Assessment of ground water pollution on the bank of river Amaravathi at Karur district, Tamil Nadu

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ABSTRACT

The ground water quality on the basin of Amaravthi river at Karur was studied. Two ground water samples were taken near the basin of the river both sides and the other two samples were taken nearly 0.5 km away from the river at seven station. The study was carried out during premonsoon season. The samples were subjected to Physico-chemical analysis. The results showed that most of the physico-chemical parameters were in higher than the permissible limit at most of the groundwater stations.

Keywords: Ground Water, Amaravathi river, Karur, Tamil Nadu, India.

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INTRODUCTION

Groundwater has been a very important source of water for various uses since ancient times .Much of the drinking water used by human and other living beings. During the recent years due to urbanization and industrialization, groundwater is increasingly laced with pollutants from industries, Municipal sewers, and agricultural fields that are treated with fertilizers and pesticides. Today, human activities are constantly adding industrial, domestic swage, and agricultural wastes in to the groundwater resources at an alarming rate. Groundwater contamination is generally irreversible, i.e., once it is contaminated it is difficult to restore the original water. Karur is one of the most important Industrial cities in Tamil Nadu, which is located on the bank of river Amaravathi river. Industries of diverse fields such as dying, bleaching, textiles, Steel rolling mills, cement and Paper are located in and around Karur town. There is no proper management and planning for the disposal of municipal sewage and industrial efficients at Karur. The city generates organic and inorganic wastes of about 250-300 tonnes per day and the municipal corporation dumps them in the dump yard at Amaravathi river. The typical sewage comprising of domestic and other wastewater are discharging directly into the river without any proper treatment. Hence, the present study has been undertaken to investigate the physico-chemical analysis of ground water on the bank of Amaravathi river at Karur.

Details of study area
The details of the study area were collected from Public Works Department, Groundwater division, Tamil Nadu water and Drainage board, Agricultural department, river Amaravathi on Karur District and located about 371km southwest (SW) of Cheñnai. It is centrally located in Tamil Nadu with an area 11,098 km^2 and lies between 10.95°'N and 78.08° east longitudes.

Fig. 1 location map of the study area
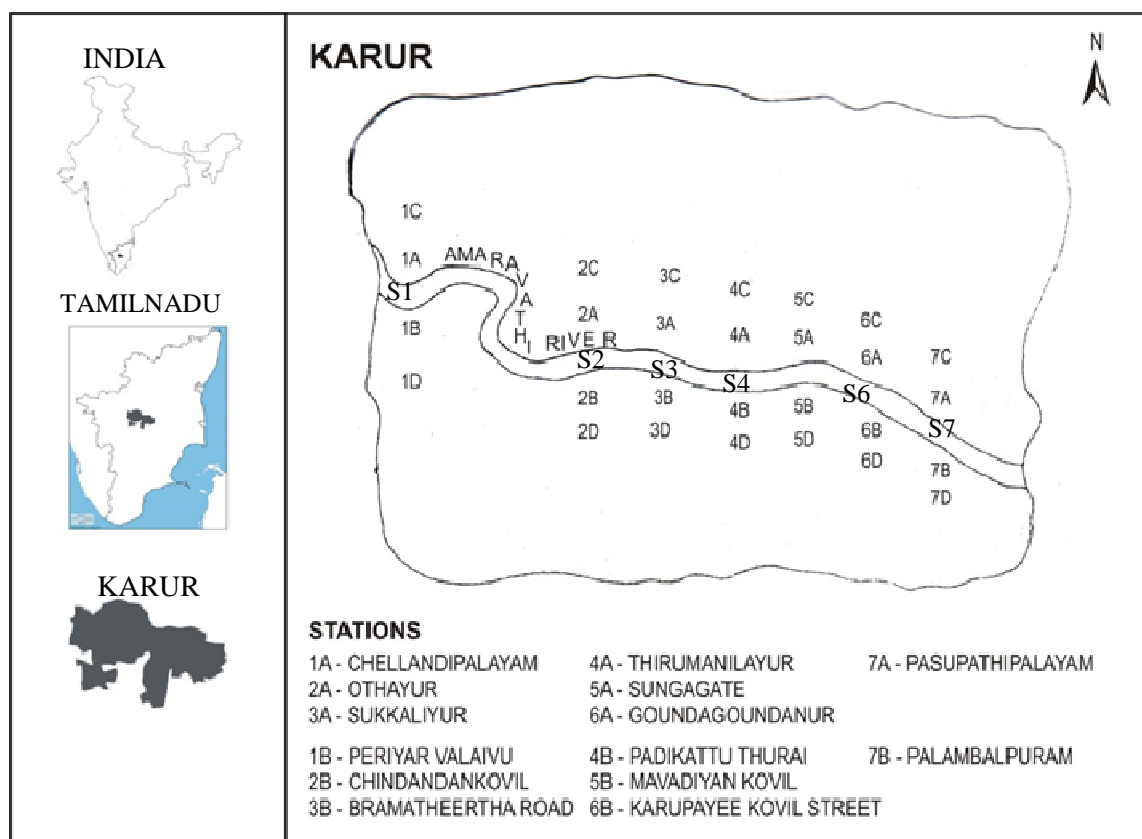
MATERIALS AND METHODS

