International Journal of Advanced Research in Biological Sciences
ISSN: 2348-8069
www.ijarbs.com
DOI: 10.22192/ijarbs Coden: IJARQG(USA) Volume 3, Issue 10 - 2016

Research Article

DOI: http://dx.doi.org/10.22192/ijarbs.2016.03.10.022

Monitoring vegetation change detection of Mayurbhanj district, Odisha by using Geoinformatics

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Abstract

The study was conducted to detect vegetation changes using Gioinformatics in Mayurbhanj district, Odisha. It was conducted using Landsat 5 TM, and Landsat 7 ETM, images. For the vegetation change ERDAS Imagine 9.2 was used. for raw images and Arc GIS 10.1 for creating new feature for mapping was used. The result showed that during the year 2009-2014, there was an increase in vegetation cover in dense forest (13%). Over all, there was an increase in the dense forest vegetation cover of Mayurbhanj district of Odisha.

Key words: Dense forest, Geoinformatics, Monitoring, Vegetation.

Introduction

Vegetation coverage change is a very important indication of the ecological environment change. Vegetation change, which can be readily detected and mapped by satellite remote sensing data (Xiao *et al.*, 2004). By collecting the satellite imageries, changes in vegetation coverage of Mayurbhanj district concentrating mostly upon the forest areas can be detected.

Forests are living ecosystems influenced by continuous natural and anthropogenic processes. Monitoring changes in the forest cover and canopy structure through time is important for many applications, such as decision-making, forest planning and management climate change.

Forest and land cover change detection are one of the major applications of satellite-based remote sensing. Satellite images from different dates for a particular geographic area are analyzed for changes in spectral patterns, and these changes are classified into appropriate forest change or land cover change categories (Singh, 1989).

The use of remote sensing data in recent times has been of immense help in monitoring the changing pattern of forest cover. It provides some of the most accurate means of measuring the extent and pattern of changes in vegetation cover conditions over a period of time. In our country including dense forest, open forest and mangroves is 67.83 m ha which is 19.39%

of India's geographical area. The recent researches show that the overwhelming population pressure, practicing of unscientific agricultural methods and the lack of awareness about the importance of forests among the population in general and tribal folk in particular are the prime causes of deforestation / degradation of forests. Hence, it is essential to assess the forest cover and understand the reason for the decrease in forest cover. The objectives of our study include: To analyze the land use and land cover of Mayurbhanj, district in the context of vegetation monitoring for the years 1999, 2004,2009 and 2014,to assess the temporal changes in vegetation of the study area and to examine the effects or impacts of vegetation change on environment.

Materials and Methods

Location

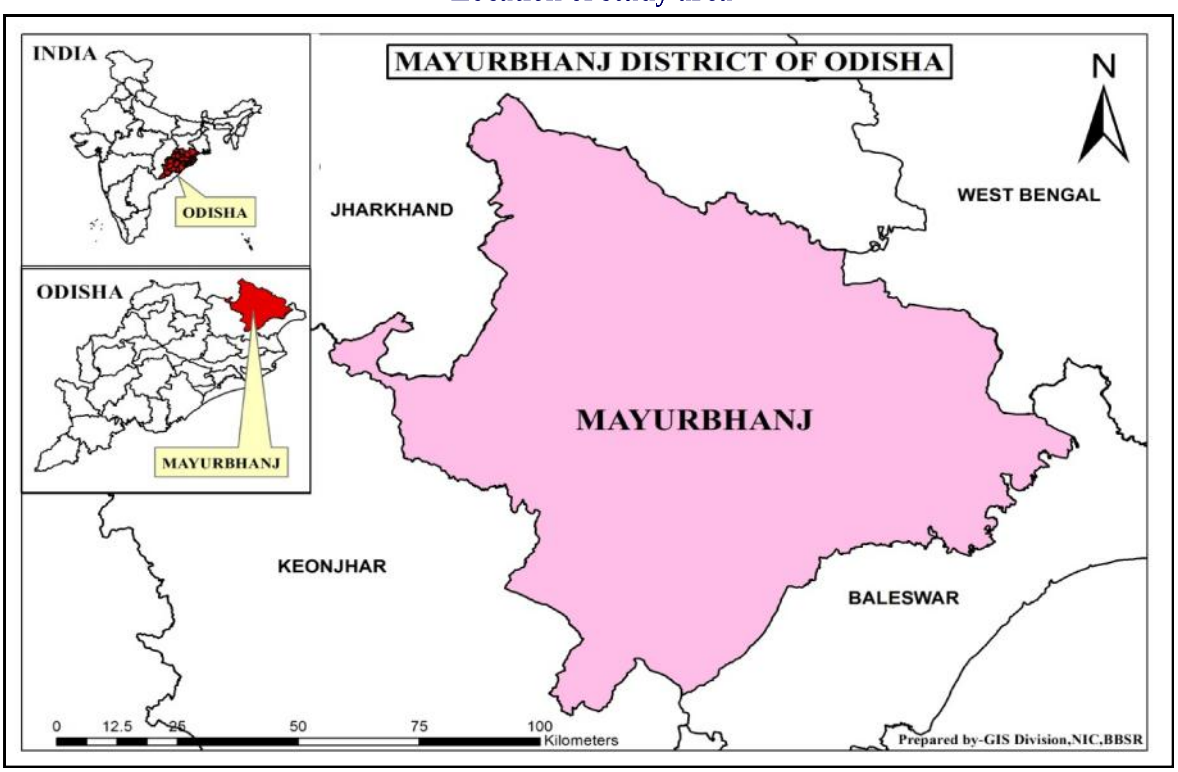
Odisha is located on the east coast of the country having 155,707km^2 geographical area which constitutes 4.74% area of the country. It lies in the tropical zone between latitudes of $17^0$47'N & $22^0$34'N & longitudes of 81^0 22'E $87^0$29'E.The state is drained by three major rivers, Mahanadi, Brahmani and Baitarani. The famous Hirakud dam on river Mahanadi is one of the longest dams in the world. The state is rich in mineral resources including coal, iron, bauxite, chromite & nickel. The annual rainfall varies between 1200mm to 1600mm & the mean annual temperature ranges between 25^0c to 27.5^0c. As per census 2011, the total population of the state is 43.12 million which constitutes 3.47% of the country's population. The population density is 269 persons per km^2.

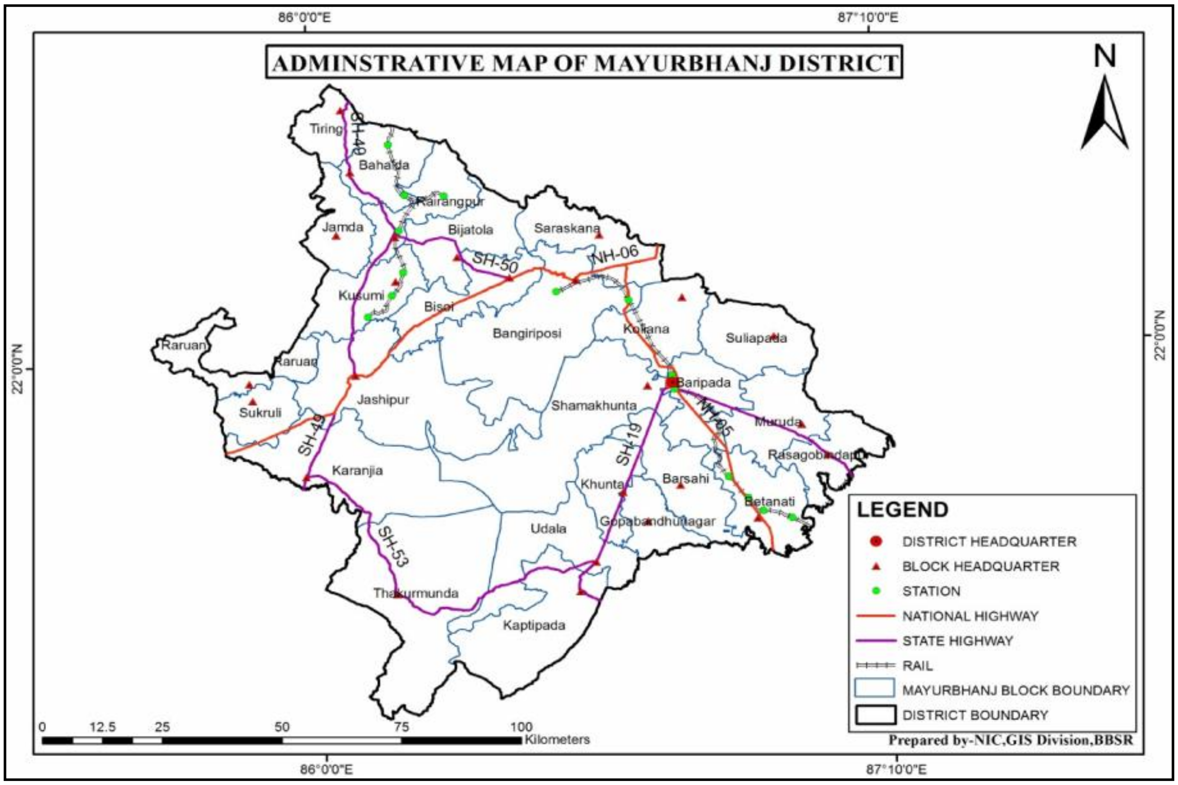
As our study area is concerning about the Mayurbhanj district of the state, so the discussion about the study area is given below briefly.

Mayurbhanj – a district in the northern Odisha historically famous as the " land of the Maharajas", is also known for its dominant tribal population, vibrant culture, the famous Similipal forests, Chhau dance, beautiful temples, stone, dhokra and tassar work and of course "mudhi" among other things. The district presents a panorama of many millennia in the human history. The district gets its name from the continuous reign of two ancient kingdoms for over a thousand years – the "Mauryas" and the "Bhanjas" until its merger with the state of Odisha on January 1, 1949.

Mayurbhanj is a landlocked district with a total geographical area of 10, 418 sq. kms and is situated on the northern boundary of the State with its district headquarters at Baripada. The District lies between 21^o and 22^o North latitude and 85^o and 87^o East longitude. The District is bounded on the North by West Bengal and Jharkhand, on the West by Keonjhar District and on the East by Balasore District of Odisha.

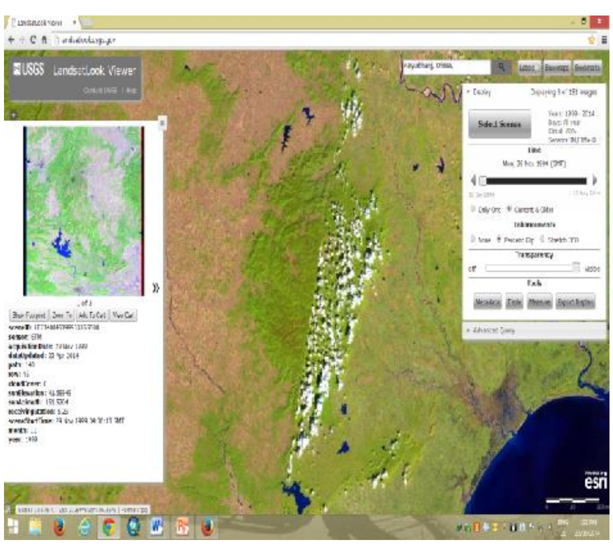
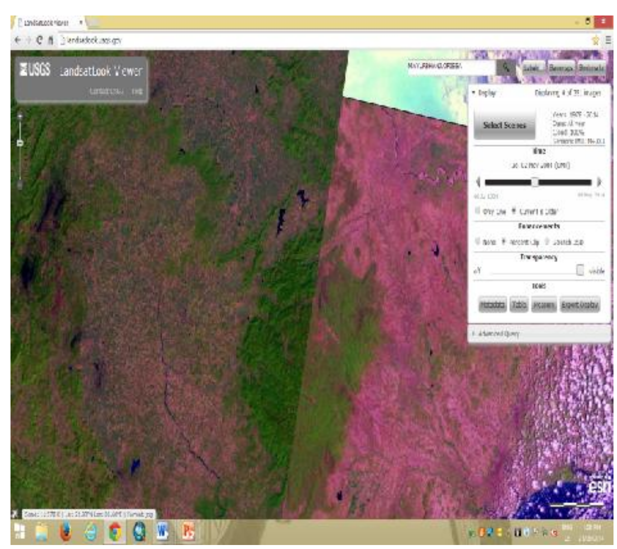
Location of study area

