ENVIRONMENTAL IMPACT AND WATER QUALITY ASSESSMENT IN SAMUTHIRAM LAKE, THANJAVUR USING GIS TECHNIQUES

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Abstract* — This study represents the basic components that sustainable development are considered to be water quantity and quality. Cities like Thanjavur, which are growing urbanly, require an evaluation of surface water bodies. The development of Thanjavur city has harmed the water resources. The study's main goal is to qualitatively categories Samuthiram Lake in Thanjavur City using useful qualitative standards for Indian drinking water regulations. It focuses on spatial variations in surface water quality in Samuthiram Lake using a composite of physical and chemical parameter measurements. For this analysis' output to deliver precise information, GIS is the sustainable method of evaluating data from both geographical and non-spatial sources.

***Keywords*— Water Quality, Environmental Impact, GIS.**

I. INTRODUCTION

In the current world, water is necessary for all forms of work. Water resources are closely tied to urban development, residential development, commercial and industrial sector growth, and agricultural development. Additionally, maintaining the public's health, society, and economy depends on effective management of water resources. One of the biggest problems in recent years is the strain on the sources of drinkable water. At initially, all of the water required by the villages in Tamil Nadu was provided by the ponds and lakes that were constructed around the deltaic towns. The lakes are presently used as dumps for solid waste, domestic sewage, and industrial effluents. Originally, the lakes offered water for drinking, fishing, irrigation, and other uses. This investigation's study area is the Samuthiram Lake. an Amman temple in the east, near the lake, and a sewage treatment plant (STP) in the west. The main causes of contamination include untreated sewage from the neighbouring residential area, municipal sewage, and household wastewater. The northeastern bank of the lake is affected by high levels of anthropogenic activity such open defecation and mixing of sewage from subterranean aquifers.

GIS was a tool employed in this study. A system-based tool called a Geographic Information System (GIS) is used to gather, analyze, interpret, store, alter, and visualize data in the form of maps. Data Base Management System (DBMS) and GIS are both acceptable tools for users to create and analyse spatial and non-spatial data. Thus, the use of contemporary GIS technologies for digital information in this study. Samuthiram Lake, one of the freshwater lakes, is the research area. Thanjavur City, Tamil Nadu, India is where it is situated. The lakes' geographic location is 1046'58.38"N, 7910'43.01"E. 800 acres or so were formerly occupied by the lake. It provides water for around 1186 acres. This lake receives water from Grand Anicut.

WATER QUALITY

The chemical, physical, and biological characteristics of water are referred to as its quality in accordance with the needs for its utilization. It most frequently refers to a set of requirements that may be used to assess compliance, which is commonly obtained by water treatment. The state of ecosystems, the safety of human contact, the level of water pollution, and the quality of drinking water are the most often used metrics for measuring and evaluating water quality. Water supply is significantly impacted by water quality, which also commonly influences supply alternatives. Environmental water quality, also known as ambient water quality, is regarded as existing in lakes, rivers, and seas. Water quality criteria for surface waters are influenced by a variety of environmental conditions, ecosystems, and intended human uses. According to the EPA, laws governing water quality frequently include provisions for protecting fisheries and recreational use as well as maintaining current quality requirements. Some examples of ideal water quality qualities in certain locations include high dissolved oxygen concentrations, low chlorophyll-a concentrations, and high water clarity.

ENVIRONMENTAL IMPACT ON WATER QUALITY

Water stress and water use both have numerous negative effects on the environment. Water depletion may have a direct impact on aquatic creatures, and it may also have a negative impact on terrestrial ecosystems that rely on groundwater downstream from the region of water usage. Crop yields are decreased by a lack of water, and people particularly those in underdeveloped nations may go hungry. In many areas, fossil groundwater supplies, reservoirs, and lakes are already being exhausted. The geographical context has a significant impact on all of these environmental effects. For example, because to the Nile watershed's significantly lower water availability, one litre of water consumed there cannot be compared to one from the Mississippi. Thus, it is essential to classify water use in terms of its effects on the ecosystem at. As a result, it's important to categorise water usage based on how it will affect the environment where it's being used. Associating environmental problems with products is extremely important from a "polluter pays" perspective. Significant variations in the usage of water and land are seen depending on the crop variety, the production system, and the environmental circumstances. In order to compare the production of alternative crops and in various areas, environmental evaluation criteria are needed. The findings have implications for both producers and consumers, particularly in the fields of product-based life cycle assessments (LCA) and the growing water footprint analysis , which concentrate on the life cycles of goods and services and cover the entire value chain.

