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A STUDY ON DRINKING WATER QUALITY OF EDUCATIONAL INSTITUTIONAL AREA OF HAMREN SUB-DIVISION OF KARBI ANGLONG DISTRICT OF ASSAM, INDIA

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ABSTRACT

Thirty water sources are collected from different schools and public places in and around of Hamren Sub-Division of Karbi Anglong district. The sources of water are dug wells, ring wells, ponds, rivers and PHE supply. Water were analyzed for various physio-chemical parameters such as temperature, pH, turbidity, conductance, total solid, acidity, alkalinity, DO, BOD, COD free CO_2, hardness, bicarbonate, potassium, magnesium and microbiological examination.

Key words: Water Quality, Hamren, Karbi Anglong, Assam.

INTRODUCTION

Water is a basic need and extremely essential for all living organisms for survival. Ground water is the chief source of drinking water in India and this is only 0.61% of the total available water on the earth. Only 4% of world's fresh water resources are available in India, while India inhabitants 14% of the world population. This shows scarcity of water in India. Article 47 of Indian Constitution rests the responsibility of providing safe drinking water to the public with the State Governments. According to one estimate 94% of rural population and 91% of the urban people have access to safe drinking water[2]. The availability of water to India is almost fixed due to limited resources. But, with growing Indian population the per capita avaibility of water is steadily reducing; and when this drops below 1700 m^3 /person/year, India will be water stressed[3].

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In this communication, we have reported drinking water qualities of educational institutional areas of Hamren Sub-Division, Karbi Anglong, Assam.

Hamren Sub-Division located in the middle part of Assam, surrounded by N.C. Hills, Nagaon, Morigaon districts of Assam and Meghalaya state. The total projected population is around 3 lakh. The area is valley like place having hilly rivers and vast cropland. The area surrounds with rural area. The most of the rural people are poor and illiterate. They are not concerned with the chemistry of water and they use the available water from the traditional sources of water like ring wells, dug wells, ponds, springs and river without aeration. So it is important to determine the physical and chemical quality of water for human welfare. The climate of the locality becomes dry from November to April and the climate of this Sub-Division is characterized by a highly humid atmosphere all through the year (Assam State Gazette, Volume 1999). The maximum temperature is around 40^{o}C during July and August and minimum temperature becomes as law as below 12^{o}C during winter seasons.

EXPERIMENTAL

Study area

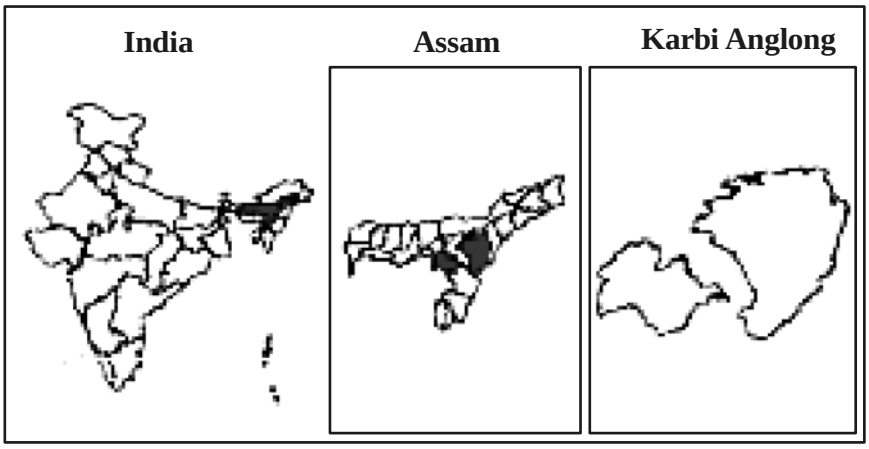
The Karbi Anglong Distrcit is situated in the central part of Assam. It is bounded by Golaghat district in the east, Meghalaya and Morigaon district in the west, Nagaon and Golaghat district in the north and N. C. Hills district and Nagaland in the south. The district with dense tropical forest covered hills and flat plains is situated between 25^{o}33' N to 26^{o}35' N Latitude and 92^{o}10' to 93^{o}50' E Longitude.

