Spatial Analysis of Land Use Change In Takhatpur Tehsil, Bilaspur District, Chhattisgarh, India, Using Remote Sensing And Geographical Information System

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Abstract

Land use change is a major issue of global environment change. Land use land cover serves as an important source of information for both the scientific and business communities, and remote sensing is a cost effective method to gather the land use land cover information.The Present study was about the analysis of temporal changes in Takhatpur Tehsil (Bilaspur district State of Chhattisgarh) between the year 2001 and 2011. The Resource Sat -2, LISS-4 and Landsat image was used for the study. The result of the study showed the significant increase in the agriculture area, build up coverage and mining activities. The data also indicate the decline trend in Forest area, Water body, waste land and river –stream area. Through the study, it may be said that the remote sensing and GIS technique is very helpful in analyzing the land surface changes among the time span.

Keywords: GIS, Land use change, Remote Sensing.

Introduction

India is the agriculture land use, assumes a great significance for optimizing land utilization for future development. Land resources constitute the fundamental base for all human activities. In the past, increasing population coupled with economic growth has resulted in large scale land cover and land use (LCLU) changes such as deforestation, agricultural expansion, and urbanization in India (DES, 2010; Richards & Flint, 1994). Chhattisgarh is one in every of the fastest-developing states in Bharat.

The term land use is used to describe the use of an area of land of a certain time is put to. It is related to the human activity associated with a specific piece of land. Land cover refers to the material present such as natural vegetation, water bodies and rock or soil, artificial cover and other features resulting due to land transformation.

The pattern of land use is not uniform but it changes from place to place and time to time. The changes in land use are studied by conventional as well as the modern methods. It is useful to prepare integrated plans for optimal utilization of natural resources, their planning for development of the region. Agricultural and non-agricultural are the two major types of rural land use. Agricultural land use means the proportion of area used to grow different crops during the year which is the core study of Agricultural Geography.

Land use and land cover (LULC) changes, apart from changing the physical dimension of the spatial extent of the land use and land cover classes, also influence several of the secondary processes that results in the ultimate degradation of the ecosystems of the planet (Dregne and Chow, 1992).

Remote sensing technology and geographic information system (GIS) provide efficient methods for analysis of land use issues and tools for land use planning and modeling.

Land use changes are the result of the complex interaction between human and biophysical driving forces that act over a wide range of temporal land spatial scales.

The main objective of the study was to analyses the land use/land cover and temporal changes in Takhatpur Tehsil, Bilaspur district through the satellite imagery of temporal data of year 2001 and 2011 (10 years) and to identify the main forces behind the changes.

MATERIALS AND METHOD

The study area was covering a part of Chhattisgarh state of india. Chhattisgarh is situated between 17º to 23º7' degrees north latitude and 80º40' to 83 º38' east longitude. The resource sat -2 liss-4 and Landsat image which was used for present study covered the district part of Chhattisgarh state mainly Takhatpur Tehsil of Bilaspur district. Takhatpur Tehsil of Bilaspur district is located in eastern part of Chhattisgarh and fall within latitude 21º58'15.62"n to 22º18'40.44" and longitude 81º43'52.45"e to 82º8'9.11"e.

