

# GROUND WATER QUALITY STATUS WITH RESPECT TO FLUORIDE CONTAMINATION IN HARUR TALUK, DHARMAPURI DISTRICT, TAMILNADU

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**ABSTRACT:** In the present work, our aim was to study about the ground water quality assessment. The water samples were collected from 10 villages in Harur Taluk, Dharmapuri District, a fluorosis-prone District in Tamilnadu. Various water quality physico-chemical parameters such as pH, EC, TDS, TA, TH, Turbidity, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Na<sup>+</sup>, K<sup>+</sup>, Cl<sup>-</sup>, DO along with Fluoride (F<sup>-</sup>) have been measured and compared with standard values (WHO and BIS). The analysis shows significant linear relationship among different pairs of water quality parameters, more importantly Calcium and Fluoride. The results have indicated that the contaminants in the ground water are close to the permissible limits.

**Keywords:** ground water quality, physicochemical parameters, Fluoride contamination

## INTRODUCTION

Water, in its natural form, is one the most important natural assets on the earth that plays a vital role for all living organisms. Because of the pollution, the natural fresh water has become a scarce commodity. Major contribution of water is derived from the ground water resources and in many areas is the only fresh source available. The contents in ground water influence many factors viz., the concentration of calcium and fluoride and bicarbonate ions, viscosity of water, pH, COD, BOD and EC ( Hem, J.D 1991).

One of the pollutants that make water non-potable is Fluoride ion, the main source of which is fluoride-bearing rocks such as Fluorites. Among the water quality parameters, fluoride ion exhibits unique properties in drinking water that its concentration in optimum dose is advantageous to health whereas its overdose affects the

health(Saravanan et al 2008). High fluoride concentration in the water sources is a major concern for the mankind. The properties of Calcium, Sodium and Fluoride are interrelated that the higher the fluoride level, the lower is that of Calcium. This may be as a result of the substitution of Na by Ca as well as due to high affinity of Fluoride ion towards Calcium (Diabl et al 2005).

WHO, 2008 and BIS, 1991 has set a range of allowable concentration for fluoride in drinking water (WHO 1991). The permissible limits of fluoride in drinking water by various organizations are given in table 1. When administered in more than 1 ppm level of concentration, Fluoride has been reported to cause depressions in DNA and RNA synthesis in cultured cells (Shivasankara 2000).

**Table 1.** Range of allowable Fluoride concentration in drinking water

S. No	Name of the Organizations	Permissible limit of Fluoride (mg/l)
1	World Health Organization (WHO) International Standards	1.5

	for drinking water	
2	Bureau of Indian Standards (BIS)	1.0
3	The committee on Public Health Engineering (PHE), Govt. of India	1.0
4	Indian Council of Medical Research (ICMR), Govt. of India	1.0

**Distribution of Fluoride content in Tamil Nadu**

In Tamil Nadu, the high concentration of fluoride in groundwater is found to be in Dharmapuri and Salem district closely followed by Coimbatore,

Madurai, Trichy, Dindigul and Chidambaram district (Lilly Florence 2012) The districts having low fluoride are Tirunelveli, Pudukottai, North Arcot, and Ramnad. The district wise fluoride status in Tamil Nadu is presented in Table 2.

**Table 2.**Distribution of Fluoride content in Tamilnadu state

S.No	Status	Districts
1	Severe	Dharmapuri, Salem
2	Moderate	Coimbatore, Madurai, Trichy, Dindigul, Chidambaram
3	Less	Pudukottai, Tirunelveli, North Arcot, Ramnad

Since there were no major studies in the recent past, the present study was carried out to understand the present status of groundwater quality in Dharmapuri district in Tamil Nadu and also to assess the possible causes for high concentration of fluoride in groundwater (Sendesh Kannan et al 2012).

