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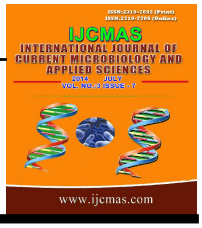


**Original Research Article**

# Ground water quality and its health impact analysis in an industrial area

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**A B S T R A C T**

**Keywords**

Ground water quality, Maraimalar Nagar, Tamilnadu, Industrial runoff,

Ground water quality, especially in areas that immediately surround industrial zones are of increasing interest owing to the nearing proximity of residential zones. This paper is an important report on the ground water quality status near the industrial area of Maraimalai Nagar, Kanchiputam District, Tamil Nadu,India. Industries located in industrial area of Maraimalai Nagar dispose their effluents on land and as a result the nearby shallow open wells get polluted and also the salt content of soil has started building up slowly. Forty representative samples were collected from various sources, such as borewells and open-wells during different seasons over three seasons. However, if the pollution continues unabated it could pose serious problems in the future for the expanding residential zones.

## Introduction

The quality of ground water is of great importance in determining the suitability of particular ground water for a certain use (public water supply, irrigation, industrial applications, power generation etc.). This depends on a large number of individual hydrological, physical, chemical and biological factors. that have acted on the water from the moment it condensed in the atmosphere to the time it is discharged by a well[1,2,3]. The quality of ground water varies with location, depth of water table, season and by the extent and composition of dissolved solids. Generally, higher proportions of dissolved constituents are found in ground water than in surface water because of greater interaction of ground water with various materials in geologic strata. Adverse effects on ground water quality are a result of anthropogenic activity at ground surface such as unintentionally by agriculture, uncontrolled release of domestic and industrial effluents, by sub-surface or surface disposal of sewage and industrial wastes. It is important to know the geochemistry of the chemical-soil-groundwater interactions in order to assess the fate and impact of pollutant discharged on to the ground [4,5,6,7]. Ground water pollution is intrinsically difficult to detect, since the problem may well be concealed below the surface and monitoring is costly, time consuming and hard to resolve. Pollutants move through several different hydrologic zones as they migrate through the soil to the water table. The contamination of ground water by heavy metals and pesticides has assumed much

significance during recent years due to their toxicity and accumulative behaviour. Industrial disposal of chemicals by surface and sub surface runoff, direct release into natural water bodies or waste, dumped near the factories can be subjected to reaction with percolating rain water and reach the ground water level. Solid wastes are dumped into the ravines of river, as fill in for village ponds and as spread over the grazing or waste lands. The percolating water picks up a large amount of dissolved constituents and reaches the aquifer system and contaminates the ground water [8,9].

This is a report on the ground water quality status near the industrial area of Maraimalai Nagar, Kanchiputam District, Tamil Nadu. The main objective of this paper is to examine pollution threats, especially to the groundwater resources, around industrial area of Maraimalai Nagar in Kanchipuram District of Taminadu State, India and suggest remedial measures that may also be relevant to other industrial areas. Forty representative samples were collected from various sources, such as borewells and open-wells during different seasons (summer, winter and Post-monsoon) for physio-chemical and bacteriological analysis. Industries located in industrial area of Maraimalai Nagar dispose their effluents on land and as a result the nearby shallow open wells get polluted and also the salt content of soil has started building up slowly.

## Materials and Methods

Maraimalai Nagar is the Head quarters of Maraimalai Nagar taluk in Kancheepuram district. Maraimalai Nagar is located in the south direction at a distance of 81 km (12'41'30" latitude and 74'58'00" longitude and 28m elevated from M.S.L), from the city of Chennai. The Municipal Area extends to 58.08 sq.km. Representative ground water samples were collected from 40 locations at a 10 km radius starting from Maraimalai nagar's Industrial area for the analysis of Physico-chemical and biological parameters.

