

## **Pollution Status of Futala and Gandhisagar Lake - Nagpur**

**H. D. Lohkare, M.P. Gujar, S. Pathak, D. S. Ramteke and S. R. Wate**

*Environmental Impact & Risk Assessment Division  
National Environmental Engineering Research Institute (NEERI),  
Nehru Marge, Nagpur -440020, Maharashtra, India.  
e-mail – harshali\_lohkare@yahoo.co.in, e-mail – uday\_gujar@yahoo.com  
email – pathak.shabdendu@gmail.com*

### **ABSTRACT**

Vidharbha region in Maharashtra is known as the region of Lakes. There are many different lakes in Nagpur district. These lakes serve for multiple uses for the population of Nagpur. The lakes are mainly used for fish culture, irrigation, drinking purposes and various domestic uses.

Today's status of Futala Lake and Gandhisagar Lake presents a standing example of man's disregard towards nature. The lake was constructed at time when Nagpur was being expanded by Raje Raghujji Bhonsle. Gandhisagar Lake is known as Shukrawari Lake. It is smallest and old lake covering an area at 19.15 ha and about 7 m deep. The surrounding area of the lake is density populated and commercial vegetable market is located nearby this lake.

Lakes play an important role in the ecology and environmental aspects of the region. These lakes satisfy the various needs of surrounding population and support irrigation, fishery, recreation, swimming, washing and other activities. Considering the activities around the lakes, these lakes are monitored for their physico-chemicals characteristics (Pre and post monsoon).

It was observed that these lakes are deteriorating day by day with respect to organic load, heavy metals and nutrients like nitrogen and phosphates. The lake water has turned to greenish due to the formation of large quantity of algal growth followed by algal blooms. At some places in the lake, algal blooms are observed on the surface of water, restricting the photosynthetic activity and creating nuisance conditions inside the water body and distributing the aquatic flora and fauna.

### **INTRODUCTION**

Clean and fresh water is the substance most essential to human life. Almost every life form on this earth is dependent upon the water for its survival and existence. Due to this the water quality is widely used expression, which has an extremely broad spectrum of meanings. Each individual has vested interest in water for a particular use, which may

involve commercial and industrial use. Since the desirable characteristics of water are different according to the quality is concerned.

Vidharba region is known as the lake region of Maharashtra. (Fig. 1) Nagpur district with its headquarters at Nagpur lies between  $20^{\circ} 15'$  and  $79^{\circ} 40'$  North Latitudes and  $78^{\circ} 15'$  and  $79^{\circ} 40'$  East Latitudes. Nagpur district stretches over an area of 9930 sq. km. and constituents 3.2% of the total area of Maharashtra state. The topography is typically one of the Deccan traps having fattop and terraced feathares. Nagpur district experienced typical monsoon climate with hot summer and followed by rainy season. The district receives an average rainfall is 1063mm. In given maps located the sampling loation of Futala lake and Gandhisagar lake. (Fig. 2 & 3)

