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Studies on Land Use/Land Cover and change detection from parts of South West Godavari District, A.P – Using Remote Sensing and GIS Techniques

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ABSTRACT
Land use/ land cover is an important component in understanding the interactions of the human activities with the environment and thus it is necessary to monitor and detect the changes to maintain a sustainable environment. In this paper an attempt has been made to study the changes in land use and land cover of southern part of West Godavari district. The study was carried out through Remote Sensing and GIS approach using SOI toposheets, Landsat imagery of 2000 and IRS-1D-LISS-III 2010. The land use/land cover classification was performed based on the Survey of India toposheets and Satellite imageries. GIS software is used to prepare the thematic maps and ground truth observations were also performed to check the accuracy of the classification. The present study has brought out that the aquaculture tanks have been decreased from 33.02% to 25.66% during 2000-2010 with a net decrease of 7.34%. Agriculture was also decreased from 43.32% to 37.75% with a net decrease of 5.56% during 2000-2010. The reasons for this decrease have been discussed. However, some plantations mixed with crops, fallow lands and settlements have shown considerable increase. The areas under natural streams/ rivulets, mangroves etc have shown no significant change and can be considered as a positive sign for sustainable development. Though there are some changes detected in landuse/land cover analysis of the period 2000-2010, it does not indicate any significant environmental impact on the study area. However, it is necessary to closely monitor the landuse/land cover changes for maintaining a sustainable environment.

INTRODUCTION

Land use/land cover (LULC) changes are major issues of global environment change. The satellite remote sensing data with their repetitive nature have proved to be quite useful in mapping land use/land cover patterns and changes with time. Quantification of such changes is possible through GIS techniques even if the resultant spatial datasets are of different scales/ resolutions (Sarma et al., 2001). Such studies have helped in understanding the dynamics of human activities in space and time. Land use refers to man's activities. The varied uses which are carried over on land and land cover refer to natural vegetation, water bodies, rock/soil, artificial cover on the land .Land use change is the modification in the purpose and usage of the land, which is not necessarily the only change in land cover. It also includes changes in intensity and management (Verburg, et al, 2000). Information about land use change is necessary to update land cover maps and for effective management and planning of the resources for sustainable development(Alphan 2003).Over the years, remote sensing has been used for land use/land cover mapping in different parts of India (Gautam and Narayanan, 1983: Sharma et al.,1984: Jain, 1992; Brahabhatt et al., 2000). Accurate and up-to-date land cover change information is necessary to understand and assess the environmental consequences of such changes (Giri et al, 2005). The present study has been taken up in order to understand the changes that have taken place in land use/land cover in southern parts of West Godavari district. This area is known for extensive aquaculture activity in recent times. It is believed that this aggressive human activity might have influenced on the landuse/land cover patterns resulting in a possible impact on the environment. This work is taken up to better understand this aspect.

Keywords: Land use/land cover, Change Analysis, Remote Sensing techniques.

STUDY AREA

The study area is located in and around the southern parts of West Godavari district, Andhra Pradesh. The area covered in this investigation is about 845.552 sq.km lying in between 81°20' to 81°50' E longitude and 16°15' to 16° 35' N latitude (Fig: 1). The study area is in between the delta regions of the Krishna and Godavari rivers.

OBJECTIVES

The aim of this study is to produce a land use/land cover map of southern parts of West Godavari district and surrounding areas in order to detect the changes that have taken place over a given period using change detection method.

The following specific objectives are pursued in order to achieve the aim.

- To create a land use / land cover classification scheme.
- To determine the trend, nature, rate, location and magnitude of land use / land cover change.

DATA USED

For monitoring the changes in land use/land cover, **IRS-1D-LISS-III digital data of 2010** along with **Landsat ETM digital data of 2000** have been used. The Survey of India (SOI) topographical maps of the series **65 H/6, 65 H/7, 65 H/9, 65 H/10, 65 H/11, 65 H/14, 65 H/15** published on a scale 1:50000 have been used along with other collateral data.

