Turkish Online Journal of Qualitative Inquiry (TOJQI)
Volume 12, Issue 8, July, 2021:7387 – 7397

Research Article

Analysis of Groundwater Quality in Thiruvallur

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Abstract

The study was aimed to determine the quality of Groundwater flowing in the Tiruvallur District. Tiruvallur is an administrative district present in the southern state of Tamil Nadu.The district has a mixture of urban and rural characteristics while the southern and northern part of the district has influence of Andhra culture due to its position in the state. In order to determine the quality of groundwater along the entire district,the district is divided into 14 blocks and water samples were collected nearer the residential dwellings of these bocks and were tested to determine the Physico-Chemical Characteristics such as pH, Alkalinity, Hardness, Acidity and Chlorides of the district. The results indicated that the Physico-Chemical parameters of all the samples were within the prescribed limits except Minjur and pallipetu which exceeded for Chlorides. Water Quality Index (WQI) is determined considering these parameters which proves the Groundwater flowing in the district is fit for drinking and domestic purposes.

Keywords: Physico-Chemical Characteristics ,Ph,AlkalinityHardness,Acidity,chlorides

Introduction

Water considered an “elixir of life” is an important constituent in the midst of living organisms present in a society and plays a significant role in the continuity of life. All forms of life require water for their development and sustenance. Ground water is the prime source of water in most of the rural areas all over India as they serve the domestic needs of an household. In addition to rural households, urban, public water supplies and farmers too depend on groundwater which serves their needs. The sub surface water is considered free from contamination, but due to undue exploitation and contamination of groundwater the consumption proves detrimental to the welfare of the people. Hence it is imperative to wisely manage and protect the quality of Groundwater against pollution.

The term Groundwater or subsurface water refers to the water that occurs below the surface of earth. The major source of groundwater is infiltration. The infiltrated water after meeting the soil moisture deficiency percolates deeply and becomes groundwater. The groundwater is free from pollution and is very useful for domestic and drinking purposes in small towns and isolated farms. It can be made available at a small capital cost and also in least possible time. In arid regions, groundwater is often the only reliable source of water for irrigation.Like any

other natural resource, groundwater is not unlimited. They must be wisely managed and protected against undue exploitation and contamination by pollutants and salt water.

The formation below the earth's surface is divided into two zones by an irregular surface called water table. At all points on the water table the pressure is atmospheric. The zone between the ground surface and the water table is called the unsaturated zone or the vardose zone. In the vardose zone the soil pores may contain either air or water or both. Hence it is also called the zone of aeration. Water in this zone is held to soil particles by capillary forces. Thus, while the water is able to move within the vardoes zone, it cannot move out of the zone into the wells or other places that are exposed to atmospheric pressure.

In the zone below the water table all the soil pores are completely filled with water and hence it is called the zone of saturation or the phreatic zone. The phreatic zone may extend to considerable depth, but as the depth increases the weight of overburden tends to close the pore space and relatively little water is found at depths greater than 3 km. Since the water in the phreatic zone is under pressure more than atmospheric, if a hole is dug in this zone water begins to flow in the hole whereas it is not so in the vardose zone. It is this water in the phreatic zone which moves freely under the force of gravity that is actually called the groundwater.

Groundwater pollution is an introduction of certain pollutants into the groundwater which reduces the quality of groundwater making its use very limited, or in some cases impossible. Many different chemicals and various synthetic products used today are usually the main causes of groundwater pollution.

The following are the sources of ground water pollution.

a) Domestic Wastes.
b) Industrial Wastes. Agricultural Wastes.

Wastes generated by households that are termed no longer useable are considered as domestic waste. The classification of domestic waste are as follows:

a) Biodegradable waste: food and kitchen waste and green waste.
b) Recyclable material: paper, glass, bottles, cans, metals, certain plastic wastes, etc.
c) Inert waste: Construction and demolition waste, dirt, rocks, debris
d) Composite waste: waste clothing, waste plastics such as toys.
e) Hazardous waste (also called "household hazardous waste") & toxic waste: medication, e-waste, paints, chemicals, light bulbs, fluorescent tubes, spray cans, fertilizer and pesticide containers, batteries, shoe polish.
f) Liquid waste: septic tank, grease traps, oily water, surfactants, washwaters.

