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# APPRAISAL OF DISTINCTIVENESS OF PHYSICO-CHEMICAL PARAMETERS IN TUNGABHADRA RIVER NEAR HARIHAR, KARNATAKA (INDIA)

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## ABSTRACT

Tungabhadra in Karnataka is an important tributary of Krishna, one of the major rivers in peninsular India. It has a drainage basin of 71,417 sq. km out of which 57,671 sq. km lies in the Karnataka state. Tungabhadra covers a distance of 293 km in the state. This river can be considered as lifeline of this area, which fulfills the needs of hundreds of villages, situated along the banks of the river. Due to antropogenic activities, rapid industrial growth, domestic and agricultural activities of the region, the river water is being polluted, which is the case with almost all major rivers of the country. An year long study was conducted to measure various physico-chemical and bacteriological parameters including levels of phytoplankton in the river water. The study revealed that there is indication of pollution in the river and hence preventive measures are required to avoid further deterioration of the river water quality.

## 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. Lotic water bodies like rivers and streams 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 rivers. The increase of pollution is caused by population growth and increasing urbanization. Related to this is the industrialization that also causing huge environmental problems (Nirmal, 1997; Jain *et al*, 1998).

Tungabhadra River in Karnataka is an important tributary of Krishna. It has a drainage area of 71,417 sq.km out of which 57,671 sq.km lies in the state. It covers a distance of 293 km in the state and is getting polluted due to rapid industrial growth, domestic and agricultural activities of the region. 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 district Davangere is located in the central part of Karnataka state (India) between latitude $14^{O}17'$ to $14^{O}35'$ N and longitude $75^{O}50'$ to $76^{O}05'$ E covering an area of 6500 sq. km at an average altitude of 540 m above Mean Sea Level (MSL).

The present study is an attempt to characterize the water quality of Tungabhadra river 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 river water management. Bacteriological parameters like Most Probable Number of bacteria per 100 ml (MPN) including levels of diatoms and phytoplankton.

## MATERIALS AND METHODS

The sampling is done at three stations of the river named as:

Station ($S_1$): The sites of this habitat are located at the upstream where before the Tungabhadra river enters into Harihar city.

Station ($S_2$): This station is located on the main stream of river Tungabhadra in a place just near the confluence point of Sulekere stream which is at the distance of 2 km from $S_1$.

