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IMPACT ASSESSMENT OF MUNICIPAL CORPORATION CAMPAIGNING ON PUBLIC AWARENESS TO CONSERVE THE TAPI RIVER WITH REFERENCE TO IDOL IMMERSION: A STATISTICAL EVALUATION

BENGANI R.[1]*, GADHIA M.[2] AND N.C. UJJANIA[3]

Department of Aquatic Biology, Veer Narmad South Gujarat University, Surat (Gujarat)

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Abstract– India is the culturally diversified country where large numbers of festivals are celebrated every year. Among these festivals, Ganesh Chaturthi is one of the important festivals and during this festival different sized Ganesh idols are worshiped for few days and later on immersed in nearby water body. The idol immersion process is the major cause of water quality deterioration and ultimate increase the pollution in water resources. The present study focused on evaluation of the municipal corporation campaigning and public awareness to conserve the Tapi river which gets polluted due to idol immersion. To fulfill the objective of the present study, water samples were collected during the Ganesh festivals of 2010, 2014 & 2019 and were analyzed for important water quality parameters including temperature, pH, dissolved oxygen, total hardness, total alkalinity, bio-chemical oxygen demand, chemical oxygen demand, oil & grease and total calcium. Results showed that the water quality parameters were more fluctuated during the idol immersion of 2010 and 2014 compared to 2019. These results were statistically verified and observed that temperature and BOD had significant changes in the year 2014 whereas total alkalinity, COD and oil & grease exhibited significant changes during the year 2010 and 2014. Insignificant changes in temperature, BOD, total hardness and significant changes in COD were noted during immersion and post immersion period of 2019. The outcome of present study clearly indicated that campaigning of municipal corporation is effectively work to aware the public to use of ecofriendly idols, idol immersion in artificial small water holdings etc. to conserve the Tapi River during the idol immersion.

INTRODUCTION

Water quality deterioration has become unadorned threat to the aquatic ecosystem affecting the living creatures including human beings. In India, since old ages, there is a substantial relationship of religion, customs and rituals. Therefore, it is considered diversified country for the rituals and cultures where every year different religious activities are gratified at the bank of water resources like ponds, lakes, rivers etc. The Ganesh Chaturthi is the important festival during which idols are worshiped and immersed in nearby water resources that play an important role to deteriorate the water quality and add the pollutant in water resources (Ujjania *et al*., 2018). People are always excited to celebrate the religious activities and large number of different sized idols 27000 (2010), 30000 (2017) and 60000 (2018) were immersed in Tapi river (Surat) during Ganesh festival (Anon, 1018). These idols are being made up of various degradable and non-degradable components *viz.,* clay, plaster of Paris (POP), hay, cloth, paper, wood, bamboo, Thermocol, adhesive material and decorated by different colors, paints and pigments (Joshi *et al.,* 2017) which contain a wide range of organic and inorganic pollutants including oil, grease, plastics, plasticizer, phenol, heavy metals, pesticides and suspended solids that leads to toxicities and significant deterioration in water quality of aquatic ecosystem (Bengani *et al*., 2020 and Ujjania *et al*., 2018). For the idol preparation, POP is preferable material because

it is cheap and lighter but contains calcium sulfate hemihydrates which takes lot of time to assimilate and release toxic components that are responsible for oxygen reduction into the water body and mortality of aquatic organisms including fishes (Malvia and Vaghani, 2016).

Idol immersion and pollution load assessment in different water bodies including rivers were studied in different parts of India by Gorain and Paul (2019) in urban lakes (Karnataka), Lokhande (2019) in Gorai Jetty (Maharashtra), Rakshit and Sarkar (2018) in Hooghly River (West Bengal), Sorte *et al.* (2018) in Gandhisagar Lake (Maharashtra), Joshi *et al.* (2017) in Narmada River (Madhya Pradesh), Belsare *et al.* (2017) in Futala Lake (Maharashtra), Sarbari and Pande (2015) in Yamuna River (Delhi), Billore and Dandawate (2015) in Kakerpura Lake (Madhya Pradesh), Patil *et al.* (2014) in Futala Telangkhedi Lake (Maharashtra) and Kaur (2012) in marine and freshwater body (Maharashtra). Similarly, notable study in Tapi River were reported by Bengani *et al*. (2020), Ujjania *et al.* (2018), Jain *et al*.(2018), Sangani and Manoj (2017), Malvia and Vaghani(2016), Ekhalak *et al. (*2015), Gadhia *et al.* (2014) and Malik *et al.* (2012).

