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Micro Nutrients Concentration Deviation of Ground Water with Respect to Two Seasons in and Around Walajapet Town (Domestic Areas), Vellore District

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Abstract: ***The aim of the present study is to analysis present quality of the groundwater in and around Walahjapet-domestic region, Vellore district, Tamil Nadu, India. The major objectives of this study are to characterize the groundwater quality of the study area to Study heavy metals present in water by AAS method water pollution is the biggest problem for human beings characterization by deterioration of the water quality as a result of various human activities which makes water unfit for drinking and domestic purposes. Some of micro nutrients are environmentally stable, non-biodegradable and tend to accumulate in plants and animals causing chronic adverse effects on human health. However some of the metals like Fe, Pb, Cd and Cr are essential as micronutrients for plants and microorganism. It has been found that there was no significant change of heavy metals in the ground water samples.***

Keywords: Walajapet town, Micro nutrients, Vellore district, Ground water,

I. INTRODUCTION

One of the major developments of the industrial era is refining of leather practically Vellore district in Tamil nadu . Refined leather is used for suitable manufacturing of consumer products such as luggage, foot wares and like. Leather refining undergoes three main processes such as preparatory stages, tanning and crusting [1]. These processes have various other sub processes such as liming, drying etc., [2]. Chemicals used for these type processing consists of heavy metals such as Chromium, lead, cadmium, arsenic etc, [3]. Even small traces of these elements can create serious hazards to the habitants. The study is confined to Ranipet which is a suburb of Vellore district. It has around 240 leather processing tanneries. Since most of them are located on the banks of Palar River, the effluents that contain traces of metals used for refining are discharged into them. The three major sources for water in Ranipet are dug well; bore well and Palar River water. Sustained discharge leads to contamination of these sources posing health discomfort to the human beings and the animals. The leather produced in India accounts to about 12 percent of the total world production [4]. The Indian Government has identified the Leather Sector as a Focus Sector, as it has immense potential for export growth prospects and also in employment generation. According to 2011 Census [7], Ranipet had a population of 50,764 with a sex-ratio of 1,091 females for every 1,000 males.

From this around 37 percentage is contributed by Vellore [5].Ranipet in Tamil Nadu, known for its tanneries and chemical treatment units, is the lone Indian city to make it to the top 10 dirtiest and polluted industrial cities in the world. The New York-based Blacksmith Institute (BI) which streamlines and scientifically identifies polluted cities in the world identified Ranipet as one of the top 10 polluted countries in the world in 2007[6]. Among the top 20 polluted cities in India, Vellore is ranked as 6th most polluted city in 2011 [7].According to a study by the Tamil Nadu Pollution Control Board, nearly 15 lakhs tonne of solid wastes accumulated over two decades of plant operation are stacked in an open yard on the premises contaminating the groundwater. The contamination has affected the health, resources and livelihood of thousands, the BI report said. If the pollution level is left unnoticed, the Palar basin, the main drinking water source in the region, could also be contaminated. One tonne of hide or skin generally leads to the production of 20 to 80 m^3 of turbid and foul-smelling wastewater, including chromium levels of 100–400 mg/L, sulphide levels of 200–800 mg/L and high levels of fat and other solid wastes, as well as notable pathogen contamination. These wastes on subsequent deposition in the water sources eventually lead to reduce the quality of water specially ground water. Sustained intake of water contaminated with hazardous metals will lead to deformation in the health of the habitants and other organisms that rely on these

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sources for water. When this water is used for irrigation, the plants subsequently get contaminated with heavy metals and hence enter the human body indirectly.

