing and GIS, Arc GIS.

I. INTRODUCTION

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.

Globally changes in land use are increasingly altering land cover. In environmental studies, "Change" implies an alteration in the surface components of a landscape. Common types of change detectable on remotely sensed (RS) imagery are associated with vegetation clearance, urban expansion, changing water levels in surface water bodies, vegetation regeneration after disturbance and soil disturbances resulting from mining, landslides and overgrazing(1,2). The principal value of generating change maps is that they allow identification of the locations of high magnitude changes. This results in the concentration of monitoring and modelling efforts in the "hot spots" (3,4).

The Land Use/Land Cover Change (LULCC) is mainly due to urbanization, deforestation and changes in agricultural pattern (5,6). Change in LULC is not only direct removal of forest cover, but also as a result of numerous other factors like infrastructure development, resource exploitation, NTFP extraction, etc. LULCC also influences the change in composition of the natural flora of the region by introducing multiple edges, where edge species predominate that are better adapted to utilize the scarce nutrients, replacing the endemic species especially in the climax or sub-climax forest.(7,8,9,10).

Swarnamukhi River is one of the major rivers flowing among 13 rivers in Chittoor District, State of Andhra Pradesh, India. It gets originated from Chandragiri mandal hills of the Chittoor District of A.P. The Swarnamukhi river is passing nearly 83 Km length of the river is passing in Chittoor District. The total length of the river is approximately 142 Km. The course of the river starts through a valley between Tirupati and Chandragiri towns and meets the Srikalahasti town. The river finally merges into the Bay of Bengal at Siddavaram village in Nellore District. Swarnamukahi river basin comprises of 56 mandals and 832 villages in Chittoor and Nellore Districts. Swarnamukhi

International Journal of Innovative Research in Science, Engineering and Technology

(An ISO 3297: 2007 Certified Organization)

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River has five major Saivite shrines along its course in the Chittoor District. Besides Srikalahasti, there are temples of Agastheswara in Thondavada, Parasareswara in Yogimallavaram, Parasurameswara in Gudimallam in Chittoor District.

II. STUDY AREA

River Swarnamukhi, an ephemeral river, is the east flowing river between Pennar and Cauvery Rivers. The basin is spreading over a catchment area of 3200 Km, is bounded by North Latitude $13^{\circ} 25' 30''$ and $14^{\circ} 28' 30''$ and East Longitude $79^{\circ} 08' 39''$ and $80^{\circ} 11' 00''$, in Chittoor and Nellore Districts in A.P. In the basin, it has one hydrological observation station located in Naidupet and an average rainfall is 1,000 mm. The basin covers 5 watersheds and each watershed covering 5000 Ha. The river basin is occupied by granite and granitic gneisses.

