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Remote Sensing Based Temporal Changes Analysis Due to Mining Activities in Joda Block, Keonjhar District, Odisha State, India

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Abstract: Mining creates several impacts on social, environmental and economic which can be analysed spatially using remote sensing (RS) and geographical information systems (GIS). This paper provides an overview of this studies using these techniques to assess mining impacts on environment, land, and society. In recent years, remote sensing technology has emerged as a powerful tool for mapping and monitoring the environmental conditions. Satellite imagery has become an intelligent and quick tool for temporal detection of features. This paper deals with a case study of mining area of joda block, state of Odisha, India. The temporal changes from the year 2008 to 2018 have been brought out on the feature classes identified as built up land, crop land, forest land, scrub land, water body and mining activity area. This study involves the analysis of spectral characteristics of the land cover changes over one decade in joda area. Remote sensing based technology helps in identifying the classes changes from the year 2008 to 2018. In this present study efforts have been made to evaluate change detection in land cover features using temporal and multi resolution satellite images. Continuous mining activities have severe impact on environment and health of the native peoples.

***Index Terms* – GIS, Remote sensing, Landsat, Mining, Land use change, Temporal changes**

I. INTRODUCTION

Mining is an activity to fulfill current desire and to overwhelm the future. Mega factories, industry oriented developments and their vast requirements forced to mining activity in a large manner. Mining is one of few industries that change entire landscapes, making it the source of a variety of impacts (Bebbington et al., 2008; Mudd, 2010). These impacts are geographical in nature, as mines are unevenly distributed around the world and disproportionately affect the communities or ecosystems nearest to them (Sonter et al., 2014). The impact of mining on environment and human are similar dangerous for their sustenance. These impacts looks like large cut pits, processing infrastructures, quarries, waste dump sites, water storage unusual ponds and unmannered landscape. These prime reasons make a hot topic for researchers and scholars to evaluate mining activity. Aerial imagery and remote sensing data are used to capture ongoing changes in landscape structure (Mishra, P.K et al 2020). Environmental monitoring using remote sensing is becoming an increasingly important tool in the study of various aspects of ecosystems at local, regional, and global scales (Latifovic, R et al). Remote sensing refers to the use of aerial or satellite imagery to study features on Earth's surface, and GIS is essentially a computer-based system by which geographical data are managed, analysed and manipulated, usually to produce visualizations. The purpose of this paper is to show the significance changes of the land use and land cover in a decade by using remote sensing and GIS techniques.

Joda mining circle is endowed with vast resources of variety of minerals and placed as a mineral rich area in the country. It reserves of high grade iron ore, manganese ore, quartz and quartzite etc., which is the main reasons creates opportunities for locating mineral based industries for manufacture of steel, Ferro-alloys etc. Such availability of resources increasing the attraction of the industrialist and mining occupational people and representing as a store house of minerals in the state of Odisha. The impacts of mining industry have been an object of wide research. Using RS imagery, research studies were conducted in mining locations to understand the effect of mining on vegetation changes and ground water disturbances (LU Xia et al). In this study the objective sets to identify the temporal changes due to mining involvement and its impact on land use and land cover changes in Joda area in between the period of the year 2008 to 2018.

II. STUDY AREA

Joda is situated at Keonjhar district in the state of Odisha, India. The area is rich of iron and manganese ore deposits and the economy centers on the large-scale production of iron ore and manganese ore. The year-round river named Sona River passes through Joda city. As of the 2011 Indian census the population of Joda has been enumerated to be 46,631. The Joda is escalating over Keonjhar district of Odisha around 41Sq. km. The geographical position of this division is Longitudes 85°13'37.12"E and 85°33'20.40"E and Latitudes 22° 9'48.24"N 21°47'48.46"N and located at an elevation of 428 to 718 meters above sea level.