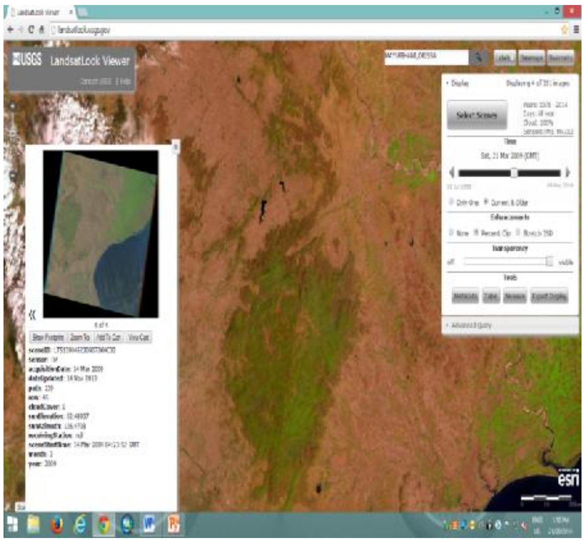
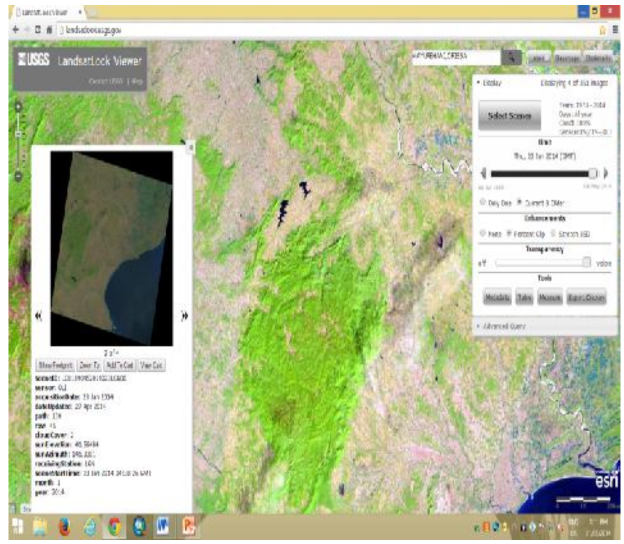




Data Collection and Analysis

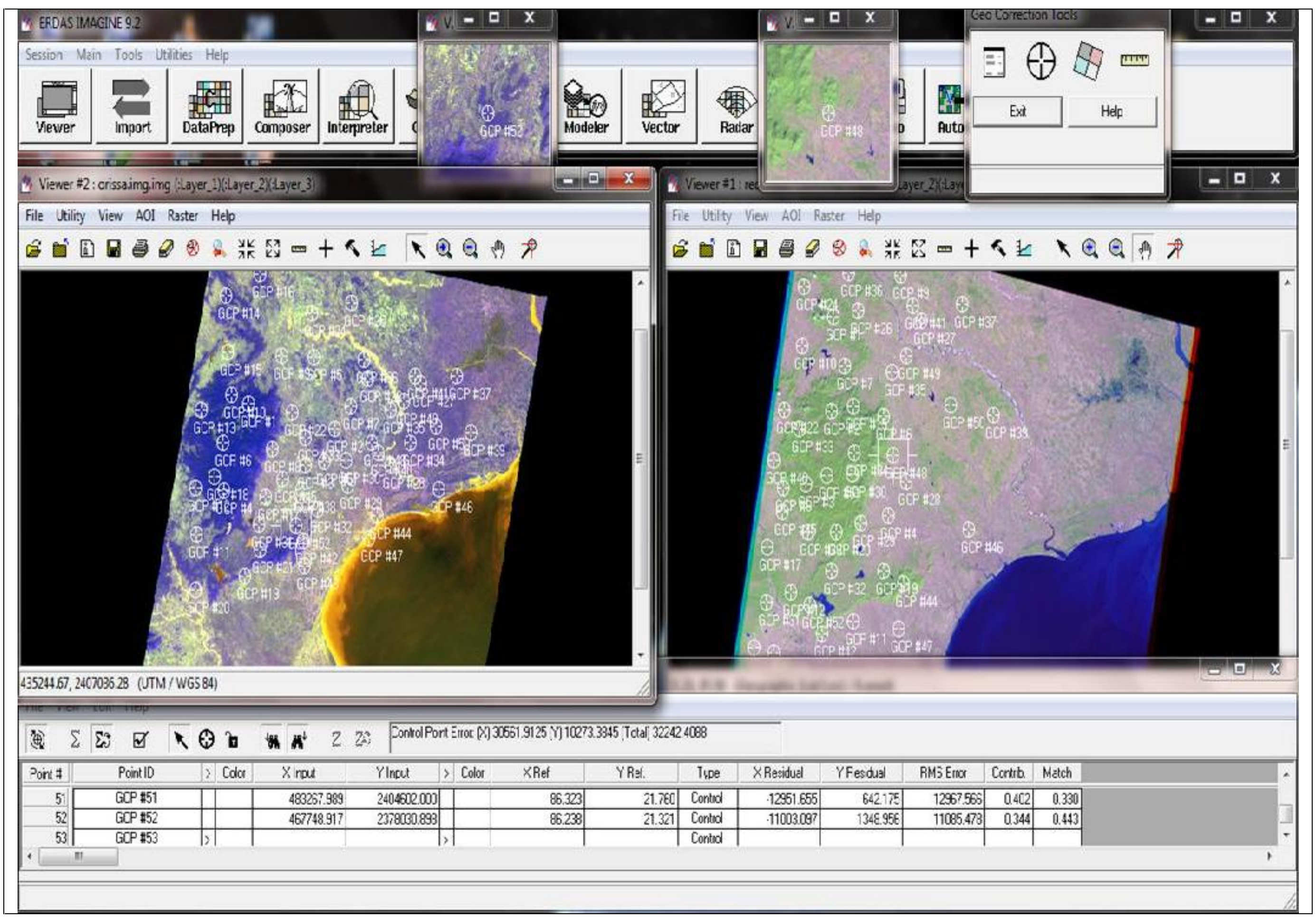
Data is a collection of facts, such as values or measurements. It can be numbers, words, measurements, observations or even just descriptions of things. It is also facts and statics collected together for reference or analysis. Data acquisition is the first step for all Remote Sensing and GIS functions to be performed. Without the data acquisition process there is no work can be done in Remote Sensing and GIS. The data were acquired (downloaded) (images) of Mayurbhanj district of the year 1999, 2004, 2009 and 2014 from the site http://landsatlook.usgs.gov. Followings are the snapshots from where images are downloaded.

Landsat image of Mayurbhanj of 1999	Landsat image of Mayurbhanj of 2004
	

Landsat image of Mayurbhanj of 2009	**Landsat image of Mayurbhanj of 2014**
	

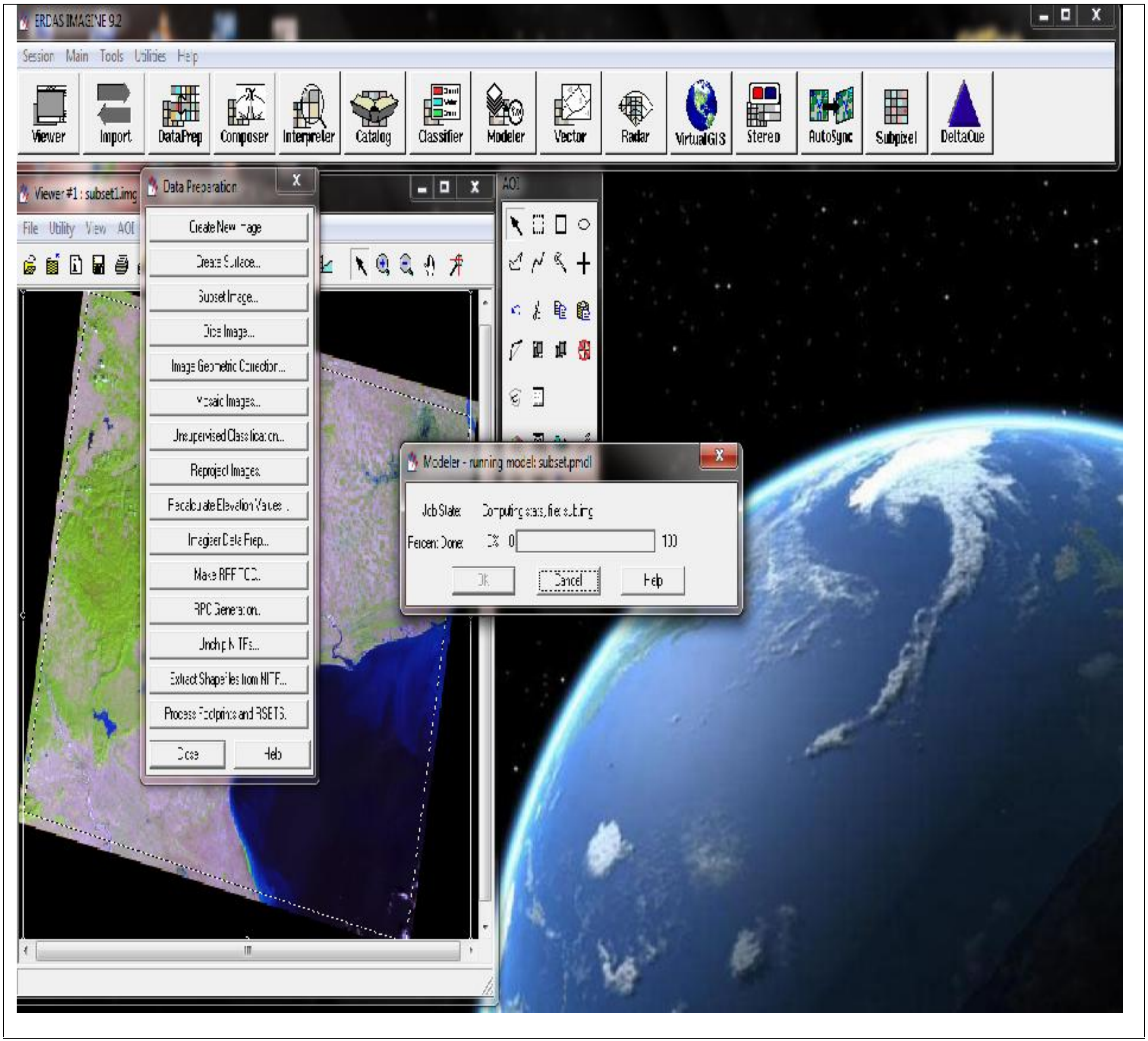
The study was conducted using Landsat 5TM and Landsat 7 ETM

The images were rectified by the help of GIS software i.e. ERDAS IMAGINE 9.2. In this registration process we put the GCP points on the downloaded raw images with reference to another registered image. The following snapshot shows the rectification process of an image.



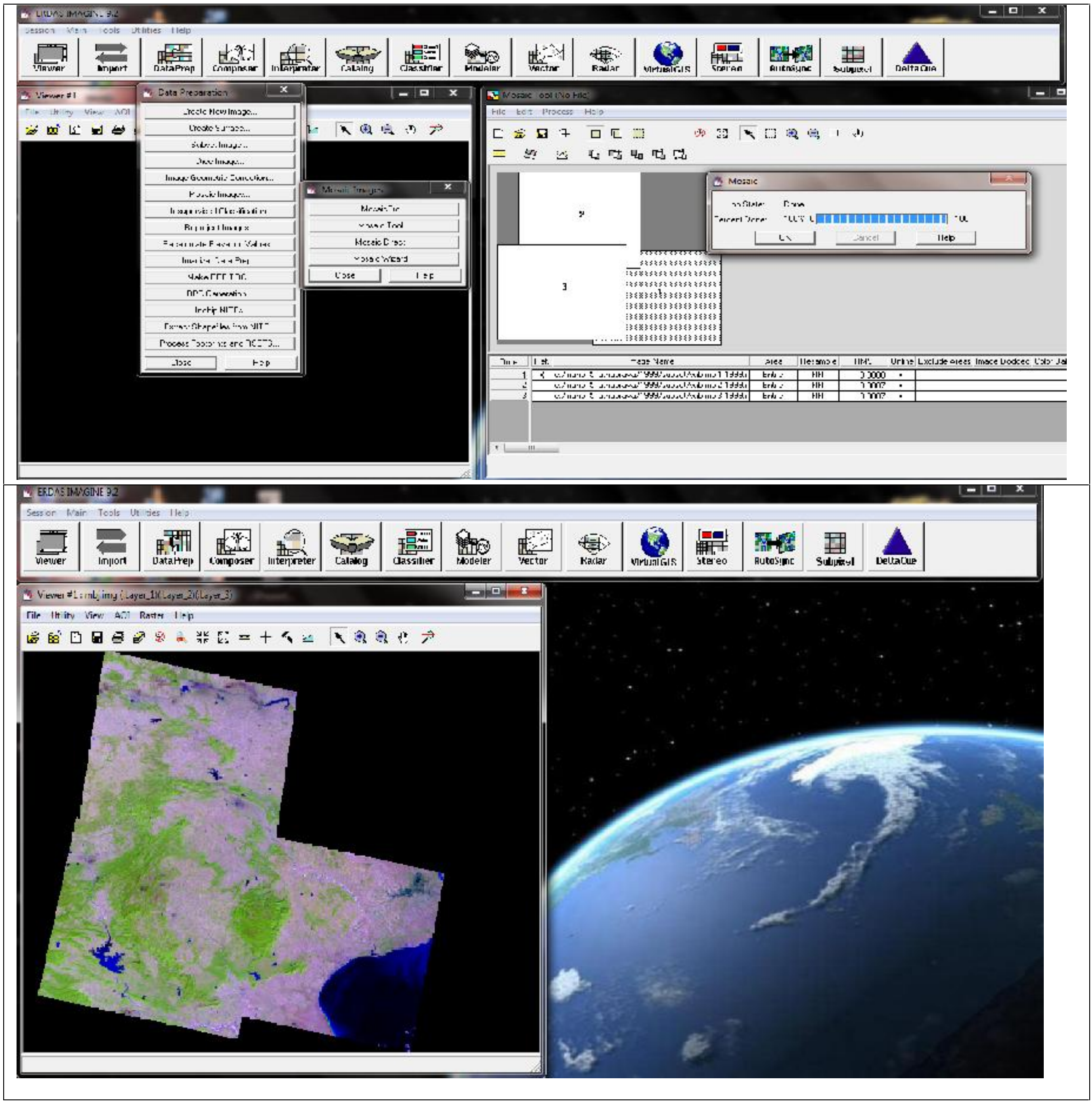
Subset of image

The four different LANDSAT images of the years 1999, 2004, 2009 and 2014 with the help of GIS software ERDAS IMAGINE 9.2 to obtain the required portion from the raw images for this project specific. Following snapshot shows the subset of the image.



