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ASSESSMENT OF WATER QUALITY IN THE CATCHMENT AREA OF ARKAVATHI RIVER- SHIVAPURA LAKES, KARNATAKA, INDIA

Environmental Science

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ABSTRACT

Groundwater is extremely responsive to fluctuations. Increasing urbanization, uncontrolled use of agrochemicals in agriculture, land usage, land cover changes, and exotic species are all creating substantial and diverse contamination in the aquatic system, resulting in water quality degradation. The Shivapura Lake is one among four major lakes belongs to Arkavathi river basin. Water samples were analysed for critical the standard of water parameters i.e.; pH (Potentia Hydrogen), 2. BOD (Biochemical Oxygen Demand), 3. COD (Chemical Oxygen Demand), 4. DO (Dissolved Oxygen), and 5. TC (Total Coliform) and the Water quality index are developed. The standard of water analysis reveals high BOD value of 40 mg/l, high COD value of 254 mg/l minimum DO value of 2.15 mg/l and Total Coliform concentration of 84600000 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 Shivapura lakes, shows that the water is unfit for human consumption, since the WQI class was E. Hence there is a need have interventions remediation measures for restoration of Shivapura Lake. The interventions may be stoppage of direct entry of untreated sewage in to the lake, establishment of STP at strategic locations for treating the untreated sewage and stoppage of discharge of untreated trade effluent from industries.

KEYWORDS

Water quality, Critical water quality parameter, Pollution control and Methodical remediation of lakes

1. INTRODUCTION

Water quality is extremely sensitive to changes. Rapid industrialization, indiscriminate use of chemical fertilisers and pesticides in agriculture, land usage, land cover changes, and invasive species are all producing substantial and diverse contamination in the aquatic environment, resulting in worsening of water quality and biota depletion. The human population is afflicted with a variety of water-borne diseases as a result of the usage of contaminated water. As a result, it is vital to monitor the water quality at regular intervals [1].

Water contamination has arisen as a matter of anxiety in India's fast developing cities. With ongoing huge investments in centralised waste water treatment systems and an increasing number of innovations in decentralised possible treatments, storm water drainage networks are sometimes disregarded as a possible locus of intervention. However, these networks provide the potential for targeted strategy to increase soil and groundwater quality [2].

It is necessary to monitor the water quality of lakes to assess the pollution of ponds, lakes, underground water, river water to regulate the environmental deterioration and potential health threats. To improve the quality of water to make it appropriate for the specific use water treatment is necessary. Specific use may be for irrigation, water recreation, industrial water supply, river flow maintenance and most importantly for drinking. Treating the water to remove the undesirable components and contaminants or to reduce their concentration to fit for the specific use and treating water is key to health of mankind and allows human being to get benefit either for drinking or domestic uses [3].

Present water quality monitoring study was carried out for Shivapura lake to monitor water quality as per the standard procedure and providing methodical remediation for improving the water quality or reducing the pollution.

The study area is Shivapura Lake - a major lake belongs to arkavathi river basin. Figure 1 shows the location of Shivapura lake. The location, surrounding areas and water inflow details are discussed in the following paras.

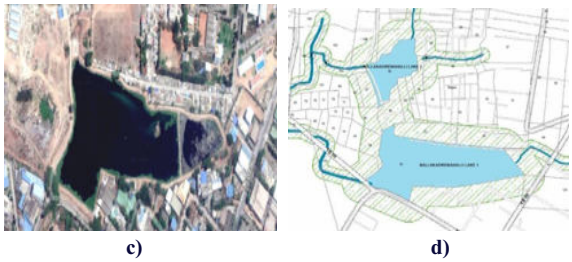
The Shivapura lake is located adjacent to Peenya Industrial area. The Shivapura village and Nelagadaranahalli village are surrounded by this lake and also these two villages are located on the upstream side of the Shivapura lake. This lake falls in the jurisdiction of BBMP. The Shivapura lake is spread over an area of 7.75 acres. Figure 2 shows photographs of lake, outflow of water, google map and Comphrensive development plan related to Shivapura lake.

2. MATERIALS AND METHODS

2.1 Shivapura Zone

Figure 1: Gangondanahalli lake catchment area leads to Shivapura lake

a) **b)**



c) **d)**

Figure 2: a) Photograph of Shivapura lake on the eastern side

b) Outflow of water through rajakaluve from Shivapura lake which finally joins Karihobanahalli lake.

c) Google map of Shivapura lake
d) Comprehensive Development Plan map of Shivapura lake.

The major inflow of water into the lake is from the eastern side of the lake. There is a stone bund constructed on the eastern side to arrest the solid waste entering the lake. The sewage generated from part of Rajagopalnagara, Shivapura village, 2ndphase & 4th Phase Peenya industrial area is joining the Shivapura lake. The main source of sewage/storm water to this lake is the entry of sewage generated from the unauthorized residential growth from above said two villages and unauthorized disposal of municipal/industrial solid waste from the surrounding establishments.

