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Int. Jr. of Contemp. Res. in Multi. *PEER-REVIEWED JOURNAL* *Volume 5 Issue 2 [Mar-Apr] Year 2026*

Research Article

Change Detection in Land Use Land Cover Pattern in Paithan Tahsil of Sambhajinagar (Aurangabad) district, Maharashtra (2011 & 2019)

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DOI: https://doi.org/10.5281/zenodo.21698216

Abstract

The results from the study showed that drastic changes in Land Use Land Cover (LULC) over a very short (2011 &2019) period of time in Paithan Tahsil. The study founded that Land Use Land Cover (LULC); in comparison between 2011 & 2019 year; that increase in Barren Land (+23.59%) & in Settlement (+11.51%), decreased in vegetation/ agriculture (-32.43%) & water bodies (-2.67%) in study area.

Analysis of Satellite imagery of 2011 and 2019 of land use land cover revealed following conclusions- The drastic changes in LULC over a very short (2011-2019) period of time in Paithan Tahsil. That change is mainly in total Barren Land and Vegetation. Another one striking thing is that the Water body / Agriculture area decreases very faster in Paithan Tahsil. By the results it is concluded that in Paithan Tahsil Barren land and Settlement area is increasing; whereas Vegetation and Water body / Agriculture area is decreasing year by year. The study revealed that Land Use Land Cover in comparison between 2011 to 2019 year that increased in Barren Land +23.59%, Settlement in +11.51%, decreased in vegetation/ agriculture in -32.43%, decrease in water bodies in -2.67%. So, there should be proper planning of Paithan Tahsil of Barren Land, Settlement, Vegetation/ Agriculture Land, and Water Body.

The study resulted that overall actual total rainfall was increased in 2019 (+208.1 mm) comparison with 2011 and LULC distribution of 2019 showed increasing area in Barren land and Settlement whereas decreasing area in vegetation and Water bodies in comparison to 2011. So, there should be proper management of water available in the water bodies to increase the Vegetation and Agriculture land. For this River and other water bodies should be joined with canals. Purposefully planning of water to Agriculture area should be focused and Plantation of trees should be done every year and grow the trees. There are 187 villages in Paithan Tahsil so the target and responsibility should be given to each village to grow the vegetation and conserve water bodies in their area.

Manuscript Information

- **ISSN No:** 2583-7397
- **Received:** 11-03-2026
- **Accepted:** 28-04-2026
- **Published:** 30-04-2026
- **IJCRM:**5(2); 2026: 1105-1114

- **Plagiarism Checked:** Yes
- **Peer Review Process:** Yes

How to Cite this Article

Kachave D S. Change Detection in Land Use Land Cover Pattern in Paithan Tahsil of Sambhajinagar (Aurangabad) 0district, Maharashtra (2011 & 2019). Int J Contemp Res Multidiscip. 2026;5(2):1105-1114.

Access this Article Online

www.multiarticlesjournal.com

KEYWORDS: Land Use Land Cover (LULC, Change Detection, Remote Sensing, GIS (Geographic Information System), Paithan Tahsil.

1. INTRODUCTION

Human is only object onearth surface, who responsible for changing the nature on earth. Due to anthropogenic activities, the natural elements are decreased and artificial elements are increased. So, there remain only few landscapes on the earth that is still in their natural state. The change is not only natural, but temporal, we try to detect this change in this work.

The land use land cover pattern of a region is an outcome of natural & socioeconomic factor and their utilization by Paithan in time and space. Land is becoming a change day to day due to agricultural urbanization and demographic pressure. Hence, information of land use landcover their optimal use is essential for the selection, urban planning and implementation of land use land cover schemes to meet the increasing demands for human basic needs. This information is also supporting the optimal land use land cover by increasing population.

Land use land cover change has become central component in current strategies for managing water body, barren land, vegetation, settlement. Paithan Tahsil area change the construction the agricultural changes. Have direct proportion the increasing water body build up area for the land use land cover change, so foe we say need PaithanTahsil study area that change for the agricultural.

Remote sensing and GIS are now providing new tools for advance ecosystem management the collection of remotely sensed data facilitates the synoptic analysis of earth system function pattering and change at local region and global scale over TIME such data also provide and important link between intensive, localized ecological research and regional, nation and international conservation and management of biological diversity.

