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Research Article

VARIATION IN PHYSICOCHEMICAL CHARACTERISTICS OF GROUNDWATER QUALITY BETWEEN TALUKS OF CUDDALORE DISTRICT, TAMIL NADU

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ABSTRACT

The present study was carried out to ascertain the variation in physicochemical parameters such as pH, Bicarbonate, Chloride, Sulphate, Nitrate, phosphate, Calcium, Magnesium, Sodium and Potassium are analyzed for the period of March-2014 Post monsoon. There are twenty four samples were collected in six taluks around Cuddalore District, Data's from different taluks were correlate one another by graphically, Significant variation of physicochemical parameters of ground water were observed, some water samples were more than highest desirable limit (HDL) prescribed by WHO. The results suggest that the quality of ground water has to be improved by treatment in filtration plant as per Recommendation of WHO.

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INTRODUCTION

Ground water is ultimate, most suitable fresh water resource with nearly balanced concentration of the salts for human consumption. Over burden of the population pressure, unplanned urbanization, unrestricted exploration policies and dumping of the polluted water at inappropriate place enhance the infiltration of harmful compounds to the ground water. Studies regarding the ground water quality analysis have been made by many authors like B.K.Gupta and R.R.Gupta (1999), M.Rajasekara *et al.* (2005), M.R.Rajanand, I.Paneerselvam. (2005), S. B. Thakare *et al.* (2005), ShikhaBisht *et al.* (2007). They concluded that it is the high rate of exploration then its recharging, inappropriate dumping of solid as well as liquid wastes, lack of strict enforcement of law and loose governance are the cause of deterioration of ground water quality.

Water is the elixir for life. Adequate supply of potable safe water is absolutely essential and is the basic need for all human being on the earth². Earth surface is acting as an effective filtrate to filter out particulate matters like leaves, soils, Bugs, dissolved chemicals and gases. Above matters also occur in large concentrations to change the physicochemical properties of groundwater¹.

Cuddalore and Villages surrounded in various talus are facilitates to drink Municipal Corporation water, in alternate to

this people keeps option as hand pumps and jet pumps etc. from last few years it has been seen that the water quality of the alternative sources like hand pumps, wells has been deteriorating and its responses are in the form of yellowish and uncommon odor of the water people in this area using chlorine tablets for disinfect the drinking water³. The objective of this study is to assess the quality of groundwater in Cuddalore District.

MATERIALS AND METHODS

The ground water samples were collected from boreholes with a two liter polyethylene containers in each location, Physicochemical parameters i.e., pH, electrical conductivity (EC) were measured using field kit (Thermo Orion 5-Star pH Multi-Meter). and another container used to measure other parameters, they were measured in the laboratory using the standard procedure (APHA, 1998).

Study Area

Cuddalore District is situated at Northern region of Tamil Nadu state, lying between latitude 11^o43'to 12^o30' North and longitude 79^o 49' to 80^o East. The district has an area of 3,564 km², It is bounded on the north by Villupuram District, on the east by the Bay of Bengal, on the south by Nagapattinam District and on the west by Perambalur District, The district is drained by Gadilam and Pennaiyar rivers in north, Vellar and Kollidam rivers in south. It divided into six Taluk. The

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sampling locations of Cuddalore District for assessment of physicochemical parameter of ground water are given in Table1.

RESULTS AND DISCUSSION

The physicochemical parameters of the above mention sites in Cuddalore District can be calculated and it is described as bellow.

Table-1 Name of Villages Used For Water Sampling.

