



Research Article

ISSN : 0975-7384
CODEN(USA) : JCPRC5

Correlation analysis and assessment of ground water quality and its parameters of Namagiripettai village, Rasipuram Taluk, Namakkal District Tamilnadu, India

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ABSTRACT

We have determined the current status of physico-chemical contaminants of ground water samples of bore wells and hand pumps collected from 10 different locations in Namagiripettai village, Rasipuram Taluk in Namakkal district. Physico-chemical parameters such as pH, Electrical conductivity (EC), Total dissolved solids (TDS), Total Hardness (TH), Total Alkalinity (TA), Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Manganese (Mn^{2+}), Iron (Fe^{2+}), Sodium (Na^+), Potassium (K^+), Ammonium (NH_4^+), Nitrate (NO_3^-), Nitrite (NO_2^-), Fluorine (F), Chlorine (Cl), Sulphate (SO_4^{2-}), Phosphate (PO_4^{2-}), were analyzed by standard procedure. The results were compared with standards approved by WHO. The statistical tool as correlation coefficient analysis was drawn to locate possible interrelations among measured water quality statistics. An effort has been made to find whether the quality of ground water is appropriate for drinking purposes or not in the Namagiripettai village, Rasipuram Taluk in Namakkal district.

Keywords: Physico-Chemical parameters: WHO, Namagiripettai village, Correlation Analysis.

INTRODUCTION

Water is very important role in the survival of all life forms and is essential for all performances for human beings [1-2]. The consequence of water pollution on human health is of severe environment [3]. Drinking water is acting a significant role in the bodily intake of the true element by humanity. Although some trace elements are essential to man, at prominent levels indispensable as well as dispensable element can source of morphological abnormality, decrease the growth and increase the mutagenic effect of the humanity. Ground water is about 20% of the earth's funds for fresh water and larger amount of water used in industry, irrigation and household activity [4].

In the present investigation of water samples were collected from bore well and hand pumps of different areas in and around Rasipuram Taluk, Namakkal District. The various physical and chemical were determined by using standard analytical methods, the result was compared with level of the World Health organization (WHO). The aim of this study was to report on the assessment of the physico-chemical analysis and trace element present in the drinking water sources earmarked for this study. These paper water quality parameters of correlation coefficient analyses the ground water of Namagiripettai area in Namakkal district.