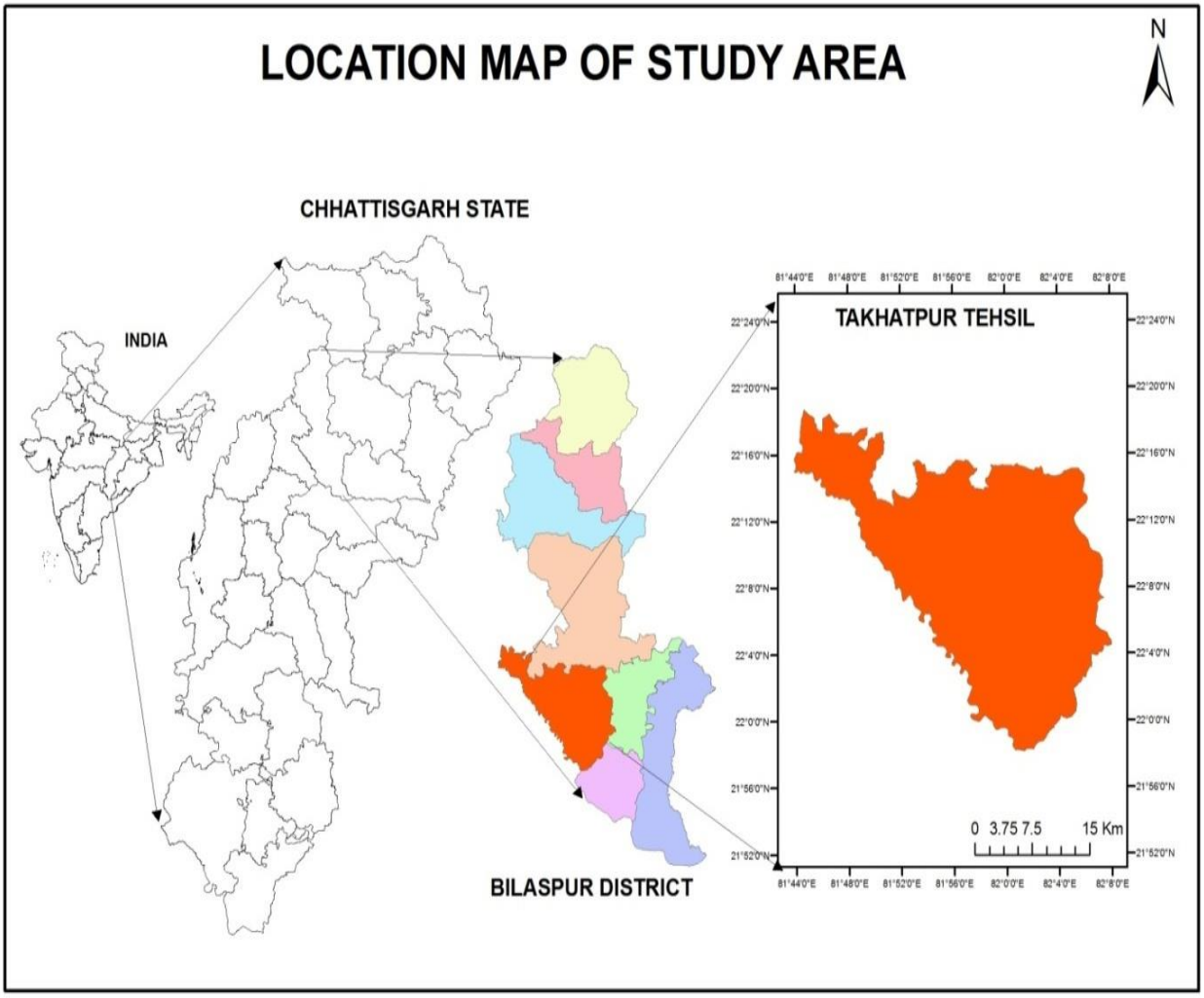


Figure: 1 Location Map of Study Area in Takhatpur Tehsil

Satellite Data- Data were used for study purpose are cense report 2001 and 201, Government of India to link with the land use map of study are. The present study is carried out moderate resolution RESOURCE SAT -2 LISS-4, satellite image (path/row: 70/23). The LISS-4 sensor mounted on Resource Sat platform acquires images using green (0.52-0.59 microns), red (0.62-0.68 microns) and near infrared (0.77-0.86 microns) bands. The ortho-rectified Land Sat data was provided by CGCOST (Chhattisgarh council of science and technology) for analysis of spatial changes.

Geo-referencing of the image

Geo-referencing process was done for the assigning of map coordinates to image and data processing.

Area of Interest (AOI)

For subseting image we have required to cut AOI of specific area (study area) from toposheet and satellite imagery After Georefereing the AOI was selected by using AOI tool and specific area was cut and saved AOI layer.

Subseting of the Satellite Image

After selection of AOI the study area from toposheet and satellite imagery were cut by subseting process. Data preparation tool was opened then went to subset image. After that input file, output file, and AOI layer was taken and click ok button. AOI of study area and subset toposheet and satellite imagery was cutted and study area map, road map, drainage map, contouring satellite imagery was made.

Digitizing

Digitization is the process by which coordinates from a map, image, or other sources of data are converted into a digital format in a GIS.

Colour Composites

After the area selected image was processed by False colour composite and true colour composite. RGB and Band matching process was occurred and image was set for classification.

Land Use Change Detection

The major objective of change detection analysis is to compare spatial representation of two points in time by controlling all variances (Green, *et al*. 1994).These issues directly affect the selection of remotely sensed data and the selection of change detection algorithms. It is helpful to list some questions, for example, the kinds of change detection contents that are required: binary change and no change information, detailed "from-to" change trajectories, or the detection of continuous change.

RESULT AND DISCUSSIONS

Result indicated the Land use changes of The Thakhatpur Tahsil of Bilaspur district during past 10 years.The various area like Agriculture land , Forest land , Water body , Waste land, River Stream,Built-up, Mining area were significantly changed during years 2001 to 2011.Table 2 presents Absolute change in study area between years 2001 to 2011.

The data of Table 2 indicate that the; absolute area changed in the year 2001 to 2011. It can see that major area increasing change in agricultural land about 53.81 sq km, followed by built up area change 10.28 sq km. while 7.93 sq km area of water bodies, 1.74 sq km area of mining / industrial area and 0.27 sq km area is change in river/stream. The data also reveals that waste land is decreased about 72.48 sq km and 1.56 sq km area decreased of forest land.

