

ASSESSMENT OF WATER QUALITY ANALYSIS IN LAKES OF BHAVNAGAR REGION

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Abstract: Assessment of surface water quality is a fundamental and important technique for sustainable management of water resources. The aim of this study is to evaluate the lake water quality of the Bhavnagar region. The findings will support effective water management in the research area for a variety of future demands, including irrigation, industry, and river conservation. Environmentally significant variables were examined, including physio-chemical parameters (PH, color odor, test, Turbidity, calcium, hardness, total dissolved solids, chloride, magnesium, sulphate,). The results were contrasted with the BIS and WHO's accepted upper limits. All of the water quality metrics have been determined by correlating various parameters and comparing them with BIS, and the variations in various parameters were statistically significant when compared to the monthly seasonal variation in a lake. The QGIS software through Interpolate Map of The Water-quality parameters indicate that lakes Water is safe for Drinking Purpose

Keywords: Bhavnagar city lakes, Physio-chemical Parameters, Correlation parameters, Water quality, Assessment Lake Polluted, QGIS Software,

I. INTRODUCTION

Water is a vital element of the environment and is necessary for the survival of all living things on Earth. Every organism depends in water. We are over 65% water in our human body so water supply must be kept sanitary and safe. India's minor water bodies are affected by the rural-urban mobility that is occurring as a result of population growth and industrialization. These migrants settle down close to natural water sources, such as lakes, canals, and so forth, where solid and chemical waste is dumped.

Contamination water claims more lives than disease, AIDS, terrorism, or accidents. contaminated water major impact on the quality of its water. Not only the aquatic life but also the surrounding ecology can be impacted by the deterioration of water quality. The water won't be fit for drinking if it's dirty or has too much salt in it. Saline water used to irrigate crops and plants will not be healthy, and food output will decrease.

Lakes water quality Monitoring can help researchers identify human impacts on an ecosystem and forecast and learn from natural processes in the environment. In addition to helping with restoration projects, these measurement efforts can guarantee that environmental regulations are being met.

Need of study

The reasons for the need of presents study are:

1. lake water quality parameter not tasted for drinking purpose.
2. assess the quality of water collected from this lake
3. insufficient data available for future study (physio-chemical parameters) or research.

Objectives of the study

The present study was carried out with following objective

1. To check water quality parameters of various lakes drinking purpose.
2. To check water quality parameters of various lake to compare standard data of bis for drinking purpose.
3. To develop thematic map indicating actual water quality parameter using QGIS software.

II. LITERATURE REVIEW

Reena Patidar (2022) Assessment of physio-chemical parameters of Govardhan Sagar lake. The lake has a very high bacterial load of faecal coliform, which makes the water dangerous to drink without proper treatment, according to the current study. The net productivity of the aquatic ecosystem tends to increase with nitrogen value. The presence of nitrogen in water indicates the presence of organic matter and that the lake is contaminated. Three separate stations watched the lake during the duration of four months, from January 2022 to April 2022. The lake's physio-chemical properties were found to be moderate over the study period in accordance with drinking water regulations. The average temperature was found to be 28.31 C. The average pH of Govardhan Sagar Lake was 9.1, which is a moderately alkaline figure. High electrical conductivity and TDS sustain a respectable level of aquatic productivity. The mean values of total hardness, calcium hardness, and magnesium hardness, according to this study, were 31.50 ppm, 7.60 ppm, and 23.91 ppm, respectively. These values are within acceptable ranges.

Hardik Vashishtha, Himanshu kumar Sadhya (2020) have studied Physio-chemical parameters of lake. Over the research of the examination, were found to be moderate in conformity with drinking water criteria. The average temperature was 28.6 °C, the colour and smell were unpleasant, the pH was 9.0, the EC was 735 ppm, the BOD was 3.8 ppm, the COD was 42.3 ppm, the DO was 5.3 ppm, the nitrogen content was 7.1 ppm, the alkalinity was 245.9 ppm, the total hardness was 30.9 ppm, and the calcium hardness was 7.9 ppm.

Jahangir Mohd (2021) Statistical Analysis and Assessment of physico-chemical parameters in manasbal lake, Ganderbal, Kashmir, India. 15 parameters were studied in two years' worth of water quality data from six sites. Data was gathered monthly, however the results were presented seasonally. Manasbal Lake is changing as a result of cultural excess, which is mostly brought on by human pressures such encroachment and excessive pollution, the quantity of which varies by location. The range of the water's temperature was 5 to 24 C. The water's pH fluctuated between 7.0 and 8.5, with the lowest value of 7.0 being recorded, and the EC ranged from 259 S/cm to 563 S/cm over the winter. Alkalinity values ranged from 46 mg/L to 242 mg/L, with the minimum value of 295 S/cm being recorded. the bare minimum of 46 mg/L The range of the total suspended solids was from 199.2 mg/L to 433.0 mg/L. Maximum concentration of 433.0 mg/L and minimum concentration of 199.2 mg/L were both noted.

Nitish Kumar, Sharma, Firdous, Seema Azmat (2021) Latest Trends in Physio-Chemical Parameters of Dal Lake, Kashmir. Samples were taken throughout the course of two seasons (2020 and 2021). winter (December, January, and February) and the monsoon season (September, October, and November). All samples were taken from the surface. parameters and related techniques BOD - Dilution method, DO - Winkler's method, TDS - TDS metre, Hardness Titration method, PH -pH Metre, Water temperature - Celsius Thermometer, Turbidity - Nephlo Turbidity Metre, TDS -TDS metre Titration technique for total alkalinity in this study, the water quality of the lake was assessed using a total of 8 parameters. The temperature fluctuated between 6-80°C in the winter and 15-24°C in the autumn, dropping throughout the winter and rising during the summer. Alkalinity readings in the winter ranged from 92.0 to 180 mg/l and from 84.0 to 144.4 mg/l. Hardness levels ranged from 132-236 mg/l in the summer and from 173.0-241 mg/l in the winter.

Dr. Durairulneyam (2018) Assessment of Water Quality in Saroornagar Lake, Hyderabad. During the three months from January to March 2018, 12 water samples from 4 different places surrounding Saroornagar Lake were collected for the study. Analysis of variables such as temperature, pH, total solids, total dissolved solids, alkalinity, total hardness, calcium hardness, magnesium, chlorides, carbonates, and bicarbonates, as well as dissolved oxygen (DO), biological oxygen demand (BOD), and chemical oxygen demand (COD). higher level of contamination in lake's status. This resulted from the disposal of untreated home sewage and industrial effluents, as well as from the washing of garments and cleaning of automobiles. Furthermore, it has been established that water from Saroornagar Lake cannot be used for home, agricultural, industrial, and other purposes without the proper filtration.

