International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 04 | Apr42018 www.irjet.net p-ISSN: 2395-0072

CHANGE DETECTION AND PREDICTION OF LAND USE AND LAND COVER

Ritesh Midha[1], Nisha Yadav[2], Nishant kumar[3], Tej Kumar[4]

[1,2,3,4] *B.Tech students, Dept. of Information Technology, IMS Engineering College, Ghaziabad, India*

ABSTRACT: *In remote sensing application, a change may be considered to as an alteration of the surface components. Change detection is used in Forest or vegetation, landscape and urban change. The process of identifying differences in the state of an object or phenomenon by observing it at different times. It is useful in many applications such as land use changes, habitat fragmentation, rate of deforestation, coastal change, urban sprawl and other cumulative changes. It involve the application of multi temporal datasets to quantatively analyze the temporal effects. Therefore, we have used RS and GIS to study land use land cover Samastipur district, Samastipur is one of the thirty-eight districts of Bihar. Samastipur is a district in Bihar which is spread over an area of 2904 sq. kms. The people of Samastipur mainly speak Hindi. According to the 2011 census, Population Density in the District is 1465 per sq.km. and the total population is 4.25 million. The district comprises of 4 sub-divisions, and 20 Blocks. The latitude of Samastipur, Bihar, India is 25.862968, and the longitude is 85.781029. Samastipur, Bihar, India is located at India country in the Cities place category with the gps coordinates of 25° 51'46.6848"N and 85° 46'51.7044"E.*

Keywords: GIS, Remote Sensing, LULC, Google Mapper, Google Earth

1. INTRODUCTION

Land cover changes are driven by natural forces or by human land uses. Thus, it involves both the natural and the human dimensions. Land cover affects land use. Locally, the land cover changes due to environment or climatic factors determine the vulnerability of people to climatic perturbations and thus affect the decisions on land use by people.

1.1 Land Use

Land use is commonly defined as a series of operations on land, carried out by humans, with the intention to obtain products and benefits through using land resources. Land use and land cover have same fundamental difference. Land use refers to the purpose the land serves, for example-

Recreation, wildlife habitat or agriculture, it does not describe the surface cover on the ground.

1.2 Land Cover

Land cover is commonly defined as the vegetation (natural or planted) or man –made constructions (buildings etc.) which occur on the Earth surface. Water, ice, bare rock, sand and similar surfaces also count as land cover. Land cover refers to the surface cover on the ground, whether vegetation, urban infrastructure, water, bare soil or other, it does not describe the use of land, and the use of land may be different for lands with some cover type.

1.3 Change Detection

Change detection for GIS is a process that measures how the attribute of a particular area have changed between two or more-time periods. Change detection often involves comparing aerial photographs or satellite imagery of the area taken at different times. Change detection has been widely used to assess shifting cultivation, deforestation, urban growth, impact of natural disasters like tsunamis, earthquakes land use and land cover changes etc.

"Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times". Changes in land cover by land use do not necessarily imply degradation of the land. However due to a shift in land use patterns, land cover changes that affects biodiversity, water and other processes that come together to affect climate and biosphere.

Remote sensing is the science and art of obtaining information about an object, area, phenomenon through the analysis of data acquired by a device that is not in contact with object, area, and phenomenon under investigation.

2. STUDY AREA

2.1 Introduction

Our project study area is Samastipur district. Samastipur is one of the thirty-eight districts of Bihar. Samastipur is a district in Bihar which is spread over an area of 2904 sq. kms. Samastipur is bounded on the north by the Bagmati River which separates it from Darbhanga district. On the west it is bordered by Vaishali and some part of Muzaffarpur district, on the south by the Ganges, while on its east it has Begusarai and some part of Khagaria district. The district headquarters is located at Samastipur.

2.2 Location

The latitude of Samastipur, Bihar, India is 25.862968, and the longitude is 85.781029. Samastipur, Bihar, India is located at India country in the Cities place category with the GPS coordinates of 25° 51'46.6848"N and 85° 46'51.7044"E.

