International Journal of Researches in Biosciences, Agriculture & Technology | January 2014 Issue-2, Volume-1 | ISSN No. (Online) 2347-517X

WATER QUALITY ASSESSMENT OF GANDHI SAGAR AND GOREWADA LAKES AT NAGPUR USING WATER QUALITY INDEX

A. Mishra[1]*, P. Meshram[2], S. Deshpande[3], M. Sinha[4]
[1]Environment Officer, Nagpur Municipal Corporation (NMC), Nagpur.
[2]Assistant Professor, Sevadal Mahila Mahavidyalaya, Nagpur
[3]Freelance consultant
[4]Project Assistant, National Environmental Engineering Research Institute (NEERI), Nagpur
Corresponding author E-mail : mishra.as@gmail.com

ABSTRACT

Nagpur is a fast developing cosmopolitan city harboring many surface water bodies. The City is blessed with 11 Water bodies. One of the Major Lake situated exactly at the centre of Nagpur City is Gandhi Sagar Lake. It is known by the names Shukravari Talao (lake), and Jumma Lake, located near Raman Science Center. The lake, which is said to be, exists for more than 275 years, was established as a source of water supply by Chand Sultan, then ruler of Nagpur. He created the water body in the form of streams being diverted to the Nag River, which was connected to the water reservoir and named it as 'Jumma Talab'. Subsequently it came to be known as 'Shukrawari Talao' during the Bhonsla and British periods when the first Raghuji declared Nagpur as the capital of his domain in 1742. While Gorewada Lake is situated on the northwest corner of Nagpur city. It is created with a 2,350 feet long dam in 1912; Water supply dept of Nagpur Municipal Corporation developed it as the primary drinking water source for Nagpur Gorewada Lake is surrounded by a dense forest.

For the evaluation of water quality WQI tool has been used. Data was collected in the pre and post-monsoon seasons. pH; Turbidity, Dissolved Oxygen, Fecal Coli forms, Biological Oxygen Demand, Total Phosphates, Nitrates and Total Dissolved Solids have been taken to calculate Water quality Index using an online calculating softaware[20, 21]. The present study revealed that Gandhi Sagar Lake is more polluted than that of Gorewada Lake, although few parameters have shown a variation with reference to surface water standards.

Keywords: *Lakes, water quality Index WQi, Water quality Management*

INTRODUCTION

Surface water bodies play a very vital role in maintaining the available water resources on Earth's surface. Among the surface water bodies, urban lakes

serve as an important source of water for the people living in the surrounding area. These lakes also enhance the aesthetic value of the adjacent area by supporting various aquatic flora and fauna (Dave, 2011). In recent years, due to advent of industrialization, urbanization and uncontrolled anthropogenic activities, most of these lakes have become pot holes for pollutants and exhibit highly polluted state at different trophic levels (Khapekar et al., 2008; Dixit & Tiwari, 2008; Gupta, 2010).

In India, regular bathing and washing, release of waste material and immersion of idols in surface water body, are the major sources of water pollution (Kaur & Dhavale, 2013). In aquatic ecosystems, physicochemical, and biological pollutants are regarded as serious pollutants because of their environmental persistence, toxicity and ability to be incorporated into the food chain at different levels **(**Nemr, 2003). The problem of environmental pollution gets enhanced in case of accumulation of non-biodegradable materials, which become persistent through decades and keeps on increasing day by day (Lone et al., 2008).

Nagpur is the second largest city (spread over 220km^2) located in Central India with a population above twenty five lacs, near to a cosmopolitan city (Marganwar et al., 2012). The temperature ranges between 10-48°C and annual rainfall is around 1200mm. The city has many manmade lakes which have been constructed by historic rulers in the past (Kedar & Patil, 2010). Surface Most lakes in the city have been known to play significant environmental, social and economic functions ranging from being a source of drinking water, means of recharging groundwater, providing livelihoods and supporting biodiversity (Puri et al., 2011a). In Nagpur Gorewada Lake plays a major role in all-purpose source of water to the City. Several measures have been taken by various sectors of the society so as to keep a check on the pollution status of these lakes. Recent research has revealed that the water quality of lakes around Nagpur city has been started deteriorating (Lanjewar & Kelkar, 2008).

