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WATER QUALITY INSPECTION AND METHODICAL REMEDIATION OF ANDRAHALLI LAKE, KARNATAKA, INDIA

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Abstract:

Basic necessity of life supporting system and important natural resource for human kind from industrial development to agriculture is water. Water bodies in urban area are influenced strongly by discharge of industrial waste and untreated domestic water, solid waste dumping, runoff storm water and chemical spills. Due to these various pollutants, which have a greater ecological impact on quality of water in the regions of affected watershed. Andrahalli lake is one among the major lakes belongs to Arkavathi river basin, Bengaluru, Karnataka, India. Water samples of Andrahalli lake were analysed for critical water quality parameters like Potential Hydrogen (pH), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Dissolved Oxygen (DO), Total Coliform (TC) and the Water Quality Index (WQI) were developed. The water quality analysis reveals high BOD value of 18 mg/l, high COD value of 204 mg/l, minimum DO value of 3.23 mg/l and Total Coliform concentration of 270000 MPN/ml of water indicating the pollution of lake due to discharge of untreated domestic sewage. According to the Central Pollution Control Board (CPCB), water quality of Andrahalli lake, indicates that the water is not suitable for drinking purposes, since the WQI class was E. Hence there is a need have interventions remediation measures for restoration of Andrahalli Lake. The interventions may be stoppage of direct entry of untreated sewage in to the lake, establishment of Sewage Treatment Plant (STP) at strategic locations for treating the untreated sewage and stoppage of discharge of untreated trade effluent from industries etc.

Key Words: Water quality, critical water quality parameter, Pollution control and Methodical remediation of lakes, Water Quality Index.

1. Introduction:

Since water is a primary requirement of a life supporting system and the water availability governs the abundance of vegetation, natural arrangement and further forms of terrestrial life. Availability of water sources are not distributed evenly across the globe, few countries having excess water sources while several countries are by now facing water scarcity due to insufficient numbers of suitable water sources. Rapid growth of population in continents is an additional addition to the crisis across the globe. Between several continents, Asia continent alone has 36% of existing reserves of fresh water, but still the water is a scarce commodity is mainly due to containing almost 60% of world of population [1-5]. Approximately 70.91% surface of earth is covered by water, in the form of seas and oceans. Slight percentage of water is available as glaciers (1.7%), and the ice caps, ground water (1.7%), and in precipitation, clouds, and in the air as vapor (0.001%) [6-10]. Authorities regularly need to investigate the pollution in, ponds, lakes, underground water, rivers and additional bases of water to regulate the reason of environmental deterioration and potential health threats. Therefore, environmental officials need a consistent, efficient way to measure possible water contaminants using reference values and measurement methods stipulated by law [11-15]. To improve the quality of water or waste water to make it appropriate for the specific use water treatment process is necessary. Specific use may be for irrigation, water recreation, industrial water supply, river flow maintenance and most importantly drinking. Treating the water to remove the undesirable components and contaminants or to reduce their conc. to fit for the specific use and treating water is key to health of mankind and allows mankind to get benefit either for drinking or domestic uses [16-20]. Nutrients show a significant part in ponds and lakes by helping as the basis of the food chain, but in overly concerted levels they can fuel the growth of undesirable algae, bad odours toxic cyanobacteria, and weeds. Nutrient remedy is the utmost consistent means of dealing poor water quality circumstances while reassuring the development of advantageous microbes and flourishing zooplankton. Nutrients arrives to the water column in numerous ways like motor oil, grass clippings, stormwater containing trash, watershed inflow, and other pollutants [21-25]. Also, it can occur within water itself either by sediment, decomposing vegetation

and accumulated muck. To reduce nutrient for longer term, target has to be done on both internal and external sources of pollution. Current water quality monitoring study was carried out for Andrahalli lake to monitor water quality as per the standard procedure and providing methodical remediation for improving the water quality or reducing the pollution.