Table 2 : **Absolute Change in Study Area between years 2001 to 2011**

Land Use/Land Cover Classification	AREA 2001 (sq. km)	Percentage	AREA 2011 (sq. km)	Percentage	Change in Area between 2001 - 2011 (sq. km)
Agriculture Land	519.18	72.00	573.00	79.46	53.81
Built Up	28.43	3.94	38.71	5.37	10.28
Forest	6.10	0.85	4.54	0.63	-1.56
Mining/Industrial	0.00	0.00	1.74	0.24	1.74
River/Stream	5.85	0.81	6.12	0.85	0.27
Waste Land	149.07	20.67	76.59	10.62	-72.48
Water Body	12.49	1.73	20.41	2.83	7.93
Total Area sq. km	**721.12**	**100.00**	**721.12**	**100.00**	**0.00**

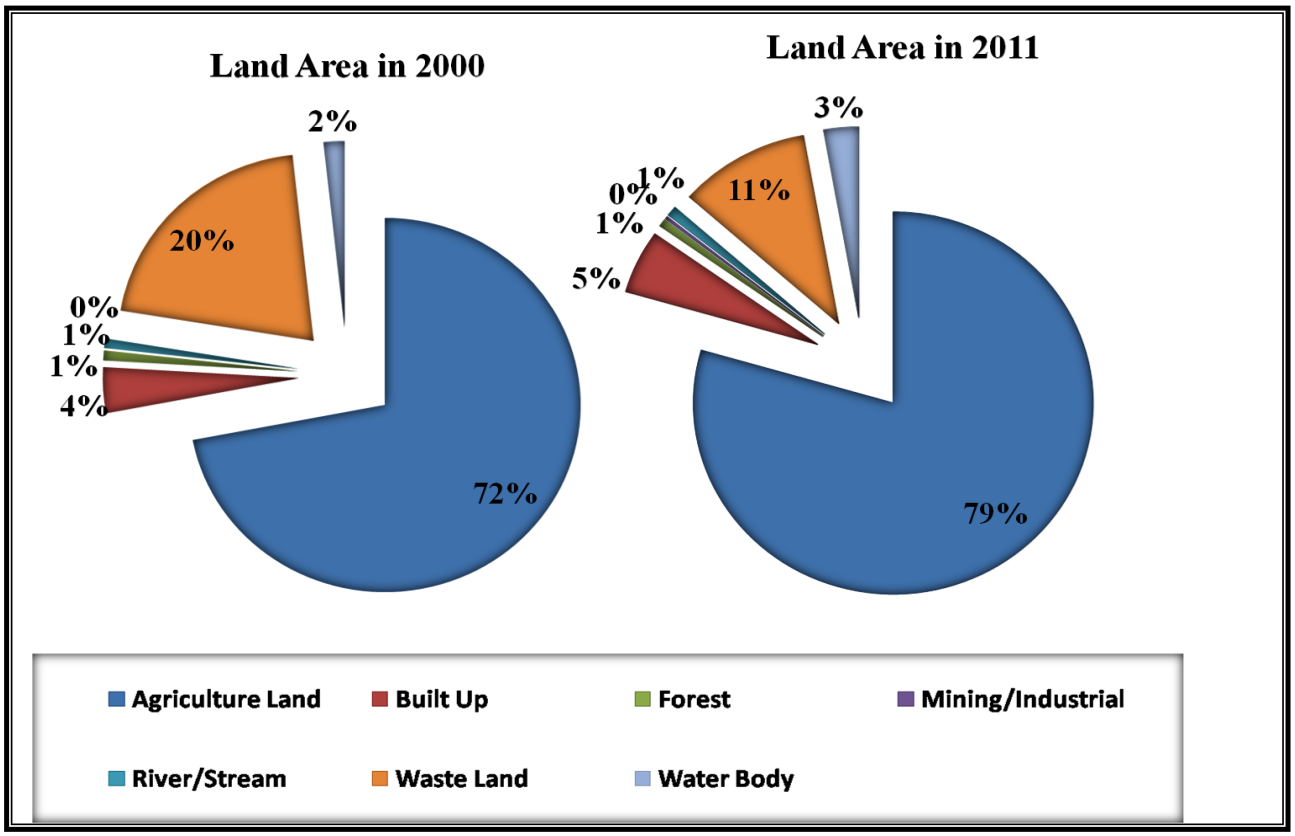
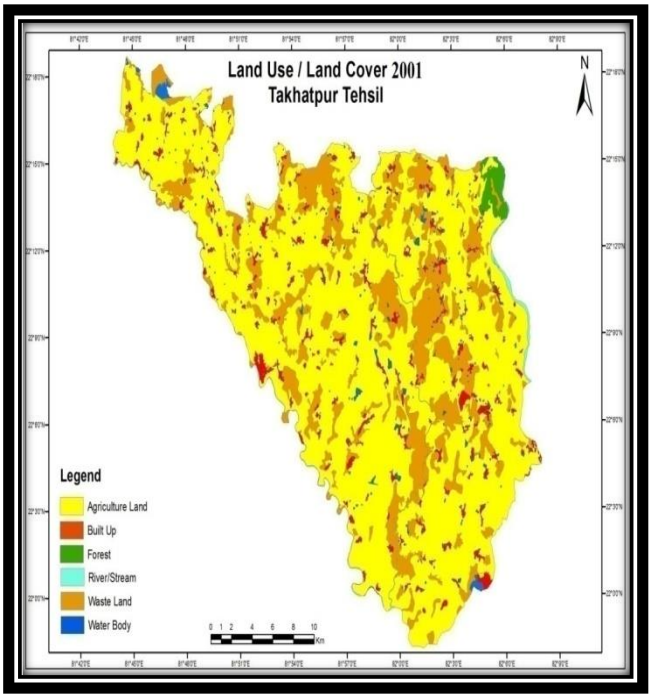