These wastes decompose on the surface of the earth. Any liquid passing through these wastes react with the organic matter, extracts solutes, suspended solids or any other component of the material through which it has passed is called leachate. The leachate from the landfill sites affects the surface and groundwater.

Industrial wastes are produced by industrial activity such as factories, mills and mines which includes Dyeing and Textile industry, Paper industry, Plastic industry, Plating industry etc.

Agricultural wastes include run-off from agricultural pesticides and fertilizers.

Groundwater can be optimally used only when the quantity and quality is properly assessed. Water quality assessment involves evaluation of the physical, chemical and biological nature of water in relation to natural quality and human effects.

The objective of this assessment are:

To evaluate the quality of groundwater using Physio – chemical characteristics.
To compare the Physio – chemical results with the standard values as recommended by the Bureau of Indian Standards for drinking and public health.
To calculate the Water Quality Index (WQI) values in order to express the quality of water in a consistent manner.

a) The investigation was carried out in an around Tiruvallur with a specific focus on the 14 blocks of the district.
b) The impact of pollutants on public health was assessed by measuring ground water quality which gives rise to a debate concerning the issues.

Method

Study Area

Tiruvallur District

Tiruvallur is an administrative district present in Tamil Nadu. Tiruvallur district is having administrative divisions of 8 taluks, 14 blocks, 539 Panchayats and 805 villages. Due to dumping of domestic waste alongside the residential area, the groundwater may seem to get polluted. Hence, in order to asses the quality of groundwater, water samples are collected from 14 blocks of the tiruvallur district and are tested for Physico – chemical characteristics to determine the quality of groundwater present in the district.

Samplıng Procedure

The sampling bottles were made of plastic, usually polyethylene. The bottles were soaked with 10% HCl for 24 hours and then thoroughly cleaned and rinsed with distilled water. Water samples were collected from bore wells around the residential dwellings in the district with high grade plastic bottles of 1 liter capacity after rinsing it with distilled water and thrice with the sample water before collection. The co-ordinates and location of water samples are given below.

Table 1: Locatıon Of The Samples

Sample No	Area	Location
Thiruvalangadu	13.126375	79.788101
Tiruttani	13.179796	79.611989
Tiruvallur	13.144207	79.894434
Sholavaram	13.227204	80.165620

R.K. Pet	13.164436	79.439746
Puzhal	13.165952	80.171166
Poondi	13.208075	79.881187
Poonamalle	13.047024	80.076749
Pallipet	13.336930	79.443287
Minjur	13.272266	80.258464
Kadambathur	13.100075	79.861271
Gumidipoondi	13.409646	80.123407
Ellapuram	13.307412	80.04769

Analysis Techniques

Samples were brought to the laboratory and parameters like pH, Electrical Conductivity and Turbidity of water samples were measured immediately after sample collection. Other physico-chemical parameters were analyzed within thirty six hours. Standard methods were adopted for the analysis of the water samples (APHA 1998).

Research Process

The physico-chemical parameters of the samples have been compared with Bureau of Indian standards.

Results

pH

pH is one of the important factor of groundwater. In the study area pH varies from 7.19 to 8.1. pH value of all the samples was within the permissible limit prescribed by the BIS. The samples has the pH value in the range of 6.5 to 8.5. Comparison of data is given in table 2 and the graphical representation is given in figure 1

Table 2 pH Results

Sample No	Area	pH value	Permissible limit
1.	Villivakkam	7.63	6.5-8.5
2.	Thiruvalangadu	8.1	6.5-8.5
3.	Tiruttani	7.75	6.5-8.5
4.	Tiruvallur	7.5	6.5-8.5
5.	Sholavaram	7.25	6.5-8.5
6.	R.K. Peth	7.40	6.5-8.5
7.	Puzhal	7.60	6.5-8.5
8.	Poondi	7.65	6.5-8.5
9.	Poonamalle	7.19	6.5-8.5
10.	Pallipetu	7.5	6.5-8.5
11.	Minjur	8.09	6.5-8.5
12.	Kadambathur	7.9	6.5-8.5
13.	Gummidipoondi	7.48	6.5-8.5
14.	Elapuram	7.52	6.5-8.5

