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International Journal of Current Research
Vol. 5, Issue, 10, pp.3100-3103, October, 2013

INTERNATIONAL JOURNAL OF CURRENT RESEARCH

ISSN: 0975-833X

RESEARCH ARTICLE

# BIO-CHEMICAL INVESTIGATION OF SELECTED WATER QUALITY PARAMETERS IN AMARAVATHI RIVER BASIN, KARUR DISTRICT, TAMILNADU, INDIA

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**ARTICLE INFO**

***Article History:***
Received 18h July, 2013
Received in revised form
06th August, 2013
Accepted 15th September, 2013
Published online 23rd October, 2013

***Key words:***

Amaravathi River,
Chemical Oxygen Demand,
Dissolved Oxygen, Karur,
Organic pollution,
Physico-chemical characteristics

**ABSTRACT**

The study was conducted to assess the physico-chemical characteristics of river water and groundwater of Amaravathi River Basin, Karur district, Tamilnadu, India. The collected samples were analyzed for the water quality parameters such as pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD) and Chemical Oxygen Demand (COD), using the procedure outlined in the standard methods prescribed by American Public Health Association (2005). The low level of DO in some sampling spots indicates that the industrial activities consume dissolved oxygen present in the water. Higher BOD values found at few sampling sites indicates that they are severely polluted by the agricultural organic manure wastes and effluents of the industries and City Corporation wastes, respectively. COD varied from 4 to 85 mg/L for surface water and from 4-92 mg/L for groundwater, which indicates organic pollution in water due to percolation of effluents containing soluble organic compounds. Hence it is recommended that careless disposal of the waste should be dispirited and there is need to treat the waste properly before dumped in to the environment.



## INTRODUCTION

Water is the elixir of life, a precious gift of nature to mankind and millions of other species living on the earth and is fast becoming a fright commodity in most parts of the world. Water resources comprising of surface water, groundwater, marine and coastal waters hold up all living organisms including human beings (Usharani *et al.,* 2010). Groundwater fulfills 80% of domestic needs in rural areas and 50% in urban areas. India's total replenishable groundwater has been estimated at 431.8 $km^3$ by the Central Statistical Organization. The average level of groundwater development in India is 32%, although some states have exploited their resources to a much greater extent, 94% in Punjab, 84% in Haryana, 60% in Tamil Nadu, 64% in Lakshadweep, and 51% in Rajasthan (Simerjit Kaur and Promila Malik, 2012). However, water is available in the universe in huge quantity in the order of 1400 x 106 $km^3$ out of which only 3% of the waters in the world are fresh water. Among the fresh waters, only about 5% of them or 0.15% of the total world waters are readily available for beneficial use. Tamilnadu state accounts for 4 % of the land area and 6 % of the population, but only 3 % of the water resources of India. Fresh water resource is becoming day-by-day at the faster rate of deterioration of the water quality is now a global problem. Discharge of toxic chemicals, over pumping of aquifer and contamination of water bodies with substance that promote algae growth are some of the today's major cause for water quality degradation. Pollution caused by fertilizers and pesticides used in agriculture, often dispersed over large areas is a great hazard to fresh groundwater ecosystems. These impurities may give water a bad taste, color, odor or turbidity and cause hardness, corrosiveness, staining or frothing (Arti Maheshwari *et al.*, 2011). The chemical composition of surface and groundwater is controlled by many factors that include composition of precipitation, mineralogy of the watershed and aquifers, climate, and topography. These factors combine to create diverse water types that change spatially and temporally (Guler *et al.*, 2002). BOD is the amount of dissolved oxygen needed by aerobic biological organisms in a body of water to break down organic material present in a given water sample at a certain temperature over a specific period of time (Enujiugha and Nwanna, 2004; Kulandaivelu and Bhat, 2012). COD is the quantitative estimation of oxygen equivalent of organic matter that is vulnerable to oxidation in the presence of strong oxidizing agent like potassium dichromate (Basavaraddi *et al.*, 2012). The objective of this study is to assess the present water quality, through analysis of some selected water quality parameters like pH, EC, TDS, DO, BOD and COD and to compare the results with the international standards.