Mosaic of image

The mosaic of four different subset images of LANDSAT of the years 1999, 2004, 2009 and 2014 in ERDAS IMAGINE 9.2 software to obtain the four complete image of Mayurbhanj district which is this study area. The following snapshot shows the mosaicking of images.

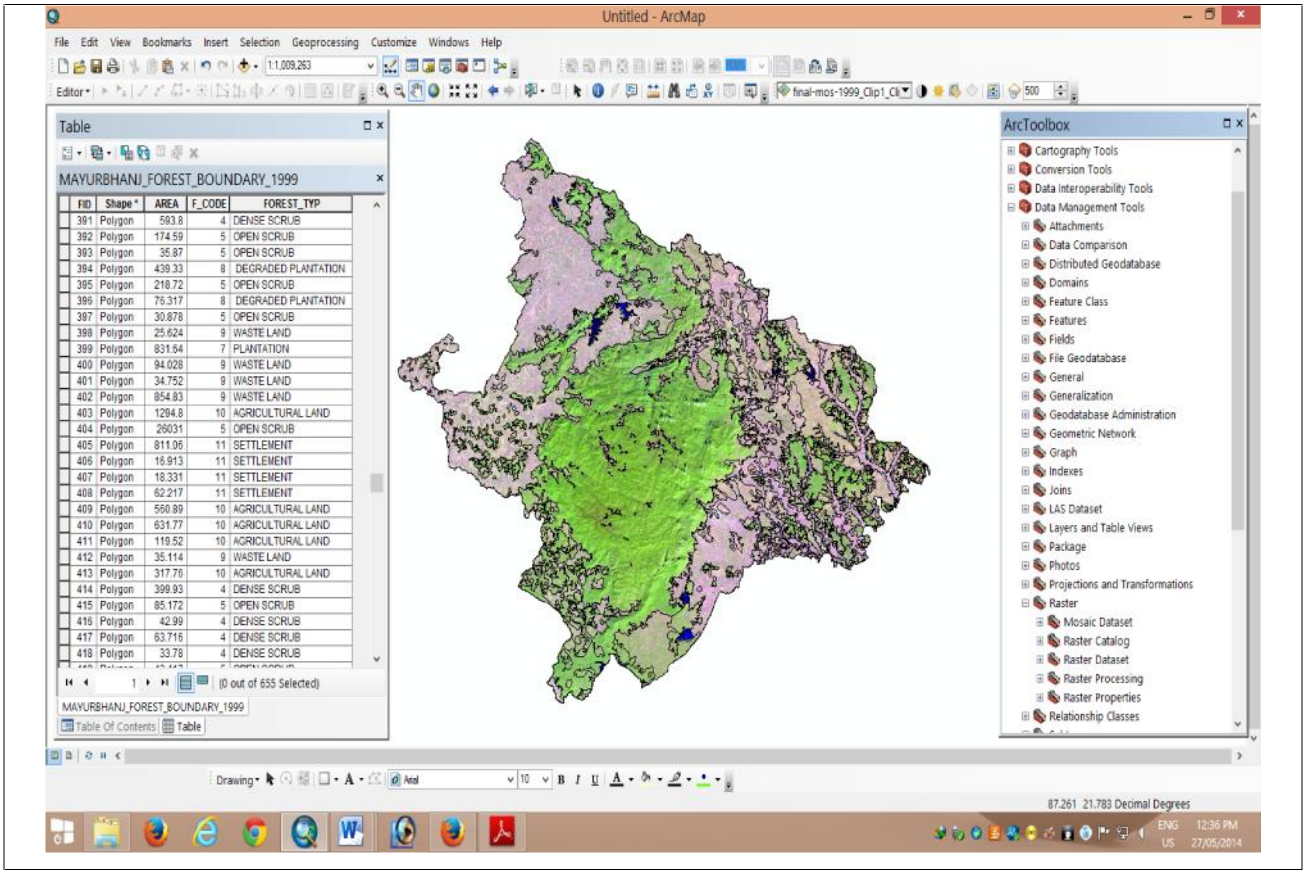


Digitization or Vectorization

The digitization with the help of GIS software i.e. Arc GIS 10.1. were created new features; cut polygons, polygons etc. with the help of respective tools present in Arc GIS tool box. The following snapshot shows the digitization process on the image.

Creation of attribute database

The attribute database in the software Arc GIS-10.1 by considering the followings such as- “FOREST AREA, FOREST CODE & FOREST TYPE”. The following snapshot shows creating attributes of the digitized features on the image.


Untitled - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table
MAYURBHANJ_FOREST_BOUNDARY_1999
FID Shape* AREA F_CODE FOREST_TYP
391 Polygon 593.8 4 DENSE SCRUB
392 Polygon 174.59 5 OPEN SCRUB
393 Polygon 35.87 5 OPEN SCRUB
394 Polygon 439.33 8 DEGRADED PLANTATION
395 Polygon 218.72 5 OPEN SCRUB
396 Polygon 76.317 8 DEGRADED PLANTATION
397 Polygon 30.878 5 OPEN SCRUB
398 Polygon 25.624 9 WASTE LAND
399 Polygon 831.64 7 PLANTATION
400 Polygon 94.028 9 WASTE LAND
401 Polygon 34.752 9 WASTE LAND
402 Polygon 854.83 9 WASTE LAND
403 Polygon 1294.8 10 AGRICULTURAL LAND
404 Polygon 26031 5 OPEN SCRUB
405 Polygon 811.06 11 SETTLEMENT
406 Polygon 16.913 11 SETTLEMENT
407 Polygon 18.331 11 SETTLEMENT
408 Polygon 62.217 11 SETTLEMENT
409 Polygon 560.89 10 AGRICULTURAL LAND
410 Polygon 631.77 10 AGRICULTURAL LAND
411 Polygon 119.52 10 AGRICULTURAL LAND
412 Polygon 35.114 9 WASTE LAND
413 Polygon 317.76 10 AGRICULTURAL LAND
414 Polygon 399.93 4 DENSE SCRUB
415 Polygon 85.172 5 OPEN SCRUB
416 Polygon 42.99 4 DENSE SCRUB
417 Polygon 63.716 4 DENSE SCRUB
418 Polygon 33.78 4 DENSE SCRUB
(0 out of 655 Selected)
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ArcToolbox
Cartography Tools
Conversion Tools
Data Interoperability Tools
Data Management Tools
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Generalization
Geodatabase Administration
Geometric Network
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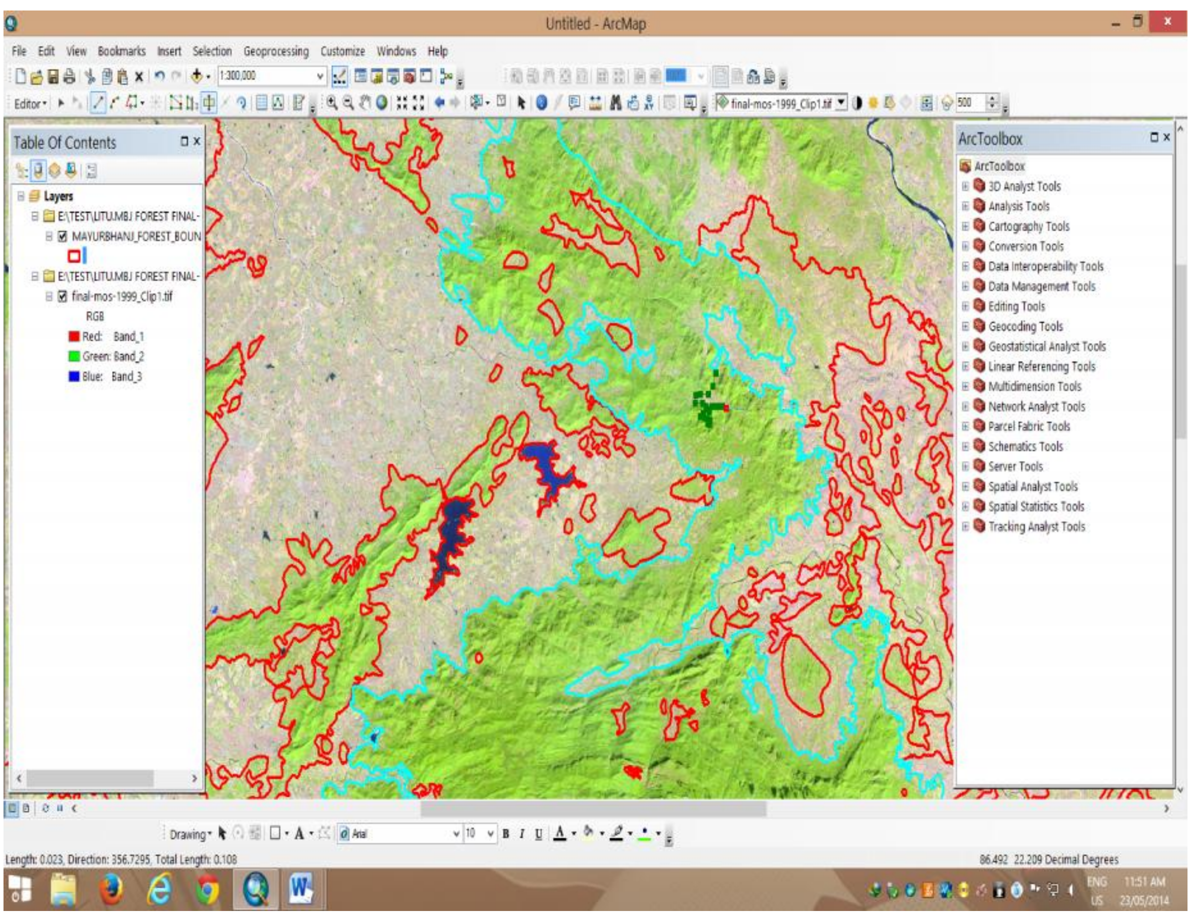
LAS Dataset
Layers and Table Views
Package
Photos
Projections and Transformations
Raster
Mosaic Dataset
Raster Catalog
Raster Dataset
Raster Processing
Raster Properties
Relationship Classes
87.261 21.783 Decimal Degrees
12:36 PM
27/05/2014