The present study aims at evaluating the recent seasonal variation of selected parameters in two major lakes of Nagpur namely Gorewada, and

Gandhi Sagar. Therefore, the research work has been carried out to determine the status of these lakes and their suitability for drinking, irrigation, aquaculture and industrial purpose.

MATERIAL AND METHODS

Study area

Two different lakes within Nagpur city have been taken for the study. Both the lakes are of man-made. These lakes have their historical significance and were built about 300 years ago.

The selection was based on heavy metal pollution results obtained during the study, which showed Gandhi Sagar to be more polluted than Gorewada Lake (**Mishra et. al., 2013**).

Sample collection

The samples have been collected in pre-monsoon and post-monsoon seasons respectively for highlighting the seasonal variations in heavy metal cycle and fluctuations in the eco-toxicity. Samples were collected from these water bodies using depth sampler with inbuilt neck-bottle lock systems to avoid any surface/external contamination by methods prescribed as per CPCB guidelines (CPCB, 2007).Four representative aliquots were collected at different point and mixed together for making one composite water sample.

Preservation of samples

All the samples were stored according to standard protocols mentioned in Standard methods for water and wastewater (APHA, 2005) using non-reactive inert sampling bottles with suitable preservatives. These samples were preserved at 4°C until analyzed. The samples were analyzed within 24h of its collection except dissolved oxygen which was analyzed onsite and temperature. Details of Methodology and Instruments used were depicted in Table no 1 all the reagents and chemicals used during the study were of analytical (AR) grade.

Analysis of samples (As per APHA Standard Methods 22nd edition)

The samples have been taken in the range of 50 -100 ml of each sample was taken the samples were analyzed by advanced analytical approach using

suitable instruments. The final results obtained were expressed in mg/L. except for Turbidity in NTU and Fecal coli forms in CFU/100 ml of the sample.

RESULT AND DISCUSSION

The parameters have been compared according to the pre-monsoon and the post-monsoon season. The status of the lakes in the pre-monsoon season is represented in Table 1

As reflected from the data of pre-monsoon, and post monsoon among all the 9 parameters analyzed, higher values observed predominantly in Gandhi Sagar lake for pH, Dissolved Oxygen, Biochemical Oxygen Demand ,Total Phosphates and Total Dissolved Solids While Other parameters like Turbidity, Fecal coli forms and Nitrates have shown a variations and Found to be maximum at Gorewada lake.

Table 1: Water Quality of Lakes Pre and Post Monsoon

Parameter	Method / Instrument used	Gorewada Lake		Gandhisagar Lake	
		Pre-monsoon	Post-monsoon	Pre-monsoon	Post-monsoon
pH	Model APX 75 E/C	7.42	8.07	7.94	8.22
D.O. (mg/L)	DO meter (Fischer Scientific)	6.62	7.00	4.87	3.68
Turbidity (NTU)	Nephalometer (Model–Ratio/Xr)	43.33	50.50	43.33	44.50
Fecal coli form (CFU/100 ml)	membrane filter technique	104	157	63	94
Nitrate (mg/L)	Spectro-photometric method	32.02	40.48	24.55	32.44
TDS (mg/L)	gravimetric method	249.33	310	352.83	430
Phosphate (mg/L)	Spectro-photometric method	0.80	1.12	2.10	2.48
BOD (mg/L)	Winkler's method	22.17	18.22	44.50	43.67

In the present study, all the parameters were taken and applied on WQI software so as to evaluate a water quality index of both the lakes studied were found Out of the 2 lakes based on 9 factors applied were described in **Table 2**. The occurrence of WQI can be due so several point and non point sources at Gandhi Sagar lake like industrial discharges, municipal waste water, storm water, discharge zinc coated pipelines and run off of water from contaminated soil (Pistelok & Galas, 1999).

Water Quality Index: (Wqi) - WQI is a dimensionless number that combines multiple water-quality factors into a single number by normalizing values to subjective rating curves (Miller et al. 1986). Factors to be included in WQI model could vary depending upon the designated water uses and local preferences. Some of these factors include DO, pH, BOD, COD, total coli form bacteria, temperature, and nutrients (nitrogen and phosphorus), etc. These parameters occur in different ranges and expressed in different units. The WQI takes the complex scientific information of these variables and synthesizes into a single number. Several authors have worked on these concepts and presented examples with case scenarios (Bolton et al. 1978, Bhargava 1983, House 1989, Mitchell and Stapp 1996, Pesce and Wunderlin 2000, Cude 2001, Liou et al. 2004, Said et al. 2004, Nasiri et al. 2007, NSF 2007).

