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Assessment of water quality of Mahad (Maharashtra) before and after ganesh festival using nemerow's pollution index

Mayur Shitole
Research Scholar, Tuljaram Chaturchand College of Arts, Science and Commerce, Baramati, Pune, Maharashtra, India

Abstract
The present study was intended to assess effect of Ganesh idol immersion on quality of the surface water for drinking purpose and to determine principal pollutants of water through Nemerow's Pollution Index (NPI) in Mahad, Maharashtra, India. For this, water quality data of Mahad before and after Ganesh festival was extracted from publically available database of Maharashtra Pollution Control Board from 2016 to 2018 and analyzed for ten physico-chemical parameters namely pH, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Conductivity, Turbidity, TDS, Total Solids, Iron and Zinc. Also analysis of NPI water quality index of Mahad and correlation between water quality parameters was done. Analysis of results showed that for all the time from 2016 to 2018 before (Pre-) and after (Post-) Ganesh festival, dissolved oxygen (DO) was noticed to exceeding the permissible limit prescribed by BIS & ICMR with the NPI value between 1.00-1.40 at all three site except for post-2018 at Mahad Dadli Bridge & Mahad Ram Ghat with NPI value 0.92 & 0.98 respectively. Also Iron (Fe) was found to exceeding permissible limit after (Post-) Ganesh festival for 2016 & 2017 and same for Pre-2017 at all three sites.

Keywords: water quality, idol immersion, physico-chemical parameters, nemerow's pollution index

Introduction

Water is the most important requirement for all humans on the planet. Rapid industrialization has resulted in contamination of both land and groundwater sources as a result of its far-reaching effects on human health. As a result, understanding pollution and how to treat it is a must. Water can be found in lakes, groundwater, glaciers, rainwater, rivers, and other bodies of water. Water sources are likely to be important in a number of industries, including livestock production, agriculture, fisheries, hydropower generation, and day to day life activities, aside from the need for water for consumption, such as drinking.

Water is referred to as the "universal solvent," since a wide variety of compounds can be dissolved. Seasonal rain and flood cycles have influenced many ecosystems. Owing to these properties, water is never entirely pure in nature. This indicates also that much of the chemistry of life is done in water solutions. For the welfare of marine animals, water quality is important. Examples of this include fish, coral, invertebrates, turtles and amphibians. These animals feed, drink and disposal waste in the same water in most cases. The additional difficulty of surviving in much less water than their wild counterparts is for animals kept in captivity.

Since freshwater is related to human health, it is a crucial problem for human being. Surface water bodies, which are essential sources of water for human activities, are constantly under stress due to a variety of natural and man-made stressors and various pollutants (Rakshit & Sarkar, 2018) [19]. Because of the spatial and temporal variations in the hydrochemistry of surface waters, daily monitoring programmes are needed for reliable water quality estimates. Monitoring water quality is an important tool for not only assessing the impact of pollution sources, but also for ensuring good water resource management and aquatic life protection (Raju *et. al.*, 2020) [18].

Many indices for assessing water quality have already been established (Effendi *et. al.*, 2015) [9]. This study used Nemerow's Pollution Index (NPI) to evaluate the physico-chemical parameters that cause water pollution and to assess the water quality status of Mahad. Nemerow and Sumitomo developed the Nemerow Pollution Index (NPI), which is a very important pollution index (Rathod *et. al.*, 2011 [20]; Zhang *et. al.*, 2018 [31]) provides the information about those parameters which are responsible for change in water quality status of any water body. Therefore, this is helpful to measure pollutant parameters of water quality. As a consequence, using NPI is advantageous in terms of obtaining quick and simple water quality assessment results (Dawood, 2017) [7].

Monitoring water quality offers scientific data that can be used to support health and environmental decisions (Samlafo & Ofoe, 2018) [21]. Owing to the vast number of chemicals used in our everyday lives and in commerce that can end up in bodies of water, monitoring water quality in the twenty-first century is becoming more difficult. Governments, cities, and industries must now follow a number of water quality targets. Data from monitoring can be used to decide whether emissions regulations are being enforced.

Physico-chemical and biological water quality parameters can be measured and controlled based on the desired water parameters of concern. Temperature, dissolved oxygen, pH, conductivity, and turbidity are some of the most important water quality parameters (Al-Othman, 2015 [1]; Singh & Shrivastava, 2015 [25]). During water quality testing, additional parameters such as total algae, ISEs (ammonia, nitrate, chloride), or laboratory parameters such as BOD, titration, COD as well as elemental analysis of Calcium, Phosphate, Heavy metal ions (Zhong *et. al.*, 2015 [32]; Wang *et. al.*, 2019 [29]) can be measured.

The Ganesh festival is held every year to commemorate Lord Ganesha's birth as the God of New Beginnings. The festival falls in the Hindu month of Bhadra, while it falls in August/September on the Gregorian calendar. The tenth day is Ganpati Visarjan day, when Lord Ganesha's idol statue is submerged in water. However, since we are currently dealing with a serious water pollution issues, this idol immersion is likely to be increased, potentially resulting in additional negative side effects that contribute to water pollution (Bengani *et. al.*, 2011 [3]; Bhattacharya *et. al.*, 2014 [4]; Dubey, 2016 [8]; Billore & Dandawate, 2016 [5]). There is needed to be having Go-green Ganesh and ecofriendly celebration. The current study aims to assess the quality of surface water for drinking and irrigation. The study used Nemerow's Pollution Index (NPI) to classify major contaminants in surface water in Mahad. Mahad is in the North Konkan region and is part of the Raigad district of Maharashtra, India. It is 108.5 kilometres west of Alibag, the district headquarters, and 167 kilometres west of Mumbai, the state capital of Maharashtra. The findings can be used to spot any changes or patterns in water bodies over time. These innovations can be either short-term or long-term.

