WATER QUALITY ASSESSMENT OF SOME DUG AND BORE WELLS IN AND AROUND CHITTODE, ERODE DIST, TAMILNADU

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ABSTRACT

In the present investigation, we assess the quality of ground water in and around chittode villages in Erode District,Tamilnadu. Ground water samples (10 sampling stations) were collected as both dug well and bore well from different localities in and around chittode villages. All the twenty samples collected (10dug well and 10 bore well samples) were analysed for physical and chemical water quality parameters like pH, electrical conductivity, Cl^-,SO_4^{2-},Na^+,K^+,Ca^{2+},Mg^{2+}, total dissolved solids, total hardness, fluoride, sulphate, phosphate, nitrate, iron etc., This analysis results were compared with the WHO and BIS standards of drinking water quality parameters. Thus an attempt was made to analyse the quality of ground water which is suitable for drinking purpose or not. Hence our study confirms that only one sample(Mettupalayam station-sample 2 which is collected as dug well and sample 12 which is collected as bore well) shows variation in all parameters and which is not suitable for any purpose. So it is important to take measure in that region for future sustainability.

Keywords: Ground Water, Borewell, Dugwell, Water Quality Parameters, Chittode Villages

I INTRODUCTION

Water is the easily available, cheapest material in earth. In many purpose, water can be used based on its unique physical and chemical properties[1].Ground water is the purest form of water when compare to surface water.Ground water plays a central role in the maintenance of India's economy, environment and standard of living. It is the primary source of water supply for domestic and many industrial uses.But modern development has chance to make many undesirable modification to environment, with increased number of pollution like land, air water etc., and increase the less rain fall.Industrialisation, urbanization and population growth altered the flow, quality and pollution and contaminant load of rivers in the past few decades. The pervasive nature of water, its importance for sustenance, it's easy accessibility and other activities leave it open to a variety of man-induced changes causing heavy pollution. Such abuses over the last few decades have created serious problems of water quality and quantity.

The utilization of water resource in India is not enoughto irrigate the cultivable area, hence the effects are needed to maximize the changes of water for irrigation purpose mainly in villages[1].Geochemical process in

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ground water involves the interaction of country rock with leading to development of mineral phase. Now a days, there has been increase in the demand for fresh water due to development of population growth as a result this has given rise to new ideas in the field of monitoring and increasing the water table. Monitoring and water quality assessment give the information about the condition of ground water level and how to improve ground water level indrinking and irrigation purpose.Thus,water forms an important resource for drinking, irrigation and industrial purposes. This is especially true in the tropical countries like India. As there is no perennial river in the western districts of Tamilnadu, for all practical purposes people depend on ground water sources. In this background, it has become necessary to investigate the quality of water in the selected village. In the chittode, area though there is no major industry in and around the study area, yet the water supply for human consumption is directly sourced from ground water without any biochemical treatment. Hence it is essential to assess the quality of the ground water in the selected area of in and around Chittodevillages,Erodedistrict, Tamilnadu.

II.MATERIALS AND METHODS

Ground water samples (10 sampling stations) were collected as both dug well and bore well from different localities in and around chittode villages. All the samples were collected in two litre polythene cans in one day.The details of sampling stations are given in Table 1. Water samples were collected and preserved as per the standard methods.Analytical reagents were used for the analysis.Making solutions and dilutions were done by using double distilled water.The various physicochemical parameters and biological investigations such as pH, temperature, turbidity, electrical conductivity, total dissolved solids, total hardness, total dissolved salt, nitrate, sulphate, phosphate, iron, etc., have analysed as per standard methods[2,3] by employing known procedures. Analyses were repeated for precision and accuracy and to eliminate determinate and indeterminate errors.

Sampling Stations

Table. 1

Sample number	Sampling stations
1	Nadu palayam (OW)
2	Mettupalayam (DW)
3	Perode (DW)
4	Kambilmpatti (DW)
5	Kavindampalayam (DW)
6	Ellispettai (DW)
7	Pallapalayam (DW)
8	Thairpalayam (DW)
9	Karattupalayam (DW)
10	Thangamedu (DW)
11	Nadu palayam (BW)

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12	Mettupalayam (BW)
13	Perode (BW)
14	Kambilmpatti (BW)
15	Kavindampalayam (BW)
16	Ellispettai (BW)
17	Pallapalayam (BW)
18	Thairpalayam (BW)
19	Karattupalayam (BW)
20	Thangamedu (BW)

DW = dugwell andBW = bore well.

