

Study of Sewage Treatment Plant in Trivandrum Corporation Using Remote Sensing and GIS Techniques

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Abstract

Sewage waste represents a threat to the environment and human health if not handled or disposed of properly. The present work aims to analyze the sewage network system of the sewage treatment plant of Thiruvananthapuram corporation situated at Muttathara, its functioning and land use pattern in the vicinity of 1.5 km around it using remote sensing and GIS techniques. Results of this study could aid in evolving relevant management strategies to improve the sewage water treatment management in Trivandrum Corporation.

Keywords sewage treatment plant, Thiruvananthapuram, RS and GIS

Introduction

Scientists have carried out numerous studies covering various economic and management aspects of sewage wastes generation by the world urban society. Kumar [1] assessed the efficiency of sewage treatment plants on a comparative study between Nagasandra and Mailasandra sewage treatment plants in Karnataka, which were constructed to manage sewage water by minimizing and/or removing organic matter, suspended solids and pathogenic organisms, before it reenters a water body. Muthukumar and Ambujam [2] analyzed the population growth in Srirangam, Tamil Nadu in conjunction with the water supply status, drainage system details, industrial water requirement and sewage water generation. All these studies point towards the necessity of a well-planned and

properly managed sewage disposal system for the healthy and prosperous well-being of any civilized society. The objective of the present study is to analyze the functioning and networking system of the sewage treatment plant in Thiruvananthapuram Corporation located at Muttathara and the changes in the land use pattern of the study area over a period of five years' time (2009-2014).

Study Area

Thiruvananthapuram Municipal Corporation is the largest city corporation in the state of Kerala by area and population. However, only 30 % of it is covered by a piped sewerage system out of an area of 141.74 sq. km that serves the core city area. Quantum of solid waste generated is 300 MT and the quantum of liquid waste generated is 100 Mld (CPCB, 2013). Presently, about 50 mld reaches the only sewage disposal facility, at Muttathara locality in Thiruvananthapuram. The quantity of sewage from the city, conveyed through a system of sewer network aided by pumping stations, reaches a stilling chamber located at Muttatharai, from where the sewage flows by gravity to reach the Sewage Farm after crossing Parvathy Puthanar Canal (TS Canal). Figure 1 shows the map of the study area and the location of the sewage farm located on the south bank of the canal.

The sewage farm was initially designed for a capacity of 8 mld and commissioned in 1945 with no system for grey water reuse. The farm is now overloaded with six times higher quantity of sewage. The soil in the area, due to prolonged load of sewage and lack of maintenance provision has

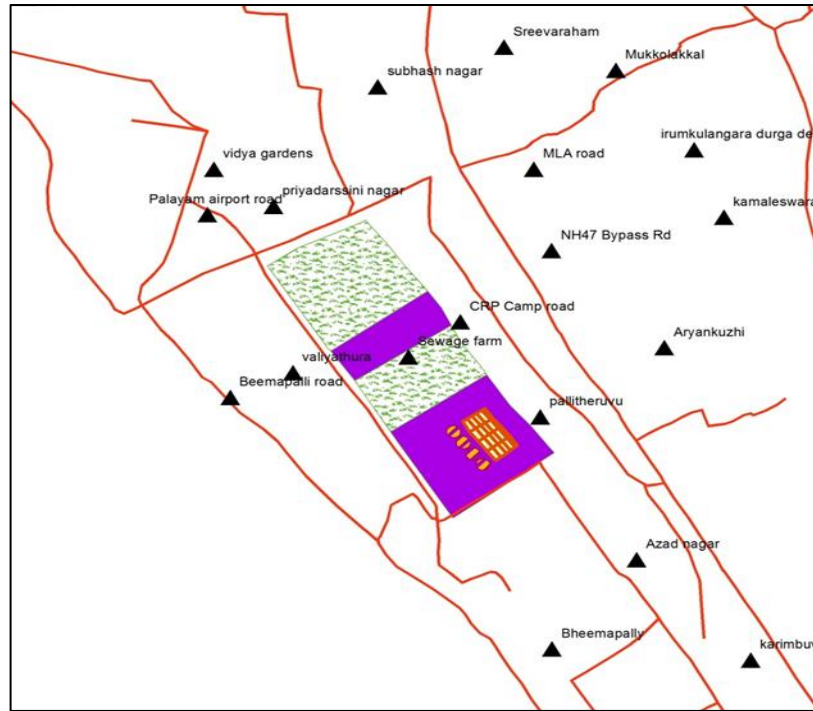


Figure 1. Map of the Study Area-Sewage Plant

substantially lost its porosity. Consequently, the raw sewage remains stagnated within the farm resulting in septic conditions. The advent of rainy season aggravates the situation when there is spillage of sewage to the adjacent TS Canal. Ground water contamination, mosquito nuisance and serious health hazards are some of the environmental issues posed by the said facility.

Land Use/ Land Cover

Land use/ land cover studies help to assess the interactions of the human activities with the environment and also its monitoring to aid a sustainable environment. Since the land use/land cover information is the basic pre-requisite for land, water and vegetation resources utilization, it becomes necessary to use latest technologies and tools like Remote Sensing Satellites for effective planning and management of these resources in modern times. 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. The regular monitoring of these changes in turn helps in better conservation and management of natural resources.

