



## Study of physico-chemical characteristics of groundwater at Ariyalur Block, Tamilnadu, India

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### ABSTRACT

Groundwater is a important natural resource that is essential for human drinking and irrigation purposes. The fast industrial growth and unsuitable agricultural practices have affect the water sources. The present work evaluates the different ground water quality parameters at various locations of Ariyalur block, Tamil Nadu. Ground Water samples were analyzed for various water quality parameters like 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) to evaluate their quality. All the parameters compared with Indian and WHO standards. The analysis results indicate that the water have high values of Hardness, Alkalinity and Total dissolved solids in the most of the samples, which makes the water unsuitable for drinking purposes.

**Keywords:** Ground Water, Physico – Chemical Parameters, Drinking Water Standards, Ariyalur Block, Permissible limit

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### INTRODUCTION

Groundwater is the important source of water supply throughout the world. The world's total water resources estimated at  $1.37 \times 10^8$  million ha.m of these global water resources about 97.2% is sea water and 2.8% is available as fresh water. Out of this 2.8% about 2.2% is available as surface water and 0.6% as ground water. At present nearly one fifth of water in the world is obtained from ground water sources. The ground water is being used for domestic, municipal purposes as well as irrigation. It is an economic resource and more than 80% of the public, industrial and agricultural water supplies are obtained from wells. The demand ground water is increasing every day due to irrigation. Ground water are not unlimited resource, this should be contaminated due to improper disposal of liquid waste, unsuitable agriculture practices, etc. The objective of the present work is to discuss the major physicochemical parameters of groundwater at Ariyalur block.

### Study Area

Ariyalur is located in the central part 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 longitudes and covers an area of 326.85 sq.km. The normal rainfall of Ariyalur region is 1043 mm. The Ariyalur region fairly rich in limestone deposits. Lime stone is an important ingredient for cement manufacturing.

### EXPERIMENTAL SECTION

Ground water samples were collected from different hand pumps and bore wells of twenty sampling stations from the Ariyalur block. The details of the sampling stations are given in Table (1). The water samples were collected in

two litres of high grade polythene bottles which were previously rinsed with distilled water. Before collection of samples they were rinsed thrice with the sample water. The Analysis of pH, Turbidity, Electrical conductivity, Total hardness, Calcium, Magnesium, Sodium, Potassium, Iron, Nitrate, Chloride, Fluoride and Sulphate are carried out as per BIS and WHO standards.

