

LANDUSE/LANDCOVER STUDIES OF AREAS IN AND AROUND PARADIP PORT, EAST COAST OF INDIA

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ABSTRACT

The coast of paradip is one of the regions where several coastal based developments have taken place in the last 10 years. Satellite imageries of IRS 1D & P6 LISS III for the period 1999-2005 have been used to detect the land-use changes that occurred in the areas around paradip port due to natural and anthropogenic activities. Coastal land-use categories such as forest, fallow land, sandy beaches, urban/reclaimed area, vegetation and water have been identified using the interpretation keys. The results of land-use/land cover assessment based on visual interpretation are presented (Table.1). The results show that urban/reclaimed land has increased from 71.71 km² (1999) to 94.33 km² (2005) and in the same period, sand bodies also increased from 22.21 km² to 28.86 km²; however, mangroves have reduced from 149.42 km² to 121.71 km² (Fig.1). This significant reduction in mangroves and increase in the urban/reclaimed land reveal the human interferences on the natural environment. Increase in sand bodies explains accretion in their region. Year-wise analysis of different land-use/land cover (LU/LC) changes are presented in the paper.

Key words: Paradip coast, Land-use, Land cover, IRS-1D, IRS-P6

INTRODUCTION

Coastal zone is a very complex, dynamic and delicate environment, which performs important functions such as shoreline stabilization, fish nurture, recreation besides providing habitat for nearly all shellfish and finfish of nutritional and commercial value. Apart from these, coastal areas are also rich sources of food, energy and minerals and therefore a primary source of livelihood for a large part of the world's population. The modern scientific technologies of remote sensing and digital image processing are extremely useful in periodic assessment of the coastal land-use/land cover (LU/LC) changes and analyze them to formulate better management. There are many case studies that used satellite imagery and digital image processing techniques to map coastal zones, coastal dynamics and shoreline conditions. Remote Sensing Satellite data provides a synoptic view of the coastal zones.

STUDY AREA

The Study area is bounded by North latitudes 20^o15'0'' to 21^o50'0'' and East longitudes 86^o30'0'' to 87^o10'0''. It falls in the areas around Dhamra river of Kendrapara district in the state of Orissa and covered by Survey of India (SOI) toposheet No.73L/10, 73L/11, 73L/13, 73L/14, 73L/15, 73P/1, 73P/2.

OBJECTIVES

The objectives for the present study are to identify and map the different coastal land use/land cover and to perform the multi temporal image classification. Based on the land-use/land cover(LU/LC) maps, change detection analysis was done.

DATA USED

Topographic sheets of Survey of India No 73L/10, 73L/11, 73L/13, 73L/14, 73L/15, 73P/1, 73P/2 (Table-1) on 1:50000 scale, IRS-1D LISS III Satellite imagery of Path 107/ Row 58 from 1999, 2000, 2001, 2002, 2003 and IRS-P6 LISS III Satellite imagery of Path 107/ Row 58 from 2004, Feb-2005(Table- 2)

Table 1 Survey of India Topo sheets used

Toposheet	Year of Publication	Scale	Source
73 L/10	1973	1:50,000	Survey of India
73 L/11	1973	1:50,000	Survey of India
73 L/13	1973	1:50,000	Survey of India
73 L/14	1973	1:50,000	Survey of India
73L/15	1973	1:50,000	Survey of India
73P/1	1973	1:50,000	Survey of India
73P/2	1973	1:50,000	Survey of India

Table 2. Satellite images used

Year	Path / Row	Satellite ID	Sensor	Date & Time of acquisition (GMT)
1999	107-058	1D	LISS - III	28 th Feb1999 & 05:10:30
2000	107-058	1D	LISS - III	19 th Jan2000 & 05:13:44
2001	107-058	1D	LISS - III	22 nd Feb2001 & 05:11:43
2002	107-058	1D	LISS - III	13 rd Jan2002 & 05:05:26
2003	107-058	1D	LISS - III	17 th Feb2003 & 04:53:16
2004	107-058	P6	LISS - III	13 rd Jan2004& 04:59:09
2005	107-058	P6	LISS - III	24 th Feb2005 & 04:57:30

METHODOLOGY

Remote Sensing technology is an ideal tool to identify, locate and map various types of lands associated with different landform units. The timely information about the changing pattern of land use plays significant role in land use planning and sustainable land development. The mapping and monitoring of the land use/land cover requires a land use classification system.

One of the most widely used data format for information extraction about the land use and land cover is the False Color Composite (FCC) of the image. The extraction of information from such images about ground reality is done by image interpretation for which generally photo interpretation, spectral analysis are used.

The research is involved of two main steps. The first step is classification of satellite data for Landuse/Landcover (LULC) types, image analysis and accuracy estimation. The second step is concentrated on the change detection analysis in the LULC types. Analysis of satellite data includes registration, classification and change detection using post-classification comparison. Satellite data analysis is done by using ERDAS IMAGINE 8.5 software.