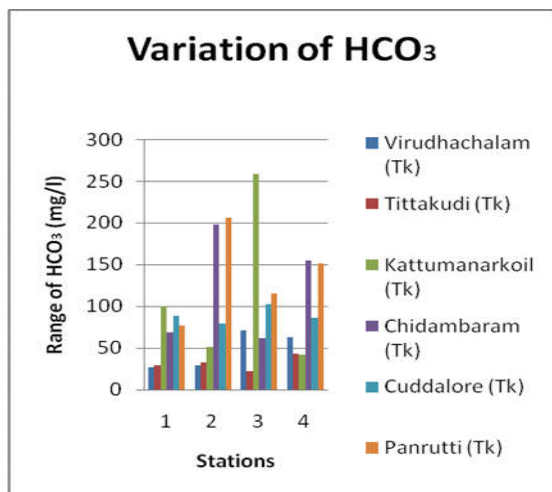
Virudhachalam (Tk)	Tittakudi (Tk)	Kattumanarkoil (Tk)	Chidambaram (Tk)	Cuddalore (Tk)	Panrutti (Tk)
V ₁ -Mangalampet	T ₁ -Koodalor	K ₁ -Kattumanarkoil	C ₁ -Nanjyior	D ₁ -Cuddalore	P ₁ -Nellikuppam
V ₂ -Virudhachalam	T ₂ -Avinangudi	K ₂ -Srimusnam	C ₂ -Chidambaram	D ₂ -Mettoor	P ₂ .Pattampakkam
V ₃ -Neiveli	T ₃ -Tittakudi	K ₃ -Soladharam	C ₃ -C.Mutloor	D ₃ .Aarkima peroxide, Pvt, Ltd.	P ₃ .Panrutti
V ₄ -Pennadam	T ₄ -Keelseruvai	K ₄ -Lalpet	C ₄ -B.Mutloor	D ₄ -Pioneer jellice, Pvt, Ltd.	P ₄ -Sanmar, Pvt, Ltd.

pH

pH is a term used universally to express the intensity of the acid or alkaline condition of a solution. Most of the water samples are slightly alkaline due to presence of carbonates and bicarbonates. The pH values of water samples varied between 6.98 (K₂) to 8.60 (K₄) and were found within the limit prescribed by WHO. The higher range of pH indicates higher productivity of water⁶. The maximum permissible limits of pH as prescribed by WHO are (7.0 to 8.5)⁷, pH values of all the Samples have been found within the desirable and suitable range, except the sample from K₄.

Bi Carbonate

The hardness of water is not pollution parameter but indicates water quality mainly in terms of Ca²⁺ and Mg²⁺ expressed as CaHCO₃.The Bi Carbonate hardness was found to be due to intrusion of sewage nearby area¹³. The hardness is mainly due to presence calcium and magnesium ion. The water containing excess hardness is not desirable for potable water. It consumes more soap during washing of clothes. As per *Moyle et al (1956)*. The Bi Carbonate concentration varied between 18.8 (V₃) mg/L and 340.3 (K₁) mg/L. and found within the prescribed limit of WHO (500 ppm).



Chloride

Chloride usually occurs as NaCl, CaCl₂ and MgCl₂ in widely varying concentration, in all natural waters⁸.They enter water by solvent action of water on salts present in the soil, from polluting material like sewage and trade wastes (Shaikh and Mandre, 2009).The Chloride concentration varied between 21.6 (T₃) mg/L and 258.4 (K₃) mg/L. and only one sample found more than the limit (250mg/L) prescribed by ISI 10500-91.

Sulphate

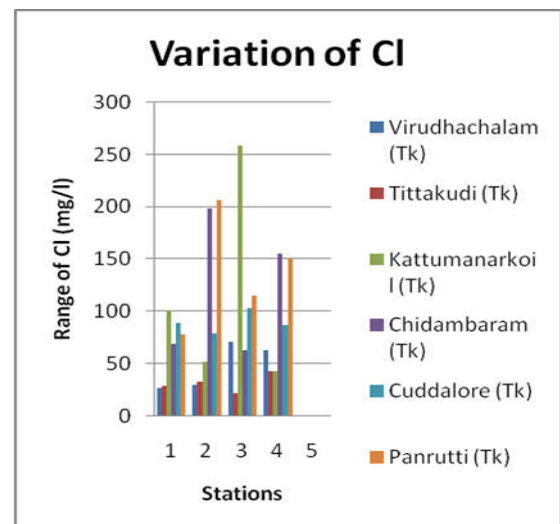
Sulphate occurs naturally in water as a result of leaching from gypsum and other common minerals⁹. Discharge of industrial wastes and domestic sewage tends to increase its concentration. The sulphate concentration varied between 14.6 (V₁) mg/L and 72.6 (P₂) mg/L. and found within the limit (200mg/L) prescribed by ISI 10500-91.

