Jiya George et al. 2016, Volume 4 Issue 2
ISSN (Online): 2348-4098
ISSN (Print): 2395-4752

International Journal of Science, Engineering and Technology
An Open Access Journal

Land Use/ Land Cover Mapping With Change Detection Analysis of Aluva Taluk Using Remote Sensing and GIS

[1]Jiya George, [2]Linda Baby, [3]Anjaly P Arickal, [4]Jose Dev Vattoly

Abstract

Land use and land cover change has become a central component in current strategies for managing natural resources and monitoring environmental changes .In the present study, Land Use /Land Cover mapping and change detection analysis of Aluva taluk was done using remote sensing and GIS. Multi spectral satellite data of LANDSAT has been used to map and monitor land use changes occurred during 2000 and 2010. LU/LC classification has been done using ERDAS imagine 9.2 software. The supervised classification technique was used, which is based on Maximum Likelihood Algorithm (MLA). The results obtained shows considerable land use changes in the major classes like Built up, Crop land, Plantation and Forest.

Keywords: Land Use/Land Cover change, Remote Sensing, GIS, Maximum likelihood classifier.

Introduction

Land Use/Land Cover

Land is one of the most important natural resources, as life and various developmental activities are based on it. Land-cover change has been identified as one of the most important drivers of changes in ecosystems and their services. These changes result from population growth and migration of poor rural people to urban areas for economic opportunities. However, information on the consequences of land cover change for ecosystem services and human well-being at local scales is largely absent. The sprawling process of expansion is disordered, unplanned, leading often to inefficient and unsustainable urban expansion patterns.

The fundamental objectives of studying land use / land cover changes is to investigate the social, economic, and spatial causes of changes so that proposals can be made on the suitable use of land and patterns of development. Land use/land cover change detection studies coupled with spatial analysis serves as an effective tool for scientists and policy makers for efficient land management plans. Remote sensing and GIS plays an important role by offering an advantage of rapid data acquisition for land use/land cover mapping.

Objectives and Scope

Objectives

To prepare the Land use / Land cover map& change detection analysis over a period of 10 years using satellite images of years 2000& 2010, of Aluva taluk in Ernakulam district. The goal of the work is also to map and monitor the land use / land cover and identify the area of changes occurred during a year span of 10 years.

Scope of the Work

Land use and land cover change mapping will help to take up clear strategies for managing natural resources and monitoring environmental changes. Urban expansion has brought serious losses of agriculture land, vegetation land in the recent years. The improper study of the urban land expansion is responsible for a variety of urban environmental issues like decreased air quality, increased runoff and subsequent flooding, increased local temperature, deterioration of water quality, etc. Knowledge of drainage, land use/land cover and hydro-geomorphology and other terrain attributes are important for planning and management activities. Remote Sensing and GIS both from the conventional sources has proved to be an effective tool in planning for Land and Water Resources

management. Land and Water Resources Management will imply utilization of land and water resources for optimal and sustained production with the minimum hazard to natural resources and environment.

Literature Review

T.Subramani *et al.*[14] (2014)**-** Landsat images of TM and ETM+ of Panamarathupatti lake salem city area are collected from the USGS Earth Explorer web site. After image pre-processing, un-supervised and supervised image classification has been performed to classify the images in to different land use categories. Five land use classes have been identified as Urban (Built-up), Water body, Agricultural land, Barren land and Vegetation. Classification accuracy is also estimated using the field knowledge obtained from field surveys. The obtained accuracy is between 73 to80 percent for all the classes. Change detection analysis shows that Built-up area has been increased by 372.28%, agricultural area has been decreased by 65.16% and barren area reduced by 60.98%. Information on urban growth, land use and land cover change study is very useful to local government and urban planners for the betterment of future plans of sustainable development of the city.

P. P. Nikhil Raj *et al.* [7] (2010) - Analyzed the LULC of Bharathapuzha river basin, south India using multispectral LANDSAT imageries of 1973-2005 time periods. 31% depletion in the natural vegetation cover and 8.7%depletion in wetland agriculture area were seen in the basin during the period. On the other hand the urbanspread in the basin increased by 32%. The study highlights the need for a scientific management plan for the sustainability of the river basin, keeping in view the recent climatic anomalies and hydrological conditions of the basin. The study was carried out through Remote Sensing and GIS approach using SOI toposheets, Landsat imagery of 2000 andIRS-1D-LISS-III 2010. The land use/land cover classification was performed based on the SOI toposheets and Satellite imageries. GIS software is used to prepare the thematic maps and ground observations were also performed to check the accuracy of the classification. The study has brought out that the aquaculture tanks have been decreased from 33.02% to25.66% during 2000-2010 with a net decrease of 7.34%.Agriculture was also decreased from 43.32%to 37.75%.

