

Innovations

Water Quality Assessment of Ground Water in the Villages of Sirkali Taluk, Mayiladuthurai District, Tamilnadu

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Abstract

The main aim of the World Water Quality Assessment is to examination the state of fresh water quality and its influences on health and food security. Anefficient analysis has been carried out to study the Physico-Chemical parametersof groundwater quality of some villages of Sirkali, of Mayiladuthurai district, Tamilnadu, India, is determined by Physico -Chemical methods. Ground water samples were collected by adhering to standard methods. The study was carried out by collecting ground water samples from further Twenty different villages of Sirkali. Different quality parameters are dignifiedlike Colour and appearance, Odour, Total Dissolved Solids (TDS), Turbidity, pH, Temperature, Electrical Conductivity (EC), Total Alkalinity, Total Hardness, Calcium (Ca^{2+}), Nitrate, Chloride, Fluoride, Phosphate, Sulphate, Iron, Dissolved Oxygen(DO), Ammonia and COD present in water. An Investigation has been made to find the quality of the ground water is suitable for drinking and irrigation purpose. The Physico-Chemical Parameters of Open well and BoreWell water results are discussed.

Key Words: Open well, Bore Well, Physico-Chemical Parameters, Ground water Sample and TDS

1. Introduction

Water is a living element, housing many organisms—wanted or unwanted, harmful or harmless. Water is elixir of life. All the living things sustain life through water. Water is one of the five elements that constitute the universe. Our earth is called ‘Blue Planet’ since seventy-five percent of earth surface contains water. The quality of groundwater depends on a large number of individual hydrological, physical, chemical and biological factors. Generally higher proportions of dissolved constituents are found in groundwater than in surface water because of greater interaction of groundwater with various materials in geologic strata. The water used for drinking purpose should be free from any toxic elements, living and nonliving organism and excessive amount of minerals that may be hazardous to health. Some of the heavy metals are extremely essential to humans, for example, Cobalt, Copper, etc., but large quantities of them may cause physiological disorders.

Ground water plays a central role in the maintenance of India’s economy, environment and standard of living. It is the primary source of water supply for domestic and many industrial uses. It is also the single largest and most productive source of irrigation water. A physicochemical study of ground water sample from different places carried out¹⁻¹¹. It has been observed that the ground water has high concentration of hardness and fluoride which makes out that the raw water is unsuitable for drinking purposes.

. In most of the places the quality of water was found not suitable for irrigational and industrial activities because of high concentrations of electrical conductivity and total hardness. In generally the values of all the studied parameters were high and above the standards during the post-monsoon season, compared to the pre-monsoon season¹². Central Pollution Control Board, Ministry of Environment and Forest, Government of India, New Delhi, made an extensive study (2006) on the pollution of ground water in 8 metro cities and 16 problem areas and suggested methods of abatement of pollution. It is worth here to note the relevant part of the project.

In this paper, we wish to study the Physico-Chemical parameters of the Open Well and Bore Well drinking water in Sirkali Taluk, Mayiladuthurai District, Tamilnadu.

2. Materials and Methods

About 20 Ground Water Samples (Open Well as well as Bore Well) were collected in a dry and clean glass bottle without air bubbles. All the collected samples were immediately stored in dark places. Different Analysis have been processed for after 24 hours from the collection time. AR Grade Chemicals and Double Distilled Water was used for preparations of solutions and reagents.

The ground Water samples have been analysed in the Department of Chemistry, Government Arts College, Chidambaram by Physico-Chemical analysis methods. The sampling stations are shown in **Table 1**.

