ORIGINAL ARTICLE

Determination of the Level of Contamination of Underground Water (hand- dug well) by Organic Waste: A case Study of Ado-Ekiti, Nigeria.

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Abstract

The recent increase in urbanization has lead to increase in city population, spatial size, and generation of waste. This is a common phenomenon in Nigeria Cities, where Ado-Ekiti is a typical example. With the ever increasing population coupled with increasing waste (contaminant) generation and high demand for potable water, there have been reported cases of water associated health problems in the state specialist hospital. The aim of this study is to determine the level of contamination of hand-dug well which is one of the major source of water supply for the population. Water samples were taken from a total of fifteen wells at the vicinity of three major refuse dumpsite taking measurement of depth of the well, diameter, volume of water, distance to toilet and dumpsite and the physical condition of the wells. The determination of bacteria level was done using, Experimental scientific set standard. The total coliform bacteria count shows that the water is exposed to serious and complex contaminations, which indicates source pollutant of sewage and faecal materials from man and animal. With the findings, location, design and construction of wells should not be determined by only hydro geological facts, but a set standard that will put distance from toilet/dumpsite into consideration should be strictly followed. Also health workers should carry out regular monitoring of the well for contaminations.

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INTRODUCTION

The town of Ado-Ekiti in Ekiti central local Government Area of Ekitl state is located between latitude $7^0$31' and $7^0$49' north of the equator and longitude $5^0$7' and 5^0 27 east of the Greenwich Meridian. It is bounded in north by Ido-Osi and Oye Local Government Areas, in the west by Ijero and Ekiti-south west, Ikere and Emure-Ise-Oru tocal Government Areas Ado Ekiti has a planimetric area of about 84km^2 (Ebisemiju, 1989).

Ado- Ekiti is supplied by a single water work built on the Ireje River in the late sixties to provide potable water for about 263, 377 people (National population census, 1962). The geometric increase in population has made the dam unable to provide adequate water for the present population of 900,000 (National population census, 1991). The consequence of this is that the people of Ado-Ekiti are faced with the problem of water shortage and are left with sourcing of water from hand dug wells and rivers.

Initially the main aim of digging wells is to obtain potable water that is free from contamination. However, reported cases of water related health problem was frequently reported in the state Specialist Hospital and this was, also linked to the consumption of water from the wells. The man objectives of the study is to determine the level of contamination from the wells compare the level of contamination with the world Health recommend level permissible for consumption, Identify the source of contamination (s) and possibly make recommendation (s) on the findings.
This study is prompted by observation of the unhygienic nature of the wells and reported cases of health problem associated with consumption of water from the wells. There are many studies carried out on subsurface water and their possible contamination by microbial organism pickup et al (1990) reported that aquatic ecosystem contain characteristic bacterial communities such as E. Coli and Faecal Coliform

Material and sample collection

Pre-sampling (population and site)
In carrying out the pre-sampling, topographical map and residential map of Ado-Ekiti were made use of to locate three dumpsite that are in constant use in the city center. Five wells at different location of the dumpsite were picked as study wells (totaling fifteen wells), they were closely monitored to know the demand on them by the inhabitant, distance to dumpsites and latrines, the general physical condition of the wells and surrounding environment (depth of well and volume of water to the surface) were carefully studied and presented in table one and two below,

Table 1 Distance of wells from Refuse Dumpsite/Toilet

Dumpsite S/N	Well site No	Distance from Toilet Dumpsite (m)
1	WS A 1	15.60
2	WS A2	10.22
3	WS A3	15.32
4	WS A4	16.48
5	WS A5	19.54
6	WS B1	11.20
7	WS B2	18.02
8	WS B3	21.96
9	WS B4	17.44
10	WS B5	17.33
11	WS C1	15.42
12	WS C2	16.25
13	WS C3	15.23
14	WS C4	19.56
15	WS C5	23.50