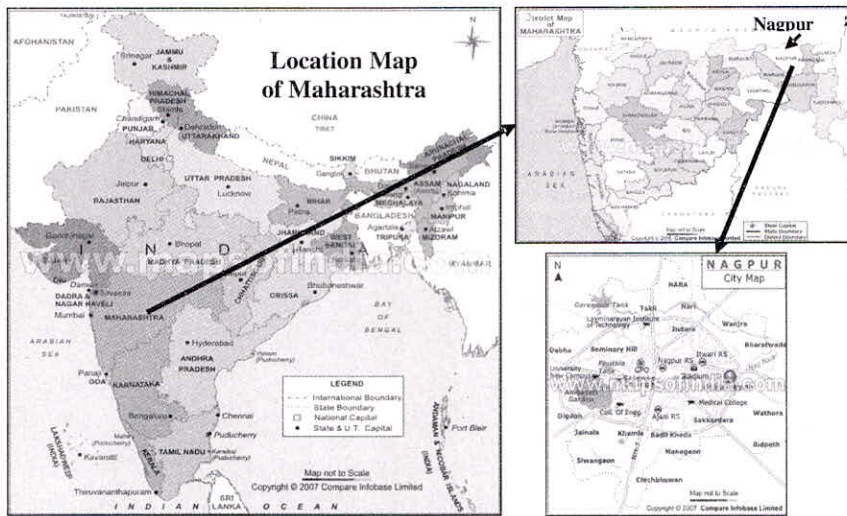


Figure 1: Location in Map

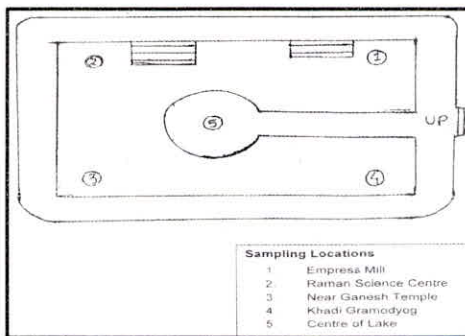


Fig. 2: Locations of Gandhisagar Lake in Nagpur

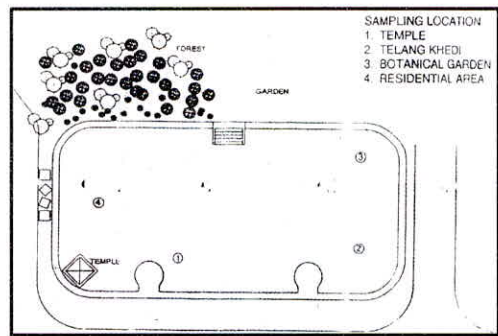


Fig. 3: Location of Futala Lake in Nagpur

There are different lakes which are used as commercial fish culture ponds since many years. One of these lakes is Gandhi sagar lake is also known as Jumma tank or Shukrawari Lake. It is a small and old lake and about 7m deep. The lake is constructed by Chand Bakht Buland Shaha. It is located at the heart of Nagpur city. The surrounding area is densely populated and a commercial vegetable market is located nearby this lake. In past the lake was receiving waste water from textile mill and some quantity of city sewage. (9)

Another lake is a Futala lake which is constructed at the western side of the Nagpur city. Today's status of Futala lake presents to standing example of man's disregard toward nature. The lake was constructed at the time when Nagpur was being expanded by Raje Raghujji Bhonsle. The catchment area of the dam was 6.475km. The length of the main dam was 725.59m while the length of west weir was 8.0m. The lake was having capacity to irrigate an area of 34.42ha(85 acres)of cultivated agricultural land "Telangkheldi Garden". There is the Masonary wall on the water side with parapet wall of 0.99m higher above the level of land. (8)

In Nagpur district, the climate is almost dry and without variation in the temperature. It is quite warm during summer months of March, April and May, the worst month being May. The rainy season commences with the onset of the south-west monsoon in the latter part of the month of June and ends in the month of October. More rainfall occurs in the month of July, August and September. Lake waters generally get enriched with nutrients but, this natural nutrient enrichment is very slow process. Man's interference with lake ecosystem can affect the natural ageing or eutrophication. Due to the industrial development in towns and cities, large quantities of industrial wastes and sewage are dumped in to the water bodies like lakes, rivers, streams. Apart from this, tremendous increase in population, extensive irrigation has been practiced due to which many nutrients like phosphates, sulphates, nitrates, etc., find their way to these water bodies. The catchment of the lake is constituted of various land uses namely Residential, Commercial And Agricultural activities. An attempt has been made in the present work on Gandhisagar and Futala lake, to study the physico-chemical characters. (7)

The lake waters were to serve the irrigation requirements domestic and industrial usage has decreased. Instead, domestic discharges started polluting the lake waters. Further, industrial development around the city aggravated the pollution levels of the lake. The degradation of the lake has continued till date not only due to effluents inflow but also by the domestic sewage, immersion of Ganesh idols and other activities around the lake like washing clothes , cattle's, vehicles and dumping of solid wastes.

### **Need for study**

The overall impact on the lake has resulted in the deterioration of the water quality, accumulation of toxic chemical and sediments, shrinkage of lake area and above all a loss of the aesthetic value.

Tourists and general public are constantly complaining of bad odor around the lake. Near by residents complain of ground water pollution due to seepage of the polluted waters. After the Environmental pollution Rules of 1988 were levied, government has undertaken several projects in order to understand the status of the lake.

In the view of public health, government has also stopped discharge of untreated industrial effluents into the lake. Therefore, continuous monitoring of the pollution level is a must in order to promote better living conditions around the lake along with improvement of aquatic life in the lake.

### **Pollution Load**

Most of our water resources are gradually becoming polluted due to the addition of foreign materials from the surrounding. These include organic matter of plant and animal origin, land surface washing, and industrial and sewage effluents. Rapid urbanization and industrialization with improper environmental planning often lead to discharge of industrial and sewage effluents into lakes. The lakes have a complex and fragile ecosystem, as they do not have self-cleaning ability, and therefore readily accumulate pollutants. (6)

Geography and hydrology of Gandhisagar and Futala Lake are such that it receives inflow from numerous inputs. These inputs carry pollutant loadings from myriad urban, commercial, industrial and agricultural sources, affecting the lake across a wide spectrum of impacts. All acknowledged that obtaining the necessary data would be a substantial project requiring a considerable commitment of resources beyond that which is allocated to lake monitoring today.

