Technical journals online.com

Research Paper

USE OF GEOGRAPHICAL INFORMATION SYSTEM AND WATER QUALITY INDEX TO ASSESS GROUNDWATER QUALITY IN AND AROUND RANIPET AREA, VELLORE DISTRICT, TAMILNADU

[1]K.Ambiga, [2]Dr. R. Anna Durai

Address for Correspondence

[1]M.E., Asst. Professor (S-II), SCSVMV University, Enathur, Kanchipuram,TamilNadu.

[2]Ph.D, Professor and Head, Department of Civil Engineering, SRM University, Kattakalathur. TamilNadu.

ABSTRACT

An attempt has been made to understand the ground water quality by using water quality index in and around Ranipet area of Vellore District. It is a technique of rating water quality, is an effective tool to assess spatial and temporal changes in ground water quality. Thirty five groundwater samples were collected from open and tube wells during the Monsoon and Post Monsoon season in the year 2012. This was done by subjecting the 35 groundwater samples collected to comprehensive physico-chemical analysis using standard methods of analysis. From the data obtained, the water quality index was calculated by adopting the method developed by Tiwari and Mishra. Water quality index rating was carried out to quantify overall ground water quality status of the area. For calculating the index, the following 9 parameters have been considered such as pH, Total Dissolved Solids, Total Hardness, Calcium, Magnesium, Sulphates, Chlorides, Fluorides, and Nitrates. The average values of water quality index of the samples were found in the value of **142.59** in monsoon season while it was **115.4** in post-monsoon season. The higher concentration of dissolved solids during post monsoon samples exhibits poor quality of water as compared to Monsoon season. It may be due to more seepage and movement of ground water during post-monsoon.

KEY WORDS: Ground water, physico-chemical analysis, Seasonal Variation, water quality index

INTRODUCTION:

Only two to three percent of total water on earth is fresh water, and groundwater constitutes a significant portion of the fresh water resources. This scars and fragile resource is under the risk of degradation in both quality and quantity in many parts of the world. Three major activities cause large quantities of human and industrial waste disposals, and hence, pose serious threat to the groundwater resources. The first of these activities is excessive use of fertilizers, pesticides and automation in agricultural areas. The second one is unregulated discharge of natural and artificial chemical substances to the environment. Finally, excessive pumping and improper management of aquifers result in reducing the pumping potential and degrading the water quality. Detection of unknown sources is a challenging problem in groundwater pollution management. Often, groundwater pollution is detected in a water supply well, years after the source of contamination has become active in the aquifer. Groundwater pollution occurs due to clandestine disposal of toxic wastes, especially from industrial sites, or undetected leakage from pipes, waste storage containers, or underground tanks. In the last few decades, there has been a tremendous increase in the demand for fresh water due to rapid growth of population and the accelerated pace of industrialization. Human health is threatened by most of the agricultural development activities particularly in relation to excessive application of fertilizers and unsanitary conditions. Groundwater due to its over exploitation and improper waste disposal, especially in urban areas. According to WHO organization, about 80% of all the diseases in human beings are caused by water. Once the groundwater is contaminated, its quality cannot be restored by stopping the pollutants from the source. It therefore becomes imperative to regularly monitor the quality of groundwater and to device ways and means to protect it. Contamination of groundwater by domestic, industrial effluents and agricultural activity is a serious problem faced by developing countries. The industrial waste water, sewage sludge and solid waste materials are currently being discharged into the environment indiscriminately. These materials enter subsurface aquifers resulting in the pollution of irrigation and drinking water (Girija.T.R. et al., 2007). High rates of mortality and morbidity due to water borne diseases are well known in India. Access to safe drinking water remains an urgent necessity, as 30% of urban and 90% of rural households still depend completely on untreated surface or groundwater (Palanisamy.P.N, Geetha.A et al., 2005). While access to drinking water in India has increased over the past decade, the tremendous adverse impact of unsafe water on health continues (WHO, 2004). The number of industries in India, during the last decade, has grown more than ten times and accordingly the problems related to environmental degradation have increased many folds. There is a need for sustainable development of economic growth and industries. Some of the industries release their effluents either on the open land or in surrounding surface water bodies contaminating the soil, surface water and ultimately groundwater. Governments of India are aware of these problems and have started looking into the remedial measures to clean some of the highly contaminated surface water bodies. Involvement of very high costs of remediation will make this process slow and therefore, it is essential that the contamination of water bodies is controlled rather than remediation.

Water quality index is defined as a rating reflecting the composite influence of different water quality parameters. The index developed by Tiwari and Mishra (1985) was used. The water quality of this study samples was assessed using the weighted arithmetic index method by Brown et al, taking into account the nine important parameters such as pH, TDS, Total Hardness, Calcium, Magnesium, Sulphates, Chlorides, Fluorides, Nitrates.

WQI is calculated from the point of view of the suitability of groundwater for human consumption. Water quality index is one of the most effective tools to communicate information on the quality of any water body. WQI is a mathematical equation used to transform large number of water quality data into a single number. It is simple and easy to understandable for decision makers about quality and possible uses of any water body. It serves the understanding of water quality issues by integrating complex data and generating a score that describes water quality status.

Materials and Methods

Study Area: The study area lies between Latitude N 12°52′30’’ – 12°57′30’’ and Longitude E 79°15’00’’–79°25′00’’ is located in North of TamilNadu in India, covering about 154.52 Sq.Km area (Fig.1). The area includes Ranipet, Walajapet, Arcot and Melvishram. The drainage of the study area is mainly Palar River and Ponnai River. The Ranipet area is a chronic polluted area and one of the biggest exporting centers of tanned leather. Many small-scale tanneries are processing leather in the study area and discharging their effluents on the open land and surrounding water bodies (S.Srinivasa Gowd.Pradip K.Govil, 2008). The total numbers of tannery industrial units located in and around this town are 240 besides other industries like ceramic, refractory, boiler auxiliaries plant, and chromium chemicals. Industries located in Ranipet are discharging effluents into Puliathengal, Vanapadi, and Thandalam lakes and it is a matter of increasing concern, as these industries are located in Palar river basin. Studies of groundwater also indicated the high concentrations of chromium in Palar river basin, which is much more than the permissible limit in drinking water. These tanneries are polluting the Palar River, causing ecological degradation and health hazards (Maheswari. J. and K. Sankar, 2011). Geologically the study area is covered by crystalline rocks of Archaean age consisting of Granites and some basic intrusive bodies. 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 (Gautam. D.K. and M.R. Sharma, 2011).