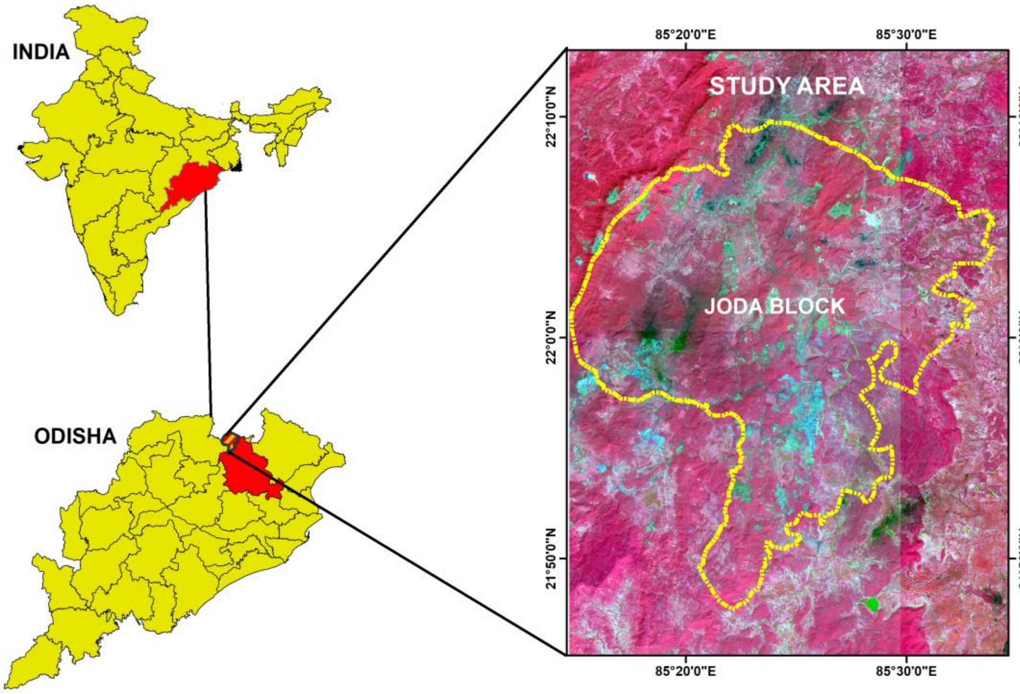

Fig 1- Showing study area map.

III. METHODOLOGY

The block boundary was considered as the study area in this present study. Joda block boundary was downloaded from the Diva GIS website. Lanssat-8 image is used in this study which was acquired from the USGS earth explorer bearing the following link https://earthexplorer.usgs.gov/. Landsat-8 images of the year 2008 and 2018 taken for analysis of the study area. The road networks and settlements were digitized from the topographic maps and Google Earth maps. Topographies maps used in this study area are 73F-8, 73G-5. Both the topographic maps were downloaded from the Survey of India portal. The satellite images were pre-processed and applied with the digital image processing techniques and then divided into classified feature classes for further class analysis. Land use and land cover mapping was carried out by the standard methods by analyzing remote sensed data. Land use and land cover mapping undertaken two times in this study for the year 2008 and for the year 2018. The change detection analysis has been done to find the significance changes occurred in the last 10 years in Joda block from 2008 to the year 2018. Land use and land cover change matrix derived analyzing different land use and land cover categories like built up land, crop land, dense & open forest, tree clad area, scrub land, water body and mining activity area.

IV. RESULTS AND DISCUSSION

Image interpretation done using visual interpretation techniques in ArcGIS software using LISS-III image of year 2008. Using remote sensing and GIS techniques land use and land cover changes around the Joda area were mapped. It was found that the built up area was 1803.34 Ha, Crop land was 12174.45 Ha, Total forest was 39213.08 Ha, scrub land was 11330.27 Ha, water body was 514.63 Ha, mining activity area was 3890.24 Ha. In this land use mapping it was found that forest cover area is highest and the built up area is less comparing to all area. The land use and land cover map of Joda block for the year of 2008 is shown in the figure number-2.

After interpreting the LISS-III image of 2018, it was found that the built up area was 2219.95 Ha, Crop land was 11267.93 Ha, Total forest was 39609.39 Ha, scrub land was 10106.56 Ha, water body was 542.05 Ha and mining activity area was 5186.12 Ha. The land use and land cover map of Joda block for the year of 2018 is shown in the figure number-3.