Drinking water wells, Wells closer to polluting sources like industries, urban wastewater drains, garbage, dumpsites etc. and Wells suspected for natural contaminants like fluoride, iron, arsenic or such pollutants were used as a basic selection criterion for the sampling. Open dug wells, which are not in use or have been abandoned, were not used for sampling. Open dug wells (in use for domestic or irrigation water supply) [10,11] , Tube wells (fitted with a hand-pump or a power-driven pump for domestic water supply or irrigation) and Hand Pumps (used for drinking) were the types of wells from which samples were collected from the sampling locations. The sampling locations are listed in Table 1.

Samples were collected once every week across three seasons namely Summer, Winter and Post-Monsoon respectively. For collection of samples a weighted sample bottle or sampler was used to collect sample from an open well.

Samples from the production tube were collected after running the well for about 5 minutes. For bacteriological samples, when collected from tube wells / hand pump, the spout/outlet of the source was sterilized under flame by spirit lamp before collection of sample in the container [12,13]. From open wells the samples were collected directly in to the pre-sterilized glass bottles. The samples were transported to the laboratory for analysis. The parameters tested, samples collected with sample size and the methods of storage/preservation have been tabulated in Table 2.

## Results and Discussion

The Overall minimum and maximum values for the eight water quality parameters studied are given in Table 3. In addition, the Correlation coefficients for the different parameters in relation to each other were determined for all three seasons. From the analysis of correlation coefficients, 101 positively correlated values and 46 negatively correlated values were found.

**Table.1** Details of Location with name, type of well and code

| S.No | Type of Well | Location Name | Location Code |
|---|---|---|---|
| 1 | Borewell | Periyar Park | W1 |
| 2 | | Near Ford | W2 |
| 3. | | Maraimalai Nagar II | W3 |
| 4. | | Maraimalai Nagar A-II | W4 |
| 5. | | Peramanur | W5 |
| 6. | | Selva Nagar Ex–V, Oorapakkam | W6 |
| 7 | | Keezhkaranai | W8 |
| 8 | | GST Road (Hotel),Oorapakkam | W9 |
| 9 | | Oorapakkam (Near Chocklate industries) | W11 |
| 10 | | Opp. Guduvancherry Rly station | W13 |
| 11 | | Near Mahendra World city | W15 |
| 12 | | Guduvancherry | W17 |
| 13 | | Vadamelpakkam | W22 |
| 14 | | Near Engineering College | W26 |
| 15 | | SP Koil | W27 |
| 16 | | Near Mahendra World city | W30 |
| 17 | | Kolathur | W31 |
| 18 | | VOC street, Maraimalai nagar | W32 |
| 19 | | Near Industrial Estate | W33 |
| 20 | | Chengalpattu | W34 |
| 21 | | Guruvanmedu | W38 |
| 22 | | Maraimalai Nagar | W40 |
| 1 | Handpump | Near Police Station, Maraimalai nagar | W14 |
| 2 | | Near Maraimalai Nagar Municipality | W18 |
| 3 | | Paranur | W19 |
| 4 | | Thirukatchur | W20 |
| 5 | | Villiyampakkam | W21 |
| 6 | | Kattankulathur | W23 |
| 7 | | Peramanur | W24 |
| 8 | | Industrial Estate | W25 |
| 9 | | SP Koil | W28 |
| 10 | | Potheri village | W29 |
| 11 | | Chengalpattu | W35 |
| 12 | | Senneri | W36 |
| 13 | | Karambakkam | W37 |
| 14 | | Ezhichur | W39 |
| 1 | Openwell | Amman Temple, Oorapakkam | W7 |
| 2 | | Oorapakkam east | W10 |
| 3 | | Oorapakkam | W16 |
| 1 | Drinking Water | Oorapakkam | W12 |