Figure 2: Major Change in Land Use of Study Area during 2001 & 2011



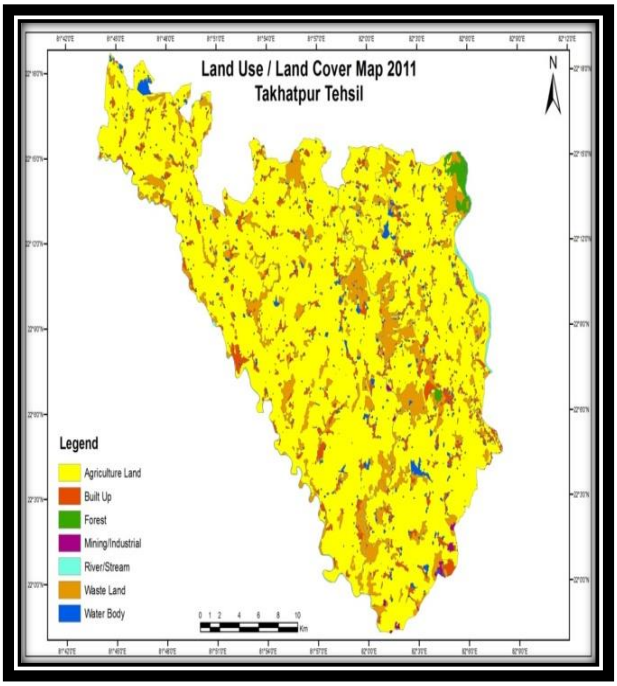


Fig. 2.1 Land use/ Land Cover Map Of 2001. **Fig. 2.2 Land use/ Land Cover Map Of 2011.**

Land use Change detection during 2001-2011

To measure the change from one class to another class, the form to change method is used. This method provides us the category wise changes from different time data. Both of 2001 and 2011 data are overlapped and measure the changes from one class to another class.

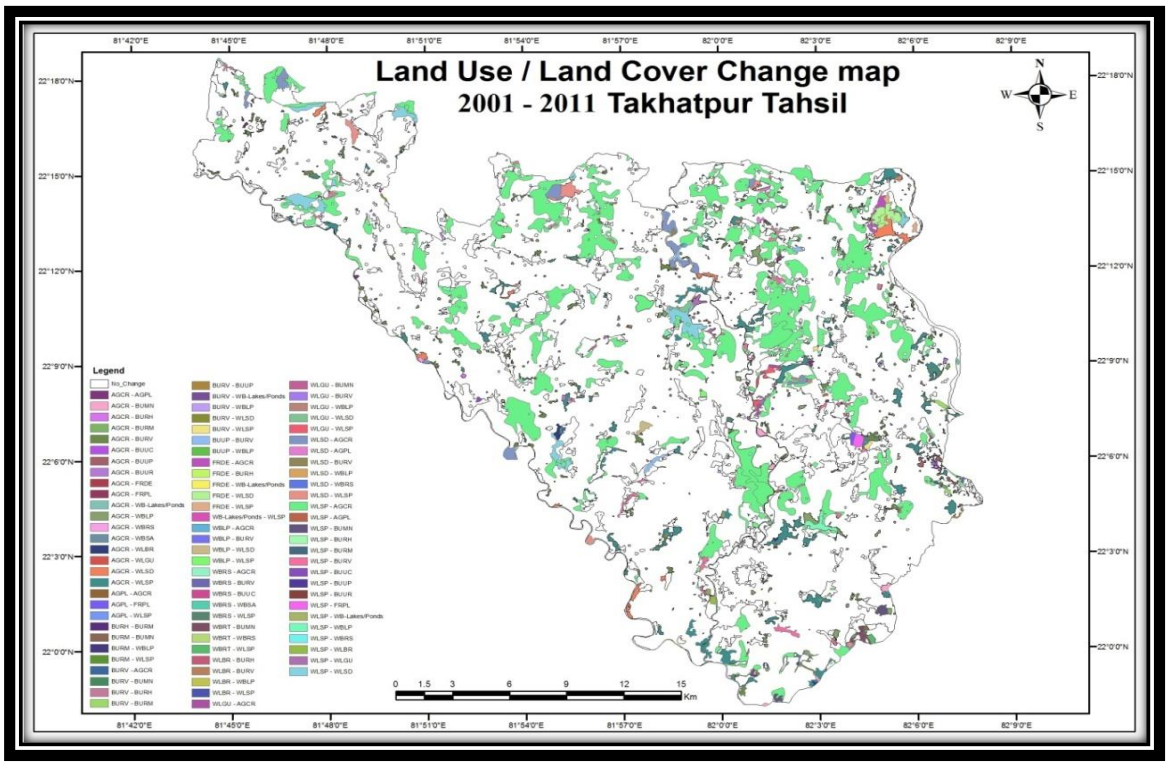


Figure: 2.3 Land Use /Land Cover Change Map of Study Area Between 2001 to 2011.