WATER QUALITY TEST

Physical, chemical, bacterial, and microscopic testing methods and criteria can all be categorized .Chemical testing establish the concentrations of organic and mineral compounds that have an impact on water quality. Physical tests reveal qualities observable by the senses. The results of bacterial tests indicate the presence of bacteria that are indicative of faecal pollution.

WHY WATER QUALITY ANALYSIS IS NEEDED?

Water quality analysis is required mainly for monitoring purpose. Some importance of such assessment includes:

(i) To check whether the water quality is in compliance with the standards, and hence, suitable or not for the designated use.

(ii) To monitor the efficiency of a system, working for water quality maintenance

(iii) To check whether up gradation / change of an existing system is required and to decide what changes should take place

(iv) To monitor whether water quality is in compliance with rules and regulations.

Water quality analysis is of extremely necessary in the sectors of:

□ Public Health (especially for drinking water)

□ Industrial Use.

WHAT IS GIS?

A geographic information system (GIS) is a system that creates, manages, analyzes, and maps all types of data. GIS connects data to a map, integrating location data (where things are) with all types of descriptive information (what things are like there). This provides a foundation for mapping and analysis that is used in science and almost every industry. GIS helps users understand patterns, relationships, and geographic context. The benefits include improved communication and efficiency as well as better management and decision making.

ROLE OF GIS IN WATER QUALITY:

GIS is used as an effective tool for developing solutions for water resources problems for assessing and mapping of ground water quality, understanding the natural environment and managing water resources on a required scale, assessing groundwater vulnerability to pollution.

Table 1: Details of sample location

Sl.No.	Object-ID	Northing	Easting	Location Remarks
1	S1	10.784966	79.169648	Q5M9+JQP Samuthiram Lake, Thanjavur, TN, India
2	S2	10.782272	79.168099	T98 PGP Nagar, Kumbakonam Bye Pass, Nagai Road, Evergreen Nagar, Thanjavur, TN, India
3	S3	10.784952	79.172375	145 Mariamman Kovil, Thanjavur, TN, India
4	S4	10.782558	79.171089	Q5JC+HVP, Nagapattinam-Coimbatore-Gundlupet Hwy, Gnanam Nagar, Pulianthoppu, TN, India
5	S5	10.780942	79.171423	Q5JC+7H Gnanam Nagar, Thanjavur, TN, India
6	S6	10.782737	79.172416	Q5JF+J5H, Thanjavur, TN, India
7	S7	10.782647	79.171479	Q5JC+MW4, Thanjavur, TN, India
8	S8	10.782848	79.174234	Q5JF+PJ, Thanjavur, TN, India
9	S9	10.783926	79.185914	Q5MP+8CF, Nagapattinam-Coimbatore-Gundlupet Hwy, Gnanam Nagar, Mariamman Kovil, Marungai, TN, India
10	S10	10.783066	79.174200	Q5JG+W29, NH67, Mariamman Kovil, Thanjavur, TN, India
11	S11	10.785358	79.185614	Q5PP+892, Mariamman Kovil, Arulmolipet,Thanjavur, TN, India