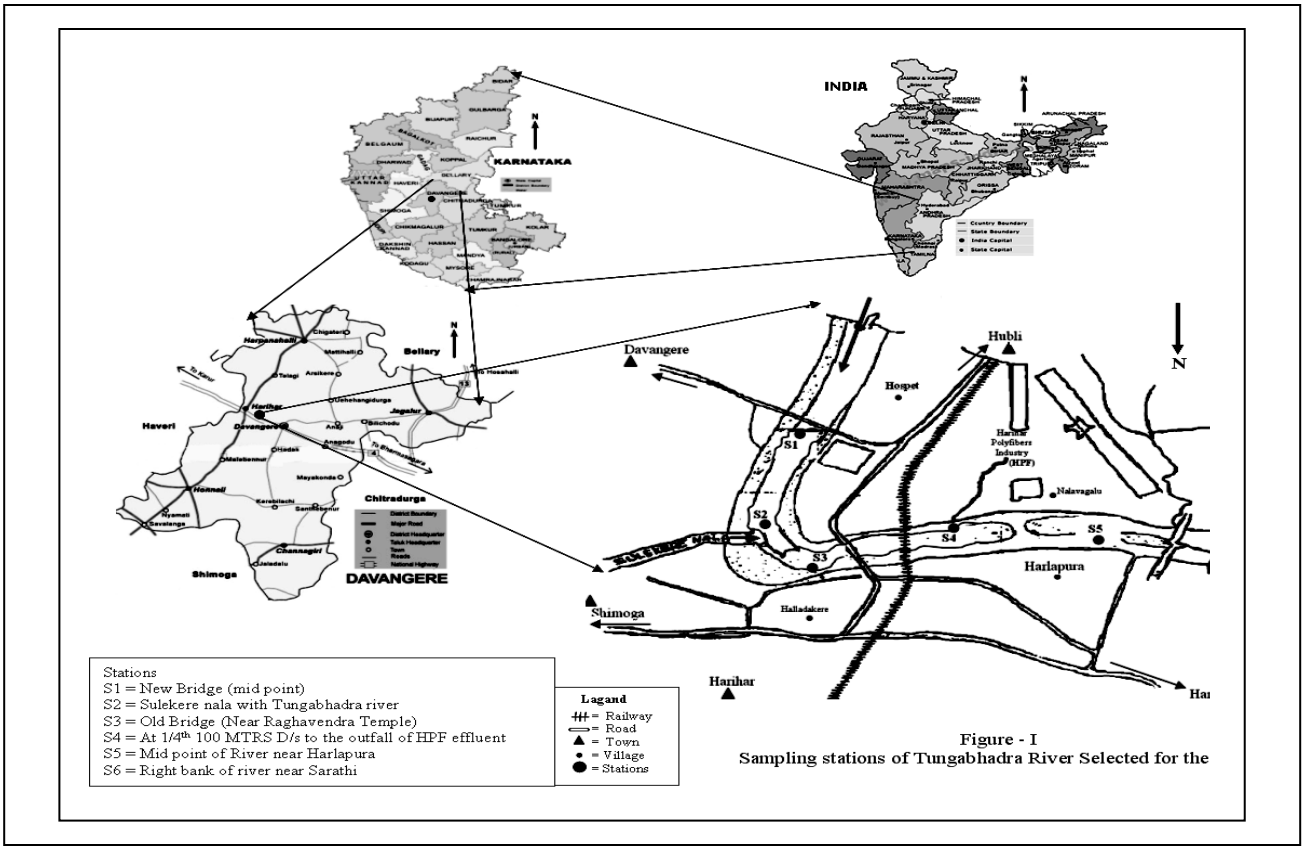


Figure - I
Sampling stations of Tungabhadra River Selected for the

**Table 1. Monthly variations in physico-chemical characteristics of Tungabhadra river water at Harihar (December 2013 – November 2014)**

| No | Parameters | Station $S_1$ | Station $S_2$ | Station $S_3$ | Station $S_4$ |
|---|---|---|---|---|---|
| 1 | Temperature $^0C$ | 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 μ 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 $CaCo_3$ 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/100ml | 1100 | 1800 | 2500 | 1100 |

Station ($S_3$): This is located downstream of Harihar Polyfibers effluent discharge (near Harlapura).at the distance of 1 km from station $S_2$. Station ($S_4$): This sampling station is located about 2 km away from confluence point ($S_2$).

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 (1995), Diatom and phytoplankton were studied (Trivedi *et al*,. 1995).

**RESULTS AND DISCUSSION**

**Temperature:** Temperature is important parameters for the biochemical and physiological processes in the aquatic organisms. Values of water temperature ranged from 28.5$^{O}$C to 30$^{O}$C in all the four stations Minimum value of 28.5$^{O}$C was observed in station $S_2$ and maximum value of 30$^{O}$C in station $S_3$. The results of present work corresponds to the lower temperature range recorded as 25.75$^{O}$C to 30.81$^{O}$C in Kallada River (Martin *et al* 2000).

**pH:** Measurement of hydrogen ion concentration which is represented as pH. Values ranged between 7.4 and 8.4 with minimum value in station $S_3$. 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 (Rajan and Murugan 2001).

**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.

**Electrical Conductivity**: Electrical Conductivity varied from 235.04 μ mohs/cm to 595.76 μ mohs/cm (Table-1) maximum value was recoded at the station $S_3$. 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 area with in the limit prescribed for water quality prescribed for drinking standards under IS and WHO and other quality prescribed for surface water under the classification of A to E.

**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 $S_1$ and minimum at station $S_3$. 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 river water. The low dissolved oxygen value indicates the bio-degradation of organic matter and decay of vegetation (S. K. Singh and J. P. N Rai 2003). 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.

**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 $S_3$ but minimum at station $S_1$. BOD in general gives a quantitative index of the organic substance, which is degraded quickly. High BOD value observed in station $S_3$. Due to oxidation of the organic waste by natural microorganisms created high BOD.

**Table 2. Diatoms in Tungabhadra river, (+) indicates pollution sensitive (Dec. 2013 – Nov. 2014).**

| No | Species/Liter | Station $S_1$ | Station $S_2$ | Station $S_3$ | Station $S_4$ |
|---|---|---|---|---|---|
| 1 | *Cymbella turgidulas (+)* | 15 | 9 | 9 | 5 |
| 2 | *Cymbella tumida* | 4 | 3 | 4 | 6 |
| 3 | *Cyclotella menehiniana (+)* | 6 | 9 | 14 | 13 |
| 4 | *Diatoma elangata (+)* | 5 | 4 | 3 | 6 |
| 5 | *Fragillaria rumens (+)* | 3 | 2 | 1 | 4 |
| 6 | *Fragillaria intermedia* | 11 | - | 15 | 8 |
| 7 | *Melosira granulate (+)* | 35 | 28 | 31 | 52 |
| 8 | *Synedra ulna (+)* | 42 | 52 | 64 | 71 |
| 9 | *Tabullaria flocculosa* | 8 | 5 | 9 | 6 |