II. MATERIALS AND METHODS

A. Study Area

Vellore district is one of the 32 districts in the Tamil Nadu state of India. Vellore City is the headquarters of this district. As of 2016, the district had a population of 3,936,331 with a sex ratio of 1,007 females for every 1,000 males. Vellore district lies between 12^o and 13^o 15' of Northern latitude and 78^o 20' and 79^o 50' of Eastern longitude. It slopes from East to West and the land in Eastern part is flat (figure 1). They produce 3,122 kilo litres of effluent per day. The Ranipet area is a chronic polluted area and one of the biggest exporting centres of tanned leather [8]. Ranipet is a medium-sized municipality located along Palar River bank in the Vellore District and 120 km from Chennai [11]. Many small-scale tanneries are processing leather in the study area and discharging their effluents on the open land and surrounding water bodies. There were a total of 18,243 workers, comprising 45 cultivators, 100 main agricultural labourers, 373 in house hold industries, 16,095 other workers, 1,630 marginal workers, 15 marginal cultivators, 29 marginal agricultural labourers, 95 marginal workers in household industries and 1,491 other marginal workers [3]. Palar is the major source of water for the villages situated in Ranipet. Palar River that has a catchment area of about 2813 sq metres, originates from talagavara village in kolar [9]. Walajapet is one the major municipality which is located in Vellore district.

B. Geology and Hydrogeology

The study area predicts undulating topography, falling in pediment zone and structural hills in the northern side. The flat to undulating Pedi plain nature continue and extends up to the flood plain of Palar River. The Pedi plain has granites, gneisses and basic and ultra basic intrusive, which are discontinuous unconfined to semi-confined aquifers down to 150 m bal and restricted to weathered zone and fractures GSI (2000). The major dolerite dyke, striking NE–SW passes through the factory area. Quaternary sediments are restricted to the alluvial sand and clay of the Palar River and its tributaries. Sand thickness in the Palar River is hardly 10 m and the width being 2000 m along the river course. The alluvium consisting of fine to coarse sand and clay occurring in the area is of a fluviatile origin and restricted to the course of Palar River and major streams (Subramanian and Selvan 2001). Discontinuous unconfined to semi-confined aquifers down to 150 mg/l restricted to weathered zone and fracture zone have been encountered in the granite and gneissic formations in the Palar basin.

C. Sample Collection and Processing

Around 25 samples were collected from Walahja residential areas. About 10 samples were collected each from bore well, dug well etc. For the assessment, water was taken and analysed for various major physical – chemical parameters. 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 dump yard in Vellore region in high grade plastic bottles of 1 litre capacity after rinsing it with distilled water and thrice with the sample water before collecting the sample for analysis (figure 3). Data were then stored in excel format and linked. The samples were collected at regular intervals for about three-four times a month in one litre polyethylene bottles, rinsed with water sample before the sampling. The ground water samples were stored at 1 - 4°C temperature prior to analysis in the laboratory. Thus, standard method of collection, preservation and analysis were adopted.

D. Heavy Metal Assessment Methodologies

After the collection of water samples from the sources, the samples are tested using various methods to deduce the amount of heavy metals and the other physical and chemical characteristics of the water samples. The physic-chemical parameters such as pH, EC, iron, lead, chromium, and cadmium, were determined, the chemical characteristics including heavy metals for examination of water. The physic-chemical parameters were measured at the sample site using handheld analysing kits. Groundwater samples were collected and the samples were kept in a polythene bottle for further laboratory analysis of major ions. The extra pure analytical reagents and chemical standards were used Figure2: sample collected area for the groundwater quality assessment. The analytical procedures are suggested by the American Public Health Association. pH was determined by electrometric method by using pH meter [10-11]. These four micro nutrients of heavy metals were determined by Flame Atomic absorption spectrophotometer (VARIAN SPECTRA A240), Technology Business Incubator Lab, Department of Science and Technology, VIT, Vellore, Tamilnadu. The results obtained were tabulated and evaluated in accordance with the standards prescribed under 'Indian standard drinking water specification IS 10500: 1992' of Bureau of Indian Standards.

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E. Determination Of Heavy Metals

The analysis measurements of heavy metal concentration were carried out with an Atomic Absorption Spectrophotometer (AAS) and the results were compared with WHO standard values. All concentrations were determined using the absorbance made with air-acetylene flame. Eight working solutions were prepared from the stock solutions for each of the metals by successive serial dilution and each of the standard solutions was then aspirated into the flame of AAS and the absorbance recorded in each case. A plot of the concentration against the corresponding absorbance gives the calibration curve of each metal. The samples, after aspirated into the flame and the absorbance obtained were then extrapolated from the calibration plot to obtain the corresponding concentration.

III. RESULTS AND DISCUSSION

The obtained results of heavy metals are tabulated in Table 2. The results are discussed and compared with standard values.

