



## **Studies on Environmental Status of Bagali Tank Near Harpanahalli, Bellary District, Karnataka (India)**

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### **Authors' contributions**

*This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.*

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### **ABSTRACT**

Bagali tank is a perennial artificial water body situated 10 kms away from Harapanahalli to north-eastern region. The area of the tank is 146.2 hectares and depth is about 30 feet. The water body is irregular in shape. It is located at 14.842°N latitude and 75.989°E longitude. Rainwater, sewage and seepage from hilly regions is the main source of water to this tank. The water is used for agricultural practices and domestic activities. Due to anthropogenic activities, rapid industrial growth, domestic and agricultural activities of the region, the tank water is being polluted, which is the case with almost all major tanks of the region and also in India. A yearlong study was conducted to measure various physico-chemical and bacteriological parameters including levels of phytoplankton in the tank. The study revealed that there is indication of pollution in the Bagali Tank and hence preventive measures are required to avoid further deterioration of the tank water quality.

*Keywords: Diatoms; phytoplankton; Bagali tank; physico-chemical; bacteriological.*

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## 1. INTRODUCTION

In India 80% of the surface water is vulnerable to pollution as more than 95% of the sewage in the country is not treated. Lentic water bodies like pond, tank and open well play a very important role in maintaining the biodiversity and over all ecological balance in nature. However, the water quality of fluvial systems is deteriorating due increase in the amount of raw sewage entering the surface water body. The increase of pollution is caused by population growth and increasing urbanization. Related to this is the industrialization that also causing huge environmental problems [1,2].

Bagali tank is a perennial artificial water body situated 10 kms away from Harapanahalli to north-eastern region. The area of the tank is 146.2 hectares and depth is about 30 feet. The water body is irregular in shape. It is located at 14.842°N latitude and 75.989°E longitude. Rainwater, sewage and seepage from hilly regions is the main source of water to this tank. The water is used for agricultural practices and domestic activities. Pollution is as old as man himself. In prehistoric time the population was very thin, the man used to move from place to place in search of food and better living. The Taluk Harpanhalli is located in its center being heart/center Taluk in the whole state between 14.8°N 75.98°E covering an area of 6.98 km<sup>2</sup> (2.69 sq mi) at an average altitude of 633 m above Mean Sea Level (MSL).

The present study is an attempt to characterize the water quality of Bagali Tank water with respect to their pH, Turbidity, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Dissolved oxygen (DO), Biological Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Total hardness, Calcium, Magnesium, Sulphate, Nitrate, Phosphate, and Chloride with a few to find out some clue(s) for Bagali Tank water management. Bacteriological parameters like Most Probable Number of bacteria per 100 ml (MPN) including levels of diatoms and phytoplankton.

## 2. MATERIALS AND METHODS

The sampling is done at four different locations of the Tank water named as: Location (S<sub>1</sub>): The sites of this habitat are located at the north side near Shimogga –Hospet Road. Location (S<sub>2</sub>): This station is located on the west side of the city in a place algal growth is indicating Location (S<sub>3</sub>):

This is located south side of the tank near Bagali village at the distance of 500 meter from location S<sub>2</sub>. Location (S<sub>4</sub>): This sampling location is located near Bagali village.

Collected water samples were brought to the laboratory and samples were analyzed for physico-chemical characteristics and bacteriological study MPN index were determined by methods given in APHA [3], Diatom and phytoplankton were studied [4,5].

In order to determine the water quality, surface water samples were collected at selected water body from four sampling sites during study period. The samples were collected in sterilized bottles using the standard procedure for grab samples in accordance with standard methods of [6]. The samples were analyzed as per standard methods. In situ measurement was adopted to determine unstable parameters including; pH, EC and DO by portable meters. The analysis of the parameters total hardness and ions of each calcium, magnesium, chloride were carried out by volumetric analysis in accordance with standard methods of [6].

## 3. RESULTS AND DISCUSSION

It is well known fact that potable safe water is absolutely essential for healthy living. Adequate supply of fresh and safe drinking water is a basic need for all human beings on the earth. The problem of drinking water contamination, water conservation and water quality management has assumed a very complex shape. Attention on water contamination and its management has become a need of our because of far reaching impact on human health. The major hazard in drinking water supplies is microbial contamination, which is due to agricultural land wash, domestic sewage, industrial effluents, improper storage and handling WHO [7,8].