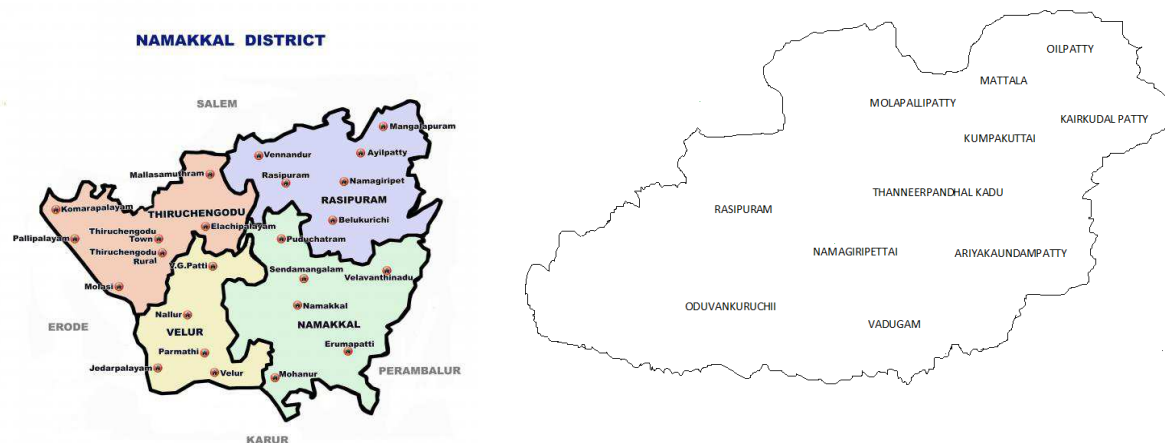


Fig-1.Sampling locations and map of study area

EXPERIMENTAL SECTION

2.1. Study Area

Rasipuram is a municipal corporation of Namakkal district in the Indian state of Tamil Nadu. Rasipuram is located at 11.47° North and 78.17° East (Fig-1). Namagiripettai is located at 10th kilometre from Rasipuram. It has an average elevation of 273 meters (895feet). A lot of medicinal plants and varieties of fruits are available. Bore well water is generally used for drinking and irrigation purposes in this district. The ground water samples were collected from bore wells and hand pumps of 10 areas of Namagiripettai village Rasipuram taluk of Namakkal district during December 2014-February 2015.

2.2. Water Samples Collection.

Water samples were collected from ten locations of drinking water in plastic containers previously washed with nitric acid and rinsed with sampled water several times. The samples container was tightly sealed and labelled in the field. The temperatures of the samples were measured in the field itself at the time of sample collection. The sample locations are given Table-1

Table-1 Namagiripettai villages of Namakkal district used for water sampling

Villages of various region of Namakkal district			
S.No	Sample locations	Source	
		Bore well	Hand Pump
1	Namagiripettai	BW ₁	HP ₁
2	vadugam	BW ₂	HP ₂
3	Ariyakaundampatty	BW ₃	HP ₃
4	Oduvankuruchii	BW ₄	HP ₄
5	Thanneerpandal kadu	BW ₅	HP ₅
6	kumpakuttai	BW ₆	HP ₆
7	Molapallipatty	BW ₇	HP ₇
8	Kairkudal patty	BW ₈	HP ₈
9	Koraiyaru	BW ₉	HP ₉
10	Mattala	BW ₁₀	HP ₁₀

2.3. Analysis of water samples.

Analysis was carried out for different types of water quality parameters such as pH, Electrical conductivity(EC), Total dissolved solids(TDS), Total Hardness(TH), Total Alkalinity(TA), Calcium (Ca²⁺), Magnesium (Mg²⁺), Manganese(Mn²⁺), Iron (Fe²⁺), Sodium (Na⁺), Potassium (K⁺), Ammonium(NH₃⁺), Nitrate(NO₃⁻), Nitrite(NO₂⁻), Fluorine(F⁻), Chlorine(Cl⁻), Sulphate (SO₄²⁻), Phosphate(PO₄²⁻), as per standard procedure recommend by APHA 1995 method. The water quality parameters values are in mg/L expect PH and EC. The water quality parameters have been assessed by comparing with the standard desirable limit of the parameters in drinking water as prescribed by WHO/ ISI 10500-91[8].

RESULTS AND DISCUSSION

The result of the physic chemical parameters for water samples are presented in table -2

Table-2 Water quality Parameters of Bore Well sample

Parameters	Water samples for Bore Well										WHO Limits
	BW ₁	BW ₂	BW ₃	BW ₄	BW ₅	BW ₆	BW ₇	BW ₈	BW ₉	BW ₁₀	
Temp	25	26.2	25	26.4	24.9	25.4	26.	25.6	25.8	26.1	-
P ^H	7.0	7.3	8	7.9	7.5	7.4	7.9	8.3	8.4	7.9	7-8.5
EC	2450	2320	1980	1803	2532	1448	1586	1345	1486	1686	1400
TDS	1952	1563	1486	1345	1442	1524	1985	1284	1652	1568	500
Turbidity	1.8	1.0	2.2	1.4	1.0	1.2	1.3	1.0	0.8	1.6	10
DO	1.2	1.4	0.8	1.6	0.9	1.8	2.2	2.0	3.4	1.8	5
TA	212	254	243	330	234	200	212	264	254	270	200
TH	415	352	364	320	432	416	456	345	384	312	300
Ca ²⁺	122	98	84	102	96	86	125	108	96	114	75
Mg ²⁺	56	48	25	34	32	29	30	54	75	60	30
Na ⁺	360	280	310	280	264	320	356	220	240	320	200
Fe ²⁺	0.5	0.4	0.9	1.2	1.0	0.4	0.5	0.8	0.9	1.0	0.3
K ⁺	48	50	35	42	28	35	24	30	52	41	30
Cl ⁻	258	245	213	216	198	186	204	256	235	248	250
F ⁻	0.3	0.8	0.4	0.5	0.5	0.6	0.3	0.4	0.9	1.0	1
NO ₃ ⁻	28	32	45	36	29	34	38	42	60	52	50
PO ₄ ²⁻	0.1	0.12	0.8	0.06	0.05	0.1	0.2	0.04	0.06	0.04	0.1
SO ₄ ²⁻	320	345	248	202	250	354	348	325	354	320	200