Girish *et al.* [9] (2004) **-**demonstrated the role of hydro-geo-morphological unit sand lineaments in the storage of ground water study using LISS III data, other than the usual water bodies such as river, pond. The major hydro-geo-morphological units identified in the basin in the descending order of ground water potential are valley fill, plateau, pediments, residual mount, and linear ridge.

Study Area

The study area is Aluva Taluk in Ernakulam district, Kerala located between the North latitudes 10°1'30" to 10°18'0" and East longitudes 76°18'0" to 76°42'0" (Figure 4.1). The total are covered is about 544.3 sq.km. Located on the River Periyar, Aluva is the industrial epicenter of the state. A major transportation hub, with easy access to all major forms of transportation, Aluva acts as a corridor which links the highland districts to the rest of the state. The International airport of Cochin at Nedumbassery falls within the taluk. Periyar is the main river which flows through the taluk.

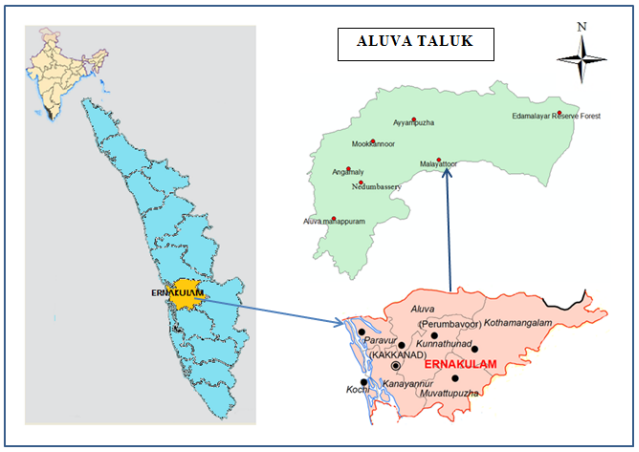

Figure 4.1: Study Area

Materials Used

DATA COLLECTION FOR LAND USE/ LAND COVER MAPPING

Cloud Free LANDSAT satellite data (geo coded with UTM projection, spheroid and datum WGS 1984, Zone 43 North) of 30m spatial resolution of two different years (2000 & 2010) has been downloaded from USGS Earth Explorer website (http://earthexplorer.usgs.gov/). The Landsat Enhanced Thematic Mapper Plus (ETM+) sensor onboard the Landsat 7 satellite has acquired images

of the Earth nearly continuously since July 1999, with a 16-day repeat cycle. Landsat 7 images are referenced to the Worldwide Reference System-2.Landsat 7 ETM+ images consist of eight spectral bands with a spatial resolution of 30 meters for bands 1 to 7. The panchromatic band 8 has a resolution of 15 meters. The details of satellite data collected are shown in the Table 5.1.

Table 5.1: Details of satellite data

No	Characteristics	Satellite	Path and row	Date of Acquisition
1	Spatial resolution : 30m No : of bands : 7	Landsat 7 ETM+	144/53	26-10-2000
2	Spatial resolution : 30m No : of bands :7	Landsat 7 ETM+	144/53	21-12-2010

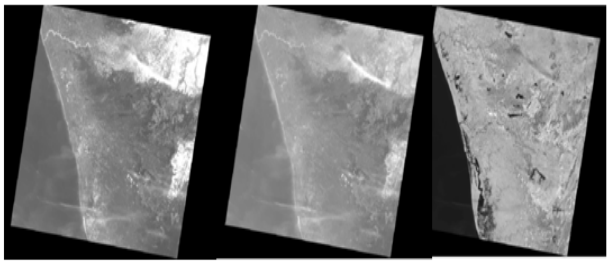

Figure 5.2: Satellite image – band 4, 3, 2

Software Used

ERDAS IMAGINE is a remote sensing application with raster graphics editor abilities designed by ERDAS for geospatial applications. ERDAS IMAGINE is aimed primarily at geospatial raster data processing and allows the user to prepare, display and enhance digital images for mapping use in geographic information system (GIS) or in computer-aided design (CAD) software. The level of brightness or reflectance of light from the surfaces in the image can be helpful with vegetation analysis, prospecting for minerals etc.