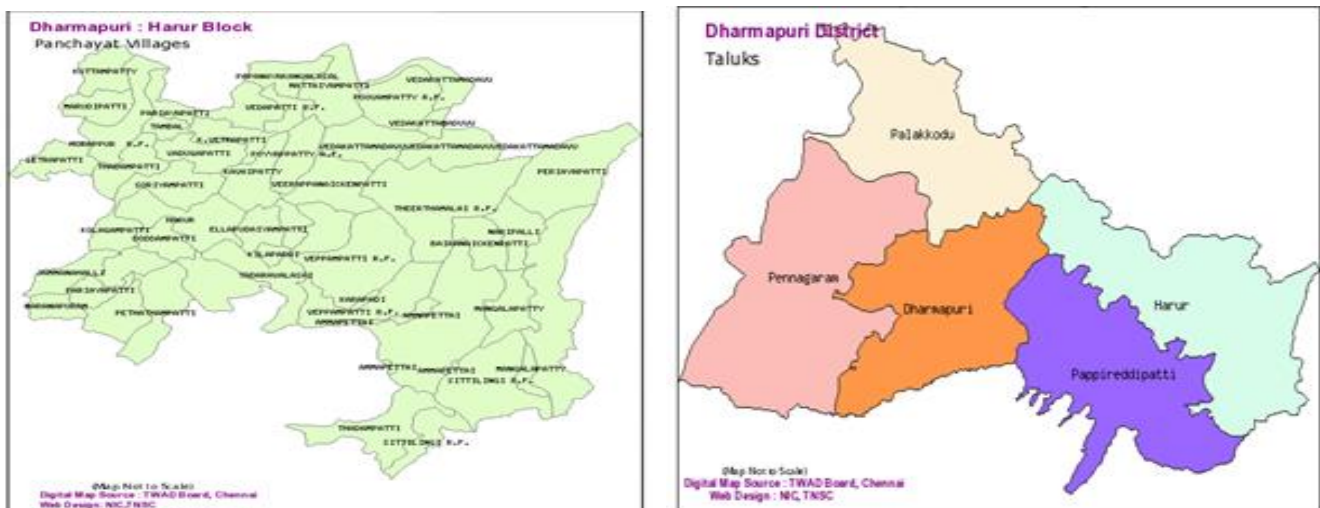
Tiruvannamalai and Villupuram Districts on the east, Salem District on the South, Krishnagiri District on the north and Cauvery River on the west. The famous Hogenakkal waterfalls is in Dharmapuri district. The sub basin area is bounded by Harur, Palakodu, Pennagaram, Dharmapuri, Pappireddipatti Taluks. Dharmapuri district goes through a hot climate during the summer (March-May) with a temperature upto 36°C and in winter it varies between 16°C - 12°C. The district has an average annual rainfall of about 895.56 mm.

**MATERIALS AND METHOD**

**Study Area**

The study area Dharmapuri District, Tamilnadu is situated 12.12° N 78.26° E, which is bounded by

**Figure 1.** Map of Dharmapuri District and Harur Taluk (administrative)



### Water samples collection

Ground water samples were collected from ten different villages of Harur Taluk as given in the Table 3. Ground water samples were collected in

polyethylene bottles as per standard procedures of APHA to avoid unpredictable changes in their characteristics (Sudhakar 2013, Brown et al 1974, APHA, 1998).

**Table 3.**Names of the samples collected from villages

S.No	Sample ID	Name of the sampling stations
1	A	Harur
2	B	Palayapettai
3	C	Velimadurai
4	D	Kiraipatty
5	E	Dasirihalli
6	F	Mobirippatti
7	G	Tandekuppam
8	H	Ettipatti
9	I	Agraharam
10	J	Morappur

### Methods of analysis of various water quality parameters other than fluoride

The collected ground water samples were tightly corked to avoid any entry of foreign particles and brought to the laboratory. They were analyzed for pH, Electrical Conductivity (EC), Total Dissolved Solids (TDS), Total Alkalinity (TA), Total Hardness (TH), Ca<sup>2+</sup>, Mg<sup>2+</sup>, Cl<sup>-</sup>, F<sup>-</sup> and Dissolved Oxygen (DO) as per the standard methods available in literature (Sudhakar 2013, Brown et al 1974, APHA, 1998) and the methods used for the analysis of TH, TA, Ca<sup>2+</sup>, Mg<sup>2+</sup>, Cl<sup>-</sup> and DO were by Titrimetry, pH was by pH-metry, EC was by Conductometry, TDS was by TDS analyzer and F<sup>-</sup> were by Spectrophotometry. All the chemicals used were of AR grade of pure quality. Double distilled water was used for the preparation of all the reagents and solutions. The average values of

three replicates were taken for each determination.

### Sample preservation and handling

The collected samples were preserved in an icebox to avoid retarding biological action, deterioration, hydrolysis of chemical compounds and complexes, volatility of constituents and then brought to the laboratory for the determination of both physico-chemical parameters. The preservation techniques of various parameters of water were given by U.S. Environmental Protection Agency (USEPA 1983).

### RESULTS AND DISCUSSION

The quality parameters of groundwater such as pH, fluoride, EC, etc., measured in this study are given in Table 4.

**Table 4.**Physico-chemical parameters and fluoride content in ground water  
(Location: Harur Taluk Dharmapuri district, Tamilnadu)

Parameters	A	B	C	D	E	F	G	H	I	J
pH	9.3	8	8.9	8.7	8.2	8.5	8.3	8.1	7.8	8.4
EC (mS/cm)	2794	1868	1516	2652	2906	2786	1896	2542	1678	2728
DO (ppm)	3.31	4.27	3.58	4	4.55	4.68	3.86	4.96	5.51	4.55
TDS (ppm)	300	600	400	500	700	1080	980	460	1020	1240