Source: Derived from field source

Table 2 General Condition of Well And Dumpsite

Dumpsite S/No	Sample Sample No	Location Address	Condition of well and Environment
1	Ds A1	Jakeyemi House 7 odo otu street of post office	Well not ringed contain algar, close to dumpsite
2	Ds A2	Sabo Mosque off Iron astreet	Ringed not covered close to toilet
3	Ds A3	No 3 Igbehin street	Not ring, covered, contain clay suspension and close to toilet
4	Ds A4	18 Ajilosun street Ikere Road	Close to refuse dump tinged and covered
5	Ds A5	49 Ajilosan Street Ikere road Ado Ekiti	Not ringed, not covered contain clay suspension
6	Ds B1	8 Irems street Odo Ado	Not ringed, close to dumpsite and toilet, contain algar
7	Ds B2	Ayisola street Odo-Ado	Not ringed, not well kept contain clay suspension
8	Ds B3	No 26 Iremo street Odo-Ado	Not ringed, not well kept contain clay suspension
9	Ds B4	Iremo Street Odo-Ado	Uncovered, close to toilet hove clay suspension
10	Ds B5	Iremo Street Odo-Ado	Uncovered, close to toilet have clay suspension
11	Ds C1	No 6 Kajola Strect Okeyimi	Fairly kept, close to toilet have clay particles
12	Ds C2	No 7Stadum Oke-lyime	Close to dumpsite, not covered
13	Ds C3	No 8 kajola Street	Contain algar and close to toilet
14	Ds 14	No 19 kajola strect off stadium road	Contain agar, contain clay suspension.
15	Ds 15	No 19 Kojola street off stadium road	Well covered, sited in best environment

Source: Derived from field source

Sampling

A graduated measuring stick about twelve meters (12m) was design to measure the depth of the water to the surface Two liter plastic boltless were washed thoroughly and severally with detergent, rinsed with distilled water and finally filled with the water to be sampled and covered with cellophane paper, cotton wool soaked in menthylated spirit round the neck of the bottle to prevent evaporation and to prevent external microbes respectively.

Field test

The field-test involved measurement of some physical parameters of the wells, which include the well depth to water surface, distance to dumpsite and latrines, odour, diameter and taste of water from the wells.

Laboratory Analysis/Result

The Laboratory test was done in two directions, to know the total number of bacteria and coliform count to trace source pollutant.

METHOD OF BACTERIAL ANALYSIS

i. Enumeration of total Bacteria count

Bacterial plate count was carried out using the pour plate method with nutrient agar. The method depend on the serial dilution of the water. Sample which is prepared into each sterile Petri-dish 20 ml of molten nutrient agar cooled to about 45^0c was poured into each Petri dish containing 1.0ml of water sample, then to the molten medium and inoculation were quickly but carefully mixed by a combination of "to and for" and circular movement for about 5-10 seconds. The plates were allowed to cool and set, after which they were then incubated in an inverted position at 37^0C. After 24-48 hours of incubation, the plate counts was done by using colony counter and the count multiplied by the dilution ratio.

Table 3 Bacteriological Analysis Enumeration of Total Bacterial count

S/N	Sample No	Cuf/ml	Distance From dumpsite/ Laterines (m).
1	Ds A1	$0.17x10^4$	15.60
2	Ds A2	$2.17x10^4$	10.22
3	Ds A3	$1.50x10^4$	15.32
4	Ds A4	$1.52x10^4$	16.48
5	Ds A5	$1.32x10^4$	19.45
6	Ds B1	$1.76x10^4$	24.92
7	Ds B2	$1.29x10^4$	11.40
8	Ds B3	$3.33x10^4$	22.40
9	Ds B4	$0.37x10^4$	10.20
10	Ds B5	$0.25x10^4$	23.30
11	Ds C1	$0.15x10^4$	15.42
12	Ds C2	$1.80x10^4$	16.24
13	Ds C3	$2.2x10^4$	15.23
14	Ds C4	$1.30x10^4$	19.95
15	Ds C5	$2.20x10^4$	23.5

Source: Derived from laboratory data

METHOD OF ANALYSIS OF TOTAL COLIFORM

ii. Enumeration of total coliform

Twenty millimeter (20 ml) of the molten Macorkey agar was poured into the Petri-dish containing 1.0ml of water sample from serial dilution, mixed thoroughly and allowed to set. The plate were incubated at 37^0c for 24-48 her for which the visible colony was counted and then obtained.

Table 4 Enumeration of Total Coliform Count

Well S/N	Dumpsite/well number	Coliform count (cuf/ml	Distance to dumpsite/latrine (m)
	D-SA		
1	1	$0.035x10^4$	15.60
2	2	$0.450x10^4$	10.22
3	3	$0.003x10^4$	15.32
4	4	$0.033x10^4$	16.48
5	5	$0.020x10^4$	19.45
	D-SB		
6	1	$0.350x10^4$	24.92
7	2	$0.300x10^4$	11.40
8	3	$0.046x10^4$	22.10
9	4	$0.074x10^4$	10.20
10	5	$0.005x10^4$	23.30
	D-SC		
11	1	$0.030x10^4$	15.42
12	2	$0.035x10^4$	16.24
13	3	$0.440x10^4$	15.20
14	4	$0.080x10^4$	19.59
15	5	$0.040x10^4$	32.50

Source Derived from laboratory data.

