IMPACT: International Journal of Research in Humanities, Arts and Literature (IMPACT: IJRHAL)
ISSN (P): 234-4564; ISSN (E): 2321-8878
Vol. 7, Issue 5, May 2019, 445-456
© Impact Journals

ASSESSMENT OF GROUNDWATER QUALITY IN CHIDAMBARAM TOWN, CUDDALORE DISTRICT, TAMILNADU STATE

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Received: 08 Apr 2019 **Accepted:** 26 Apr 2019 **Published:** 31 May 2019

ABSTRACT

Water is referred to as a universal solvent. It is a prime necessity of life and has lead to the growth of population along banks of natural water sources. Water is required for satisfactory performance of physiological organism as a circulatory fluid. Water plays an important role in the global world. Seasonal variation of ground water quality is defined as the monotonic change in particular constituents with time. Two major causes of variation in water quality data are seasonality and discharge. The present study deals about the quality of drinking water in and around Chidambaram Town, Cuddalore district, Tamil Nadu State. The groundwater quality to be assessed for various seasons (Pre-monsoon & Post monsoon). Samples have been collected monthly from a different location in and around Chidambaram town. The various parameters are tested such as pH, chloride, hardness, total dissolved solids, iron, phosphate, fluoride, ammonia, alkalinity and dissolved oxygen. The seasonal variation in groundwater quality parameters has been analyzed. The results of the analysis have been compared with the WHO and BIS standards and a suitable recommendation have been suggested.

KEYWORDS: *Groundwater, Water Quality, Hydrogeo Chemical, WHO & BIS Standards*

INTRODUCTION

Groundwater is commonly understood to mean water occupying all voids within the geological stratum and the water that occur below the earth Water from beneath the ground has been exploited for domestic use, livestock and irrigation since the earliest times. Demand for freshwater continues to grow in the human population. A continuous supply of freshwater may vary all seasonally and geographically. The study of quality of groundwater alone is not sufficient to solve the water management problem because their use for various purposes depends only on its quality. When seawater intrusion is the only cause for the salinity of groundwater in an aquifer system, the groundwater does not only exhibit high total dissolved solids (TDS) but also shows a high concentration of most major caution and anions (Richter and Kreitler, 1993). Hydrogeo chemical data helps in estimating the extended of mixing, the circulating pathways and residence time of groundwater (Edmunds, 1994). The type and concentration of salts in depend on the geological environment and movement of groundwater (Ragunath 1987). The purposes of this study are to examine spatial and temporal variations of groundwater chemistry in a coastal aquifer system. Which is located in Cuddalore coastal area and interpret reasonable processes that control the groundwater chemistry. Chemical composition of groundwater and chemical aspects used to determine factors affecting the hydrogeo chemistry of groundwater in the study area. Drinking water or potable water is

defining as that having acceptable quality in terms of its physical, chemical, bacteriological, and acceptability parameters so that it can be safely used for drinking and cooking (WHO, 2004).

NEED FOR STUDY

With the ever rowing urban population and the need for increase housing complex which establish a new area for construction and development of residential colonies, this has a severe impact on the land and water resource and ultimately leads severely irreversible.

OBJECTIVES OF THE STUDY

- To collect the groundwater sample from various stations in the study area.
- To study the physical characteristics of the water sample.
- To study the chemical characteristics of the water samples by using a water testing kit.
- To compare the test parameters with the standards for ensuring the quality of ground water samples.

This study deals with the study of physical, chemical characteristics of groundwater. Physical properties like colour, Electric Conductivity, Odor, pH, Salinity, Temperature, Turbidity and chemical properties like Aluminum, Calcium, Dissolved gases, Hardness, Iron, Magnesium, Nitrate, Potassium, Trace Elements.

STUDY AREA

Figure 1: Shows a Cuddalore District Map.

Chidambaram is located at 11.39 N 79.69 E. It is located in Cuddalore district of the south Indian state, Tamilnadu, at a distance of 250 km from Chennai. The topography is almost plain with the forest around the town, with no major geological formation. These are no notable mineral resources are available in around town. The soil type is alluvial conducive for a crop like paddy. The temperature ranges from the maximum of 32.7 o a minimum 24 c like the rest of the state. April to June is the hottest month and December to January is the coldest. Chidambaram received an average of 1200 mm annually which is lesser than the state average of 1000 mm. The south-west monsoon with onset in June and lasting up to August bring scanty rainfall. The bulk of the rain fall is received during the northeast monsoon in the month of October, November, and December. The average number of rainy days' range from 35-40 every year.

METHODOLOGY

The water samples collected from the different location are stored in polyethylene bottles of 2–1 capacity. These samples are transported to the laboratory in an icebox to avoid unpredictable changes in physic-chemical and biological characteristics. Sampling and analysis were carried out according to standard methods prescribed by the World Health Organization.

DATA COLLECTION

Primary Data

Groundwater samples were collected in the various location of Chidambaram town. Various field visits were conducted water collection of primary data.

Secondary Data

The historical data on water quality collected from WRO, Ground Water division, Chidambaram Town. The ground-water quality resources have been computed jointly by the central groundwater board and state and surface water resources data center.

Groundwater **s**ample locations are presented in table 1. Different methods adapted for chemical analysis of water sample are shown in table 2.