The place of study at which water samples were collected is referred to as 'Stations'. The study pertains to the quality of Amaravathi river water and its impact on the groundwater. Seven sampling stations are selected. They are represented as Chellandipalayam(S1), Chindan kovil(S2), Sukkaliyur(S3), Thirumanilayur(S4), Sungagate(S5), Thozilpettai (S6), Pasupathipalayam(S7). The groundwater samples were taken from the bore wells on either side of the basin of Amaravathi river [1A-7A, 1B-7B] of each station. Two other samples were collected nearly a kilometer away from the river at all the station [1C-7C, 1D-7D].

The locations of the study area on the sampling stations are shown in Fig.1. The samples were collected in plastic cans. Prior to use, cans were cleaned thoroughly and rinsed with distilled water. They were dried, cooled, and labeled. For the estimation of dissolved oxygen (DO), biochemical oxygen demand (BOD), and chemical oxygen demand (COD), well-sterilized BOD bottles were used. All necessary precautions were taken during sampling analysis and transportations of water samples to the laboratory (Brown et al. 1974). The physico-chemical parameters such as pH, electrical conductivity, total dissolved solids, total hardness, carbonate, bicarbonate, chloride, calcium, magnesium, nitrate, sulphate and phosphate, BOD, COD, and DO were analyzed using the procedure as per standard method of APHA (1995), Manivasakam (1984) and Goel (2000)

RESULTS AND DISCUSSION

The groundwater samples were collected during premansoon season. The physico-chemical characteristics are determined. The obtained results are presented in the Table 1 and the results are discussed.

pH
pH value is an important factor in maintaining the carbonate and bicarbonate levels in water. The mean pH values recorded are within the range of 7.1—7.9 for groundwater samples (Table 1). The pH values are found to be within the permissible limit of WHO (1977) (6.5—8.5) in all the sampling stations for groundwater samples. There are no abnormal changes in groundwater samples. The slight alkalinity may be due to the presence of bicarbonate ions, which are produced by the free combination of CO_2 with water to form carbonic acid, which affects the pH of the water (Azeez et al. 2000). Carbonic acid (H_2CO_3) dissociates partly to produce (H^+) and bicarbonate ions (Jha and

Verma 2000). The pH values increase slightly for groundwater samples in all the sampling stations. The mild alkalinity indicates the presence of weak basic salts in the soil (Abdul Jameel 2002). The low pH does not cause any harmful effect.

