

Satellite Image Based Study for Land Use Land Cover Changed Due to Mining Activity during (1987 to 2011) at Dhanbad District of Jharkhand

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Abstract— Land use and land cover change has become a prime issue in present scenario for managing natural resources and utilization of land. Dhanbad is the coal capital of India and the fastest mining area in India witnessing fast land use change in agriculture land, vegetation, open scrub and water bodies. This study reveals a dynamic land cover change in the study area due to sand and enhancement of agriculture land. Using the Landsat-5 TM images of Dhanbad District acquired in 1987 and 2011 classification was done. Land Use Land Cover change (LU/LC) is a dynamic process taking place on the surface and it became a central component in current strategy. Therefore, land use land cover change analysis is very important for environmental management. LU/LC helps to plan for future changes that may occur in that area and to taking decision to realize the effects of these changes. Decision makers also have to identify, what are the factors that affect the LU/LC change (such as population, agricultural growth etc.). the aim of this study to detect land use land cover changed during 1987 to 2011 using satellite images of Landsat-5 TM. Remote sensing and geographical information system technology are providing new tools for monitoring fast land use change. The massive changes of land use land covers are dense forest, low dense forest, open scrub, agricultural land, agricultural fallow, built-up, mining, river, water bodies, sand and barren land. The synoptic analysis revealed to the rapid increase in mining activity and degraded the forest land cover. The study was found that a phenomenal change in the mining areas, change in vegetation cover and change in built-ups land. The overall trend indicates considerable growth in the mining areas with increase in urban areas. Mining area shows the maximum change with an increase of 5% and as a result decreases in vegetation cover. The low dense areas and open scrub suffered decrease in area i.e. 1% and 2% respectively. The land is now converted into open cast and underground mining. The second major change noticed is the increase in built-up i.e. 2%, this resulted in decrease in dense forest covers. The dense forest cover gone through a tremendous change; with a decrease in 4% land cover. Rest of the land cover showed minor changes like water bodies increased up to 2%, reason may be seasonal variation or other. Certain land covers like river and sand shows no change.

Key words: Change Detection, Landsat-5 TM, Spatial and Temporal, LU/LC, Environment Management, Forest Cover

I. INTRODUCTION

Land is the most important natural resources on which all activities are based. It is scalar dynamic in nature and changes more rapidly. (Phukan P, et al, 2013). About one third to two one half land surface changed due to anthropogenic activities (Ellis E C 2011; Vitousek P et al. 1997). According to (Carpenter S et al. 2006) changing land may be also increased in future to accommodate a growing demand of land.

However the study of land use and land cover is essential for environmental management not only in mining dominated areas, over populated developing areas but throughout the world because of its relationship with different human experience. It has been observed that, remote sensing technique is one of the essential scientific tool in concurrence with ground truth and toposheet for collection of spatial information and very useful in identification, classification and mapping of the land use units (Rao N et al. 1981). In case of India explosive growth of population and their diverse needs has steadily increased the need for optimum utilization of our land resources. Now the country requires sufficient quantities of food grains to feed its huge population, various raw materials for a sound industrial base and creation of adequate job opportunities for the large majority of unemployed people. The systematically planned and proper way utilization of our land resources can play a major role in solving these problems. Therefore, the proper utilization of land according to its capability should be the prime concern of people and our government. However, present research aimed to suggest the potential land use for sustainable development in the Dhanbad district, Jharkhand state of India.

There are basically three fundamental ways in which LU/LC is important. The first lies in the interaction of land cover with the atmosphere, which leads to regulation of the hydrologic cycle and energy budget. Second, land cover plays a major role in the carbon cycle acting as both sources and sinks of carbon. Finally, land cover also reflects the availability of food, fuel, timber, fiber, and shelter resources for human populations and serves as a critical indicator of other ecosystem services such as biodiversity. Land use is distinct from land cover; despite they are used interchangeably. Land cover is the physical material at the surface of the earth. It includes grass, trees, bare ground, water, etc. The change in land cover occurs even in the absence of human activities through natural processes whereas land use change refers to the manipulation of land cover by human being for their basic needs i.e. multiple purposes- food, fuel wood, timber, fodder, leaf, litter, medicine, raw materials and recreation. (Bhagawat R, 2011).

II. STUDY AREA

The study area “Dhanbad District” is a part of Jharkhand state, India. It is the administrative headquarters of this district. As of 2011 it is the second most populated city in Jharkhand. Dhanbad along with its urban areas population ranks 42nd in population amongst other cities in India. The Study area (Figure-1) has an average elevation of 227 m (745 ft.). Its geographical length extending from north to south is 15 miles (24 km) and the breadth stretching across east to West is 10 miles (16 km) (Dhanbad City Guide). It lies

between 23°37'3" N to 24°4' N latitude and 86°50' E to 86°59' E longitude.

