



## Evaluation of groundwater quality of bore wells at Ariyalur Block, Tamilnadu, India

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### ABSTRACT

Groundwater is an essential natural resource for human drinking, washing, bathing etc and also used for irrigation purposes. The recent scientific development and improper agricultural management should contaminate the ground water resources. The present experimental work to assess the ground water quality characteristics at various places of Ariyalur block in Ariyalur district, Tamil Nadu, India. The ground Water samples were collected from bore wells and assessed different water quality characteristics of pH, Turbidity, Electrical conductivity(EC), Total dissolved solids(TDS), Total hardness(TH), Calcium( $Ca^{2+}$ ), Magnesium( $Mg^{2+}$ ), Sodium( $Na^+$ ), Potassium( $K^+$ ), Iron(Fe), Nitrate( $NO_3^-$ ), Chloride( $Cl^-$ ), Fluoride(F), Sulphate ( $SO_4^{2-}$ ) and Total Alkalinity(TA). All the quality characteristics compared with WHO and Indian standards. The test results prove that the water has higher values of Hardness, Total dissolved solids and Alkalinity in many samples, which conclude that these water samples are not suitable for drinking purposes.

**Keywords:** Ground Water, Physical and Chemical Characteristics, Water Quality, Ariyalur Block, WHO standard

### INTRODUCTION

Groundwater is the essential natural resource in and around the world. The total water resources of the world is estimated at  $1.37 \times 10^8$  million hacter meter of these global water resources about 97.2% is salty water and 2.8% is fresh water. This 2.8%, only 0.6% is the ground water and remaining 2.2% as surface water. Now a day's ground water sources are mainly used in the world compare to other resources. The ground water is used for domestic, industrials, municipals and agricultural purposes. It is an economic, important resource and more than 85% of the ground water is obtained from bore wells. The ground water demand is rising day by day due to agricultural usages. Ground water is the limited resource; this should be affected due to improper disposal of industrial waste water, poor agriculture practices and recent scientific development. The main objective of this work is to evaluate and study their physical, chemical characteristics of ground water samples at Ariyalur block.

### Study Area

Ariyalur is situated in the Eastern region of Tamil Nadu state between  $10^{\circ}42'00''$  to  $11^{\circ}12'00''$  North latitude and  $78^{\circ}42'00''$  to  $79^{\circ}00'00''$  East longitude .It covers an area of 326.85 square kilometer. The annual average rainfall of Ariyalur region is 1043 mm. This region mostly covered in limestone deposits. Lime stone is the main constituent for manufacturing of cement.

### EXPRIMENTAL SECTION

Ground water samples were collected from fifteen bore wells points at different locations from the Ariyalur block Fig. 1. The locations of sampling stations are tabulated in Table No (1). The bore well water samples were sampled in two liters of cleaned polythene bottles .Before sample collection they polythene bottles were thoroughly washed with distilled water and sample water. The assessment of pH, Electrical conductivity, Turbidity, Total hardness,

Magnesium, Calcium, Sodium, Potassium, Nitrate, Chloride, Iron, Sulphate and Fluoride were carried out as per norms of WHO[18][19] and BIS[4] standards.