Table 1 Sampling Stations Around Sirkali Taluk

S.No.	Sampling Stations	Source	Sample Number
1	Kollidam	Bore Well	1
2	Kollidam	Open Well	2
3	Santhapadugai	Bore Well	3
4	Santhapadugai	Open Well	4
5	Hanumanthapuram	Bore Well	5
6	Hanumanthapuram	Open Well	6
7	Nallur	Bore Well	7
8	Nallur	Open Well	8
9	Thaikkal	Bore Well	9
10	Thaikkal	Open Well	10
11	Puthur	Bore Well	11
12	Puthur	Open Well	12
13	Arasur	Bore Well	13
14	Arasur	Open Well	14
15	Thittupadugai	Bore Well	15
16	Thittupadugai	Open Well	16
17	Seeyalam	Bore Well	17
18	Seeyalam	Open Well	18
19	Erukkur	Bore Well	19
20	Erukkur	Open Well	20

Colour of the water sample from bore well and open well water is obtained by direct observation through the naked eye. There are various types of odours which may be arising in the water sample. Aromatic,

Chemical, Chlorinous, Hydrocarbon, Medicinal, Disagreeable, Fishy, Septic, Earthy, Peaty. Greasy, Vegetable. sample is mixed thoroughly and the odour of the given sample is observed by smelling the sample.

Nephelo turbidity meter is used for the measurement of turbidity. Higher the intensity of scattered lights higher the turbidity of the sample. Formazine solution is used as the reference turbidity standard suspension. TDS refers to the quantity of substances present in dissolved form. It directly gives the detail about the range of pollution of the water sample to be analyzed.

50 ml of well mixed sample was filtered through the filter paper to a pre-weighed dish and evaporated at 98°C. After evaporation a dish was dried for an hour at 103°C-105°C and cooled in desiccators. After cooling the dish was weighed. The difference gives the amount of total dissolved solids. The electrical conductance is the ability of a substance to conduct the electric current. Ions present in water have the ability to conduct electric current. The conductivity of pure water is very low and incises proportionally to the level of contamination present.

The conductivity cell was rinsed thoroughly with the deionised water. The conductivity of the deionised water is zero (>1 mohs / cm). The conductivity cell was rinsed with KCl solution. The cell was rinsed with one or more portion of the sample. The temperature of the sample was adjusted to 25°C and the conductivity was measured.

pH, Total Alkalinity, Total Hardness, Calcium, Magnesium, Nitrate, Chloride, fluoride, Phosphate, Sulphate, Sodium and Potassium, Iron, Ammonia, Dissolved Oxygen and Chemical Oxygen Demand are measured by following the literature procedure¹³.

3. Results and Discussion

Viewing the importance of ground water and their potential uses an attempt has been made to assess the quality of water in some of the bore wells and open wells in the villages of Sirkali Taluk, Mayiladuthurai District.

Ground water samples were collected by adhering to standard methods. These collected samples were analysed implying known procedural methods (APHA, 1982). Analysis of Ground Water sample values are given in **Table 2**.

Both open well and bore well samples were (1 to 7, 9 to 15, 19 and 20) all clear and colourless indicating that the ground water has no dissolved inorganic ions and organic substances which would impart colour to water. In the twenty samples out of the three samples were found Slightly turbid (8 and 16) and two exceptions (17 and 18) bore well and open sample was slightly brownish in which indicating the ground water has dissolved inorganic ions and organic substances which could impart colour to the water.

All the twenty samples were found to be odourless which show that there are no dissolved substances or gases in ground water of this selected area.

According to Bureau of Indian Standards, BIS (IS 10500: 1991) and World Health Organization (WHO) guidelines, the desirable limit is 5 NTU and permissible limit for turbidity is 10 NTU. In all twenty samples, out of the fourteen (1- 6, 8 -14 & 18 - 20) the turbidity value lies below the prescribed limit, in other samples (7, 15 - 17) the turbidity values are little bit above the prescribed limit. These samples of water contain no suspended solids or particles.

Electrical conductivity of a sample of water reflects the presence of inorganic ions in it. Observed conductance ranges from 741 to 2258 µmohs/ cm. It is expected that ground water invariably contain dissolved inorganic ions when water percolates through layers of earth surface.