2. Materials and Methods:

2.1 Andrahalli Zone:

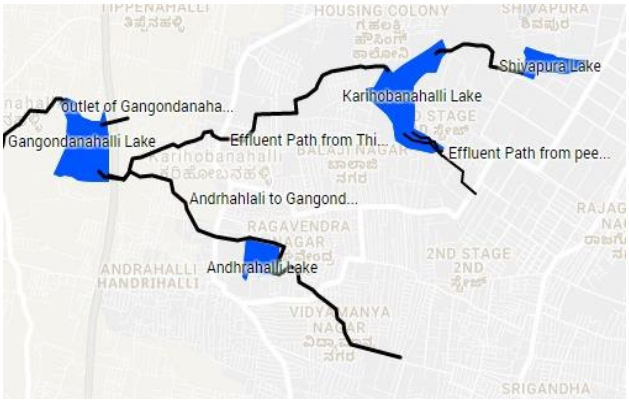
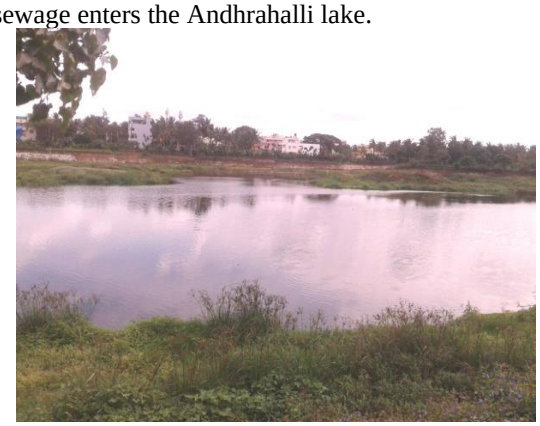


Figure 1: Andrahalli Lake Catchment Area

The study area is Andrahalli Lake - a major lake belongs to arkavathi river basin. Figure 1 shows the location of Andrahalli lake. The location, surrounding areas and water inflow details are discussed in the following paras. The Andhrahalli lake is situated at Sy.No.8 of Andhrahalli village, Bangalore North Taluk. The lake is situated at N 13.010967, E 77.486384. The lake is spread over an area of 16 acres 6guntas. Figure 2 shows photographs of lake, outflow of water, google map and survey map related to Andhrahalli lake.

The main inflow of water into the lake is from rainfall only. The lake is developed by BBMP and is stone pitched all around the lake. A walking path is constructed all around the lake. A stone bund is constructed on the east side of the lake. A rajakaluve is present on the eastern side of the lake whose outflow is diverted to an underground pipeline. The pipeline is laid underground along the periphery of the lake and the outlet of the pipeline flows in a rajakaluve on the North-western side of the lake along with the outflow water of the lake. However, during the rainy season, when the rajakaluve overflows at the eastern side, the storm water along with sewage enters the Andhrahalli lake.



a)

b)

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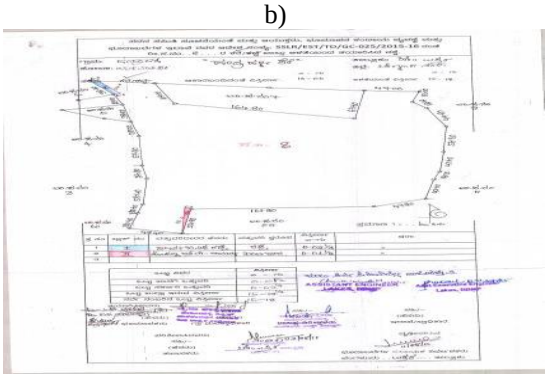

d)

Figure 2: a) Photograph of Andhrahalli lake b) Stormwater drain flowing beside Aar Vee chemicals, Bhyraveshwara industrial Area c) Google map of Andhrahalli lake d) Survey map of Andhrahalli lake

2.2 Sample Collection, Preparation and Analysis:

Samples were collected during winter, summer, monsoon and post monsoon of 2020 for Andrahalli lake. Collection of 1 sample in each season (total 4) and compared for the water quality standards. Dry weather flow in summer season influences on receiving lake pollution at the maximum level. So, the dry season very important for analysing water quality. Four sampling sites were preferred based on the point source pollution. Grab sampling method has been used for collecting the samples. Sampling sites details related to location were shown in Table 1.

Table 1: Sampling codes and locations details of the lakes

Code	Sites Description	Longitude, Latitude
Sample 1	Andrahalli lake	N 13.024278, E 77.499067.

The study involves monitoring of physical, chemical and biological parameters of lake water. All the samples were analysed as per guidelines published by American Public health Association for the inspection of water or wastewater. Importance has been given to five major parameters relevant to water quality i.e.; 1. pH, 2. BOD, 3. COD, 4. DO, and 5. TC. Analysis of lake water samples has been done on season wise like, winter, summer, monsoon and post monsoon. The process implemented in the study has shown in Figure 3 flow chart and procedure along with steps are mentioned & briefed below.