Untitled - ArcMap
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
Table Of Contents
Layers
E:\TEST\LITU.MBJ FOREST FINAL-
MAYURBHANJ_FOREST_BOUN
final-mos-1999_Clip1.tif
RGB
Red: Band_1
Green: Band_2
Blue: Band_3
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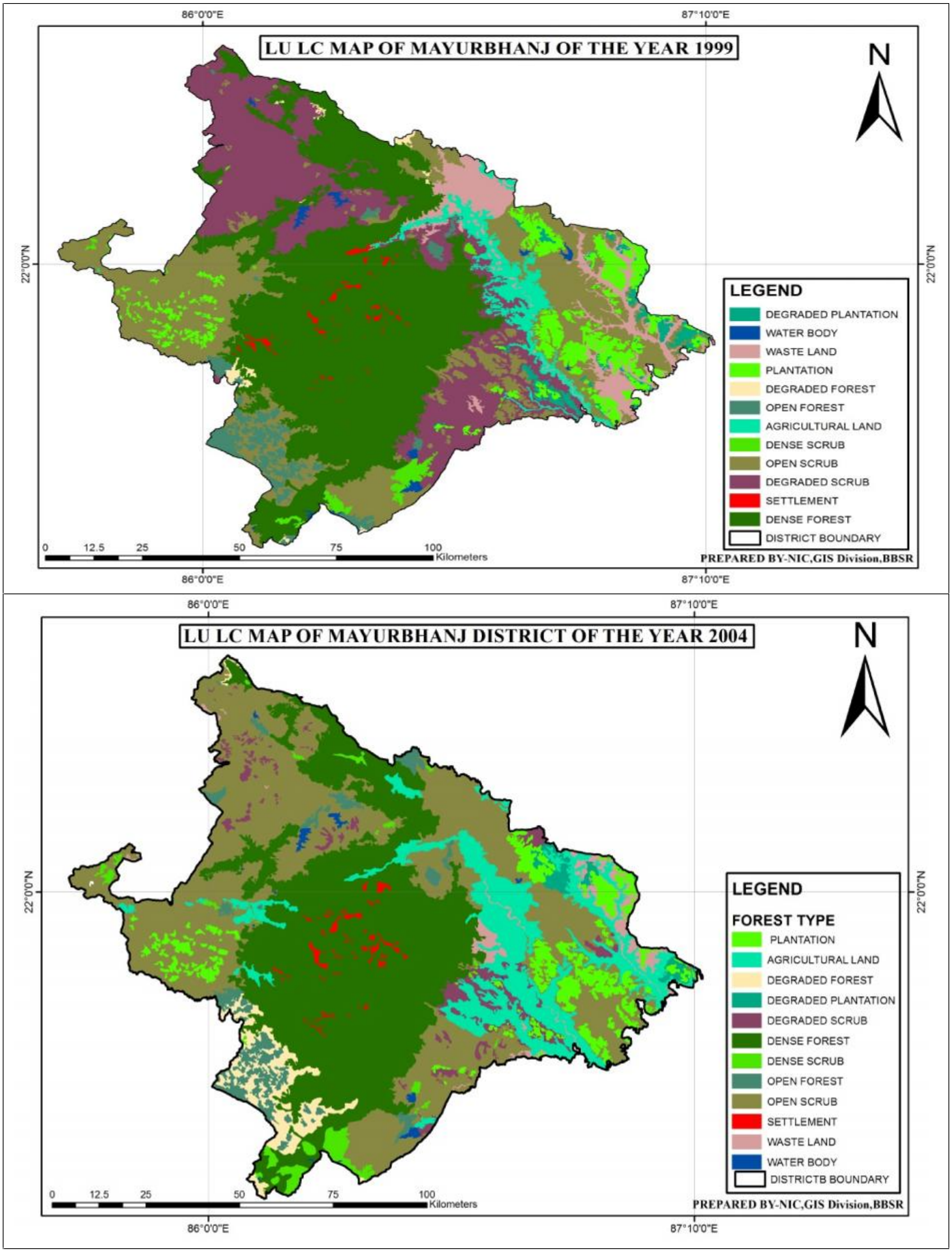
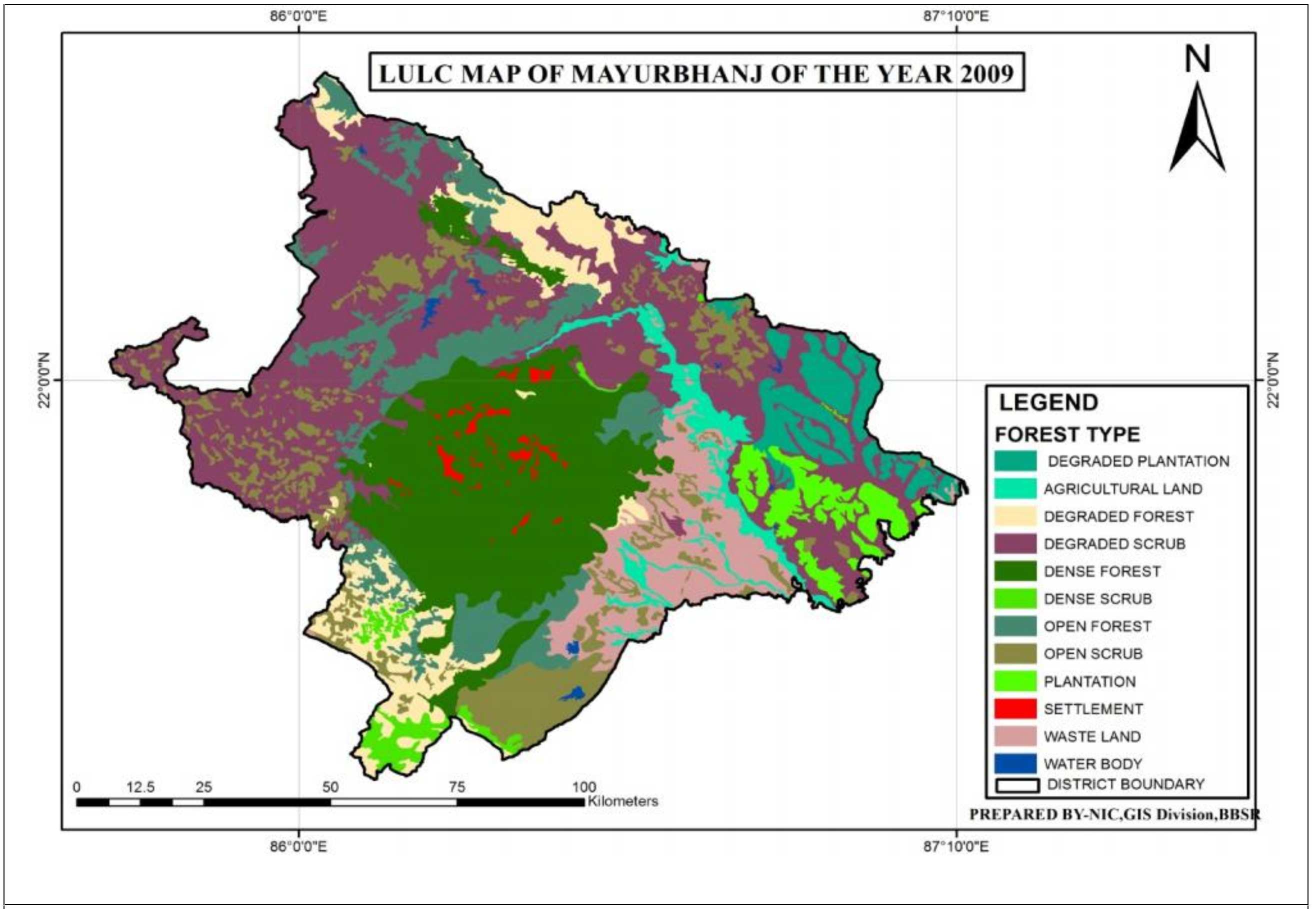
3D Analyst Tools
Analysis Tools
Cartography Tools
Conversion Tools
Data Interoperability Tools
Data Management Tools
Editing Tools
Geocoding Tools
Geostatistical Analyst Tools
Linear Referencing Tools
Multidimension Tools
Network Analyst Tools
Parcel Fabric Tools
Schematics Tools
Server Tools
Spatial Analyst Tools
Spatial Statistics Tools
Tracking Analyst Tools
Length: 0.023, Direction: 356.7295, Total Length: 0.108
86.492 22.209 Decimal Degrees
11:51 AM
23/05/2014

Results and Discussion

The visual observation of images over the subsequent periods shows their decrements in vegetation biomass from the year 1999 to 2004.

Land use land cover maps of Mayurbhanj district




86°0'0"E
87°10'0"E
LULC MAP OF MAYURBHANJ OF THE YEAR 2009
N
22°0'0"N
LEGEND
FOREST TYPE
DEGRADED PLANTATION
AGRICULTURAL LAND
DEGRADED FOREST
DEGRADED SCRUB
DENSE FOREST
DENSE SCRUB
OPEN FOREST
OPEN SCRUB
PLANTATION
SETTLEMENT
WASTE LAND
WATER BODY
DISTRICT BOUNDARY
0 12.5 25 50 75 100
Kilometers
PREPARED BY-NIC,GIS Division,BBSR

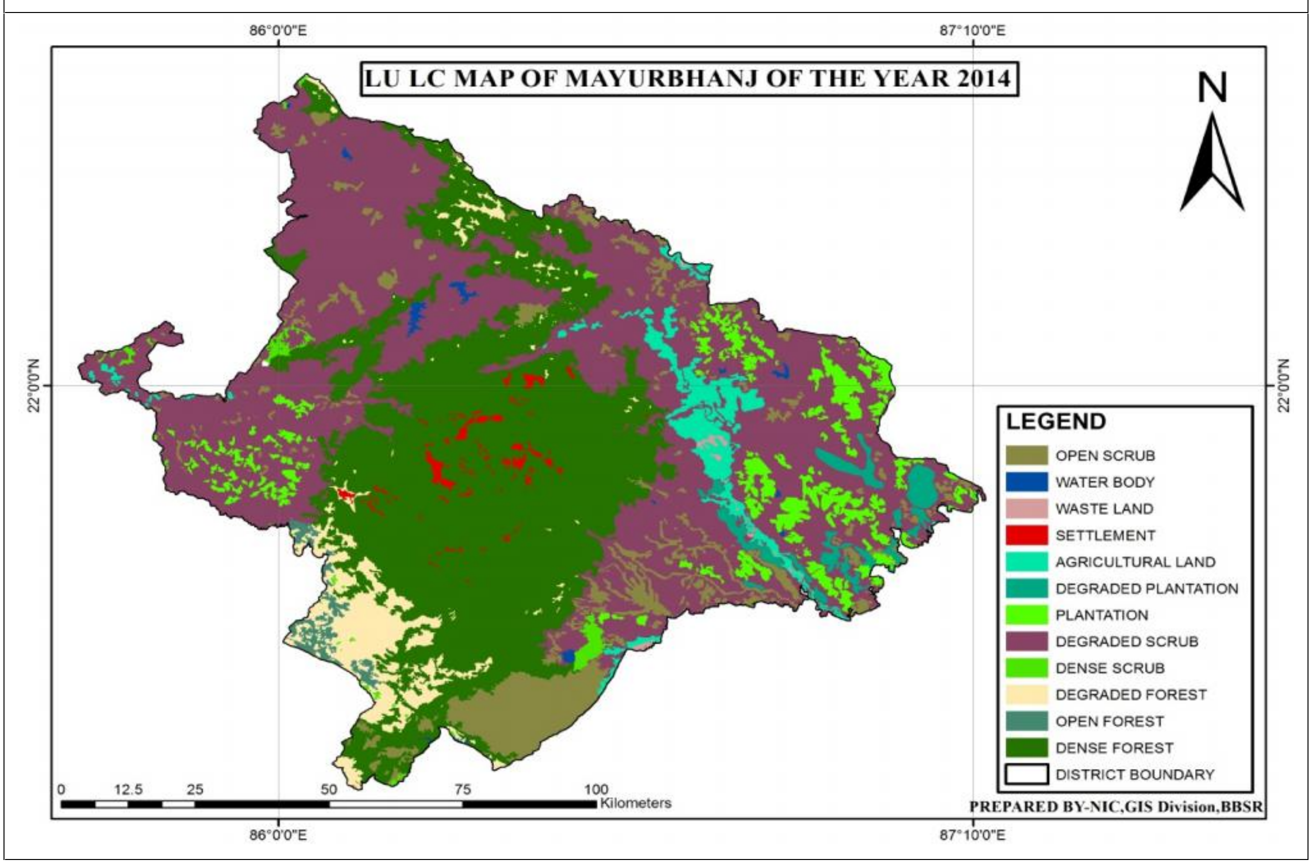
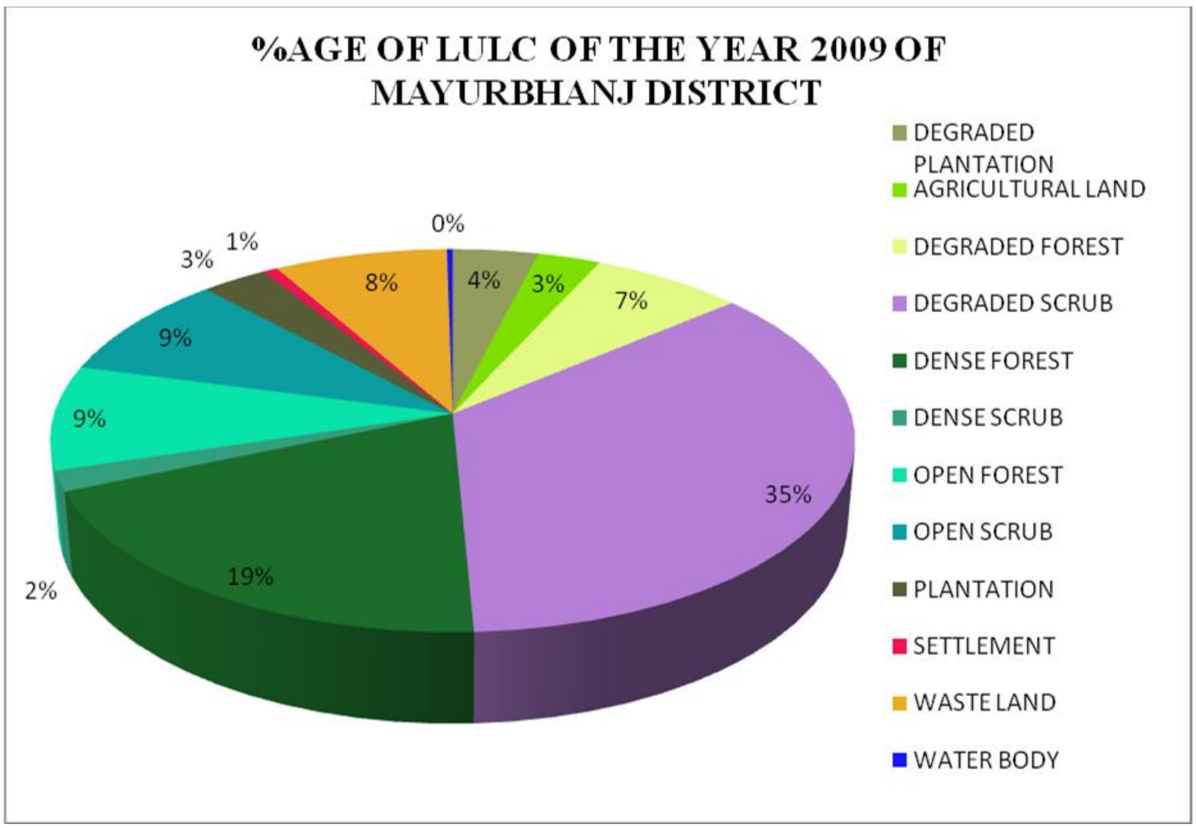

86°0'0"E
87°10'0"E
LU LC MAP OF MAYURBHANJ OF THE YEAR 2014
N
22°0'0"N
LEGEND
OPEN SCRUB
WATER BODY
WASTE LAND
SETTLEMENT
AGRICULTURAL LAND
DEGRADED PLANTATION
PLANTATION
DEGRADED SCRUB
DENSE SCRUB
DEGRADED FOREST
OPEN FOREST
DENSE FOREST
DISTRICT BOUNDARY
0 12.5 25 50 75 100
Kilometers
PREPARED BY-NIC,GIS Division,BBSR

Table 1: The following table shows the %age of area covered by the vegetation types of different years of Mayurbhanj district

