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Supervised Classification for LULC Change Analysis

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ABSTRACT
Spatial distribution of Land use / Land cover information and its change is desirable for any planning, management and monitoring programmers at local, regional and national levels. The classification system by National Remote Sensing Agency India (NRSA) is taken as base model for this research work. The methodology involves the supervised classification with the help of ERDAS Imagine 10.0 software. Pan+LissIII satellite data for 2000 and 2011 years has been used for LULC classification. The result shows that Belgaum city has experienced urban growth and in the last decade this has caused a rapid loss of vegetated area and wasteland. These changes in LULC have occurred mostly, with the conversion of cropland and built-up area to low density urban use.

General Terms
Land use, Land cover, Change Analysis, Cropland.

Keywords
LULC Classification, Change detection, Planning, Erdas Imagine 10.0

1. INTRODUCTION
The objective of the study is determination of land use and land cover change analysis of Belgaum city and its surroundings by image classification. The study area is located in northwest of Karnataka. In this study, Pan +Liss III satellite image is used for determination of land use and land cover characteristics of research area. The image is analyzed by using data images processing techniques in ERDAS Imagine© 10.0 and ArcGIS© 10.0 software. Land cover nomenclature is classified according to the NRSA (national State Remote Sensing Agency). Furthermore, the image analysis results are confirmed by the field research.

2. STUDY AREA GENERAL INFORMATION
1. Absolute location : 15° 15'North Latitude 74° 51' East Longitude
2. Height : 710 meters above Mean Sea Level
3. Area (Study Unit) : 231.51 sq.km
4. Population (Study Unit): 5,16,151 (2001 Census)

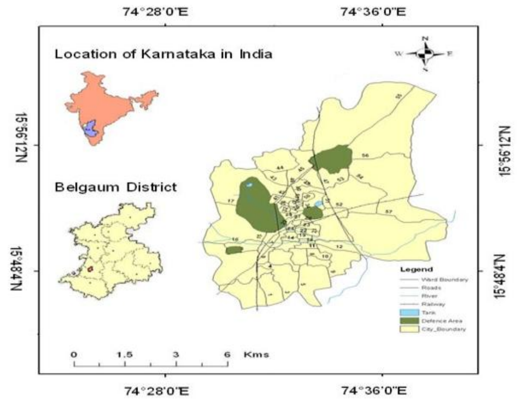

Figure 1 : Location Map of Study Unit

3. METHODOLOGY
3.1. Edge detection preprocessing Technique
For a continuous image f(x,y), where x and y are the row and column coordinates respectively, consider 2D derivatives δyf(x,y) and δxf(x,y) [5] . Two functions can be expressed:

1. Gradient magnitude
$| \Delta f(x,y) | = \sqrt{\ }(\partial x\ f(x,y))\ 2 + (\partial y\ f(x,y))2$

2. Gradient orientation
$\llcorner \Delta f(x,y) = \mathrm{ArcTan}\ (\partial y\ f(x,y) / \partial x\ f(x,y))$

Local maxima of the gradient magnitude identify edges in f(x,y). The first derivative achieves a maximum and the second derivative is zero.

3.2. Edge-band Image Segmentation Technique
The edge-based segmentation is taken into account which is namely grounded on discontinuity of gray-level in imagery. Adopting this method, the accuracy of edge positioning is High.

3.3. K-means Clustering Technique
One common form of clustering, called the "k-means" approach accepts from the analyst the no. of clusters to be located in the data[1]. The algorithms then arbitrarily "seeds" or locates that number of clusters centres in the multidimensional measurement space[2]. Each pixel in the image is then assigned to the cluster whose arbitrary mean vector is closet .

3.4. Supervised Classification Technique

Supervised classification is a data-driven (empirical) modeling tool in that the process derives statistical relationships between the input and the ground truth habitats [3].The spectral response depends on the nature of the objects the light is reflected off and this is used to create a characteristic signature for each habitat type. [7].These spectral values are then used to create the habitat signature. The signature is in the form of a stastical probability distribution in as many dimensions as there are input images. The probability distribution is calculated using the maximum likelihood estimator (MLE).Each habitat will have its own signature and together they form a single catalogue[4].

