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LAND USE AND LAND COVER (LULC) SURVEY THROUGH REMOTELY SENSED DATA FOR THE ANALYSIS AND MANAGEMENT OF NATURAL RESOURCES IN GAYA DISTRICT (BIHAR), INDIA.

Geography

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ABSTRACT

Land use change is an inevitable process. Earlier ages, land use was very limited but the development with the time, the land use has expanded. Remotely sensed data and GIS techniques has given a wide scope to explore these changes over the time. The study focuses on to investigate the changes over time that have been taken place during the period of 1994 to 2019 for suggestive measures for sustainable development, planning and management. The study was done through Remotely sensing data and GIS technique. Supervised classification are developed to classify LULC. LISS III (Nov 1994, 2018 & March 1995, 2019) images are used for the analysis for change detection. Changes have been authenticating through the deep calculation and analysis of all the available images using supervised classification in Arc GIS software. Changes have been calculated on the basis of increase and decrease of area under particular LULC class on a given period of time. Eight main class are focused under investigation for change detection. They involve barren land, fellow land, forest, agricultural land, sand bar, built-up land, water bodies and river. Cropland and buildup area are the main feature of change detection during all the selected year. Study shows that build up area increase tremendously. But cropland and forest area decrease rapidly. Result shows that due to increase in population and desire of more development result turning of villages into town and urban into metropolitan with full of concreate forest. Surface water also decrease due to climate change resultant of LULC. Here cropland has change from 31.31% to 29.32%, barren lang change from 6.42% to 7.22%, build-up area change from 6.26% to 12.49%, forest change from 18.60% to 12.46%, water bodies change from 11.75% to 8.64%, fellow land change form 20.68% to 14.48% and sand bars change from 4.98% to 15.39%.

KEYWORDS

Change Detection, Remote Sensing, GIS, Supervised Classification.

INTRODUCTION

Generating valuable information of concerned area is now very much facilitated by the ability of satellite-based data (Hathout, 2002, Herold et al., 2003, Lambin et al., 2003, Yuan et al., 2005, Saadat et al., 2011)). Study of LULC becomes even more important on modern times because various effects of needs and demands of increasing population on natural resources have to be seen. The best technology to study the different LULC parameters, is the remote sensing and GIS. As these techniques are time-saving and at the same time they provide real time accurate data. Also it reduces the chances of error. LULC changes on the surface of the earth are generally divided into land use and land cover which are two concepts (Barnsley et al., 2001) and are often used interchangeably (Dimyati et al., 1996). Study of LULC is very important for planning and management of the concerned area. LULC is totally influence by the local condition, altitude, height, slope, structure, so with the study of two different time period satellite data is accurate and easy way to analyse LULC by comparing different time set data. Population growth, industrialization and urbanization have rapidly changed the LULC (Voogt and Oke, 2003). Changes in the LULC has a huge impact on the local environment, ecological balances, and sustainability. LULC as one of the environmental factor is important for sustainable development and management of natural ecosystem. Changes in LULC is however responsible for rising temperature, heat wave, decrease in the rainfall in Gaya district. Land use and Land cover is a result of socio-economic factors, natural factors and their utilization by human being (Amritpal Digra and Arun Kaushal et al.,2021). For the present study, Landsat Thematic Mapper (TM) 4-5 C1 level-1 satellite images is used. DEM data of Cartosat-1 of 2.5 m resolution and LISS III multi spectral sensor of 23.5m spatial resolution data is also used in the analysis. The study area is largely depended on agriculture for their lively hood. But recent trends show decrease in agricultural land for building construction.

