

MICROBIOLOGICAL ANALYSIS OF GROUND WATER IN SOME AREAS OF VILLUPURAM DISTRICT, TAMIL NADU, INDIA.

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ABSTRACT

The aim of this study was to investigate microbiological quality of the bore well water in some areas of villupuram district. In this study, a total of 20 bore well water samples were taken from bore-wells in sterile glass bottle. The microbial quality of gathered samples was determined based on standard methods in laboratory. Statistical analysis of the results was performed. Based on the obtained results it was found that most of the samples were seriously contaminated to total coliform and fecal coliform bacteria. The existing results revealed that water from bore wells are not safe for human use. The existence of indicator bacteria in high amounts indicates the probable presence of pathogenic bacteria. A widespread microbial contamination of water sources was observed necessitating better sanitary measures. So that it is necessary to disinfect the groundwater before human consumption.

Keywords: Groundwater, microbiological analysis, villupuram district.

1. INTRODUCTION

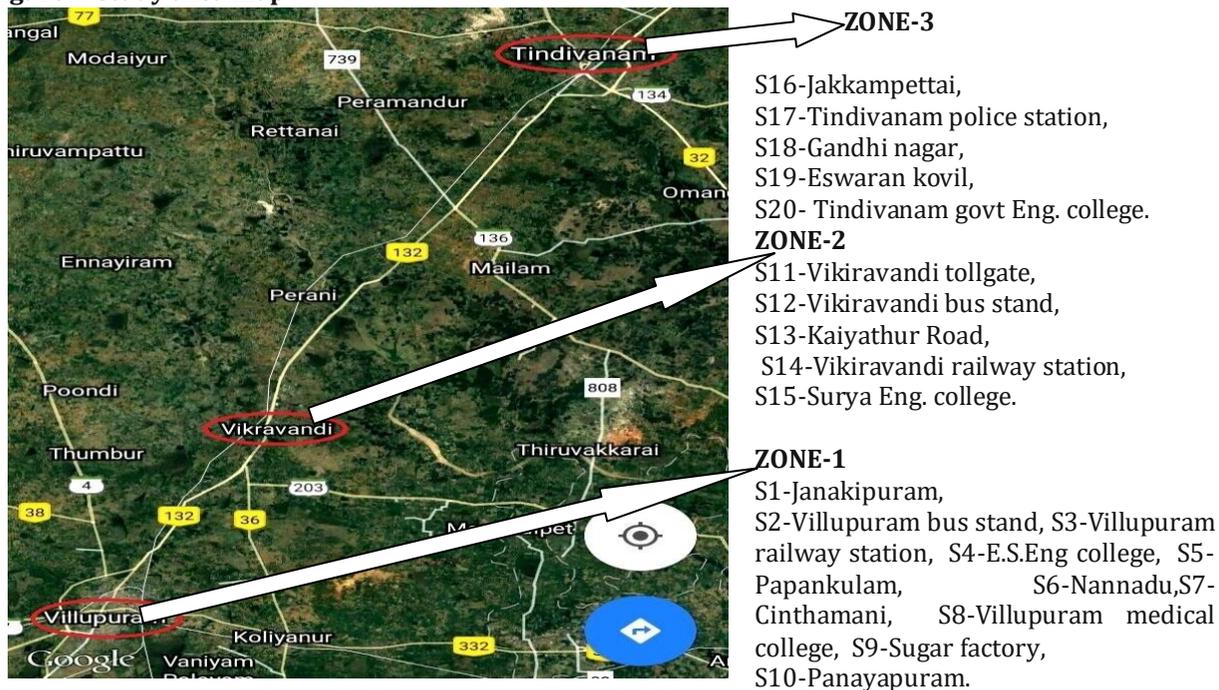
Ground water is an important source of drinking water and much of the world's population depends on this important natural resource for human consumption. The quality and purity of ground water has direct effect on human health. The problem of ground water quality is more acute in areas that are densely populated [1]. In many areas groundwater is polluted by human activities. In areas where material above the aquifer is permeable, pollutants can readily sink into groundwater supplies. If groundwater becomes polluted, it will no longer be safe to drink. The microbiological quality of groundwater is likely to arise from a variety of sources like leakage, infiltration and seepage of domestic sewage lines, household septic tanks, and infiltration from sewage treatment plants, earthen sewer lines, septic tanks, pits, lagoons, ponds, sanitary land filled areas and soak pits into the shallow aquifers. It is evidently important to control ground and surface water from the contamination. It is necessary to have a continuous monitoring on the water quality through microbial and chemical examinations. In general, safe drinking water should not have any infectious agents that are dangerous to human health and should be aesthetically acceptable to the consumer. Infectious agents that are found in drinking water in the first place are those caused by fecal contamination [2]. However, groundwater could be chemically, physically, or microbiologically contaminated. Each of which is linked to various sources and health related problems and consequences. Two main factors determine the chemical and microbiological composition of water quality: artificial and natural contamination. Any microbiological or chemical analysis of water reveals the combined effects of both sources of contamination, and it is usually impossible to fully identify and separate these sources [3]. The main source of microbiological contamination are microorganisms from human or animal excreta, which reaches humans through contaminated groundwater from wastewater, landfills, or wastewater treatment stations, causing serious health problems. For example, according to the UN, diarrhea accounts for 80% of all diseases and over one third of deaths in developing countries, which are caused by the patients' consumption of contaminated water [4]. Most of the gastrointestinal infections that may be transmitted through drinking water are transmitted via fecal-oral pathway [5]. Hence, the effects of improvements in the quality of groundwater were felt on the combat against endemic diseases such as typhoid and cholera in adults, and diarrhea in children [6]. The most commonly used indicators for bacteriological contamination are the coliforms: total and fecal coliforms and fecal streptococci. *E. coli* is a subgroup of fecal coliform group, and its presence indicates the fecal pollution of groundwater [7]. Detection of bacterial indicators in drinking water signifies the presence of pathogenic organisms that are the source of water-borne diseases [8].