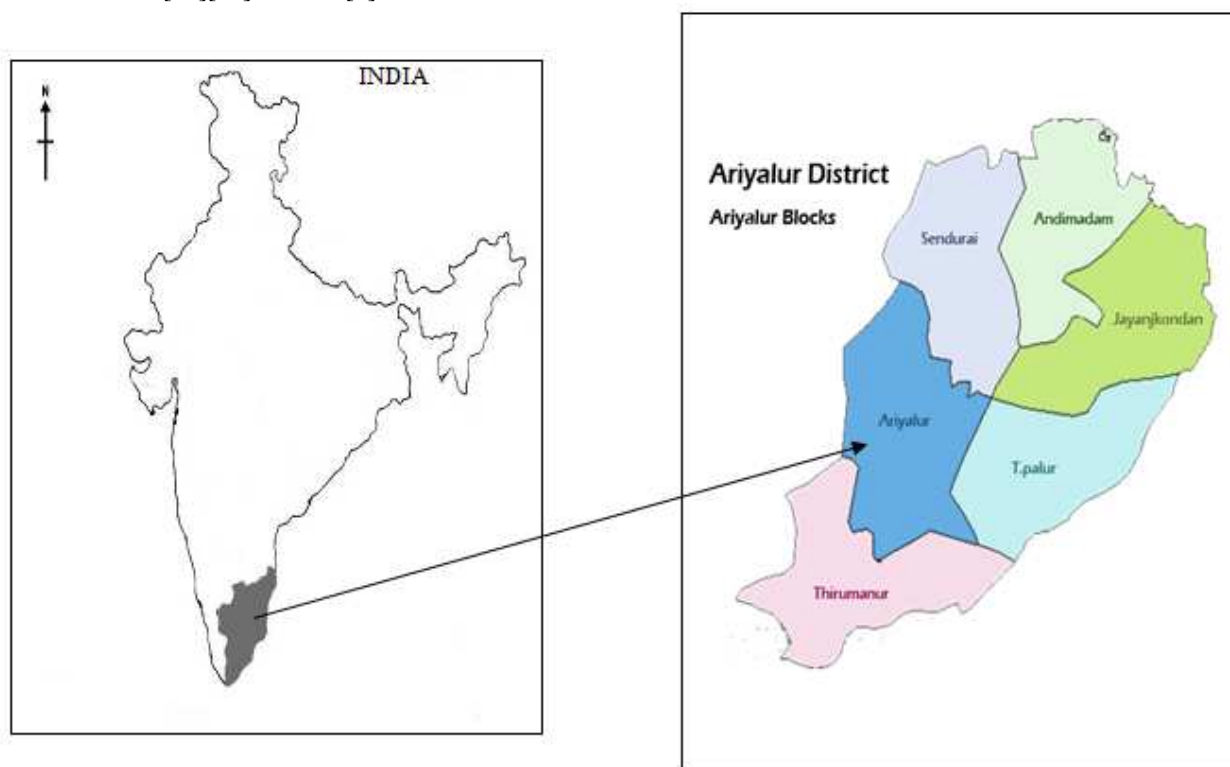


Figure 1: Ariyalur Block Location Map

Table 1: Sampling Locations

Sample No	Sampling Location	Block	District
S1	Kavanur	ARIYALUR	ARIYALUR
S2	Thealur	ARIYALUR	ARIYALUR
S3	Periyanalur	ARIYALUR	ARIYALUR
S4	Kairlabad	ARIYALUR	ARIYALUR
S5	Ponambalampatti	ARIYALUR	ARIYALUR
S6	Hastinapuram	ARIYALUR	ARIYALUR
S7	Siruvallur	ARIYALUR	ARIYALUR
S8	Reddipalayam	ARIYALUR	ARIYALUR
S9	Vilangudi	ARIYALUR	ARIYALUR
S10	Nagamangalam	ARIYALUR	ARIYALUR
S11	Melakaruppur	ARIYALUR	ARIYALUR
S12	Priyathirukonam	ARIYALUR	ARIYALUR
S13	Sundakudi	ARIYALUR	ARIYALUR
S14	Pungankuzhi	ARIYALUR	ARIYALUR
S15	Arungal	ARIYALUR	ARIYALUR

Table 2: Physical characteristics values obtained in the study area

Sample No	Physical characteristics				
	Appearance	Color	Odour	EC	TDS
S1	Clear	Colorless	Odourless	1100	590
S2	Clear	Colorless	Odourless	1068	525
S3	Clear	Colorless	Odourless	612	389
S4	Clear	Colorless	Odourless	2066	1095
S5	Clear	Colorless	Odourless	1176	567
S6	Clear	Colorless	Odourless	1366	726
S7	Clear	Colorless	Odourless	788	340
S8	Clear	Colorless	Odourless	1362	721
S9	Clear	Colorless	Odourless	1368	736
S10	Clear	Colorless	Odourless	2122	1022
S11	Clear	Colorless	Odourless	1044	504
S12	Clear	Colorless	Odourless	1422	786
S13	Clear	Colorless	Odourless	3122	1876
S14	Clear	Colorless	Odourless	688	392
S15	Clear	Colorless	Odourless	1174	546