METHODOLOGY

For the purpose of study of land use/land cover ARC GIS 9.2 and ERDAS IMAGINE 9.1 are powerful tools for extracting the land use, land cover layers, from SOI toposheets and satellite imageries. The land use/land cover classes include agriculture land, aquaculture tanks, settlements, rivers, drains, mangroves, mud flats etc. This classification and methodology (Fig: 2) is performed based on the standard methodology. Later Change Detection methodology was done for the images to find out the changes that have taken place in the study area using ERDAS IMAGINE 9.1. The

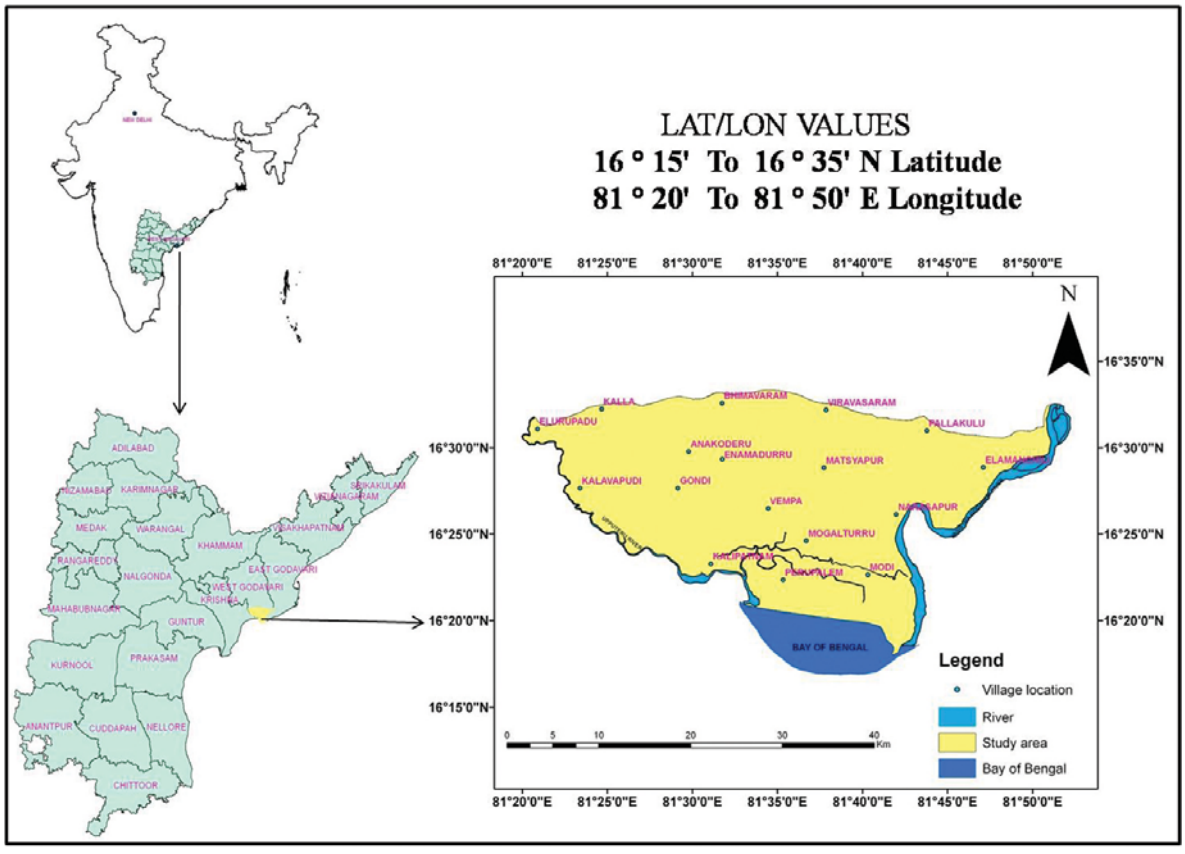

Figure 1. Location Map of Study Area

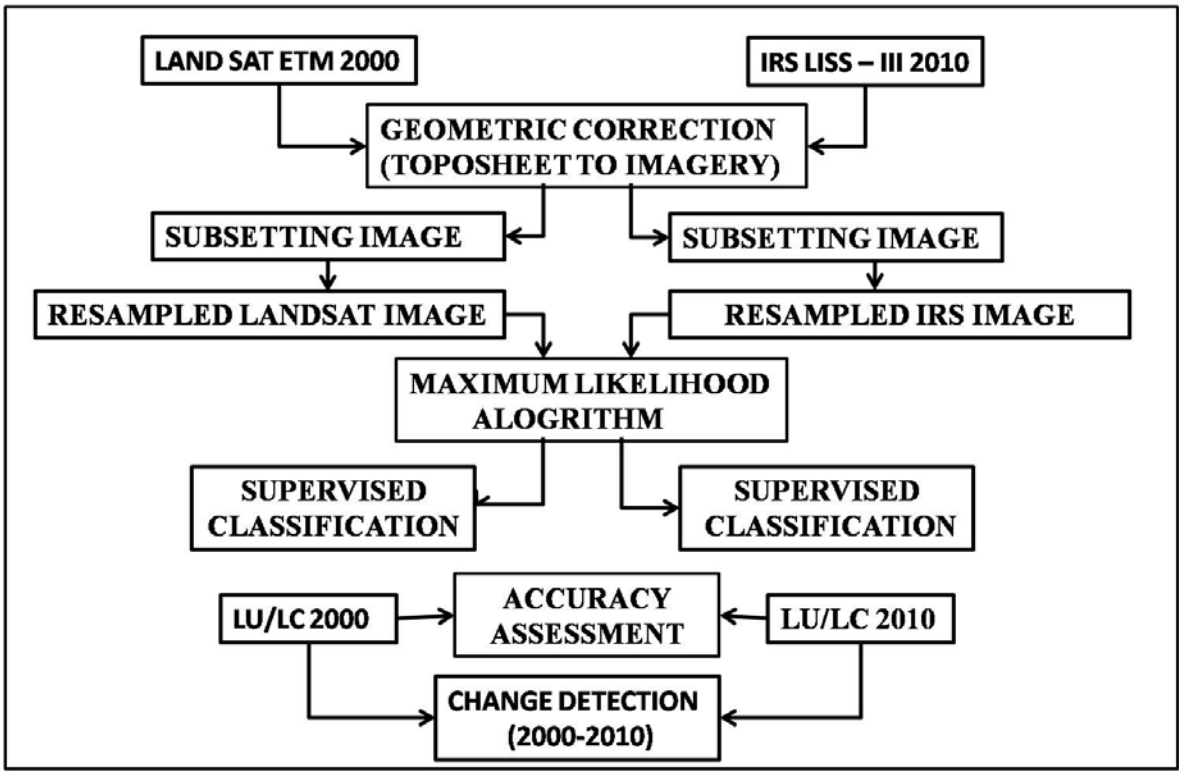

Figure 2. Flow Chart of the Methodology for LU/LC and Change Detection

feature classes were identified based on the visual interpretation of the satellite imagery coupled with filed checks. These datasets were digitized and analyzed to obtain land use/land cover statistics for the areas under each of these categories for both the years.

RESULTS & DISCUSSIONS

The satellite data sets of West Godavari IRS-1D-LISS-III of the year 2010 and Landsat ETM of year 2000 were rectified in ERDAS IMAGINE 9.1 by Geo-referencing the satellite data with the help of already rectified SOI topo maps of the particular area by giving lat/lon values. After Geo-referencing the satellite data these were opened in ARC GIS 9.2 and by visual interpretation the classes were identified and they were ditiziged as shape files to produce a detailed land use/land cover map for both the digital data sets of the study area (Fig: 3 & Fig. 4). Attribute information is also obtained (Table. 1), i.e. the area and percentage occupied by different classes for both the data sets of the study area. Based on this the changes that have taken place between the two data sets have been brought out and presented in pictorial representation (Fig: 5). The details are discussed below.

CHANGE DETECTION ANALYSIS

Change detection is an important application of Remote Sensing technology. This gives us the changes of specific features within a certain time interval. For a given research purpose, when the remotely sensed data and study areas are indentified, selection of an appropriate change detection method has considerable significance in producing a high-quality change detection product.

Now after obtaining detailed land use/land cover information, change detection analysis is done by using two data sets to find out the changes that have taken place between the years 2000 to year 2010. A detailed attribute information of the feature classes, that has been changed between the two data sets (Table: 2).