III. STUDY AREA

Bhavnagar district is a peninsular in Western Gujarat and Bhavnagar city of serves as the district's administrative hub. Bhavnagar In the year 2021, the urban population was 7,12,000 people. Around 664 villages. The total area of the Bhavnagar district is 108.27km² The Bhavnagar city, often called Kathiawar, is a seaside settlement on the eastern coast of Saurashtra that is situated at 21.76°N latitude and 72.15°E longitude. 24 metres (78 feet) is the average elevation. The fifth most populated city in Gujarat, it has an area of 53.3 km² (20.6 sq mi). At the top of the Gulf of Khambhat, the overall slope dips towards the northeast.

Bhavnagar district has a lot of medium-black soil in the. Along the Shetrunji River, which passes through portions of the Gariyadhar and Palitana talukas, alluvial soil may be seen. This region's soil is less productive due to its salinity. Alkaline soil can be found in several areas of the Gariyadhar taluka. They are composed of both fertile and unproductive soils. The soils of Rajula and Jafrabad talukas are saltier and less fertile than the incredibly productive soils in Kodinar taluka. According to the Central Ground Water Board Report 2014.

Bhavnagar city biggest Lake is Gaurishankar Lake also called Bortalav lake, is a man-made lake located in the city of Bhavnagar in the Indian state of Gujarat. The lake was built in the 19th century by the then ruler of Bhavnagar, Maharaja Takhtsinhji, as a source of drinking water for the city's residents. It covers an area of approximately 381 acres and is surrounded by a beautiful garden, known as Gaurishankar Udyan, which serves as a popular recreational spot for locals and tourists alike. The lake also has a beautiful fountain situated in the center, which adds to the charm of the place. Other Bhavnagar city's lake is Akwada lake, Tarasamiya lake, Nari Lake is compare to small but popular tourists spot lakes.

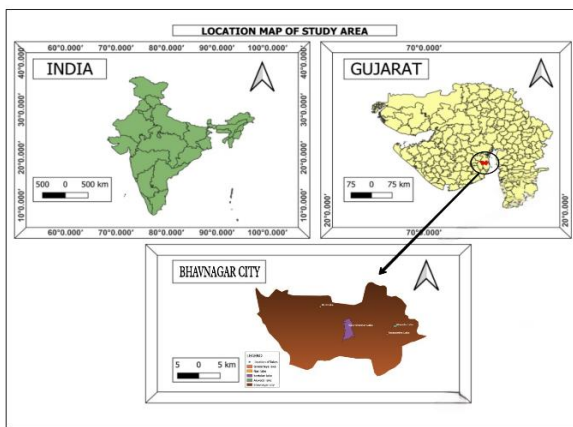


Figure 1 Study Area Map



Figure 2 Google Earth Satellite Map

Table 1 Geographical directions of various lakes in Bhavnagar city

Sr. No.	Lake Name	Latitude	Longitude	Reservoir Area (sq. km)	Average Annual Rainfall (Bhavnagar)
1	Gaurishankar Lake (Bortalav)	21.7436° N	72.1164° E	3.186789	550 mm
2	Nari Lake	21.7730° N	72.0798° E	0.031088	550 mm
3	Akwada Lake	21.7420° N	72.1792° E	0.167357	550 mm
4	Tarasamiya Lake	21.7321° N	72.1697° E	1.673565	550 mm

IV. DATA COLLECTION

The present study, lakes water quality sample data testing in private Maa Aqua laboratory in Bhavnagar city and some physio-chemical Parameters test in manually in Maharaja krishnakumarsinhji Bhavnagar University in Department of chemistry laboratory testing. The water samples are collecting from November month 2022 to January month and April month 2023. The collected water sample such as a color, odor, temperature, turbidity, PH, TDS, total hardness, magnesium, chloride, sulphate. The test result from water quality analysis is below table.

Table 2 November 2022 Month All Lakes Water Quality Data Analysis

SR.NO	PARAMETERS	GAURISHANKAR LAKE	NARI LAKE	AKWADA LAKE	TARASAMIYA LAKE
1	COLOR (1-5)	3.5	4.2	4.5	5.5

2	ODOR	AGREEABLE	AGREEABLE	AGREEABLE	AGREEABLE
3	TEMPERATURE	27.5 C	26.4 C	27.4 C	28.5 C
4	TURBIDITY (1-5)	2.12	1.65	1.32	2.18
5	PH (6.5-8.5)	9.12	8.3	7.38	7.13
6	TDS (500-2000)	459	453	1566	628
7	HARDNESS (500-600)	96.5	59	359	118
8	CALCIUM (75-200)	459	456	953	785
9	MAGNESSIUM (30-100)	42	45.6	35.2	55.2
10	CHLORIDE (250-1000)	345	165	250	1058
11	SULPHATE (200-400)	325	420	350	380

Table 3 December 2022 Month All Lakes Water Quality Data Analysis

SR.NO	PARAMETERS	GAURISHANKAR LAKE	NARI LAKE	AKWADA LAKE	TARASAMIYA LAKE
1	COLOR (1-5)	4	5	3.5	4.5
2	ODOR	AGREEABLE	AGREEABLE	AGREEABLE	AGREEABLE
3	TEMPERATURE	27.6 C	26.5 C	27.8 C	28.6 C
4	TURBIDITY (1-5)	2.5	1.35	1.15	1.28
5	PH (6.5-8.5)	8.85	7.56	7.16	7.36
6	TDS (500-2000)	436	469	1809	684
7	HARDNESS (500-600)	112.2	100.25	458	189
8	CALCIUM (75-200)	385	596	1200	765
9	MAGNESSIUM (30-100)	65	55	43	65
10	CHLORIDE (250-1000)	410	210	325	1045
11	SULPHATE (200-400)	245	250	410	390

Table 4 January 2023 Month All Lakes Water Quality Data Analysis

SR.NO	PARAMETERS	GAURISHANKAR LAKE	NARI LAKE	AKWADA LAKE	TARASAMIYA LAKE
1	COLOR (1-5)	3.8	3.9	3.4	4.2
2	ODOR	AGREEABLE	AGREEABLE	AGREEABLE	AGREEABLE
3	TEMPERATURE	28.9 C	28.5 C	27.8 C	26.1 C
4	TURBIDITY (1-5)	2.1	1.38	1.32	1.17
5	PH (6.5-8.5)	9.18	7.78	7.23	7.18
6	TDS (500-2000)	435	389	1756	598
7	HARDNESS (500-600)	156	160	478	211
8	CALCIUM (75-200)	589	684	1059	586
9	MAGNESSIUM (30-100)	55	48.8	35.2	45.9

10	CHLORIDE (250-1000)	355	145	180	1030
11	SULPHATE (200-400)	315	350	450	446

Table 5 April 2023 Month All Lakes Water Quality Data Analysis

SR.NO	PARAMETERS	GAURISHANKAR LAKE	NARI LAKE	AKWADA LAKE	TARASAMIYA LAKE
1	COLOR (1-5)	3.7	4.2	3.8	4.4
2	ODOR	Agreeable	Agreeable	Agreeable	Agreeable
3	TEMPERATURE	29.4 C	29.8 C	30.6 C	29.6 C
4	TURBIDITY (1-5)	2.13	1.56	1.25	1.34
5	PH (6.5-8.5)	8.96	8.06	7.31	7.26
6	TDS (500-2000)	398.2	393.2	1735	537.3
7	HARDNESS (500-600)	177.5	115	460	227.5
8	CALCIUM (75-200)	639	426	1136	639
9	MAGNESSIUM (30-100)	48	62	42	59
10	CHLORIDE (250-1000)	425	185	260	1066
11	SULPHATE (200-400)	350	386	425	468

V. METHODOLOGY

The various parameter the approaches described in the literature; we choose the following way to analyze the corresponding parameter in the table below.