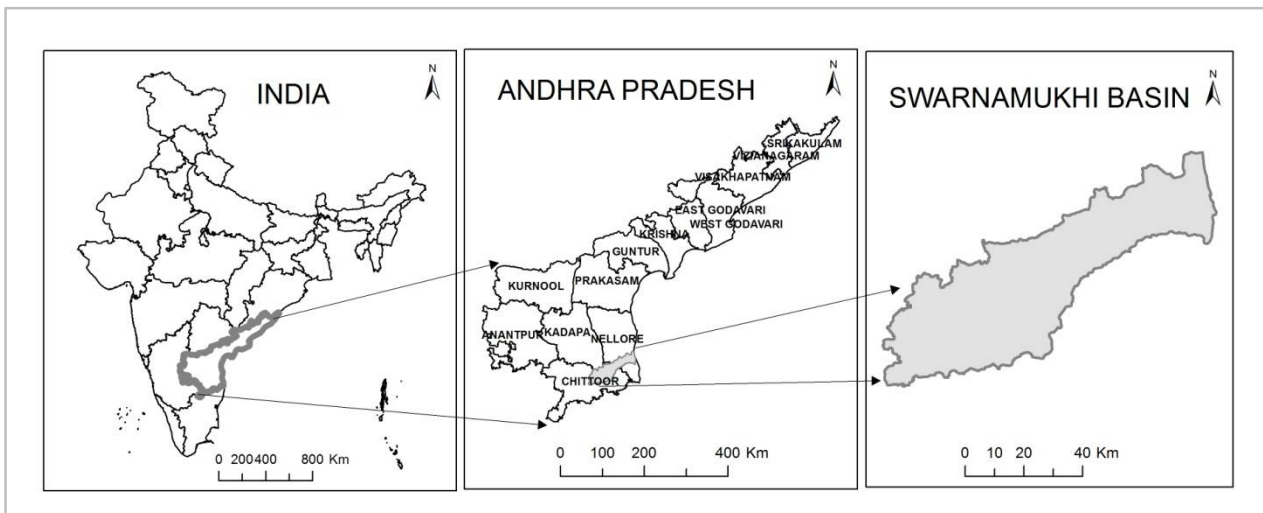


Fig1: Showing the location map Swarnamukhi River basin in the state of Andhra Pradesh. The basin covers 5 watersheds and each watershed covers 5000 Ha. Swarnamukahi river basin comprises of 56 mandals and 832 villages in Chittoor and Nellore Districts.

III. OBJECTIVES:

- To study the Land Use/Land Cover (LU/LC) for the study area for 2000-01, 2005-06, 2011-12 and 2014-15 respectively.
- To identify the LU/LC changes in the study area.

IV. 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 mapping is 1:50,000 in the study area. ERDAS 2015 software is used for satellite data rectification. ARC GIS 10.3 software is used for creating of LU/LC vector data. The detailed methodology is given in Figure2.

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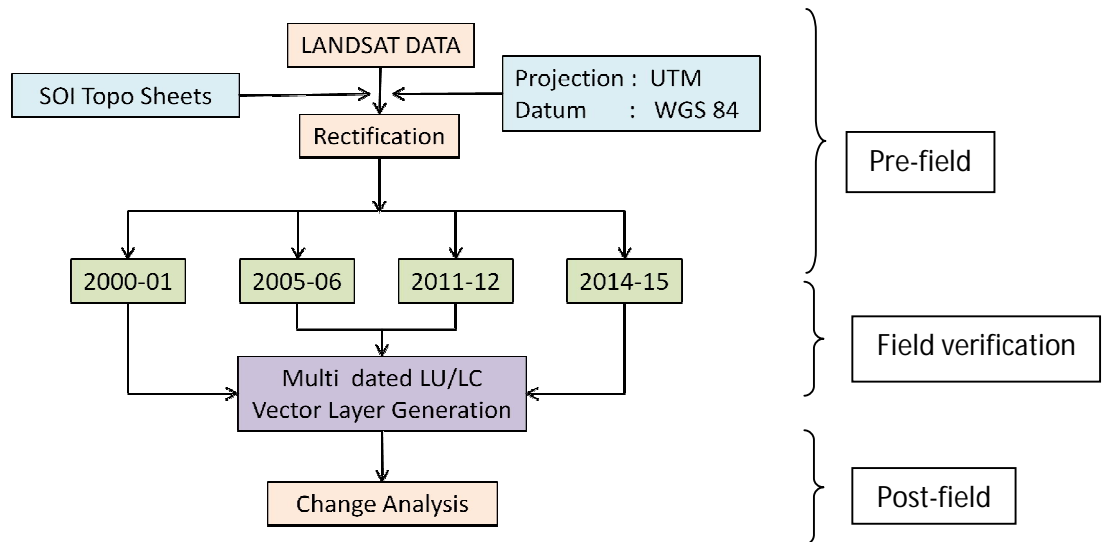


Fig: Showing the methodology adopted from National Remote Sensing Centre (NRSC). The methodology has 3 stages followed i.e. (i) Pre-field (ii) Field verification and (iii) Post-field sates.

