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RESEARCH ARTICLE

ASSESSMENT OF GROUNDWATER QUALITY IN AND AROUND MANAPPARAI BLOCK, TAMILNADU (INDIA)

Selvam. G[1], Prabakaran. K[2], Srinivasan. D[3] and Kumar. G[4]

[1,3]Department of Geology, National College, (Autonomous)Tiruchirappalli
[2]Kalasalingam University, Krishnankoil, Tamilnadu
[4]Department of Civil Engineering, SVS College of Engineering, Coimbatore

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ABSTRACT

An attempt has been made in this work to evaluate the environmental chemistry of groundwater in Manapparai block, Trichirappalli District, Tamil Nadu, India. Ten villages of manapparai block were selected; where the people use groundwater for drinking purpose, and the water samples were subjected to systematic analysis with a view to understand the portability of drinking water sources. The depth of the bore wells varied from 100 to 200 feet. The values obtained for different parameters were compared with the standard values given by ISI/ICMR/WHO and the variations were notable for the parameters like nitrate and total hardness for few samples. Therefore, a medical survey was carried out to study the harmful effects on the society due to these two parameters at the villages— Chitthanatham & Usilam patty.

INTRODUCTION

Groundwater is used for agricultural, industrial, household, recreational and environmental activities all over the world. In India, most of the population is dependent on groundwater as the only source of drinking water supply. 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. Potable water is the water that is free from disease producing microorganisms and chemical substances. About 10% of the rural and urban populations do not have access to regular safe drinking water and many more are threatened. Most of them depend on unsafe water sources to meet their daily needs. The story of each city may be different, but the main reasons for the water crisis are common, such as, increasing demand, zonal disparity in distribution of water supply, lack of ethical framework, inadequate knowledge and resources, major land-use changes, long term water level declines, increase in salinity and pollution. The reason for elucidation of important parameters in water quality assessment may be attributed to the fact that in the overall portability of water.

The present study deals with the physico-chemical characteristics of groundwater samples of selected bore wells in Manapparai block. A systematic analysis of correlation and regression coefficients of the quality parameters not only helps to assess the overall water quality but also to quantify relative concentration of various pollutants in water and provide necessary cue for implementation of rapid water quality management programmes. . Although water pollution is an age-old problem, in this modern age, the problems like growing population, sewage disposal, industrial waste, radioactive waste, etc. have polluted our water resources so much that about 75% rivers and streams, not only of India but of all the countries, contain polluted waters; (Kudesia 1996).

The hydrology and geochemistry of waters have been further discussed in the classic works of (Stumm and Morgan (1981), Hem (1991), Drever (1988), Domenico and Schwartz (1990a, b), Dar *et al*. 2009, 2010, 2010a, b, c).

Study Area Locations

The study area falls in parts of Manapparai block (survey of India toposheet 58 J/6), Tiruchirappalli district (Fig.1) covering an area of 347.29 sq. km comprising of totally twenty eight villages.

The lies between Latitude 10°36’ 27” N – 10° 35’ 59”S and Longidute78° 25’00”E – 78° 25’ 12” w. Mostly rain fed area and main source of irrigation are tanks and wells.

Corresponding author:* **Selvam. G
Department of Geology, National College, (Autonomous)Tiruchirappalli

Groundnuts, Chilies, jowar, Bajra are major crops cultivated. Bore well water is generally using for drinking and irrigation purposes in this block

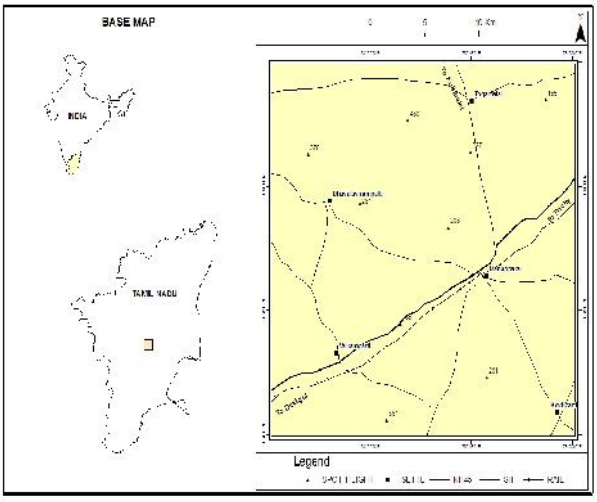

Fig Study Area Map

MATERIALS AND METHODS

Ten different villages at Manapparai block, Trichy District, Tamil Nadu, India were selected (Fig. 1) for testing portability of drinking water sources. The sampling sites are rural places and the samples are the major sources of drinking for the villagers, which are all, bore well-water samples. The details of the samples are given in Table 1. Samples were collected in polythene bottles, which were previously cleaned. The analysis was carried out systematically both volumetrically and by instrumental techniques. The procedures were followed from standard books and manuals (Hooda and Kaur 1999; Lab Manual for Water and Wastewater analysis 2010).The analysis was carried out immediately for pH, electrical conductivity, and for all the other parameters within 3 h of sampling time. Analysis was carried out during January to April 2013.