TABLE 6 METHODOLOGY SELECTED FOR THE PRESENT STUDY

PARAMETER	METHOD APPLIED
Color	Visual comparison method
Temperature	Lab. & Field Method
Turbidity	Nephelometry method
PH	pH Meter
TDS	TDS Meter
Total Alkalinity	Titration Method
Hardness & Calcium	EDTA Titration Method (Ethylene diaminetetra acetic Acid)
MAGNESSIUM	Calculation Method
CHLORIDE	Flame Emission Photometric Method
SULPHATE	Iron chromatography

A. EXPERIMENTAL PROCEDURE

The study was carried for a period of 4 months (November 2022 to January and April month 2023). Variation in monthly data was gathered. The sampling was done during morning hour. The polyethylene bottles were used to collect the water samples. A closed bottle was dipped into the lake between 0.5 and 0.7 metres deep, opened inside, and then sealed shut to bring it to the surface.

The water samples were preserved by lowering the temperature. The water temperature, pH, and TDS were analysed immediately trying on the spot after the collection, whereas the analyses of remaining parameters were done in the laboratory. The analytical method in the equipment from laboratory to laboratory, and human practice may have some effect on analytical results. Very high accuracy and precision even for very small quantities of component to be analysed for such instruments, but these instruments are very costly not easily available in most laboratories.

The laboratory performed the necessary analysis on the acquired water samples. Using a conventional mercury thermometer, the temperature was measured. Using a digital pH metre, pH was measured electrometrically. Using a TDS metre, total dissolved solid was determined. Using a Nephthalo turbidity metre, turbidity is measured. By using the EDTA Titration Method (Ethylene diaminetetra acetic Acid) and a calculating method, the following parameters were determined: chloride, TDS, calcium, magnesium, and total hardness.

The collected water sample such as a color, odor, temperature, turbidity, PH, TDS, total hardness, Magnesium, Chloride, Sulphate etc. The comparative test result from experiment analysis is graph. The graph is plotted between collected water quality test parameters with BIS standard code comparison. The QGIS Software through making Thematic indicating actual water quality Spatial IDW Interpolation Maps.

VI. RESULT AND DISCUSSION

The analysis results water samples from the lakes, located in the Bhavnagar city. collected from Tarasamiya lake, Gaurishankar Lake (Bortalav), Akwada lake, Nari Lake. The samples were collected in 4 months i.e., November 2022, December 2022, January 2023 and April 2023 and over a period. The observation to data sample that's collected for testing purpose in present study

The water quality data in Bar graphs are showing the variation of water quality and parameter between monthly variation and that's samples is reference to BIS standard code. The graph colors are Blue indicated BIS standard and other colors are indicate lakes. Comparative Lakes Water Quality Data with BIS code in below graphs

A. Test Result of Temperature

The physio-chemical and biological behaviour of aquatic systems is greatly influenced by temperature. When the temperature rises, the solubility of water decreases, affecting the quality of the water and revealing the extent of pollution

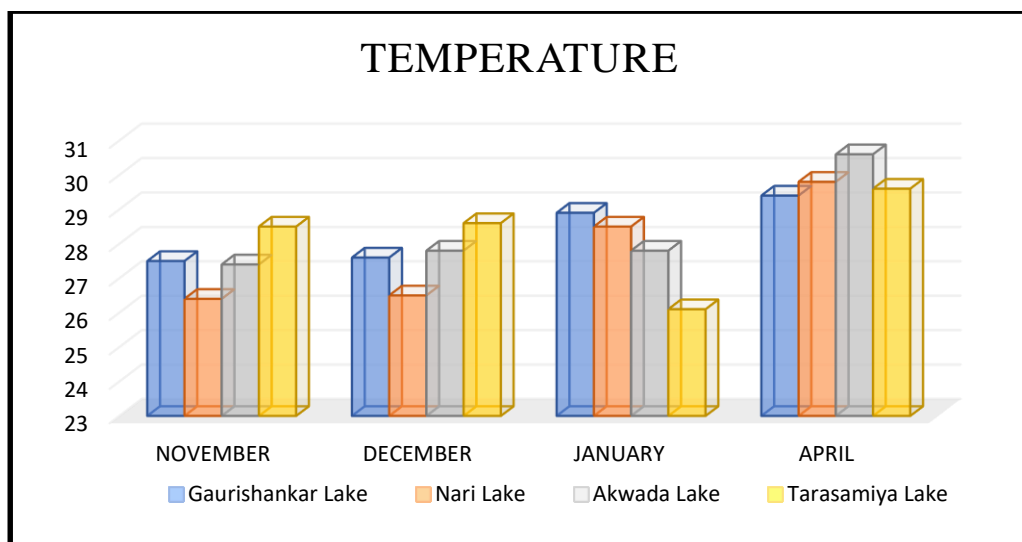


Figure 3 Analysis of Temperature Comparative Data with BIS code

B. Test Result of Color

The color parameter is the maximum Color was recorded during November 2022 month in Tarasamiya lake has high 5.5 color value record and minimum color value 3.5 are record in December 2022 in Akwada lake.