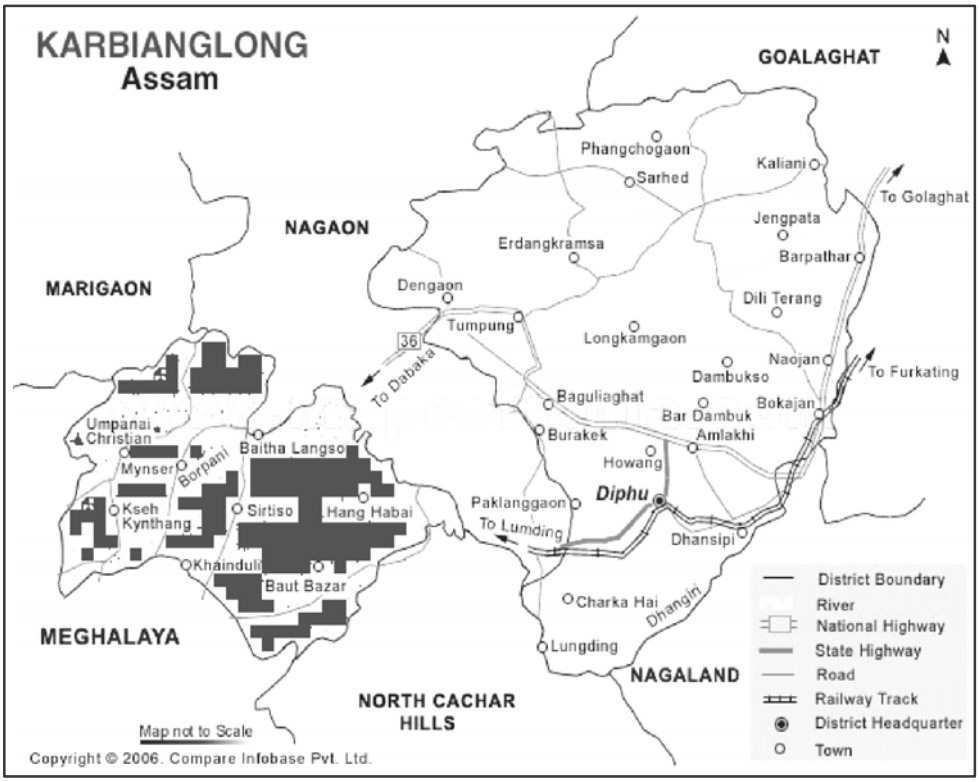
Due to variation in the topography, this hill zone experiences different climates in different parts. The winter commences from October and continues till February. During summer, the atmosphere becomes sultry. The temperature ranges from 6^{o} to 12^{o} and 23^{o} to 32^{o} Celcius in summer. The average rainfall is about 2416 mm.

The population of the district is predominantly tribal. The major tribal ethnic groups of this district are Karbis, Bodos, Kukis, Dimasas, Hmars, Garos, Rengma Nagas, Tiwas, Man (Tai Speaking's). Besides, a large number of non-tribals also live together in this hill region.

Literature review

In developing country like India, the ground water continuously going to polluted due to population explosion and inadequacy waste disposal facilities, which results serious problem in cities and Industrial areas.





The quality of ground water in many parts of the country was found to be degraded. Many studies have been reported that high fluoride content was found in tube well, ring well etc. The fluorosis endemic states are Andhra Pradesh, Assam, Bihar, Delhi, Gujrat, Haryana, Jammu Kashmir, Madhya Pradesh, Kerala, Tamilnadu and Uttarpradesh in India.

Pradesh pointed out that nitrogen is essential to maintain the life balance in natural echo system. However, if nitrogen level high in form of nitrate it is harmful to man and animal. High nitrate content has been found in Cuddapath town (Andhra Pradesh, Sikandrabad, Hyderabad, Nagpur, Chennai etc.).

Heavy metals particularly lead, iron, arsenic were found in ground water of Faridabad District, of the toxic metals like Sc, Cr, Se, Cd, Sb and Hg were found in Delhi, Allahabad.

In Bardhaman district, Murshidabad (West Bengal) the Arsenic level were found very high. There are various reports that high concentrations of heavy metals in various parts of India were detected.

The situation of Assam as well as North-Eastern region is not better and more or less same as the rest of the country. The surface water of greater Guwahati has been found contaminated by iron. The well water of Arunachal Pradesh has been found high bacteriological contamination. The trace metals Zn, Cu, Co, Ni, Pb were found in Lawkhowa oil field in Assam. The ground water of Nagaon district, Assam was polluted due to high concentration of fluoride.