Methodology

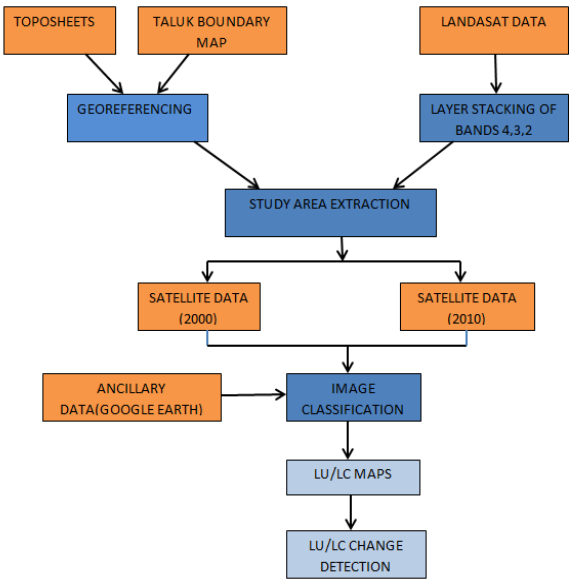

Figure 6.1: Flowchart of land use/ land cover mapping

The toposheet map (1:50,000 scale) was first georeferenced and projected to UTM 43 N. Then the shape file of the study area was created. The satellite imagery of the study area was downloaded from USGS (United States Global Survey) web site, of two different years; the downloaded imagery was then subset using ERDAS Imagine 9.2 software to clip the study area. The satellite images was clipped by stacking the bands 4,3,2 obtained from the USGS site (Figure 6.2) and the study area is masked out from it (Figure 6.3)

BAND 2**-** The spectral response of Band 2 is in the visible portion of the electromagnetic spectrum that corresponds with green light. It can be used with bands 1 and 3 to create "true" color composite images.

BAND 3- The spectral response of Band 3 is in the visible portion of the electromagnetic spectrum that corresponds with red light. It is also one of the three component bands used to create "true" color composite images.

BAND 4**-** The spectral response of Band 4 is in the Near Infrared (NIR) portion of the electromagnetic spectrum. This form of infrared sits just outside the visible red light portion of the electromagnetic spectrum. This form of radiation is reflected to a high degree of leafy vegetation since chlorophyll (the green pigment in green vegetation) reflects much of the NIR that reaches it.

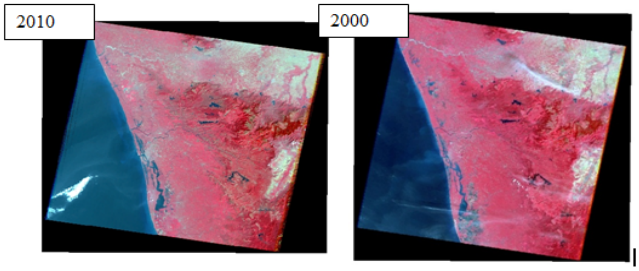

Figure 6.2: Stacked Satellite images of 2010 and 2000

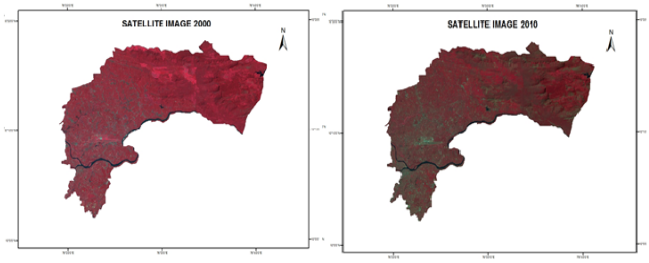

Figure 6.3: Masked satellite image (2000 & 2010) of study area

The process of image classification is to assign the pixels of a raster image to predefined land cover classes. The basic way of image classification is by visual interpretation where tone, texture, size, shape and association are considered (Serra et al. 2008; Qasim et al. 2011, Lillisand and Keifer 2004).