Methodology

Data Collection

The data was extracted from the Maharashtra Pollution Control Board (MPCB) database (https://mpcb.gov.in/node) [15]. The Maharashtra Pollution Control Board was created on September 7, 1970, in accordance with the Maharashtra Prevention of Water Pollution Act, 1969. On 01/06/1981, Maharashtra adopted the Water (P&CP) Act, 1974, which is a central legislation, and the Maharashtra Pollution Control Board was established in accordance with the provisions of Section 4 of the Water (P&CP) Act, 1974. The database of MPCB is publically available on official web portal of the Maharashtra Pollution Control Board [15].

The database constitutes the air quality, water quality and noise pollution. Water quality data of Mahad before and after Ganesh festival was extracted consist of data from 3 sites namely Mahad Dadli bridge, Mahad Ram Ghat & Mahad Seeta Ghat from publically available database of Maharashtra Pollution Control Board from 2016 to 2018 and analyzed for ten physico-chemical parameters namely pH, Dissolved Oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Conductivity, Turbidity, TDS, Total Solids, Iron and Zinc. Also analysis of NPI water quality index of Mahad and correlation between water quality parameters was done.

Nemerow's Pollution Index (NPI) analysis

The Nemerow index is a metric for assessing water quality (Swati & Umesh, 2015) [26]. The pollution-causing parameters are determined using the average values of three years of water physico-chemical parameters of selected areas before and after the Ganesh festival, as shown in Table-1. NPI is determined for all parameters in each value, allowing the pollution-causing parameters to be defined.

NPI is calculated with the help of following equation-

$$\mathrm{NPI} = \frac{\mathrm{Ci}}{\mathrm{Li}}$$

Where, C_i is observed concentration of i^{th} parameter & L_i is permissible limit of i^{th} parameter.

In above equation, C_i and L_i should have the same unit. Each NPI value represents the amount of pollution caused by a single parameter. It doesn't have any units. Table-2 shows the L_i values for various water quality parameters. The presence of impurity in water is indicated by an NPI value greater than 1.0. The pollution parameters at each station are estimated using Nemerow's Pollution Index (NPI).

Statistical analysis

The extracted data from the Maharashtra Pollution Control Board (MPCB) database was analyzed using the NPI water quality index system to determine the responsible parameters affecting Mahad's water quality before and after the Ganesh festival. Correlation matrix was calculated to check the correlation between water physico-chemical parameters.

Results

On the basis of water quality parameters, the effect of idol immersion was determined and summarized as follows:

The pH of water is an important chemical property that describes the ecological characteristics of aquatic systems. The addition of organic matter and Ganesh idol materials to the water body during the analysis may have caused pH variations. The pH of each site decreased from alkaline to neutral. The average pH from 2016-2018 of Mahad Dadli Bridge was 7.67 before & 7.01 after idol immersion; for Mahad Ram Ghat, it was 7.33 before & 6.90 after idol immersion and for Mahad Seeta Ghat, it was 7.40 before & 7.10 after idol immersion. During the post-immersion process in Hooghly estuary of India, Rakshit and Sarkar (2018) [19] also reported the same result that change in pH was from alkaline to slightly acidic. The pH of all sites was within acceptable limit of BIS and ICMR standards with exception of pH 8.6 at Mahad Ram Ghat on Pre-2017 (Fig-1, 2 & 3; Tab.-1). Dissolved oxygen (DO) is a key indicator of contamination, as well as the physical, chemical, and biological processes of a body of water. Photosynthesis, organic matter degradation, and reaeration are the causes of DO in aquatic environments, according to Garnier *et al*. (2001) [11]. The immersion of idols has a negative impact on dissolved oxygen levels in water bodies. The average DO of from 2016 to 2018 of Mahad Dadli Bridge was 6.73 mg/L before and 6.10 mg/L after idol immersion, for Mahad Ram Ghat, it was 6.73 mg/L before and 6.06 mg/L after idol immersion. And for Mahad Seeta Ghat, it was 6.77 before and 5.77 after idol immersion. The limit for drinking water is 5.0 mg/L (ICMR) (Fig-1, 2 & 3; Tab.-1). Because of the disruption in the water column, DO increases mostly at the surface layer due to mixing of ambient oxygen. According to Malik *et al.* (2010) [16] the decrease in DO was caused by immersion activity. Dissolved oxygen decreased during Ganesh idol immersion in water bodies, according to Billore and Dandawate, (2016) [5] and Jain *et al.* (2018) [13], which was also observed in the current report.

