

# Qualitative Analysis of Drinking Water in Pollachi, Coimbatore, Tamilnadu, India

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**Abstract:** *In the present investigation, the physico chemical parameters of bore well, open well and municipal water of Pollachi town was analysed from different consumer points during the period of May 2014 to April 2015. The samples were collected during pre monsoon, monsoon, post monsoon and summer for physico chemical analysis. The analytical survey of bore well water showed that the electrical conductivity (EC) (1456 to 1510 mMhos/cm), pH (7.1 to 7.3), calcium (76 to 88 mg/l), magnesium (30 to 32 mg/l), sodium (7 to 8 mg/l), potassium (7 to 8 mg/l), bicarbonate (628 to 648 mg/l), sulphate (20 to 22 mg/l), chloride (158 to 164 mg/l), nitrate (0 to 1 mg/l), total dissolved solids (833 to 841 mg/l) and alkalinity (525 to 535 mg/l). Open well water contains the electrical conductivity (1048 to 1062 mMhos/cm), pH (7.2 to 7.4), calcium (52 to 59 mg/l), magnesium (21 to 22 mg/l), sodium (127 to 130 mg/l), potassium (11 to 12 mg/l), bicarbonate (406 to 413 mg/l), sulphate (25 to 27 mg/l), chloride (80 to 83 mg/l), nitrate (59 to 64 mg/l), total dissolved solids (605 to 613 mg/l) and alkalinity 327 to 332 mg/l). The evaluation of municipal water registered the EC (183 to 188 mMhos/cm), pH (7.5 to 7.6), calcium (14 to 15 mg/l), magnesium (6 to 7 mg/l), sodium (11 to 12 mg/l), potassium (4 to 5 mg/l), bicarbonate (102 to 104 mg/l), sulphate (nil), chloride (11 to 12 mg/l), nitrate (0 to 1 mg/l), total dissolved solids (103 to 108 mg/l) and alkalinity (83 to 85 mg/l). The parameters pH, sulphate, chloride and nitrate of bore well water were within the recommended quality standard and EC, calcium, magnesium, total dissolved solids and alkalinity exceeded the permissible limits. The results of well water survey indicated that the pH, calcium, magnesium, sulphate and chloride content were within the quality standards and the concentration of nitrate, total dissolved solids and alkalinity exceeded the standards. The quality of municipal water showed that except the concentration of EC all the other (calcium, magnesium, sodium, chloride, nitrate, total dissolved solids and alkalinity) parameters were within the drinking water quality standards. The order of quality standard of drinking water is municipal water supply > open well > bore well.*

**Keywords:** Water quality standards, Electrical conductivity, Total dissolved solids, Alkalinity.

## 1. Introduction

The significance of water quality in human healthiness has recently attracted a great deal of interest. In India around 80 % of all diseases are directly related to poor drinking water quality and unhygienic conditions [26], [28]. Fresh water is predetermined resource, essential for agriculture, industry and even human existence, without fresh water of adequate quantity and quality, sustainable development will not be possible [32]. Almost all the fresh water bodies are under tremendous pressure from human population explosion and developmental activities in and around the water bodies. Tamilnadu is deficit state from the point of view of water resources both for irrigation and drinking water and is dependent on monsoons. Though Tamilnadu receives rainfall in the north east as well as south west monsoon, the precipitation is limited to about two months only. Tamilnadu accounts for 4% of the land area and 6% of the population, but only 3% of the water resources of the country. Most of Tamilnadu is located in the rain shadow region of the Western Ghats and hence receives limited rainfall from the South West monsoon (TNRD, 2005). Coimbatore district is located in the western part of Tamilnadu. The district is spread out in an area of 7469 square kilometer. The average rainfall in this area is around 700 mm. This district has two revenue divisions, Coimbatore and Pollachi (10.662° N 77.0065° E). The district enjoys tropical climate. The district is underlain by both porous and fissured formations. Acute shortfall of monsoon rains, poor water shed management, lavish use of water for domestic and agricultural purposes have led to the overexploitation of the surface water sources especially from the river bodies [22]. The deficiency of the

clear water increases day by day due to pollution, so the drinking water analysis for physical, chemical properties are very important and essential for public health studies. Hence a study was conducted to assess the quality of drinking water in Pollachi town.

