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## Groundwater Quality Assessment of Mayiladuthurai Taluk During Summer 2008, Tamil Nadu, India.

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### Research Article

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#### ABSTRACT

Groundwater samples were collected from the study area Mayiladuthurai Taluk during March 2008 to May 2008. The sampling and analyses were performed using standard methods determined by APHA (1995) and BIS (1991). The physico-chemical parameters like pH, EC, TDS, Total Alkalinity, Na, K, Ca, SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, PO<sub>4</sub><sup>3-</sup> & heavy metals Cu, Zn, Fe, Mn were within the permissible limit. But the health related parameters TH, Mg, F, Pb & Cr were crossed the maximum permissible limit. And hence cannot be used for drinking purpose without introducing into the treatment processes.

#### INTRODUCTION

Water is nature's most wonderful, abundant and useful compound and it is the basis of all lives-ecological resources of our earth and basic necessity for all lives. The quality of water is the most important than the quantity of water supply and for drinking purposes quality is very important.

Many villages in Mayiladuthurai Taluk, Tamil Nadu, India are facing water quality as well as water scarcity problem, especially during summer season. Inhabitants of this region are suffering from health related problems due to the consumption of contaminated water. This paper assesses groundwater quality of Mayiladuthurai taluk of Nagapattinam district to determine its suitability for drinking purposes.

#### MATERIALS AND METHODS

Ground water samples from different open well and bore well of 20 sampling stations were collected from the study area during summer 2008 (March 2008 to May 2008). One litre capacity of pre-cleaned polyethylene bottles were used to collect the samples. To prepare the solution for analysis analar (AR) grade chemicals and double distilled water were used. Ground water samples were analysed for 19 parameters. Physical parameters like pH, EC were recorded at the site itself using calibrated digital equipments. Chemical parameters like Ca<sup>2+</sup>, Mg<sup>2+</sup>, Cl<sup>-</sup>, SO<sub>4</sub><sup>2-</sup>, NO<sub>3</sub><sup>-</sup>, total Alkalinity, Na, K and heavy metals (Zn, Cu, Fe, Mn, Cr & Pb) were analyzed using standard methods [1].

#### RESULTS AND DISCUSSION

Analysis of groundwater samples for summer 2008 (March 2008 to May 2008) are shown in Table 1. Physico-chemical properties of ground water of Mayiladuthurai Taluk compared to standards is shown in Table 2 and sampling stations are given in Table 3.

Table 1: Physico-chemical parameters of ground water of Mayiladuthurai Taluk of Nagapattinam District during March 2008- May 2008.