2.1 STUDY AREA:

Paithan is a Tahsil in Sambhajinagar (Aurangabad) District, Maharashtra. It lies between 19°38' and 19°80' north latitudes and 75°26' and 75°38' East longitudes. Paithan is surrounded by Sambhajinagar (Aurangabad), Gangapur Tahsil of Sambhajinagar (Aurangabad) District; Shevgaon Tahsil of Ahmadnagar District; Ambad Tahsil of Jalna District and Georai of Beed District. There are 187 villages in the Paithan Tahsil and the population is 3,48,872 as per the 2011 census. Paithan Tahsil has rich historical background. Paithan is associated with many spiritual leaders of all faiths since ages. To name some of them are - Changdev Maharaj, Saint Dnyaneshwar, Saint Sopandev, Saint Nivruttinath, Saint Muktabai, Saint Eknath, Saint Jaganade Maharaj, Saint Bhanudas, etc. Paithan was the home town and Samadhi sthal of the great Marathi saint Eknath; people flock yearly to his shrine during the time of the Paithan yatra, also known as the Nath Shashti. Apegaon village, the birthplace of Saint Dnyaneshwar and his three other siblings is located along the northern bank of the River Godavari, about 12 kilometers easterly to Paithan. The religious saints and philosophers enthralled the masses through their works written in simple Marathi style and popularized the bhakti cult in the wake of Islamic expansion. Therefore, Paithan eminently deserves the appellation as "Santpura". Paithan is also an important place for followers of Mahanubhava Sampradaya. Sarvajna Chakradhar Swami stayed in Paithan for a long period. Paithan continued to play a pre-eminent role even during the Muslim period when the Sufi saints dominated the realm of religious activities in the region.

A major dam named the "Jayakwadi Dam (Nathasagar)" is located near Paithan, and is known for attracting a wide variety of resident and migratory birds. This is the world's first dam made from soil. It has 27 gates. On 9 August 2006, Paithan experienced its worst flood in known history when the dam floodgates were opened because of heavy rainfall in the region.

Jayakwadi dam is the chief source of water for Paithan Tahsil area. Industrial companies are increasing in Paithan Tahsil MIDC area year by year. So, the stress of settlement in the area is increasing with the population and MIDC. Paithan Tahsil is trying to fulfil the growing demand of infrastructure facility metalloid roads, water supply, medical emergencies, education etc. Peoples from adjoining area prefer to reside in the Paithan city place due to historical importance and other facilities and it is affecting in change of land use land cover drastically.

Present study is an attempt to understand and measure the level of change in various land use land cover factors over a period of time in study area.

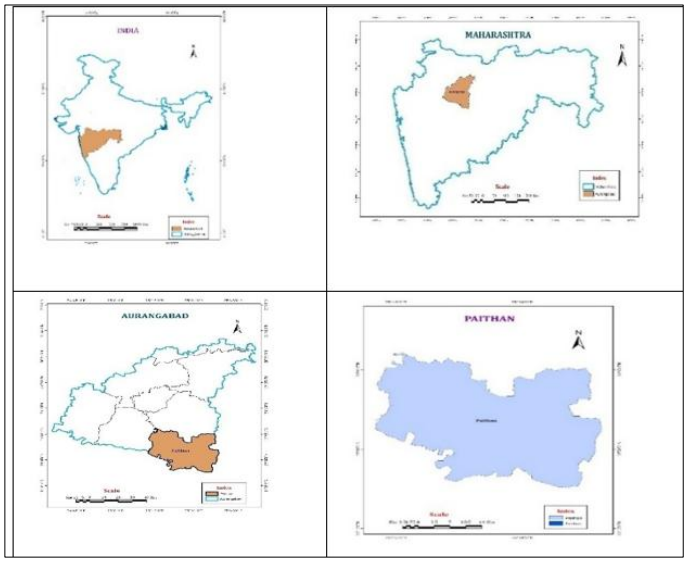


Fig. 1.1 Location Map of Paithan Tahsil

2.2 OBJECTIVES OF THE STUDY:

The following specific objectives to be pursue in order to achieve the aim above.

1. To create a land use land cover map of study area.
2. To compare the land use land cover of 2011 to 2019.
3. To detect the change in land use land cover during the study period 2011 to 2019.