Material and Methods

To facilitate the analysis to meet the study objectives, both primary and secondary data were collected. Demarcation of the study area boundary was done in GIS, using Survey of India Toposheet No.58D/14 in 1:50,000 scale. The study area lies between $8^{\circ}57'27''\text{N}$ -- $76^{\circ}83'58''\text{E}$ and $8^{\circ}42'59''\text{N}$ -- $76^{\circ}99'25''\text{E}$. Land use change analysis was also carried out using Remote Sensing techniques and the dataset used for this purpose is the Quick bird imagery of 2.44 m resolution. The software used in the study is ARC-GIS of version 10.1. The raster data was interpreted and digitized to generate the thematic maps of land use and land cover, drainage, transportation and administrative boundary.

The initial (2009) and final (2014) Quick bird imageries were subjected to a classification of zones. Visual image interpretation was utilized to classify the images to different land use categories. In order to classify the rectified images, five classes of interest were specified in the images namely, built-up, coconut plantation, sea, sandy area and water bodies and lay out map of each year is prepared by exporting the data into JPEG format.

Results and Discussion

The main objective of this study was to demarcate the sewage plant and the surrounding environments using the Geographical Information Systems mapping techniques and Remote sensing data. The present land use pattern has been interpreted from satellite data and maps were generated in GIS. Temporal changes were demarcated using two sets of data. The main land use is settlements, followed by coconut plantation. Figure 2 depicts the land use changes during the period 2009-14 in the form of bar diagrams.

On carrying out the change detection analysis, it has been found that there is a marked increase in the area of built-up land at the cost of coconut plantations. It can be observed that the plantation areas are being converted for settlements. There are some changes in the land use patterns between the years 2009 and 2014. There is an increase in the number of buildings in 2014 compared to the year 2009. The amount of coconut plantation decreased in 2014 than that in 2009.

There is not much drastic changes happened in the case of water bodies, sea etc. It is clear that the plantation areas are being converted for settlements in the process of urban agglomeration. This increase in built-up area and population pressure on lands is pointing towards the necessity of better sewage waste management in the area.

A GIS based analysis of the pattern of urban expansion over the demographic change and land use modifications has also indicated that urban growth has mainly taken place linearly along the major roads in the study area [3]. Land is one of the prime natural resources and the changes of land-use/land-cover pattern over a time period control the pressure on land [4].

The timely information about the changing pattern of urban land use plays significant role in urban land use planning and sustainable urban development. The remote sensing technology along with GIS is an ideal tool to identify, locate and map various types of lands associated with different landform units [5-6]

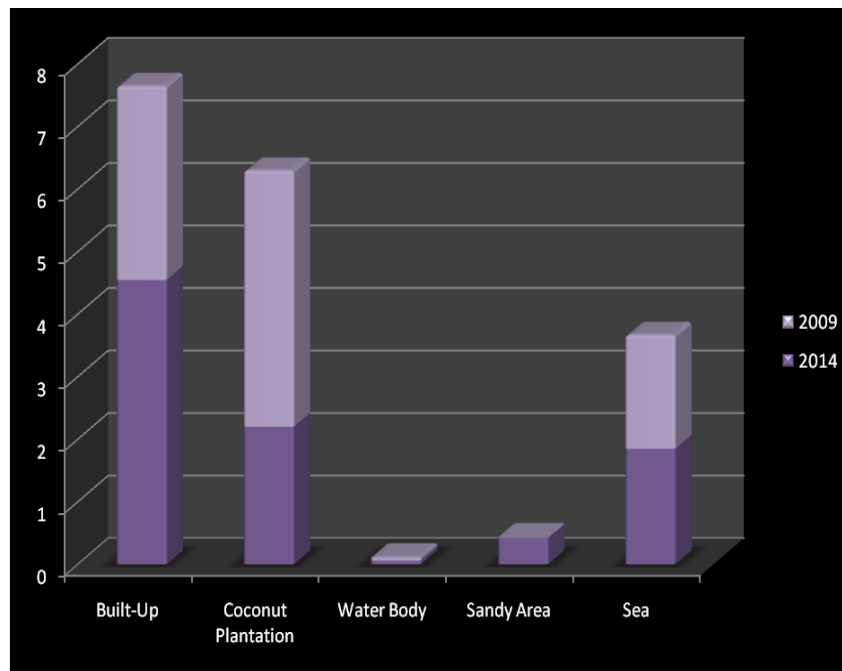


Figure 2. Bar diagram showing the land use changes (2009-2014)

Conclusions

Domestic waste from urban areas without proper planning is turning to be an unconquered problem [7]. Thiruvananthapuram Municipal Corporation being one of the densely populated in the state also faced the problem of proper sewage treatment facilities provided to its inhabitants. Only 30 % of its total area is actually covered by a piped sewerage system, which serves the core city area.

As a part of the present study, an attempt has been made to study the sewage treatment facility in the study area, using the techniques of GIS and remote sensing and the changes in the land use patterns over a period of five years from 2009 to 2014. It is observed that there is a marked increase in the area of built-up land at the cost of coconut plantations. The spatial-temporal variations observed as part of the study in the extent of built-up area and population pressure on land is pointing to the necessity of a systematic sewage waste management in the area. The results of the study could be well utilized to identify the relevant management strategies to improve the sewage water management in Trivandrum Corporation.

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