Well Diameter/Water Volume

There are no significant variations in the values obtained in the diameter of the wells, which varies between 0.98m (well 13) and 1.27m (well 10). Well sample 1,4, 8 and 9 have water volumes of 3.46, 4.56, 4.36 and 3.80 cubic meters (m^3) respectively. Well sample 13 contains the least volume of water ($0.29m^3$) as represented in table 5

Table 5 Well Diameter/ Water Volume

S/N	Well sample	Well depth (m)	Depth to water surface (m)	Water column	Well Diameter (m)	Water volume (m^3)
	D-SA					
1	1	5.30	2.44	2.86	1.24	3.46
2	2	5.32	2.60	2.72	1.20	3.08
3	3	3.54	2.61	0.93	1.03	0.78
4	4	5.00	0.20	4.80	1.10	4.56
5	5	9.00	5.02	3.98	1.80	3.63
	D-SB					
6	1	7.01	4.82	2.19	1.02	1.80
7	2	6.40	1.00	2.40	1.20	2.72
8	3	7.52	2.50	5.02	4.05	4.35
9	4	6.00	2.60	4.60	1.02	3.80
10	5	6.20	2.69	3.59	1.27	4.57
	D-SC					
11	1	4.50	2.51	1.99	1.02	1.63
12	2	5.10	2.41	2.69	1.10	2.56
13	3	6.50	2.31	4.19	0.98	0.29
14	4	4.82	1.00	3.82	1.08	3.50
15	5	4.93	5.03	2.42	1.20	2.84

Source: Derived from field source

DISCUSSION

All the sampled wells are close to either open toilet/latrines or refuse dumpsite well sample 5, 14 and 15 are noted to be a bit farther than others by 19.54, 19.56 and 23. 50 meters away from the toilet respectively most of the water from the wells are odorless, while well samples 2,3,11 and 15 give unpleasant smell.

Coliform bacteria occur in high quantity in human faeces, and detected occurrence are as low as one bacterium per 100ml. Hence, they are sensitive indicators of faecal pollution. E. coli test in water sample is usually done using the membrane filter technique (W.H.O 1984, 1987). The filtration method determines the number of organism in measured sample which filtered through 0.45 um pore diameter membrane filter and incubated face upward in a selective medium.

The total bacteria count was carried out using Nutrient Agar. The highest count is observed in sample 2,8,13 and 15. The degree of pollution varies with depth of well and the closeness to toilet/dumpsite.
The coliform count carried out using Mac-Counkey aga to trace the source of pollutant bacteria, indicate well sample 1,2,6,7 and 13 having high coliform count.

The result shows that the wells are generally shallow and close to toilet/refuse dumps which are littered with animal and human waste, decaying plants and animals remains which are host to coliform bacteria.

CONCLUSION

The total coliform bacteria count in the samples show that the well are exposed to serious and complex pollution. The degree of pollution varies with depth of the well and their closeness to toilet/refuse dumps. From a very close observation, the town is generally littered with animal and human faeces, refuse, dead plant and animal remain that are host to coli form bacteria. According to Twort et al, (1985), coliform count indicate the likelihood of sewage

pollution, and faecal coliform count confirms the pollution source as that of human or animal origin. Also, the result obtained through the observed coliform bacteria count indicate that the bacteria content is above the recommended value by the World Health Organization (W.H.O) of less them 10 coliform bacteria per 100ml of water (6). The high level of coliform is directly traced to improper faecal, household waste and unhygienic nature of getting water out of the wells there by rendering it questionable for human consumption.

Table 6 WHO Bacteriological standards for drinking water

E. Coli/100ml of water	Category	Desirable level
0	A	Excellent
1-10	B	Acceptable level, adequate sanitary precaution
10-50	C	Unacceptable, disinfect source and equipment
Above 50	D	High degree of pollution, need serious treatment before consumption

Source: World Health organization 1983

RECOMMENDATIONS

Location, design and construction of wells should not be determined by hydro geological consideration alone but a set standard on how and where to site a well putting into consideration distance from dumpsite, latrines and slope of the area.
Efforts should be made by state and local authorities to provides public latrines and household waste dumpsite, taking into consideration the geologic nature of the area to prevent underground infiltration of leached substance from the dumpsite and latrines.

Routine check should be carried out by Health Authority on the wells in the area to detect and control any further contaminations.

APPENDIX

Nutrient Agar

Peptone	5.0g
Beef Extract	3.0g
Sodium Chloride	12.0g
Agar	15.9g
pH	7.3

MacConkey Agar

Peptone	20g
Lactose	10g
Bile Salt	5.0g
Sodium Chloride	5.0g
Neutral red	0.075g
Agar	12.0g
pH	7.4

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