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Study of Land Use/Land Cover by Using IGiS Software

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***Abstract*: Land use/land cover is an important factor to understand the relation of human activities with the environment that is why it is necessary to able to simulate change. The focus of this paper is to study the Land use/land cover patterns and change among 2002 to 2019 satellite imagery. It also produces a land use and land cover maps of MIDC area of Nagpur city in Maharashtra in order to detect the change that take place in the diverse natural resources. After analyzing the image, supervised maximum like hood algorithm was used to classify the imagery into different land use categories. Various land use classes have been recognized such as vegetation, settlement, water bodies, and open land. The classification of image shows comparison of MIDC of various years 2002, 2007, 2014 & 2019 and major change detection analysis revealed that settlement area in 2002 is 18.10 % and 33.54 % in 2019 it has been increase by 15.44%, vegetation area is decrease by 5.54%, water bodies area also decreased by 0.89% & open land decreased by 9.01% this analysis is done by using GIS software Integrated Geographical Information System (IGiS) software. Thus, above study demonstrated the usefulness of RS and IGiS technologies regarding resource management and urban planning.**

***Keywords*: GIS, Remote sensing, Satellite, GIS, LU/LC, Sensor, Image processing, Change detection.**

1. Introduction

The LU/LC of a region is a result of natural and socio-economic factors and their utilization by man with respect to time and space. These are two different terms generally assessed in combination, i.e. firstly (physical properties of surface elements) and later (human use of cover) which cannot be seen as independent from each other. Land is becoming danger resource due to immense agricultural and demographic pressure. Hence information on LU/LC for their optimal use is necessary for the selection, planning and implementation to meet the increasing demands of humans as well as welfare. If the area is small then the land cover is based on ground surveillance and survey. However, if the area is large, then such method are found to be realistic. In earlier study top sheet, censuses, demographic data may be used for reference but are not sufficient for the analysis of multi-complex environmental study. Modeling the impact of change on the environmental change research. Inventory and monitoring of LU/LC changes are indispensable aspects for further understanding of change mechanism and modeling the impact of change on the environment and associated ecosystems at different scales.

So, to handle multidisciplinary data set, we require new technologies like Satellite remote sensing, image processing and geographical information system.

GIS is a system has features to capture, store, manipulate, analyse, manage and present geographic data. whereas Remote Sensing means obtaining information about an object, area or phenomenon without coming in direct contact with it. Geomatics application software gives a power to visualize the spatial data- (Raster & vector) geographically, manipulate raster and vector data for standard analysis, create maps, images and provides all the tools needed to put data on a map and display it in effective manner, solves the geo-location and attribute based queries, present the results of work shown in the form of publication quality maps and create interactive displays that flowchart, graphs, tables, drawing, photographs, and other elements to the data. The software is made available in the form of library of reusable components for further reengineering purpose. IGiS software supports spatial analysis using advanced analysis tool perform geo-processing, overlay analysis and proximity analysis. In this output presentation in the form of maps, reports and charts using map composition tool, reports creation tool respectively.

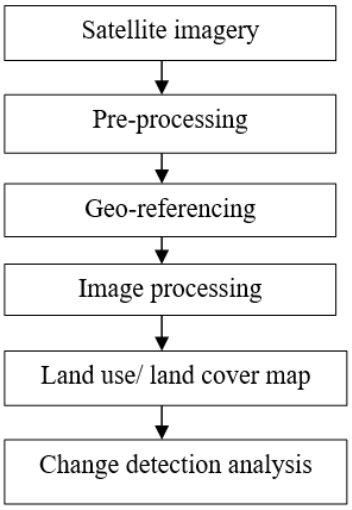
The main objective of this paper is to notice and analyze the land use/land cover of MIDC area of Nagpur city in Maharashtra between 2002 to 2019 using IGiS software and satellite imagery. The study also views the implementation of image processing and statistical techniques for analysis of LU/LC in view of change detection changes that have taken place in LU/LC of study area. The paper uses remote sensing and geographic information system approach for recognition, measurement and analysis of LU/LC changes in the study area.