Table 1 : Physico-chemical characteristic of of ground water in Karur town

Stations	pH	EC	TDS	TH	HCO$_3$	Cl	Ca	Mg	No$_3$	S0$_4$	Po$_4$	BOD	COD	DO
1A	7.3	3290	2303	840	444	860	224	67.2	27	97	0.15	20	21	5.3
1B	7.5	5178	3625	1400	312	1525	360	120.0	54	167	0.14	19	14	4.9
1C	7.2	2702	1891	750	388	625	168	79.2	19	85	0.14	45	56	2.1
1D	7.2	3311	2317	860	556	790	200	86.4	19	97	0.32	86	63	2.6
2A	7.2	2062	1443	590	368	455	144	55.2	19	76	0.15	23	13	4.3
2B	7.3	3405	2384	920	400	910	240	76.8	39	116	0.17	63	25	2.5
2C	7.2	4045	2832	1180	480	1020	304	101.0	34	113	0.37	18	14	4.1
2D	7.2	3562	2494	1000	352	910	248	91.2	38	84	0.17	13	16	5.9
3A	7.1	7245	5072	2000	400	2150	480	192.0	161	134	0.20	63	25	2.5
3B	7.4	2019	1413	550	472	350	144	45.6	17	117	0.98	14	35	4.7
3C	7.4	4496	3147	1250	350	1275	600	60.0	94	143	0.10	15	21	5.7
3D	7.6	3332	2332	920	308	780	224	86.4	37	150	0.31	34	41	3.2
4A	7.1	8525	5968	2500	364	2750	640	216.0	39	60	0.20	15	21	5.7
4B	7.1	5440	3808	1500	688	1400	400	120.0	71	117	0.24	23	41	5.8
4C	7.6	2125	1488	610	410	440	148	57.6	17	81	0.07	25	18	4.8
4D	7.3	1895	1327	532	600	226	131	49.0	13	42	0.10	11	13	5.8
5A	7.1	4549	3184	1400	468	1275	380	108.0	50	104	0.17	21	22	5.1
5B	7.1	2775	1943	730	600	410	172	72.0	18	76	0.14	13	20	4.4
5C	7.4	1801	1261	452	400	356	48	79.7	14	26	0.26	20	21	5.3
5D	7.5	2807	1965	780	480	640	184	76.8	36	85	0.29	24	28	5.9
6A	7.3	2482	1737	660	412	515	156	64.8	34	144	0.26	45	56	2.1
6B	7.6	3867	2707	1120	596	690	264	110.0	62	111	0.18	14	14	5.6
6C	7.3	9081	6357	2600	600	2550	640	240.0	99	133	013	08	18	5.1
6D	7.2	3415	2391	1060	496	830	360	38.4	38	76	0.25	44	36	3.2
7A	7.8	3233	2266	900	500	760	240	72.0	43	151	0.05	86	63	2.6
7B	7.9	3720	2604	1060	236	760	248	62.4	54	152	0.98	38	38	3.7
7C	7.2	3101	2171	900	388	730	240	72.0	51	106	0.20	73	34	2.7
7D	7.4	2303	1612	630	408	505	172	48.0	38	76	0.20	14	35	4.7

EC is expressed in μmho/cm-^{1}. All parameters are expressed in ppm except pH.

Electrical conductivity
The importance of electrical conductivity (EC) is its measure of salinity, which greatly affects the taste and has a significant impact of the user acceptance of the water as potable (Yadav S.S. 2011). The higher the ionisable solids, the greater will be the EC (Mehta and Kumar Rajesh,2011).

The EC values are within the range of 1801-9081 umho/cm^{-1} for the groundwater samples. The EC values are well above the permissible limit of WHO (1977) (600 umho/cm^{-1}) for groundwater samples. High electrical conductivity is due to high concentration of inorganic salts in ionic constituents and dissolved minerals in the water sample (Murgasan *et al.* 2005)

Total dissolved solids
The total dissolved solids (TDS) values are found within the range of 1261-6357 ppm for groundwater samples. Most of the groundwater samples show higher TDS values that are well above the permissible limit of WHO (1977) (500 ppm). The maximum TDS values are observed at stations 4A and 6C. It is to be noted that all these groundwater stations are located nearer to the river. The river water along with domestic sewage may percolate into the groundwater, which may lead to increase in TDS values (Ward 1994). The same result was inferred by Indrajit Sen, Shandil and V.S. Shrivastava, (2011).

Total hardness
The principal cations that impart hardness are Ca and Mg ions. The anions responsible for hardness are mainly carbonate, bicarbonate, sulfate, chloride, and nitrate. The total hardness (TH) values are within the range of 610-2600 ppm for groundwater samples. TH values exceeded the desirable limit of WHO (1977) (300 ppm) in all the stations for groundwater samples. It clearly indicates that high value of TH of groundwater near the river is due to the impact of river water containing large quantities of sewage, detergents, and solid wastes. The same result was inferred by Patel (1991) and Bhanja and Ajoy (2000).

Carbonate (CO$_3$) and bicarbonate (HCO$_3$)
The values of bicarbonate are found within the range of 308-688 ppm for groundwater samples (Table 1). The maximum value of bicarbonate (688 ppm) is recorded at station 4B (Table I). Since the observed pH is below 8.6,

the carbonate values are not detectable for groundwater samples. The same result was inferred by Zahir hussain (2010). Even though the carbonate alkalinity is absent, the total alkalinity is found, which may be due to the accumulation of bicarbonates. The bicarbonate values are within the permissible limit of WHO (1977) (500 ppm) for most of the groundwater samples except 1D,4B, 4D,5B, 6B, and 6C. The high values are found for groundwater samples that are nearer to the river. Bicarbonates are produced from the decomposition and oxidation of organic pollutants (Sadhana 1994) and to the frequent exchange of atmospheric CO_2 with water to form H_2CO_3.Zahir hussain et.al(2012).

