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A study on changed land use pattern of the proposed harbour area-Vizhinjam, Thiruvananthapuram using Remote Sensing and GIS Techniques

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Abstract

The coastal environment is a unique and dynamic system where elements from land, sea, air and people converge and they are unique in a very real economic sense as sites for port and harbour facilities that capture the large monetary benefits associated with waterborne commerce. The present study is carried out in Vizhinjam Panchayath, a coastal area located in Thiruvananthapuram, Kerala and has a natural harbour surrounded on most sides by land which is going to develop into an International Seaport. In this study, an attempt has been made to analyze the changed land use pattern of the proposed harbour area during 2009-2014. The study uses IRS-LISS- IV, Cartosat data and Arc GIS software. The study has observed that the built up activities have been increased by 8.8% during 2009-2014 whereas agriculture in the area showed negative growth with a net decrease of 6.4%. The results of the study underscore the fact that the future harbour developmental activities and their operations need more land and it has chances of negatively affecting the land use pattern of the study area.

Keywords: Land use change analysis, Remote Sensing and GIS, Vizhinjam harbour

Introduction

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. Although the terms land cover and land use is sometimes used interchangeably, they are actually different. Land use is referred to various human activities, which are carried on land, and land cover is referred to 'Natural vegetation, water bodies, rock or soil, artificial cover and other land transformations noticed on the land'. The latest technologies and tools like GIS and Remote Sensing Satellites are used for effective planning and management of the resources like land, water and vegetation in modern times. The temporal data provided by the remote sensing satellites helps to monitor or detect the changes that occur from time to time in the land use/ land cover. Change detection is the process of identifying differences in the state of an object or phenomenon by observing it at different times and it is very useful in land use change analysis. The regular monitoring of these changes in turn, helps in better conservation and management of natural resources. Otherwise, changes in land use and land cover impact both environmental quality and the quality of life. Changes in habitat, water and air quality and quality of life are some of the environmental, social and economic concerns associated with land use and land cover changes. Over the years, remote sensing has been used for land use/land cover mapping and their change detection in different parts of India. While carrying out this work, a number of similar works were reviewed (Samal *et al*., 2013, Nobi *et al*., 2009, Asadi *et al*., 2013, Arunachalam *et al*., 2011 and Anil *et al*., 2011.)

Study area

The present study is carried out in Vizhinjam village in Neyyattinkara Taluk and is located at $8^0$21'N and $77^0$0'E on the west coast of India in Thiruvananthapuram district, Kerala. The study area is surrounded by Venganoor Panchayath in

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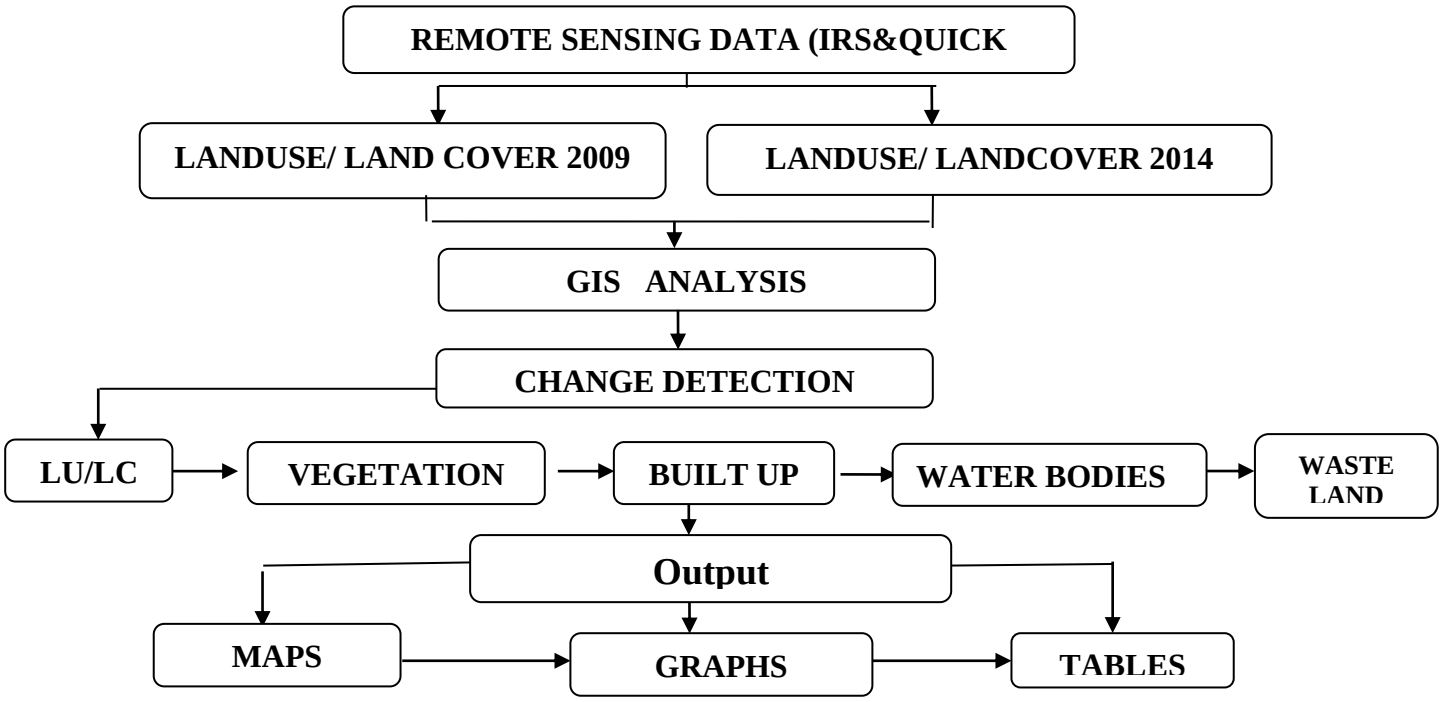
North, Arabian Sea in the east, Thiruvallam South and at a distance of 12 Km from the city centre. Physiographically the study area comes under the coastal plains.

