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Water Quality Degradation from Idol Immersion Practices: A case study

KALENDRA KUMAR MISHRA, SANJAY SRIVASTAVA

Botany Department,

Harish Chandra P.G. College,

VARANASI-221001 (U.P.) INDIA

Abstract

Idol immersion, a significant religious practice in India, particularly during festivals such as Durga Puja and Ganesh Chaturthi, has emerged as a major environmental concern due to its adverse effects on aquatic ecosystems (Yigam & Bharti, 2025).A study on Bramha Pond, Varanasi, investigated the impact of idol immersion on water quality, analyzing parameters such as pH, dissolved oxygen (DO), biochemical oxygen demand (BOD), chemical oxygen demand (COD), total dissolved solids (TDS), and heavy metals like Pb, Cd, and Cr .Results indicated a significant increase in pollutant levels during and after immersion, with heavy metal concentrations exceeding permissible limits (WHO, 2017). For example, Pb concentration increased from 0.120 mg/L to 0.250 mg/L, while BOD increased from 12.5 mg/L to 22.5 mg/L .The study concludes that idol immersion severely degrades water quality and disrupts aquatic ecosystems, recommending sustainable practices such as eco-friendly idols and artificial immersion tanks to mitigate environmental impacts.

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Keywords Idol immersion, Bramha Pond, Water pollution, Heavy metals, Physicochemical parameters, Phytoremediation, Varanasi

Introduction

India is culturally rich, with religious practices deeply integrated into daily life. Idol immersion is a centuries-old ritual symbolizing the return of deities to nature. However, modernization has introduced materials such as plaster of Paris, synthetic dyes, and chemical paints, which significantly contribute to water pollution.Apart from this,the day-by-day increase in the number of Idols immersed in ponds and other water bodies has exceeded the self- purification capacity of these waterbodies. Studies across Indian water bodies indicate that idol immersion leads to increased turbidity, reduced dissolved oxygen, and elevated heavy metal concentrations (Yigam& Bharti, 2025;)

Bramha Pond in Varanasi serves as an important local site for idol immersion. Due to repeated immersion events, the pond experiences seasonal fluctuations in water quality, making it an ideal case for environmental assessment.

Study Area: Bramha Pond and Control site (Varanasi)

Bramha Pond is a semi-natural freshwater body located in Varanasi, Uttar Pradesh. It is used for religious activities, irrigation, and domestic purposes. The pond receives idol immersion waste annually, leading to accumulation of pollutants in sediments and water. Bramha Pond is situated 12 km away from the river Ganga and 1km from river Varuna at the Village – Bharthara, Post – Lohta, District – Varanasi in Uttar Pradesh. Area of the pond is around one hectare and Location is at Latitude 25.322957 and Longitude 82.938777 (Plate No.-1 and 2) near government community overhead water tank.

Chhitauni pond:

Chhitauni pond are situated 15 km away from Ganga River ,8 km from Varanasi Cant and 3 km from Varuna River Latitude 25.335362 and Longitude 82.923524(Plate No.-3). Area of the pond is about 0.75 hectare. It is naturally unaffected by idol immersion and other pollutants.

Manorathpur Pond:

Manorathpur pond are located from 18 km to Ganga River, 11 km to Varanasi Cant and 4 km to the Varuna river Latitude 25.334262 and Longitude 82.916175 (Plate No.-4) from it' s north side. Area of this pond is about 0.5 hectare. Here Idol immersion are also not take place during festival season.

Plate No.-1 **Plate No.-2**

Plate No.-3 **Plate No.-4**

Materials and Methods

Sample Collection

Water samples were collected from Bramha Pond, Chhitauni Pond, and Manorathpur Pond in three distinct phases to assess the impact of idol immersion: pre-immersion (September 2025), during immersion (October 2025), and post-immersion (November 2025) [APHA]. Sampling was carried out between 8:00 and 10:00 a.m. from three representative locations in each pond at a depth of 0.3 m below the surface to ensure homogeneity [BIS]. Samples were collected in pre-cleaned, acid-washed polyethylene bottles for physicochemical analysis and in glass BOD bottles for Biochemical Oxygen Demand (BOD) determination. All samples were transported to the laboratory in ice boxes and analyzed within 6 hours of collection [APHA2023].

Analytical Methods

The physicochemical parameters were analyzed following standard procedures outlined in Standard Methods for the Examination of Water and Wastewater (APHA, 2023). Total Dissolved Solids (TDS) and pH were measured in situ using calibrated digital TDS meter (Model AMPEREUS Digital Water TDS EC and Temperature Meter, Purity Tester , ATC Function, 1ppm Resolution, 0- 9990 ppm Digital TDS Meter) and pH meter (Model Model AMPEREUS Digital Water pH Meter for Water Testing,0.01-

13.09pH, ATC (Automatic Temperature Compensation) Function), respectively [APHA, 2023; Gupta et al., 2011].