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## Study Area

Amaravathi River is a tributary of Cauvery River passing through Coimbatore and Tiruppur districts of Tamilnadu state, South India. The 175 km long Amaravathi River begins at the Kerala / Tamilnadu border at the bottom of Manjampatti Valley between the Annamalai hills and the Palani hills in Indira Gandhi Wildlife Sanctuary and National Park in Tiruppur. It descends in a northerly direction through Amaravathi Reservoir and Amaravathi Dam at Amaravathinagar. It is joined by the Kallapuram River at the mouth of the Ajanda valley in Udumalaipettai, and it merges with the river Cauvery at Thirumukkudal, about 10 km from Karur.

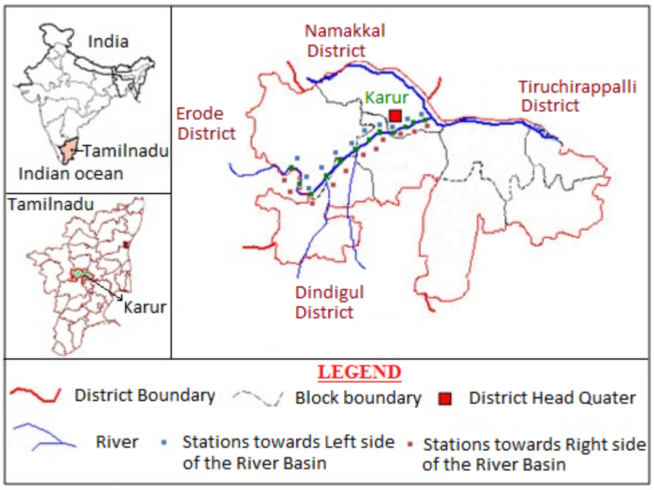


**Figure 1. Map of the study area showing sampling sites**

Amaravathi River irrigates over 60,000 acres of agricultural lands in Coimbatore, Erode and Karur districts and fulfills the drinking water requirements of these regions. The Amaravathi River and its basin, especially in the vicinity of Karur, are heavily used for industrial processing water and waste disposal and as a result are severely polluted due to large amount of textile dyeing and bleaching units. Amaravathi watershed in Karur district lies between 10° 77' and 10° 95 N' and 77° 92' and 78° 23 E'. The lithology of the study area is characterized with older Pre-Cambrian basement and younger alluvia. Rocks of the khondalite group including garnet-sillimanite schists and gneisses, calc-granulites with crystalline schists and gneisses, calc-granulites with crystalline limestone pockets and quartzite are well exposed. Quartz of very fine quality is found in many places, especially in the village of Vaduvanampalli near Kodiyur and Kothapalayam near Aravakurichi. A major portion (90 %) of the soil of Amaravathi basin is red sand. Amaravathi River is seasonal and carries substantial flows during monsoon period only (November to January). Karur has average annual rainfall of 25.04 in inches and average number of rainy days in a year being 40.

## MATERIALS AND METHODS

Groundwater samples were collected during the year 2011-12 as monsoon (November), post-monsoon (February) and summer (May) from 22 bore wells which are almost uniformly distributed over the Amaravathi river bed area. Eleven river water samples were taken from 10 cm to 15 cm below the surface using acid washed plastic container to avoid unpredicted changes. The collected samples were analyzed for specific water quality parameters such as pH, EC, TDS, DO, BOD and COD using standard methods as tabulated in Table 1. The World Health Organization (WHO, 2005) permissible limit of drinking water quality parameters were also specified in Table 1. Biochemical oxygen demand analysis was carried out after 5 days incubation at 20°C, as the major portion of organic matter is oxidized during this period. Similarly, analysis of Chemical oxygen demand was carried out by acidifying sample at pH <2 with sulphuric acid and carried out within 7 days.

