

# Land Use/Land Cover Changes in Addalaichenai DS Division From 1991 to 2011

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**Abstract:** Land use / land cover information is the basic pre-requisite for managing land, water and vegetation resources. The information on land use / land cover available today in the form of thematic maps and published statistical figures in records. Publications are inadequate, inconsistent, and do not provide updated information on the changing land use patterns, process and their spatial distribution. A comprehensive household sample survey, enterprise sample survey, institutional survey and formal interviews were carried out as primary data source. In order to supplement the data gathered in the field, secondary data were gathered such as relevant research reports and articles written on the town and its functions, land issues and official publications and reports issued by the UDA, Land Commissioners Department, Title Settlement Department and the Department of Census and Statistics, publications by relevant authorities. The samples were processed and analyzed using advanced spatial information techniques. Geographic Information System (GIS) has been utilized to generate maps and diagrams and to find suitable areas for the stipulated criteria. The current research focused the main characteristics of the Addalaichenai Divisional Secretariat area and its immediate periphery. However, the area covering the coastal belt will be considered as the potential development areas.

Further the rapid development such as high ways, Oluvil port project, urbanization, re-greening projects, etc., after the disaster (war & tsunami) are the prime elements in the process of Land use / land cover changes in Addalaichenai DS Division.

It has grown up to be urban town in the south east region with it slim of its municipality.

**Key Words:** Land use / land cover, thematic maps, supervised classification and spatial information techniques

## Introduction

Land use / land cover information is the basic pre-requisites for managing land, water and vegetation resources. The information on land use / land cover available today in the form thematic maps, and published statistical figures in records. Publications are inadequate, inconsistent and do not provide updated information on the land use patterns, process and their spatial distribution. Land is one of the prime natural resources and is the basic unit of all material productions. It is a limited resource which has to be used very carefully due to the rapid increase in population growth which would result in decline of land resources. The concept of land use / land cover is parts of a whole and should be studied together but they do contain inherent differences (Burly, 1961).

Land use is generally defined as the activity occurring on the land and as such human values attached to it (Burly, 1961; Clawson et al, 1965; Campbell, 1981). This also applies to the visible landscape and describes what is on the land. Land use refers to “men activities and the various uses which are carried on land” (NRSA, 1987). Land cover refers to “national vegetation, water bodies, rock, soil, artificial cover and other result due to land transformation”. In the urban areas, the problems related to the rapid

transformation that are taking place in terms of the land cover and land use now very much pronounced (Okunuki, 2001). Urbanization has often been viewed as a sign of the vitality of the regional economy; however, the urbanization had greatly accelerated the environmental pressure on the eco-system, thus placing enormous burden on responsibility of organization for the planning and management of urban areas authority (Herald et al, 2003).

Land use is a primary indicator of the extent of mans impressions on the earth. It reflects the socio-economic and cultural aspects of human activity and provides an index of environs he has settled in. The science of land use deals with the study of land covered under different usages like forest land covered under different categories like forest, agricultural, non-agricultural, waste land, barren land, water bodies, industrial, rural, urban centre, waste disposal sites, etc.

Land use system depends upon a combination of complex dynamic factors like hydrology, soil, micro-climatic and community of biotic assemblages that are continuously interacting under the influence of static natural processes such as geology, topography and other anthropogenic activities.

With the growing population on limited land resources the relevance of land use study and management assumes significance. The concept of optimal land use is basic which aims at balancing the competitive demands in a scientific manner for sustainable development. The purpose of land use study is to regulate uses on the misuse, abuse or over use of the land. To extract maximum utilization with minimum interception with ecosystem is the sole purpose of the land use study. Land use study considers the ecosystem in the entire process. Management of land, water and biotic form in union with human beings is an integrated system. The management of one is complementary to the other (Kaleel M.I.M, 2010).

Geo Information Technology; Geographic Information System (GIS), Remote Sensing and Global Positioning System (GPS) provided the environment

to undertake this study with maximum efficiently. The GIS with the added values of earth observation techniques widely known as remote sensing techniques (image analysis) have already shown their value of mapping dynamic areas, and as data sources for the analysis and modeling of urban growth and land use changes (Jensen & Cowen, 1999). Remote sensing provides especially consistent data set of large area coverage in both high spatial details with higher temporal frequency in multi spectral regions (Herald et al, 2002).