III.RESULT AND DISCUSSIONS

The physio-chemical parameters of the bore and dug well water are given in the Table 2.The values were compared with standard values by WHO[4] and BIS[5].Various physio-chemical parameters are appearance, colour,odour,taste etc., and the chemical parameters arepH, alkalinity, total hardness, calcium, magnesium,sodium, potassium, chloride,iron etc.,

3.1 Physical Parameters

By analysing the physical parameters of both the dug well and bore well samples, the dug wells samples were clear and colorless. It indicates that ground water has no dissolved inorganic ions and organic substance. The samples 14 and 15 of bore wells are turbid and brownish indicates the presence of dissolved ions in those samples.All the twenty samples were found to be odorless which shows that there are no dissolved substances or gases in all the sampling stations.

Turbidity

Turbidity is the measure of relative clarity of a liquid. It is an optical characteristic of water and is an expression of the amount of light that is scattered by material in the water when a light is shined through the water sample. According to Bureau of Indian standards (BIS) and WHO guidelines, the desirable limit is 5NTU and permissible limit for turbidity is 10NTU.In the presence study, samples 13, 14, 20 lie above the prescribed limit and rest of the samples are lie below the permissible limit. There are no suspended solids or particles in these water samples.

pH

pHis considered as an important ecological factor and provides an important piece factor and piece of information in many types of geochemical equilibrium or solubility calculation. It is an important parameter in water body since most of aquatic organisms are adapted to an average pH and do not withstand abrutchanges[6].

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The suggested limit of pH according to BIS and WHO are 6.5 to 8.5 in our study, the pH range of all the samples lie between 7.01 to 8.46, which indicate that all the twenty samples are slightly alkaline nature. Thus,thesesamples could be used for drinking and agriculture purpose.

Alkalinity

The total alkalinity values ranges from 106 to 460 mg/L. All the samples are lying in the BIS and WHO prescribed limit 200 to 600 mg/L.In all dug well and bore well samples except sample 14 and 16; all other samples have zero phenolphthalein alkalinity. So it indicates that most of ground and surface water does not contain Na_2CO_3. It indicates these samples are used for drinking and agriculturepurpose.

Total Dissolved Salts (TDS)

For irrigation purpose, the quality of water depends on the quality of dissolved salts. Salinity problem mainly occurs if the salts accumulates in the root zone of the plants which may significantly affect quality of the crop production (Jain et al., 2011)[7]. BIS and WHO set standard value of total dissolved solids in water as 500mg/L to 1000mg/L is considered as good; greater than 2000mg/L is unsuitable for irrigation purpose. The TDS values of all the samples were show in Fig 1.

In our study area, the samples numbers 8,9,16, 17, 18, are lie below the prescribed limit. It indicates small amount of dissolved organic and inorganic ions present in these samples. Samples 2 and 12 lie beyond the prescribed limit which shows high amount of dissolved organic and inorganic solids,high value of TDS in ground water are not harmful to living things but it may also affect the human beings, who are suffered from kidney and heart Diseases[8].