<b>COD (ppm)</b>	12	11.2	12.8	10	15.2	14.8	14	15.2	13.2	12.4
<b>BOD (ppm)</b>	7.48	3.4	4.08	2.04	13.6	6.12	5.44	4.76	12.24	7.48
<b>Total Alkalinity (ppm)</b>	125	100	110	120	115	130	135	145	140	130
<b>Total hardness (ppm)</b>	260	256	190	216	244	142	150	120	154	146
<b>Chloride (ppm)</b>	218.68	275.48	123.54	293.94	248.94	220.1	214.48	113.6	255.6	333.7
<b>Calcium (ppm)</b>	96.19	108.21	101	80.96	104.2	106.61	76.15	74.54	105	153.1
<b>Magnesium (ppm)</b>	23.87	29.23	32.16	11.69	27.77	25.82	9.25	5.36	30.21	57.01
<b>Fluoride (ppm)</b>	0.6	0.8	0.94	0.72	0.28	0.91	0.97	1.1	0.68	0.34

The groundwater quality of the Dharmapuri district is evaluated by comparing the values of different geochemical parameters observed with that of standards defined by both BIS and WHO. Physico-chemical properties of the analyzed water sample show concentration variation in the water quality with respect to their chemical composition. The logarithm of the reciprocal of the hydrogen ion concentration (pH) in the water sample varies from 7.8 (Agraharam) to 9.3 (Harur). The entire samples, except Sample A are within the recommended limits for consumption. The concentration of Calcium (Ca<sup>2+</sup>) ion concentration in these regions shows wide variation from a minimum of 74 mg/l to as high as

106 mg/l. However all the samples are almost within the maximum permissible limit according to the Indian Standard. Thus it is proved that the higher the fluoride level, the lower is that of Calcium. The magnesium (Mg<sup>2+</sup>) concentration varies from 5 mg/l to 57 mg/l. This magnesium is coming under the permissible limit of the standards. The Chloride concentration (Cl<sup>-</sup>) concentration ranges from 113 mg/l to 333 mg/l, and is within the recommended limit. The fluoride concentration shows variation from minimum of 0.34 mg/l to 1.1 mg/l which just exceeds the permissible level for drinking water which results in causing Fluorosis problem to human being.

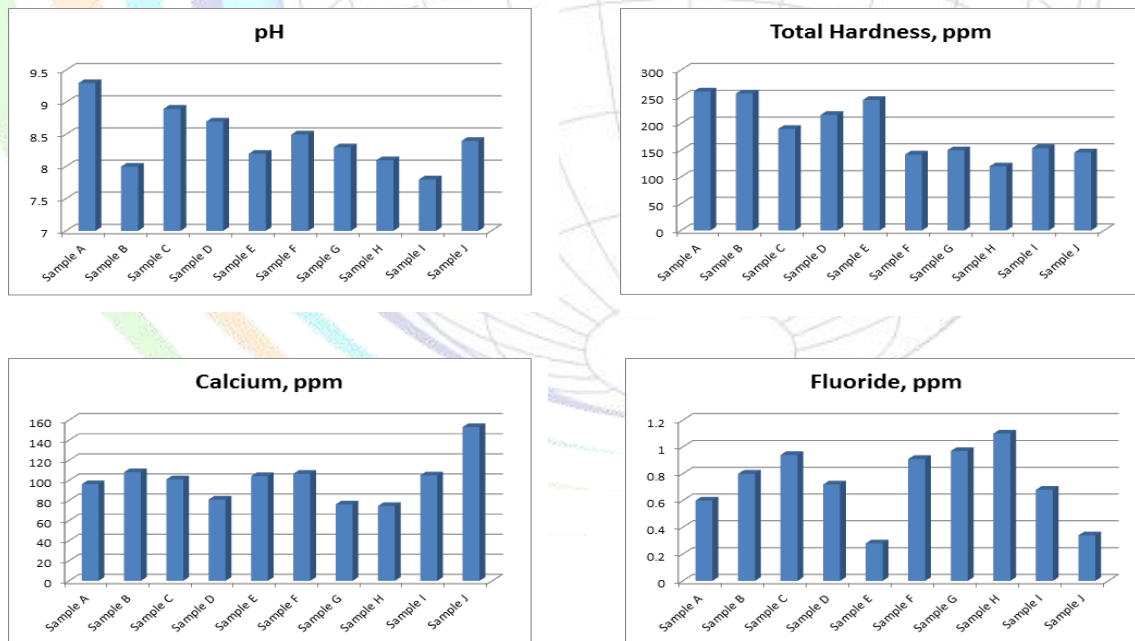


Figure 2. Measurement of selected water quality parameters viz., pH, Total hardness, Calcium and Fluoride

## CONCLUSION

The analysis shows significant linear relationship among different pairs of water quality parameters, more importantly Calcium and Fluoride. The results have indicated that the contaminants in the ground water are close to the permissible limits. Thus it is concluded that the fluoride content is within the permissible limit, though it just exceeds the permissible level for drinking water in some cases.

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