3.5. Area Calculations and change detection using cell statistics

This aspect of analysis examined the area and percentage change for each year(2000 and 2011) for land use and land cover type[6].The 'count' field, which represents the number of cells in a particular raster category, is used to calculated area in square kilometers(Sq.Kms).Using the cell statistics function in spatial Analysis, changes that occurred between LULC 2000 and 2011 is identified. the general settings and raster analysis settings was established in the environmental setting. The input raster used were both the 2000 and 2011 layers. The results and overlay statics were written to a geo database. The output indicated areas where change had and had not occurred using two values 1 and 2. To isolate areas of change, the CON function from the arc Toolbox was used. The value of 1 indicated areas of no change. Cells with a value of 2 indicated areas where change occurred [8].

4. RESULTS AND DISCUSSIONS

4.1. Change Analysis 2000-2011

This epoch of period 2000 to 2011 shows changes positive and negative both. Agricultural land, Built-up, Roads and Railway and Others show positive change and Vegetation cover, wasteland and water bodies show negative change. There is increase in the area of Agricultural land, it was 86.35 Sq.Kms in 2000 and increased to 99.50 Sq.Kms in 2011. Built –up area was 47.55 Sq.Kms in 2000 it increased to 58.13 Sq.Kms in 2011. The trend and extent of urban change is likely to continue with the rapid development of infrastructure. Roads and railway increased by 2% whereas others category increased by 1%. The comparison of land use and Land cover between 2000 and 2011 shows changes in terms of greenery loss and lake loss. Vegetation cover decreased from 32.11 Sq.kms to 16.22 Sq.Kms. It also depicts that the loss are converted into built- up environs, attributing to the urban sprawl and encroachments of urban built-up structures. Waste land occupied 16.78 Sq.Kms in 2000 and was reduced to 14.35 Sq.Kms in 2010. Water bodies covered 17.36 Sq.Kms in 2011 and decreased to 9.26 Sq.Kms in 2011. This change detection analysis research work aid to generate up- to – date information about every bit of the land which is very important for sustainable land use management.GIS tool also provides a technical support in planning and decision making. Maching the land with appropriate land use/land cover and resources allotment support for better design of City.

Table 1: Change Analysis 2000-2011

LULC Categories	**2000 Area in Sq. Kms.**	**Percentage**	**2011 Area in Sq. Kms**	**Percentage**	**Change**
Agricultural Land	86.35	37.30	99.50	42.98	+
Built-up	47.55	20.54	58.13	25.11	+
Vegetated Area	32.11	13.87	16.22	7.01	-
Others	15.39	6.65	18.05	7.8	+
Wasteland	16.78	7.25	14.35	6.2	-
Railway & Roads	13.54	5.85	15.88	6.86	+
Water bodies	17.36	7.5	9.26	4.01	-
Total	231.51	100	231.51	100	

5. SUGGESTIONS

There is likely going to be density brought by compactness in study unit in the coming years. This situation will have negative implications on the area because of the associated problems of crowdedness like crime and social jelequency and uncomfortable living conditions. It is therefore suggested that encouragement should be given to people to build houses towards the outskirts through the provision of incentives and forces of attraction that are available at the city centre in these areas. Some of the vertical developments are also expected.

Change detection analysis aid to generate up-to-date information about every bit of the land and facilitates wise utilization of the natural resources in a sustainable manner. GIS tool also provides a technical support in planning and decision making using maps and other related statistical data. Therefore, the use of Remote Sensing and GIS coupled with geostatistical analysis used for the planning of appropriate resource utilization and strategy formulation which is crucial in Urban planning in the study area, as a decision support for better design of City.

6. REFERENCES

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