**Table 1. Methods used for analysis of water quality parameters**

| Quality parameters studied | Methods used | *WHO Limit |
|---|---|---|
| pH | pH meter | 7.0-8.5 |
| Electrical conductivity | Conductivity meter | 1000 |
| Total dissolved solids | Evaporation method | 500 |
| Dissolved Oxygen | Winkler's Iodometric method | >6 |
| Biochemical oxygen demand | 5 days incubation at 20°C | 5 |
| Chemical oxygen demand | Titrated with an excess of $K_2Cr_2O_7$ | 10 |

*Values are expressed in mg/L except pH and EC in µScm-1

## RESULTS AND DISCUSSION

The analytical results of the selected parameters of the Amaravathi River are shown in Figures 2-9. The pH decides the acidic or basic condition of water quality. If the pH is not within the prescribed limit of 6.5-8.5, it damages mucous membrane present in eyes, nose, mouth, abdomen, anus, etc. (Subba Rao *et al.*, 2012). The pH value of the water samples in the study area in November ranged between 6.92 and 7.84 with a mean of 7.41. The pH decreased slightly in February (6.52-8.41) with a mean of 7.37 and decreased again in May (6.76-7.52 with a mean of 7.14). The pH value of water is controlled by the amount of dissolved $CO_2$, carbonate and bicarbonate concentrations (Yu Zhou *et al.*, 2013). From the point of view of human consumption, all the samples may be considered potable, as they are neither acidic nor strongly alkaline (Figure 4). pH values of the surface water during November ranges from 7.44 to 8.71 (Figure 2) due to the interaction of number of minerals and sewage run-off.

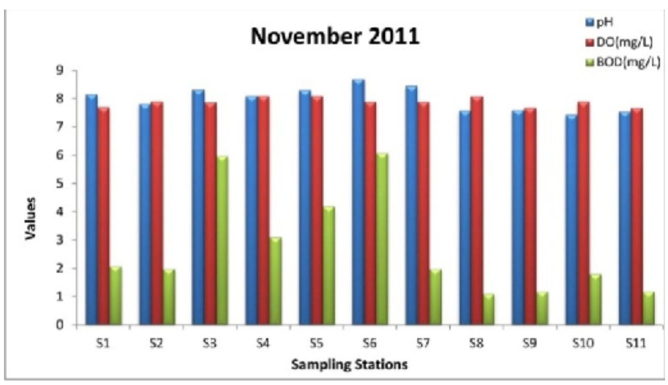


**Figure 2. Variation of pH, DO and BOD in Surface water samples**

EC is a measure of a material's ability to conduct an electric current so that the elevated EC indicates the enrichment of salts in the groundwater. The EC values varied from 806 to

1010 µScm$^{-1}$ for surface water (Figure 3) and for groundwater it varies from 404 to 11800 µScm$^{-1}$, 857 to 8843 µScm$^{-1}$, 967 to 8851 µScm$^{-1}$ for monsoon, post-monsoon and summer seasons (Figure 5) respectively.

