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To Study the Use of Land by using Remote Sensing and GIS Technique

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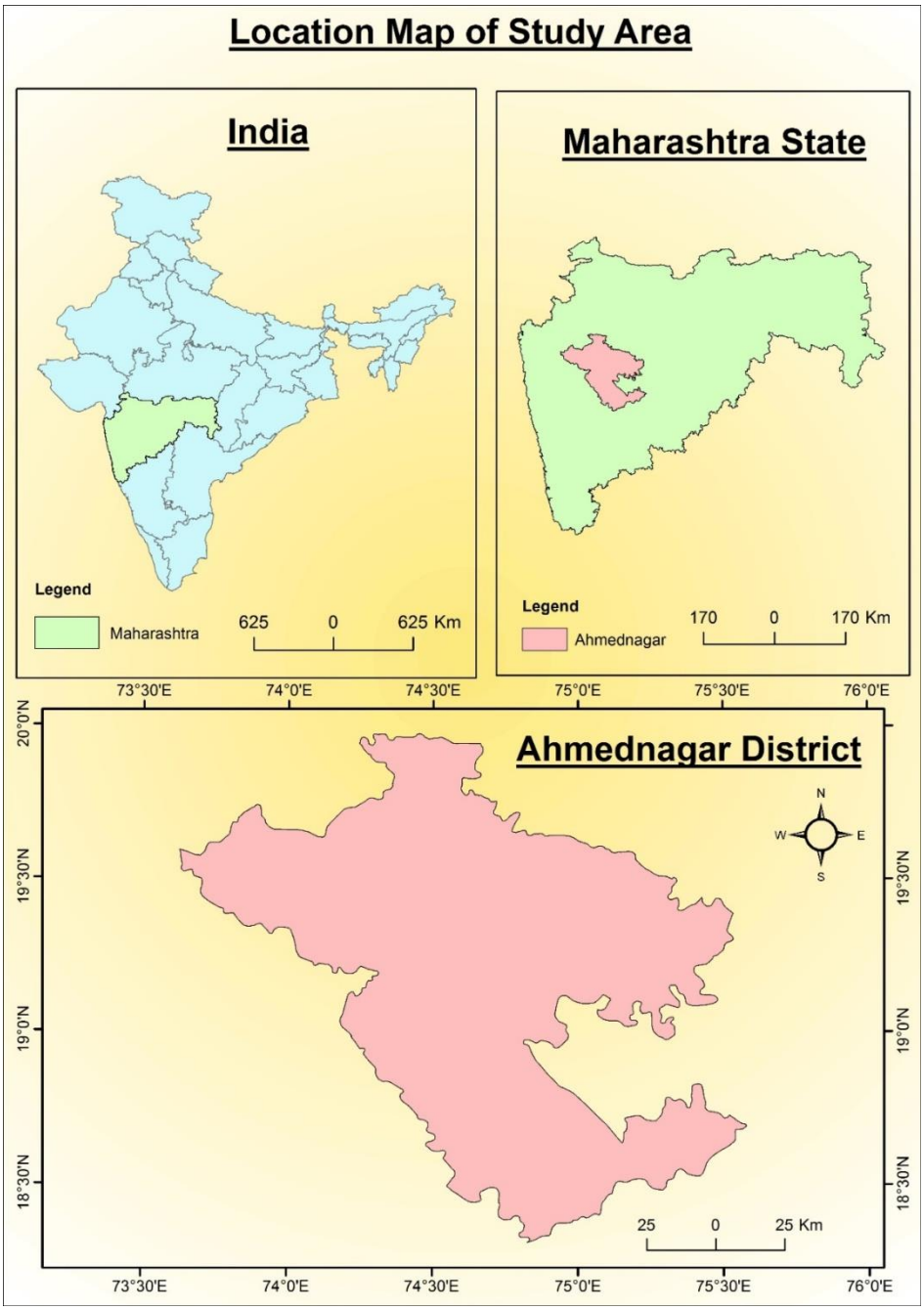
Abstract : This study has been determine the trend, nature, rate, location and magnitude of land use land cover change also create a land use land cover classification scheme. In this paper is detect the changes in land use by using remote sensing and GIS technique. The aim of this study is to produce a land use land cover map of Ahmednagar District at different epochs in order to detect the changes that have taken place particularly in the built-up land, agricultural land and subsequently predict likely changes that might take place in the same over a given period. Here take Ahmednagar District as a source and doing analysis based on Tool like ArcGIS and Erdas. Ahmednagar District has witnessed remarkable expansion, growth and developmental activities such as building, road construction, deforestation and many other anthropogenic activities since its inception just like many other districts.

IndexTerms **- Component,formatting,style,styling,insert.**

I. INTRODUCTION

Studies have shown that there remain only few landscapes on the Earth that are still in their natural state. Due to anthropogenic activities, the Earth surface is being significantly altered in some manner and man's presence on the Earth and his use of land has had a profound effect upon the natural environment thus resulting into an observable pattern in the land use/land cover over time. The land use/land cover pattern of a region is an outcome of natural and socio – economic factors and their utilization by man in time and space. Land is becoming a scarce resource due to immense agricultural and demographic pressure. Hence, information on land use / land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. This information also assists in monitoring the dynamics of land use resulting out of changing demands of increasing population. Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes. The advancement in the concept of vegetation mapping has greatly increased research on land use land cover change thus providing an accurate evaluation of the spread and health of the world's forest, grassland, and agricultural resources has become an important priority. Viewing the Earth from space is now crucial to the understanding of the influence of man's activities on his natural resource base over time. In situations of rapid and often unrecorded land use change, observations of the earth from space provide objective information of human utilization of the landscape. Over the past years, data from Earth sensing satellites has become vital in mapping the Earth's features and infrastructures, managing natural resources and studying environmental change.