It is observed that the land cover classes of the Addalaichenai DS Division have undergone extreme changes in the recent past due to the rapid development; high ways, Oluvil port project, urbanization, re-greening projects, etc.,. As such, the need of the estimate extent and change dynamics of each land cover classes in this area is essential to enable for proper management strategy that is necessary to ensure effective planning for sustainable development.

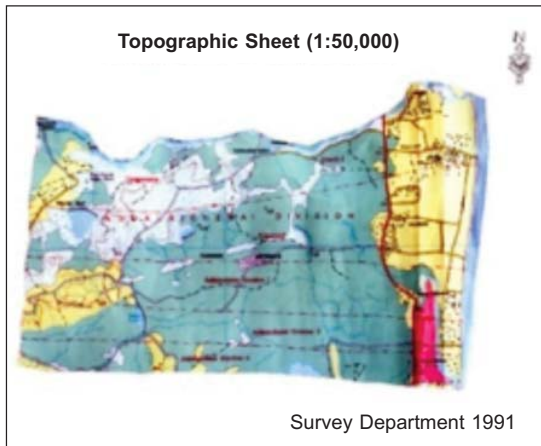
## Objective of the Research

The prime aim of the research is to assess the changes of spatial extent of each land cover classes due to anthropogenic activities. The research has been undertaken with the following objective in order to achieve this aim;

1. To map out of present and past land use pattern of Addalaichenai Divisional Secretariat area
2. To compare them to past and present land use pattern
3. To assess the pattern of changes in the land class cover.

## Study Area

Addalaichenai Divisional Secretariat of Ampara District has been selected to undertake this research. The costal DS areas of the Ampara district are Kalmunai, Sainthamaruthu, Karaitivu, Nintavur, Addalaichenai, Akkaraipattu, Alayadivemb, Thirukkivil, Pottuvil and Lahugala. The population

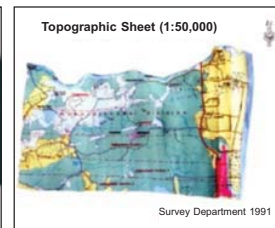
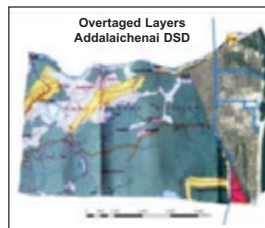
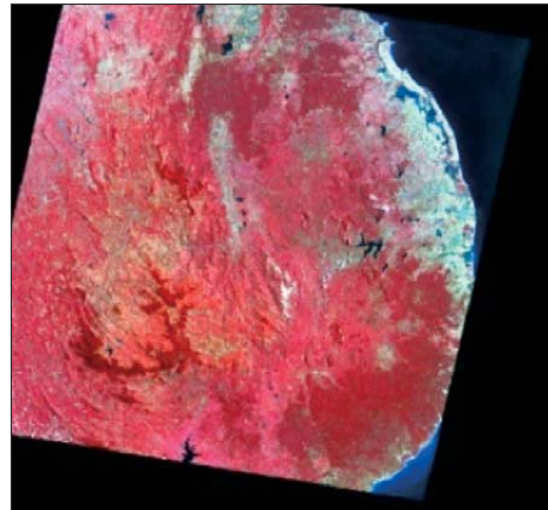


and the land extent of the above DS areas are **297105** and **1161.0 Sq km** respectively. Ampara is one of the densely populated coastal districts in the Northeast Province in Sri Lanka. The district is **4431.4 Sq km** in extent and has a population of **605553**. Sinhala, Muslim and Tamils are major three communities living in the districts. The total numbers of GN divisions are **259**.

The forest area located at east of Addalaichenai known as 'Konawatta' was inhabited only after 1830. Before 1930, Addalaichenai DS Division was a small village. During the course of development the Addalaichenai Division had expanded to include the villages of Palamunai and Oluvil. Presently the area consists of 32 GN Divisions. The total land area of this Division is 94.5 square Km with a population of 40,213 persons. Population density is 425 persons per sq km. The North boundary of this Division is Kaliodai and the eastern border is the Bay of Bengal, the Thaikanagar of Akkaraipattu DS area borders the South and Deegawapiya forms the western Border. A well established and efficient road network running parallel to the coast is one of the main characteristics of the Addalaichenai Division. However, there is no railway line. The existing road network connects Addalaichenai to Ampara town that is a major crossroad. Therefore, Addalaichenai enjoys significant advantages over most other Division.