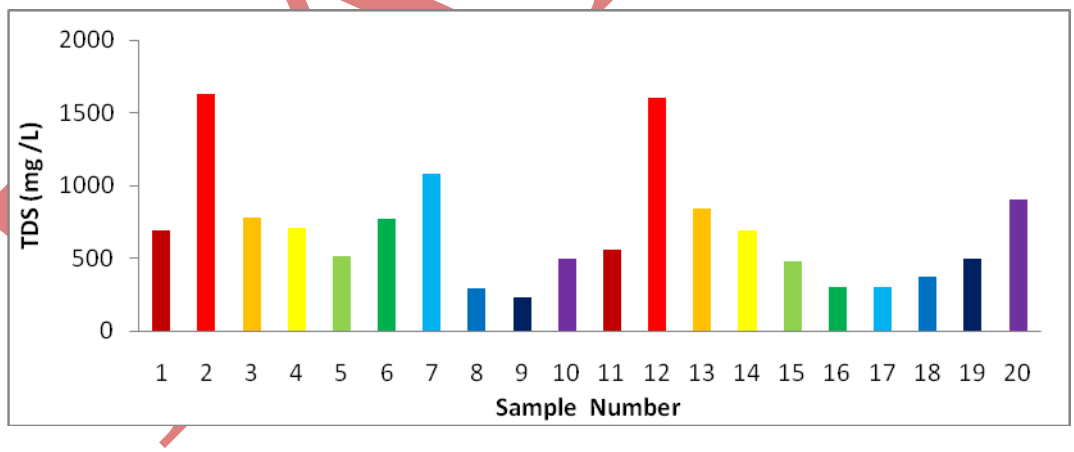

Fig. 1TDS values of all samples

3.2 Electrical Conductivity

Electrical conductivity of water depends upon the concentration of ions, nutrient content and variations in dissolved solid content. The standard value of electrical conductivity is 1500 µmols / cm. The values of EC of all samples are shown in Fig 2. In our sampling area, observed conductance range varied between 328 to 2323 µmols / cm. The high electrical conductivity value was observed in the sampling side of Mettupalayam. It was

found to exceed the WHO and BIS standards. The samples 2 and 12 have high dissolved inorganic ions.The high variation is due to the usage of large amount of fertilizer for irrigation purpose.In these areas sample 6 and 20 also lie beyond the permissible limit. Other samples are lie within the permissible limit.

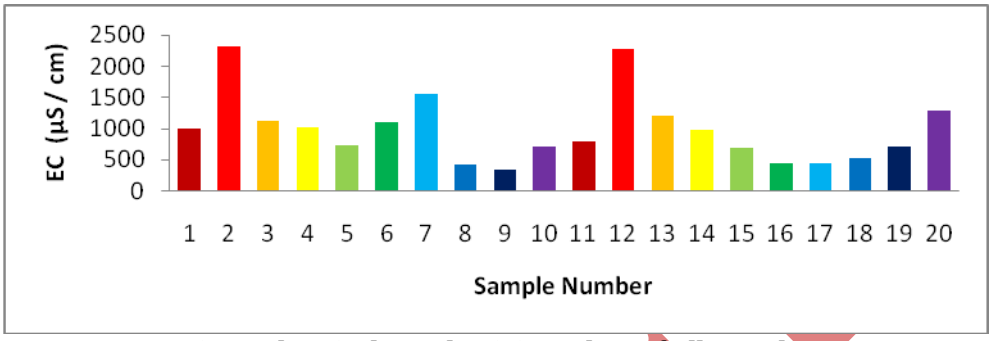

Fig. 2 Electrical Conductivity values of all samples

Based on the Electrical conductivity and sodium adsorption ratio the ground water quality can be classified into excellent, good, fair, and poor .The values are given in Table.3.

Table.3

Water quality Classification		
Quality of water	**Electrical Conductivity**	**SAR**
Excellent	Up to 250	Up to10
Good	250-750	10-18
Fair	750-2250	18-26
Poor	2250-72250	26-726

Sodium Adsorption Ratio (SAR)

Sodium when present in excess produce adverse effect of changing soil properties and reduced soil permeability for irrigation. Hence the assessment of sodium concentration is necessary while considering the suitability for irrigation.SAR is an important factor for the determination of suitability irrigation water because it is responsible for sodium hazard.

SAR is calculated by using the formula

$$SAR = \frac{Na^{+}}{\sqrt{\frac{1}{2}(Ca^{2+} + Mg^{2+})}}$$

All the bore and dug wells in the study area were in excellent category because none of the samples exceed the values of SRA=4.3. (Table. 4)

Total Hardness

Hardness of water is due to the presence of soluble salt of calcium and magnesium. BIS and WHO guideline indicates the desirable and permissible limit for total hardness of water as 300 to 600 mg/L. The samples that we

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analysed that Total Hardness vary from 116 to 520 mg/L. The maximum amount of total hardness present in the water sample (for sample 2 is 520 mg/L& for sample 12 is 500mg/L) is collected fromMettupalayam Village. It indicates that both bore and dug well in this area may be used for drinking purpose. The values of total hardness of all the samples were shown in Fig. 3.