Parameters	S-1	S-2	S-3	S-4	S-5	S-6	S-7	S-8	S-9	S-10
pH	7.47	7.59	7.77	7.71	7.59	7.81	7.75	7.80	7.59	7.72
EC(ds/m)	1.79	1.83	1.81	1.76	1.93	1.90	1.93	2.39	1.86	1.86
TDS(mg/l)	1145.3	1173.6				1216.0	1237.3	1314.0		
TA(mg/l)	3	7	1158.33	1128.67	1233.33	0	3	0	1192.67	1192.33
Cl(mg/l)	340.70	335.60	380.00	398.90	400.80	365.00	340.00	365.00	347.80	333.00
SO <sub>4</sub> <sup>2-</sup> (mg/l)	175.90	187.80	195.80	180.30	188.00	187.00	215.67	225.00	238.90	223.70
NO <sub>3</sub> <sup>-</sup> (mg/l)	123.40	126.50	135.70	128.30	139.80	138.00	140.00	143.00	154.90	124.00
F (mg/l)	0.14	0.08	0.11	0.10	0.07	0.06	0.06	0.05	0.08	0.05
TH (mg/l)	3.32	3.19	3.27	3.33	3.21	3.52	3.46	3.38	3.30	3.17
Ca(mg/l)	712.31	675.37	826.29	738.53	828.90	800.19	793.93	857.45	836.52	795.98
Mg(mg/l)	143.60	145.30	155.00	132.50	150.00	144.00	156.33	160.33	158.00	156.00
Na(mg/l)	85.90	75.90	106.67	99.00	110.33	107.00	98.00	111.00	107.33	98.70
K(mg/l)	21.90	21.90	21.90	21.90	21.90	28.33	29.67	25.67	25.00	23.00
Zn(mg/l)	0.25	0.25	0.25	0.25	0.25	0.23	0.25	0.25	0.27	0.16
Cu(mg/l)	0.01	0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02	0.03
Fe(mg/l)	0.01	0.01	0.02	.02	0.02	0.01	0.02	0.01	0.01	0.01
Mn(mg/l)	0.05	0.04	0.04	0.04	0.05	0.05	0.05	0.05	0.05	0.05
Cr(mg/l)	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.01
Pb(mg/l)	0.12	0.13	0.05	0.15	0.04	0.03	0.03	0.03	0.08	0.05
Parameters	S-11	S-12	S-13	S-14	S-15	S-16	S-17	S-18	S-19	S-20
pH	7.71	7.52	7.47	7.58	7.65	7.65	7.57	7.63	7.57	7.65
EC(ds/m)	2.02	2.05	2.03	2.20	2.04	1.71	2.03	1.77	1.96	1.98
TDS(mg/l)	1294.6	1314.0				1094.3	1299.0	1135.0		
TA(mg/l)	7	0	1297.00	1408.00	1303.33	3	0	0	1254.33	1267.33
Cl(mg/l)	359.40	360.90	380.70	398.00	365.00	370.80	398.90	356.89	360.80	370.50
SO <sub>4</sub> <sup>2-</sup> (mg/l)	230.90	233.00	243.80	245.00	256.67	249.80	256.89	243.80	276.80	233.40
NO <sub>3</sub> <sup>-</sup> (mg/l)	133.40	153.00	165.00	132.00	143.00	104.89	134.89	123.60	133.50	132.40
F (mg/l)	0.05	0.06	0.09	0.08	0.07	0.06	0.07	0.05	0.07	0.06
TH (mg/l)	3.46	3.28	3.24	3.18	3.32	3.58	3.56	3.55	4.00	3.99
Ca(mg/l)	812.33	875.98	811.10	887.41	899.11	853.02	914.23	867.00	918.22	855.18
Mg(mg/l)	167.00	176.00	183.00	172.33	178.67	180.00	190.00	179.00	185.00	199.33
Na(mg/l)	96.00	106.00	86.00	111.00	110.00	98.00	106.80	102.00	110.80	86.80
K(mg/l)	34.00	36.67	32.00	34.33	34.00	32.90	34.33	30.00	32.00	34.00
Zn(mg/l)	0.20	0.19	0.23	0.20	0.22	0.23	0.24	0.19	0.22	0.24
Cu(mg/l)	0.01	0.01	0.01	0.02	0.02	0.01	0.01	0.02	0.01	0.02
Fe(mg/l)	0.01	0.01	0.01	0.02	0.03	0.01	0.02	0.02	0.03	0.01
Mn(mg/l)	0.05	0.03	0.04	0.04	0.04	0.05	0.05	0.04	0.05	0.04
Cr(mg/l)	0.02	0.01	0.02	0.02	0.02	0.01	0.01	0.02	0.01	0.01
Pb(mg/l)	0.11	0.04	0.02	0.01	0.06	0.04	0.03	0.05	0.08	0.10
	0.08	0.06	0.03	0.05	0.11	0.03	0.02	0.18	0.05	0.08

(TA - Total Alkalinity, EC- Electrical Conductivity, TH - Total Hardness, TDS - Total Dissolved Solids)

**Table 2: Standards for drinking water quality.**

Substance or Characteristics	BIS (2003)		WHO (2006b)	
	Desirable	Max. acceptable	Permissible	Max. acceptable
pH	6.5 – 8.5	No relax.	6.5 – 8.5	6.5 – 9.2
EC (dS/m)	1	3	-	-
TDS (mg/l)	500	1500	500	1500
Total Alkalinity (as CaCO <sub>3</sub> ), mg/l	200	600	500	-
Total hardness (as CaCO <sub>3</sub> ), mg/l	300	600	200	500
Calcium (as Ca), mg/l	75	200	-	-
Magnesium (as Mg), mg/l	30	100	-	-
Sodium (as Na), mg/l	-	-	-	200
Potassium (as K), mg/l	-	-	-	-
Chloride (as Cl), mg/l	250	1000	250	600
Fluoride (as F), mg/l	1.0	1.5	-	1.5
Sulphate (as SO <sub>4</sub> ), mg/l	200	400	250	500
Nitrate (as NO <sub>3</sub> ), mg/l	45	No relax.	-	50
Copper (as Cu), mg/l	0.05	1.5	-	2.0
Zinc (as Zn), mg/l	5	15	3.0	5.0
Lead (as Pb), mg/l	0.05	No relax.	-	0.01
Iron (as Fe), mg/l	0.3	1.0	0.3	1.0 – 3.0
Manganese (as Mn), mg/l	0.1	0.3	0.4	0.5
Chromium (as Cr), mg/l	0.05	No relax.	-	0.05