Table 2. Concentrations of heavy metal ions in groundwater samples

	Pre monsoon						Post monsoon					
S. No	pH	EC [µmho/cm]	Fe	Pb	Cd	Cr	pH	EC (ds/m)	Fe	Pb	Cd	Cr
S1	7.12	3.2	0.43	0.005	0.003	0.02	7.83	3.6	0.48	0.004	0.003	0.03
S2	8.21	2.7	0.53	0.002	0.02	0.03	8.32	1.6	0.45	0.005	0.021	0.02
S3	7.65	0.9	0.03	ND	0.007	0.01	7.30	1.8	0.12	ND	0.003	0.04
S4	7.30	2.1	ND	0.005	0.05	0.03	7.93	1.6	ND	0.06	0.04	0.05
S5	8.52	1.9	0.56	0.002	0.001	0.01	7.64	2.3	0.02	0.005	0.02	0.04
S6	7.87	1.1	0.70	0.007	0.002	0.02	8.32	1.2	0.52	0.01	0.03	0.08
S7	8.21	1.4	0.06	0.02	0.003	0.05	7.30	1.9	0.07	0.06	0.004	0.02
S8	7.52	2.7	0.74	0.07	0.007	0.04	7.73	2.6	0.67	0.08	0.004	0.03
S9	7.95	2.0	0.17	0.005	0.004	0.01	7.20	2.1	0.29	0.002	0.01	0.01
S10	7.87	2.8	0.25	0.004	0.01	0.04	7.50	3.4	0.42	0.02	0.04	0.06
Max	8.52	3.2	0.74	0.07	0.05	0.05	8.32	3.6	0.67	0.08	0.04	0.07
Mini	7.30	0.9	0.03	0.002	0.001	0.01	7.20	1.2	0.02	0.002	0.003	0.01
Average	7.82	2.08	0.385	0.013	0.011	0.026	7.70	2.21	0.337	0.027	0.017	0.038

1) All the parameters were given in unit (ppm)

