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# Assessment Of Heavy Metal In Selected Water Bodies Of Bhiwandi

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**Abstract:** Rivers and lakes serve as crucial sources of livelihood for the surrounding communities. However, increasing urbanization and industrialization have led to the emergence of environmental contaminants, particularly heavy metals, which poses significant threat to human health and aquatic ecosystems. Industrial discharge is a major contributor to heavy metal pollution, and the extent of accumulation in water bodies largely depends on the effectiveness of wastewater treatment processes. Heavy metal contamination adversely impacts aquatic flora and fauna, leading to biomagnification and subsequent risks to human health. This study examines the concentration of heavy metals in major water bodies of Bhiwandi, specifically the Kamwari River, Varala Lake, and Diwanshah Lake. Findings indicate that water samples from the Kamwari River contain significantly higher concentrations of copper, lead, and iron compared to those from Varala and Diwanshah lakes. The elevated levels observed in the Kamwari River can be attributed to increased anthropogenic activities in the vicinity, highlighting the need for enhanced pollution management strategies in the region.

**Keywords:** Heavy metal contamination, aquatic pollution, Kamwari River, Varala Lake, Diwanshah Lake, industrial discharge, water quality assessment.

## I. INTRODUCTION

The aquatic ecosystem serves as the ultimate sink for various water pollutants, including heavy metals. Pollution from heavy metals in aquatic environments has become a global concern, escalating to critical levels in recent years. These metals originate from multiple sources, primarily industrial discharges, as well as from anthropogenic activities such as sewage drainage, hospital waste disposal, and recreational practices. In addition, trace amounts of heavy metals can enter water bodies through natural processes like rock leaching, airborne dust, forest fires, and vegetation decay (Fernandez and Olalla, 2000). Since heavy metals are non-degradable, they persist in the environment, accumulating in water, sediments, and aquatic organisms, thereby contributing to long-term contamination of aquatic (Linnik and Zubenko, 2000).

Heavy metals are a group of elements characterized by high atomic weights and densities—typically five times greater than that of water. This category includes transition metals, certain metalloids, as well as elements from the lanthanide and actinide series (Singh et.al., 2011). Among the wide range of environmental pollutants, heavy metals have garnered particular attention from environmental scientists because of their pronounced toxicity and potential to cause long-term ecological and health impacts. These metals can contaminate drinking water sources not only through industrial discharge but also via acid rain, which breaks down soils and rocks, releasing heavy metals into rivers, lakes, and groundwater systems. Although naturally present in trace amounts in aquatic environments, many heavy metals are harmful even at very low concentrations. Elements such as arsenic, lead, cadmium, nickel, mercury, chromium, cobalt, zinc, and selenium are known to be extremely toxic, even in minute quantities. The increasing concentration of heavy metals in the environment is a growing concern, particularly due to the expanding number of industries that discharge metal-laden effluents into freshwater sources without adequate treatment (Masindi and Muedi, 2018).

Bhiwandi, located in the Thane district of western Maharashtra, is a prominent commercial hub often referred to as the "Manchester of India" due to its major role in the textile trade. Nestled in the scenic Konkan coastal lowlands, the city is characterized by its hills and water streams. In the early 20th century, Bhiwandi was a small yet strategically important town, acting as a crucial connection between Mumbai and the rest of India through the Mumbai–Agra highway. During that period, the primary occupations of the local population included agriculture, fishing, and handloom weaving. With the introduction of electricity, traditional handlooms were gradually replaced by power looms, marking the city's transformation into a nucleus of the textile industry by the 1930s. Today, Bhiwandi hosts the second-largest concentration of power looms in India, following Surat, and plays a vital role in manufacturing and distributing textile machinery across the country. The city's economic growth and employment opportunities have been significantly supported by its abundant water resources. Currently, Bhiwandi is home to a wide range of industries, including textile, dyeing, sizing, moulding, and others, all of which consume large volumes of water. However, the extensive industrial activity has also led to challenges related to the disposal of chemical effluents and industrial waste. Over the past decade, Bhiwandi has been grappling with severe water scarcity, groundwater pollution, and the degradation of natural water bodies such as rivers and lakes, many of which have been encroached upon or repurposed as dumping grounds for solid waste.

