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Impact Of Anthropogenic Activities Leading To Deterioration In Futala (Telangkhedi) Lake In Nagpur City

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ABSTRACT
The article focused on the primary pollution caused by the plaster of Paris idols and chemical paints by idol immersion activities during Gokulashtami, Ganesh, Durga Puja, and Chat Puja festivals Nagpur city, Maharashtra for the session 2019. Water samples assembled for pre-immersion, immersion, and post-immersion periods during and after various festivals and analyzed for multiple physicochemical, microbiological parameters viz. pH, temperature, dissolved oxygen, BOD, COD, total hardness, total solids, total dissolved solids, heavy metals, and total viable count. Sampling points were selected based on their importance. Significant variations have occurred in the investigated areas due to human activities and wastewater discharge to the Futala (Telankhedi) lake. It observed that these parameters' values remarkably increase during the immersion period and then declined in the post-immersion period. However, the general trend observed was: immersion higher than post-immersion higher than pre-immersion values. This study will also help assess and periodic water quality monitoring for proper management strategies to minimize the lake water pollution level despite increasing anthropogenic activity and urbanization within the sensitive area. Lake Water pollution caused by idol immersion activities can harm the ecosystem as it kills fishes, damages aquatic plants, and blocks the water's natural flow, causing stagnation. No one can change these religious activities, but awareness among the people and society can reduce pollution.

KEYWORDS: *Idol immersion, Religious activities, Lake water pollution, Paint Physico-chemical Parameter.*

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I. INTRODUCTION:

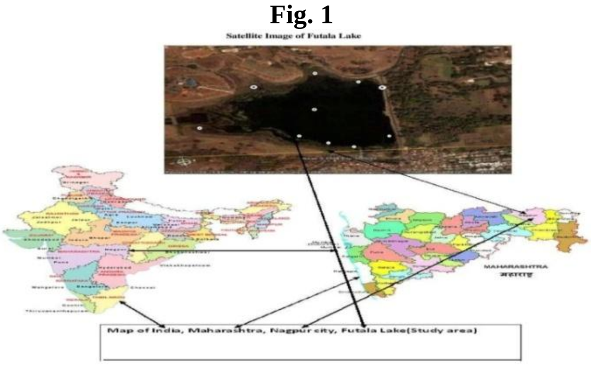
Water is the earth's most ubiquitous and most effective dissolving agent, playing a pivotal role in human civilization. It quenches the thirst and enables the growth of food and fiber for 6.1 billion human inhabitants. Humans now use half of the readily available freshwater, which is in short supply; less than 1% of the earth's water resource goes for domestic, agricultural, horticultural, and industrial needs. An increase in population, rapid industrialization, and agriculture activities have increased the water demand significantly. In the meantime, the quality of natural water bodies is becoming acute due to ad-hoc approaches in disposing of municipal wastewater and industrial effluents. Worldwide more than one billion people do not have safe water to drink, and two to three billion lack access to essential sanitation services. About three to five million people, mostly children, die every year from water-related diseases. Human societies have an issue challenged by assuring the most precious water quantity and quality while maintaining or improving its environmental integrity. Several states in the country are cladding problems due to over-exploitation of groundwater resources and surface water pollution. Its demonstration is declining per head water availability, falling water tables, and deterioration of water quality. Woefully, the inability of the authorities keeps checking the issue to blame for this state of affairs. These increasing imbalances and anomalies shed doubt on the long term availability of water resources. Accurate data on the condition and trends of water resources quantity and quality required as a basis for economic and social development and the development and maintenance of environmental quality.

In India, a lot of idols are revering with all rituals at different times in a year. After worship, these idols are plunged into water bodies (Lakes). Among the significant Indian festivals, some actual examples are Durga Puja, Tazia, Ganesh Puja, Jagadhatripuja, Laxmi puja, etc. In these incidences of the idol, immersions can view. Millions of Ganesh and Durga idols of various sizes, reaching heights up to 15 to 45 feet, are immersed each year in different water bodies. These idols were prepared by plaster of Paris, clay, cloths, small iron rods, bamboo, and decorated with other paints such as varnish, watercolors, etc. Plaster of Paris (POP), which is cheaper and lighter, has become the favored material to mold these idols. POP contains chemicals such as phosphorus, gypsum, sulfur, and magnesium. These idols are garnished with plastic and thermocouples. Out of all the materials used to make the idol, thermocol, and plastic are not bio-degradable, hence toxic. Chromium and Lead are very toxic even in tiny quantities for human beings through the process known as Bioaccumulation and Biomagnifications. These heavy metals can enter into the living systems (maybe directly incorporated through the digestive tract due to the consumption of contaminated water or food, or through non-dietary routes across permeable membranes such as gills). Immersion of these idols poisons the waters of lakes, rivers, and the sea by increasing acidity and the content of heavy metals.[1] It damages human beings' health by polluting drinking water sources, causing breathing problems, blood, and skin diseases. Non-degradable metals, inorganic, and organic pollutants accumulate in various fishes' vital organs and lead to long-term toxic effects. They also induce abnormalities in different organs of fishes and humans. However, amidst the celebrations, people tend to forget the ill effects of the practice. The most severe impact of idol immersion is on the environment. It disturbs the ecological balance by polluting water and adversely affecting flora and fauna. Water needs are in all lives, from microorganisms to man, which is a serious problem today because all water resources have reached the point of crisis due to unplanned urbanization and industrialization. The purpose of studying is to promote and coordinate activities in Environmental Chemistry and health-related water microbiology and hygiene.

II. STUDY AREA

Nagpur city with coordinates of 21°8'55"N and 79°4'46"E is the second capital of Maharashtra state. Nagpur city is popularly known as an orange city, also the city of lakes. The town had ten lakes in the past, but unfortunately, only seven are present. The Lake with a coordinate of 21°8'44"N and 79°03" 48"E is a closed water body. The area of Futala Lake is growing over sixty acres. Futala Lake is located on the western side of Nagpur city, as shown in figure 1. The catchment area of the dam is 6.475 sq. Km. The length of the west weir is 8.0m. Futala Lake can flood an area of 34.42 hectors of cultivated agriculture land and Telenkhedi Garden. The initial purpose of irrigating nearby agricultural land was prominent amongst the utilization of Futala lake.

Fig. 1



III. PROBLEM ON HAND

The Futala lake water is unpotable and nowadays used for irrigation purposes and commercial fisheries. It doesn't have self-cleaning capacity; hence continuous addition of nutrients through many polluting sources is leading. The Four streams are prominent within a catchment. The Lake and its surrounding near Telankhedi Garden on Amravati Road, Nagpur, is a garden party spot. The sewage let out into Futala Lake without treatment; therefore, the lake water is foul at a moderate level. In Futala Lake, eutrophication saw in some portion towards the west, but almost half of the lake area is covered by weeds, especially on all sides. Species ground level in the water starts to diminish due to lack of sunlight, affect oxygen level in lake water already drastically dropped. Another worry for the Lake was the collapse of a large portion of embankment towards the bund dam, constructed with a black stone in some time ago, raising the needs for inspection of the dam's remaining part. Futala Lake was a choice in this study since it is profoundly affected by human actions leading to domestic and agricultural pollution sources. The fundamental objective of the present study is to forearm people by creating awareness also to evolve future strategies for the benefit of humanity and to highlight the underlying issues regarding water pollution prevention as well as prevention of wistful and management of surface water bodies (Lakes)

IV. MATERIALS AND METHODS

Ten permanent stations for monthly sampling were established and marked within inlet S1 to S4, center S5, corner S6 to S9, and outlet S10 regions to assess water grade in the bottom side of the selected Lake. Regular samples were collected in sterilized glass sample bottles for various physicochemical analyses; the sample bottle was used. Before sampling, the entire sampling containers were washed and rinsed with lake water taken for review. The collected surface samples from these ten locations in 2 L pre-cleaned polyethylene bottles for three months from August to October 2019. The continuous monitoring involved comprehensive Physico-chemical analyses encompassing estimation of significant cations (Ca^{2+}, Mg^{2+}, Na^{+}, K^{+}, Fe^{2+}), anions (Cl^{-}, SO_4^{2-}, NO_3^{-}, F^{-}, PO_4^{3-}) besides parameters like pH, E.C., TDS, alkalinity, total hardness, D.O., BOD, COD, and temperature, etc.were measured immediately in the field shortly after examine. As recommended by the American Public Health Association [2], the entire analytical procedures were employed in the present study shown in Table 1. The fortune of the surface water from these Futala Lake for drinking, domestic, and irrigation purposes observe by comparing the values of different water quality parameters with those of the Bureau of Indian standards [3] guideline values for drinking water.

