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Original Article

Study the load of pollution in lentic (Vishrale Lake) and lotic ecosystem (Gadhi River), Navi Mumbai, Maharashtra

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Abstract

The study focuses on Gadhi River and Vishrale Lake situated at Panvel. Gadhi river receives discharge from industry and domestic activities such as idol immersion, washing cloths and fishing purpose as well as litter from plants and Vishrale lake river receives discharge from domestic activities such as idol immersion, washing cloths and fishing purpose, also litter from plants that enables the introduction of harmful compounds into the water. This report compares the physicochemical parameters of Vishrale Lake and Gadhi River water in Panvel, Navi Mumbai. The study was carried out in the month of February 2025. The pH, temperature, conductivity, hardness, alkalinity, total dissolved solids, dissolved oxygen, total suspended solids, chlorides, potassium, and sodium levels were measured. The analysed results of Vishrale Lake were compared to those of Gadhi River water and it is found that all the parameters were maximum in river water except pH and DO, whereas Chlorides were same in both the water bodies.

Key Words: *River, Lake, Water, Physico-Chemical properties.*

Introduction

Water is critically necessary for life, as it transports nutrients and oxygen, regulates body temperature, and eliminates waste. It is also essential for several daily activities, including drinking, cooking, sanitation, and agriculture. But for decades, hazardous pollutants have accumulated in water bodies, leading to a decline in water quality due to mismanagement between waste management systems and rapid industrialisation as well as urbanisation (Singare et al., 2011). Heavy metals such as Fe, Cu, Zn, Ni, and other trace elements play crucial roles in biological systems, their deficiencies or excesses can cause various illnesses (Ward, 1995; Singare et al., 2011). In recent years, major concern is the accumulation of heavy metals in bio-systems through contaminated water, soil, and air, making food chain contaminated. Hence, it is better to do current risk assessment research that helps in understanding heavy metal sources, accumulation in soil, and their impact on plant systems (Sharma et al., 2004). Our water bodies are being increasingly polluted from alien contaminants in the environment. This include organic materials derived from plants and animals, land surface washing, industrial and sewage effluents (Karnataka State Pollution Control Board, 2002). Inadequate environmental planning during rapid urbanisation and industry can result in the discharge of industrial and sewage wastewater into lakes. Vishrale Lake, which covers 1.75 hectares, collects sewage and trash from surrounding areas like building debris, washing of clothing, vegetables and automobiles, as well as tree litter from nearby plantations, all of which enter the lake and contribute to pollution. Human activity had a significant impact on the lake contributing to the ecological degradation. As a result, the current research will help us understand the biotic and abiotic variables that effect water bodies, enabling for fast monitoring of the lake and the adoption of an emergency action plan to save it from dystrophication by Rahman et al., (2021); Anita and Shashikala, (2011). In July 2016, the United Nations General Assembly proclaimed access to safe and clean drinking water to be a human right (UN, 2016; Rahman et al., 2021). Since the hydrological cycle is changing significantly due to climate change and human activity, water quality degradation has emerged as a critical global concern for humankind's sustainable development (Rahman et al., 2021).

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The main causes of surface water pollution and declining water quality are anthropogenic sources, including untreated industrial effluents, inadequately disposed of household trash, and agricultural runoff (UN, 2016; Hasan et al., 2019; Uddin and Jeong, 2021; Rahman et al., 2021). In India, around 70% of water is contaminated. Sewage is the primary cause of contamination, accounting for 84-92% of total waste water. Industrial wastewater accounted for 8 to 16 percent (Joshi et al., 2009). Correlation studies between Chlorophytes and physicochemical parameters of river Gadhi showed that highly polluted sites had many genera showing moderate to strong positive correlation with BOD (Gurav et al., 2017).

