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Comparative Analysis Of Eutrophication Induced By *Eichhornia Crassipes* In Multi Freshwater Lakes Of Dahanu, Maharashtra

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Abstract: The invasive aquatic plant *Eichhornia crassipes* (water hyacinth) is a significant ecological challenge affecting freshwater ecosystems globally. This study investigates the impact of water hyacinth infestation on water quality in four lakes within the Dahanu Municipal Area, Maharashtra. Using seasonal water samples collected from December 2024 to March 2025, parameters such as pH, conductivity, and biological oxygen demand (BOD) were analyzed. Results revealed marked differences in water quality correlated with the presence and density of hyacinth cover, with the most heavily infested site showing acidic pH and reduced water quality. The study emphasizes the urgent need for site-specific management strategies, underlining the importance of biological control and integrated environmental planning to mitigate the negative ecological, economic, and social impacts of water hyacinth.

Index Terms - *Eichhornia crassipes.* pH, conductivity, and biological oxygen demand

I. INTRODUCTION

Eutrophication, often driven by nutrient enrichment, is accelerated in tropical and subtropical waters by invasive macrophytes such as *Eichhornia crassipes*. Native to the Amazon basin, water hyacinth thrives in nutrient-rich conditions, forming dense mats that restrict sunlight penetration, impede gas exchange, and suppress aquatic biodiversity (Villamagna & Murphy, 2010).

Globally, *E. crassipes* has been linked to severe declines in water quality, fisheries collapse, and public health risks due to stagnant water promoting mosquito breeding (Ndimele et al., 2011). The Dahanu lakes, situated in Maharashtra's coastal belt, are vital for local water supply, small-scale fisheries, and cultural activities. This study evaluates the degree to which varying infestation levels influence eutrophication indicators, providing evidence for targeted management.

II. STUDY AREA

Four lakes with distinct infestation intensities were selected:

- **Shiv Vishveshwar Mahadev Mandir Lake** – Moderate infestation (3.81%)
- **Masoli Patil Pada Lake** – Low infestation (0.96%)
- **Kevda Devi Mandir Lake, Aagar** – No infestation (0%)
- **Lotus Lake, Dahanu Fort** – Severe infestation (94.91%)

All sites were geo-referenced using Google Maps. Monthly water samples were collected from December 2024 to March 2025.

III. LITERATURE REVIEW

Water hyacinth's ecological impact extends beyond physical shading. Its decomposition increases nutrient availability, further stimulating algal blooms and creating hypoxic zones (Smith et al., 1999; Gichuki et al., 2012). Prolonged oxygen depletion disrupts trophic networks and can lead to fish mortality (Khan & Ansari, 2005).

Management strategies include:

- **Mechanical removal**, which is rapid but costly and labor-intensive (Hussner et al., 2017).
- **Chemical control**, which is effective but risks secondary pollution.
- **Biological control**, such as weevils (*Neochetina eichhorniae*), which provide long-term suppression (Abdel-Tawwab & El-Marakby, 2018).

Successful mitigation often involves integrating control methods with watershed nutrient management (Paerl & Otten, 2013).

IV. MATERIALS AND METHODS

Sampling Period: December 2024 – March 2025
Measured Parameters: pH, electrical conductivity, and BOD
Methodology: Standardized water quality kits were used for measurements. Differences between sites were analyzed to determine correlations between hyacinth density and eutrophication indicators.