2. Study Area

The selected study area was MIDC area of Nagpur city in Maharashtra State of India. It is located in latitude 21° 15’ 2” and longitude 79° 06’ 3”, which occupies area about 3,160 ha. This area has been selected because it covers all the classes or parameters we have taken. At the same time, study area adversely affecting the vegetation and water bodies due to increase in urbanization.

3. Methodology

To recognize the change detection comparison between Landsat-8 image of February 2002, February 2007, January 2014 and January 2019. The data have been collected from Google Earth Pro. The selection of images was constrained to similar season to avoid seasonal differences. Multispectral and multi-temporal images are chosen because they enclosed the period of intended study and their resolutions are suitable for classification of images. The maps are executes only for these images.



A. *Pre-processing of images*

In the analysis of imagery, the image pre-processing was carried out. each pre-processing of an image consists of restoration and rectification of an image. The download image contains image, scenes mosaicking of image and was done to get essential study area. In this to position ground features of an image, image enhancement and extraction was used.

B. *Mosaicking*

This is process of mosaicking. Mosaicking does not mean putting the images next to each other. It is one of the techniques of image processing which is helpful for tiling digital images. Mosaicking is bending together of several randomly balanced image so that the boundaries between original images are not seen. Any number of geo-coded images can be blended together along use specified cut lines (polygons). Mosaicking is a case of geometric correction in which registration takes place in the existing image.

C. *Geo-referencing*

Each of the images was geo-referenced. sufficient numbers of Ground Control Points (GCPs). Add geographic information to the image so that mapping software can "place" the image in its appropriate real world location. GCPs are taken from recognizable, permanent features such as road intersection, corner of buildings, pond, large building and the points were well dispersed for accurate rectification.

D. *Land Cover Image Classification*

Image classification is a process of assigning pixels of continuous raster image to pre-defined land cover classes. The land cover classes generated were Vegetation, Water bodies, Open land Settlement. The classification shows the land use/land cover image of the area. Table below show the nomenclature used for the land covers. It is the process of taking the result of Classification affected by the values of input images, classification methods, algorithm etc. For increase classification accuracy selection of appropriate classification method is required. Image classification is performing to recognize and allocate real world thematic classes to the image pixels. In this study image classification was done by performing supervised maximum likelihood classification method and classified image shown in Figure-1, 2, 3 & 4. The maximum likelihood classification algorithm was chosen because it has the capability to incorporate the statics of the training samples before conveying the land covers to each pixel and the training data given by the user which tells the software, that what types of pixels are to be selected for certain land cover type.

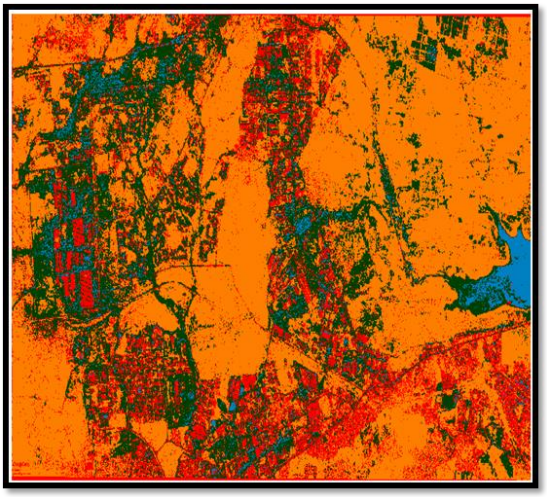


Fig. 1. 2002 Image Classification

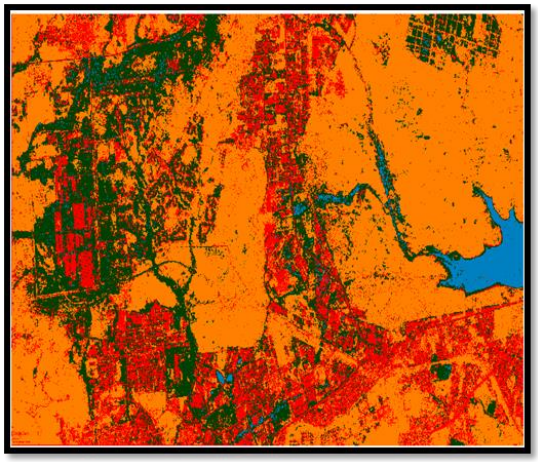


Fig. 2. 2007 Image Classification

Table 1
Land Cover Nomenclature

S. No.	Land use / Land cover classes	Colours assign to classes
1.	Open Land	
2.	Settlement	
3.	Vegetation	
4.	Water bodies	