## 2. Materials and Methods

### 2.1 Sample Collection

The bore well, open well and municipal water samples for the present study were collected from Mahalingapuram, Venkatesa colony, Kandasamy Chettiar Park, Sudharsan Nagar and Jothi Nagar. The water samples were collected at monthly interval from May 2014 to April 2015. Water samples were taken in closed sterilized glass containers (500 ml capacity) and stored at 4°C on ice and transport aseptically for analysis within 24 hrs.

### 2.1 Chemical Analysis of Water

Physico-chemical parameters as Electrical Conductivity (EC), pH, Calcium (Ca), Magnesium (Mg), Sulfate (SO<sub>4</sub>), Chloride (Cl), Nitrate (NO<sub>3</sub>), Total dissolved solids (TDS) and Total Alkalinity (CaCO<sub>3</sub>) were analyzed in the laboratory as per APHA [5].

### Electrical Conductivity (EC)

Electrical conductivity was recorded with the help of Conductivity meter 304.

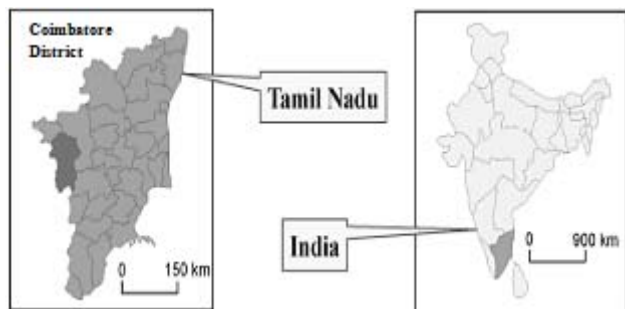


Figure 1: Study Area



Figure 2: Study Area – Pollachi, Coimbatore District

### pH

Systronics digital pH meter No.335 was used for pH determination.

### Calcium and Magnesium

EDTA titration method as recommended by Jhingran [17] was adopted for calcium and magnesium quantification.

### Sulphate

The sulphate in the drinking water samples were evaluated by the method given by Michael [25].

### Chlorides

Chloride estimation was done by titration method given by Jackson [16].

### Nitrate

The Nitrate in the water samples were estimated by the method of Strickland and Parson [41] [Colorimetric method (650 nm), Brucine sulphate acid method (530nm)].

### Total Dissolved Solids (TDS)

The filtrate obtained from the above process was evaporated, dried, weighed and recorded as the quantity of dissolved solids in the water samples.

### Total Alkalinity

Total alkalinity was estimated as per the method given by Piper [29].