Vegetation types	1999	2004	2009	2014
Dense forest	35%	32%	19%	32%
Open forest	3%	3%	9%	1%
Degraded forest	1%	3%	7%	4%
Dense scrub	1%	2%	2%	2%
Open scrub	25%	38%	9%	6%
Degraded scrub	21%	3%	35%	46%
Plantation	5%	5%	3%	4%
Degraded plantation	1%	1%	4%	1%
Agricultural land	3%	10%	3%	3%



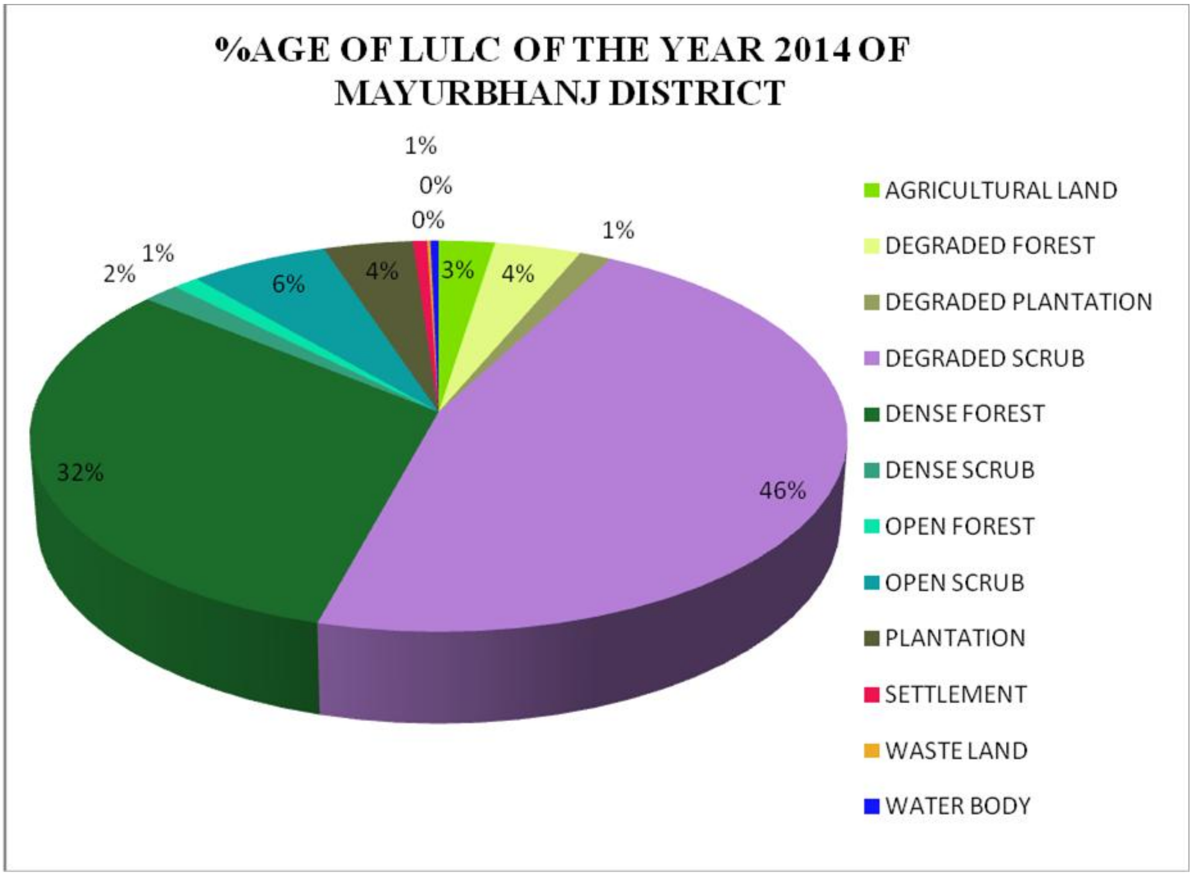
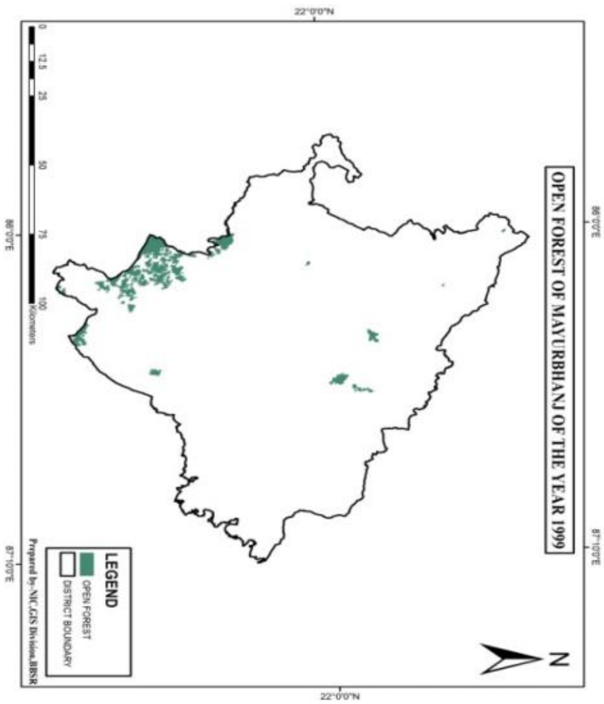


Table 2: The following table shows the +ve or -ve change of area covered by the vegetation types of different years of Mayurbhanj district

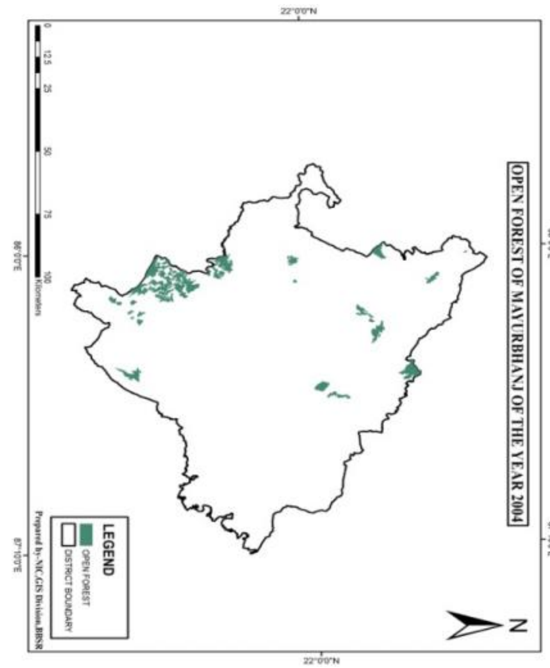
Vegetation types	1999-2004		2004-2009		2009-2014	
	+ve	-ve	+ve	-ve	+ve	-ve
Dense forest		3%		13%	13%	
Open forest			6%			8%
Degraded forest	2%		4%			3%
Dense scrub	1%					
Open scrub	13%			29%		3%
Degraded scrub		18%	32%		11%	
Plantation				2%	1%	
Degraded plantation			3%			3%
Agricultural land	7%			7%		

Maps showing changes in areas in different vegetation classes individually
Dense forest