The Land use/Land cover interpretation key using satellite imagery as per the Manual of Nationwide Land use/ Land cover Mapping Using Satellite Imagery published by (National Remote Sensing Agency (NRSA) is given in the Table 6.1

Table 6.1: Land use/ Land cover Interpretation key using satellite images

LAND USE / LAND COVER CATEGORY	TONE/COLOR	SIZE	SHAPE	TEXTURE	PATTERN
Built up land	Dark bluish green in the core and bluish in periphery	Small to big	Irregular and discontinuous	Coarse and mottled	Clustered and scattered & non contiguous
Crop land	Bright red to red	Varying in size	Regular to Irregular	Medium to smooth	Contiguous to non-contiguous
Fallow land	Yellow to greenish blue	Small to large	Regular to Irregular	Medium to smooth	Contiguous to non-contiguous
Plantations	Dark red to red	Small to medium	Regular with sharp edges	Coarse to medium	Dispersed contiguous
Evergreen forest	Bright red to dark red	Varying in size	Irregular discontinuous	Smooth to medium	Contiguous to non-contiguous
Deciduous forest	Dark red to red	Varying in size	Irregular discontinuous	Smooth to medium	Contiguous to non-contiguous
River/ Stream	Light blue to dark blue	Long narrow to wide	Irregular sinuous	Smooth to medium	Contiguous , nonlinear to dendritic

For digital image classification, software like ERDAS imagine, ENVI etc are used. For the present study, supervised classification using Maximum Likelihood Classifier (MLC) is carried in ERDAS Imagine 9.2 software. The maximum likelihood classification algorithm was selected because it has the ability to incorporate the statistics of the training samples before assigning the land covers to each pixel. The MLC is a parametric classifier which assumes that the data for individual classes are distributed normally. It evaluates both the variance and covariance of the category spectral response patterns when classifying an unknown pixel (Nguyen et al. 2013).Because of this, it requires more computation per pixel .MLC requires sufficient spectral training sample data for each class to accurately estimate the statistics needed by the classification algorithm. In this 10 training samples of each Land use classes were taken. The study area is classified with Eight classes namely Water bodies, Built up, Cropland, Agriculture ,Plantation, Forest deciduous, Forest evergreen and Fallow land. Using the signature files of each of the classes, supervised classification was carried out using MLC.

Results and Discussion

Land Use/ Land Cover Mapping And Change Detection

In the present study, Landsat satellite imagery of different years (2000 and 2010) were classified and compared for the land use/land cover analysis. The classified images obtained after preprocessing and supervised classification which are showing the land use and land cover of the Aluva taluk are given in the following Figures (7.1 &7.2). These images provide the information about the land use pattern of the study area. The cyan color represents the built-up area, light green color shows the agricultural area, blue color shows the water bodies, dark green shows forest deciduos, maroon shows plantations, magenta color shows cropland, yellow shows waste land and brown color shows evergreen forest.

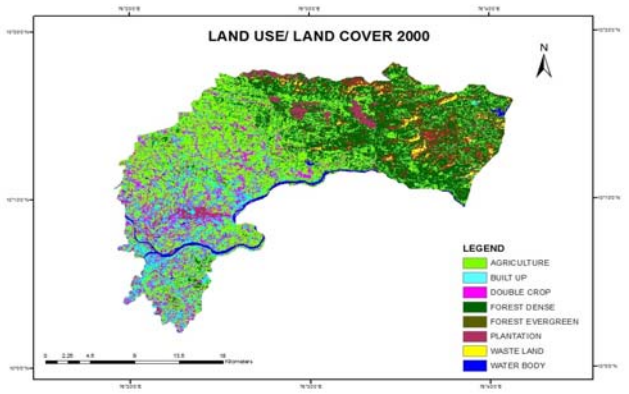

Figure 7.1 : LULC map 2000

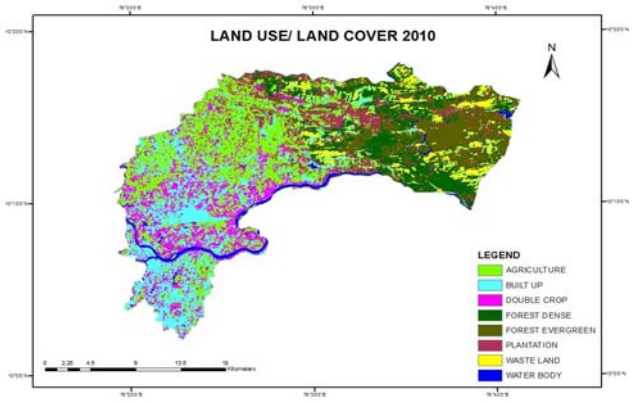

Figure 7.2: LULC map 2010

The classes identified and the respective areas for the year 2000 and 2010 are given in Table 7.1