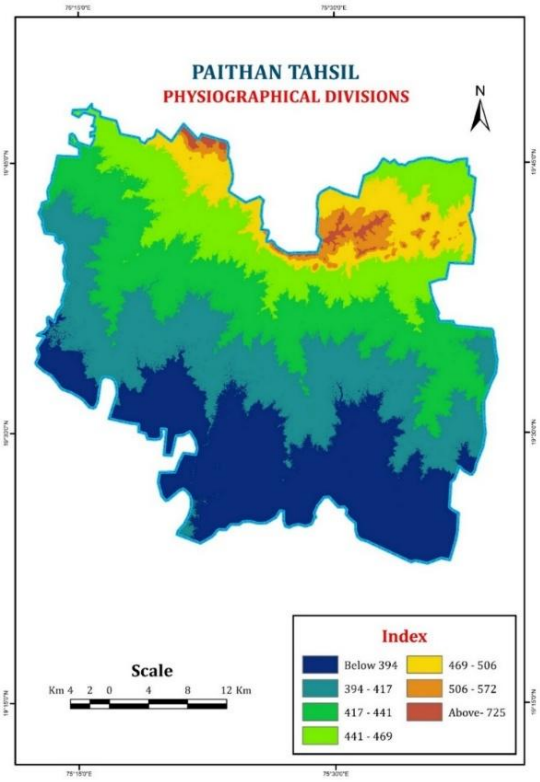


Fig. 1.2 Physiographical Divisions of Paithan Tahsil

2.3 Graphical Presentation of Methodology

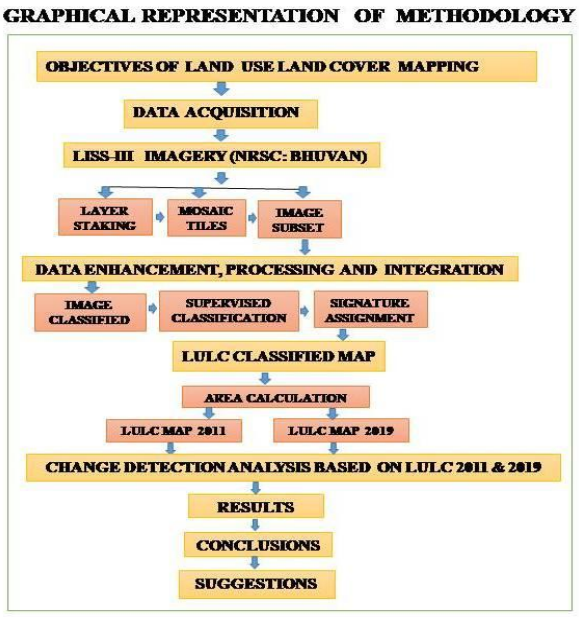


Fig. 1.3 Graphical Presentation of Methodology

2.4 Development Of A Classification Scheme

The classification scheme was developed gives a rather broad classification where the land cover was identified by a single digit.

Land Use Land Cover Classification Scheme

Table: 1.1 Land Use Land Cover Classification Scheme

Sr. no.	CATEGORIES/ CLASSES
1	Vegetation
2	Settlement
3	Barren lands
4	Water bodies

Source: Compiled by researcher from LISS-III data

2.5 LIMITATION OF THE STUDY

There was a major limitation is a result of resolution difference as well as two different files are used for the study area which are different coding.

2.6 METHOD OF DATA ANALYSIS

There are four methods of data analysis were adopted in this study.

1. Image downloading
2. Layer staking and mosaic.
3. Image classification.
4. Calculation of area in sq. km. of the resulting land cover and land cover

types for each study and subsequently comparing the results.
The first three methods above were used for identifying change in the land cover types. Therefore, they have been combined in this study.
The comparison of the land use land cover statistics assessed in identifying the percentage and rate change in between 2011 & 2019.

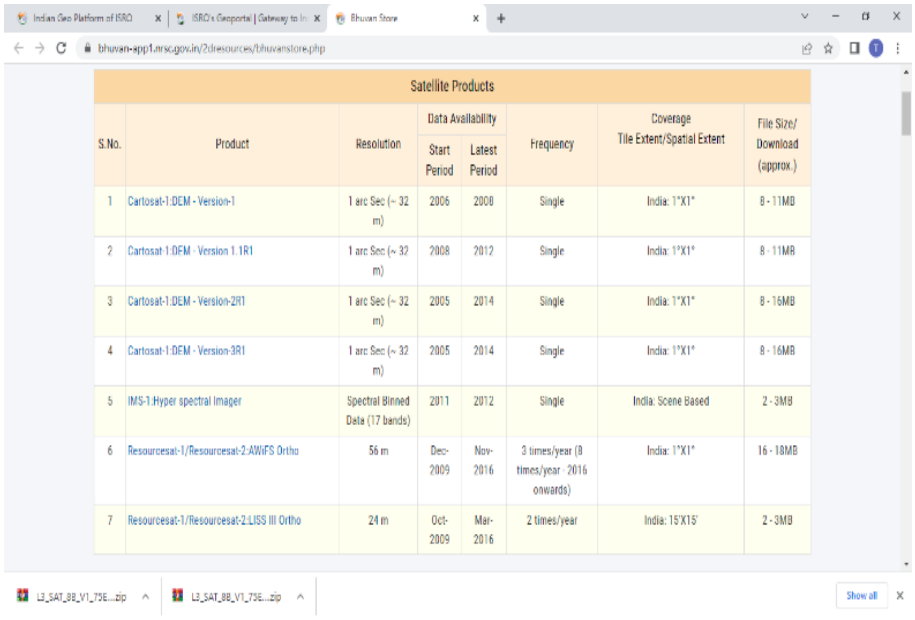
2.7 DATA PROCESSING AND ANALYSIS

2.7.1 DATA ACQUISITION

India is the vast and hostile country of the world. More Indian land is acquiring the hilly and vegetation cover area. Man is not able to collect the information about all regions from India. Hence, for the study and collect information about regions human established institutions in India to collect correct information and more accuracy about land and related things with the help of Digital devices. NRSC (National Remote Sensing Center) is one of the important institutions. NRSC is collecting more and more important digital data about Indian as well as earth. Indian government is launching more satellites from launching centers and these satellites are transferring the collected data to NRSC. NRSC established free BHUVAN (Gateway to Indian earth observation) system. NRSC is keeping saved data on their website and it is available to all by registering users name and password.