Based on the interpretation of satellite images of the year 2008 and 2018 eight land cover classes were identified. Applying remote sensing and GIS techniques land cover changes around the Joda block are mapped and their statistics were generated for one decade between the years 2008 to 2018. It is found that there have been rapid land cover changes in the study area during the period of 10 years. It is found that built up area has been increased from 1809.34 Ha to 2219.95 Ha an increased to 22%. Open forest area increased from 9310.60 Ha to 11690.18 which increased of 25% and the most important area that is mining activity also increased from 3890.24 Ha to 5186.12 Ha which is 33%. Which clearly represents the access mining increased activity. Water bodies area also increased of 5%. Some of the classes decreased in compare to the previous year and these are crop land reduced from 12174.45 Ha to 11267.93 Ha which is 7%, dense forest reduced to 20421.59 Ha from 21904.24 Ha. Tree clad area reduced from 7998.23 Ha to 7497.63 Ha which is 6% and scrub land also reduced to 10106.56 Ha from 11330.27 Ha.

It has been observed that feature classes have been considered with the philosophy of one class encroaching on the other. Analysis through digital image processing tools applied to unravel the conversion of one class into another. The result of such classes mutation are illustrated in the change matrix table. The land use and land cover change matrix done in each classes of from the year 2008 to the year 2018 which is shown in Table No.1.