Rivers and streams exhibit significant regional and temporal variation, with researchers focussing on their physicochemical dynamics. Research has focused on the quality and quantity of river water in various global regions. Riedel et al., (2000) studied trace element fluctuations in the Patuxent River in Maryland, whereas Sileika et al. (2006) investigated nutrient levels in Russia's Nemunas River. In 2007, Schaefer and Alber investigated nitrogen and phosphorus levels in the Altamaha River, Georgia. The present study focuses on a comparative study of Gandhi river and Vishrale Lake to analyse the difference in their qualitative perspective.

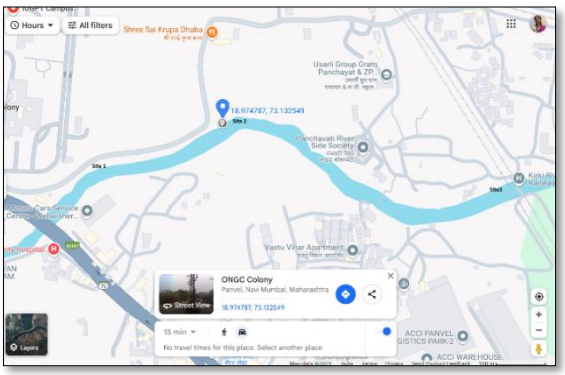

Fig. 1: Sampling Stations of Gadhi River

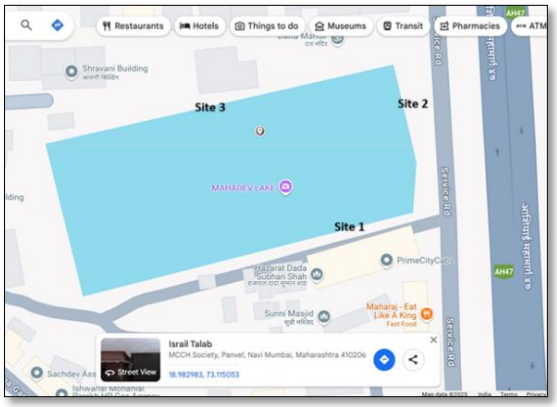

Fig. 2: Sampling Stations of Vishrale Lake

Material Method

In February 2025, sampling was conducted at three distinct lake and river sites between 7.30 and 8.00 a.m. Water samples were collected in a one-litre bottle and delivered to the laboratory for analysis. Location of lake and river, and their sampling stations are shown in (Fig 1 and 2).

Temperature and pH were measured directly in the field. Water temperature was monitored with a thermometer, pH with a pen pH meter. Dissolved oxygen was fixed on the site with Winkler A, Winkler B and Conc. H_2SO_4 and titration was carried out in laboratory. Other parameters such as hardness, alkalinity, total dissolved solid, electrical conductivity, total suspended solid and chlorides were analysed as specified in APHA (2005), Trivedy and Geol (1986), and Kodarkar (2006). Potassium and Sodium was analysed with the help of Flame spectrophotometry.

Observation and Result

A total of 11 parameters were studied from Vishrale lake and Gadhi river (Table No.1 and Fig. No. 3, 4

and 5). The pH in Vishrale Lake was recorded to 8.5 whereas in Gadhi River it was 8.6. Temperature remains same for both the water bodies as 24°C. In vishral Lake conductivity was 710 µ mhos/cm and in Gadhi River it was 730 µ mhos/cm. Hardness was recorded to be high in Gadhi River as 200.4 mg/L whereas in Vishrale Lake it was 120.24 mg/L. Gadhi River showed maximum alkalinity with 165 mg/L and Vishrale lake showed less alkalinity as 162 mg/L. Total dissolved solid is high in Gadhi River as 230 mg/L and low in Vishrale Lake as 189 mg/L. Dissolved oxygen is found to be more in Vishrale lake as 5.9 mg/L and less in Gadhi River as 4.9 mg/L. Gadhi River recorded maximum value of total suspended solid and Vishrale Lake minimum as 0.121 and 0.108 mg/L respectively. Chloride was recorded to be same in both the water bodies as 21.27 mg/L. Potassium was found to be more in Gadhi River as 04 mg/L and less in Vishrale Lake as 02 mg/L. Sodium recorded to be high in Gadhi river and less in Vishrale as 46 mg/L 38 mg/L respectively.

