



LAND USE / LAND COVER CHANGE ANALYSIS OF BHUBANESWAR CITY FROM 1973 TO 2017

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ABSTRACT

The study describes the land use and land cover change analysis of Bhubaneswar city –the state capital of Odisha from 1973 to 2017 using remote sensing and Geographical Information System (GIS). Landsat-MSS and OLI satellite images of the period 1973 and 2017 were used to prepare the land use/land cover (LULC) maps. The methodology employed consists of an object-oriented classification approach for LULC mapping and a post-classification change-detection technique for quantifying the changes for four major land use and land cover types. The results indicated that severe land cover changes have occurred in built-up (+ 42.77%), vegetation (-30.51%) and crop land (-15.11%) areas. Most of the areas have been compensated to expansion in areas under built-up category. The study concludes that the LULC change is the result of growing urbanization as a results of new capital city of the state which took its inception from year 1948.

KEYWORDS : Land use Land cover, Land use Land cover Change, GIS and Remote Sensing, Bhubaneswar

INTRODUCTION

The global population has rapidly increased over the last century and it will continue to augment in the years to come, although at a lower rate. By 2050, the world population will reach 9.7 billion (UN Report, 2014). A significant percent of this growth is expected to take place in urban centres. Urban areas cover less than 2% of the earth surface but more than half of the world's population reside in urban areas (UN Report, 2017). Therefore, many scholars consider population growth as the main driver of land use change, especially in developing countries (Allen and Barnes, 1985; Attua and Fisher, 2011). Recently, more attention has also been allocated to the role of climate change in land use change (Zak et al., 2008).

Land cover (LC) is defined as the features that are present on the earth's surface. Land use refers to the human induced changes for agricultural, industrial, residential or recreational purposes (Ramachandra et al., 2012). Land cover changes refer to conversion and modification of vegetation, changes in biodiversity, soil quality runoff, erosion, sedimentation and land productivity (Xiubin, 1996). Land use changes eliminate species locally and decline natural habitats and ecosystem functioning, thus, affecting biodiversity and provision services of ecosystem. LULC change also has a significant effect on the global climate change which may include increase in mean temperature in the tropics and intensification of Indian summer monsoon.

Land use/cover change detection is very essential for better understanding of landscape dynamic during a known period of time having sustainable management. Land use/cover changes is a widespread and accelerating process, mainly driven by natural phenomena and anthropogenic activities, which in turn drive changes that would impact natural ecosystem (Setturu and Ramachandra, 2012). Understanding landscape patterns, changes and interactions between human activities and natural phenomenon are essential for proper land management and decision improvement. With this afore said background the objective of this paper is to analyse the land use/land cover change in Bhubaneswar city (BDA) between 1973 and 2017 to provide a better understanding regarding the extent and pattern of land use change.

Study Area

The study area of present research is the Bhubaneswar city i.e. the operational area of Bhubaneswar Development Plan Area (BDPA). This is in fact a part of a greater urban complex formed by Bhubaneswar Municipal Corporation, Khurda Municipality, Jatni Municipality and Bhubaneswar Development Plan Area (BDPA) rural area located at boundary corners with Bhubaneswar municipality being at center. It is location between Latitude 20° 12' 46" to 20° 22' 03" N and longitude 85° 45' 24" to 85° 54' 21" E in the eastern part of Odisha state of India (Fig.1) As per the 2001 census, Bhubaneswar is classified as a Class-I town, where as Khurda and Jatni are classified as Class-III towns of the state. As per the 2011 census, this urban complex

have 1102701 total population and the overall population density of the entire BDPA is 2361 persons per sq. kilometer, However separately Bhubaneswar Municipal Corporation (BMC) has 5813 population density, Khordha Municipality (1582), Jatani Municipality (2474) and BDPA rural has 641 population density.

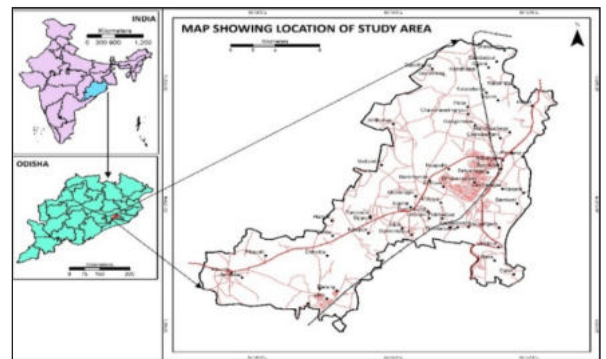


Fig. 1 Location Of Study Area (bhubaneswar City-development Plan Area)

Methodology

Data Used

Cloud Free Landsat satellite data of Year 1973 and 2017 for the study area has been downloaded from United States Geological Survey (USGS) Earth Explorer website (<https://www.usgs.gov>). The satellite images used in the study are Landsat-1 MSS (Path/Row-140/46) and date of acquisition was 24 April 1973 and another satellite image having same Path/Row is Landsat-8 (OLI) and date of acquisition was 14 May, 2017. Both the images are pre-processed and projected to the Universal Transverse Mercator (UTM) projection system.

Method Of Land Use/cover Mapping

In the present study Land use/land cover map was prepared using landsat 1 (MSS) and Landsat 8 (OLI) satellite images in order to understand the dynamics of LU/LC change by using object based image classification method using Arc GIS 10.2. Compared to the computer based interpretation of remote sensing images, object based image classification usually takes more time and effort, but yield more accurate result. Based on the prior knowledge of study area four LU/LC types were identified by applying the Object based Image Classification, which is based on fuzzy logic, allows the integration of a broad spectrum of different object features such as spectral values, shape and texture. Such classification techniques, incorporating contextual and semantic information, can be performed using not only image object attributes, but also the relationship among different image objects.