Methodology

Sample Collection and Processing: The water samples were collected from thirty five different open and tube wells during Monsoon and post monsoon season (Fig.2) Ground water sampling locations were located on the basis of above areas. The ground water samples were collected in acid washed plastic container to avoid unpredictable changes in characteristic as per standard procedures (Mangukiya Rupa et al., 2012). Nine parameters were analyzed for WQI such as pH, TDS, Total Hardness, Calcium, Magnesium, Sulphates, Chlorides, Fluorides, and Nitrates. Water quality index (WQI) is defined as a technique of rating that provides the composite influence of individual water quality parameter on the overall quality of water. It is calculated from the point of view of human consumption. Water quality and its suitability for drinking purpose can be examined by determining its quality index. The standards for drinking purpose (Ramakrishnaiah. C. R et al., 2009) have been considered for calculation of WQI. In this method the weight age for various water quality parameters is assumed to be inversely proportional to the recommended standards for the corresponding parameters (Ahmad I. Khwakaram et al., 2012).

The WQI has been calculated to evaluate the suitability of groundwater quality of the study area for drinking purposes. The WHO (2004) standards for drinking purposes have been considered for the calculation of WQI. For the calculation of WQI, Nine parameters such as: pH, TDS, Total Hardness, Calcium, Magnesium, Sulphates, Chlorides, Fluorides, Nitrates have been used. To compute WQI four steps are followed.

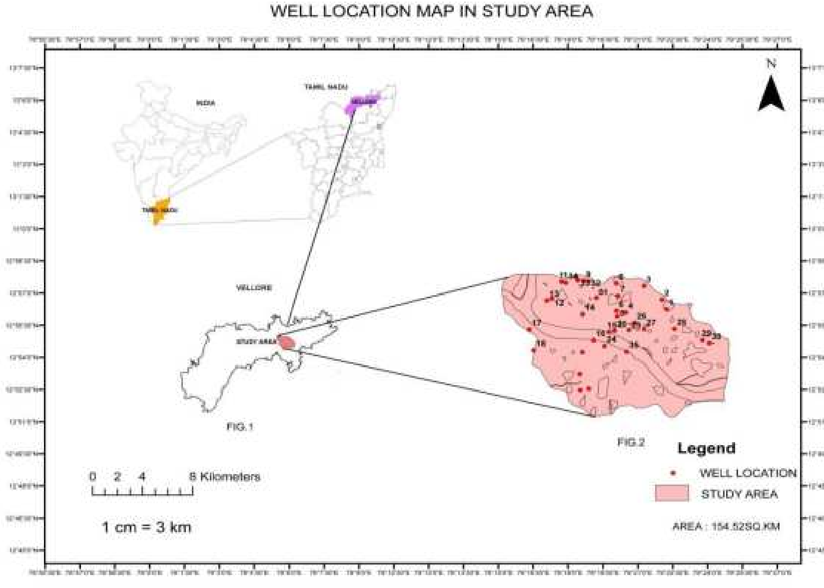
FIRST STEP: Each of 9 parameters has been assigned a weight (w_i) according to its relative importance in the overall quality of water for drinking purposes (Table 1). The maximum weight of 5 has been assigned to parameters such as nitrate due to their major importance in water quality assessment (Srinivasamoorthy et al., 2008). Other parameters like calcium, magnesium, sodium and potassium were assigned a weight between 1 and 5 depending on their importance in the overall quality of water for drinking purposes.

SECOND STEP: The relative weight (W_i) is computed using a weighted arithmetic index method given below (Brown et al., 1972; Horton, 1965; Tiwari and Manzoor, 1988) in the following steps.

$$W_i = \frac{w_i}{\sum_{i=1}^{n} w_i}$$

Where, W_i is the relative weight, w_i is the weight of each parameter and n is the number of parameter.

WELL LOCATION MAP IN STUDY AREA



THIRD STEP: A quality rating scale (Q_i) for each parameter is assigned by dividing its concentration in each water sample by its respective standard according to the guidelines of WHO (2004) and then multiplied by 100.

$$Q_i = (C_i / S_i) \times 100$$

Where Q_i is the quality rating, C_i is the concentration of each chemical parameter in each water sample in mg/L, and S_i is the WHO drinking water standard for each chemical parameter in mg/L according to the guidelines of WHO (2004) (Table 3).

FOURTH STEP: The SI_i is first determined for each chemical parameter, which is then used to determine the WQI as per the following equation:

$$SI_i = W_i \times Q_i$$

Where SI_i is the sub index of ith parameter and Q_i is the rating based on concentration of i^{th} parameter.

The overall water quality index (WQI) was calculated by adding together each sub index values of each groundwater samples as follows:

$$WQI = \Sigma SI_i$$

Table 1. WHO standards weight (w_i) and calculated relative weight (W_i) for each parameter.

Parameters	Indian Standard	Weight (w_i)	Relative Weight (W_i)
pH	6.5 - 8.5	4	0.1333
TDS	500-2000	4	0.1333
Th	300-600	2	0.0667
Ca	75-200	2	0.0667
Mg	30-100	2	0.0667
Nitrate	1 - 45	5	0.1667
Chloride	250-1000	3	0.1000
Flouride	1-1.5	4	0.1333
Sulphate	200-400	4	0.1333
Total		**30**	**1.0000**

RESULT AND DISCUSSION:

pH: The permissible limit of pH in drinking water is within 6.5 – 8.5 according to Bureau of Indian Standard(BIS).The value of pH in all categories of water is within the permissible range . The value of pH in groundwater samples of the study area ranges between 7.0 - 8.5. The seasonal variation shows the pH values fluctuating minimum during monsoon and maximum in post monsoon at all locations.