2) ND- Not Detectable

Seasonal Variation of heavy metals in ground water at Vellore district

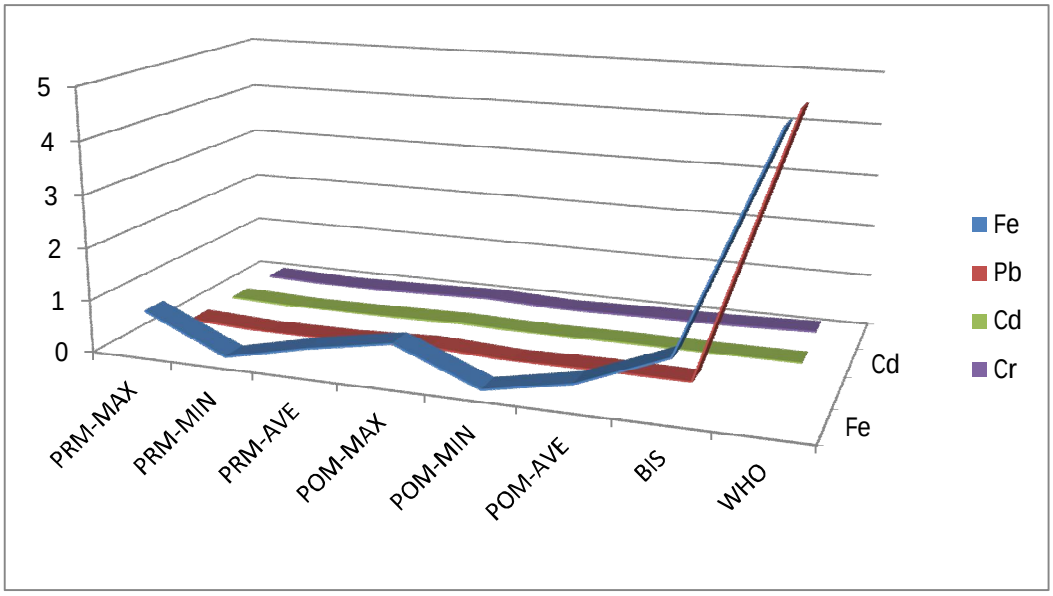
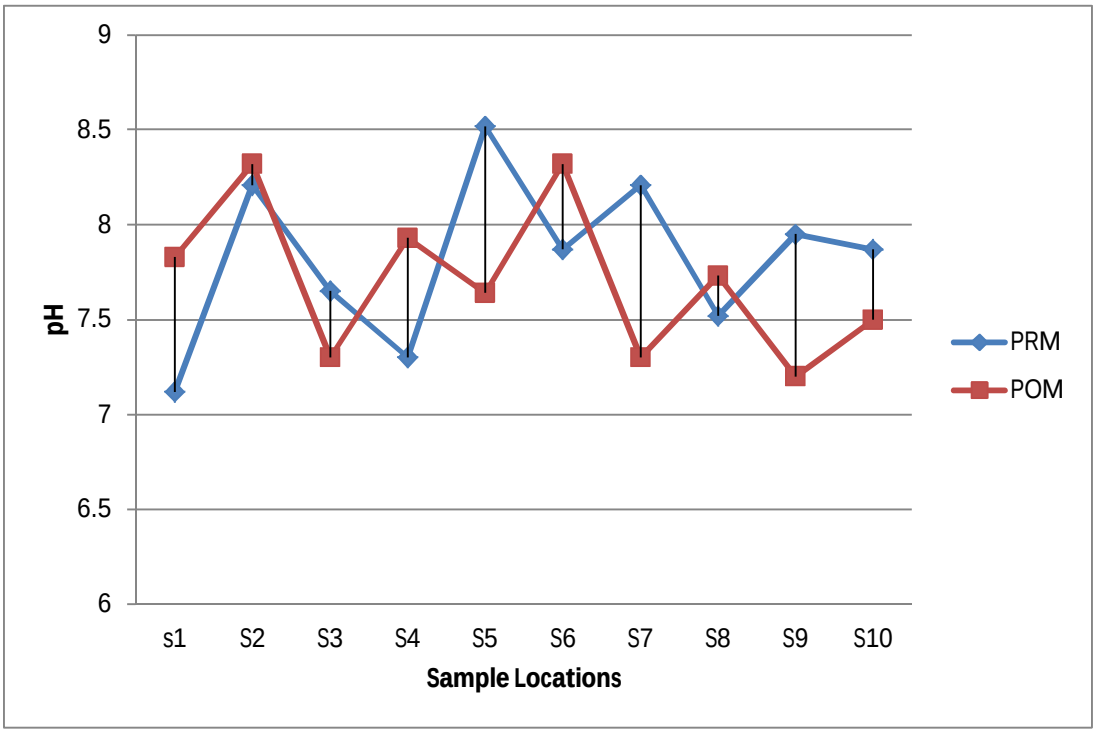


Fig -1

Table 3. Results of Heavy Metals in Ground Waters used for Drinking and Irrigation.

S. No	Heavy metals	BIS Guideline for Drinking (ppm)	WHO Guideline for irrigation (ppm)
1.	Fe	1.0	5.0
2.	Pb	0.01	5.0
3.	Cd	0.003	0.01
4.	Cr	0.05	0.1

A. Hydrogen ion concentration (pH)



Note:

1) Post monsson (POM)

2) Pre monsoon(PRM)

pH is a measure of the balance between the concentration of hydrogen ions and hydroxyl ions in water. The pH of an aqueous solution is controlled by interrelated chemical reactions that procedure or consume hydrogen ions. The pH of groundwater samples in the study area (Table 2) ranges from 7.30 to 8.52 and 7.20 to 8.32 with an average value 7.70 to7.82 in pre- and post-monsoon season respectively. It shows that the groundwater in the study area is slightly alkaline in nature and found within the maximum permissible limits of WHO standards.

B. Electrical conductivity (EC)

Electrical conductivity is the capacity of water to convey current and this may be due to the presence of soluble salts and ionic species which act as conducting medium. Conductivity of the samples (Table 2) ranged between 0.9 µmho/cm to 3.2 µmho/cm and 1.2 µmho/cm to 3.6 µmho/cm with an average value 2.08 to 2.21 in pre- and post-monsoon season respectively. The most desirable limit of EC in drinking water is prescribed as1.82 dS/m. Electrical conductivity in pre and post monsoon seasons exceeds the permissible limit most of the sample in post monsoon (BIS, 2016).

