



Ground Water Levels of Nitrate and Fluoride in Tiruchirappalli East and West Taluka in Tamilnadu India

Arockia Raj C.A.^{1*,3} and Naga Rajan E.R.²

¹Research and Development Centre, Bharathiar University, Coimbatore - 641 046, Tamil Nadu, INDIA

²Department of Chemistry, Kalasalingam University, Krishnankovil - 626 126, Tamil Nadu, INDIA

³Department of Chemistry, Annai Teresa College, Karaikudi - 630 002, Tamil Nadu, INDIA

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Abstract

The quality of ground water supplies in Tiruchirappalli Taluk, situated in central part of Tamilnadu has been investigated with respect to fluorides and nitrates, pH, dissolved solids, chlorides. The levels of fluorides and nitrates, pH, TDS and Chloride, dissolved solids and chlorides were found within the safe limits as prescribed by BIS, for more than 95% of the samples. Out of the 61 different borewell samples analysed, selected from different areas of Tiruchirappalli Taluk, 26% of the samples are found to contain fluorides less than 0.50 PPM (lower safe limit prescribed by BIS) and 11.5% of the samples are found to contain more than 1.5 PPM of fluorides (higher safe limit prescribed by BIS) Further it was also found during study that, 16 00% of the borewell samples analyzed were found to contain more than 100.00 PPM of nitrates (measured as NO₃ mg/L, safe limit prescribed by BIS). The values of fluorides and nitrates observed in different samples were in the range of 0.19- 2.06 PPM and 0.08 - 308 PPM, respectively.

Keywords: ground water, borewell samples BIS limits fluoride and nitrate levels.

Introduction

Deterrious effects of nitrates and fluorides, effect on infants and fluorides on human beings. Nitrate poisoning brings about a condition called as haemoglobinemia, resulting from changes in haemoglobin red blood cells and reduces their capacity to carry oxygen¹. One of the symptom of nitrate poisoning has described as cyanosis, in which there has been a decoloration of the skin and mucous membranes, causes blood to turn dark and resulting in death. Fluorides are known to be beneficial, when the concentration of 0.5 - 1.00 PPM. But when it exceed the limit of 1.5 PPM it is found to cause flourosis². The skeletal and non-skeletal fluorosis may be resulted depending upon concentration of fluorides in drinking water. Fluoride is higher content in water then the teeth changed from original color.

The Tiruchirappalli taluk is located in central part of the Tamilnadu in India. The located State located in south part of India. Recently Tiruchirappalli has declared as district head quarter and contains eight talks.

The main source of drinking water for the major population of this taluk is water obtained through bore wells. As no information was available on the levels of nitrate and fluoride in ground water supplies of Tiruchirappalli taluk, a study was conducted to access the quality of drinking water with respect to nitrate and fluorides. pH, TDS and chloride contents of the ground water samples have also been evaluated. The Values of WHO Standard BIS 10500:1991 for Nitrate is 45, Fluoride 1.5

ppm, TDS 200, PH 6.5-8.5, chloride 250.

This paper gives the results of the study conducted during April 2013 - March 2015, in urban and rural areas of Tiruchirappalli taluk.

Material and Methods

Water samples from different sources were collected in clean polyethylene bags. The Samples locations were selected at random as indicated in the map of Tiruchirappalli taluk (figure-3). Suspended matter, if any, in the samples, were removed by filtering through Whatmann No. 41, filter paper prior to analysis. Nitrate (calculated as NO₃ mg/L), fluoride and PH are estimated by ion selective electrode method using the ion analyzer model 720A. TDS was analyzed using the (IND), EC-TDS analyzer model CM 183. Chloride was determined by titrimetric method^{3,4}.

Experiment Aspects of pH and TDS: If water dipped in litmus paper, after 30 seconds the paper shows in between yellow and green colour, that is good condition to drink, pH value 6.5 to 7.5 is neutral that is no acidic and no basic character. It is good for drink, less than 6.5 acidic character. If drink causes to ulser and stomach problems, greater than 8.5 basic character If drink casus to formation of kidney stones, if the total dissolved solvents measure 40 to 60 then that is good for drink, If the measure 51 that is equal to International Standard. Up to 250 that is permissible to drink.