The Kamvari River, which flows through the Bhiwandi city, Thane district, Maharashtra, was a large commercial navigation port, is now a receding perennial river with a total length of 34 km length flowing polluted through the Bhiwandi city, Kalyan Taluka, Maharashtra (Donde, 2020). The Kamwari River, which served as a port during the British era, is one such contaminated river today. The river, which previously served as a means of transport for cargo, has shrunk to the size of a tiny stream. Additionally, the status of the river is a result of the expanding industrialization and urbanization on its banks. Seventy years ago, Kamwari was tributary of Ulhas River and joined the Thane Creek.

Varala Devi lake is in Bhiwandi city, District Thane, Maharashtra. Varala Devi Lake experiences extreme anthropogenic stress and receives significant amounts of residential trash and sewage. The locals use the lake water for recreational purposes, including fishing, as well as for drinking. It gets household raw sewage from nearby habitations and activities such as bathing, washing clothes, washing animals, performing religious rituals such as idol immersion, etc., resulting in a high concentration of harmful chemicals entering the lake (Shaziya et.al., 2015) The Diwanshah Lake, which is two kilometers from Bhiwandi and the second-largest water body after Varala Lake, is about fifty years old, measures 1.03 hectares in size, and has a depth of 5.4 meters. Fishes including Rohu, Catla, Tilapia, and Chinese carp are included in the composite culture because they are in high demand for human consumption in the surrounding local fish market (Heena and Shakir, 2021). The present study deals with the testing of physico-chemical parameters of all the three water bodies of Bhiwandi for water quality testing.

## II. MATERIALS AND METHODS

### 1. Study Area:

The selected study sites, as illustrated in Figures 1, 2, and 3, were strategically chosen based on their proximity to catchment areas with significant anthropogenic activities that are potential contributors to river and lake pollution.

### 2. Sample Collection:

Water samples were collected from three distinct locations: Kamwari River (Sample 1), Varala Lake (Sample 2), and Diwanshah Lake (Sample 3). To minimize the risk of contamination, clean 1-liter polyethylene bottles were used for sample collection, and each bottle was accurately labeled for proper identification.


**Fig. No. 1: Location of Kamwari River, Maharashtra, India**


**Fig. No. 2: Location of Varala lake, Maharashtra, India**


**Fig. No. 3: Location of Diwanshah Lake, Maharashtra, India**

**3. Analysis of physical parameters and estimation of heavy metals:**

The collected water samples were analyzed for various physical parameters, including pH, odor, color, and temperature. Additionally, chemical analysis was conducted to determine the concentrations of selected heavy metals such as copper (Cu), lead (Pb), and iron (Fe) using the colorimetric method. Standard procedures were followed for the assessment of these physico-chemical parameters (APHA,1992).

## III. RESULTS & DISCUSSION

### 1. Physical parameters for water quality testing:

The parameters observed in this study include pH, odor, color, and temperature. The results obtained from the analysis of the physical and chemical conditions of the water provide a comprehensive overview of the current state of the three water bodies in Bhiwandi, as presented in Table No. 1.

**Table No. 1: Physical parameters for water quality testing**

| Sr. No. | Parameters | Kamwari river (Sample 1) | Varala Lake (Sample 2) | Diwanshah Lake (Sample 3) |
|---|---|---|---|---|
| 1 | pH | 8.23 | 7.28 | 7.39 |
| 2 | Odour | Foul | Foul | Slightly pungent |
| 3 | Colour | Brownish gray | Brownish green | Brownish green |
| 4 | Temperature | 29 °C | 28°C | 28°C |

#### a. pH

The pH of water is a critical parameter as it helps assess the corrosive potential of the water. A lower pH indicates higher acidity, which can lead to increased corrosiveness, whereas a higher pH suggests that the water is less acidic and less corrosive. In the provided data, Sample 1 from the Kamwari River has a higher pH (8.23) compared to the other samples, which may indicate the presence of water pollutants influences the pH level. A higher pH value could also suggest the disruption of the carbon dioxide-carbonate-bicarbonate equilibrium, possibly due to changes in environmental conditions or pollution (Karanth, 1987). Such variations in pH may lead to the formation of sediment incrustations and deposition in water bodies, which can affect water quality and aquatic life.

#### b. Temperature

There is a strong correlation between atmospheric temperature and water temperature, as air temperature significantly influences the physiological behavior of aquatic ecosystems and the distribution of microorganisms. In this study, the water temperature of the collected samples ranges from 28°C to 29°C. The lowest temperature was observed in Samples 2 and 3, while the highest temperature was recorded in Sample 1. This variation in temperature can impact the aquatic environment, potentially affecting microbial activity and other ecological processes within the water bodies.