Table 3: Chemical characteristics values obtained in the study area

Sample No	Chemical characteristics											
	pH	TA	TH	Ca <sup>2+</sup>	Mg <sup>2+</sup>	Cl <sup>-</sup>	SO <sub>4</sub> <sup>2-</sup>	NO <sub>3</sub> <sup>-</sup>	Fe	F	K <sup>+</sup>	Na <sup>+</sup>
S1	7.4	248	200	112	88	100	6	6	0	0.2	28	142
S2	8.1	240	100	122	72	88	3	2	0	0.2	26	138
S3	8.0	240	140	134	64	30	4	2	0	0.2	18	64
S4	7.5	376	272	104	62	240	4	16	0	0.2	48	172
S5	7.9	280	184	88	52	84	8	2	0	0.2	26	144
S6	8.1	272	260	112	72	140	12	3	0	0.2	34	152
S7	7.9	176	84	57	32	42	4	2	0	0.2	22	68
S8	7.0	372	248	142	76	94	10	4	0	0.2	36	148
S9	7.7	360	244	138	65	112	6	2	0	0.2	34	143
S10	7.4	400	172	126	58	220	18	2	0	0.2	46	158
S11	7.4	244	168	118	62	62	24	2	0	0.2	24	136
S12	7.8	340	272	134	66	112	25	2	0	0.2	32	152
S13	7.2	500	460	152	94	488	48	6	0	0.2	68	208
S14	7.8	180	132	98	52	66	4	15	0	0.2	22	68
S15	7.4	200	172	120	48	124	10	2	0	0.2	26	128

Table 4: Comparative table for Physical analysis characteristics of bore well water samples with standards

Physical Characteristics	Concentrations of ions		Average Value	BIS Standards	WHO Standards	Percentage of bore well water samples exceeding permissible limit
	Minimum	Maximum				
Appearance	Clear		Clear	Clear	Clear	Nil
Color	Colorless		Colorless	Colorless	Colorless	Nil
Odour	Odourless		Odourless	Odourless	Odourless	Nil
EC (µs/cm)	612	3122	1365.2	750-2250	1000-2000	0.6
TDS(mg/l)	389	1876	721	500	500	80

Table 5: Comparative table for Chemical analysis characteristics of bore well water samples with standards

Chemical Characteristics	Concentrations of ions		Average Value	BIS Standards	WHO Standards	Percentage of bore well water samples exceeding permissible limit
	Minimum	Maximum				
pH*	7.00	8.10	7.64	6.5-8.5	7-8.5	Nil
Total alkalinity	176	500	295.2	200	100	87
Total hardness	84	460	207.2	300	300	0.6
Calcium	57	152	117.13	75	75	93
Magnesium	32	94	64.2	50	50	87
Chloride	42	488	133.46	250	200	0.6
Sulphate	3	48	12.4	200	200	Nil
Nitrate	2	16	4.53	100	100	Nil
Iron	0	0	0	0.321	-	Nil
Fluoride	0.2	0.2	0.2	1	1	Nil
Potassium	18	68	32.66	12	12	100
Sodium	64	208	134.73	200	200	0.6

\* Except pH, all the values of chemical parameters are given in mg/l

## RESULTS AND DISCUSSION

The analyzed Physical and Chemical characteristics of bore well water samples are shown in Table No (2) and Table No (3). The bore well ground water sample parameters values were compared with as per norms of WHO and BIS standards as shown in Table No (4) & (5). The pH (Hydrogen ion concentration) parameter value of ground water samples varies between 7.00 to 8.10 (Table No 2). The pH average value was 7.36. This parameter values are within WHO and BIS permissible norms. If pH parameter value is more than the acceptable limit means, this will cause the soil fertility and quality characteristics .

From the Table No (4), we observed that value of EC parameter was varies from 612 to 3122  $\mu\text{s}/\text{cm}$ , which proves that the values are within the acceptable limit, except one station of bore well water sample. The Electrical conductivity parameter value more than the permissible limit means, this will affect the soil fertility and quality characteristics [1] [2]. This type water is not suitable for agriculture and drinking usage [3]. The permissible and acceptable limit of Total dissolved solids (TDS) as per WHO and BIS Standard is 500 mg/l. From the test results we conclude that 80% of bore well water samples are having higher concentration of dissolved solids. The TDS parameter values vary from 389 mg/l to 1876 mg/l. The TDS average value of bore well water sample is 721 mg/l. This analyzed result proves that the water is not suitable for drinking and agricultural purposes. Higher concentration value of TDS will affect the soil fertility characteristics [5] [6] [7].