2. MATERIALS AD METHODS

2.1 Study Area:

The present study was conducted in the Gaya district which lies in between 24°30´N to 25° 06´N and 84° 24´E to 85° 30´E (Fig. 1). The district is divided into 4 sub-divisions, i.e., Tekari, Gaya Sadar, Neem Chak Bathani and Sherghati. The Gaya district has also 24 administrative blocks namely Konch, Tikari, Belaganj, Khizasarai, Neem Chak Bathani, Muhra, Atri, manpur, Gaya, paraiya, Guraru, Amas, Banke Bazaar, Imamganj, Dumaria, Sherghati, Dobhi, Bodh Gaya, Tan Kuppa, Wazirganj, fatehpur, Mohanpur, Barachtti (CPCB). Gaya district is the part of south Bihar plain. It is divided into 3 sub-micro regions, viz., Phalgu Plain, Sherghati, Fatehpur Uplands and Rajgir Hills on the basis of geographical factors like relief, drainage, geology, soil and natural vegetation. The drainage network in the district is represented by four parallel streams, the Morhar, the Phalgu, the Paimar and the Dhadhar all emanating from the southern plateau and flowing north and north-easterly. The Phalgu river flows from south of Gaya to North. River Phalgu is the compilation of two river Lilajan and Mohana originated from Hazaribagh Plateau and flows as tiny rivulets meandering through wide sandy beds mainly in Gaya with very little water.
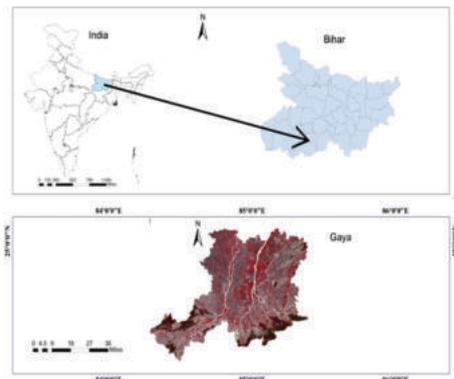

Fig. 1. Location Map of Gaya District.

2.2. Data Used:

The satellite images of Landsat Thematic Mapper (TM) 4-5 the year 1994, 1995, 2018, 2019 is used for the production and analysis of different parameters of LULC. Related various different topographical maps collected from the official website of Survey of India (https://surveyofindia.gov.in/). Satellite imagery of Landsat 4-5 TM C2 L2 from USGS and Resources at LISS III and DEM data of Cartosat-1 of 2.5 m resolution from Bhuvan portal is taken for the purpose. LISS III MSS images have 23.5m spatial resolution and Land set 4-5 TM C2 L2 consist seven spectral band having 30 m resolution. The image data were freely accessed from the Landsat archive of the United States Geological Survey (USGS) website (https://glovis.usgs. gov/) (https://earthexplorer.usgs.gov/). Landsat images were spatially projected to WGS_1984_UTM_Zone 44N.

Table 1. Description of the Satellite Images used in the Study.

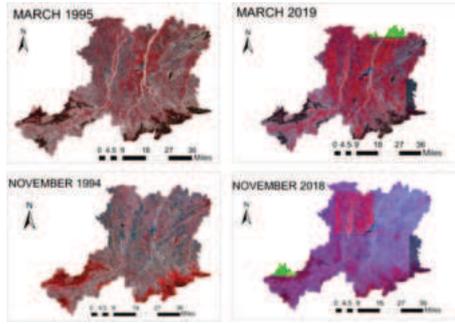| Satellite	Sensor	Bands used	Spatial Resolution
Landsat 5	Thematic mapper	Visible (B1, B2, B3, B4, B5, B6, B7)	30 m
DEM		B1	29 m

Fig.2. FCC Landsat LISS III Images.

2.3 Methodology:
This study mainly focusses on interpreting the changes taken place in the selected parameters of LULC, i.e., barren land, fellow land, forest, agricultural land, sand bar, built-up land, water bodies and river. All the satellite images were geo-referenced and a subset of Gaya district was extracted. A FCC image was generated for the analysis and interpretation. ArcGIS 10.1 and ERDAS imagine software were employed in the analysis. Using training data set for different classes of LULC each satellite image is classified to find the changes by compared according to the pixel-by-pixel approach by using a change detection matrix using supervise classification in Arc GIS. Google Earth, officials map and other secondary datasets were also utilized for reference and better understanding of land use distribution.

