Assessing the impact of urbanization and health of freshwater Lakes in thane, India
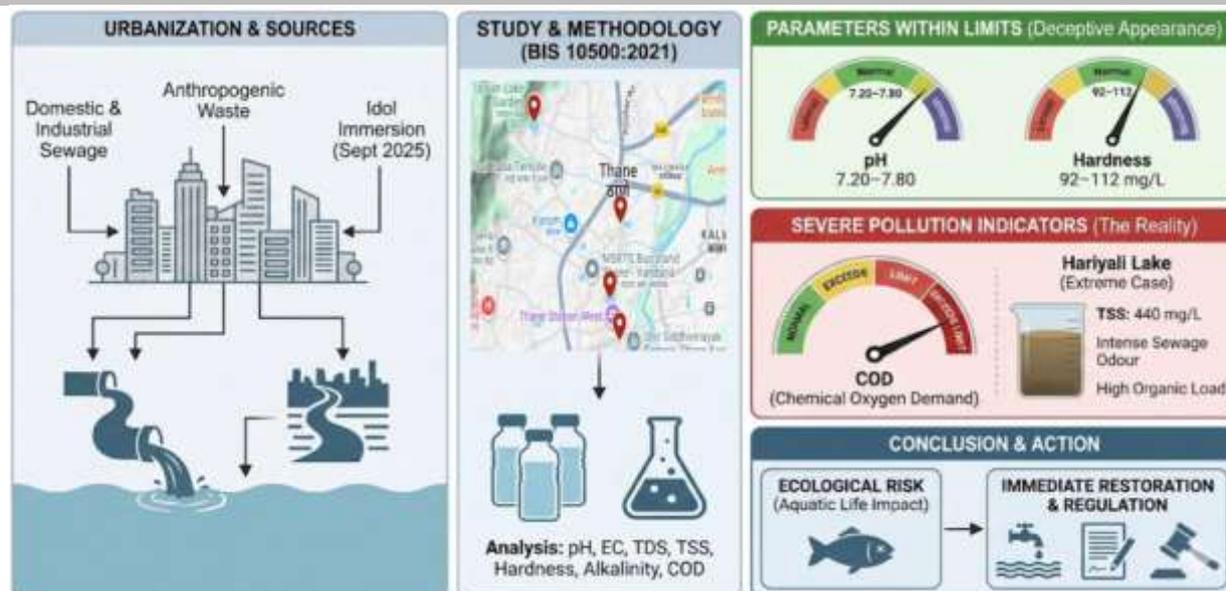
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Abstract:

Increasing urbanisation, especially in metropolitan regions, disrupts the ecological environment of freshwater bodies through many factors, such as heavy sewage discharge and anthropogenic waste. This study analyses the quality of four prominent lakes in Thane City: Masunda, Upvan, Hariyali, and Ambe Ghosale by testing for physico-chemical parameters against the Bureau of Indian Standards (BIS 10500:2021) guidelines. Water samples were collected in September 2025, right after the tradition of idol immersions, to observe the impact on these lakes. The samples were analysed for pH, Total Dissolved Solids (TDS), Electrical Conductivity (EC), Total Suspended Solids (TSS), Hardness, Alkalinity, and Chemical Oxygen Demand (COD). While pH levels (7.20-7.80) and Hardness (92-112 *mg/L*) remained within permissible limits, the study revealed significant organic pollution. COD ranges far exceeding the limit. Hariyali Lake showed extreme turbidity and TSS (440 *mg/L*) with an intense sewage odour. These results show that despite normal pH and mineral content, these water bodies are in severe conditions that pose risks to the local ecosystem, which requires immediate restoration and regulation.

KEYWORDS: Water Quality Index, Thane City, Lakes, Freshwater, Physico-chemical parameters.

Introduction:

Water quality has become a most serious issue due to increasing industrialisation, urbanisation and man-made problems. The constituents present in the water systems depend on the nature where the water body and the discharge quality from various sources in that water body.[1] Thane city is also termed as the "City of Lakes" due to the presence of over 30 scenic lakes throughout the district, providing a natural balance and tranquil surroundings amidst the increasing urban landscape. These lakes provide space for recreational activities, and some also play the role of being an essential water source. The city of Thane has begun facing immense urbanisation, with increasing population, and the rise of concrete infrastructure has led to the huge negative impact of pollution (industrial activities, encroachment), anthropogenic activities (idol immersions, sewage discharge), leading to worsening water quality, which has proven to be harmful to local aquatic biomes and the deterioration of the overall ecosystem. The poor water quality that is currently being released by hotels, restaurants, and other commercial locations that sell food contains varying levels of pollutants. The level of said pollutants that are deemed harmful is declared by the World Health Organisation (WHO) and the Bureau of Indian Standards (BIS).[2] The inadequate handling of food wastewater discharge is the cause of this low water quality. These pollutants are released into the environment intentionally or inadvertently, either directly or indirectly, into dumping yards, public sewer lines, reservoirs, or nearby bodies of water, mostly unmonitored lakes.[3] The world is facing problems related to the management of wastewater because increase industrial area, an increase urbanised societies and population density. On a daily basis, effluents generated from industrial and domestic activities significantly contribute to the pollution of receiving water bodies, posing a serious challenge to effective water quality management. Some of these pollutants are phosphorus, nitrogen, hydrocarbons, pathogenic microorganisms, endocrine disruptors, heavy metals, and organic matter.[4]

The contamination of urban aquatic ecosystems is often exacerbated by highly water-soluble fertilisers and pesticides, which further infiltrate the surface, groundwater and trick down to drinkable water systems as well. Rapid urbanisation and improper waste management are the main causes of the complex problem of declining water quality. According to recent regional research conducted in the districts of Surat and Tapi (Gore et al. 2025), 34% of samples did not fulfil essential mineral requirements, and other sites exceeded safety limits as a result of unregulated waste disposal. Although the study concentrated on drinking water, it highlights a larger environmental concern in India: the ecological harm and "hidden" health hazards

brought on by insufficient water system monitoring. These same anthropogenic pressures affect Thane's urban lakes, which are used for recreation and local subsistence, making a thorough physico-chemical evaluation of these bodies imperative.[5]

Lake eutrophication is one of the world's major ecological concerns in recent times. Most of the freshwater lakes and wetlands are facing the problem of water quality deterioration and ecological imbalance due to the increasing anthropogenic activities, particularly in developing countries. The understanding of the mechanism and identification of the sources of eutrophication will be beneficial to mitigate the problem through a proper management policy. Eutrophication is one of the most challenging environmental issues presently affecting surface water bodies worldwide. In a similar ecological process to ageing, eutrophication occurs when a body of water becomes more and more enriched with vital nutrients for aquatic plants. This raises the primary productivity of the aquatic ecosystem, or the rate at which photosynthesis occurs. It has since spread, particularly in some areas, and resulted in major issues with water use, especially with drinking water treatment, as well as degradation of the aquatic environment.[6]

Urban lakes tend to receive higher nutrient loads and to show a higher trophic state than non-urban lakes. Nutrient enrichment is frequently associated with a shift from macrophyte-dominated to phytoplankton-dominated environments. As a consequence, the ecosystem structure radically changes because of, among others, the decrease in environmental heterogeneity, the erosion of the banks and the increase in turbidity. Among phytoplankton, cyanobacteria, which may produce a large variety of toxic and smelly secondary metabolites, are generally advantaged by these changes and their blooms are often recorded in urban aquatic ecosystems, which is the most frequent contact lakes have with anthropogenic activities.

Besides, municipal wastewater discharges, failing septic systems and sewage overflows may contribute to creating sanitary and environmental problems, as a strong increase in the concentrations of heavy metals and faecal bacterial contamination. Thus, in the last years, a growing public awareness has developed regarding the quality of urban lakes and special management plans in several urban areas have been started worldwide to restore and maintain the recreational value of these water bodies, to enhance their educational power, and to avoid sanitary problems arising from the deterioration of their water quality.[7]

The aim of this project entails the analysis of a few parameters, which are deemed to be reliable sources of assessing water quality and its impact on the health of the ecosystem, to

find solutions and take affirmative action in the future. This report focuses on four essential lakes and analyses how they have been continuously affected by the aforementioned issues, such as Masunda Lake (Talao Pali), a lake located in the central region of Thane, which faces high amounts of recreational activities by the populace. Upvan Lake, famous for its leisure and hence more anthropogenic activities, Haryali Lake (near Thane Station), which is affected by dense habitation and severe sewage inflow, and Ambe Ghosale Lake, which, due to its small size, is often prone to dumping of waste.

Materials and Methods:

MATERIAL

All the chemicals required in this work were procured from Sigma-Aldrich and Merck in high purity, except for the water samples. The pH of the water sample was measured using a digital pH meter (EQUIPTRONICS, Model EQ-610). The conductivity of the water sample was checked using a digital conductivity meter (EQUIPTRONICS, Model EQ-660A).