Table 1: Name of the Sample Locations

S. No	Sample Location	Type of Pump
1	Usuppur	Hand Pump
2	Kadavacheri	Hand Pump
3	Vallampadugai	Hand Pump
4	Themmur	Hand Pump
5	Meiyathur	Hand Pump
6	Vadamur	Hand Pump
7	NanjaimaghattuVahkai	Hand Pump
8	Thillaividangan	Hand Pump
9	Kodippallam	Hand Pump
10	Kanakkarapattu	Hand Pump
11	Veerankovil Thittu	Hand Pump
12	Kumaramangalam	Hand Pump
13	Kovilanpoondi	Hand Pump
14	Bhuvanagiri	Hand Pump
15	Kodiyalam	Hand Pump

Table 2: Methods Adopted for Chemical Analysis of Water Sample

S. No.	Parameters	Methods
1	pH(mg/L)	pH meter
2	CL(mg/L)	Mohr's Method
3	Hardness(mg/L)	Titration
4	Fluoride(mg/L)	Water Testing Kit
5	Alkalinity(mg/L)	Titration
6	Phosphate(mg/L)	Water Testing Kit
7	Ammonia(mg/L)	Water Testing Kit
8	Total dissolved solids(mg/L)	Electrical Conductivity meter
9	DO(mg/L)	Winkler methods
10	Iron(mg/L)	Water Testing Kit

RESULTS AND DISCUSSIONS

Table no 3 to 12 are the comparison of water quality parameters with WHO and BIS standard values. Figures 2 to 11 are depicted comparisons of water quality parameters with pre-monsoon and post-monsoon seasons. The results show that pH ranges in which between 6.50 and 8.00 in pre-monsoon period and 7.00 in 8.50 in post-monsoon period. The station Kanakkarapattu recorded the lower value of 6.18. It is below the limits as per WHO standards (6.5 – 8.5). Chloride content is more than 250 mg/L the water cannot be used for drinking, domestic as well as agriculture purpose. The station Kadavacheri, Vallampadugai, Themmur, is having a lower concentration. The total hardness varies from 160 to 600 mg/L in pre-monsoon period, 220 to 587 mg/L in post-monsoon period and 160 to 550 mg/L in the winter season. In most of the stations, the hardness content is within the permissible limit. But in the stations Meiyathur, Vadamur and Nanjaimaghattu vazhkai have high hardness content. The water cannot be used for drinking purpose.

Table 3: Comparison of Ph Vs Standards

S. No	Station	Pre Monsoon	Post Monsoon	WHO Limits	Remarks
1	Usuppur	370	424	250–1000	Normal
2	Kadavacheri	110	92	250–1000	Low
3	Vallampadugai	162	212	250–1000	Low
4	Themmur	70	98	250–1000	Low
5	Meiyathur	1556	1400	250–1000	High
6	Vadamur	386	820	250–1000	Normal
7	Nanjaimagatthu Vazhkai	688	464	250–1000	Normal
8	Thillaividangan	640	788	250–1000	Normal
9	Kodippallam	662	804	250–1000	Normal
10	Kanakkarapattu	1740	1732	250–1000	High
11	Veerankovil Thittu	188	294	250–1000	Low
12	Kumaramangalam	230	234	250–1000	Low
13	Kovilampoondi	176	284	250–1000	Low
14	Bhuvanagiri	380	300	250–1000	Normal
15	Kodiyalam	370	424	250–1000	Normal

The fluoride concentration lies in the range of 0.5 to 1.0 mg/Lin pre-monsoon period.0.5 to 1.5 mg/L in post-monsoon period and 0.5 to 1.0mg/L in winter season. Alkalinity is an important determination to the water treatment plant operation become the action of coagulants used for purification requires sufficient alkalinity to ensure a proper reaction for domestic is agricultural purposes carbonates alkalinity. All the station is within the permissible limit. Natural water usually

contains phosphate at concentration less than 0.1 mg/L. The station Kumaramangalam has higher phosphate concentration more than 0.1mg/L.

The present study shows values range of TDS from 908-1816 mg/L in both pre-monsoon and post-monsoon periods. The values of samples in some of the stations are within the permissible limit (< 1500mg/l), but Meiyathur, Kanakkarapattu, Veerankovilthittu, and Kodiyalam are above the permissible limit in both pre-monsoon and post-monsoon periods. Dissolved oxygen is used as an indicator of the health of a water body. The permissible limit for dissolved oxygen is 5-9.5 mg/l, the station no 4,11,1314 and 15 are within the permissible limits. The permissible limit of iron in drinking water is 1.0 mg/L.The station Usuppur and Kanakkarapattu have higher iron concentration

Table 4: Comparison of Chloride Vs Standards (Mg/L)

S. No	Station	Pre Monsoon	Post Monsoon	WHO Limits	Remarks
1	Usuppur	370	424	250–1000	Normal
2	Kadavacheri	110	92	250–1000	Low
3	Vallampadugai	162	212	250–1000	Low
4	Themmur	70	98	250–1000	Low
5	Meiyathur	1556	1400	250–1000	High
6	Vadamur	386	820	250–1000	Normal
7	NanjaimagatthuVazhkai	688	464	250–1000	Normal
8	Thillaividangan	640	788	250–1000	Normal
9	Kodippallam	662	804	250–1000	Normal
10	Kanakkarapattu	1740	1732	250–1000	High
11	Veerankovil Thittu	188	294	250–1000	Low
12	Kumaramangalam	230	234	250–1000	Low
13	Kovilampoondi	176	284	250–1000	Low
14	Bhuvanagiri	380	300	250–1000	Normal
15	Kodiyalam	370	424	250–1000	Normal