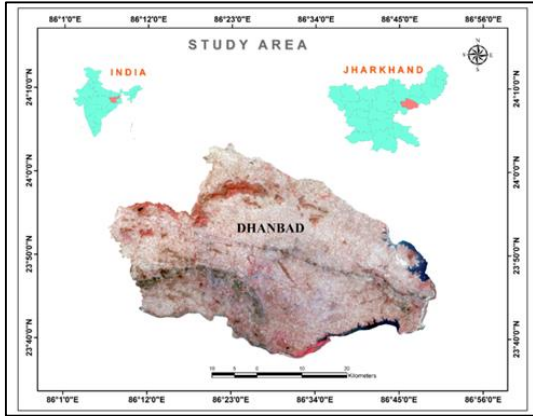


Fig. 1: The Study Area

III. DATA & SOFTWARE USED

In this study Landsat-5 TM, 1987 & 2011 satellite image used to prepare LU/LC map. The Dhanbad district political map was used to demarked study area. Toposheet used to verify land surface feature. All the data analysis and thematic map were prepared in GIS environment using ERDAS 9.0 & Arc GIS 10.1 software.

IV. METHODOLOGY

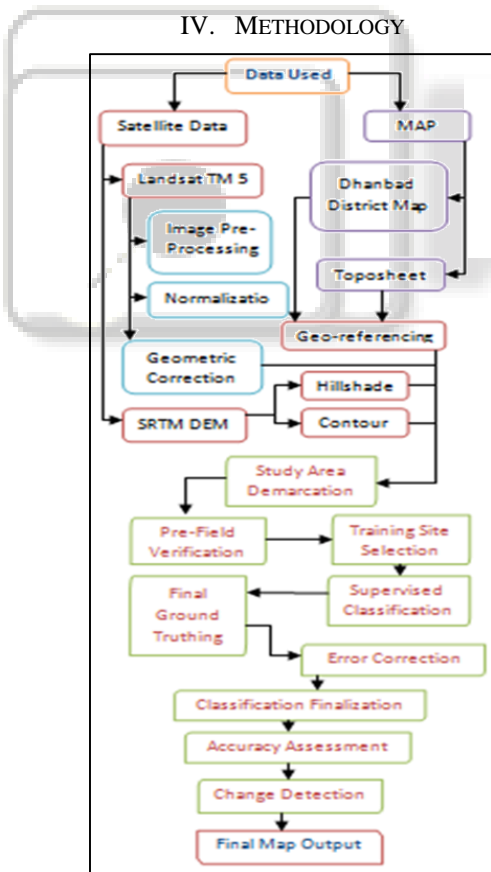


Fig. 2: Methodological Flow Chat

The LU/LC change detection study of Dhanbad district due to effect of coal mining activity is done by using LU/LC changed model (Figure-2). Multitemporal satellite data set observed by Landsat 5, Thematic Mapper (TM), which has 7 multispectral bands between visible and infrared radiations. The resolution is 30 meters/pixel. Digital land use / land cover classification through supervised classification method,

based on the field knowledge is employed to perform the classification. This classification is performed based on the classification scheme of National Remote Sensing Center (NRSC), Department of Space, Govt of India. After primary classification, Ground Truthing, error corrected and finally classify different year image. Calculate the changed area in different year and finalized LU/LC changed map.

V. RESULT & DISCUSSION

A. Land Use / Land Cover in 1987

The study shows that in 1987 (Figure-3) is covered with 15026.24 hectare of dense forest which takes up 7% of the total area. An area of 45610.11 hectare is covered with low dense forest (22%), 23473.08 hectare with open scrub (12%), 50599.12 hectare with agricultural land (24%), 34440.3 hectare with agricultural fallow (17%), 10555 hectare with built-up land (5%), 5071.59 hectare with mining (4%), 8055.35 hectare with river (3%), 4981.23 hectare with water bodies (2%), 1046.73 hectare with sand (2%) and 5472.84 hectare with barren land (3%). Water bodies constitute small ponds, lakes or other water bodies.