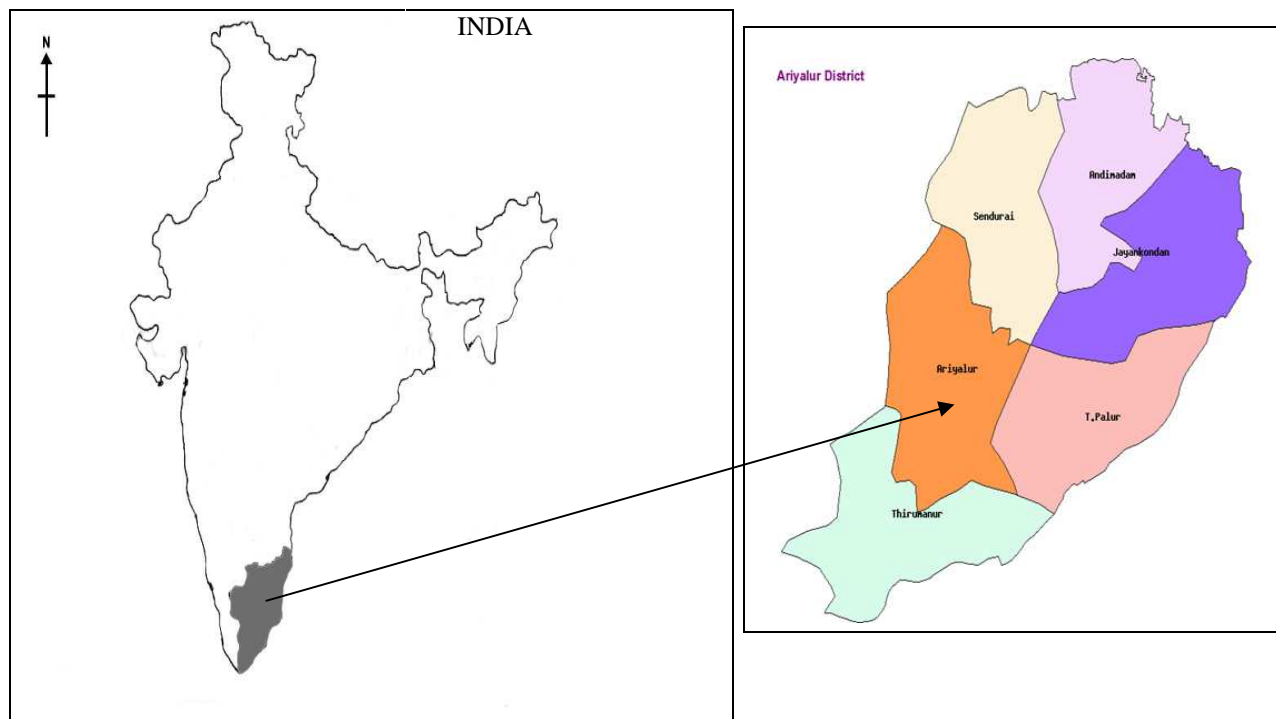


FIG.1 ARIYALUR LOCATION MAP

## RESULTS AND DISCUSSION

The analysed Physical and Chemical parameters values of ground water samples are shown in (Table 2) and (Table 3). The water samples values are compared with BIS and WHO standards as shown in (Table 4). The pH value of water samples varies from 7.00 to 7.6 (Table 3). The average value of pH is 7.36 (Table 4). These values are within the permissible limits. If pH value is more than the permissible limit means, this will affect the soil quality.

From table 4 the average value of Electrical conductivity was ranged from 662 to 3823  $\mu\text{S}/\text{cm}$ , which indicates the values are within the permissible limit except one water sample. Higher value of Electrical conductivity will affect the soil permeability and structure. This will indicate the water is unfit for agriculture and also for drinking purpose. The permissible limit of TDS as per WHO and BIS Standard is 500 mg/l. From the analysis 100 % water samples are having excess TDS concentration. The TDS concentration ranged from 504 mg/l to 1904 mg/l. The average value of TDS is 951.05 mg/l. This result indicates the water is unsuitable for drinking and irrigation purpose. Higher value of TDS will affect the soil permeability.

Alkalinity of water is decided in the water sample due to presence of Carbonate and bicarbonate salts. The maximum permissible limit of alkalinity concentration as per BIS Standard is 200 mg/l. In this study area all the water samples having excess alkalinity. The alkalinity values varied from 220 mg/l to 580 mg/l with an average value of 353.80 mg/l. The Total hardness values ranged from 164 mg/l to 480 mg/l in the study area. Average value of total hardness was 270.60 mg/l. On the basis of total hardness amount 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 300 mg/L) (Gawas *et al.* 2006). From the analysis it was observed that the 80 percent samples are hard. Remaining 20 percent of samples are very hard. These 20 percent water samples are exceeding permissible limit. This result indicates water is unsuitable for drinking and irrigation purpose.

Calcium is the important component in the ground water. The permissible limit of calcium in the ground water for drinking purpose is 75 mg/l. Highest value of concentration in drinking water will create the heart problem in

human health. From table 4 the minimum value of calcium in the study area was 40 mg/l. and the maximum value of 92mg/l. The average value was 75.85 mg/l. The analysis results indicate 85percent samples are having more than permissible limit which is mainly due to limestone. The analysis value of magnesium was ranged from 30mg/l to 112 mg/l. The average value of magnesium in the study area is 59.55 mg/l. The maximum permissible limit of magnesium as per BIS and WHO Standard is 50 mg/l. The table 4 results that 85 percent water samples are more than the permissible limit. 15 percent samples only within the permissible limit. Higher value of magnesium is harmful to human health.

