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Land use and land cover change detection for Velachery using remote sensing and GIS techniques

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ABSTRACT

The knowledge of land use/land cover changes is very important in understanding natural resources, their utilization, conservation, and management. Though urban growth is seen to be a worldwide phenomenon, in countries like India the rate of urbanization is very fast. India possessed a number of fast-growing cities. This paper presents the land use/land cover changes that have taken place in Velachery, from 2008 to 2018. To classify the urban land use and land cover supervised classification method has been employed. The GIS is used to prepare the different layers belonging to various land uses identified from remotely sensed data. The land use and land cover classification maps were prepared through remote sensing and GIS technology. Nowadays in the analysis of temporal data at the district and city level, remote sensing and Geographical Information System have gained great importance as vital tools in the analysis process. The results indicate that there was a significant increase in the built-up land decrease in the vegetation.

Keywords— *Land use and cover, Change detection, Urban growth, Remote sensing, Geographical Information System*

1. INTRODUCTION

The central theme in land use and land cover change issues is the interaction between humans and the environment they live in. Land use/land cover exhibits the physical and economic situations of any region. At the country level, the root causes of land use/land cover change could be demographic, institutional, political, socio-cultural, developmental or environmental. At the regional level, the gains or losses of land use types in and around protected areas are mainly impacted by interactions between institutional and environmental factors. The consequence of land use/land cover change can only be observed in a longer time frame. Land use and land cover changes are dynamic, widespread and accelerating processes, mainly driven by natural phenomena and anthropogenic activities, which in turn changes the natural ecosystem. It has been led to an increased interest in the use of satellite data for large scale mapping applications and detailed land use assessments by the recent availability of high-resolution satellite imagery.

Vegetation changes are often the result of anthropogenic pressure and natural factors such as variability in the planet. Due to increasing population growth rates, there have been increasing rates of conversion of forests into built-up land all over the land. Urbanization is not only a side effect of economic growth of a country, but it is an integral part of the modern world. As in many countries, Towns and cities of India make a major contribution to the country's economic growth. Although less than one-third of India's population lives in urban areas, these areas generate more than two-thirds of the country's GDP and account for 90% of government revenues. (Planning commission, GOI 2008).

Due to the synoptic view, repetitive coverage and real-time data acquisition Remote sensing data are seemingly approved to be very useful. And to study the changes in land cover in less time, at low cost and with better accuracy the application of remotely sensed data in association with GIS which provides an appropriate platform for data analysis, update and retrieval. Remote sensing data of better resolution and different time interval help in analyzing the rate of changes as well as the causal factors or drivers of changes. Hence in regional planning at different spatial and temporal scales, the remote sensing data plays a significant role. To develop and understand the global, physical processes affecting the earth remote sensing data has become an important tool to be applied. Recent development in the use of satellite is to take advantage of increasing amounts of geographical data available in conjunction with GIS to assist in interpretation. GIS is an integrated system of computer hardware and software capable of 9capturing, storing, retrieving, manipulating, analyzing and displaying geographically referenced information for the purpose of aiding development-oriented management and decision-making process. Within the field of urban sprawl research, the use of GIS modelling has become very dominant. Through remote sensing technology, temporal changes in land cover have

become possible to be detected in less time, at lower cost and with better accuracy. The information being in digital form can be brought into a Geographical Information System (GIS) to provide a suitable platform for data analysis, update and retrieval.

The aim of this study is to produce a land use/ land cover map of Velachery that experienced a fast increase of urban population in the recent decades at different years in order to detect changes that have taken place within the inter-classes in land cover and particularly in the built-up land and also to analyze subsequently the urban sprawl of the different time periods and to predict the urban area growth in the same given period (2008-2018).

2. OBJECTIVES

- To create land use and land cover maps for Velachery from 2008 to 2018.
- To determine the extent of inter-class changes in land use and land cover.
- To determine the urban growth sprawl in Velachery from 2008 to 2018.