Total dissolved solids: Solids refer to matter suspended or dissolved in water or wastewater. Solids may affect water or effluent quality adversely in a number of ways. Waters with high dissolved solids generally are at inferior waters. The value of TDS of the study area ranges from 362 - 4232 mg/l in ground water samples. The seasonal fluctuation shows that to dissolved solids are higher in monsoon and minimum in post monsoon in most of the locations. The higher range during monsoon may be due to leaching of surrounding rainwater.

Turbidity: The present study areas of the turbidity of sample stations are within the permissible limit (10 NTU). The seasonal fluctuation was maximum in monsoon and minimum in post monsoon in most of the locations.

Electrical Conductivity: High concentration of dissolved solids about 3000 mg/l may also produce distress in livestock. The values of EC ranged from 516 and 6046 (ds m -1). The seasonal average conductivity values shows maximum in monsoon and minimum in post monsoon in most of the locations.

Total Alkalinity: The values of alkalinity at stations were found in the range of 108 – 800 mg/l. the alkalinity values for all the seasons fluctuate from 286.63 to 358 mg/l. The value shows that is very little fluctuation in the alkalinity throughout the year.

Total Hardness: The values ranged from 212 to 1299 mg/l of all type of hardness were quiet high with their prescribed standards. The seasonal fluctuation in total hardness of the region shows minimum in monsoon and maximum in post monsoon. The higher value is mainly found owing to abundant availability of limestone rocks in the surrounding area consequently more solubility of Ca++ and Mg++ salts under anaerobic conditions (P.N.Palanisamy et al ., 2007)

Calcium: The maximum permissible and allowable concentration of calcium in drinking water in study area ranges between 48 to 320 mg/l. Calcium is a major constituent of various types of rock. Calcium is a cause for hardness in water and incrustation in boilers. Calcium is an essential constituent of human being. The low content of calcium in drinking water may cause rickets and defective teeth. It is essential for nervous system, cardiac function and coagulation of blood.

Magnesium: The maximum permissible limit of calcium hardness is 30 mg/l. /the concentration of magnesium in the study area ranges between 22 to 153 mg/l. Chemical softening, reverse osmosis, electro dialysis, or ion exchange reduces the magnesium and associated hardness to acceptable levels.

Sodium: The concentrations of sodium in the study are ranges between 28 to 790 mg/l in all the samples Person afflicted with certain diseases require low sodium concentration. The seasonal average of sodium values shows maximum in monsoon and minimum in post monsoon in most of the locations.

Potassium: Potassium ranks seventh among the elements in order of abundance yet its concentration in most drinking waters seldom reaches 20 mg/l. However, the concentrations of potassium were analyzed from 4 to 53 mg/l for all the samples. The seasonal average of potassium values shows maximum in monsoon and minimum in post monsoon in most of the locations.

Iron: High levels of iron are attributed to the dominating literatic soil. Iron in drinking water may be present as geological sources, industrial wastes and domestic discharges and also from mining products. Excess amount of iron i.e., more than 10 mg/l causes rapid increase in respiration, pulse rate and coagulation of blood vessels. The concentration of iron an all water samples of the study area ranges from 0.1 – 10 mg/l. The maximum seasonal values of iron in the area were post monsoon and the minimum in monsoon.

Nitrite: The nitrite concentration in the study area of ground water in the range of 0 to 2.09 mg/l. The normally permissible limit of nitrite is 0 – 0.1 mg/l. In the Palar river (well station No. 14) is highly nitrite concentration (2.09 mg/l) in the water. The nitrite concentration in groundwater in normally low but can reach high levels as a result of leaching or runoff from agricultural land and contamination from human or animal wastes as consequence of the oxidation of ammonia and similar sources. Anaerobic conditions may result in the formation and persistence of nitrite. The maximum seasonal value of nitrite in the area was monsoon and the minimum in post monsoon.

Nitrate: The nitrate concentration in the study area ranges from 7 – 70 mg/l. The permissible limit of nitrate is 45 mg/l. Nitrates generally occur in trace quantities in surface waters but may attain high levels in some ground waters. It can be toxic to certain aquatic organisms even at concentration of 100 mg/l. In excessive limits, it contributes to the illness known as methenoglobinemia in infants. The seasonal average of nitrate values shows maximum in monsoon and minimum in post monsoon in most of the locations.

Chloride: The Chloride concentration in the study area ranges from 42 – 1609 mg/l. The permissible limit of chloride is 250 mg/l. High chloride content may harm metallic pipes and structures as well as growing plants. Chlorides in excess imparts the salty taste to water and people are not accustomed to high chloride are subjected to laxative effect (H.Manjunatha et al., 2011). The chloride values for all the seasons fluctuate from 481 to 507 mg/l. The seasonal average of chloride values shows maximum in monsoon and minimum in post monsoon in most of the locations.

Fluoride: The fluoride concentrations were found to be in the range of 0.26 to 1.5 mg/l. In groundwater, fluoride concentrations vary with the type of rock that the water flows through but do not usually exceed 10 mg/l, (V. Ashwini et al., 2010). Presence of large amounts of fluoride is associated with dental and skeletal fluorosis (1.5 mg/l) and inadequate amounts with dental caries (< 1 mg/l). The maximum seasonal value of fluoride in the area was post monsoon and the minimum in monsoon.

Sulphate: The major physiological effects resulting from the ingestion of large quantities of sulphate are catharsis, dehydration, and gastrointestinal irritation. Sulfate may also contribute to the corrosion of distribution systems. The sulphate concentrations were found to be in the range of 29 to 486 mg/l. The seasonal average of sulphate values shows maximum in monsoon and minimum in post monsoon in all water sample stations.

Phosphate: The levels of phosphate in groundwater from all parts of the sample stations are found to be in the range of 0.1 – 1.5 mg/l. High concentration of phosphate might be due to use of detergents for washing of clothes and utensil activities by the villagers around most of the dug wells. The seasonal average of phosphate values shows minimum in monsoon and maximum in post monsoon in all water sample stations.