II. STUDY AREA AND METHODS

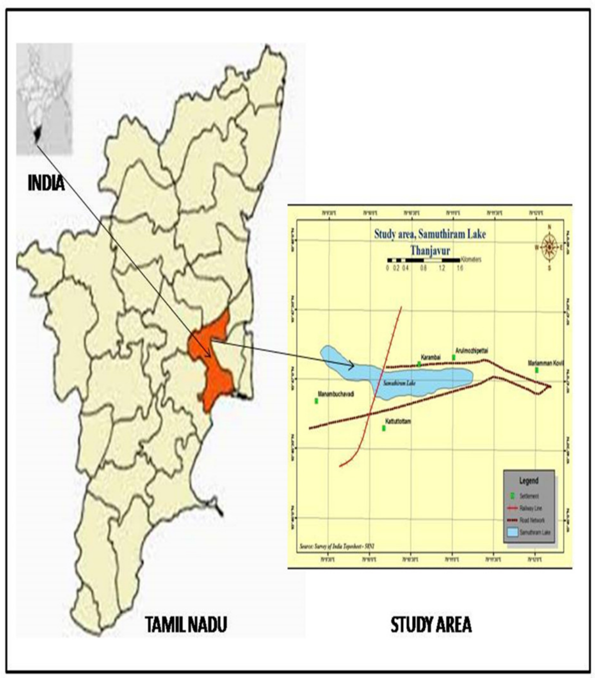

Figure 1. Location Map of the Study Area

The study area geographically lies between 10°78' N and 79°19´E. Samuthiram Lake is situated in Thanjavur district about 7 km to the East of Thanjavur town. The lake if formed in view of providing the local residents with clean water for irrigation, domestic use, fisheries etc. the quality of the lake has drastically changed over the years.

WATER SAMPLES DATA

In this research, water samples were taken from 11 accessible places in the Samuthiram Lake. We have collected the Northing Easting i.e. spatial data from those areas the collected data is mentioned in the above tabular column (Table 1).

Sample number is designated as S1, S2, S3, S4, S5, S6, S7, S8, S9, S10 and S11. In this study, water samples tested which is obtained from this lake and obtained certain values. The result is mentioned in the below Table 2 & 3.

Table 2. Value

Sample No	pH	Total Alkalinity	CaCo3	NO3	CL	Fluoride	Sulphate	Turbidity	TDS
S1	7.01	160	172	11	78	0.88	44	33.44	545
S2	7.04	190	118	11	100	0.65	40	23.40	634
S3	7.02	192	160	12	74	0.69	17	5.70	449
S4	7.37	172	166	12	86	0.67	20	2.50	429
S5	7.22	205	236	13	106	0.44	15	30.43	455
S6	7.80	300	300	13	114	0.56	30	8.50	647
S7	6.60	120	190	9	70	0.66	34	23.90	327
S8	6.90	244	240	8	98	0.62	38	25.50	612
S9	6.40	123	298	6	96	0.84	28	7.40	345
S10	6.20	239	256	7	113	0.67	19	22.45	543
S11	6.80	210	126	8	117	0.76	17	29.65	567

Table 3. Value

Sample No	Conductivity	Calcium	Magnesium	Sodium	Potassium	Iron	Ammonia	Nitrite	Tidy_s
S1	765	44	7	45	3	1.45	9.65	0.07	0.33
S2	876	54	8	55	2	2.43	8.65	0.080	4.56
S3	642	42	13	60	4	0.72	10.17	0.08	10.45
S4	613	76	14	58	3	0.29	7.54	0.55	0.20
S5	456	40	54	6	4	0.99	0.08	0.87	6.55
S6	925	78.	25	81	4	0.61	0.02	0.02	1.14
S7	467	48.	17	14	1	2.790	0.21	0.21	1.23
S8	784	56	20	81	4	3.60	0.17	1.44	6.72
S9	975	65	33	87	3	2.98	0.32	0.09	4.44
S10	864	23	22	54	4	3.40	0.56	1.45	5.65
S11	753	76	13	65	3	2.43	0.89	1.43	7.65

Based upon the above result we have splitted water into whether they are potable are not based upon their acceptable and permissible limit as per IS 10500-2012. Their classification has been segregated as potable and not potable water.

III. RESULT AND DISCUSSION

Using the known values at nearby sample points, interpolation is the technique of guessing a variable's value at locations. A continuous surface that can be utilised for mapping and analysis is made using the estimated values. The graph has been draw 'X'axis as samples object ID, 'Y'axis as parameter values.