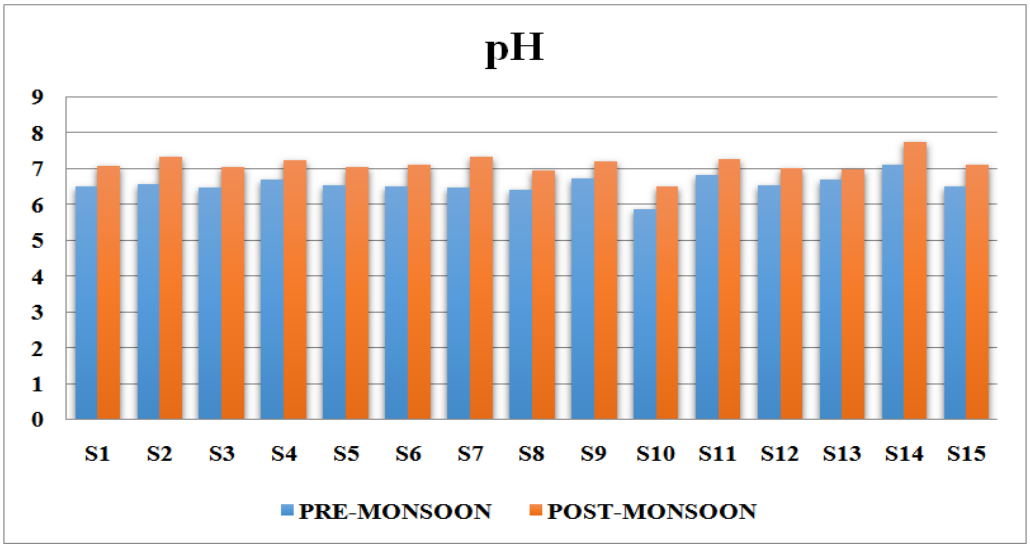

Figure 2: Comparison of the Water Samples Ph.

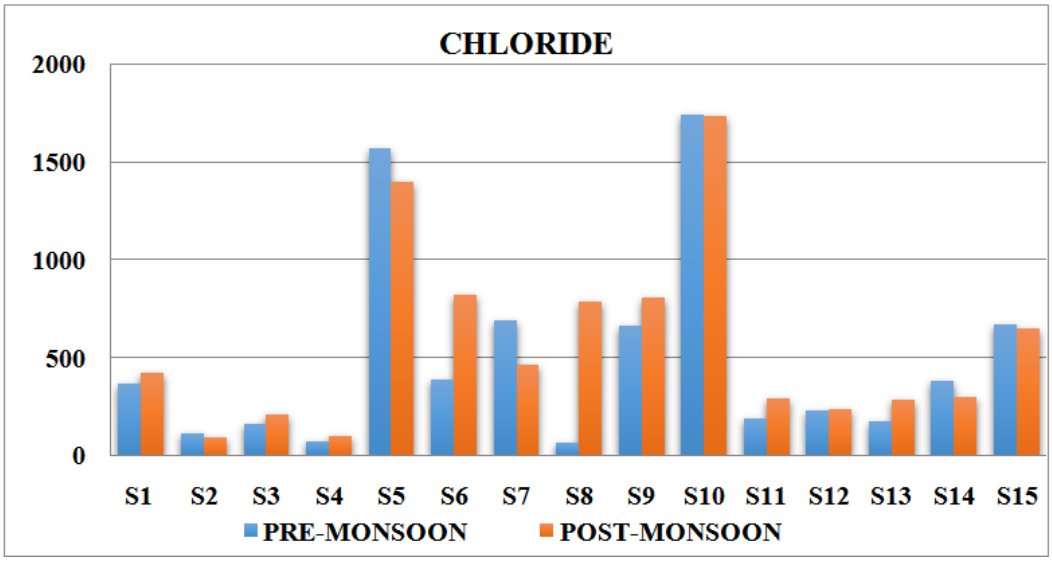

Figure 3: Comparison of the Water Samples Chloride (Mg/L)

Table 5 Comparison of Hardness Vs Standard (Mg/L)

S. No	Station	Pre Monsoon	Post Monsoon	BIS Limits	Remarks
1	Usuppur	1.0	0.5	0.5–1.5	Normal
2	Kadavacheri	1.0	1.0	0.5–1.5	Normal
3	Vallampadugai	0.5	1.0	0.5–1.5	Normal
4	Themmur	0.5	0.5	0.5–1.5	Normal
5	Meiyathur	0.5	0	0.5–1.5	Low
6	Vadamur	0	0.5	0.5–1.5	Low
7	Nanjaimagatthu Vazhkai	1.0	1.0	0.5–1.5	Normal
8	Thillaividangan	0.5	0	0.5–1.5	Low
9	Kodippallam	1.5	1.0	0.5–1.5	High
10	Kanakkarapattu	1.0	2.0	0.5–1.5	High
11	Veerankovil Thittu	1.0	0.5	0.5–1.5	Normal
12	Kumaramangalam	0.5	1.0	0.5–1.5	Normal
13	Kovilampoondi	0.5	0	0.5–1.5	Low
14	Bhuvanagiri	1.5	1.0	0.5–1.5	High
15	Kodiyalam	1.0	1.0	0.5–1.5	Normal