Data Collection Included The
1) Ground reference data obtained from field surveys including pre-field and post field survey.
2) Toposheet No.
a. G45M12_72C12   b. G45M16_72C16   c. G45N4_72G4
d. G45N8_72G8   e. G45S6_72D6   f. G45S7_72D7
g. G45S9_72D9   h. G45S10_72D10   I. G45S11_72D11
j. G45S13_72D13   k. G45S14_72D14   l. G45S15_72D15
m. G45T1_72H1   n. G45T2_72H2   o. G45T3_72H3
p. G45T5_72H5   q. G45T6_72H6   r. G45T7_72H7
3) Google Earth data. Land set 4-5 TM C2 L2 Satellite imagery downloaded from USGS site. DEM data is used to extract the slope. The Landsat data which is downloaded through USGS was already georeferenced to its longitudes and latitudes and projected to the Geographic (Lat/Lon) WGS 1984 datum. Finally, the study area was clipped from the georeferenced imagery with the use of Arc GIS.

2.4 Land Use Classification Scheme
Seven major classes are selected and classified for LULC mapping. Each class is derived according to texture, tone, and colour according to the analysis of each pixel of the image (Radhakrishnan et al., 2014). The seven classes are build up land, barren land, forest, crop land, river, fellow land and sand bars (Table. 2).

Table 2. Description of Different LULC Categories.

LU/LC Class	Description
Agricultural land	Cultivated area
Fallow land	Agricultural fellow land for some time mainly seasonal.
Barren land	Areas devoid of vegetation; e.g., sediments, exposed rocks, landslide zones, degraded forest area
Built-up	Land covered by settlements, roads & Canal
Forest	Land having forest cover, Shrubs, area under Agroforestry and land with tree canopy density
Water-bodies	Areas covered by river & pond.
Sand Bars	Area having lots of sand mainly river bed.

2.5 Data Processing in Arc GIS
On the Basic of LULC classes, training samples were collected using defined polygons upon the various locations of different land use classes overs to be mapped. The collected training samples were grouped depending on the land cover more than 20 training sample were collected for each class. The signature file was then created as a training set for supervise classification. The accuracy of classified maps was assessed by comparing the created land use maps for the given with the referenced satellite imagery and public land use maps

and other sources. For batter accuracy, the output classification results were manually inspected many times before being updated by introducing new training sets.

3. RESULT AND DISCUSSION
3.1 LULC Change Detection and Analysis
A comparison in a pixel-based technique of two different season Rabi and Kharif was apply to generate changes on pixel basis which is more efficient way to the analyse change of all the categories. Landsat images of 1994, 1995, 2018, 2019 are taken. False Colour Composite image is generated with the band combinations of 4, 3, and 2 are used to identifying training areas for classification.

Data of Land Used Land Cover Gaya District (Bihar)							
LULC	Agricultural Land	Barren Land	Built-up	Forest	Water Bodies	Fellow Land	Sand Bars
1994	31.31 %	6.42 %	6.26%	18.60%	11.75 %	20.68 %	4.98%
1995	31.455%	6.864 %	6.927%	12.577 %	14.324 %	12.331 %	15.521 %
2018	26.684%	3.291 %	12.241 %	24.934 %	7.495 %	11.691 %	13.664 %
2019	29.32%	7.22%	12.49%	12.46%	8.64%	14.48 %	15.39 %
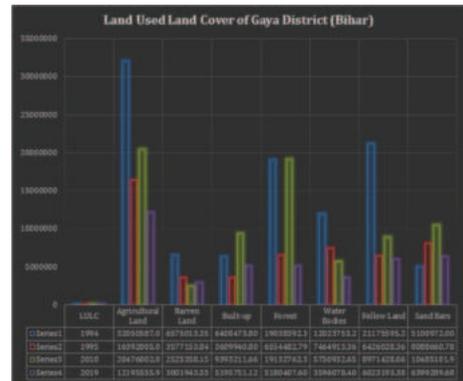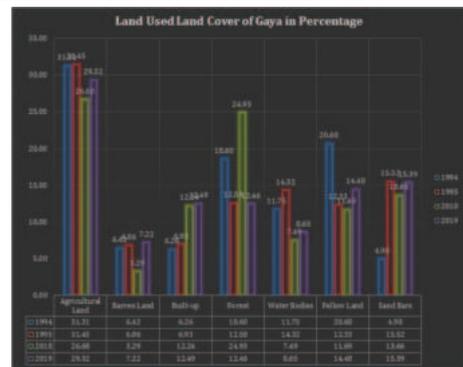
In 1994, under selected categories of LULC, the agriculture land was 31.31%, but in 2019, the area under agriculture has decreased due to expansion and degradation of land. Area under barren land is showing increases trend. As slowly it has risen from 6.42% to 7.22 %. Buildup land has a tremendous change from 6.26% to 12.49%. Area under barren land has also a great concern. Its effect is highly notice on agriculture. In 1994 area under barren land was 6.42% but its area increased about 7.21% in 2019. The main reason of converting agricultural land into barren land is excess use of irrigation water by farmers. Imbalance use of chemical fertilizers and absence crop rotation technique. Area under forest has also decreased due to cutting of forest. It has decreased from 18.60% to 12.46%. Ponds and other water bodies are also depleting due to lack of proper care. It has decreased from 5.25% to 2.39%.

