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LANDSCAPE CHANGES ASSESSMENT AIDED BY GEOGRAPHICAL INFORMATION SYSTEM (GIS) : A STUDY CONDUCTED AT SASTHAMCOTTAH LAKE, INDIA

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ABSTRACT

Wetland studies carried out using the conventional equipments like theodolite, plane table, sextant, range finders, sounding rods, echo-sounders and slow moving boats are time consuming and sometimes it takes up to three years to complete the survey of a major Ramsar Site i.e. Sasthamcottah lake , Kerala, India. During such long time of survey, the siltation pattern and the bed levels also get changed. So the need to update the sediment measurement techniques and to introduce latest technology available in the field is required to overcome the difficulties faced in the conventional method especially in major lakes and reservoirs. With this objective, the present study of the assessment of lake area change of Sasthamcottah lake is carried out using remote sensing and GIS techniques. The revised lake area is 356.17 Ha. and the revised lake capacity is 32806.322 M. Cu.m. In this way each year the lake area changes can be detected as well as compared with the data of the previous years.

Key Words : Remote Sensing, G.I.S., Echo-Sounder, Sextant, Theodolite, Ramsar site

INTRODUCTION

Wetlands are defined as lands transitional between terrestrial and aquatic systems where the water table is usually at or near the surface of the land is covered by shallow water[1,2]. Wetlands act as centres of biological productivity and perform many functions including regulation of the hydrological cycle and flood control, improvement and protection of water quality, erosion control and shoreline protection of water quality, conservation of biological diversity, habitat for wildlife and fisheries and resources for human communities[3].

Wetland destruction by human intervention commenced long ago and has accelerated in recent times. As a consequence wetlands are among the most degraded of all ecosystems. Direct anthropogenic activities such as irrational uses of wetlands for agriculture leading to its degradation and loss[4,5]. The role of tropical wetlands in the global climate system, ecosystem regulation and food supply has long been recognized[6,7]. Despite the economic and ecological importance of wetlands, there are many uncertainities regarding the extant, distribution, ecological and physical functions[8-10].

Remote sensing and Geographical Information System (GIS) techniques yield promising results for mapping and quantifying and understanding the present condition of the tropical wetlands. Most studies use photo-interpretation methods to identify and understand the condition of the different wetlands. The satellite remote sensing data with its repetitive nature have proved to be a cost effective tool for mapping the lake area change[11]. It also provides synoptic coverage of area of interest and facilitates optimal monitoring capabilities. These special characters make remote sensing an optimal tool for this type of

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study[12]. Quantification of lake area changes is possible through GIS techniques even if the resultant spatial datasets are on different scales or resolutions. Such studies have helped in understanding the dynamics of human activities[13].

AIMS AND OBJECTIVES

Study used remote sensing data in order to analyze and assess the lake area change that have taken place during the last 40-50 years and its impact on environment around the lake. This study provides fundamental scientific knowledge and understanding of the magnitude and spatial distribution of lake area changes of Sasthamcottah Lake of Kollam, Kerala. This information can be useful for scientific and non-scientific organizations involved in environmental resource management, policy decision makers and planners.

STUDY AREA

The lake considered for investigation during present work is Sasthamcottah lake **(Fig. 1)** which is also designated as a Ramsar Site. This lake is situated in the Kollam district of Kerala (India) covering an area of 373 hectares. The lake lies between 9^0 0'-9^0 5' N latitude and 76^0 35' to 76^0 40' E longitude in the South west coast of India. Sasthamcottah lake is situated at a height of 33 m above MSL. The lake has a capacity to hold 22,390 million litres of water and is the main source of drinking water for half a million people of Kollam district of Kerala.

MATERIAL AND METHODS

The Survey of India (SOI) topographic sheets Nos. H/2, 54 H/5 and 54 H/6 in scale of 1:25000 for Sasthamcottah lake were used for preparation of base map of 1956. In order to analyze the existing lake area in the study site standard visual image interpretation method based on photo-graphic and geotechnical elements such as shape, size, pattern, association and field knowledge was followed using IRS LISS II of 2007. Limited ground truth verification was carried out before the finalization of maps.

The lake area of 1956 and 2007 were imported to Arc-View GIS 3.2 version software for spatial analysis **(Table 1)**. Each lake area was assigned a unique ID in the polygon coverage. The polygon coverage was then projected and transformed using sub modules available in Arc View GIS 9.0 version. Polygon topology was built after editing and cleaning. The area under each category was calculated in square kilometre (km^2). The difference in the lake area is obtained by image to image comparison.