The current study focused on four distinct freshwater lakes in Thane, Maharashtra, India.
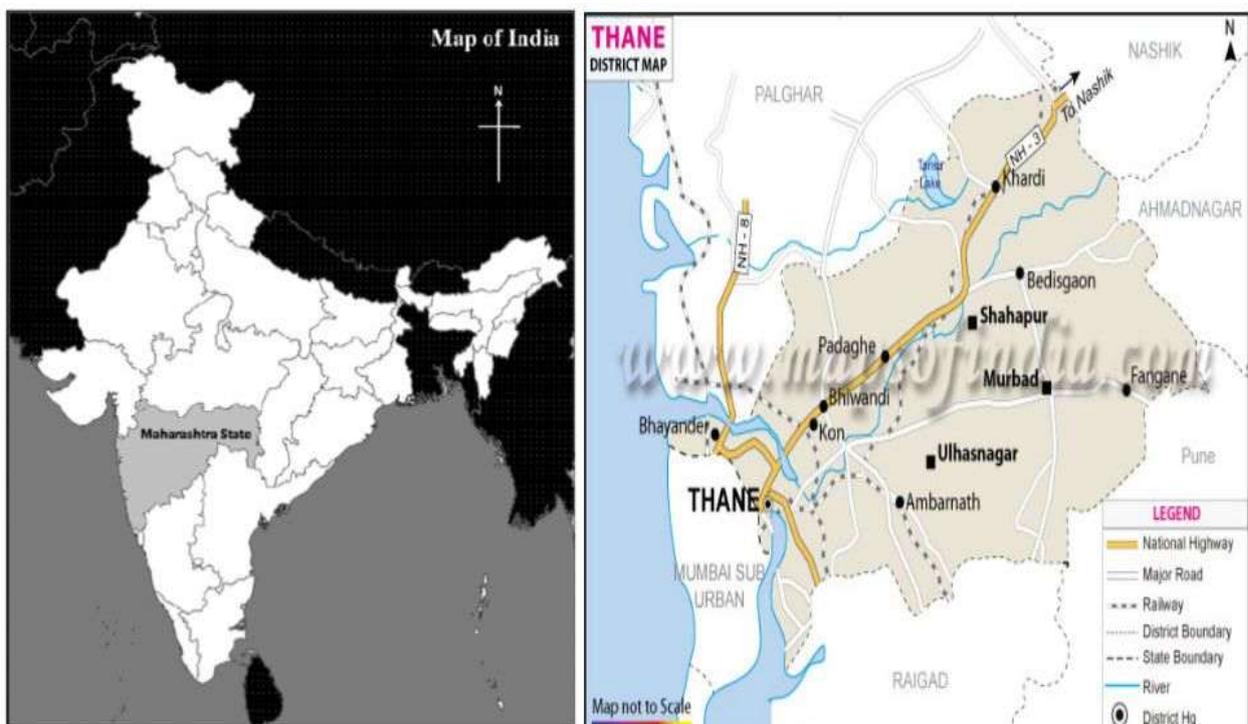

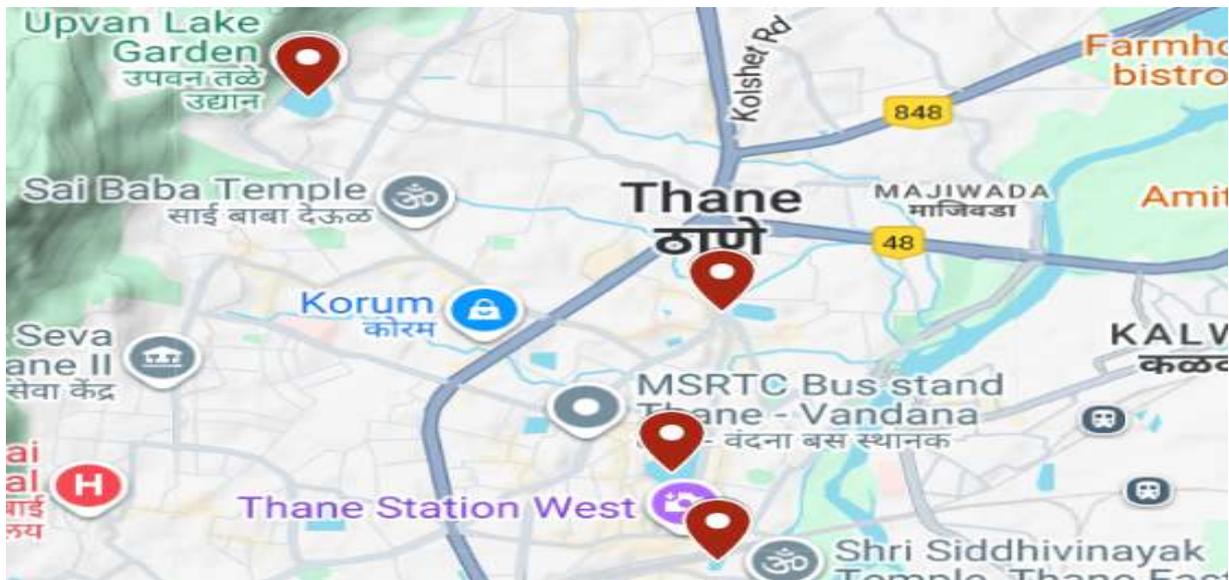**Fig**. 1. Geographical location of the study area, showing Thane District within the state of Maharashtra, India.

