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Assessment of Reduction in Water Spread of Shanthisagara Lake in Davanagere District Karnataka using Geoinformatics

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Abstract **- The aim of present study is to assess the causes for reduction in water spread of Shanthisagara lake in Davanagere district from the last 50 years using Remote Sensing and GIS techniques. The remote sensing data like, Landsat-5MSS, Landsat-7ETM+ and Resourcesat-2, LISS-IV were used to map the water spread area of the lake. Multidate satellite data analysis showed that, there is change in lake water spread over the years. To know the reasons, rainfall data for more than 50 years were collected and analyzed along with Land use/ Land cover studies carried out using LISS-IV data for the year 2009 and 2018. The result infers that, there is a reduction in water spread area of Shanthisagara lake over the years is due to reduction in rainfall in the catchment area and significant change in Land use/Land cover pattern from year 2009 to 2018 has also contributed to reduced inflow to lake.**

Keywords: Shanthisagara lake, Water spread, Remote sensing, GIS

INTRODUCTION

Lake is an area filled with water localized in a basin, which is surrounded by land, apart from any river or other outlet that serves to feed or drain the lake. Lakes lie on land and are not part of the ocean, and therefore are distinct from lagoons, and are also larger and deeper than ponds, though there are no official or scientific definitions. Lakes can be contrasted with rivers or streams, which are usually flowing. Most lakes are fed and drained by rivers and streams. (Kalaiselvanet.,al 2018) Natural lakes are generally found in mountainous areas, rift zones, and areas with ongoing glaciation. Other lakes are found in endorheic asins or along the courses of mature rivers. In some parts of the world, there are many lakes because of chaotic drainage patterns left over from the last Ice Age. All lakes are temporary over geologic time scales, as they will slowly fill in with sediments or spill out of the basin containing them. Many lakes are artificial and are constructed for industrial or agricultural use for hydroelectricity power generation or domestic water supply or for aesthetic, recreational purposes or other activities.

IMPORTANCE OF THE STUDY

The study reveals the causes for the reduction of water spread area in the lake over the years using satellite remote sensing data (from last 50 years) either rainfall over 50 years or the impact of LU/LC patterns changes in the lake catchment area.

Data Used: The change in the water spread area has been studied using multi-temporal satellite datasets used is as given in Table 1.

Table 1: Data used for the present study area

Satellite data	Year	Acquisition date	Spatial Resolution
Corona	1964	March 14th	7.5 meters
Landsat 5 MSS	1973	April 8th	30 meters
Landsat 7 ETM+	1999	March 22nd	30 meters
LISS-IV	2009	March 8th	6 meters
LISS-IV	2018	January 22nd	6 meters

Software Used:

ArcGIS: ArcGIS is Geographic Information System developed by ESRI (Environmental System Research Institute) creates and analyzes geographic data, tests predictions and ultimately makes better decision which allows a user to visualize and manage the database. ArcGIS is used by people all over the world to put geographic knowledge to work in government, business, science, education and media. ArcGIS enables geographic information to be published so it can be accessed and used by anyone.

ERDAS Imagine: High resolution images are used to analyze the Land use/Land cover changes using ERDAS, because of the popularity and wide acceptance in remote sensing image classification. In this project, ERDAS imagine is used for the purpose of geo-referencing.

RESULTS AND DISCUSSION

In the **figure 1,** Satellite image is Corona acquired on March 14th 1964. This satellite image represents the Shanthisagara lake water spread area is about 18.16 Sq km out of 26.51 Sq km of the boundary of Shanthisagara lake .

In the **figure 2**, Satellite image is Landsat-5 acquired on April 8th 1973. This satellite image represents the

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Shanthisagara lake water spread area is about 22.73 Sq km out of 26.51 Sq km of the boundary of Shanthisagara lake.

In the **figure 3,** Satellite image is Landsat-7 acquired on March 23rd 1999. This satellite image represents the Shanthisagara lake water spread area is about 15.17 Sq km out of 26.51 Sq km of the boundary of Shanthisagara lake.

