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LAND USE/LAND COVER STUDIES USING REMOTE SENSING AND GIS FOR MUTHUPET

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ABSTRACT

Land Use/Land Cover Change has become an important Component in Current strategies for managing natural resources and monitoring environmental changes. This Project examines the use of GIS and Remote sensing in studying the Land use and Land cover in Muthupet from 2007 to 2012 so as to detect the changes that have been taken place in this status between these periods. This Project also reveals that the agricultural activity has been decreasing these years. With this data this has been found that the Agricultural Lands are decreasing at the coast of haphazard growth of population. This will help in maintaining the ecological balance and improving micro-Environment of the Region.

Index terms: Remote sensing, GIS, Land Use Changes, PCA Analysis, NDVI, Supervised Classification.

INTRODUCTION

Human-dominated environments are becoming – or have become – equally important in the Earth System as natural ones. Human-dominated environments include various types of land use such as managed forests, agricultural fields, grasslands and pastures used to produce food for livestock but also oceans, seas, lakes, rivers, coastlines, and deltas used for transport, fishing, and irrigation as well as urban environments with varying amounts of vegetation. All these environments have significant and in some cases crucial interactions with climate, air quality, ecosystem services and biodiversity of the region on a potentially very large range of spatial and temporal scales. Land use / Land cover change has become an important component in current strategies for managing natural resources and monitoring environmental changes. The advancement in the concept of vegetation of the spread and health of the world’s forest, grassland and agricultural resources has become an important priority. Although the terms land cover and land use is often used interchangeably, their actual meanings are quite distinct. Land cover refers to the surface cover on the ground, whether vegetation, urban infrastructure, water, bare soil or other. Identifying, delineating and mapping land cover is important for global monitoring studies, resource management, and planning activities. Identification of land cover establishes the baseline from which monitoring activities (change detection) can be performed, and provides the ground cover information for baseline thematic maps. Land use refers to the purpose the land serves, for example, recreation, wildlife habitat, or agriculture. Land use applications involve both baseline mapping and subsequent monitoring, since timely information is required to know what current quantity of land is in what type of use and to identify the land use changes from year to year. This knowledge will help develop strategies to balance conservation, conflicting uses, and developmental pressures. Issues driving land use studies include the removal or disturbance of productive land, urban encroachment, and depletion of forests. Application of remotely sensed data made possible to study the changes in land cover in less time, at low cost and with better accuracy. Remote sensing and Geographic Information System (GIS) provide efficient methods for analysis of land use issues and tools for land use planning and modeling.

STUDY AREA DESCRIPTION:

The Mullipallam creek is a semi enclosed coastal wetland surrounded by mangrove swamps and intertidal land situated on the southeastern coast of India, approximately 400 km south of Chennai. The study area spreads over 10º18′ to 10º22′ N latitude and 79º28′ to 79º36′ E longitude and is a medium tropical transition climate, characterized by a monthly average temperature of over 27ºC. The extensive mangrove habitat is estimated to be about 1,500 ha [30], and the creek is used for fishing and it serves as a nursery ground for marine fish and shrimps. The creek receives freshwater from five tributaries of the Cauvery River, such as the River Paminiyar, Kilathangiyar, Korayar and Marakkakorayar and the Kandankurichanar channel. The creek receives fresh water mostly during the north eastern monsoon season, from October to November but fresh water input into the creek is limited to the north eastern monsoon period. The developmental activities around the Mullipallam creek area are very scanty, and the commercial activities include salt pans, aquaculture ponds, agricultural. The multifarious uses and values of the Muthupet mangroves were reduced over a period of time due to direct and indirect natural and man-made activities.

Muthupet mangrove forest was under the control of Chatram Department from 1853 to 1912 (Chengappa, 1918). The Government of the Presidency of Madras Gazette (1937) shows, from 1923 to 1936, half of the revenue obtained from selling mangrove products was paid to the revenue department and the remaining half was spent to maintain the “Chatrams” (Charity homes). The Government declared the Muthupet mangrove forest as revenue forest in February 1937 and accordingly the mangrove forest was handed over to the forest department of the Madras Presidency.