The biochemical oxygen demand (BOD) is a calculation of how much oxygen microorganisms need to decompose some organic and inorganic matter in water. BOD indicates the amount of biodegradable organic substances in water (Singh *et. al.*, 1999) [24]. B.O.D.'s improved value was attributed to the idol immersion once more. Jadhav and Dongare (2009) [12] came to the same conclusion. The average BOD from 2016 to 2018 of Mahad Dadli Bridge was 2.2 mg/L before and 2.6 mg/L after idol immersion; for Mahad Ram Ghat, it was 2.1 mg/L before and 2.6 mg/L after idol immersion and for Mahad Seeta Ghat, it was 2.1 mg/L before and 2.73 mg/L after idol immersion (Fig-1, 2 & 3; Tab.-1). Higher BOD values indicate the presence of more biodegradable organic matter. The increase in nutrient levels in the lake due to immersion operation is directly proportional to the higher BOD values (McCoy & Olson, 1985) [17].

The ability of water to absorb oxygen during the decomposition of organic matter is referred to as chemical oxygen demand (COD). COD is used to determine if a water source is polluted. The average COD from 2016 to 2018 of Mahad Dadli Bridge was 14.67 mg/L before and 24.00 mg/L after idol immersion; for Mahad Ram Ghat, it was 14.67 mg/L before and 22.67 mg/L after idol immersion and for Mahad Seeta Ghat, it was 16.00 mg/L before and 24.00 mg/L after idol immersion (Fig-1, 2 & 3; Tab.-1). Drinking water has a maximum limit of 250 mg/Litre (ICMR). During idol immersion, the C.O.D. values reached a peak. Vyas and Bajpai (2008) [27] & Jadhav and Dongare (2009) [12] reported similar findings.

Conductivity is an indicator of an aqueous solution's ability to bear an electric current. This capability is affected by the presence of ions, their total concentration, stability, and valence, as well as the measurement temperature. Electrical conductivity has been discovered to be a strong measure of water quality (Gaikwad *et. al.*, 2019) [10]. The average value of conductivity from 2016 to 2018 of Mahad Dadli Bridge was 106.67 µs/cm before and 140.33 µs/cm after idol immersion; for Mahad Ram Ghat, it was 96.33 µs/cm before and 113.33 µs/cm after idol immersion and for Mahad Seeta Ghat, it was 127.00 µs/cm before and 127.66 µs/cm after idol immersion. Conductivity values have been found to significantly increase at Mahad Dadli Bridge and Mahad Ram Ghat at all time, while values of Mahad Seeta Ghat in 2017 & 2018 was found to 80 µs/cm & 133 µs/cm before and 103 µs/cm & 155 µs/cm after idol immersion, with exception of 2016 which was 168 µs/cm before and 125 µs/cm after idol immersion (Fig-1, 2 & 3; Tab.-1). Turbidity is a measure of the relative transparency of a liquid. It is an optical property of water and is a representation of the amount of light scattered by material in the water when a light is shone through a water sample. The greater the strength of scattered light, the greater the turbidity. Turbid water is caused by clay, silt, very small inorganic and organic matter, algae, dissolved coloured organic compounds, plankton, and other microscopic species. The average value of turbidity from 2017 to 2018 of Mahad Dadli Bridge was 0.72 NTU before and 0.44 NTU after idol immersion; for Mahad Ram Ghat, it was 0.47 NTU before and 0.45 NTU after idol immersion and for Mahad Seeta Ghat, it was 0.39 NTU before and 0.43 NTU after idol immersion. Turbidity data of 2016 for all three sites of Mahad was unavailable in database. Therefore during statistical analysis, values for 2017 & 2018 have been considered for data analysis (Fig-1, 2 & 3; Tab.-1).

Total dissolved solids (TDS) include salt and a variety of organic substances that dissolve easily in water but are frequently hard. The average TDS from 2016 to 2018 of Mahad Dadli Bridge was 90.00 mg/L before and 120.33 mg/L after idol immersion; for Mahad Ram Ghat, it was 82.33 mg/L before and 97.33 mg/L after idol immersion and for Mahad Seeta Ghat, it was 109.67 mg/L before and 109.00 mg/L after idol immersion. Total dissolved solid values have been found to significantly increase at Mahad Dadli Bridge and Mahad Ram Ghat as a result of idol colour dissolution and different incubation days. The TDS values of Mahad Seeta Ghat in 2017 & 2018 was found to 68 mg/L & 116 mg/L before and 86 mg/L & 131 mg/L idol immersion, respectively with exception of 2016 which was 145 mg/L before and 110 mg/L after idol immersion (Fig-1, 2 & 3; Tab.-1).

Total Solids refer to the total amount of suspended and dissolved solids in a given volume of water. Suspended solids are those that can be stored in a water filter and can settle out of the water column onto the stream bottom at low stream speeds. Silt, organic wastes, plankton, and inorganic precipitates like those from acid mine drainage are among them. Those that move through a water filter are known as dissolved solids. They contain salts, inorganic nutrients, and contaminants, as well as some organic materials. Low total solids concentrations can stifle the growth of aquatic organisms. Overly high total solids levels, on the other hand, can lead to eutrophication and increased turbidity in the water (Butler & Ford, 2017) [6]. The average Total solids from 2016 to 2018 of Mahad Dadli Bridge was 101.33 mg/L before and 128.00 mg/L after idol immersion; for Mahad Ram Ghat, it was 93.33 mg/L before and 104.33 mg/L after idol immersion and for Mahad Seeta Ghat, it was 121.00 mg/L before and 121.00 mg/L after idol immersion. Total solids have been found to significantly increase at Mahad Dadli Bridge and Mahad Ram Ghat at all time, while values of Mahad Seeta Ghat in 2017 & 2018 was found to 79 mg/L & 129 mg/L before and 97 mg/L & 145 mg/L after idol immersion, respectively with exception of 2016 which was 155 mg/L before and 121 mg/L after idol immersion (Fig-1, 2 & 3; Tab.-1).