Fallow is the term indicating to a land which has been ploughed and tilled but left fellow without seeding during growing season. It is a type of crop rotation and beneficial for land. But in Gaya district the farmers has adopted multiple cropping pattern, due to which the fertility of the land is deteriorating, we can understand it from the above data in which

for the year 1994, it is 20.68% of the total land, but it has now reached to 14.48% only in 2019.
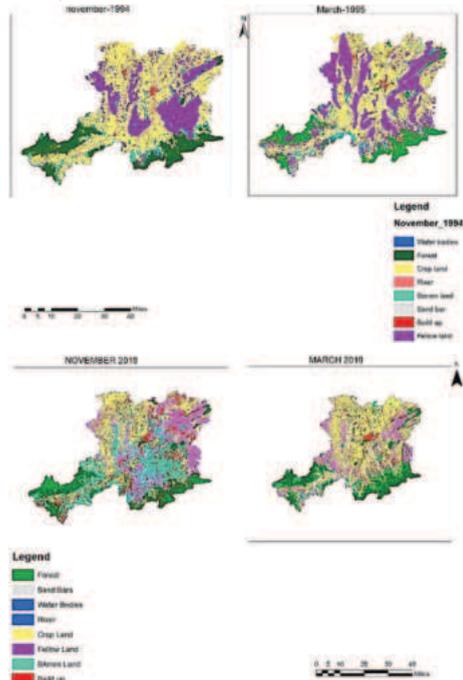
The finding of this research indicated that changes in LULC is directly linked with growing population and demand of natural resources foe livelihood. More than half of the area that was covered with cultivated and settlement. Remaining are still in the process of changing. Study have shown that agricultural land and forest is the most at high risk in term of conversion. Different land uses compete with one another, which cause degradation and reduce the quality of natural resource and its land productivity. The main causes of LULC change in the study area are population pressure, constructional woks, industrial development, road construction, and etc , resulting expansion of settlement land. On the other hand, change in LULC have long term impact on hydrological processes, runoff and infiltration, which has directly or indirectly impact on the ecosystem, biodiversity and land productivity large variation of temperature in Gaya district.

Hence, sustainable land use planning and management is necessary which firstly implement from local level, individual supervision, restore of barren land and depleted waterbodies, reforestation, chackbandi of agricultural land.

4. CONCLUSION:

With the help of above table, we can easily understand that Barren land and build up area dominate other LULC like Forest, water bodies, River. This study indicates that LULC of Gaya is changing predominantly, especially buildup area capturing other LULC, which lead expansion of Gaya city and it might be converted from agricultural or natural lands to urban use in a recent year. Forest area at risk of deforestation, which need effective plan to conserve it. Agricultural planning is must on the basis of future agricultural land use based on population growth and food demand predictions. By using LULC analysis, planners and policy makers can make wise decisions to manage land resources sustainably, mitigate environmental impacts, and plan for future development needs.

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