In the **figure 4,** Satellite image is Landsat-5 acquired on April 8th 2009. This satellite image represents the Shanthisagara lake water spread area is about 12.69 Sq km out of 26.51 Sq km of the boundary of Shanthisagara lake.

In the **figure 5,** Satellite image is LISS-IV merged satellite acquired on October 8th 2017. This satellite image represents the Shanthisagara lake water spread area is about 10.27 Sq km and out of 26.51 Sq km of the boundary of Shanthisagara lake.

Year	Water spread area (in Sq km)
1964	18.16
1973	22.73
1999	15.17
2009	12.69
2017	10.27

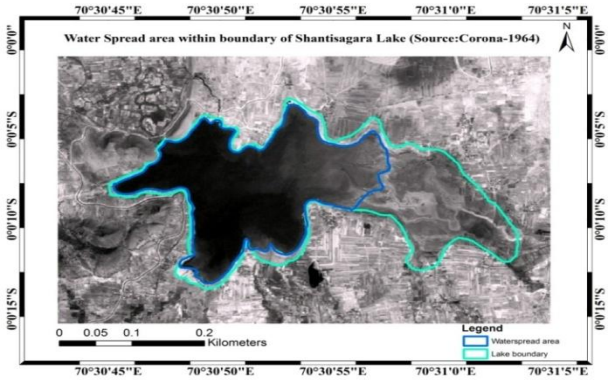

Figure 1: Water spread of the lake in 1964

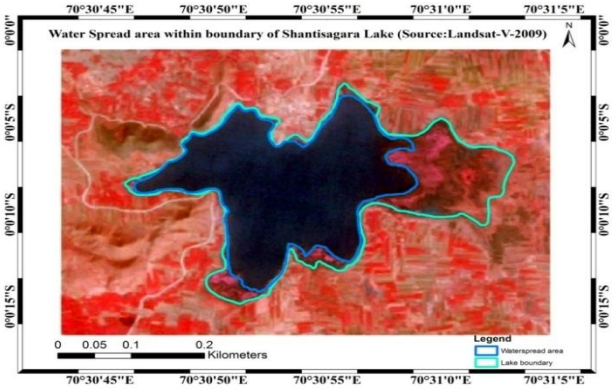

Figure 4: Water spread of the lake in 2009

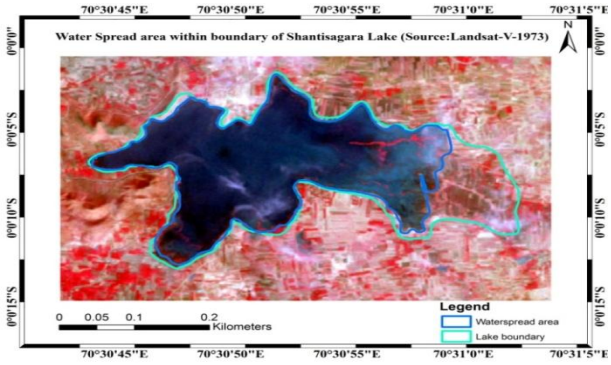

Figure 2: Water spread of the lake in 1973

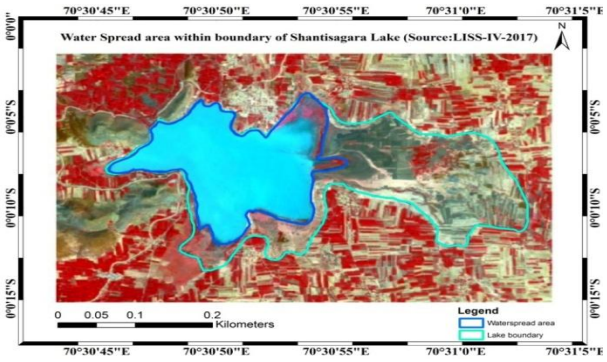

Figure 5: Water spread of the lake in 2017

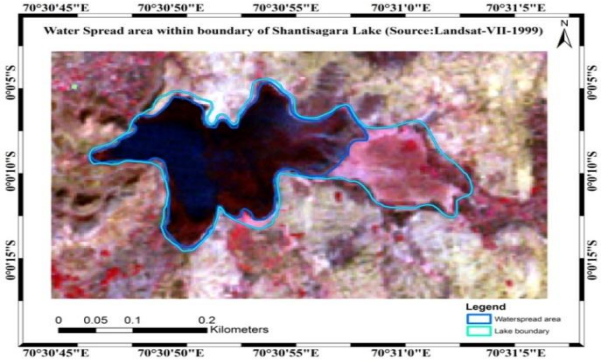

Figure 3: Water spread of the lake in 1999.