Table 6: Comparison of Fluoride Vs Standard (Mg/L)

S. No	Station	Pre Monsoon	Post Monsoon	BIS Limits	Remarks
1	Usuppur	534	554	300–600	Normal
2	Kadavacheri	286	276	300–600	Normal
3	Vallampadugai	300	338	300–600	Normal
4	Themmur	156	188	300–600	Low
5	Meiyathur	1340	1210	300–600	High
6	Vadamur	534	870	300–600	High
7	Nanjaimagatthu Vazhkai	426	414	300–600	Normal
8	Thillaividangan	764	710	300–600	High
9	Kodippallam	582	618	300–600	Normal
10	Kanakkarapattu	690	704	300–600	High
11	Veerankovil Thittu	192	242	300–600	Low
12	Kumaramangalam	390	330	300–600	Normal
13	Kovilampoondi	432	434	300–600	Normal
14	Bhuvanagiri	130	100	300–600	Low
15	Kodiyalam	666	620	300–600	High

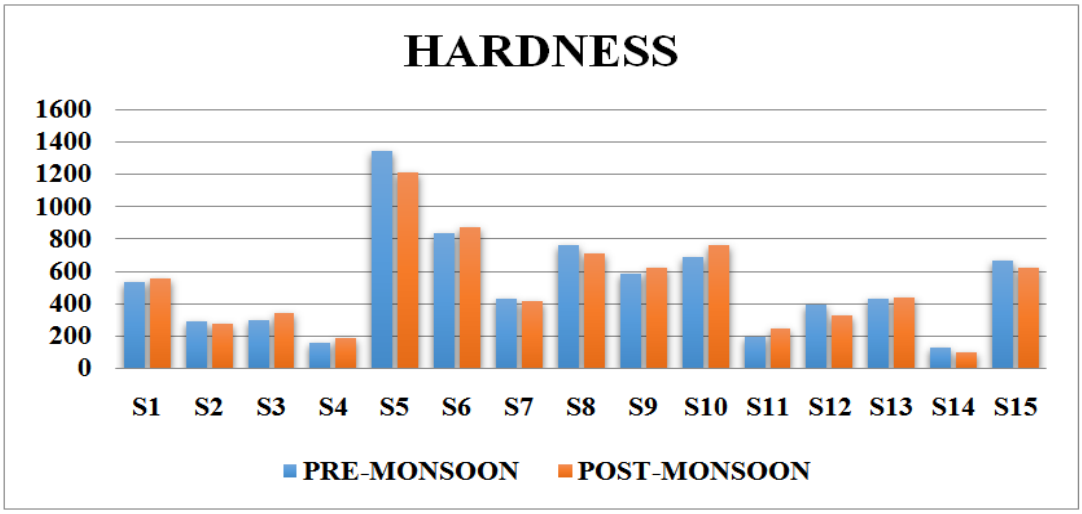

Figure 4: Comparison of the Water Samples hardness (Mg/L).

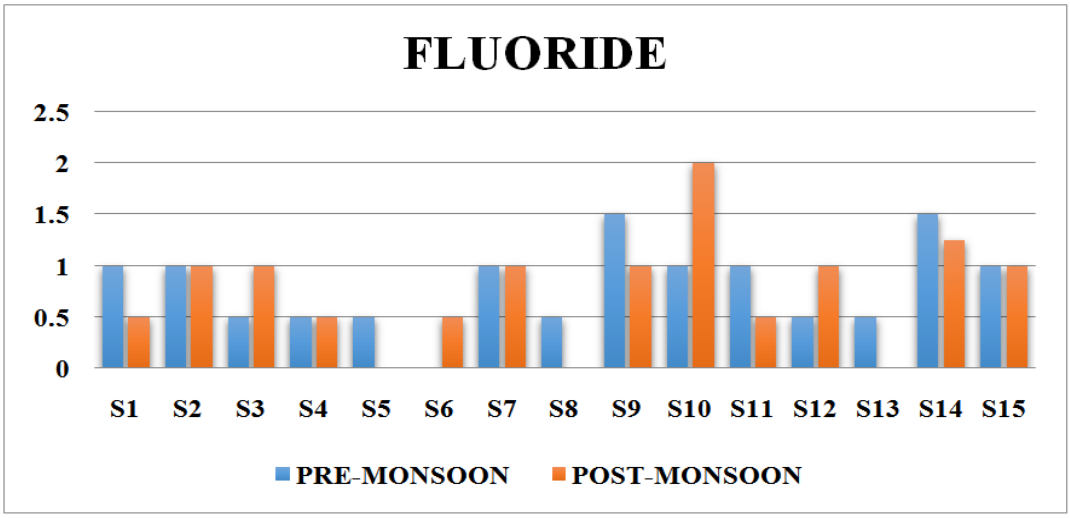

Figure 5: Comparison of the Water Samples Fluoride (Mg/L).