2. DESCRIPTION OF THE STUDY AREA

Study Area:

The study area lies between Latitude N 11°56' and Longitude E 79°29' and is located in Northeast of TamilNadu in India, which is in the far southeast part of India, situated 160 km south of Chennai 160 km north of Trichy, 177 km east of Salem, 40 km west of Pondicherry it shares the seashore of the Bay of Bengal covering about 7217 Km² area (Figure-1). The area includes Villupuram, Vikravandi, Tindivanam.

Figure-1 Study area map



Rainfall

Villupuram district receives rainfall from both southwest and northeast monsoons. The annual normal rainfall for the district is 1046.8 mm (41.2in). The driest month is March with 6 mm (0.24in) with an average of 222 mm (8.7in) per annum, the most precipitation falls in October.

Climate

The district enjoys a tropical climate. The highest temperatures are recorded during May and June. The mean daily minimum and maximum temperature are 24.6 to 32.0° C. The average annual temperature 28.4.°c

Topography

The general geological formation of the district appears to be simple. The greater part of it is covered by the metamorphic rocks belonging to Genesis family. There are also three great groups of sedimentary rocks belonging to different geological periods. The Kalrayan Hills in the north represents a continuous range of hills covered with some thorny forests and vegetation. Among the hills, the most beautiful part of the district lies, round about the Gingee Hills.[13]

3. Materials and Methods

Collection of water samples

Groundwater samples were collected from 20 locations within the study area during month of Jan 2017 & Sep 2017, Sampling is done at each station in polythene bottles of two-litre capacity. The samples were analyzed for various water quality parameters such as **Total coliform and Faecal coliform** within 3 hrs of its collection. Microbial studies

Were carried out by MPN method

Most Probable Number (MPN) technique

This method is also called as multiple tube fermentation technique. This technique was used to detect the total coliforms. The test was performed sequentially in three stages namely the presumptive, confirmed, completed tests. Hi-media supplies dehydrated Double & Single strength MacConkey liquid media and EMB agar. To prepare this media an amount of the

dehydrated powder, (as mentioned on the container) is dissolved in 1 liter of distilled water and autoclaved to get the specific medium ready.