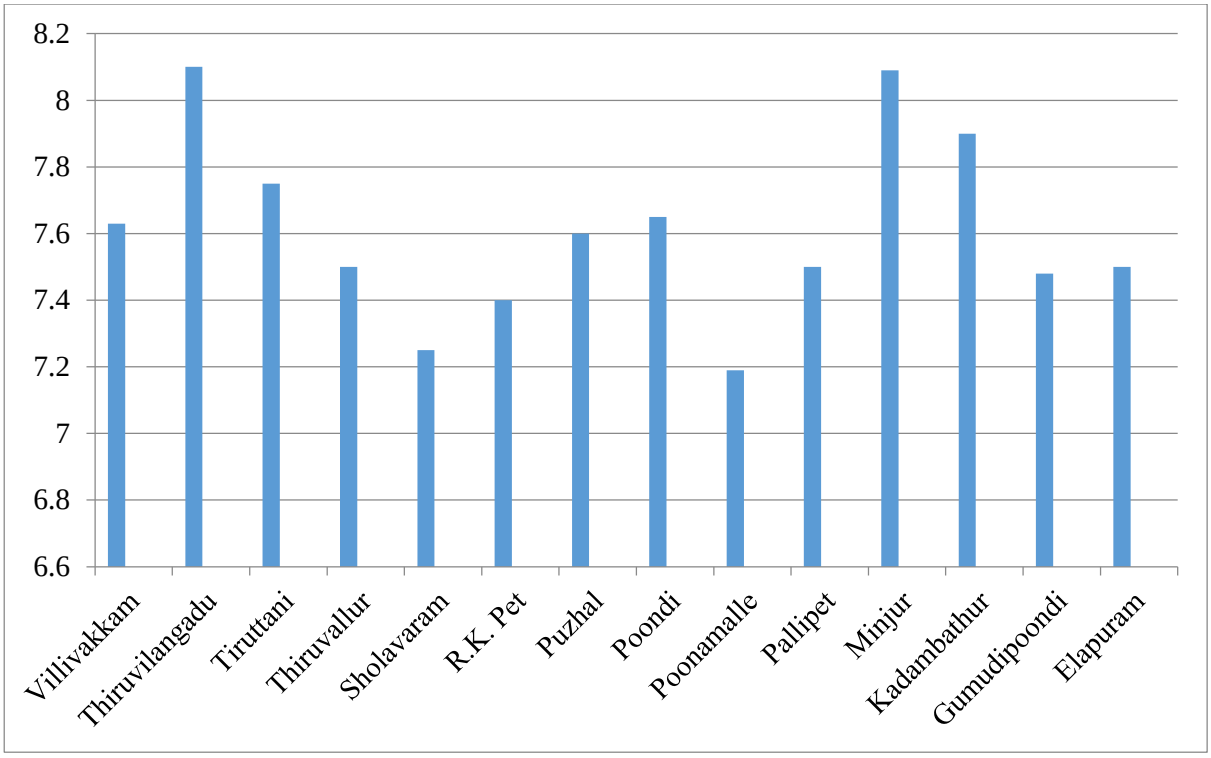

Figure 1 **pH variation in the study area**

Alkalınıty

Alkalinity is the measure of the capacity of water to neutralize a strong acid. The alkalinity in the water is generally imparted by the salts of carbonates, silicates, etc. together with the hydroxyl ions in the free state. The alkalinity varies from 150 to 410 mg/L. Alkalinity of all the samples are within permissible limits as prescribed by BIS.Comparison of data are given in table 3 and the graphical representation is given in fig 2

Table 3 Total Alkalinity results.

Sample No	Area	Total Alkalinity (mg/L)	Allowable and Permissible limit in ppm
1.	Villivakkam	250	200 - 600
2.	Thiruvalangadu	200	200 - 600
3.	Tiruttani	150	200 - 600
4.	Tiruvallur	240	200 - 600
5.	Sholavaram	200	200 - 600
6.	R.K. Pet	260	200 - 600
7.	Puzhal	230	200 - 600
8.	Poondi	210	200 - 600
9.	Poonamalle	230	200 - 600
10.	Pallipetu	410	200 - 600
11.	Minjur	160	200 – 600
12.	Kadambathur.	270	200 – 600
13.	Gummidipoondi	300	200 – 600
14.	Elapuram	260	200 – 600

