



## Assessment of Physico-Chemical Parameters of River Cauvery In and Around Nerur

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### ABSTRACT

Natural water is a crucial source in route to a sustainable future. In the hydrologic cycle, water is the basis for food production, trade, human needs and the wealth of aquatic ecosystems. Natural source of water is finite, while water demand is steadily growing, thanks to human activity in the last decades. Currently, one of the major problems of mankind is pollution. It is obvious that the natural environment is deteriorating gradually and that ecological systems cannot adapt to anthropogenic factors pressure, and self-regulation of ecosphere is no longer possible. The fresh water ecosystem occupies a very small area in comparison to marine ecosystem. Now a day's degradation of these fresh water resources due to water pollution has become a serious problem for entire world. Polluted water needs to be dully treated in order to minimize its negative effects on people, animals, birds, and aquatic biota. Polluted water is unsuitable for drinking, recreation, agriculture, and industry. It diminishes the aesthetic quality of surface water sources. No doubt, the indiscriminate release of liquid waste of organic and inorganic nature changes physico-chemical characteristics of water and causes hazard to flora and fauna including important member of food chain of man and aquatic ecosystem. Hence the present study is aimed to investigate some of the important physico-chemical parameters of the Cauvery river water in and around Nerur.

### 1. Introduction

As today's technology progresses, the natural environment suffers from the detrimental effects of pollution. The natural process of transportation of metal ions between soil and water consolidates metal contamination, in high concentrations, that affect the areas of natural ecosystems. The growth of human population and rapid industrialization led to increasing use of urban waters as sewers, compromising their other uses. The discharge of industrial effluents has led inevitably, to alterations in the quality and ecology of receiving water bodies [1]. This brings new challenges to both water resource managers and aquatic ecologists. Several attempts have been made to regulate/control the quality of effluents that are discharged from waste generating industries into our water systems.

Today, most urban areas of the developing world remain inadequately served by sewage treatment infrastructure. Untreated wastes pose serious threat to associated environment including human health risks. Commonly cited effects of industrial effluents on the receiving waters are high turbidity, reduced transparency, increased suspended solids and oxygen depletion [2-5].

Good quality of water resources depends on a large number of physico-chemical parameters and biological characteristics. To assess that monitoring of these parameters is essential to identify magnitude and source of any pollution load. These characteristics can identify certain condition for the ecology of living organisms and suggest appropriate conservation and management strategies. Many researches are being carried out till present [6-21].

The high toxic and persistent nature of heavy metals in the environment has made heavy metals priority pollutants. For good environmental management an understanding of the changing concentration and distribution of heavy metals and their compounds in various compartments of the environment is of the essence. Several workers have investigated the concentration of heavy metals in the Cauvery River [12].

The present study is aimed to investigate some of the important physico-chemical parameters and heavy metals content of the Cauvery river water in and around Nerur.

### 2. Experimental Methods

#### 2.1 Data Collection and Analysis

This study was carried out in Cauvery River in and around Nerur. The Cauvery River is one of the major rivers of India, which is considered sacred. The river originates at Talakaveri in the Western Ghats in the state of Karnataka, flows generally south and east through Karnataka and Tamil Nadu and across the southern Deccan plateau through the southeastern lowlands, emptying into the Bay of Bengal through two principal mouths.

The Cauvery River basin is estimated to be 27,700 square miles with many tributaries including the Shimsha the Hemavathi River, the Arakavathy River, Honnuhole River, Lakshmana Tirtha River, Kabini River, Bhavani River, the Lokapavani River, the Noyyal River and the Amaravathi River; Rising in southwestern Karnataka state, it flows southeast some 475 miles (765 km) to enter the Bay of Bengal. The primary uses of Cauvery are providing water for irrigation, water for household consumption and the generation of electricity. The Cauvery, like many major rivers in general, in India faces many problems, including dry summers, wetland filling, large dams, and pollution.

#### 2.2 Materials

Totally 10 sampling stations were utilized for data collection and they are listed in the Table given below.

