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Assessment of Open Well Water Contamination in High Density Residential Area

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Abstract :*The study was carried out to ascertain open water quality for human consumption in a high density area where the source of water is limited to open wells and where there are no consideration giving between open well and a pit latrine, soak ways and drainages. Stratified random sampling techniques was use to select nine open wells where samples were taken three times to ascertain and validate the result of the water analysis. Coli form test was used to determine the presence of microbial contaminates, pocket conductivity meter was used to determine the concentration of some chemical element and compound and spectrophotometer was used to analyzed some physical parameters. From the result of the analysis it was discovered that nitrate exceed the limit in about 75% of the samples analyzed while e- coli bacteria was detected in 8 out of the 9 samples analyzed. But Iron was found to fall below the minimum requirement. The study while considering that the sources of both nitrate and e coli is normally from sewages it can be attributed to lack of conforming to established standard of 30 meters between well water and nearest sewer thereby allowing the possible seepage of the contaminates contaminants into the underground water and also the open well practice allows for susceptibility to non point source of nitrate through pollution from surface water runoff. The study conclude that there is need for another source of domestic water supply to the area and recommend the use of other additional water purification techniques that is consumer friendly for households uses.*

Keywords: *Water Contaminants. Analysis, High density, Open well water, Samples*

I. INTRODUCTION

At the start of the 20th century, 95 per cent of Africans lived in rural areas. By the 1960s, Africa was still the least urbanized continent, with an urban population of 18.8 per cent. By 1996 this number had doubled. At the present rate of the urban population growth in the continent at least 43 per cent of the people are expected to live in urban areas by 2010 (United Nations Population Division 1997). Average annual urban growth rates in Africa from 1970 to 2000 were the highest in the world, at more than 4 per cent. Current estimates show that the number of urban inhabitants in Africa increased by an average annual rate of 4.3 per cent during the period 1950-2005, resulting in the rise in population from about 33 million to 353 million persons (Hassan Y, 2005) With the continuous growth of African cities rapid urbanization is expected to continue for decades (GEO-2000). The rapid growth of urban areas has further affected the ground water quality due to over exploitation resulting from waste disposal practices improper sanitary conditions and poor drainages. Safe water and adequate sanitation are basic to the health of every person on the planet, yet many people especially in Africa and Asia do not have access to this fundamental need (Bartram *et al*., 2005).

Water is a vital part for both our environment and our body systems. It covers nearly three quarters of the earth's surface and makes up between 60 and 70% of the human body matter. It is an essential component of nearly everything we eat and drink. Water intake is crucial to our survival. For example, drinking ample amounts of water has been tied to general good health. In addition, water can be a specific antidote to some of the more troubling and inconvenient health problems, such as obesity and various types of cancer. Water has the potential to be one of the most useful and cost-effective medicinal substances available. Water is the basis of all life - an ecological resource for the flora and fauna of the earth and a fundamental necessity for human life. Without an adequate supply of safe water, we have no hope of improving the health of the people in our partner countries. The (WHO 1984) estimates that 80% of all disease is in some way is connected with contaminated

water. Without a well-functioning water supply it is difficult to imagine productive human activity, be it agriculture or forestry, livestock farming or fisheries, trade or industry. Water is thus becoming a crucial factor for development and the quality of life in many countries. In individual arid areas communities it has even become a survival factor.

An important step towards resolving this global crisis is to understand its magnitude: how many people lack access to safe drinking-water and sanitation (WHO 2000). Water is one of the indispensable resources for the continued existence of all living things including human. Government has failed to adequately provide safe portable pipe-borne water for the increasing population in Nigeria and this has encouraged the sale of drinking water by private enterprises that have little knowledge about good manufacturing practices. (Edema et.al. 2011) The Millennium Development Goal 7, Target 7C calls on countries to "Half by 2015, the proportion of people without sustainable access to safe drinking water and basic sanitation" (WHO, 2008). Population forecast suggests that, an additional 784 million people worldwide will need improved drinking water sources for the MDG target to be met (WHO, 2008). From 1990 to 2006, approximately 1.56 billion people gained access to improved drinking-water sources. Currently 87% of the people of the world drink water from improved sources, as compared to 77% in 1990. Improved drinking water coverage in sub-Saharan Africa is still considerably lower than in other regions. Nevertheless, it has increased from 49% in 1990 to 58% in 2006, which means that an additional 207 million Africans are now using safe drinking water (WHO, 2008).