Discussion

The present study showed a little higher value of pH in Gadhi River as 8.6 mg/L than permissible limit by USPH Standard but within permissible limit by ISI Standard. Fakayode (2005) and Singh et al., (2011) asserts that a water body's pH plays a crucial role in determining its quality since it influences other chemical processes such as metal toxicity and solubility. This indicates that the water is alkaline in Nature under the study. Gupta et al., (2017) claim that when the pH rises above 8.5, water tastes saltier, which can lead to skin conditions and eye pain.

Water temperature is important because it influences several physical and chemical properties of water, such as the solubility of oxygen and other gases, the speeds of chemical reactions, toxicity, and microbiological activity as said by Dallas and Day (2004), (Abhilash & Mahadevaswamy, (2022). The temperature in present study was 24°C.

Conductivity, which is directly correlated with total solids, is a useful and quick way to determine the total dissolved ions. Singh et al., (2011) reported that when there are more ions in water then the dissolved solids value is also higher. In the present study conductivity was found to more than the permissible limits in both the water bodies and hence it is not suitable for domestic purpose. Natural waters contain alkaline earth elements, especially calcium and magnesium, which contribute to the water's hardness said by Abhilash & Mahadevaswamy, (2022). This feature is brought on by the dissolving of rocks and minerals in the soil, but it can also be directly caused by rubbish from various anthropogenic sources as observed by Wurts, (1993) and Abhilash & Mahadevaswamy, (2022). Hardness of water bodies was found to be within permissible limits of ISI Standard which is 300 mg/L. Similar records were observed by Abhilash & Mahadevaswamy, (2022).

Surface water's alkalinity, which neutralises acids, is principally determined by its carbonate and hydroxide content. Alkalinity was strong in both the water bodies with a value of 165 and 162 mg/L in Gadhi River and Vishrale Lake respectively. According to Mookherjee and Bhattachary (1949), biological activity in water can cause high alkalinity, while rainfall can cause low alkalinity. Moyle (1946), Latha and Mohan (2010) defined productive water bodies as those with total alkalinity levels exceeding 50 mg/L.

TDS is the total amount of inorganic compounds in a solution. The dissolved solids include carbonate, bicarbonate, and sulphate. Aside from other elements, chloride, sodium, and calcium also exist. Total dissolved solids were below the permissible limit as 280 and 189 mg/L in Gadhi and Vishrale Lake. A high TDS concentration has laxative effects and can impart an unpleasant mineral taste to water. According to Chathwal (1998), Latha and Mohan (2010) a maximum TDS level of 400 mg/L is acceptable for various fish populations.

Water quality assessment relies heavily on dissolved oxygen levels to determine pollution levels. According to Bhat et al. (2019), Abhilash & Mahadevaswamy, (2022) the concentration of DO is determined by water temperature, agitation, aquatic plant types and numbers, light penetration, and the amount of dissolved or suspended materials. DO was recorded to be less in its concentration as 4.5 mg/L and 5.9 mg/L in Gadhi River and Vishrale Lake individually. Both the water bodies showed higher value than permissible limits of ISI Standard (3 mg/L). Concentrations below 5 mg/L may disrupt biological communities, while concentrations below 2 mg/L can cause fish death as observed by Goel et al., (1980), Latha and Mohan (2010); Joshi et al., (2009); Thakor et al. (2011), Abhilash & Mahadevaswamy, (2022).

Total suspended solids were below permissible limit of 5.0 mg/L USPH Standard. Joshi et al., (2009) recorded total suspended solids between 110.28 – 3125.7 mg/L in Ganga river at Haridwar.

Dwivedi and Odi (2003), Sanap et al. (2006), Jindal & Sharma, (2011) found that the presence of city sewage and home garbage in river water led to an increase in chloride levels. Jindal & Sharma, (2011) recorded a value between 28.30 to 45.98 mg/L of chlorides. Present study recorded same value for both the water bodies which was far below the permissible limits of USPH standard.