**Table 3. Phytoplankton in Tungabhadra river, (+) indicates pollution sensitive (Dec. 2013 – Nov. 2014).**

| No | Species/Liter | Station $S_1$ | Station $S_2$ | Station $S_3$ | Station $S_4$ |
|---|---|---|---|---|---|
| 1 | *Ankistrodesmus falcatus* | 8 | 4 | 5 | 7 |
| 2 | *Anabaena (+)* | 40 | 30 | 53 | 19 |
| 3 | *Chlorell pyronoidosa (+)* | 16 | 14 | 8 | 9 |
| 4 | *Coelsatrum microporms (+)* | 4 | 3 | 5 | 6 |
| 5 | *Closterium moniforum (+)* | 4 | 3 | 5 | 8 |
| 6 | *Euglena (+)* | 9 | 8 | 6 | 5 |
| 7 | *Niztia plaea (+)* | 7 | 8 | 10 | 14 |
| 8 | *Oscillatoria* | 12 | 16 | 14 | 18 |
| 9 | *Oedogonium (+)* | 16 | 14 | 10 | 9 |
| 10 | *Pediatrum* | 8 | 4 | 5 | 7 |
| 11 | *Phormidium (+)* | 2 | 4 | 2 | 3 |
| 12 | *Rivularia (+)* | 4 | 2 | 5 | 4 |
| 13 | *Spirogyra* | 7 | 5 | 2 | 2 |
| 14 | *Scenedesmus* | 14 | 4 | 15 | 9 |

the same trend has been noticed for COD (Dhaneshwar *et al* 1970 and Baruah *et al* 1996). The BOD and other microbial activities are generally increased by the introduction of sewage (Hynes. H. B. N, 1971). The high value of COD indicates the possibility of pollution due to chemically oxidisable organic matter (Rekha Rani, *et al* 2004). BOD values area more than 1.0 in all the stations hence the water cannot be used directly for drinking purposes. This has been classified as C grade the water can be used as source of drinking water only after conventional treatment and disinfection to remove microorganisms.

**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 (Trivedy *et al.*, 1987). 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.

**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 (Trivedy *et al.,* 1995). Values of phosphate ranged from 0.4 to 1.13 mg/l with the minimum value in station $S_1$ and maximum value in station $S_3$. Values of Phosphate content lower and higher than the present findings were reported in some south Indian rivers (river of Dakshina Kannada, Karnataka – Madhyastha et al., 1999; Khandepar River, Goa-Desai *et al.*, 1995b)

**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 $S_3$. Chlorides increase the degree of eutrophication Goel et al, (1980), but low level of chloride suggests reduction in eutrophication. Present study indicates that chloride concentration is in the lower concentration except in station S3 which may be due to the entry of treated effluent from the industry situated on the right bank of the river Tungabhadra.

**Total hardness**: Total hardness of water is not a pollution parameter but indicates water quality mainly in terms of $Ca^{2+}$ and $Mg^{2+}$ 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 Ca2+, Mg2+ and total hardness is in the acceptable range for drinking water as per the classification of IS and WHO standards.

**Bacteriological studies**: The results of bacteriological studies are given in (Table 1). The MPN index is high, it indicates dense pollution of bacteria in the water samples (S.O. Adewoye and A. Lateff 2004). The comparative analysis of the microbial load indicates that bacteria were encounted at station $S_3$ where effluents are discharged into the river than both the upstream and the down stream. Similar results were obtained in the study area of a polluted river, Oba river exposed to human and agricultural wastes (Bakare *et al.*, 2002).

Diatoms and other phytoplankton of the Tungabhadra River water were indicated with reference to distribution and composition. The major Diatoms distributed in the area were *Synedra ulna, Melosira granulate* 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 3).

**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 station to station due to discharge of domestic and industrial wastes around the study area.

Based on the investigation all the parameters are well with in 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 river 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 station $S_3$ near Harihar town. 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 along the watercourse indicated the existence of pollution tolerant species. In order to maintain the health of the river 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 river should be properly treated before being discharged.

- Arrangement should be made to avoid the entry of non point source of effluent into the river.
- The people be educated by organizing awareness programme .
- Monitoring agencies should strictly follow the protocol and take suitable action on defaulting industries and municipal administration.
- Authorities be informed to maintain and operate the waste water/sewage water treatment plants properly and the discharge from those plants to confirm to the discharge standards.
- Signboard may be erected to indicate the quality of water for designated use.

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