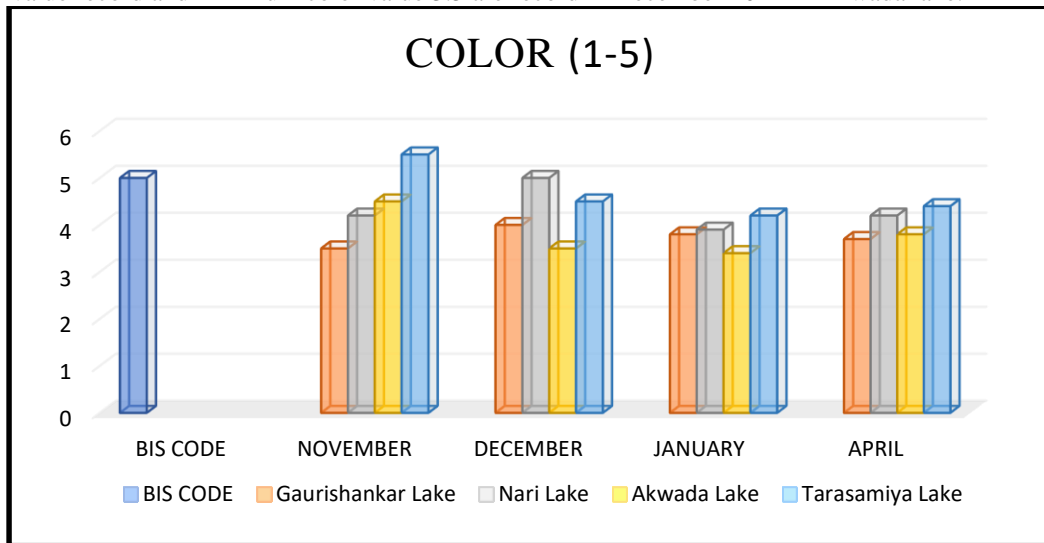


Figure 4 Analysis of Color Comparative Data with BIS code

C. Test Result of Turbidity

The turbidity recorded ranges value is low in December 2022 month in 1.15 NTU Akwada lake and maximum 2.5 NTU value present in Gaurishankar Lake its excess limit BIS code according. A high turbidity indicates the presence of many suspended particles. The development of aquatic vegetation and a reduction in water volume may also contribute to the rise in turbidity.

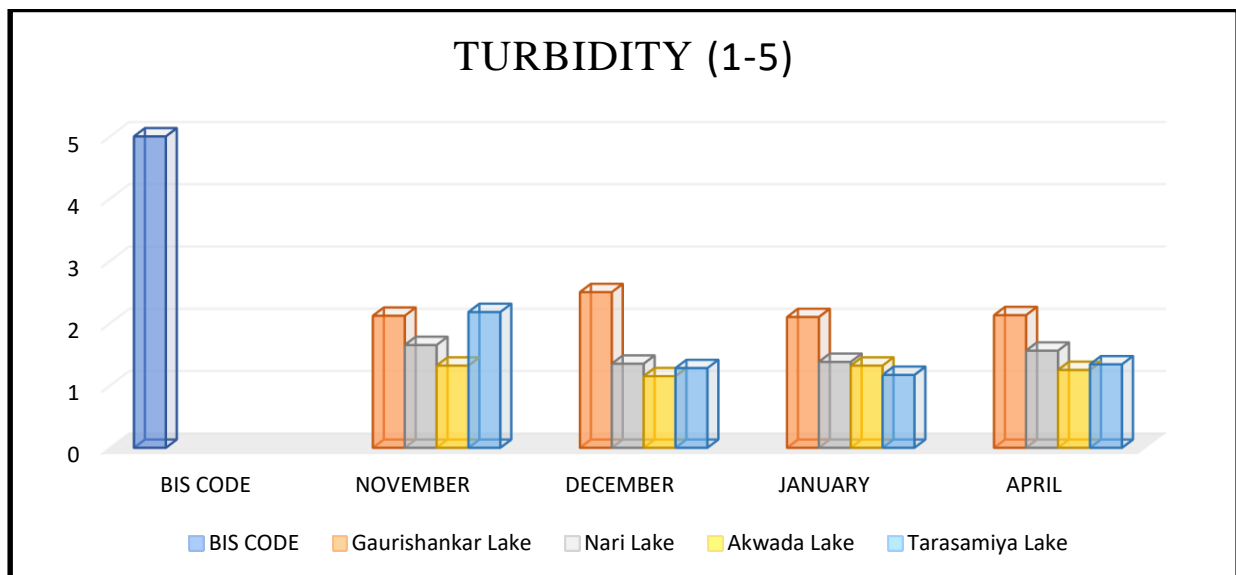


Figure 5 Analysis of Turbidity Comparative Data with BIS code

D. Test Result of PH

The concentration of hydrogen ions or pH indicates the presence of hydrogen ions in water, which determines the water is suitable for uses. In The maximum pH was recorded during December 2022 month Gaurishankar Lake (Bortalav) 9.18 ppm and minimum PH value record in November month 2022 in 7.13 ppm Tarasamiya lake. The pH influences the body's metabolism and balance to some extent. The relative amounts of calcium, carbonate, and bicarbonate affect water's pH as well.

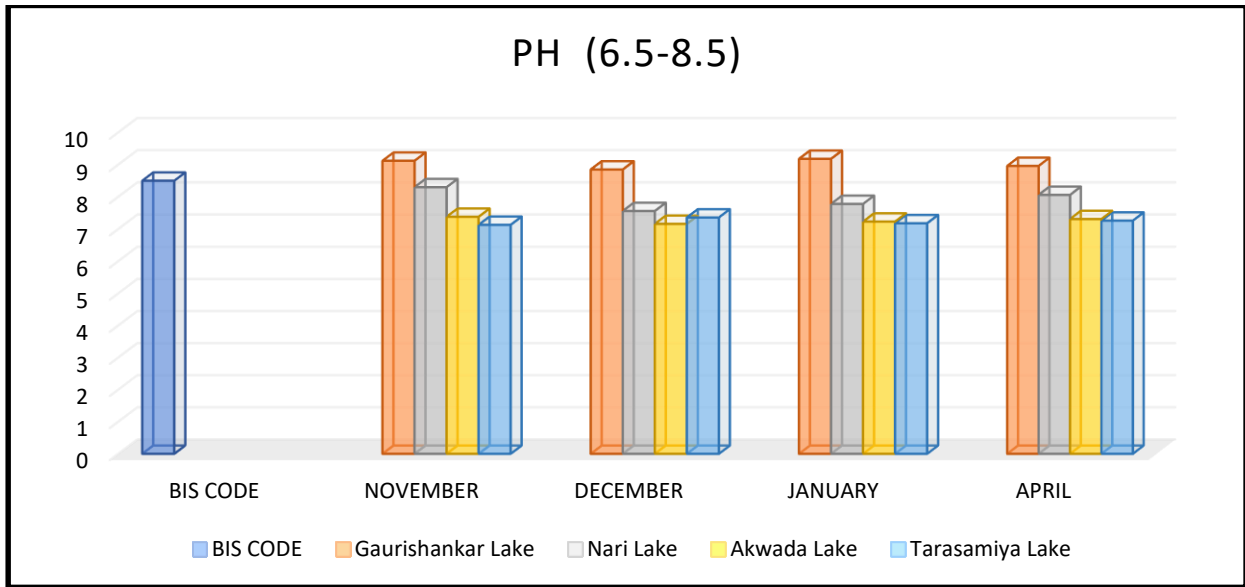


Figure 6 Analysis of PH Comparative Data with BIS code

E. Test Result of TDS

TDS In natural water include main components carbonates, bicarbonates, chloride, sulphate, nitrate, calcium, magnesium, potassium, iron, and manganese. The value of TDS was noted to be high due to contamination from home waste water, trash, fertilizer, etc. in the natural surface water body. TDS maximum range recorded during December 2022 month in Akwada lake in value is 1809 NTU and minimum TDS value is recorded in April 2023 month in Nari Lake 393.2 NTU