3. STUDY AREA

Velachery is an important residential area in the southern part of Chennai, Tamil Nadu, India. The growth of the IT sector in South Chennai is the main reason for the growth of the neighbourhood during the last decade. It displays to be an important hub connecting the fast-growing business class information technology corridor familiarly known as the OMR, the more mature and well-connected GST road and the central business districts within the city, which has more pertinent to Chennai's history. Hence between the old and new Chennai, Velachery entirely draws a perfect balance and is a phenomenon in terms of development and growth

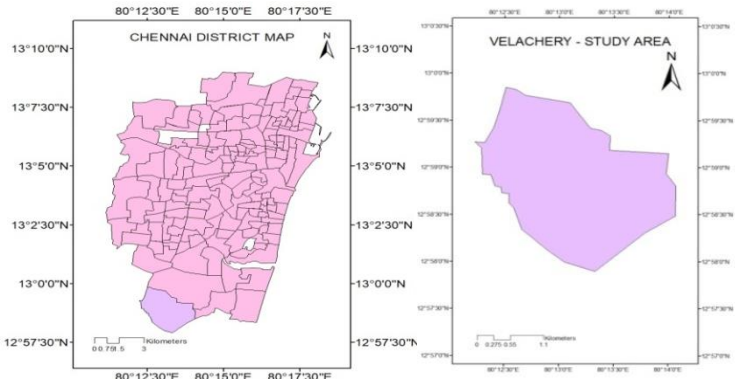

Fig. 1: Study area

Velachery had existed as a village from as far back as the 9th century and earlier. Velachery derived its name from the Tamil words Velar and Cheri, where Velar means form as and Cheri means a community. However, earlier to its name origin, Velachery was called as Vedasirani which means a place where they taught and enchanted Vedas.

Velachery covers usually mostly clayey and hard rocky areas. Southern Velachery comprised marshy land in thousands of acres collectively known as Kazhuveli. Owing to the rapid development and human encroachment, all those marshy lands disappeared. Pallikarani wetland is made by the remaining southern portions of the marshland.

4. THE SCOPE OF THE STUDY

Land use and Land cover changes are some of the most sensitive indicators of environmental changes as it reflects the impacts of human activities on the environment. Land cover refers to the physical and biological cover over the surface of the land, including water, vegetation and/or artificial structures. For many planning and management activities concerning the surface of the Earth, it is very important to attain the knowledge of land cover. And to balance a sustainable environment, it is obviously necessary to monitor and detect the land use changes. The study of the changes in land cover in less time, at low cost and with better accuracy was made possible by the application of remotely sensed data in association with GIS.

5. NEED FOR THE STUDY

In countries like India, the magnets that attract investment leading to the development of the industrial and service sector, employment generation, migration and population growth are the big cities and urban agglomerations. In terms of land use changes especially in the context of privatization and globalization, the above processes have been the significant implications. The review made upon earlier works shows that separate studies are there pertaining to migration and land use, but very few studies the association between the economic activities, migration, and land use changes, to bring out the aspect of population and its effect on land use. This study proposes to take care of these lacunas, by covering changes in population structure, migration & land use and study their association in spatiotemporal perspective.

6. MATERIALS AND METHODS

6.1 Satellite Data

The governments and business around the world operate the imaging satellites that collect the images of the Earth and other planets collectively known as satellite images. For the study, Landsat satellite images of Velachery, Chennai, India were acquired for the year from 2008-2018 from USGS, Landsat 7 images were used.

In the Landsat program, the seventh satellite that was launched on April 15, 1999, is the Landsat 7. Landsat 7's principal target is to refresh the global archive of the satellite photos, providing up-to-date and cloud-free images. The Landsat program is operated by the USGS, and data from Landsat 7 is collected and distributed by USGS. It has sun-synchronous, near-polar orbital characteristics.