**Table 1** List of Sampling Stations

| S. No | Sampling stations       | S. No | Sampling stations    |
|-------|-------------------------|-------|----------------------|
| 1     | Seethapatti             | 6     | NadupalayamKudiTheru |
| 2     | Nadupalayam             | 7     | Nadupalayam          |
| 3     | EmurPudur Colony        | 8     | Kunnanur             |
| 4     | Seethapatty West Colony | 9     | EmurPudur Colony     |
| 5     | Seethapatti             | 10    | Emoor                |

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Collected samples were preserved in pre-cleaned plastic containers prior to analysis from the above said selected sites, placed in dark boxes and processed with 6 hours of collection. Parameters like Electrical Conductivity (EC), Total dissolved solids (TDS), pH, Alkalinity, Total Hardness (TH), Nitrate (NO<sub>3</sub>), Chloride (Cl), Fluoride (F), Sulphate (SO<sub>4</sub>) and heavy metals like Iron, Manganese and Chromium were determined according to APHA 1989 [2, 3].

**Table 2** The water quality parameters standard level for WHO & BIS (HDL - Highest Desirable Limit; MPL- Maximum Permissible Limit) [5, 6, 20]

| Parameters   | WHO – standard  |               | BIS -Standard   |
|--|-----------------|---------------|-----------------|
|  | HDL             | MPL           |                 |
| Odour  | Unobjectionable |               | Unobjectionable |
| Turbidity NT units                                 | 5               | 10            | 1               |
| Total dissolved solids mg/L                        | 500             | 2000          | 500             |
| Electrical conductivity in $\mu\text{S}/\text{cm}$ | Nil             | Nil           | Nil             |
| <i>Chemical parameters</i>                         |                 |               |                 |
| pH   | 6.5-9.5         | No relaxation | 6.5-8.5         |
| Alkalinity total as CaCO <sub>3</sub> (mg/L)       | 200             | 600           | 200             |
| Total hardness as CaCO <sub>3</sub> (mg/L)         | 300             | 600           | 200             |
| Calcium as Ca <sup>2+</sup> mg/L                   | 75              | 200           | 75              |
| Magnesium as Mg <sup>2+</sup> mg/L                 | 30              | 150           | 30              |
| Sodium as Na <sup>+</sup> mg/L                     | Nil             | Nil           | Nil             |
| Potassium as K <sup>+</sup> mg/L                   | Nil             | Nil           | Nil             |
| Iron as Fe <sup>2+</sup> mg/L                      | 0.3             | 1.0           | 0.1             |
| Manganese as Mn <sup>2+</sup> mg/L                 | 0.1             | 0.1           | 0.05            |
| Chromium as Cr <sup>3+</sup> mg/L                  | Nil             | Nil           | Nil             |
| Nitrite as NO <sub>2</sub> mg/L                    | Nil             | Nil           | Nil             |
| Nitrate as NO <sub>3</sub> mg/L                    | 50              | No relaxation | 45              |
| Chloride as Cl <sup>-</sup> mg/L                   | 250             | 1000          | 200             |
| Fluoride as F <sup>-</sup> mg/L                    | 1               | 1.5           | 1               |
| Sulphate as SO <sub>4</sub> <sup>2-</sup> mg/L     | 200             | 400           | 200             |

### 3. Results and Discussion

The results of the water quality testing are summarized in Table 3.