Remote Sensing (RS) and Geographic Information System (GIS) are now providing new tools for advanced ecosystem management. The collection of remotely sensed data facilitates the synoptic analyses of Earth - system function, patterning, and change at local, regional and global scales over time; such data also provide an important link between intensive, localized ecological research and regional, national and international conservation and management of biological diversity (Wilkie and Finn, 1996). Therefore, attempt will be made in this study to map out the status of land use land cover of Ahmednagar District between 2008 and 2018 with a view to detecting the changes that has taken place in this status particularly in the built-up land so as to predict possible changes that might take place in this status in the next using both Geographic Information System and Remote Sensing data. Ahmednagar district is the largest district in the state of Maharashtra. The total geographical area of the district is 17.02 lakh hectares, constituting 5.66 per cent of the state's geographical area. Ahmednagar District is surrounded by Ahmednagar district in the west, Nasik district in the north, Aurangabad district in the north-east, Beed district in the south-east and Solapur district in the south. Ahmednagar district has a glorious history. Being a drought prone area in the state of Maharashtra, the district gets an annual rainfall of over 500 mm. Sugarcane, bajra, jawar and wheat are the main crops. The district has historical heritage. The name of the district Ahmednagar has come from the name of the founder of the town Ahmednagar by Ahmed Shah Nizam Shah. The District place Ahmednagar has many places of Historical importance including Ahmednagar fort where many national heroes of Indian freedom struggle including Late Pandit Jawaharlal Nehru were detained during Indian freedom movement. Pandit Jawaharlal Nehru wrote his famous book "Discovery of India" in Ahmednagar Fort. Ahmednagar is Maharashtra's most advanced



Map 1.1 Location Map

district in many ways. It has the maximum number of sugar factories, perhaps to spread the message of "Rural Prosperity through Cooperation" it gave the country half a century ago. The first cooperative sugar factory in Asia was established at Pravanagar. Role Model of water conservation work can be seen at Ralegan-Siddhi and Hivare Bazar which are also called ideal Villages. Newase where Dnyaneshwari was written, Shri Saibaba's Shirdi, one of Ashtavinayaks at Siddhatek, the famous Kanifnath temple, attract devotees. The Palace of Chandbibi, the Bhandardara dam, the Maldhok (Indian Bustard) sanctuary and the Rehkuri sanctuary are some of the places of tourist attraction. There other worth visiting places in the district which include Devgad, Tank Museum, Mohta Devi, Mula Dam, Shani Shingnapur, Madhi and Vriddheshwar.

Ahmednagar District is situated partly in the upper Godavari basin and partly in the Bhīma basin occupying a somewhat central position in Maharashtra State. It extends between 18”10' and 20”00' North latitudes and 73”30' and 75”37' East longitudes. The District is irregular in shape and resembles a slanting cross with a length of 200 kms and a breadth of 210 kms. It is surrounded by Nashik District to the North, Aurangabad District to the North-East, Bid District to the East, Osmanabad and Solapur District to the South, Pune District to the West and Thane District to the North-West.

II. LITERATURE REVIEW

According to Meyer, 1999 every parcel of land on the Earth’s surface is unique in the cover it possesses. Land use and land cover are distinct yet closely linked characteristics of the Earth’s surface. The use to which we put land could be grazing, agriculture, urban development, logging, and mining among many others. While land cover categories could be cropland, forest, wetland, pasture, roads, urban areas among others. The term land cover originally referred to the kind and state of vegetation, such as forest or grass cover but it has broadened in subsequent usage to include other things such as human structures, soil type, biodiversity, surface and ground water (Meyer, 1995).

Land use affects land cover and changes in land cover affect land use. A change in either however is not necessarily the product of the other. Changes in land cover by land use do not necessarily imply degradation of the land. However, many shifting land use patterns driven by a variety of social causes, result in land cover changes that affects biodiversity, water and radiation budgets, trace gas emissions and other processes that come together to affect climate and biosphere (Riebsame, Meyer, and Turner, 1994).

Land cover can be altered by forces other than anthropogenic. Natural events such as weather, flooding, fire, climate fluctuations, and ecosystem dynamics may also initiate modifications upon land cover. Globally, land cover today is altered principally by direct human use: by agriculture and livestock raising, forest harvesting and management and urban and suburban construction and development. There are also incidental impacts on land cover from other human activities such as forest and lakes damaged by acid rain from fossil fuel combustion and crops near cities damaged by tropospheric ozone resulting from automobile exhaust (Meyer, 1995).

Hence, in order to use land optimally, it is not only necessary to have the information on existing land use land cover but also the capability to monitor the dynamics of land use resulting out of both changing demands of increasing population and forces of nature acting to shape the landscape.

Conventional ground methods of land use mapping are labor intensive, time consuming and are done relatively infrequently. These maps soon become outdated with the passage of time, particularly in a rapid changing environment. In fact, according to Olorunfemi (1983), monitoring changes and time series analysis is quite difficult with traditional method of surveying. In recent years, satellite remote sensing techniques have been developed, which have proved to be of immense value for preparing accurate land use land cover maps and monitoring changes at regular intervals of time. In case of inaccessible region, this technique is perhaps the only method of obtaining the required data on a cost and time – effective basis.

A remote sensing device records response which is based on many characteristics of the land surface, including natural and artificial cover. An interpreter uses the element of tone, texture, pattern, shape, size, shadow, site and association to derive information about land cover.

The generation of remotely sensed data/images by various types of sensor flown aboard different platforms at varying heights above the terrain and at different times of the day and the year does not lead to a simple classification system. It is often believed that no single classification could be used with all types of imagery and all scales. To date, the most successful attempt in developing a general-purposeclassification scheme compatible with remote sensing data has been by Anderson et al which is also referred to as USGS classification scheme. Other classification schemes available for use with remotely sensed data are basically modification of the above classification scheme.

Ever since the launch of the first remote sensing satellite (Landsat-1) in 1972, land use land cover studies were carried out on different scales for different users. For instance, waste land mapping of India was carried out on 1:1 million scales by NRSA using 1980 – 82 Landsat multi spectral scanner data. About 16.2% of waste lands were estimated based on the study.

Xiaomei Y, and Rong Qing L.Q.Y in 1999 noted that information about change is necessary for updating land cover maps and the management of natural resources. The information may be obtained by visiting sites on the ground and or extracting it from remotely sensed data.

Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times (Singh, 1989). Change detection is an important process in monitoring and managing natural resources and urban development because it provides quantitative analysis of the spatial distribution of the population of interest.