Due to Chronic pollution of surface water there is scarcity of safe water supply, the toll of water related disease is frightening in its extent particularly in the third developing world. Millions of people die every year as the consequence of unsafe water.

Municipal waste water us a major source of contamination of water bodies in urban areas. The municipal waste water carries (1) Domestic or sanitary waste water (2) Industrial waste water from small and large industries within municipal areas. The waste water is rich in nitrogen and phosphorous for excessive microbial growth. Inflow of domestic waste water also introduces considerable amounts of phosphates and borates from the use of detergents and washing powder.

Methodology

Thirty (30) water samples were collected in winter season for a period November 2011 to January 2012 from eight dug well, three ponds, twelve ring well, three river, two PHE supply and two spring water. Temperature was determined in the field. pH (Digital pH meter) turbidity (Nephelometer), conductance (Conductivity meter) and total dissolved solid (Evaporation method) were determined.

Acidity, total alkalinity, D.O. free CO_2 total hardness, bicarbonate, calcium and magnesium were analyzed by volumetric titration methods.

Sodium and potassium were measured by digital flame photometer. In each case 2500 mL of a sample were collected and methods used were as per APHA (1989), 1995, Maiti 2003).

BOD into a BOD bottle at 20^{o}C for five days. The value is represented as BOD^{20}_{5} and COD is measured by open reflux method. The values were compared with WHO value.

RESULTS AND DISCUSSION

Table 1: Sources of ground water and their locality

S. No.	Sampling station	Place	Nature of source
1	Amguri LP School	Amguri	DW
2	Borgaon LP School	Borgaon	P
3	Dalimbari LP School	Dalimbari	DW
4	Borkok High School	Mazgaon	DW
5	Enghin Abae LP School	Enghin Gaon	RW
6	Umsawi ME School	Umsawi	RW
7	Tokbi Rmso LP School	Ramso Tokbi	RW
8	Hadao LP School	Hadaw	RW
9	Langhteng LP School	Lanteng Teon Gaon	RW
10	Umchera ME School	Umcheragaon	RW
11	Rongkor LP School	Rongkar Krogaon	RW
12	Hamren Model LP School	Hamre Bazar	RW
13	Hamren HS School	Hamren Habe	PHE
14	Mailo Bazar LP School	Mailo Dengja	RW
15	Baithalangso HS School	Baithalangso	RW
16	Hongkram LP School	Hongkram Langherang Gaon	RW
17	Borthal ME School	Raja Gaon	RW
18	Dokamokam High School	Dokmamukam	DW
19	Satgaon High School	Satgaon	DW

Cont…

S. No.	Sampling station	Place	Nature of source
20	Turmpreng HS school	Tumpreng Bazar	DW
21	Kalanga High School	Krungieng	P
22	Kalanga ME School	Klengdum	P
23	Mugasong LP School	Mugasong	DW
24	Karbi Rongsopi LP School	Hemari Tisso Gaon	R
25	Sildubi LP School	Sildubi	DW
26	Langmapi ME School	Langmepi	R
27	Deuri Engleng LP School	Deuri Engleng	R
28	Angawadi Centre	Malaber	S
29	Dayanmukh High School	Dayangmukh	PHE
30	Hawaipur HS School,	Hawaipur Reserve	DW

Abb: DW-Dug well, P-Pond, RW Ring well, R-River, S.W – spring water, PHE-Public Health Engineering Supply water

Table 2: Value of parameter in different sources

S. No.	Sources	pH	Temp. (^oC)	Conductance µmho/cm	Turbidity N.T.U	Total solid (mg/L)	Acidity (mg/L)	Total akalinity (TA)	Free CO_2 (mg/L)
1	DW	7.1	15	110	2.7	42	48.5	180	9.9
2	P	7	18	200	2.8	43.6	50	200	10
3	DW	7.5	16	99	1.5	56	48	450	6
4	DW	6.3	13	105	4.1	114	42	300	7
5	RW	6.5	17	320	3	48	150.5	20	20
6	RW	6.7	18	155	1.9	109	20	20	25
7	RW	7.0	17	110	18.9	117	40	20	10
8	RW	7.5	14	335	2.8	100.3	64	60	12
9	RW	8.3	17	125	3	103	65.4	40	20
10	RW	7.4	14	98	5.1	136	41	80	23