Chromium: The chromium concentration in the study area ranges from 0 - 0.5429 (GW15) mg/l. The seasonal average of chromium values shows minimum in monsoon and maximum in post monsoon in most of water sample stations. Tannery effluents are mostly characterized by high salinity, high organic loading, and specific pollutants, such as chromium (Mangukiya Rupal et al., 2012).

In this study, the computed WQI values ranges from 53.25 to 311.70 for monsoon period and values range from 43.28 to 288.90 for Post monsoon period had shown in Table 3 and 4. Therefore, can be categorized into five types “excellent water” to “water unsuitable for drinking” shown in Fig 3. Table 5 and 6 shows the water quality classification based on WQI value for Monsoon and Post Monsoon seasons.

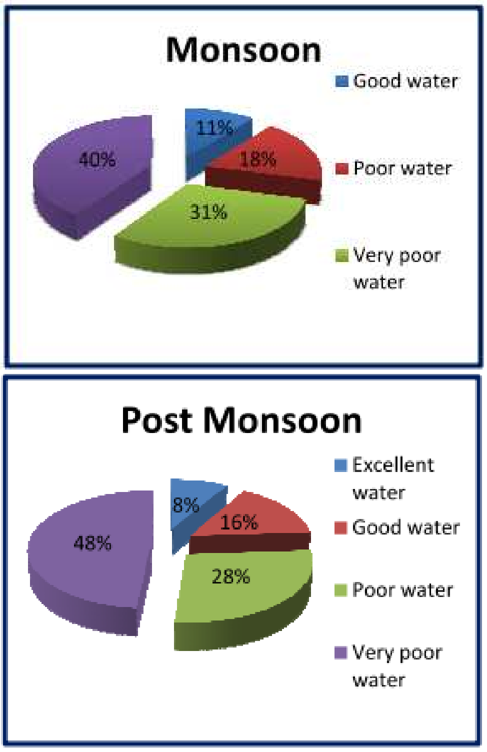


Fig. 3: WQI Categories of samples (%) in monsoon and post monsoon seasons

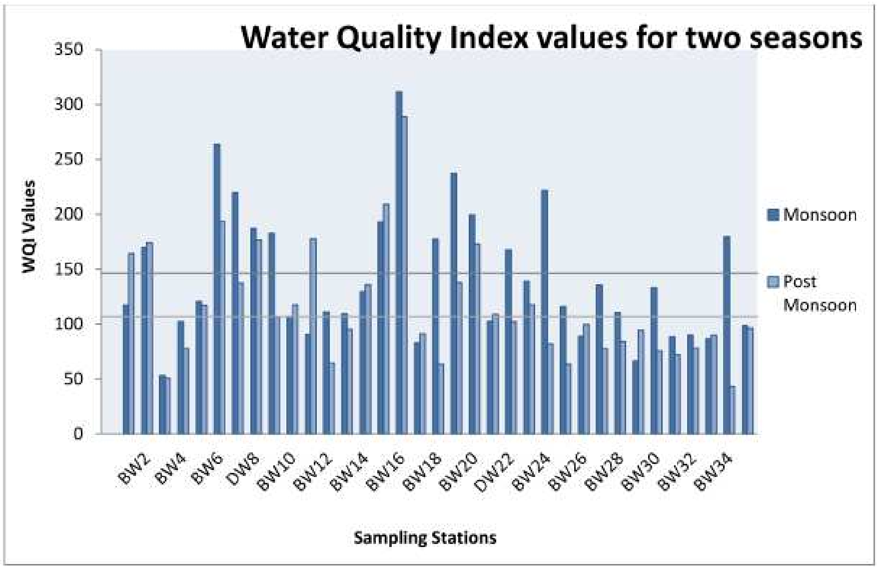


Fig. 4: WQI of groundwater samples for monsoon and post monsoon

Table 2. Water classification of each groundwater sample during Monsoon for Quality rating (Q_i), Sub index (SI_i) and WQI