The overall objective of image classification is to automatically categorize all pixels in an image into land cover classes or themes. Normally, multi spectral data are used to perform the classification, and the spectral pattern present within the data for each pixel is used as numerical basis for categorization. That is, different feature types manifest different combination of DN's based on their inherent spectral reflectance and emittance properties.

Classification of multi-spectral images is the process of sorting pixels into a finite number of classes, or categories of data, based on their data file values(Singh .A,1989). There are two methods of classification, (1) Unsupervised and (2) Supervised. Unsupervised classification is based on statistical patterns that are inherent in the image data itself where as Supervised classification is based on the cognition and skills of the image specialist. In this study, an integrated approach (Supervised classification + Expert visual Interpretation) was applied to classify images into different classes of LULC. LULC training sets were prepared representing each known LULC category that appears fairly homogeneous on the image. In total six LULC classes were recognized. Using these signature files, supervised classification was done by Maximum likelihood classification algorithm processing in ERDAS IMAGINE 8.5 software. Accuracy assessment was done using the generated error matrix by comparing the classified image and ground truth training sets. In the classified images some of the LULC classes (Built-up and Built-up under development) were intermixed and also the industrial areas class has not been classified accurately. This integrated approach provided better accuracy (83%) of image classification.

The accuracy assessment utility allows you comparison of certain pixels in thematic raster layer to reference pixels for which the class is known (Jenson.J.R 1983). This is an organized way of comparing a classification with ground truth data. After displaying the digital data of spectral band 2, 3, 4 on to a colour monitor and by identifying the training sets where field observations with respect to LU/LC categories were made, their spectral response pattern was generated. A similar procedure was adopted for generating the spectral response pattern in terms of mean, standard deviation, variance and co-variance matrices of various landuse/landcover categories from other band combinations of TM data. Class separability analysis was subsequently carried out by computing the transformed divergence value. All the data sets were classified using maximum likelihood classifier. For quantitative estimates of the classification accuracy of landuse/landcover(LU/LC) maps, sample areas representing different landuse/landcover categories were selected randomly in each output. Accuracy of the classification of each datasets and classifier was expressed as an error matrix from which the overall accuracy, user's accuracy, producer's accuracy, the Kappa statistics were derived.

RESULTS & DISCUSSION

In the present Study, Survey of India (SOI) toposheet of 1973 and IRS 1D & P6 Liss-III satellite imagery of different years from 1999-2005 were compared qualitatively and quantitatively. This study has given the land use changes during these years. Different coastal land use categories were identified viz. Forest, Fallow land, Sandy beaches, Urban/Reclaimed area, vegetation and Water. The results of landuse/landcover assessment based on visual interpretation for different years of satellite data (From 1999 to Feb. 2005) and its area are showing in Table 3. The variations in the land use pattern (Fig. 1) are clearly shown and the changes in area can be seen. More pixels of urban, industrial, reclaimed land are seen in 2005 LULC map than 1999 map (Fig.2). Increase in mangrove area from 1999 to 2000 indicates the afforestation measures taken by the local government. But the sudden decrease in the subsequent years to 116.16 Sq.Km in 2001 and 121.71 in 2005 show the large reclamation work due to rapid industrialization in the study area. Constant increase in urban, industrial, reclaimed area is evidenced from 71.71Sq.Km to 94.33 Sq.Km. Agricultural and fallow lands are changing based different agricultural practices and monsoonal effect. Beach area is affected by local activities as well as by natural processes along the coast.