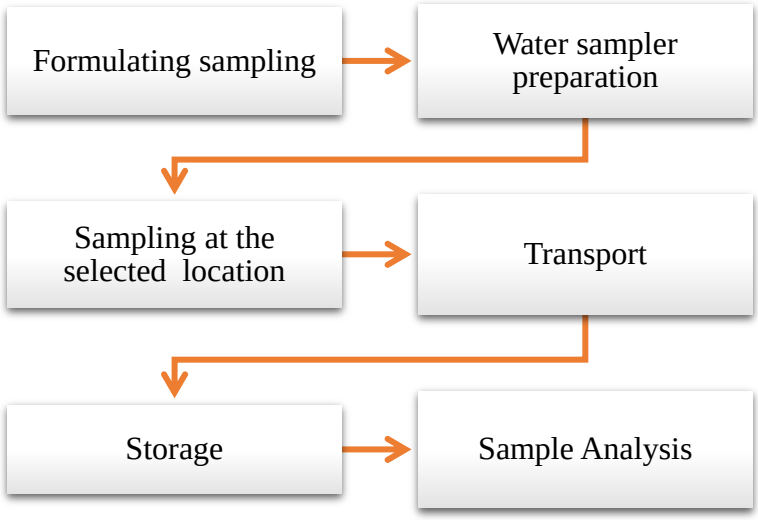

Figure 3: Flowchart of process implemented in inspection of water quality in lake water

3. Results and Discussions:

3.1 pH Analysis:

Table 2: pH analysis of Andhrahalli lake

Seasons	pH	Drinking Water Standard
Winter	6.95	6.5 – 8.5
Summer	8.5	
Monsoon	6.75	
Post Monsoon	7.2	

Source: Author

pH analysis has been done to know the alkalinity and acidic value of the water. pH isn't a quality that falls under EPA regulation since it's considered an aesthetic quality of water. Considering the range of pH 6.5-8.5 suitable for drinking water the obtained results of sample shows that water is suitable for drinking purpose. Table 2 shows the pH values of Andrahalli Lake. The analysis report reveals that the maximum pH recorded i.e., 8.5 during summer season and minimum pH was 6.75 during Monsoon season. The water quality in terms of pH indicates that there no pollution in terms of Acidity or Alkalinity and hence for drinking purposes.

3.2 BOD Analysis:

BOD analysis was primarily used in this study to know the amount of dissolved oxygen is needed to break down organic materials present in a water sample by aerobic biochemical action at 27°C for 3 days. Indication of high BOD represents organic pollution.

Table 3: BOD analysis of Andhrahalli Lake

Seasons	BOD in mg/l	Drinking Water Standard in mg/l
Winter	7	2-3
Summer	18	
Monsoon	9.66	
Post Monsoon	7.66	

Source: Author

Based on CPCB of India the permissible amount of BOD for drinking water is 2-3 mg/l. Table 3 shows the BOD values of Andrahalli Lake. The analysis report reveals that the maximum BOD value of 18 mg/l during Summer and minimum BOD value of 7.0 mg/l during Winter. Based on analysis it's also confirms that maximum BOD values have obtained for summer season and minimum BOD values for Winter season. This high value of BOD indicates discharge of either untreated sewage or partially treated sewage in to the lake from residential area. The results indicate that the lake water quality is deteriorated due to discharge of untreated/partially treated domestic sewage from the surrounding area.

3.3 COD Analysis:

COD analysis was used to determine the amount of oxygen required to break chemically oxidizable organic matter present in water samples with suitable oxidizing agent.

Table 4: COD analysis of Andrahalli Lake

Seasons	COD in mg/l	Drinking Water Standard in mg/l
Winter	80.5	250
Summer	204	
Monsoon	100.66	
Post Monsoon	81.33	

Source: Author

Based on CPCB of India the permissible number of COD for limits for industrial effluence is 250 mg/l. Table 4 shows the COD values of Andrahalli Lake. The above table reveals that the maximum COD value of 204 mg/l during Summer and minimum COD value of 80.5 mg/l during Winter. Based on analysis it's also confirms that maximum COD values have obtained for summer season and minimum COD values for Winter season. The results indicate that the lake water quality is polluted due to discharge of untreated/partially treated industrial effluent from the surrounding area.

3.4 DO Analysis:

DO was analysed for determining the water quality and to observe the presence of aquatic life in the lake water. It is an essential tool for indicating quality of water also it increases taste of water.