Table 7: Comparison of Alkalinity Vs Standard (Mg/L)

S. No	Station	Pre Monsoon	Post Monsoon	BIS Limits	Remarks
1	Usuppur	110	120	200–600	Low
2	Kadavacheri	100	80	200–600	Low
3	Vallampadugai	130	140	200–600	Low
4	Themmur	90	80	200–600	Low
5	Meiyathur	120	100	200–600	Low
6	Vadamur	110	100	200–600	Low
7	Nanjaimagatthu Vazhkai	140	160	200–600	Low
8	Thillaividangan	150	140	200–600	Low
9	Kodippallam	180	200	200–600	Low
10	Kanakkarapattu	170	150	200–600	Low
11	Veerankovil Thittu	90	100	200–600	Low
12	Kumaramangalam	120	110	200–600	Low
13	Kovilampoondi	120	110	200–600	Low
14	Bhuvanagiri	110	120	200–600	Low
15	Kodiyalam	190	200	200–600	Low

Table 8: Comparison of Phosphate Vs Standard (Mg/L)

S.No	Station	Pre Monsoon	Post Monsoon	WHO Limits	Remarks
1	Usuppur	0	0	0.1	Low
2	Kadavacheri	0	0	0.1	Low
3	Vallampadugai	0	0	0.1	Low
4	Themmur	0	0	0.1	Low
5	Meiyathur	0	0	0.1	Low
6	Vadamur	0	0	0.1	Low
7	Nanjaimagatthu Vazhkai	0	0	0.1	Low
8	Thillaividangan	0	0	0.1	Low
9	Kodippallam	0	0	0.1	Low
10	Kanakkarapattu	0	0	0.1	Low
11	Veerankovil Thittu	0.3	0.3	0.1	High
12	Kumaramangalam	0	0	0.1	Low
13	Kovilampoondi	0	0	0.1	Low
14	Bhuvanagiri	0	0	0.1	Low
15	Kodiyalam	0.5	0.3	0.1	High

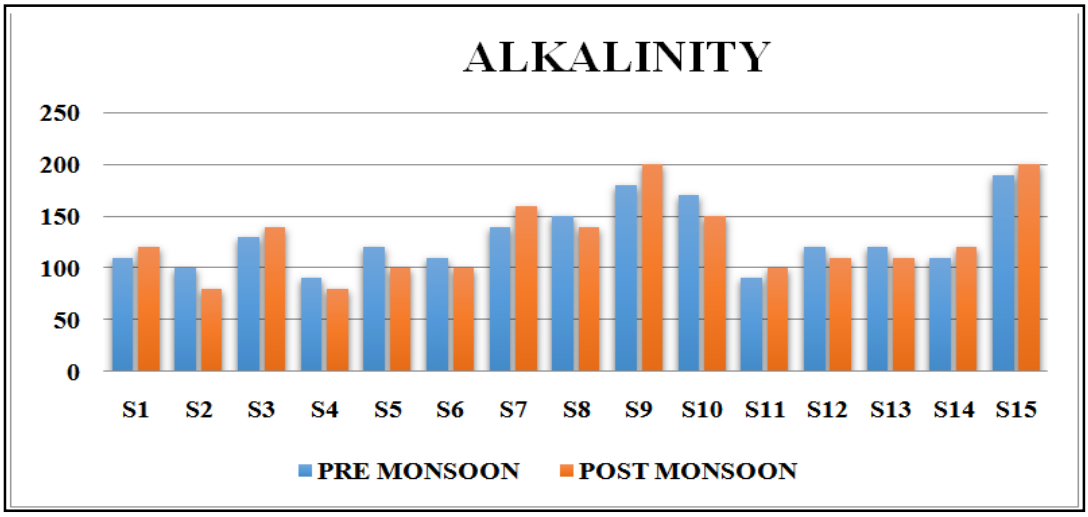

Figure 6: Comparison of the Water Samples Alkalinity (Mg/L).

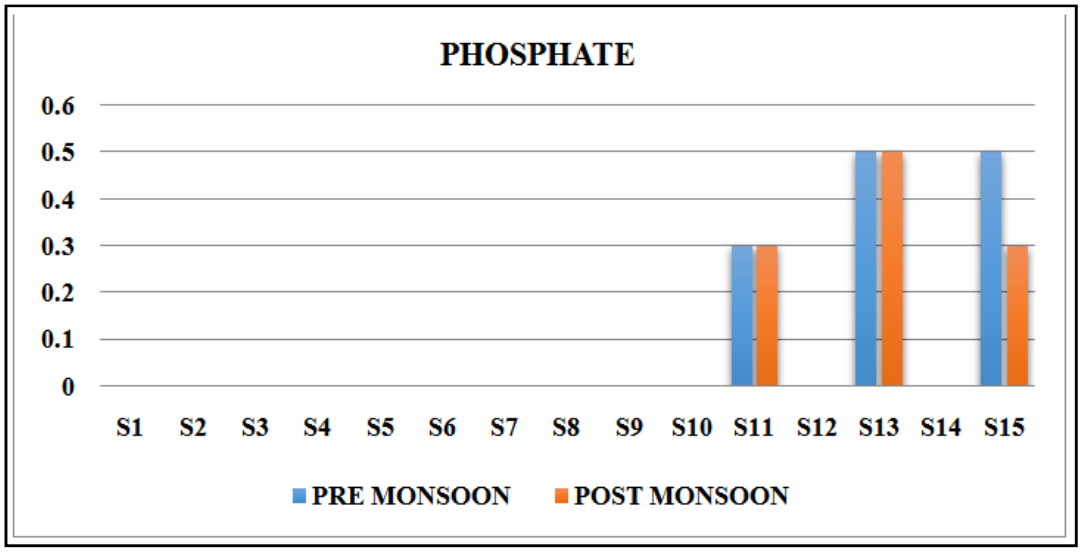

Figure 7: Comparison of the Water Samples Phosphate (Mg/L).