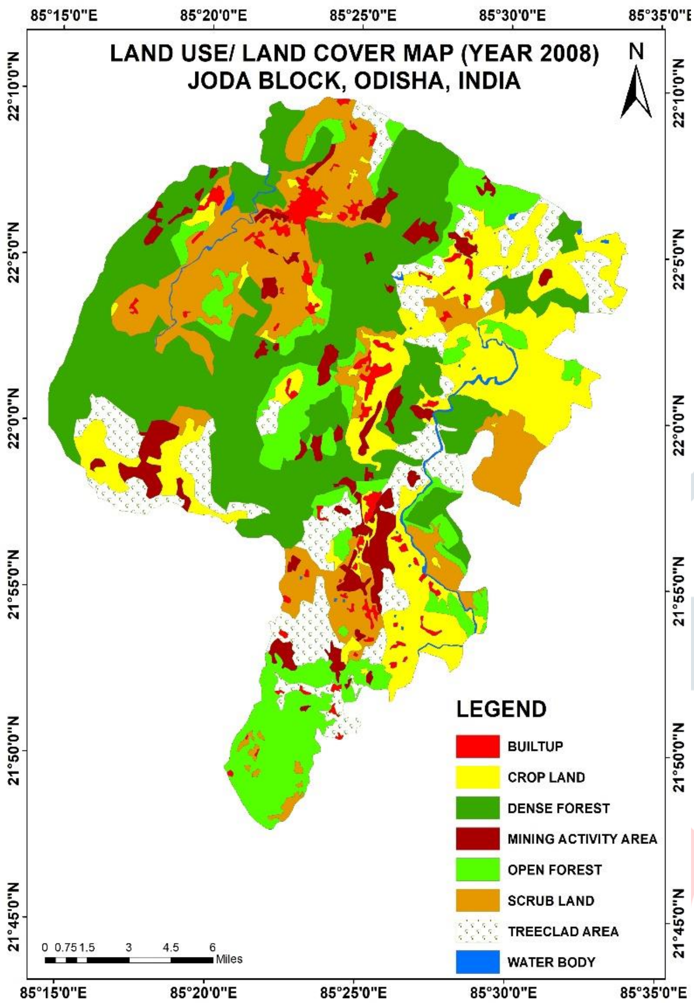

Fig 2- Showing LU/ LC map of 2008

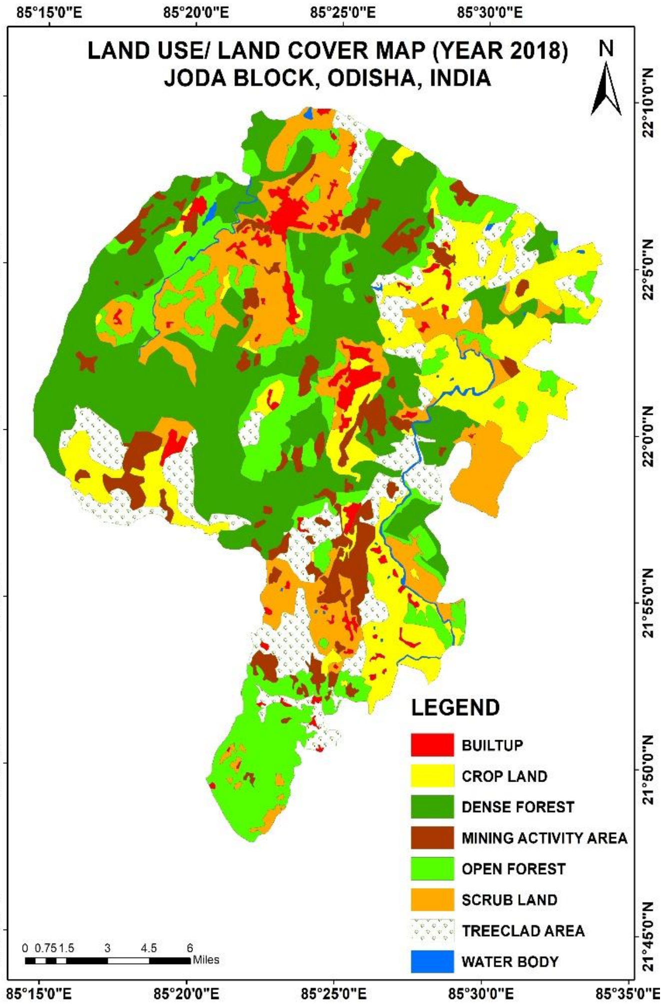

Fig 3- Showing LU/ LC map of 2018

LAND USE/ LAND COVER CHANGE MATRIX (YEAR 2008 TO 2018)

YEAR 2018	YEAR 2008 →								AREA IN HECTRE
↓	LU/LC CATEGORIES	BUILT UP	CROP LAND	DENSE FOREST	OPEN FOREST	TREE CLAD AREA	SCRUB LAND	WATER BODY	MINING ACTIVITY AREA	GRAND TOTAL
	BUILT UP	**1777.15**							32.19	**1809.34**
	CROP LAND	442.80	**10636.48**		273.73		513.72	0.30	307.42	**12174.45**
	DENSE FOREST		75.55	**20421.59**	608.12		129.21	5.36	664.41	**21904.24**
	OPEN FOREST		242.00		**8834.56**		17.83		216.21	**9310.60**
	TREE CLAD AREA		313.90		93.01	**7497.63**			93.69	**7998.23**
	SCRUB LAND				1861.82		**9445.81**	22.64		**11330.27**
	WATER BODY							**513.75**	0.88	**514.63**
	MINING ACTIVITY AREA				18.93				**3871.31**	**3890.24**
	GRAND TOTAL	**2219.95**	**11267.93**	**20421.59**	**11690.18**	**7497.63**	**10106.56**	**542.05**	**5186.12**	**68932.01**

Table No.1- Showing LU/ LC change matrix year 2008 to 2018

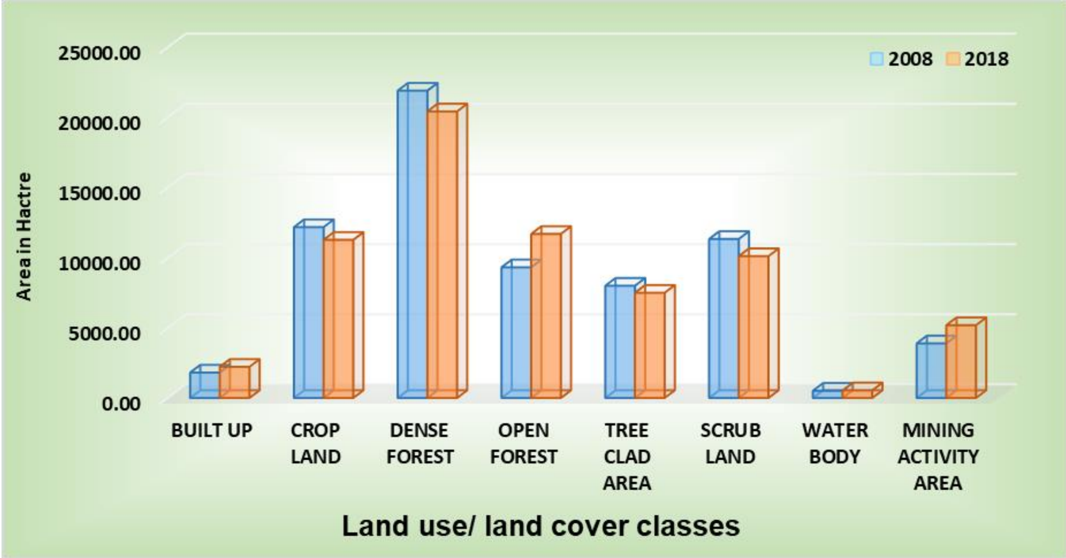

Fig 4- Showing relative LU/ LC change graph of 2008 to 2018.