Fig. 2. Locations of the lakes in Thane city

Fig. 3. Masunda Lake (Talao Pali)
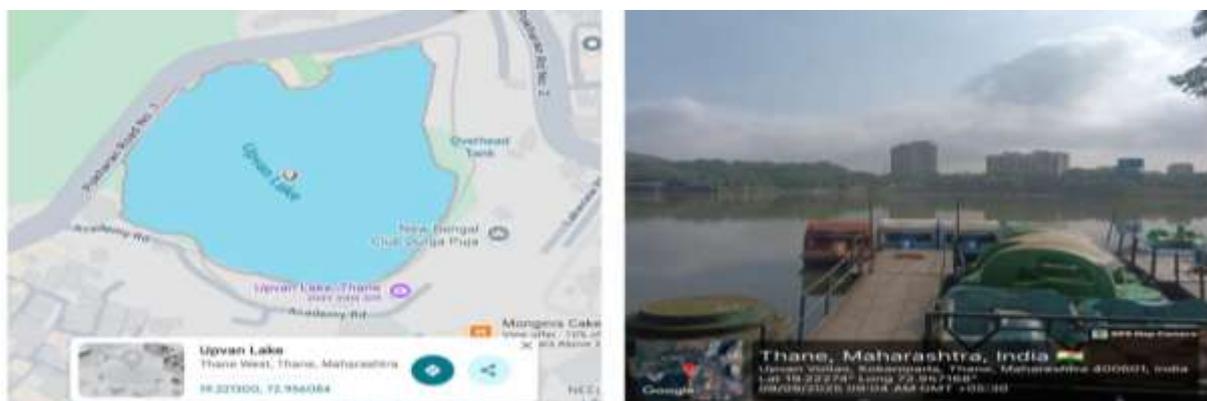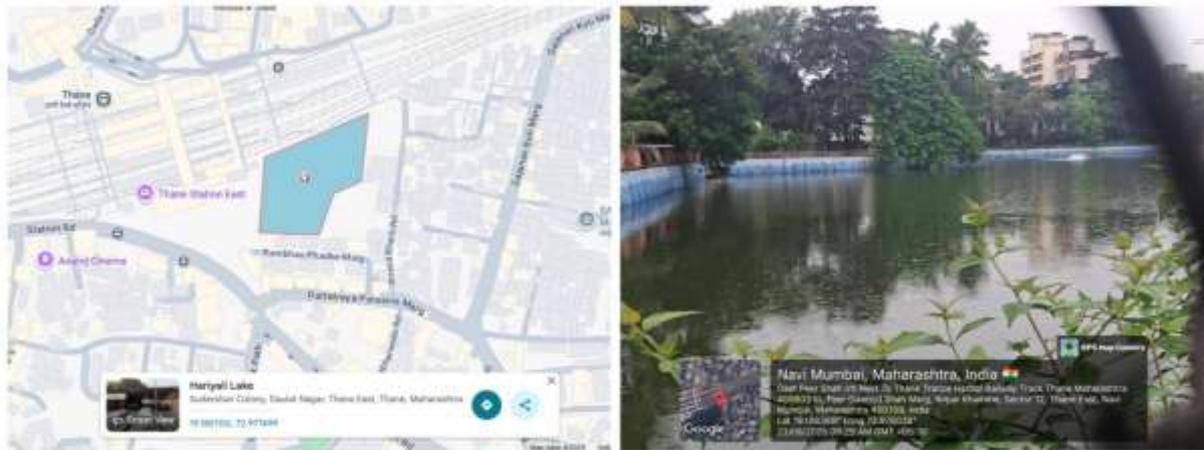

Fig. 4. Upvan Lake

Fig. 5. Hariyali Lake

Fig. 6. Ambe Ghosale Lake

SAMPLING SITES:

(1) *Masunda Lake (Talao Pali)*

Location: 19.1925°N, 72.9752°E; Type: Natural lake.