**Table 3** The results of the water quality measurements (station names are mentioned in Table 1)

| Station/<br>Tests              | 1    | 2    | 3    | 4    | 5      | 6    | 7      | 8      | 9      | 10   |
|--------------------------------|------|------|------|------|--------|------|--------|--------|--------|------|
| EC ( $\mu\text{S}/\text{cm}$ ) | 950  | 886  | 906  | 1609 | 2356   | 1321 | 3439   | 2706   | 5751   | 1660 |
| TDS (mg/L)                     | 665  | 620  | 634  | 1126 | 1649   | 925  | 2407   | 1894   | 4026   | 1162 |
| pH                             | 7.45 | 7.39 | 7.39 | 7.36 | 7.44   | 7.19 | 7.03   | 7.35   | 7.46   | 7.23 |
| TA (mg/L)                      | 180  | 184  | 172  | 192  | 252    | 260  | 252    | 360    | 244    | 264  |
| TH (mg/L)                      | 164  | 166  | 166  | 532  | 590    | 440  | 1000   | 600    | 1000   | 552  |
| NO <sub>3</sub> (mg/L)         | 17   | 18   | 17   | 12   | 22     | 17   | 87     | 37     | 71     | 19   |
| Cl (mg/L)                      | 80   | 85   | 80   | 300  | 570    | 240  | 920    | 650    | 1700   | 380  |
| F (mg/L)                       | 0.2  | 0.2  | 0.2  | 0.2  | 0.2    | 0.2  | 0.6    | 0.2    | 0.7    | 0.4  |
| SO <sub>4</sub> (mg/L)         | 10   | 14   | 12   | 128  | 120    | 86   | 108    | 95     | 96     | 38   |
| Fe (mg/L)                      | 0.27 | 0.21 | 0.21 | 0    | 0      | 0    | 0      | 0      | 0      | 0    |
| Mn (mg/L)                      | 0    | 0    | 0    | 0    | 0      | 0    | 0      | 0      | 0      | 0    |
| Cr (mg/L)                      | 0    | 0    | 0    | 0    | 0.0013 | 0    | 0.0012 | 0.0016 | 0.0012 | 0    |

#### 3.1 pH

It is a measure of the intensity of acidity/alkalinity and the concentration of hydrogen ion. Its range is give between 0 – 14. The pH 7 being neutral, less than 7 being acidic and above 7 being basic or alkaline. The presence or absence of various ions can have direct relation with pH of the water. The pH value varied between 7.03 – 7.46.

#### 3.2 Electrical Conductivity (EC)

The electrical conductivity is a measurement of capability of water to transmit electric current in a water bodies. It represents the total concentration of soluble salts/mineral salts in water [18], thereby making it sour and unsuitable for drinking. Electrical conductivity (EC), also called salinity, is the parameter that is used to estimate concentrations of total dissolved solids (TDS) [5, 6]. EC in the study area varies between 886 – 3439 ( $\mu\text{S}/\text{cm}$ ).

#### 3.3 Total Dissolved Solids (TDS)

It refers to that fraction of solids that pass through a 0.45  $\mu\text{m}$  filter paper. Small particles of certain wastewater materials can dissolve like salt in water. Excessive amounts of dissolved solids in water can have adverse effects on the environment. The Total Solids of the water samples are given in Table 1. The TDS ranges from (620 – 4026) mg/L. The high concentration of the TDS in all the sampling sites may be due to the effluent discharge of the dyeing industries.

#### 3.4 Total Hardness (TH)

Hardness is measure of polyvalent cations (ions with a charge greater than +1) in water. Hardness generally represents the concentration of calcium (Ca<sup>2+</sup>) and magnesium (Mg<sup>2+</sup>) ions, because these are the most common polyvalent cations. Other ions, such as iron (Fe<sup>2+</sup>) and manganese (Mn<sup>2+</sup>), may also contribute to the hardness of water, but are generally present in much lower concentrations. Waters with high hardness values are referred to as "hard," while those with low hardness values are "soft". The TH in the study area varies between 164 – 1000 mg/L. In five stations TH exceeds the permissible level given by WHO and BIS.

#### 3.5 Total Alkalinity

The Concentration of total alkalinity as CaCO<sub>3</sub> in ground water ranges from 172 to 360 mg/L. The carbonate alkalinity is absent in all the stations. Therefore the total alkalinity is mostly due to the presence of bicarbonate. Alkalinity (150 mg/L) has been found conductive to productivity of water bodies. The high alkalinity imparts water with unpleasant taste and may be deleterious to human health with high pH, TDS and TH.

#### 3.6 Nitrate

Nitrate is a colourless, odourless and tasteless compound. Nitrate (NO<sub>3</sub>) is highly soluble (dissolves easily) in water and is stable over a wide range of environmental conditions. It is easily transported in streams and groundwater. Nitrates are used as feed by plankton (microscopic plants and animals that live in water), aquatic plants, and algae, which are then eaten by fish. Nitrite (NO<sub>2</sub>) is relatively short – lived in water because it is quickly converted to nitrate by bacteria.