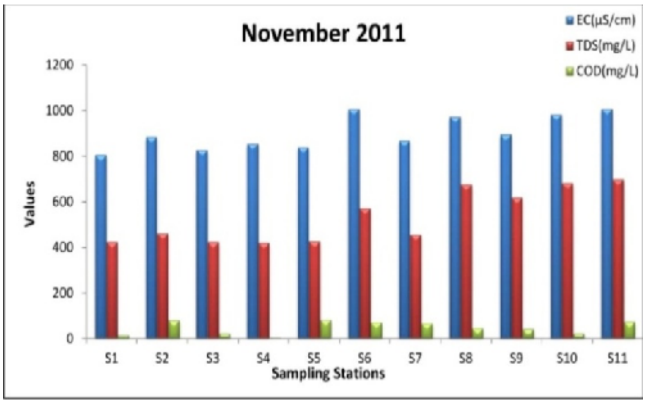


**Figure 3. Variation of EC, TDS and COD in Surface water samples**

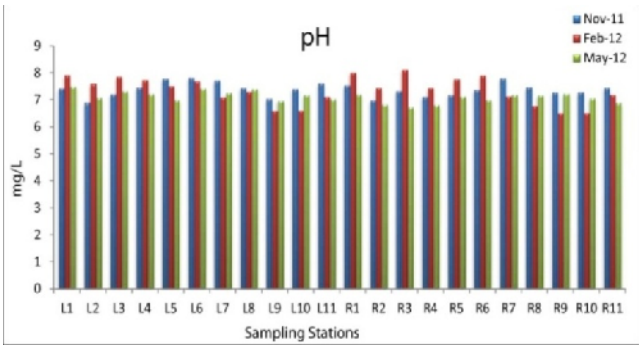


**Figure 4. Variation of pH in groundwater samples**

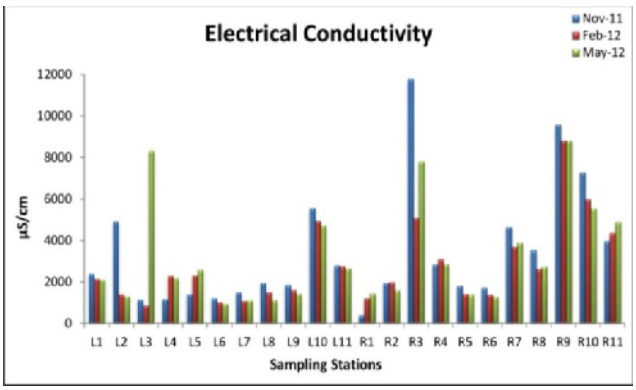


**Figure 5. Variation of EC in groundwater samples**

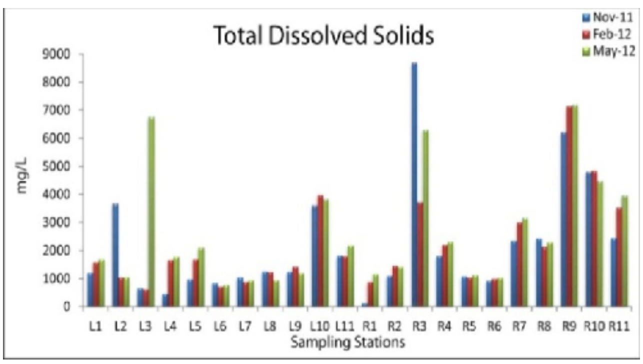


**Figure 6. Variation of TDS in groundwater samples**

The TDS, which indicates total dissolved ions in the surface water, is between 424 and 699 mg/L. TDS for groundwater varied from 142 to 8720 mg/L (average, 2237 mg/L) in monsoon, 628 to 7168 mg/L with an average of 2179 mg/L in post-monsoon season and in summer it varied between 789 and 7226 mg/L (Figure 6) with average value of 2643 mg/L.

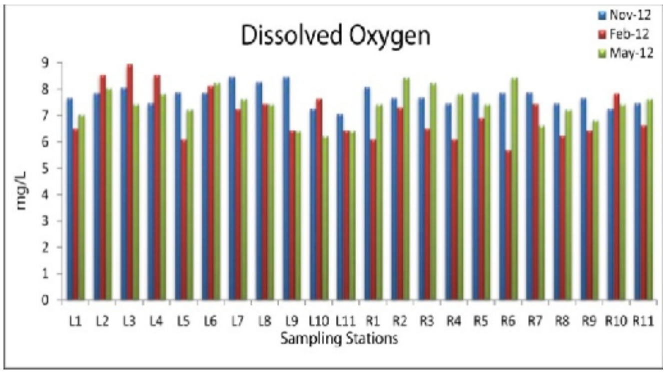


**Figure 7. Variation of DO in groundwater samples**

The observed concentration of dissolved oxygen content during monsoon season in the surface water varied from 7.69 to 8.11 mg/L was likely due to the high rate of dissolution of ambient oxygen into water and low rate of microbial degradation. Higher BOD values were found at two sites indicating that they are severely polluted by the domestic wastes and effluents from the dyeing and bleaching industries and adjacent urban developments, respectively.