Sampling date: 08/09/2025; Sampling time: 08:23 AM

(2) *Upvan Lake*

Location: 19.221591, 72.956235; Type: Artificial/Man-made lake.

Sampling date: 09/09/2025; Sampling time: 09:04 AM

(3) *Hariyali Lake*

Location: 19.185677, 72.97747; Type: Natural lake.

Sampling date: 17/09/2025; Sampling time: 08:45 AM

(4) *Ambe Ghosale Lake*

Location: 19.205191, 72.979626; Type: Naturally occurring lake.

Sampling date: 17/09/2025; Sampling time: 08:50 AM

SAMPLING AND ANALYSIS:

Water samples were collected in September 2025 during the post-monsoon season. The sample was collected from a singular entry point near the periphery of the lakes, as the other points could not be accessed. Locations were selected based on accessibility, representativeness, and recreational or ecological importance. Samples were obtained from accessible shoreline points using pre-rinsed 1-litre PET bottles and glass-stoppered bottles. All samples were transported to the laboratory and analysed within one hour of collection to minimise chemical changes.

In September 2025, during the post-monsoon season, the sampling was purposefully carried out, specifically in accordance with the custom of idol immersions. This particular time frame was chosen in order to observe the lakes during a time when human pressure was at its highest and to evaluate the direct ecological effects of seasonal waste loading on the water quality.

Additionally, although it is ideal to have several sampling locations per lake, water samples were taken from a single entry point close to each lake's edge. Physical limitations and other locations along the shoreline being inaccessible at the time of collection made this method necessary. Despite this drawback, the sites were picked because they are representative of regions with significant recreational and ecological value.

ANALYTICAL PROCEDURES

The following physicochemical properties were determined in accordance with the BIS through the following procedures.

1. **pH AND ELECTRICAL CONDUCTIVITY (EC) ANALYSIS**:

   The pH and Electrical Conductivity (EC) were measured using a digital pH meter and a conductivity meter, respectively. Before analysis, the pH meter was calibrated using standard buffer solutions of pH 4.0, 7.0, and 9.72. The conductivity meter was calibrated using a 0.01 M KCl solution. The electrodes were rinsed with the use of distilled water between measurements to prevent cross-contamination. Approximately

50 mL of each sample was placed in a clean beaker, and readings were taken once the digital display stabilised.

2. **TOTAL SUSPENDED SOLIDS (TSS):**

This was measured gravimetrically using Whatman filter paper (No. 42). A known amount (50 mL) of each sample was filtered through the use of a pre-weighed Whatman filter paper, which was then dried with the sample evaporating and weighed using an analytical balance till a constant weight was observed for further calculation.

3. **TOTAL DISSOLVED SOLIDS (TDS):**

The filtrate from the TSS procedure was poured onto a petri dish with a known weight and then dried by evaporation till a constant weight was achieved.

4. **TOTAL SOLIDS (TS):**

It was estimated using the summation of the two values procured via the calculation of the weights in the procedures mentioned above.

5. **HARDNESS:**

A direct method was followed for estimating the hardness of water that involved EDTA titration with the use of Erichrome Black T indicator at pH 10. This value gives the total hardness of Ca^{2+} and Mg^{2+} ions. EDTA solution (0.01M) was used as titrant, whereas 25 cm³ of the water sample with 3 cm^3 of pH 10 buffer solution, along with 3-4 drops of 2% Erichrome Black T, was the titrand solution in the conical flask.

6. **CHEMICAL OXYGEN DEMAND (COD):**

Determined using the open reflux potassium dichromate method, most standard and common for high-strength wastewater analysis, since the organic substances present in the water sample are oxidised by $K_2Cr_2O_7$ in an acidic medium. The water samples are heated with a known excess of $K_2Cr_2O_7$ in the presence of 4N H_2SO_4. The excess of $K_2Cr_2O_7$ is titrated back against standard *ferrous alum* solution. The amount of oxidisable organic matter measured as oxygen equivalent is proportional to the $K_2Cr_2O_7$ consumed.