Dissolved oxygen was determined by Winkler's iodometric method with azide modification to minimize nitrite interference [Winkler, 1888; APHA, 2023]. Biochemical Oxygen Demand (BOD) was estimated by measuring the difference in DO after 5 days of incubation at 20 ± 1°C in the dark, and Chemical Oxygen Demand (COD) was determined by the closed reflux, titrimetric method using potassium dichromate as the oxidizing agent [APHA].[2023]

Heavy metal analysis for lead (Pb), cadmium (Cd), and chromium (Cr) was performed using Inductively Coupled Plasma Mass Spectrometry (NexION 5000 Multi-Quadrupole ICP-Mass Spectrometer) after acid digestion of samples with concentrated HNO_3 and HCl in a 3:1 ratio[USEPA, 2007;]. All reagents used were of analytical grade, and Milli-Q water was used for dilution. Instrument calibration was carried out using multi-element standard solutions (Merck), and quality control was ensured by analyzing blanks and certified reference materials with each batch [APHA].[2023]Statistical Analysis

Data were expressed as mean ± standard deviation of triplicate measurements. Significant differences among pre-, during, and post-immersion phases were evaluated using one-way ANOVA followed by Tukey's post-hoc test at $p < 0.05$.[Zar][2010]

Results

The result of the present investigation has been presented in the following tables and graphs.

TABLE- 1- Physicochemical Changes

Sr. No.			TDS	pH	BOD(mg/L)	COD(mg/L)
1	Brahma pond	**Pre-Immersion**	210	7.5	4.5	30
		During immersion	470	8.2	12.5	42
		Post-Immersion	630	9.2	22.5	64
2	Chhitauni pond	**Pre-Immersion**	190	7.4	2.5	22
		During immersion	190	7.4	2.5	22

		Post-Immersion	190	7.4	2.5	22
3	Manorathpur pond	**Pre-Immersion**	220	7.2	2.8	24
		During immersion	220	7.2	2.8	24
		Post-Immersion	220	7.2	2.8	24

- **Increase in BOD & COD:** Indicates high organic pollution due to biodegradable materials.
- **Decrease in DO:** Suggests oxygen depletion affecting aquatic life.
- **Rise in pH:** Caused by alkaline substances in POP.

TABLE -2-Heavy Metal Analysis

Sr.No.			Pb	Cd	Cr
1	Bramha pond	**Pre-Immersion**	0.030	0.003	0.006
		During immersion	0.120	0.010	0.075
		Post-Immersion	0.250	0.018	0.085
2	Chhitauni pond	**Pre-Immersion**	0.002	0.001	0.001
		During immersion	0.002	0.001	0.001
		Post-Immersion	0.002	0.001	0.001
3	Manorathpur pond	**Pre-Immersion**	0.001	0.001	0.002
		During immersion	0.001	0.001	0.002
		Post-Immersion	0.001	0.001	0.002

Heavy metals significantly increased after immersion due to chemical paints and decorations. Similar trends have been reported in multiple Indian lakes where concentrations exceeded WHO limits.

Sources of Pollution

- Plaster of Paris ($CaSO_4 \cdot \frac{1}{2}H_2O$)
- Synthetic paints containing Pb, Cd, Hg
- Organic offerings (flowers, cloth, plastics) as in Plate No.5

Plate No.-5 **Plate No.-6**

Environmental Impact

1.Aquatic Life Damage
Reduced DO leads to fish mortality and ecosystem imbalance(Plate No.-6).

2.Bioaccumulation
Heavy metals accumulate in aquatic organisms, entering the food chain.

3.Sediment Contamination
Non-degradable materials settle at the bottom, affecting benthic organisms.

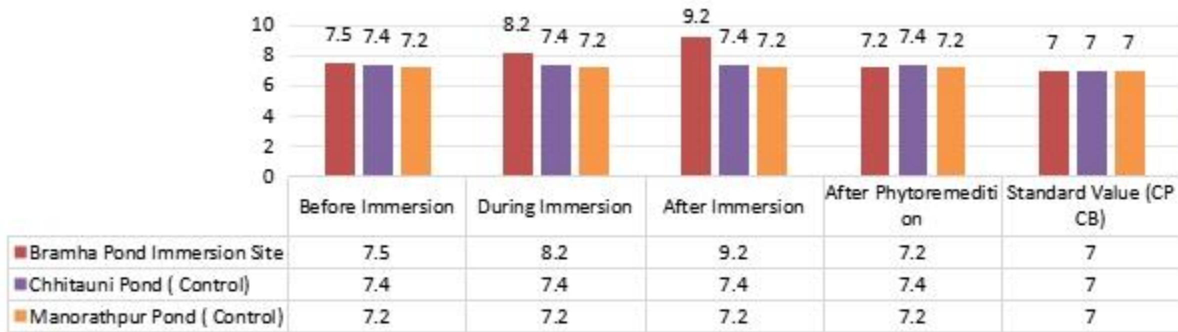
Studies in Nagpur lakes reported significant increases in Pb, Cd, and Cu after idol immersion, confirming similar trends observed in Bramha Pond .

