

The scenario of Land use /land cover change of Udaipur District, Rajasthan: Study using Remote Sensing and GIS technology.

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Abstract- The pattern of Land use/land cover has been changing pretty much consistently in Udaipur district because of urbanization and furthermore from deforestation. The examination assesses the Land use/land cover change in Udaipur area by utilizing Remote Sensing and GIS technology. Landsat scenes of year 2001, 20015, 2010, 2015 and 2018 were taken and administered order system was utilized to arrange the Land use/land cover classes into Built up, Forest, Scrubland, Agriculture, Fellow land, Barren/Rocky, Water. The outcomes infer outstanding development of developed and significant abatement in the forest cover. Remote Sensing and GIS advances give the information to study and screen the earth and the climate. The after-effects of the examination additionally helps in the planning deforestation locales which must be recuperated by doing estate and gives genuine situation of Land use/land cover in remote areas.

Keywords- Land use /land cover, Deforestation, Urbanization, Remote Sensing.

1. Introduction- The segment information of the most recent couple of many years uncovered an expanding propensity of urbanization in many states, including Rajasthan. Udaipur city, being an instructive center point just as a place of interest of worldwide significance. The current investigation is intended to (I) determine the changing situation of land use and land cover design, (ii) learn the adjustment of the forest front of the district, and (iii) Change in the natural magnificence of the scene of the natural beauty. The investigation of landuse and land cover change is one of the preeminent fields to comprehend the level of cooperation among man and climate. The investigation of land use and land cover change is one of the principal fields to comprehend the level of connection among man and environment (DhanjitDeka and Pradip Sharma 2012). The actual backwoods are dynamic in nature and are going through consistent changes because of both normal and anthropogenic powers(Deepti Singh, et.al. 2018). The forest is under danger from regular and anthropogenic powers prompting forest degradation, fundamentally because of top-kicking the bucket illness and over-abuse of woodland assets. The land-cover changes happen normally in a reformist and steady manner, anyway once in a while it could be quick and sudden because of anthropogenic exercises (Giriraj A. et. al. 2008). Remote sensing detecting information at various time span help in investigating the pace of changes just as the causal components or drivers of changes (S. Santhosh Babooand M. Renuka Devi (2010). Forests have significant and indispensable worldwide natural just as financial assets and they require a feasible administration (Muhammad AsimRizwan, 2011). The investigation of satellite symbolism permitted us to test the general effect of population and settlements on forest cover (Simula M. and Mansur E. 2011). Satellite information have

become a significant application in forest change recognition on account of the redundant inclusion of the satellites at short spans (El Gunaidet. al. 2013). Forest cover today is modified essentially by direct human use and any origination of worldwide change should remember the unavoidable impact of human activity for land surface conditions and cycles (Boisier, J. P., et. al. 2012). Planning LULC is presently the standard method to monitor changes and to monitor land use change and advancement, a change recognition investigation was performed to decide the nature; degree and pace of land cover change over the time period (Eric K Forkuo and AdubofourFrimpong, 2012). The International Union of Forest Research Organizations (IUFRO) characterizes forest detecting as 'the occasional estimation or perception of those physical, compound and natural boundaries (of forest) for building up baselines for recognizing and measuring changes over the long haul'. Observing the areas and circulations of land-cover changes is significant for building up joins between strategy choices, administrative activities and ensuing area use exercises. Maps delivered utilizing satellite information enjoy upper hands over conventional ground based guides because of the nonstop inclusion and interior consistency of distantly detected informational collections. Landuse order is indispensable in light of the fact that it gives information which can be utilized as contribution for demonstrating, particularly the one managing climate, for example models manages environmental change and approaches advancements (Disperati, L. et al., 2015).

Supervised, Per-Pixel, Maximum-Likelihood Spectral classifiers are the most regularly applied automated land-cover classification strategies due to some extent to a very much created hypothetical base, ease in automation, and demonstrated history (Al-sharif, et. al..2014). Spatial information in a GIS have been displayed to further develop grouping precision and help in the extraction of data from classification (Muhammad AsimRizwan. 2011). Techniques incorporate fuse previously, during, or after a greatest probability grouping (Pielke, R. A., et.al. 2011). Significant drivers of tropical deforestation incorporate enormous scope forest extraction, agrarian extension and foundation advancement, all of which have expanded drastically in many parts inside the forest in the course of recent many years (Ashraf M. Dewan& Yasushi Yamaguchi. 2009). Landsat classification for the most part gives an unmistakable depiction among forest and non-forest cover types and permits both manual and semi-computerized translation (Bharadwaj G.S. 2014). The error matrix and kappa coefficient have become a standard method for evaluation of image classification accuracy. The absence of handily got to, peer explored information sources might add to the clashing insights with respect to timberland cover and deforestation in Udaipur district. In this paper we employ a simple yet accurate time-series satellite change detection method to monitor forest change in the Udaipur district. The overall objective of this study is to map out and analyze the structural changes of forest cover using Landsat imageries of the study area.