1. The data acquired from the Bhuvan website. (https://bhuvan.nrsc.gov.in/home/index.php). The product selected the RESOURCE SAT-1: LISS-III Ortho which has 24m resolution (Fig.1.2).
2. After that researcher selected the study area on the map of India which is divided in the tiles. The tiles were selected with the help of bounding box, or map sheet or tiles and interactive growing (Fig.1.3).
3. Later on, researcher selected the tiles. A double click opened a new window. Researchers checked the opened

toposheets are correct and checked toposheets were numbered as E43005, E43006, E43005, E43009, E43010, E43011, E43013, E43014, E43015 and downloaded data from website.



Satellite Products

S.No.	Product	Resolution	Data Availability		Frequency	Coverage Tile Extent/Spatial Extent	File Size/ Download (approx.)
			Start Period	Latest Period			
1	Cartosat-1:DEM - Version-1	1 arc Sec (~ 32 m)	2006	2008	Single	India: 1°X1°	8 - 11MB
2	Cartosat-1:DEM - Version 1.1R1	1 arc Sec (~ 32 m)	2008	2012	Single	India: 1°X1°	8 - 11MB
3	Cartosat-1:DEM - Version-2R1	1 arc Sec (~ 32 m)	2005	2014	Single	India: 1°X1°	8 - 16MB
4	Cartosat-1:DEM - Version-3R1	1 arc Sec (~ 32 m)	2005	2014	Single	India: 1°X1°	8 - 16MB
5	IMS-1:Hyper spectral Imager	Spectral Binned Data (17 bands)	2011	2012	Single	India: Scene Based	2 - 3MB
6	Resourcesat-1/Resourcesat-2:AWiFS Ortho	56 m	Dec-2009	Nov-2016	3 times/year (8 times/year : 2016 onwards)	India: 1°X1°	16 - 18MB
7	Resourcesat-1/Resourcesat-2:LISS III Ortho	24 m	Oct-2009	Mar-2016	2 times/year	India: 15'X15'	2 - 3MB

Fig. 1.4 LISS-III Image: Satellite Product from BHUVAN

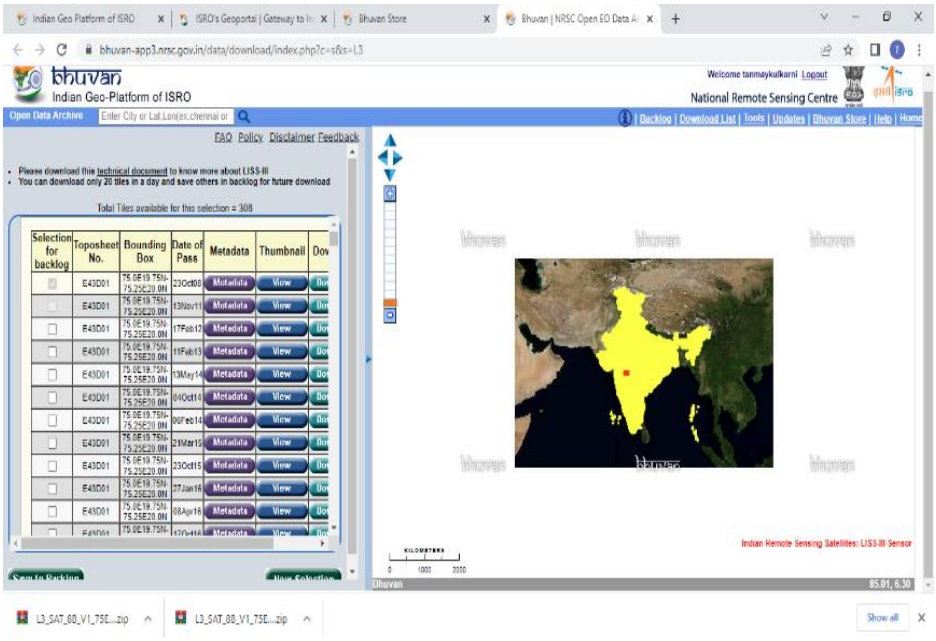


Fig. 1.5 LISS-III Image: Downloading From BHUVAN

1. The Bhuvan LISS-III data was downloaded through proper login.

Downloaded Bhuvan data was free of charge and that was useful for researcher's research work. This data was available in digital format (Fig. 1.4); later on, it was processed with GIS software and interpreted with the same (Fig. 1.5).

2.8 DATA PREPERATION AND PROCESSING

2.8.1 DATA PREPERATION

After data acquisition mainly the data processing step comes. In this process whole data preparation was done by ERDAS software. This process was done by following steps.

2.8.1.1) LAYER STACKING

After data acquiring from Bhuvan website we have to process on data. In that process first step is layer stacking. The layer stack function is useful for playing layer one on top of the other. In ERDAS, researcher selected the interpreter icon on the

main icon panel. Then selected utilities from the drop-down menu then selected layer stack; then gave the input file and clicked add button and added four layers. Then output path is given with selecting ignore zero in stat box to active the option. The process completed with running the staked images and all staking done in one image.