#### c. Colour and Odour.

The color of water is influenced by a combination of factors such as silt, clay, organic matter, algae, plant life, and microorganisms present in the water. As shown in Table No. 1, the color of the water samples varies accordingly. In most cases, water samples may not have a noticeable odor, but some may emit a distinct smell, which can help identify potential pollution sources. Natural odors can be described as fishy, soil-like, or musky, whereas non-natural odors may indicate the presence of pollutants such as chlorine, sulfide (rotten eggs), sewage, manure, or chemicals. In this study, Samples 1 and 2 exhibit a foul smell, suggesting the possible presence of contaminants, while Sample 3 has a slightly pungent smell, which may also indicate a different level of pollution or natural organic activity.

## 2. Chemical parameters for water quality testing: Estimation of heavy metals

The analysis of water samples from Kamwari River, Varala Lake, and Diwanshah Lake reveals that the levels of certain heavy metals are slightly above the acceptable limits set for maintaining healthy environmental conditions in rivers and lakes. When compared to the established standards for these aquatic environments, it appears that the concentrations of these heavy metals may pose potential risks to the ecosystem and aquatic life. Elevated levels of heavy metals can be harmful to living organisms, affecting water quality and overall ecological balance.

**Table No. 2: Concentration of heavy metals in the tested samples.**

| Sr. No | Parameters | Unit | Standard limits as per WHO guidelines (mg/L) | Result | | |
|---|---|---|---|---|---|---|
| | | | | Kamwari river (Sample 1) | Varala Lake (Sample 2) | Diwanshah Lake (Sample 3) |
| 1 | Copper (Cu) | mg/L | 2.0 mg/L | 16.07 ± **0. 43** | 13.07 ± **0. 68** | 9.72 ± **0.**11 |
| 2 | Lead (Pb) | mg/L | 0.01 mg/L | 5.02 ± **0. 2** | 2.83 ± **0. 08** | 3.4 ± **0. 10** |
| 3 | Iron (Fe) | mg/L | 3.0 mg/L | 4.43 ± **0. 16** | 4.43 ± **0. 16** | 3.32 ± **0. 10** |

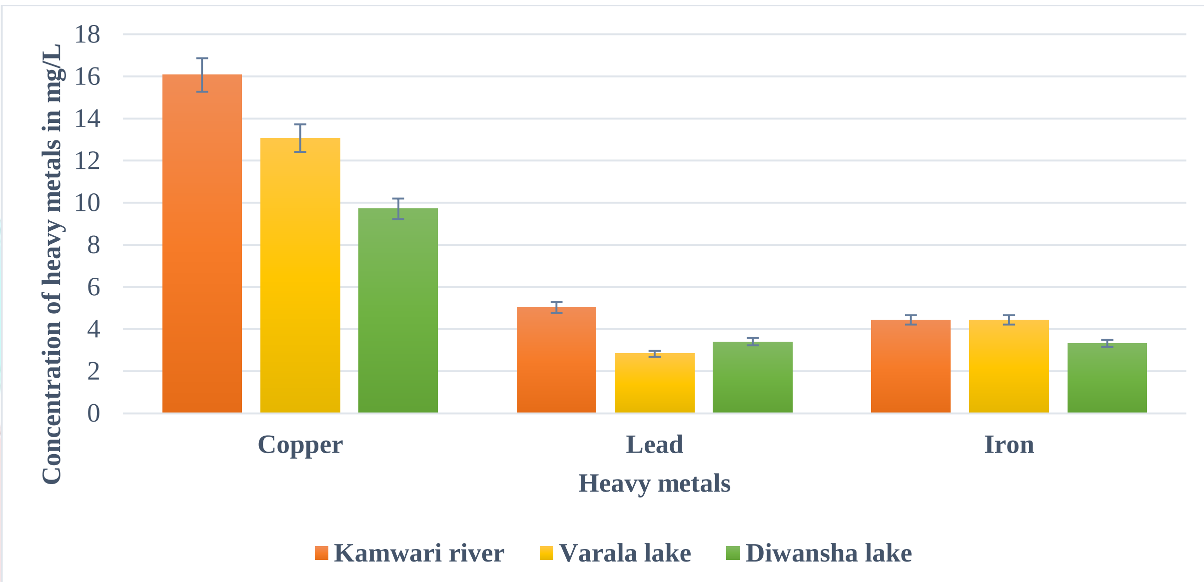


**Fig. No. 4: Graphical representation of concentration of heavy metals of Sample 1, 2 and 3**

### a. Copper (Cu):

Copper is an essential element for human health in small quantities, but excessive exposure can lead to adverse effects, including anaemia, liver and kidney damage, and gastrointestinal irritation. Copper typically enters drinking water through copper pipes or from additives used to control algal growth. Over time, the concentration of copper in water can fluctuate, influenced by both natural factors and human activities contribute copper to water bodies (Yusni and Ifanda, 2020).