6.2 Image acquisition

The physical scene or the interior structure of an object can be created as photographic images and this process is known as Digital imaging or Digital image acquisition. The term often assumed to imply or include the processing, compression, storage, printing and display of such images.

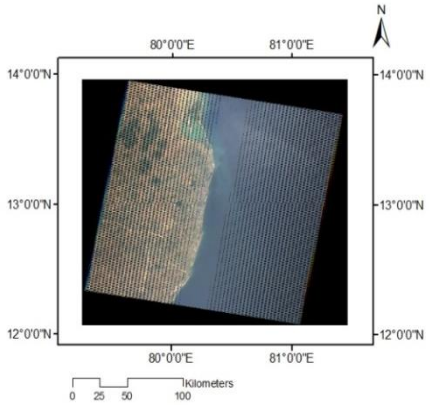

Fig. 2: Satellite data

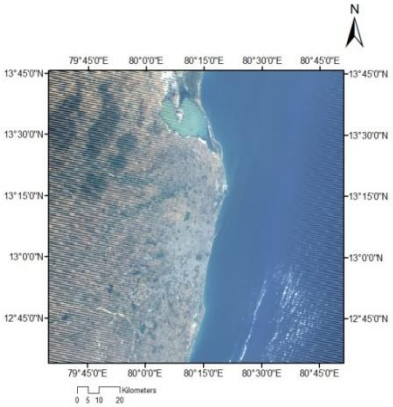

Fig. 3: After image rectification

6.3 Image Rectification

The transformation by projecting multiple images onto a common image surface is called image rectification. It is used for correcting a distorted image into a standard coordinate system. When the map points are not known properly or when the clearly identifiable points are lacking in images that correspond to the maps, then they seem to be as primary difficulties.

6.4 Image Preprocessing

The preprocessing is done prior to the main data analysis and extraction of information. The radiometric correction method is an effective one to improve the data which has any sensor irregularities and atmospheric noise and to correct and convert the data so that the reflected radiation as measured by the sensor is represented accurately have also been included in the preprocessing techniques. Geometric corrections include correcting for geometric distortions due to sensor-Earth geometric variations.

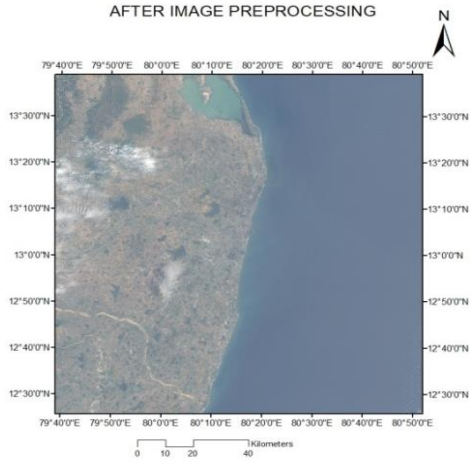

Fig. 4: After image preprocessing

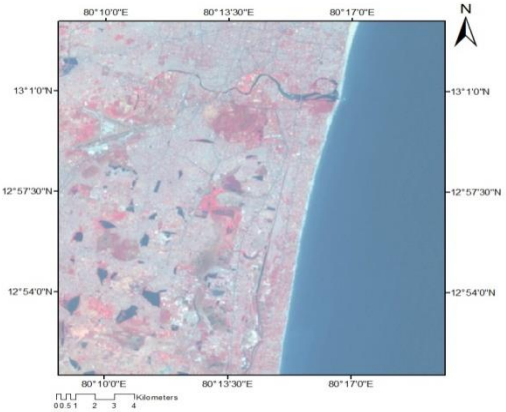

Fig. 5: After image enhancement

6.5 Image Enhancement

The visual impact of an image that has on the interpreter can be altered in a fashion through which the information content can be improvised. This process is known as image enhancement. It is necessary to use the original brightness values that have been recorded by the instrument with exact geometric and radiometric corrections while conducting digital image analysis. However, to make desirable changes to the visual appearance of the imagery to improve interpretation by a human being is possible since most of the remotely sensed data is viewed on a computer display.