**Table.2** Details of sample collection and parameters tested

| Parameter | Sampling Collection | Sample Size | Storage/ Preservation |
|---|---|---|---|
| pH | Grab sampling in Plastic /glass container | 50 ml | |
| Electrical Conductivity | | 50 ml | |
| Total suspended solids | | 100 ml | Refrigeration (7 days) |
| Total Dissolved Solids | | 100 ml | |
| BOD | | 500 ml | Refrigerationn (48 hrs) |
| Hardness | | 100 ml | Add HNO3 to pH<2, refrigeration (6 months) |
| Chlorides | | 50 ml | Not required (28 days) |
| Sulphates | | 100 ml | Refrigeration (28 days) |
| Sodium, Potassium | | 100 ml | Not required (6 months) |
| Nitrates | | 100 ml | Refrigeration (48 hrs) |
| Fluorides | | 100 ml | Not required (28 days) |
| Alkalinity | | 100 ml | Refrigeration (14 days) |
| Ammonia | | 100 ml | Add $H_2SO_4$ to pH>2, refrigeration (28 days) |
| Hexavalent Chromium, Cr+6 | Plastic/ Glass rinse with 1+1 HNO3 | 100 ml | Grab sample; refrigeration (24 hrs) |
| Heavy Metals (Hg, Cd, Cr, Cu, Fe, Zn, Pb etc.) | | 500 ml | Filter, add $HNO_3$ to pH>2; Grab sample (6 months) |

**Table.3** Minimum and Maximum values observed across three seasons

| S.No | Parameter | PostMonsoon | | | Winter | | | Summer | | | LIMITS |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Min | Max | SD | Min | Max | SD | Min | Max | SD | |
| 1 | pH | 6.58 | 7.8 | 0.24 | 6.58 | 7.92 | 0.31 | 6.58 | 8.12 | 0.38 | 6.5 – 8.5 |
| 2 | Turbidity(NTU) | 4 | 30 | 6.39 | 4 | 50 | 9.67 | 4 | 40 | 7.4 | 10 |
| 3 | TDS (mg/L) | 458 | 1620 | 251.67 | 492 | 1700 | 285.72 | 492 | 1692 | 276.9 | 500 |
| 4 | Total Hardness(mg/L) | 148 | 512 | 84.38 | 154 | 512 | 92.01 | 168 | 548 | 98.3 | 300 |
| 5 | Chloride(mg/L) | 104 | 492 | 91.71 | 114 | 524 | 100.65 | 114 | 518 | 103.2 | 250 |
| 6 | Sulphate (mg/L) | 40 | 128 | 24.20 | 42 | 154 | 29.30 | 42 | 156 | 31.5 | 200 |
| 7 | Fluoride(mg/L) | 0.02 | 0.14 | 0.04 | 0.02 | 0.5 | 0.05 | 0.02 | 0.14 | 0.04 | 1.0-1.5 |
| 8 | Iron (mg/L) | 0.02 | 1.28 | 0.28 | 0.02 | 1.64 | 0.33 | 0.02 | 1.58 | 0.31 | 0.3 |