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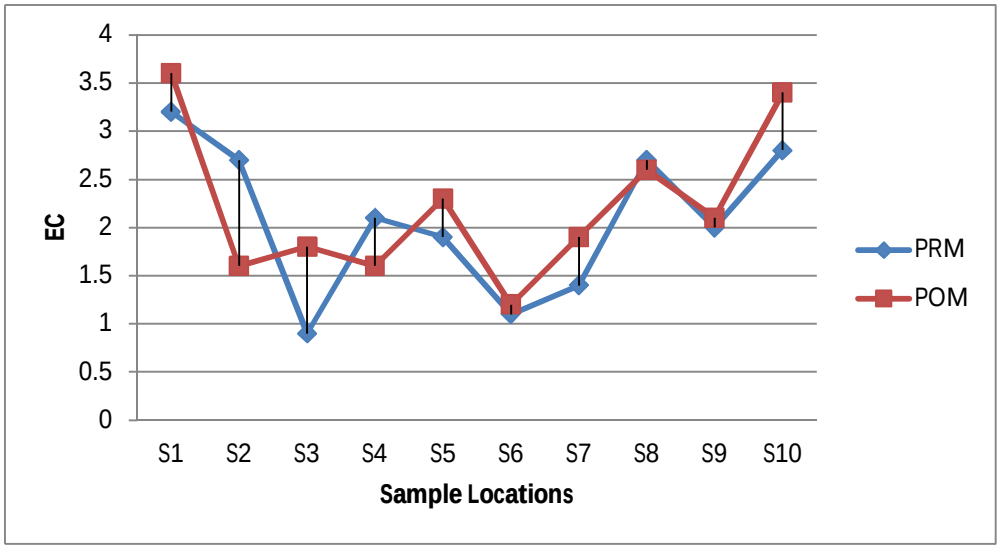

Note:
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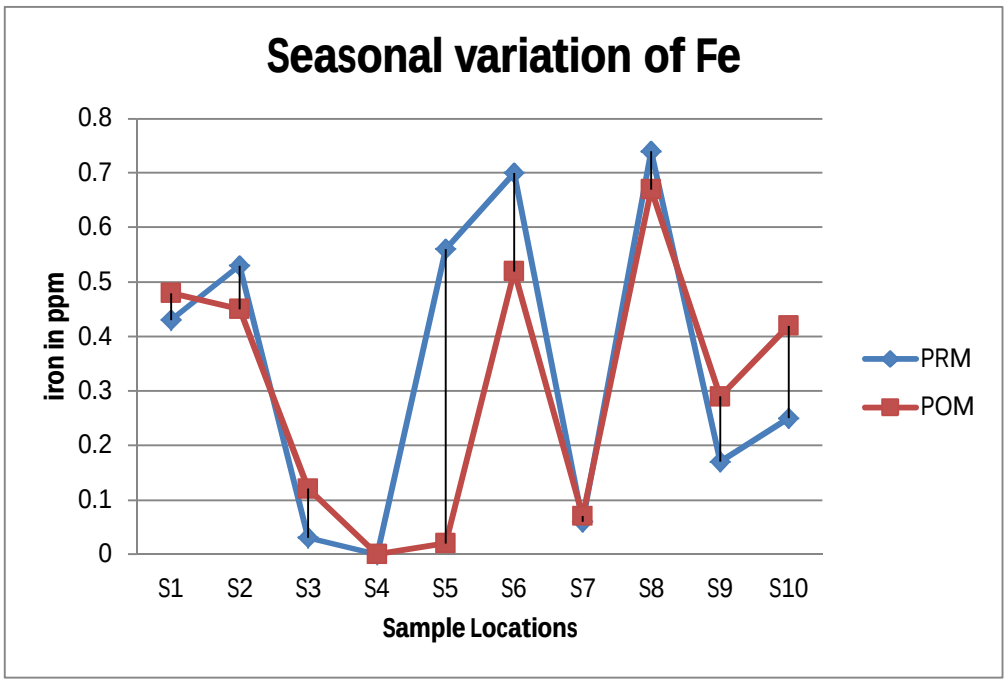
2) Pre monsoon(PRM)

C. Iron (Fe)



Note:
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2) Pre monsoon(PRM)

The groundwater sample values of iron (Table) in the ranges from 0.03-0.74 ppm and 0.02-0.67 ppm in both the seasons (WHO, 2016). All the values are less than the permissible limit of 1.0 ppm. The content of Fe is within the permissible limit of BIS standards for drinking water. It can be attributed to the dissolution of iron bearing rock and/or soils. The iron concentration obtained in the irrigation water used along the ground water were found to be higher than the value obtained for the control irrigation water which exhibits a concentration of 1.0 ppm.