Table 9: Comparison of Ammonia Vs Standard (Mg/L)

S. No	Station	Pre Monsoon	Post Monsoon	BIS Limits	Remarks
1	Usuppur	1.0	1.0	0.5–1.5	Normal
2	Kadavacheri	0.5	0	0.5–1.5	Low
3	Vallampadugai	0	0	0.5–1.5	Low
4	Themmur	0.5	0.5	0.5–1.5	Normal
5	Meiyathur	0.5	1.0	0.5–1.5	Normal
6	Vadamur	0	0.5	0.5–1.5	Low
7	Nanjaimagatthu Vazhkai	1.0	0.5	0.5–1.5	Normal
8	Thillaividangan	1.0	0.5	0.5–1.5	Normal
9	Kodippallam	0.5	0.5	0.5–1.5	Normal
10	Kanakkarapattu	1.0	2.0	0.5–1.5	Normal
11	Veerankovil Thittu	0	0	0.5–1.5	Low
12	Kumaramangalam	0.5	0.5	0.5–1.5	Normal
13	Kovilampoondi	0.5	0.5	0.5–1.5	Normal
14	Bhuvanagiri	0.5	0	0.5–1.5	Low
15	Kodiyalam	0.5	1.0	0.5–1.5	Normal

Table 10: Comparison of Total Dissolved Solids Vs Standard (Mg/L)

S. No	Station	Pre Monsoon	Post Monsoon	BIS Limits	Remarks
1	Usuppur	1216	1365	500–2000	Normal
2	Kadavacheri	720	598	500–2000	Normal
3	Vallampadugai	715	949	500–2000	Normal
4	Themmur	377	449	500–2000	Low
5	Meiyathur	3510	3250	500–2000	High
6	Vadamur	1216	2080	500–2000	High
7	Nanjaimagatthu Vazhkai	1885	1365	500–2000	Normal
8	Thillaividangan	1690	1885	500–2000	Normal
9	Kodippallam	1885	2015	500–2000	Normal
10	Kanakkarapattu	4940	4615	500–2000	High
11	Veerankovil Thittu	793	969	500–2000	Normal
12	Kumaramangalam	852	871	500–2000	Normal
13	Kovilampoondi	793	1112	500–2000	Normal
14	Bhuvanagiri	1690	1495	500–2000	Normal
15	Kodiyalam	2015	1950	500–2000	High

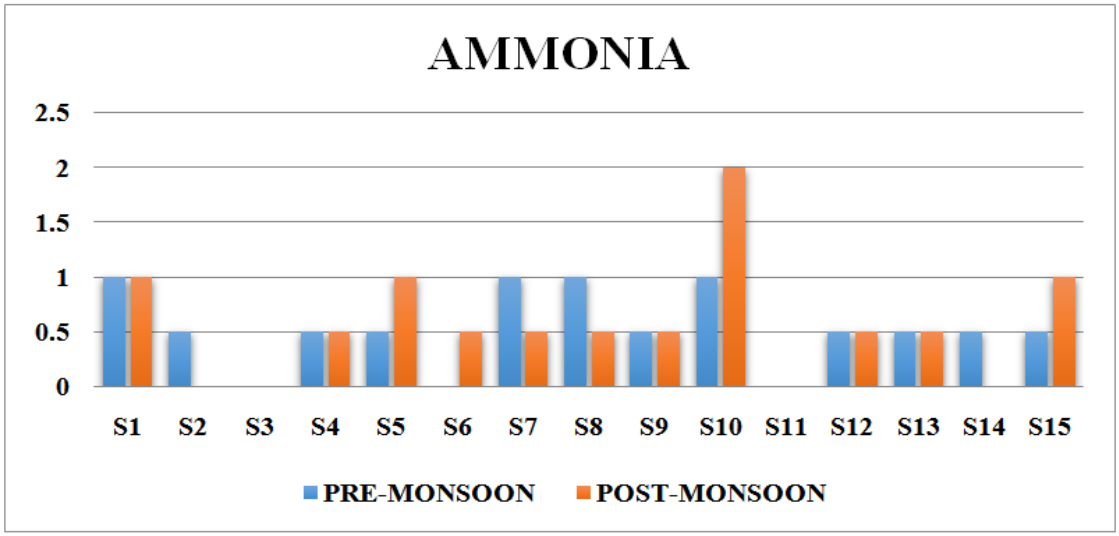

Figure 8: Comparison of the Water Samples Ammonia (Mg/L).