Various components of the overall pollutant loading picture of the Lake are known or have recently been estimated from data that is available. For example, there are quite a few spot or point analysis of pollutant levels at most of the significant inflows into the lake, such as at municipal discharge points, domestic discharge, immersion of idols etc.

Through adequate information and data to fully define the pollutant loading into the Lake and all of the impacts caused by these pollutants. Significant data and information do exist to define most of the important factors that impact the Lake and characterize its overall picture. The remainder of this report attempts to summarize some of the major facts that pre dominate concerning sources of pollution and their impacts. (5)

### **Non point sources pollution**

Nonpoint source pollution, unlike pollution from industrial and sewage treatment plants, comes from many diffuse sources. Non point source pollution is caused by rainfall. The pollutant includes algae, nutrients, sediments (3).

### **a) Algae**

Algae are necessary for a healthy lake ecosystem, but there can be too much algae. When this happens, the grazers who eat the algae die off, they sink to the Lake Bottom and decay. The process of decay requires bacteria, which in turn require oxygen. If there is an abundance of dead algae bacteria use up too much oxygen, and there isn't enough left over for all of the animals, like insects and fish. Too much algae can also give lakes an unpleasant green color, a surface scum, or (in the case of drinking water reservoirs) a "fishy" taste.

### **b) Nutrients**

Nutrients in the water are insufficient, algal growth will slow or stop entirely until more nutrients became available. An increase in the concentration of nutrients in a lake will probably increase the amount of algae as well. Nutrients, especially phosphorus also attach to soil particles which wash into lakes as suspended sediment particles during rain events. To truly control algae in lakes, we must control the nutrients.

### **c) Sediments**

While nutrients encourage algal growth in a lake, suspended sediments can restrict growth. These soil materials decrease water clarity, limiting the amount of light available to algae. Suspended sediments make a lake brown, reducing its aesthetic appeal. As the sediments settle out of suspension, they fall to the bottom of the lake and eventually fill in its bottom, requiring that the lake be abandoned or dredged. Dredging is the extremely expensive process of scoping out a lake's bottom and taking the removed from lake water that is to be used for drinking (4).

## **Pollution and Eutrophication**

Lake water generally get enriched with nutrients but, this natural nutrient enrichment is a very slow process. Man's interference with the lake ecosystem can effect the natural ageing or eutrophication. Due to the industrial development in towns and cities, large quantities of industrial waste and sewage are dumped into the water bodies like lakes. Also tremendous increase in population, extensive irrigation has been practiced due to which many nutrients like Phosphates, Sulphates, Nitrates, etc. find way to these water bodies(7). Nitrogen and phosphorus are natural components of soil but are also frequently applied on land as fertilizer. If terrestrial plants do not take up these fertilizers, the nutrients may be transported as non point source pollution to our lakes (4).

## **EXPERIMENTAL METHODOLOGY**

### **Sampling preparation**

Lake water samples were collected from different regions of the study areas. Standard method collection, preservation and analysis were adopted, from APHA.(1) Polyethylene bottles 1000ml capacities were used for collection of water samples. All sampling bottles were soaked in 10% nitric acid then rinsed with distilled water before

use. The bottles were dried, cooled to room temperature, capped and labelled. Water samples collected from Futala and Gandhisagar Lake.

Dissolved oxygen was determined at the sampling site. One set of sample was kept for Physico-chemical examination.

## **AIMS AND OBJECTIVES**

Lake water pollution is a serious pollution problem, which needs concern, as it is known that a lake is less self-assimilating than a flowing river. The stagnant waters of the lake can only undergo aerobic purification which is a slow process. In the present study, an attempt has been made to understand the pollution of the Futala and Gandhisagar lake of Nagpur.

Considering the activities around the lakes, for their physico-chemical characteristics (pre and post monsoon). There are various physical and chemical methods which include a variety of procedures, each applicable to the particular situation. Also considering the merits and demerits of making idols and discharge it into the lakes. It is appropriate to check the physico-chemical characteristics of the lake water samples, and generate the pre and post monsoon scenario of the lake water.