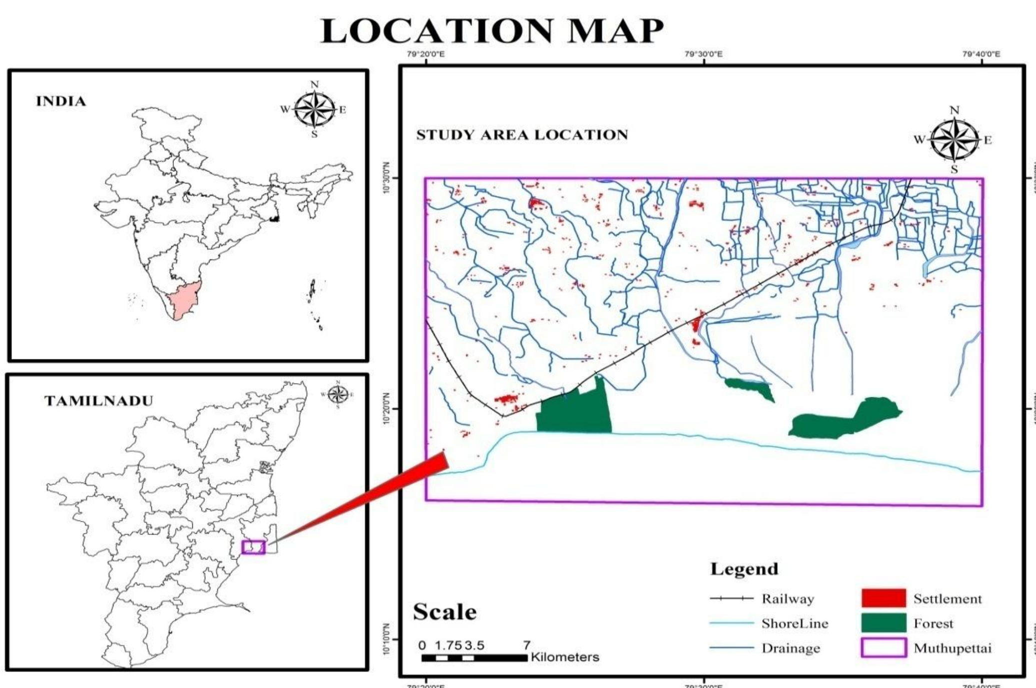

Fig.1. Study area Location map

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METHODOLOGY

To reach the above mentioned objectives the following methodology steps were adopted. For the Landuse/ land cover changes study temporal satellite data were used, LISS III data for the year 2007 and LISS IV 2012. Base map was prepared from SOI Toposheet on 1: 50, 000 scale and updated using satellite data. Geological map of the area was prepared from Geological Quadrangle Map published by Geological Survey of India (GSI). Soil map was prepared from soil survey of India map. All the basic thematic maps like geology, soil, geomorphology, Landuse/land cover maps were digitized using Arc GIS 10.0 software.

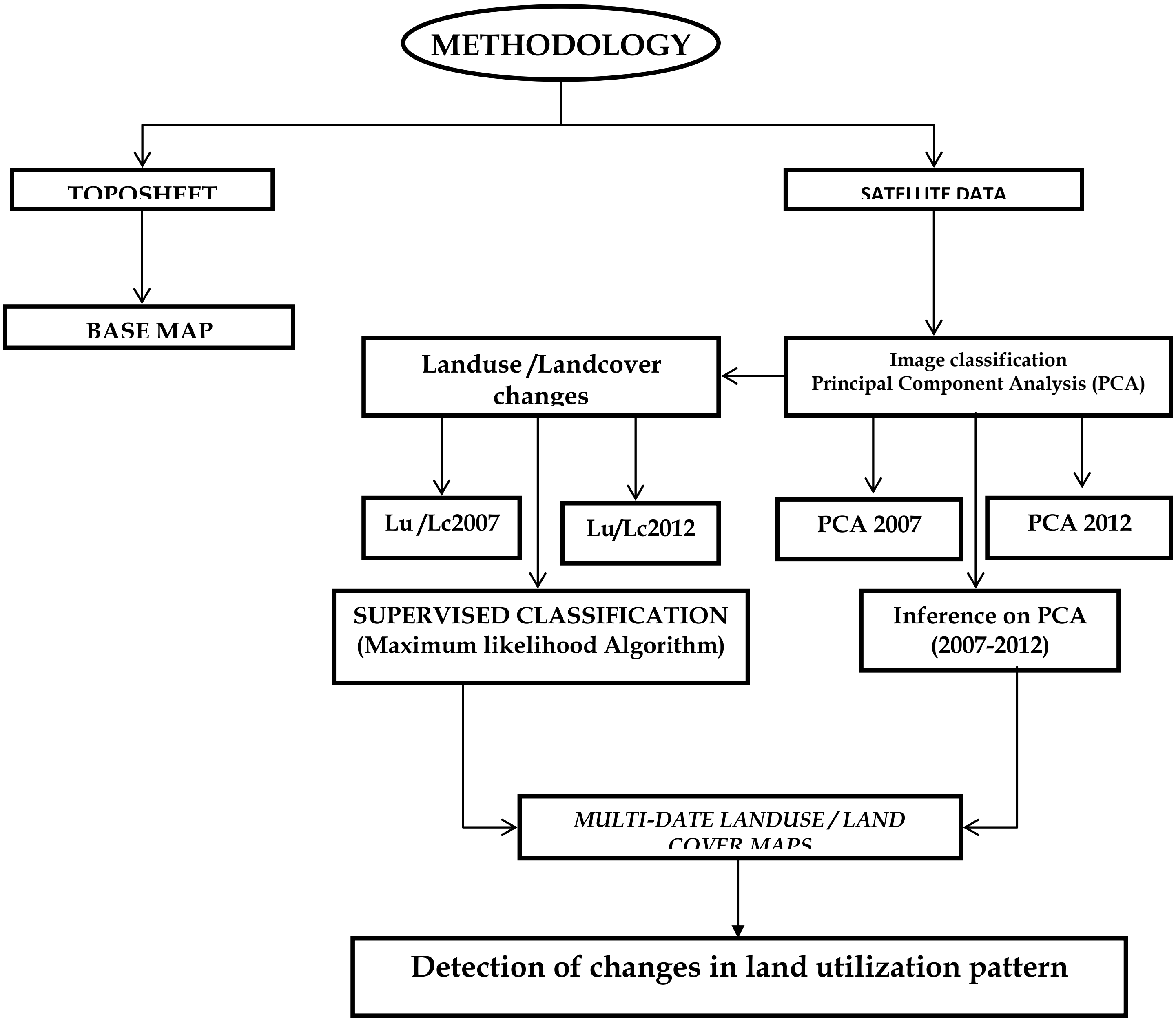

Fig.2. Methodology

RESULT AND DISCUSSION:

Land use / Land Cover Changes during 2007-2012:

A broad classification of different types of vegetation and land use patterns was done and 8 different classes were identified. The land use features like forest, plantations, water bodies, mudflat/tidal flat, aquaculture, crop lands, barren lands, were identified from the satellite imagery. Analysis shows that the aquaculture lands have been increased from 25.07 sq km in 2007 to 26.64 sq km in 2012. The plantation cover has also increased from 67.77 sq km in 2007 to 97.51 sq km, the crop lands has been decreased from 148.65 sq km in 2007 to 110.28 sq km in 2012, the forest cover has been increased when compared to 2007 from 18.66 sq km to 20.97 sq km in 2012, the mud flat has been decreased from 155.18 sq km in 2007 to 131.54 sq km, the water cover has also been decreased when compared from 241.71 sq km to 168.47 sq km, the land left barren has also been increased from 160.31 sq km to 267.82 sq km, the settlements cover has been decreased when compared to 2007 and 2012 from 131.38 sq km to 117.76 sq km. The analysis shows that the features like crop lands, settlements, and mud flat has been decreased when comparing from 2007 to 2012.

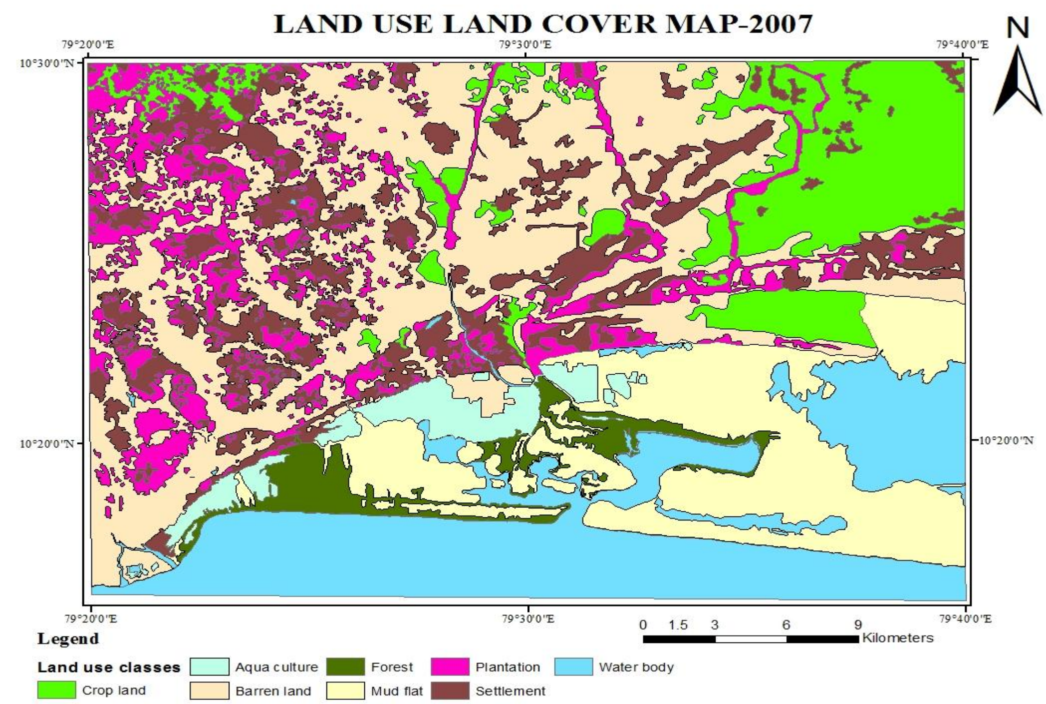

Fig.3.Land use/ Land cover changes (2007)

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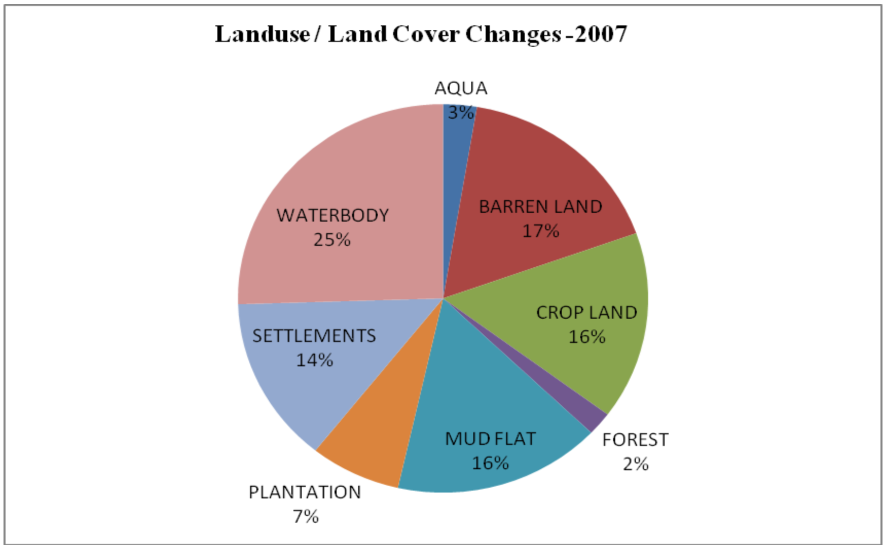

Fig.3.Land use/ Land cover changes (2007)