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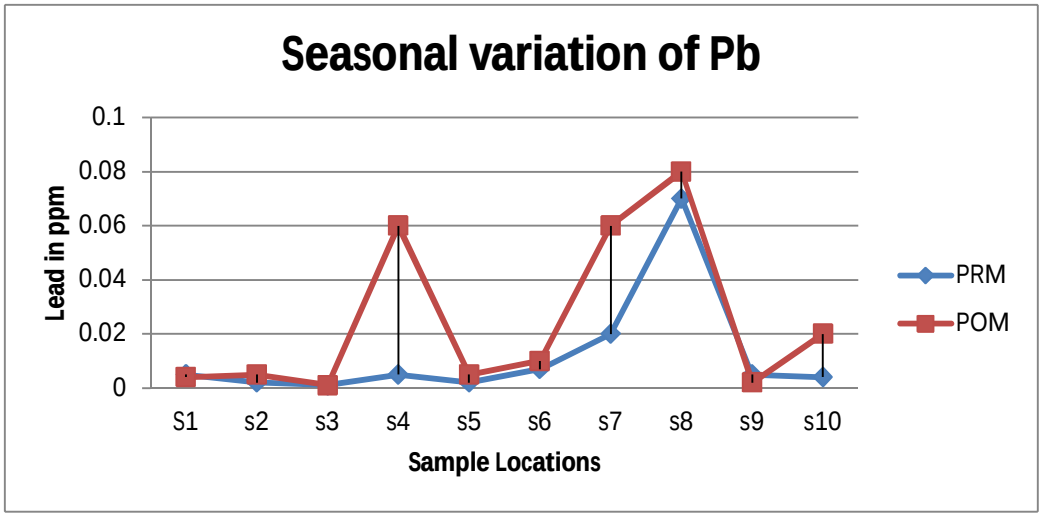
D. Lead (Pb)

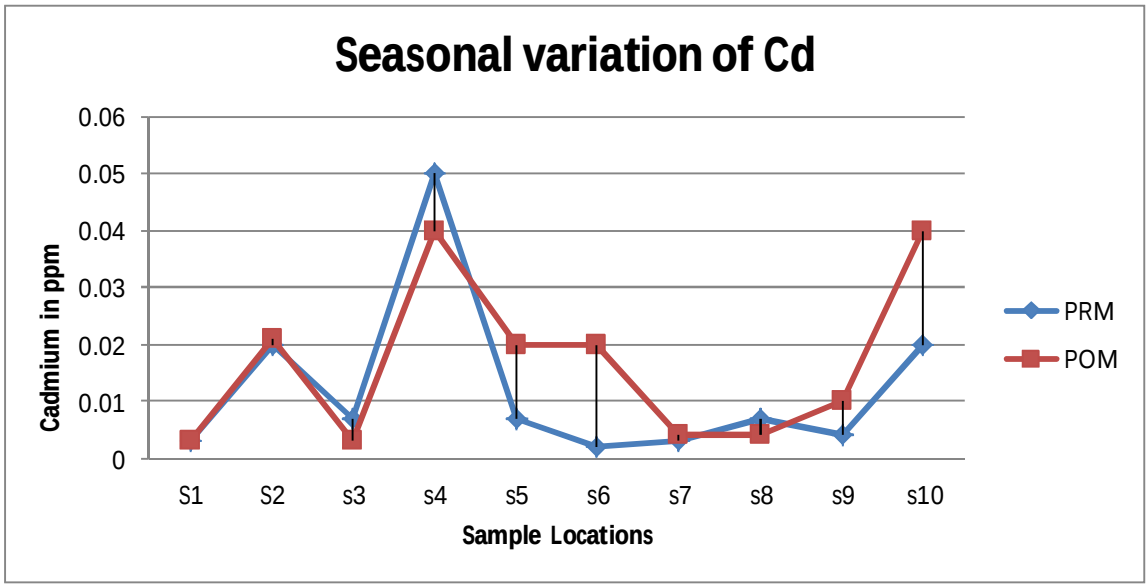


Note:
1) Post monsson (POM)
2) Pre monsoon(PRM)