Table-3 Water quality Parameters of Hand Pump sample

Parameters	Water samples for Hand Pump										WHO Limits
	HP ₁	HP ₂	HP ₃	HP ₄	HP ₅	HP ₆	HP ₇	HP ₈	HP ₉	HP ₁₀	
Temp	25	26.2	25	26.4	24.9	25.4	26	25.6	25.8	26.1	-
P ^H	6.4	6.8	7.4	6.9	7.1	8.6	6.8	8.4	8.1	8.3	7-8.5
EC	2450	2320	1680	1503	1532	1448	1386	1445	1486	1586	1400
TDS	1782	1433	1236	1125	1032	1324	1085	1344	1252	1468	500
Turbidity	2.2	2.3	1.8	1.6	1.2	1.5	2	2.8	3	1.6	10
DO	4.5	3.2	3.3	4.2	2.8	4.8	3.6	4.6	3.8	4.5	5
TA	212	196	245	263	260	241	236	212	218	232	200
TH	414	362	342	240	354	345	348	414	384	362	300
Ca ²⁺	64	53	62	88	45	52	76	84	90	52	75
Mg ²⁺	25	22	36	40	45	26	28	33	34	23	30
Na ⁺	146	152	186	164	156	162	154	178	150	186	200
Fe ²⁺	0.1	0.2	0.1	0.3	0.2	0.1	0	0.2	0.3	0.2	0.3
K ⁺	21	22	24	25	26	25	22	29	26	20	30
Cl ⁻	310	332	360	352	245	263	230	303	345	360	250
F ⁻	0.4	0.6	0.8	0.9	0.5	0.2	0.5	0.3	0.2	0.4	1
NO ₃ ⁻	46	48	36	34	39	29	36	45	29	41	50
PO ₄ ²⁻	0.06	0.86	0.56	0.68	0.46	0.86	0.76	0.64	0.69	0.35	0.1
SO ₄ ²⁻	243	233	245	286	255	214	256	245	232	196	200

All parameters are in mg/L except P^H, EC in micromho/cm, Turbidity in NTU (nephelometric turbidity unit)

The P^H value 6.0 to 8.5 within the permissible limit. The water samples all are slightly basic in nature. Electrical conductivity is to determine the water quality capacity to suggest the electric current. High EC values were observed for bore well and hand pump indicating the presence of high amount of dissolved inorganic substance in ionized form. Total dissolved solid point out the salinity behaviour of ground water. Water containing more than 50mg/L TDS is not considered desirable for drinking water supplies.

The Dissolved oxygen values are very low for bore well and hand pump water samples. The lower values of the DO may be affecting the fish life in aquatic systems. The hand pump value is lower than bore well water; all samples are exceeding the maximum permissible limit. High alkalinity in water bodies leads to sour taste and salinity. Total Hardness of water mainly depends on the amount calcium and magnesium salt of ground water content. Bore well and hand pump exceeds the permissible limits.