2. Study area and data preparation-

2.1 Study Area-The study area(Figure-1) chosen for present investigation is Udaipur district having all out geological region covers as per Forest Survey of India is 11,724 Sq. Km. Udaipur is a southern district arranged among the Aravalli territories which is rich of natural flora and fauna of Rajasthan. Udaipur area is a piece of south-east Rajasthan and arranged between matches 23°26', 26°20' North scopes and 73°09', 74°45' East longitude at normal heights of about 579.4 meter above mean ocean level. Udaipur has an all encompassing setting given by a few lakes and limited on the northwest by the Aravalli Range. Udaipur was established in 1559 by MaharanaUdai Singh and was the capital of Mewar State. It is bound in the north by Rajsamand and Pali areas, in the south by Dungarpur and Banswara,

in the east by Bhilwara and Chittorgarh and on the west by Pali and Sirohi locale and Sabarkantha region of Gujarat.

2.2 Landsat scene acquisition - A requirement of time series change detection is the availability of relatively cloud free data satellite imagery of each date (Jamal Suliman Alawamy et. al 2020). Scenes from October were used to coincide with winter dry season. This season minimize the error of classification results.

2.3 Image Data- Landsat subscenes covering the study area were used having path- and row- .The first subscene was acquired in 2001 by Landsat Thematic Mapper (TM), second subscene was acquired in 2005 by Landsat7 Enhanced Thematic Mapper (ETM), third subscene was acquired in 2010 by Landsat7 Enhanced Thematic Mapper (ETM) and the forth subscene was acquired in 2015 by Landsat8 Operational Land Imager (OLI). All the satellite imagery (Level-2, Reflectance imagery) was downloaded from the USGS Earth Explorer (<https://earthexplorer.usgs.gov/>). Satellite data specifications have been shown in the Table No.1.

3. Methods-

3.1 Landsat scene normalization– There was no much need of normalization because we used atmospherically corrected scene of the Landsat which was ready to analysis scene(Level-2, Reflectance imagery).

3.2 Image classification - The classification was performed with the standard maximum likelihood estimation approach at 30-meter (m) spatial resolution and was verified and improved using existing maps and field data. Post-classification comparison was found to be the most accurate procedure and presented the advantage of indicating the nature of the changes (Kushwaha, S.P.S. 2012). On the basis of GPS survey points and field knowledge the signatures were assigned for each particular class. A stepwise work design is showed in the figure 2.False color composite map presented in figure-3. Details of the different Land use/land cover class were given in the Table No. - 2.

Data Processing- The raw data and imagery was processed using software -

- ERDAS Imagine
- Arc GIS

4. Accuracy assessment- A standard overall accuracy for land-cover and land-use maps is set between 85 (Anderson et. al. 1976) and 90 percent (Lins&Kleckner, 1996). Details of ground control points for the accuracy assessment is presented in Figure 4.Accuracy statistics for the classification result of the October 2018 were presented in Table- 3 and accuracy of the previous image years selected for the study was more than 85 Percent.

5. Results and discussion-The year wise change in the area of different classes of land use in Udaipur district (Table- 4). The classified land use maps were prepared by using Erdas Imagine (Figure-5). The table depicts the area wise change detection in different classes like dense forest was 62923.1 hectares in the year 2001 whereas it reduced to 51339.1 hectares in 2005. Similarly continuous decrease in dense forest has occurred during consecutive years from 2005 to 2010 and further in a spell of next five years there is sharp decrease in forest cover. Likewise open forest also disturbed which was 116401 hectares in the year 2001 whereas it reduced to 97996.1 hectares in the 2018 (Figure 6) which shows great loss. A later report covering a piece of the southern side of the Al-Jabal Al-Akhdar district announced a sensational change in LULC somewhere in the range of 1984 and 2005, where forest and shrub covers lost about 21% and 46%, respectively, while farmlands and urban

areas have expanded by about 58% and 75%, individually. The investigation likewise indicated that, in 1984, there was irrigated cultivation inside the examination zone while inundated farmlands involved about 3.8% of the absolute region in 2005 (Mnsur and Rotherham, 2010).