Table-1
The Samples Locations of Fluoride and Nitrate

Sample	Places of Sampling	Fluoride mg/L	Nitrate mg/L	pH	TDS mg/L	Chloride mg/L
1	Annamalai Nagar	0.45	144.00	7.32	608.00	24.00
2	Cholarajapuram	0.78	119.00	6.69	690.00	500.00
3	Thillainagar	0.41	17.80	7.76	414.30	60.00
4	Bharathi Nagar	0.40	51.80	7.60	427.20	70.00
5	Ramalinga Nagar	0.98	42.20	7.58	297.60	50.00
6	Renganathapuram	1.24	26.10	7.70	376.20	52.00
7	Puthur	0.48	21.10	7.71	290.8	24.00
8	Sangiliyandapuram Main Road	0.97	17.40	7.50	385.90	86.00
9	Ammayappa Nagar	0.97	28.40	7.65	200.10	46.00
10	Thilagar Nagar	0.59	46.90	7.90	108.70	20.00
11	Canara Bank Colony	0.67	50.40	7.95	539.00	118.00
12	Thiru V.K. Nagar	1.12	254.00	8.47	689.00	254.00
13	Keelavannar Pet	1.46	19.10	8.35	656.00	224.00
14	Melapanda Mangalam	1.73	23.80	7.96	252.60	22.00
15	Anbu Nagar Airport	1.23	101.20	7.50	585.30	112.0
16	Kaja Nagar Kudisai Part	1.05	35.60	7.61	411.80	128.00
17	Linga Nagar	0.71	42.00	7.40	394.10	80.00
18	Fathima Nagar	0.37	139.00	6.61	480.00	186.20
19	Thiyagaraja Nagar	0.85	308.00	7.94	444.20	94.00
20	Woraiyur, West	1.41	39.20	7.50	305.20	20.00
21	Kauveri Nagar	1.01	280.00	7.80	553.00	94.00
22	Jayalalitha nagar	0.96	8.40	7.76	302.00	39.00
23	Sathanur Kavibharathi Nagar	0.63	8.90	7.62	504.20	90.00
24	Nachiyar Palayam	0.99	0.08	7.17	398.00	66.00
25	Nesavalar Colony	0.30	6.10	7.23	571.50	144.00
26	Anna Nagar	0.60	1.06	7.70	574.80	204.00
27	Sankaran Pillai Road Police Colony	0.48	25.36	7.35	690.80	170.00
28	Seenivasa Apartment (Pattavarth Road)	1.56	43.50	7.10	693.00	398.00
29	Sangilikonarsandhu	0.93	55.00	6.63	645.00	360.00
30	Palakkarai Bazaar ,	0.97	47.10	6.82	653.00	426.00
31	Kattapomman Street Jeeva Nagar	2.00	30.10	7.50	606.08	234.00