**Table 1: Sampling Station Locations**

Sample No	Sampling Location	Block
S1	Hasthinapuram	ARIYALUR
S2	Kadugur	ARIYALUR
S3	Karuppilakattalai	ARIYALUR
S4	Kavanur	ARIYALUR
S5	Rayampuram	ARIYALUR
S6	Kallankurichi	ARIYALUR
S7	Kayarlabath	ARIYALUR
S8	Nagamangalam	ARIYALUR
S9	Ottakoil	ARIYALUR
S10	Erthukaranpatt	ARIYALUR
S11	Pudupalayam	ARIYALUR
S12	Edayathankudi	ARIYALUR
S13	Reddipalayam	ARIYALUR
S14	Srinivasapuram	ARIYALUR
S15	Subburayapuram	ARIYALUR
S16	Pudupalayam	ARIYALUR
S17	Thehur	ARIYALUR
S18	Usenabat	ARIYALUR
S19	V.Kaikatti	ARIYALUR
S20	Villangudi	ARIYALUR

**Table 2 : Physical parameters values obtained in the study area**

Sample No	Physical parameters				
	Appearance	Color	Odour	EC	TDS
S1	Clear	Colorless	Odourless	853	634
S2	Clear	Colorless	Odourless	1631	711
S3	Clear	Colorless	Odourless	842	567
S4	Clear	Colorless	Odourless	1652	1848
S5	Clear	Colorless	Odourless	3823	504
S6	Clear	Colorless	Odourless	662	651
S7	Clear	Colorless	Odourless	1260	806
S8	Clear	Colorless	Odourless	665	601
S9	Clear	Colorless	Odourless	814	1904
S10	Clear	Colorless	Odourless	646	1210
S11	Clear	Colorless	Odourless	692	1149
S12	Clear	Colorless	Odourless	814	963
S13	Clear	Colorless	Odourless	1430	721
S14	Clear	Colorless	Odourless	667	742
S15	Clear	Colorless	Odourless	1092	658
S16	Clear	Colorless	Odourless	814	1149
S17	Clear	Colorless	Odourless	1340	980
S18	Clear	Colorless	Odourless	1652	1376
S19	Clear	Colorless	Odourless	1580	1077
S20	Clear	Colorless	Odourless	1520	770

The Permissible value of chloride as per BIS and WHO Standards are 250 mg/l and 200 mg/l. respectively. In our study, table 4 indicates the chloride value ranged from 40 mg/l to 424 mg/l. with an average value of 191.60 mg/l. From the analysis we result that 20 percent samples are having more concentration. Higher concentration leads to kidney problem in the human health. The permissible limit of sulphate as per BIS and WHO Standard is 200mg/l. The table 4 indicates the lowest value 3 mg/l and the highest value 68 mg/l with an average value of 23.65 mg/l. In the study area all the samples are within the permissible limit. Higher concentrations of sulphate increase the hardness and Electrical conductivity value.

The permissible limit of nitrate is 100 mg/l. The table 4 indicates the minimum result value as 3 mg/l and the maximum value as 23 mg/l with an average value of 6.60 mg/l .All the water samples are within the permissible limit. Iron is the important element for all organisms. Increase in iron content causes toxicity. The table 4 indicates

the iron concentration in the analysed water samples varies from 0.05mg/l to 0.20 mg/l. All the samples are within the acceptable limit.

The Fluoride concentration ranging from 0.20 mg/l to 0.40 mg/l. permissible limit of fluoride as per BIS and WHO standard is 1 mg/l. Table 4 shows the average value of fluoride concentration is 0.23 mg/l. All the tested values are within the permissible ranges. Higher concentration fluoride concentration leads to the dental problem. Sodium is the important element in the ground water field. Higher amount of sodium concentration causes the soil permeability and structure. The analysis results indicates the sodium concentration varies from 34 mg/l to 69 mg/l. The maximum permissible limit of sodium concentration as per standard is 200 mg/l. The table 4 shows all the water samples are within the permissible limit. The potassium concentration value varies from 6 mg/l to 23 mg/l. The permissible limit is 12mg/l as per standards. From the analysis 50 percent samples are above the permissible limit.