The areas covered by agriculture and builtup area have increased simultaneously. The outcomes unmistakably uncovered that the built-up land (settlement) has radically expanded from about 8.08 km² in the year 1999 to 8.62 km² in year 2004 (Giriraj Kumar Songara and Nidhi Rai, 2010). There is some vacillation in the absolute areas covered by every one of these land cover types, however the Dense and Open forest, scrubland classes in general show a diminishing pattern while Agriculture, Fallow land, Wasteland and Built-up have an expanding pattern (Figure 7). Remotely sensed data are a helpful apparatus and have logical incentive for the investigation of human environment interactions, particularly land use and land cover changes (Boori, M. S., et. al. 2014). Huge human disturbances in and around the forest limit are the potential reasons for decreases in dense and open forest since this zone is the significant wellspring of timber. Likewise, the feet of the nibbling steers greatly affect fragile ecosystem, making vegetation misfortune, and land degradation. Forest degradation, along with deforestation, are set second to consuming of petroleum derivatives regarding adding to ozone depleting substance (GHG) emissions (Simula and Mansur 2011) a vital driver of global climate change [Intergovernmental Panel on Climate Change (IPCC). Deforestation, forest degradation and peat land fires represented around 15% of global anthropogenic emissions of carbon dioxide (CO₂) somewhere in the range of 1997 and 2006 (Van der Werf et al. 2009). Details of the change detection matrix were given in the Table No. 5 and 6.

The plausible reasons of dense forest degradation during the most recent decade can be many out of which the anthropogenic activities are one of the significant reason. Expansion in the monetary development of the region the anthropogenic activities zone additionally expanding connected to the utilitarian utilization of land and populace development, are applying similarly gigantic tension on the natural resources particularly to the forest. The developing demand for space of human settlement, agriculture, grazing, mechanical, business and the travel industry design are steadily disparaging the green front of the zone. It is expected that controlling hydrological, biotic and landscape interactions and cycles, through utilizing for example vegetation and its natural administrations for environmental quality improvement (phytotechnology), add to improve ecosystem protection from stress, to the upkeep of a homeostatic harmony inside an ecosystem, and to the chance of expanding ecosystem flexibility to anthropogenic changes. It can likewise give financial advantages all alone (Pongratz, J. et. al. 2009).

6. Conclusion-The growth in urban areas of Udaipur city over more than 65 years together with population density is given in Table 4.22. Udaipur city covered an area of 17.17 km² in 1946 with a density of 4347 persons per km². The expansion of urban areas doubled from 17.75 km² in 1951 to 35.97 km² in 1961, while the population density decreased from 5049 persons per km² to 3089 persons per km² during the same period of time. Similarly, the urban area further expanded from 35.97 km² in 1961 to 61.10 km² in 1971. During the 20 year period from 1971 to 1991 the expansion of the city was only marginal at 64.28 km² in 1991 (Bharadwaj 2014).

As the overall accuracy of the change detection results exceeded 85% recommend the result of the mentioned work clearly indicates the change in the forest cover. The main conclusion of the study which is clearly revealed is the deterioration of forest land cover which is a threat to biodiversity of Jaisamand area. The study has demonstrated the utility of multi-

temporal satellite data and GIS to monitor changes in the forest cover. This is very simple, fast and effective technique to detect change in land use/land cover of a particular region. It is very powerful tool in the monitoring and research especially in the inaccessible areas to eliminate the lot of time, money and human power. The main LULC classes identified were forest, scrubland, water and Barren/rocky land. Other high resolution satellite imagery will be useful to do further studies on deforestation and forest monitoring.

Major Anthropogenic disturbances which are the main cause for the degradation of LULC are the following-

1. Increase in the mining production
2. Population Expansion-
3. Increase in the Agriculture
4. Urbanization
5. Increase in the No. of vehicles
6. Increase in the tourism influx

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Tables-

Table 1- Satellite data specifications

Sl. No.	Data	Date of acquisition	Bands	Spatial Resolution	Source
1	Landsat5	2001/10/17	Multispectral	30 m	USGS Earth Explorer
2	Landsat7	2005/10/20	Multispectral	30 m	USGS Earth Explorer
3	Landsat7	2010/10/26	Multispectral	30 m	USGS Earth Explorer
4	Landsat8	2015/10/24	Multispectral	30 m	USGS Earth Explorer
5	Landsat8	2018/10/16	Multispectral	30 m	USGS Earth Explorer