Weighted arithmetic mean [21] - In this model, different water quality components are multiplied by a weighting factor and are then aggregated using simple arithmetic mean (Equation 1).

Equation 1: $WQI = \sum_{i=1}^{n} Sli * Wi$	SIi = Sub-index I
Where WQI = Water Quality Index	n= number of sub-indices
	Wi = Weight given to sub-index i

WQI for Gandhi Sagar lake is found to be **32** while that of Gorewada lake is found to be **33** it is further concluded that both the lakes are highly polluted and needs a comprehensive management plan so as to sustain these water bodies.

Table 2: Water Quality factors and weights: Gandhi Sagar Lake [20, 21] and Gorewada Lake

Factor	Weight	WQI - Gorewada	WQI - Gandhisagar
Dissolved oxygen	0.17	06	04
Fecal coli form	0.16	40	45
pH	0.11	82	76
Biochemical oxygen demand	0.11	14	05
Temperature change	0.10	28	28
Total phosphate	0.10	38	24
Nitrates	0.10	17	25
Turbidity	0.08	39	42
Total solids	0.07	58	58

WQI	$WQI = \sum_{i=1}^{n} Si * Wi$	33	32

Table 3: Water Quality Index Legend

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

CONCLUSION

Urban lakes and other surface water sources can be seen under varying degrees of degradation which is occurring mainly due to anthropogenic activities like encroachment, eutrophication load from effluents and silt deposition. These anthropogenic activities have been considered the major source for the contamination in surface water bodies (Lokeshwari and Chandrappa, 2006).The average levels of contaminants studied in the pre-monsoon season followed order of concentration in post monsoon is high in both the lakes it is concluded that Gorewada and Gandhi Sagar lakes have been more affected by pollution load discharge. Even though, considerable dilution was observed in the post-monsoon season, a clear result of pollution status was not obtained in the post-monsoon season. This study will help in providing an insight to better management measures that need to be taken in order to maintain the water quality of surface water bodies. It also emphasizes the need to develop suitable remediation measures to control the pollution load in water resources.

Recommendations:

- Conservation and restoration of all water resources required an integrated developmental approach. The management of sewerage system and storm water drain becomes a necessity
- The situations of the lakes are highly influenced by the land uses surrounding the lakes. It is observed, that a significant increase in the

development around the lake leads to the deterioration of the lake quality.

- There should be Artificial immersion ponds for immersion of Idols and for spiritual waste vermi composting pit is necessarily required
- Surrounding walls of the Lakes must be covered with channeling and heighted fencing so as to minimize the pollution load on Lakes

Management Tools:

Following measures are necessary to control the eco-balance of these lakes:

- Periodic monitoring of water quality as per environmental guidelines
- Removal of silt/sludge deposited at the benthic level.
- Limnological studies through biological system need to be carried out every year.
- Enhancement of land scoping around the lake through proper plantation and providing amenities
- Restriction of the discharges of wastewater into the lake water body
- Development of the socio-cultural aspects.
- Development of green zone around the lakes.
- Restrictions on all bathing and washing activities in the lakes
- Restriction and total ban on Immersion of idols in the lake during festival seasons.
- Restriction or disposal of garbage and debris into the lake by the surrounding habitat
- Certain common measures which are also applicable to most of the lakes are;
- Dredging and desilting of the lake before the monsoon period.
- Sewage from surrounding developments to be treated before entry into lake.
- Water hyacinth to be completely removed.
- Appropriate buffers to be provided.
- Direct use of lake water without treatment must be prohibited
- Islands with wetland vegetation, shrubs, grasses etc. can be created with perching sites for birds and bioswales.

- Monitoring of the entire water body along with its catchment.
- A thick vegetative barrier and a physical barrier are necessary for the entire lake region to increase the aesthetic view.
- A detailed documentation of the biodiversity of all the flora and fauna existing around the lakes is to be carried out through monitoring or survey for three seasons over a period of three years.