RESULTS AND DISCUSSION

Different physico-chemical parameters studied are electrical conductivity, total dissolved solids, pH, alkalinity, total hardness, calcium, magnesium, iron, manganese, sodium, potassium, nitrate, chloride, and sulfate. The values obtained after the analytical study are given in Table 2. The values were compared with the standard values given by ISI and ICMR shown in Table 3.Of the physical parameters studied, variations were observed for the parameters electrical conductivity and total dissolved solids.

Table 1 Samples with village name

S.NO	Village Name	Sample No
1	Kalingapatty	S1
2	Kannudaiyan patty	S2
3	Pannapatty	S3
4	K.Periya patty	S4
5	Samuthiram	S5
6	Thoppam patty	S 6
7	Manapparai	S7
8	Malaiyadi patty	S8
9	Usilam patty	S9
10	Chithanatham	S10

The standard value for EC is 1,500 µS cm−1 according to ISI. The electrical conductivity value is an index to represent the total concentration of soluble salts in water (Purandara *et al.* 2003). The electrical conductivity value of sample S10, which is a sample from the village of Chithanatham, was found to exceed the standard value given by WHO. It is observed that waters with high electrical conductivity values are predominant in sodium and chloride ions. While concentrations of both ions are considered together for all 10 samples, sample S10 alone was found to have both the ions at higher concentration. The reason behind this may be continuous usage of synthetic fertilizers and minerals. People staying at various locations in these villages were inquired of early death of infants after the body becoming blue. From the survey, it was revealed that no medical report on such disease was observed. The drinking water source of the village Usilam patty (S9), having highest value of total hardness among all the samples, was expected to have harmful effects like kidney stone formation and other related diseases. The villagers were surveyed for these diseases and a rare occurrence was reported. The sample was also found to have the highest value of total dissolved solids (TDS) as 2,185 mg/l compared with other ten samples (Fig. 2). The highest value of TDS could be due to low water levels within the aquifers and sediment effect (Damodharam and Suresh 2005). Dissolved material results from the solvent action of water on solids, liquids, and gases. Like suspended material, dissolved substances may be organic or inorganic in nature.

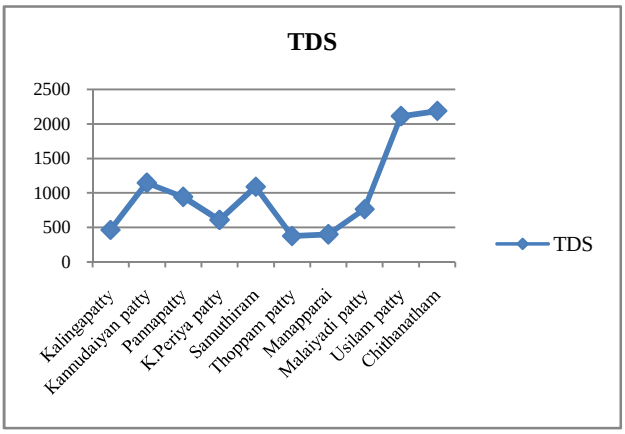

Fig. 2

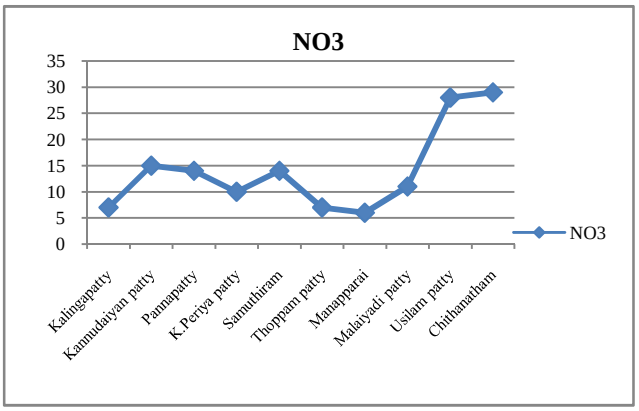

Fig. 3

surfaces, and within the soil. Decay products of vegetation, organic chemicals, and gases are common organic dissolved constituents of water (Peavy *et al.* 1987). Among the different