Results And Discussion

Area Statistics

The Land use / Land cover of the study area over the span of 44 years (1973 to 2017) has been presented in (Figure -2) which basically shows four types of land use (built-up, crop land, water bodies and vegetation in 3 subtypes (degraded, dense and sparse). The statistics of LULC has been presented in (Table-1) and from this it is clearly shows that, in the year 1973 vegetation was the most predominant land cover type constituting 46.5% (18953.55 ha) followed by cropland 38.97% (15885.09 ha), whereas during that period the percentage share of the built-up area was only 11.2% (4568.89ha) similarly water bodies constitute only 3.31% (1350.44 ha) of the total area.

Considering the land cover status of Bhubaneswar in 1973 it has been revealed that larger part was covered with vegetation, followed by cropland which appears to be more concentrated at the northern, southern, and south-western parts of the city. The built-up area appears to cover a very small portion compared to other land cover classes which are concentrated in the south-eastern part of the city. Water bodies constituted the lowest proportion of total geographical area in comparison to other land use classes (Fig-2).

Table 1 Land Use Change Analysis Bhubaneswar (bdpa) 1973-2017

LU/LC Type	1973		2017		Change 1973-2017	
	Area (in ha.)	%	Area (in ha.)	%	Area (in ha.)	%
Built up Area	4568.89	11.21	22001.72	53.98	17432.83	42.77
Crop Land	15885.09	38.97	9723.12	23.86	-6161.97	-15.11
DegradedVegetation	-	-	1197.07	2.94	1197.07	2.94
Dense Vegetation	5646.22	13.85	2555.86	6.27	-3090.36	-7.58
Sparse Vegetation	13307.33	32.65	2763.58	6.78	-10543.75	-25.87
All Vegetation	18953.55	46.5	5319.44	15.99	-12437.04	-30.51
Waterbodies	1350.44	3.31	2516.62	6.17	1166.18	2.86
Total	40757.97	100	40757.97	100		

Source: Calculated by authors from satellite imageries

In 2017, built-up area, cropland, vegetation, and water bodies were covered 53.98%, 23.86%, 13.05%, and 6.17% of the total area respectively. The built-up area covered more than the half (53.98%) of the total area and come out as a giant class in comparison to other LU/LC classes in this year.

Lulc Change From 1973 To 2017

As presented in (Table 1) and (Fig. 2) the change status of LULC during the span of 44 years shows that, the built-up area increased tremendously with an increase of 17432.83 ha. (42%), Crop land area was 15885.09 ha (38.97%) in 1973 which has been reduced to 9723.12(23.86%) with a decrease of 6161.97 ha (15.11%) over the years.

Dense vegetation constitute 5646.22(13.85%) in 1973 which is reduced to 2555.86(6.27%) with a decrease of 3090.36(7.58%). Sparse vegetation (Scrub land) constitute 13307.33 ha (32.65%) in 1973 and reduced to 2763.58(6.78%) in 2017 with a loss of 10543.75 ha (25.87%).

Over the years 1197.07 ha (2.94 %) dense vegetation became degraded. Waterbody shares 1350.44 ha (3.31%) of total geographical area in 1973 which has increased to 2516.62 ha (6.17%) in 2017 with an increase of 1166.18 ha. which happen due to the construction of some new ponds.

From the LULC analysis the status of change in vegetated land has been identified over the study period. A total area 12437.04 ha of vegetated land has been converted to build up areas which constitute 30.51% of total area of BDA.

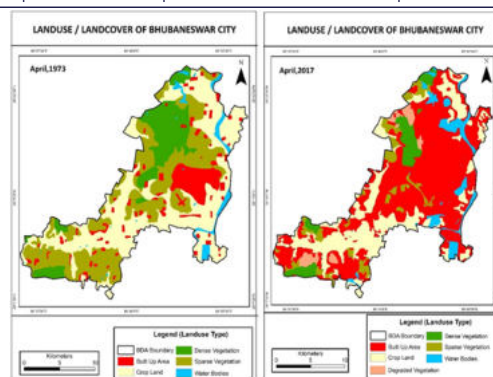


Fig. 2: Maps Showing Land Use/land Cover Of Bhubaneswar City In 1973 And 2017

Over the years, there has been 44.77 % increase in built-up areas and 2.86% increase in waterbodies, whereas the other categories of land (cropland and vegetation) have undergone negative change. Out of total crop land 15.11% is changed to other land use and similarly the vegetated land got declined. Out of that 7.58% dense vegetation declined and 25.87% sparse vegetation (scrub type) land also changed to other land uses, it is also noticed that 2.94% increase in degraded vegetation which not a positive sign because, that amount of vegetated land has been degraded.

Bhubaneswar the capital city of Odisha, which emerge after independence have attracted people for its amenities and facilities and still acting as pull factors due to which existing land cover in the city is going through rapid LULC changes.

CONCLUSION

Based on the results obtained by employment of GIS and RS applications to achieve the specific research objectives, it is concluded that the land cover/land use practices in the study area have altered significantly in 44 years. The LULC shift in the study area was evident by the decline in the area of Vegetation and Crop land (-30.51% and -15.11% respectively) and augmentation of area covered by Built-up class (42.77%), degraded vegetation (2.94%) and waterbodies (2.86%). Finally, urban development in a fast urbanizing city in Odisha cannot be stopped but it can be restrained with the help of proper planning and management and directed towards a healthy city development. Thus, the present study illustrates that remote sensing and GIS are important technologies for temporal analysis and quantification of spatial phenomena which is otherwise not possible to attempt through conventional mapping techniques.

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