2.2 Sample Collection, Preparation and Analysis

Four samples were collected during winter, summer, monsoon and post monsoon of 2020 for Shivapura lake. Collection of 4 samples in each season (total 16) 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	Shivapura lake	N 13.023259, E 77.506573.

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 2 flow chart and procedure along with steps are mentioned & briefed below.

Figure 2: Flowchart of process implemented in inspection of water quality in lake water

3. RESULTS AND DISCUSSIONS

3.1 pH Analysis:

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: pH analysis of Shivapura lake catchment area

Seasons	pH	Drinking Water Standard
Winter	7.7	6.5 – 8.5
Summer	7.75	6.5 – 8.5
Monsoon	6.87	6.5 – 8.5
Post Monsoon	6.7	6.5 – 8.5

Source: Author

Table 2 shows the pH values of Shivapura Lake. The analysis report reveals that the maximum pH recorded i.e., 7.75 during summer season and minimum pH was 6.70 during post 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 Biochemical Oxygen Demand (BOD) Analysis:

Biochemical Oxygen Demand or 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 Sivapura Lake

Seasons	BOD in mg/l	Drinking Water Standard in mg/l
Winter	40	2-3
Summer	18	2-3
Monsoon	19	2-3
Post Monsoon	7.5	2-3

Source: Author

Based on Central Pollution Control Board (CPCB) of India the permissible amount of BOD for drinking water is 2-3 mg/l. Table 3 shows the BOD values of Shivapura Lake. The analysis report reveals that the maximum BOD value of 40 mg/l during winter and minimum BOD value of 7.5 mg/l during post monsoon. Based on analysis it's also confirms that maximum BOD values have obtained for winter season and minimum BOD values for post monsoon 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 Chemical Oxygen Demand (COD) Analysis:

Chemical Oxygen Demand or 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 Shivapura Lake

Seasons	COD in mg/l	Drinking Water Standard in mg/l
Winter	254	250
Summer	178	250
Monsoon	132	250
Post Monsoon	76.5	250

Source: Author

Based on Central Pollution Control Board (CPCB) of India the permissible number of COD for limits for industrial effluence is 250 mg/l. Table 4 shows the COD values of Shivapura Lake. Teh above table reveals that the maximum COD value of 254 mg/l during winter and minimum COD value of 76.5 mg/l during post monsoon. Based on analysis it's also confirms that maximum COD values have obtained for winter season and minimum COD values for post monsoon 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 Dissolved Oxygen (DO) Analysis:

Dissolved oxygen or DO was analysed for determining the water quality and to observe teh 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 Shivapura Lake

Seasons	DO in mg/l	Drinking Water Standard in mg/l
Winter	2.15	6.5 - 8
Summer	6.9	6.5 – 8
Monsoon	3.275	6.5 – 8
Post Monsoon	3.95	6.5 – 8

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 Shivapura Lake. The analysis report reveals that the maximum DO value of 6.9 mg/l during summer and minimum DO value of 2.15 mg/l during Winter Season. Based on analysis it's also confirms that maximum DO values have obtained for Summer season and minimum DO values for winter 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 eutrofication of lake due to no water/minimum water in the lake.

3.5 Total Coliforms (TC):

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

Table 6: TC analysis of Shivapura Lake

Seasons	Total Coli Form	Drinking Water Standard in mg/l
Winter	8460000	Nil
Summer	27000	Nil
Monsoon	482250	Nil
Post Monsoon	22100	Nil

Source: Author

For drinking water no total coliform should be detected. Table 6 shows the TC values of Shivapura 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 846000 MPN/100 ml during winter and minimum TC value of 22100 MPN/100 ml during post monsoon season. Based on analysis it's also confirms that maximum TC values have obtained for winter season and minimum TC values for post monsoon 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 Shivapura lake

Sample Code	Location	Water Quality Index Class
Sample 1	Shivapura lake, Peenya Industrial Area, 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 Shivapura Lake for irrigation, domestic and other purposes. As per Central Pollution Control Board (CPCB) WQI classes, Shivapura Lake water quality was assessed as bad and is classified as class E. 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 Shivapura 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 Shivapura lake water.

4. CONCLUSION

The current analysis serves as the first assessment on the Shivapura lake. In the current study, water quality Monitoring of Shivapura lake has been studied along with the seasonal variation too. Here overall suitability of the Shivapura lake water quality is based on WQI classes. The prominent features of several vital physico-chemical parameters of quality water of the lake of Shivapura Lake are highlighted.

The water quality analysis reveals high BOD value of 40 mg/l, high COD value of 254 mg/l minimum DO value of 2.15 mg/l and Total Coliform concentration of 84600000 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 Shivapura 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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