**Table 3: Sampling Stations of the study area.**

Sl. No	Sampling stations	Source of water
S-1	Kuthalam	Open well
S-2	Sethrabalapuram	Bore well
S-3	Arayapuram	Bore well
S-4	Malliyam	Bore well
S-5	Mahadhanapuram	Bore well
S-6	Moovalur	Bore well
S-7	Sitharkadu	Bore well
S-8	Mayiladuthurai Pookadai Street	Bore well
S-9	Mayiladuthurai Koranadu	Bore well
S-10	Mayiladuthurai Mahadhana Street	Bore well
S-11	Thiruvazhandur	Bore well
S-12	Mayiladuthurai Coconut tree street	Bore well
S-13	Senthangudi	Bore well
S-14	Nagangudi	Bore well
S-15	Lakshmipuram	Bore well
S-16	Uluthukuppai	Bore well
S-17	S.S. Nallur	Bore well
S-18	Thirunanriyur	Bore well
S-19	Keezha Athukudi	Bore well
S-20	Mela Athukudi	Bore well

## pH

pH value of water samples from 7.47 to 7.81 were within the permissible limit prescribed by WHO Fig.1. The ground water sample collected from S-6 showed the highest value, but was within the permissible limit.

## Electrical Conductivity

EC of ground water samples varied from 1.71 dS/m to 2.309 dS/m Fig.2. None of the sample exceeded the maximum permissible limit as prescribed by WHO (3dS/m).

Figure 1: Variations of pH values in the groundwater sample of the study area during summer 2008

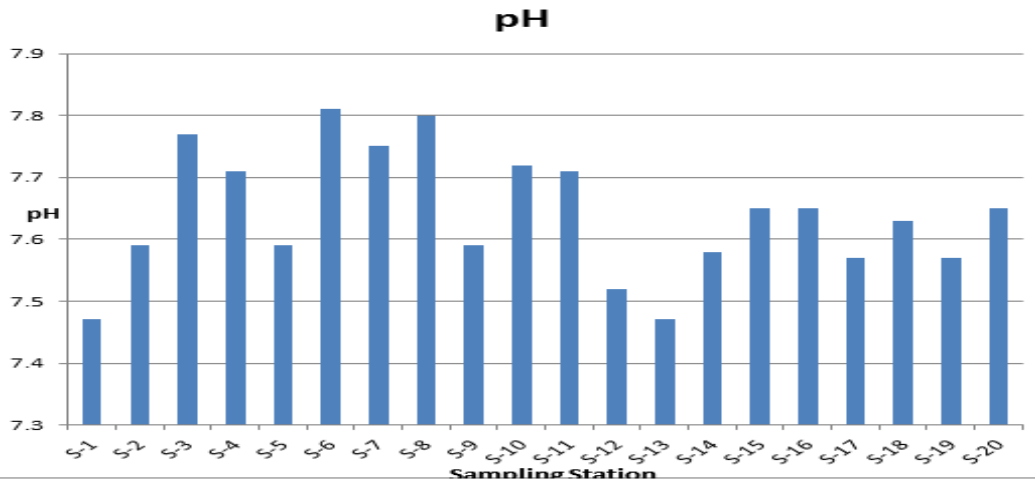
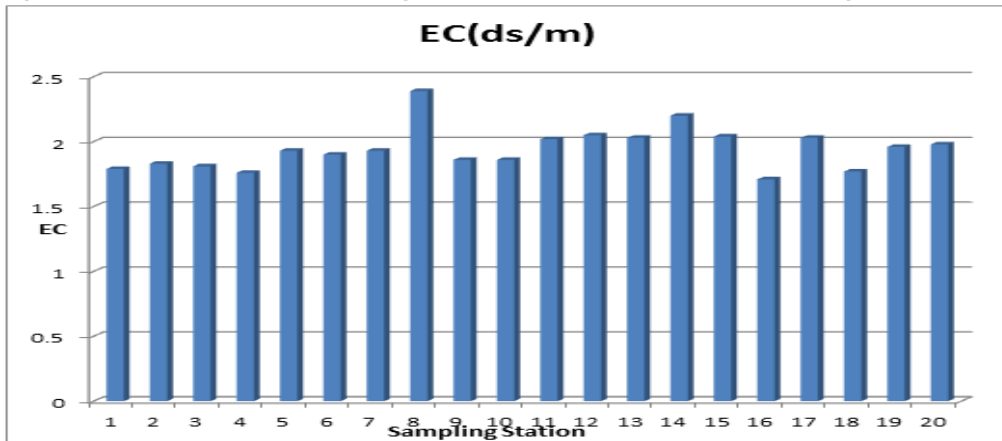


