

Spatial and Temporal Analyses of Land Use and Land Cover Changes in Negombo Lagoon-Muthurajawela Marsh Areas

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Abstract

In the present study, an investigation has been carried out to identify and assess the spatial and temporal changes of land use/land cover in the Negombo lagoon and Muthurajawela marsh areas from 1987 to 2001. The paces of changes of land use and land cover in this area keep rising due to urbanization and industrialization. Time-series satellite images of Landsat TM and ETM+ which covered the time frame from 1987 to 2001 were used in this study. Interpretation of images and analysis of data was accomplished through integrated use of ERDAS imagine (version 9.2) and ArcGIS (version 9.2) software packages along with Microsoft Excel analytical tool. The results revealed that there are nine different major land use categories namely, built-up areas, coconut lands, home-gardens, marshy lands, paddy fields, sandy covers, shallow water areas, vegetation areas and water bodies. More than 28% of the total area has been covered by both deep water and shallow water bodies throughout the 14 year period. Paddy lands, coconut plantations, sandy covers and marshy lands have been considerably decline during the 14 year period. Apparently those lands were converted to home gardens and built-up areas due to urbanization and industrialization; residential occupation has significantly increased during 1987 and 2001. In 2001 the home garden and built up areas constituted 41% of the total land extent. An Increasing trend has been detected in built up areas and home gardens while decreasing trend is observed in all other cases. Extent of built-up areas seems to expand in eastern and southern part due to industrial development. Built-up area expansion in the western part is associated with tourism, where as in the northern part it relates to urbanization.

Key words: Land use and land cover change, GIS and remote sensing, Satellite imageries.

Introduction

Knowledge about land use and land cover has become increasingly important as the nations plans to overcome the problems of haphazard, uncontrolled development, deteriorating environmental quality, loss of fish and wild life habitat. Land use data are needed in the analysis of environmental problems and process. (Anderson et al.1976). Coastal wetland of Negombo lagoon-Muthurajawela marsh is a highly dynamic ecosystem which is associated with tides and the river flow. During the recent past there has been considerable degradation of natural ecosystem due to anthropogenic activities such as inadequately planned settlement, industrial and municipal pollution, increasing of irrational fish harvesting methods and general habitat destruction (CEA/Euroconsult, 1994, Jayakody and Dahanayaka, 2005). Human activities are also contributed to coastal erosion (Maddumabandara et al,

1987). However, the factors that contributed to the impacts are difficult to grasp due to lack of accurate timely information and limitations in the availability of information sources. To overcome some of the above difficulties associated with information gap, time series analysis of available satellite data can successfully be used. Interpretation of satellite data helps to provide quantitative information about the temporal changes of different land use/land cover categories. The difference between chronological maps can be analyzed to reveal the distribution of land use/land cover changes that have occurred during the intervening periods.

In order to understand the land use/land cover changes, consequences of these changes, associated characteristics of the changes and degree of changes in a particular area; spatial and temporal terms needs to

be understood. Furthermore the future trends in land use/land cover dynamics and associated results are also to be predicted.

In the present study, an attempt was made to address pattern of spatial and temporal changes of land use/land cover and associated characteristics, using remotely sensed data acquired in 1987, 1992 (Landsat TM) and 2001 (Landsat ETM+). The objective of the study; was to Identify and assess the spatial and temporal changes of land use at Negombo lagoon and Muthurajawela marsh areas during 1987-2001 and examine the present and future changing pattern of the land use/land cover.

Materials and Methods

The study was conducted at Negombo lagoon, Muthurajawela marsh and surrounding local administrative divisions, which are situated along the western coast of Sri Lanka, north to the Kelani estuary. The total land extent of the study area is about 12570ha. The major economic activities found in the study area include fishery, agriculture, trade shipping and habitation from times preceding the colonization of the maritime province in 1505. In the post-independence period urbanization and industrialization of the area has been increased to the east of the marsh and to Negombo in the north (CEA/EUROCONSULT, 1994).

For the present study Thematic Mapper (TM) and Enhanced Thematic Mapper Plus (ETM+) multi temporal Landsat images of 1987, 1992 and 2001 were used. Interpretation of images and analysis of data was completed using ERDAS imagine (version 9.2) and ArcGIS (version 9.2) software packages along with Microsoft Excel analytical tool.

The satellite images were subsetted to study area. The images were geometrically corrected and projected to other GIS layers. Unsupervised classification was performed for 40 classes using 'initialize from statistics clustering' option with approximately true colour combination. Then the classes were combined to identify land use and land cover classes. The accuracy of the classes produced using the unsupervised classification approach was examined using field visits, aerial photographs and topographic maps. Three

chronological land use maps were created using the land use raster layers, to demonstrate the land use patterns in 1987, 1992 and 2001 respectively.

All three layers of land use/land cover were re-classified into nine major categories and spatial analysis tools in ArcGIS 9.2 were used to assess and illustrate the temporal changes of land use between, 1987-1992 and 1992-2001. Areas of different land use types were computed to assess the temporal dynamics quantitatively.