Table 3 : **Change in Agriculture Area**

Sub - Categories	Area(Sq.km)	Area in Percent
AGCR - WLSP	12.23	41.89
AGCR - BURV	6.13	20.98
AGCR - WBLP	5.00	17.10
AGCR - WLSD	2.16	7.38
AGCR - BUMN	0.64	2.17
AGCR - BURH	0.63	2.15
AGCR - WB-Lakes/Ponds	0.55	1.89
Other		
AGCR - BURM	0.24	0.83
AGPL - AGCR	0.01	0.04
AGPL - FRPL	0.14	0.47
AGPL - WLSP	0.01	0.04
AGCR - WBRS	0.19	0.64
AGCR - WBSA	0.02	0.07
AGCR - WLBR	0.29	0.99
AGCR - BUUC	0.14	0.49
AGCR - BUUP	0.43	1.46
AGCR - BUUR	0.08	0.27
AGCR - FRDE	0.03	0.09
AGCR - FRPL	0.01	0.04
AGCR - AGPL	0.29	1.00
AGCR - BURM	0.24	0.83

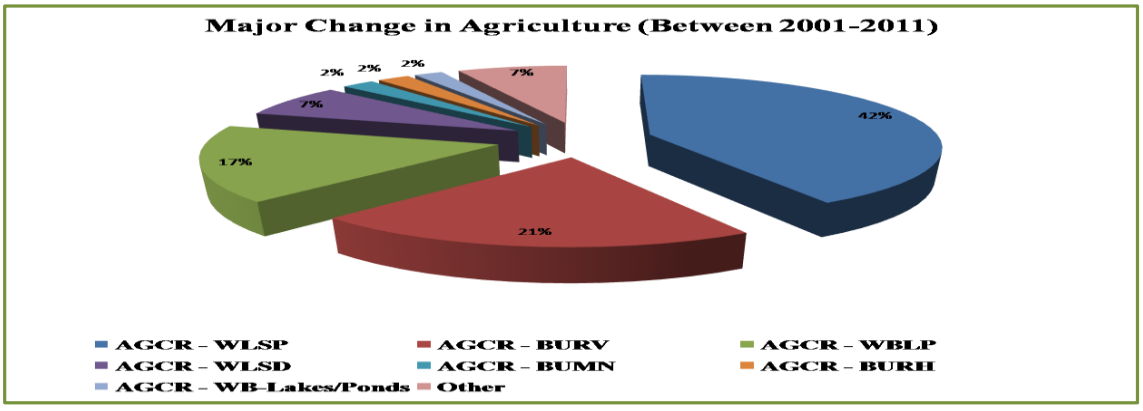


Figure 3 Major Changes in Agriculture Land of study area during 2001 to 2011

The data indicate in the table 3 and a figure 3 that the 41.89 per cent Agriculture land changed to WL-Scrub – Land – Open, 20.98 per cent Agriculture Land is changed into BU – Village, 17.10 per cent Agriculture land changed to Water Bodies, 2.17 per cent Agriculture land changed to Mining/ industrial area, 2.15 per cent Agriculture land changed to Hamlets house hold and 1.89 per cent Agriculture land changed to Water Bodies.

The data also reveals that the Agriculture land is changed to different purpose i.e. Agriculture – Crop Land_Water Body Sandy Area(0.07 percent), Agriculture – Crop Land_WL_Barren Rocky (0.99 percent), Agriculture – Crop Land_BU-Core Urban (0.49 percent), Agriculture – Crop Land_BU-Peri Urban(1.46 percent), Agriculture – Crop Land_Dence Forest (0.09 percent), Agriculture – Crop Land_Agriculture – Plantation(1.00 percent),Agriculture – Crop Land_BU- Mixed Settlement (0.83 percent), Agriculture – Plantation Agriculture – Crop Land(0.47 percent), Agriculture – Plantation_WL-Scrb Land Open(0.04 percent).

Table 4 : Change in Built - Up Area

Sub-Category	Area	Area in %
BUUP – BURV	0.52	28.95
BURV – BURM	0.29	16.4
BURV - WBLP	0.27	15.13
BURV – AGCR	0.21	11.52
BURV – WLSP	0.18	9.96
Other		
BURH – BURM	0.02	1.39
BURM - BUMN	0.04	2.36
BURM - WBLP	0	0.1
BURM - WLSP	0.03	1.85
BURV - BUMN	0	0.2
BURV – BURH	0.08	4.53
BURV – BUUP	0.08	4.45
BURV - WBLP	0	0.27
BURV - WLSD	0.04	2.49
BUUP – WBLP	0.01	0.41