Figure 2: Variations of EC values in the groundwater sample of the study area during summer 2008.



**TDS**

Total Dissolved Solids (TDS) varied between 1094.33 mg/l and 1408.00 mg/l Fig.3. For all samples TDS was within the permissible limit. A high value of TDS reduces water utility for drinking, irrigation and agricultural purposes.

**Total Alkalinity**

Total Alkalinity ranged between 333 mg/l to 400.80 mg/l, which was also not exceeded the permissible limit (500 mg/l)Fig.4.

Figure 3: Variations of TDS values in the groundwater sample of the study area during summer 2008 .

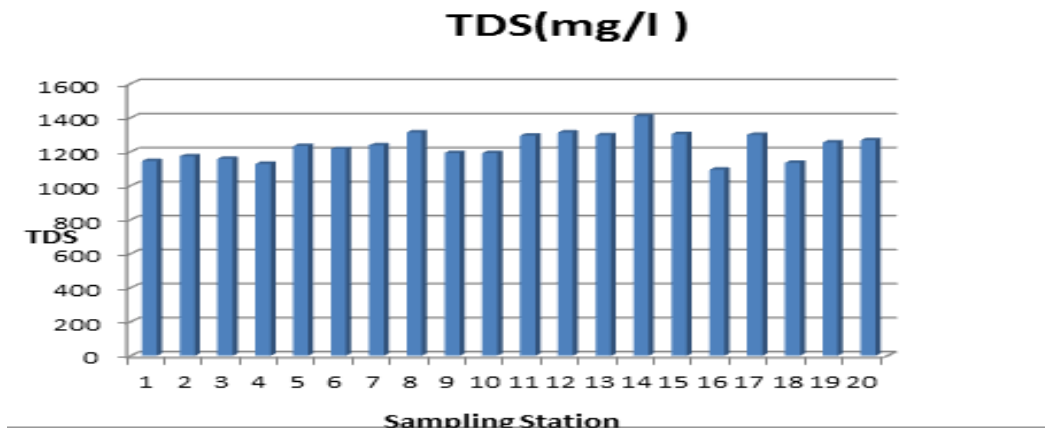
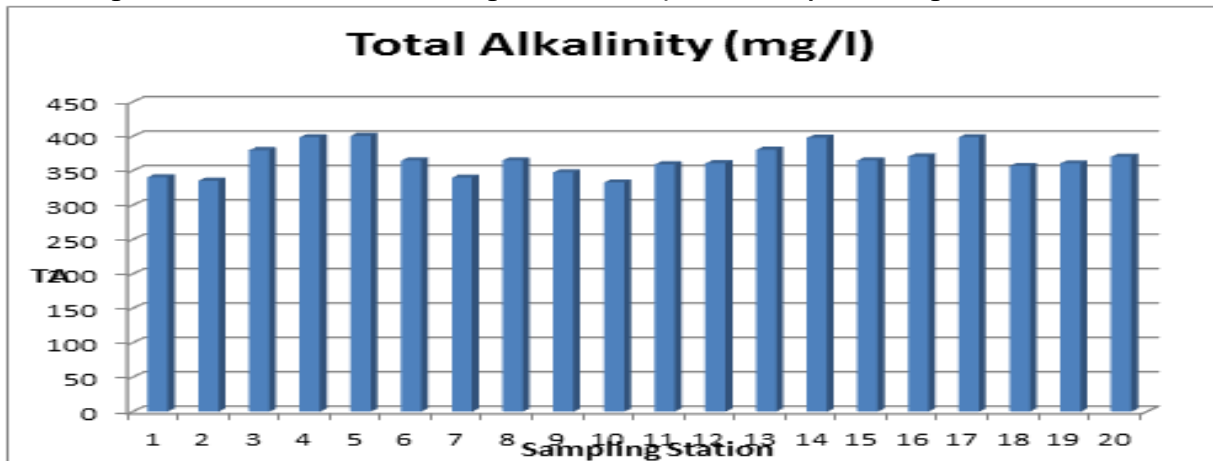