Well Type	PH		TDS		TH		Ca		Mg		Nitrate		Chloride		Fluoride		Sulphate		WQI
	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	
GW1	84.824	11.31	277.2	36.95	113.3	7.559	101.3	6.76	120	8.004	37.8	6.3	196	19.6	37.33	4.98	120	16	**117.45**
GW2	85.765	11.43	386.4	51.51	193.3	12.9	170.7	11.4	206.7	13.78	73.3	12.2	289	28.92	48.67	6.49	160	21.33	**169.96**
GW3	85.647	11.42	72.4	9.651	70.67	4.713	64	4.27	73.33	4.891	44.4	7.41	16.8	1.68	54.67	7.29	14.5	1.933	**53.25**
GW4	83.059	11.07	250	33.33	93.33	6.225	85.33	5.69	96.67	6.448	17.8	2.96	178	17.8	32	4.27	107	14.2	**101.99**
GW5	84.0	11.2	312.4	41.64	110	7.337	96	6.4	120	8.004	102	17	152	15.24	40.67	5.42	63	8.398	**120.68**
GW6	86.118	11.48	784.4	104.6	273.3	18.23	266.7	17.8	256.7	17.12	40	6.67	566	56.6	57.33	7.64	178	23.73	**263.82**
GW7	85.765	11.43	623.6	83.13	253.3	16.9	224	14.9	273.3	18.23	48.9	8.15	404	40.4	52.67	7.02	147	19.6	**219.79**
GW8	84.471	11.26	559.2	74.54	240	16.01	261.3	17.4	183.3	12.23	73.3	12.2	211	21.12	45.33	6.04	123	16.4	**187.25**
GW9	85.176	11.35	581.6	77.53	246.7	16.45	266.7	17.8	193.3	12.9	24.4	4.07	216	21.6	46	6.13	112	14.93	**182.75**
GW10	84.588	11.28	293.2	39.08	113.3	7.559	106.7	7.11	113.3	7.559	24.4	4.07	121	12.08	47.33	6.31	88	11.73	**106.79**
GW11	85.059	11.34	241.2	32.15	110	7.337	96	6.4	96.67	6.448	15.6	2.59	105	10.48	26	3.47	79	10.53	**90.748**
GW12	85.647	11.42	313.2	41.75	116.7	7.782	101.3	6.76	126.7	8.449	20	3.33	150	15.04	32	4.27	91	12.13	**110.93**
GW13	86.00	11.46	278	37.06	106.7	7.115	96	6.4	113.3	7.559	97.8	16.3	98.8	9.88	28.67	3.82	74.5	9.931	**109.53**
GW14	85.412	11.39	280	37.32	116.7	7.782	101.3	6.76	126.7	8.449	156	25.9	170	17.04	22.67	3.02	91	12.13	**129.82**
GW15	83.647	11.15	533.2	71.08	236.7	15.79	256	17.1	183.3	12.23	68.9	11.5	250	24.96	27.33	3.64	191	25.46	**192.86**
GW16	85.647	11.42	846.4	112.8	400	26.68	426.7	28.5	320	21.34	60	10	644	64.36	48.67	6.49	226	30.13	**311.7**
GW17	84.588	11.28	177.2	23.62	85.33	5.692	74.67	4.98	93.33	6.225	82.2	13.7	59.2	5.92	41.33	5.51	46.5	6.198	**83.128**
GW18	82.824	11.04	401.2	53.48	203.3	13.56	224	14.9	160	10.67	153	25.6	238	23.76	39.33	5.24	143	19.06	**177.32**
GW19	82.588	11.01	639.2	85.21	273.3	18.23	266.7	17.8	256.7	17.12	84.4	14.1	376	37.6	28	3.73	243	32.39	**237.15**
GW20	85.765	11.43	467.2	62.28	220	14.67	224	14.9	193.3	12.9	156	25.9	321	32.08	19.33	2.58	170	22.66	**199.47**
GW21	84.235	11.23	252.4	33.64	106.7	7.115	96	6.4	113.3	7.559	48.9	8.15	115	11.48	41.33	5.51	84	11.2	**102.29**
GW22	85.765	11.43	417.6	55.67	206.7	13.78	224	14.9	160	10.67	17.8	2.96	291	29.12	42.67	5.69	176	23.46	**167.73**
GW23	86.0	11.46	354.4	47.24	173.3	11.56	176	11.7	153.3	10.23	64.4	10.7	158	15.84	38.67	5.15	112	14.93	**138.9**
GW24	86.941	11.59	611.2	81.47	243.3	16.23	288	19.2	160	10.67	149	24.8	356	35.64	47.33	6.31	119	15.86	**221.81**
GW25	83.412	11.12	284.4	37.91	116.7	7.782	101.3	6.76	93.33	6.225	77.8	13	150	15.04	42	5.6	96	12.8	**116.2**
GW26	83.765	11.17	227.6	30.34	90	6.003	74.67	4.98	103.3	6.892	6.67	1.11	118	11.8	32.67	4.35	91	12.13	**88.777**
GW27	84.706	11.29	357.6	47.67	133.3	8.893	117.3	7.83	143.3	9.56	102	17	158	15.84	37.33	4.98	94.5	12.6	**135.69**
GW28	84.588	11.28	219.2	29.22	128.7	8.582	112	7.47	140	9.338	133	22.2	98.8	9.88	30	4	62	8.265	**110.26**
GW29	82.471	10.99	127.2	16.96	86.67	5.781	74.67	4.98	96.67	6.448	33.3	5.56	63.2	6.32	25.33	3.38	46	6.132	**66.543**
GW30	85.059	11.34	334.8	44.63	136.7	9.116	117.3	7.83	153.3	10.23	102	17	156	15.64	32	4.27	98	13.06	**133.15**
GW31	85.647	11.42	215.2	28.69	120	8.004	101.3	6.76	136.7	9.116	6.67	1.11	113	11.28	25.33	3.38	65	8.665	**88.414**
GW32	84.588	11.28	217.8	29.03	116.7	7.782	96	6.4	136.7	9.116	6.67	1.11	129	12.88	26	3.47	68	9.064	**90.13**
GW33	84.941	11.32	212.4	28.31	113.3	7.559	96	6.4	126.7	8.449	4.44	0.74	117	11.68	25.33	3.38	64.5	8.598	**86.442**
GW34	84.588	11.28	465.6	62.06	213.3	14.23	213.3	14.2	193.3	12.9	133	22.2	224	22.36	30	4	122	16.26	**179.54**
GW35	84.235	11.23	258	34.39	130	8.671	106.7	7.11	153.3	10.23	22.2	3.7	95.2	9.52	26	3.47	76	10.13	**98.454**
AVERAGE VALUES OF WQI																			**142.59**

Table 3. Water classification of each groundwater sample during Post Monsoon for Quality rating (Q_i), Sub index (SI_i) and WQI