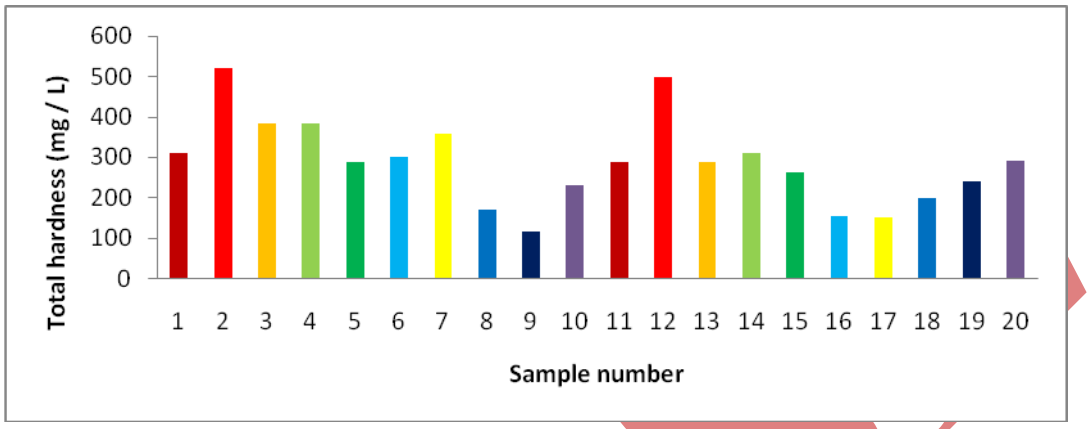

Fig. 3 Total hardness values of all samples

Chloride

The presence of chloride ion is attributed to soluble inorganic salts. Human release very high amount of chlorides through urine and fasces[9]. Chlorides affinity towards sodium is high. Therefore its concentration is high in ground waters, where the temperatureis high and rain fall is less[10].

The water samples contain chloride values between 16-325mg/L WHO and BIS prescribed 250 mg/Lfor drinking water asdesirable limit and 1000mg/L as the maximum allowable limit. The values of chloride for all the samples were shown in Fig. 4

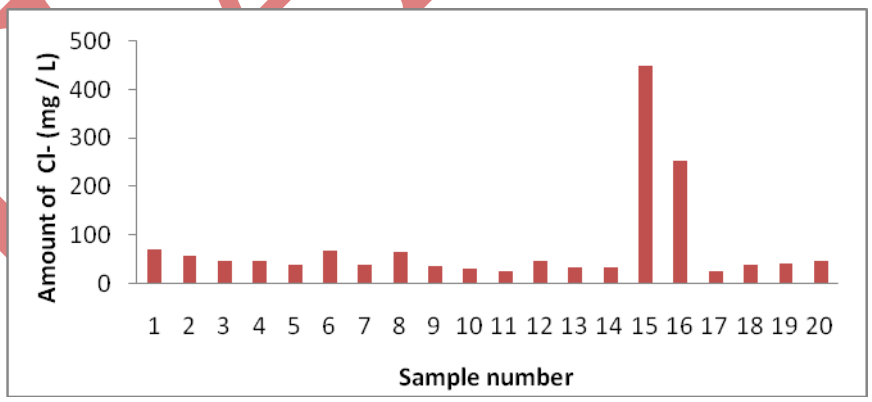

Fig.4 Chloride values of all samples

Potassium,Nitrate and Phosphate

Presence of nitrate is due to dissolved ions of sodium and potassium salts. BIS prescribed the limit for nitrate as 45-100mg/Las the maximum allowable concentration. In all the twenty samples, the value varies from 0-54

mg/L.If the concentrations of nitrate ion excess the limit, it would lead to certain disorder.Phosphate content in the surface water results from agricultural runoff into a water stream. The study has shows that phosphate concentrations vary from 0.02-0.89 mg/L which will not pose any problem. It can be used for drinking water.

Calcium, Magnesium &Sodium

Sodium, Magnesium, Calcium and Total hardness in the ground water are interrelated. Calcium concentration varied from 32 to 128 mg/L in the sampling stations. Magnesium ions are usually occurs in less concentration than calcium. The WHO prescribed limit for magnesium concentration is 150 mg/L. In present study, the magnesium concentration varied from 09 to 65 mg/L in sampling stations and it is within the permissible limit. Sodium concentration more than 50mg/L are unsuitable for domestic use.The value of sodium concentration of our samples varied from 14 to 272 mg/L.Hence the samples 2 and 12 of Mettupalayam Village lie beyond the limit.The values of Sodium, Magnesium and Calcium for all the samples were shown in Fig. 5.