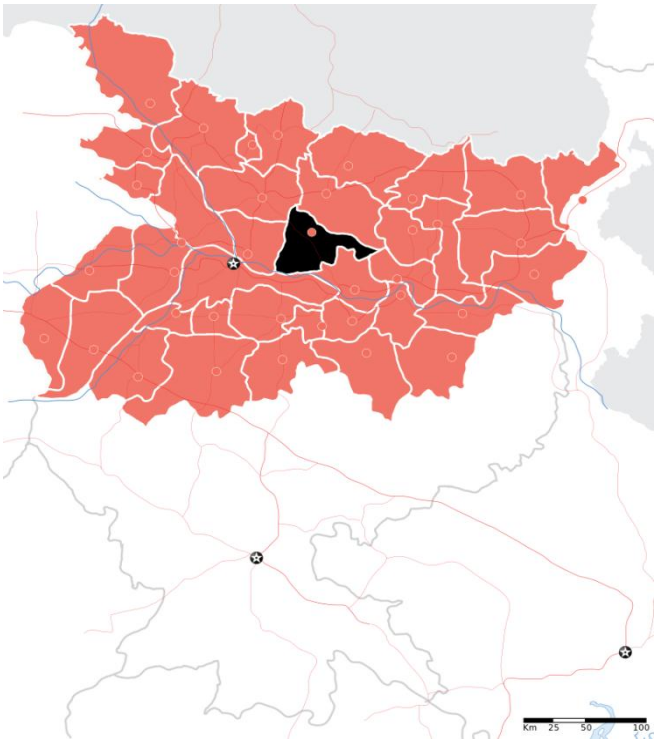

Figure-1: Samastipur map

2.3 Climate and Temperature

The climate is warm and temperate in Samastipur. In winter, there is much less rainfall in Samastipur than in summer. The Köppen-Geiger climate classification is Cwa. The average annual temperature is 25.5 °C in Samastipur. The average annual rainfall is 1097 mm.

2.4 Population

Samastipur is a Nagar Parishad + Outgrowth city situated in Samastipur block of Samastipur district. The Samastipur city is divided into 28 wards for which elections are held every 5 years. As per the Population Census 2011, there are total 13,135 families residing in the Samastipur city. The total population of Samastipur is 67,925 out of which 35,718 are males and 32,207 are females thus the Average Sex Ratio of Samastipur is 902.

The population of Children of age 0-6 years in Samastipur city is 8683 which is 13% of the total population. There are 4591 male children and 4092 female children between the ages 0-6 years. Thus as per the Census 2011 the Child Sex Ratio of Samastipur is 891 which is less than Average Sex Ratio (902).

2.5 Rivers

Samastipur is traversed by a number of rivers including Budhi Gandak, Baya, Kosi, Kamla, Kareh and Jhamwari and Balan, which are both the offshoots of Burhi Gandak. The Ganges also skirts the district on the south.

2.6. Geography of Samastipur

Samastipur district occupies an area of 2,904 square kilometers (1,121 sq. mi), [2] comparatively equivalent to Indonesia's Muna Island.[3] Samastipur is bounded on the north by the Bagmati River which separates it from Darbhanga district. On the west it is bordered by Vaishali and some part of Muzaffarpur district, on the south by the Ganges, while on its east it has Begusarai and some part of Khagaria district. The district headquarters is located at Samastipur.

2.7 Agriculture of Samastipur

Samastipur is rich in agriculture, because of its fertile plain. Tobacco, maize, rice and wheat are the main crops. Leechi and mango fruits are grown in abundance. There is a jute mill in Samastipur at Muktapur Village. This is very famous jute mill (Rameshwar Jute Mill), employing around 5000 people. Shekhopur is one of the best agricultural villages and it also has famous temple, Bhagwatisthan at Manipur. Samastipur has many a sugar mills which make it Samastipur is major producer of potatoes. There are more than 20 cold storages in the district, all storing potatoes and total capacity is 650000 quintals.