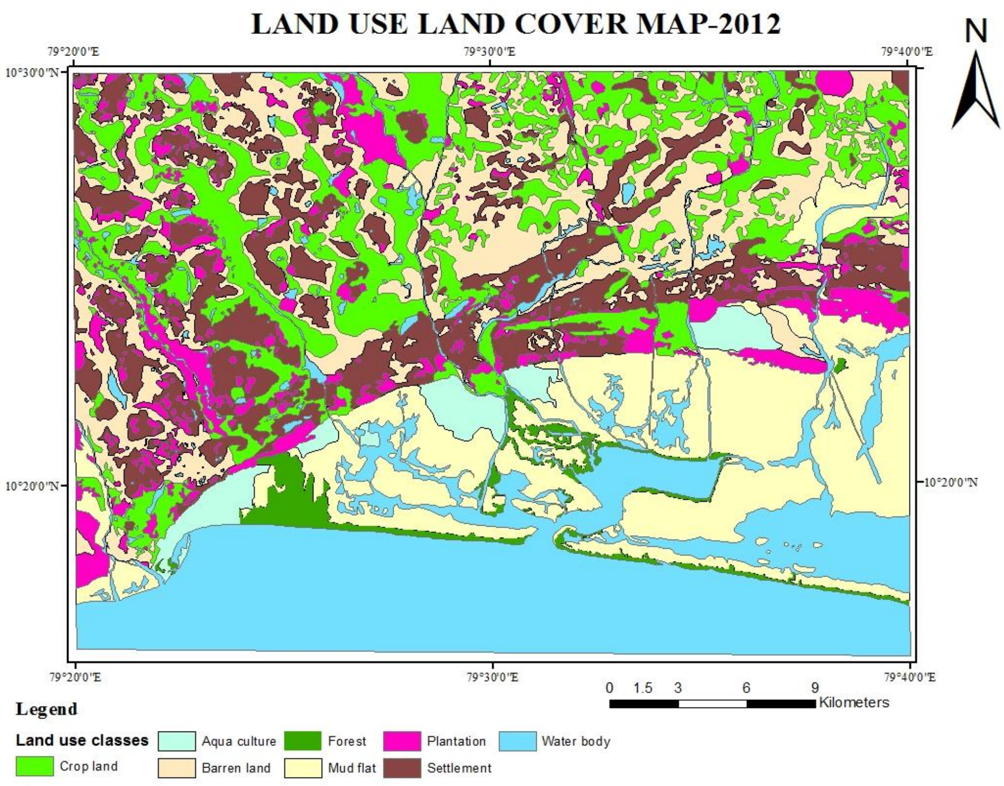

Fig.4.Landuse/Landcoverchanges(2012)

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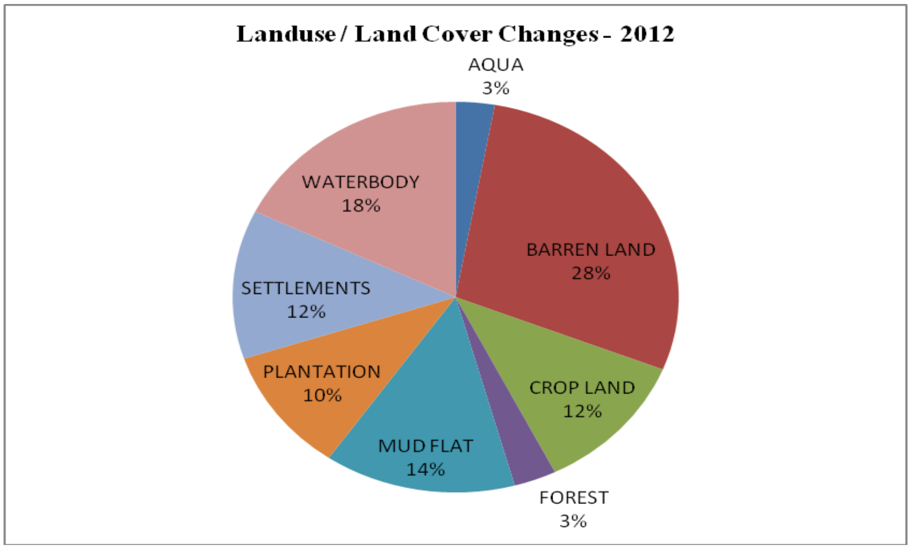

Fig .5. Land use / Land cover changes (2012)

Table.1. Land Use/ Land Cover Changes during 2007-2012**.**

S.NO	LAND USE CLASSES	AREA(Sq.km)	
		2007	**2012**
1	***AQUACULTURE***	*25.07*	*26.63*
2	***BARREN LAND***	*160.30*	*267.82*
3	***CROP LAND***	*148.62*	*110.28*
4	***FOREST***	*18.66*	*29.06*
5	***MUD FLAT***	*155.18*	*131.53*
6	***PLANTATION***	*67.77*	*97.51*
7	***SETTLEMENTS***	*131.37*	*117.15*
8	***WATERBODY***	***241.70***	***168.47***
	TOTAL AREA	*948.70*	*948.48*