Material and Methods

Materials used in the study are satellite data to generate various thematic information in GIS platform. The present study uses IRS-LISS- IV, Cartosat data and Arc GIS software. Arc GIS software is used for extracting the land use/ land cover layers, from SOI toposheets and satellite imageries. The methodology of land use/land cover pattern analysis consists of four steps: Data acquisition, Pre-processing, analysis/classification, Product generation and documentation. A flow chart on the methodology followed for the present study is shown in Figure 1.

Figure 1. Flow chart showing methodology



RESULTS AND DISCUSSION

The satellite data sets of vizhinjam Panchayath of the year 2009 and 2014 were rectified by georeferencing with the help of already rectified SOI topo sheets. After Geo-referencing, the satellite data were opened in ARC GIS 10.1 and by visual interpretation the classes were identified and they were digitized as shape files to produce a detailed land use/land cover map for both the digital data sets of the study area (Figure 2 and 3). Attribute information pertaining to percentage of the area occupied by different classes for both the data sets of the study area were also obtained (Table 1). between the two data sets have been brought out and presented in Figure 4 and 5. In this study four land use / land cover categories have been delineated at the first level. They are again differentiated into second and third levels. In the first level the patterns were classified as Built up land, Agricultural land, waste lands and water bodies. These were further sub classified into mixed built-up, residential area, plantations, beaches, coastal sand, grasslands, mining areas etc.

Quantitative analysis during 2009 and 2014

The analysis finds out the changes that have taken place between the years 2009 and 2014. Land use / land cover pattern commonly shows that the cultivation of mixed crop dominantly with coconut

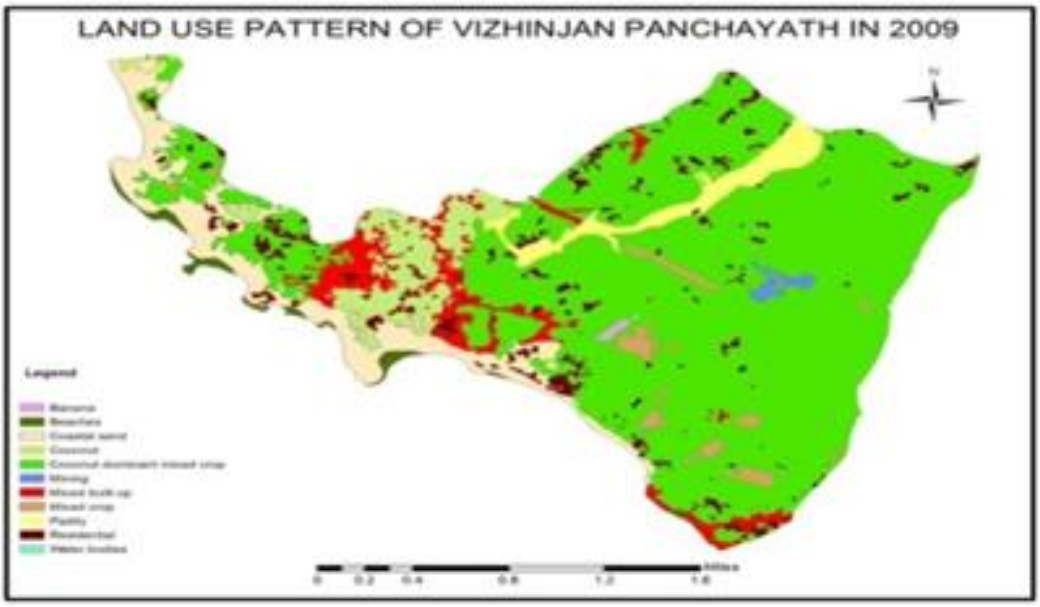


Figure 2. Land use pattern of Vizhinjam Panchayath (2009)