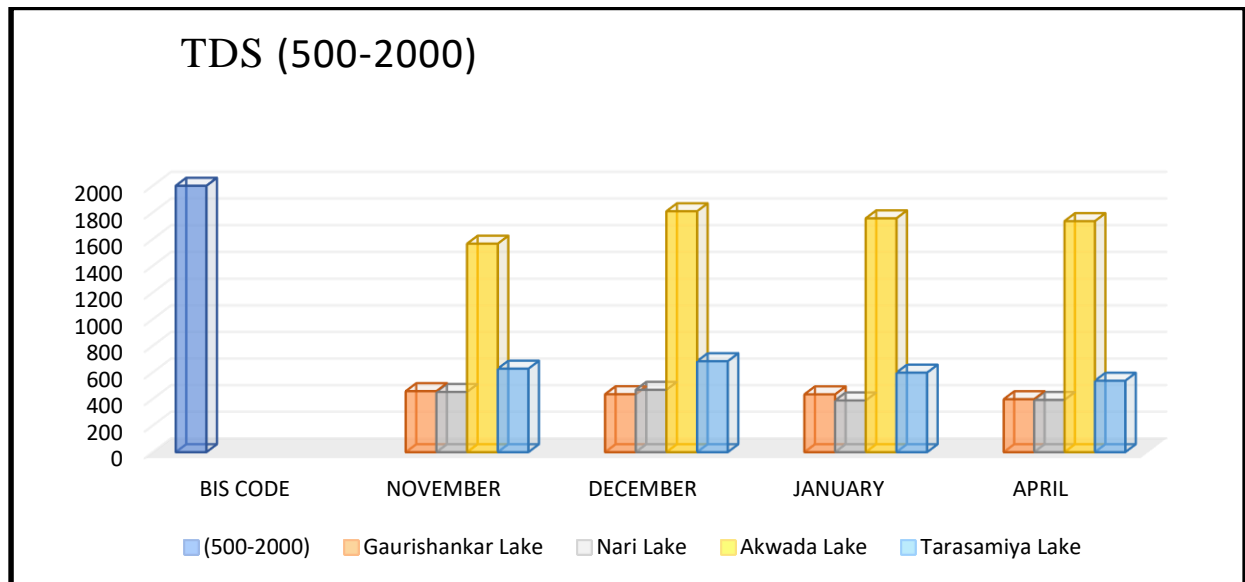


Figure 7 Analysis of TDS Comparative Data with BIS code

F. Test Result of Total Hardness

Hardness ratings are determined by the amount of calcium and magnesium dissolved in water. The maximum amount of total hardness was recorded during January 2023 month in Akwada lake 478 mg/l and minimum amount of total hardness was recorded in April 2023 month in Gaurishankar Lake (Bortalav) 112.2 mg/l.

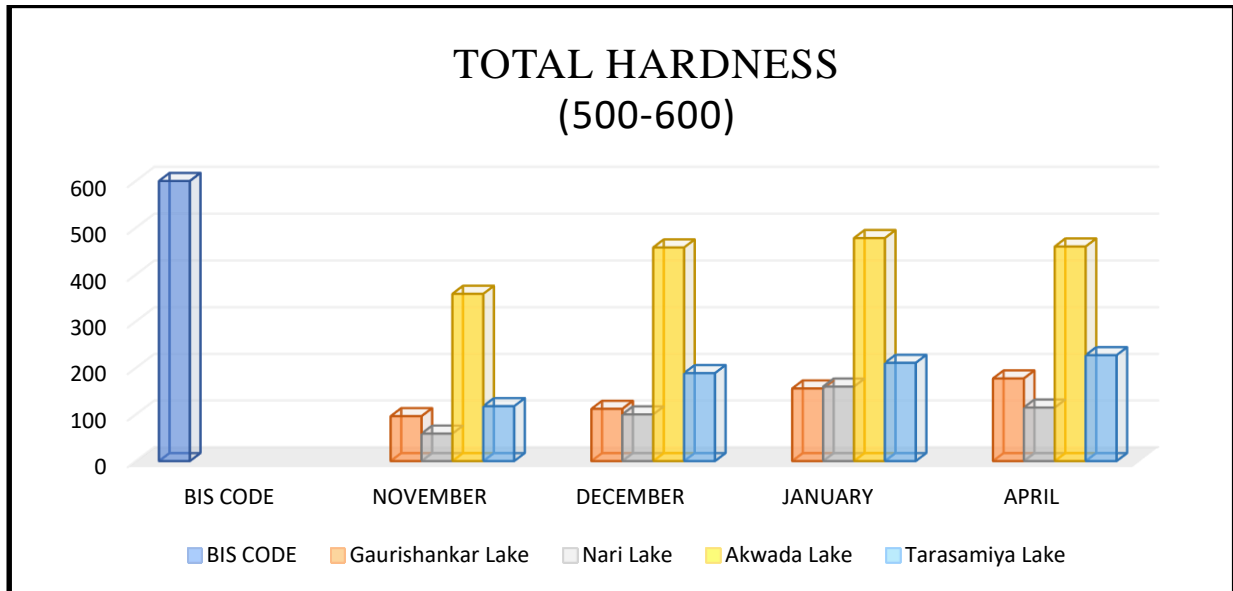


Figure 8 Analysis of Total Hardness Comparative Data with BIS code

G. Test Result of Calcium

The Calcium is a crucial nutrient for aquatic life. The maximum amount of Calcium was recorded during December 2022 month in Akwada lake in value is 1200 mg/l and lowest value recorded during December month its 385 mg/l in Gaurishankar Lake (Bortalav).