The various operations like band slicing, band rationing and normalized difference water index were performed to identify the water pixels. The images of water spreads as obtained from the interpretation were edited to remove the effect of noise, isolated water pixels, extension of tail and joining or rivers around the water spread. The computation of lake capacity has been made using the following prismoidal formula :

$$V=h/3 \{A1+A2+sqrt (A1*A2)\}$$

Table 1 : Revised water spread area of Sasthamcottah lake

Date of satellite picture	Lake Area (Ha)	Area Change (Ha)	Lake Capacity (M.Cu.m.)
1956	438.84		
2007	356.17	82.67	32806.322

RESULTS AND DISCUSSION

The lake area change was calculated using the Indian Remote Sensing data. The lake area change are shown in **Fig. 2.** The IRS data with spatial resolutions of 36.25m for LISS II and 23.5m for LISS III enabled delineation of lake area change upto level II.

Lake Area Change Detection

Analyzing the study area i.e. Sasthamcottah lake, the lake area change was noted to be 82.67 hectare from 1956 to 2007.

The comparison between original and revised area shows the present capacity of Sasthamcottah

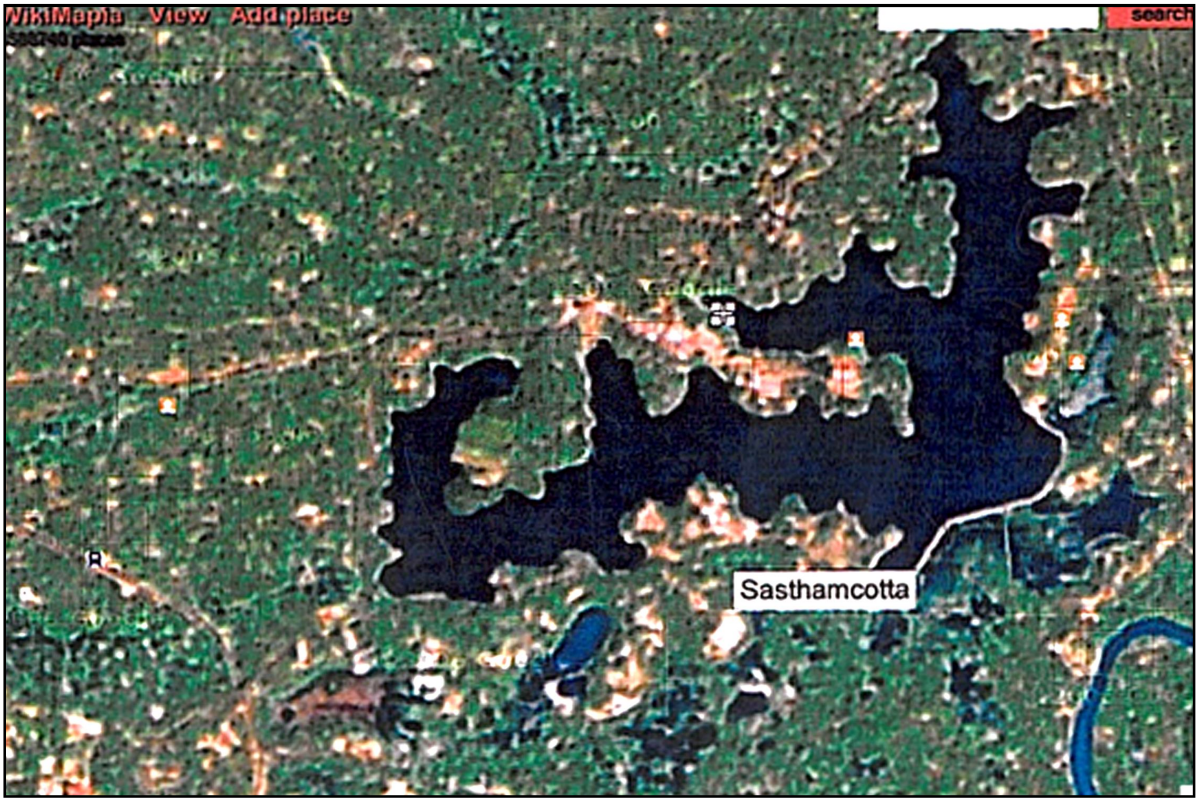

Fig. 1 : Satellite imagery of Sasthamcottah Lake

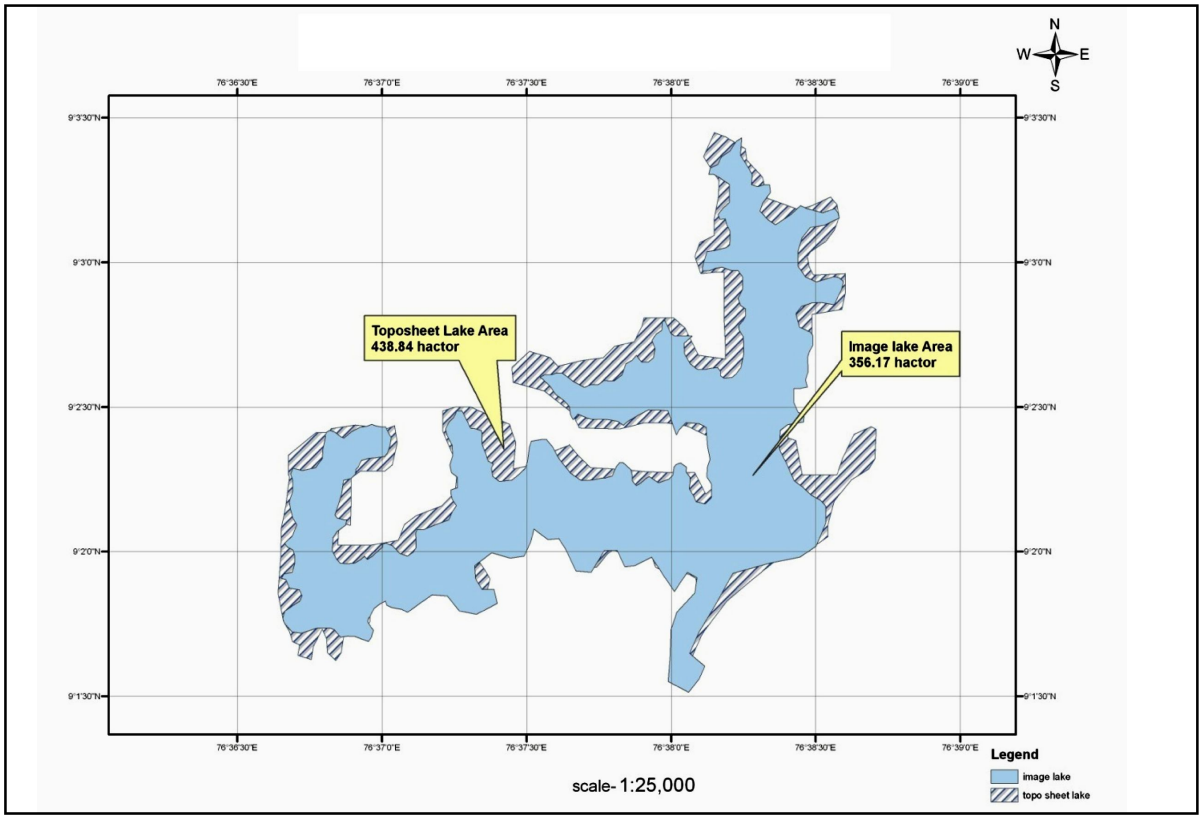

Fig. 2 : Sasthamcottah lake area change detection

Lake. The present capacity of Sasthamcottah Lake is 32806.322 M.cu.m. With the development of highly precise remote sensing techniques in spatial resolution and GIS the modelling of the watershed has become more physically based and spatially distributed to enumerate interactive hydrological processes considering spatial heterogenicity. The results indicate decrease