Well Type	PH		TDS		TH		Ca		Mg		Nitrate		Chloride		Fluoride		Sulphate		WQI
	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	Q_i	SI_i	
GW1	85.9	11.45	330	44	290	19.34	232	15.5	347	23.12	44.44	7.409	308	30.8	66.7	8.89	28	3.7	**164.2**
GW2	82.4	10.98	345	46	333.3	22.23	267	17.8	400	26.68	22.22	3.704	304	30.4	100	13.3	22	2.9	**174**
GW3	83.5	11.13	71.6	9.54	83.33	5.558	66.7	4.45	100	6.67	22.22	3.704	24	2.4	33.3	4.44	23.5	3.1	**51.03**
GW4	81.2	10.82	148	19.8	100	6.67	80	5.34	120	8.004	11.11	1.852	168	16.8	33.3	4.44	33	4.4	**78.08**
GW5	94.1	12.55	233	31.1	186.7	12.45	149	9.96	223	14.9	8.889	1.482	176	17.6	100	13.3	30	4	**117.3**
GW6	91.8	12.23	410	54.7	356.7	23.79	285	19	427	28.46	11.11	1.852	348	34.8	120	16	21	2.8	**193.6**
GW7	92.9	12.39	342	45.6	170	11.34	136	9.07	203	13.56	6.667	1.111	320	32	66.7	8.89	25.5	3.4	**137.3**
GW8	96.5	12.86	410	54.7	273.3	18.23	219	14.6	327	21.79	4.444	0.741	332	33.2	133	17.8	20	2.7	**176.5**
GW9	95.3	12.7	230	30.7	186.7	12.45	149	9.96	223	14.9	8.889	1.482	144	14.4	73.3	9.78	2	0.3	**106.6**
GW10	98.8	13.17	248	33.1	133.3	8.893	107	7.11	160	10.67	11.11	1.852	320	32	53.3	7.11	29.5	3.9	**117.8**
GW11	87.1	11.6	352	46.9	346.7	23.12	277	18.5	413	27.57	111.1	18.52	128	12.8	133	17.8	4.5	0.6	**177.4**
GW12	88.2	11.76	118	15.7	113.3	7.559	90.7	6.05	133	8.893	11.11	1.852	36	3.6	46.7	6.22	22.5	3	**64.66**
GW13	89.4	11.92	220	29.3	133.3	8.893	107	7.11	160	10.67	17.78	2.964	80	8	100	13.3	24	3.2	**95.42**
GW14	90.6	12.08	316	42.1	233.3	15.56	187	12.5	280	18.68	11.11	1.852	192	19.2	80	10.7	25	3.3	**135.9**
GW15	92.9	12.39	476	63.5	410	27.35	341	22.8	510	34.02	20	3.334	280	28	120	16	13.5	1.8	**209.1**
GW16	82.4	10.98	758	101	386.7	25.79	309	20.6	463	30.9	22.22	3.704	840	84	66.7	8.89	22	2.9	**288.9**
GW17	85.9	11.45	222	29.6	120	8.004	96	6.4	143	9.56	13.33	2.223	160	16	33.3	4.44	26.5	3.5	**91.21**
GW18	83.5	11.13	132	17.6	100	6.67	80	5.34	120	8.004	22.22	3.704	72	7.2	6.67	0.89	24	3.2	**63.73**
GW19	80	10.66	338	45.1	253.3	16.9	203	13.5	303	20.23	15.56	2.593	212	21.2	33.3	4.44	24.5	3.3	**137.9**
GW20	95.3	12.7	420	56	250	16.68	200	13.3	300	20.01	22.22	3.704	380	38	66.7	8.89	27	3.6	**172.9**
GW21	100	13.33	262	34.9	173.3	11.56	139	9.25	207	13.78	8.889	1.482	164	16.4	33.3	4.44	27	3.6	**108.8**
GW22	89.4	11.92	276	36.8	153.3	10.23	123	8.18	183	12.23	11.11	1.852	144	14.4	20	2.67	28	3.7	**102**
GW23	95.3	12.7	360	48	86.67	5.781	69.3	4.62	103	6.892	17.78	2.964	296	29.6	33.3	4.44	21	2.8	**117.8**
GW24	97.6	13.02	212	28.3	56.67	3.78	45.3	3.02	66.7	4.447	11.11	1.852	216	21.6	33.3	4.44	12.5	1.7	**82.09**
GW25	95.3	12.7	158	21.1	83.33	5.558	66.7	4.45	100	6.67	13.33	2.223	48	4.8	20	2.67	25.5	3.4	**63.53**
GW26	94.1	12.55	292	38.9	140	9.338	112	7.47	167	11.12	22.22	3.704	120	12	13.3	1.78	19.5	2.6	**99.48**
GW27	92.9	12.39	184	24.5	126.7	8.449	101	6.76	150	10.01	26.67	4.445	72	7.2	6.67	0.89	24	3.2	**77.86**
GW28	91.8	12.23	216	28.8	120	8.004	96	6.4	143	9.56	11.11	1.852	116	11.6	20	2.67	23	3.1	**84.18**
GW29	90.6	12.08	228	30.4	186.7	12.45	149	9.96	93.3	6.225	13.33	2.223	136	13.6	33.3	4.44	23.5	3.1	**94.5**
GW30	88.2	11.76	172	22.9	113.3	7.559	90.7	6.05	133	8.893	15.56	2.593	108	10.8	13.3	1.78	22.5	3	**75.36**
GW31	87.1	11.6	160	21.3	120	8.004	96	6.4	143	9.56	6.667	1.111	100	10	6.67	0.89	24.5	3.3	**72.17**
GW32	85.9	11.45	178	23.7	133.3	8.893	107	7.11	160	10.67	8.889	1.482	108	10.8	6.67	0.89	24	3.2	**78.23**
GW33	87.1	11.6	192	25.6	153.3	10.23	123	8.18	183	12.23	11.11	1.852	152	15.2	13.3	1.78	24.5	3.3	**89.93**
GW34	84.7	11.29	94	12.5	46.67	3.113	37.3	2.49	53.3	3.557	11.11	1.852	36	3.6	13.3	1.78	23	3.1	**43.28**
GW35	85.9	11.45	234	31.2	183.3	12.23	147	9.78	220	14.67	13.33	2.223	100	10	13.3	1.78	23	3.1	**96.39**
AVERAGE VALUES OF WQI																			**115.4**

WQI VALUE RANGE	WATER QUALITY	NO. OF STATION	(%)
<50	Excellent	Nil	**Nil**
50 – 100	Good	3,17,26,29,31-33,35	**11**
100 – 200	Poor	1,2,4-5,8-10,12-15,18,20-23,25,27-28,30,34	**18**
200 – 300	Very Poor	6-7,19,24	**31**
>300	Unfit for drinking	16	**40**

Table 4: Water quality classification based on WQI value for Monsoon

WQI VALUE RANGE	WATER QUALITY	NO. OF STATION	(%)
<50	Excellent	34	**8**
50 – 100	Good	3-4,12-13,18-19,24-33,35	**16**
100 – 200	Poor	1-2,5-11,14,19-23	**28**
200 – 300	Very Poor	15-16	**48**
>300	Unfit for drinking	Nil	**Nil**

Table 5: Water quality classification based on WQI value for Post Monsoon

The WQI for 35 Ground water samples ranges from 53.25 to 311.70 during monsoon period and values range from 43.28 to 288.90 during Post monsoon period. The high value of WQI at these stations has been found to be mainly from the higher values of pH, total dissolved solids, total hardness, calcium, magnesium, nitrate, chloride, fluoride and sulphate in the groundwater.