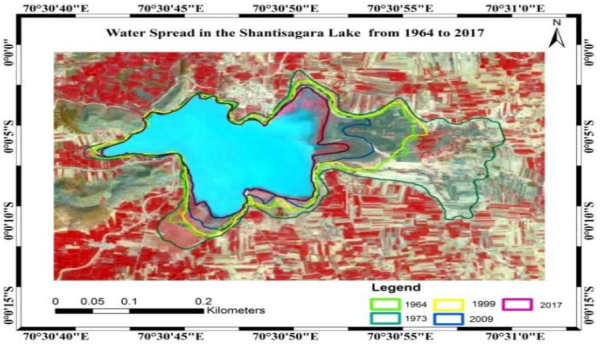

Figure 6: Water spread in the Shanthisagara lake from 1964 to 2017

International Journal of Engineering Research & Technology (IJERT)
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Annual Rainfall of Channagiri and Holalkere Raingauge Stations from 1964-2017

The rainfall data from Indian Metrological Department (IMD) website has been downloaded for the Channagiri and Holalkere raingauge stations from the year 1964 to 2017. The year wise variation of annual rainfall for Channagiri raingauge station is shown in figure 7, which reveals that the maximum amount of rainfall occurs in 1973 and the minimum amount of rainfall occurs in 2016-17. Similarly, for the Holalkere raingauge station, annual rainfall variation is shown in figure 8, where the maximum amount of rainfall occurs in 1972 and the minimum amount of rainfall occurs in 2016.

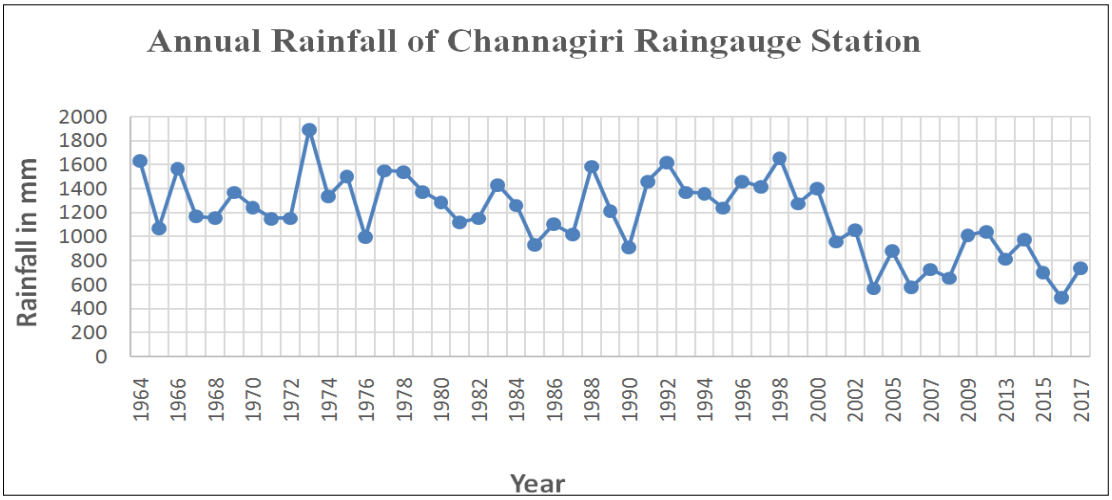

Figure 7: Year wise annual rainfall variation diagram for Channagiri Raingauge station (from 1964-2017).