V. RESULTS AND DISCUSSION

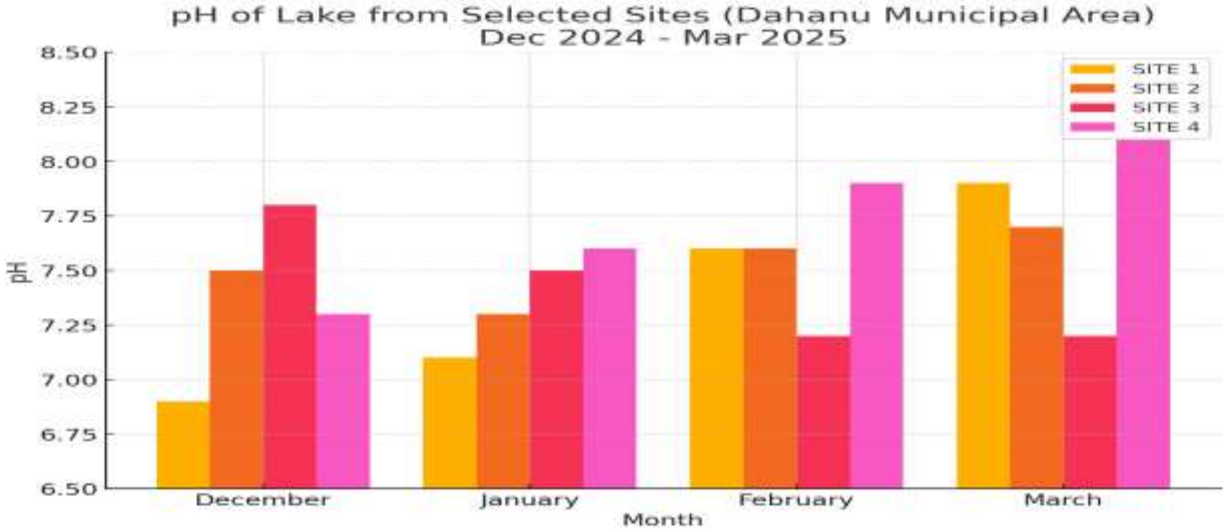
5.1 pH Variation:

Across the study period, pH values ranged from **6.9** to **8.1**, indicating neutral to slightly alkaline water conditions. A general increasing trend in pH was observed at Sites 1, 2, and 4, while Site 3 exhibited relatively stable values with only minor fluctuations (7.8 in December to 7.2 from February onwards). Site 4 recorded the highest pH (8.1) in March, suggesting higher alkaline ion content, possibly from runoff containing carbonates or domestic wastewater.

The seasonal rise in pH from December to March may be attributed to reduced rainfall and freshwater inflow during the dry season, leading to increased concentration of bicarbonate and carbonate ions through evaporation processes. Similar seasonal pH shifts have been reported in semi-tropical lake systems influenced by climatic seasonality.

Month	SITE 1 (pH)	SITE 2 (pH)	SITE 3 (pH)	SITE 4 (pH)
December	6.9	7.5	7.8	7.3
January	7.1	7.3	7.5	7.6
February	7.6	7.6	7.2	7.9
March	7.9	7.7	7.2	8.1

Table 1: **pH of lake from selected site from Dahanu Municipal Area (Dec.2024 to March 2025)**



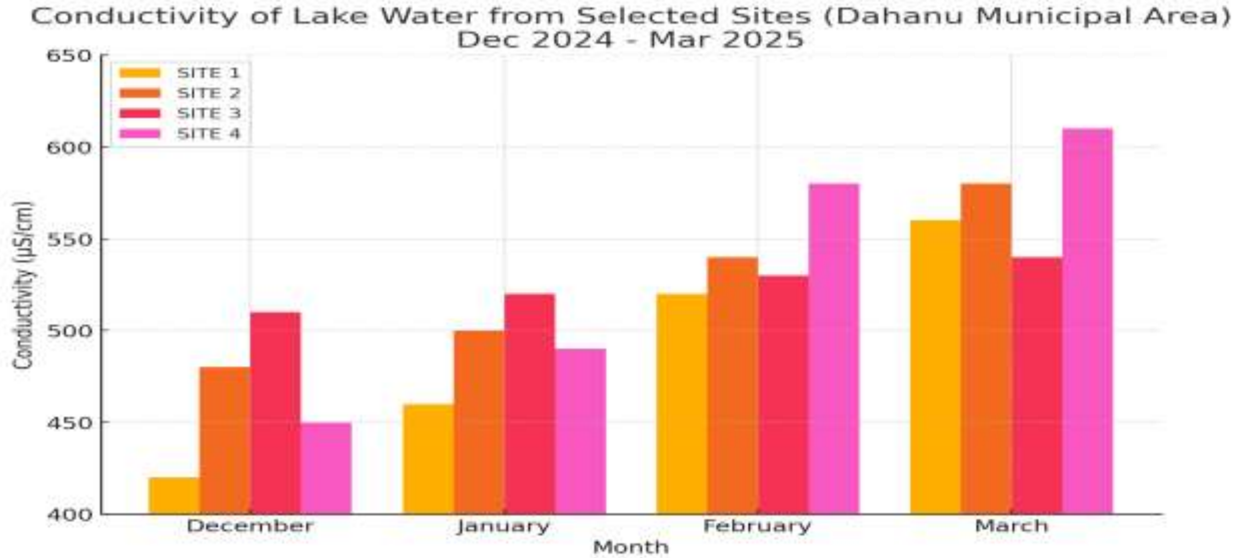
5.2 Conductivity:

Conductivity values ranged from **420 µS/cm** to **610 µS/cm**. The lowest EC was recorded at Site 1 in December (420 µS/cm), while the highest was recorded at Site 4 in March (610 µS/cm). All sites displayed a steady upward trend in EC over the study period, consistent with reduced dilution and higher ion concentration during late dry season months.

Notably, Site 4 exhibited both the highest EC and the highest pH in March, supporting the inference that the elevated alkalinity at this site is linked to higher dissolved ion concentrations. Conversely, Site 3, despite relatively stable pH values, displayed only moderate EC increases, suggesting a stable buffering capacity and less influence from anthropogenic or catchment-based solute inputs.

Month	**SITE 1** (µS/cm)	**SITE 2**(µS/cm)	**SITE 3**(µS/cm)	**SITE 4**(µS/cm)
December	420	480	510	450
January	460	500	520	490
February	520	540	530	580
March	560	580	540	610

Table 2: Conductivity of lake from selected site from Dahanu Municipal Area (Dec. 2024 to Mar. 2025)

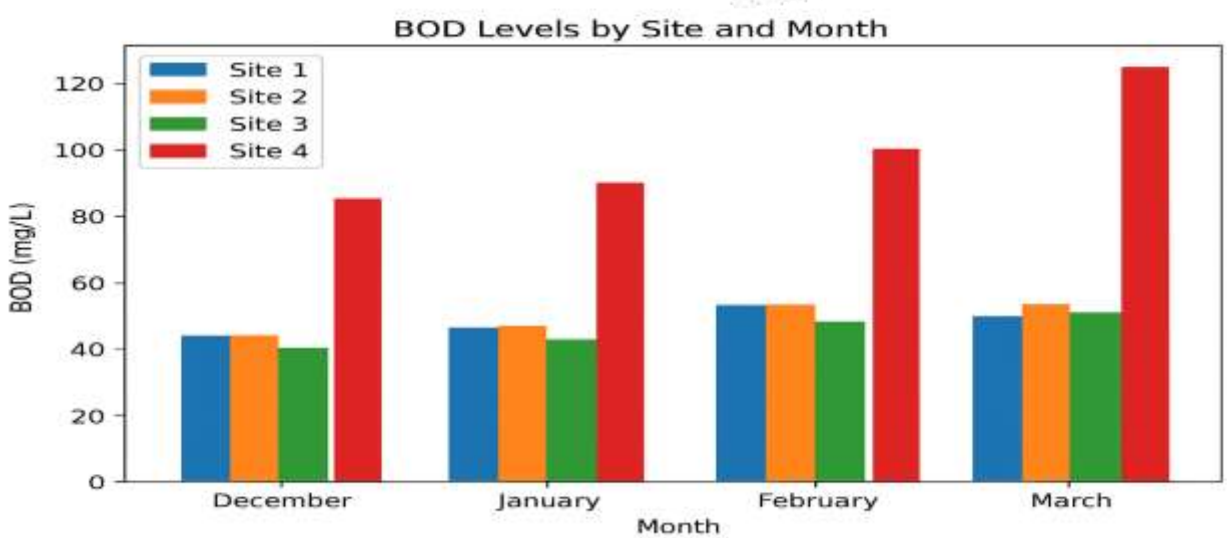


5.3 BOD:

Infested sites generally had elevated BOD, reflecting high microbial activity in decomposing vegetation. Notably, the non-infested site still had moderately high BOD due to other pollution sources, aligning with observations from Carpenter (2005) that eutrophication can result from multiple nutrient inputs.