Macleod and Congation (1998) list four aspects of change detection which are important when monitoring natural resources:

i. Detecting the changes that have occurred
ii. Identifying the nature of the change
iii. Measuring the area extent of the change
iv. Assessing the spatial pattern of the change

The basis of using remote sensing data for change detection is that changes in land cover result in changes in radiance values which can be remotely sensed. Techniques to perform change detection with satellite imagery have become numerous as a result of increasing versatility in manipulating digital data and increasing computer power.

A wide variety of digital change detection techniques have been developed over the last two decades. Singh (1989) and Coppin & Bauer (1996) summarize eleven different change detection algorithms that were found to be documented in the literature by 1995. These include:

1. Mono-temporal change delineation.
2. Delta or post classification comparisons.
3. Multidimensional temporal feature space analysis.
4. Composite analysis. 5. Image differencing.

6. Multitemporal linear data transformation.
7. Change vector analysis.
8. Image regression.
9. Multitemporal biomass index
10. Background subtraction.
11. Image ratioing

In some instances, land use land cover change may result in environmental, social and economic impacts of greater damage than benefit to the area (Moshen A, 1999). Therefore, data on land use change are of great importance to planners in monitoring the consequences of land use change on the area. Such data are of value to resources management and agencies that plan and assess land use patterns and in modeling and predicting future changes.

Shosheng and Kutiel (1994) investigated the advantages of remote sensing techniques in relation to field surveys in providing a regional description of vegetation cover. The results of their research were used to produce four vegetation cover maps that provided new information on spatial and temporal distributions of vegetation in this area and allowed regional quantitative assessment of the vegetation cover.

Arvind C. Pandy and M. S. Nathawat (2006) carried out a study on land use land cover mapping of Panchkula, Ambala and Yamunanger districts, Hangana State in India. They observed that the heterogeneous climate and physiographic conditions in these districts has resulted in the development of different land use land cover in these districts, an evaluation by digital analysis of satellite data indicates that majority of areas in these districts are used for agricultural purpose. The hilly regions exhibit fair development of reserved forests. It is inferred that land use land cover pattern in the area are generally controlled by agro – climatic conditions, ground water potential and a host of other factors.

It has been noted over time through series of studies that Landsat Thematic Mapper is adequate for general extensive synoptic coverage of large areas. As a result, this reduces the need for expensive and time-consuminggground surveys conducted forvalidation of data. Generally, satellite imagery is able to provide more frequent data collection on a regular basis unlike aerial photographs which although may provide more geometrically accurate maps, is limited in respect to its extent of coverage and expensive; which means, it is not often used.

In 1985, the U. S Geological Survey carried out a research program to produce 1: 250,000 scale land cover maps for Alaska using Landsat MSS data (Fitz Patrick – et al, 1987). The State of Maryland Health Resources Planning Commission also used Landsat TM data to create a land cover data set for inclusion in their Maryland Geographic Information (MAGI) database. All seven TM bands were used to produce a 21 – class land cover map (EOSAT 1992). Also, in 1992, the Georgia Department of Natural Resources completed mapping the entire State of Georgia to identify and quantify wetlands and other land cover types using Landsat Thematic Mapper ™ data (ERDAS, 1992). The State of southern Carolina Lands Resources Conservation Commission developed a detailed land cover map composed of 19 classes from TM data (EOSAT, 1994). This mapping effort employed multi-temporal imagery as well as multi-spectral data during classification.

An analysis of land use and land cover changes using the combination of MSS Landsat and land use map of Indonesia (Dimyati, 1995) reveals that land use land cover change were evaluated by using remote sensing to calculate the index of changes which was done by the superimposition of land use land cover images of 1972, 1984 and land use maps of 1990. This was done to analyze the pattern of change in the area, which was rather difficult with the traditional method of surveying as noted by Olorunfemi in 1983 when he was using aerial photographic approach to monitor urban land use in developing countries with Ilorin in Nigeria as the case study.

Daniel et al, 2002 in their comparison of land use land cover change detection methods, made use of 5 methods viz; traditional post – classification cross tabulation, cross correlation analysis, neural networks, knowledge – based expert systems, and image segmentation and object – oriented classification. A combination of direct T1 and T2 change detection as well as post classificationanalysis was employed. Nine land use land cover classes were selected for analysis. They observed that there are merits to each of the five methods examined, and that, at the point of their research, no single approach can solve the land use change detection problem.

Also, Adeniyi and Omojola, (1999) in their land use land cover change evaluation in Sokoto – Rima Basin of North – Western Nigeria based on Archival Remote Sensing and GIS techniques, used aerial photographs, Landsat MSS, SPOT XS/Panchromatic image Transparency and Topographic map sheets to study changes in the two dams (Sokoto and Guronyo) between 1962 and 1986. The work revealed that land use land cover of both areas was unchanged before the construction while settlement alone covered most part of the area. However, during the post - dam era, land use /land cover classes changed but with settlement still remaining the largest.

III. METHODOLOGY

The procedure adopted in this project work forms the basis for deriving statistics of land use dynamics and subsequently in the overall, the findings.

For the study, Landsat satellite images of Ahmednagar District were acquired for two Epochs; 2008 and 2018. Both 2008 and 2018 were obtained from United States Geological Survey Government Agency (USGS).

Table 3.1 Data Source

S.No.	Data Type	Date	Scale	Scene/Tile	Source
1	Landsat 5 Image	25/12/2008	30m	146/047	USGS
2	Landsat 5 Image	16/12/2008	30m	147/046	USGS
3	Landsat 5 Image	16/12/2008	30m	147/047	USGS

4	Landsat 8 Image	19/01/2018	30m	146/047	USGS
5	Landsat 8 Image	10/01/2018	30m	147/046	USGS
6	Landsat 8 Image	10/01/2018	30m	147/047	USGS
7	DEM	------	-------	-------	BHUVAN
8	Boundary Shape File	-------	--------	------	Diva GIS

Based on the priori knowledge of the study area for over 10 years and with additional information from previous research in the study area, a classification scheme was developed for the study area after Anderson et al) 1967 .(The classification scheme developed gives a rather broad classification where the land use land cover was identified by a single digit.