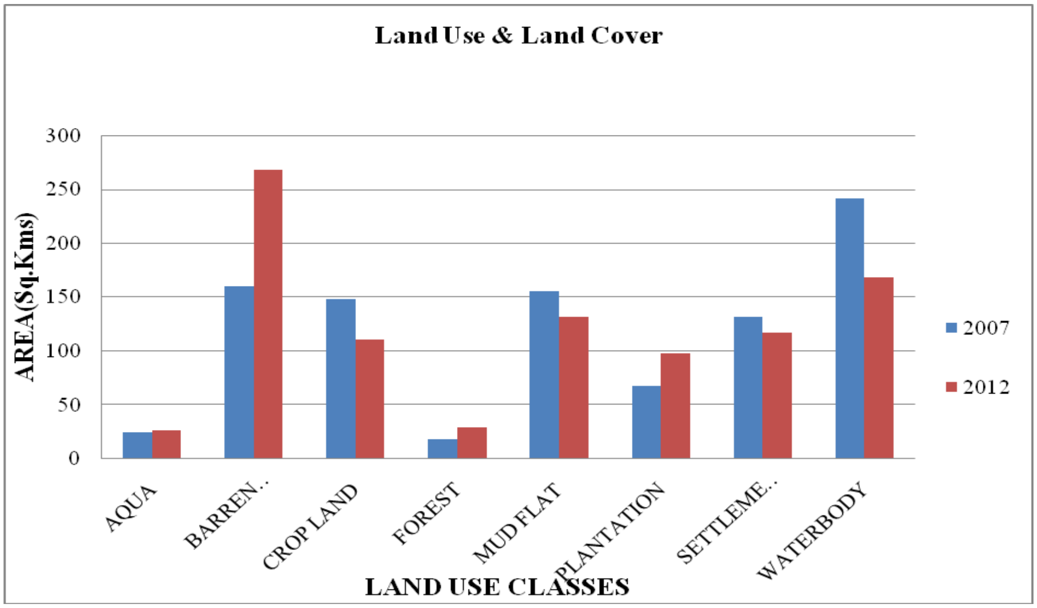

Fig .6.Land use / Land cover changes (2007-2012)

SUPERVISED CLASSIFICATION:

In supervised classification, the image analyst supervises the pixel categorization process by specifying to the computer algorithm; numerical descriptors of the various land-cover types present in the scene. To do this, representative sample sites of known cover types, called training areas or training sites, are used to compile a numerical interpretation key that describes the spectral attributes for each feature type of interest. Each pixel in the data set is then compared numerically to each category in the interpretation key and labelled with the name of the category it looks most like.

In supervised classification, we identify examples of the Information classes (i.e., land cover type) of interest in the image. These are called ***"training sites"***. The image processing software system is then used to develop a statistical characterization of the reflectance for each information class. This stage is often called ***"signature analysis"*** and may involve developing a characterization as simple as the mean or the range of reflectance on each bands, or as complex as detailed analyses of the mean, variances and covariance over all bands. Once a statistical characterization has been achieved for each information class, the image is then classified by examining the reflectance for each pixel and making a decision about which of the signatures it resembles most based on suitable classifier algorithm.

The most commonly used supervised classification is maximum likelihood classification (MLC), which assumes that each spectral class can be described by a multivariate normal distribution. (Fig 1.8 & Fig 1.9)

Algorithm:

The maximum likelihood classifier quantitatively evaluates both the variance and covariance of the category spectral response patterns when classifying an unknown pixel. To do this, an assumption is made that the distribution of the cloud of points forming the category training data is Gaussian (normally distributed). This assumption of normality is generally reasonable for common spectral response distributions. Under this assumption, the distribution of a category response pattern can be completely described by the mean vector and the covariance matrix. Given these parameters, we may compute the statistical probability of a given pixel value being a member of a particular land cover class.

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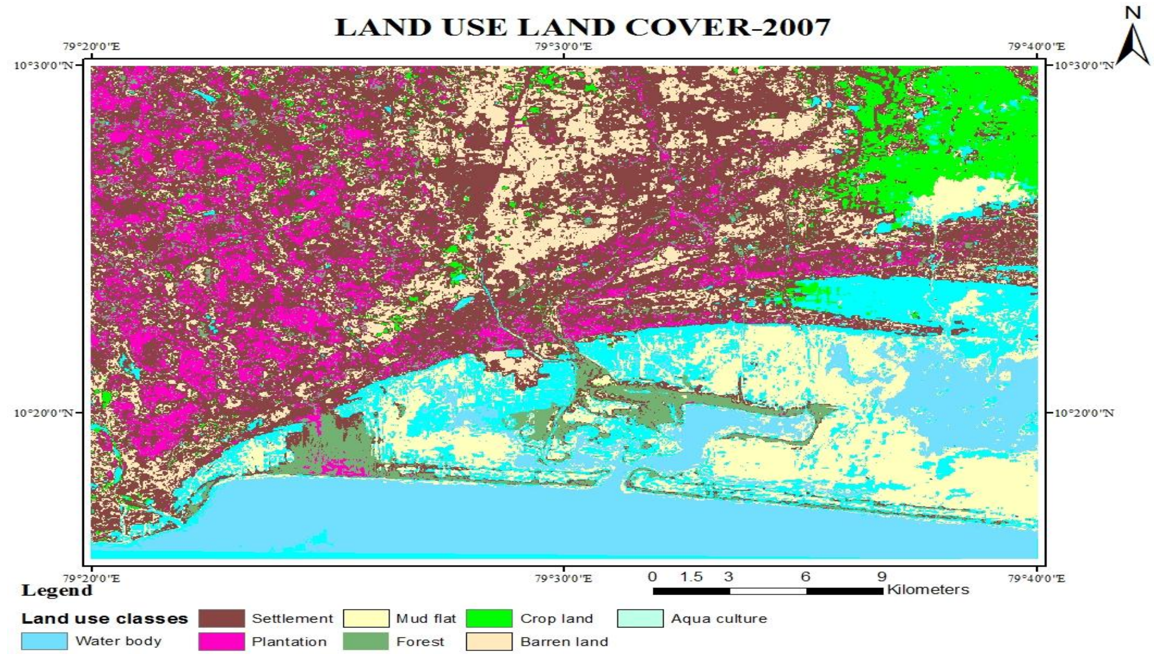