### 3.1 Temperature

Temperature is important parameters for the biochemical and physiological processes in the aquatic organisms. Values of water temperature ranged from 28.5°C to 30°C in all the four locations Minimum value of 28.5°C was observed in location S<sub>2</sub> and maximum value of 30°C in location S<sub>3</sub>. The results of present work corresponds to the lower temperature range recorded as 25.75°C to 30.81°C in Banjara Lake, Dahikhura reservoirs and in lake at Nainital [9,10]. Generally water temperature correspond

with air temperature indicating that the samples collected from shallow zone has a direct relevance with air temperature, shallow water reacts quickly with changes in atmospheric temperature. Similar type of observation is made by freshwater hill stream at Nandadevi and in Sruinsar lake of Jammu [11].

### 3.2 pH

Measurement of hydrogen ion concentration which is represented as pH. Values ranged between 7.4 and 8.4 with minimum value in station S<sub>3</sub>. The pH values observed meets the quality of water required for drinking purposes with respect to IS and WHO standards. Results of pH of present study collaborates with the pH values registered as 7.10 to 8.10 in Arjuna River in Sivakasi, Tamil Nadu [12]. The factors like photosynthesis, respiratory activity, temperature exposure to air, disposal of industries wastes etc bring out changes in the pH [13].

### 3.3 Turbidity

Turbid water interferes with self-purification of streams by reducing photosynthetic activity of aquatic plants. The turbidity ranged from 5 to 18 NTU. The results are above the permissible limits prescribed by WHO, ISI and ICMR for drinking water standards [3]. Turbidity of water is actually the indication of optical property in which the light is scattered by the particles present in the water. Clay, silt, organic matter, phytoplankton and other microscopic organisms cause turbidity in lake water [14]. High turbidity shows presence of large amount of suspended solids [15].

### 3.4 Electrical Conductivity

Electrical Conductivity varied from 235.04  $\mu$  mhos/cm to 595.76  $\mu$  mhos/cm (Table 1) maximum value was recorded at the station S<sub>3</sub>. The total dissolved solids ranges from 129.27 mg/l to 357.45 mg/l. The total dissolved solids mainly consist of inorganic solids, small amount of organic matter and dissolved gasses. Electrical conductivity and total dissolved solids values are within the limit prescribed for water quality prescribed for drinking standards under IS and WHO. The relative high conductivity recorded during study may be attributed to the predominance of non-leached substratum and the large size of the catchments area. A high level of conductivity reflects the pollution status as well as trophic levels of the aquatic body [16].

Conductivity of water depends upon the concentration of ions and its nutrient status and variation in dissolved solid content.

### 3.5 Dissolved Oxygen

DO concentration in a water body indicates its ability to support aquatic life. In the present study the DO level fluctuated between 6.8 mg/l to 8.1 mg/l. Maximum DO 8.1 mg/l was at station S<sub>1</sub> and minimum at station S<sub>3</sub>. The fluctuation of DO level could be due to the fluctuation of water temperature and the addition of oxygen demanding substances through sewage and industrial wastes. Higher DO facilitating the abundant growth of phytoplankton and related zooplankton leading to higher biological activity was observed in Bagali tank water. The low dissolved oxygen value indicates the bio-degradation of organic matter and decay of vegetation [17]. The Dissolved oxygen values are acceptable for the use of water for drinking purposes. However, the BOD values obtained indicates that the water is contaminated by degradable organic impurities. The minimum amount of dissolved oxygen in the water of Chandola lake was recorded during summer season, whereas the maximum amount of dissolved in the water of Chandola lake was recorded during monsoon season. Dissolved oxygen in water is often attributed to the fact that the oxygen is dissolved more during the period of active photosynthesis [18,19].