## **RESULT AND DISCUSSION**

The water was found to be green in colour because of algae and accumulation of nutrient, untreated sewage and eutrophication, having a foul odor during summer. The colour of water turns muddy in the rainy season and the intensity of the odor vanishes gradually. The green colour is due to the floating green algae in the surface waters. High productivity rates are associated with fertile or green colour lakes that experience large algal blooms during summer months. The foul odor is due to the decomposition of organic matter in the water.(2)

Water samples were collected from two respective lakes namely Futala Lake and Gandhisagar Lake and sampling locations are shown in dig (2) & (3). The lakes are used regularly for immersion of idols and other domestic activities.

The collected water samples were analysed physico-chemically and the results are presented in following tables 1, 2, 3. It was observed that the inorganic contents concentration with sulphate, chlorides and alkalinity were observed to be more in some location and some were less because of the dilution of ions after post monsoon.

In nutrient analyses, it was observed that the DO range in pre monsoon in lakes are low as compared to post monsoon because of the dilution of ions in lake water after post monsoon. Oxygen demand is going on increasing. The range in pre monsoon is 5.8 to 6.9 and in post monsoon 6.2 to 7.5. COD has high range in pre monsoon (i.e. 42 to 52 mg/l) as compared to post monsoon (i.e. 22 to 49 mg/l). COD shows high range inferring

**Table 1: Water Quality – Physical Parameters of Lakes (pre and post monsoon)**

Location	pH		Turbidity (NTU)		Total Suspended Solids (mg/L)		Total Dissolved Solids (mg/L)		Conductivity (µmhos/cm)	
	pre	post	pre	post	pre	post	pre	post	pre	post
(A) Gandhisagar Lake										
1. Empress Mill	7.68	7.50	0.9	0.8	0.5	0.6	234	298	355	450
2. Raman science Center	8.10	7.78	0.8	1.0	0.4	0.9	322	289	465	420
3. Near Ganesh Temple	7.98	7.65	1.0	1.3	1.4	1.0	259	229	395	357
4. Khadhi Gramodyog	7.58	7.89	1.2	1.4	1.3	1.3	275	405	405	460
5. Center of lake	7.50	7.45	1.1	0.9	1.5	1.2	230	204	350	315
(B) Futala Lake										
1. Temple	7.87	7.50	1.0	1.4	1.1	1.2	258	299	404	460
2. Telang Khedhi	7.89	7.90	0.9	1.0	0.8	1.0	244	227	381	350
3. Botanical Garden	7.65	7.98	0.6	1.0	1.1	1.2	207	253	323	390
4. Residential area	7.94	8.20	1.1	0.9	1.3	1.1	267	245	418	375

**Table 2: Water Quality- Inorganic Parameters of Lakes (pre and post monsoon)**

Location	Alkalinity (mg/L)		Chlorides (mg/L)		Sulphates (mg/L)	
	pre	post	pre	post	pre	post
(A) Gandhisagar Lake						
1. Empress Mill	130	184	237	245	18.5	20.3
2. Raman science Center	180	190	265	211	18.3	19.3
3. Near Ganesh Temple	145	150	232	187	17.3	19.2
4. Khadhi Gramodyog	160	165	277	283	20.3	19.5
5. Center of lake	139	150	162	258	15.3	18.2
(B) Futala Lake						
1. Temple	152	180	263	305	19.3	18.5
2. Telang Khedhi	145	160	246	275	15.2	19.1
3. Botanical Garden	115	172	200	283	15.3	12.1
4. Residential area	140	168	240	288	16.6	19.7

**Table 3 : Water Quality- Nutrient Parameters of Lakes  
(pre and post monsoon)**

Location	Phosphates (mg/L)		DO		COD(mg/L)	
	pre	post	pre	post	pre	post
(A) Gandhisagar Lake						
1. Empress Mill	3.20	2.98	6.5	7.1	45	27
2. Raman science Center	2.45	2.58	6.9	7.2	42	30
3. Near Ganesh Temple	3.5	3.1	6.5	7.5	45	22
4. Khadhi Gramodyog	2.98	2.67	5.8	7.2	52	30
5. Center of lake	1.0	0.98	6.5	7.0	48	29
(B) Futala Lake						
1. Temple	3.50	2.76	6.1	6.2	49	42
2. Telang Khedhi	2.5	2.8	6.2	6.3	47	40
3. Botanical Garden	2.1	0.11	5.9	5.8	50	49
4. Residential area	1.3	0.73	6.0	6.5	48	40

that the organic contents in the lake are very high and the oxygen depletion and carbon dioxide formation in bottom water of Eutrophic lake intensifies with the progression of summer. Because bacteria and organic matter are concentrated at the sediment surface, oxygen depletion typically proceeds "From the bottom up".