Surface mining operations typically involve some sort of strip mining during the lifespan of a given mine. Strip mining, in general is characterized by the removal of overburden to expose the mineral for extraction. This mining is typically employed in situations where the overburden is relatively thin, or where underground mining would not be economically feasible.

The main environmental impacts of surface mining include the loss of habitat, erosion, acid rock drainage or acid mine drainage, and dust pollution. These impacts are caused primarily by the disturbance of the ground surface as overburden is removed to access the coal seam. One of the major impacts of surface mining is the loss of wildlife habitat. The disturbance of the ground surface effectively destroys any wildlife habitat in the area. In many areas, mined lands are initially re-vegetated with grassland species to control erosion. This creates a less diverse habitat compared to the pre-mining conditions (Ololade HJ, et al 2008).

V. CONCLUSION

The present study will be very helpful in monitoring of changes in land use pattern and temporal expansion of the mining area to the researchers and environmentalist and the mining department and forest and environment department. Land use and land cover changes in mining and surrounding area can be easily mapped & monitored by remote sensing and GIS techniques. Result shows that the major classes been changed in during the period of 2008 to 2018. From the analysis of land use land cover classification of multi-temporal satellite data, it is found that there are enormous changes especially in forest and built up area. Almost scrub vegetation have been converted either into mine area and mine overburden. The water bodies have also increased due excavation of huge quantity of sandstone excavation, not because of natural water surface bodies. Mining area has also increased manifold since one decades of the study periods. Dense forest reduced to open forest and mining activity area. Due to the increase of mining activity area, it is found that the pollution also increased in Joda area. Continues mining process resulting lots of dust particle in the environment. Remote sensing and GIS based approach for quantifying surface mining area and their impacts is presented and applied for assessment of the mining development in a region. The techniques used in this study area can be an effective tool for the analysis and monitoring of mining activity for the departments and organizations concerned.

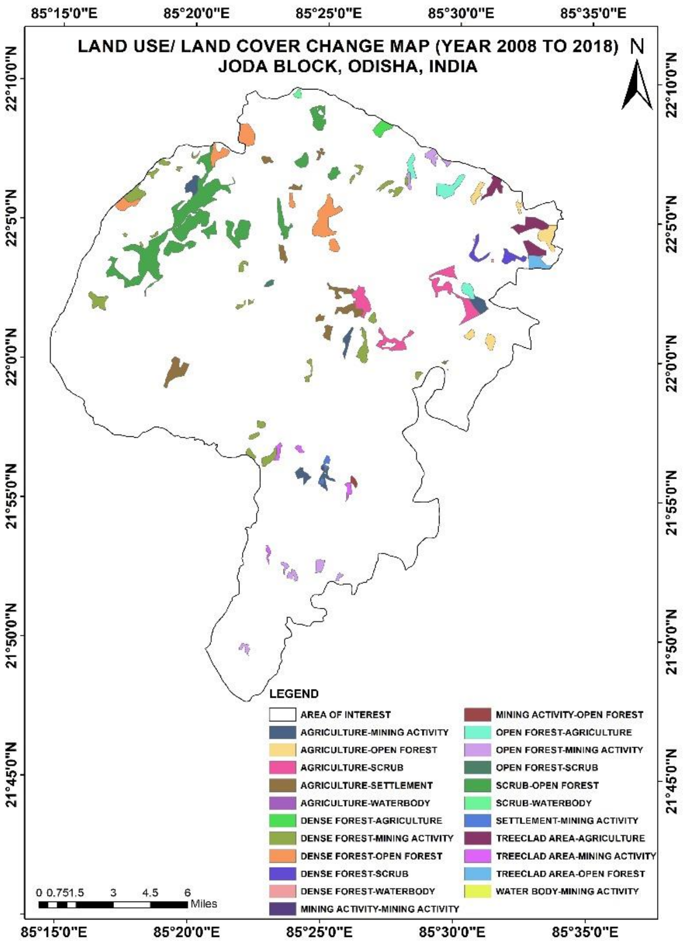

Fig 5- Showing LU/ LC change map

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