Table 5: DO analysis of Andrahalli Lake

Seasons	DO in mg/l	Drinking Water Standard in mg/l
Winter	4.65	6.5 - 8
Summer	4.1	
Monsoon	3.23	
Post Monsoon	4.96	

Source: Author

Concentration of dissolved oxygen has major role in analysing water quality, if the water is having less dissolved oxygen, then aquatic animals may suffocate or die and with increased dissolved oxygen will leads to cause a corrosion. Healthy water should normally have dissolved oxygen concentrations above 6.5-8 mg/L. Table 5 shows the DO values of Andrahalli Lake. The analysis report reveals that the maximum DO value of 4.96 mg/l during Post Monsoon and minimum DO value of 3.23 mg/l during Monsoon Season. Based on analysis it's also confirms that maximum DO values have obtained for Post Monsoon season and minimum DO values for Monsoon season. The high value of DO during Summer season indicates no entry of sewage and healthiness of water for survival of aquatic life and minimum value during winter indicates that the aquatic life cannot survive and eutrophication of lake due to no water/minimum water in the lake.

3.5 TC Analysis:

Table 6: TC analysis of Andrahalli Lake

Seasons	Total Coli Form	Drinking Water Standard in mg/l
Winter	270000	Nil
Summer	135000	
Monsoon	184866.66	
Post Monsoon	178000	

Source: Author

Total Coliforms or TC analysis was used to measure the level or degree of bacterial pollution and sanitary quality of waste water.

For drinking water no total coliform should be detected. Table 6 shows the TC values of Andrahalli Lake. EPA Maximum Contaminant Level (MCL) for coliform bacteria in drinking water is zero (or no) total coliform per 100 ml of water. The analysis report reveals that the maximum TC value of 270000 MPN/100 ml during Winter and minimum TC value of 135000 MPN/100 ml during summer season. Based on analysis it's also confirms that maximum TC values have obtained for winter season and minimum TC values for summer season. The results indicate that the lake water quality is deteriorated due to discharge of untreated/partially

treated domestic sewage from the surrounding area. During post monsoon, the dilution from rain water is helping to reduce the bacterial contamination.

3.6 Water Quality Index (WQI):

Table 7: WQI Classes of Andrahalli lake

Sample Code	Location	Water Quality Index Class
Sample 1	Andrahalli lake, Bengaluru	E

The Water quality index is major tool for determining the quality of drinking water in rural, urban and industrial areas. After summarizing quality of water completely, results don't indicate extensive variation from zone to zone. The objective of the study is to evolve water quality of Andrahalli Lake for irrigation, domestic and other purposes. As per Central Pollution Control Board (CPCB) WQI classes, Andrahalli Lake water quality was assessed as bad and is classified as class E in all the season. Hence as per the class, the water from this lake can be used for controlled waste disposal, industrial cooling and irrigation after tertiary level treatment.

3.7 Methodical Remediation:

Water quality inspection results based on WQI class E shows that the quality of Andrahalli Lake water is not fit for drinking purposes. Due to the regular increase in the pollution level of the lakes and rapid urbanization along with industrial waste & domestic waste depleted the quality of water in lakes. So considered an effective technique to control, regulate the lake water quality. Physical, Chemical and Biological, remediation technologies can be adopted as cost-effective method for improving Andrahalli lake water.

4. Conclusion:

The current analysis serves as the first assessment on the Andrahalli lake. In the current study, water quality Monitoring of Andrahalli lake has been studied along with the seasonal variation too. Here overall suitability of the Andrahalli lake water quality is based on WQI classes. The prominent features of several vital physico-chemical parameters of quality water of the lake of Andrahalli Lake are highlighted. The water quality analysis reveals high BOD value of 18 mg/l, high COD value of 204 mg/l minimum DO value of 3.23 mg/l and Total Coliform concentration of 270000 MPN/ml of water indicating the pollution of lake due to discharge of untreated domestic sewage. for According to the Central Pollution Control Board (CPCB), water quality of Andrahalli lakes, indicates that the water is not suitable for drinking purposes, since the WQI class was E.

Immediate action plan has to be implemented to assess & augment the lake water quality by essential water quality management plan, which influences sustainable lake restoration. Quality of the water has to be improved by employing numerous parameters like restricting inflow of sewage from residential area and industries and preventing solid waste disposal by residential communities to the lake bed. Along with this, to increase quality of lake water by de-silting the lake bed and avoiding major encroachments for urban developments. Apart from this, Physical, Chemical and Biological treatment up to tertiary level can be considered and suitable remediation technologies can be adopted as cost-effective method for improving overall lake water quality.

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