**Table.4** Correlation Co-efficients of major parameters studied

| Para-meters | Season | pH | TDS | Temp | Zinc | Iron | TH | Turbidity |
|---|---|---|---|---|---|---|---|---|
| pH | POST MONSOON | 1 | -0.05736 | 0.2675 | -0.2869 | -0.2296 | -0.1497 | -0.0686 |
| | WINTER | 1 | 0.0302 | 0.08469 | -0.2998 | -0.1663 | -0.0764 | -0.0216 |
| | SUMMER | 1 | 0.1997 | 0.3163 | -0.2534 | -0.04026 | 0.0407 | -0.05970 |
| TDS | POST MONSOON | -0.05736 | 1 | -0.12268 | 0.1858 | 0.7689 | 0.8628 | 0.6630 |
| | WINTER | -0.4653 | 1 | -0.1362 | -0.2954 | 0.6292 | 0.8662 | 0.7662 |
| | SUMMER | 0.1997 | 1 | 0.05941 | 0.2070 | 0.1284 | 0.2381 | 0.6664 |
| Temp | POST MONSOON | 0.2939 | -0.1227 | 1 | 0.1161 | 0.00937 | 0.1730 | -0.0591 |
| | WINTER | 0.2990 | -0.1362 | 1 | 0.0847 | -0.0049 | -0.1386 | -0.0846 |
| | SUMMER | 0.2990 | -0.1362 | 1 | 0.0847 | -0.0049 | -0.1386 | -0.0846 |
| Zinc | POST MONSOON | -0.2869 | 0.2523 | 0.1161 | 1 | 0.2933 | 0.4439 | 0.3849 |
| | WINTER | -0.2998 | 0.2249 | 0.0118 | 1 | 0.9901 | -0.4939 | -0.0138 |
| | SUMMER | -0.0612 | 0.2070 | 0.1883 | 1 | -0.1360 | 0.6257 | 0.2060 |
| Iron | POST MONSOON | -0.2044 | 0.7721 | -0.0057 | 0.2973 | 1 | 0.6140 | 0.4591 |
| | WINTER | -0.0918 | 0.6663 | 0.00607 | 0.1604 | 1 | 0.5542 | 0.7599 |
| | SUMMER | -0.07573 | 0.6572 | 0.01996 | -0.0256 | 1 | -0.0744 | 0.5960 |
| TH | POST MONSOON | -0.1724 | 0.8621 | -0.2173 | 0.39954 | 0.6279 | 1 | 0.6379 |
| | WINTER | -0.0764 | 0.8343 | - 0.1776 | 0.4338 | 0.6133 | 1 | 0.5963 |
| | SUMMER | 0.0407 | 0.1373 | 0.0581 | 0.6364 | -0.5114 | 1 | -0.0096 |
| Turbidity | POST MONSOON | -0.1486 | 0.7612 | -0.0591 | 0.3794 | 0.8014 | 0.6307 | 1 |
| | WINTER | -0.0319 | 0.1195 | -0.0849 | -0.0183 | 0.8581 | 0.5519 | 1 |
| | SUMMER | -0.0019 | 0.6664 | -0.0234 | 0.2060 | 0.5870 | 0.0421 | 1 |

**Table.5** Water Quality Index of Important Parameters

| S.No | Parameter | SEASON | | |
|---|---|---|---|---|
| | | Post-Monsoon | Winter Season | Summer Season |
| 1 | pH | 89 | 86 | 87 |
| 2 | Total Solids | 21 | 21 | 21 |
| 3 | Temperature | 17 | 17 | 17 |
| 4 | Turbidity | 79 | 77 | 37 |
| | Overall WQI | 58 % | 52 % | 36 % |

They are tabulated in Table 4. Correlation coefficients for the different parameters were determined for the summer, winter and Post - Monsoon seasons. From the analysis $r \geq 0.06$ is significant cases. There are 101 number of positive correlated values and 46 number of negatively correlated values as found in the above tables.

Highest correlation was found among (a) In post- monsoon Seasons: pH and Temperature, TDS and Iron, TDS TH, TDS and Turbidity, Iron and TH (b) Winter Season: Turbidity and Iron Between TDS and Iron, TDS and Turbidity, Iron and TDS. TH and Turbidity, Turbidity and Iron and (c) In summer season between TDS and Turbidity , TH and Zinc, Iron and Turbidity, Turbidity and Iron, Turbidity and TDS.

On ascertaining the Water Quality Index, the percentage of the samples were found as "bad category" in Summer, "medium category" in Post-monsoon, and "medium category" in the Winter. The results are tabulated in Table 5. It could be generalized that Water taken in the industrial area of Maraimalai Nagar town within 5 Km radius was found to be un-potable, whereas the water taken from the 10Km radius of the industrial town was found to be potable.

This study found that continuous disposal of industrial effluents on land, which has limited capacity to assimilate the pollution load, has led to groundwater pollution. Ground water quality surrounding the industrial areas has deteriorated, and the application of polluted groundwater for potability has resulted in increased salt content of soils.

In some locations drinking water wells (deep bore wells) also have high concentration of salts. Since the local municipality is supplying drinking water to households the impact in the domestic sector has been minimised. It has also been noticed that in some locations industries are supplying drinking water to the affected households. However, if the pollution continues unabated it could pose serious problems in the future. Hence, our research plays an experimental work on ground water quality assessment in the nearby industrial area of Maraimalai nagar in Kanchipuram district of Tamilnadu.

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