Since last few years government agencies including municipal corporation, city police, non-government organizations and many other agencies campaigned to encourage the people to use the ecofriendly idols, immerse the idols in artificial ponds and restricted the immersion in Tapi River. Similarly, Government authorities constructed artificial ponds and insisted the people to immerse the idols during the 2017 and 2019. This is an interesting academic desire to evaluate the efficacy and impact of such efforts to conserve the Tapi river from the pollution.

MATERIALS AND METHODS

Tapi is one of the important rivers of west coast river system of India which originated from Satpura hill range of Betul (Madhya Pradesh) and flows through Madhya Pradesh, Maharashtra and Gujarat to covered about 724 km to meet the Arabian Sea.

Water samples were collected from idol immersion site of Tapi River during Ganesh festival (August to October) of the year 2010, 2014 and 2019 at the time of pre-immersion, immersion and post immersion period of the idol immersion. The measurement of water quality parameters like water temperature and pH were completed and fixation of dissolved oxygen were proceeded at sampling sites while other parameters *viz*., dissolved oxygen, total hardness, total alkalinity, bio-chemical oxygen demand, chemical oxygen demand, oil & grease and total calcium were analyzed at the Research Laboratory, Department of Aquatic Biology, Veer Narmad South Gujarat University, Surat to follow the standard methods of Trivedy and Goel (1986) and APHA (2005). Statistical analysis of these data was carried out by SPSS 16.0software and results were statistically summarized.

RESULTS AND DISCUSSION

The important water quality parameters evaluated reflected changes in water quality of Tapi river during Ganesh festival. The results depict the comparative fluctuations in water quality during 2010, 2014 and 2019 as a result of Idol immersion during Ganesh rituals. These results were statistically verified to assess the impact of municipal corporation campaign on awareness of the public in order to conserve the Tapi river from polluting due to idol immersion activities (Table 1 and 2).

The ANOVA test conducted to validate the variation in the water quality parameters during the Ganesh festival (pre-immersion, immersion and post-immersion period of idol) of different studied years showed significant differences in studied water quality parameters. Analysis showed significant differences in dissolved oxygen, total hardness, total alkalinity, chemical oxygen demand, oil & grease and calcium during Ganesh festival of 2010 while significant differences were observed in pH, temperature, total hardness, total alkalinity, biochemical oxygen demand, chemical oxygen demand and oil & grease during Ganesh festival of 2014 whereas pH, dissolved oxygen, COD and calcium showed significant differences during the Ganesh festival of 2019 (Table 1).

The results of Post hoc test revealed significant differences in number of water quality parameters and significant values are designated in Table 2. pH showed significant difference between pre-immersion – immersion, pre-immersion – post-immersion and immersion – post-immersion period of 2014, pre-immersion-post immersion and immersion – post-immersion period of 2019. In case of temperature strong significant difference was noted between all immersion period of 2014 and dissolved oxygen showed strong significant

Table 1. Statistical analysis (ANOVA test) to compare significant difference between different parameters during pre-immersion, immersion and post immersion periods of Ganesh festivals.

Parameters	Significant value (P)		
	2010	2014	2019
pH	0.228	0.000*	0.000*
Temperature	0.418	0.000*	0.476
Dissolved oxygen	0.019*	0.290	0.034*
Free carbon dioxide	0.639	NS**	0.096
Total hardness	0.001*	0.000*	0.139
Total Alkalinity	0.000*	0.000*	NS**
Biochemical oxygen demand	0.142	0.059*	0.441
Chemical oxygen demand	0.001*	0.000*	0.034*
Oil & grease	0.000*	0.010*	NS**
Total calcium	0.002*	0.084	0.007*

*The mean difference at 0.05 level of significance, **Not studied

Table 2. Post hoc test for multiple comparisons of water quality parameters for the years 2010,2014 and 2019 during Ganesh festivals