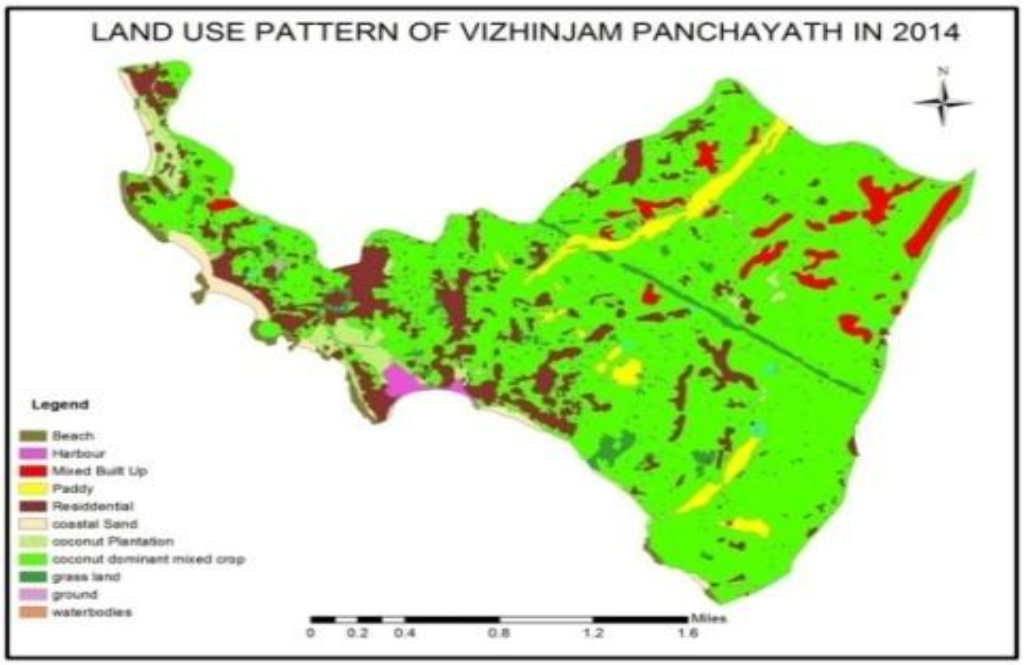


Figure 3. Land use pattern of Vizhinjam Panchayath (2014)

Table 1. Land use / land cover classes in Vizhinjam Panchayath in 2009 and 2014

Categories		Classes	% of the area in 2009	% of the area in 2014	% difference
Built up land	Mixed built up		5.17	5.52	0.35
	Residential		4.34	12.79	8.45
Agricultural Land	Plantation	Banana	0.16		
		Coconut	5.91	2.73	3.18
		Mixed crop withcoconut dominant	68.17	67.22	0.95
		Mixed crop	1.80		
		Paddy	3.70	3.39	0.31
Waste lands	Beaches		1.06	1.02	0.14
	Coastal Sand		9.11	3.93	5.18
	Grassland			2.15	
	Ground			0.15	
	Harbour			0.96	
	Mining		0.52		
Water bodies			0.01	0.07	0.06

is the major agricultural practice found and also the settlements are seen in every part of this area. In 2009, the built up land covers 9.51% of the total geographical area. But in 2014 it reaches 18.27%. The built up land includes the mixed built up and residential. The area recorded under the settlements in the year 2009 was 4.34%; this has gone up to 12.62%in the year 2014, a net increase of 8.28%. This is a natural consequence of increased urbanization and resultant construction activity in terms of residential areas, commercial establishments including harbour development, tourism developmental activities like hotels, facilitation centres, Ayurvedic centres etc. Vizhinjam Panchayath shows the maximum agricultural activities like plantation in banana, coconut, paddy etc. in 2009. But the 2014 map shows that there is no banana cultivation, and the coconut plantations and paddy cultivations are gradually decreased. The reasons attributed for this are the changes in the pattern of agricultural activity and increased urbanization. In recent times, farmers have been encouraged to go for mixed plantations with two or three commercial crops at a time and it has less expenditure and more profit.In 2009, the waste land comprises 10.69% the total geographical area. But in 2014, it reduced to 8.21%. There is a 5.18% decrease in coastal sand as well because of the tourism activities.