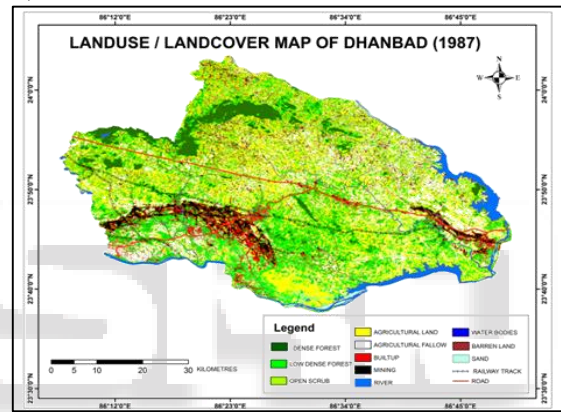


Fig. 3: LU/LC of 1987

B. Land Use / Land Cover in 2011

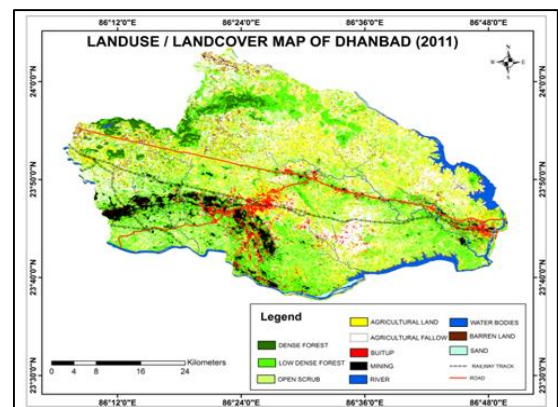


Fig. 4: LU/LC of 2011

A phenomenal change has occurred during this period. In the year 2011 (Figure-4), the land cover has completely changed. A decrease in land cover classes is seen also there are land covers which are left unchanged. Now only 3% of the land is covered with dense forest covering an area of 6059.16 hectare, 21% with low dense forest an area of 49512.09 hectare, 10% with open scrub which cover an area of 30031.02 hectare, and 21% with agricultural lands which covers 42228.72 hectare of area. An increase in land cover is observed i.e. built-up land is increased up to 7% covers an

area of 12865.62 hectare and mining is increased up to 9% and the area covered is 7508.61 hectare. Also a positive increase in the land cover is detected. Water bodies have been increased up to 4% covers an area of 1823.22 hectare which may be due to seasonal variation or the flow of rivers. The land left barren has been decreased 1% with area coverage of 3593.25 hectare which is now covered with agricultural fallow which shows a gradual increase.

C. Land Use / Land Cover Change Between the Years 1987 to 2011

The study shows the area covered by different land cover categories in the year 1987 to 2011. Landsat TM 5 image gives a synoptic view of the study area. It gives a wide resolution over 30 m that helps to make a clear distinction between different land use and land cover classes. The (Table-1) shows a tremendous change in the areas during a period of 24 years. A major change in the mining region has occurred. In the year 1987 mining covers an area of 5071.59 hectares which has increased up to an area of 7508.61 hectare, and takes up 9% of the total area. Built-up lands also gone through a tremendous change which is obvious due to growing population. It has increased from 10555hectare to an area of 12865.62hectare. The growing population is directly or indirectly has become a major cause of land use land cover destruction or deterioration. Due to increasing buildings, commercials, industrial plots etc. forests has been degraded. It can be observed from the above data that from 1987 to 2011, a rapid decrease in dense forests, low dense forests, open scrub and agricultural lands has taken place. A phenomenal change has occurred during this period. In the year 2011, the land cover has completely changed. A decrease in vegetation is seen. Now only 3% of the land is covered with dense forest, 21% with low dense forest, 10% with open scrub, and 21% with agricultural lands. An increase in land cover is observed i.e. built-up land is increased up to 7% and mining is increased up to 9%.Also a positive increase in the land cover is detected. Water bodies have been increased up to 4% which may be due to seasonal variation or the flow of rivers. The land left barren has been decreased 1% which is now covered with agricultural fallow which shows a gradual increase. The Pie Chart (Figure- 5) shows the Percentage Change that occurred in land use/land cover classes in the period 1987 to 2011. From the graph it is very clear that mining shows the major percentage change 5%. The reason is very obvious and clear. As Dhanbad is known as “The Coal City of India”, the economy of Dhanbad depends mostly on coal mining. Open cast mining, underground mining has been established over these years to meet the respective demands. Tata Steel and BCCL is the major source of income of the people of Dhanbad, and the company works by the utilization of coal. Built-up land has been also increased to 2%. Construction of buildings, flats are going on to accommodate the increasing population. Dhanbad has now a population of 1,195,298 according to the 2011 India provisional census. The second major negative change observed is the decrease of dense vegetation -4%. For making buildings, commercials, industrial plans trees are uprooted, forests are destructed; which leads to the decrease in vegetation covers. Whereas river bodies and sand shows no change as the slight changes are negligible. Water bodies show a positive change with the increase in land cover.