## 3. Results and Discussion

The analytical data on physico chemical properties of bore well water is furnished in Table - 2. The results showed that the survey on bore well water samples contained the electrical conductivity (EC) (1456 to 1509 mMhos/cm), pH (7.1 to 7.3), calcium (76 to 88 mg/l), magnesium (30 to 32 mg/l), sodium (196 to 202 mg/l), potassium (7 to 8 mg/l), bicarbonate (628 to 648 mg/l), sulphate (20 to 22 mg/l), chloride (158 to 164 mg/l), nitrate (0 to 1 mg/l), total dissolved solids ( 833 to 841 mg/l), and alkalinity (525 to 535 mg/l). The electrical conductivity was higher during summer season than in pre monsoon, monsoon and post monsoon. The average concentration of EC was 1480 (mMhos), pH 7.2, calcium 81 (mg/l), magnesium 32 (mg/l), sodium 199 (mg/l), potassium 8 (mg/l), bicarbonate 637 (mg/l), sulphate 21 (mg/l), chloride 161(mg/l), nitrate 04 (mg/l), total dissolved solids 836 (mg/l) and alkalinity 528 (mg/l). Electrical conductivity (EC) is measure of water capacity to convey electric current. It signifies the presence of total dissolved salts. EC is found to be good indicators of the overall water quality [1]. In the present study, the EC values were exceeded the quality standards of ICMR (Table - 1). This corroborates with the earlier observations [18]. The EC value of most of the samples was ranged between 1020 and 2910 ( $\mu\text{mho/cm}$ ) in Perur block, Coimbatore district. The EC value of KAK pond water in Pollachi varied between 1620 and 17330, 1800 and 1950, 1560 and 1660 and 1430 and 1570 mMhos/cm during pre monsoon, monsoon, post monsoon and summer period [10]. The concentration of EC value depends upon the basic rock type, soil and the amount of rainfall received. The average EC value of drinking water samples of Coimbatore was 2633.06 ( $\mu\text{mho/cm}$ ) with rang of 670 to 9820 ( $\mu\text{mho/cm}$ ) [13]. Hagnesh [11] reported that the EC value of bore well water samples of Coimbatore ranged from 540 to 2060 and 960 to 2570 ( $\mu\text{mhos/cm}$ ) during 2009 and 2010. The ground water samples of Perur block in Coimbatore ranged from 1.1 to 1.34 (mmMhos/cm) [43]. The pH value of water is an important indicator of acidity or alkalinity. In the present research work, the pH value of all the samples lies within the limit prescribed by WHO [44],[45]. Calcium and magnesium

Table 1: Standard values of Drinking Water

Particular	Drinking water standard		
	Highest desirable	Maximum permissible	ICMR 1975
Electrical Conductivity ( $\text{d}^3/\text{m}^2$ )			40
pH	7.50-8.5	6.5-9.2	7.6-8.5
Calcium (mg/l)	75	200	75
Magnesium (mg/l)	30	45	30
Sulphate	200	400	-
Chloride	200	600	250
Nitrate	45	45	20
Total Solids	500	1500	-
Total Hardness as $\text{CaCO}_3$	-	-	300
Total Alkalinity as $\text{CaCO}_3$	-	-	120

are the important constituents of drinking water and play important role in the hardness. In the present survey, concentration of calcium and magnesium was higher than the

water quality standards. Calcium concentration of bore well water of Telungupalayam area of Coimbatore varied from 7 to 71 mg/l [39]. The calcium and magnesium content of bore well water samples of Pollachi town ranged from 69 to 90 and 29 to 34 mg/l [9]. The present observation on sodium and potassium was comparable with the earlier reports of [11]. They reported that the concentration of sodium and

potassium varies from 33 to 280 mg/l in 2009 and 52 to 218 mg/l during 2010 in Coimbatore. Chloride serves as a basis for detecting pollution of ground water by sewage before the development of bacteriological producers [35]. According to ICMR [14] the maximum permissible limit of chloride in

**Table 2:** Physicochemical properties of bore well water

Season	1	2	3	4	5	6	7	8	9	10	11	12	13
Pre Monsoon	1456	7.2	76	32	201	8	633	0	20	162	0	837	527
Monsoon	1467	7.3	78	30	197	8	648	0	22	164	1	834	526
Post Monsoon	1488	7.1	88	32	196	7	628	0	21	161	0	833	535
Summer	1510	7.1	81	32	202	8	638	0	22	158	1	841	525

1 - EC (mMhos/cm) 2- pH 3 - Calcium (mg/l) 4 - Magnesium (mg/l) 5 - Sodium(mg/l) 6. Potassium (mg/l)  
 7 - Bicarbonate (mg/l) 8 - Carbonate (mg/l) 9 - Sulphate (mg/l) 10 - Chloride (mg/l) 11 - Nitrate (mg/l)  
 12 - Total Dissolved Solids (mg/l) 13 - Alkalinity (mg/l)