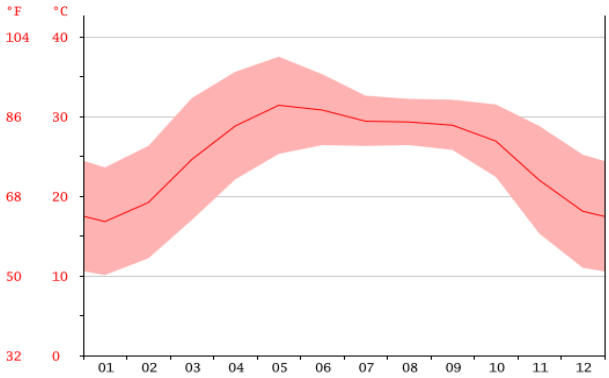

Figure-2: Temperature graph Samastipur

3. MATERIAL AND METHODOLOGY

The satellite data used in the present study includes the imagery of LANDSAT-5 "TM" And LANDSAT-8 "OLI" & "TIRS" sensor. Landsat 5 imagery is of February 2011 and Landsat 8 is of February 2017 with resolution of 30m nominal, panchromatic resolution is 15m. Map projection used is "UTM" datum used is "WGS84" and UTM zone is 45.

3.1 Software Used

In this study ERDAS IMAGINE is a remote sensing application with raster graphics editor abilities designed by ERDAS or geospatial. ERDAS IMAGINE is aimed primarily at geospatial raster data processing and allows the user to prepare, display and enhance digital image for mapping use in GIS or software.

3.2 Data acquisition

This step is dividing into two parts, in which first we have to download vector file (.shp) format of the study area. Then we have to download the satellite imagery of the study area from internet. In this study, we had taken satellite imagery of Landsat 5 & 8 of year 2011 and 2017. We used "TM" and "OLI" and "TIRS" sensors respectively.

Satellite	Landsat 5	Landsat 8
Sensor's	TM	OLI, TIRS
Date	February, 2011	February, 2017
Data category	NOMINAL	NOMINAL
Data type	"L1T"	"L1T"
Output format	GeoTiff	GeoTiff
WRS Path	140	140
WRS Row	42	42

Table-1: Sensor's Details

Operational Land Imager (OLI) it will measure in the visible, near infrared and short-wave infrared portions of the spectrum. Its images will have 15 meter panchromatic and 30-meter multi-spectral spatial resolution.

	Landsat 5	Landsat 8
Launch date	March 1,1984	February 11,2013
Vehicle	Delta 3920	Atlas- V rocket
Launched by	NASA	NASA
Site	Vandenberg Air Force Base California	Vandenberg Air Force Base California
Sensor	"TM"	"OLI", "TIRS"
Resolution	30 m.	30m.

Table-2: OLI

Thematic Mapper (TM) is an advanced, multispectral scanning, Earth resources sensor designed to achieve higher image resolution, shaper spectral separation, improved geometric fidelity and grater radiometric accuracy and resolution than the MSS sensor. TM data are sensed in seven spectral bands simultaneously. Band 6 senses thermal infrared radiation.

Thermal infrared sensor (TIRS) the specification requires TIRS to collect image data for two thermal infrared spectral bands with a spatial resolution of 120m across a 185-km swath from the nominal 705 km Landsat altitude.

Layer Stack, in this part, we have to stack the different bands of the imagery into a single file (.img) as the Data we have downloaded present in gz. Format and in this zipped file each band is present separately. For best outcome, it is necessary to stack all 7 bands of Landsat5 and all 11 bands of Landsat8 respectively.

Overlap, in this step, we had to first open the satellite imagery, then open the shape file on the imagery. If it did not work then you have to change the projection of the imagery or the shape file.

Subset - Subsetting refers to breaking out a portion of a lager file into one or more smaller file. Often image files contain areas much larger much larger than a particular study area. In these cases, it is helpful to reduce the size of the image file to include only the area of interest (AOL). This not only eliminates the extraneous data in the file, but it speeds up processing due to the smaller amount of data to process. This can be important when dealing with multiband data. In this step, we have to subset the shape file which is overlapped on the satellite imagery.

Image Classification - Multispectral classification is the process of sorting pixels into a finite number of individual classes, or categories of data, based on their data file values. If a pixel satisfies a certain set of criteria, the pixel is assigned to the class that corresponds to that criteria. This process is also referred to as image segmentation.

Depending on the type of information you want to extract from the origin data, classes may be associated with known features on the ground or may simply represent areas that look different to the computer. An example of a classified image is a land cover map, showing vegetation, bare land, pasture, urban and so forth. In this study, we are using supervised image classification maps, one common application of remotely-sensed images to rangeland management is the creation of maps, vegetation type, or other discrete classes by remote sensing software. In supervised classification, the image processing software is guided by the user to specify the land cover classes of interest.