V. RESULTS AND DISCUSSIONS

In Land Use/Land Cover change practice multi satellite data (2000-01, 2005-06, 2011-12, 2015-16) used for change detection. In this study area maps and the statics table shows vital role for land use sustainable development. Using of above satellite data onscreen interpretation has been done. There are thirty five land use categories were mapped and completed ground truth in the study area. Land Use/Land Cover maps of four selected years have been generated using above methodology. Land Use/Land cover spatial distribution and temporal changes also have been generated. Figure 3 to 6 are shown mapped of land use/land cover at multi dated satellite data. The areas in statistics are shown in Hectares.

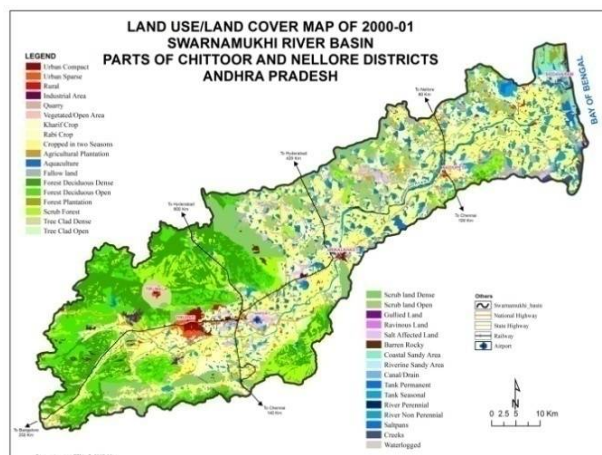


Fig3: Map is showing the Land Use/Land Cover in the year of 2000-01 using LANDST -4/5 imageries. Under agriculture lands are 39.6%, built up lands are 2.36, forest land are 31.07%, wastelands are 16.79%, waterbodies are 9.68% and wetlands are 0.51% was occupied..

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The study area is primarily agricultural as the area under crop land dominates. Under agriculture there are six sub categories are there. Agriculture plantation is increased from 2001 to 2015, 0.99%, 1.07%, and 2.03% and 2.63%. Aquaculture is also increased from 0.44%, 0.92%, and 1.00% to 1.21. Kharif crop land has changed from 6.91%, 3.20%, and 3.61% to 7.56%. Rabi crop land has changed 2.91%, 4.17%, 10.88% to 12.11%. Crops in two seasons have decreased from 24.21%, 25.78%. 18. 67% to 10.89%. Fallow land marginally increased from 4.14%, 4.11%, 3.26 to 5.48%.

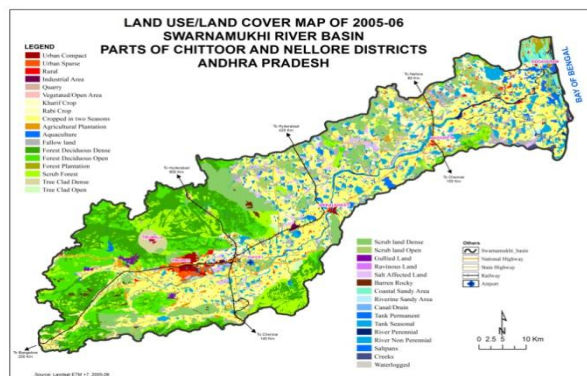


Fig4: Map is showing the Land Use/Land Cover in the year of 2005-06 using LANDST -4/5 imageries. Under agriculture lands are 39.25%, built up lands are 2.83%, forest land are 31.06%, wastelands are 16.89%, waterbodies are 9.7% and wetlands are 0.25% was occupied..

Under Built up category eight sub categories are there. Rural area increased from 1.09%, 1.24%, and 1.53% to 1.57%. Urban (Built up- Compact) areas have increased from 0.62%, 0.75%, and 0.90% to 0.93%. Built up-sparse doubled the area form 0.53%, 0.61% 0.75% to 0.99%. Industrial area has increased from 0.08\$, 0.13%, 0.42% to 0.51%. Vegetated or Open area around the built up land was not appeared in 2000-01. It is increased form (2005-06) 0.04%, 0.05% to 0.07%. Quarry area is also not in 2000-01 and 2005-06. It is increased from (2005-06 to 2011-12) 0.10% to 0.12%.The effluent area from industrials is also not appeared in 2000-01 and 2005-06. This area is increased from 0.01% to 0.02% in 2011-12 to 2014-15.