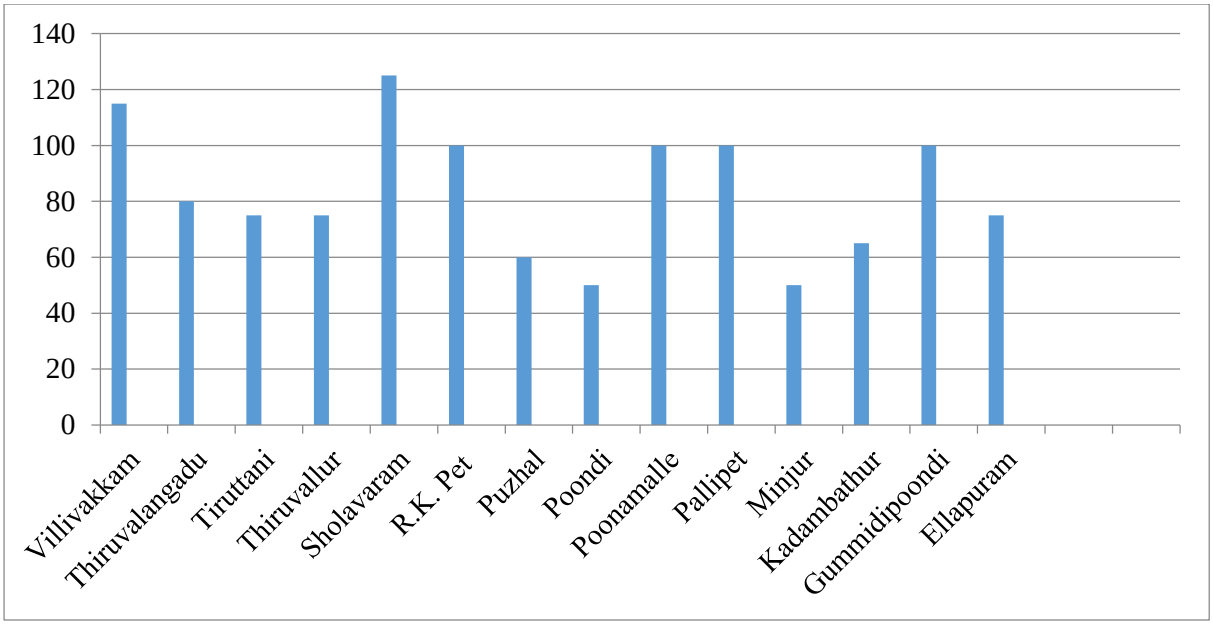

Fig 2 **Alkalinity variation in the study Area.**

Total Hardness

Total Hardness is considered as a major character of drinking water. Hardness is defined as the concentrations of calcium and magnesium ions. A total hardness value varies from 140 to 940 mg/L. The study concluded that all the samples were within the permissible value prescribed by BIS. Comparison of data are given in table 4 and the graphical representation is given in fig 3

Table 4 Total Hardness results.

Sample No	Area	Total Hardness (mg/L)	Allowable and Permissible limit in ppm
1.	Villivakkam	266.67	200 - 600
2.	Thiruvalangadu	193.33	200 - 600
3.	Tiruttani	233.33	200 - 600
4.	Tiruvallur	266.67	200 - 600
5.	Sholavaram	213.33	200 - 600
6.	R.K. Pet	215.25	200 - 600
7.	Puzhal	220	200 - 600
8.	Poondi	200	200 - 600
9.	Poonamalle	333.33	200 - 600
10.	Pallipetu	200	200 - 600
11.	Minjur	400	200 - 600
12.	Kadambathur	280	200 - 600
13.	Gummidipoondi	240	200 - 600
14.	Elapuram	266.67	200 - 600