chemical parameters analyzed, variations were observed comparing with the standard values for the parameters—total hardness (TH) and nitrate. Sample S9 was also found to have a TH value as 620 mg/l. The greatest value of total hardness was found due to dissolution of limestone, natural accumulation of salts in contact with soil and geological formation. Usilam patty and its environs were underwater. Sea receded from this locality during the late Cretaceous period, which resulted in the formation of a terrestrial ecosystem. Therefore, it is a rich source of limestone deposits and fossils ranging from protozoa to vertebrates (Ebanasar 1997). The values of sodium and potassium ions were found to be comparable with the values reported by Sudarshan (Sunitha *et al*. 2005). The desirable nitrate value from drinking water prescribed by ISI is 100 mg/L. The values of nitrate for all water samples, except S9 and S10 were found to be within the permissible limit (Fig. 3).

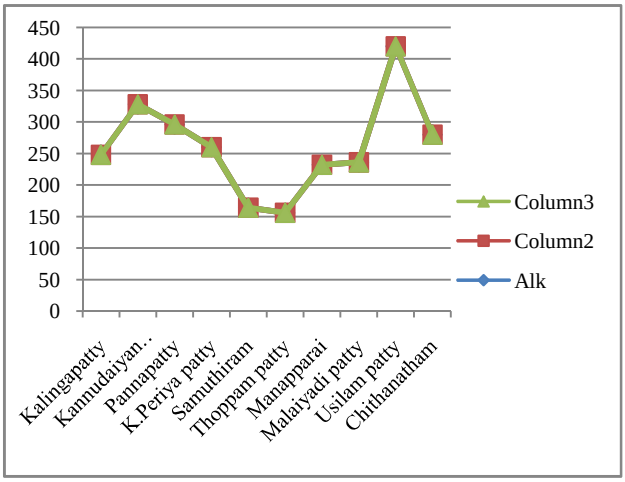