Results and Discussions

Based on the GIS and remote sensing analysis, nine major land use categories namely, built-up areas, coconut lands, home-gardens, marshy lands, paddy fields, sandy covers, shallow water areas, vegetation areas and water bodies have been identified in Negombo and Muthurajawela regions. Table-1 contains the details of land extents and percentages occupied by different covers during 1987-2001. A highest percentage (>28%) of land cover was occupied by water bodies, followed by home gardens. However, a rapid increase in built-up areas can be identified in northern, eastern western and southern parts of the study area. It is evident that the area of "built-up" land in 1987 was 2.7% and it has increased up to 18.92% by 2001. (Table-1 and Figure-1)

Home gardens represented the second highest percentage of land use, in all the periods of the analysis. Although the extent of home gardens demonstrated an increasing trend, the percentage increase was relatively low in 1992-2001 compare to 1987-1992 (Table-1 and Figure-1). Coconut lands which represented 12.88% in 1987 had declined further down to 6.32% by 1992 which has been further reduced to 2.6% in 2001. Most of the coconut land seems to be converted in to built-up areas and home gardens (Table-1 and Figure-1). The percentage of this conversion was 45.89 in 1987-1992 and 58.4 in 1992-2001.

A sharp decrease of paddy lands was observed from 8.04% in 1987 to 1.07% in 2001. About 56% of paddy areas were converted to vegetation, home gardens and built-up areas during the period of 1987-1992 and it was 79% in 1992-2001.

Table1: land use/ land cover change in Negombo and Muthurajawela area during 1987-2001

Name	1987		1992		2001		Differences of land uses/land covers (ha and %)			
	Area (ha)	%	Area (ha)	%	Area (ha)	%	1987-1992		1992-2001	
							ha	%	ha	%
Water	3452	27.4	3633	28.9	3400	27.0	181	1.4	-233	-1.8
Sand	332	2.6	144.	1.1	124	0.9	-188	-1.5	-19	-0.1
Vegetation	1230	9.7	1611	12.8	1786	14.2	380	3.0	175	1.3
Marsh	2075	16.5	1570	12.5	1333	10.6	-504	-4.0	-237	-1.8
Coconut	1619	12.8	794	6.3	331	2.6	-825	-6.5	-463	-3.6
Shallow water	165	1.3	93	0.7	250	1.9	-71	-0.5	156	1.2
Paddy	1010	8.0	1091	8.6	134	1.0	81	0.6	-957	-7.6
Home gardens	23988	19.0	2714	21.5	2830	22.5	315	2.5	116	0.9
Built up areas	285	2.2	916	7.2	2378	18.9	630	5.0	1462	11.6
Total (ha)	12570	100.0	12570	100.	12570	100				

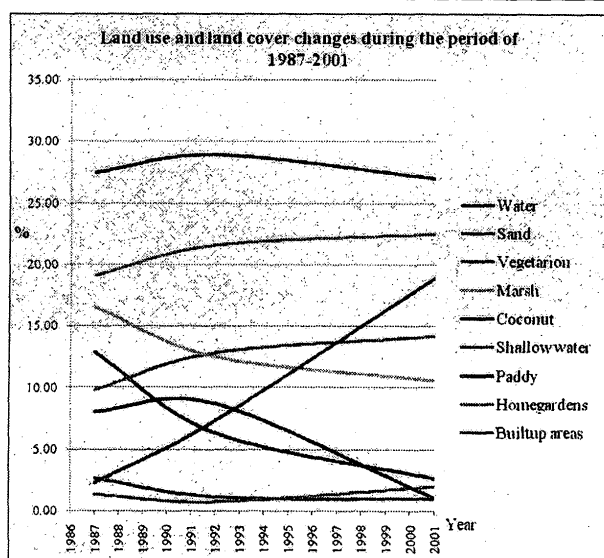


Figure3: land use and Land cover in Negombo-Muthurajawela region-1987, 1992 and 2001

Sand cover of the area was also reduced during this period. In 1987-1992 highest percentage (55%) of the sandy cover was captured by water bodies. During 1992-2001, 38% of the sandy cover converted to home garden and built-up areas while 13% of them converted to water bodies. The sandy cover is most vulnerable for erosion in the coastal strip at the western part of the study area. There is no significant change in area of water bodies during the observed period. However, changes of the depth of the water bodies were observed during the 14 year period.

Conclusion

In Negombo and Muthurajawela region land use pattern has been considerably changed from home gardens,

paddy fields, and coconut plantations to built-up areas during 1987-2001, mainly by converting coconut and paddy lands into built-up areas. Extent of built-up areas seems to expand in eastern and southern part due to industrial development. Built-up area expansion in the western part is associated with tourism, whereas in the northern part it relates to urbanization. Further encroachments can be expected to the marsh area and paddy areas in the future due to increasing population and anthropogenic activities. Coconut area can be totally displaced from the study area if the current trend continues. Analogously a large portion of the home-gardens will also be converted to built-up areas.

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