Table No - 1
Analytical Methods BIS Adopted with the desirable and Permissible limits [3]

Sr. No.	Characteristics	Analytical method	Unit	BIS limits (1998)	
				Desirable	Permissible
1	pH	Electrode	-	6.5-8.5	6.5-8.5
2	Electrical conductivity (E.C.)	Conductivity meter	µS/cm	2,000	3,000
3	Total dissolved solids (TDS)	Conductivity - TDS meter	mg/L	1,000	2,000
4	Total Alkalinity (TA)	Titrimetric	mg/L	200	600
5	Total hardness (T.H.)	EDTA Titrimetric	mg/L	300	600
6	Dissolved Oxygen (D.O.)	Modified Winder's method	mg/L	6.0	NA
7	Biochemical oxygen demand (BOD)	Modified Winder's method	mg/L	3.0	6.0
8	Chemical oxygen demand (COD)	Closed reflux method	mg/L	NA	NA
9	Calcium (as Ca^{2-})	EDTA Titrimetric	mg/L	75	200
10	Magnesium (as $Mg^{2+)}$	EDTA Titrimetric	mg/L	20	100
11	Potassium (as K)	Flame photometric	mg/L	10	10
12	Chlorides (Cl^{-})	Argentometric titration	mg/L	250	1,000
13	Nitrates (as NO_3^{-})	Ion selective electrode (ISE)	mg/L	45	45
14	Fluoride (as F)	Ion selective electrode (ISE)	mg/L	1.0	1.5
15	Phosphates (as PO_4^{3-})	Stannous chloride	mg/L	0.3	0.3
16	Sulphates (as SO_4^{2-})	Barium chloride	mg/L	200	400

V. WATER QUALITY INDEX (WQI) [4]

The water quality guideline index (WQI) shows the most effective tools to communicate water quality information to the concerned citizens and policymakers. WQI is defined as a rating that reflects the composite influence of different water quality parameters [5] WQI calculated from the feasibility of surface in deepwater for human utilization. The calculating the WQI in the present study, Fourteen parameters, namely, pH, electrical conductivity, TDS, total hardness, alkalinity, calcium, magnesium, sodium, potassium, chloride, sulfate, iron, nitrate, and fluorides, considered in Table no 2. There are three steps for evaluating WQI for the collected water sample.a. Each of the chemical parameters allocated weight (w_i) based on their perceived effects on primary health and their relative importance in the overall quality of water for drinking purposes (Table 2). The highest weight of five assigned to parameters that have significant effects on water quality and their importance in condition (viz, NO_3^{-}, F^{-} and TDS) and a minimum of two assigned to parameters considered as not harmful ions like Ca^{2+}, Mg^{2+}, K^{+}etc.

b. Calculating the relative weight (Wi) of each parameter using Eq. 1. Table 2 present the weight (w_i) and derived relative importance (W_i) values for each parameter.

c. A quality rating scale (q_i) for each set analyzed by splitting the water sample concentration by guidelines created by BIS in 1998. The result multiplies by hundreds using Equation no 2. Finally, to enumerate the WQI, the water quality sub-index (SIi) for each chemical parameter is first determined, which is used to determine the WQI as per the Eqs. 3 and 4.

$$W_i = \frac{w_i}{\sum_{n=i}^{n} w_i} \quad \text{……………..} \ (1)$$

Where W_i = relative weight, w_i = weight of each parameter, and n = number of parameters.

$$q_i = \left(\frac{c_i}{s_i}\right) \times 100 \quad \text{…………..} \quad (2)$$

Where q_i is the quality rating, C_i represents a chemical parameter concentration in every sample using unit mg/L. Si indicates that the Indian potable water standard in BIS year 1998 for each chemical parameter in mg/L excludes conductivity (µS/cm) and pH.

S.I. = Wiki

$$\text{WQI} = \sum_{i=1}^{n} SIi \qquad \ldots\ldots\ldots\ldots\ldots (3)$$

SIi is the sub-index of the ith parameter; qi is the rating based on the ith parameter concentration, and n is the number of parameters.

Table no -2

The weight and relative weight of the Physico-chemical parameters used for WQI determination [4]

Parameters	BIS desirable limit (1998)	Weight (wi)	Relative importance (Wi)
pH	8.5	3	0.698
Electrical conductivity	2,000	3	0.0698
Total dissolved solids	1,000	5	0.1163
Total alkalinity	200	2	0.0465
Total hardness	300	3	0.0698
Calcium	75	2	0.0465
Magnesium	30	2	0.0465
Sodium	100	3	0.0698
Potassium	10	2	0.0465
Chloride	250	3	0.0698
Sulphate	200	3	0.0698
Nitrate	45	5	0.1163
Fluoride	1	5	0.1163
Iron	0.3	2	0.0465
		Ew_i = 43	$\sum.W_i$ = 1.000

VI. QUALITY ASSURANCE AND QUALITY CONTROL

Appropriate quality assurance procedures and precautions were carried out to ensure the reliability of double distilled water results throughout the study. Glassware was adequately cleaned, and the reagents were of analytical grade. Reagents blank determinations used to correct the instrument readings.

VII. RESULT AND DISCUSSION :

The study reveals a clear picture of Futala Lake water status at different sites during the other months tabulated in Tables 1, 2, 3. Lakes are a dynamic inland aquatic system that supports and maintains a balanced adaptive community of organisms with diverse species composition. The bodies' functional organization supports unique biotic integrity lakes, the major life-supporting systems facing ecological degradation today due to undesirable anthropogenic activities. The unwanted actions and unscientific utilization of resources from the lakes have caused adverse environmental problems, thus threatening its biodiversity. Exercising control on the usual anthropogenic activities is necessary to maintain these socio-economically and bio-aesthetically critical aquatic ecosystems. These marine ecosystems represent the highest ecological; integration clearly emphasizes the obligatory relationships, interdependence, and interactions.

Based on physicochemical analyses, irrigation quality parameters like sodium absorption ratio (SAR), percent sodium (% Na) were calculated. The suitability of the surface water from Futala lake for drinking, domestic, and irrigation purposes evaluated by differentiating values of different water quality parameters with those of the Bureau of Indian Standards (BIS 1998) guideline values for drinking water. The higher concentration of some settings is due to heavy pollution load due to idol immersion activities during festival season resulting in deterioration of the natural water body. Futala Lake is affected by several pollution sources, including washing clothes, animals, vehicles, and even bathing. These activities lead to the Lake's contamination by soaps, detergents, and organic matter and are take all around the Lake. The lake area is misused as public toilets, leading to an unsanitary environment increasing the Lake's organic matter. In the southern region of the Lake, its banks are used as a cineration. Dumping of waste around the Lake is taking place, which pollutes the Lake and spoils its beauty. Cattle were grazing the west and north of the Lake. The volume of the Futala lake is decreasing due to the accumulation of silt coming from the runoff. There are several upcoming layouts (residential area) around the Lake, affecting the water quantitatively and qualitatively. Futala Lake is used as a repository for human wastes and also for irrigation water purposes.