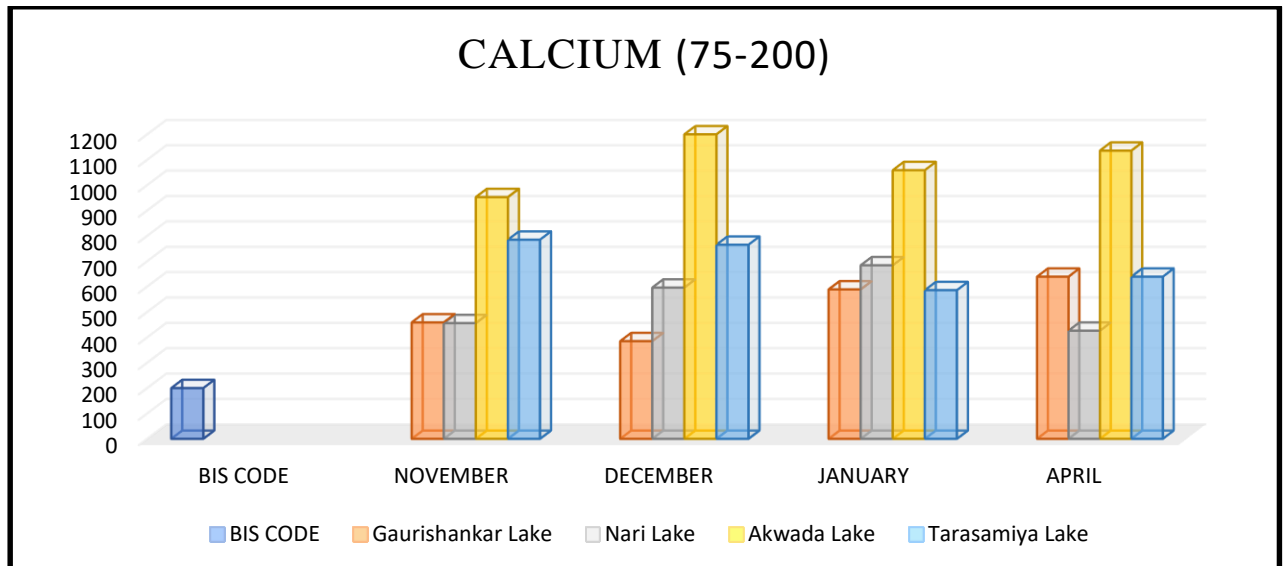


Figure 9 Analysis of Calcium Comparative Data with BIS code

H. Test Result of Magnesium

Magnesium can be found in a variety of salts and minerals, typically in compounds with iron. The micronutrient magnesium is essential for both plants and animals. The minimum value was recorded during November 2022 in Akwada lake 35.2 mg/l and maximum value was recorded Tarasamiya lake 75 mg/l in December 2022 month.

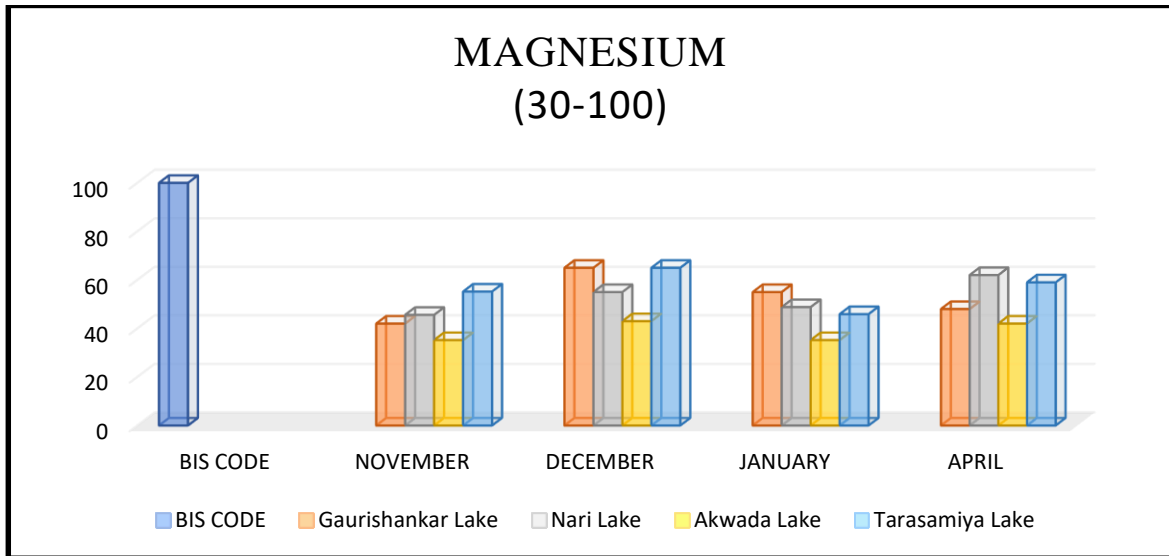


Figure 10 Analysis of Magnesium Comparative Data with BIS code

I. Test Result of Chloride

The chloride creation of bacterial and other tests like BOD and COD, concentration was utilized as a key criterion for the detection of sewage contamination. For both plants and animals, chloride ions are necessary. They are kept in the bodies of animals and plants as sodium chloride (NaCl). The minimum amount was recorded during January 2023 in Nari lake 145 mg/l and maximum amount was recorded in April 2023 in Tarasamiya lake 1066 mg/l.

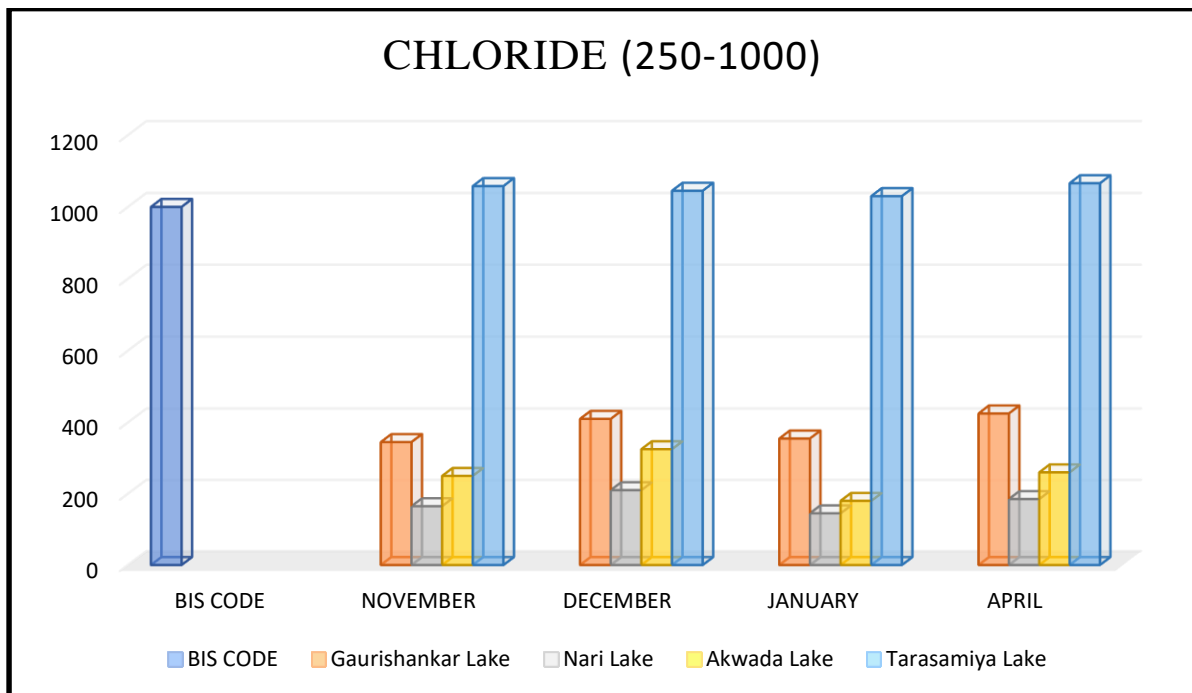


Figure 11 Analysis of Chloride Comparative Data with BIS code

J. Test Result of Sulphate

Sulphate High sulphate concentrations can have an effect on aquatic life by affecting some species' growth and survival as well as changing the food chain. The minimum amount was recorded during December 2022 month its 245 mg/l in Gaurishankar Lake (Bortalav) and maximum amount is recorded April 2023 in Tarasamiya lake 448 mg/l.