Calcium and magnesium are directly related to hardness and are essential elements for all organisms. Bore well water indicates that the calcium and magnesium is greater than permissible limits. The hand pump content in the study area shown Calcium is more than the WHO. The high hardness concentration indicated that heart and kidney problems.

Sodium and potassium are the more significant minerals occurring naturally. The high Sodium value indicates for drinking water may cause the salinity problems. The high amount of potassium in the ground water samples is due to the presence of silicates minerals from ignition and metamorphic rocks.

The value of iron in all hand pump samples are acceptable limits. Bore well water indicates the high value of iron concentration. The excess iron in bore well water indicates imparts an astringent taste to drinking water [5].

Chloride values all ground water sample ranges from 186 to 410mg/L. Most of ground water sample is acceptable limits. The hand pump values are more than the permissible limits. Increase the chloride level in water is harmful to the people suffering due to heart and kidney problems. The concentration of fluoride ion in study area values within tolerance limits. The fluoride ion values were very low, a good sign for the use age of this water for drinking and domestic purpose.

The value of nitrate in all the ground water sampling stations is found the accept values for permissible limits. The maximum values of nitrate in the study area such as BW₉, BW₁₀. Phosphate concentration showed under the permissible limit up to 1Mg/L. Sulphate concentration showed bore well water exceeded the permissible limits.

3.1. Statistical analysis

The statistical analysis has been performed using standard methods, by calculating correlation coefficients between different types of parameters.

Table-4 Basic Statistics of ground water samples

Parameters	Maximum		Minimum		Mean		Standard Deviation		Variance	
	BW	HP	BW	HP	BW	HP	BW	HP	BW	HP
TEMP	26.4	26.4	24.9	24.9	25.6	25.6	25.13	25.13	632.0	632.0
PH	8.4	8.6	7	6.4	7.8	7.5	7.25	7	52.6	49.0
EC	2532	4320	1345	1386	1863.6	1783.6	1908.4	6245	3642041.4	3900481.4
TDS	1985	1782	1284	1032	1580.1	1308.1	1594.7	418.7	2543324.2	1753334.2
TUR	2.2	3	0.8	1.2	1.3	2.0	0.77	1.516	0.6	2.3
DO	3.4	4.8	0.8	2.8	1.7	3.9	1.303	3.44	1.7	11.9
TA	330	263	200	196	247.3	231.5	249.34	231.926	62174.8	53790.8
TH	456	414	312	240	379.6	356.5	381.9	358.9	145867.0	128878.0
Ca ²⁺	125	90	84	45	103.1	66.6	103.45	67.96	10703.0	4619.2
Mg ²⁺	75	45	25	22	44.3	31.2	46.56	31.54	2168.4	995.2
Na ⁺	360	186	220	146	295.0	163.4	297.7	163.50	88678.2	26735.4
Fe ²⁺	1.2	0.3	0.4	0	0.8	0.2	-0.316	-0.316	-0.1	-0.1
K ⁺	52	29	24	20	38.5	24.0	39.06	1.6542	1527.8	558.8
Cl ⁻	258	360	186	230	225.9	310.0	223.7	312.92	51403.6	97925.6
F ⁻	1	0.9	0.3	0.2	0.6	0.5	-0.447	-0.447	-0.2	-0.2
NO ₃ ⁻	60	48	28	29	39.6	38.3	40.29	38.32	1624.2	1469.4
PO ₄ ²⁻	0.8	0.86	0.04	0.06	0.2	0.6	-0.316	-0.447	-0.1	-0.2
SO ₄ ²⁻	354	286	202	196	306.6	240.5	310.31	241.11	96292.8	58137.6

3.2. Correlation coefficient

The mathematical models used to determine the water quality parameters. Correlation coefficient measures the closer relationship between choosing independent and dependent variables. In the study, the relationship of physico-chemical analysis on each other in the data of water analyses was determined by calculating correlation coefficient R, by using the formula as given

$$R = \frac{N \sum(X_i Y_i) - \sum(X_i) \cdot \sum(Y_i)}{\sqrt{[N \sum(X_i)^2 - \sum(X_i)^2][N \sum(Y_i)^2 - \sum(Y_i)^2]}}$$

Hence X_i and Y_i represents two different parameters. N is the number of total observations. The numerical values of correlation coefficient R for 17 parameters are tabulated in Table -3. [6-7].