Table 2
Land covers statistics by using maximum likelihood classification

Class name	Area(ha)							
	2002	%	2007	%	2014	%	2019	%
Open land	1687	53.4	1685.86	53.35	1547.768	48.98	1402.724	44.39
Settlement	571.96	18.1	681.928	21.58	857.94	27.15	1059.864	33.54
Vegetation	808.012	25.57	716.688	22.68	717.636	22.17	632.948	20.03
Water bodies	92.588	2.93	75.208	2.38	68.572	2.17	64.464	2.04
Total	3160	100	3160	100	3160	100	3160	100

Table 3
Change detection from 2002 to 2019

Class name	Area (ha)				Change (ha)	Variation %
	2002	%	2019	%		
Open Land	1687.44	53.40	1402.724	44.39	-284.716	-9.01
Settlement	571.96	18.10	1059.864	33.54	487.904	15.44
Vegetation	808.012	25.57	632.948	20.03	-175.064	-5.54
Water Bodies	92.588	2.93	64.464	2.04	-28.124	-0.89
Total	3160	100	3160	100	00	00

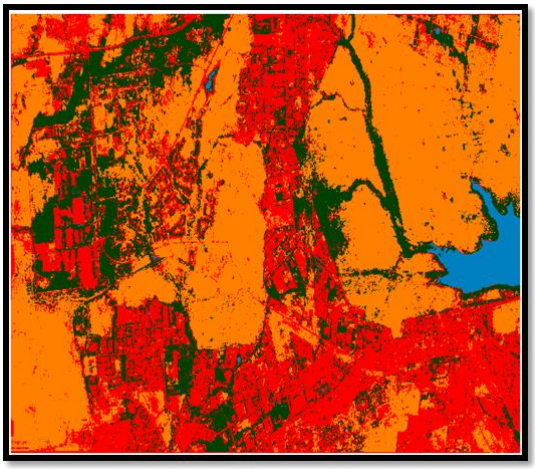


Fig. 3. 2014 Image Classification

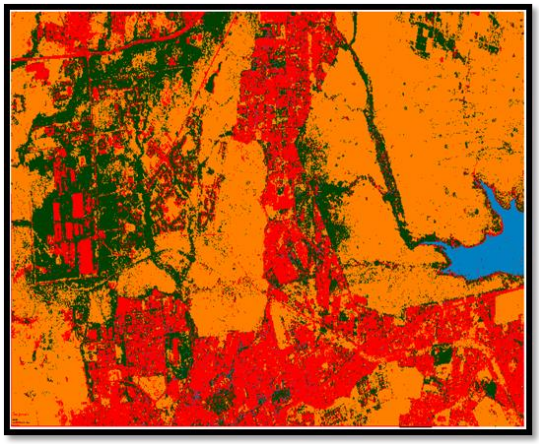


Fig. 4. 2019 Image Classification

E. Change Detection Analysis

Change detection analysis describes and quantities differences among imagery of the same scene at different years. The process of change detection depends on the phenomenon at different times. The change detection process use for this study is the post feature under investigation. This is because the method is simple to implement and it provide through "from to" statistics suitable for decision making. The method was executed by using the four land cover maps generated for 2002, 2007,2014 and 2019. The outcome was a land cover change map from 2002, 2007, 2014, & 2019 and land cover change map from 2002 and 2019. Table 2, shows the statistical analysis of change detection of all the imagery.

