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Assessment of Wells Water Quality in Birshi Gandu Village & Selected Areas of Federal Polytechnic, Bauchi, Nigeria.

J.E. Lagasi, J.O.Uloko, and A. M. Maleka
Department of Civil Engineering Technology, Federal Polytechnic, Bauchi, Nigeria.
Corresponding Author: J.E. Lagasi

Abstract: *Water is a basic requirement for human daily activities; well water is commonly used within the villages and settlements around the Federal Polytechnic area. The study covers the analysis of well water samples collected from five wells within BirshiGandu and selected part of the Federal Polytechnic, Bauchi. The five samples were collected using sterilized sample bottles and were analyzed at RUWASSA (Rural Water Supply and Sanitation Agency) laboratory, Bauchi within 3hrs after collection to check the well water quality. From the analysis of well water samples A B C D and E, the values of pH obtained were 6.78, 6.61, 6.13, 6.30 and 6.86, the turbidity of well samples A, B, C, D, and E were found to be 5.7, 20, 19 and 15 NTU.The sample temperatures ranged between 27.2 ℃ and 28.6 ℃, free Chlorine ranged from 0.06 and 0.39mg/l, the total solid (TDS), ranged between 87.8 and 112.8mg/l. All these values including the amount of Iron values of 0.07 to 0.85mg/l, and cyanide values of 0.002 to 0.026mg/l, fell within the World Health Organization (WHO), Nigerian Standard for Drinking Water Quality (NSDWQ) and National Agency for Food and Drug Control of Nigeria (NAFDAC) standard. The well water samples obtained from Federal Polytechnic, Bauchi meets the bench mark of portable water but water from wells in BirshiGandu did not satisfy the drinking water standard and are therefore recommended for treatment. Drilling of bore holes for the community is also recommended.*
Keywords*: Water sample, analysis, WHO, NAFDAC, projected population, RUWASSA*

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I. Introduction

One of the major problems confronting BirshiGandu and selected areas of the Federal Polytechnic Bauchi is the non-availability of portable water supply, a commodity which is very scarce to come by in so many communities from cities to villages for domestic use.

The common sources of water are the hand dug wells and boreholes. The well water is obtained through manual means. Well water collected within the school from three wells and two fromBirshiGaudu village is the main source of water samples for the study. Water plays a vital role in the development of any community especially the Federal Polytechnic Bauchi campus. However, portable water is seldom available at the right quantity and place.

In an ideal water works projects, the water supplied for public distribution should be free from pathogenic organisms, undesirable taste and color, it should be and of palatable, of reasonable temperature, neither corrosive nor scale forming in pipes and should be free from minerals which could produce undesirable physiological effects (Kamala, et al 1993). The public health and socio economic development of a community can be enhanced if there is adequate accessibility to safe water supply. The availability of portable water plays a key role in the realization of health improvement measures in any community and it is an acceptable fact that water supply contributes to the reduction of the infant mortality and mobility rate and increase the children's life expectancy. For some diseases, water provides the only transmission route, so that improved supplies are the only way to reduce disease incidence. Before the supply of piped water in 1963 and 1965, Fidti and Igbo-Ora in Nigeria (combined population 30,000) recorded incidences of Guinea worm of 20% among school children in one town and 60% among the total population in the other. No further cases were reported two years after completion of the water supplies, even though the disease was endemic in the surrounding areas (Yusuf, 1999).

Official statistics indicate that access to improved water sources rose from 49% in 1990 to 57% in 2000. While access in urban areas increased from 78% in 1990 to 81% in 2000, it declined to 72% in 2002. In the rural areas, where the majority live only 33% had access in 1990, 39% in 2000 and 49% in 2002, suggesting slow growth. This implies that to achieve the MDG target Nigeria must reduce the proportion of rural populations without access to an improved water source from 67% in 1990 to 33.5% in 2015 and the urban proportion from 22% to 11% (Water Aid, 2006).

Water related diseases result in over five million deaths annually, of whom most are children. Over 1.1 billion people lack access to safe water and 2.6 billion live without proper sanitation (Mark, 2007).

Governments and non-governmental organization (NGOs) alike have been making massive world-wide efforts over the past 25 years to find lasting solution, to no avail. The recent statistics prepared by the (WHO) highlights the alarming global water supply situation and the need for some radical alternative solution. An adequate provision of water to urban and rural areas by Nigerian government with emphasis on sanitary conditions can greatly reduce the incidence of water borne diseases. As a region's economy develops and its population grows, water supply systems typically also grow from serving one jurisdiction to several.