In the present investigation (Table 2) the lead concentration ranges from 0.002-0.07 ppm in pre monsoon and 0.002-0.08 ppm in post monsoon. Some values of lead are showed higher than the permissible set by WHO (0.01 ppm). The maximum permissible concentration of lead in drinking water is 0.05 ppm. This may be due to the various anthropogenic activities. Lead contamination of the ground water may be the result of entry from industrial effluents, household sewages containing phosphate fertilizers and human and animal excreta. In this case, high concentrations of lead in the body can cause death or permanent damage to the central nervous system and brain which the effects can be in memory. Other effects are high blood pressure, hearing problems, headaches, slowed growth, reproductive problems in men and women, digestive problems, muscle and joint pain.

E. Cadmium (Cd)

The groundwater samples values (Table 2) of Cadmium in the ranges from 0.001-0.05 ppm and 0.003-0.04 ppm in both the season.



Note:
1) Post monsson (POM)
2) Pre monsoon(PRM)

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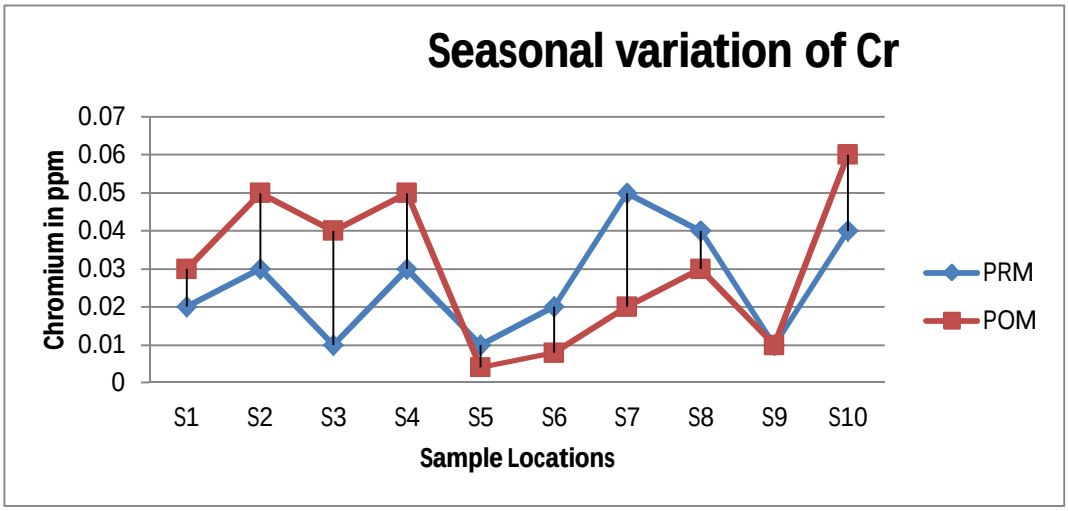
F. Chromium (Cr)



Note: Post monsoon - (POM), Pre monsoon - (PRM)

Chromium is an essential micronutrient for animals and plants, and is considered as a biological and pollution significant element. Generally the natural content of chromium in drinking water is very low ranging from 0.01 to 0.05 ppm. The values of chromium in the groundwater sample are recorded within the range of 0.001-0.05 ppm and 0.01-0.07 ppm in both the seasons. The concentration levels of chromium in all the samples are shown in (Table 2). All the values are less than the permissible limit of 0.05 ppm, but one samples are exceed in post monsoon seasons. High content of chromium may be due to various anthropogenic activities, industrial effluents, tanneries, old plumbing and household sewage.

IV. CONCLUSIONS

Water is one of the abundantly available substances in nature and also called an elixir of life. The study assessed the evolution of water quality in groundwater and water of Vellore district. High concentration of EC at a number of areas clearly indicates the unsuitability of groundwater for drinking purpose. Groundwater samples are slightly alkaline nature.