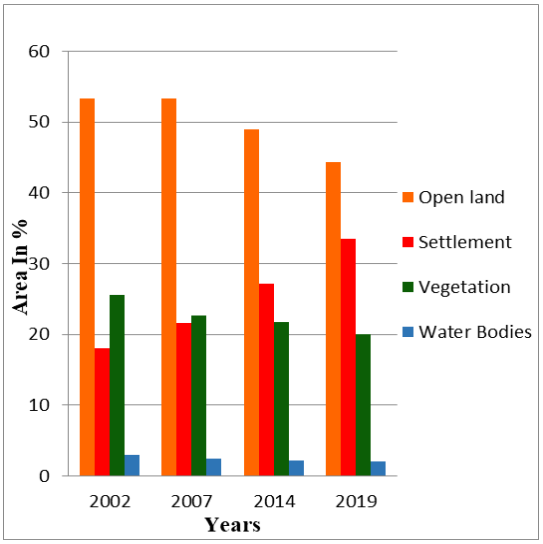


Fig. 5. Statistical analysis of maximum likelihood classification

Percentage of each class was calculated separately for each class of all the images. The statistical calculation of the classes is as follows:

Area in percentage = Category*100/(Sum of area of all number of points) where category assign each individual class of image.

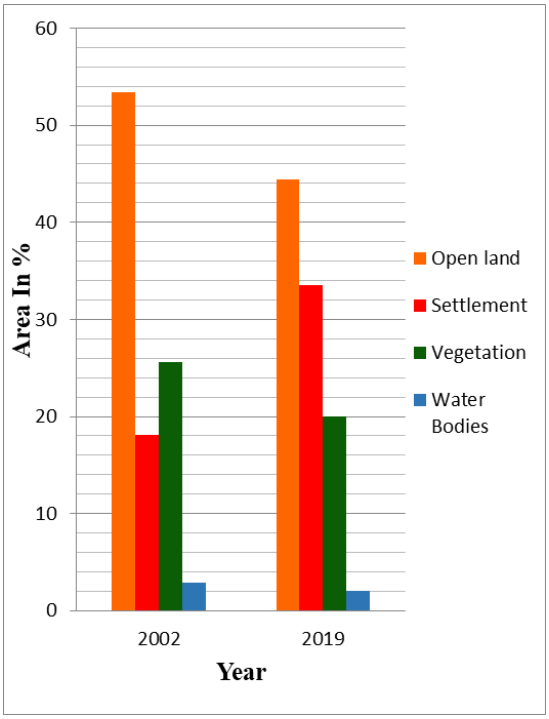


Fig. 6. Change detection from 2002 to 2019

4. Results and Discussion

Land use and land cover of the study area have been analyzed for the time periods of 2002 and 2019. The results are presented in the form of charts and statistical tables. The result of the land use/land cover changes was analyzed using post classification approach which is based on a supervised maximum likelihood classification method. An estimation area of each classified LULC type or surface was complete on basis of the number of pixels. The statistical analysis shows water body is decrease by -0.89%. Water body includes lakes and ponds. Water body are in 2002 is 2.93% and in 2019 it is 2.04%. The area was decreased due to alteration of water spread area into built up area or human development area. Vegetation area was also decreased by -5.54% during the study period. As shown in table 3 settlement was increased by 15.44%. Such urban expansion was takes place due to expenses of open land and vegetation.

5. Conclusion

The current study aims to investigate land use/land cover change that occurred in MIDC area of Nagpur city during 2002 and 2019 IGiS Software and remote sensing. The study of land use and land cover classification establish the fact that the accurate land use data can be obtained from satellite imagery more resourcefully and precisely than traditional methods. By using image processing techniques, the different land use classes are analyzed and mapped easily. The land use category compares with 2002, 2007, 2014 & 2019 and between 2002 & 2019. It shows that there is expansion in settlement (15.44%). Water body and vegetation area were decreased due to less rain fall. The LU/LC changes are important elements of the larger problem of global and regional environmental changes. Land use/ land cover data is essential for planners, decision makers and those concerned with land resource management. Monitoring and analyzing of urban environment formulate use of up-to-date land use and land cover information for capable and sustainable management of urban areas. Change detection techniques with temporal remote sensing data provide complete to detect and asses land use dynamics.

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