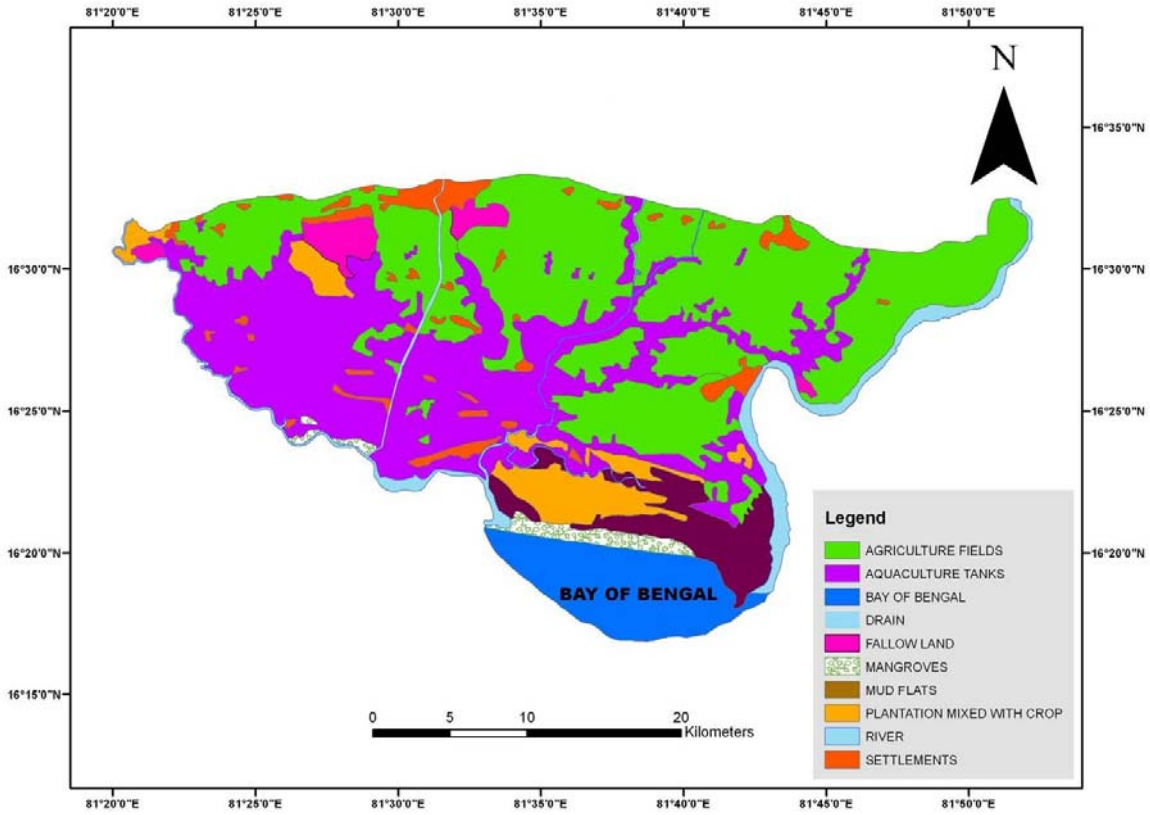

Figure 3. Land use/Land cover of Landset (2000)