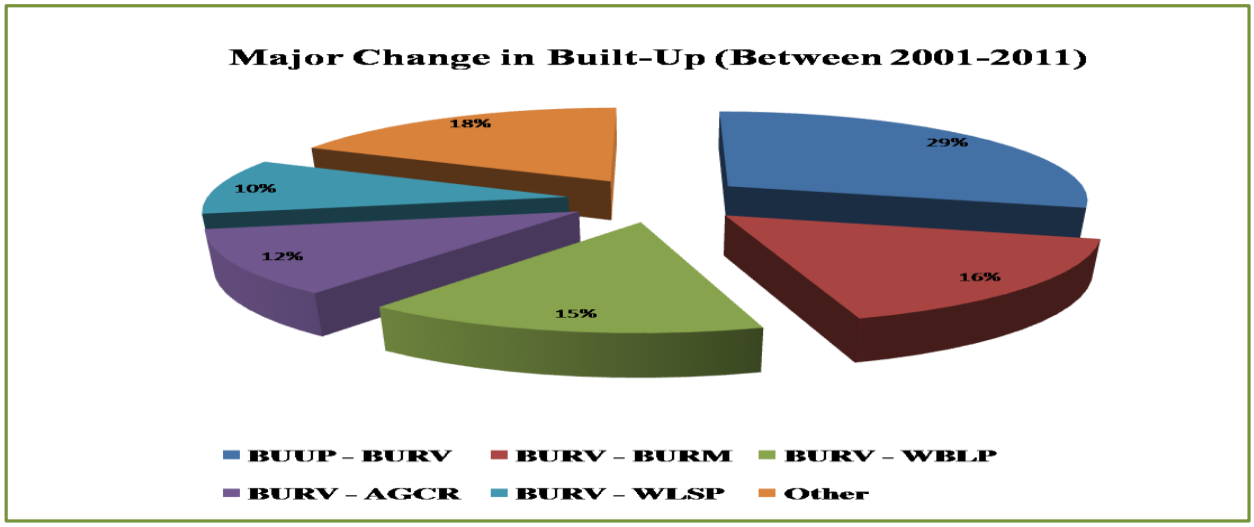


Figure: 4 Major Changes in Built – Up of study area during 2001-2011

The data indicate in the table 4 and a figure 4 that the 28.95 per cent Built Up – Peri Urban change to Built Up – Village area, 16.40 per cent Built Up - Village change to Built Up - Mixed Settlement, 11.52 per cent Built Up – Village change to Agriculture – Crop Land and 9.96 per cent Built Up – Village change to Waste Land Open scrub land. The data also reveals that the Built-Up is changed into different purpose i.e. BU- Hamlets and dispersed Household_BU-Mixed Settlements (1.39 percent), BU-Mixed Settlement_BU- Mining/Industrial (2.36 percent), BU-Mixed Settlement_WB-Pond/Lake (0.10 percent), BU-Mixed Settlement_WL-Scrub-Land-Open (1.85 percent), BU-Village_BU-Mining/Industrial(0.20 percent), BU-village_ BU -Hamlets and Dispersed Household (4.53 percent), BU-Village_BU-Peri Urban (4.45 percent), BU-Village_WL-Scrub-Land_Dense (2.49 percent), BU-Peri Urban_WB-Lake Pond (0.41 percent).

Table 5 : Change in Forest

Sub - Category	Area	Area in %
FRDE - WLSD	1.22	58.84
FRDE - AGCR	0.54	25.83
FRDE - WLSP	0.26	12.58
Other		
FRDE - WB-Lakes/Ponds	0.05	2.36
FRDE - BURH	0.01	0.39

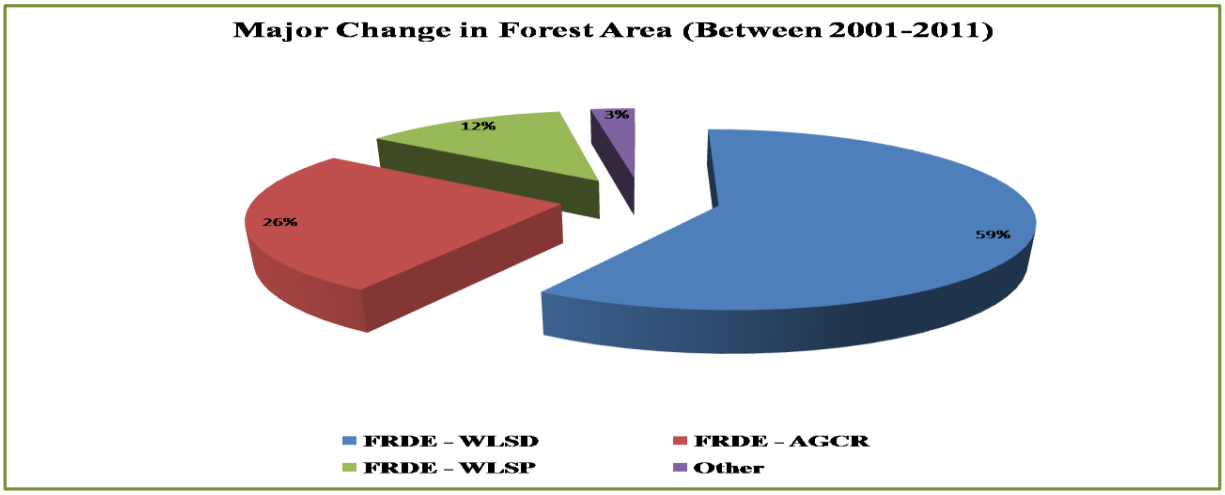


Figure 5 Major Change in Forest Land of study area during 2001-2011

The data indicate in the table 5 and figure 5 that the 58.84 per cent Forest area change in Waste Land, 25.83 per cent Forest area change in Agricultral Crop Land and 12.58 per cent Forest area change in Waste Lnad Open Scrb. The data also reveals that the Forest is changed into different purpose i.e Forest_WB-Lake/Pond (2.36 percent) and Forest_BU-Hamets and Dispersed Household (0.39 percent).