Presumptive test

- (i) First set of 3 test tubes containing 10.0 ml of double strength MacConkey liquid media and Durham's tube were inoculated aseptically with 10.0 ml of water sample.
- (ii) Similarly 1.0 ml and 0.1 ml of water samples was inoculated aseptically into each of three tubes of 2nd and 3rd sets respectively, each containing 5 ml of single strength MacConkey liquid media and Durham's tube.
- (iii) All tubes were incubated at 37°C for 2 days.
- (iv) Tubes were then observed for gas production after 24 and 48 hours. The presence of gas in any tube after 24 hr is a positive presumptive test, the numbers of tubes in each set showing gas production were counted and the most probable count number/100 ml of the water sample was calculated by comparing with McCrady chart, following the standard methods for examination of water given by APHA [9].

Confirmed test

This test was applied to all samples that give a positive or doubtful presumptive test.

- (i) Inoculum from the MacConkey liquid media tube showing positive presumptive test with least quantity of water sample, was taken and streaked onto a plate of Eosin methylene blue (EMB) agar and kept for overnight incubation at 37°C.
- (ii) If typical dark colored colonies with green metallic sheen developed (most probably colonies of *E. coli*) on the plate within this period, the confirmed test was considered to be positive.

Completed test

- i) From the EMB-agar plates, a single dark colored colony with metallic sheen (most probably colony of *E. coli*) was picked up and inoculated into 5ml peptone water and incubated at 37°C.
- ii) After 4 hrs of incubation of peptone water at 37°C, inoculum from the incubated peptone water was inoculated on to citrate slope.
- iii) Inoculated citrate media is incubated at 37°C, in an incubator. And the previously inoculated peptone water is further incubated at 44°C in a water bath for overnight incubation. Since, bacteria *Escherichia coli* (*E. coli*) and *Enterobacter aerogenes* (*E. aerogenes*) bear a close resemblance to each other in their morphological and cultural characteristics, biochemical tests were performed to differentiate between them.

These tests were

Indole test (I):

E. coli synthesizes an enzyme, tryptophanase, which forms indole, from tryptophan, i.e. it is positive for indole test, whereas *E. aerogenes* cannot catabolize tryptophan and is negative for indole test.

Citrate utilization test (C):

E. aerogenes is capable of utilizing sodium citrate as its sole source of carbon, i.e. it is positive for citrate test. *E. coli* does not grow under these circumstances and is citrate negative [10].

Categories used for water quality assessment

The microbial content is a very important water quality parameter because of its bearing on human health. Water can be classified based on microbial quality as shown in table 1 for human use safely.

4. RESULTS AND DISCUSSION

Table-1. Total coliform and Faecal coliform values of ground water for 2016 and 2017.

S.NO	2016						2017					
	JAN		MAY		SEP		JAN		MAY		SEP	
	TC	FC	TC	FC	TC	FC	TC	FC	TC	FC	TC	FC
S1	25	8	22	11	27	13	28	11	25	9	32	14
S2	17	5	14	8	19	10	20	8	17	6	24	11
S3	14	3	13	6	18	8	17	6	14	4	21	9
S4	11	2	10	5	15	7	14	5	11	3	18	8
S5	8	0	7	4	12	6	11	4	8	2	15	7
S6	1	0	0	0	5	0	4	1	4	0	8	4
S7	0	0	0	0	0	0	1	0	0	0	5	0

S8	0	0	0	0	0	0	0	0	0	0	0	0
S9	0	0	0	0	0	0	0	0	0	0	0	0
S10	0	0	0	0	0	0	0	0	0	0	0	0
S11	18	9	21	9	26	11	21	8	18	6	25	11
S12	6	2	13	7	18	9	8	3	5	2	12	6
S13	13	3	9	5	14	7	10	5	7	3	14	8
S14	9	2	12	6	17	8	12	6	9	4	16	9
S15	15	7	0	0	7	3	0	0	0	0	0	0
S16	11	5	0	0	6	2	0	0	0	0	0	0
S17	4	0	7	3	12	5	7	3	4	1	11	6
S18	2	0	4	0	9	4	5	0	2	0	9	3
S19	9	4	20	11	25	13	23	11	20	9	27	14
S20	5	1	5	3	10	5	8	4	5	2	12	7