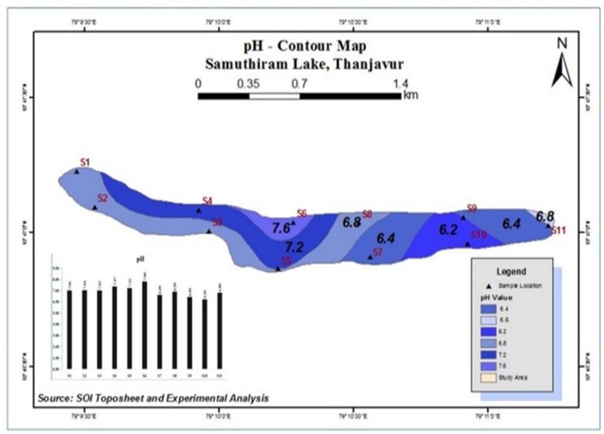

Figure 2. pH -Map and Graph

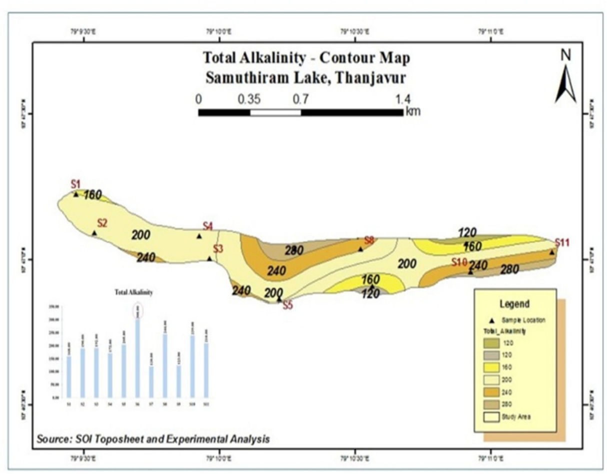

Figure 3. Total Alkalinity -Map and Graph

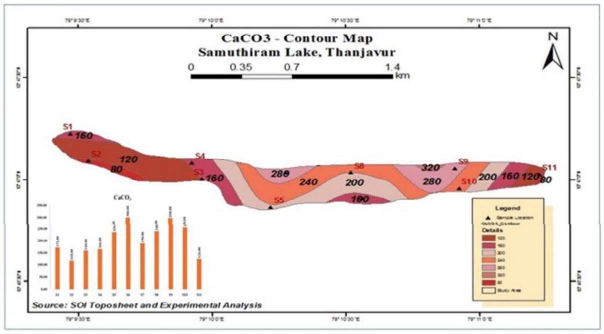

Figure 4. $CaCO_3$ -Map and Graph

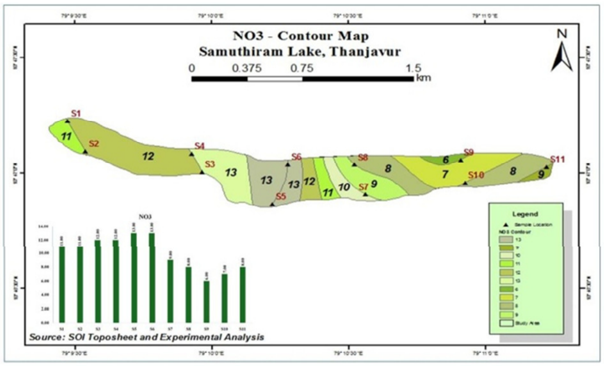

Figure 5. NO_3- Map and Graph

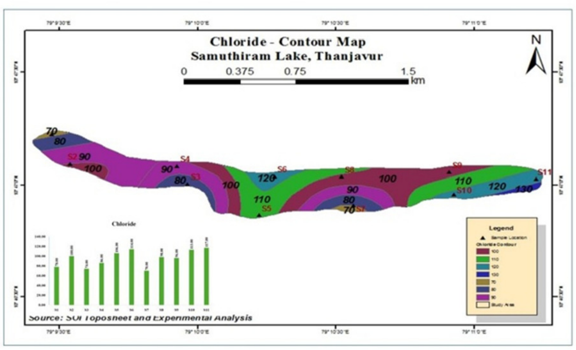

Figure 6. Chloride -Map and Graph

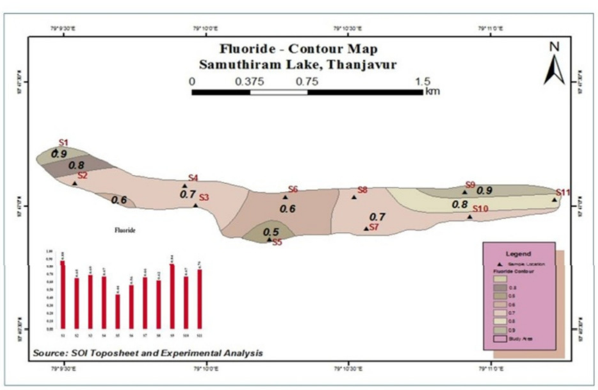

Figure 7. Fluoride - Map and Graph

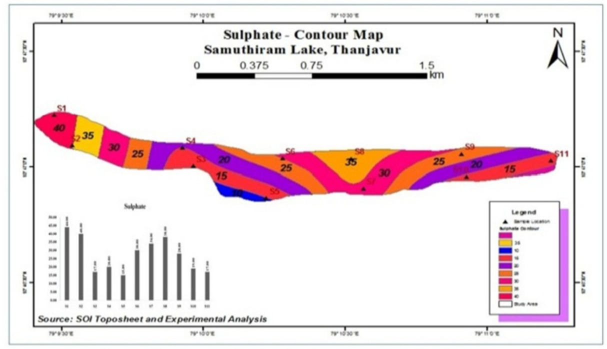

Figure 8. Sulphate -Map and Graph

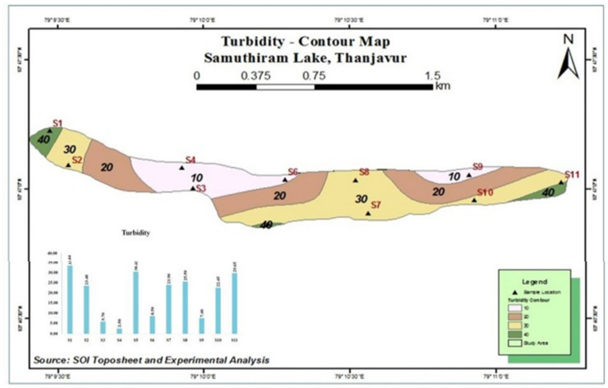

Figure 9. Turbidity-Map and Graph

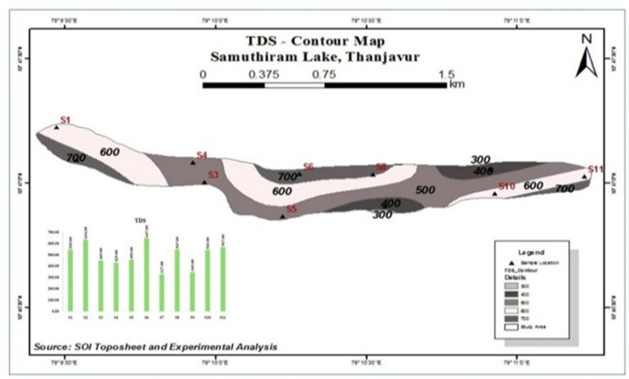

Figure 10. TDS -Map and Graph

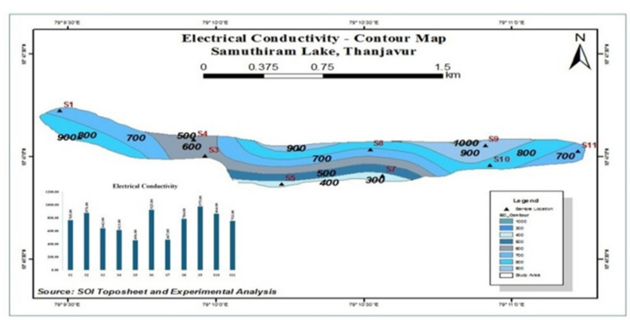

Figure 11. Electrical conductivity - Map and Graph