Nitrate

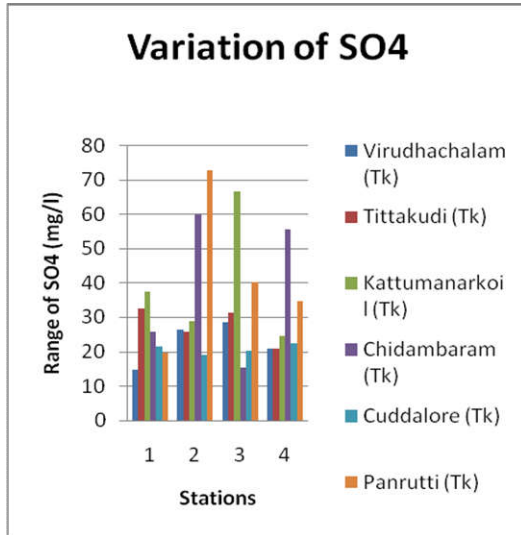
Groundwater contains nitrate due to leaching of nitrate with the percolating water. Groundwater can also be contaminated by sewage and other wastes rich in nitrates¹¹.The increased nitrates level was due to fresh water inflow, mangrove leaves litter fall decomposition and terrestrial runoff during the monsoon season (*Karuppasamy and Perumal, 2000*). Another possible way of nitrates entry is through oxidation of ammonia form of nitrogen to nitrite formation (*Rajasegar, 2003*). Concentration varied between 1.40 (P₄) mg/L and 11.4 (K₄) mg/L. and found within limit (45mg/L) prescribed by ISI 10500-91.

Phosphate

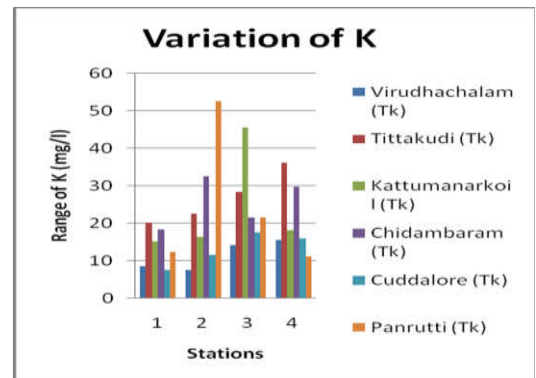
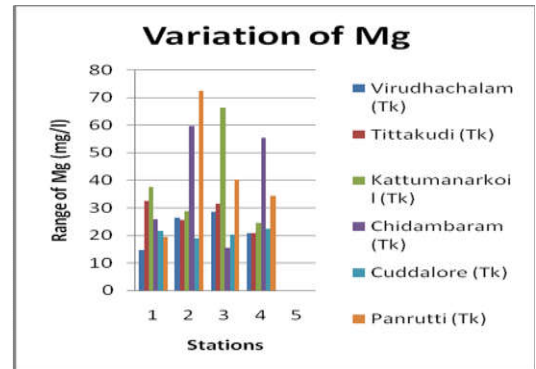
Phosphate may occur in ground water as a result of domestic sewage, detergents, and agricultural effluents with fertilizers¹¹.