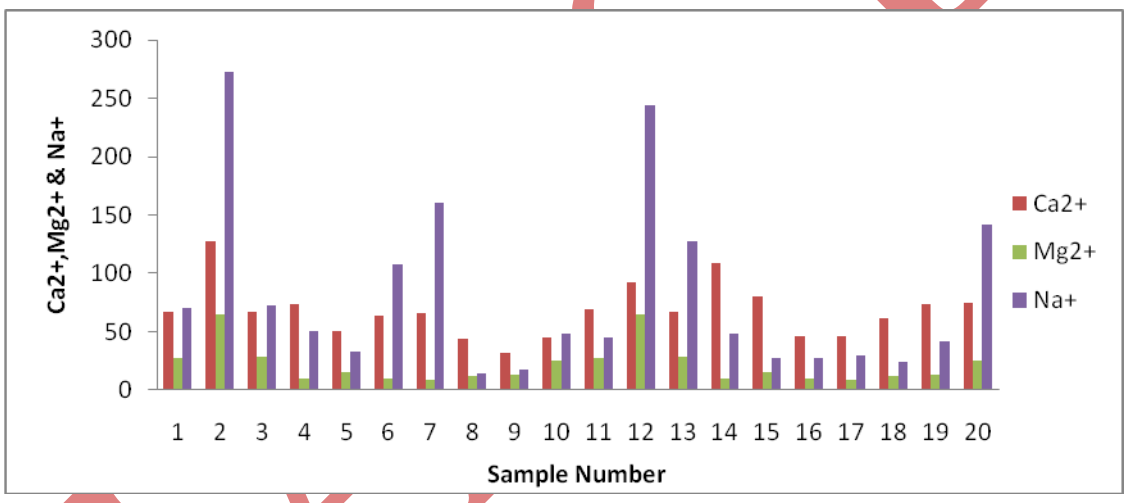

Fig. 5 Calcium, Magnesium and Sodium values of all samples

Fluoride, Iron and Sulphate

Natural water contains less than 0.1mg/L fluoride ions, Mineral water consists of an averageof 0.16 to 6.45 mg/L.Transport and production of fluorides in water depends on environment, pH,water hardness and the presence of ionchangeable substances such as alumina[11]. WHO recommends the drinking water should not contain more than 1.5 mg/L of fluoride.Concentration of fluoride below 1.5 mg/L is helpful in prevention of tooth decay, andto develop the perfect bone sturcture in human beings and animals. When fluoride ion concentration exceeds 1.5mg/L, it would result in dental fluorosis. In out of twenty samples, some of the samples 2, 5,6,12 slightly above 1 mg/L.

BIS and WHO standards prescribed the desired iron concentration should be 0.3 mg/L and permissible limit is 1 mg/L. The study revealed that the sample water is free from iron except sampling stations 13,14,and 20 were

observed values are 11.33 mg/L,8.53 mg/L, 2.67 mg/L. If iron is present in water, it would import colour to the textile or papers while processing being carried out.

Similarly the concentration of sulphate ion may not have determinal effect on human health when present in the lower concentration. In all the samples, sulphate ion concentration lie between 11-238mg/L which are far below than the allowed limit 200-400mg/L by BIS and WHO standards.The values of Fluoride, Iron and Sulphate for all the samples were shown in Fig. 6.