Development activities discharged of nutrients and growth of the population have caused changes in the mentioned lake ecosystem. Massive blooms of algae have developed, water-borne diseases have increased in frequency, and water hyacinth has started choking important waterways and landings as well as water supply intakes. Futala lake bore the brunt of Ganesh idol immersions this year as Nagpur Municipal Corporation (NMC) had banned immersions in all nine other lakes in the city. All Ganesh idols were immersed in Futala, unleashing all the pollution caused due to PoP and chemicals. Water monitoring of Futala lake revealed 3.0-3.5mg/L dissolved oxygen (D.O.) after the immersions, as against 4.0-4.5 mg/L before Ganpati idol immersion. Turbidity, which refers to the presence of swing solids, was recorded at 70 Jackson Turbidity Unit (JTU) and pH at 8. Nirmalya is creating an anaerobic condition and reducing the oxygen level of the Futala lake water.

Table 3
Water quality data collected and average pollution load from ten studied points in Futala Lake during August 2019

	Inlet				Center	Corner				Outlet
Parameters	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8	S_9	S_{10}
pH	7.9	7.8	7.9	7.7	7.8	8.3	6.3	6.1	8.3	8.2
EC	590	480	360	420	510	600	410	430	430	510
TDS	340	268	370	580	430	320	410	285	395	400
TH	170	210	280	360	240	160	165	180	190	280
Alkalinity	160	160	184	186	195	200	180	150	150	170
PO_4^{3-}	0.02	0.01	0.01	0.03	0.04	0.01	0.02	0.02	0.02	0.04
Ca^{2+}	40.85	80.40	37.30	40.20	70.28	27.30	34.46	37.22	30.12	42.12
Mg^{2+}	9.93	18.40	8.30	15.30	16.48	17.30	8.40	12.37	18.40	30.16
Na^+	12.48	18.78	14.89	25.40	29.14	13.61	19.21	18.11	13.76	14.24
K^+	3.21	6.28	3.77	4.78	5.12	5.12	3.86	2.96	8.11	8.38
Cl^-	40.68	36.12	34.12	42.14	43.16	12.18	16.86	17.96	18.11	9.46
SO_4^{2-}	16.32	14.68	13.12	16.04	6.82	17.31	20.96	14.88	15.87	16.18
NO_3^-	3.78	4.14	3.66	2.84	1.96	0.34	0.84	0.94	0.88	0.78
F^-	0.032	0.098	0.048	0.077	0.084	0.011	0.08	0 .098	0.014	0.03
Fe^{2+}	0.88	0.46	0.76	0.84	0.72	0.33	0.22	0.24	0.94	0.94
DO	4.62	4.98	5.12	3.79	4.31	8.8	4.16	6.00	7.14	3.88
BOD	14	18	16	12	18	20	18	27	24	28
COD	60	44	72	38	46	52	48	74	68	70
WQI	50.76	61.21	70.24	30.14	38.11	46.32	48.14	62.14	68.00	70.12
%Na	20.32	24.48	10.12	18.00	17.98	14.78	18.38	12.78	18.18	20.14
SAR	2.12	7.89	4.76	4.88	1.89	2.14	3.18	2.12	1.86	1.92

Note: All values expressed in mg/L except pH, Conductivity (umhos/cm), WQI, SAR, and % Na

Graph 1
Graphical representation of Water quality data collected and average pollution load from ten studied points in Futala Lake during the month of August 2019

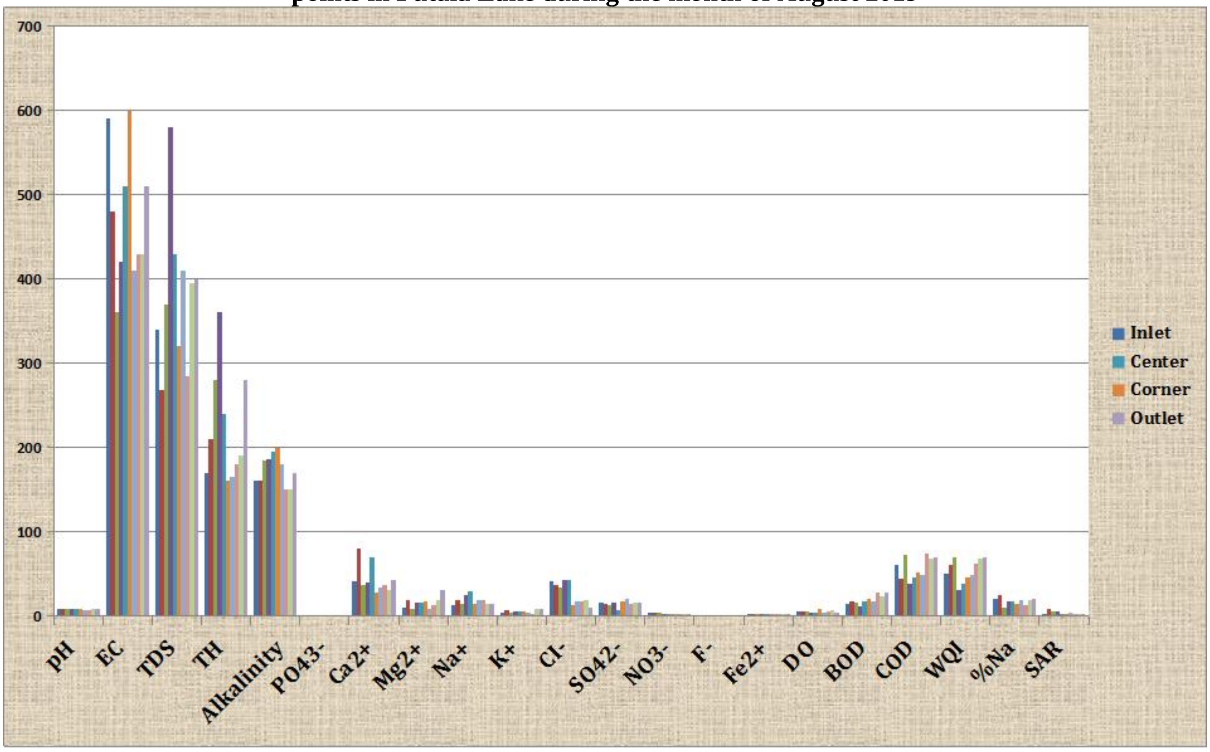


Table 4
Water quality data collected and average pollution load from ten studied points in Futala Lake during September (immersion period)