### 3.6 BOD and COD

BOD and COD values range from 4.1 mg/l to 4.8 mg/l and 66.90 mg/l to 186.40 mg/l respectively (Table 1). A maximum value of BOD and COD was at station S<sub>3</sub> but minimum at station S<sub>1</sub>. BOD in general gives a quantitative index of the organic substance, which is degraded quickly. Maximum BOD value observed in station S<sub>3</sub>. Due to oxidation of the organic waste by natural microorganisms created high BOD. The discharge of wastes with high levels of BOD can cause water quality problems such as severe dissolved oxygen depletion and fish kills in the receiving water bodies [20]. Chlorine can also affect BOD measurement by inhibiting or killing the microorganisms that decompose the organic and inorganic matter in a sample. In chlorinated waters, such as those below the effluent from a sewage treatment plant, it is necessary to neutralize the chlorine with sodium thiosulphate [3].

The same trend has been noticed for COD [21,22]. The BOD and other microbial activities are generally increased by the introduction of sewage [23]. The high value of COD indicates the possibility of pollution due to chemically oxidisable organic matter [24]. BOD values are more than 1.0 in all the stations hence the water cannot be used directly for drinking purposes. This water can be used as source of drinking water only after conventional treatment and disinfection to remove microorganisms.

### 3.7 Sulphate

Sulphate is naturally occurring anion found in almost all kinds' water bodies. It may undergo transformation to sulphur or hydrogen sulphide. It is also an important anion imparting hardness to the waters [4]. The sulphate content in the present study ranged between 7.6 and 14.8 mg/l (Table 1). Present concentration is acceptable for designated use of water. Sulphur bearing mineral is common in most sedimentary rocks. In the weathering process, gypsum (calcium sulphate) is dissolved and sulphide minerals are partly oxidized, giving rise to a soluble form of sulphate that is carried away by water. In humid region, sulphate is readily leached from the zone of weathering by infiltrating waters and surface run off but in semiarid and arid regions the soluble salts may accumulate within a few tens of feet of land surface [3].

### 3.8 Phosphate

Phosphorus occurs in natural water as various types of phosphates. It is also a critical nutrient like nitrate for the growth of algae in the aquatic realm. The most important sources of phosphates are the discharge of domestic sewage, detergents and agricultural runoff [4]. Values of phosphate ranged from 0.4 to 1.13 mg/l with the minimum value in station S1 and maximum value in station S3. Values of Phosphate content lower and higher than the present findings were reported in some south Indian surface waters (river of Dakshina Kannada, Karnataka- [25]; Khandepar River, Goa- [26]. NH<sub>4</sub>- N is generated by heterotrophic bacteria as the primary nitrogenous end product of decomposition of organic matter and is readily assimilated by plants in the trophogenic zone [27].

### 3.9 Chloride

Chloride is one of the important indicators of pollution. Chlorides are present in sewage and

farm drainage. In the present study the highest chloride level (146.94 mg/l) showed in the station S<sub>3</sub>. Chlorides increase the degree of eutrophication [28], but low level of chloride suggests reduction in eutrophication. Present study indicates that chloride concentration is in the lower concentration except in station S<sub>3</sub> which may be due to the entry of domestic effluent from the surroundings of the Bagali tank. The minimum amount of chloride in lake water was recorded during the winter season and the maximum amount was recorded during summer season. The high chloride concentration of the lake water may be due to high rate of evaporation or due to organic waste of animal origin [29].

### 3.10 Total Hardness

Total hardness of water is not a pollution parameter but indicates water quality mainly in terms of Ca<sup>2+</sup> and Mg<sup>2+</sup> content. Total hardness values observed are 80.5 mg/l to 189.40 mg/l. calcium and magnesium concentrations are observed to be in the range 50.0 to 141.40 mg/l and 31.0 to 48.0 mg/l respectively. The water quality with respect to Ca<sup>2+</sup>, Mg<sup>2+</sup> and total hardness is in the acceptable range for drinking water as per the classification of IS and WHO standards. The high value of hardness during summer may be due to evaporation of water and addition of calcium and magnesium salts by mean of plants and living organism. Similar result was observed in J.N.U lake in Delhi and in various water bodies of Tamilnadu [30].