Fig 6 Alkalinity

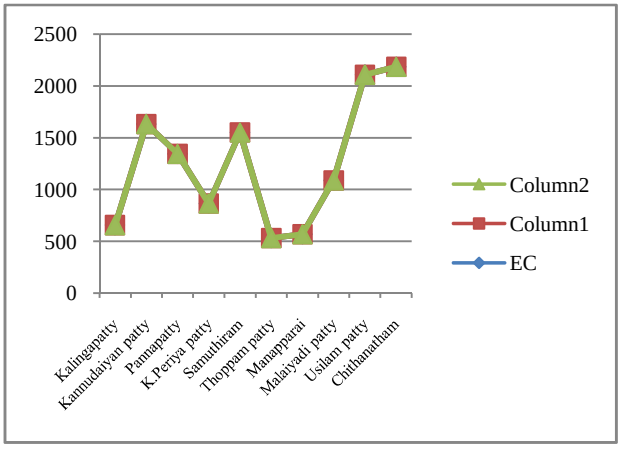

Fig 4 Eletriconductivity

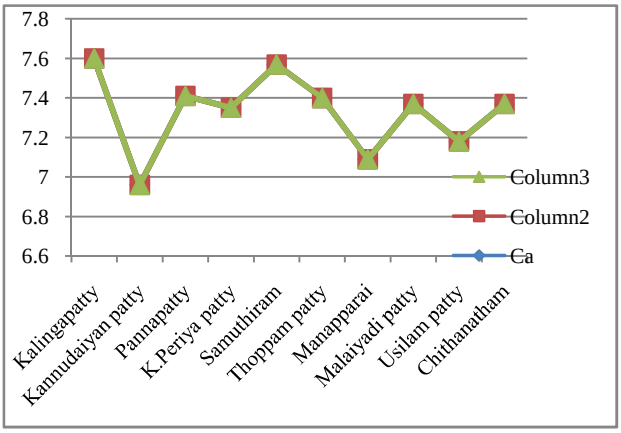

Fig 7 Calcium

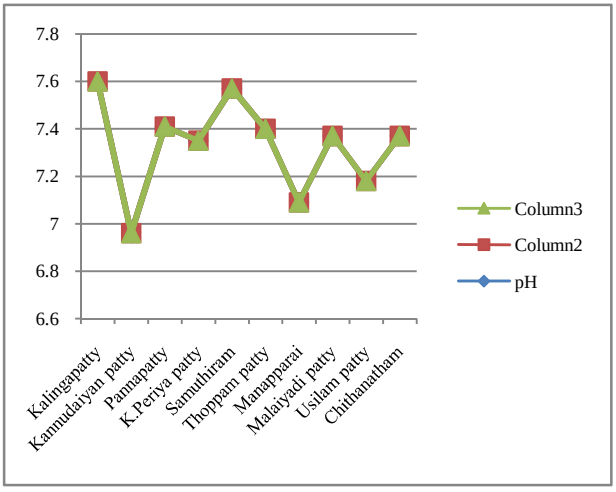

Fig 5 pH

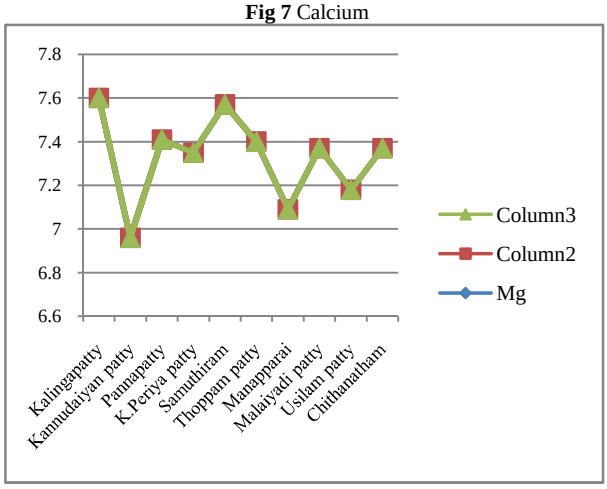

Fig 8 Megnesium

Table 2 values obtained for physico-chemical parameters in the study area 2013

S. no	Village	EC	TDS	pH	Alk	Ca	Mg	Fe	CL	NO3	SO4	FL
S 1	Kalingapatty	657	460	7.60	248	7.60	7.60	7.60	028	07	40	0.6
S 2	Kannudaiyan patty	1633	1143	6.96	328	6.96	6.96	6.96	304	15	46	0.6
S 3	Pannapatty	1344	940.6	7.41	296	7.41	7.41	7.41	244	14	32	0.0
S4	K.Periya patty	866	606.2	7.35	260	7.35	7.35	7.35	099	10	46	0.8
S5	Samuthiram	1551	1086	7.57	164	7.57	7.57	7.57	416	14	17	0.0
S 6	Thoppam patty	532	372.6	7.40	156	7.40	7.40	7.40	070	07	17	0.4
S7	Manapparai	568	397.6	7.09	232	7.09	7.09	7.09	034	06	13	0.4
S8	Malaiyadi patty	1088	761.9	7.37	236	7.37	7.37	7.37	180	11	29	0.8
S9	Usilam patty	2109	2109	7.18	420	7.18	7.18	7.18	400	28	94	0.2
S10	Chithanatham	2185	2185	7.37	280	7.37	7.37	7.37	475	29	97	0.8