	Inlet				Center	Corner				Outlet
Parameters	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**S_6**	**S_7**	**S_8**	**S_9**	**S_{10}**
pH	8.0	8.0	8.3	7.8	7.9	7.9	8.0	8.2	8.2	8.4
EC	648	720	648	732	730	662	700	740	600	598
TDS	490	390	380	370	400	510	420	380	290	310
TH	240	288	320	318	290	400	400	298	230	360
Alkalinity	168	192	380	184	190	148	196	132	196	210
PO_4^{3-}	0.08	0.18	0.12	0.18	0.22	0.12	0.62	0.18	0.12	0.14
Ca^{2+}	60.32	50.12	60.12	40.18	38.32	42.18	52.18	60.12	62.14	50.34
Mg^{2+}	20.11	13.18	27.12	24.18	30.18	18.11	24.12	10.98	10.98	12.14
Na^+	20.18	47.18	35.12	48.12	35.32	30.12	28.00	10.22	20.18	30.12
K^+	4.68	3.88	5.84	5.86	4.48	6.00	6.00	4.00	2.98	3.12
Cl^-	68.32	42.18	38.12	46.12	30.18	24.18	20.12	17.11	18.24	19.18
SO_4^{2-}	16.14	22.00	28.18	16.12	14.18	30.18	10.98	20.74	16.78	20.00
NO_3^-	5.34	8.12	8.14	3.81	1.78	3.12	1.98	2.78	3.00	3.12
F^-	0.076	0.084	0.032	0.046	0.055	0.048	0.044	0.083	0.076	0.084
Fe^{2+}	1.32	2.10	3.12	4.84	2.85	1.78	2.11	3.18	1.98	2.00
DO	2.0	1.9	2.2	2.6	3.8	2.7	2.9	3.0	3.0	3.00
BOD	24	28	32	40	24	20	18	18	16	24
COD	72	78	98	110	60	68	78	48	58	72
WQI	110.12	120	116	164	80	91.33	86.14	80.18	78	118
%Na	68.92	62.10	50.53	27.16	30.14	16.98	20.36	28.44	16.32	18.20
SAR	6.98	7.00	9.78	2.10	6.12	8.14	10.14	16.00	12.00	10.00

Note : All values expressed in mg/L except pH, Conductivity (umhos/cm), WQI, SAR ,and% Na.

Graph 2
Graphical representation of Water quality data collected and average pollution load from ten studied points in Futala Lake during the month of September (immersion period)

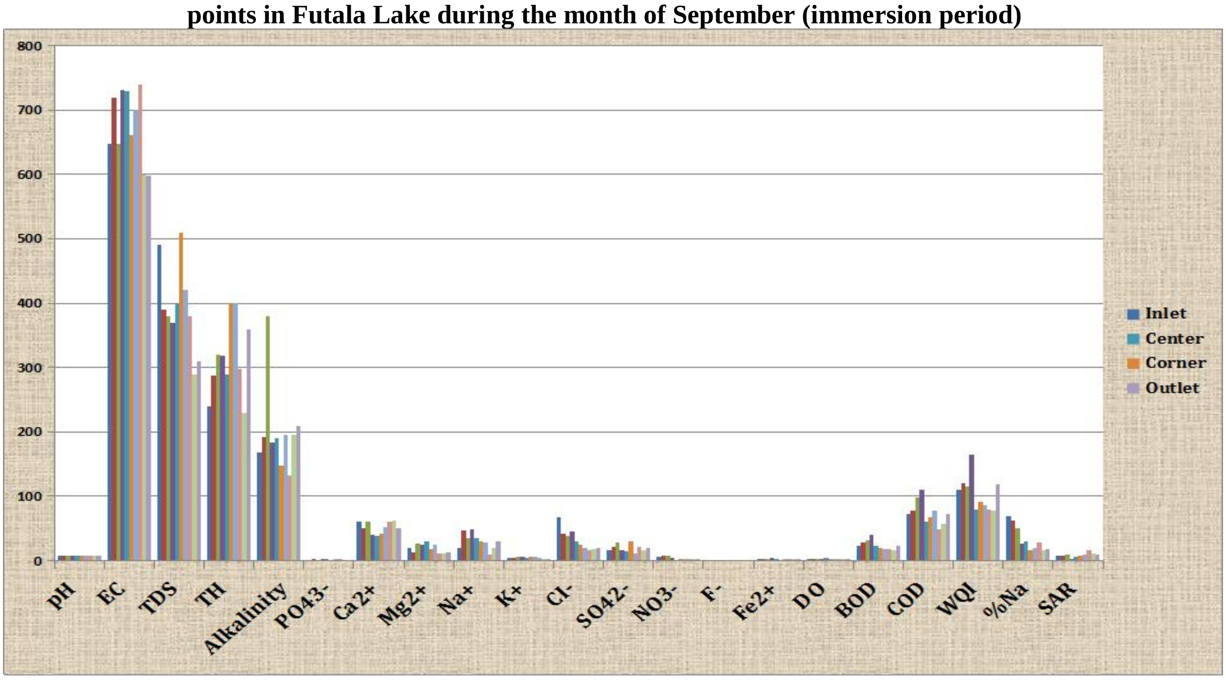


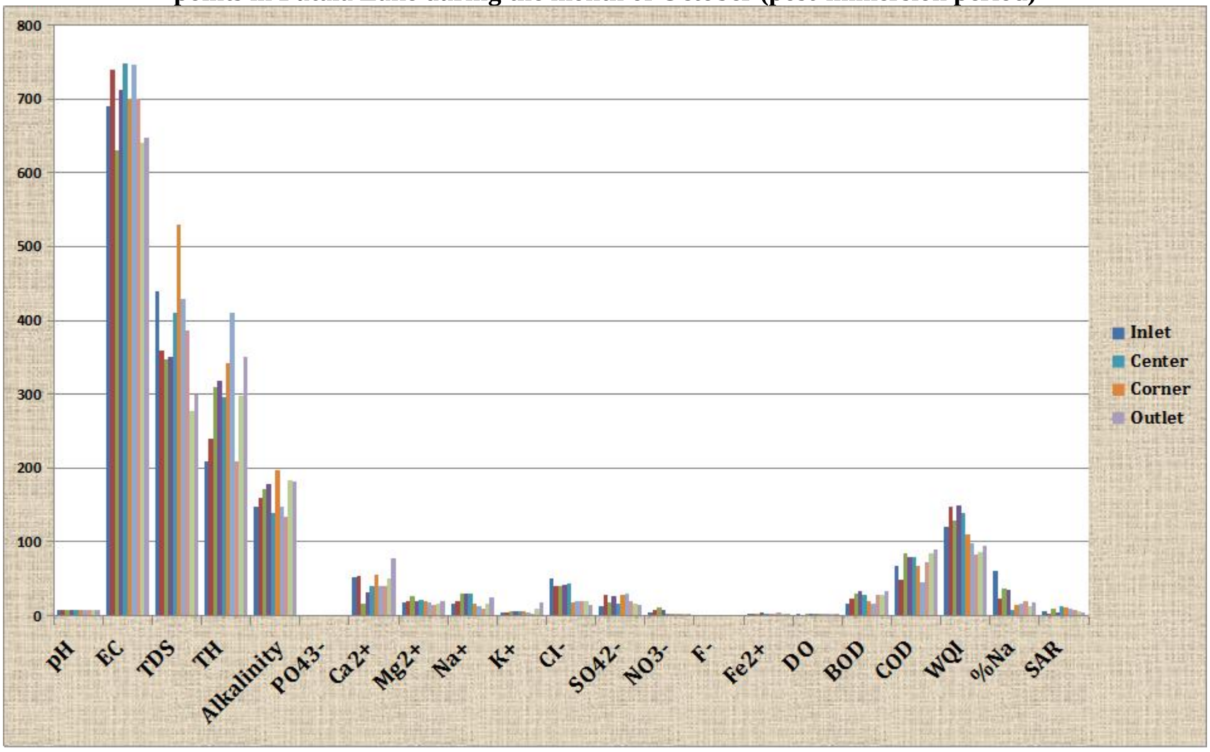
Table 5
Water quality data collected and average pollution load from five studied points in Futala Lake during October (post-immersion period)