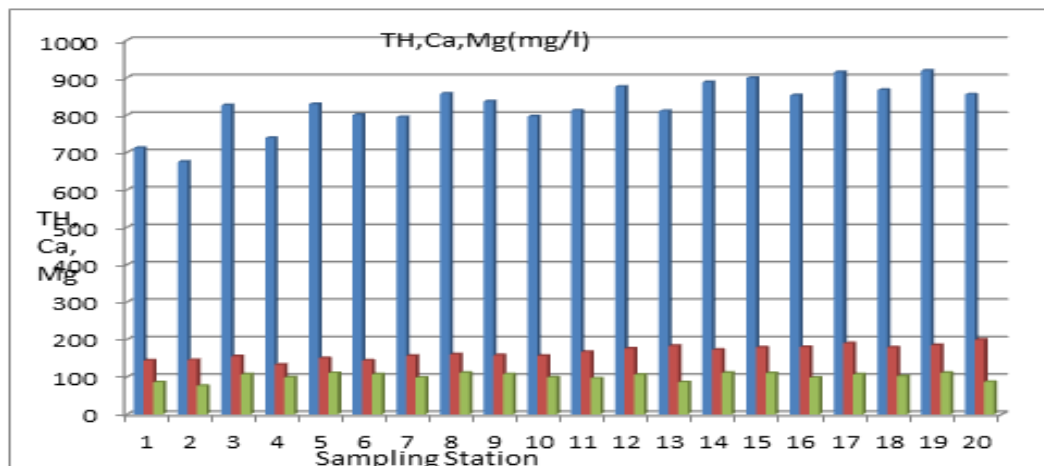
Figure 4: Variations of TA values in the groundwater sample of the study area during summer 2008.



### Total Hardness, Calcium & Magnesium

Total Hardness, Calcium & Magnesium are interrelated. Generally in water, the hardness is due to the presence of calcium and magnesium sulphates & chlorides. Calcium concentration varied from 132.50 mg/l to 199.33 mg/l, all samples were within the permissible limit prescribed by WHO Fig.5. Magnesium concentration in water samples from S5, S6, S8, S12, S14, S15, S17, S18 & S19 were beyond the permissible limit. Total hardness of ground water samples from Mayiladuthurai Taluk were beyond the permissible limit (600mg/l) during the summer season. This high value of total hardness and magnesium might be due to large scale usage by the inhabitants and evaporation of water in the summer. This was supported by Bhanja and Patra<sup>[2]</sup>.

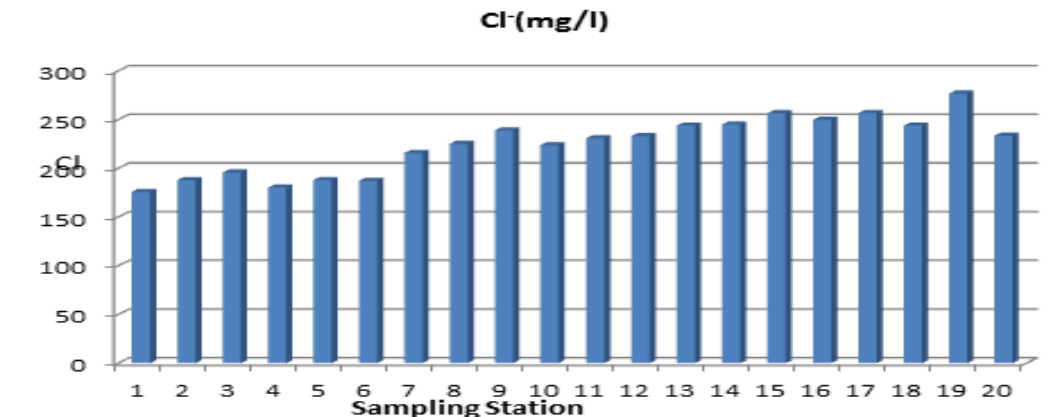
Figure 5: Variations of TH, Ca & Mg values in the groundwater sample of the study area during summer 2008.