Table-5 correlation matrix for different water quality parameters from Bore well water

	TEMP	PH	EC	TDS	TUR	DO	TA	TH	Ca ²⁺	Mg ²⁺	Na ⁺	Fe ²⁺	K ⁺	Cl ⁻	F ⁻	NO ₃ ⁻	PO ₄ ²⁻	SO ₄ ²⁻
TEMP	1																	
PH	0.0326	1																
EC	0.3377	-0.2564	1															
TDS	-0.1324	0.1098	0.2274	1														
TUR	0.1826	-0.1516	-0.098	-0.6976	1													
DO	0.165	0.3454	-0.417	-0.0382	0.4631	1												
TA	-0.1396	0.0594	-0.432	-0.0801	-0.56	-0.3149	1											
TH	-0.4454	0.2521	0.0658	0.6045	-0.221	-0.0412	-0.4687	1										
Ca ²⁺	0.3961	0.0029	-0.331	-0.235	0.2942	0.2931	-0.1285	-0.1742	1									
Mg ²⁺	-0.2939	-0.0754	-0.386	-0.417	-0.101	-0.4058	0.6477	-0.3485	0.225	1								
Na ⁺	0.0115	0.2874	-0.246	-0.5096	0.5649	0.4184	-0.083	-0.2977	0.0317	0.0194	1							
Fe ²⁺	0.3689	0.1153	0.0638	-0.3702	0.4346	0.1755	-0.1417	-0.3517	0.3671	0.3241	0.2584	1						
K ⁺	-0.1925	0.2322	-0.294	-0.6802	0.6054	0.2569	-0.1103	-0.1835	0.4284	0.4993	0.4109	0.5165	1					
Cl ⁻	0.2995	0.1714	0.2487	0.4797	-0.303	-0.0453	-0.0031	-0.0081	0.153	-0.0687	0.0861	0.3348	-0.3246	1				
F ⁻	0.1889	-0.5861	0.1027	-0.5985	0.49	-0.0596	0.0839	-0.7423	0.1235	0.2657	0.4955	0.2822	0.2124	0.0417	1			
NO ₃ ⁻	-0.0278	-0.4238	0.3714	-0.0605	0.5029	0.1523	-0.648	0.1941	-0.1586	-0.3185	0.3083	0.1218	0.0769	-0.1055	0.3668	1		
PO ₄ ²⁻	0.4719	0.3273	0.3723	0.1007	-0.499	-0.3585	0.2281	-0.9999	0.0717	0.0288	-0.3596	-0.1597	-0.0526	0.0607	-0.2937	-0.5549	1	
SO ₄ ²⁻	0.0424	-0.4455	-0.045	0.0831	-0.464	-0.4655	0.5198	-0.2527	0.3543	0.6059	-0.4724	-0.0869	-0.0155	0.053	0.1885	-0.2511	0.3073	1

Table-6 correlation matrix for different water quality parameters from Hand pump water