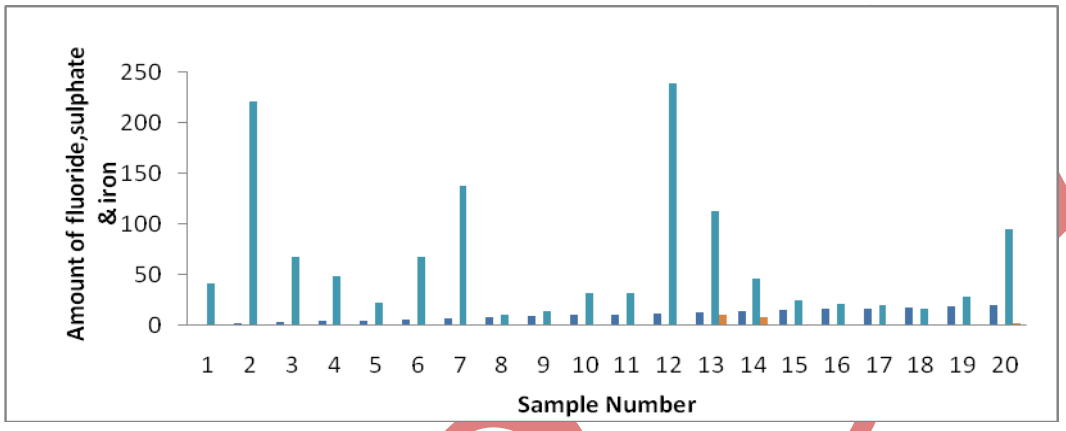

Fig.6 Fluoride, Iron and Sulphate values of all samples

Geo-Chemical Parameters of the Samples

Table.4

Sample number	Total Dissolved Solid (mg/L)	Electrical conductivity µS / cm	Percentage of Sodium (%Na)	SAR
1	692	989	29.68	1.7224
2	1626	2323	50.31	5.1984
3	784	1121	28.03	1.6027
4	713	1018	21.14	1.1114
5	515	736	18.82	0.8515
6	767	1095	41.71	2.7114
7	1085	1550	44.20	3.6745
8	295	422	14.07	0.4644
9	230	328	23.16	0.7234
10	495	707	28.74	1.3825
11	560	800	23.64	1.1534
12	1599	2285	46.20	4.7563
13	844	1206	45.25	3.2869
14	688	983	23.12	1.1783
15	482	689	18.43	0.7524
16	306	438	29.94	0.9741
17	302	431	28.99	1.0578
18	374	534	18.48	0.7343
19	497	709	25.97	1.1824
20	900	1285	48.07	3.6230

Percentage of Sodium (%Na)

Sodium concentration is important in classifying irrigation water because sodium reacts in soil and reduce its permeability. Soil contain large proportion of Sodium with carbonate as the predominate anions or saline solis. The percentage of sodium is calculated by the equation.

$$\% \text{ Na} = \frac{Na^{+} + K^{+}}{Ca^{2+} + Mg^{2+} + Na^{+} + K^{+}} \times 100$$

Wilcox proposed a method for rating irrigation water based on % Na and EC. The diagram consists of five district areas such as excellent to good, good to permissible, permissible to doubtful, doubtful to unsuitable and finally unsuitable[12].

Wilcox diagram (Fig.7) revealed that out of twenty samples, nine samples to fall under excellent to good category, nine samples of good to permissible level and two samples of permissible to doubtful. Hence the nine sampling station could be utilized for drinking and agriculture purpose. One sample of mettupalayam village (sample 2 & 12) both dug and bore wells could not be used for drinking purpose.

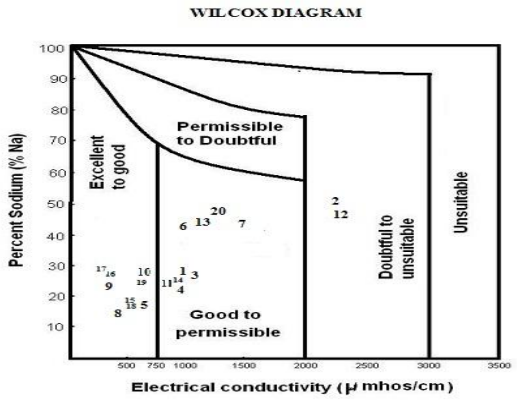

Fig.7 The Quality of groundwater in relation to Electrical Conductivity and % sodium

IV.CONCLUSION

The present study revealed that physicochemical examination of all the twenty samples collected inbore wells and dug wells were complied with the standards prescribed by WHO and BIS. All the twenty samples are free from microorganisms in general since there is no adjacent pollution source.It has been well established from the study that the ninesampling stations of ground water samples of bore wells and dug wells are free from pollution. But one samplewater (Metttupalayam sample 2 & 12)both bore and dug well is having all types of impurities and is slightly polluted which is unfit for drinking purpose. This is due the usage of large amount of fertilizer used for irrigation purposes and also due to the human activities. Thus the study of the analyses of twentyground water samplesgives the information about the usageof ground water for drinking, domestic and irrigation purposes.