Table 2 – Land use/land cover class details

Sl. No.	Class	Remark
1	Dense forest	Moderate dense forest. Lands with a forest cover with canopy density of 40-70 %
2	Open forest	Lands with forest cover with canopy density of 10 to 40%
3	Scrubland	Lands generally in and around forest areas, having bushes and or poor tree growth, chiefly small or stunted trees with canopy density less than 10%
4	Agriculture	Agricultural land
5	Fallow land	Cropland that is not seeded for a season; it may or may not be plowed.
6	Barren/Rock	Unproductive bare soil including rocks Barren Land includes areas of bare soil, sand, and exposed rocks. In a barren area, less than one-third of the area has vegetation or other cover (Anderson et al, 1976).
7	Built up	Any land on which buildings and/or non building structures are present, normally as part of a larger developed environment like – Urban and Rural Residential, Commercial, Industrial, Roads, Mining, , building material etc.
8	Water	Rivers, Lakes, Ponds etc.

Table 3 - Accuracy statistics for the classification result (October 2018)

Sl. No.	Class Name	Reference Totals	Classified Totals	Number Correct	Producers Accuracy	Users Accuracy	Kappa statistic
1	Dense Forest	5	5	5	100	100	1.0000
2	Open Forest	24	24	24	100	100	1.0000
3	Scrubland	97	98	97	100	98.98	0.9836
4	Agriculture	19	18	18	94.74	100	1.0000
5	Fallow land	2	2	2	100	100	1.0000
6	Waste/Barren/Rocky	102	102	102	100	100	1.0000
7	Built up	3	3	3	100	100	1.0000
8	Water	4	4	4	100	100	1.0000

Overall Classification Accuracy = 99.61%

Overall Kappa Statistics = 0.9943

Table 4 - Year wise change in LULC area of different class of the month of October

Sl. No.	Land Use / Land Cover Class	Area in Hectares (2001)	% Area	Area in Hectares (2005)	% Area	Area in Hectares (2010)	% Area	Area in Hectares (2015)	% Area	Area in Hectares (2018)	% Area
1	Dense forest	62923.1	5.36	51339.1	4.37	50277.5	4.28	48060	4.09	43013	3.66
2	Open forest	116401	9.92	118226	10.07	110378	9.40	96791.8	8.25	97996.1	8.35
3	Scrubland	529888	45.14	507860	43.27	488981	41.66	438050	37.32	419699	35.76
4	Agriculture	72217.7	6.15	95114.7	8.10	89541.7	7.63	109004	9.29	112494	9.58
5	Fallow land	91467.2	7.79	103108	8.78	95569.5	8.14	59413.2	5.06	59777.4	5.09
6	Waste/ Barren/Rocky	283623	24.16	271777	23.15	313391	26.70	390636	33.28	409458	34.88
7	Built up	7857.45	0.67	12541.4	1.07	15393.1	1.31	18741.3	1.60	21862.7	1.86
8	Water	9376.92	0.80	13789	1.17	10222.7	0.87	13057.9	1.11	9454.86	0.81
Total		1173755	100	1173755	100	1173755	100	1173755	100	1173755	100

Table 5 - Change detection matrix in LULC class in between October 2001 to 2015

	2001									
	Class	Dense forest	Open forest	Scrubland	Agriculture	Fallow land	Waste/ Barren/Rocky	Built up	Water	Grand Total
2015	Dense forest	17970.3	6976.53	3954.06	217.53	166.41	253.98	28.35	137.34	29704.5
	Open forest	24023.4	37162.9	20258.5	1491.39	176.58	1619.19	67.32	135.9	84935.18
	Scrubland	17379.9	52462.1	227097	27731.2	12078.2	55505.7	354.6	706.23	393314.93
	Agriculture	1386.72	3027.33	17219.2	12531.9	3327.66	13705	661.14	978.48	52837.43
	Fallow land	1142.46	3469.68	38124.6	3890.34	10490.5	20968.6	566.82	263.52	78916.52
	Waste/ Barren/Rocky	939.33	13166.3	219835	24990.7	61693.1	183962	3230.01	3251.52	511067.96
	Built up	68.76	126.09	3155.4	1224	2817.27	6979.68	2907.27	287.37	17565.84
	Water	12.24	10.53	243.36	140.76	717.48	628.74	41.94	3616.56	5411.61
	Grand Total	62923.11	116401.46	529887.12	72217.82	91467.2	283622.89	7857.45	9376.92	1173753.97