Iron is a mineral that can cause problems in water sources. High levels of iron reduce the quality of drinking water. In water, iron is mostly found in two forms: soluble ferrous iron and insoluble ferric iron. Since the iron is fully dissolved, water containing ferrous iron is transparent and colourless. As the water is exposed to air in the pressure tank or in the atmosphere, it becomes cloudy and a reddish brown material forms. The oxidized or ferric form of iron in this sediment will not dissolve in water. Iron is not harmful to one's health; it is regarded as a secondary or cosmetic pollutant. Iron is essential for good health because it aids in the transportation of oxygen in the body (Akter *et. al.*, 2016) [1]. The average Iron (Fe) value from 2016 to 2018 of Mahad Dadli Bridge was 0.32 mg/L before and 0.55 mg/L after idol immersion; for Mahad Ram Ghat, it was 0.31 mg/L before and 0.54 mg/L after idol immersion and for Mahad Seeta Ghat, it was 0.30 mg/L before and 0.47 mg/L after idol immersion. Iron (Fe) values have been found to significantly increase at Mahad Dadli Bridge and Mahad Ram Ghat at all time, while values of Mahad

Seeta Ghat in 2016 & 2018 was found to 0.17 mg/L & 0.10 mg/L before and 0.59 mg/L & 0.24 mg/L after idol immersion, respectively with exception of 2016 which was 0.63 mg/L before and 0.58 mg/L after idol immersion (Fig-1, 2 & 3; Tab.-1).

Zinc is a trace element that is essential to many aquatic species as well as to human being. Zinc reaches the environment through natural processes as well as human activities. A zinc (Zn) contamination level varies between water sources such as land, river, tap, and lake water. Zinc is potentially toxic and non-biodegradable (Sankhla *et. al.,* 2019) [22]. The average value of Zinc (Zn) from 2017 to 2018 of Mahad Dadli Bridge was 0.12 mg/L before and 0.25 mg/L after idol immersion and for Mahad Seeta Ghat; it was 0.13 mg/L before and 0.18 mg/L after idol immersion. Zinc (Zn) concentration Data of pre-2016 of all sites was unavailable & also available data of Mahad Ram Ghat was insufficient. Therefore both have been excluded from statistical analysis (Fig-1, 2 & 3; Tab.-1). In NPI water quality analysis, It was found that for all the time from 2016 to 2018 before (Pre-) and after (Post-) Ganesh festival, dissolved oxygen (DO) was noticed to exceeding the permissible limit prescribed by BIS & ICMR with the range between 1.00-1.40 at all three site except for post-2018 at Mahad Dadli Bridge & Mahad Ram Ghat with NPI value 0.92 & 0.98 respectively. Also Iron (Fe) was found to exceeding permissible limit after (Post-) Ganesh festival for 2016 & 2017 and same for Pre-2017 with NPI value range between 1.73-2.10 at all three sites while at Pre-2018, Mahad Dadli Bridge & Mahad Ram Ghat reported the exceeding permissible limit of Iron with NPI value 1.60 for both. But at Mahad Seeta Ghat, it was within permissible limit with NPI value 0.80. Out of all 10 parameters, one parameter namely Total solids was excluded from NPI analysis. The pH and Turbidity were noticed to exceeding permissible limit at Mahad Ram Ghat and Mahad Dadli Bridge respectively (with NPI value of 1.01 & 1.22 respectively) only for Pre-2017 Ganesh festival while for other times at all three sites it was within permissible limit with range between 0.71-0.95 for pH and 0.18-0.72 for Turbidity. All others parameters including BOD, COD, TDS, conductivity & Zinc (Zn) were found to be within permissible limit all the time from 2016 to 2018 before (Pre-) and after (Post) Ganesh festival at all three sites. The range of NPI values for BOD, COD, TDS, conductivity, and Zn was 0.40-0.64 for BOD, 0.03-0.10 for COD, 0.13-0.29 for TDS, 0.25-0.55 for conductivity, and 0.02-0.08 for Zn (Table-2 & 3).

Correlation matrix analysis revealed that pH is strongly correlated with dissolve oxygen; COD is also strongly correlated with BOD and Iron. Conductivity is strongly correlated with Total solids and Total dissolve solids, while Total solids are also strongly correlated with Total dissolve solids. pH was found to have a strong negative association with BOD, conductivity, TDS, and total solids. DO was also found to be negatively associated with BOD (Table-4).