Table-2. Summaries of Minimum, Maximum, Average, Median, Std deviation and Std error for TC and FC

S.NO	2016						2017					
	JAN		MAY		SEP		JAN		MAY		SEP	
	TC	FC	TC	FC	TC	FC	TC	FC	TC	FC	TC	FC
Min	0	0	0	0	0	0	0	0	0	0	0	0
Max	25	9	22	11	27	13	28	11	25	9	32	14
Average	8.4	2.55	7.85	3.9	12	5.55	9.45	3.75	7.45	2.6	12.45	5.85
Median	8.5	2	7	3.5	12	5.5	8	3.5	5	2	12	6.5
Std dev	7.13332	2.91051	7.576	3.892	8.73	4.383	8.696	3.71	7.695	3	9.9339	4.782
Std error	1.59506	0.65081	1.694	0.87	1.952	0.98	1.945	0.83	1.721	0.7	2.2213	1.069

Total coliform bacteria are known as “indicator organisms” meaning that their presence provides indication that other disease causing organisms may also be present in the water body. The total coliform count in the borehole water samples are ranged from 0-28, 0-25, and 0-32 in Jan, May and Sep months of 2016 and total coliform count in the borehole water samples are ranged from 0-25, 0-22, and 0-27 in Jan, May and Sep months of 2017. Most of the water samples were within the permissible standards of WHO (10/100 ml) drinking water standards.

The faecal coliform count in the borehole water samples are ranged from 0-9, 0-11, and 0-13 in Jan, May and Sep months of 2016 and faecal coliform count in the borehole water samples are ranged from 0-11, 0-9, and 0-14 in Jan, May and Sep months of 2017. Most of the water samples were within the permissible standards of WHO (0/100 mL) drinking water standards.

The possible of high coliform count could be the proximity of certain boreholes to pit latrines and poor sanitary completion of boreholes may have led to contamination of groundwater. Total coliforms can also originate from environmental sources such as soils or from biofilms. Although information on the depth of the sampled boreholes was not available, another possible cause of microbial contamination is the depth of the borehole [11,12].

During the study, it was observed that some of the boreholes are electrical such that the water is pumped into pipes for distribution. Rusty pipes affect the quality of water by allowing seepage of microbial contaminants into the borehole [13].

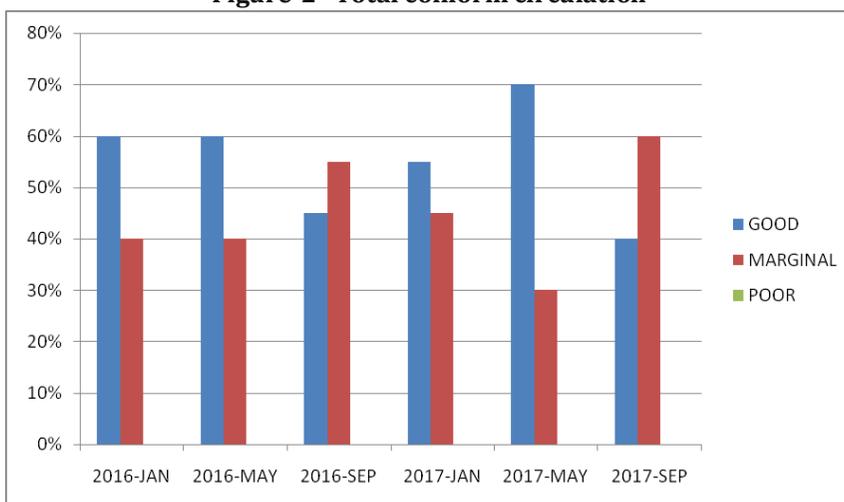
Table- 3. Classification of water based on microbial quality [14]

Parameter	Good	Marginal	Poor
Total Coliform	<10 cfu.100 ml-1	11-100 cfu.100 ml-1	> 100 cfu.100 ml-1
Faecal Coliform	0 cfu.100 ml	1-10 cfu.100 ml-1	> 10 cfu.100 ml-1