Table 6 : Change in Water Body

Sub Category	Area (sq km)	Area in %
WBRT - BUMN	0.40	30.58
WBLP - WLSD	0.29	22.36
WBRT - WLSP	0.20	15.74
WBLP - WLSP	0.12	9.26
WBLP - AGCR	0.10	7.82
Other		
WBRT - WBRS	0.08	5.96
WBRS - AGCR	0.05	4.10
WBRS - WBSA	0.03	2.58
WBRS - WLSP	0.00	0.17
WBLP - WLSP	0.00	0.35
WBLP - BURV	0.01	0.93
WBRS - BURV	0.00	0.03

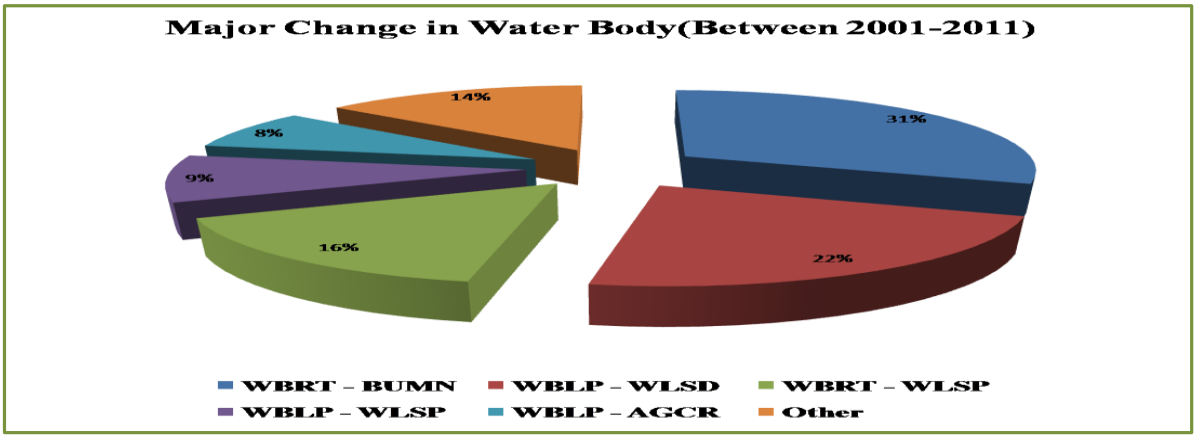


Figure 6: Major Change in Water Body of study area during 2001-2011.

The data indicate in the table 6 and figure 6 that the 2001 to 2011 in major change are 30.58 per cent WB – Lakes–Ponds area BU - Mining/Industrial, 22.36 per cent WB–Lakes/Pond is changed to WL-Scrub-Land Dance. 15.74 per cent WB – Reservoir/Tanks is changed to WL_Scrub Land Open, 9.26 per cent WB – Lakes/Ponds is changed to WL_Scrub Land Open and 7.82 per cent WB–Lakes/Ponds is changed to Agriculture Crop Land. The data also reveals that the water body is changed into different purposes i.e. WB – Reservoir/Tanks_WB- River/Stream (5.96 percent), WB- River/Stream_Agriculture Crop Land (4.10 percent), WB- River/Stream_WB- Sandy Ares (2.58 percent), WB- River/Stream_WL-Scrub-Land Open (0.17 percent), WB- River/Stream_BU-Village (0.03 percent), WB-Lake/Pond_BU-Village (0.93 percent)

Table 7 : **Change in Waste Land**

Sub - Categories	Area(Sq.km)	Area in %
WLSP - AGCR	77.87	80.42
WLSP - WLGU	0.33	0.34
WLSP - WLSD	4.52	4.66
WLSP - WBLP	2.89	2.98
WLSP - FRPL	0.35	0.36
WLSP - BURV	2.87	2.96
WLSP - BUMN	0.65	0.67
WLSD - WLSP	1.53	1.58
WLGU - WLSP	0.43	0.44
WLSD - AGCR	3.37	3.48
WLGU - AGCR	0.33	0.34
Other		
WLBR - BURH	0.01	0.01

WLBR - BURV	0.02	0.02
WLBR - WBLP	0.02	0.02
WLBR - WLSP	0.03	0.04
WLGU - BUMN	0.01	0.01
WLGU - BURV	0.05	0.05
WLGU - WBLP	0.19	0.20
WLGU - WLSD	0.25	0.26
WLSD - AGPL	0.14	0.14
WLSD - BURV	0.11	0.12
WLSD - WBLP	0.06	0.06
WLSD - WBRS	0.02	0.02
WLSP - AGPL	0.11	0.12
WLSP - BURH	0.19	0.20
WLSP - BURM	0.03	0.03
WLSP - BUUC	0.11	0.11
WLSP - BUUP	0.01	0.01
WLSP - WBLP	0.09	0.09
WLSP - WBRS	0.02	0.03
WLSP - WLBR	0.20	0.21