6.6 Supervised Classification

Supervised and unsupervised classification is often employed in a combination manner; classifying the image based on the user-specified land cover classes will be allowed by the remote sensing program, classification of other less common or lesser known cover types into separate groups will also be done. Maximum Likelihood classification has been employed in this project. The tool will take both the variance and covariance into account while each cell has been assigned to one of the classes as mentioned in the signature file. The class sample distribution is assumed to be normal and the mean vector and the co-variance will characterize the class.

7. RESULTS AND DISCUSSIONS

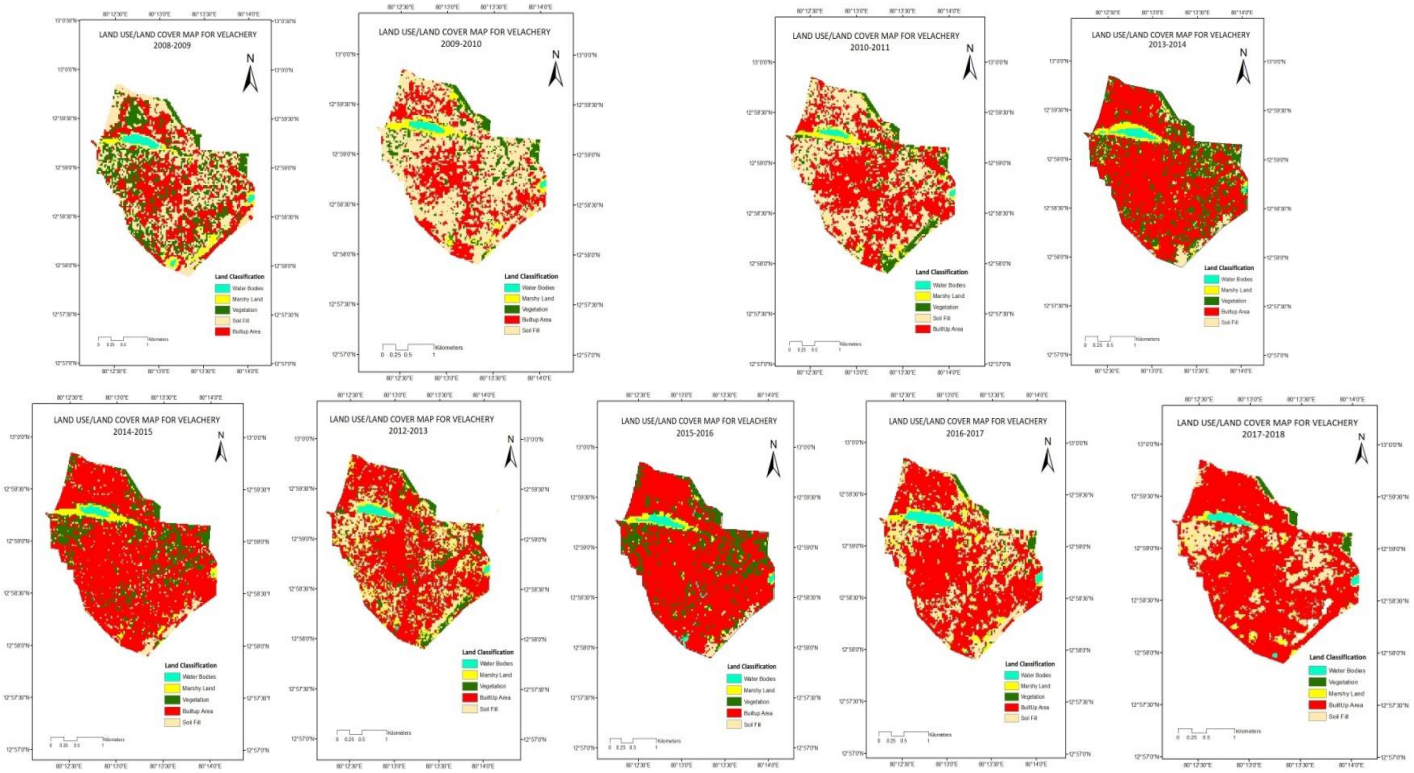

Fig. 6: Land use/Landcover map for Velachery 2008-2018

The study conducted in Velachery shows that multi-temporal satellite data are very useful to detect the changes in land use quickly and accurately. The study uncovers that the Built-up areas are the major land use in Velachery. Water Bodies have increased from 1.83% to 2.26%. Marshy Land has decreased from 2.75% to 2.6%. Soil Fill has reduced from 31.43% to 26.41%. During the study period, the areas under built-up area have been increased from 42.7% to 57.01% due to urbanization and exploitation of vegetative lands, while the areas under vegetation land are decreased from 21.25% to 11.71% due to deforestation and are converted into built-up areas for the development of commercial and infrastructural activities.

Table 2: Land use distribution

Landuse categories	2008-2009	2012-2013	2017-2018
	Area (%)	Area (%)	Area (%)