Except pH and EC all parameters are in mg/l

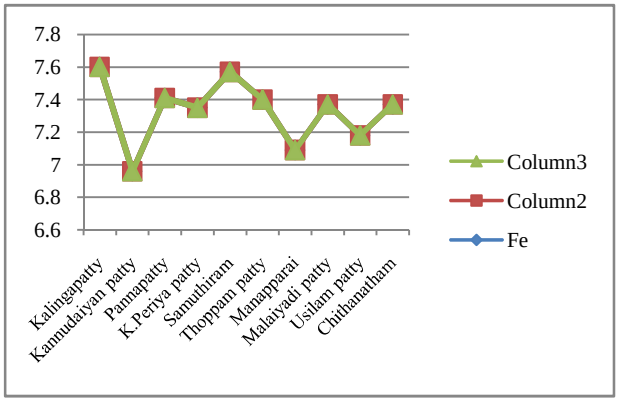

Fig 9 Iron

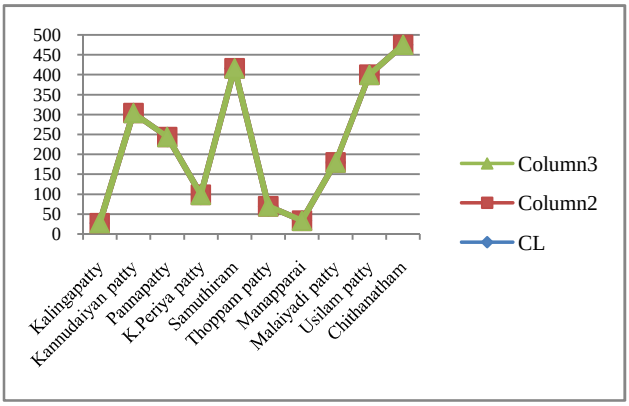

Fig 10 Chlorine

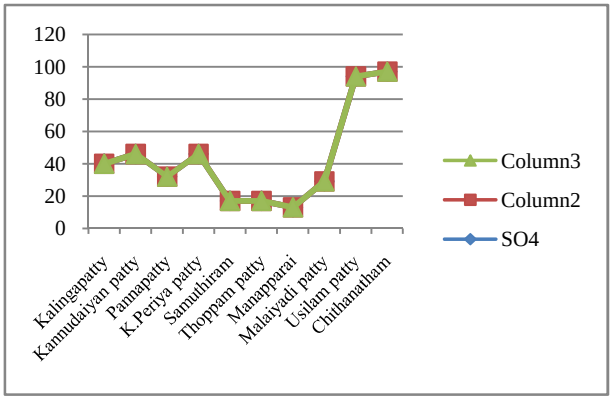

Fig 11 So_4

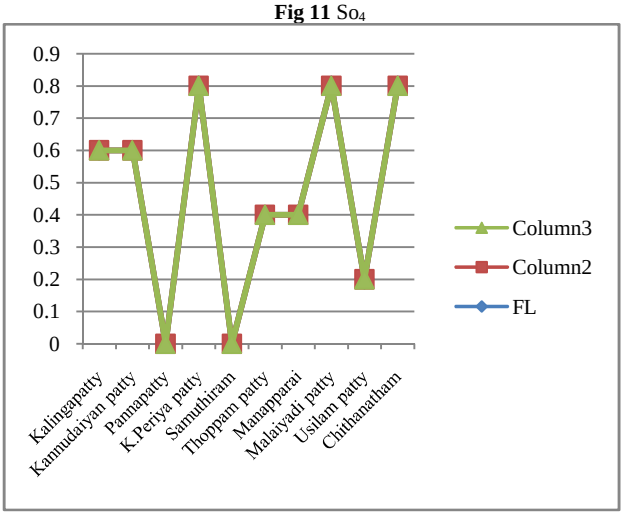

Fig 12 Fluride

The main source of nitrate pollution was found to be the heavy use of nitrate fertilizers in these regions. S9 and S10 have plenty of cultivating land and this may be the reason for excess nitrate ions. The major contributors of nitrate in groundwater are decaying organic matter, sewage, burning yard wastes, and nitrate fertilizers to produced indigenously in the waste (Purandara *et al*. 2003) is also a significant source of nitrate in ground water.

Table 3 Standard values for portability

Sr. no	Physical parameters	ISI standard
1	Electrical conductivity	1,500 µS/cm
2	TDS	1,500–3,000 (ICMR)
	Chemical parameters	
1	pH	6.5 to 8.5[a]
2	Alkalinity	600
3	Total hardness	600
4	Calcium	200
5	Magnesium	100
6	Iron	1
7	Manganese	0.3
8	Sodium	----
9	Nitrate	100
10	Chloride	1,000
11	Sulfate	400

Except pH, the values for all the parameters are given in mg/L ICMR Indian Council of Medical Research, ISI Indian Standard Institution

Table 4 Criterion table showing Weightages and Ranking assigned for different Water Quality parameters

S.no	Parameter	Parameter Range	Rank	Weightages
1	pH	7 to 7.5 7.5 to 8.5 >8.5	1 2 3	20%
2	Electrical conductivity (µmhos/cm)	0-2250 2250-3000 >3000	1 2 3	15%
3	Total Dissolved Solids (mg/l)	0-500 500-1000 >1000	1 2 3	15%
4	Total Hardness (mg/l)	0-300 300-600 >600	1 2 3	15%
5	Sulphates (mg/l)	0-200 200-400 >400	1 2 3	10%
6	Fluorides (mg/l)	1-1.5 <1.5 >1.5	1 2 3	10%
7	Calcium (mg/l)	0-75 75-200 >200	1 2 3	15%

CONCLUSION

Among 10 well-water samples analyzed, all the samples except two were found to have the values according to the standard values prescribed by ISI/ICMR for all the parameters. The samples S9 and S10, after analysis, revealed that the water needs additional gentrification and ion exchange process. General filtration methods should be adopted for all the samples especially for S9 and S10.

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