### 3.11 Bacteriological Studies

The results of bacteriological studies are given in (Table 1). The MPN index is maximum; it indicates dense pollution of bacteria in the water samples [31]. The comparative analysis of the microbial load indicates that bacteria were encountered at station S<sub>3</sub> where effluents are discharged into the river than both the upstream and the downstream. Similar results were obtained in the study area of a polluted river, Oba River exposed to human and agricultural wastes [32]. Diatoms and other phytoplankton of the Bagali Tank water were indicated with reference to distribution and composition. The major Diatoms distributed in the area were *Synedra ulna*, *Melosira granulates* and Phytoplankton species include *Anabena*, *Rivularia*, *Oedogonium*, *Oscillatoria*, *Chlorella pyronoidosa* respectively occurring in polluted water were common and dominant in the area (Table 2 and Table 1).

**Table 1. Monthly variations in physico-chemical characteristics of Bagali Tank water at Harpanahalli Taluk (December 2018 – November 2019)**

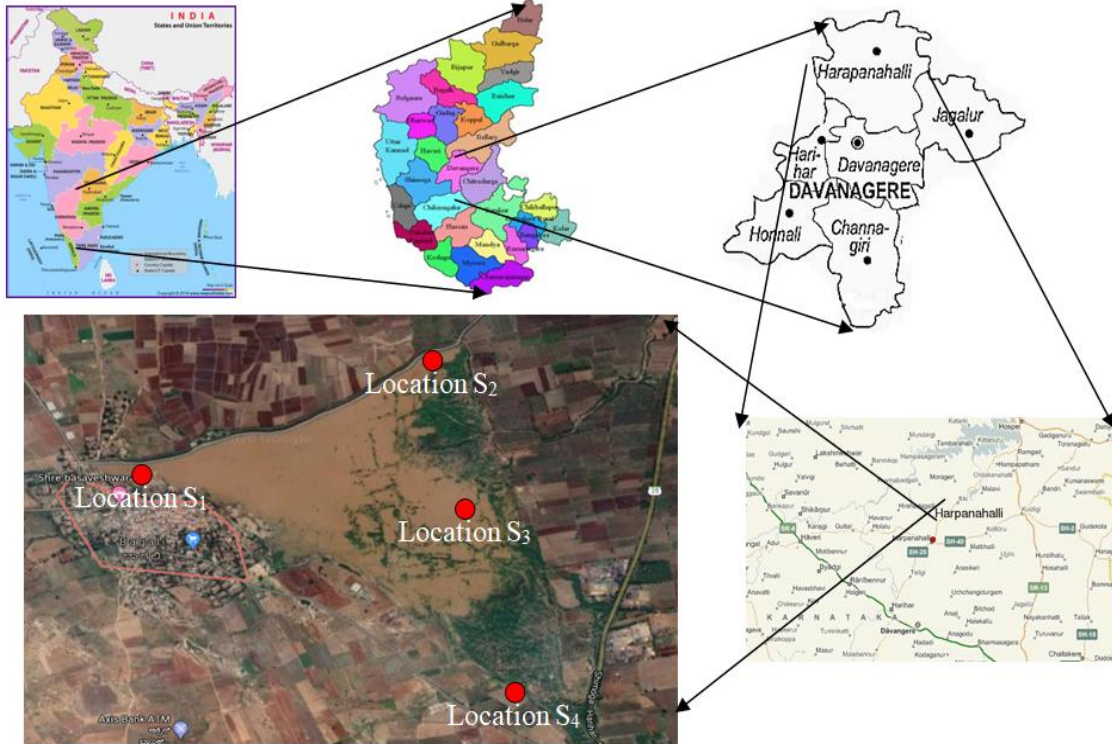
No	Parameters	Station S <sub>1</sub>	Station S <sub>2</sub>	Station S <sub>3</sub>	Station S <sub>4</sub>
1	Temperature °C	29.00	28.50	30.00	29.50
2	pH	8.10	7.98	7.57	7.86
3	Turbidity NTU	5.00	10.00	18.00	8.00
4	Electrical Conductivity $\mu$ mohs/cm	235.04	332.23	595.76	294.60
5	D.O. mg/l	8.10	7.70	6.80	7.60
6	B.O.D. mg/l	4.18	4.50	4.80	4.20
7	C.O.D. mg/l	66.92	81.33	186.42	94.50
8	Nitrates mg/l	8.46	4.86	9.00	2.71
9	Chlorides mg/l	35.22	45.94	146.94	51.00
10	Sulphates mg/l	7.67	9.25	14.82	8.45
11	Total Dissolved Solids mg/l	129.27	199.32	357.45	162.03
12	Phosphates mg/l	0.46	0.68	1.13	0.56
13	Total Hardness CaCO <sub>3</sub> mg/l	83.75	80.58	189.42	97.00
14	Calcium as Ca mg/l	52.70	58.00	141.40	50.00
15	Magnesium as Mg mg/l	31.00	36.00	48.00	47.00
16	MPN Index/100 ml	1100	1800	2500	1100