	Inlet				Center	Corner				Outlet
Parameters	**S_1**	**S_2**	**S_3**	**S_4**	**S_5**	**S_6**	**S_7**	**S_8**	**S_9**	**S_{10}**
pH	8.3	8.4	8.1	8.0	7.9	8.3	8.0	8.0	7.8	7.8
EC	690	740	630	712	748	700	746	700	640	648
TDS	440	360	348	350	410	530	430	386	278	300
TH	210	240	310	318	296	343	410	210	298	350

Alkalinity	148	160	172	178	140	198	148	134	184	182
PO_4^{3-}	0.03	0.08	0.02	0.02	0.01	0.04	0.05	0.08	0.07	0.06
Ca^{2+}	52.18	53.14	16.48	32.48	40.88	56.14	40.16	40.38	50.78	78.20
Mg^{2+}	18.11	19.38	27.12	20.34	22.14	19.38	18.32	14.28	16.0	20.14
Na^+	16.16	18.98	29.18	30.64	30.18	16.24	12.18	10.18	17.18	24.14
K^+	4.24	3.82	5.78	5.76	5.48	5.98	4.00	2.98	8.98	18.18
Cl^-	50.62	40.18	40.18	42.14	43.18	18.18	20.00	19.18	20.00	14.78
SO^{2-}	12.32	28.14	18.38	27.18	16.24	28.12	30.00	19.12	16.78	14.38
NO_3^-	4.32	8.32	10.48	8.14	2.98	0.96	0.92	0.88	0.32	0.82
F-	0.038	0.022	0.098	0.018	0.010	0.022	0.014	0.018	0.016	0.012
Fe^{2+}	1.88	2.18	3.18	4.61	3.0	3.0	3.0	4.11	2.86	1.982
DO	2.0	1.8	2.3	2.8	2.8	2.7	3.2	3.0	2.7	3.0
BOD	16	24	30	34	28	20	16	28	28	34
COD	68	48	84	79	80	68	46	72	84	90
WQI	120.68	148.12	128.81	149.00	140	110	98	82.24	86.12	94.12
%Na	60.24	22.47	36.28	35.74	8.10	14.98	16.14	20.12	12.48	18.00
SAR	6.48	3.21	8.71	4.51	12.29	10.6	9.2	8.00	6.12	4.98

Note : All values expressed in mg/L except pH, Conductivity (umhos/cm), WQI, SAR ,and % Na.

Graph 3
Graphical representation of Water quality data collected and average pollution load from five studied points in Futala Lake during the month of October (post-immersion period)



i) Hydrogen ion concentration (pH)

The pH is an expression that indicates the degree to which water is acidic or alkaline. pH below 6.5 starts corrosion in pipes. The decrease in pH values during the month August to October is mainly related to the high bicarbonate content, while the uptake of CO_2 by phytoplankton decreasing as a result of an increase in the concentration of HCO_3^- [6]

The values of pH play an essential role in many life processes in the aquatic system. It may also reflect the productivity and pollution levels of the marine environments. pH is the majority important in determining the corrosive nature of water. Lower the pH value higher is the destructive nature of the sample. To reduced rate of photosynthetic activity and the assimilation of carbon dioxide and bicarbonates are ultimately responsible for increased pH. The low oxygen values coincided with high temperatures during the summer season month. The various factors are changing the pH of the water sample. The high pH observed suggests that carbon dioxide, carbonate-bicarbonate equilibrium is affected more due to change in physicochemical condition. The mean pH values in Futala (Telangkhedi) lake were found to be 7.7 to 8.3 (Pre-immersion period, August 2019); 7.8 to 8.4 (Immersion period, September 2019); 7.8 to 8.5 (Post-immersion period, October 2019) respectively.

ii) Total dissolved solids (TDS)

Total dissolved solids (TDS) mainly consist of inorganic salts such as carbonates, bicarbonates, chlorides, sulfates, phosphates-and nitrates of calcium, potassium, iron, magnesium, sodium, etc. and a small amount of organic matter.[7] Due to the immersion of idols and worship materials into Futala lake, TDS values increased in September. The concentration is high during the rainy season, which may be due to the addition of solids from runoff water, sewage, and upper household runoff and cattle waste effluents to the Futala (Telankhedi) lake. The low total dissolved solids (TDS, mg/L) values in Futala (Telankhedi) lake found to be 268 to 580 (Pre-immersion period, August 2019); 290 to 510 (Immersion period, September 2019); 278 to 530 (Post-immersion period, October 2019) respectively.

iii) Total hardness (T.H.)

Total hardness, a measure of water supplies' quality, is governed by calcium and magnesium salts' content combined with carbonate and bicarbonate and sulfates, chloride, and other anions of mineral acids. However, total hardness is used to classify water as soft or hard. It suggested that the total hardness of 50 mg/L of $CaCO_3$ is equivalent to the dividing line between soft and hard water, and the rain is having hardness > 15 mg/L is suitable for the growth of fishes. Also, the pool with < 5 mg/L $CaCO_3$ is not at all ideal for fish growth.[8] Calcium and magnesium ions in water result in scales in hot water systems and increase soap consumption. Carbonate hardness occurs when metals are associated with carbonates and bicarbonates, and non-carbonate hardness is when the minerals are associated with sulfates and chlorides. Hardness, alkalinity, and acidity are by convention all expressed in terms of calcium carbonates so that total hardness - alkalinity = non-carbonate hardness. The mean total hardness (T.H., mg/L) values in Futala (Telankhedi) lake were found to be 160 to 360 (Pre-immersion period, August 2019); 240 to 400 (Immersion period, September 2019); 140 to 198 (Post-immersion period, October 2019) respectively.

iv) Total Alkalinity (T.A.)

T.A. measures the ability of a water sample to offset acids. It's due to the presence of carbonates, bicarbonates, and hydroxide of sodium, calcium, magnesium, potassium, strong bases, salts of weak acids, and borates, silicates, phosphates, etc. A large amount of alkalinity imparts a bitter taste, harmful for irrigation as it damages soil and reduces crop yields.[9]

If pH exceeds 8.3, caustic alkalinity is present due to carbonates and hydroxides, but bicarbonate alkalinity exists in the pH range 4.5 to 8.3. The low total alkalinity (T.A., mg/L) values in Futala (Telankhedi) lake were found to be 150 to 200 (Pre-immersion period, August 2019); 148 to 210 (Immersion period, September 2019); 140 to 198 (Post-immersion period, October 2019) respectively.

v) Total Phosphate (T.P.)

Phosphate constitutes essential nutrients essential for the growth of organisms. Phosphate occurs in natural water in low quantity as many aquatic plants absorb and store phosphate many times their actual needs.[10] Household detergents, domestic sewage, leaching of phosphate fertilizers may be a reason for phosphate level increase in Futala (Telankhedi) Lake. The high values of phosphate are mainly due to rain, surface water runoff, agriculture runoff, and washing activities could have also contributed to the inorganic phosphate content.

Table 6
The classification of lakes based on total phosphate,[10]

Sr. No.	Trophic status	Values of PO_4^{3-} in mg/L
1	Oligotrophic	< 0.005
2	Mesotrophic	0.005 to 0.01
3	Mesoeutrophic	0.01 to 0.03
4	Eutrophic	0.03 to 0.1
5	Hypereutrophic	>0.1 mg/L

The trophic status of Futala lake as per the above classification varies from mesotrophic to hypereutrophic during different months. Increase phosphate concentration beyond 0.2 mg/L has increased the growth of phytoplankton in Futala (Telankhedi) lake.