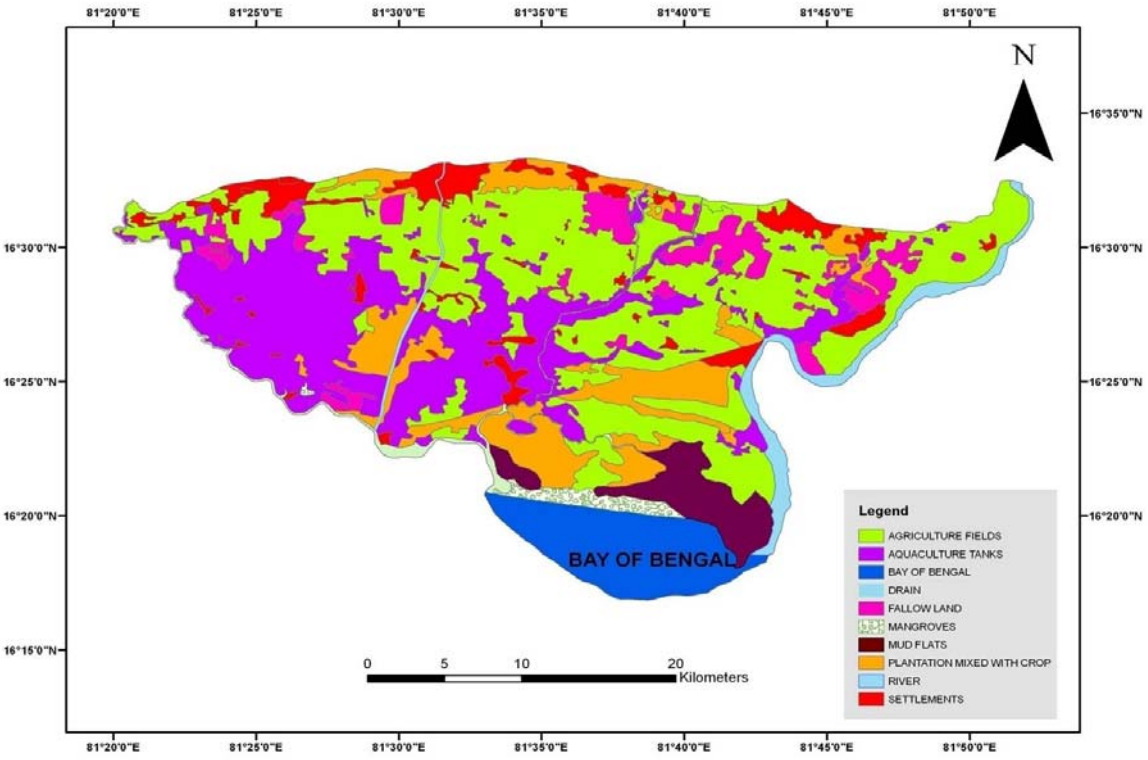

Figure 4. Land use/Land cover of LISS - III (2000)

Table 1. Attribute data of supervised classification of change detection images

	LISS-III 2010		LAND SAT 2000	
FEATURE NAME	AREA OCCUPIED IN (Sq.Km)	% OF AREA OCCUPIED	AREA OCCUPIED IN (Sq.Km)	% OF AREA OCCUPIED
AGRICULTURE FIELDS	317.354	37.75	364.297	43.32
AQUACULTURE TANKS	215.757	25.66	277.668	33.02
DRAINS	4.234	0.27	4.234	0.27
FALLOW LAND	57.113	6.79	19.587	2.31
MANGROVES	13.868	1.64	13.868	1.64
MUD FLATS	37.918	4.51	46.006	5.47
PLANTATION MIXED WITH CROP	106.025	12.61	45.132	5.47
RIVERS	36.414	4.3	36.414	4.3
SETTLEMENTS	56.869	6.76	35.346	4.2
TOTAL	845.552	100.00	845.552	100.00