- BOD increased by **~144%**, indicating severe organic pollution.
- Pb increased by **100%**, indicating toxic contamination.

Graphical Analysis

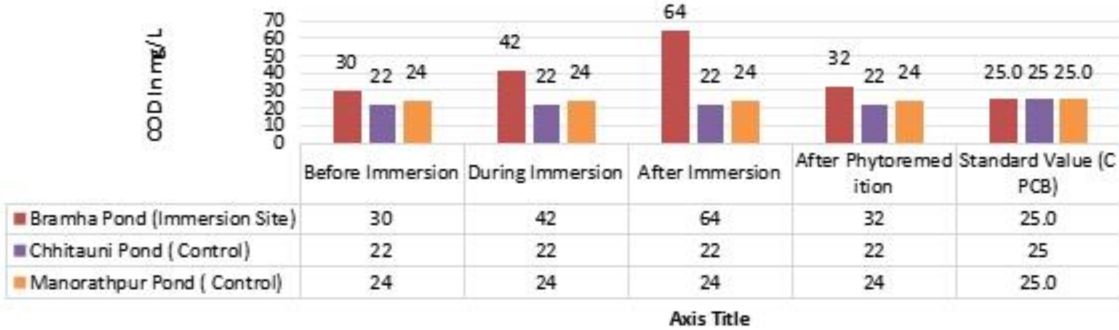
Graph No. 1 - TDS

Graph No. 2 - pH



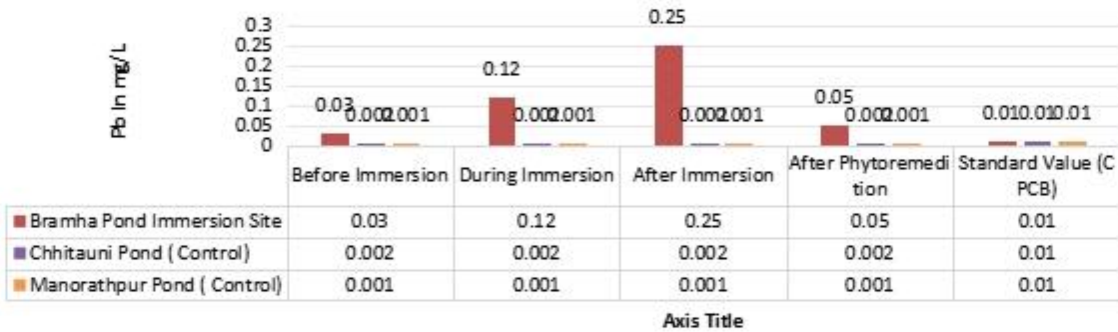
Graph No. 3- BOD

Graph No. 4- COD



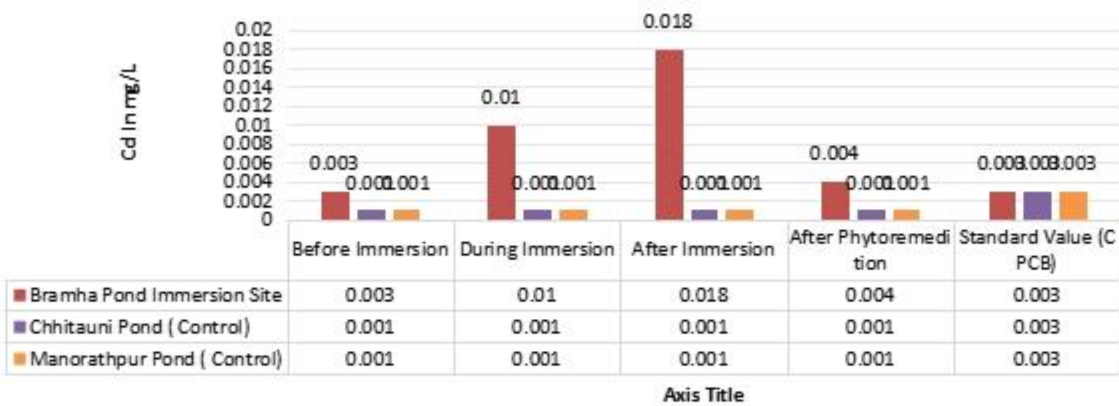
	Before Immersion	During Immersion	After Immersion	After Phytoremediation	Standard Value (CPCB)
Bramha Pond (Immersion Site)	30	42	64	32	25.0
Chhitauni Pond (Control)	22	22	22	22	25
Manorathpur Pond (Control)	24	24	24	24	25.0