Table 3.2 Land use land cover classification scheme

Code	Land use Landcover Categories
1	Agricultural Land
2	Vegetation
3	Waterbody
4	Barren Land
5	Fallow Land
6	Built-up Land

The classification scheme given in table 3.2 is a modification of Anderson's in 1967 .Prior to the interpretation of multidate satellite data, a reconnaissance survey of the study area was done to develop a classification scheme based on local knowledge and ancillary information. An interpretation key was also developed based on standard Photo-elements like tone, texture, size, shape, association, pattern, location etc .to identify and map different classes .With the help of interpretation key onscreen preliminary interpretation of satellite data was done using ERDAS IMAGINE software

The main methods of data analysis were adopted in this study.
Calculation of the Area in hectares of the resulting land use/land cover types for each study year and subsequently comparing the results and Overlay Operations
The methods above were used for identifying change in the land use types.

Therefore, they have been combined in this study.

The comparison of the land use land cover statistics assisted in identifying the percentage change, trend and rate of change between 2008 and 2018 .In achieving this, the first task was to develop a table showing the area in hectares and the percentage change for each year)2008 and 2018 (measured against eachland use land cover type.

Overlay operations which is the last method of the three, identifies the actual location and magnitude of change although this was limited to the built-up land.

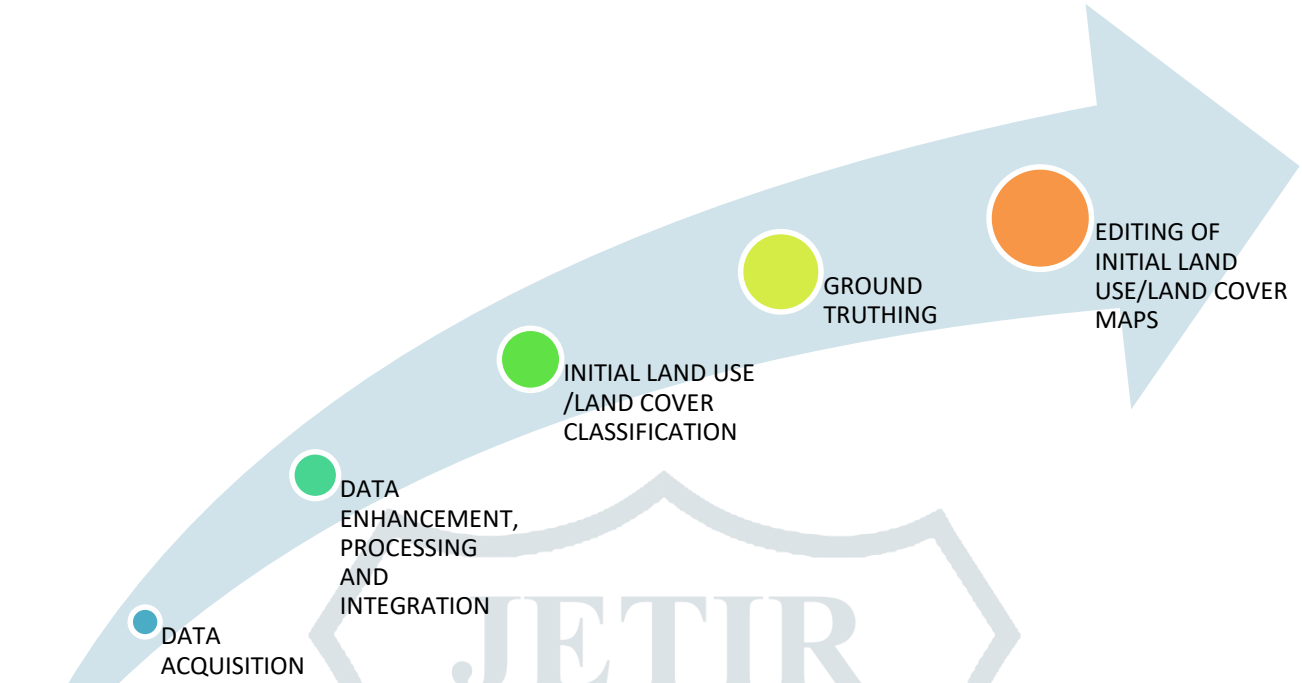


Fig 3.1Cartographic Model

- **Analysis process**

1. Data formation or Modulation

(i) The Landsat images are geo referenced and projected
(ii) Layer stacking of each tile of image)as 3 tiles are there for each year(
(iii) Mosaic all the three tiles
(iv) Place shapefile of Ahmednagar district boundary on the mosaic image
(v) Create AOI)area of interest (of that shapefile
(vi) Subset the image to get the Landsat image of Ahmednagar district
(vii) Now the images are ready for the further analysis