A significant percentage (31%) of persons is employed in the agricultural sector. Rice is the main income generating crop in this Division as rice is the

staple food of the region. 3740 acres of paddy are cultivated. Coconut cultivation, considered mainly as a home garden crop spreads over 249 acres. Other crops grown in the Division are vegetables and plantain. Some persons are also involved and are interested in the livestock industry such as poultry, cattle and goat.



## Materials and Methods

The research has been conducted using satellite images of GeoEye images of 2006, 2009, 2010 and 2011 and Topographic Sheets (1:50,000) of 1991 and 2001) and the thematic layers prepared by the Survey Department of Sri Lanka (Figs. 2-4).

Initially all the satellite images were geo-referenced and geo-coded with topographic sheets (Fig 04). Then the images were classified using supervised classification technique in Arc GIS-9.2 version software.

The time series analysis was also done in the same environment to obtain the results.

## Data collection and methodology

The research has been undertaken with the primary and secondary data sources to focus on both qualitative and quantitative data analysis. The primary data were collected through questionnaires as well as personal observations and by interviewing stakeholders and old inhabitants. The primary data used in the study was thus taken from a social survey of households using questionnaires.

Secondary data were collected from the published and unpublished sources. Published sources are listed in the bibliography. The basic mapping of geology, physiography and land use was carried out from the sources available at the Survey Department, Colombo, Sri Lanka from which the village information on land use population and occupational structures were obtained.

The research focused on preparing a comprehensive land use profile of Addalaichenai DS area and to identify the land use changes between 1991, 2001 and 2011. A comprehensive household sample survey, enterprise sample survey, institutional survey and formal interviews were carried out as primary data source. In order to supplement the data gathered in the field, secondary data were gathered such as relevant research reports and articles written on the town and its functions, land issues and official publications and reports issued by the UDA, Land Commissioners Department, Title Settlement Department and the Department of Census and Statistics, publications by relevant authorities. The samples were processed and analyzed using advanced spatial statistical techniques. Geographic Information System (GIS) techniques were utilized to generate maps and diagrams and to find suitable areas for the stipulated criteria. The current research focused the main characteristics of the Municipal area and its immediate periphery. However, the area covering the coastal belt will be considered as the potential development areas.

## Results and Discussion

### Land use changes in Addalaichenai DS division

Land use pattern in Addalaichenai can be categorized into residential or Built-up area, wetland, agriculture (paddy, coconut and other crops) and marshy lands. At present Addalaichenai faces the threat of the land and environmental degradation due to the unplanned urbanization and rapid development activities. Due to the influence of various factors of many origins, land cover has undergone dynamic changes (for an example, creating heat island).

The land use changes shown in Table-1 were selected as the basis of time series analysis. After selecting proper classification system, the area encompassed (in km<sup>2</sup>) by each land use type for all years (1991, 2001 and 2011) were computed. Minor changes of land uses are common in everywhere due to localized factors and seasonal variation in weather & climate and anthropogenic activities. But the research focuses the major changes due to Oluvil harbour construction, highway development, post tsunami rehabilitation & reconstruction and agricultural blooming, over the period have only been considered. Subsequently, land use maps were drawn for each year and visual assessment as made to analyze the spatial patterns of land use changes as experienced from 1991 to 2011 (figures 04 to 08).

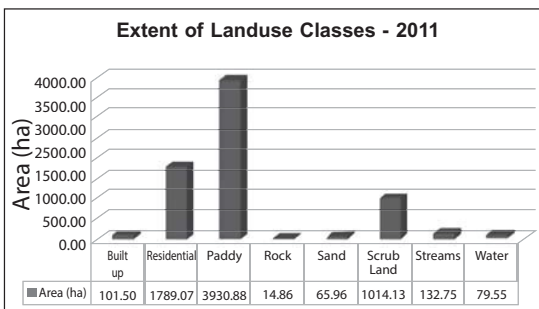
Overall accuracy of the classified images derived from "error matrix" under supervised classification method was 87.5%, 85.3% and 91.2% respectively for all three images.