**Table 3: Chemical parameters values obtained in the study area**

Sample No	Chemical Parameters											
	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	7.60	220	188	79	75	120	32	3	0.05	0.20	8	47
S2	7.30	280	248	76	55	140	21	3	0.10	0.25	12	52
S3	7.60	220	184	82	58	100	28	3	0.06	0.20	10	38
S4	7.50	480	320	76	52	500	48	3	0.15	0.20	14	62
S5	7.20	220	164	82	112	86	3	2	0.10	0.30	12	60
S6	7.20	300	240	78	48	100	18	4	0.20	0.20	7	58
S7	7.70	380	288	86	57	120	33	8	0.07	0.20	18	61
S8	7.40	328	240	77	62	60	14	2	0.05	0.20	14	34
S9	7.70	580	480	40	30	424	68	5	0.10	0.20	12	43
S10	7.20	400	280	76	68	280	24	6	0.05	0.30	19	69
S11	7.40	412	280	60	53	240	8	14	0.06	0.20	22	52
S12	7.60	340	340	48	70	200	32	8	0.15	0.20	6	47
S13	7.00	372	248	85	63	94	10	4	0.20	0.20	16	55
S14	7.30	360	288	79	57	112	20	4	0.18	0.25	15	52
S15	7.20	272	220	82	65	130	4	2	0.12	0.20	23	48
S16	7.40	412	280	76	39	240	8	14	0.05	0.20	13	63
S17	7.40	372	272	78	56	210	13	2	0.15	0.40	10	41
S18	7.00	356	352	89	58	340	60	20	0.10	0.20	7	55
S19	7.00	384	240	76	52	240	17	23	0.20	0.20	14	63
S20	7.60	388	260	92	61	96	12	2	0.12	0.20	12	68

**Table 4: Comparison table for Physico chemical analysis Values of ground water samples with standards**

Physical Parameter	Concentrations of ions		Average	BIS Standards	WHO Standards	Percentage of ground water samples exceeding maximum standards
	Min	Max				
Appearance	Clear		Clear	Clear	Clear	Nil
Color	Colorless		Colorless	Colorless	Colorless	Nil
Odour	Odourless		Odourless	Odourless	Odourless	Nil
EC (µs/cm)	662	3823	1222.45	750-2250	1000-2000	0.05
TDS(mg/l)	504	1904	951.05	500	500	100
Chemical Parameters	Concentrations of ions		Average	BIS Standards	WHO Standards	Percentage of ground water samples exceeding maximum Standards
	Min	Max				
pH*	7.00	7.60	7.36	6.5-8.5	7-8.5	Nil
Total alkalinity	220	580	353.80	200	100	100
Total hardness	164	480	270.60	300	300	20
Calcium	40	92	75.85	75	75	85
Magnesium	30	112	59.55	50	50	85
Chloride	60	424	191.60	250	200	20
Sulphate	3	68	23.65	200	200	Nil
Nitrate	2	23	6.60	100	100	Nil
Iron	0.05	0.20	0.113	0.321	-	Nil
Fluoride	0.2	0.4	0.23	1	1	Nil
Potassium	6	23	13.2	12	12	50
Sodium	34	69	53.4	200	200	Nil

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

## CONCLUSION

In this study, most of the water samples are having higher concentration of Total dissolved solids(TDS), Total hardness(TH), Calcium(Ca<sup>2+</sup>), Magnesium(Mg<sup>2+</sup>), Potassium(K<sup>+</sup>), and Total Alkalinity(TA). Higher amount of TDS

was found from all the samples. This noticed that the water samples are unsuitable for drinking and irrigation purpose. General water treatment methods and suitable agricultural practice should be adopted for above areas.

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