Water is an essential part of human nutrition, both directly as drinking water or indirectly as a constituent of food, in addition to various other applications in daily life. Water is not only essential for life, it also remains a most important vector of illness and infant mortality in many developing countries and even in technologically more advanced countries Ford TE 1997 and Edema et.al. 2011. It is also a key parameter influencing survival and growth of microorganisms in foods and other microbial environments. In the order of importance, air, water and food are the three main necessities of life. A person can survive for about a month without food, about a week without water, and less than five minutes without air Edema et.al. 2011 and Soorymoorthy and Antony 2003. The provision of an adequate supply of safe drinking water was one of the eight components of primary health care identified by the International conference on primary health care in 1978. Increase in human population has exerted an enormous pressure on the provision of safe drinking water especially in developing countries.

The importance of groundwater for the existence of human society cannot be overemphasized. Besides, it is an important source of water for the agricultural and industrial sector. Till recently it had been considered a dependable source of uncontaminated water. Groundwater crisis is not the result of natural factors. It has been caused by human actions. Much of ill health which affects humanity, especially in the developing countries can be traced to lack of safe and whole some water supply. The quality of ground water is the resultant of all the processes and reactions that act on the water, from the moment it condensed in the atmosphere to the time it is discharged by a well or spring and varies from place to place and with the depth of the water table (R.Shyamala*et al*. 2008 and Jain CK 1995). Ground water is particularly important as it accounts for about 88% safe drinking water in rural areas, where population is widely dispersed and the infrastructure needed for treatment and transportation of surface water does not exist (R.Shyamala*et al*. 2008 and Kumar 2004).

In many developing countries, availability of water has become a critical and urgent problem and it is a matter of great concern to families and communities depending on non-public water supply system (Oladipo et al 2009 and Okonko et al., 2008). Increase in human population exerts an enormous pressure on the provision of safe drinking water especially in developing countries (Oladipo et al 2009 and Okonko et al., 2008). Unsafe water is a global public health threat, placing persons at risk for a host of diarrhea and other disease as well as chemical intoxication (Hughes and Koplan, 2005 sndOladipo et al 2009). Unsanitary water has particularly developing effects on young children in the developing world. Each year greater than 2 million persons, mostly children less than 5 years of age, die of diarrhea disease (Hughes and Koplan, 2005). For children in this age group, diarrhea disease accounted for 17% of all death from 2000 to 2003 (WHO, 2005), ranking third among causes of death, after neonatal causes and acute respiration infections (WHO, 2005).Water in nature is seldom totally pure. Rainfall is contaminated as it falls to earth, the combustion of fossil fuel put sulphur compound responsible for acid precipitation in the air. Water that moves below the ground's surface undergoes filtration that removes most organisms. For this reason, water from springs and deep wells are generally of good quality. The most dangerous form of water pollution occurs when feacal contaminant like *Escherichia coli* enter the water supply. Contaminants ingested into water supply cause many diseases. Examples of such pathogens are *Salmonella* spp, *Shigella*spp, *Vibrio cholerae*and *E. coli* (Oladipo et al 2009 and Tortora et al., 2002).

II. METHODOLOGY

The Study Area

Bauchi metropolis is the headquarters of Bauchi state, north eastern Nigeria. It is located between latitudes 90, 00 and 90, 30" north of the equator and longitudes 10025" and 11020" east of the Greenwich meridian. It occupies a total land area of 3, 604, 0 hectares, and it is about 128km north east of Jos and 150km

west of Gombe town. It is one of the town in northern Nigeria that falls within sudan savannah vegetation zone. It is generally less uniform and grasses are shorter than what is obtainable further south. The topography of Bauchi metropolis is relatively flat in the centre.

Bauchi metropolis has witnessed tremendous transformations in recent times, in terms of population growth and uneven urbanization, these were as a result of the improved relative peace and economic activities and the instability of neighboring cities like Jos in plateau state, Damaturu and Potiskum in Yobe state, Gombe town and Maiduguri in Borno state, which result in massive influx of people relocated to the metropolis. There are indications that the population of the town would double itself. However, due to the recent rapid growth in population, uncontrolled development began to take place. Plots of lands are subdivided into smaller units, houses are erected without approval, blocking access to infrastructures development and indeed these posed difficulties in waste management services.

Yelwa area of Bauchi metropolis is high density populated area which is mainly residential with isolated commercial activities. The neighborhood host higher intuitions which include AbubakarTafawaBalewa University Bauchi, AbubakarTatari Ali College of Agriculture and is in a close proximity to Federal Polytechnic Bauchi and Police Training College. The study area also host some boarding and day secondary schools.