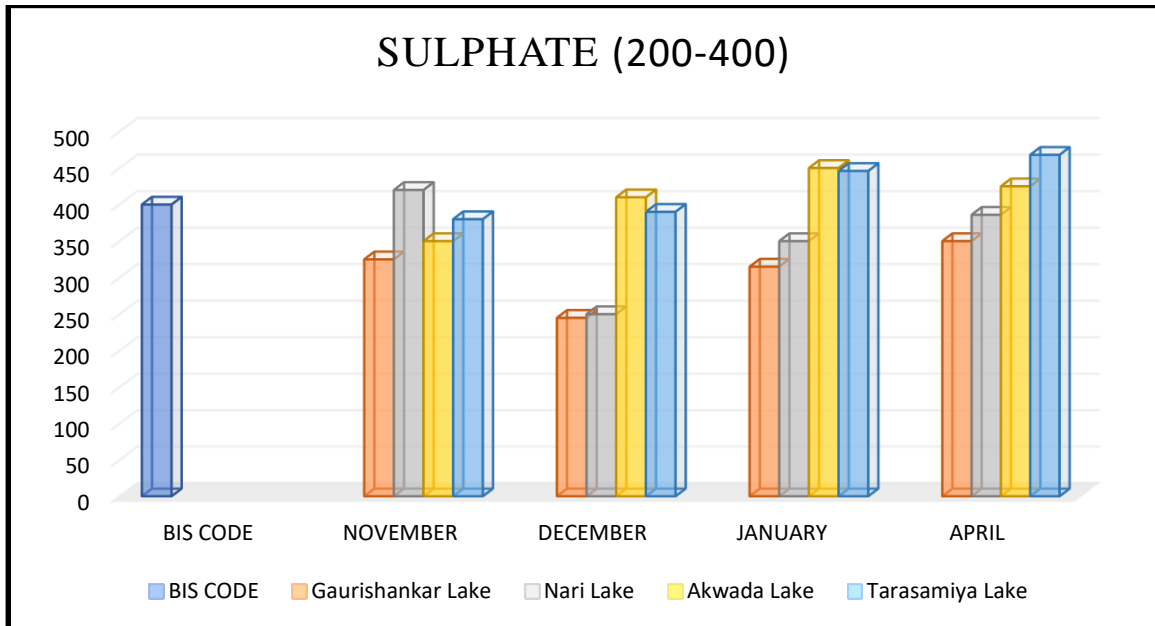


Figure 12 Analysis of Sulphate Comparative Data with BIS code

K. April Month Water Quality Data Interpolate with Thematic Map QGIS

A thematic map is a style of map that shows the geographic distribution of a specific subject matter in a geographical area. In order to visualize specific characteristics of geographical features that are not readily apparent, such as a sulphate, chloride, or magnesium, map parameters are typically used. One or more water chemical parameters' spatial distribution is depicted on thematic maps as their primary focus. Making a spatial distribution thematic map in QGIS software using data from the month of April (2023) with Interpolate Bhavnagar city map.