2.8.1.2) IMAGE MOSAIC

After layer stacking, we must need to mosaic the tiles which are staked in ERDAS. In this section we use a template to mosaic two photo images. Firstly, we selected the data preparation then selected the option Mosaic image, then the Mosaic tool and after the open Mosaic tool add the tiles then clicked on Ok. By this way we mosaic the tiles (FIG. 1.6).

2.8.1.3) SUBSET OF IMAGE

After the Mosaic the image next process is to subset the image. Firstly, selected the data preparation; secondly, selected the subset images then gave the input file and given the output then selected Ok and subset of image completed. After the sub setting the image clipped the study area from images.,

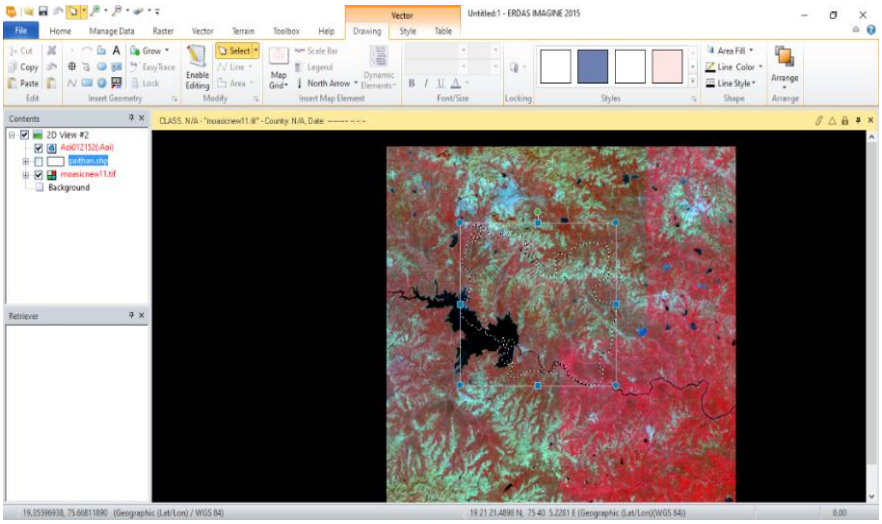


Fig. 1.7 Image Subset: Paithan 2011

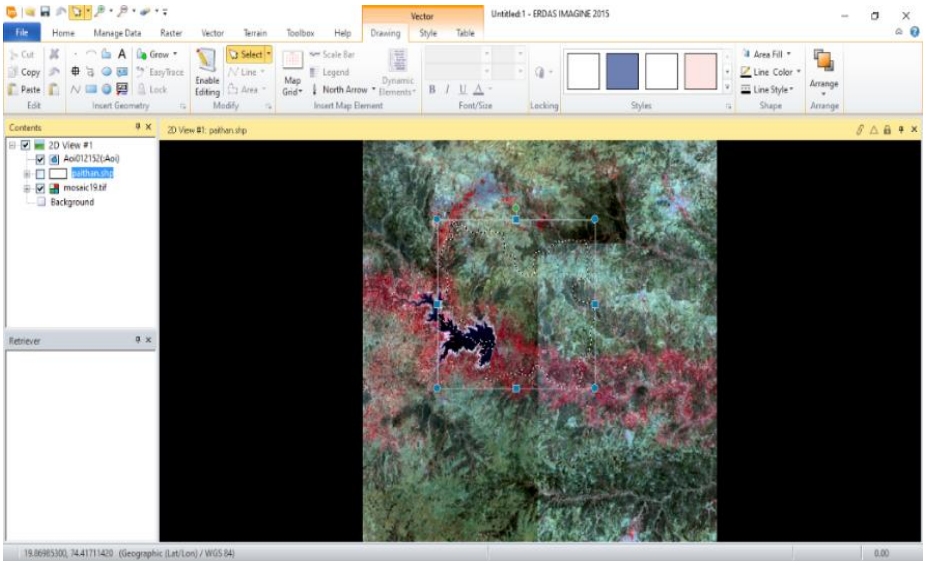


Fig. 1.8 Image Subset: Paithan 2019

2.9.1) DATA PROCESSING

2.9.1.1) Initial Detection And Land Use Land Cover (Lulc) Classes

After the subset of images are given the mosaic image of study area. This image opens in ERDAS. This image is present in Falls Color Composite. According the Falls Color Composite red color represents vegetation, bluish and yellowish represents the barren/open land and black represents water body. The study region is a Tahsil hence major part is giving a barren (bluish and yellowish) area. After that this detection image transfers in to supervised classification.

2.9.1.2) SUPERVISED CLASSIFICATION

After clipping the study area researcher classified the study region and classification is done by two types i.e. 1) Supervised classification 2) Unsupervised classification. For this research supervised classification is used. This classification is used pixels of known classes to identify pixels of unknown classes.