Discussion

Ganesh idols are made of a variety of materials that degrade water quality when submerged. The paints used to colour these idols are carcinogenic and contain numerous toxic metals. Plaster of Paris (POP) is used in the Idol, which is insoluble in water and can cause sedimentation. Immersion of idols and their accessories such as decorating materials, thermocol, garlands, cosmetic products, plastics flowers, and other non-degradable synthetic colours are often found floating on the water during religious activities and are major sources of pollution (Jain *et. al.,* 2018) [13]. Furthermore, the toxic paints used to paint these idols contain heavy metals, which can be harmful to marine ecosystems and bio-magnify their way up the food chain. Vyas *et al*. (2006) [28] stated that parameters such as turbidity, dissolved oxygen (DO), biochemical demand (BOD), and chemical oxygen demand (COD) become higher on immersion idols have increased in number and size over the years, and urban water bodies are facing increasing nutrient load. Bengani *et al*. (2010) [1] evaluated the pollution in the Tapi River caused by Ganesh idol immersion. During the immersion process, pH and DO decreased, while BOD and COD increased.Sarkar (2013) [23] studied the variations in Ganga water quality at Ranighat in West Bengal during the pre-immersion, immersion, and post-immersion periods of Jagadhatri idols. It was found that the values of BOD, COD, and conductivity increased dramatically during the immersion process. Dubey (2016) [8] discovered that after idol immersion, the water of Ganga Sarovar-I and -II was contaminated with large amounts of inorganic and organic materials. Because of the dissolution of idols colouring materials and the various days of incubation, the overall dissolved solid values increased dramatically. After a few days of idol immersion, TSS, turbidity, and bad odour increased, while the clarity of the pond water decreased to a black appearance.

Watkar and Barbate (2017) [30] investigated the effect of Ganesh idol immersion on the water quality of the Chandrabhaga river in Nagpur, reported that the pH of the water was approximately 8.2, indicating that it was alkaline. After idol immersion, the total dissolved solids value was 316 mg/L. The idol immersion resulted in the highest B.O.D. and C.O.D. values ever.

According to Lokhande (2019) [14] in a study on the Water Quality of Gorai Jetty in Mumbai, the average pH of water before Ganapati immersion was 7.13, which increased to 7.91 after Ganapati immersion. BOD levels were also higher after immersion, ranging from 22 mg/L before immersion to 56 mg/L after immersion. The amount of Total Dissolve Solids was 837 mg/L before immersion and 18078 mg/L after immersion.

The current study also found that after immersing the Ganesh idol in water, pH and DO decreased while conductivity, TDS, total solids, iron, zinc, BOD, and COD increased. This demonstrates the critical importance of celebrating Ganesh festival with an ecofriendly Ganesh idol.