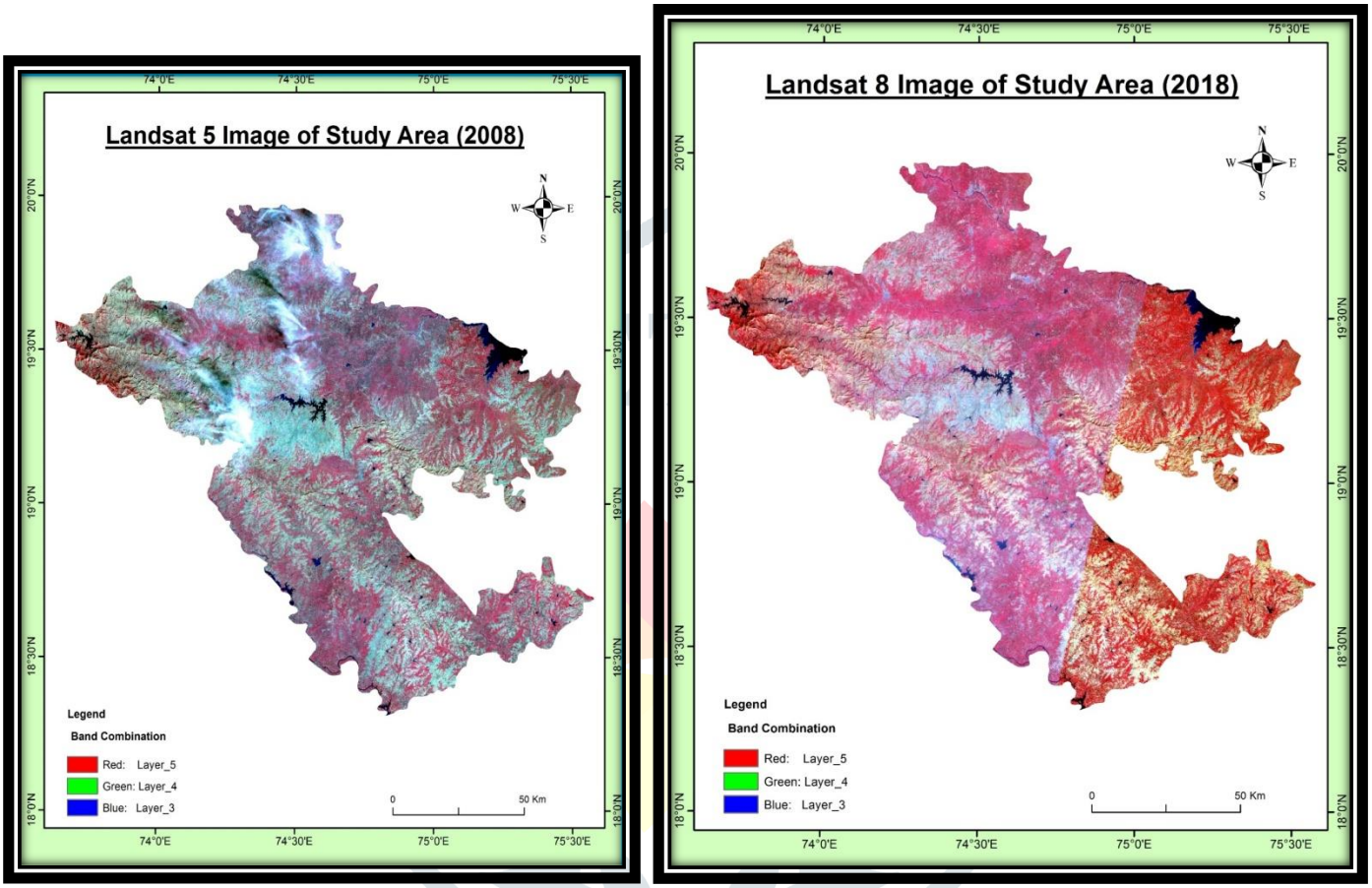
2. Classification

(i) Open the image of Ahmednagar district in Erdas software
(ii) Use Supervised classification tool for classification
(iii) Now open signature editor to specify the land cover/land use class
(iv) The classes made for each class should be merge in one class and named accordingly)repeat this with all classes(
(v) Minimum 10 sub-class should be taken to merge it into one land use/land cover class
(vi) After this now create classification and classification is done
(vii) Open the attribute table to see the counts, classand values
(viii) Export the data to the excel-sheet
(ix) By using the pixel size and data calculate the area for each class
(x) By this data area of each year for each class should be known
(xi) By using this data we can further find the changes in classes between these periods
(xii) In this the area of each land cover/land use for each study year is calculated and subsequently comparingthe results

3.Accuracy Assessment

(i) The classified image is used for the accuracy assessment
Open the classified image in Erdas software
(ii) Now in supervised classification tool go to the accuracy assessment

(iii) Select the classified image for the assessment
(iv) Take minimum 50 points to start the assessment
(v) Give the value for all points according to the class value and point on the image
(vi) Now go to calculate accuracy tool
(vii) The software calculates the accuracy
(viii) The result is shown in the form of the table
(ix) The accuracy percentage and kappa value are obtained by this assessment
(x) The accuracy should always lie between 75 to 99
(xi) Now all the data are analyzed with the help of these functions