	TEMP	PH	EC	TDS	TUR	DO	TA	TH	Ca ²⁺	Mg ²⁺	Na ⁺	Fe ²⁺	K ⁺	Cl ⁻	F ⁻	NO ₃ ⁻	PO ₄ ²⁻	SO ₄ ²⁻
TEMP	1																	
PH	0.2981	1																
EC	-0.3999	-0.4394	1															
TDS	-0.0764	0.218	0.3594	1														
TUR	-0.3164	-0.4955	-0.283	-0.802	1													
DO	0.4634	-0.0814	-0.647	-0.6184	0.7516	1												
TA	0.604	0.5354	0.0127	-0.0025	-0.376	-0.2637	1											
TH	-0.5096	-0.0503	0.3093	0.6842	-0.473	-0.3723	-0.5034	1										
Ca ²⁺	0.2522	0.1756	0.188	0.7349	-0.524	-0.3602	0.1507	0.3583	1									
Mg ²⁺	0.2255	0.3412	-0.061	0.287	-0.311	0.1325	0.2506	-0.1512	0.3809	1								
Na ⁺	-0.1155	-0.1574	0.3534	0.8002	-0.456	-0.5916	-0.1782	0.5408	0.5893	-0.1266	1							
Fe ²⁺	0.1104	0.6445	0.0994	0.1012	-0.435	-0.3728	0.7881	-0.1989	0.1263	0.1814	-0.0824	1						
K ⁺	0.259	-0.0137	0.2675	0.2788	-0.272	-0.0807	0.3383	-0.2255	0.0718	0.6773	0.0769	0.0911	1					
Cl ⁻	0.1865	-0.086	-0.022	-0.1976	0.2859	0.3114	0.1321	-0.5572	0.2177	0.6378	-0.2979	-0.1321	0.4203	1				
F ⁻	0.458	-0.076	-0.295	-0.4966	0.428	0.6037	0.0551	-0.6038	-0.4314	0.3524	-0.4775	-0.0748	0.3356	0.3205	1			
NO ₃ ⁻	0.2854	0.5358	-0.653	-0.3055	0.2925	0.626	0.1299	-0.4729	-0.2517	0.4258	-0.4264	0.2034	0.1336	0.2909	0.6291	1		
PO ₄ ²⁻	-0.3748	-0.1443	0.1175	0.072	0.0324	-0.3019	-0.1095	0.0524	-0.2912	-0.4395	0.2469	0.0544	-0.1445	-0.2457	-0.3135	0.0841	1	
SO ₄ ²⁻	0.1112	0.2156	-0.11	0.6713	-0.578	-0.1574	-0.2622	0.4726	0.4649	0.518	0.3787	-0.3135	0.275	0.0444	-0.0411	0.0082	-0.2066	1

In this study, the mathematical values of correlation coefficient, R for the fourteen water quality parameters are tabulated in table 5 and 6. It shows a range from 0.0025 to 0.8020 for all water quality parameters.

The correlation coefficient shows R more than 0.90, i.e. there is more than 90% association in the data. As we can see the calculated values depict some strong correlations. However, some weak correlations were observed the pair having very high positive correlation between them shows the dependence of one parameter on the other while the pair having very high negative correlation shows inverse relation between them. In the light of correlation, regression study, we can conclude that all the parameters are more or less correlated with each other.

CONCLUSION

The ground water samples are collected from the various places in Rasipuram Taluk Namakkal District were analyzed for various physico-chemical parameters such as pH, Electrical conductivity (EC), Total dissolved solids(TDS), Total Hardness(TH), Total Alkalinity(TA), Calcium (Ca^{2+}), Magnesium (Mg^{2+}), Manganese(Mn^{2+}), Iron (Fe^{2+}), Sodium (Na^+), Potassium (K^+), Ammonium (NH_3^+), Nitrate (NO_3^-), Nitrite(NO_2^-), Fluorine(F), Chlorine(Cl), Sulphate (SO_4^{2-}), Phosphate(PO_4^{2-}). According to study the physico-chemical parameters shows that the turbidity, Iron, TDS, and hardness percentage values are higher than the permissible limit for most of the place. So the open well and bore well were studying the area should with filter based on activated alumina adsorption or iron remover resin might be a solution for filtering drinking water. In all purpose this water possibly to boiling, filtered and then used for drinking purposes.

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