4. RESULT

We have used supervised image classification with maximum likelihood algorithm, for classifying the imagery of Samastipur Bihar for years 2011 and 2017. For computing accuracy assessment, we have used the KHAT statistics formula to compute the overall accuracy (OA), Producer's accuracy (PA) and User accuracy (UA). The study uses Landsat time series images for showing land use and land cover change over the period of time in Samastipur Bihar. The results can be shown in the following tables.

CLASS	Area(sq.km) 2011	Area(sq.km) 2017	Overall Change in (sq. km)
OPEN SPACE	185.2	138.254	46.946
SETTLEMENT	1131.25	1272.1	140.85
AGRICULTURE	902.1	872.581	29.519
FOREST	640.38	580.95	59.43
WATERBODY	45.8	40.32	5.48
Total Area	2904	2904	

Table-3: Land use Land cover mapping

The table-3 represents the area of each land use land cover category of three different years.

S.no	Class	Producer Accuracy (%)	User Accuracy (%)	Overall Accuracy (%)
1	Settlement	90.34090909	96.36363636	9.668592277
2	Agriculture	99.87639061	99.63008631	24.56673761
3	Open space	97.12460064	96.20253165	18.48586196
4	Water body	99.11111111	97.95021962	20.34052904
5	Forest	98.66989117	97.95918367	24.80997264
Total		Overall Accuracy		97.8716

Table-4: representing the producer's accuracy, overall accuracy, user's accuracy 2011

During the period from 2011 to 2017 the area of settlement, has increased by 140.85 square kilometer respectively. The other four feature class namely water body, forest, agriculture & water body cover of the area has also decreased in past 6 years.

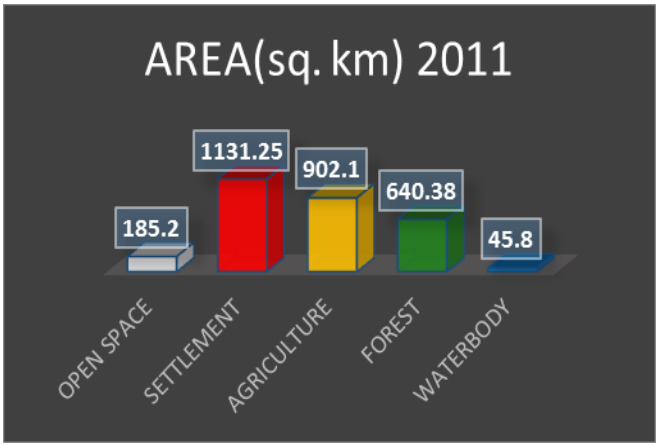

Figure-3: The land use and land cover map of year 2011S

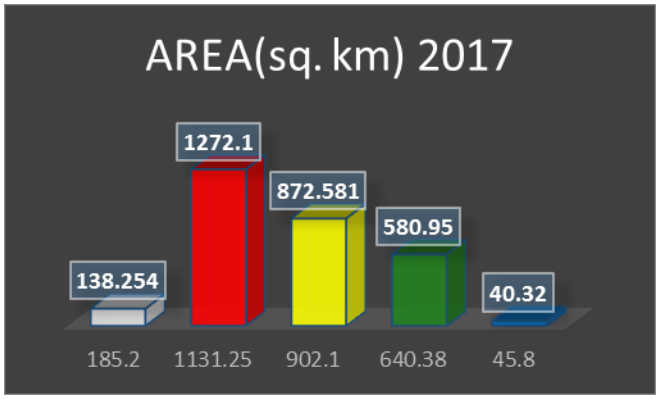

Figure-4: Land Use Land Cover map 2017 in Area (sq.km)

S.no	Class	Producer accuracy (%)	User accuracy (%)	Overall accuracy (%)
1	Settlement	83.15301391	97.99635701	11.36459654
2	Forest	99.37304075	99.68553459	6.696239966
3	Open space	99.1634981	92.87749288	27.54541614
4	Water body	100	99.31869796	27.71440642
5	Agriculture	99.91235758	99.82486865	24.08111534
Total		Overall Accuracy		97.401

Table-5: representing the (PA), (UA), and Overall accuracy 2017.