Table 7.1: Area of Land use classes

CLASS NAME	AREA IN SQ.KM	
	2000	**2010**
BUILT UP	72.941	103.361
AGRICULTURE	170.057	131.555
CROP LAND	47.121	76.599
WATER BODY	12.336	14.243
WASTELAND	13.11	31.279
FOREST EVEGREEN	33.439	74.281
FOREST DECIDUOS	168.923	70.767
PLANTATIONS	26.588	42.43

The percentage area of each Land use/ Land classes are represented in the following pie diagrams.

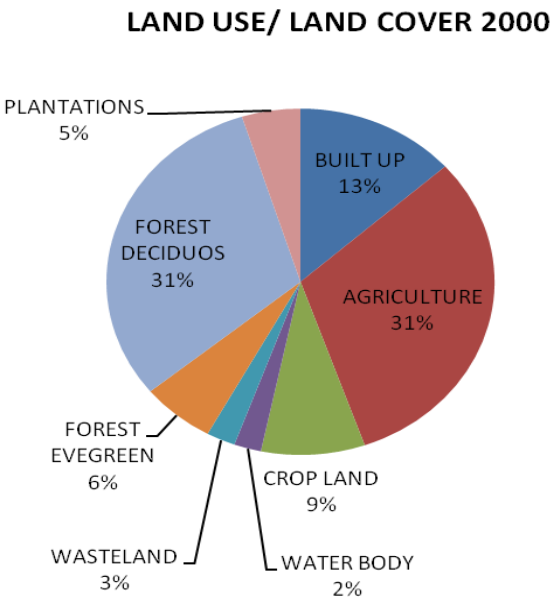

Figure 7.3 : Pie diagram of LULC 2000

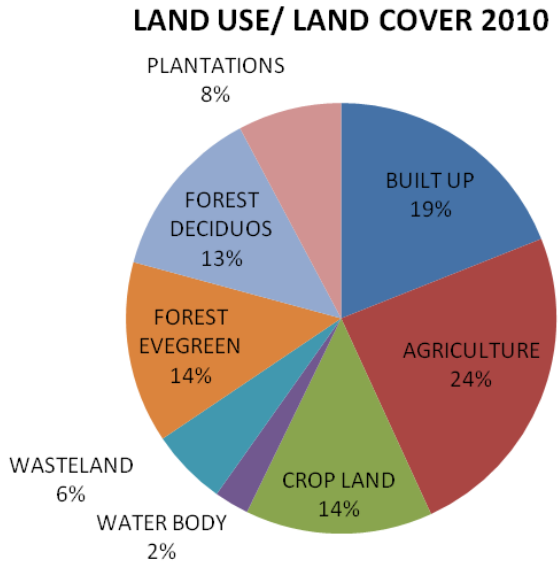

Figure 7.4: Pie diagram of LULC 2010

The varying trend of different LU/LC classes over a period of 10 years is shown in the graph (Figure 7.5).The main objective of this study was to evaluate and quantify the land use /land cover changes that have taken place over Aluva taluk from 2000 to 2010 using remote sensing technologies. From the results obtained considerable changes in Land use/Land cover is observed from 2000 to 2010.

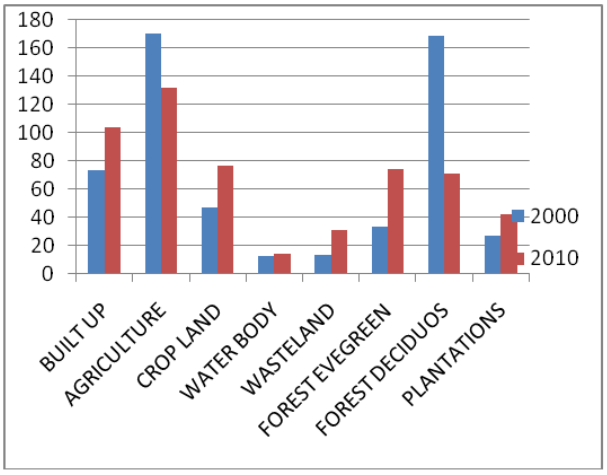

Figure 7.5: Bar chart showing the land use/ land cover change

The attribute data of land use/land cover from the study area between years 2000 and year 2010 with regard to various features indicated significant changes in feature classes .The data indicates that the area under agriculture has been reduced from 31 % in the year 2000 to 24 % in 2010. A decrease of 7 % area under agriculture has been indicated. This may be due to slow and steady growth of urbanization by the way of residential and commercial constructions.