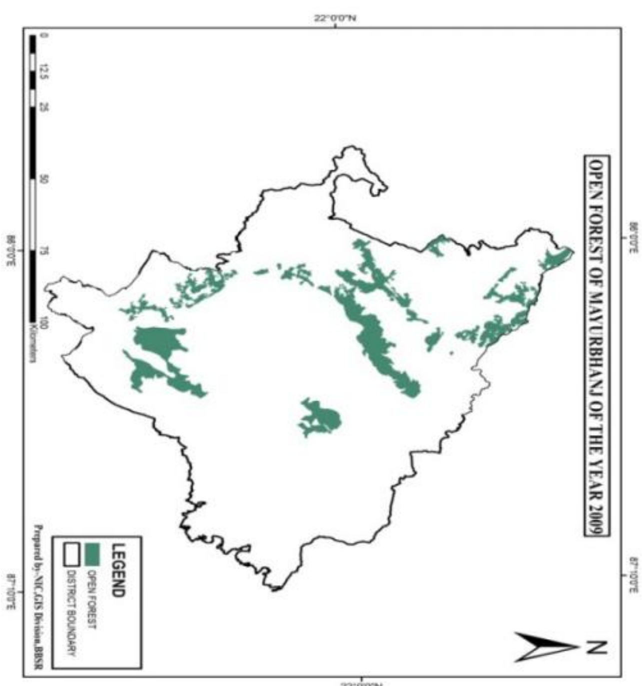
1999



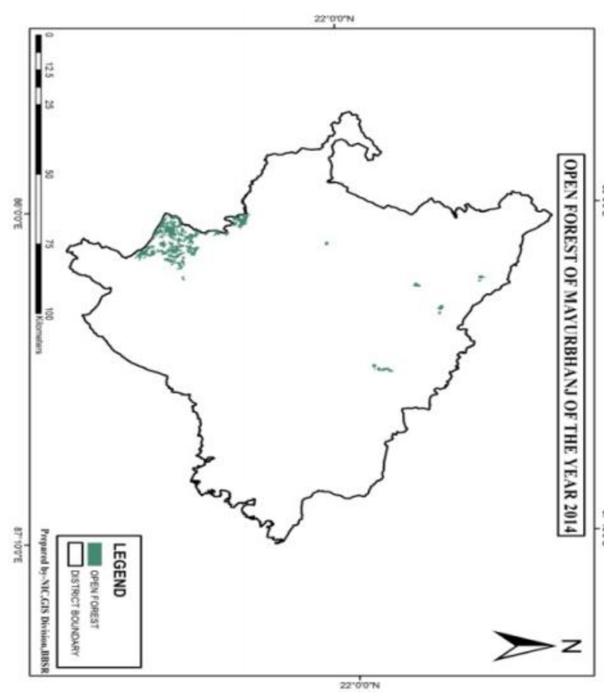
2004



2009

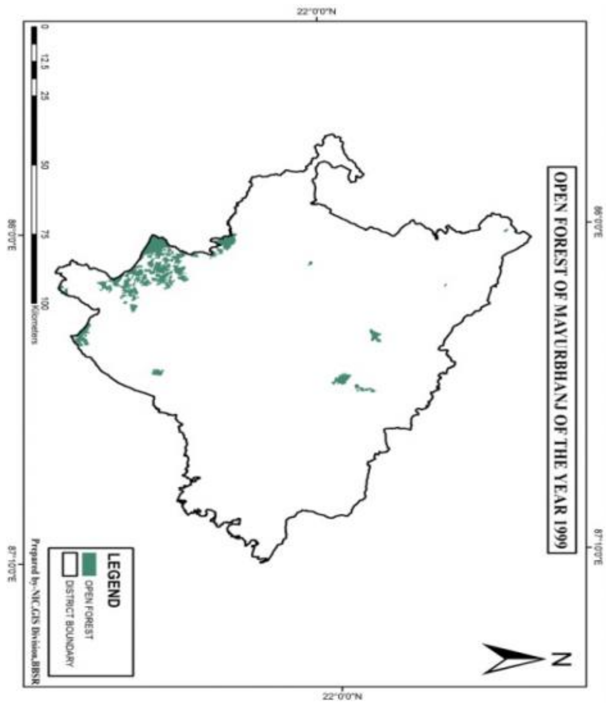


2014

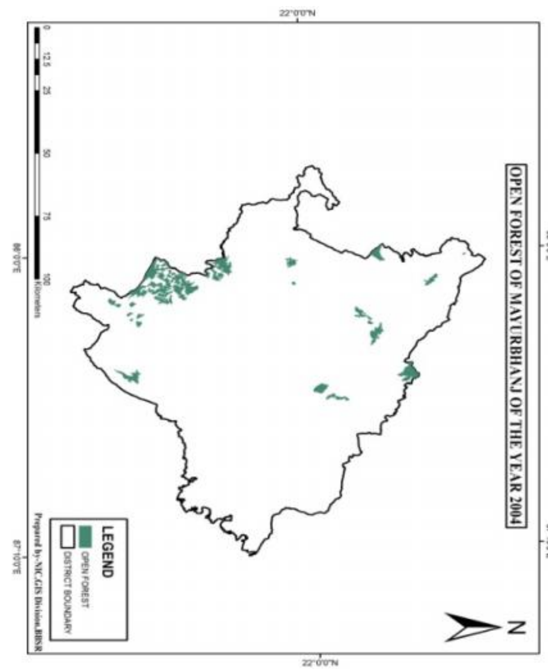


Open forest

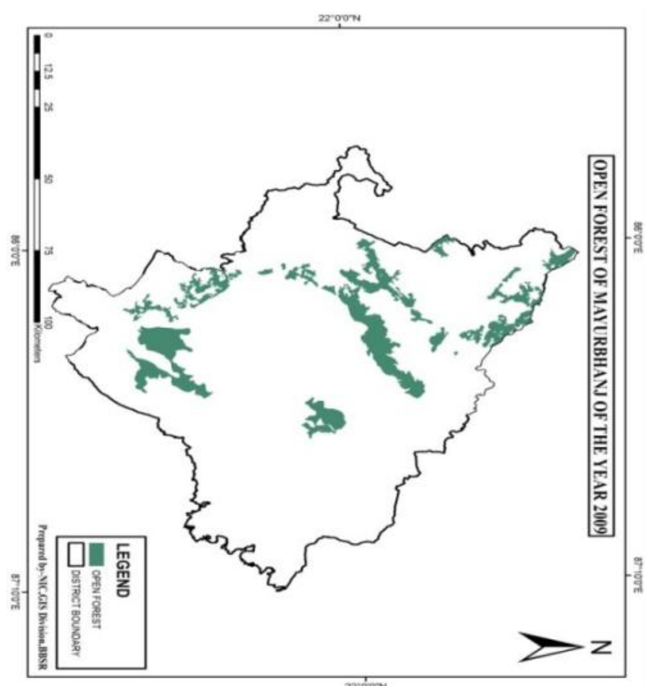
1999



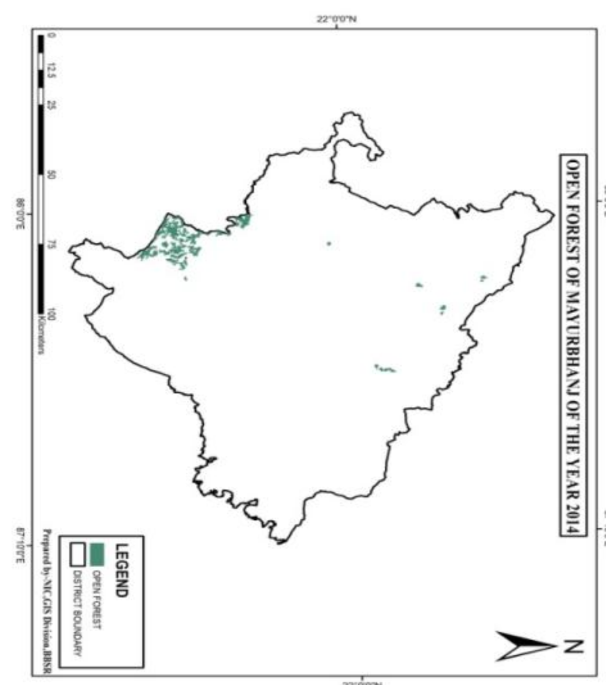
2004



2009

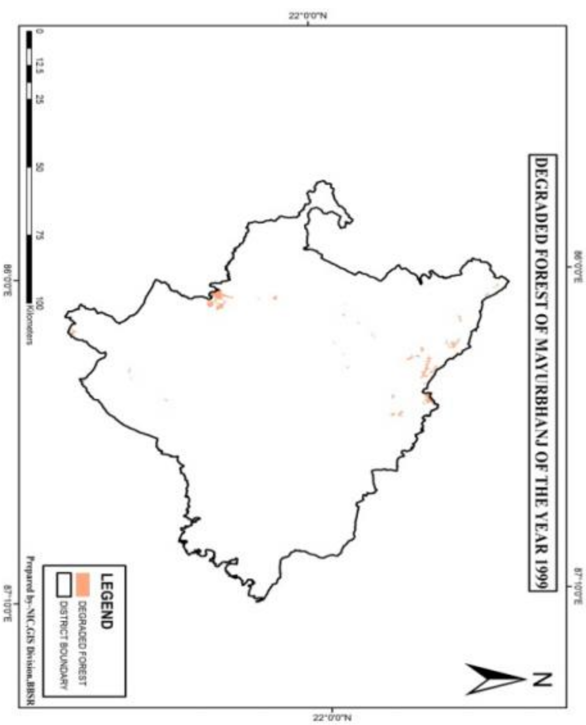


2014

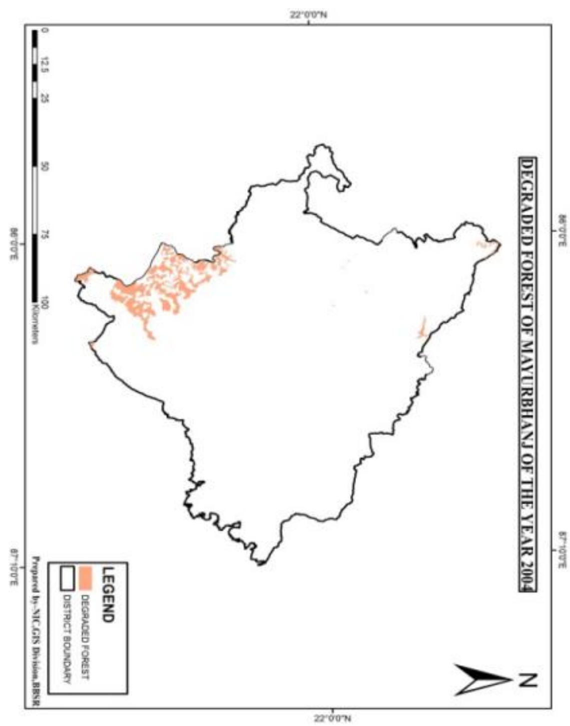


Degraded forest

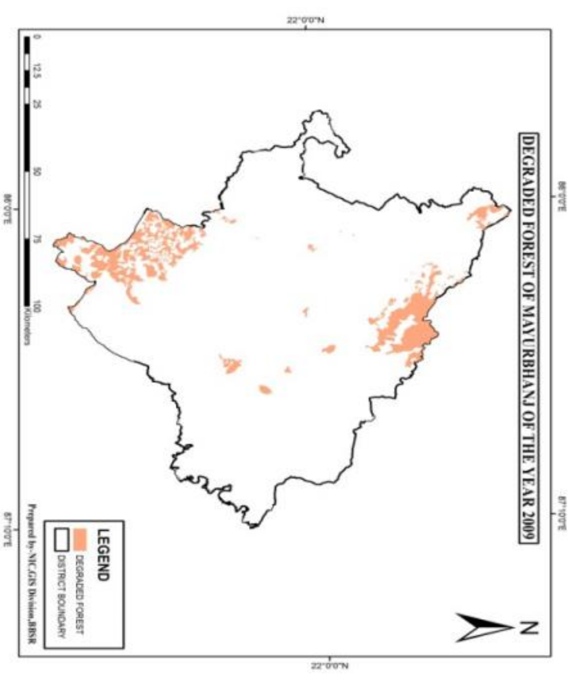
1999



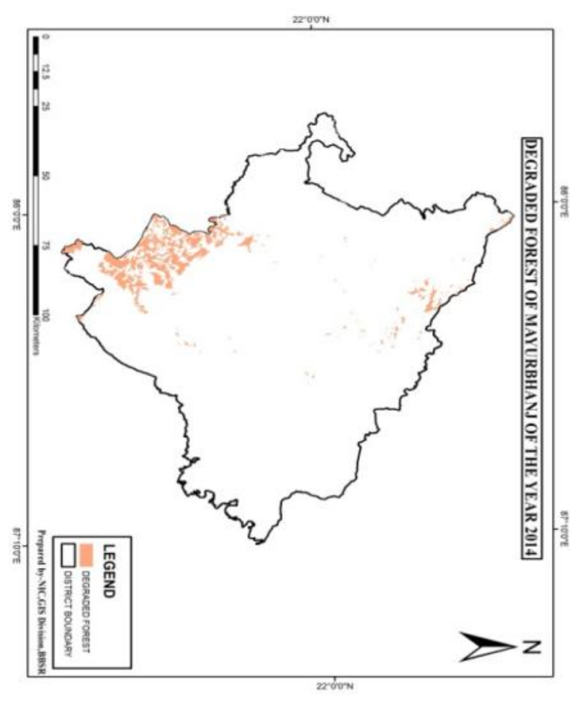
2004



2009

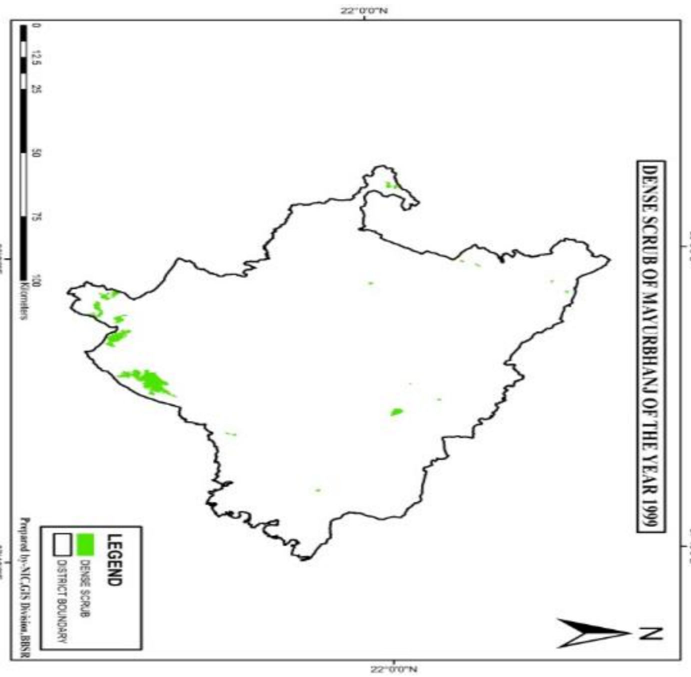


2014

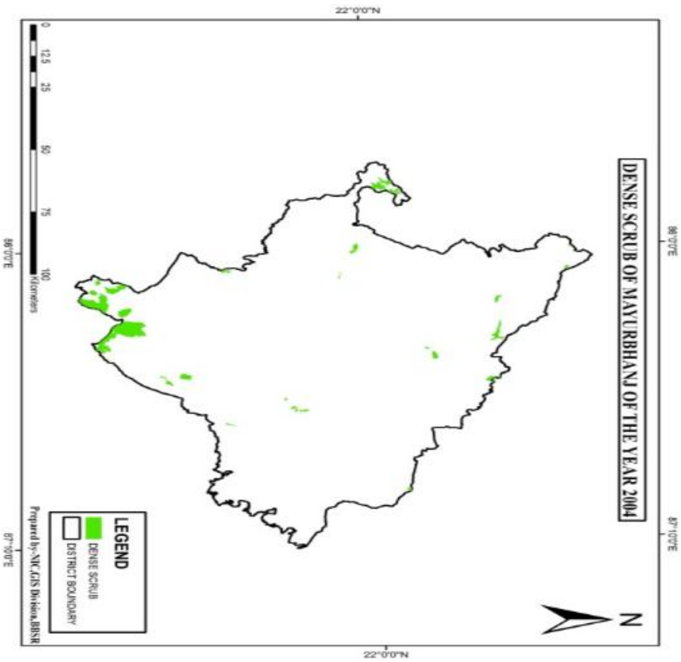


Dense scrub

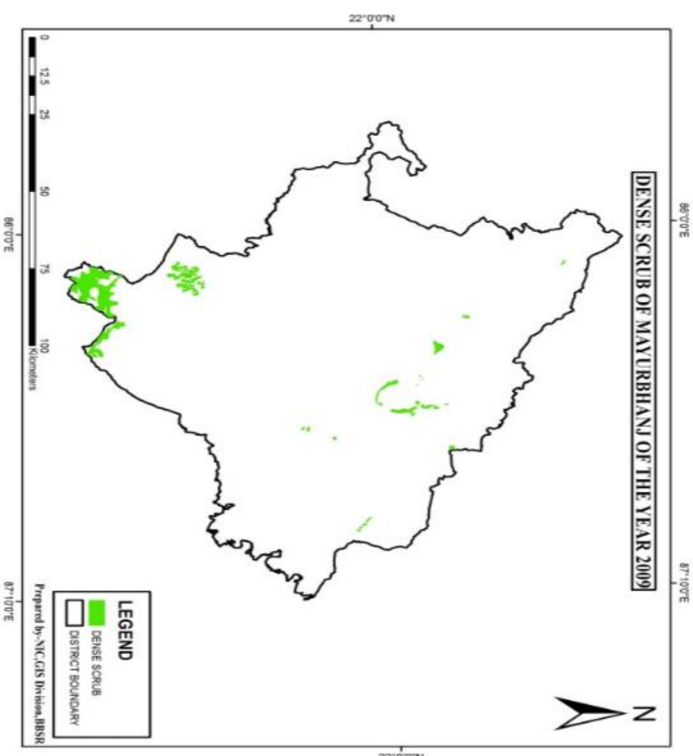