Table 6 - Change detection matrix in LULC class in between October 2001 to 2018

	2001									
	Class	Dense forest	Open forest	Scrubland	Agriculture	Fallow land	Waste/Barren/Rocky	Built up	Water	Grand Total
2018	Dense forest	19153.5	8722.89	6397.11	465.84	55.35	266.31	10.8	59.85	35131.65
	Open forest	33469.3	40543	20771.3	1540.35	162.63	1337.76	63.81	107.55	97995.7
	Scrubland	8737.83	53297.1	261195	25676.8	18254.4	62154.8	282.69	98.37	429696.99
	Agriculture	1162.08	9183.33	63807.5	20788	6462.45	26377.9	527.94	184.59	128493.79
	Fallow land	5.94	32.4	3759.3	427.23	4869.81	2441.97	91.98	26.91	11655.54
	Waste/Barren/Rocky	276.84	4457.16	170620	21618.9	57629.5	181207	2923.38	723.87	439456.65
	Built up	96.03	148.5	2902.5	1476.9	2777.13	8592.93	3886.56	1982.16	21862.71
	Water	21.6	15.84	433.17	223.47	1254.24	1242.72	70.2	6193.62	9454.86
	Grand Total	62923.12	116400.22	529885.88	72217.49	91465.51	283621.39	7857.36	9376.92	1173747.89