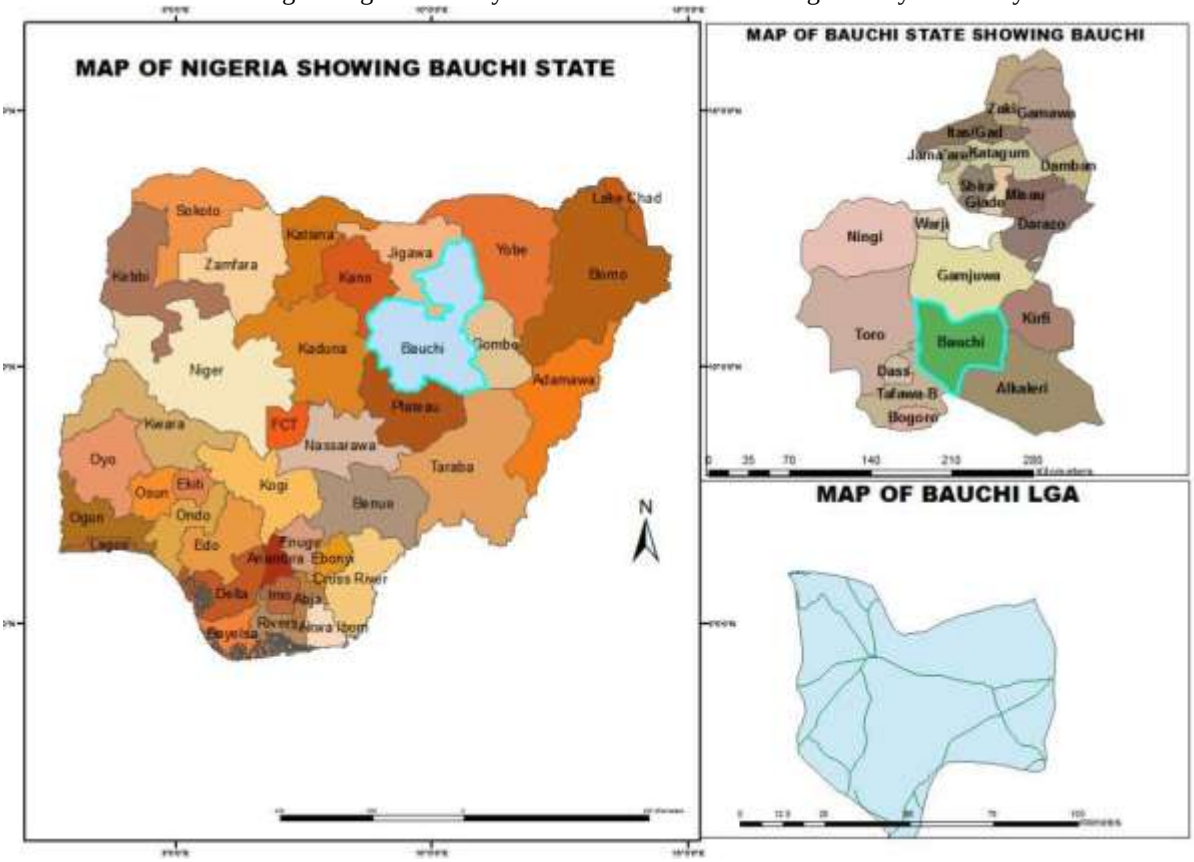

Figure 1: Description of the Study Area

Sample Collection

Using stratified random sampling techniques nine samples were collected from open well water during the early hours of the day to avoid the introduction of foreign contaminants by fetchers of water in the morning. The samples were collected using sterilized plastic bottles. The samples were tested for on field for colour and temperature thereafter the samples were taken to the laboratory where they were kept at room temperature prior to the analysis.

Sample Analysis

The sample were analyzed using spectrophotometer, titration methods, Orion Model 520 Ph Meter, Pocket conductivity meter etc to estimate; total hardness Ph Bio oxygen demand (BOD), chemical Oxygen demand (COD), total hardness. Nitrate, Nitrite, Total Dissolve Solid (TDS), e-coli and total coli form count (TCC). The data obtained were statistically analyzed using mathematical standards.