Nitrogen and phosphorus are important in water and wastewater because they influenced biological activity. Nitrogen and phosphorus levels indicate that the Lake is mesotrophic or moderately productive. Futala Lake is expected to support higher algal production with increased nutrient enrichment. At present, it would probably sustain higher phytoplankton growth under improved water clarity, although this hypothesis remains tested experimentally. The Futala lake has also declined in aesthetic quality over the past decade following the invasion of aquatic weeds like hydrilla and water primrose, which line most of the shores during October. The mean nitrates (as NO_3^-, mg/L) values in Futala (Telankhedi) lake were found to be 0.34 to 4.14 (Pre-immersion period, August, 2019); 1.78 to 8.12 (Immersion period, September, 2019); 0.32 to 10.48 (Post-immersion period, October, 2019) respectively. The mean phosphates (as PO_4^{3-}, mg/L) values in Futala (Telankhedi) lake were found to be 0.01 to 0.04 (Pre-immersion period, August, 2019); 0.08 to 0.062 (Immersion period, September, 2019); 0.01 to 0.08 (Post-immersion period, October, 2019) respectively.

vi) Fluoride :

Fluoride comes from fluorine, whose natural, abundant and common, element. Add on fluoride to a water sample supply bring down the incidence of tooth decay. TheFluoride protects teeth from decay by demineralization and remineralization. Too much fluoride can lead to dental fluorosis or skeletal fluorosis, which can damage bones and joints.[11] The mean fluoride (as F, mg/L) values in Futala (Telangkhedi) lake were found to be 0.098 to 0.077 (Pre-immersion period, August, 2019) ; 0.032 to 0.084 (Immersion period, September, 2019); 0.012 to 0.038 (Post-immersion period, October, 2019) respectively.

vii) Sulfates:

The sulfate ion (SO_4^{2-}) is one of the universal anions occurring in rainfall, especially in air masses that have encountered metropolitan areas. Sulfate concentrations in wastewater can vary from only a few milligrams per liter (mg/L) to hundreds of milligrams per liter. Generally, for domestic wastewater, the main source of sulfide is a sulfate. Sulfates are not toxic to plants or animals at normal concentrations. In humans, concentrations of 500 - 750 mg/L cause a temporary laxative effect. However, doses of several thousand mg/L did not cause any long-term ill effects. At very high concentrations, sulfates are toxic to cattle.[12] The low sulfates (as SO_4^{2-}, mg/L) values in Futala (Telangkhedi) lake found to be 16.82 to 20.96 (Pre-immersion period, August 2019); 10.98 to 30.18 (Immersion period, September 2019); 14.38 to 30.00 (Post-immersion period, October 2019) respectively.

viii) Calcium and Magnesium (Ca^{2+} and Mg^{2+})

The distribution of calcium and magnesium concentrations in Futala lake water has high fluctuations during different periods. The calcium and magnesium in water are generally used to classify the suitability of water. Calcium and magnesium are directly related to the hardness of the water. These ions are the most abundant elements in the surface and groundwater and exist mainly as bicarbonates and to a lesser degree in the form of sulfate and chloride.[13] The mean calcium (as $Ca^{2+,}$ mg/L) values in Futala (Telankhedi) lake were found to be 27.30 to 80.40 (Pre-immersion period, August, 2019) ; 38.32 to 62.14 (Immersion period, September, 2019); 16.48 to 78.20 (Post-immersion period, October, 2019) respectively. The mean magnesium (as Mg^{2+}, mg/L) values in Futala (Telangkhedi) lake were found to be 8.30 to 30.16 (Pre-immersion period, August 2019); 10.98 to 27.12 (Immersion period, September 2019); 14.28 to 27.12 (Post-immersion period, October 2019) respectively.

ix) Sodium and potassium (Na^+ and K^+)

Since natural sodium and potassium ions in soil and water are deficient, their presence might indicate lake pollution caused by human activities. Sodium is often associated with chloride. It finds its way into lakes from road salt, fertilizers, human and animal waste. Soil retains sodium and potassium to a greater degree than chloride or nitrate. The sodium and potassium values overtime can mean there are long-term effects caused by pollution.[14] The mean Sodium (as $Na^{+,}$ mg/L) values in Futala (Telangkhedi) lake were found to be 12.48 to 29.14 (Pre-immersion period, August, 2019) ; 10.22 to 48.12 (Immersion period, September, 2019); 10.18 to 30.64 (Post-immersion period, October, 2019) respectively. The mean Pottasium (as K^+, mg/L) values in Futala (Telangkhedi) lake found to be 2.96 to 8.38 (Pre-immersion period, August 2019); 2.98 to 6.0 (Immersion period, September 2019); 2.98 to 5.98 (Post-immersion period, October 2019) respectively.

Table No. 7
Nature of impurities and their Ill-effects[14]

Nature of Impurity			Effect of Impurities on Quality of water
(a) Minerals :			
(i)	Calcium and Magnesium	Carbonate Bi-Carbonate	Causes alkalinity and hardness
		Chloride sulfate	Causes Hardness
(ii)	Sodium	Carbonate Bi-Carbonate	Causes alkalinity and Softening
		Chloride	Causes salty taste

		Fluoride	Causes teeth and bone problems
(iii)	Metals and Oxide	Lead	Causes lead poisoning
		Arsenic	Causes arsenic poisoning
		Manganese	Produces brown or black color in water
		Iron	Causes taste, red color, hardness, and corrosion
(b) Gases :			
(i)	Oxygen (O_2)	Corrodes the metals	
(ii)	Carbon dioxide (CO_2)	Causes acidity and corrosion of metals	
(iii)	Hydrogen Sulphide (H_2S)	It causes foul-smelling, acidity, and corrosion of metals.	

x) Percent sodium (%Na)

It has been widely recommended that the percentage of sodium in irrigation water should not exceed 50-60, to avoid its harmful effects on soil. The percent sodium exceeds 60, and the water is considered to be unsuitable for irrigation purposes. It believed that water is prime grade if the % sodium is subordinate 30%, class II grade if % sodium is allying 30 and 75, and class III grade higher than 75%. The Percentage of Na can be determined using the successive formula:

$$\%Na = \frac{Na}{(Ca + Mg + K + Na)} \times 100$$

Where the concentration of $Na^{+,}$ K^+, Ca2+, and Mg2+, expressed in mill equivalents per liter (ppm or meq/L), soil permeability is affected by a high sodium ratio. The mean Na% values in Futala (Telankhedi) lake were found to be 14.78 to 24.48 (Pre-immersion period, August 2019); 16.32 to 68.92 (Immersion period, September 2019); 12.48 to 60.24 (Post-immersion period, October 2019) respectively. The present study indicates Futala (Telankhedi) lake comes under the category III to IV permissible to doubtful for irrigation purpose as per Table 8 given below. Water quality throwback by sodium percentage values can be categorized, as shown in Table 8.

Table no. 8
Classification of Irrigation Water Based on % Na Sodium percent (15)

Category	Sodium (%)	Water class
I	<20	Excellent
II	20-40	Good
III	40-60	Permissible
IV	60-80	Doubtful
V	>80	Unsuitable

xi) Chloride

Chloride occurs in all-natural water. The high concentration of chloride is considered an indication of pollution due to the high organic waste of animal origin.[16] The ecological significance of chloride lies in its potential to regulate the salinity of water and exert consequent osmotic stress on biotic communities. The mean chlorides (Cl, mg/L) values in Futala (Telankhedi) lake found to be 9.46 to 43.16 (Pre-immersion period, August 2019); 17.11 to 68.32 (Immersion period, September 2019); 19.18 to 50.62 (Post-immersion period, October 2019) respectively.

xii) Dissolved oxygen (D.O.)