(A) Landsat Image 2008 (B)Landsat Image 2018
Map 3.1 Landsat Image Ahemadnagar

IV. RESULTS AND DISCUSSION

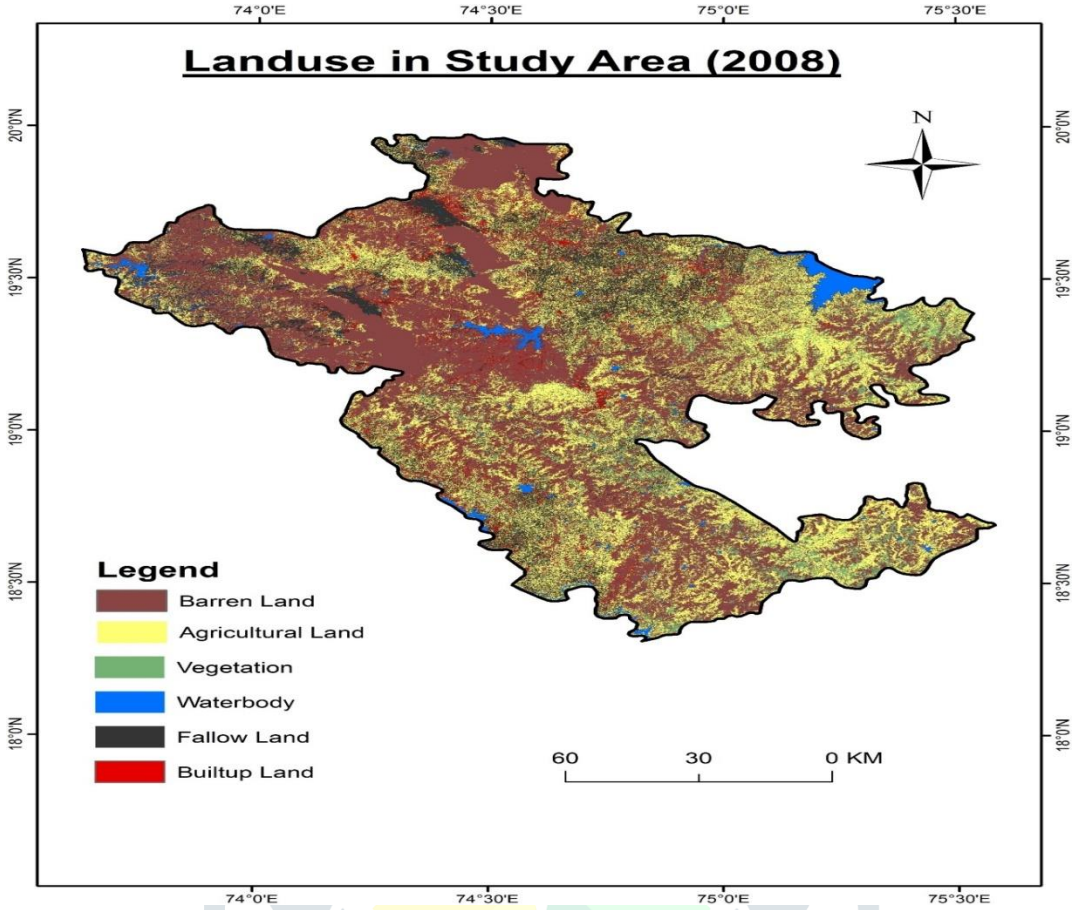
4.1 Land Use Land Cover Distribution

The static land use land cover distribution for each study year as derived from the maps are presented in the table below
Table 4.1 Land use Land Cover Distribution

Land use Landcover Categories	2008		2018	
	Area (sq. km)	Area %	Area (sq.km)	Area %
Agricultural Land	4815.6	28.2	4271.45	25
Vegetation	735.99	4.3	1253.45	7.3
Waterbody	366.63	2.1	373.82	2.2
Barren Land	7554.79	44.3	5861.66	34.3
Fallow Land	2982.85	17.5	4631.92	27.1

Built-up Land	614.43	3.6	678.98	4
Total	17071.29		17071.29	

Water bodies in 2008 and 2018 occupy the least class with just 2.1 %of the total class .This may not be unconnected to the fact that the availability of water has not changed during these 10 years



Map 4.1 Classified Image 2008

Also, farming seems to be practiced moderately, occupying 28 %of the total classes) as shown in table .(This may be due to the fact that the district is just moving away from the rather traditional setting where farming seems to form the basis for living .Apart from this, the time of the year in which the area was imaged which happens to be fall within the time when agriculture is not practiced more as there is the time of harvesting or some other factor these could be a major contributing factor to the observed classification, contributing to the high percentage of fallow land and low percentage of vegetation as there is the dry period when image is taken.

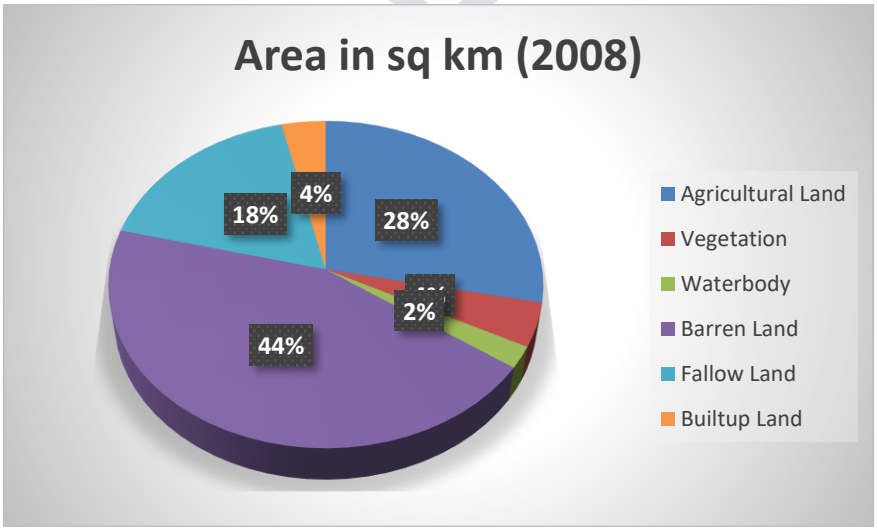
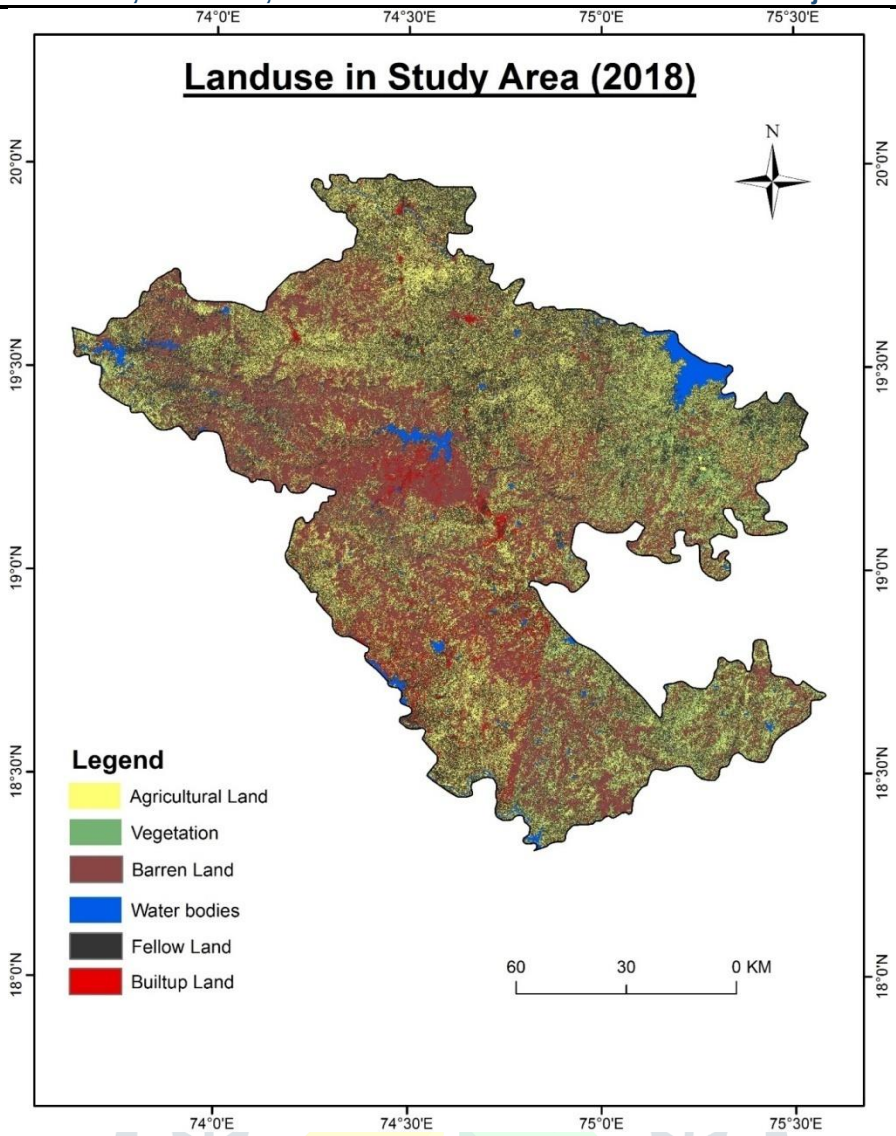