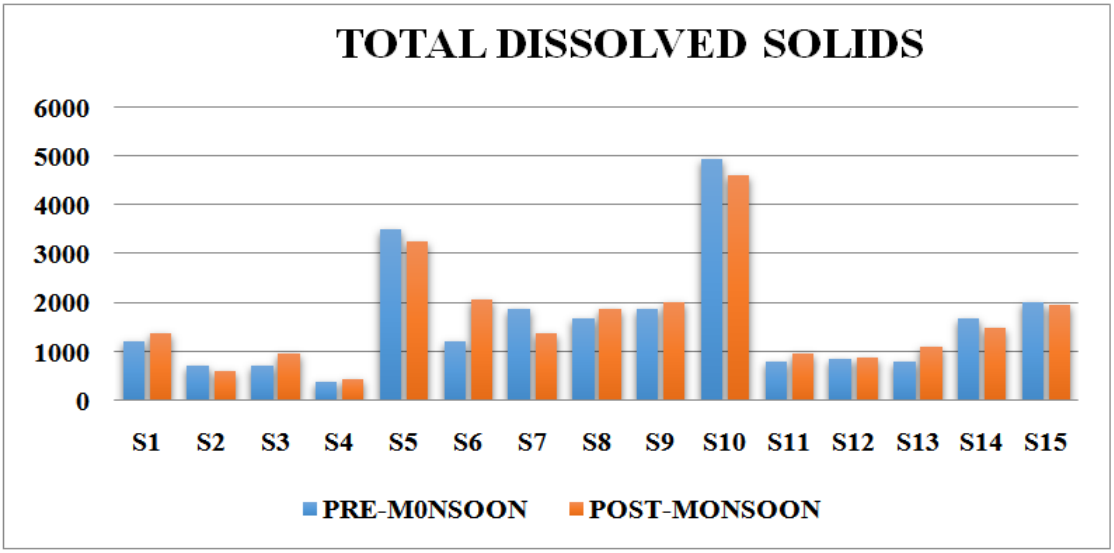

Figure 9: Comparison of the Water Samples Total Dissolved Solids (Mg/L).

Table 11: Comparison of Dissolved Oxygen Vs Standard (Mg/L)

S. No	Station	Pre Monsoon	Post Monsoon	CPCB Limits	Remarks
1	Usuppur	4	4.2	5–9.5	Low
2	Kadavacheri	4.3	4.5	5–9.5	Low
3	Vallampadugai	3.5	3.9	5–9.5	Low
4	Themmur	7.2	6.5	5–9.5	Normal
5	Meiyathur	5.2	3.0	5–9.5	Low
6	Vadamur	5.1	4.6	5–9.5	Low
7	Nanjaimagatthu Vazhkai	4.2	3.8	5–9.5	Low
8	Thillaividangan	3.9	3.5	5–9.5	Low
9	Kodippallam	4.3	4.0	5–9.5	Low
10	Kanakkarapattu	3.3	3.5	5–9.5	Low
11	Veerankovil Thittu	5.9	5.9	5–9.5	Normal
12	Kumaramangalam	4.6	4.7	5–9.5	Low
13	Kovilampoondi	6.5	6.3	5–9.5	Normal
14	Bhuvanagiri	5.3	5.8	5–9.5	Normal
15	Kodiyalam	5.8	6.0	5–9.5	Normal

Table 12: Comparison of Iron Vs Standard (Mg/L)

S. No	Station	Pre Monsoon	Post Monsoon	BIS Limits	Remarks
1	Usuppur	3.0	5.0	0.3–1.0	High
2	Kadavacheri	0.3	0.3	0.3–1.0	Normal
3	Vallampadugai	0.0	0.0	0.3–1.0	Low
4	Themmur	0.3	0.3	0.3–1.0	Normal
5	Meiyathur	0.0	0.0	0.3–1.0	Low
6	Vadamur	0.0	0.0	0.3–1.0	Low
7	NanjaimagatthuVazhkai	1.0	0.3	0.3–1.0	Normal
8	Thillaividangan	0.3	0.3	0.3–1.0	Normal
9	Kodippallam	0.3	0.3	0.3–1.0	Normal
10	Kanakkarapattu	5.0	5.0	0.3–1.0	High
11	Veerankovil Thittu	0.3	0.3	0.3–1.0	Normal
12	Kumaramangalam	0.3	1.0	0.3–1.0	Normal
13	Kovilampoondi	0.3	0.3	0.3–1.0	Normal
14	Bhuvanagiri	0.3	0.3	0.3–1.0	Normal
15	Kodiyalam	0.3	0.3	0.3–1.0	Normal