During Monsoon period, about 40% of water samples are unfit for drinking in sample station like GW16

(Veppur), 31% of water samples are very poor quality in sample stations such as GW6 (Thandalam), GW7 (Settithangal), GW19 (Masppettai) and GW24 (Arcot Bus Stand) and should not use directly for drinking purpose, 18% of water samples are poor quality in sample stations such as GW1(Ananthalai), GW2 (PudhuPettai), GW4 (Maanthangl), GW5 (Navalpur), GW8 (Vanapadi), GW10(Sipcot–I), GW12 (Maniyampattu) GW15 (PalarRiver), GW18 (Kathiavadi), GW20 (ArcotMain–Town), GW23 (Kurampadi), GW25 (V.C.Mottur-1), GW27 (Vanniyavedu), GW28 (Walajapettai), GW30 (Pulithangal), GW34 (Maniyampattu) and not use for drinking purpose and use for other purposes. As per the classification based on water quality index 11% of ground water samples are of good quality in sample stations such as GW3(Ammur), GW17 (Melvisharam), GW26 (V.C.Mottur – 2), GW29 (Chennasamudaram), GW31(Ranipet Sipcot - II), GW32(Ranipet Sipcot - III), GW33 (Ranipet Sipcot -IV), GW35(Mudiyor Illam) and suitable for drinking purpose.

During Post Monsoon period, about 48% of water samples are very poor quality in sample stations such as GW15 (Palar River),GW16 (Veppur) and should not use directly for drinking purpose, 28% of water samples are poor quality in sample stations such as GW1 (Ananthalai), GW2 (PudhuPettai), GW5 (Navalpur), GW6 (Thandalam), GW7(Settithangal), GW8 (Vanapadi), GW9 (Ranipet Agravaram), GW10 (Sipcot–I), GW11 (Pulianthangal), GW14 (Puliamkannu) , GW19 (Masappettai), GW20 (Arcot Main – Town), GW21 (Uppupettai), GW22 (Krishnavaram), GW23 (Kurampadi) and not use for drinking purpose and use for other purposes. As per the classification based on water quality index 16% of ground water samples are of good quality in sample stations such as GW3(Ammur), GW4(Maanthangl), GW12(Maniyampattu), GW13 (Thengal), GW18(Kathiavadi), GW19 (Masappettai), GW24(ArcotBusStand), GW25 (V.C.Mottur-1), GW26(V.C.Mottur–2), GW27 (Vanniyavedu), GW28 (Walajapettai), GW29 (Chennasamudaram), GW30(Pulithangal), GW31 (Ranipet Sipcot - II), GW32 (Ranipet Sipcot - III), GW35 (Mudiyor Illam) and suitable for drinking purpose. About 8% of ground water samples are of excellent quality in sample stations like as GW34 (Maniyampattu). In this WQI studies, the groundwater quality may improve due to inflow of freshwater of good quality during post monsoon season. The analysis reveals that the groundwater of the area needs some degree of treatment before consumption, and it also needs to be protected from the perils of contamination.

CONCLUSION

The ground water which were taken from the various places of in and around Ranipet area were analyzed and the analysis reports that the water quality parameters like pH, total dissolved solids, total hardness, calcium, magnesium, nitrate, chloride, fluoride and sulphate lies within the maximum permissible limit prescribed by WHO and ICMR. Except few parameters were reported within the permissible level, but this value does not have any impact for the water to use for drinking purpose.The analysis of experimental investigation on quality of groundwater using nine physico-chemical parameters of the study area indicate that in general about the water quality was poor, very poor and unsuitable for drinking purpose. In this study, the computed WQI values ranges from **53.25 to 311.70** during monsoon period and values range from **43.28 to 288.90** during Post monsoon period respectively. The Percentage of water quality index shows that maximum in post monsoon and minimum in monsoon period. The overall view of the Water Quality Index of the present study zone had a higher WQI value indicating the deteriorated water quality. Apart from ground water assessment, the WQI model can be used for wide ranging of applications. Among other uses, it can help the planner and policy maker when selecting areas for waste disposal and industrial sites.

ACKNOWLEDGEMENT

The author wish to record deep sense of gratitude to Vice-Chancellor, Director (E &T), Dean (E &T) and other dignitaries of Faculty of Civil Engineering , SRM University, Chennai, Tamil Nadu.

The authors are gratefully acknowledged to Dean and HOD in SRM University for providing necessary laboratory facilities.

The authors also wish to sincere thanks to Prof. K.Srinivas,Dean(E&T),Mr.N.SeshadriSekharHOD, Mr.P.SundaraPandiyan Asst.Professor, Mrs. R.Sumathi,Asst.Professor(II) and Mr.M.SureshKumar, Asst.Professor, Department of Civil & Structural Engineering, SCSVMV University, Kanchipuram, TamilNadu, for constant support in the research work.