Fig .7.Landuse / Land cover classification map (2007)

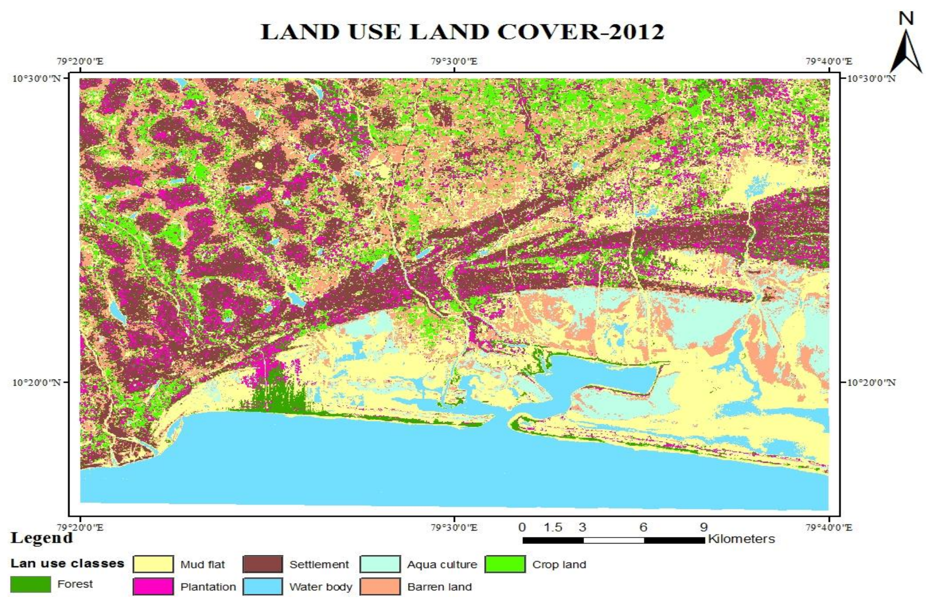
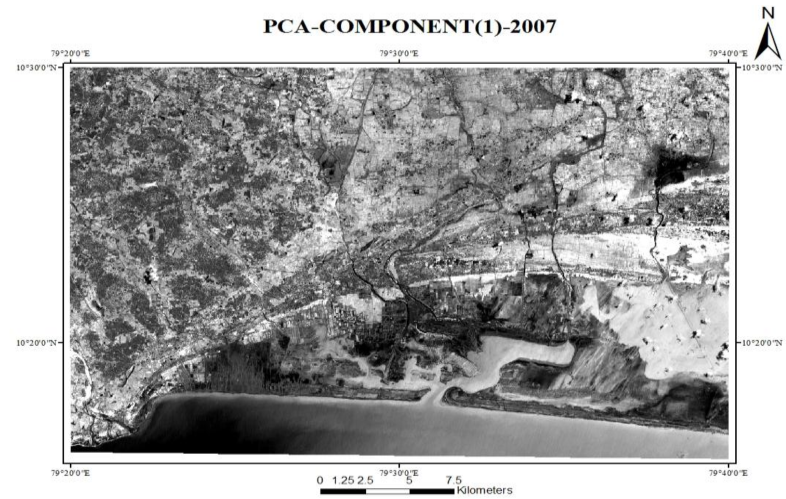


Fig .8.Landuse / Land cover classification map(2012)

PRINCIPAL COMPONENT ANALYSIS:

Principal components analysis is a method in which original data is transformed into a new set of data which may better capture the essential information. Often some variables are highly correlated such that the information contained in one variable is largely a duplication of the information contained in another variable. Instead of throwing away the redundant data principal components analysis condenses the information in inter correlated variables into a few variables, called principal components. Principal component analysis is an image enhancement technique which is related to Factor analysis that transforms a set of correlated bands (variables) into a set of uncorrelated bands called principal components (PC) which are quite easy to interpret. Multi-spectral bands in any remote sensing imagery have similar spatial structure and high inter band correlation and there is duplication of information in all spectral bands. To reduce this redundancy in these multi-spectral bands this multivariate statistical technique called principal component analysis (PCA) is used.