Cont…

S. No.	Sources	pH	Temp. (^oC)	Conductance µmho/cm	Turbidity N.T.U	Total solid (mg/L)	Acidity (mg/L)	Total akalinity (TA)	Free CO_2 (mg/L)
11	RW	8.5	19	200	16.7	94.5	30	220	22
12	RW	6.6	20	160	17	80	80	60	26
13	PHE	8.1	16.9	425	4.4	71.2	65.5	100	16
14	RW	7.7	16.3	650	16.7	105.0	20	80	18
15	RW	7.2	17	1442	5	118.5	52	102	40
16	RW	7.4	15	978	3	466.6	58	40	42
17	RW	8.1	14.5	655	17	281.2	66	111	55
18	DW	7.9	18	125	6.8	540	20	40	35
19	DW	7.1	21	102	16.7	260	28	300	53
20	DW	8.5	19.2	850	15.8	272.5	63	102	60
21	P	7.7	18.7	160	15	163.7	23	64	35
22	P	7.1	16.3	1280	10	154.5	55	110	32
23	DW	7.0	20	850	9.8	395.6	40	180	30
24	R	7.5	17	98	5.1	117.2	42	200	26
25	DW	7.1	20	1240	4.4	56	48	60	55
26	R	7.6	16.3	155	4.6	48.9	152.5	70	12
27	R	8.0	17	110	3	109.3	64.5	90	7
28	S	7.1	15	430	5	103.5	30	60	42
29	PHE	7.4	17	625	13.7	87.5	80	70	58
30	DW	7.6	16	160	9.8	70.1	81.3	71	41

Table 3: Value of parameter in different sources

S. No.	Sources	Bicarbonate (HCO_3) mg/L	Total Hardness (TH) mg/L	Na mg/L	K mg/L	Ca mg/L	Mg mg/L
1	DW	38	150	6.5	2	118.5	140.3
2	P	40	62	7.1	1.5	8.1	19.3
3	DW	34	160	3.1	15	77.4	30.2

Cont…

S. No.	Sources	Bicarbonate (HCO_3) mg/L	Total Hardness (TH) mg/L	Na mg/L	K mg/L	Ca mg/L	Mg mg/L
4	DW	45	132	2	10	180	50.4
5	RW	60	300	43	3	77.5	20.5
6	RW	185	400	8	8	88	145.5
7	RW	120	50	28	5.1	10	12.5
8	RW	85.3	44	1.1	28	7.6	19.5
9	RW	181.2	148	2.6	4.8	102	18.5
10	RW	156.1	120	7.4	5.2	100.5	3.5
11	RW	300.5	48	28	4.1	105	11.5
12	RW	200	62	6.5	5	10.3	15
13	PHE	45	51	5.5	15.5	96.5	12.5
14	RW	30	62	2.6	3.6	68.4	25.8
15	RW	25	130	7.4	23	87.9	20.5
16	RW	280	151	19.8	22.5	8	20.1
17	RW	23	140	1.3	5.4	10.7	12.5
18	DW	65	59	16.4	2.2	152	30.2
19	DW	80	70	1.9	2.9	20	18.2
20	DW	68	140	26	5.3	103	20.8
21	P	50	56	19.8	20.1	68.5	17.8
22	P	35	140	2.4	15	107.8	20.7
23	DW	65	70	2.7	8	8	21
24	R	180	56	2.3	8.4	20.1	19
25	DW	68	74	24	4.3	152	150
26	R	180	230	24.6	5.7	108.8	15.3
27	R	270	140	5.5	6.7	97.5	8.5
28	S	200	120	2.8	17.5	10.8	21.5
29	PHE	182	51	3.8	9.3	34.5	17.2
30	DW	65	50	4.2	8.4	52.3	15