5. CONCLUSION

The Samastipur district was a chosen as a study area to monitor land use/land cover dynamics over a period of 6 years. During 2011 to 2017. The study area has been divided into five categories such as Settlement, Forest, Agriculture, Water body and Open Space. For remote sensing propose we take the help of ERDAS imagine software 2011 software and for GIS purpose we took help of Google earth and Arc map 10.1 software. We have used supervised image classification with Parallelpiped algorithm, for classifying the imagery of Samastipur Bihar for years 2011 and 2017. For computing accuracy assessment, we have used the KHAT statistics formula to compute the overall accuracy (OA), Producer's accuracy (PA) and User accuracy (UA). The study uses Landsat time series images for showing land use and land cover change over the period of time in Samastipur Bihar. During the period from 2011 to 2017 the area of settlement, has increased by 140.85 square kilometer respectively. The other four feature class namely water body, forest, agriculture & water body cover of the area has also decreased in past 6 years. The 2011 map shows that the area was densely covered by agriculture area followed by forest area, settlement can be seen in near the river bodies and other areas of the map. The area of water body has lowest area in 2011 (45.8 sq.km). Land use land cover map of 2017 shows a significant change in area of settlement, agriculture,

forest and other features, showed in the map. The area of settlement feature is increased by 140.85 sq.km. over the last 6 years. The area of agriculture is decreased by 29.519 sq. kms over the span of 6 years. Settlement has increased from 1131.25 to 1272.1 sq. kms, a change of 140.85 sq. kms is seen in 2011 to 2017. In the Highlight change map red portion of the map showing decrease area, green portion of the map showing increase area and white portion of the map showing no change in the area. In the image difference map 4 shows there is high change in image and -4 shows there is low change in image. Error matrix showing user, producer & overall accuracy as well as overall kappa statistics in the classified imageries of the two years 2011 and 2017. Overall output is come from the map, graph and pie diagram for the year 2011 to 2017, there is decrease in forestry, open space, agriculture, and water body in between 6 years but settlements is gradually increasing the main factor behind the growth of the urban areas in the district could be development of industries and other amenities.

REFERENCES

[1] G. Sreenivasulu et al. "An Analysis on Land Use/Land Cover Using Remote Sensing and GIS – A Case Study In and Around Vempalli, Kadapa District, Andhra Pradesh, India", International Journal of Scientific and Research Publications, Volume 3, Issue 5, May 2013 1 ISSN 2250-3153.

[2] Madan Mohan, "Urban Land Cover Land Use Change Detection In National Capital Region (NCR) Delhi: A Study Of Faridabad District, India" Http://www.Fig.Net/Pub/Cairo/Papers/Ts_24/Ts24_05 _ Mohan.Pdf.

[3] K.Anitha et al. "Land use Change Detection through Image Processing and Remote Sensing Approach: A Case Study of Palladam Taluk, Tamil Nadu", International Journal of Engineering Research and Applications (IJERA) Vol. 2, Issue 4, July-August 2012, ISSN: 2248-9622

[4] James R. Anderson, Ernest E. Hardy, John T. Roach, And Richard E, A Land Use And Land Cover Classification System For Use With Remote Sensor Data, Witmer Geological Survey Professional Paper 964.

[5] Dwivedi, R.S.; Sreenivas K.; Ramana, K.V. Land-use/land-cover change analysis in part of Ethiopia using Landsat Thematic Mapper data. International Journal of Remote Sensing 2005, 26 (7), 1285-1287.

[6] Chauthan, T.S., 2003, Geographical Information system and Remote Sensing for sustainable Development, Vol, 2, Universal Scientific publishers, Jaipur.

[7] Sabins F.F., 1997, Remote Sensing Principles and Interpretation W.H. Freeman and Company, Newyork.

[8] Rajan, K.S. and Shibasaki, R., (2000). A GIS Based Integrated Land Use/Cover Change Model To Study HumanLand Interactions. In: International Archives of Photogrammetry and Remote Sensing, Vol. XXXIII Part B7 (3), pp.12121219.

[9]Atasoy, M.; Karslı, F.; Bıyık, C.; Demir, O. Determining Land Use Changes with Digital Photogrammetric Techniques. Environmental Engineering Science 2006, 23 (4), 712-721.