Table-4. Classification of water on microbial quality for 2016 and 2017

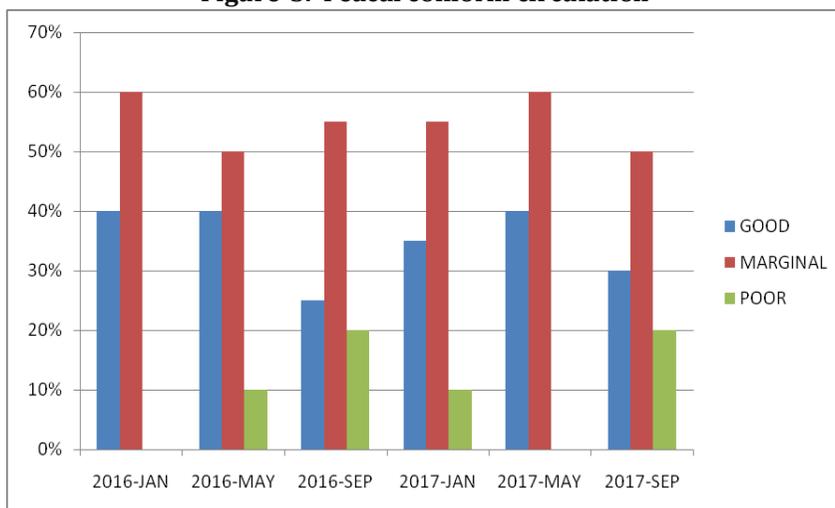
	2016		2016		2016		2017		2017		2017	
	JAN		MAY		SEP		JAN		MAY		SEP	
	T.C	F.C										
Good	60%	40%	60%	40%	45%	25%	55%	35%	70%	40%	40%	30%
Marginal	40%	60%	40%	50%	55%	55%	45%	55%	30%	60%	60%	50%
Poor	--	--	--	10%	--	20%	--	10%	--	--	--	20%

Figure-2 Total coliform circulation



The present study area values were classified into three types according to TC values, that is, good (<10 cfu.100 ml), marginal (10-100 cfu.100 ml), and poor (> 100 cfu.100 ml) categories. According to TC circulation in 2016 - 60%, 40%, and 60%, 40%, 45% and 55% of the samples fall in a good and marginal types in Jan, May and Sep. TC circulation in 2017 - 55%, 45% and 70%, 30%, and 40%, 60% of the samples fall in a good and marginal zones in Jan, May and Sep respectively.

Figure-3. Faecal coliform circulation



And also study area FC values was classified into three types, that is, good (0 cfu.100 ml), marginal (0-10 cfu.100 ml), and poor (> 10 cfu.100 ml) categories. According to FC circulation in 2016- 40%, 60% and 40%, 50%, 10% and 25%, 55%, 20% of the samples fall in a good, marginal and poor types in Jan, May and Sep. FC circulation in 2017- 35%, 55%, 10% and 40%, 60% and 30%, 50%, 20% of the samples fall in a good and marginal types in Jan, May and Sep respectively.

5. CONCLUSIONS

The study has revealed that borehole water of villupuram district is vulnerable to bacteriological pollution. It was found that change in the seasons (from winter to monsoon) did not have any impact on the quality of water except for the microbial quality of the borehole water which deteriorated extensively. Therefore, groundwater may not always be of pristine quality as is perceived.

For this reason, it is recommended that groundwater for human consumption is treated in the same manner as surface water sources before distribution to users. Early detection of possible contamination can lead to faster performance of corrective measures; preventing an imminent waterborne disease outbreak. Communities using borehole water as their source of water should be educated of the possible risks when borehole water is used for human consumption. Education should also include possible means of treatment of water such as boiling and use of chlorination tablets so as to prevent possible adverse health effects. In addition, community participation through protection of drinking water sources from contamination could help to improve the water situation in the area thereby ensuring a health environment. For example, regulations governing activities in the area especially pit latrine siting, best management practices for agriculture, general hygiene and appropriate storage practices at household level.

6. REFERENCE

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