This study focuses on determining the suitability of water samples collected from wells within the study area which the population has depended on for consumption. In so doing, the physical, chemical and bacteriological properties used in measuring the portability of water for consumption by WHO would be employed. The international standard for drinking water WHO (1993) in its definition for water fit for human consumption stated that water intended for human consumption must be free from organism and concentrations of chemical substances that may be hazardous to health. Furthermore, the WHO stipulates stringent conditions for standards of raw water sources for drinking purposes all stipulates standards to be met for either the influent or effluent water produced or both.

II. Materials And Methods

The Federal Polytenic Bauchi is located in Bauchi, the State capital of Bauchi State. The school is 14 kilometers to the south-western part of Bauchi town along Bauchi-Dass road which is about 9km away from Wunti Gate and is on latitude 030^{o} 31' 30'' and longitude 090^{o} 00' 00''. It has an area of 748 hectares, while BirshiGandu village is annex to the school fence, close to staff quarters B.

2.1Analysis of Water Sample

2.1.1 Water Sampling

The reliability of laboratory analysis and test depend upon the method of sampling. The samples of water were taken from three wells in Federal PolytechnicBauchi i.e. A, D & E and two wells from BirshiGandu village i.e. B & C. The samples were properly labeled with each sample data attached, the data includes: date and time of collection, sources of the sample and the temperature of the water collected at the time of sampling.
The water samples were collected from existing wells in the study area in a container made of polythene glass. The sample bottles were carefully washed three times. The sample of the water collected reached the place of analysis at RUWASSA laboratory within 3hrs after collection.

The method of analysis of the well water samples for physical, chemical and bacteriological analysis were carried out in the Laboratory for the following properties: color, appearance, taste/odor, pH scale, Total dissolve solids, free chlorine, conductivity and turbidity.

2.1.2 Determination of color

About 0.249g of potassium chloroplatinate (K_2PtCl_6) and 0.200g of crystallized cobalt chloride ($CoCl_26H_20$) were dissolved in a small amount of distilled water. 20ml of concentrated hydrochloric acid was added and diluted with 200ml of distilled water. Nessler tubes of 1,2,3, to 10ml was placed and diluted to the mark. Another 100ml Nessler tube was filled to the mark with the water sample to be tested. The color was compared with the standards prepared above, by looking vertically down through the tubes on a white surface.

Calculation:

Color of water $= \frac{\text{MlofstandardplatinumsolutionX500on (Hazeunit)}}{\text{Mlofsample}}$

2.1.3 Determination of appearance using clean glass

The appearance of the water samples were determined by using clean glass.The sample was observed to be clear and sparkling, the result obtained is shown in table 1.

2.1.4Determination of Taste/odor using glass bottle with stopper

The water samples were put into a clean glass bottles half-full and glass stoppers were used to close the bottles and were vigorously shaken. The stopper was removed to sniff the odor and any distinctive odors were noted. The result is shown in table 1.

2.1.5 Determination of pH Value

The pH meter was warmed for 20 minutes. The electrode was removed from inside the distilled water and rinsed with fresh distilled water. It was then wiped with soft tissue. The meter was calibrated using the buffer solutions at ambient temperature. The pH knob was switched off and the glass electrode was removed from the second buffer and rinsed thoroughly with distilled water and then wiped with soft tissue. The clean and dried glass electrode was inserted into the water sample and the pH knob switched on and pH valve was directly read from the scale. See result in table 1.

2.1.6 Determination of Turbidity using Dr/2000 model Spectrometer

A Dr/2000 model 1990 spectrophotometer was used, the stored program number for turbidity was entered by pressing number 750 read/enter. 25ml of distilled water was poured into a sample cell (blank) and placed into the cell holder and the zero number of the machine pressed. Then, 25ml of the samples each was poured into another sample cell and immediately placed into the cell holder; the read/cell was pressed after closing the light shield. The turbidity values were then read, the result obtained is shown in table 1.

2.1.7 Determination of free Chlorine using Screen

10ml of each well water samples was diluted with DPD content, the mixture was placed into a calorimeter and then the result in mg/l chlorine was then displayed on the screen; the result obtained is shown in table 1.