Results and Discussion:

PHYSICAL PARAMETERS:

The physical parameters of these lakes ranged from 22°C to 25°C. All lake collecting sites exhibited noticeable odour ranging from mild (in Upvan lake) to intense (in Hariyali lake), indicating sewage release and also anaerobic decomposition of organic matter.

pH and ALKALINITY:

The pH values ranged between 7.20 and 7.80, falling well within the BIS range of acceptable range of 6.5–8.5. The water samples were found to be neutral or slightly alkaline, implying the intact buffering capacity of lakes despite the pollutant loading. (see Fig. 7)
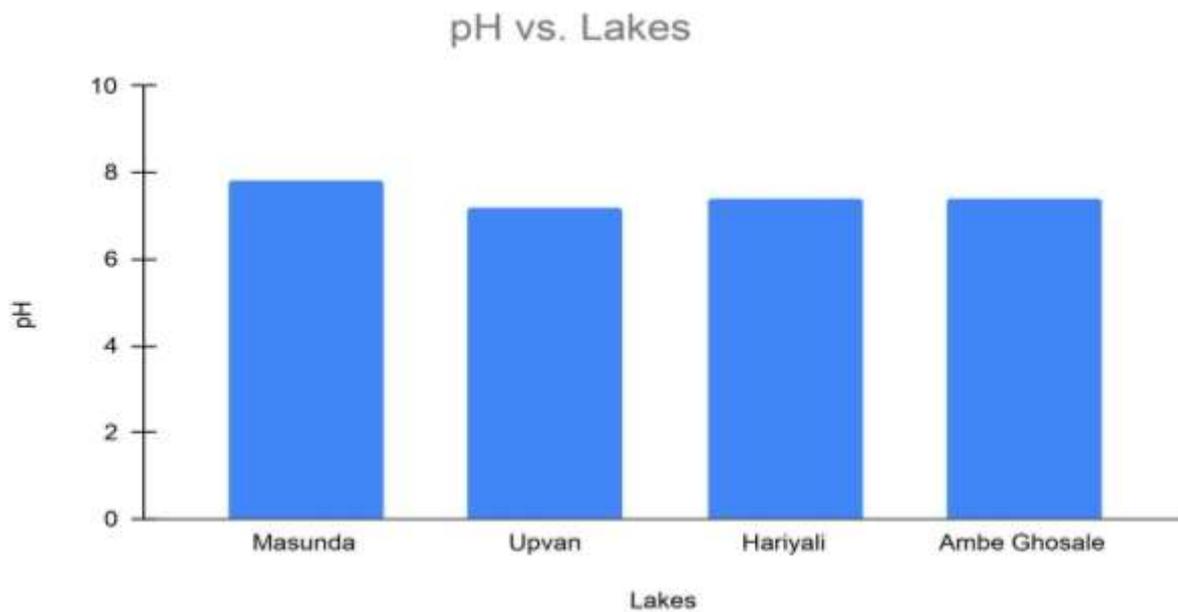

Fig. 7. *p*H levels of water samples collected from Masunda, Upvan, Hariyali, and Ambe Ghosale lakes

SOLIDS:

Variations were observed in the solid content of the lakes (Table 1)

1. Upvan Lake recorded the lowest TDS (188 *mg/L*), likely due to its geography, which is near Yeoor Hills, and away from the urban sewage output.

2. Hariyali Lake showed a high TSS value of 440 *mg/L*, compared to just 274 *mg/L* in Upvan Lake. The extreme turbidity in the previously mentioned lake corresponds to the intense sewage smell also noted during the collection of samples, and suggests direct massive loading of untreated effluents and sewage.

3. Masunda Lake also showed a relatively elevated TSS (366 *mg/L*), with potential

reasons of recreational boating and other anthropogenic activities.