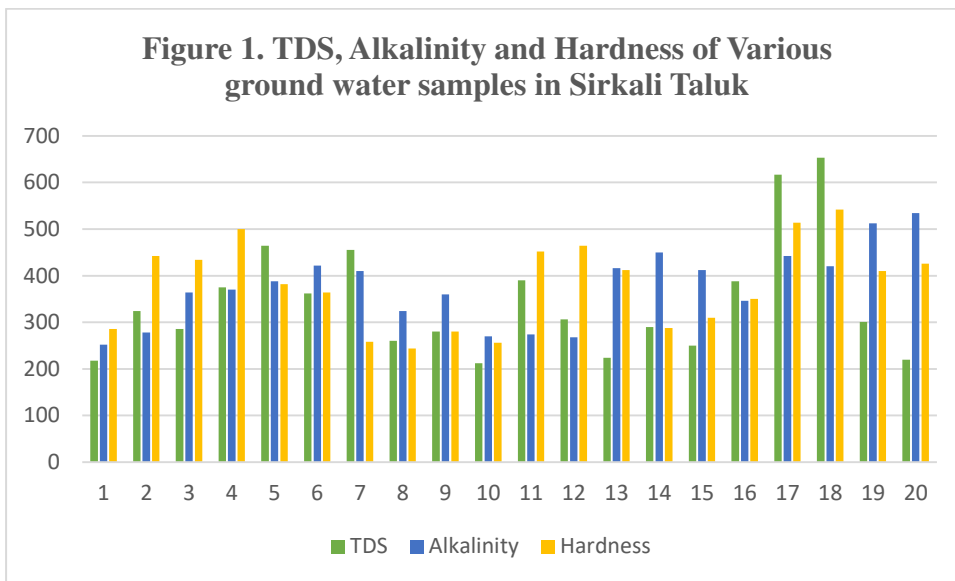
BIS and WHO set standards for total dissolved solids (TDS) as 500 mg / L (desirable limit) and 2000 mg / L (maximum permissible limit). In the study, TDS values vary from 212 mg / L to 653 mg / L which are below the permissible limit.

pH is a measure of hydrogen ion concentration in a solution or a sample of water. For drinking water purpose as far as possible it should be neutral (pH = 7). pH value ranges between 7.10 to 8.28 which indicate that they are slightly alkaline. BIS and WHO specify that

pH value may vary between 6.5 to 8.5. Ground water from bore wells could be used for drinking and irrigation purposes.

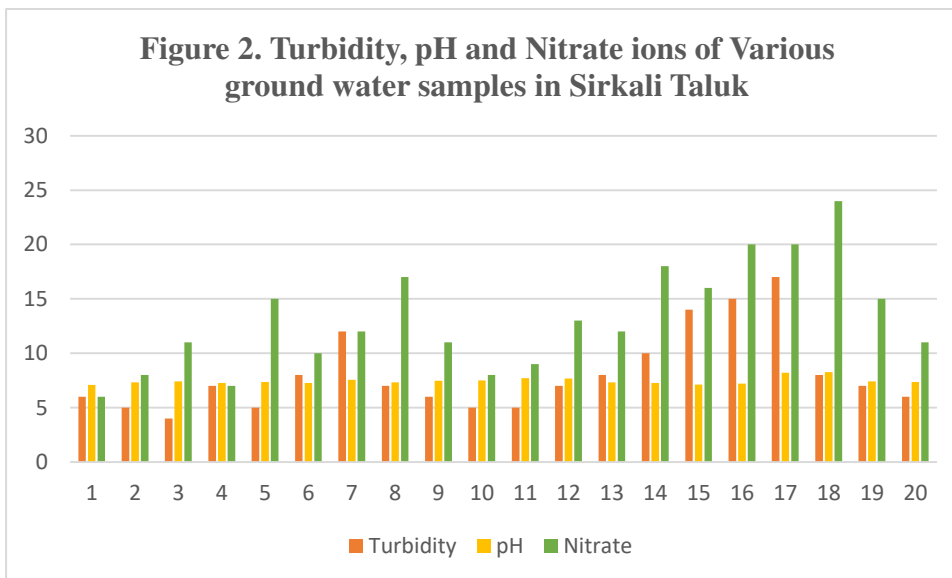
In the present study, phenolphthalein alkalinity is found to be zero almost in all twenty samples. Ground water has no dissolved Na_2CO_3 . The total alkalinity values range from 252 to 534 mg / L. Which lie well below the prescribed (BIS and WHO) limit 200 to 600 mg / L. This study has confirmed that these sources of ground water could be used for drinking and agriculture purposes.