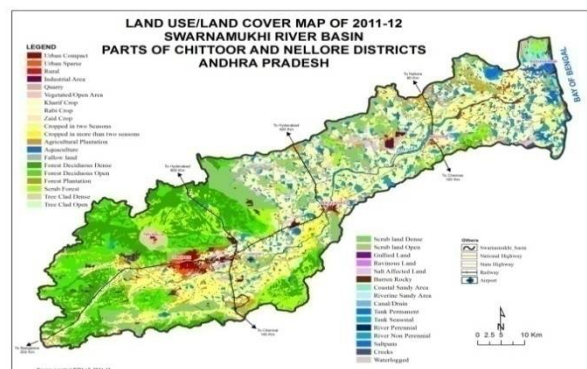


Fig5: Map is showing the Land Use/Land Cover in the year of 2011-12 using LANDST -7 imageries. Under agriculture lands are 39.45%, built up lands are 3.85%, forest land are 31.05%, wastelands are 15.66%, waterbodies are 9.25% and wetlands are 0.76% was occupied..

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Under the Forest category deciduous forest-open is not much changed from 9.32%, 9.32%, and 9.28% to 9.20%. Dense forest is also marginally changed from 12.82%, 12.82%, and 12.80% to 12.80%. Forest Plantations is 0.23%, 0.23%, 0.22% and 0.24%. Scrub Forest is marginally increased from 7.83%, 7.82%, 7.88% to 7.91%. Tree clad dense and open forest areas are not changed in study periods. Wastelands are sub divided into eight categories.

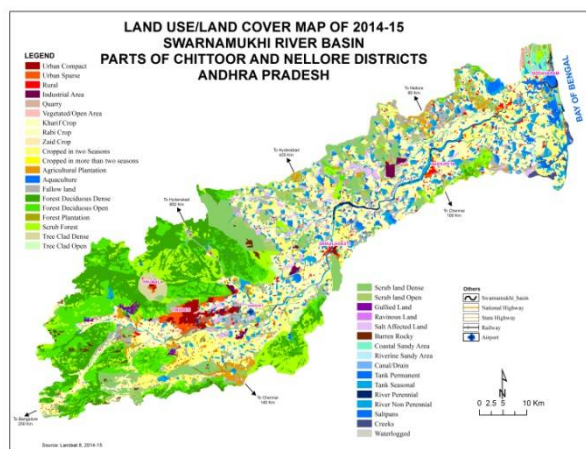


Fig6: Map is showing the Land Use/Land Cover in the year of 2011-12 using LANDSAT -7 imageries. Under agriculture lands are 39.93%, built up lands are 4.3%, forest land are 31.07%, wastelands are 14.81%, waterbodies are 9.66% and wetlands are 0.21% was occupied.

Under this Barren rocky, Gullies lands are not changed during the period. Ravinous land has changed into cropland land in 2011-12 in the study area. It was in the 2000-01 and 2005-06 is 0.01%. Salt effected land was decreased from 2.62%, 2.21%, 2.15% to 2.10%. Coastal sandy area has shown decreased from 1.16%, 1.08%, 0.90% to 0.79%. Riverine sandy areas have changes over the years from 0.05%, 0.13%, 0.08% to 0.07%. Scrub land dense has changed from 7.05%, 8.21%, 7.96% to 7.23%. A scrub land open area was changed from 5.25%, 4.61%, 3.93% to 4.01%. Under category of Waterbodies eight sub divisions are there. Canal/drain has been marginally changed from 0.13%, 0.13%, 0.19% to 0.19%. Tank permanent areas were changed from 1.93%, 0.76%, 1.01% to 1.47%. Tank seasonal areas were changed from 5.45%, 6.61%, 6.35% to 5.75%. River non perennial was changed from 0.38%, 0.80%, 0.32% to 0.51%. Mud flats area was decreased from 0.34%, 0.23%, 0.71% to 0.25%. Saltpans area has been decreased from 0.16%, 0.01%, 0.04% to 0.03%. Waterlogged area was changed over the years in the study area.