drinking water is 250 mg/l [18]. The concentration of chloride in the sampling area was within the limits. The chloride content of drinking water samples of Coimbatore ranged from 5.67 to 255.24 mg/l [36]. Mean chloride content of ground water in Coimbatore was 218.63 and 200.3 during pre monsoon and post monsoon period [20]. The main source of nitrate in water is due to decaying of plant and animal material, natural soil nitrogen, fertilizers and domestic wastes [4]. The water samples of study area revealed that presence of traces of nitrate throughout the area. Elevated levels of nitrate in drinking water may cause methaemoglobinemia and gastric cancer [31]. According to WHO's specification total dissolved solids (TDS) up to 500 mg/l is the highest desirable and upto 1500 mg/l is maximum permissible limit. In the present investigation area indicating that all the samples lies within the highest desirable limit. The TDS level in Perur block of Coimbatore district ranged from 968 to 2010 mg/l [19]. The ground water samples of Unjavelampatty in Pollachi showed higher concentration of TDS in 2005 pre monsoon period (5604) and shows very low concentration (304) in 2008 post monsoon period [6]. The concentration of total dissolved solids in subsurface water of Coimbatore ranged between 313 mg/l and 1264 mg/l, and 516 mg/l and 1799 mg/l in the year 2009 and 2010 respectively [11]. The analyzed data show that 57% samples had more than the maximum permissible limit in Perur block of Coimbatore [19]. Water body exhibited high values of TDS which is caused by the addition of huge quantities of

sewage. High solids in water cause inferior potable quality of water. Similar observations were recorded by Pinaki [27]. Total alkalinity is a measure of buffering capacity of the water.

The main source for alkalinity is due to weathering of rocks. Higher alkalinity value contributes sour and saline taste to water. The alkalinity of water is a measure of its capacity to neutralize acidity in water. Alkalinity content of water samples of study area was exceeded the quality standards. Elevation of total alkalinity of water is considered to be more productive [33]. The higher alkalinity value of water is due to the contamination of municipal sewage, domestic sewage and urban wash in to ground water. The alkalinity ranged between 62 mg/l and 481 mg/l in the year 2009, and 68 mg/l and 481.9 mg/l in the year 2010 in subsurface water of Coimbatore [11]. The open well water of Pollachi town samples registered the concentrations of electrical conductivity ranged 1048 to 1062 (mMhos/cm), pH 7.2 to 7.4, calcium 52 to 59 (mg/l), magnesium 21 to 22 (mg/l), sodium 127 to 130 (mg/l), potassium 11 to 12 (mg/l), bicarbonate 406 to 413 (mg/l), sulphate 25 to 27 (mg/l), chloride 80 to 83 (mg/l), nitrate 59 to 64 (mg/l), total dissolved solids 605 to 613 (mg/l) and alkalinity 327 to 332 (mg/l) during pre monsoon, monsoon, post monsoon and summer period (Table - 3).

**Table 3:** Physicochemical properties of open well water

Season	1	2	3	4	5	6	7	8	9	10	11	12	13
Pre Monsoon	1059	7.4	54	21	130	11	411	0	25	82	62	610	332
Monsoon	1048	7.3	55	22	130	12	413	0	27	80	63	608	331
Post Monsoon	1049	7.4	52	22	129	11	406	0	25	83	59	613	327
Summer	1062	7.2	59	22	127	11	406	0	25	82	64	605	332

1 - EC (mMhos/cm) 2- pH 3 - Calcium (mg/l) 4 - Magnesium (mg/l) 5 - Sodium(mg/l) 6. Potassium (mg/l)  
 7 - Bicarbonate (mg/l) 8 - Carbonate (mg/l) 9 - Sulphate (mg/l) 10 - Chloride (mg/l) 11 - Nitrate (mg/l)  
 12 - Total Dissolved Solids (mg/l) 13 - Alkalinity (mg/l)

The average concentration of physico chemical parameters were EC 1055 (mMhos/cm), pH 7.3, calcium 55 (mg/l), magnesium 22 (mg/l), sodium 129 (mg/l), potassium 11 (mg/l), bicarbonate 409 (mg/l), sulphate 25 (mg/l), chloride 82 (mg/l), nitrate 62 (mg/l), total dissolved solids 609 (mg/l) and alkalinity 330 (mg/l). The present investigation showed

that presence higher EC value throughout the studied period. Higher EC value was recorded in the well water samples of Coimbatore district [36]. In Coimbatore district, the EC value of ground water during pre monsoon and post monsoon season of 2008 ranged between 210 and 2940 [6]. The tolerance limits of pH range from 6.5 to 8.5 and the

present water samples were within the prescribed drinking water standards [15]. The mean pH value of drinking water was 7.47 and 7.26 during pre and post monsoon period in Coimbatore [20].