4. While the values remained under the BIS set limit for drinkable standards (see Fig. 8), the water present in these lakes is not suitable for drinking purpose due to the significantly high organic load, as indicated by the test of Chemical Oxygen Demand that shows levels that exceed the threshold for unpolluted surface water by far. This is further confirmed by the TSS and the on-site observational test of odour, which was sewage-related, indicating that the health and balance of these water bodies are severely affected by anthropogenic waste and untreated domestic effluents as well.
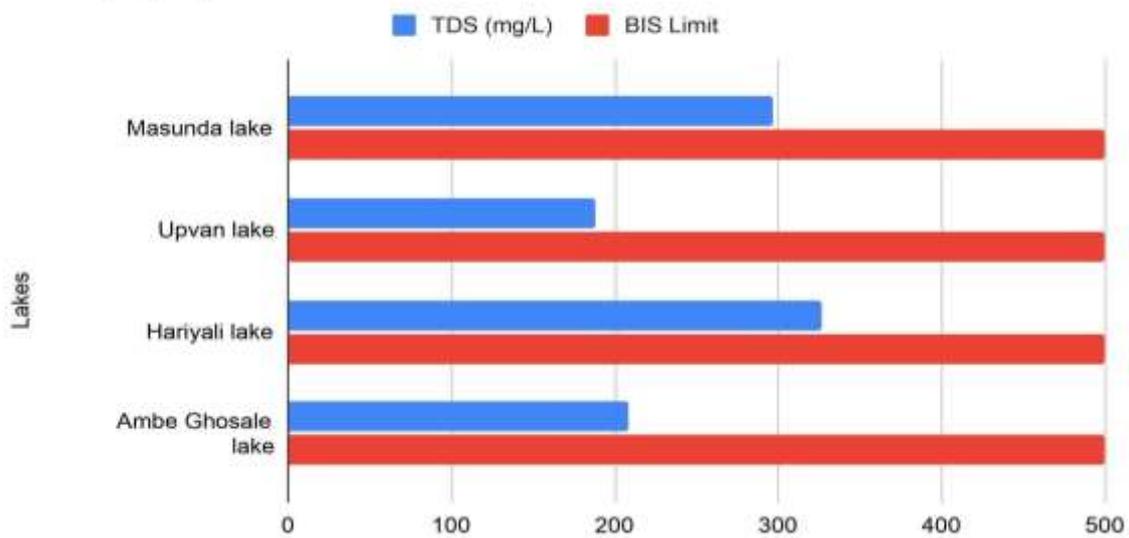

Fig. 8. Total Dissolved Solids (TDS) across selected lakewater samples in comparison to BIS standards.

Table 1: Physico-chemical Analysis of Selected Lakes

Lakes	Temperature (in °C)	pH	EC (in *mS/cm*)	Total Solids (TS)	Total Suspended Solids (TSS) (in *mg/L*)	Total Dissolved Solids (TDS) (in *mg/L*)
Masunda	24	7.80	0.268	662	366	296
Upvan	25	7.20	0.206	462	274	188
Hariyali	22	7.38	0.323	766	440	326
Ambe Ghosale	23	7.39	0.280	500	292	208

Table 2: Water Quality Parameters of the Lakes Studied

Lakes	Odour	Hardness (in *mg/L*)	Total Alkalinity	Chemical Oxygen Demand (in *mg/L*)
Masunda	Fishy/sewage smell	100	Neutral	92.8
Upvan	Musty/earthy smell	92	Neutral	86
Hariyali	Intense sewage smell	112	Neutral	102.4
Ambe Ghosale	Stagnant water smell	108	Neutral	94.8

3.4 CHEMICAL OXYGEN DEMAND (COD): COD is a very crucial indicator of organic pollution. Generally, unpolluted surface waters show COD values <20 mg/L. In this study, all four lakewater samples exceed this value significantly. This creates a state of hypoxia (oxygen deficiency), which prevents the survival of local aquatic biomes and fish populations. These indicate a high load of chemically oxidisable organic matter, likely originating from domestic waste or urban runoff, with Hariyali Lake being at a severe eutrophic level. (see Fig. 9)
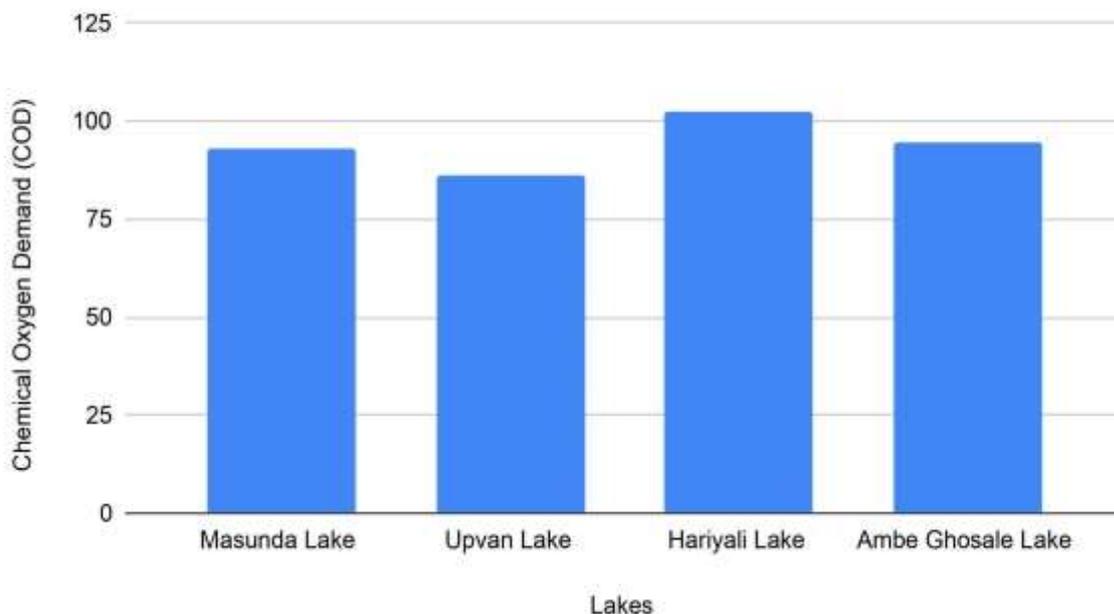