Table 1: Showing the table of Land Use/Land Cover categories and its statistics of the study area in Hectares in the year 2000-01, 2005-06, 2011-12 & 2014-15. Under agriculture land 6 categories, built up land 8 categories, forest land 6 categories, wasteland 8 categories, waterbodies 5 categories and wetlands are 3 categories.

Land Use	Year 2000-01		Year 2005-06		Year 2011-12		Year 2014-15	
	Area	%	Area	%	Area	%	Area	%
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
Cropland-Kharif	22837.12	6.91	10578.48	3.20	11934.13	3.61	24983.11	7.56
Cropland-Rabi	9624.97	2.91	13786.56	4.17	35948.43	10.88	40039.99	12.11
Cropped in two Seasons	79996.25	24.21	85218.17	25.78	61688.93	18.67	35980.99	10.89
Fallow land	13685.17	4.14	13591.22	4.11	10762.61	3.26	18278.72	5.53

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Effluent and other waste	0.0	0.00	0.0	0.00	38.17	0.01	70.27	0.02
Quarry-Mining -Active	0.0	0.00	0.0	0.00	338.29	0.10	402.19	0.12
Quarry	133.51	0.04	195.45	0.06	293.09	0.09	296.88	0.09
Built Up-Rural	3596.99	1.09	4103.75	1.24	5065.59	1.53	5190.31	1.57
Built up-Compact	2042.96	0.62	2489.14	0.75	2971.33	0.90	3082.02	0.93
Built up-Sparse	1739.68	0.53	2025.35	0.61	2480.37	0.75	3270.75	0.99
Industrial Area	264.46	0.08	431.35	0.13	1395.11	0.42	1697.19	0.51
Vegetated/Open Area	0.0	0.00	146.93	0.04	158.68	0.05	236.37	0.07
Deciduous Forest -Open	30807.76	9.32	30790.26	9.32	30660.38	9.28	30390.95	9.20
Deciduous Forest - Dense/Closed	42376.34	12.82	42376.34	12.82	42318.89	12.80	42300.61	12.80
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-Dense/Closed	2263.28	0.68	2263.28	0.68	2231.59	0.68	2172.58	0.66
Tree Clad Area-Open	631.81	0.19	631.81	0.19	631.81	0.19	626.34	0.19
Barren Rocky	1408.80	0.43	1357.94	0.41	1357.94	0.41	1347.44	0.41
Gullied land	714.17	0.22	751.97	0.23	751.97	0.23	751.97	0.23
Ravinous land	25.66	0.01	25.66	0.01	0.0	0.00	0.0	0.00
Salt Affected Land	8664.01	2.62	7309.28	2.21	7112.81	2.15	6945.24	2.10
Sandy area-Coastal	3840.27	1.16	3575.73	1.08	2959.61	0.90	2623.97	0.79
Sandy area-Riverine	181.46	0.05	420.22	0.13	273.78	0.08	229.47	0.07
Scrub land-Dense/Closed	23296.98	7.05	27123.65	8.21	26303.73	7.96	23909.45	7.23
Scrub land-Open	17339.35	5.25	15247.06	4.61	12980.38	3.93	13142.87	3.98
Canal/drain	429.91	0.13	429.91	0.13	612.34	0.19	612.34	0.19
Tank-Permanent	6386.80	1.93	2526.34	0.76	3334.57	1.01	4851.81	1.47
Tank-Seasonal	18006.24	5.45	21844.40	6.61	20990.36	6.35	19015.52	5.75
River-Non-Perennial	5922.24	1.79	4611.70	1.40	4545.37	1.38	5758.97	1.74
River-Perennial	1249.24	0.38	2653.29	0.80	1060.55	0.32	1679.81	0.51
Mud flats	1110.68	0.34	756.79	0.23	2362.27	0.71	817.30	0.25
Saltpans	517.37	0.16	37.15	0.01	125.40	0.04	114.09	0.03
Waterlogged	19.87	0.01	19.87	0.01	19.87	0.01	25.92	0.01
Total	330504.83	100.00	330504.83	100.00	330504.83	100.00	330504.83	100.00