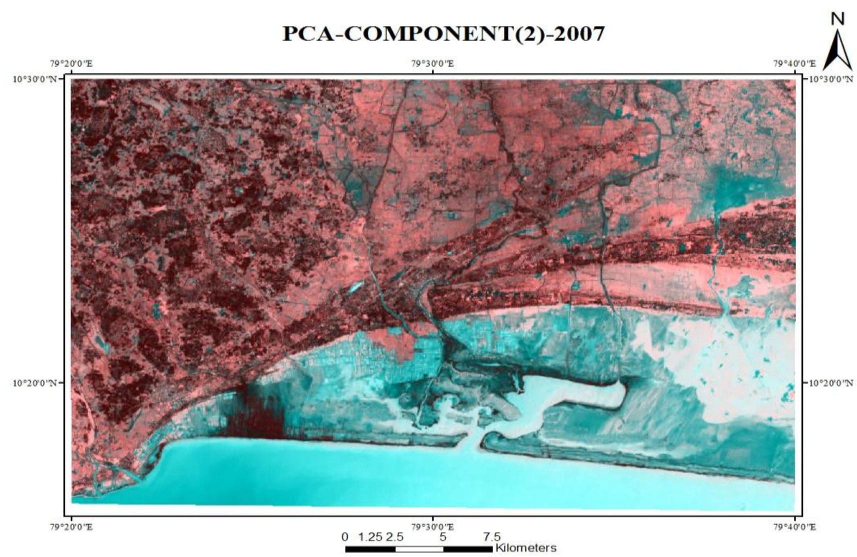


Fig .10. PCA –component (2) - 2007

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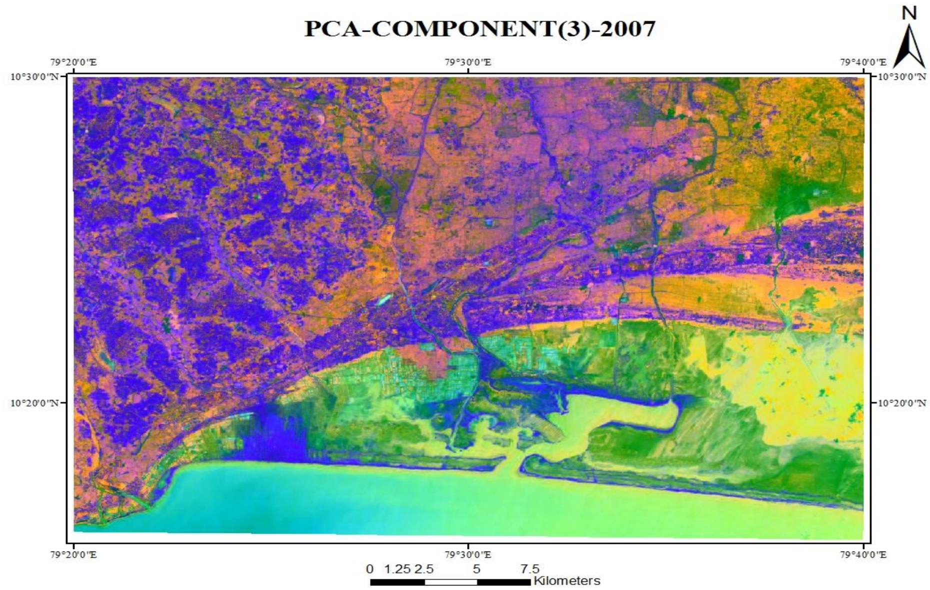

Fig.11. PCA - component (3) - 2007

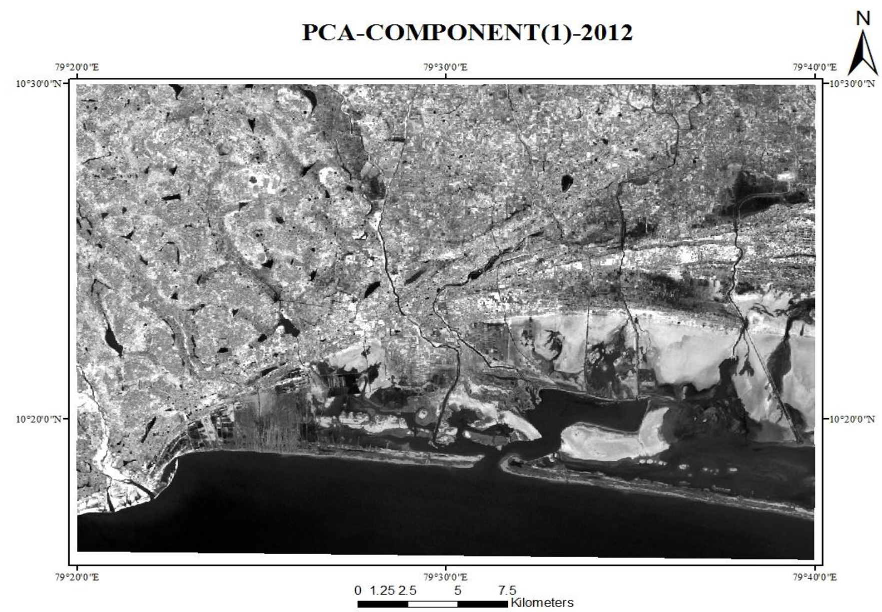

Fig.12. PCA – component (1) - 2012

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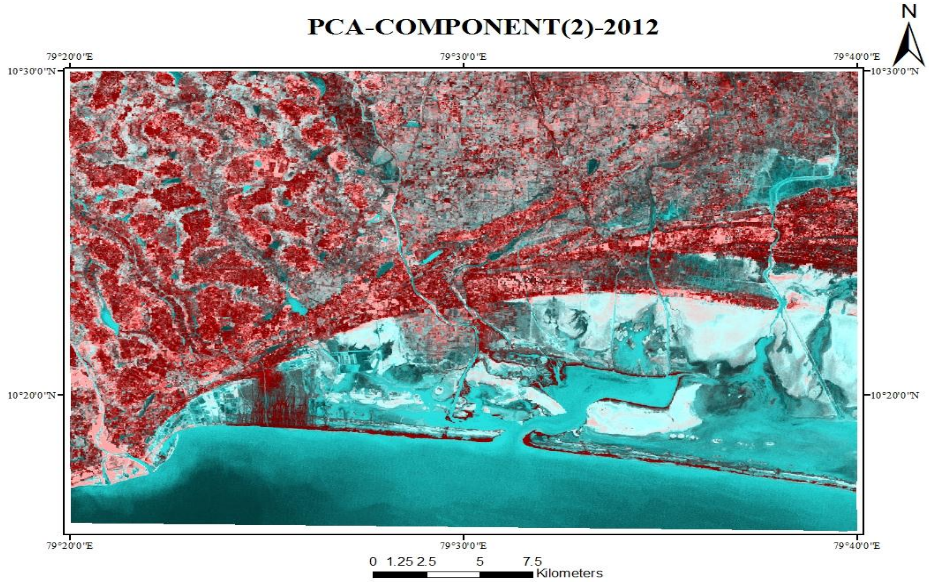