in the water spread area of the lake over the years though has been designated as a Ramsar Site. Water spread of hirakud reservoir from multi-data landsat-MSS imagery was computed[14] who reported that the area capacity curves derived using remote sensing data were almost similar to the curves obtained from the conventional methods[15] employed digital techniques in which density slicing of Landsat-MSS near Infrared (IR) data was performed for extracting the water spread area of Ubolratana reservoir in Thailand. It carried out reservoir sedimentation study using the density slicing approach for water-spread area extraction[16]. The assessment of reservoir capacity loss of Tungabhadra reservoir using satellite data was successfully applied by Durbude and Varadarajan[17-18].

CONCLUSION

Present study demonstrated the usefulness of remote sensing and GIS to assess the magnitude of sedimentation and the decreasing water spread area of Sasthamcottah lake, Kollam, India. This study indicates that remote sensing is the best technology which provides periodical data with high resolution that can be used to detect the changes and also evaluate its impact. The study shows that merely designating a wetland as a Ramsar Site is not just enough but a paradigm shift in our conservation ethic is also a strong need of the hour. This shift is necessary and mandatory due to the very nature of the resource being conserved and protected. Wetlands are common property resources. The dynamic nature of wetlands necessitates the widespread and consistent use of satellite based remote sensors and low cost, affordable GIS tools for effective management and monitoring.

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