Water Bodies	1.83	1.57	2.26
Marshy Land	2.75	2.85	2.6
Vegetation	21.25	13.05	11.71
Built up areas	42.7	50.25	57.01
Soil Fill	31.43	32.27	26.41

As India's population keeps on increasing, the distresses on land use and land cover are also increasing. Urban Sprawl has an important part in the development of urban civilization to both extents positively and negatively. For regional balance and development in a sustainable manner, the resources must be utilized effectively since urban sprawl is found to be a serious threat. As observed from the above graph, the land utilized for built-up areas had a sharp increase from 42.7% to 57.01% within the time period of 2008 to 2018.

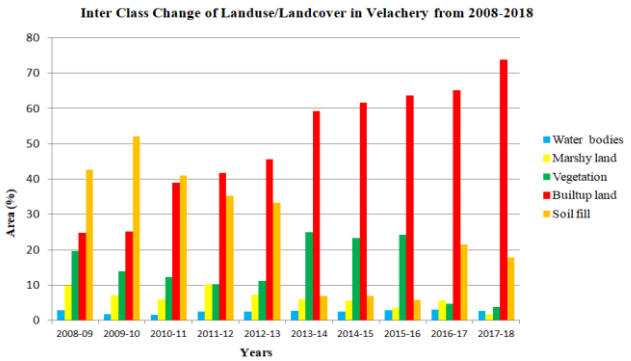

Fig. 8: Inter class change of landuse/landcover in Velachery from 2008-2018

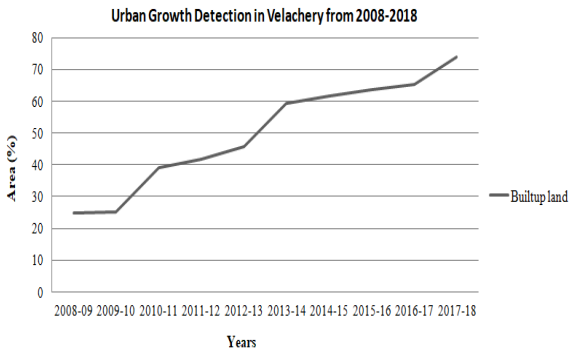

Fig. 9: Urban Growth detection in Velachery from 2008-2018

8. CONCLUSION

This paper is about the Land Use Land Cover Changes in Velachery, Chennai, using remote sensing data and GIS techniques. From the results, it is evident that Land Use Land Cover Changes were so prominent during the time period from 2008 to 2018. There is a major expansion of built-up areas and on the other hand, there is a drastic decrease in vegetation, water bodies, marshy land. This study precisely indicates the significant impact of population and urbanisation in LULC change. This was made possible by the integration of remote sensing and GIS technologies. This can be of great use for policymakers and also for the public to better understand the surroundings.

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