Figures-

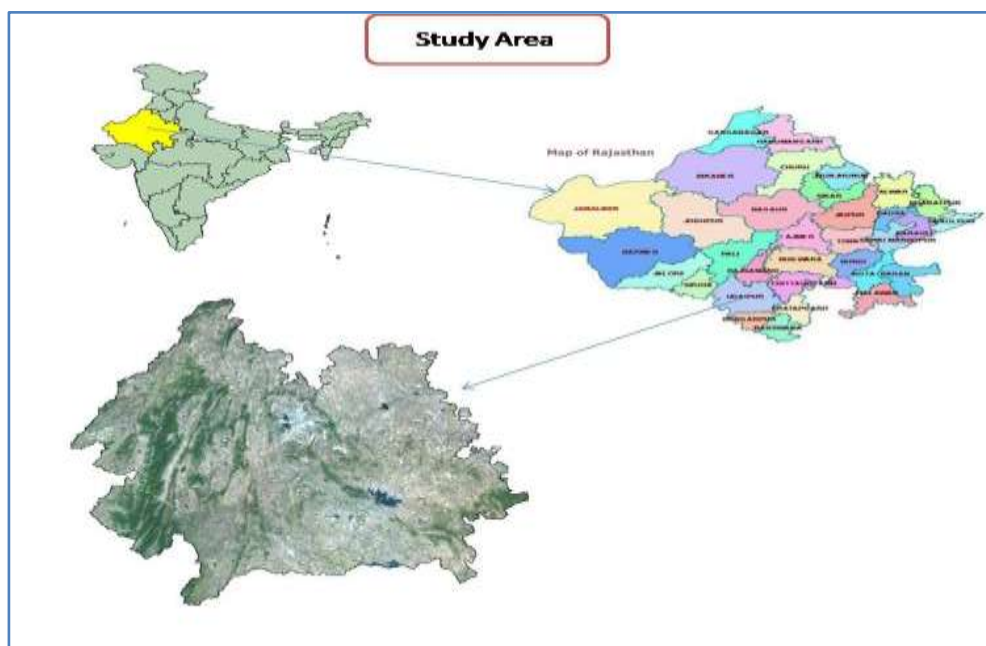


Figure 1- Study area map

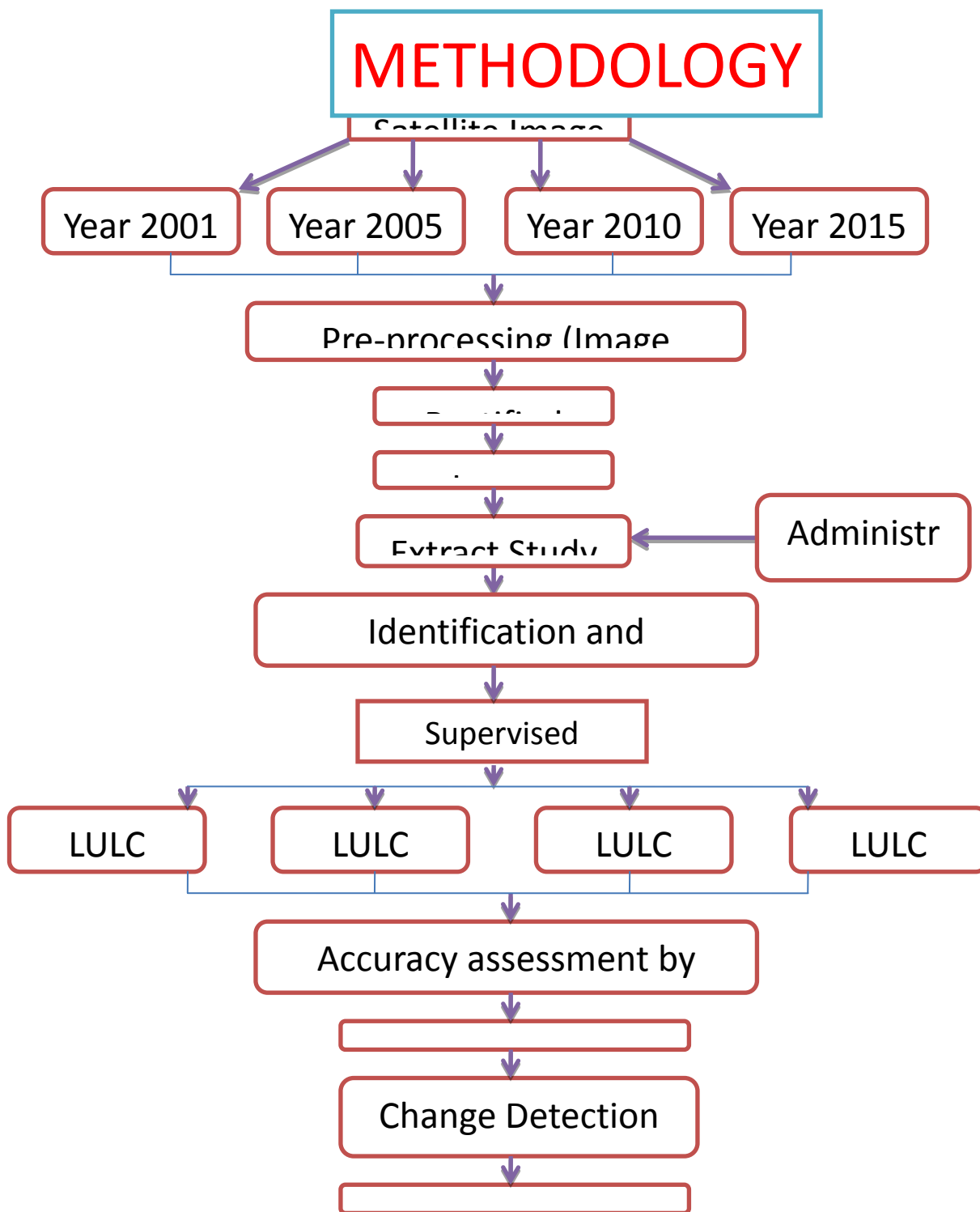


Figure 2- Methodology chart

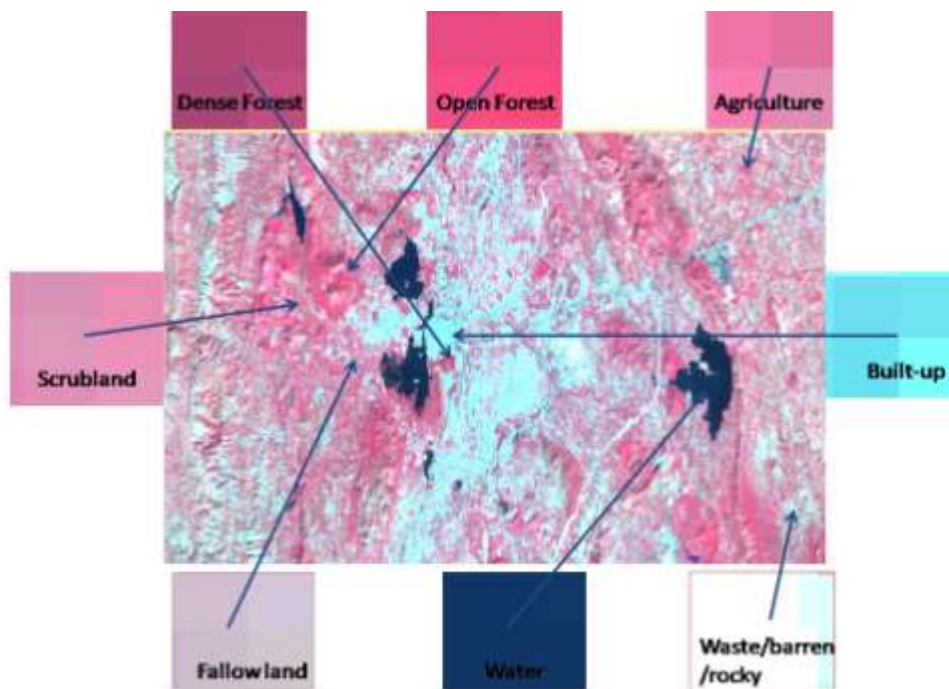


Figure 3 - False Color Composite of Landsat 8 MSS showing pixels of the different Land use/ land cover class of the study area.