In nutrient parameter the phosphorus pollution showed in lake. Their range not much high but there is pollution by algal blooms. This produced eutrophication in lakes. In Futala lake there are shown much algal bloom as compared to Gandhisagar lake. But the low concentration of phosphate in post monsoon as compared to pre monsoon in lake. The limit of phosphates 4mg/l. It stimulates the growth of algae and other aquatic plant. When sewage is allowed to flow in a natural body of water, it depletes the oxygen from the sources and causes pollution. DO in rainy season were probably due to the decomposition of organic matter, transported from catchment area and domestic sewage. COD shows high range inferring that the organic contents in the lakes are very high and the oxygen demand is going on decreases.

### WATER QUALITY INDEX

A water quality index is common with many other indices system transforms a group of water quality parameters to a common scale and combines them to form single number in accordance with a chosen method or model computation.



The main objective of the water quality index system is to use it as a preliminary means to assess a water body for compliance with the standards adopted for designated classes of beneficial uses. (11)

In Gandhisagar Lake and Futala lake has good water quality in post monsoon as compared to their pre monsoon. The water quality in post monsoon has good as compared to pre monsoon because of in pre monsoon there are evaporation in summer season, lot of pollutants inputs, immersion of idol in lakes. And after post monsoon there are dilution of pollutant in lake water. The dilution of ions then the water quality of lake has good. Which are shown in following tables.(A, B, C).

**A) Water quality factors and weights**

	Factor	Weight
1)	Dissolved Oxygen	0.17
2)	pH	0.11
3)	Total phosphate	0.10
4)	Turbidity	0.08
5)	Total solids	0.07

**B) Water quality index legend**

Range	Quality
90-100	Excellent
70-90	Good
50-70	Medium
25-50	Bad
0-25	Very bad

**C) Lake water quality rating based on water quality index**

Sr. No.	Sampling location	Water quality index		Inference	
		Pre	Post	Pre	Post
A	Gandhisagar Lake				
1	Empress Mill	62	65	Medium	Medium
2	Raman Science Centre	59	65	Medium	Medium
3	Near Ganesh Temple	61	66	Medium	Medium
4	Khadhi Gramodyog	61	62	Medium	Medium
5	Centre of Lake	67	68	Medium	Medium
B	Futala lake				
1	Temple	61	62	Medium	Medium
2	Telang Khedi	62	65	Medium	Medium
3	Botanical Garden	63	78	Medium	Good
4	Residential area	63	68	Medium	Medium

## **CONCLUSION**

The study reveals that Futala and Gandhisagar Lakes are polluted by immersion of idols during festivals and also may contribute increased levels of organic and inorganic loads into the water bodies. The water has turned to greenish and bluish due to the formation of large quantity of algal growth and sediments. At some places in the lake algal blooms are observed on the surface water, this will restrict the photosynthetic activity and nuisance condition may create after some time. Pollution load line sediments, nutrients, organic matters were found to be increased in the lakes. Increased in levels of minerals ingredients may affect the aquatic flora and fauna. The water quality of Gandhisagar and Futala lake is good in post monsoon as compared to pre monsoon.

## **REFERENCES**

1. APHA, (1985). Standard Method for the examination of water and waste water. 16th Ed.
2. Dixit, S. and Tiwari , S 2008. Impacts assessment of Heavy Metal Pollution of Shahpura Lake, Bhopal, India. IJER Vol. 2, No.1,2008, pp.37-42.
3. EPA-841- F-94-005, 1994, Polluted water (non point source pollution).
4. File://D:/13/ Non point source pollution and Lake Ecology.htm
5. File://D:/13/ Sources and Impacts of pollution in Lake Pontchartrain.htm.
6. Lokeshwari, H.and G.T. Chandrappa 2008. Impact of heavy metal concentration of Bellandur Lake on soil and cultivated vegetation. Current Science, Vol.91, No.5, 10 Sept. 2006.
7. Malti, C. S. Apportionment of pollutional load form Lake catchment.
8. Suklikar, G.J. Pollution status of Futal Lake-Nagpur. (2004). Nagpur University.
9. Saxena, R.V. Assessment of Benthic Biotic and Abiotic Quality of lakes of Nagpur city during Pre and Post Idol Immersion. (2007). From Nagpur University.
10. www.mapsofindia.com
11. Water Quality Index. Wilkes University Center for Environmental Quality Environmental Engineering and Earth Sciences