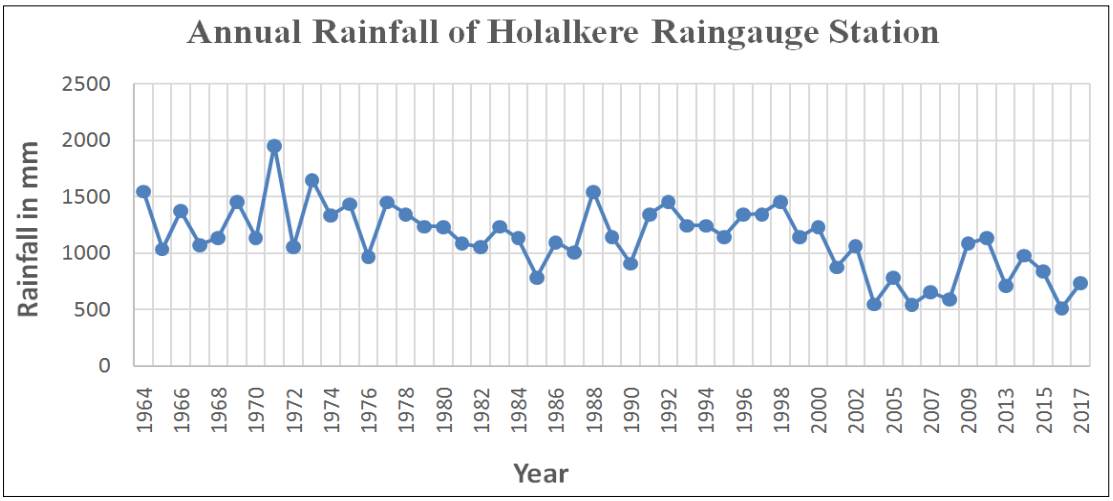

Figure 8: Year wise annual rainfall variation diagram for Holalkere raingauge station (from 1964-2017)

From the above analysis, we can see a significant decrease in the rainfall in the catchment area over the years contributing to the reduction in the water spread area.

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LU/LC Pattern of Shanthisagara Lake Catchment Area of Year 2009

Land use Land cover map (Fig 9) generated for the catchment area for the year 2009 using LISS-1V Satellite image. Visual Image interpretation technique used to classify the images to different land use categories. In order to classify the rectified images, seven categories were delineated in the images namely, Plantation crop, Agriculture crop, Agriculture fallow land, Scrub land, Forest, Built - up land and Waterbodies. Plantation crop is about 419.42 Sq km, Agriculture crop is about 296.79 Sq Km, Agriculture fallow land is about 26.90 Sq Km, Scrub land is about 281.28 Sq Km, Forest is about 125.98 Sq Km, Built-up land is about 33.18 Sq Km, and Water bodies is about 44.53 Sq km.

LU/LC Pattern of Shanthisagara Lake Catchment Area of Year 2018

Land use Land cover map (Fig 10) done for the considered study catchment area for the Year 2007-09. LISS-1V Satellite image is used. Visual Image Interpretation was utilized to classify the images to different land use categories. In order to classify the rectified images, seven categories were delineated in the images namely, Plantation crop, Agriculture crop, Agriculture fallow land, Scrub land, Forest, Built - up land and Water bodies. Plantation crop is about 691.03 Sq Km, Agriculture crop is about 244.27 Sq Km, Agriculture fallow land is about 30.45 Sq Km, Scrub land is about 95.40 Sq Km, Forest is about 90.98 Sq Km, Built-up land is about 29.24 Sq Km, and Water bodies is about 38.11 Sq Km.