Potassium is retained in plant tissues rather than the surrounding media and is necessary for all cells, primarily as an enzyme activator mentioned by Hornes and Goldman, (1983) and Singh et al., (2011). Present study recorded 04 mg/L and 02 mg/L in Gadhi River and Vishrale Lake, which is less than permissible limit of WHO Standard and less than Sodium.

Present study recorded 46 mg/L and 38 mg/L of Sodium in Gadhi River and Vishrale Lake, which was more than potassium values in the study. Similar records were observed by Joshi et al., (2009)

Regression Analysis

Regression analysis and coefficient of determination was carried out to measure the outcome of variables and see how much of the variance in the dependent variable (y) in a regression model can be accounted for by the independent variable or variables (x) (Table No.2). Both the water bodies showed weak negative regression having a value of -21.84 to -23.45 and insignificant coefficient of determination with a value of 0.212 to 0.129.

Conclusion

From the observation it is clear that Gadhi River showed higher value for all parameters except dissolved oxygen and both the water bodies showed similar chloride content. All the water parameters were below the permissible limits except the conductivity. Inorganic content was also below the permissible limits. Both the water bodies showed negative regression values and insignificant coefficient of determination. As per water parameters Gadhi River is more polluted than Vishrale Lake.

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Conflicts of interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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Table No. 1: Table showing Physico-chemical parameters of Vishrale Lake and Gadhi River in the month of February 2025.

Sr. No.	Water Parameters	Gadhi River	Vishrale Lake	Permissible limit
1.	pH	8.6 units	8.5 units	6.0-8.5 USPH Standard 6.0-9.0 ISI Standard
2.	Temperature ^{o}C	24	24	24^{o}C
3.	Conductivity (μ mhos/cm)	730	710	300 μ mhos/cm USPH Standard and ICMR
4.	Hardness (mg/L)	200.4 mg of cal^{2+}/L	120.24 mg of cal^{2+}/L	300 mg/L ISI Standard
5.	Alkalinity (as $CaCO_3$) (mg/L)	165	162	50 mg/L (Weak) 100 mg/L (medium) 200 mg/L (strong)
6.	Total dissolved solid (mg/L)	230	189	500 mg/L USPH Standard
7.	DO (mg/L)	4.5	5.9	4.0-6.0 mg/L USPH Standard

				3.0 mg/L ISI Standard
8.	Total suspended solid (mg/L)	1.089	0.972	5.0 mg/L USPH Standard
9.	Chlorides (mg/L)	21.27	21.27	250 mg/L USPH standard 600 mg/L ISI Standard
10.	K (mg/L)	04	02	20 mg/L WHO standard
11.	Na (mg/L)	46	38	50 mg/L WHO standard

Table No. 2: Table showing Regression and Coefficient of determination of Gadhi River and Vishrale Lake in the month of February 2025

Sr. No.	**Particulars**	**Gadhi River**	**Vishrale Lake**
1.	Regression (y)	-23.459x + 271.1	-21.846x + 247.53
2.	Coefficient of determination (R^2)	0.129	0.121

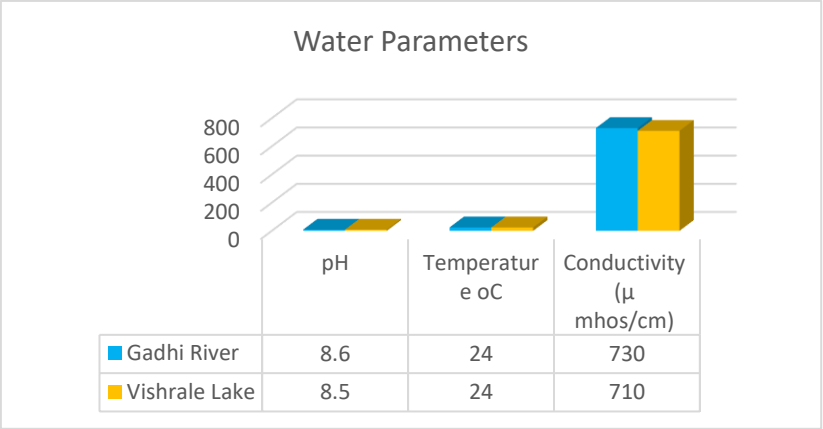

Fig. No.: 3 Histogram showing pH, temperature and conductivity in Gadhi river and Vishrale Lake in the month February 2025.