The addition of super phosphates applied in the agricultural fields as fertilizers and alkyl phosphates used in households as detergents can be other sources of inorganic phosphates during the season (Senthil Kumar *et al.*, 2002; Ajith Kumar *et al.*, 2006). The Phosphate concentration varied between 1.8 (K₁) mg/L and 15.6 (P₂) mg/L. All the samples were found more than the prescribed limit of WHO (0.1mg/L).



with calcium, is a main contributor to water hardness. Magnesium arises principally from the weathering of rocks containing Ferro magnesium minerals and from some carbonate rocks²¹. Magnesium occurs in groundwater due to logging of the sewage and dissolution of rock and weathering of soil in Monsoon Seasons¹⁴.



*Note =Graph prepared for selected parameters only.

Calcium

Calcium and Magnesium are directly related to hardness. The main sources of calcium in natural water are various types of rocks, industrial waste and sewage. There is evidence that hard water plays a role in heart diseases (Sastry *et al* 1998).The Calcium concentration varied between 24.6 (D₁) mg/L and 84.4 (P₂) mg/L. and some of the samples were found more than the limit (75mg/L) prescribed by ISI 10500-91.

Table -2 Physiochemical parameters in ground waters of Cuddalore district, Tamil Nadu – Monsoon 2014

S.No	Sample code	Physiochemical parameters									
		pH	Ca mg/L	Mg mg/L	Na mg/L	K mg/L	HCO ₃ mg/L	Cl mg/L	SO ₄ mg/L	NO ₃ mg/L	PO ₄ mg/L
1.	V ₁	7.02	32.4	26.4	18.6	8.6	22.4	26.4	14.6	2.1	6.8
2.	V ₂	7.64	28.5	41.5	26.2	7.6	36.5	29.4	26.4	4.2	8.2
3.	V ₃	7.52	18.6	34.6	32.5	14.2	18.8	70.7	28.6	5.5	10.9
4.	V ₄	7.42	21.4	23.6	22.4	15.6	26.5	62.4	20.8	4.3	5.8
5.	T ₁	7.35	12.6	17.6	40.6	20.2	32.4	28.6	32.4	3.5	6.6
6.	T ₂	7.22	29.8	22.8	32.6	22.6	22.8	32.6	25.6	2.8	4.6
7.	T ₃	8.01	32.0	25.4	41.8	28.4	45.9	21.6	31.4	6.8	3.9
8.	T ₄	7.45	42.6	32.4	20.4	36.2	37.5	42.6	20.8	5.2	2.8
9.	K ₁	8.10	48.5	50.2	22.6	15.1	340.3	100.4	37.5	3.8	1.8
10.	K ₂	6.98	33.4	34.6	52.6	16.4	52.1	51.3	28.7	3.7	6.4
11.	K ₃	7.06	77.6	78.4	114.6	45.6	111.6	258.4	66.4	8.9	13.8
12.	K ₄	8.60	54.8	61.2	34.2	18.2	94.6	41.9	24.5	11.4	9.7
13.	C ₁	7.52	40.2	44.5	48.6	18.4	46.6	68.9	25.8	3.8	8.2
14.	C ₂	7.64	68.4	74.6	98.6	32.6	95.4	198.2	59.8	7.6	10.5
15.	C ₃	7.81	40.5	32.4	26.1	21.5	58.4	62.1	15.4	2.8	2.6
16.	C ₄	7.46	62.8	56.2	72.6	29.8	88.5	154.6	55.4	8.6	12.5
17.	D ₁	7.32	32.8	21.6	30.2	7.6	76.4	88.62	21.5	2.7	2.2
18.	D ₂	7.28	24.6	21.6	20.6	11.6	26.4	78.5	18.9	4.2	3.4
19.	D ₃	7.69	20.5	17.5	41.5	17.5	39.8	102.6	20.2	4.4	4.4
20.	D ₄	7.34	24.6	29.4	55.5	16.0	74.7	86.1	22.5	3.7	6.2
21.	P ₁	7.66	41.5	30.5	24.4	12.4	158.6	77.2	19.6	3.2	3.4
22.	P ₂	8.21	84.4	90.6	80.1	52.6	80.6	206.1	72.6	11.4	15.6
23.	P ₃	7.98	32.2	25.6	39.8	21.6	40.2	114.6	40.2	4.4	7.8
24.	P ₄	7.84	28.4	16.6	19.0	11.2	34.2	150.7	34.5	1.4	5.9