Hardness of water is due to presence of soluble salts of calcium and magnesium. BIS and WHO guidelines indicate the desirable and permissible limit for total hardness of water as 300 mg / L and 600 mg / L. The study revealed that total hardness vary from 244 mg / L to 542 mg / L. Hardness of ground water sources of this area may not be harmful to drinking and irrigation purposes. Hardness of water may lead to disastrous effects when used in industrial losses consequent to scale formation. Comparative Study of TDS, Alkalinity and Hardness are given in **Figure 1**.



Estimation of calcium hardness indicates that the value ranges from 56 to 130 mg / L. BIS prescribes desirable limit for Ca^{2+} ion as 75 mg / L and permissible limit as 200 mg / L. Ca^{2+} has no detrimental effect on human consumption.

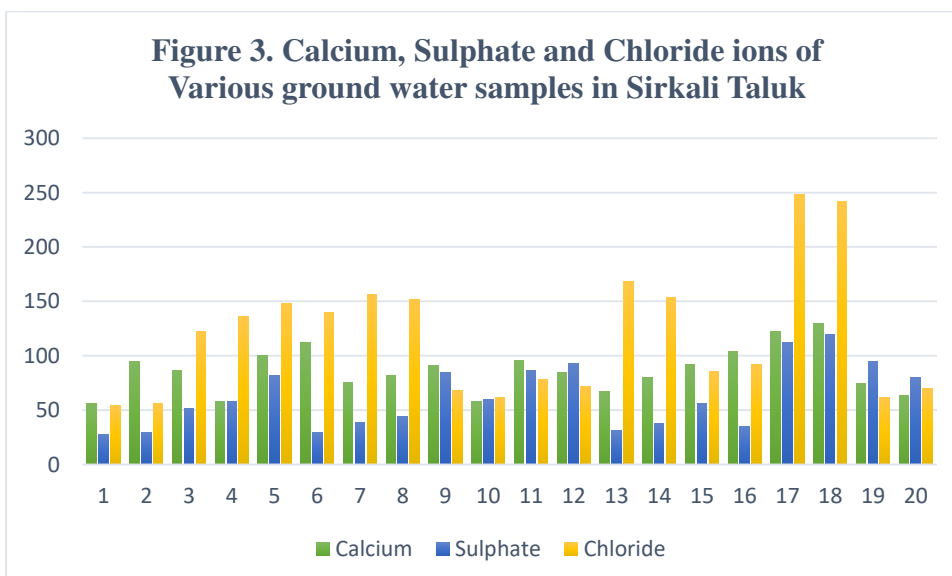
Nitrate (NO_3^-) in ground water is due to dissolved ions of sodium and potassium salts. BIS prescribed desirable and permissible limit as 45 to 100 mg / L. Whereas WHO set 10 mg / L as the maximum allowable concentration. In all the ten samples the values vary from 6.0 to 24 mg / L. When the concentration of nitrate ion exceeds the limit, it would lead to certain disorders. Comparative Study of TDS, Alkalinity and Hardness are given in **Figure 2**.



Phosphate content in the surface water results from agricultural runoff into a water stream. In ground water phosphate concentration accumulates because of soluble inorganic salts. The study has shown that phosphate concentration is 0 mg/L and these twenty samples are potable.

Similarly, the concentration of sulphate ion may not have detrimental effect on human health when present in the lower concentration. In all the ten samples, sulphate ion concentration lies between 28 and 108 mg/L which are far below than the allowed limit 200 mg/L to 400 mg/L by BIS and WHO standards.