Parameters	Sampling period		Significant value (P)		
			2010	2014	2019
pH	A	B	0.201	0.000*	0.150
		C	0.602	0.000*	0.000*
	B	C	0.707	0.000*	0.001*
Temperature	A	B	0.388	0.000*	0.400
		C	0.717	0.017*	0.859
	B	C	0.844	0.013*	0.739
Dissolved oxygen	A	B	0.03*	0.287	0.029*
		C	0.041*	0.477	0.298
	B	C	0.987	0.923	0.224
Free CO_2	A	B	0.933	NS**	0.751
		C	0.618	NS**	0.234
	B	C	0.826	NS**	0.092
Total hardness	A	B	0.001*	0.002*	0.702
		C	0.195	0.000*	0.355
	B	C	0.038*	0.666	0.127
Total alkalinity	A	B	0.000*	0.000*	NS**
		C	0.724	0.000*	NS**
	B	C	0.000*	0.81	NS**
Biochemical oxygen demand	A	B	0.920	0.408	0.502
		C	0.148	0.416	1.00
	B	C	0.284	0.048*	0.502
Chemical oxygen demand	A	B	0.001*	0.001*	0.562
		C	0.396	0.974	0.095
	B	C	0.022*	0.001*	0.025*
Oil & grease	A	B	0.000*	0.036*	NS**
		C	0.882	0.844	NS**
	B	C	0.001*	0.012*	NS**
Total calcium	A	B	0.001*	0.702	0.191
		C	0.303	0.289	0.052*
	B	C	0.042*	0.075	0.006*

*The mean difference at 0.05 level of significance, **Not studied, A is pre-immersion, B is immersion and C is post-immersion period of idols

differences between pre-immersion –immersion and pre-immersion – post-immersion period of 2010 and pre immersion - immersion period of 2019. Total hardness showed strong significant difference between pre-immersion – immersion and immersion-post immersion period in the year 2010 while it showed strong significant difference between pre-immersion –immersion and pre-immersion – post-immersion period in 2014.Strong significant differences were noted in total alkalinity between pre-immersion – immersion and immersion – post-immersion period of 2010 whereas it was strongly significant during pre-immersion – immersion and pre-immersion – post-immersion period of 2014. Biochemical oxygen demand depicted significant difference between immersion – post-immersion periods of 2014 only. Chemical oxygen demand showed strong significant difference between pre-immersion – immersion and immersion –post immersion period of 2010 and 2014 and only between immersions – post-immersion period of 2019. Oil and grease depicted strong significant difference between pre-immersion – immersion and immersion-post immersion period of 2010 and 2014. Total calcium showed significant difference between pre-immersion –immersion and immersion -– post-immersion period of 2010 and pre-immersion – post-immersion and immersion -– post-immersion period of 2019. The statistical summary elucidated the water quality degradation and pollution load due to idol immersion activities. The analysis showed overall decrease trend in 2019 compared to 2010 and 2014 which revealed that the efforts of government authorities and non-government agencies are effectively success in awaking public which helped to conserve the Tapi river.

Although such kind of research work was not conducted till the date which could elaborate the comparative variations in water quality during different years due to idol immersion but general study on impact of Idol immersion on water quality of Tapi River was conducted by different researchers. The reported work inTapi River during Ganesh festivals were by Ujjania and Mistry (2012), Gadhia *et al*. (2014); Ekhalak (2015) and Bengani *et al.* (2020). Similarly, variations in temperature, pH, Dissolved oxygen, BOD, COD, oil and grease during the idol immersion were noted by Billore and Dandavate (2015); Tiwari and Kisku (2016); Kale (2016); Joshi *et al.* (2017); Belsare *et al*. (2017); Jain *et al.* (2018); Sorte *et al.* (2018) and Lokhande (2019).

CONCLUSION

The present research work concluded that water quality of Tapi River was disintegrated during immersion of Ganesh idols which is responsible for pollution load and adverse impact on aquatic ecosystem. Statistical evaluation of data recorded since last one decade revealed that the efforts taken by Municipal Corporation and civic bodies are to some extent effective to aware the public about water pollution due to idols immersion in Tapi river. Publics accepted eco-friendly idols, started immersion in artificial ponds instead of Tapi River which were effective steps to reduce the pollution and conserve the river water from disintegration by immersion of idols. Although, such religious activity cannot be stopped completely but necessary steps can be taken to reduce the pollution and conserve the water body. Furthermore, it is suggested that revision in central and state level legislation related to the water pollution, issuing the guidelines to celebrate these festivals, advertise for ecofriendly religious activities and awareness of public can be effective to minimize the water pollution and conserve the water resources including Tapi river.

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