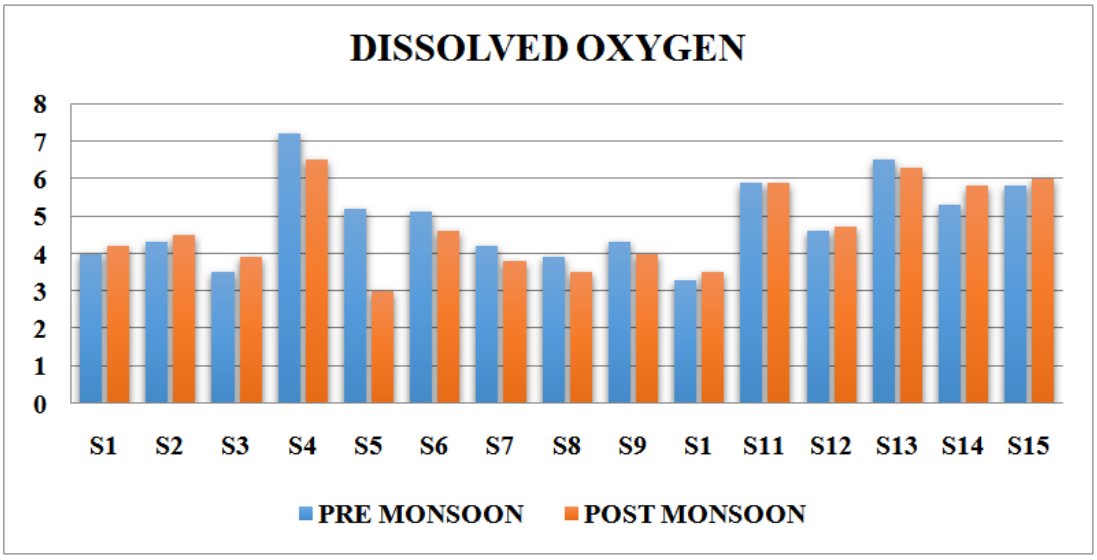

Figure 10: Comparison of the Water Samples Dissolved Oxygen (Mg/L).

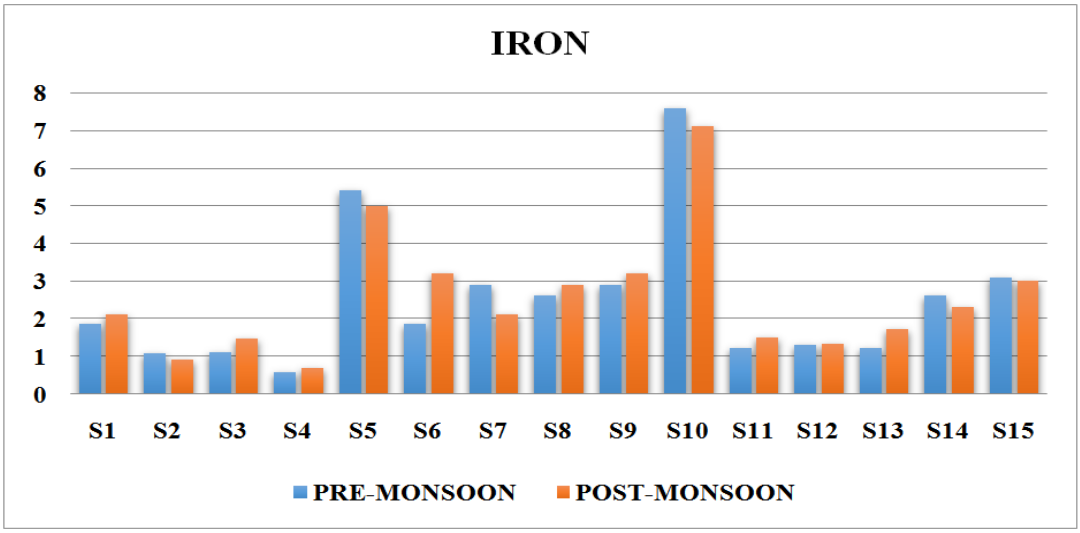

Figure 11: Comparison of the Water Samples Iron (Mg/L).

CONCLUSIONS

The physical and chemical properties of groundwater will vary with time, due to factor like climate, geologic, hydrologic, ecologic and biogenetic factor. It also varies due to artificial factor such as irrigation, reservoir, etc., to ascertain the above phenomenon. In our project, we analyze the underground water of bore wells situated in Chidambaram town. In the pre-monsoon period the pH is very low in Kanakkarapattu with the value of 5.87. The parameters like alkalinity, phosphate, ammonia, and dissolved oxygen are within the permissible limit as per WHO and BIS standards. But the test shows the slight variations in chloride value are high in station no: 5,7,8,9,10 and 15, Hardness value high in station no:5,6 and 8, Fluoride value is high in station no: 9 and 14, Total dissolved solids are high in station no:5,7,9,10 and 15 and the iron value is high in station no: 1 and 10, when compared to the WHO and BIS standards. In the post-monsoon period, the parameters like pH, Alkalinity, Phosphate, Ammonia, and Dissolved oxygen are within the permissible limits when compared to the recommended standards. In post-monsoon season also there is a variation in the chloride value high

in station no:5,6,8,10 and 15, Hardness value high in station no:5 and 6, Fluoride value is very high in station no:10 Kanakkarapattu with the value of 2.0, Total dissolved solids are high in station no:5,7,8,9,10 and 15 and Iron value is high in station no:1 and 10 when compared to the WHO and BIS standards. An analytical report obtained from the study, that the groundwater, clearly shows the presence of high value of chloride, hardness and total dissolved solids tan the permissible limits of drinking water stands. Thus the treatment of water is essentially required such as reverse osmosis, distillation activated carbon, ion exchange, neutralizing agent to convert surface water to portable water. From this study, the physical and chemical properties of groundwater are not constant and vary with season.

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