2.9.1.3) SIGNATURE

Mainly the supervised classification processes are depending upon training site and signature process. The training site process means the selecting the signature in AOI and the adding number of pixels and the creating new signature (i.e. vegetation, settlement, and barren land etc.). In order to create signatures, you must have the image. Researcher classified opening in a viewer. Then used the AOI tool to create point, line, polygon and seed areas of interest. To enter an AOI into the signature editor, first selected it, then selected edit/add from the signature editor menu bar.

Disadvantage of the supervised classification is the signatures uniformity of a class may vary and difficulty and cost of selecting training sites. That's supervised classification being selecting training samples. By identifying pattern in the imaginary researcher can command to the computer system to identify the pixels with similar characteristics supervises classification is more computer automated. It allows you to specify parameters that the computer use as guidelines to cover statistical pattern in the data.

2.9.1.4) ACTUAL SUPERVISED CLASSIFICATION

In this process selecting the signature in AOI and the adding number of pixels and the creating new signature (i.e. vegetation, settlement, and barren land etc.). In order to create signatures, you must have the image. You are classifying opened in a viewer. Then using AOI tools, first selected it, then select edit/add from the signature editor menu bar or click the enter icon on the signature editor tool bar. After that this process your study area image ready to analysis.

3. DATA ANALYSIS

Data analysis process is done with Arc map. This process is mainly converted and creating new polygons in study area (i.e. vegetation, settlement, water bodies and barren land etc.) raster data model in to vector data model.

3.1) CONVERSION OF RASTER TO VECTOR DATA:

For mapping and area calculation opened Arc Map and created new blank map document. Added the raster file to be converted to the map using the add data tool and ensured that an appropriate coordinate system has been applied to the data frame. Opened the Arc toolbox and expand the conversion tool from raster toolbox, then clicked double on the raster to polygon tool to open
its dialog and enter parameter.

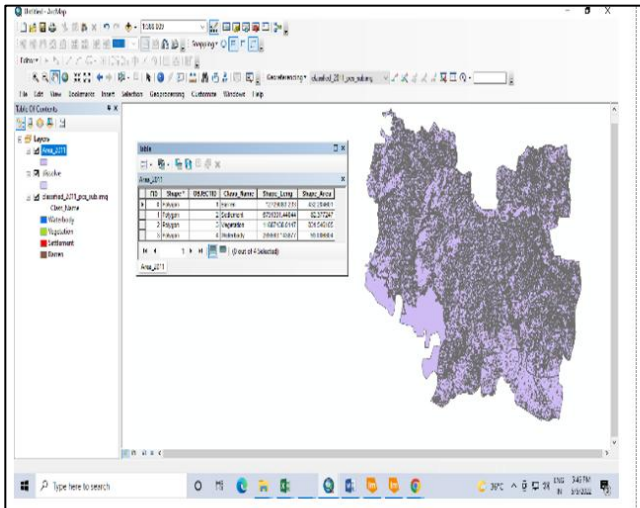


Fig. 1.9 Area Calculation in ArcMap 2011

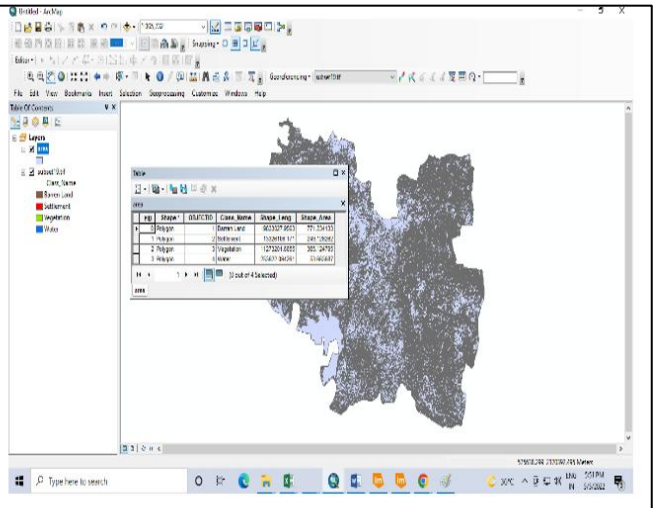


Fig. 1.10 Area Calculation in ArcMap 2019

Mainly this process is done in Arc map is follows:

In Arc map go to tool and select extensions. Check the box for spatial analyst. Then in the main Arc map session select view toolbars spatial analyst. This will open the spatial analyst toolbar in this toolbar select convert features to Raster. This will open a dialog box where you can select the vector dataset, the attribute for the call assignment in the output raster dataset, the cell size for the output raster data set and the name of the output dataset.