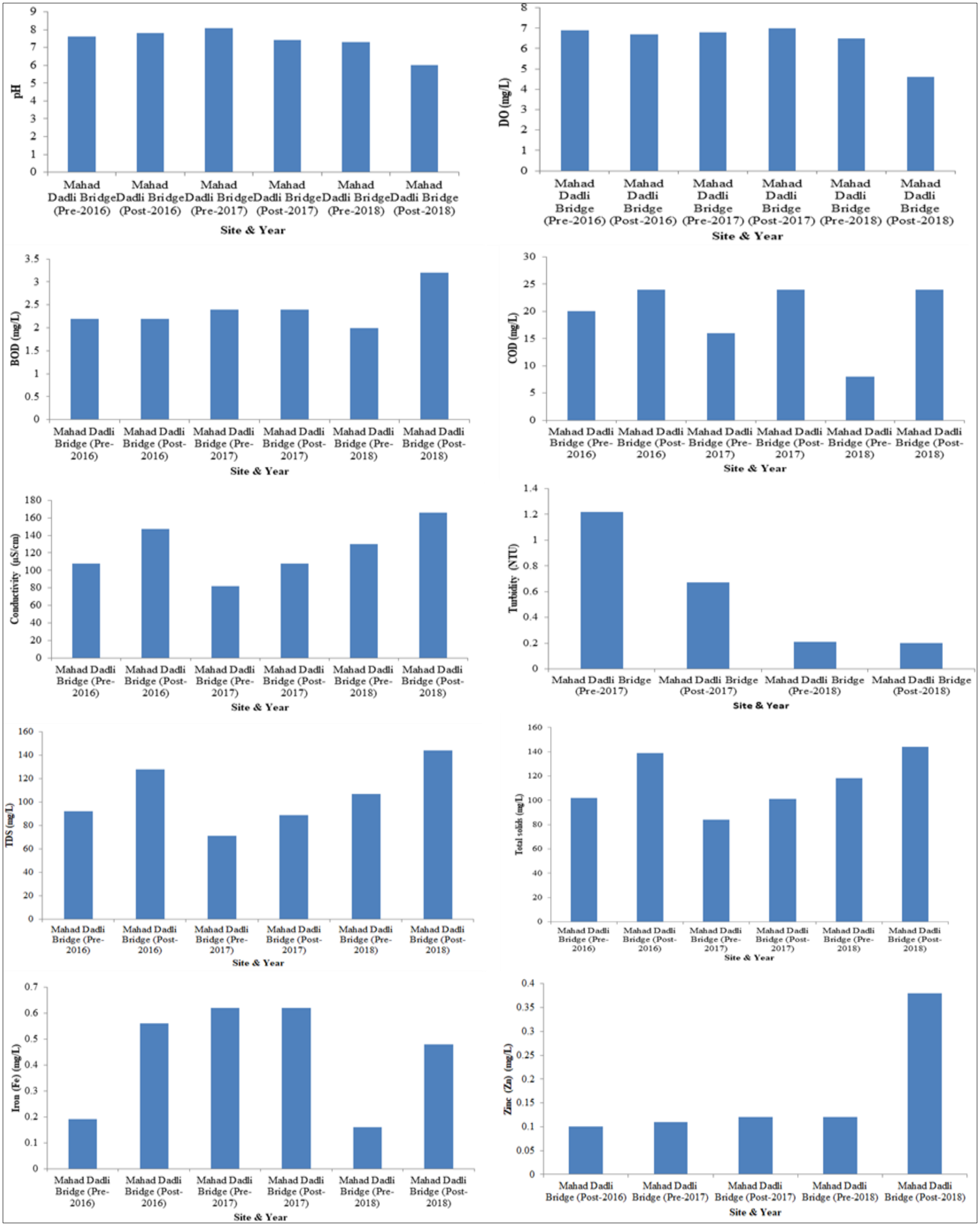

Fig 1: Water Physico-chemical parameters of Mahad Dadli Bridge

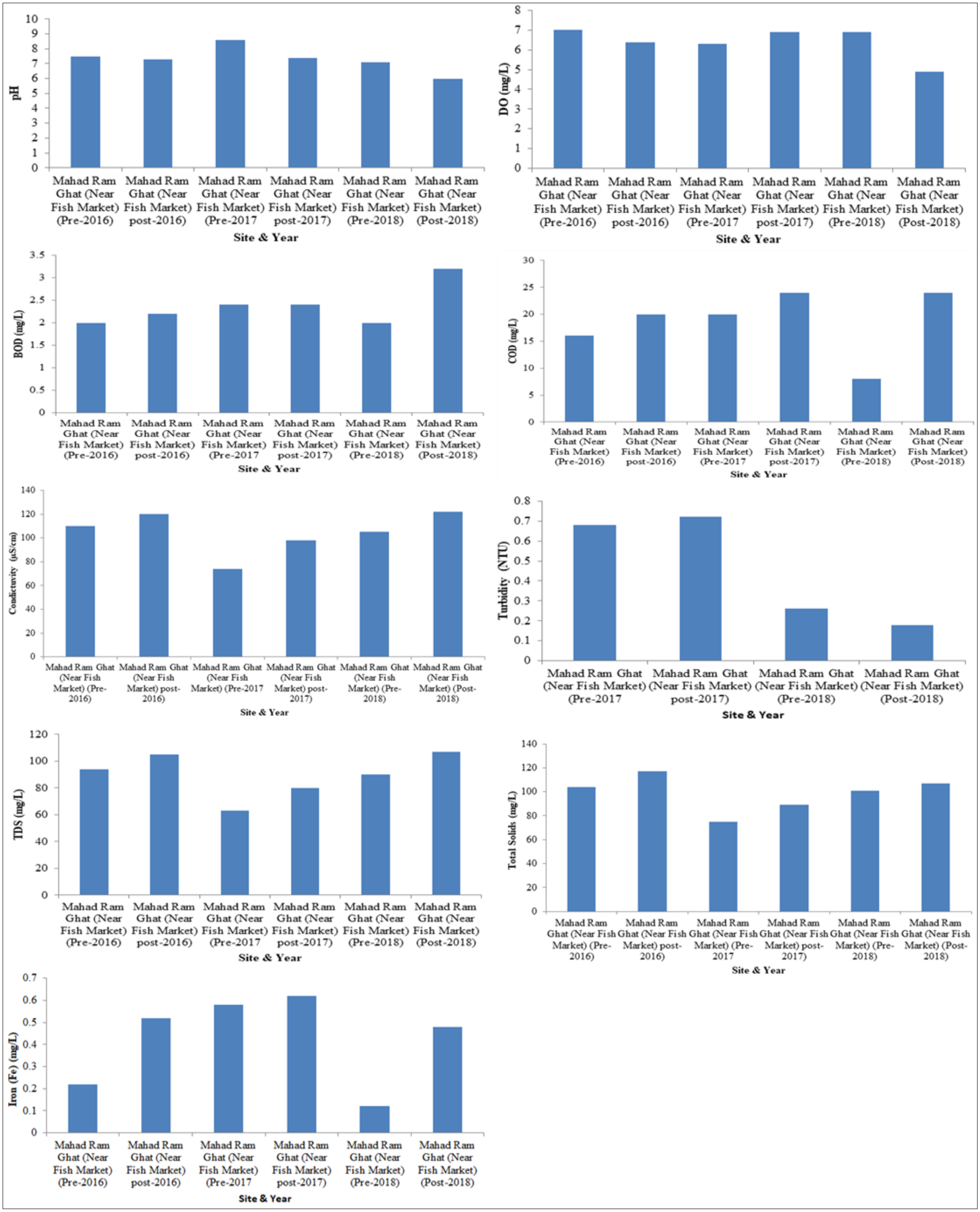

Fig 2: Water Physico-chemical parameters of Mahad Ram Ghat

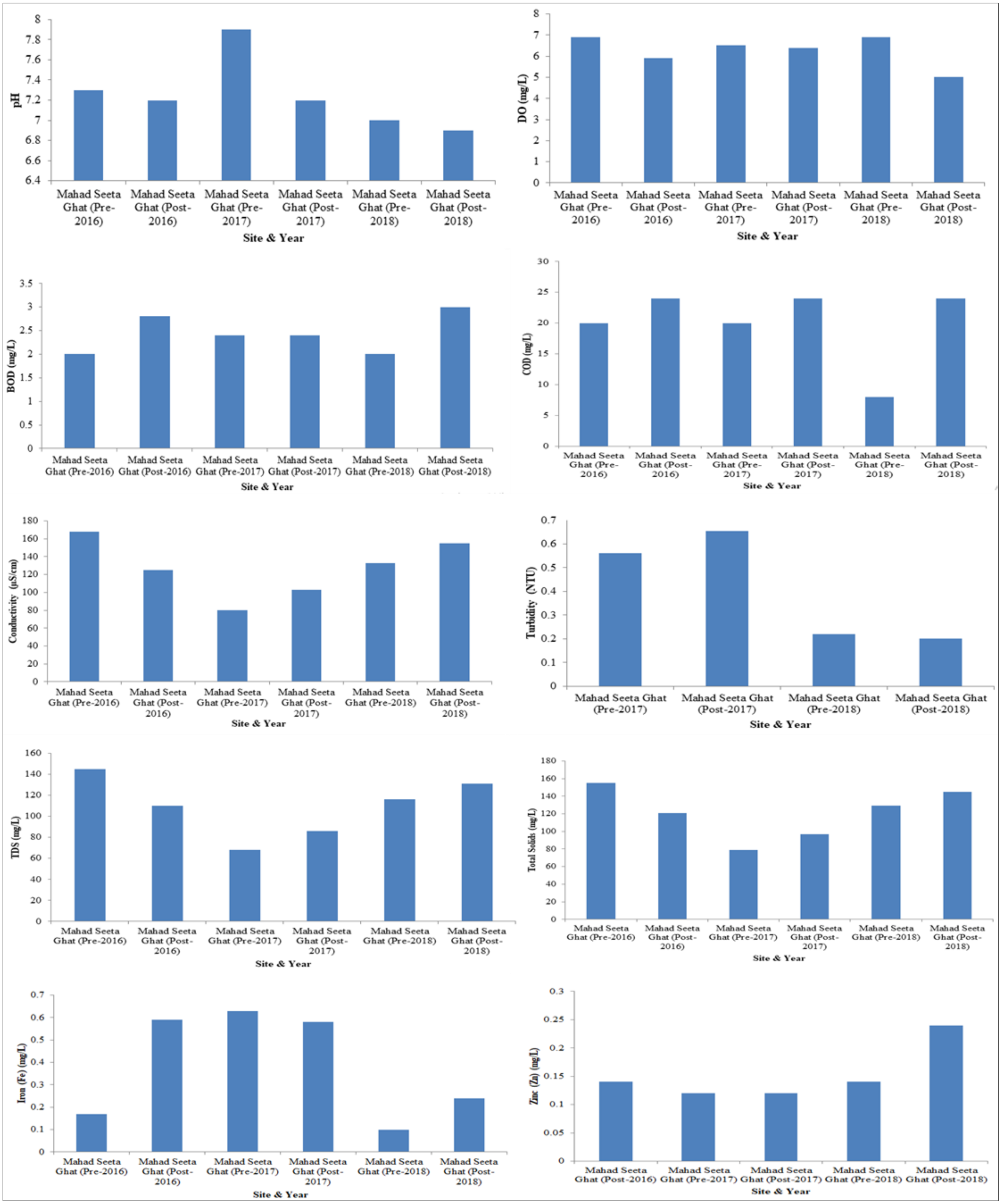

Fig 3: Water Physico-chemical parameters of Mahad Seeta Gha

Table 1: Water physico-chemical parameters value (NA- Data is unavailable in database)

Water Quality Parameter	Name of station																	
	Mahad Dadli Bridge						Mahad Ram Ghat (Near Fish Market)						Mahad Seeta Ghat					
	Pre-2016	Post-2016	Pre-2017	Post-2017	Pre-2018	Post-2018	Pre-2016	Post-2016	Pre-2017	Post-2017	Pre-2018	Post-2018	Pre-2016	Post-2016	Pre-2017	Post-2017	Pre-2018	Post-2018
pH	7.6	7.8	8.1	7.4	7.3	6	7.5	7.3	8.6	7.4	7.1	6	7.3	7.2	7.9	7.2	7	6.9