Calcium and magnesium level of open well water samples of Pollachi was within the limit. Rajiv [32] also found high level of calcium and magnesium in the ground water samples of Coimbatore. Higher concentration of magnesium in human body results nausea, muscular weakness and paralysis [3]. The sulphate concentration of sampling area was within the water quality standard. The sulphate concentration of ground water in Coimbatore and Pollachi were within the permissible limit [11],[10],[9]. Total dissolved solids were varied from 290 to 1050 mg/l in Coimbatore district [34]. TDS value of water samples of river noyyal flowing through Coimbatore was ranged between 300 to 1000 mg/l and this is due to high exploitation of that location of local people washing, domestic purpose and intrusion of sewage [24]. TDS value of KAK pond water in Pollachi registered the seasonal fluctuation of TDS with a range of 920 to 1320 mg/l [10]. The concentration of total dissolved solids of present samples was higher than the highest desirable limit and within the maximum permissible limit. The various ionic species that contribute to alkalinity includes bicarbonate, hydroxide, phosphate, borate and organic acids. These factors are characteristics of the source of water and natural process taking place at any given time [38]. The alkalinity level of present open well water sample was beyond the

limits of quality standards. Alkalinity of ground water samples of Perur block in Coimbatore was oscillated between 218 and 460 mg/l [19]. The higher alkalinity values may be due to the discharge of municipal sewage, domestic sewage and urban wash off into the fresh water bodies. An increase in the free CO<sub>2</sub> may result in increase in alkalinity [40].

Municipal water samples were collected from different consumer points and subjected for the physico chemical analysis. The observations indicated that the EC was oscillated between 183 and 188 (mMhos/cm), pH 7.5 and 7.6, calcium 14 and 15 (mg/l), magnesium 6 and 7 (mg/l), sodium 11 and 12 (mg/l), potassium 4 and 5 (mg/l), bicarbonate 102 and 104 (mg/l), chloride 11 and 12 (mg/l), nitrate 0 and 1 (mg/l), total dissolved solids 103 and 108 (mg/l) and alkalinity 83 and 85 (mg/l) (Table - 4). The average of chemical constituents of drinking water supply was EC 180 (mMhos/cm), pH 7.6, calcium 15 (mg/l), magnesium 6 (mg/l), sodium 12 (mg/l), potassium 5 (mg/l), bicarbonate 103 (mg/l), chloride 12(mg/l), nitrate 0.8 (mg/l), total dissolved solids 105 (mg/l) and alkalinity 84 (mg/l). High EC values indicate the presence of high amount of dissolved inorganic substances in ionized form. In this study municipal water supply samples showed higher concentration of EC which is lesser than open well

**Table 4:** Physicochemical properties of municipal water

Season	1	2	3	4	5	6	7	8	9	10	11	12	13
Pre Monsoon	188	7.6	15	6	11	5	102	0	0	12	0	103	84
Monsoon	187	7.6	14	6	12	4	104	0	0	11	1	104	85
Post Monsoon	188	7.5	15	6	12	4	103	0	0	12	1	108	84
Summer	183	7.6	15	7	12	5	103	0	0	12	1	104	83