Table 4: Value of parameter in different sources

S. No.	Sources	DO mg/L	BOD mg/L	COD mg/L
1	DW	5.6	3.4	31.7
2	P	6.3	5.7	40.2
3	DW	5.5	4.5	25.9
4	DW	4.9	3.3	30.2
5	RW	5.7	3.6	17.2
6	RW	4.2	1.3	18.6
7	RW	5	1.3	24.9
8	RW	2.9	3.9	48.8
9	RW	5.6	4.9	46.7
10	RW	4.9	3.7	36.4
11	RW	5.6	4.8	45.9
12	RW	6.7	4.2	51.3
13	PHE	5.7	3.7	45.9
14	RW	5.9	3.5	31.6
15	RW	4.8	2.7	45.8
16	RW	2.2	2.9	57.3
17	RW	7.1	5.4	57.9
18	DW	5.8	4.9	41.8
19	DW	4	4.9	41.5
20	DW	5.2	3.4	38.1
21	P	3.9	6.1	56.7
22	P	5.4	5.4	57.6
23	DW	5.4	4.5	76.6
24	R	4.8	5.0	55.1
25	DW	5.2	6.1	39.8
26	R	5.2	3.3	35.2
27	R	4.6	3.8	67.9
28	S	4.2	4.4	43.9
29	PHE	4.8	5.3	60.2
30	DW	4.7	5.4	56.1

Table 5: Guideline values/ permissible limits for water quality in drinking water

Parameter	WHO	ISI[7]	ICMR	EPA	USPH	BIS[2,3]
pH	6.5-9.2	6.5-8.5	6.5-9.2	6.5-8.5	7-8.5	8.5-9
Conductance (µmho/cm)	1500	-	-	-	-	-
Turbidity (N.T.U)	5-25	5-10	5-25	-	2.5-5	5.-10
TS (mg/L)	200-1500	-	1500	500	500	500-2000
Acidity (mg/L)	-	-	-	-	-	-
TA (mg/L)	200	200-600	-	-	-	200-600
FCO_2 (mg/L)	-	-	-	-	-	-
HCO_3 (mg/L)	-	-	-	-	-	-
D.O. (mg/L)	4-6	-	3-6	-	-	-
B.O.D (mg/L)	6	-	-	-	-	-
C.O.D (mg/L)	10	-	-	-	-	-
TH (mg/L)	200-600	300-600	300-600	-	200	200-600
Na (mg/L)	200	-	-	-	-	-
Potassium (mg/L)	-	-	-	-	-	-
Ca (mg/L)	75-200	75	75-200	-	75	-
Mg (mg/L)	30-150	30-150	50-150	-	30	-

Abb : N.T.U.- Nephelometric turbidity unit, TS- Total solid, TA- Total alkalinity, FCO_2- Free CO_2, D.O.- Dissolved oxygen, B.O.D- Biological oxygen demand, C.O.D- Chemical oxygen demand, TH- Total hardness

Microbiological examination

Microbiological examinations of waters enjoy a special status in studying the water quality. In this examination the Most Probable Number (MPN) indices of total coliform organisms as well as faecal coliforms were determined using the multiple tube fermentation technique. The method is based on the ability of coliform organisms to ferment lactose sugar producing an aldehyde and carbon dioxide gas. The fermentation was carried out in an incubator (SICO, India) at 350.5^{o}C for total coliforms and at 440.5^{o}C for faecal coliforms. These presumptive tests were confirmed following standard procedure. The presence of *E.Coli* was tested by the indole formation test and was confirmed by differential test. The

MPN values were calculated on the basis of number of positive and negative presumptive tests (Greenderg et al., 1985; ICMR, New Delhi, 1963; Ananthanarayan, 1987; Raina et al., 1984).

The measured Most Probable Number (MPN) indices of coliform organisms ranges lie between -

1. 7 to 1002 MPN/100 mL in deep tube wells
2. 128 to 9500 MPN/100 mL in ring wells
3. 2200 to 26000 MPN/100 mL in ponds

5 NIL to 720 MPN/100 mL in supply water

The faecal coliform organism in surface water are - *Escherichia coli* (85%), *Citrobacter freundir* (3.5%), *Enterobacter cloacae* (17%), *Klebsiella oxyloea* (0.8%), *Citrobacter diversus* (0.8%) and 5.2% unidentified.

In the present work, it was found that the coliform organisms were present in excessive amounts in all the water samples except supply water. The degree of contamination with coliform of drinking water in our study area was low in case of supply water compared to other sources. Moreover water of tube wells have found lower coliform compared to ring well, ponds and rivers. Thus tube wells are successful as a source of drinking water in many parts of India. They yield water which bacteriologically safe (Park, 1994).

Narayan Rai and Sharma studied the bacteriological contamination of ground water in rural areas of North West Uttar Pradesh.