Sample	Places of Sampling	Fluoride mg/L	Nitrate mg/L	pH	TDS mg/L	Chloride mg/L
32	Singarathoppu	2.06	13.90	7.40	380.60	34.00
33	Kamala Nehru Nagar	1.55	12.20	7.17	339.30	34.00
34	Tharanallur Thoppu Street	0.78	10.80	7.40	393.00	48.00
35	Iruthayapuram Muthal Street	0.48	19.70	7.78	479.40	72.00
36	Santhana Puram	0.51	12.70	7.60	326.70	30.00
37	Pillaima Nagar Kudisai Part	0.65	19.80	7.133	482.90	32.00
38	Aanaikatty Ground	0.81	24.60	7.47	398.00	66.00
39	Bharathidasan Road	0.21	13.69	8.63	355.40	22.00
40	Beema Nagar Mettu Theru	0.19	31.25	8.50	470.20	62.00
41	Melaputhu Street, Sembattu	0.28	24.30	8.70	387.40	22.00
42	Keelakosa Street Main	1.08	12.68	7.35	490.00	72.90
43	Hebar Road	1.98	26.98	7.58	487.20	32.40
44	Dindicul Road	0.35	19.20	8.60	483.90	69.20
45	New Raja Colony Main Road	1.00	26.00	8.42	375.50	54.00
46	Ambedhkar Nagar	0.39	25.60	8.20	693.00	200.00
47	Periyamilagu Parai New Street	0.33	42.00	7.40	181.17	84.00
48	Chinthamani Paduvai Nagar	0.65	41.00	7.20	615.80	142.00
49	Keeladevathanam Main Road ,	0.63	36.25	7.10	285.60	30.00
50	Town Station Railway Colony	1.56	21.36	7.52	459.00	94.00
51	Melavannarapettai	1.46	51.80	7.17	634.00	146.00
52	Uyyakondan Thirumalai	1.14	178.00	8.20	621.30	108.30
53	Santhaseela Nagar	0.98	28.40	7.80	472.00	82.00
54	Shanmuga Nagar	0.89	89.60	7.20	492.00	79.00
55	Ashok Nagar	0.78	30.10	7.50	730.50	248.00
56	Ramachandrapuram	0.68	12.60	7.35	508.20	92.00
57	Srinivasapuram	1.29	63.60	7.77	548.00	102.00
58	Thennur Anna Nagar	1.25	270.00	8.40	412.60	52.00
59	Chinnasami Nagar	1.04	165.00	7.78	490.40	73.50
60	Keyeidemillath Nagar Main	0.38	67.50	8.10	676.00	246.00
61	Mariyamman Koil Street	0.81	23.65	7.66	643.00	262.00

Results and Discussion

Analytical results of average values for three different seasons for all these parameters are presented in table-1.

A total of 61 bore well samples in Tiruchirappalli taluk were monitored for pH, TDS Chlorides, nitrate and fluorides. The distribution of nitrate and fluoride in ground water were analyzed statistically⁵ for range, mean, median, results tabulated. Graphical representation of fluoride and nitrate in different water samples are given in figure-1 to figure-6. Now a day's alternative approach used in analytical correlation has been used and the mathematical relationship also used for analysis of physic chemical parameters⁶⁻⁸.

Table-2
Range summary of nitrate and fluoride

Measured tendency	Nitrate	Fluoride	Unit
Range	0.08-308	0.19-2.06	mg/L
Mean	55.81	0.89	mg/L
Median	28.4	0.85	mg/L

Nitrate: A wide variation in the levels of nitrate has been observed in borewell waters. The nitrate content was ranging from 0.08-308, with a mean value of 55.81. Out of 61 samples analyzed, 50% of the samples, contain nitrates less than 28.4 mgL-1. Study further reveals that 16.00% of bore wells samples contain nitrate more than 100 mgL-1.

The excessive usage of nitrogenous fertilizers for agricultural items and inadequate sanitary system may be the reason for higher nitrate values.

It has been estimated that human waste containing nitrogen about 5 kg/ person per year. The fertilizer animal wastes from roads and industrial wastes are considered as important sources of nitrates contamination in ground water⁹. So it is suggest that total hardness of water samples is mainly due to presence the $MgCl_2$, CaF_2 ¹⁰.

Fluoride: Fluorides obtained in mainly three ways There are Fluorspar (CaF_2), Rock phosphate [$Ca_5F(PO_4)_8$] and sodium aluminium fluoride [Na_3AlF_6]. The fluoride minerals are nearly insoluble. Hence, fluoride will not be present in ground water until the conditions favour their solution. The fluorides present in the rocks and soils when come in contact with water of high alkalinity into ground water.

The fluoride content was ranging from 0.19 to. 2.06 mgL-1. About 50% of the samples were containing fluoride below 0.5 and 26% of the samples are reported containing fluorides less than 0.5. Further the study revealed that 11.5% of the samples were found to contain more than 1.5mg-L.

Among the samples of bore well water analyzed 16.00% of the samples were found to contain nitrates more than 100 mgL-1.

11.5% of the samples contained more than 1.5 PPM of fluorides and 26% of the samples were reported containing less than 0.5 PPM of fluorides. Authors also witnessed some youths under twenty years of age in some villages of Tiruchirappalli Taluk who complained of severe backache and difficulty in folding their knees with ease (for this figure legends published by A.K. Susheela, et.al. were followed)¹¹. Some individuals even complained of allergic rashes with skin itching.