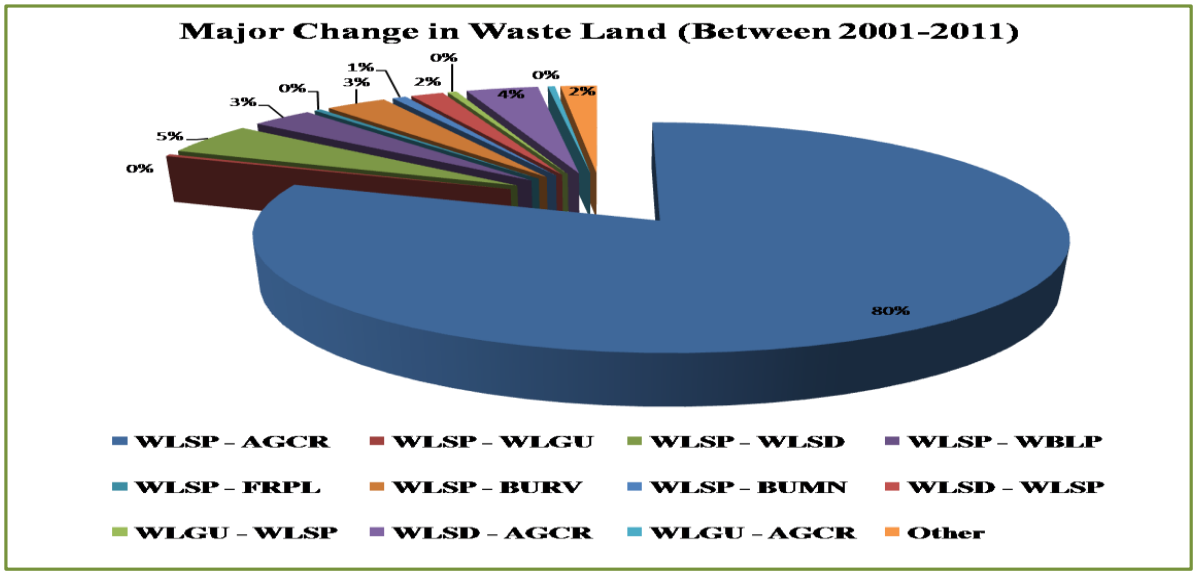


Figure 7: Major Changes in Waste Land of Study Area During 2001- 2011.

The data indicate in the table 7 and figure 7 that the 2001 to 2011 in major changes are 80.42 per cent WL–Scrub–Land–Open changed to Agriculture Crop Land, 4.66 per cent WL– Scrub-Land–Open changed to

WL–Scrub–Land–Dense, 3.48 per cent WL–Scrub–Land–Dense changed to Agriculture Crop Land, 2.98 per cent WL– Scrub-Land–Open changed to WB-Pond/Lake, 2.96 per cent WL– Scrub-Land–Dense changed to BU-Village, 1.58 per cent WL– Scrub-Land–Dense changed to WL– Scrub-Land–Open, 0.67 per cent WL–Scrub-Land–Open changed to BU-Mining/Industrial, 0.44 per cent WL-Gullies/Ravines changed to WL-Scrub-Land–Open, 0.34 per cent WL-Gullies/Ravines changed to Agricultural Crop Land, 0.36 per cent WL-Scrub-Land–Dense changed to Forest Plantation, 0.34 per cent WL-Scrub-Land–Open changed to WL-Gullies/Ravines.

The data also reveals that the Waste Land is changed into different purposes i.e. WL-Barren Rocky_BU-Hamlets and Dispersed Household (0.01 per cent), WL-Barren Rocky_ BU-Village(0.02 per cent), WL-Barren/Rocky_WB-Lake Pond (0.02 per cent), WL- Barren Rocky_WL- Scrub-Land–Open (0.04 per cent), WL-Gullies/Ravines_BU-Mining/Industrial (0.01 per cent), WL-Gullies/Ravines_BU-Village (0.05 per cent), WL-Gullies/Ravines_WB-Lake/Pond (0.20 per cent), WL-Gullies/Ravines_WL-Scrub-Land–Dense (0.26 per cent), WL-Scrub-Land–Open_Agricultral Plantation (0.14 per cent), WL-Scrub-Land–Dense_BU-Village(0.12 per cent), WL-Scrub-Land–Dense_WB-Lake/Pond (0.06 per cent), WL-Scrub-Land–Dense_WB-River/Stream (0.02 per cent), WL- Scrub-Land–Open_Agriculture Plantation (0.12 per cent), WL- Scrub-Land–Open_BU-Hamlets and Dispersed Household (0.20 per cent), WL-Scrub-Land–Open_BU-Mixed Settlement (0.03 per cent), WL- BU-Core Urban (0.11 per cent), WL- Scrub-Land–Open_ BU-Peri Urban (0.01 per cent), WL-Scrub-Land–Open_WB-Lake/Pond (0.09 per cent), WL - Scrub-Land–Open_WB-River/Stream (0.03 per cent), WL- Scrub-Land–Open_WL-Barren rocky (0.21 per cent).

Conclusion-

In the present scenario Land Use/Land Cover change has become central component in developing the strategy for managing natural resources and monitoring environment changes. During last two decade, LULC changes as one of the main driving forces for sustainable development. Remote Sensing and GIS help monitoring and developing. The strategy for better utilization of land or sustainable development. In changing electronic era old technique like surveying, mapping, countering are done thought the digital imaging and innovative software .the present study show the Spatial Analysis of Land Use Change in Takhatpur Tehsil. The notion of the present study shows the urgent need for development of suitable strategies for natural resources conservation. It also needed that the governments give the emphasis of better utilization of land and conserve water through the help of innovative technique.

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