REFERENCES:

Dave, D. (2011) Eutrophication in the lakes of Udaipur city: A case study of FatehSagar lake, Proceeding: International Conference on Biotechnology and Environment Management, IACSIT Press, Singapore ,18: pp 54-57

Dixit, S. and Tiwari, S. (2008) Impact Assessment of heavy metal pollution of Shahpura lake, Bhopal, Int. J. Environ. Res, 2(1): pp37-42

Eaton, A., Clesceri L. S., Rice, E. W., and Greenberg, A. E. (2005) Standard method of analysis of water and wastewater. 21st ed. American Public Health Association (APHA), Water Environment Federation, Washington DC

Gupta, L. N. (2010) Surface and ground water quality monitoring of Chitrakoot during amavasya occasion day, J Chem.& Chemical Sci.,1(1):pp 51-62

Kaur, R. and Dhavale, O. (2013) Comparison of immersion effects of idols made of different materials on the water quality parameters, Ind J Fund. & Appl. Life Sci., 3 (1):pp 16-23

Kedar, G. T., Patil, G. P. (2010) Study of avifaunal diversity of Gandhi Sagar lake, Nagpur, Vidyabharati Inter. Interdis. Res. J., 1(2):pp40-47

Khapekar, R.R., Chaudhari, P. R., and Wate, S. R. (2008) Limnobiotic study of Kanhan river at mouda near Nagpur (Maharashtra), Environ. Issues & Sol, Daya publishing house, Delhi, pp 82-94

Lanjewar, K. Y., and Kelkar, P. S. (2008) Studies on rejuvenation of Futala lake, Nagpur, Proceedings of Taal 2007: The 12th World lake conference, pp1660-1668

Lone, M. I., He, Z., Stoffella, P. J., and Yang, X. (2008) Phytoremediation of heavy metal polluted soils and water: progresses and perspectives, J. Zhejiang Univ. Sc.i B., 9(3):pp210-220

Marganwar, R., Dhurvey, V., Kodate, J., and Dhawas, S. (2012) Physico-chemical characteristics and quality of lake water of Nagpur city, Maharashtra (India), Bionano Frontier, 5 (2-1):pp 159-164

Mauskar, J. M. (2007) Guidelines for Water Quality Monitoring, CPCB manual, New Delhi, pp 1-35

Nemr, A. (2003) Assessment of heavy metal pollution in surface muddy sediments of lake Burullus, Southeastern Mediterranean, Egypt. J. Aqua. Biol. & Fish, 7(4):pp 67-90

Patil, G. and Ahmad, I. (2011) Heavy metals contamination assessment of Kanhargaon dam water near Chhindwara city, Acta. Chem. Pharm. Indica, 1(1):pp7-9

Lokeshwari, H., and Chandrappa, G. T. (2006) Heavy metals content in water, water hyacinth and sediments of Lalbagh tank in Bangalore, J Environ. Sci. &Engg., 48(3): pp183-188

Puri, P. J., Yenkie, M. N. K., Sangal, S. P., Gandhare, N. V., Sarote, G. B., and Dhanorkar, D. B. (2011a) Surface water (lakes) quality assessment in Nagpur city (India) based on water quality index (WQI), RASAYAN J Chem., 1:pp 43-48

Puri, P. J., Yenkie, M. N. K., Sangal, S. P., Gandhare, N. V., Sarote, G. B., and Dhanorkar, D. B. (2011b) Study regarding lake water pollution with heavy metals in Nagpur city (India), Inter. J. Chem. Env. &Pharna. Res., 2(1):pp 34-39

Pistelok, F., and Galas, W. (1999) Zinc pollution of the Przemsza river and its tributaries, Pol. J Environ. Studies, 8(1): pp 47-53

Kritzberg, E. S., and Ekstrom, S. M. (2012) Increasing iron concentration in surface waters – a factor behind brownification? Biogeosciences, 9:pp 1465-1478

Raveendran, R. Manganese removal in drinking water system, Proceedings: 64th Annual Water Industry Engineers and Operators Conference All Seasons International Hotel – Bendigo, pp92-100

http://www.waterefficiency.net/WE/Articles/The_Introduction_to_the_Water_Quality_Index_15374.aspx.

http://www.water-research.net/watrqualindex/