The analysis of water samples from Kamwari River, Varala Lake, and Diwanshah Lake revealed that the highest copper concentration was found in Sample 1 (16.07 mg/L), followed by Sample 2 (13.07 mg/L) and Sample 3 (9.72 mg/L). These elevated levels of copper suggest a significant accumulation in the water, which could potentially lead to severe toxicity in both humans and animals if exposure continues. The presence of high copper concentrations in these water bodies indicates the need for closer monitoring and potential remediation efforts to safeguard public health and aquatic life.

**b. Lead (Pb):**

Lead (Pb) is a toxic environmental pollutant that poses significant risks to various organs in the body. Exposure to lead can disrupt physiological functions and is linked to numerous health issues, including neurological, cardiovascular, and kidney damage (Ali et.al., 2013)

Upon analyzing the water samples from Kamwari River, Varala Lake, and Diwanshah Lake, varying concentrations of lead were detected across the different water bodies. Similar to copper, the concentration of lead was found to be lower in Samples 2 (3.4 mg/L) and 3 (2.83 mg/L), compared to Sample 1, where the concentration was higher at 5.02 mg/L. These elevated levels of lead in Sample 1 suggest a potential risk of contamination, and the presence of lead in all the water bodies highlights the need for monitoring and mitigating the sources of lead pollution to protect both human and environmental health.

**c. Iron (Fe):**

Iron is considered a micronutrient in water when its concentration is below 0.3 ppm. However, higher concentrations can affect water quality and pose challenges for both aquatic life and human consumption. According to the analysis of water samples, the concentration of iron in Kamwari River (Sample 1) and Varala Lake (Sample 2) was found to be similar, both measuring 4.43 mg/L. In contrast, the concentration of iron in Diwanshah Lake (Sample 3) was slightly lower, at 3.32 mg/L. These elevated levels of iron in the water bodies may indicate natural mineral deposits or potential contamination from nearby human activities, which could affect the overall water quality and the health of aquatic ecosystems.

## IV. CONCLUSION

This research study analyzed water samples from Kamwari River, Varala Lake, and Diwanshah Lake in Bhiwandi, focusing on the heavy metal content in the water. The results showed that the concentration of heavy metals such as copper, lead, and iron exceeded the limits set by the World Health Organization, poses a significant threat to human health and the aquatic ecosystem. When present in excessive amounts, heavy metals are highly toxic and can cause severe harm to living organisms.

The water quality tests revealed that Sample 1 from Kamwari River exhibited the highest concentrations of copper, lead, and iron, surpassing acceptable limits, which makes the water unsafe for drinking or domestic use. Kamwari River had the highest levels of copper and lead, while Varala Lake and Diwanshah Lake had comparatively lower concentrations. The high accumulation of copper and lead in these water bodies could lead to serious toxicity issues for both humans and animals.

Iron concentrations were similar in Kamwari River and Varala Lake, but slightly lower in Diwanshah Lake. Given that V. this water bodies are used for fishing activities, there is a high risk of heavy metals entering the food chain. This could lead to bioaccumulation of these metals in fish, which may then be consumed by humans, potentially causing health issues. The hazard of an environmental chemical is determined by its environmental persistence, toxicity, and bioaccumulation potential.

Therefore, it is crucial to be cautious about consuming fish from these areas, as it may pose significant health risks. Regular monitoring of water quality is essential to assess the state of the water bodies, and immediate action should be taken to curb anthropogenic activities around the lakes and river. Heavy metal pollution, mainly due to industrial activities, mining, agriculture, and transportation, is a pressing environmental issue that has serious implications for human health and ecosystems. Addressing this issue requires a comprehensive approach, including reducing emissions, adopting sustainable management practices, and using innovative technologies. Urgent action is needed at all levels, including raising awareness, enforcing regulations, and investing in research and development to mitigate the impacts of heavy metal pollution.

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