Chloride (Cl)
The values of chloride are recorded in the range of 226-2750 ppm for groundwater samples. Chlorides are one of the major inorganic anions present in natural water. Chloride results from agricultural activities, domestic sewage, and chloride-rich rocks. Human body releases very high quantity of chloride (Sharma and Pande 1998). High concentration of chloride is considered to be the indicator of pollution by high organic wastes of animal or industrial origin. The chloride values are exceeded the permissible limit of 250 ppm in most of the groundwater sampling stations. This observation is supported by (Zahir Hussain, 2004).

Calcium and magnesium (Ca and Mg)
The values of calcium and magnesium are found in the range of 144-640 ppm and 38.4-240 ppm, respectively, in groundwater samples (Table 1). The calcium and magnesium values are within the permissible limit of WHO (1997) (200 and 150 ppm) for most of the groundwater samples. But the calcium values are high at stations 3A, 3C, 4A and 6C. High values of magnesium are found at stations. Sodium ions replace calcium and magnesium ions thereby reducing their concentration, (Rakh MS and Bhosle AB, 2011).

Nitrate (NO₃)
The nitrate values are recorded within the range of 19-161 ppm for all groundwater samples. Nitrate values exceed the permissible limit of 45 ppm for most of the groundwater samples. High nitrate content in drinking water may lead to goiter, cancer, and methemoglobinemia (Manivasakam 1984).

Sulphate (SO₄)
The values of sulfate found in the range of 26-167 ppm for groundwater samples (Table 1). The values of sulphate are within the permissible limit of 250 ppm (WHO 1977) most of the samples stations, (Pawar and Shaikh 1995).

Phosphate (PO₄)
The values of phosphate are within the range of 0.05-0.98 ppm for groundwater samples (Table 1). In the present investigation, the values of phosphate are found to exceed the permissible limit of WHO (1977) (0.10 ppm) in all the sampling stations for groundwater. There is fluctuation of phosphate values due to the increased solar radiations that encourage the biological degradation of organic matter and subsequent release of phosphate (Davina et al.1999). High phosphate values are observed at station 3B and it may be due to the leaching form minerals or ores, agricultural run-off, and domestic sewage and the utilization of synthetic detergents(Elinge CM, Itodo AU, Peni IJ, Brinin – Yauri UA, Mbongo AN,2011).

Biochemical oxygen demand
The values of BOD are between the ranges of 08-86 ppm for the groundwater samples (Table 1) exceeding the permissible limit of WHO (1977) (5.0 ppm). High values may be attributed to the maximum biological activity at elevated temperatures where as the lowest BOD may indicate lower biological activity. There is an inverse relationship between DO an BOD (Indira Bai and George 2002; Sengar et al.1985).

Chemical oxygen demand
The COD values are within the range of 13-63 ppm for groundwater samples (Table 1). Chemical oxygen demand is a measure of pollution in aquatic system. High COD may cause oxygen depletion on account of decomposition by microbes. COD values exceed the permissible limit of 10 ppm in all the sampling stations for groundwater, which indicate the pollution by biodegradable and chemically degradable organic matter Zahir hussain et.al(2012).

Dissolved oxygen
The values of DO are recorded in the range of 2.1-5.9 ppm for all the groundwater samples. Generally, low oxygen values are associated with heavy contamination by organic matter. The general trends of changes in DO concentration in different seasons are directly or indirectly governed by fluctuations of temperature and BOD. This may be due to the fact that the solubility of dissolved oxygen increases with decrease in water temperature. The same was inferred by Tiwari (1990). DO content of water is also enhanced by the decomposition of organic matter by the microorganisms (Abdularfiu, Majolagbe O, 2011).

CONCLUSION

The groundwater samples were taken at the river of Amaravathi on both sides of each station. Two groundwater samples were taken near the basin of river on both sides and the other samples were taken about 0.5 km away from the river at all the seven stations. The water samples were subjected to physico- chemical analysis. The results of the above work show that most of the physico-chemical parameters like EC, TDS, TH, Cl, HCO_3, SO_4, BOD, and COD are well above the permissible limit. The results show that most of the groundwater sampling stations near the river are much polluted by the intrusion of river water, dumping of waste, and percolation of domestic sewage by inhabitants. Some of the groundwater stations far away from the river are also polluted. The ground and river water samples are much polluted in the urban area than rural area. This may be due to the heavy pollution load, domestic sewage, and other waste by thickly populated inhabitants. The above results confirm that the groundwater quality is affected by Amaravathi river water. But if the same condition continues in future, the groundwater source will completely be polluted and become unfit of drinking and other purposes. It is high time to preserve and protect this valuable ground source. Hence, dumping of waste polluted material should be avoided and they should not be let into the river. The mentioned pollution control measures should be taken properly to protect the ground and river water sources.

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