REFERENCE

- Ahmad I. Khwakaram, Salih N. Majid, Nzar Y. Hama. (2012). Determination of Water Quality Index (WQI) for Qalyasan Stream in Sulaimani City/ Kurdistan Region of Iraq. International journal of plant, animal and environmental sciences, v..2, No.4
- APHA, (2005). Standard methods for the examination of water and wastewater. American Public Health Association, Washington D.C.
- Ashwini.V. Chandekar and Kamble.R.K,(2010). Groundwater Fluoride in Rajura Tehsil in Chandrapur District, Maharashtra. Indian J.Env.Prot., v.30, No.10, pp. 823 - 831.
- BIS, (2003). Indian standard for drinking water specification – 10500. Bureau of Indian Standards, New Delhi.
- Charmaine Jerome and Anitha Plus, (2011). Evalution of Groundwater Quality in an industrial; Area in Bangalore, Karnataka. Indian J.Env.Prot., v.31, No.3, pp. 203 – 216.
- Gautam. D.K. and Sharma.M.R, (2011). Water Quality Modeling and Management of Seer stream in lower Himalayas. Indian J.Env.Prot., v.1, No.1, pp. 73 – 83.
- Girija.T.R., Mahanta.C, and Chandramouli.V (2007), Water Quality Assessment of an untreated effluent impacted urban stream: the Bharalu Tributary of the Brahmaputra River, India. Environmental Monitoring and Assessment, pp.221 – 236.
- Ibrahim Bathusha.M and Saseetharan .M.K, (2006). Statistical study on Physico – Chemical Characteristics of groundwater of Coimbatore South zone. Indian J.Env.Prot., v.26, No. 6, pp. 508 – 515.
- Joshi.V.A, Manivel.U, Ravindar Rao.R, and Kelkar. P.S, (2002). Water Quality Assessment in Ramanathapuram District. Indian J.Env.Prot., v.22, No.9, pp. 970- 977.
- Maheswari. J. and Sankar.K, (2011). Groundwater Quality Assessment in Vaippar River Basin Tamilnadu (India). International Journal of Current Research., v.3, No.12, pp.149-152.
- Mangukiya Rupal, Bhattacharaya Tannushree and Chakraborty Sukalyan, (2012). Quality Characterization of Groundwater using Water Quality Index in Surat city, Gujarat, India. Int.Res.J.Environmental Sci., v.1, No.4, pp. 14-23.
- Mangukiya Rupal, Bhattacharya Tanushree and Chakraborty Sukalyan, (2012). Quality Characterization

of Groundwater using Water Quality Index in Surat city, Gujarat, India. International Research Journal of Environment Sciences., v.1, No.4, pp. 14-23.

- Manjunatha .H, Arvinda. H.B. and Puttaih. E.T, (2011). Subsurface water quality of Challakera Taluk, Kartnataka. Indian J.Env.Prot., v.31, No.6, pp. 511 – 513.
- Mohammad Alam and Pathak J.K, (2011). Rapid Assessment of Water Quality Index of Ramganga River, Western Uttar Pradesh (India) Using a Computer Programme, Nature and Science, pp. 1- 8.
- Moharir.A, Ramteka D.S, Moghe C.A, Wate. S.R. and Sarin R, (2002). Surface and Groundwater Quality Assessment in Bina Region. Indian J.Env.Prot., v.22, No.9, pp. 961- 969.
- Mouna Ketata-Rokbani, Moncef Gueddari and Rachida Bouhlila, (2011). Use of Geographical Information System and Water Quality Index to Assess Groundwater Quality in El Khairat Deep Aquifer (Enfidha, Tunisian Sahel). Iranica Journal of Energy & Environment., v.2, No.2, pp. 133-144.
- Nanda Balan.I, M.Shivakumar, Madan Kumar .P.D, (2012). An assessment of groundwater quality using water quality index in Chennai, TamilNadu, India. Chronicles of young Scientists., v.3, No.2, pp. 146 – 15.
- Palanisamy.P.N, Geetha.A, Sujatha.M, Sivakumar.P and Karunakaran.K, (2007). Assessment of Ground Water Quality in and around Gobichettipalayam Town Erode District, Tamilnadu. E-Journal of Chemistry., v.4, No.3, pp. 434-439.
- Ramakrishnaiah.C.R,Sadashivaiahand. C, Ranganna .G, (2009). Assessment of Water Quality Index for the Groundwater in Tumkur Taluk, Karnataka State, India, E-Journal of Chemistry, v.6, No.2, pp. 523-530.
- Rizwan Reza and Gurdeep Singh, (2010). Assessment of Ground Water Quality Status by Using Water Quality Index Method in Orissa, India. World Applied Sciences Journal, v.9, No.12, pp. 1392-1397.
- Rosario Arun Kumar.X, Giridharan.L, Shyamala.J, Velmurugan.P.M and Jayaprakash.M, (2012). Geochemical Assessment of Ground Water Quality in Cuddalore, Tamil Nadu, Sea Coast of India. World Applied Sciences Journal., v.17, No.8, pp. 1033-1039.
- Saxena VK, Ahmed S. (2001). Dissolution of fluoride in groundwater. A water-rock interaction study. Environmental Geology, v. 40, pp. 1084-1087.
- Sayyed MRG, Wagh GS. (2011). An assessment of groundwater quality for agricultural use: a case study from solid waste disposal site SE of Pune, India. Proceedings of the International Academy of Ecology and Environmental Sciences, V.1, No.3-4, pp. 195-201.
- Sener E., Sener S. and Davraz A., (2009), Assessment of Aquifer Vulnerabilitiy Based on GIS and DRASTIC Methods: A Case Study of The Senirkent-Uluborlu Basin, Isparta,
- Srinivas.P, Pradeep Kumar. G. N, Srinivasa Prasad. A, Hemalatha. T, (2011). Generation of Groundwater Quality Index Map –A Case Study Civil and Environmental Research. v.1, No.2.
- Srinivasa Gowd.S Pradip K.Govil, (2008). Distribution of heavy metals in surface water of Ranipet industrial area in Tamil Nadu, India. Environ Monit. Assess., pp. 197 - 207.
- Tilahun K. and Merkel B.J.,(2009), Assessment of Groundwater Vulnerability to Pollution in Dire Dawa, Ethiopia Using DRASTIC: Environ Earth Sci, DOI 10.1007/s12665-009- 0134-1.
- Tiwari.R.N, (2011). Assessment of groundwater quality and pollution potential of Jawa Block Rewa District, Madhya Pradesh, India. Proceedings of the International Academy of Ecology andEnvironmental Sciences., v.1, No.3-4, pp.202-212.
- Turkey: Hydrogeology Journal, DOI 10.1007/s10040-009-0497-0.