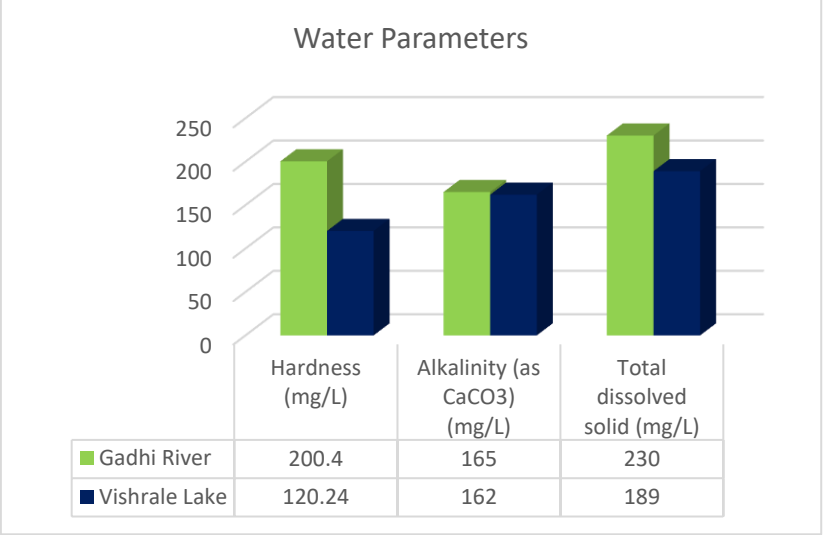

Fig. No.: 4 Histogram showing hardness, alkalinity and total dissolved solid in Gadhi river and Vishrale Lake in the month February 2025.

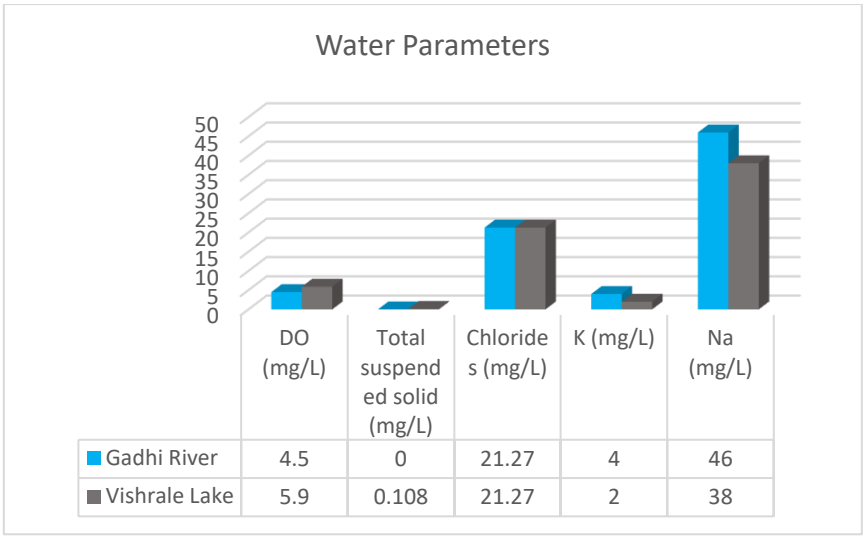

Fig. No.: 5 Histogram showing DO, total suspended solid, chlorides, potassium and sodium in Gadhi river and Vishrale Lake in the month February 2025.