In ground water the presence of chloride ion is attributed to soluble inorganic salts. As expected the ground water samples contain Cl^- between 54 mg/L and 248 mg/L. WHO and BIS presented for drinking water as 250 mg/L (desirable limit) and 1000 mg/L (maximum allowable concentration). Ground water sample contains lesser concentration of Cl^- ion, it would not affect the health of the people or soil when used for irrigation purposes. Comparative Study of TDS, Alkalinity and Hardness are given in **Figure 3**.



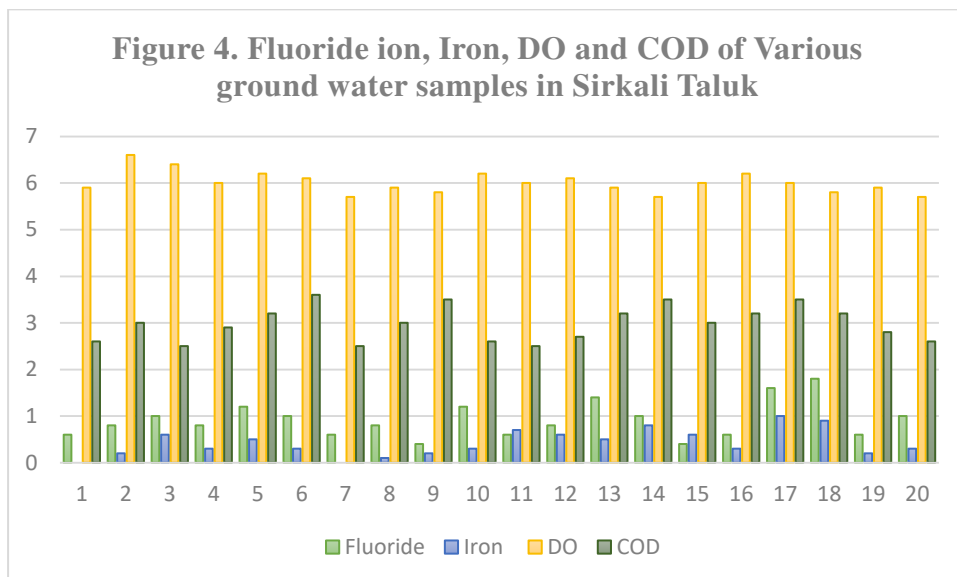
Humans need less than 1mg/L fluoride ion to maintain teeth and bone formation in good condition. When F^- ion concentration exceeds 1.5 mg/L, it would result in dental fluorosis. The study indicated that F^- ion

concentration is less than 1.5mg/L in all the samples except two samples (17 & 18). These 2 samples are physically and chemically not potable.

In ground water Iron concentration accumulates because of soluble inorganic salts. The study has shown that Iron concentration is 0 mg/L to 1.5mg/L. But as per the IS:10500 for drinking water is 0.3 to 1.0 mg/L. So in the twenty samples Iron concentrations not exceed the max permissible limit, so all the water samples are physically and chemically potable.

Dissolved oxygen (DO) is an indicator of quality of water to sustain aquatic life in water. BIS and WHO prescribed DO level as 6 ppm for normal life sustenance of a water source. When DO to below 3ppm, no microorganism or aquatic life would survive. In all the ten ground water samples, DO vary from 5.8 to 6.4 ppm. This confirms suitability of the ground water on the villages for drinking and irrigation purposes.

Chemical Oxygen Demand (COD) investigates the amount of oxidisable organic matter present in a sample of water. WHO Standard fixes the maximum COD value in a sample of drinking water as 10 mg/L. The COD values estimated vary between 2.5 to 3.6 mg/L. Since ground water has less chance of getting contaminated with organic matter, its value is expected to be low and the analysis confirmed the same. Comparative Study of TDS, Alkalinity and Hardness are given in **Figure 4**.



4. Conclusion

Ground water forms an important resource for drinking, irrigation and industrial purposes. This is especially true in the tropical countries like India. As there is no perennial river in the western districts of Tamilnadu, for all practical purposes people depend on ground water sources. In this background it has become necessary to investigate the quality of ground water in the villages of Erode District.