Sl. No	Class Name	% of Area in Total Area		% of Change
		1987	2011	
1	Dense Forest	7	3	-4
2	Low Dense Forest	22	21	-1
3	Open Scrub	12	10	-2
4	Agriculture Land	24	21	-3
5	Agricultural Fallow	17	19	2
6	Built-up Land	5	7	2
7	Mining	4	9	5
8	River	3	3	0
9	Waterbody	2	4	2
10	Sand	1	1	0
11	Barren Land	3	2	-1
Total Area		100	100	

Table 1: LU/LC changed area during the year 1987 to 2011

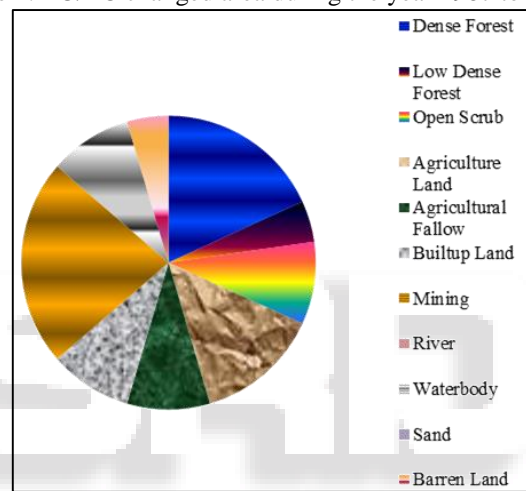


Fig. 5: % of Area changed between the years 1987 to 2011

The map (Figure-6) shows the changes occurred in mining and river features during a period of 24 years. The area covered with low dense vegetation is now showing open cast and underground mining areas. The increase in water bodies can also be depicted from the above map. It may be due to seasonal variations.

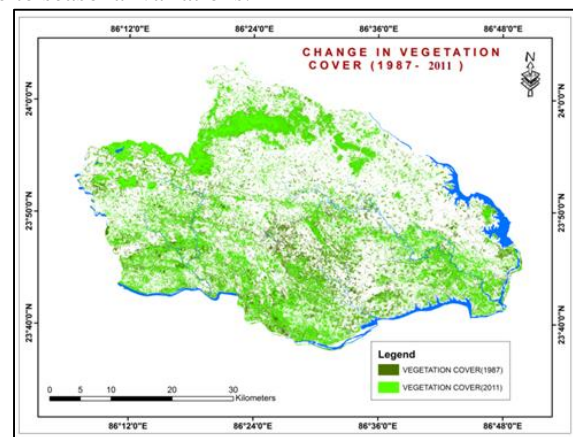


Fig. 6: Changed Mining & River Area

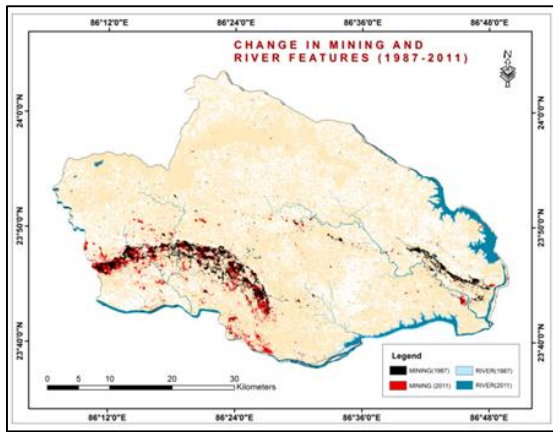


Fig. 7: Change Vegetation Cover

The map (Figure-7) shows changes occurred in vegetation cover during the study period. The low dense forest areas are now converted into open cast and underground mining areas. The change is very obvious due to rapid increase in population.

VI. CONCLUSION

The land use/land cover pattern of a region is an outcome of both natural and socio-economic factors and their utilization. It is the most important natural resource on which all activities are based. The increase in population and human activities are increasing the demand on the limited land and soil resources for agriculture, forest, pasture, urban and industrial land uses. Land is becoming a scarce commodity due to immense agricultural and demographic pressure. Hence, information on land use/land cover and possibilities for their optimal use is essential for the selection, planning and implementation of land use schemes to meet the increasing demands for basic human needs and welfare. Land use/ Land cover changes also involve the modification, either direct or indirect, of natural habitats and their impact on the ecology of the area. In this study, using satellite image (Landsat 5 TM) of 1987 and 2011 land use changes were evaluated in Dhanbad district of Jharkhand. The study revealed that the major changes occurred in mining and dense forest. The reason behind this is that the area under open scrub and low forest is converted into mining, to meet the demands of humans for their survival. The increase in built-up also indicates the growth in population during last 24 years. Therefore, we can conclude that satellite data has the unique capability to detect the changes in land use/ land cover quickly and accurately. The high resolution satellite data such as Landsat TM is a good source to provide information accurately. Accurate land cover change information is necessary for understanding main factors, causes and environmental consequences of such changes. Changes in land cover by land use do not necessarily refer to the degradation of land. However, due to a shift in land use patterns, land cover changes affects biodiversity, water and other processes that together affect climate and biosphere.

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