There is a reduction of 10 % in total forest area during the period and this may due to unprecedented rates of deforestation and rapidly rising human population pressure. The declining ratio of forest – to –agricultural lands and the increased intensity of land use , increased the pressure on remaining forest due to illicit cutting of trees (for fire wood, charcoal and for making agricultural implements). Little quantitative information is available on many of these anthropogenic activities so that it is impossible to assess the precise impacts. Nonetheless it is reasonable to assume that increasing levels of disturbances are accompanied by a reduction in forest biomass, impaired vegetation structure and an opening of forest canopy.

Whereas the area of waste land has increased from 3 % to 6%, an increase of 3 % over a period of 10 years. This increase can be attributed to the fact that due to various social and financial reasons farmers are leaving the lands without actively practicing agriculture. This trend has increased in recent times and perhaps caused this increase. It is also observed the amount of waste land has shown a slight increase. According to the waste land atlas of India by National Remote Sensing Centre (NRSC), in Kerala there has been an increase of 669.89 sq.km from the year 2000 to 2013 which is 1.72% of the geographical area.

Conclusions

Mapping and monitoring of land use/land cover is important for many management and planning activities as it is considered as an important element for understanding the earth and its whole system. The present study shows how well LU/LC classification and its change analysis of the year 2000 and 2010 of the study area can be easily carried out using Remote Sensing and GIS technology. The results show that there is noticeable increase in Built up land Plantations about 6% and 3% respectively. Forest cover and agricultural land show considerable decrease of about 10% and 7%.There is no significant fluctuation in the case of water bodies. The classification results are likely to be affected by various factors such as the quality of the input datasets, classification methods, algorithm, etc.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.

References

1. T. Subramani and V. Vishnumanoj (2014),"Land Use & Land Cover Change Detection and Urban Sprawl Analysis of Panamarathupatti Lake, Salem", International Journal of Engineering Research and Applications, ISSN : 2248-9622, Vol. 4, Issue 6(Version 2),pp.217-127

2. S.Tamilenthi1 et al,(2011), "Dynamics of urban sprawl, changing direction and mapping: A case study of Salem city, Tamilnadu, India", Achieves of Applied Science Research, 3,277-286

3. P. P. Nikhil Raj, P. A. Azeez (2010) " Land Use and Land Cover Changes in a Tropical River Basin: A Case from Bharathapuzha River Basin,Southern India", Journal of Geographic Information System, ,Published Online October 2010 (http://www.SciRP.org/journal/jgis).

4. M. Girish Kumar, Rameshwar Bali & A. K. Agarwal, October (2009) "Integration of remote sensing and electrical sounding data for hydrogeological exploration—a case study of Bakhar watershed, India" Hydrological Sciences–Journal–des Sciences Hydrologiques.

5. J.Li and H.M.Zhao, (2003), "Detecting Urban Land Use and LandCover Changes in Mississauga using Landsat TM images.

Author's details

[1]M.Tech student, Department of coastal and offshore Engineering, K.U.F.O.S. Kochi, Kerala, India, Email: jiyageorge1993@gmail.com.

[2]B.Tech Graduate, Civil Engineering, FISAT Angamaly, Kerala, India, Email: lindababy2011@gmail.com.

[3]B.Tech Graduate, Civil Engineering, FISAT Angamaly, Kerala, India, Email: anjalyarickal@gmail.com.

[4]B.Tech Graduate, Civil Engineering, FISAT Angamaly, Kerala, India, Email: josdev1993@gmail.com.

Copy for Cite this Article- Jiya George, Linda Baby, Anjaly P Arickal and Jose Dev Vattoly, "Land Use/ Land Cover Mapping With Change Detection Analysis Of Aluva Taluk Using Remote Sensing And GIS', *International Journal of Science, Engineering and Technology,* Volume 4 Issue 2: 2016, pp. 383- 389.