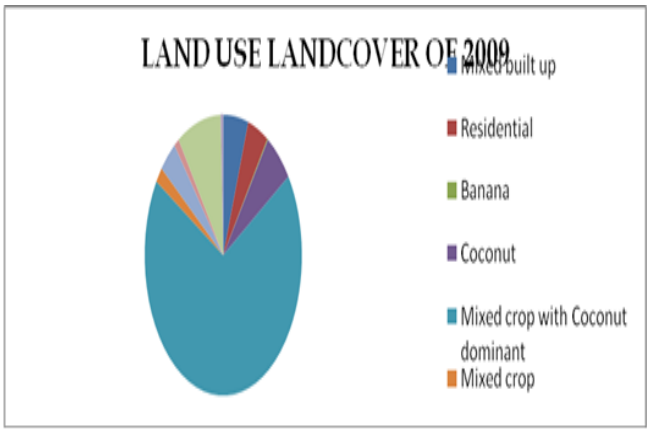


Fig 4 Land use and land cover in the study area in 2009

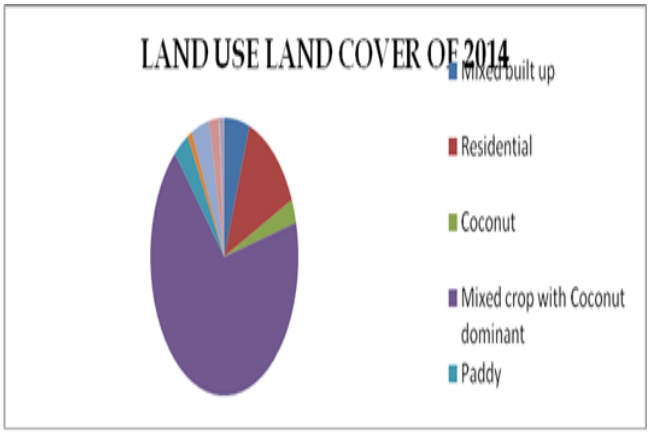


Fig 5 Land use and land cover in the study area in 2014

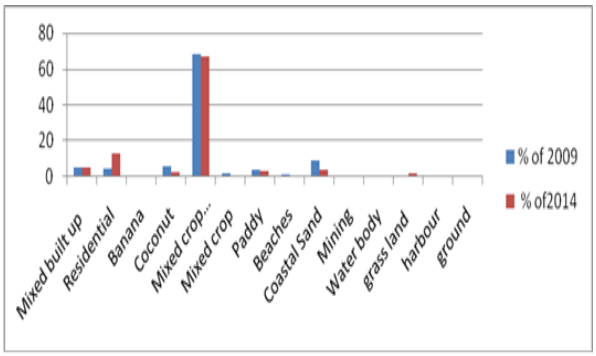


Fig 6. Percentage Distribution of LU/LC during years 2009-2014

The grass lands of 2014 indicate the mining area and it increased by 1.53% as compared with 2009. The percentage of water bodies (Figure 6) increased in 2014 as compared with 2009 which is is not a positive sign. It indicates the increase of artificial water bodies like swimming pools and other water logged areas in the study area.

Summary and Conclusion

The interpreted maps from satellite remote sensing data of 2009 and 2014 using the GIS software for land use change detection reveal that in 2009, out of the total geographical area agricultural land cover 79% (Mixed Crop with Coconut Dominant-68%, coconut-5%, banana-0.1%, mixed crop-1%, paddy-3%). Only 9% of area is left for built up activities. Out of the total area 9% only 1% area is covered with coastal sand and beaches respectively. The land use pattern in 2014, out of the total geographical area the agricultural land covers 73% (Mixed Crop with Coconut Dominant-67%, coconut-2%, paddy-3%). A total of 18% of area is left for built up activities (it includes residential and mixed built up). Out of total area, 3% and 1% area is under coastal sand and beaches respectively. The study proved that the temporal Indian remote sensing data sets can provide the thematic information on land use/land cover pattern which when coupled with GIS technique can mapped and analyzed for change detection of land use/land cover pattern. The temporal data provided by the remote sensing satellites helps to monitor the changes that occur from time to time in the land use/ land cover. In general the land use/land cover data during the study period (2009-2014) of the study area indicated certain significant changes need to be closely monitored. This would ensure the better conservation and management of natural resources and the environment of the study area in future.

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