### Chloride

Chloride is a widely distributed element in all types of rocks in one or another form. Its affinity towards sodium is high. Therefore, its concentration is high in groundwater, where the temperature is high and rainfall is less. Soil porosity and permeability also play an important role in increasing the chlorides concentration. Water that contains less than 150 mg/l chloride is satisfactory for many purposes. Groundwater contains chloride content more than 250 mg/l is generally not suitable for municipal use and water containing more than 350 mg/l is objectionable for irrigation and industrial uses. In the present study area, the chloride concentration is less, it may be due to the lower value of soil porosity and permeability and hence the groundwater resources are good for drinking purpose Fig.6.

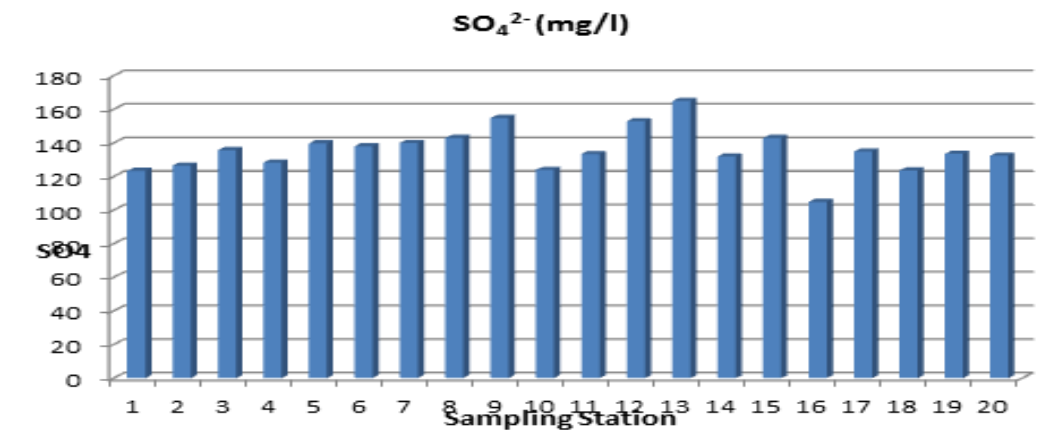
Figure 6: Variations of Cl values in the groundwater sample of the study area during summer 2008



### Sulphate

High concentration of sulphate causes laxative effect [3]. Sulphate values varied from 104.89 mg/l to 165.00 mg/l, within the permissible limit 500 mg/l Fig.7.

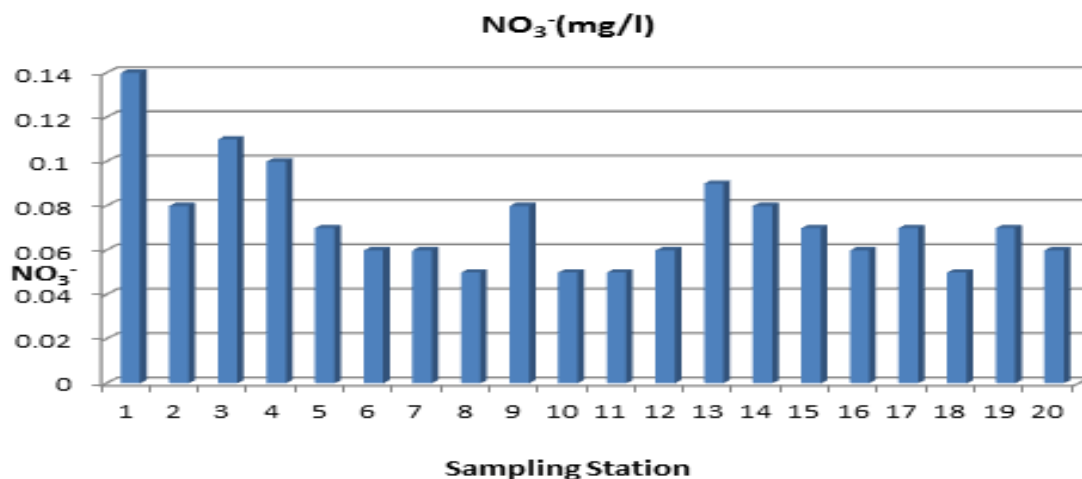
Figure 7: Variations of SO<sub>4</sub><sup>2-</sup> values in the groundwater sample of the study area during summer 2008.