The Total alkalinity of ground water sample is based on presence of Carbonate and bicarbonate salts [9] [11]. The maximum permissible limit value of alkalinity parameter concentration as per norms of BIS Standard is 200 mg/l. The analyzed test results indicate 87% of bore well water samples having higher alkalinity concentration. From the Table No (4) we observed that the alkalinity values vary from 176 mg/l to 500 mg/l with an average value of 295.2 mg/l. The Total hardness values varies from 84mg/l to 460 mg/l. Average value of total hardness observed in the area was 207.20 mg/l. Based on the concentration of total hardness, the water can be classified as soft water (0 to 70 mg/L), moderately hard water (75 to 150 mg/L), hard water (150 to 300 mg/L) and very hard water (above 300mg/L) [8] [10]. From the study area we observed that the 0.06 % percent bore well water samples are exceeding permissible value as per norms of WHO and BIS standard. Remaining samples are below the limit. But (Freeda Grana Rani D et al) [8]. Study 2006 indicates 80 % percent bore well water samples are exceeding permissible limit. This result proves that the bore well water is not suitable for drinking and agricultural purposes.

Calcium is the very important compound in the ground water [12]. The permissible limit value of calcium for drinking purpose as per standard is 75 mg/l. Higher value of calcium concentration in the drinking water will induced heart diseases in human body [14][15]. From Table No (4) we observed that the minimum value of calcium concentration in the study area was 57 mg/l. and the maximum value of 152 mg/l. The average value is 117.3 mg/l. The analyzed test results conclude that 93 percentage of bore well water samples are having higher than permissible limit, this is mainly due to presence of limestone in the study area. The test value of magnesium was varies from 32mg/l to 94 mg/l. The average value of magnesium concentration in the above locations is 64.20 mg/l. The maximum allowable permissible limit of magnesium based on Standard is 50 mg/l. The Table No (4) indicates that 87 percentage bore well water samples are exceeding the permissible limit. 13 percentage of ground samples only within the limit. Higher value of magnesium concentration will affect the human and animal health condition [13].

The chloride concentration permissible limit as per BIS Standards is 250 mg/l and a WHO standard is 200 mg/l. respectively. In our study area, the chloride concentration values vary from 42 mg/l to 488 mg/l. The chloride concentration average value of study area is 133.46 mg/l. From the test results we concluded that 0.6 percentages bore well water samples are having higher than the permissible value. Higher chloride concentration will affect the kidney in the human body [16]. The acceptable permissible limit of sulphate as per Standard is 200mg/l. The Table No (4) indicates the minimum value of sulphate is 3 mg/l and the maximum value of sulphate is 48 mg/l with an average value of 12.40 mg/l. From the analyzed results we concluded that all the bore well water samples are within the permissible limit. Higher concentration of sulphate will increase the total hardness and Electrical conductivity value of water [17].

The acceptable permissible value of nitrate concentration as per standard is 100 mg/l. The Table No (4) indicates the lowest value as 2 mg/l and the highest value as 4.53 mg/l with an average value of 6.60 mg/l. This indicates the all bore well water samples are within the standards. Iron is the important element for all living organisms [14]. Higher amount of iron content causes toxicity [16]. The Table No (4) shows there is no iron concentration in the study area. All bore well water the samples are within the standards.

The Fluoride ion concentration of all the ground water sample is 0.20 mg/l. The acceptable permissible limit of fluoride concentration as per standard is 1 mg/l. Table No (4) indicates the average concentration of fluoride in the

bore well water sample is 0.20 mg/l. All the analyzed test values are within the permissible range. Higher concentration fluoride ion concentration will create the dental problem in the human health [14] [17]. Sodium is also important compound in the ground water field. Higher amount of sodium ion concentration will cause the soil structures. The analyzed test results indicate the sodium concentration ranged from 64 mg/l to 208 mg/l. The maximum acceptable limit of sodium concentration as per norms of WHO and BIS standard is 200 mg/l. The Table No (4) shows that one water sample is exceeding the standard limit. The potassium ion concentration value ranged from 18 mg/l to 68 mg/l. The permissible limit of potassium concentration as per norms is 12mg/l. From the experimental results we conclude that all the bore well water samples are above the permissible limit.

### CONCLUSION

In this experimental study, many bore well water samples are having excess concentration of Calcium ( $\text{Ca}^{2+}$ ), Magnesium ( $\text{Mg}^{2+}$ ), Potassium ( $\text{K}^+$ ), and Total Alkalinity (TA). Excess concentration of TDS was found from 80% of the samples. This indicates that the bore well water samples are not suitable for drinking and irrigation purpose. Advance techniques of water treatment methods and suitable agricultural management implementation should be important for above areas.

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