VI. CONCLUSION

Remotely sensed data have been effectively used as a tool for mapping of land use. The classified LULC map is used to identify the changes in LULC during four different periods to understand the influence of LULCC on changing environmental changes. Under rabi crop has been increased. Aquaculture crop have been increased in the study area as a commercial corp. Built up compact or Urban area in the study area has been shown positive changes. Wastelands can be used for the sustainable development to the Government. It is identified quarry or mining of sandy area nearer to the

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coast has increased in the recent years. This study analysis provides the database for the LULC which at village level can be utilize for the development activities. The spatial pattern can also be used for formulating different NGO sponsored programmes/public-private partnership mode schemes towards rural employment generation and also for providing food security in marginal regions. Ground truth has been taken for doubtful areas in the study area. This study concludes that remote sensing and GIS technologies can be used for scientific planning and management of natural resources.

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International Journal of Innovative Research in Science, Engineering and Technology

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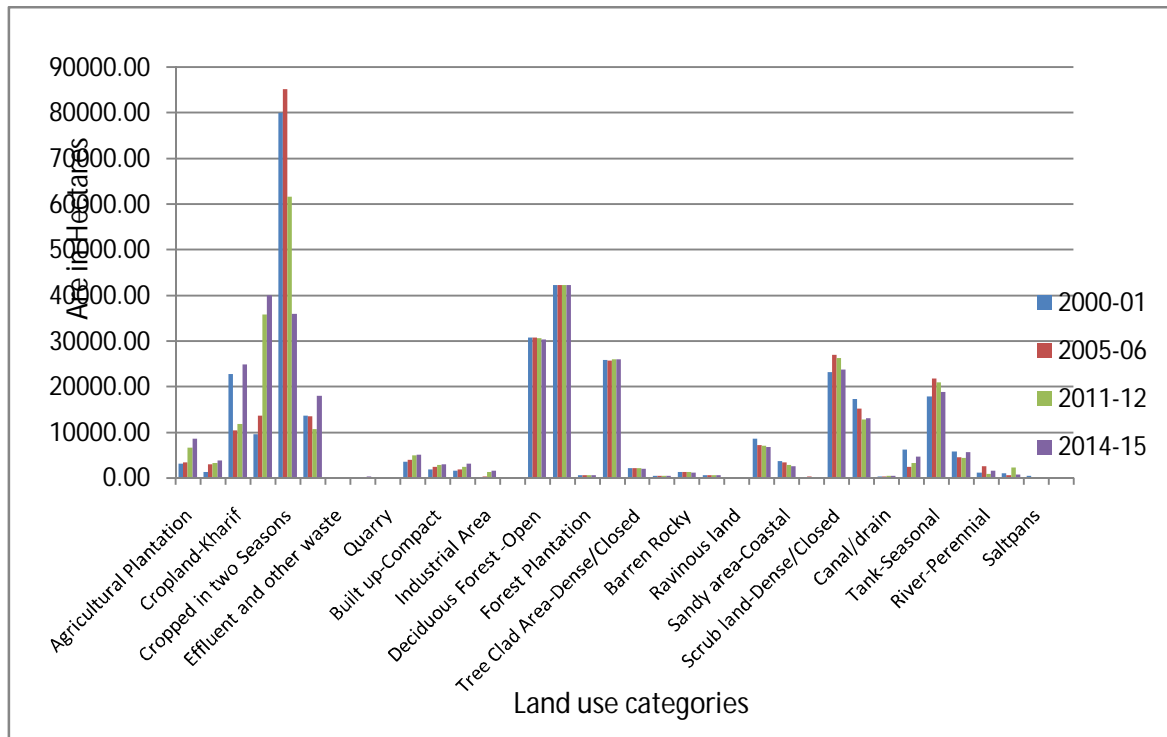


Fig7: Area under different land use categories of Swarnamukhi River basin during 2000-01, 2005-06, 2011-12 and 2014-15