Figure 4 - Image showing ground control points taken for the accuracy assessment in the October 2018

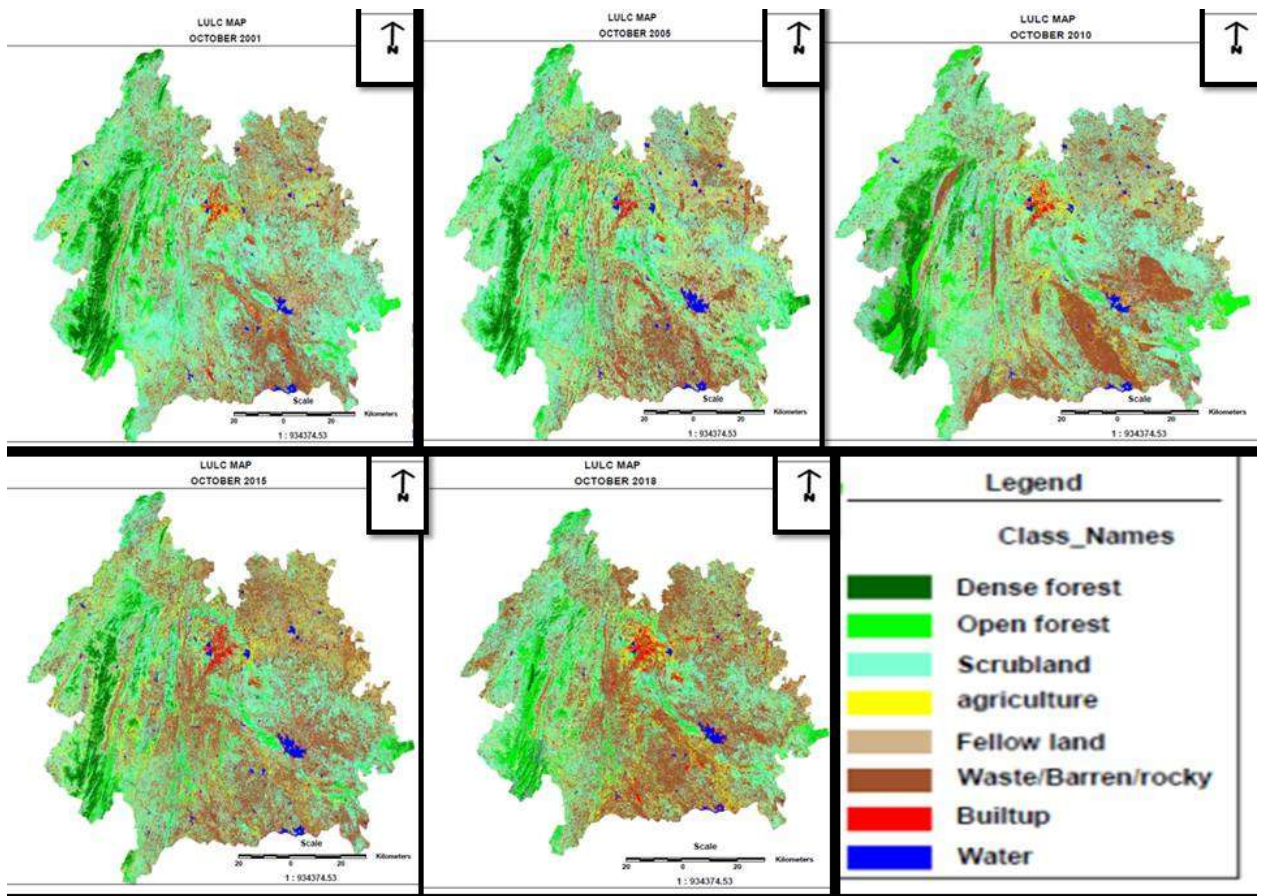


Figure 5- LULC maps of different time period

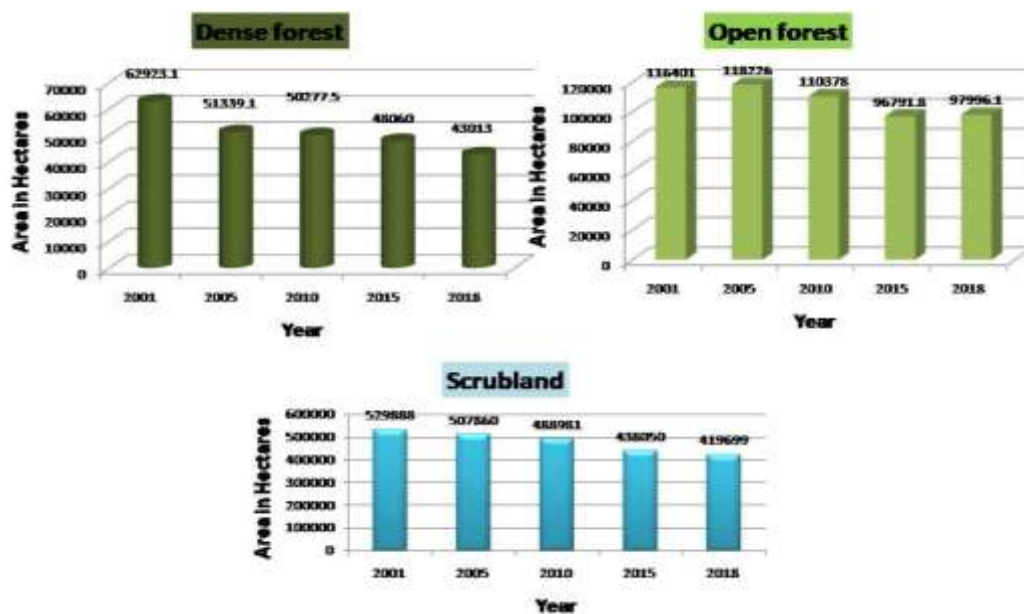