DO (mg/L)	6.9	6.7	6.8	7	6.5	4.6	7	6.4	6.3	6.9	6.9	4.9	6.9	5.9	6.5	6.4	6.9	5
BOD (mg/L)	2.2	2.2	2.4	2.4	2	3.2	2	2.2	2.4	2.4	2	3.2	2	2.8	2.4	2.4	2	3
COD (mg/L)	20	24	16	24	8	24	16	20	20	24	8	24	20	24	20	24	8	24
Conductivity (µS/cm)	108	147	82	108	130	166	110	120	74	98	105	122	168	125	80	103	133	155
Turbidity (NTU)	NA	NA	1.22	0.67	0.21	0.2	NA	NA	0.68	0.72	0.26	0.18	NA	NA	0.56	0.65	0.22	0.2
TDS (mg/L)	92	128	71	89	107	144	94	105	63	80	90	107	145	110	68	86	116	131
Total Solids (mg/L)	102	139	84	101	118	144	104	117	75	89	101	107	155	121	79	97	129	145
Iron (mg/L)	0.19	0.56	0.62	0.62	0.16	0.48	0.22	0.52	0.58	0.62	0.12	0.48	0.17	0.59	0.63	0.58	0.1	0.24
Zinc (mg/L)	NA	0.1	0.11	0.12	0.12	0.38	NA	0.13	0.12	NA	0.12	0.24	NA	0.14	0.12	0.12	0.14	0.24