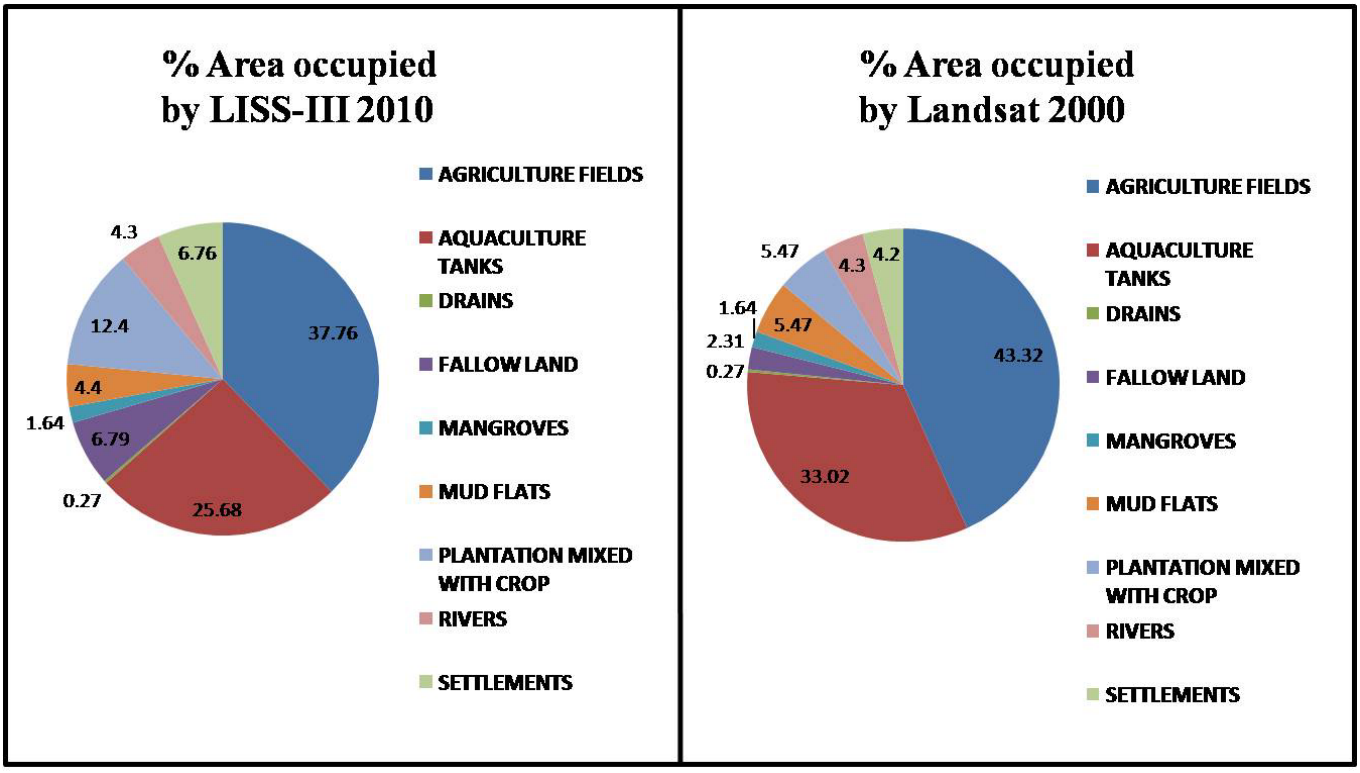

Figure 5. Pictorial representation of LU/LC classes

Table 2. Attribute data of supervised classification of change detection images

FEATURE CLASS	LISS III - 2010	LAND SAT 2000	% DIFFERENCE
AGRICULTURE FIELDS	37.75	43.32	-5.56
AQUACULTUR E TANKS	25.66	33.02	-7.34
DRAINS	0.27	0.27	0.00
FALLOW LAND	6.79	2.31	4.48
MANGROVES	1.64	1.64	0.00
MUD FLATS	4.51	5.47	-1.07
PLANTATION MIXED WITH CROP	12.61	5.47	6.93
RIVERS	4.3	4.3	0.00
SETTLEMENTS	6.76	4.2	2.56

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(Fig: 6).

The data indicates that the area under agriculture has been reduced from 43.32% in the year 2000 to 37.75% in 2010. A decrease of 5.56% area under agriculture has been indicated. This is because of the fact the study area has been classified as urban and semi urban category and the decrease of agriculture land could be due to slow and steady growth of urbanization by the way of residential and commercial constructions.

The area under aquaculture tanks in the year 2000 was 33.02% where as the area has shown considerable decrease to 25.66% in the year 2010. This is a net decrease of 7.34% which can be attributed to the declining trend of aquaculture activity in the study area. This can be due to number of problems surfaced during the last decade in the aquaculture fields. These include the viral contamination of aqua farms resulting in a drop in productivity and quality of the product. This has adversely affected the farmers. This perhaps is the reason for the decrease in the area under aquaculture.

The drains are natural streams or rivulets of smaller scale. They have indicated no significant change during the study period of years 2000-2010. Where as the area under fallow land has increased from 2.31% in the year 2000 to 6.79% in the year 2010, an increase of 4.48% 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.

The area under mangroves which is around 1.64% indicated no significant change and can be considered as a positive sign as far as the mangrove ecosystem is considered. Another natural environment under mud flats have shown a slight decrease from 5.47% in the year 2000 to 4.51% in the year 2010, a decrease of 1.07%. This can be attributed to the activity of cultivation and also due to plantations like mixed crops, where some areas have been converted in to cultivable lands at the places like Marritippa, Vemuladivi, Modi, Gobbalavanipalem etc and also at Turuputalla, Pasaladivi, Modi with mixed crop plantation.