Figure 6 - Graphic of year-wise decreasing Land use/Land cover of the study area in the month of October

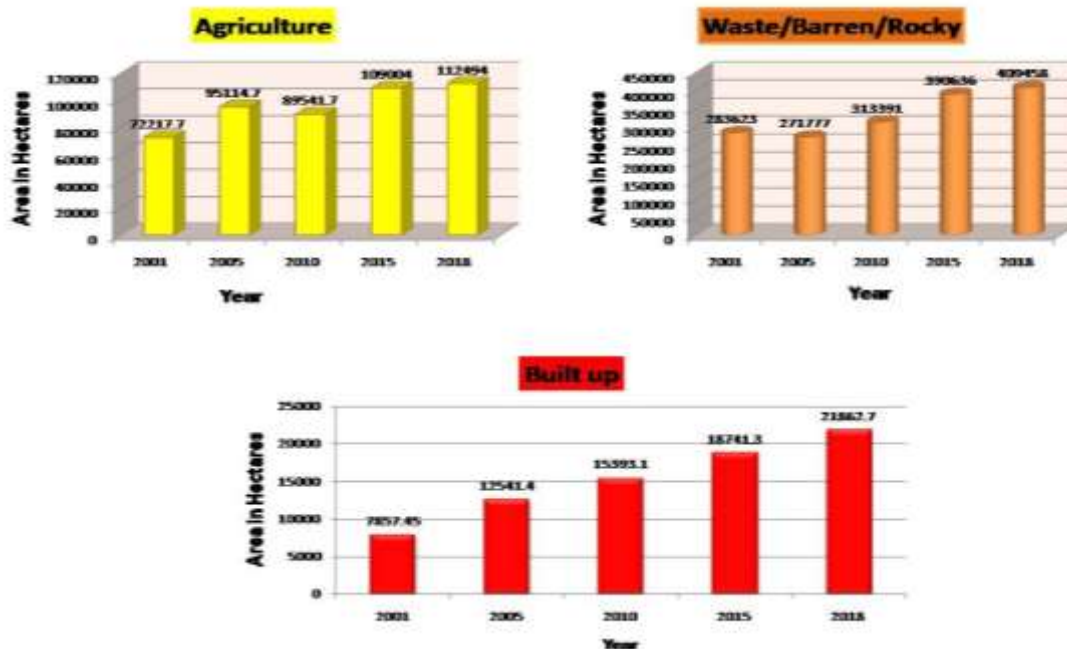


Figure 7 - Graphic of year-wise increasing Land use/Land cover of the study area in the month of October