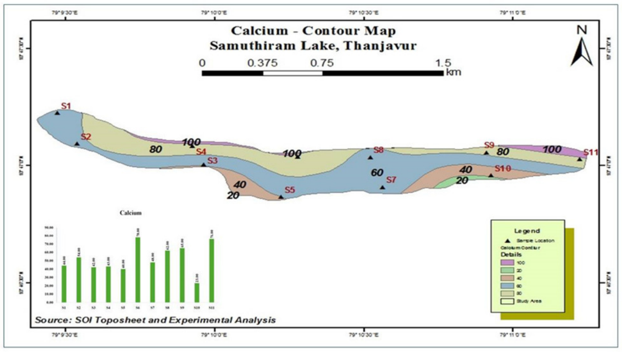

Figure 12. Calcium- Map and Graph

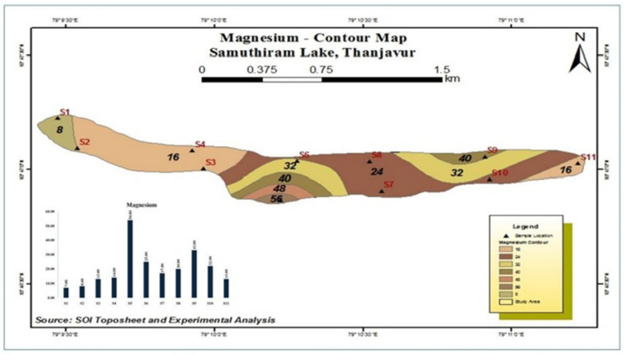

Figure 13. Magnesium -Map and Graph

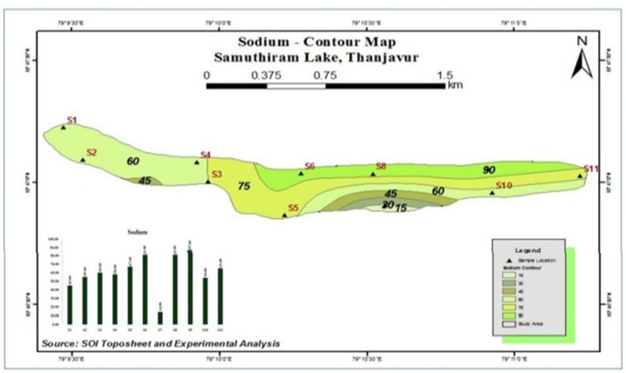

Figure 14. Sodium -Map and Graph

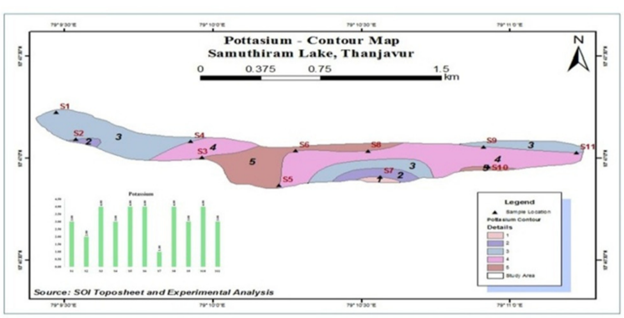

Figure 15. Pottasium -Map and Graph

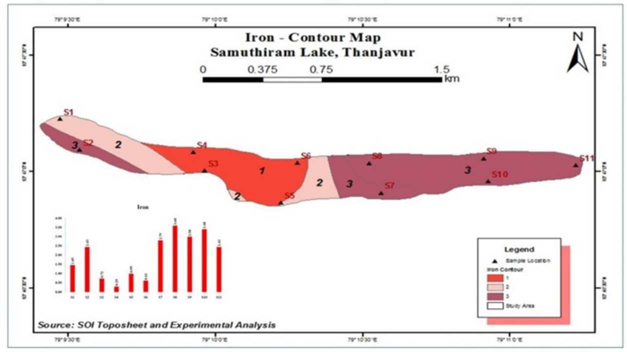

Figure 16. Iron- Map and Graph

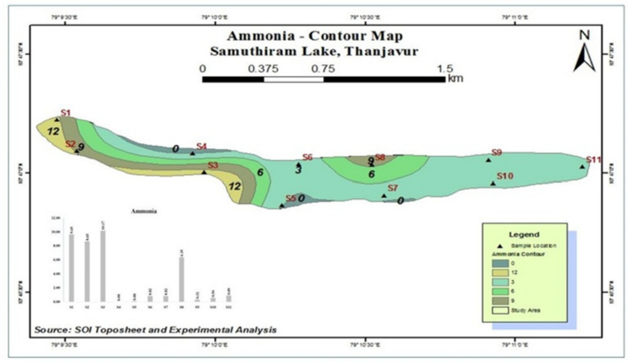

Figure 17. Ammonia- Map and Graph

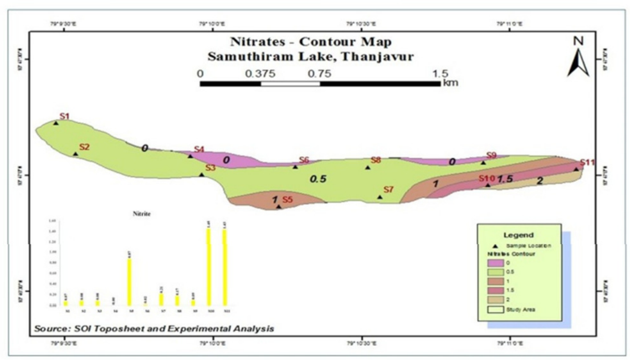

Figure 18. Nitraties -Map and Graph

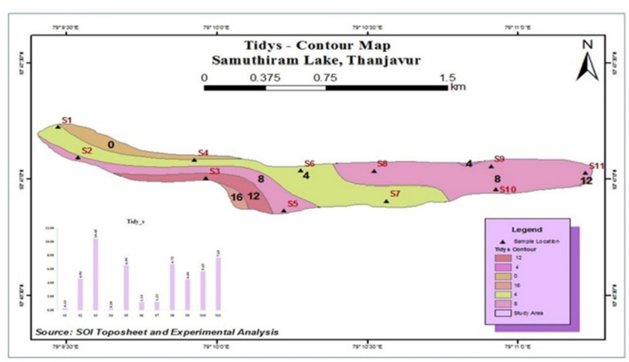

Figure 19. Tidys - Map and Graph

WATER CONTAMINATION HAZARD MAP

Water Samples were collected at different areas in Samuthiram lake. By using location points, Thiesson Polygon is generated, the each polygon