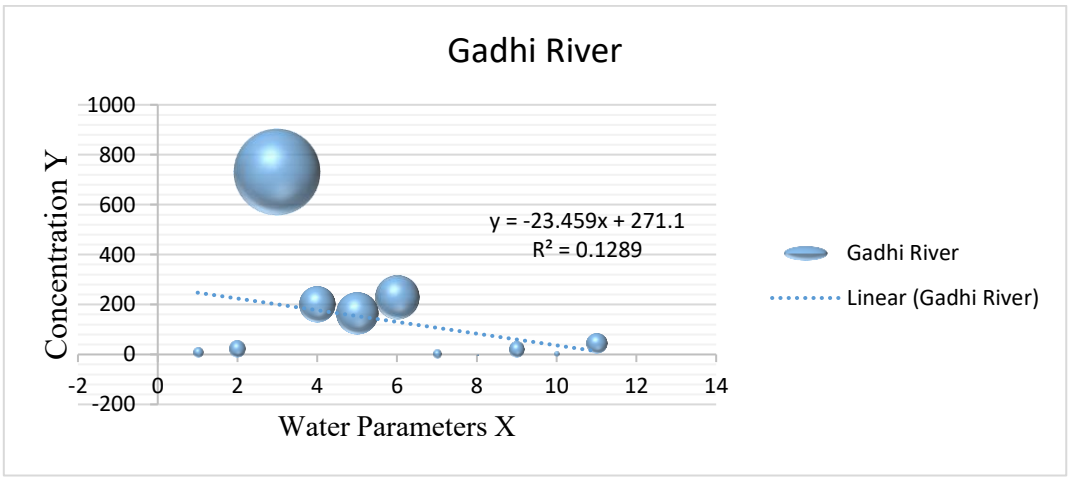

Fig. No. 6: Shows bubble line diagram showing Regression and coefficient of determination for Gadhi river when compared with Vishrale Lake.

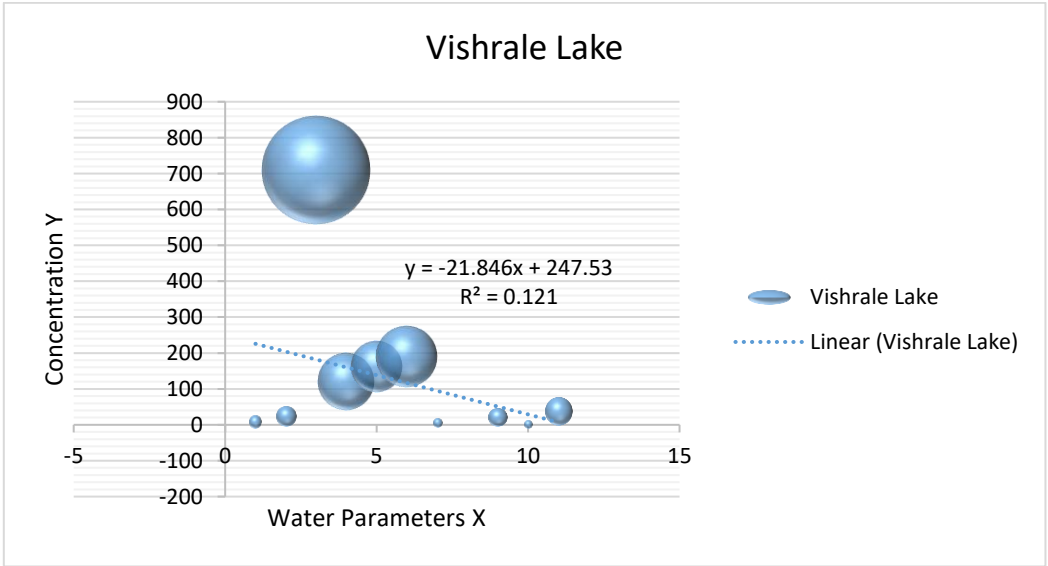

Fig. No. 7: Shows bubble line diagram showing Regression and coefficient of determination for Vishrale Lake when compared with Gadhi river.