**Table 2. Phytoplankton in Bagali Tank, (+) indicates pollution sensitive (Dec. 2018 – Nov. 2019)**

No	Species/Liter	Station S <sub>1</sub>	Station S <sub>2</sub>	Station S <sub>3</sub>	Station S <sub>4</sub>
1	<i>Ankistrodesmus falcatus</i>	8	4	5	7
2	<i>Anabaena</i> (+)	40	30	53	19
3	<i>Chlorell pyronoidosa</i> (+)	16	14	8	9
4	<i>Coelsatrum microporms</i> (+)	4	3	5	6
5	<i>Closterium moniformum</i> (+)	4	3	5	8
6	<i>Euglena</i> (+)	9	8	6	5
7	<i>Nitzia plaea</i> (+)	7	8	10	14
8	<i>Oscillatoria</i>	12	16	14	18
9	<i>Oedogonium</i> (+)	16	14	10	9
10	<i>Pediatrum</i>	8	4	5	7
11	<i>Phormidium</i> (+)	2	4	2	3
12	<i>Rivularia</i> (+)	4	2	5	4
13	<i>Spirogyra</i>	7	5	2	2
14	<i>Scenedesmus</i>	14	4	15	9

**Table 3. Diatoms in Bagali Tank, (+) indicates pollution sensitive (Dec. 2018 – Nov. 2019)**

No	Species/Liter	Station S <sub>1</sub>	Station S <sub>2</sub>	Station S <sub>3</sub>	Station S <sub>4</sub>
1	<i>Cymbella turgidulas</i> (+)	15	9	9	5
2	<i>Cymbella tumida</i>	4	3	4	6
3	<i>Cyclotella menehiniana</i> (+)	6	9	14	13
4	<i>Diatoma elangata</i> (+)	5	4	3	6
5	<i>Fragillaria rumens</i> (+)	3	2	1	4
6	<i>Fragillaria intermedia</i>	11	-	15	8
7	<i>Melosira granulate</i> (+)	35	28	31	52
8	<i>Synedra ulna</i> (+)	42	52	64	71
9	<i>Tabularia flocculosa</i>	8	5	9	6



**Fig. 1. Map showing the locations details**

#### 4. CONCLUSIONS

Moderate pollution is indicated in the study area which can be attributed to the anthropogenic activities. Further pollution parameters revealed that these parameters vary from location to location due to discharge of domestic and other wastes around the study area.

Based on the investigation all the parameters are well within the prescribed for drinking water under IS and WHO standards, except with BOD and bacteriological impurities. Therefore, the water can be conveniently used for propagation of wild life, fishes, irrigation, industrial, cooling controlled waste water disposal but it should be treated by conventional method followed by disinfection to be used for drinking purposes.

The water quality of Bagali Tank in the present investigation is serious concern due to more microbial threat. The bacterial count indicated alarming level of pollution. The influence of faecal contamination is also noticed in water at location S3. As a consequence of this the people may be susceptible to health hazards like gastro-entiretie, Intestinal and Urinary track infections etc.

The ecological status of the study area was found to be impoverished in terms of species composition and density. The communities of phytoplankton and diatoms distributed inside the watercourse indicated the existence of pollution tolerant species. In order to maintain the health of the Bagali tank with respect to water quality it is essential that authorities should take immediate steps on the following points.

- ❖ The discharge of domestic waste water into this Bagali tank should be controlled or divert the sewage into other side. Arrangement should be made to avoid the entry of non-point source of effluent into the Bagali Tank.
- ❖ The people be educated by organizing awareness programme.
- ❖ Authorities be informed to maintain and establish the waste water/sewage water treatment plants. Signboard may be erected to indicate the quality of water for designated use.

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### COMPETING INTERESTS

Authors have declared that no competing interests exist.

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