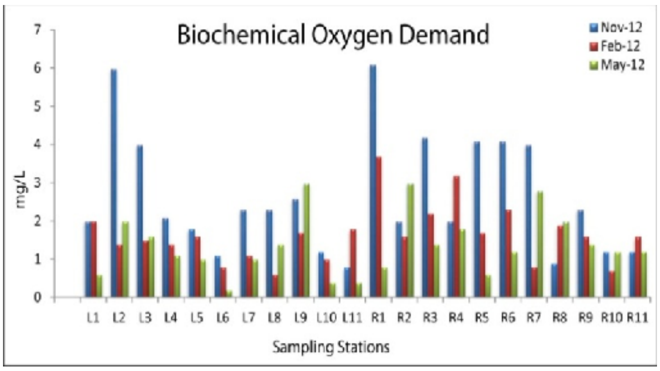


**Figure 8. Variation of BOD in groundwater samples**

According to Garcia *et al.* (2013) dissolved oxygen concentrations should not be lower than 6.0 mg/L (class I freshwater), 5.0 mg/L (class II freshwater), and 4 mg/L (class III freshwater). A further decisive factor is that in freshwater, the $O_2$ content should never fall below 2 mg/L. DO varies from 7.09 to 8.50 mg/L in monsoon and 5.71 to 8.97 and 6.26 to 8.48 mg/L in post-monsoon and summer season (Figure 7) respectively. The analyzed BOD values for groundwater samples varied from 0.8 to 6.1 mg/L, 0.6 to 3.7 mg/L and from 0.6 to 3.03 during monsoon season, post-monsoon and summer season (Figure 8), indicating that the value of BOD is higher than 5 mg/L during the monsoon season, seemingly due to the percolation of organic wastes, human and animals excreta and soap etc. into the water results in the uptake of oxygen in the oxidative breakdown of these wastes into the groundwater is likely also observed by Kensa (2012).

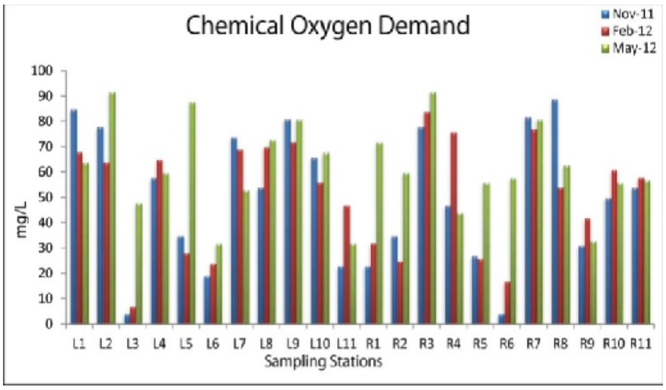


**Figure 9. Variation of COD in groundwater samples**

The values of the chemical oxygen demand oscillated between 4 mg/L to 85 mg/L for surface water during monsoon and also between 4 to 89 mg/L, 7 to 84 mg/L and 8 to 92 mg/L for monsoon, post-monsoon and summer seasons (Figure 9) respectively. BOD and COD are responsible for odour and taste (Kolawole Olatunji *et al.*, 2011). The high BOD and COD values may be due to the discharge of untreated or incompletely treated industrial effluents into the sewage from the various manufacturing plants which affects the status of groundwater.

### Conclusion

The characteristics of the waters corresponding to the Amaravathi watersheds indicate an intolerable level quality for the assigned use. Within the town and the down streams of surface water and groundwater shows high TDS and COD values which are due to untreated domestic wastewater from the municipalities, solid wastes and dye industries discharge of effluents to the river during night time. The estimation of oxygen deficit is an advantageous way for a simple, rapid and economical determination of a water quality. The management of the water resources is ineffective and incomplete, as the scarcity of potable water gets increasing. The government and Public should work for the improvement of water quality and ecological status will be achieved by implementing integrated water resources management by targeting towards furnishing water to all on a sustainable basis.

### Acknowledgment

The authors are thankful to the University Grants Commission (UGC), New Delhi for providing Major Research Fund (F. No. 41-337/2012) and the Members of the Management Committee and the Principal of Jamal Mohamed College for providing the necessary facilities.

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