### Nitrate

Nitrate values varied between 0.05 mg/l to 0.14 mg/l Fig.8. But all samples were within the permissible limit (50 mg/l) in the study area.

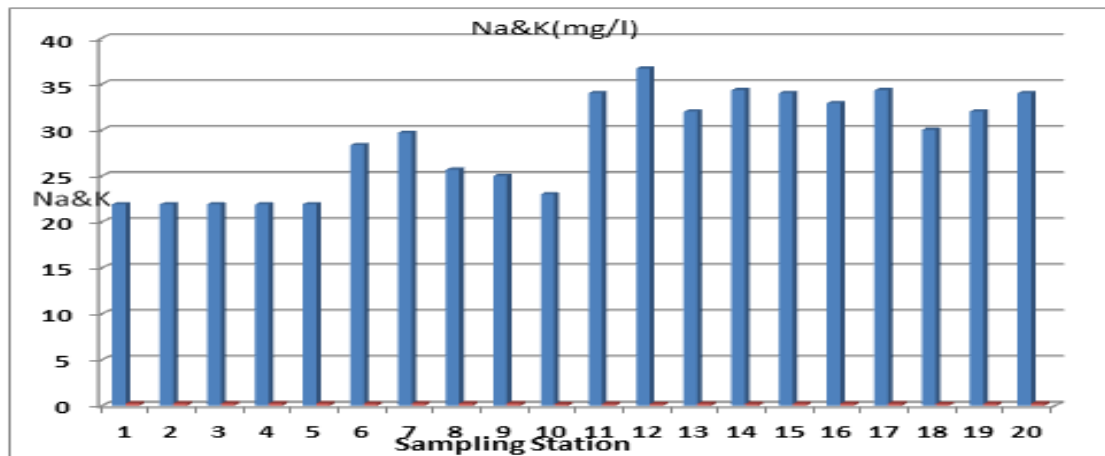
Figure 8: Variations of NO<sub>3</sub> values in the groundwater sample of the study area during summer 2008 .



### Sodium & Potassium

Sodium & Potassium values varied between 21.90 mg/l & 36.67 mg/l and 0.16 mg/l & 0.27 mg/l respectively. All samples of sodium concentration were within the permissible limit Fig.9. No prescribed limit was given to potassium concentration.

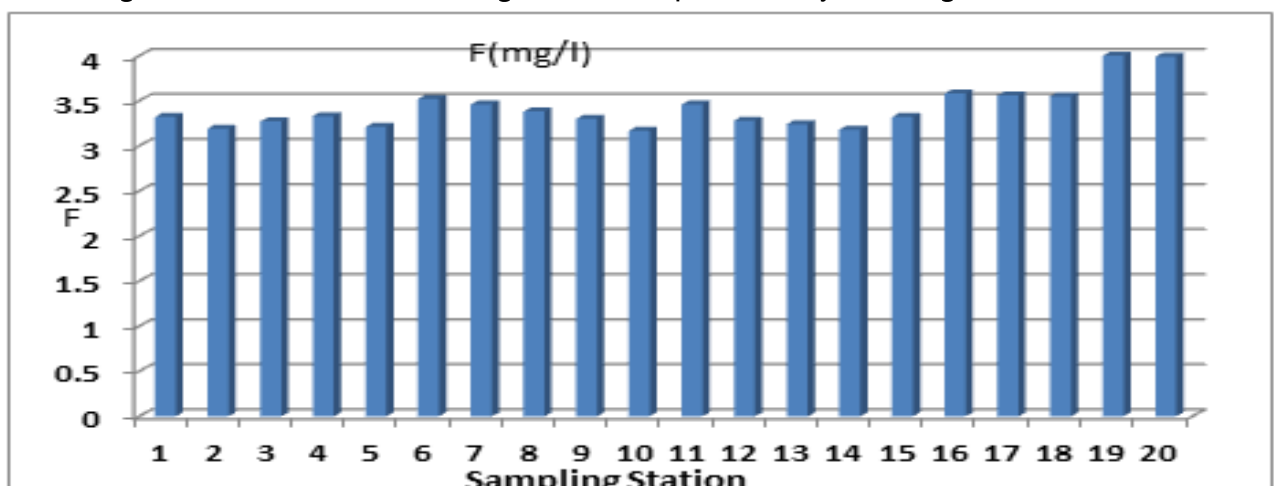
Figure 9: Variations of Na & K values in the groundwater sample of the study area during summer 2008.