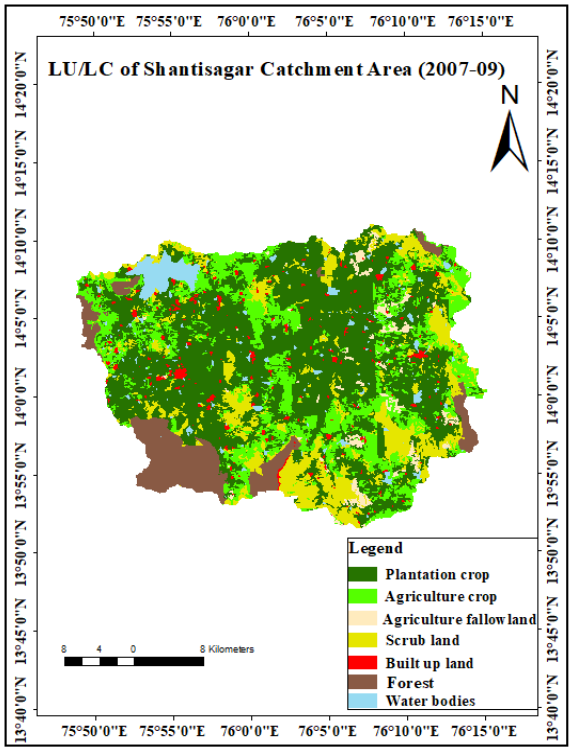

Figure 9: LU/LC map of Shanthisagara Lake Catchment Area in the Year 2009

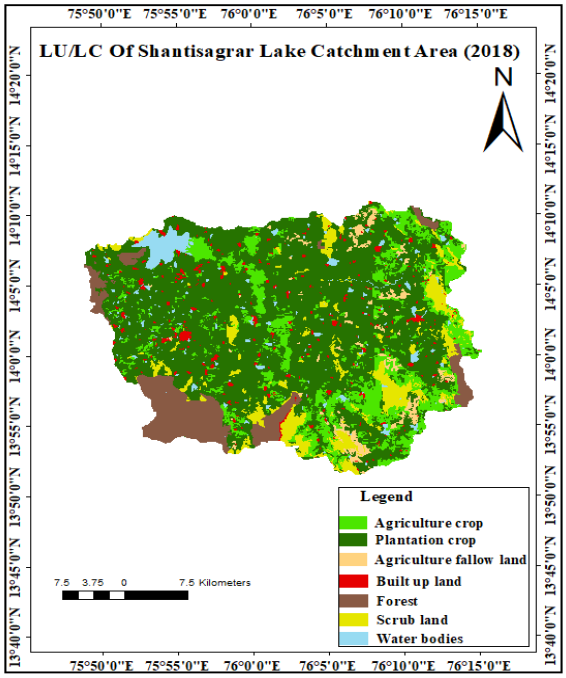

Figure 10: LU/LC map of Shanthisagara Lake Catchment Area in the year 2018

International Journal of Engineering Research & Technology (IJERT)
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Table 3: Land use/Land cover categories during Year 2009 & 2018 (area in Sq km)

Categories	Year 2009	Year 2018	Change Detection
Plantation crop	419.42	691.03	+271.61
Agricultural crop	296.79	244.27	-52.52
Agriculture fallow land	26.90	30.45	+3.55
Scrub land	281.28	95.40	-185.88
Forest land	125.98	99.98	-26.00
Built-up land	33.18	29.24	**-3.94**
Water bodies	44.53	38.11	-6.42
Total	**1228.48**	**1228.48**	

CONCLUSION

Remote sensing and GIS techniques are very useful to assess the change in water spread and LU/LC of given area. Multi-dated Satellite data for the last 50 years has enabled mapping of watershed of Shanthisagara Lake. Rainfall analysis for the last 50 years showed that, rainfall has reduced over the 50 years and it could be one of the reasons for the reduction in water spread area of the lake. Land use/Land cover change analysis has shown that there is significant increase in plantation area and this is may be one of the reasons for reduced inflow to the lake. The suggestion like desiltation of the streams, those connecting to the lake will enable to good flow of water to the lake which may leads to increase the water spread area.

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