Graph No. 5 - Lead (Pb)



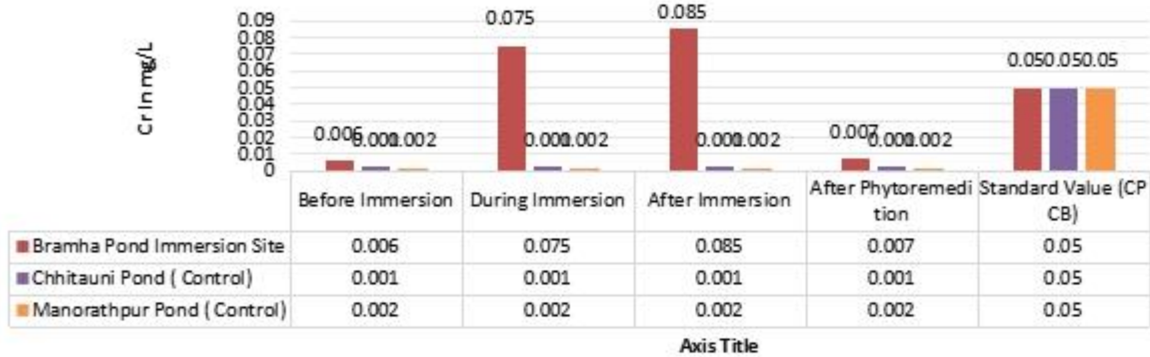
	Before Immersion	During Immersion	After Immersion	After Phytoremedition	Standard Value (CPCB)
Bramha Pond Immersion Site	0.03	0.12	0.25	0.05	0.01
Chhitauni Pond (Control)	0.002	0.002	0.002	0.002	0.01
Manorathpur Pond (Control)	0.001	0.001	0.001	0.001	0.01

Graph No. 6- Cadmium (Cd)



	Before Immersion	During Immersion	After Immersion	After Phytoremedition	Standard Value (CPCB)
Bramha Pond Immersion Site	0.003	0.01	0.018	0.004	0.003
Chhitauni Pond (Control)	0.001	0.001	0.001	0.001	0.003
Manorathpur Pond (Control)	0.001	0.001	0.001	0.001	0.003

Graph No. 7- Chromium (Cr)



This demonstrates a clear pattern of pollution spikes during immersion.

Discussion

Physicochemical parameters and heavy metal concentrations showed a significant increase in the post-immersion phase compared to pre-immersion values (Tables 1 and 2). The observed increase in pH,TDS, BOD , and COD indicates high organic pollution resulting from the decomposition of organic offerings, clay, and decorative materials associated with idol immersion as mention in Graph No.1,2,3and 4 .

Ujjania & Multani, 2011 also reported increase in pH, TDS, BOD and COD while studying environmental impact of idol immersion on Tapi River, Surat .Vyas et al., 2006 also found, increasing trend of heavy metal after idol immersion in lakes of Bhopal.

Elevated levels of Lead (Pb), Cadmium (Cd), and Chromium(Cr) were recorded after immersion, exceeding the permissible limits as mention in Graph No.5,6 and 7 . Prescribed by the World Health Organization (WHO, 2022) and Central Pollution Control Board (CPCB, 2021). These findings are consistent with previous studies reporting heavy metal contamination of water bodies due to synthetic paints and ornaments used in idols (Kaur, 2012; Bhat et al., 2026). The persistence of these metals in pond sediments poses long-term ecological risks to aquatic biota and human health.

10. Conclusion

The study concludes that idol immersion significantly deteriorates the water quality of Bramha Pond. The increase in physicochemical parameters and heavy metal concentrations indicates severe pollution. Without proper management, continued immersion practices may lead to irreversible ecological damage. Sustainable alternatives such as eco-friendly idols and phytoremediation techniques must be implemented to preserve aquatic ecosystems.

Mitigation Measures

1. **Eco-friendly idols (clay-based)**
2. **Use of natural dyes**
3. **Artificial immersion tanks**
4. **Phytoremediation using aquatic plants (e.g., Lemna)**
5. **Public awareness programs**

Government interventions and eco-friendly initiatives have been recommended to reduce environmental damage.

11. Acknowledgement

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