Fig. 9. Chemical Oxygen Demand (COD) concentrations in the water samples collected from the four studied lakes, expressed in *mg/L.*

Conclusion:

The parameters analysed of Masunda, Upvan, Hariyali, and Ambe Ghosale lakes indicate a disturbing trend of organic pollution as well as pollutant loading, which happens to be masked by the chemical neutrality of the water (as implied by the pH data). While the Alkalinity and pH ranges stay within the limits set by the BIS guidelines, the biological health of these water bodies is compromised. All four lakes showed highly elevated levels of COD, significantly above the <20 *mg/L* threshold, with Hariyali Lake recording the highest data of 102.4 *mg/L.*

The TSS values also remain elevated for the samples of a large body of fresh water, some naturally occurring, indicating high levels of solid contamination, which links anthropogenic activities, such as idol immersions, as a potential factor involving high TS (TSS and TDS combined) along with surface runoff. The particular sewage odour and high organic load suggest that the lake's self-purification capacity has been overwhelmed. This can be confirmed by the analysis of two more parameters, namely, Dissolved Oxygen (DO) and Biological Oxygen Demand (BOD), which were not a part of this study due to limited technical flexibility.

Immediate intervention and restoration effects must be practised, such as diversion of untreated sewage and industrial effluents, along with regular desilting, in the lakes studied and others that are detrimental to the anthropogenic society and the local natural biomes that survive by depending on the presence of these lakes. Regulatory actions, along with frequent testing to analyse the stability of these lakes, should be done to prevent further eutrophication and ecological collapse.

References:

[1] Rathod, K. R., Chavan, R. P., & Lokhande, R. S. (2014). Assessment on pollution impact and correlation study of lake water from the Thane region of Maharashtra, India. *International Research Journal of Environmental Sciences*, *3* (12), 44-51.

[2] Bureau of Indian Standards (BIS). (2012). *Drinking water- Specification* (IS 10500:2012).

[3] Ma, J., Wang, S., Ravi Shekhar, N. V., Biswas, S., & Sahu, A. K. (2020). Determination of physicochemical parameters and levels of heavy metals in food wastewater with environmental effects. *Bioinorganic Chemistry and Applications*, Article 8886093. https://doi.org/10.1155/2020/8886093

[4] Akpor, O. B., Otohinoyi, D., Olaolu, D., & Aderiye, B. (2014). Pollutants in wastewater effluents: Impacts and remediation processes. *International Journal of Environmental*

Research and Earth Sciences, *3* (3), 50-59.

[5] Bhavsar, P. S., Mishal, S. S., Devre, P. V., Lad, V. K., Sawat, A. H., Yadav, S. R., & Gore, A. H. (2025). Evaluating the impact of urbanisation and pollution on drinking water quality in Southern Gujarat: A study of physical, chemical, and microbial contaminants. *Cleaner Water*, 100168.

[6] Bhagowati, B., & Ahamad, K. U. (2019). A review on lake eutrophication dynamics and recent developments in lake modelling. *Ecohydrology & Hydrobiology*, *19* (1), 155-166.

[7] Naselli, F. (2008). *Urban lakes: Ecosystems at risk, worthy of the best care*. Materials of the 12th World Lake Conference, Taal, 1333-1337.

[8] Akinbile, C. O., Erazua, A. E., Babalola, T. E., & Ajibade, F. O. (2016). Environmental implications of animal waste pollution on agricultural soil and water quality. *Soil and Water Research*, *11* (3), 172-180. https://doi.org/10.17221/29/2015-SWR