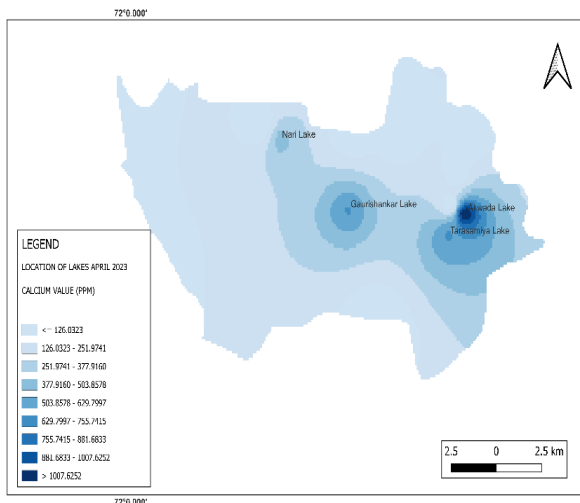


Figure 13 Calcium Impact In all Lakes

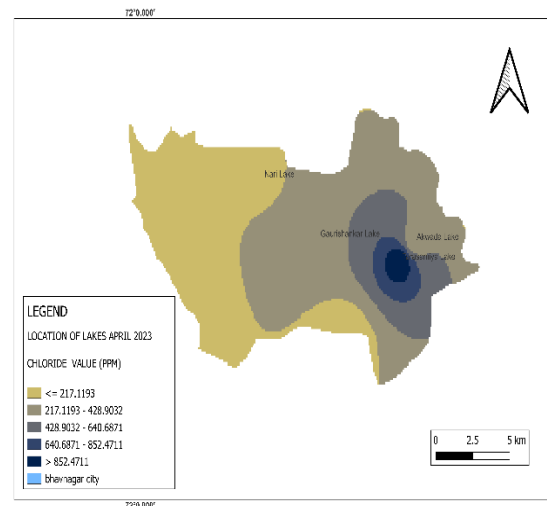


Figure 14 Chloride Impact In all Lakes

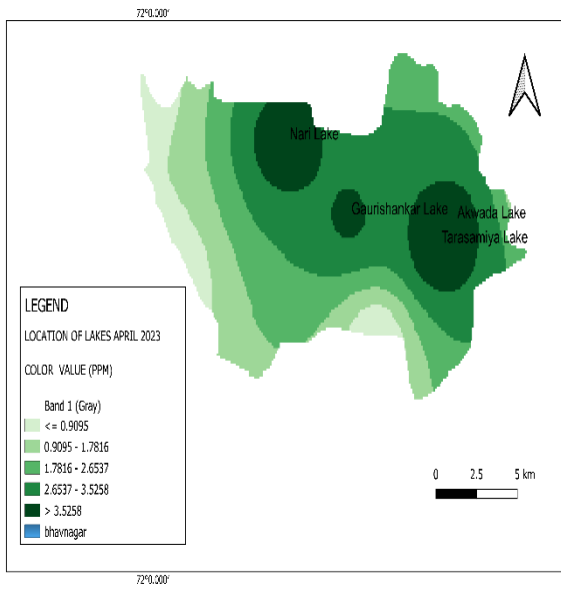


Figure 15 Color Impact In all Lakes

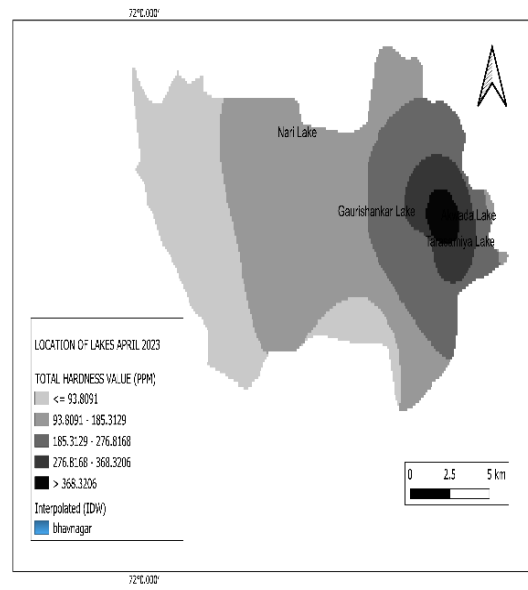


Figure 16 Total Hardness Impact In all Lakes

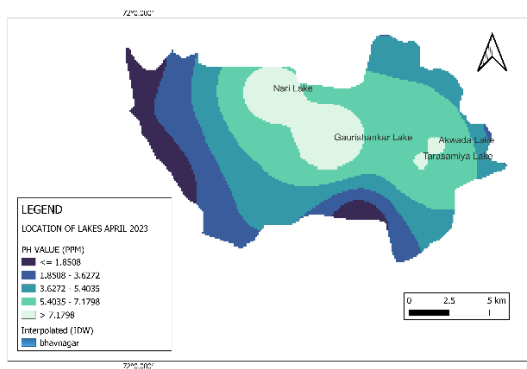


Figure 17 PH Impact In all Lakes

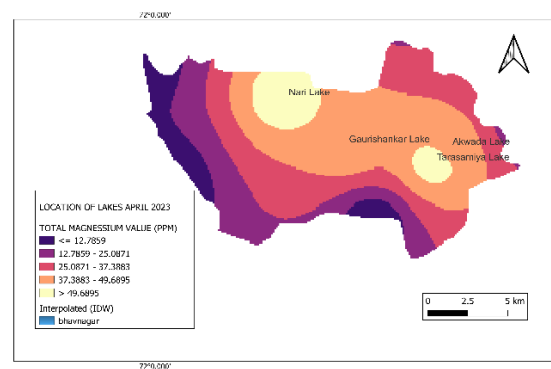


Figure 18 Magnesium Impact In all Lakes

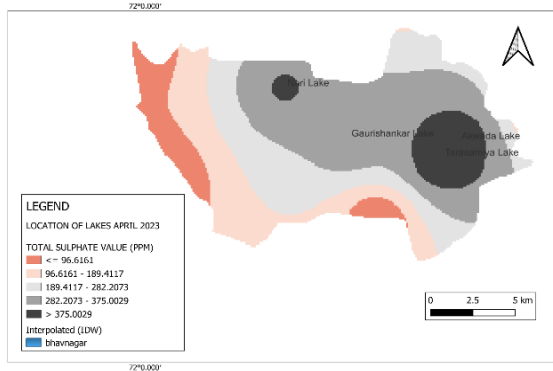


Figure 19 Sulphate Impact In all Lakes

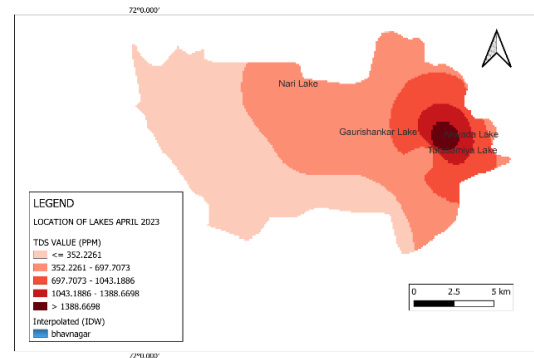


Figure 20 TDS Impact In all Lakes

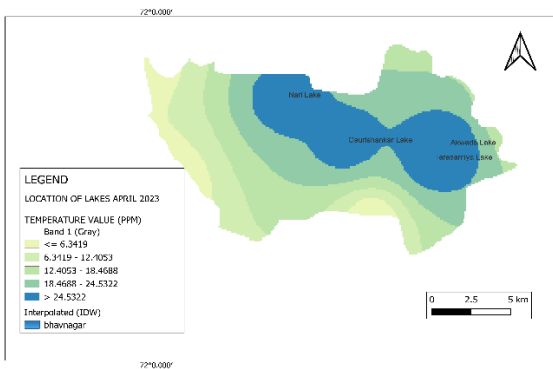


Figure 21 Temperature Impact In all Lakes

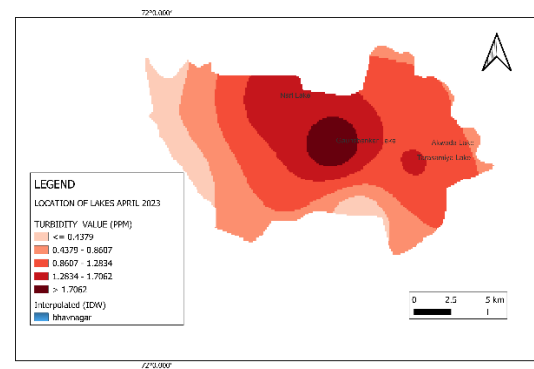


Figure 22 Turbidity Impact In all Lakes

VII. CONCLUSION

The water quality analysis result is showing the higher level of pollution in the Bhavnagar city lakes. This resulted from washing clothes and cleaning automobiles, as well as from the discharge of untreated home sewage and industrial effluents. The majority of parameters characteristics, including color, odor, temperature, turbidity, PH, TDS, total hardness, magnesium, chloride, and sulphate, are higher than the allowable limit. Above results show that the water in Gaurishankar Lake (Bortalav), Nari Lake, Tarasamiya Lake, and Akwada Lake was not being maintained in an aerobic state, which is a certain sign of eutrophic lake water. The data are displayed in this research's themed map, which is easily understood by anyone. Future research and study will yield useful information. Thematic maps also constantly have fascinating information to provide. Furthermore, it has been shown that the water from the Bhavnagar city lakes cannot be used for home purposes without the proper filtration. Government organizations should therefore surveys and lakes protection programmers for the assessment of lake water contamination and save this dying water body.

ACKNOWLEDGMENT

I express my cavernous sense of obligation and gratitude to **Prof. NEHA JOSHIPURA** and **Dr. J.P. Mehta (Department of chemistry, Maharaja krishnakumarsinhji Bhavnagar University)** for their genuine guidance and constant encouragement throughout this work. I am highly obliged as my honourable guide **Prof. NEHA JOSHIPURA Assistant Professor**, Head of Department **Dr. V. M. Patel** of civil engineering Shantilal shah Engineering College, Bhavnagar of Engineering who have devoted their valuable time and shared their expertise knowledge, sympathy and co-operation in providing necessary source and facilities.

My deepest thanks go out to my friends Singh Garima and Dhimmarr Piyush for spending time with me, helping me with my project, and being there for me whenever I needed them. I'm also grateful to all my classmates of S.S.E.C. who have helped, provided support, and offered encouragement as I worked on the entire project.

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