The water samples were subjected to the concentrations of heavy metal ions. Such as Iron, Lead, Cadmium and Chromium were found to be within the permissible limits. All these four micro nutrients contents were not much exceeded in the both seasons (post monsoon season and Pre Monsoon). Concentrations of all these four metals concentrations were found to be in permissible range of WHO and BIS standards of drinking water. Most of the water from these wells is suitable for domestic use and it's unlikely to pose a major health risk to consumers.

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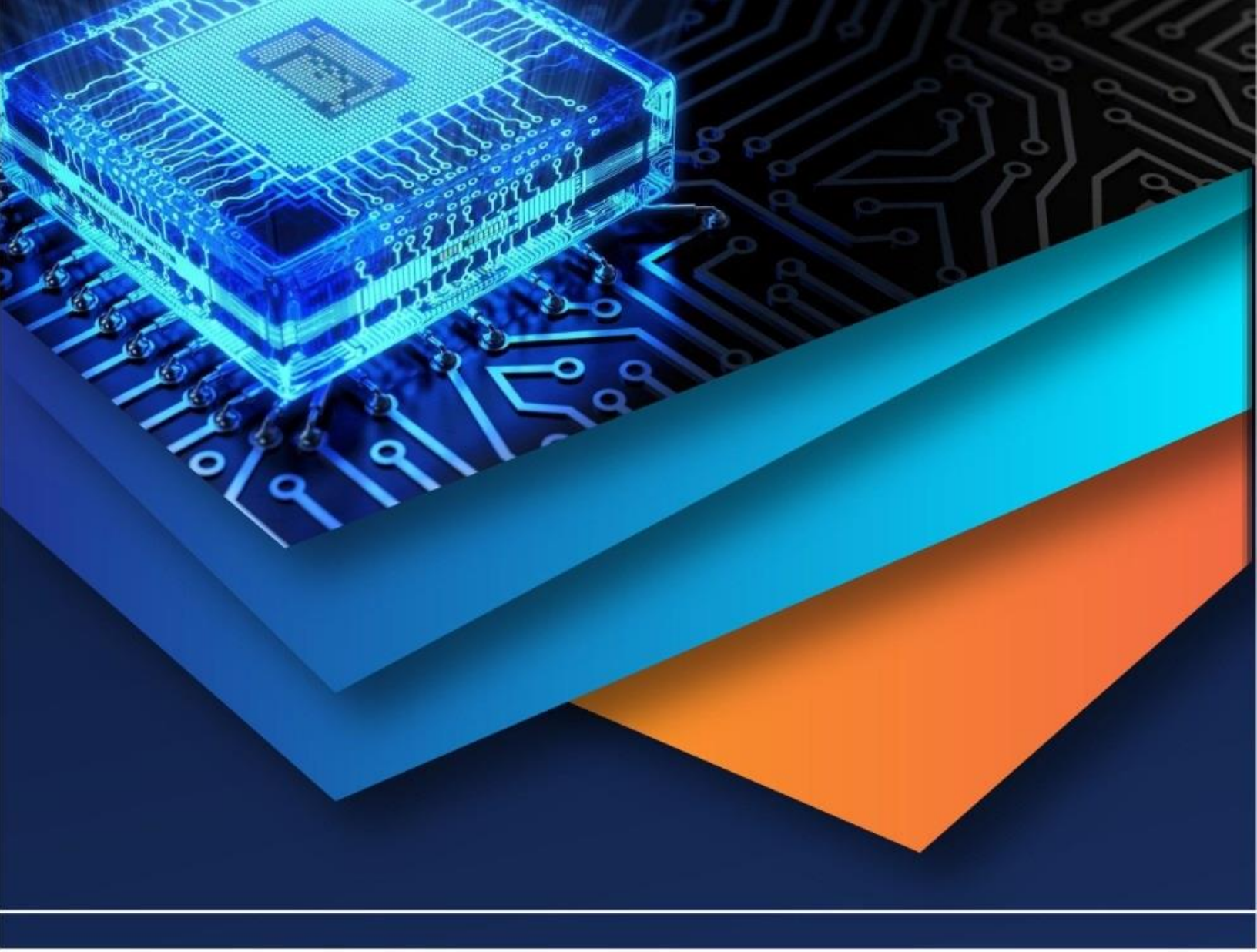

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