Dissolve oxygen is an essential parameter of the aquatic ecosystem and affects water's physical and biological processes. The oxygen acts as indicators of planktonic development and plays a significant role in the proper growth of aquatic life like fishes. The level of dissolved oxygen in the Futala (Telankhedi) lake is influenced by several factors such as temperature, wind, photosynthetic activity of phytoplankton communities, and respiration of heterotrophic, autotrophic organisms, and decomposition of organic matter.

It is crucial, which is essential to the metabolism of all aquatic organisms that possess aerobic respiration.[18]. Dissolve oxygen levels in lakes vary according to their trophic level, and exhaustion D.O. in water probably is the expected result of water pollution.[19] Dissolved oxygen means the maximum conc of oxygen that can liquefy water. The function of water temperature may vary from place to place and from time to time. The mean dissolved oxygen (D.O., mg/L) values in Futala (Telankhedi) lake were found to be 3.7 to 6.00 (Pre-immersion period, August 2019); 1.9 to 3.6 (Immersion period, September 2019); 1.8 to 3.2 (Post-immersion period, October 2019) respectively.

xiii) Biochemical oxygen demand (BOD)

The (BOD) is the amount of oxygen that has to need by bacteria while stabilizing decomposable organic matter under aerobic conditions.[20] According to the WHO drinking water standard, BOD should not exceed 6 mg/L.

BOD is required to bacteria while stabilizing decomposable organic matter under aerobic conditions, crash organic matter present in a water sample at a certain temperature over a specific period. The Sources of BOD are dead plants, leaves, woody debris, animals compost, effluents from flesh and paper industries, wastewater treatment factories, feedlots, and food-processing mills; failing septic methods, and municipal stormwater runoff. The removal of wastes with high levels of BOD can cause water quality obstacles such as critical dissolved oxygen deficiency and fish kills in the receiving water bodies. Chlorine can also affect BOD analysis by inhibiting or killing the microorganisms that disintegrate the inorganic and organic matter in a sample.The mean biochemical oxygen demand (BOD, mg/L) values in Futala (Telankhedi) lake were found to be 12.0 to 28.0 (Pre-immersion period, August 2019); 16.0 to 40.0 (Immersion period, September 2019); 16 to 34 (Post-immersion period, October 2019) respectively.

xiv) Chemical Oxygen Demand

Chemical oxygen demand test determines the oxygen required for chemical oxidation of most organic matter and oxidizable inorganic substances to support powerful chemical oxidants.[20] Throughout the month from August to September, variations were found. The COD value ranged from 58 to 110 Mg/1. As variations are found, some of the toxic pollutants released to the lake water will hurt the aquatic organisms found in the Futala (Telankhedi) lake.

In combination with the BOD, the COD test helps indicate toxic conditions and the presence of biologically resistant organic substances.[21] The mean chemical oxygen demand (COD, mg/L) values in Futala (Telankhedi) lake were found to be 38.0 to 72.0 (Pre-immersion period, August 2019); 58 to 110 (Immersion period, September 2019); 48.0 to 90.0 (Post-immersion period, October 2019) respectively.

xv) Water quality index (WQI)

A WQI means summarize large amounts of water quality data into simple terms for reporting to management and the public consistently. The water quality index provides a single number that expresses overall water quality at a specific time and location, based on several water parameters. The index's objective is to turn complex water quality data into understandable and usable information by the public. A single-digit cannot tell the whole story of water quality; many other water quality parameters are not included in the index. However, a water quality index based on some critical parameters can provide a simple water quality indicator. In general, water

Quality indices incorporate data from different water quality variables in a mathematical formula that shows the mass of water's health with a number. The present indicate that Futala (Telankhedi) lake water quality is low WQI (78-190) as per the water quality status based on water quality index.

Table 9
Water quality status based on water quality index.|9]

Water Quality Index	Water Quality Status
WQI 50	Excellent Water Quality
50 > WQI < 100	Good Water Quality
10O WQI 200	Poor Water Quality
200 > WQI < 300	Very Poor Water Quality
WQI > 300	Unfit for drinking

xvi) Irrigational Quality Parameters Sodium Absorption ratio (SAR)

If the SAR proportion of the water samples in the study area is less than 10, it is excellent for irrigation purposes. The SAR values for each water sample calculated using the following Equation.

$$SAR = \frac{Na^{+}}{\sqrt{\frac{(Ca^{2+} + Mg^{2+})}{2}}}$$

According to the classification given in Table 11, Futala lake water showed a mean SAR value below 10 to 18, indicating that lake water is fair (S3) to good (S2) for irrigation.

Table 10
Classification of irrigation water based on SAR [22]

Sr. No.	Type of water and SAR value	Quantity	Subjectivity for irrigation
I	Low sodium water (S.I.) SAR value: 0-10	Excellent	Suitable for crops and all kinds of soils, except for those crops, which are sensitive to sodium.
II	Medium sodium water (S2) SAR value: 10-18	Good	Suitable for coarse-textured or organic soil with good permeability. Relatively unsuitable in fine-textured soils.
III	High Na water (S3) SAR value: 17-26	light	Harmful for almost all kind of soil; Requires good drainage, high leaching gypsum addition
IV	Very high Na water (S4) SAR value: above 26	Poor	Unsuitable for irrigation

SAR values indicated that Futala Lake water is fair (S3) to only good (S2) for irrigation, while electrical conductivity values classified this lake water as medium salinity (C2) category. According to % sodium class, the Futala Lake water is merely right for irrigation purposes.

xvii) Electrical conductivity (E.C.)

Electrical conductivity is an essential factor that reflects the changes caused by the mixing of freshwater, drainage water, and seawater; it is directly related to the concentration of ions in the water. Conductivity revealed a significant association with temperature, pH value alkalinity, total hardness, calcium, total dissolved solids, total solids, and chemical oxygen demand chloride and iron concentration of water. A failing sewage system would raise the conductivity because of chloride, phosphate, and nitrate, an oil spill under low conductivity.[23] Water's electrical conductivity is a primary function of its total dissolved salts and is used as an index to describe the total concentration of soluble salts in water. Excess E.C. leads to comparing in boilers, corrosion, and characteristic degradation of the product. Relatively higher E.C. values listed in the Futala Lake water attributed to the high degree of anthropogenic activities such as waste control, sewage inflow, idols' immersion, and agricultural runoff. The low electrical conductivity (E.C., uS/cm) values in Futala (Telankhedi) lake were found to be 360 to 600 (Pre-immersion period, August 2019); 598 to 740 (Immersion period, September 2019); 630 to 748 (Post-immersion period, October 2019) respectively. The present study indicates that Futala (Telankhedi) lake comes under the C2 type of water as per the classification of irrigation water based on electrical conductivity.