**Table 1:**  
**Land Use Changes from 1991 to 2011**

|                              | Major land use Changes in 2011<br>(Area in sq Km) |      |      |       |      |      |
|------------------------------|---|------|------|-------|------|------|
|                              | Harb  | Setl | Pad  | Beach | Road | SWM  |
| Residential                  | 1.15  |      |      |       |      |      |
| Scrub Land                   |   | 6.15 |      |       |      |      |
| Coconut plantation (Harbour) |   | 0.13 |      |       |      |      |
| Commercial Area              |   |      |      |       | 0.02 |      |
| Paddy Area                   |   |      |      |       | 0.02 |      |
| Forest & Scrub Land          |   |      | 6.87 |       |      | 0.02 |
| Sea-water                    |   |      |      | 0.16  |      |      |

**Table 2:**  
**Present land extents of land use classes (2011)**

| Type         | Area (ha)      |
|--------------|----------------|
| Built up     | 101.50         |
| Residential  | 1789.07        |
| Paddy        | 3930.88        |
| Rock         | 14.86          |
| Sand         | 65.96          |
| Scrub Land   | 1014.13        |
| Streams      | 132.75         |
| Water        | 79.55          |
| <b>Total</b> | <b>7128.68</b> |



## Conclusion

1.155 sq Km residential area near to the beach has been occupied by the government for Oluvil harbour development. The relocated public has been resettled in a coconut plantation area close to Akkaraipattu Kalmunai main road and an area of 0.134 sq Km Coconut plants were removed from the vicinity. In addition to the Oluvil Harbour construction a huge amount of sea sand deposited in southern part of the harbour site and a coastal erosion experienced in Northern side. The coastal erosion has been eradicated by constructing special barriers in Sea (figs. 05-09).

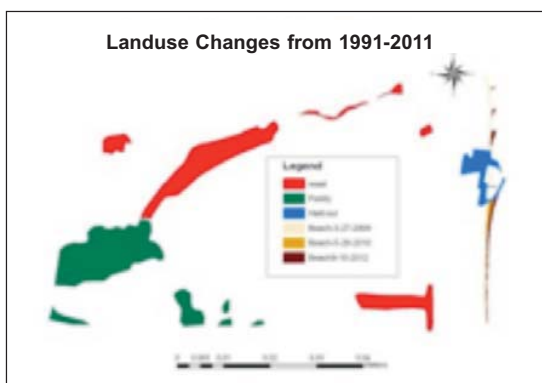
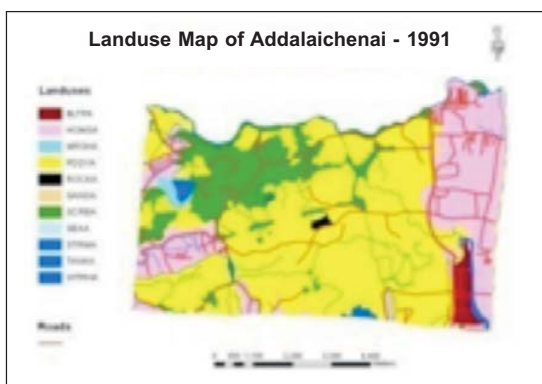
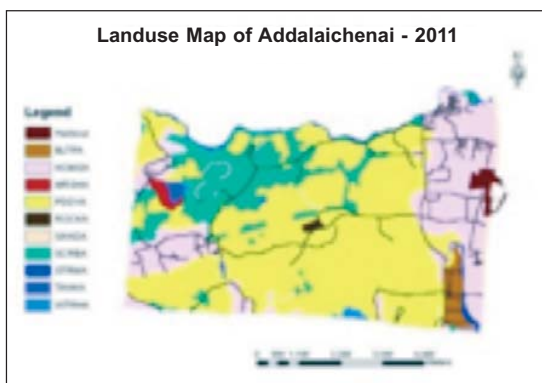
Further the tsunami disaster in 2004 has evacuated a large settlement from the coastal area and moved to many places where 6.148 sq Km of scrub land area close to Aalam Kulam and Aalim Chenai where human-elephant conflict are common in past days.

Due to the High way development under “Mahinda Chintana” facilitated the old main road connecting the Trinco Road to be expanded whereby commercial area of 0.023 sq Km and paddy area of 0.0178 sq Km were added to the road premises.

A solid waste management project was located in a Forest area where 0.0021sq km area was deforested (Fig 07 & 08). Further 6.873451 sq km of forest and scrub land were converted into Paddy land during the course of development.

The GIS environment and the remote sensing input are giving excellent tools to carry out this research accurately and quickly.





Figures: 05 – 09

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