Fig 4.1 Pie Chart of Classified Area 2008

In 2008, barren land still occupies the highest class with 44.3 %of the total class,) as shown in table(taking up almost half of the total classes .Furthermore, the percentage of fallow land may due to the season of the year as mentioned in the last paragraph . Water bodies take up the least percentage in the total class.



Map 4.2 Classified Image 2018

The pattern of land use land cover distribution 2018 also fallows the pattern as the barren land still occupies a major part of the total land but there exists a decrease by some to the agriculture which is shifted to the fallow land which may be due to the season or time at which the image is taken by satellite .There is also an increase in the built-up land still water body maintains the least position in the class.

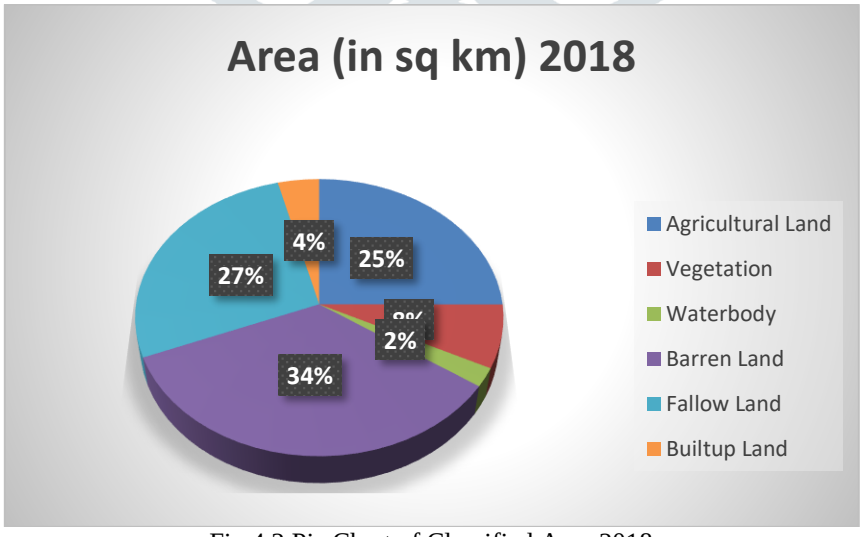


Fig 4.2 Pie Chart of Classified Area 2018

4.2 Land use Land cover change

From table, there seem to be a negative change i.e .a reduction in the agriculture land between 2008 to 2018 .This may not be unconnected to the change in economic base of the Ahmednagar district from agriculture to the white color jobs as a result of the creation of the other fields in the Ahmednagar district .Subsequently built-up land increased by 0.4 %as the industries and other infrastructure were established before the study year and the work which is going on takes time to complete so it gives little change because of that during the period 2008 to 2018 .The establishment of these cause people to migrate from area which cause decrease in agriculture.

Table 4.2 Land use Land cover change

Land use /Land cover Categories	2008-2018	
	Change in Area	**Percentage Change**
Agricultural Land	-544.14	-3.2
Vegetation	516.46	3
Waterbody		0
Barren Land	-1693.13	-9.9
Fallow Land	1649.07	9.7
Built-up Land	64.55	0.4