The feature classes namely plantation with mixed crop indicated an increase from 5.47% in the year 2000 to 12.61% in the year 2010, a net increase of 6.93%. This is an interesting observation made during this investigation. The area of investigation is traditionally known for coconut plantation, vegetable growth, banana plantation etc. In recent times farmers have been encouraged to go for mixed plantations with two or three commercial crops at a time. This has an advantage of less expenditure and more profit realization. This trend is observed in the regions like Modi, Pasaladivi, and Turuputalla etc.This can be attributed to the increased awareness of the farmers in the commerlisation of agriculture.

The feature class under rivers indicated no significant change from the year 2000 to the year 2010. Where as the areas under settlements have increased considerably. The area recorded under the settlements in the year 2000 was 4.2%, this has gone upto 6.76% in the year 2010, a net increase of 2.56%. This is a natural consequence of increased urbanization and resultant construction activity in terms of residential areas, commercial establishments including

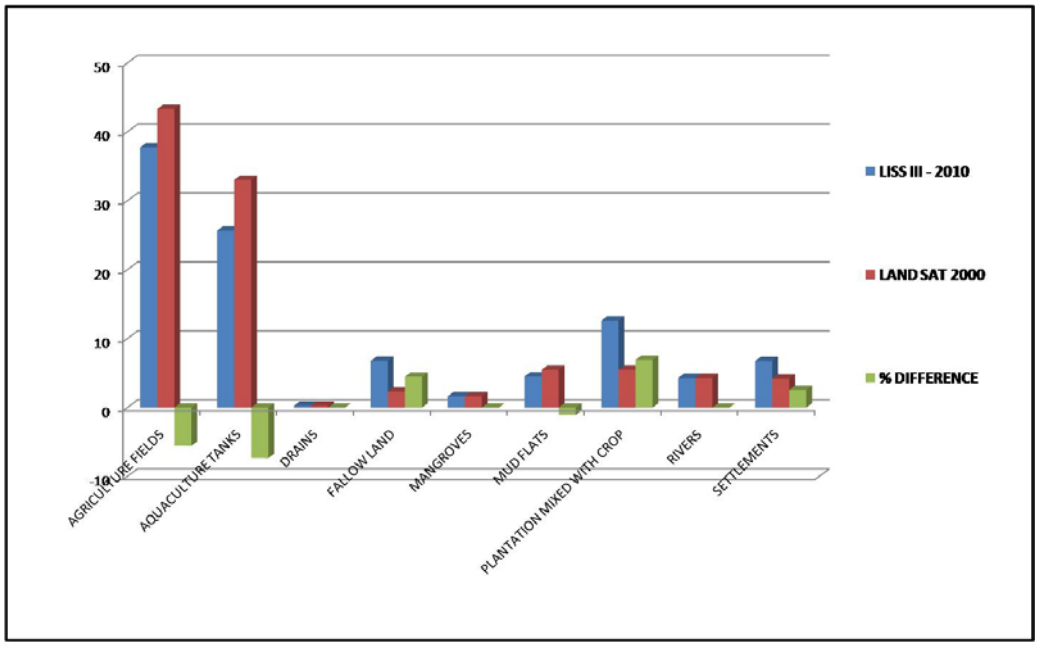

Figure 6. Percentage Distribution of LU/LC during years 2000-2010

educational institutions, hospitals, storage facilities etc at the places like Juvvalapalem, Kalla,

Kallakurru, Sisalla, Uppargudam, Chinnaamirm, Bhimavaram, Viravasaram, Palakallu, and Narasapur.

CONCLUSIONS

The study was carried out in the southern parts of West Godavari district (81°20' to 81°50' E longitude and 16°15' to 16° 35' N latitude). The study clearly established that the satellite remote sensing coupled with GIS can be a powerful tool for mapping and evaluation of land use/land cover changes of a given area.

The significant changes in the land use/land cover during the study period between the years 2000 to 2010 recorded some interesting observations. During this time span (one decade) the significant positive observations as per environment is concerned are the natural systems represented by natural drains, mud flats, mangroves and river systems indicated significant change. This is a positive sign. The features namely agricultural fields, aquaculture tanks indicated a decreasing trend where as the features like fallow land and areas under mixed plantations and settlements indicated an increasing trend. The reasons attributed for this are due to the changes in the pattern of agricultural activity and increased activity of urbanization.

In general the land use/land cover data during the study period (2000-2010) of the study area indicated certain significant changes which may not show any significant environmental impact. However, these trends need to be closely monitored for the sustainability of environment in future.

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