Month	December	January	February	March
SITE 1 (BOD) mg/L	47.60	51.03	56.43	60.33
SITE 2 (BOD) mg/L	49.05	52.03	55.05	59.05
SITE 3 (BOD) mg/L	48.40	52.00	53.60	54.80
SITE 4 (BOD) mg/L	96.27	99.42	105.37	111.57

Table 3: BOD of lake from selected site from Dahanu Municipal Area (Dec. 2024 to Mar. 2025)



5.4 Water hyacinth assessment:

Water hyacinth assessment across the four sites from December 2024 to March 2025 — Site 4 clearly has the highest infestation, while Site 3 has none.

LOCATION	Area (m^2)	Water Hyacinth area (m^2)	Water Hyacinth Assessment (%)
Site 1	3118.31	135.05	4.33%
Site 2	11750.30	122.85	1.05%
Site 3	9642.58	0.0	0 %
Site 4	13239.44	12189.87	92.07%

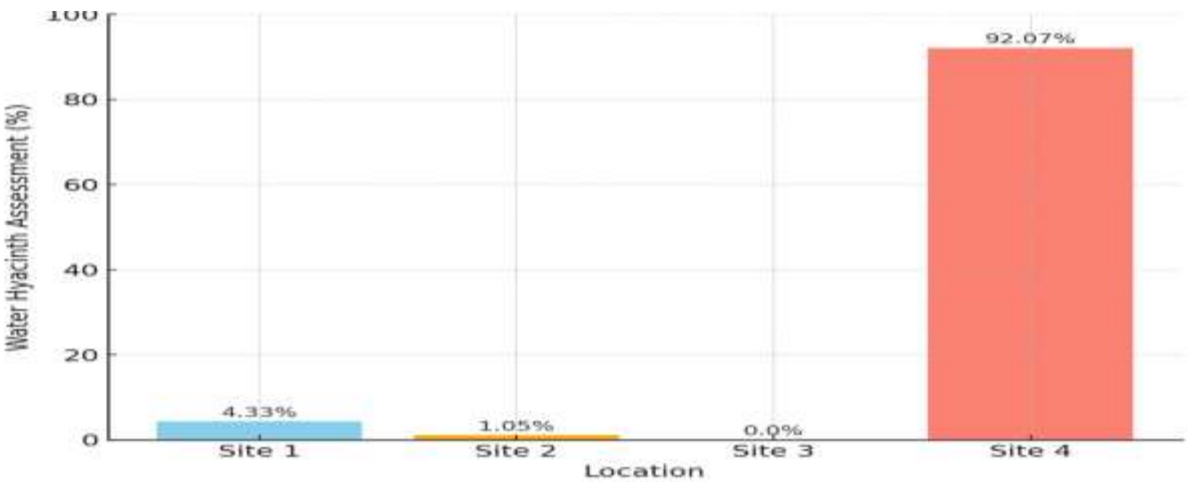


Fig. 1: Water Hyacinth Assessment in Dahanu Muncipal Area Selected Lakes (Dec. 2024-Mar. 2025)

5.5 Socioeconomic Implications:

The infestation restricted fishing activity, reduced aesthetic appeal, and limited lake use for religious festivals—paralleling impacts documented in Lake Victoria (Gichuki et al., 2012).

VI. CONCLUSION AND RECOMMENDATIONS

- The statistical evaluation of Biological Oxygen Demand (BOD) measurements from selected sites within Dahanu Municipal, conducted from December 2024 to March 2025, revealed statistically significant variation in mean BOD levels among the sampling locations at the 5% significance threshold. These findings indicate spatial heterogeneity in organic pollution levels, suggesting that site-specific factors may be influencing water quality and warranting targeted management and remediation strategies.
- This study confirms that *Eichhornia crassipes* infestation intensifies eutrophication in Dahanu's lakes, with severe infestations linked to higher pH, higher conductivity, and elevated BOD.

Recommendations:

1. **Biological control** using *Neochetina* weevils to achieve sustainable suppression.
2. **Seasonal manual removal** during low infestation periods with community participation.
3. **Nutrient source reduction**, particularly from agricultural runoff and domestic waste.
4. **Continuous monitoring** of water quality indicators to enable early intervention.

Integrated management will not only improve ecological health but also restore the economic and cultural value of Dahanu's freshwater bodies.

VII. REFERENCES

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