1999



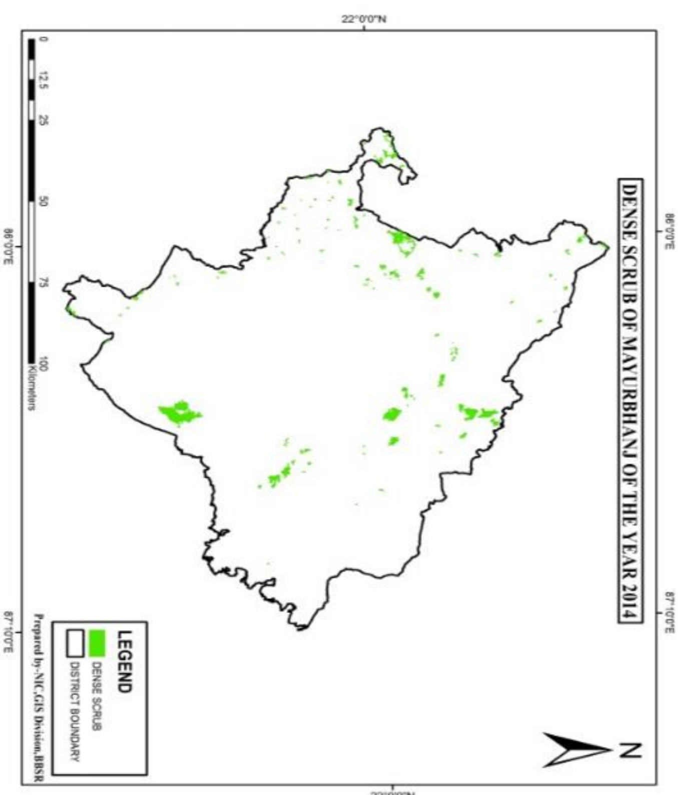
2004



2009

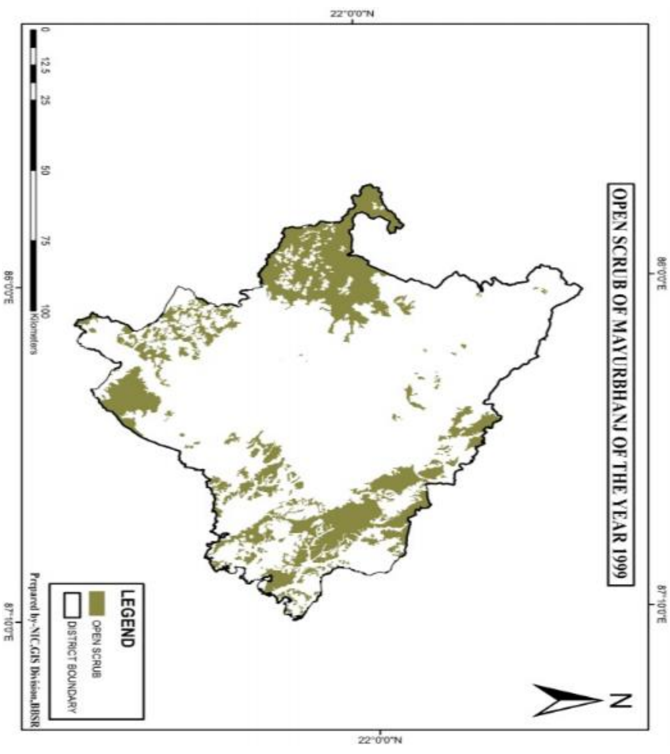


2014



Open scrub

1999



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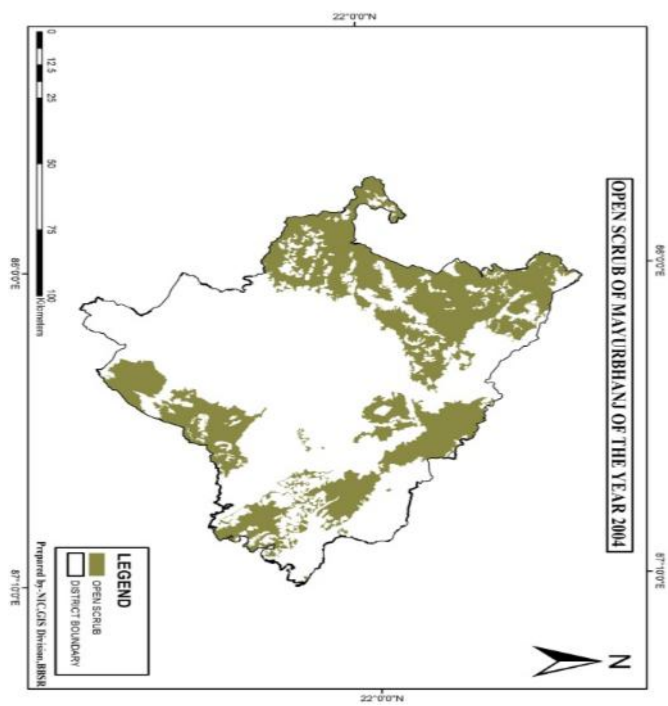
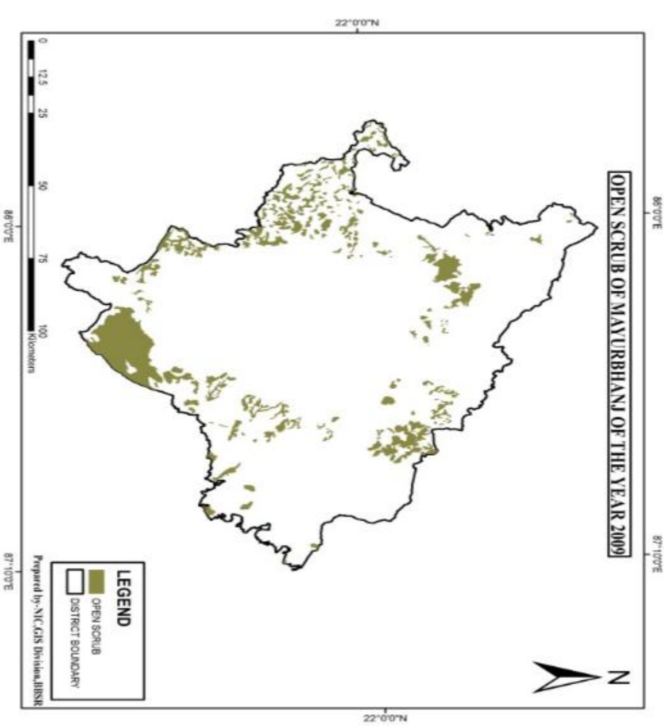


2009



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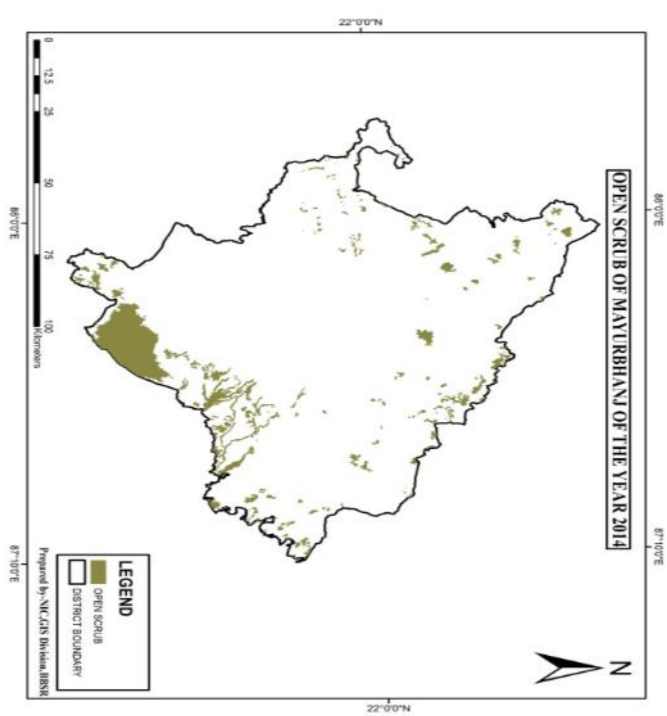
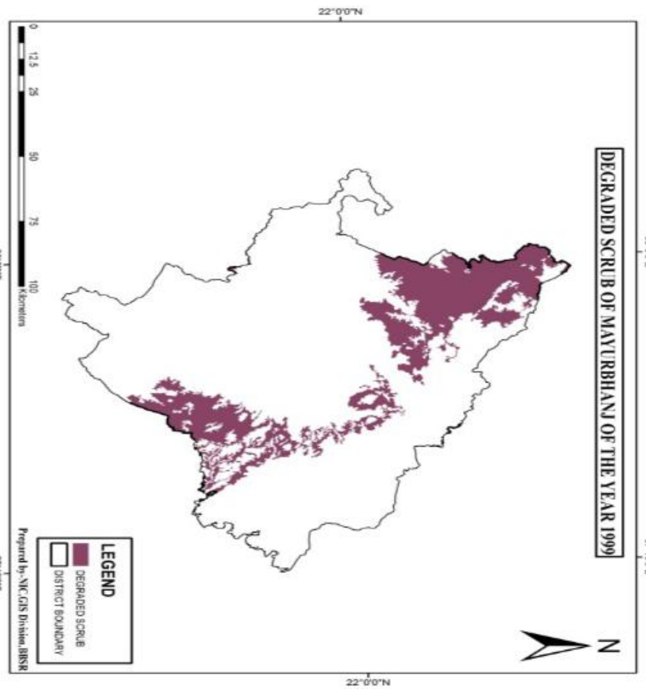
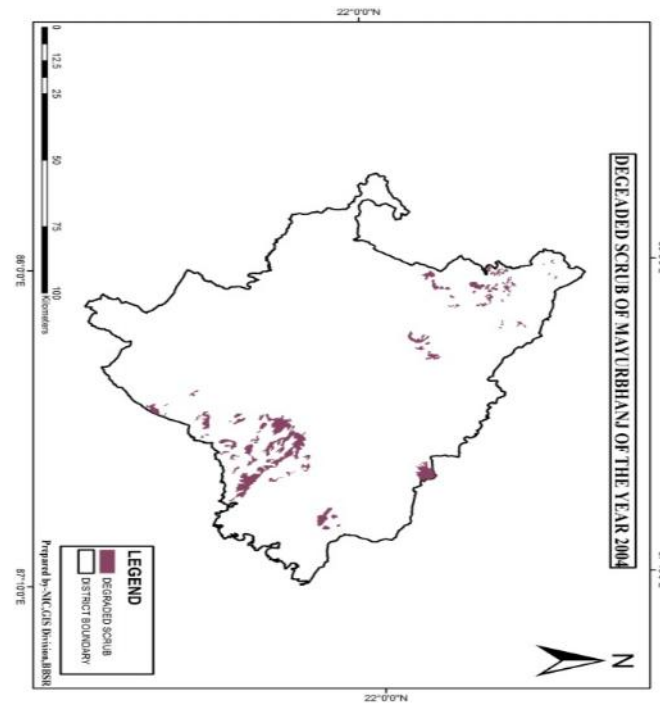


Degraded scrub

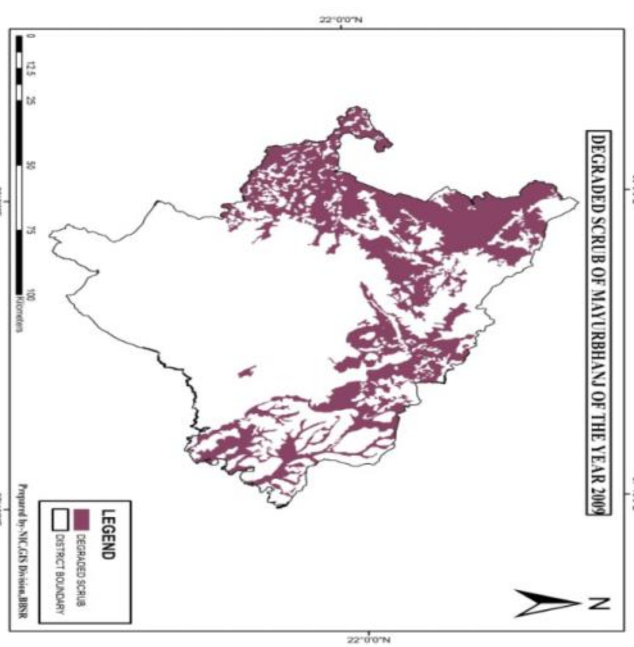
1999



2004



2009



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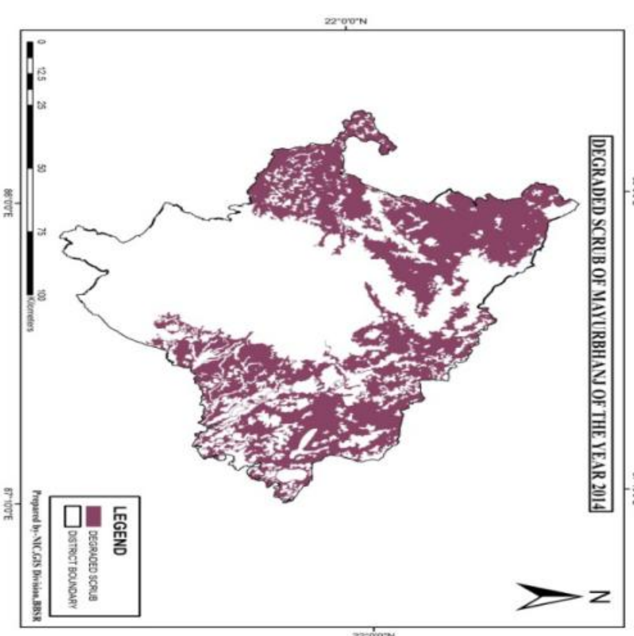
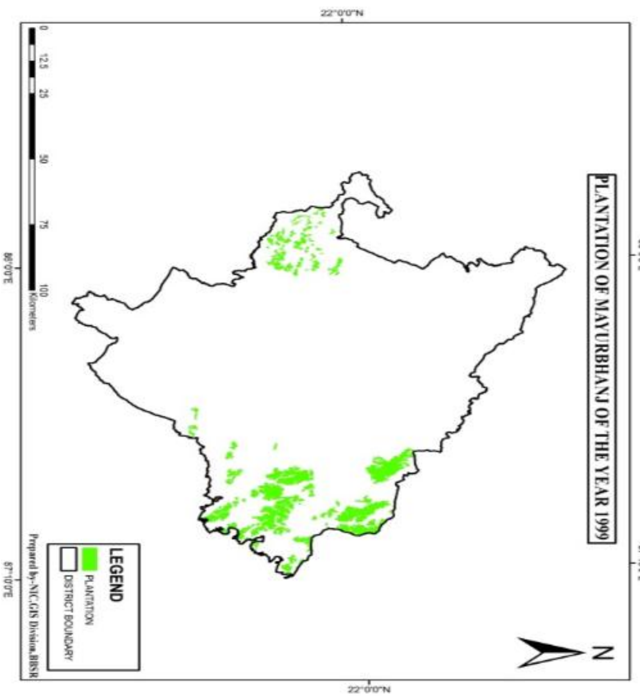