Fig .13. PCA – component (2) -2012

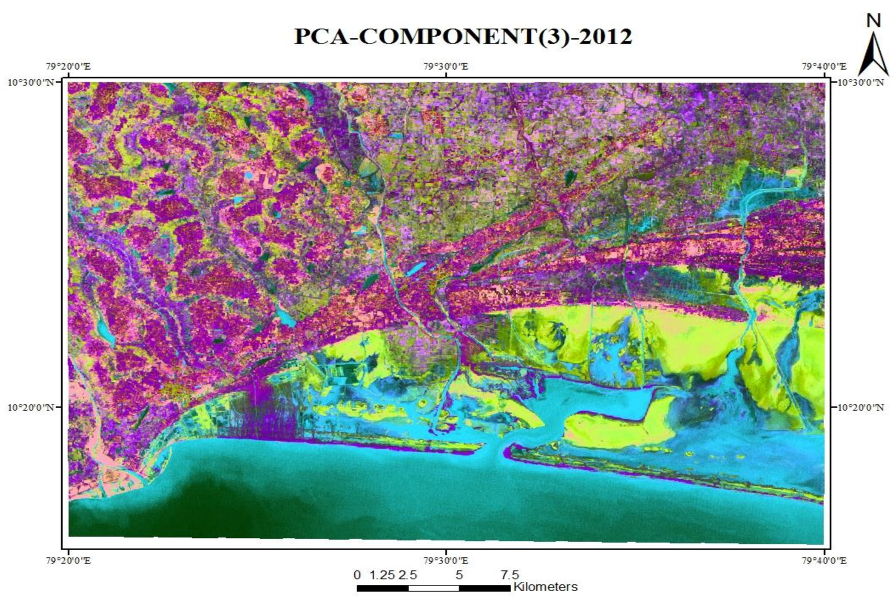

Fig .14. PCA – component (3) - 2012

Inference on PCA:

In PCA with one component the water body was very well highlighted and the aqua culture ponds and settlements were also emphasized. In PCA with two components the features such as water bodies, mudflat, forest, crop lands were well emphasizes. In PCA with three components the features such as

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forest, crop lands, barren lands, plantations were well highlighted.

NORMALIZED DIFFERENCE VEGETATION INDEX (NDVI):

NDVI = NIR – Red / NIR + Red

NDVI values lies between -1and +1. Vegetation in good condition shows higher NDVI values. This is used to eliminate the seasonal sun angle difference and minimize atmospheric effects. Higher values indicate more density and vigor of the vegetation. NDVI is extensively used to detect seasonal variations among vegetation.

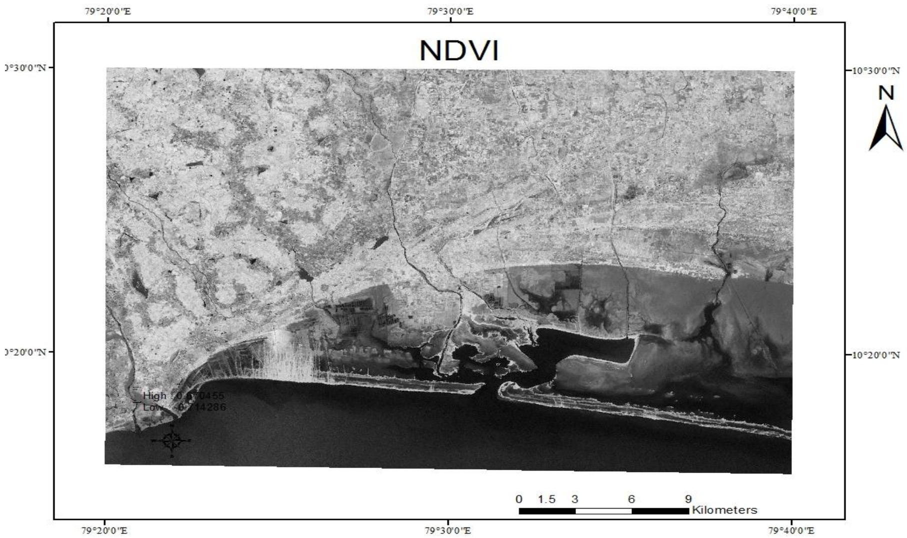

Fig.15. Normalized Difference Vegetation Index

6.1 CONCLUSION

The result of Landuse/ land cover mapping and assessment based on visual interpretation and digital clearly revealed changes in the trend of Landuse and Land cover in Muthupet area. It also reveals that the agricultural activity that is the crop land has been decreasing when compared to 2007 and 2012 and in the reverse the barren land area is been increasing which is not a good sign. It also gives us a view on the water cover that has been decreased when we compare 2007 and 2012.

Thus the study has exposed the satellite data the unique capability to detect the changes in Landuse quickly and accurately. From the analysis it has been found that the satellite data is very useful and effective for mapping the results of temporal changes. With this data this has been found that the Agriculture lands are decreasing at the cost of haphazard growth of plantation. This will help in maintaining the ecological balance and improving micro – environment of the region.

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