1- EC (mMhos/cm) 2- pH 3 - Calcium (mg/l) 4 - Magnesium (mg/l) 5 - Sodium(mg/l) 6. Potassium (mg/l)  
 7 - Bicarbonate (mg/l) 8 - Carbonate (mg/l) 9 - Sulphate (mg/l) 10 - Chloride (mg/l) 11 - Nitrate (mg/l)  
 12 - Total Dissolved Solids (mg/l) 13 - Alkalinity (mg/l)

and bore well water samples. Generally pH of water is influenced by geology of catchments area and buffering capacity of water [39]. If the water has pH less than 7 may cause tuberculation and corrosion, while higher the values may produce in crustation, sediment deposit and difficulties in chlorination for disinfection of water [7]. The present water sample survey indicated that the pH value was within the quality standard limit. 75 % of ground water samples of Coimbatore district were fall within the permissible limit of pH [37]. The mean pH value of drinking water was 7.47 and 7.26 during pre and post monsoon period in Coimbatore [20]

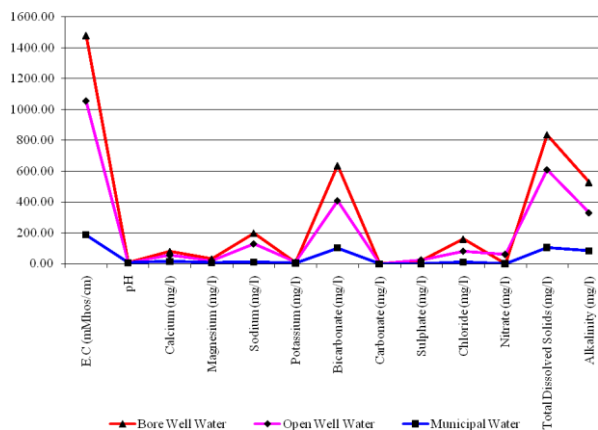
In Coimbatore, high calcium and magnesium content in portable water ranged from 413 to 1048 mg/l and 325 to 1385 mg/l [19]. Elevation of calcium and magnesium did not produce health hazards [21]. Magnesium affects the phytoplankton growth and chlorophyll development [8]. The sodium, potassium and bicarbonate concentration of present study area was ranged from 11 to 12, 4 to 5 and 102 to 103 respectively. Absence of carbonate and sulphate was observed throughout the year. The sulphate content of natural water is an important parameter in determining the suitability of water for residential use or public use. High level of TDS may aesthetically be unsatisfactory for bathing

and washing [2]. Water with high residue is normally less palatable and may induce an unfavourable physiological reaction in the transient consumer and even may cause gastrointestinal irritation [3]. Water containing high solid concentration may cause constipation effects [23]. The alkalinity content of drinking water available in Pollachi was within the quality standards and also lesser than the open well and bore well water. The maximum total alkalinity of 192 and 198 mg/l during summer month and minimum value of 120 mg/l and 140 mg/l in monsoon month in pond water during (2006-07 and 2007-08 respectively) [10]. Water having 40 mg/l or more levels of total alkalinity is considered to be more productive than that of lower alkalinity level [33]. The total alkalinity was more than 50 mg/l in Vembakottai reservoir, Virudhunagar district thereby indicating that the reservoir water is highly productive [30]. Water with higher alkalinity, hardness and chlorides are found to be more productive and support rich flora and fauna in summer.

#### 4. Conclusion

Among the water samples, bore well water registered higher EC, calcium, magnesium, sodium, potassium, bicarbonate,

chloride, total dissolved solids and alkalinity than the open well and municipal water samples (Graph - 1).



**Graph 1:** Physicochemical parameters of drinking water in Pollachi

This is mainly due to over exploitation of ground water, use of fertilizers and improper waste disposal. This is in accordance with the earlier report [12]. They reported that the use of fertilizers and pesticides, lime, septic tank, refuse dump etc., is the major source of bore well water pollution. The contamination of open well water is higher than municipal water. The order of contamination is bore well > open well > municipal water. The electrical conductivity of drinking water sampling area was exceeded the quality standard lay down by ICMR. Therefore rapid and reliable monitoring measures are essential for keeping a close watch on water quality and environment. A necessary step has to be adopted to manage the proper waste disposal.

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