III. RESULT AND DISCUSSIONS

Table 1: Mean Analysis of Parameters of the Samples

Parameters	Unit	Samples									WHO
		S1	S2	S3	S4	S5	S6	S7	S8	S9	
PH		6.89	7.86	8.11	7.53	8.25	7.92	7.65	7.13	7.12	6.5-8.5
TSS	Mg/l	9.65	11.24	13.11	18.15	9.61	14.81	12.09	13.01	21.03	
TDS	Mg/l	265	430	360	438	154	311	406	319	275	1000
COD	Mg/l	6.57	2.19	7.64	5.36	4.24	7.90	3.54	3.11	2.81	
BOD	Mg/l	13.67	18.92	10.06	25.84	34.10	21.21	15.73	18.10	36.03	
Hardness ($CaCO_3$)	Mg/l	95	86	83	75.6	88	160	53	79	65	150
NO_3 (Nitrate)	Mg/l	2.67	3.84	7.36	4.11	2.11	3.89	5.26	8.63	5.25	50
NO_2(Nitrite)	Mg/l	0.08	0.03	0.06	0.04	0.01	0.03	0.06	0.07	0.10	0.02
Fe^{2+}	Mg/l	0.005	0.015	0,005	0,006	0.008	0.001	0.004	0.003	0.003	0.3
EC	Us/cm	100	860	720	400	480	620	740	800	970	1000
Temperature	^0C	24	24	23	24	25	24	24	24	24	27.0
Colour	TCU	Unobj	Unobj	Unobj	Unobj	Unobj	Unobj	Unobj	Unobj	Unobj	-
E Coli	Mpn/100ml	14	11	12	Nil	<10	<10	<10	<10	<10	0/100ml
TCC	Mpn/100ml	$3x10^{-3}$	$1.3x10^{-4}$	$2.5x10^{-3}$	$3.1x10^{-2}$	$4.3x10^{-6}$	$4.1x10^{-2}$	$1.4x10^{-5}$	$3.6x10^{-5}$	$2.0x10^{-3}$	0/100ml

Source: Lab work 2010

Table 2: Parameters Exceeding Threshold Limits

S/N	Parameters	Unit	Samples									WHO
			S1	S2	S3	S4	S5	S6	S7	S8	S9	
1	NO_2(Nitrite)	Mg/l	0.08	0.03	0.06	0.04	0.01	0.03	0.06	0.07	0.10	0.02
2	E Coli	Mpn/100ml	14	11	12	Nil	<10	<10	<10	<10	<10	0/100ml
3	TCC	Mpn/100ml	$3x10^{-3}$	$1.3x10^{-4}$	$2.5x10^{-3}$	$3.1x10^{-2}$	$4.3x10^{-6}$	$4.1x10^{-2}$	$1.4x10^{-5}$	$3.6x10^{-5}$	$2.0x10^{-3}$	0/100ml

Source: work 2010

IV. DISCUSSIONS

From the laboratory analysis of fourteen parameters in the nine water samples collected as shown in table 1. Five parameters exceed the maximum thresh limits set as shown in table 2.

Nitrite (NO_2)

Table 2 above indicates that the highest concentration of Nitrate is found in sample 9 (S9) with that value of 0.10Mg/l exceeding the threshold value of 0.02, while the lowest concentration is recorded from sample 5 with the value of 0.01Mg/l. However, all the other samples fall within the range of 0.03Mg/l – 0.08Mg/l. This can be attributed to water runoff from fertilizer used areas, and sewers as most of the wells are not conforming to the established standard of 30m distance between a well and the nearest sewer.

E coli

The highest concentration of E coli is from sample 1 with 14Mpn/100ml. The least value (<10Mpn/100ml) is recorded from sample 5, 6, 7, 8, and 9. All the concentrations from the sample exceed the threshold value of 0/100ml except sample 4. This may be attributed to the close proximity (less than 30m) of the wells to the nearby sewers, storm water runoff, animal carcasses and runoff from animal manure and manure storage areas.

Total Coliform Count (TCC)

Sample 5 is having the highest value of total coliform count ($4.3*10^{-6}$Mpn/100ml) compared to other samples. The least TCC ($1.3*10^{-4}$Mpn/100ml) was recorded in sample 2, both exceeding the threshold value of 0/100ml. The presence of TCC to this amount is because most of the wells are wrongly sited as they are close to either sewer or gutter.

V. CONCLUSION

The concentrations of the five parameters above is found to exceed the acceptable threshold limit, this can be attributed to the close proximity of the wells to the nearby sewers or gutters as in the case of E coli and Total Coliform Count. In addition, storm water runoff washing animal carcasses. Pollutants from nearby farm lands who predominantly uses inorganic fertilizers, pesticides and insecticides appears to contribute greatly to the increase in concentration of Nitrite in water sample analysed.

VI. RECOMMENDATION

- Wells should be dug at an interval of 30 meters distance from nearby sewers as such compliance to the standard should strictly enforce.
- Water collected from these areas should be subjected to simple domestic treatment before consumption.

- Wells should always be covered and uplifted high above the ground level.
- Sanitary practices should be enforced within and around the well surrounding.

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