Water sample were collected and preserved as per the standard methods. Various physicochemical parameters were carried out by employing known procedures. Analyses were repeated for precision and accuracy and to eliminate, determinate and indeterminate error.

The present study revealed that physicochemical examination of all the ten samples of ground water (bore well and open well) out of Eighteen were complied with the standards prescribed by WHO and BIS. Remaining samples 17 and 18 are not potable due to the presence of fluoride above the norms. Dissolved oxygen and chemical oxygen demand values of all these samples vary within the allowable limits. Ground water samples are free from microorganisms, in general when there is no adjacent polluting source, in the villages where there is no source of known contaminants or pollutants. It has been well established from the study that the ground water samples are free from pollution. These water sources can be used for drinking, domestic and irrigation purposes.

5. References

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Table 2. Analysis of Physico-Chemical Parameters of Ground Water Samples

S.No.	Sample No.	Appearance	Odour	Turbidity	Conductance	TDS	pH	Alkalinity	Hardness	Ca ²⁺	Nitrate	Phosphate	SO ₄ ²⁻	Cl ⁻	F ⁻	Iron	DO	COD
1	1	Colourless & Clear	Odourless	6	741	218	7.1	252	286	56	6	0	28	54	0.6	0	5.9	2.6
2	2	Colourless & Clear	Odourless	5	1188	324	7.3	278	442	95	8	0	30	56	0.8	0.2	6.6	3
3	3	Colourless & Clear	Odourless	4	1232	286	7.4	364	434	87	11	0	52	122	1	0.6	6.4	2.5
4	4	Colourless & Clear	Odourless	7	1492	375	7.3	370	500	58	7	0	58	136	0.8	0.3	6	2.9
5	5	Colourless & Clear	Odourless	5	908	464	7.4	388	382	100	15	0	82	148	1.2	0.5	6.2	3.2
6	6	Colourless & Clear	Odourless	8	824	362	7.3	422	364	112	10	0	30	140	1	0.3	6.1	3.6
7	7	Colourless & Clear	Odourless	12	1567	455	7.6	410	258	76	12	0	39	156	0.6	0	5.7	2.5
8	8	Slight Turbidity	Odourless	7	1818	260	7.3	324	244	82	17	0	44	152	0.8	0.1	5.9	3
9	9	Colourless & Clear	Odourless	6	1686	280	7.5	360	280	91	11	0	85	68	0.4	0.2	5.8	3.5
10	10	Colourless & Clear	Odourless	5	2258	212	7.5	270	256	58	8	0	60	62	1.2	0.3	6.2	2.6

11	11	Colourless & Clear	Odour less	5	2064	390	7.7	274	452	96	9	0	87	78	0.6	0.7	6	2.5
12	12	Colourless & Clear	Odour less	7	1917	306	7.7	268	464	85	13	0	93	72	0.8	0.6	6.1	2.7
13	13	Colourless & Clear	Odour less	8	1624	224	7.3	416	412	67	12	0	31	168	1.4	0.5	5.9	3.2
14	14	Colourless & Clear	Odour less	10	1486	290	7.3	450	288	80	18	0	38	154	1	0.8	5.7	3.5
15	15	Colourless & Clear	Odour less	14	1164	250	7.1	412	310	92	16	0	56	86	0.4	0.6	6	3
16	16	Slight Turbidity	Odour less	15	1526	388	7.2	346	350	104	20	0	35	92	0.6	0.3	6.2	3.2
17	17	Slight Brownish	Odour less	17	836	617	8.2	442	514	122	20	0	112	248	1.6	1	6	3.5
18	18	Slight Brownish	Odour less	8	790	653	8.3	420	542	130	24	0	120	242	1.8	0.9	5.8	3.2
19	19	Colourless & Clear	Odour less	7	2160	301	7.4	512	410	75	15	0	95	62	0.6	0.2	5.9	2.8
20	20	Colourless & Clear	Odour less	6	1542	220	7.4	534	426	64	11	0	80	70	1	0.3	5.7	2.6