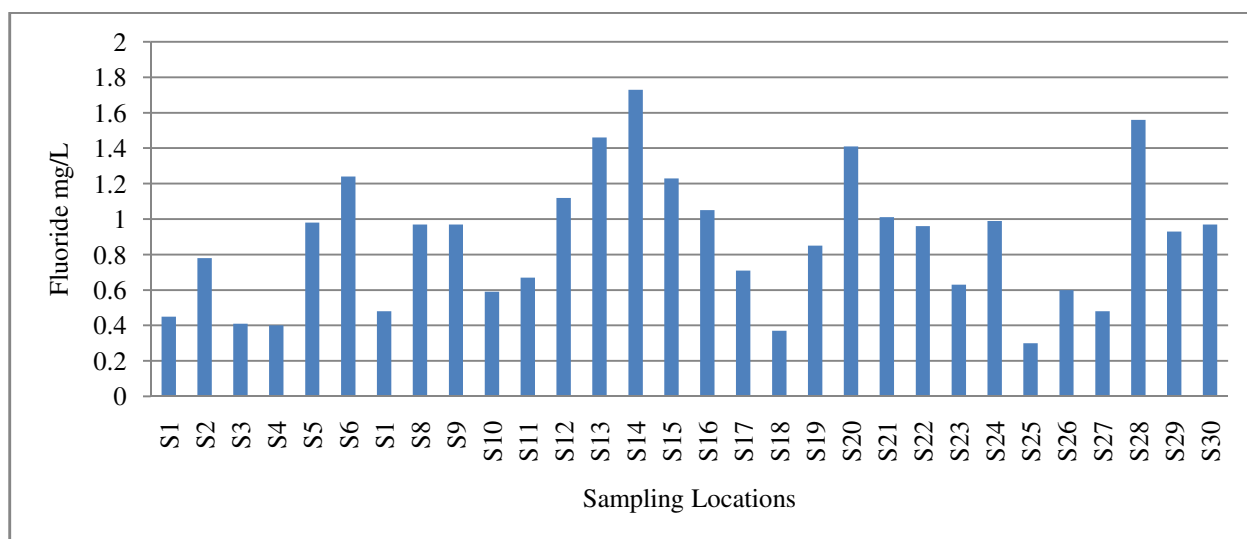


Figure-1
Fluoride mg/L Vs Sampling Locations 1 to 30

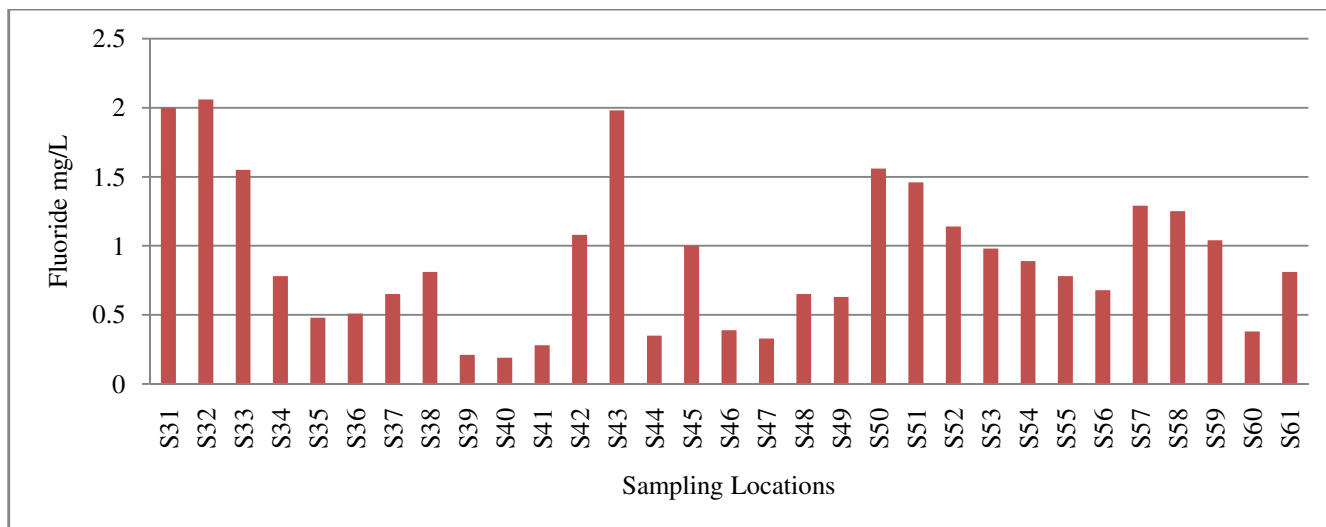


Figure-2
 Fluoride mg/L Vs Sampling Locations 31 to 61

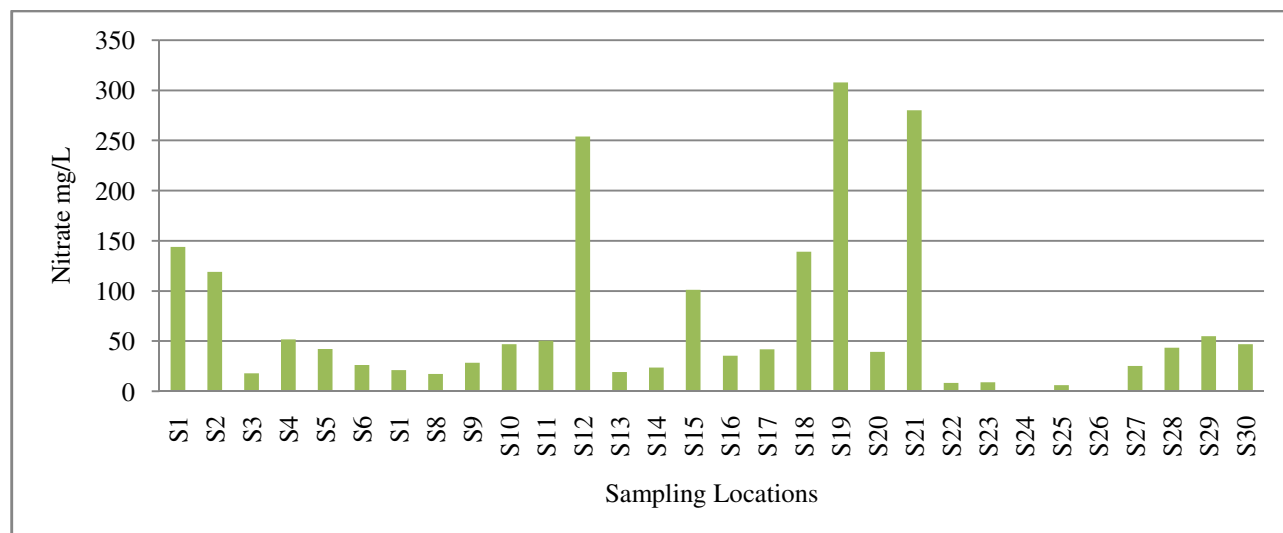


Figure-3
 Nitrate mg/L Vs Sampling Locations 1 to 30

Conclusion

This clearly indicates that the higher nitrate contents in ground water. Authors have also witnessed cyanosis in some of the infants, at few places. In India the problem of excessive fluoride in ground water reported in Andhra Pradesh¹². This clearly indicates the prevalence of fluorosis in more than one form among these villages. Hot climatic conditions, unhygienic surroundings, illiteracy and poverty have pressed these innocent rural people into the dangerous clutches of fluorosis and cyanosis. The content in ground water is a function of many factors such as availability and solubility of fluoride minerals, velocity of flowing water, pH, calcium, bicarbonate ions, high fluoride of drinking water was reported¹³.

The degradation of the quality of ground water can be controlled

by improving sanitary and drainage systems, optimizing the applications of nitrogenous fertilizers. Further in few areas of higher fluoride containing waters, adsorptive technique¹⁴ of defluoridation of water may be adopted, if change of source of water is not feasible. Also people are to be advised by the district health authorities to consume vitamin C rich food items, have diet of adequate calcium and drink more milk and consume calcium rich vegetables. Awareness must be created among people¹⁵.