3.2. POLYGON DISSOLUTION

After raster to polygon conversion, we have to dissolve polygon in predetermined classes. This process is followed:

Firstly, open the Arc tool box then open index and dissolved option. In the dissolved management to create the input and output path then check the field name for dissolved then delete all polygon which are existed in attribute table other than predetermined classes. Then open Arc catalog to create the personal geo-database folder. After its coordinates then import dissolved polygon file to shape file by giving export path. After that add that exported geo-database file after that this file

attribute table shows the quantitative feature of the study area (like area of the land cover) this information is converted to final geometry analysis and gets your sufficient result.

3.3 AREA CALCULATION

This is a last one process of the data analysis. In this process mainly the calculation and prediction of the dataset model. The main objective of this study is land cover analysis of study area. Hence, last process detects the variation in the land cover of study area.

The objective of this study area forms the basis of the analysis carried out in this chapter the results are presented in form of maps, charts and statistical tables. They induce the static change and projected land cover of each class. The static land cover distributions for each study year as derived from the maps and presented in the table below.

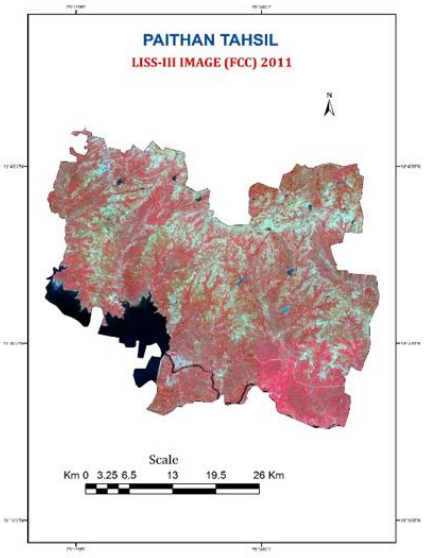


Fig. 1.11: LISS-III Image (FCC) 2011 of Paithan Tahsil

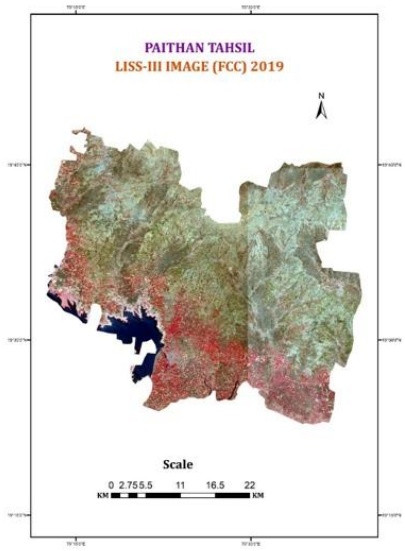


Fig. 1.12: LISS-III Image (FCC) 2019 of Paithan Tahsil

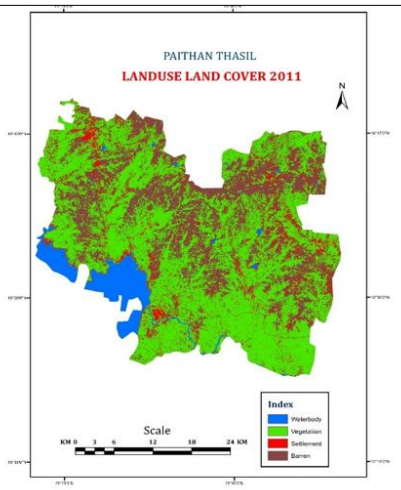


Fig. 1.13: Land Use Land Cover (LULC) in 2011 of Paithan Tahsil

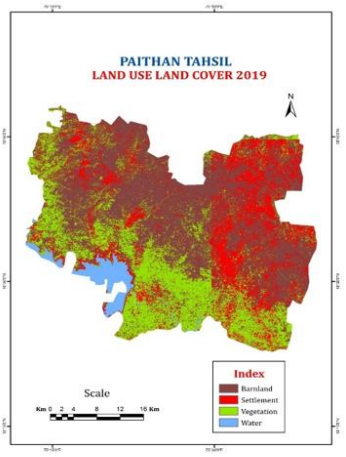


Fig. 1.14: Land Use Land Cover (LULC) in 2019 of Paithan Tahsil

4.1 INTERPRETATION:

The Paithan Tahsil LISS-III 2011 (FCC and classify) image shows the water body, vegetation and barren/ open land in different part of the Tahsil. We can observe the western part of the study area mostly covered by vegetation. The outer boundary of the western side of the study area is covered by barren land. We can easily identify the northern part of this image having maximum part covered by barren/ open land.

The study region of Paithan Tahsil LISS-III of LULC (FCC and classify) image shows that barren area is increasing in eastern part of the Tahsil. This image also shows that the barren land

has increased in between 2011 &2019 in exchange of water body and vegetation area.