In addition, nitrates from agricultural runoff and the oxidation of ammonia are problematic in drinking water. In the digestive system, nitrate is converted to nitrite. Nitrite is then absorbed into the blood where it disrupts the oxygen carrying capacity of the blood. Nitrates can cause methemoglobinemia, or blue baby syndrome, in which the nitrates in the infant's bottle or nursing mother's milk cause suffocation in the infant. This is due to the fact that infants lack the enzyme (nitrate reductase) to break down nitrate. Consequently, nitrate interferes with the blood's ability to absorb and release oxygen, and as a result, the baby turns blue. In the study area nitrate level varies between 17 – 87 mg/L. Human and animal waste, application of fertilizers and chemicals, seepage and silage through drainage system are the main sources of nitrate contamination of ground water.

#### 3.7 Chloride

Chloride is a salt compound resulting from the combination of Chlorine gas and a metal. The common chloride salts include Sodium Chloride (NaCl), and Magnesium Chloride (MgCl<sub>2</sub>). Industrial processes such as battery manufacturing, pulp mills, bullion refining, electroplating, pesticide manufacturing, a large number of small scale processing units etc are the main sources of chlorides in water. In majority of these industries, the main source of chlorides in the effluent is the use of Lime (Ca(OH)<sub>2</sub>) or Sodium Hydroxide (NaOH) for the neutralization of acidic effluents.

Chlorides are widely distributed in nature as salts of sodium (NaCl), potassium (KCl), and Calcium (CaCl<sub>2</sub>). The taste threshold of the chloride anion in water is dependent on the associated cation. Taste thresholds for sodium chloride and calcium chloride in water are in the range 200-300 mg/litre (Zoeteman, 1980). In the study area chloride value ranges between 80 – 1700 mg/L. Chloride in surface and groundwater from both natural and anthropogenic sources, such as run-off containing road de-icing salts, the use of inorganic fertilizers, landfill leachates, septic tank effluents, animal feeds, industrial effluents, irrigation drainage, and seawater intrusion in coastal areas.

#### 3.8 Fluoride

High fluoride groundwater leads a health threat to millions of people around the world. Fluoride is a key aspect of water quality in rural water supply system, which potentially affects the sustainability of water if it exceeds its prescribed limit. The fluoride content is a function of many factors such as availability and solubility of fluoride minerals, velocity of

flowing water, temperature, pH, concentration of calcium and bicarbonate ions in water, etc., [8]. In Indian continent, the higher concentration of fluoride in groundwater is associated with igneous and metamorphic rocks. An inventory of fluoride concentration in drinking groundwater is important to curb spread of the disease fluorosis. In the study area fluoride level varies between 0.2 – 0.7 mg/L. All are under permissible limits.

### 3.9 Sulfate

Sulfates are a combination of sulfur and oxygen and are a part of naturally occurring minerals in some soil and rock formations that contain groundwater. The mineral dissolves over time and is released into groundwater. Sulfate ( $\text{SO}_4$ ) occurs in almost all natural water. The sulfate concentration in natural water ranges from 0.0 to 1000 mg/L. Most sulfate compounds originate from the oxidation of sulfite ores, the presence of shales, and the existence of industrial wastes. Sulfate is one of the major dissolved constituents in rain. High concentrations of sulfate in drinking water cause a laxative effect when combined with calcium and magnesium. The Sulfate content in the water samples ranges from 10 – 128 mg/L which is under the permissible level.

### 3.10 Heavy Metals

Fe is the essential micronutrient for animals and plants. The permissible limit of Fe and Cr in drinking water is 0.3 ppm and 0.03 ppm respectively. The Concentration of Fe and Cr in ground water ranges from 0 to 0.27ppm and 0.0016 ppm respectively. The samples under investigation in the study area contain Fe and Cr content within the permissible limits as set by the WHO [20].

## 4. Conclusion

In the present study, 10 water samples were analyzed and the most of the ground water in the river bank of Cauvery samples were found excess the permissible limit except pH, F,  $\text{Mn}^{2+}$ ,  $\text{Fe}^{2+}$ ,  $\text{Cr}^{3+}$ . The ground water samples showed deviation from water quality standards indicating ground water contamination. Maximum samples having excess of EC, TDS, TA, TH,  $\text{NO}_3^-$ , Cl,  $\text{SO}_4^{2-}$  and these indicating poor water quality and water from these sites is unfit for drinking purpose. Hence proper care must be taken to avoid any contamination of ground water and its quality to be monitored periodically.

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