Table No. 11
Based on the electrical conductivity Classification of irrigation water [24]

Sr. No.	Type of water	Suitability for irrigation
1.	Low salinity water (Cl) conductivity between 100and250 uS/cm	Suitable for all crops and all kinds of soil. Permissible under regular irrigation practices except in soils of extremely low permeability
2	Medium salinity water (C2) conductivity between 250 and 750 uS/cm	It can use if a moderate amount of leaching occurs. Typical salt-tolerant plants can be grown without much salinity control
3.	High salinity water (C3) conductivity between 750 and 2,250 uS/cm	Unsuitable for soil with restricted drainage. Only high-salt tolerant plants can be grown
4.	Very high salinity (C4) conductivity more than 2,250 uS/cm	Unsuitable for irrigation

Carnivals are an integral part of the rich and diverse cultural heritage of India. Idol worship has been in practice in India since ancient times. When the idols immersed in water bodies, their colors, chemicals, and other components used for idol preparation got dissolved and led to significant changes in the Futala lake water quality. The far more substantial impact of pollution seen during the festival season when immersion of idols in these natural aquatic ecosystems destroyed the whole ecological balance. The water quality parameters like TSS, TDS, T.S., turbidity, conductivity, hardness, D.O., BOD, and COD have shown a significant increase during and after immersion of idols declined in the post immersion period. The input of biodegradable and non-biodegradable substances deteriorates the lake water quality and enhances the silt load in the Futala lake. The problem becomes more acute when the dissolution of input in the environment exceeds the decomposition, dispersal, or recycling capabilities. [25]

Suggestive Measures for Celebrating Eco-friendly Navaratri and Ganesh Festivals:

The most severe influence on the natural environment is the involvement of idols made of Plaster of Paris and polythene bags covering contributions. Rejoicing Eco-friendly Navratri does not mean giving up the things you love. Eco-friendly Navratri festival allows you to celebrate festivals grandly without harming the environment and other living beings. The following are ten useful and straightforward tips for celebrating Eco-friendly Navratri.

- **Clay idols for immersion:** The icons made for immersion during the Durga Puja festival, made up of Plaster of Paris (POP) and painted with layers of chemical paint, dissolves slowly, gradually releasing its harmful components. Using solitary, a mud idol for captivation and immersing it in the tank or bucket at-home alternative directly into natural water bodies (lakes), which helps to stop water pollution and saves the ecosystem and nature
- **Eco-Friendly Rangoli**: Rangoli is a crucial part of the Indian carnival. Instead of using dangerous synthesized colors, paints, or dye, an alternative is a natural coloring agent like rice flour, flavor, pulse, leaves, and steam in Rangoli design.
- **Eco-Friendly Dolls:** During the Navratri carnival, it is customary to display a "Golu" or dolls. It is a traditional practice to have a figurine of a boy and a girl together called 'Marapacchi' Bommai. Homes that follow the custom of displaying can adopt dolls made out of wood, clay, textile than Plaster of Paris.
- **Eco-Friendly Decorative items**: Decorative items made from thermocol have high demand since they are attractive and easily dismantled. But these decorative items made from thermocol pose a grave threat to the environment and human health. You can also adopt decorative objects made of palm leaves and other eco-friendly products to decor mandaps, idols, door, and wall hangings.
- **Hand-rolled Incense sticks**: According to the study, the incense used primarily for religious, medicinal, and meditative purposes was found to create air quality environments hazardous to human health. Hand-rolled incense sticks with natural fragrance used for the Puja. Ensure that your room or premises are well ventilated.

VIII. CONCLUSION

Conservation and management strategies for the Lake should consider different impacts due to the development instead of concentrating only, recreational development. Development strategies should have a multidisciplinary inclusive approach. Central and State government organizations. Educational and research institutes, community, citizens, and NGOs should participate in conservation and management of Lake instead of giving, into the; hands of private companies as their motto is revenue generation and not safeguarding lake water resource.

Significant variations have occurred in the investigated area due to human activity and wastewater discharge to the Lake. The relatively low pH values reflect the decreased productivity of the Futala lake due to the polluted water discharged into the Lake. In Futala lake, an increase in nitrogen and phosphorus content would naturally result in eutrophication, leading to a decrease in the oxygen content level. Lack of oxygen content can reason fish kills, and lack of fish enables malaria-hosting mosquitoes as mosquitoes are ordinary nutrition for fish. Without oxygen at the lowest at all times, useful bacteria and insects cannot biodegrade the organic sediment at the Lake's bed level. All these could lead to a significant accumulation of deposits at the bottom. Throwing waste materials and garbage in the lake water should be strictly prohibited. Purification methods should exist from purification processes before introducing any foreign material in the water body.

Therefore pollution variables must be regularly monitored and evaluated according to aquatic living and local regulations. The suggested measures to improve lake water quality include a total ban on the activities (including idols immersion). Awareness, planning, proper understanding, and environmental resources management are essential to prevent this ecological degradation.

Proper Bioremediation techniques used to improve water quality. Regular maintenance steps must be earned out for a certain period to observe its advantages and its class. Hence, the inspection revealed that the surface water of Futala lake needs some grade of treatment preparatory to usage, and it is essential to protect them from the perils of contamination.

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REFERENCES

[1]. Sayan Bhattacharya, Arpita Bera, Abhishek Datta, Uday Chand Ghosh 20(2),(2014), 234-263
[2]. APHA - A standard method for examination of water and wastewater, 21' edn. APHA, AWWA. WPCF. Washington (2005)
[3]. Bureau of Indian Standards (BIS in 1998) Drinking water specifications, I.S.: 10500, 2003
[4]. Ravikumar, P., Mohammad Aneesul Mehmud, Somashekhar, R. K., India App! Water Sci. 3 (2013), 247-261
[5]. Sahu P, Sikdar P.K, India Environ Gent, 55 (2008), 823-835
[6]. Abdel-Satar, A.M. J. Egypt Acad. Soc. EllVi1017. Develop, (2005), 49-73
[7]. Chandra S., Singh A., Tomer P.K., Chen, SO. TICI17S, 1 (3), (2012), 508-515 Rao G.S, Rao G NJ Environ Sci Eng, 52(2) (2010), 137-146
[8]. Ravikumar P. Venkatesharaju K. Prakash KL. Somashekar RK Environ Monit Assess 179 (2011), 93-112
[9]. Sundar M L, Saseetharan M K J EllViI011 Sci Eng 50(3) (2008), 187-190
[10]. Wetzel, R.G. Limnology, 1, (2000), 3-9
[11]. P.J.Puri; R.G. Choudhary, M.K.N. Yenkie; 1(2) (2014) 385-397
[12]. P.J.Puri; L.S. Awale, IJAEMS 1(2017) 27-32
[13]. D.B. Rana; M.K.N. Yenkie; P.J. Puri, IJAEMS 1(2017) 31-34
[14]. P.J.Puri; M.K.N. Yenkie; L.S. Awale, Advance in Applied Sci Res 6(1) (2015) 15-26
[15]. L.V.Wilcox Classification and use of irrigation waters. US Department of Agricultural, Washington DC. (1995)
[16]. Venkatasubramani R. Meenambal, T. Nat, Environ, Poll Tech., 6, (2007), 307-313
[17]. Haslam S.M., River Pollution, Belhaven Press, Great Britain, (1991)
[18]. Wetzel, R.G. Limnology W.B. Saunders Co. Philadelphia, (1975), pp. 743
[19]. Srivastava N, Harit GH, Srivastava R, India J Biol, 30(5) (2009), 889-894
[20]. Sawyer C N., McCarthy P L Chemistry for environmental engineering, 3" and. McGraw- Hill Rook Company, New York, (1978)
[21]. P.J.Puri; M.K.N. Yenkie; R.G. Choudhary, Der Chemica Sinica 6(2) (2015) 11-19
[22]. Richards LA (U.S. Salinity Laboratory) Diagnosis and improvement of Sakine and alkaline soils, U.S. Department of Agricultural Hand Book, (1954)
[23]. Okbah, MA et al. Chem. Res.J 2(4), 2017, 104-117
[24]. Vijayakumar, J. Narayana, E.T. Puttaiall and K. Harishbattu, J. Eoe, Tavical Environ Merit, 15,3 (2005) 253-261
[25]. Puri Yenkie, M.K.N., Rasayan J. Chem., 3(4), (2010), 800-810
[26]. CPCB, Guidelines for idol immersion 2006, http://www.cpcb.nic.in/upload159 20 March 2012
[27]. Abida Begum et al., Rasayan J. Chem. 1(3), (2008), 596-601