Magnesium

Magnesium is common in natural waters as Mg²⁺, and along

The Magnesium concentration varied between 16.6 (P₄) mg/L and 90.6 (P₂) mg/L. and some of the samples were found more than the limit (30mg/L) prescribed by ISI 10500-91.

Table -3 Minimum, maximum and average of parameters.

Parameters (Symbols)	Prescribed limit by WHO1998/ ISI 10500-91.	Minimum (mg/L)	Maximum (mg/L)	Average (mg/L)	Standard Deviation (mg/L)
pH	7-8.5	6.98	8.60	7.6038	0.3957
HCO ₃	500	18.8	340.3	77.311	67.101
Cl	250	21.6	258.4	92.489	62.715
SO ₄	200	14.6	72.6	32.124	16.069
NO ₃	45	1.40	11.4	5.034	2.726
PO ₄	0.1	1.8	15.6	6.858	3.770
Ca	75	24.6	84.4	38.844	18.696
Mg	30	16.6	90.6	38.429	20.583
Na	150	18.6	114.6	43.517	25.671
K	12	7.6	52.6	21.230	11.533

Potassium

Potassium is found in low concentrations in natural waters since rocks which contain potassium are relatively resistant to weathering. However, potassium salts are widely used in industry and in fertilizers for agriculture and enter freshwaters with industrial discharges and run-off from agricultural land²¹. The major source of potassium in natural fresh water is weathering of rocks but the quantities increase in the polluted water due to disposal of waste water¹². The potassium concentration varied between 7.6 (V₂) mg/L and 52.6 (P₃) mg/L. and some of the samples were found more than the limit (12mg/L) prescribed by ISI 10500-91.

Sodium

The possible source of sodium might be from deep percolating water from the top soil layers due to atmospheric precipitation that has been subjected to such concentration effects (Herman Bower, 1978). Sodium is commonly measured where the water is to be used for drinking or agricultural purposes, particularly irrigation. Elevated sodium in certain soil types can degrade soil structure there by restricting water movement and affecting plant growth²¹. The sodium concentration varied between 18.6 (V₁) mg/L and 114.6 (K₃) mg/L. and found within the limit (150mg/L) prescribed by ISI 10500-91.

CONCLUSION

Significant variations in the physicochemical parameters of groundwater of Cuddalore District were observed during study period of March-2014. The analysis of the water quality parameters of groundwater from different stations in Cuddalore District shows that, the variation among the taluks. Village from Kattumanarkoil taluk, K₃ –Soladharam has highest concentration of Chloride. Village from Panrutti taluk, P₂ . Pattampakkam has highest concentration of Calcium. Parameters like pH, Bicarbonate, Sulphate, Nitrate, and Sodium values were found within the permissible limits. Parameters such as Chloride, Calcium, Magnesium, and Potassium, were found above the permissible limit, in few of the stations. But concentrations of Phosphate were found above the permissible limit in all the stations. Which are due to improper drainage systems. In conclusion from the results of the present study it may be said that the groundwater of Cuddalore District though fit for domestic and drinking purpose need treatments to minimize the contamination especially the Calcium, Magnesium and Phosphate ions presence.

There is an increasing awareness among the people to maintain the groundwater at their highest quality and purity levels and the present study may prove to be useful in achieving the same. The commonly adopted monitoring processes are physicochemical monitoring. So thus concluded the investigated area of Cuddalore District was not yet polluted and may not causes any health impact on living organisms.

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