Table 2: Water Quality Standard of physicochemical parameters for NPI analysis

Sr. No.	Parameter	Permissible Value	Recommending Agency
1	pH	8.5	BIS-2012/ICMR
2	D.O.	5 (mg/L)	ICMR
3	B.O.D.	5 (mg/L)	ICMR
4	C.O.D.	250 (mg/L)	BIS-2006
5	Conductivity	300 (µS/cm)	ICMR
6	Turbidity	1 NTU	BIS-2012/ICMR
7	TDS	500 (mg/L)	BIS- 2012
8	Iron	0.3 (mg/L)	BIS- 2012
9	Zinc	5 (mg/L)	BIS- 2012

Table 3: Water Quality Analysis by NPI index (Green colour- Value within permissible limit; Orange colour- Value with exceeded limit; Blue colour- Data is unavailable in database)

Water Quality Parameter	Standards (According to Indian Standard - BIS 2012 & ICMR, BIS 2006)	NPI water quality index- Name of station																	
		Mahad Dadli Bridge						Mahad Ram Ghat (Near Fish Market)						Mahad Seeta Ghat					
		Pre-2016	Post-2016	Pre-2017	Post-2017	Pre-2018	Post-2018	Pre-2016	Post-2016	Pre-2017	Post-2017	Pre-2018	Post-2018	Pre-2016	Post-2016	Pre-2017	Post-2017	Pre-2018	Post-2018
pH	8.5	0.89	0.92	0.95	0.87	0.86	0.71	0.88	0.86	1.01	0.87	0.84	0.71	0.86	0.85	0.93	0.85	0.82	0.81
DO (mg/L)	5	1.38	1.34	1.36	1.40	1.30	0.92	1.40	1.28	1.26	1.38	1.38	0.98	1.38	1.18	1.30	1.28	1.38	1.00
BOD (mg/L)	5	0.44	0.44	0.48	0.48	0.40	0.64	0.40	0.44	0.48	0.48	0.40	0.64	0.40	0.56	0.48	0.48	0.40	0.60
COD (mg/L)	250	0.08	0.10	0.06	0.10	0.03	0.10	0.06	0.08	0.08	0.10	0.03	0.10	0.08	0.10	0.08	0.10	0.03	0.10
Conductivity (µS/cm)	300	0.36	0.49	0.27	0.36	0.43	0.55	0.37	0.40	0.25	0.33	0.35	0.41	0.56	0.42	0.27	0.34	0.44	0.52
Turbidity (NTU)	1	-	-	1.22	0.67	0.21	0.20	-	-	0.68	0.72	0.26	0.18	-	-	0.56	0.65	0.22	0.20
TDS (mg/L)	500	0.18	0.26	0.14	0.18	0.21	0.29	0.19	0.21	0.13	0.16	0.18	0.21	0.29	0.22	0.14	0.17	0.23	0.26
Iron (mg/L)	0.3	0.63	1.87	2.07	2.07	0.53	1.60	0.73	1.73	1.93	2.07	0.40	1.60	0.57	1.97	2.10	1.93	0.33	0.80
Zinc (mg/L)	5	-	0.02	0.02	0.02	0.02	0.08	-	0.03	0.02	-	0.02	0.05	-	0.03	0.02	0.02	0.03	0.05

Table 4: Correlation matrix analysis for physico-chemical parameters of water ('*'- strong positive correlation between parameters with significant p-value of 0.05)

	pH	D.O.	B.O.D.	C.O.D.	Conductivity	TDS	Total Solids	Iron
pH	1.00							
D.O.	0.66*	1.00						
B.O.D.	-0.56	-0.91	1.00					
C.O.D.	-0.13	-0.43	0.64*	1.00				
Conductivity	-0.62	-0.42	0.21	0.12	1.00			
TDS	-0.62	-0.43	0.22	0.12	0.99*	1.00		
Total Solids	-0.53	-0.35	0.14	0.08	0.99*	0.99*	1.00	
Iron	0.24	-0.14	0.42	0.67*	-0.42	-0.41	-0.44	1

Conclusion

Water pollution due to Ganesh idol immersion has a variety of social, religious, technological, and environmental consequences. People are so preoccupied with the economics of their livelihoods and money-making practices that they have forgotten about the value of the environment and natural resources. These religious rituals cannot be fully prevented, but required measures such as following the authorities' idol immersion guidelines, celebrating idol immersion in a small plastic tub or man-made pond, worshipping and immersing clay idols, and so on, if followed by the public, will help to reduce contamination and preserve these water bodies to some degree.

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