### Fluoride

Fluoride is often called a double edged sword, because low fluoride concentration causes dental caries while excess consumption of fluoride concentration causes skeletal fluorosis [4]. Fluoride values varied from 3.17 mg/l to 4.00 mg/l which were crossed the maximum permissible limit Fig10. Mottling of teeth (dental fluorosis) may occur when the concentration increases more than 1.5 mg/l. Long term intake of water containing excessive fluoride concentration in the range of 5 to 10 mg/L causes skeletal fluorosis, in which the bone structure is affected causing bone deformation and crippling. Bed rock containing fluoride minerals is generally responsible for high concentration of this ion in groundwater samples of the study area [5, 6].

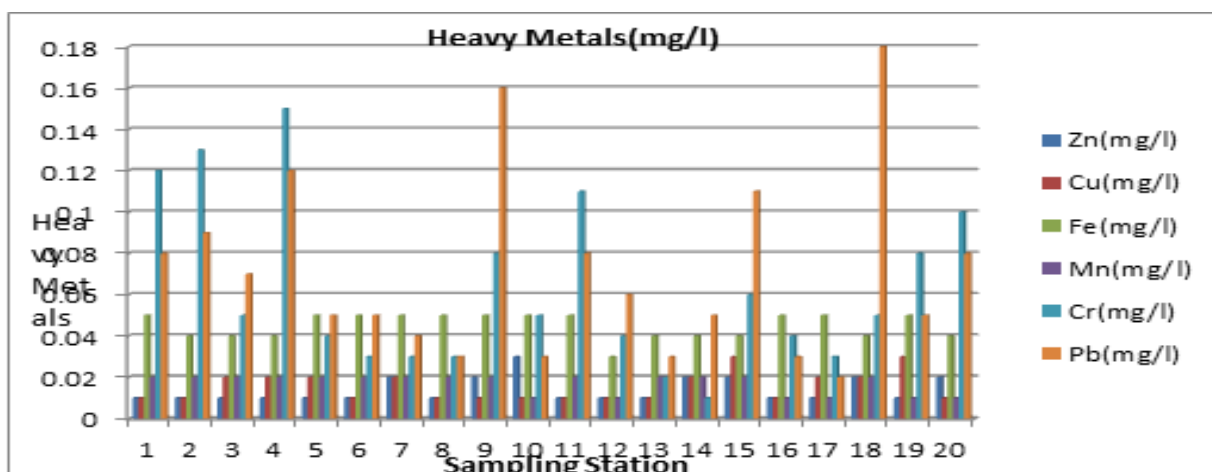
Figure 10: Variations of F values in the groundwater sample of the study area during summer 2008



### Heavy metals

Iron (0.03 mg/l to 0.05 mg/l), Zinc (0.01 mg/l to 0.03 mg/l), Copper (0.01 mg/l to 0.03 mg/l) and Manganese (0.01 mg/l to 0.02 mg/l) ion concentrations were within the permissible limit. But chromium (0.01 mg/l to 0.15mg/l) and Lead (0.02 mg/l to 0.18 mg/l) were crossed the permissible limit in some of the ground water samples Fig11.

Figure 11: Variations of heavy metals in the groundwater sample of the study area during summer 2008.



This increase might be due to the presence small scale industries in the study area. There is an increased risk of lung cancer for workers exposed to high level of chromium [7]. Lead poisoning symptoms usually develop slowly with intestinal cramps, peripheral nerve paralysis, anemia and severe fatigue [8, 9].

### CONCLUSION

It is observed that the analysis of ground water samples collected from various locations of Mayiladuthurai taluk revealed that water quality parameters (pH, EC, TDS, TA,  $\text{NO}_3^-$ ,  $\text{SO}_4^{2-}$ , Cl<sup>-</sup>, Na, K) were within the permissible limit as per WHO standard. However TH, F, Mg, Pb and Cr were crossed the maximum permissible limit. Hence, the ground water of Mayiladuthurai Taluk used requires purification.

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