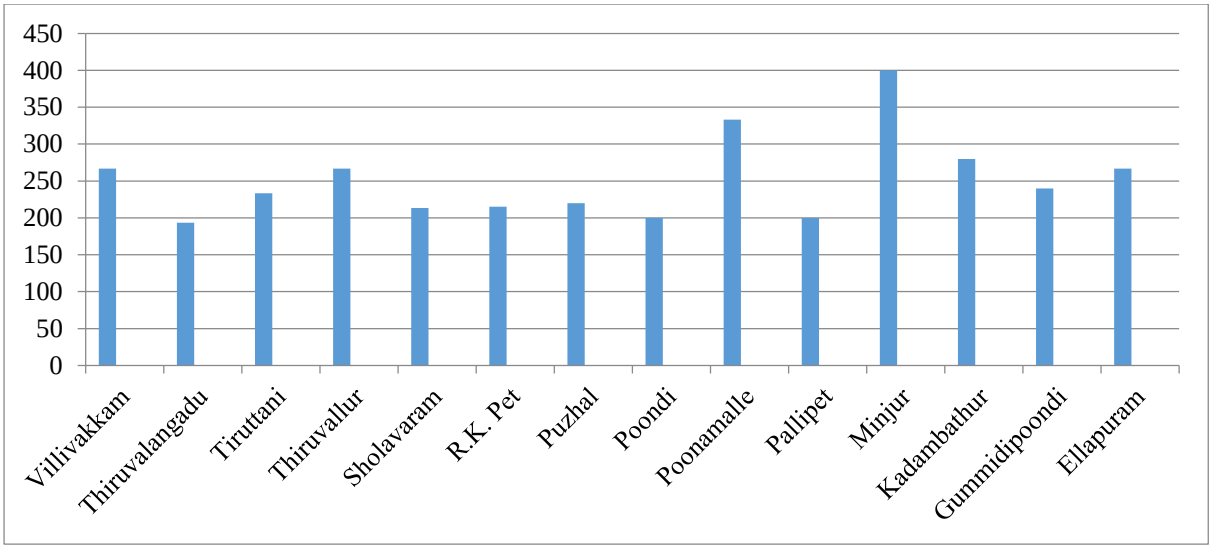

Fig 3 **Total hardness variation in the study area.**

Acıdıty

Acidity is a measure of an aggregate property of water and can be interpreted in terms of specific substances only when the chemical composition of the sample is known. Acidity may contribute to corrosiveness and influence chemical reaction rates and biological process. The measurement also reflects a change in the quality of the source of the water. Strong mineral acids, weak acids such as carbonic acid, acetic acid and hydrolyzing salts such as iron or aluminium sulphates may contribute to the measured acidity. The value of acidity varies from 50 to 125 mg/l. Comparison of data are given in Table 5 and the graphical representation is given in fig 4.

Table 5 Acidity test results

Sample No	Area	Acidity (mg/L)	Allowable and Permissible limit in ppm
1.	Villivakkam	115	250-1000
2.	Thiruvalangadu	80	250-1000
3.	Tiruttani	75	250-1000
4.	Tiruvallur	75	250-1000
5.	Sholavaram	125	250-1000
6.	R.K. Pet	100	250-1000
7.	Puzhal	60	250-1000
8.	Poondi	50	250-1000
9.	Poonamalle	100	250-1000
10.	Pallipetu	100	250-1000
11.	Minjur	50	250-1000
12.	Kadambathur	65	250-1000
13.	Gummidipoondi	100	250-1000
14.	Elapuram	75	250-1000