considered as proximate zones by weighted overlay analysis in GIS. The water contamination map has been divided into the category such as Low Contamination Hazard, Moderate Contamination Hazard and High Contamination Hazard. The details of water contamination zones as shown in Table 4.

Table 4. Water contamination zone

ZONE	SAMPLES
High Contamination Hazard	**S3,S6,S7,S8,S11**
Low Contamination Hazard	**S4,S10**
Moderate Contamination Hazard	**S1,S2,S5,S9**

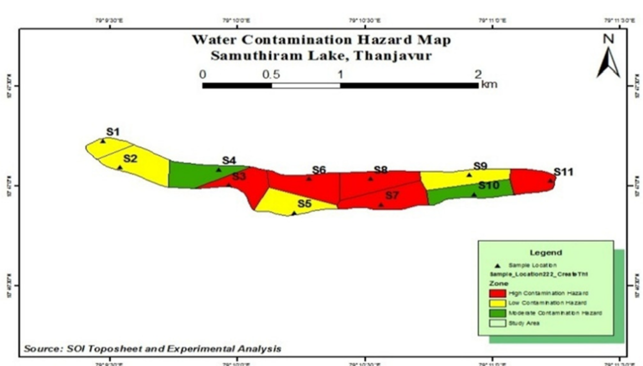

Figure 20: Water Contamination Hazard Map

IV. CONCLUSION

In this study various challenging to adequately dispose of enormous amounts of waste as the population growth. Because of the examined metrics departures from the standards Parameters TDS, pH, turbidity, conductivity, $CaCO_3$, NO_3, Chloride, fluoride etc., its aquatic biodiversity and plant life are considered to be in danger. The data obtained demonstrated that the water had a low quality and was frequently unfit for consumption. Some factors are incomparable, with encroachment and urbanisation being the main offenders. It is important to notify the public, the local administration, and the government about the current circumstances. Assessment of water quality is essential to check the suitability of a water source for the designated use. Several water quality parameters are assessed and compared with their standard values to determine the acceptability of the water to be used. GIS methods deal with spatial and non-spatial data.

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