Plantation

Degraded plantation

1999



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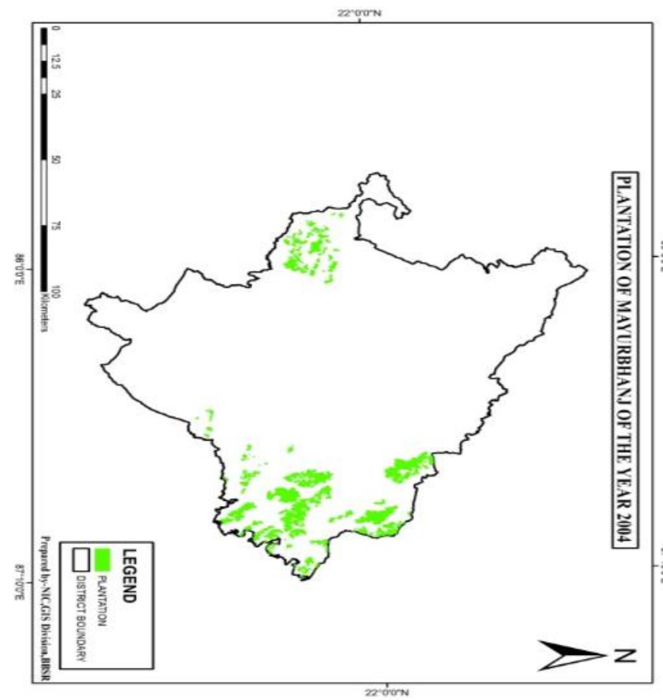

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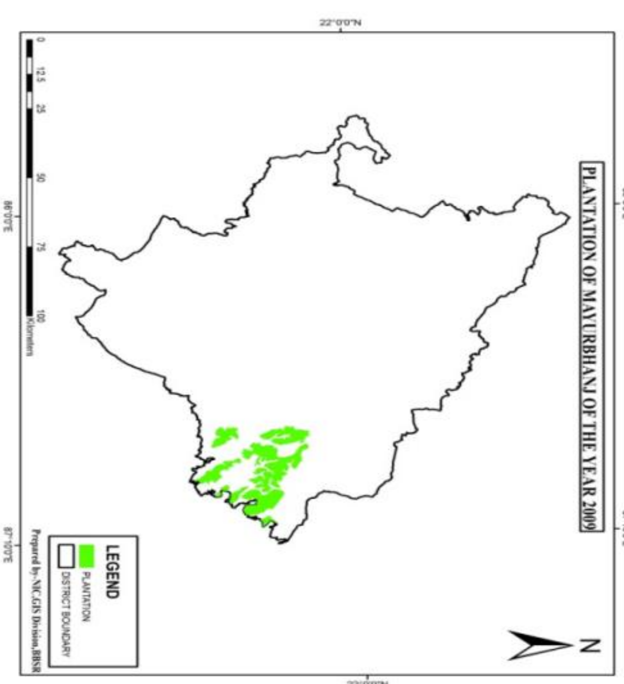
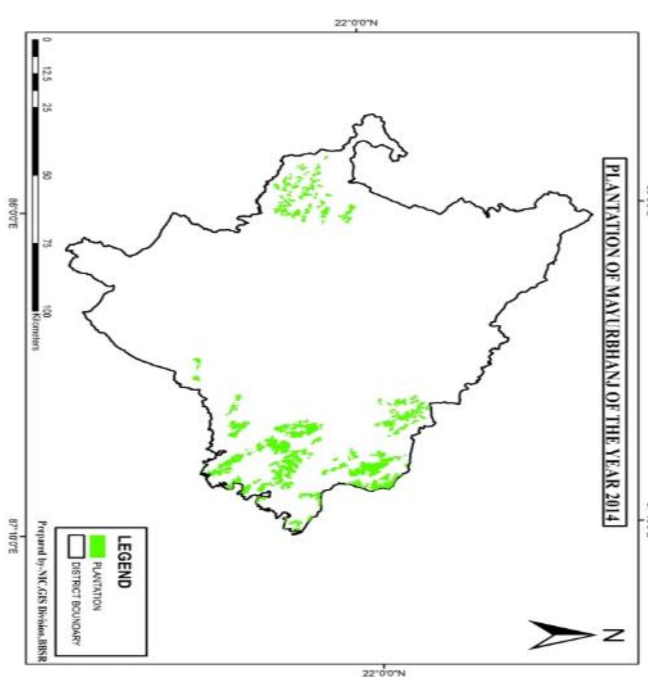
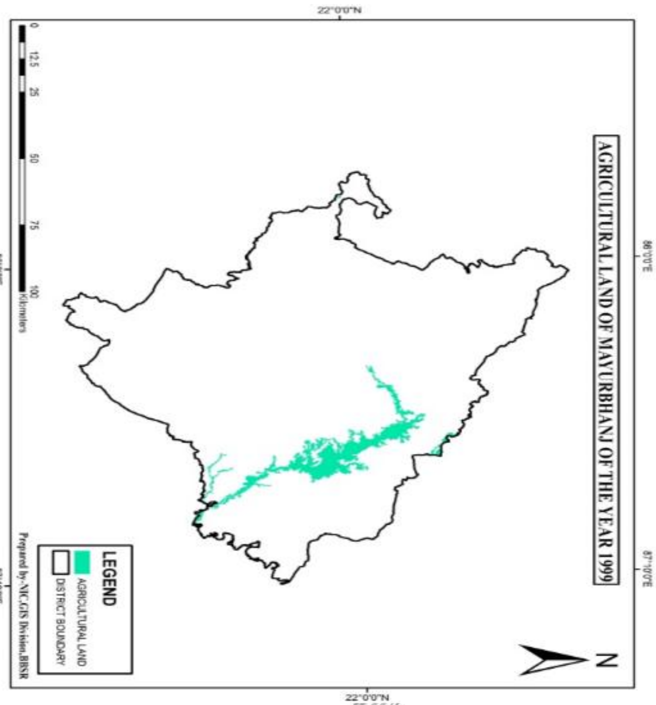
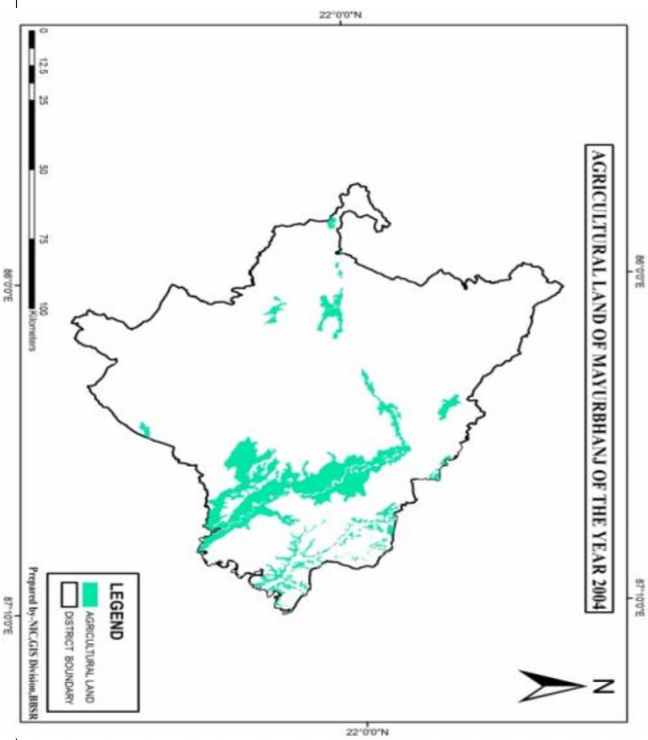
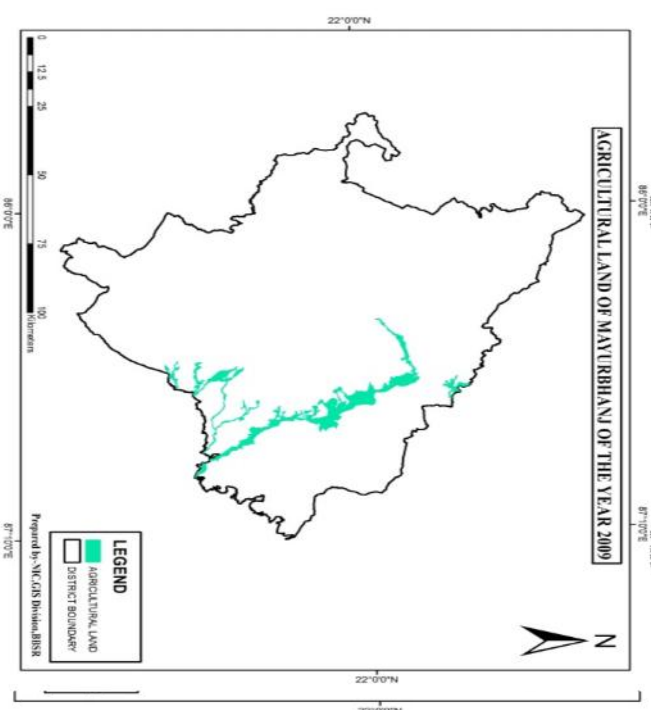
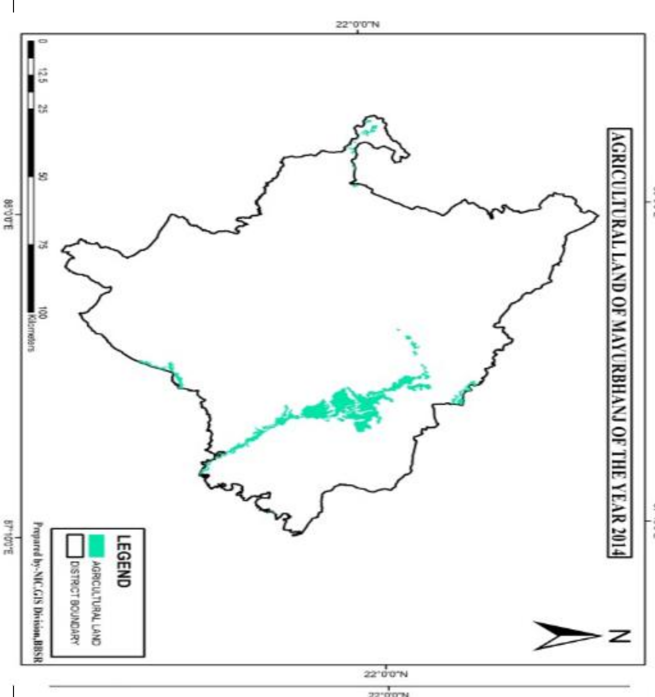


2014



Agricultural land

1999	2004
	
2009	2014
	

Changes of vegetation cover in Mayurbhanj district from 1999-2014 (Table 1and Table 2)

Changes during 1999-2004:

In this period of time there are so many changes occurred in Mayurbhanj district while monitoring the vegetation coverage. The changes are both in negative & positive type.

In Dense forest class there was a negative change of 3%. In Open forest class there was no change took place within this time period. In Degraded forest class there was a positive change occurred in 2%. In Dense scrub class there was a positive change occurred in 1%. In Open scrub class there was a positive change occurred in a very big amount i.e. up to 13%. In Degraded scrub class there was a drastic amount of negative change occurred i.e.18%. Plantation & degraded plantation class was remained same within the 5yrs of time, no change had been taking place. In Agricultural land class there was a positive change occurred in 7%. The result revealed similarity with the study conducted by Temesgen *et al.,* (2014) in Dera District, Ethiopia. Who reported that the decline of total vegetation cover in the study period of 1985 to 2011.

Changes during 2004-2009:

In Dense forest class there was a negative change of 13%. In Open forest class there was a positive change took place of 6%. In Degraded forest class there was a positive change occurred in 4%. In Dense scrub class there was no change occurred. In Open scrub class there was a negative change occurred in a very big amount i.e. up to 29%. In Degraded scrub class there was a drastic amount of positive change occurred i.e.32%. Plantation class changed negatively up to 2% & degraded plantation class was changed positively up to 3%. In Agricultural land class there was a negative change occurred of 7%.

Changes during 2009-2014:

In Dense forest class there is a positive change of 13% occurred. In Open forest class there is a negative change took place of 8%. In Degraded forest class there is a negative change occurred of 3%. In Dense scrub class there is no change occurred. In Open scrub class there is a negative change occurred up to 3%. In Degraded scrub class there is a positive change occurred i.e.11%. Plantation class changed positively up to 1% & degraded plantation class is changed negatively up to 3%. In Agricultural land class there is no changes took place until the month of February. During this period the increase in forest cove may be due to intensive conservation, regeneration and protection measures which have remarkably improve the previous scenario. The results are similar to the study conducted by Kumar *et al.,* (2001).

Conclusion

From the study it's concluded that, the district has very dense forest coverage which is highest in the state of Odisha. The results showed that the vegetation coverage of the district in four different years of time mostly the dense forest is in a decreasing state in first three years i.e. in 1999, 2004 & 2009 respectively. But in 2014 the dense forest coverage is increased due to the implementation of some Govt. schemes in forestry. Thus periodical monitoring of the vegetation density is recommended.

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How to cite this article:

R. Dash, M. K. Swain, M. Routray, B.K.Samal, D. Nandi, I.Mohanta, S.S.Patra and S. Rout. (2016). Monitoring vegetation change detection of Mayurbhanj district, Odisha by using Geoinformatics. Int. J. Adv. Res. Biol. Sci. 3(10): 151-170.

DOI:http://dx.doi.org/10.22192/ijarbs.2016.03.10.022