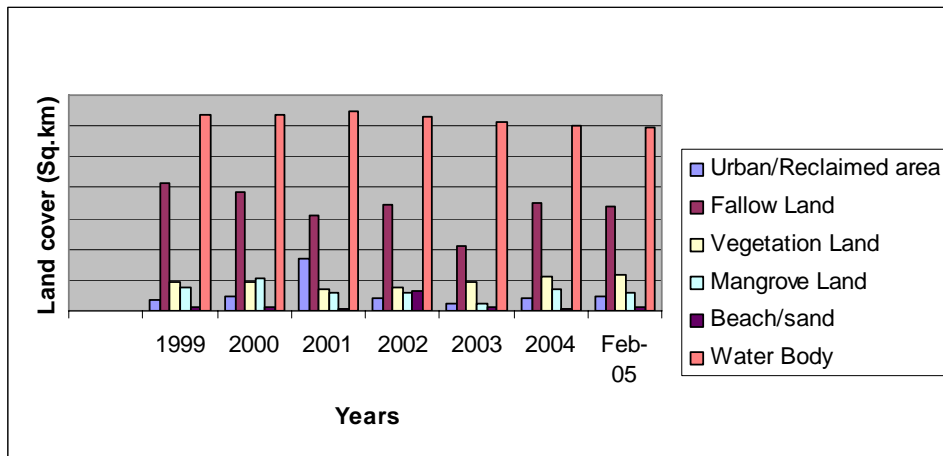


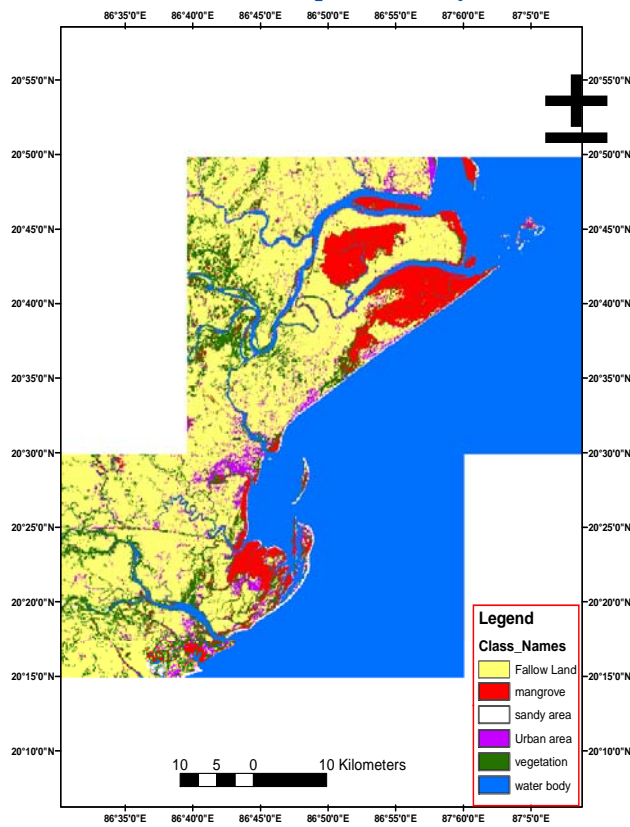
Fig.1

Landuse/Landcover categories (1999-2005)

Table 3 Area of Landuse/landcover categories (in Sq.Kms)
* cloud covered image

year	Urban/Reclaimed area	Fallow Land	Vegetation Land	Mangrove Land	Beach/sand	Water Body
1999	71.71	824.05	184.36	149.42	22.21	1274.43
2000	88.03	765.09	184.9	208.54	19.09	1271.09
2001	338.78*	622.3	139.08	116.16	14.92	1300.7
2002	84.86	690.34	152.74	122.1	130.81*	1258.95
2003	47.81	419.29	181.44	51.69	18.62	1229.54
2004	84.81	697.53	217.69	139.93	11.27	1200.87
2005	94.33	677.09	231.98	121.71	28.86	1192.85

Landuse/landcover map of the study area (1999)



Landuse/landcover map of the study area (Feb 2005)

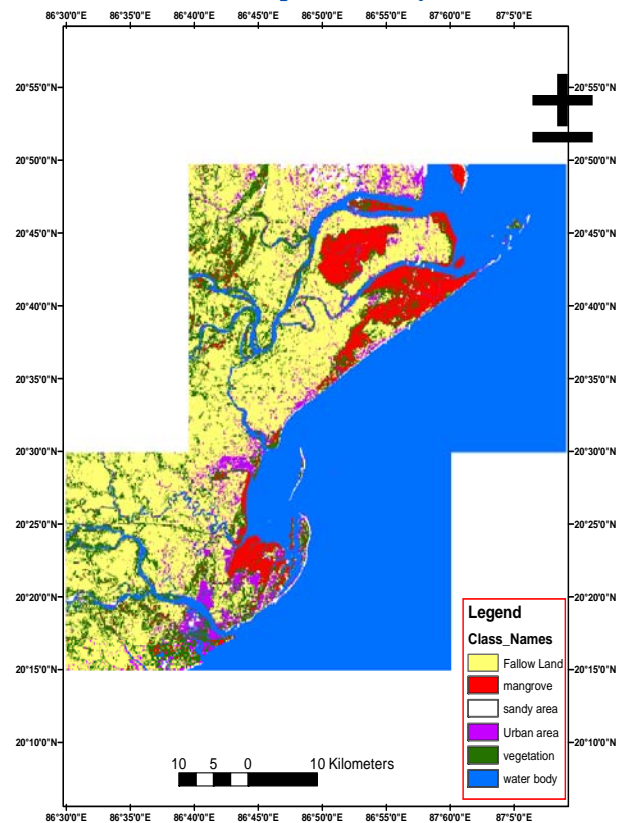


Fig 2. Land use/ Land cover map of study area (1999- 2005)

CONCLUSION

The present study suggests supervised classification to classify multi-temporal remote sensing image. Landuse/landcover maps for different years have been prepared for this study area. Year-wise changes were obtained using the post-classification comparison based on supervised classification of the two images. The synoptic capability of remote sensing provides useful reconnaissance tool to target more detailed field surveys to areas of rapid and accelerating change. The study reveals the rapid industrialization and changes in land use patterns over the period of last 7 years.

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