PAITHAN TAHSIL: LAND USE LAND COVER (LULC) DISTRIBUTION (2011&2019)

Land Use Land Cover categories	2011		2019		Change in percentage (%)
	Area in sq. km.	Percentage (%)	Area in sq. km.	Percentage (%)	
Barren Land	431.78	30.00	771.23	53.59	+23.59
Settlement	83.29	5.80	249.13	17.31	+11.51
Vegetation/ Agriculture	830.58	57.80	365.12	25.37	-32.43
Water body	93.49	6.40	53.66	3.73	-2.67
Total	1439.15	100.00	1439.15	100.00	

Source: compiled by researcher

Table 1.2

Table 1.2 shows that the Barren Land area in Paithan Tahsil in 2011 was 30% and in 2019 it was 53.59. It is increased by 23.59% from 431.78to 771.23sq.km. Settlement area in 2011 was 5.80% and 17.31% is in 2019; increased by 11.51. %amongst 2011 to 2019. Vegetation area in 2011 was 57.80% and 25.37% is in 2019; decreased by 32.43. Water body / Agriculture area in 2011 was 6.40% and 3.73% is in 2019; decreased by 2.67.

Table 1.2 shows that drastic changes in Land Use Land Cover (LULC) over a very short (2011-2019) period of time in Paithan Tahsil. That change is mainly in total Barren Land and Vegetation. Another one striking thing is that the Water body / Agriculture area decreases very faster in Paithan Tahsil. So, by the table 1.2 it is concluded that in Paithan Tahsil Barren land and Settlement area is increasing; whereas Vegetation andWater body / Agriculture area is decreasing year by year.

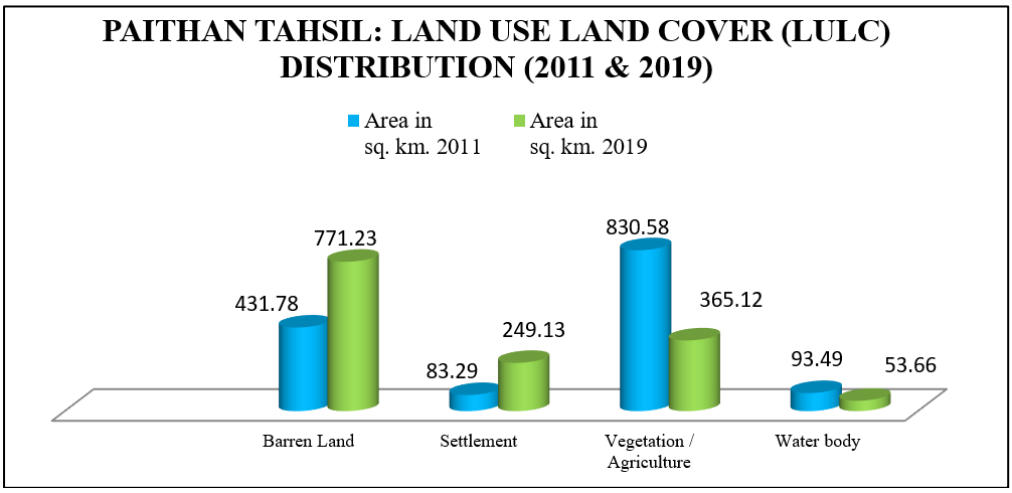


Fig. 1.15

4.2 RESULTS

The results of the study are as following-

- The results from the study showed that drastic changes in Land Use Land Cover (LULC) over a very short (2011 &2019) period of time in Paithan Tahsil. The study foundedthat Land Use Land Cover (LULC); in comparison between 2011 & 2019 year; that increase in Barren Land (+23.59%) & in Settlement (+11.51%), decreased in vegetation/ agriculture (-32.43%) & water bodies (-2.67%) in study area.

4.3 CONCLUSIONS

Analysis of Satellite imagery of 2011 and 2019 of land use land cover revealed following conclusions-

- The drastic changes in Land Use Land Cover (LULC) over a very short (2011-2019) period of time in Paithan Tahsil.
- That change is mainly in total Barren Land and Vegetation. Another one striking thing is that the Water body / Agriculture area decreases very faster in Paithan Tahsil.
- By the results it is concluded that in Paithan Tahsil Barren land and Settlement area is increasing; whereas Vegetation and Water body / Agriculture area is decreasing year by year.

4.4 SUGGESTIONS

The suggestions based on conclusions as are below-

- The study revealed that land use/land cover in comparison between 2011 to 2019 year that increased in Barren Land +23.59%, Settlement in +11.51%, decreased in vegetation/ agriculture in -32.43%, decrease in water bodies in -2.67%. So, there should be proper planning of Paithan Tahsil of Barren Land, Settlement, Vegetation/ Agriculture Land, and Water Body.

- The study resulted that overall actual total rainfall was increased in 2019 (+208.1 mm) comparison with 2011. But Land use Land Cover (LULC) distribution of 2019 showed increasing area in Barren land and Settlement whereas decreasing area in vegetation and Water bodies in comparison to 2011. So, there should be proper management of water available in the water bodies to increase the Vegetation and Agriculture land. For this River and other water bodies should be joined with canals. Purposefully planning of water to Agriculture area should be focused and Plantation of trees should be done every year and grow the trees. There are 187 villages in Paithan Tahsil so the target and responsibility should be given to each village to grow the vegetation and conserve water bodies in their area.

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