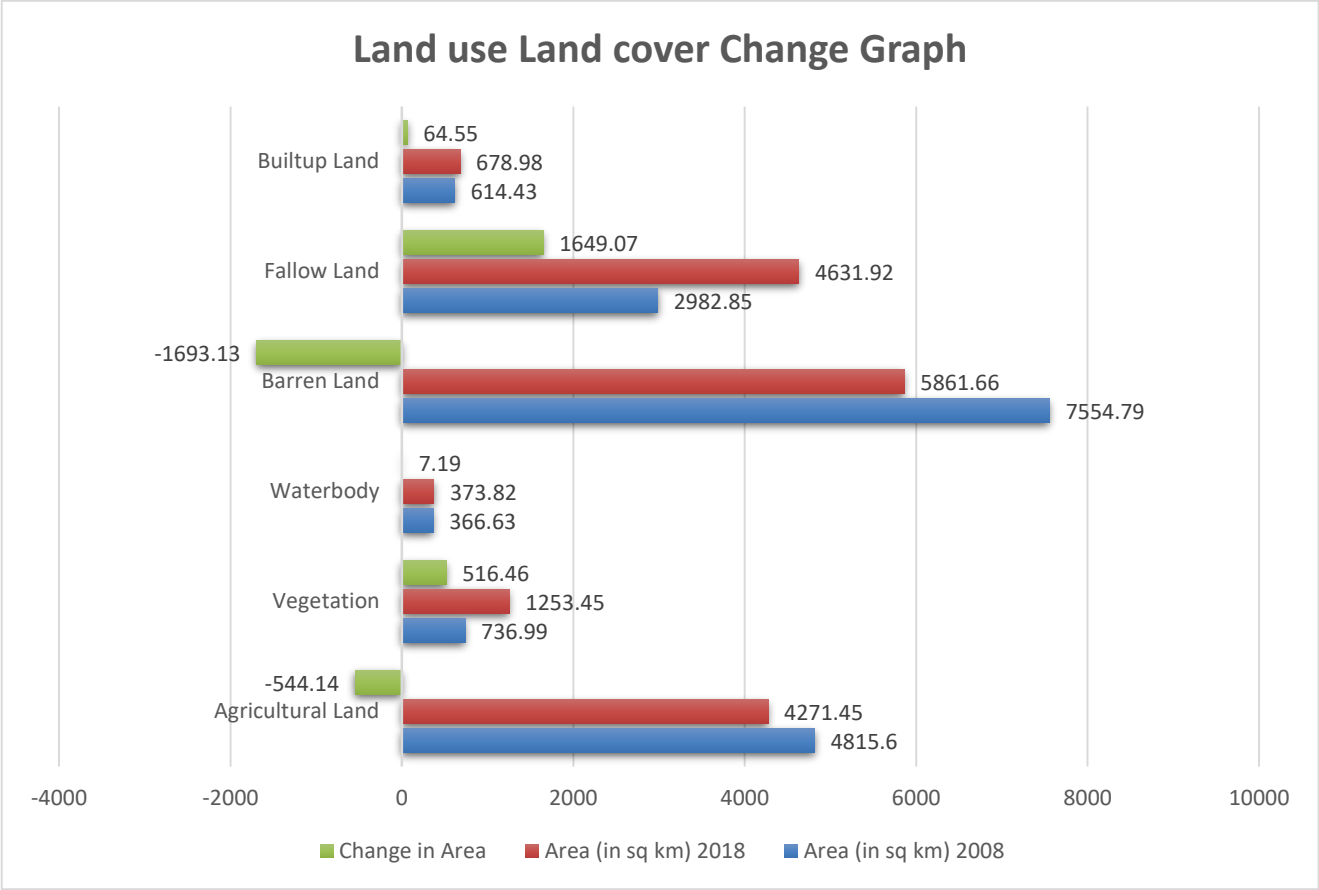


Fig 4.3 Graph of Change

These projects attract a lot of people to the areas thus contributing to the physical expansion of the Ahmednagar city .As the city become the main centre of the district.

Also there was a general increase of 9.7 %in fallow land which is evident in the reduction of barren land and 3.2 %reduction of agriculture land .This may be result of the people shift toward the white collor jobs .As the fallow land and agriculture land in both the year 2008 and 2018 does not seen much change as the sum of both in these year does not see to be not much the difference in these may be due to the time of the image taken.

Furthermore water body seem to remain 2 %through there are slight difference in the total area between this period .This is because as the rivers were dammed before this study year 2008 to 2018.

Same as we can say about the built-up which shows little change only 0.4 %which is shifted due to decrease in barren land in year 2018 .There is a large decrease in Barren land which shows the land is used for other.

The classification accuracy is most important aspect to assess the reliability of maps, especially when comparing different classification technique .During this study the accuracy assessment methods were used .In accuracy assessment, automatic random points to be selected bysoftware .Thismethod show accuracy of about above 90 %or more.

Table 4.3 Accuracy Report 2008

CLASSIFICATION ACCURACY ASSESSMENT REPORT-2008					
Class Name	**Reference Total**	**Classified total**	**Number Correct**	**Producers Accuracy**	**Users Accuracy**
Fallow Land	10	15	10	100.00%	66.67%
Waterbody	0	0	0	----	----
Built-up Land	6	3	3	50.00%	100.00%
Agricultural Land	5	5	4	80.00%	80.00%
Vegetation	19	12	12	63.16%	100.00%
Barren Land	10	15	10	100.00%	66.67%
Totals	50	50	39		
Overall Classification Accuracy = 78.00%					
Overall Kappa Statistics = 0.7149					

Table 4.4 Accuracy Report 2008

CLASSIFICATION ACCURACY ASSESSMENT REPORT-2018					
Class Name	**Reference Total**	**Classified total**	**Number Correct**	**Producers Accuracy**	**Users Accuracy**
Fallow Land	18	15	15	83.33%	100.00%
Waterbody	0	0	0	----	----
Built-up Land	3	2	2	66.67%	100.00%
Agricultural Land	3	3	1	33.33%	33.33%
Vegetation	11	12	10	90.91%	83.33%
Barren Land	15	18	15	100.00%	83.33%
Totals	50	50	43		
Overall Classification Accuracy = 86.00%					
Overall Kappa Statistics = 0.8069					

Table 4.4 Accuracy Report 2018

4.3 Nature Location of change in Land Use Land cover- :

An important aspect of change detected is to determine what is actually changing to what i.e .which land use class is changing to the other .This information will revel both the desirable and undesirable changes and classes that are relatively stable overtime . This information will also serve as a vital tool in management decisions .This process involves a pixel to pixel comparison of the study year images through overlay.

4.4 Discussions- :

In this present study Land Use Land cover of Ahmednagar district was mapped for year 2008 and 2018 .In order to monitor the changes in land use/land cover proper care was taken in the selection of cloud free temporal data .It was not possible to obtain the ground truth pertaining to older data i.e .2008 therefore a novice approach to overcome the same was followed .Mapping was

done for the year 2018 data and was used as template to analyze the data of 2001 .Union method is applied for overlay analysis using Arc info software .The final maps were prepared after reconciliation of doughtful areas observed in preliminary maps .The final maps were prepared and statistics of the area was generated using Arc Map software.

The classification accuracy is most important aspect to assess the reliability of maps, especially when comparing different classification technique .During this study the accuracy assessment

Table 4.5 Kappa Statistics

KAPPA (K^) STATISTICS		
Conditional Kappa for each Category		
Class Name	**Kappa (2018)**	**Kappa (2008)**
Fallow Land	1	0.5833
Waterbody	0	0
Built-up Land	1	1
Agricultural Land	0.2908	0.7778
Vegetation	0.7863	1
Barren Land	0.7619	0.5833
Overall Kappa Statistics (2018) = 0.8069 **Overall Kappa Statistics (2008) = 0.7149**		

IV. CONCLUSION

This research work demonstrates the ability of GIS and Remote Sensing in capturing spatial-temporal data. Attempt was made to capture as accurate as possible five land use land cover classes as they change through time.

Current common methods of change detection are discussed, particularly analysis and comparison of image change detection after classification. The work has been done with the help of ERDAS software, analyzing their result in terms of land use/land cover changes from 2008 to 2018. The overall increase in built-up area was 0.4% during 2008 to 2018. The increase in built-up area was due to transformation barren land into settlement though there is rise in the fallow land of 9.7, and increase in vegetation was 3%. There is only 0.1% increase in water body. This research also shows that visual elements in image interpretation can be used for forest/ non-forest change detection very effectively.

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