Bacteriologically, the quality of the drinking in all the sources of water is not satisfactory and proper treatment is essential before using it for drinking purpose.

According to WHO guideline the number of coliform organism and number of faecal coliforms per 100 mL should be Nil in the drinking water, so in the present study drinking water from all the sources in contaminated with *E. Coliform* organism and faecal coliforms and unit for drinking purpose.

The pH of ground water samples ranging from 6.3-8.9 were found to be within the permissible value of various regulating agencies. Temperatures of ground water samples have no abnormal range. Electrical conductance is related to total solid dissolved in water

conductance values / testing samples gives the idea that recharge of ionization takes places. There is no abnormal turbidity in the dug well and ring well water sources. Greater the turbidity in water may be used as a polluted water. The dug well (DW-3) has minimum turbidity (1.5 N.T.U.) and ring well (RW-7) has maximum turbidity 18.9 (N.T.U.).

The maximum permissible limits of total solids in drinking water are 1500 mg/L (WHO, 1984, ICMR, 1975) and 2000 mg/L (B.I.S 1983). Total solids may be due to both total dissolved and suspended solids. The maximum total solid (1185 mg/L) found in dug well are within the limits. Acid have no definite values of the international and national agencies. The acidity of water makes it sour and is corrosive to carrying pipes of drinking water and also in body. Alkalinity makes drinking water bitter. The alkalinity of water is due to hardness calcium and magnesium. Maximum alkalinity (450 mg/L) found in dug well (Source-3) was even less its permissible limit of ISI 1991 (600 mg/L). Bicarbonate contributes alkalinity to water and its level up to 400 mg/L is not hazardous to human health. All values of bicarbonate are within the permissible limit 400 mg/L.[5]

Free CO_2 in underground water is one of the polluted and it is due to sewerage of microbiological qualities underground water had more than 10 mg/L of free CO_2, which may be ascribe to presence of decomposable matter in it. The maximum free CO_2 is observed in the ring well (Source-9).[5]

Dissolved oxygen (D.O.) is one of the important water quality parameter and its content in all water samples was within its WHO's limit (4-6 mg/L).

BOD is the quantity of oxygen required for the oxidation of organic matter by the bacterial action in the presence of oxygen. In fact BOD is a measure of the strength of organic matter in terms of its ability to decrease in matter. Like DO, BOD, is also an appropriate index for assessing the pollution load in water bodies. The highest BOD (10 mg/L) was observed in the pond water (Source-23) and lowest BOD observed in the dug well (DW4).[6]

Chemical oxygen demand (COD) is a measure of total organics present in water both biodegradable and non-biodegradable. Highest C.O.D. (125 mg/L) was observed in the pond water (Source-23) which is higher than any of the national and international standard.

The alkaline earth metals, calcium and magnesium contribute mainly to water hardness. The main sources of these ions are weathering of rocks, shale and aquifer materials. Generally ground water is much harder than surface water. Groundwater of both dug and ring wells belonged to hard and very hard categories and its maximum hardness was

observed in the ring well sources-6 (400 mg/L) Maximum permissibility of of hardness is 600 mg/L (WHO 1984). Hardness causes scaling and also disturbs human stomach due to variation in osmotic pressure. Calcium (7.4-180 mg/L) and magnesium (3.5-150 mg/L) content varies greatly in the ground water samples during the present study. Sodium (1.1-43 mg/L) and potassium (1.5-28 mg/L) contents also varied in the ground water samples. Of course sodium and potassium has no effect on human body but excessive sodium intake causes blood pressure and hypertension.[4]

Considering the parameter hardness, water is classified as moderately hard water (60-200 mg/L), hard (120-180 mg/L) and very hard (>180 mg/L). Present study revealed that the ground water's of Hamren Sub-Division, Karbi Anglong, Assam belonged to moderately hard and very hard categories and therefore a proper management is needed to reduce it.

The values of coliform bacteria is considerably high in ring well, ponds and rivers, this may be due to improper waste disposal, the presence of unlined sewages and sanitary condition.

Positive confirmatory test for *E. Coli* as the predominant coliform organism in most of the sampling points indicate the contamination to be faecal inorigin. The presence of coliform bacteria in the water sources from sewage and faeces of animals from various sources, which is undesirable for human consumption. Their presence also indicates the possibilities of occurrence of pathogenic organisms in the water sources.[8]

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