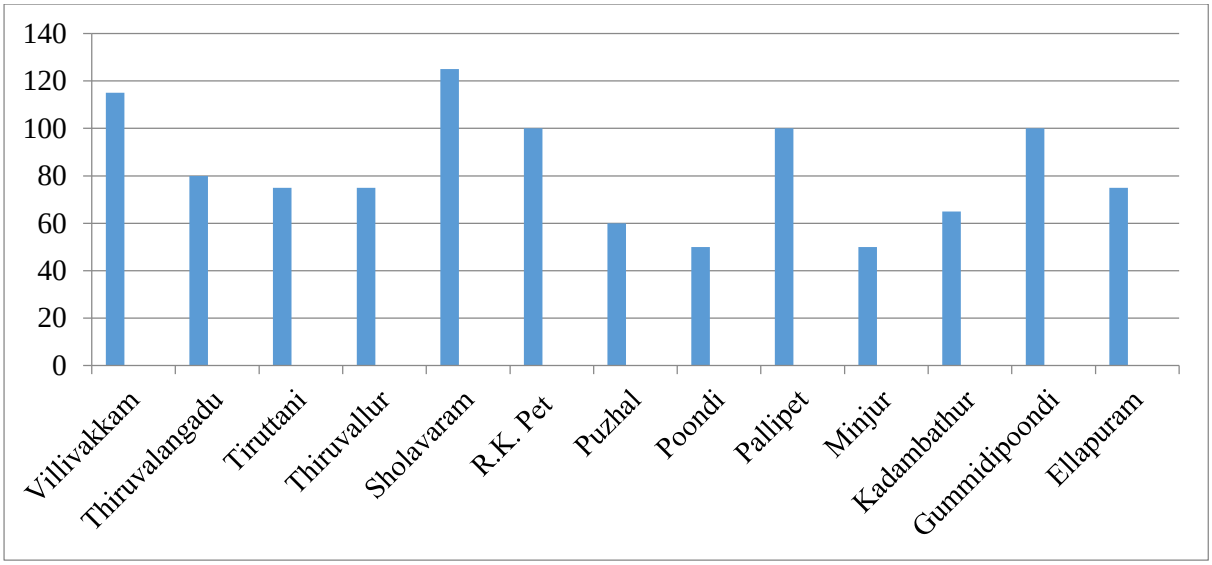

***Fig 4* Total acidity variation in the study area.**

Chlorıdes

Chloride originates from sodium chloride which gets dissolved in water from rocks and soil. It is a good indicator of groundwater will increase if it mixed with sewage or sea water. The chloride content in the study area has shown variation from 173 to 1251mg/L. It has been determined by titrating the sample against silver nitrate using potassium chromate as indicator. The end point is characterized by the colour change from yellow to brick red. Comparison of data are given in table 6 and the graphical representation is given in fig 5

Table 6 Results of Chloride

Sample No	Area	Chlorides (mg/L)	Allowable and Permissible limit in (mg/l)
1.	Villivakkam	595.56	1000
2.	Thiruvalangadu	173.71	1000
3.	Tiruttani	521.11	1000
4.	Tiruvallur	357.34	1000
5.	Sholavaram	421.86	1000
6.	R.K. Pet	496.3	1000
7.	Puzhal	471.49	1000
8.	Poondi	397.04	1000
9.	Poonamalle	436.74	1000
10.	Pallipetu	1191.12	1000
11.	Minjur	1215.94	1000
12.	Kadambathur.	387.11	1000
13.	Gummidipoondi	694.82	1000
14.	Elapuram	347.41	1000