This aspect of fluorosis is often overlooked because of the notion prevailing that fluoride only affects bones and teeth¹⁶. Besides skeletal and dental fluorosis, excessive consumption of fluoride may lead to muscle fibers degeneration, low haemoglobin levels, deformities in RBCs, excessive thirst, headache, skin rashes, nervousness, neurological manifestations

(it affects brain tissue similar to the pathological changes found in humans with Alzheimer's disease), depression, gastrointestinal problems, urinary tract malfunctioning, nausea, abdominal pain, tingling sensation in fingers and toes, reduced immunity, repeated abortions or still births, male sterility, etc.

It is also responsible for alterations in the functional mechanisms of liver, kidney, digestive system, excretory system, central nervous system and reproductive system, destruction of about 60 enzymes¹⁷. The surface of Corn Cobs also based on the portion in contact with water is negatively charged which is not conducive for fluoride adsorption¹⁸. The effects of fluoride in drinking water on animals are analogous to those on human beings. The continuous use of water having high fluoride concentration also adversely affects the crop growth. Mckee and Johnston 1934, investigated the use of powdered activated carbon for fluoride removal and achieved better result arised¹⁹. The process is pH dependent pH 3.0 or less. Therefore, the use of this material is expensive due to need of pH adjustment²⁰. So the harmful effects of F⁻ on health increase due to not only the widespread occurrence of earth F⁻ bearing minerals in the Earth's crust but also impacts of environmental factors and human activities²¹⁻²⁵.

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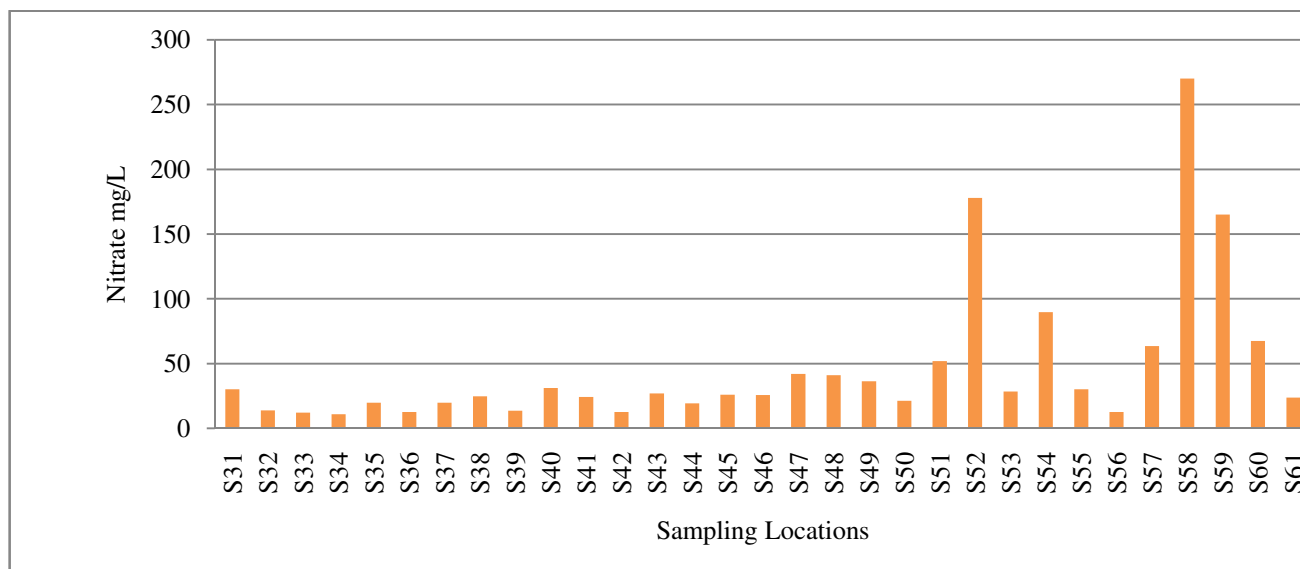


Figure-4
Nitrate mg/L Vs Sampling Locations 31 to 61

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