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Table. 2

PHYSICO - CHEMICAL PARAMETERS OF GROUND WATER ANALYSIS

Sample No	S. Station	Source	Appearance	Odour	Turbidity	TDS	EC	pH	Talk	TH	Ca	Mg	NO3	Cl	F	PO4	SO4	Na	K	NH3	NO^{2-}	Fe^{2+}	Tidys
1	NP	DW	C & C	Odourless	1	692	989	7.51	320	312	67	35	29	88	0.3	0.22	42	70	38	0.06	0.19	0.00	0.40
2	MP	DW	C & C	Odourless	0	1626	2323	7.38	416	520	128	48	33	305	1.3	0.13	220	272	52	0.06	0.06	0.00	0.30
3	PD	DW	C & C	Odourless	1	784	1121	7.40	384	384	67	52	17	76	0.9	0.11	67	72	16	0.03	0.06	0.00	0.30
4	KB	DW	C & C	Odourless	4	713	1018	7.28	308	384	74	48	42	88	0.8	0.04	48	50	18	0.00	0.06	0.13	0.50
5	KP	DW	C & C	Odourless	1	515	736	8.18	296	288	51	38	12	30	1.5	0.24	23	33	20	0.00	0.04	0.00	0.40
6	EP	DW	C & C	Odourless	1	767	1095	7.73	352	300	64	34	21	80	1.5	0.13	67	108	22	0.00	0.08	0.00	0.50
7	PP	DW	C & C	Odourless	0	1085	1550	7.53	424	360	66	47	51	124	1.1	0.31	137	160	63	0.00	0.03	0.00	0.60
8	TP	DW	C & C	Odourless	2	295	422	7.98	176	172	44	15	02	16	0.5	0.27	11	14	11	0.00	0.07	0.00	0.60
9	KT	DW	C & C	Odourless	5	230	328	8.25	106	116	32	09	00	28	0.1	0.02	14	18	10	0.00	0.46	0.13	1.40
10	TM	DW	C & C	Odourless	4	495	707	7.47	228	232	45	29	17	48	0.3	0.13	32	48	21	0.19	0.11	0.20	0.80
11	NP	BW	C & C	Odourless	3	560	800	7.37	272	288	69	28	18	62	0.5	0.89	32	45	22	0.06	0.08	0.20	0.60

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12	MP	BW	C & C	Odourless	0	1599	2285	7.76	460	500	92	65	05	325	1.3	0.20	238	244	94	0.00	0.02	0.00	0.70
13	PD	BW	T & B	Odourless	90	844	1206	8.10	268	288	67	29	14	160	0.9	0.13	113	128	39	0.13	0.02	11.33	1.90
14	KB	BW	T & B	Odourless	68	688	983	7.16	280	312	109	10	34	102	0.0	0.04	46	48	26	0.06	1.36	8.53	1.60
15	KP	BW	C & C	Odourless	1	482	689	7.42	256	264	80	15	08	36	0.5	0.09	25	28	06	0.19	0.17	0.00	0.80
16	EP	BW	C & C	Odourless	1	306	438	8.41	152	156	46	10	04	30	0.1	0.07	21	28	07	0.06	0.03	0.00	0.60
17	PP	BW	C & C	Odourless	1	302	431	8.46	150	152	46	09	04	31	0.1	0.04	20	30	06	0.19	0.03	0.00	0.40
18	TP	BW	C & C	Odourless	8	374	534	7.53	216	200	61	12	06	24	0.3	0.22	17	24	22	0.13	0.02	0.87	0.70
19	KT	BW	C & C	Odourless	1	497	709	7.72	248	240	74	13	19	48	0.1	0.24	29	42	17	0.19	0.05	0.00	0.60
20	TM	BW	C & C	Odourless	16	900	1285	7.01	260	292	75	25	54	144	0.7	0.09	95	142	34	0.06	0.39	2.67	1.10

Sampling stations

NP –Nadupalayam MP – Mettupalayam PD – Perode KB – Kambilampattti KP-Kavindampalayam EP – Ellispettai PP –PallapalayamTP –Thairpalayam KT– Karattupalayam

TM – Thangamedu DW- dugwells, BW-Borewells C&C-Clear and Colourless, T &B- Turbid & Brownish, Tur-Turbidity, EC-Electrical conductivity, TDS-Total Dissolved Solids,

Alk-Alkalinity,TH-Total Hardness, Ca- Calcium, Mg-Magnesium, Na-Sodium,K-Potassium,Fe-Iron,NH_3-Ammonia,NO_2-Nitrite, NO_3-Nitrate, Cl-Chloride, F-Fluoride,SO_4-Sulphate,

PO_4-Phosphate

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Turbidity is expressed in NTU
EC is expressed in µS / cm
pH is expressed in pH
TDS,Palk,Talk,Acidity,TH,Ca,Mg,Na,K,NO3,PO4,SO4,Cl,F are expressed in mg / L.

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