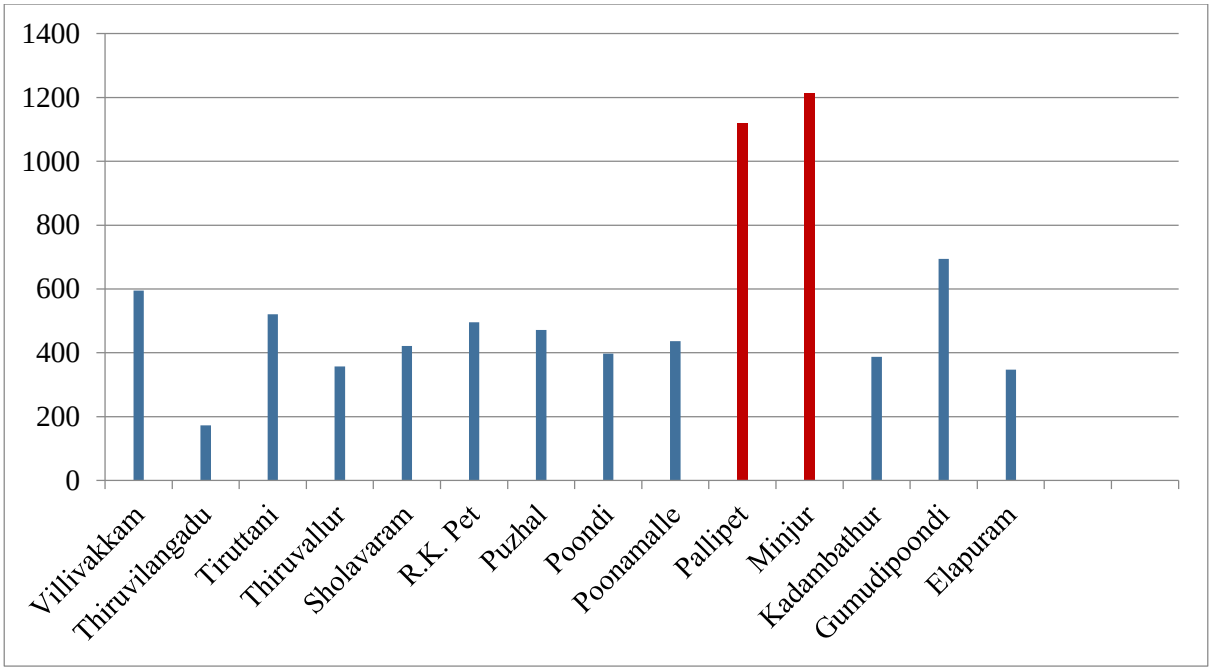

Figure .5 **Chlorides variation in the study area**

Water Qualıty Index

Water Quality Index (WQI) is a means by which water quality data is summarized for reporting to the public in a consistent manner. The WQI measures the scope, frequency and amplitude of water quality exceedances and then combines the measures into one score. This calculation produces a score between 0 and 100. The higher the score the better the quality of the water. The scores are then ranked into one of the five categories below :

a) Excellent: (WQI value <50) - Water Quality is protected with a virtual absence of impairement, conditions are very close to pristine levels.
b) Good: (WQI Value 50-100) - Water Quality is protected with a slight presence of impairement, conditions are close to pristine levels.
c) Poor: (WQI Value 100-200) - Water Quality is protected with a minor degree of impairement, conditions rarely depart from desirable levels.
d) Very Poor: (WQI Value 200-300) - Water Quality is usually protected but occasionally impaired, conditions sometimes depart from desirable levels.
e) Water unsuitable for Drinking : (WQI Value >300) - Water Quality is frequently impaired, conditions often depart from desirable levels.
f) Poor : (WQI Value 0-44) - Water Quality is almost always protected impaired, conditions usually depart from desirable levels.

Table 7 Relative weight of Physico-chemical parameters.

Physico-Chemical Parameters	Weight	Relative Weight
pH	3	0.15
Total Alkalinity	4	0.20
Total Hardness	4	0.20
Acidity	4	0.20
Chlorides	5	0.25

Table 7 Water Quality Index (WQI) values.

Sample No	Location	WQI	Water Quality
1.	Villivakkam	44.898	Excellent
2.	Thiruvalangadu	33.34	Excellent
3.	Tiruttani	41.06	Excellent
4.	Tiruvallur	67.15	Good Water
5.	Sholavaram	39.61	Excellent
6.	R.K. Pet	43.31	Excellent
7.	Puzhal	41.48	Excellent
8.	Poondi	38.091	Excellent
9.	Poonamalle	52.28	Good Water
10.	Pallipetu	69.42	Good Water
11.	Minjur	68.73	Good Water
12.	Kadambathur	47.54	Excellent
13.	Gummidipoondi	54.62	Good Water
14.	Elapuram	45.09	Excellent

Result and Discussion

Based on the results obtained for all the fourteen samples, it has been concluded that

a) Samples of Villivakkam, Thiiruvilangadu, Tiruttani, Sholavaram, R.K Pet, Puzhal, Poondi, Kadambathuor and Elapuram are excellent for drinking and domestic purposes.
b) Samples of Tiruvallur , Poonamalle, Minjur and Gumidipoondi are good for drinking and domestic purposes.

It has been observed that

a) The water samples tested for pH along the 14 blocks are within the prescribed limits
b) The water samples tested for Alkalinity along the 14 blocks are within the prescribed limits except Tiruttani and Minjur which are below the prescribed the limits.
c) The water samples tested for Hardness along the 14 blocks are within the prescribed limits except Thiruvilangadu which is below the prescribed limits.
d) The water samples tested for Acidity along the 14 blocks are within the prescribed limits.
e) The water samples tested for chlorides along the 14 blocks are within the prescribed limits except Minjur and Pallipetu which are above the prescribed limits.

From the project, it has been concluded that the district is free from Groundwater pollutants except for a few places which exceeds the limits. Henceforth, the water is fit for drinking and domestic purposes.

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