2.1.8 Determination of Conductivity using Electrical Conductivity Meter

Each sample of well water was collected into a clean beaker, the electrical conductivity meter was inserted into the beaker containing the sample of the water, the reading was measured and recorded, the result obtained is shown in table 1.

2.1.9 Determination of Temperature

The temperature measurement was done at the time the samples were collected by using the ordinary thermometer (liquid in glass thermometer), the thermometer was completely immersed in the water sample; the value of the temperature obtained is shown in table 1.

2.1.10 Determination of bacteriological Analysis

Each water samples for bacterial test were collected in a sterilized bottle; 1ml of the sample was withdrawn and dispersed in tube labeled 10^{-1} which contains 9ml of peptone water, another 9ml was withdrawn into the second tube labeled10^{-2}. The same continued to tube labeled 10^{-3} and 10^{-4} respectively. A 0.1ml of the sample was dispersed in each of the tube10^{-2},10^{-3}, 10^{-4} in duplicate .The molten nutrient agar was cooled around 45⁰C and was poured into the Petri dish and gently rotated for equal spreading of the samples. This was allowed to solidify before incubating at 37⁰C for 24 hours and the visible colonies were counted in a colony counter, the result obtained is shown in table 1.

2.1.11 Determination of Total bacteria count of the water samples

Each samples each from all the water sources under investigation were cultured and colonies counted, pour plate method was used as described by Bissnette (1977). The water samples were diluted serially according to standard method APHA, (1983), dilutions of the samples at 1.100 were serially diluted to three folds (10-3), with distilled water as described by Dukka (1978).1ml at the 3^{rd} diluents of each sample was introduced into sterile plates. Nutrient agar was poured and swirled gently for proper mixing, the plates were allowed to solidify and incubated at 37⁰C for 24 hours, and colonies were then counted.

2.1.12 Determination of Total dissolved solids (TDS) using Hach Model 44600 – 00

The total dissolved solids (TDS) and conductivities were determined using HACH model 44600-00 , about 80ml each of the three samples from all the water sources were poured into 120ml beaker. The probe of the meter was inserted into the sample and allowed for 2 minutes. The conductivity button was pressed and the result displayed on the screen in microsiemens/cm, for the same samples, the total dissolved solids (TDS) button was pressed and the result displayed in mg/l, the result obtained is shown in table1.

2.1.13 Determination of Suspended solids using photometer Method

Each water sample from the wells were shaken for 2 minutes and were poured into a 500ml beaker, the stored program number for suspended solids was entered by pressing 630 read/enter botton. The wavelength dial was rotated to 810 µm. By pressing read/enter, the values of the suspended solids were determined; the result obtained is shown in table1.

2.1.14 Determination of Iron

The photometer was calibrated with the water sample to be tested, the test was carried out by adding iron tablets (alkaline thioglycolate) to a 10ml sample of the water sample, the content was allowed to stand for 1 minute to allow full color development, the produce was directly proportional to the iron concentration measured using the WAGTECH photometer at 570nm wavelength, the percentage transmitters obtained was converted to mg/l Fe with the aid of iron calibration chart.

III. Results And Discussion

From table 1, the pH scale shows that the water sample falls within the acceptable range; hence the water is fit for human consumption, the turbidity of the wells water samples A, C, D, and E are 5.7, 20, 19 and 15 NTU, it can be deduced here that the turbidity is within the acceptable limit, the temperature of the region of sample collected reflects also the temperature of the water samples, the temperature is within the acceptable limit of the World Health Organization, the appearance of the water is clear, the total dissolved solid ranges between 87.8 to 112.8mg/l, this indicates that the well water from the sampled wells has better quality. Free chlorine of the water sample ranges from 0.06 to 0.39mg/l, which is within the limit of the World Health Organization (WHO).

From table 1, the bacteriological analysis of well water in samples A, D and E shows a very low bacterial load (Total Coli, Fecal Coli form and E.Coli) the result shows that the water sample is safe for drinking compared with the World Health Organization (WHO) but that of Sample B and C were very high and not fit for consumption.

The findings from the work carried out in the course of the data collections and the subsequent well water sample analysis shows that the results contained in Table 1 for sample A, D and E meet international standards for drinking water, while that of sample B and C parameters do not meet the standard, it can be used for irrigation purpose and further treatment can be made on the well water.

IV. Conclusion

Having determined from the analyzed water samples collected from the studied wells, sampled wells B and C from BirshiGandu shows high concentration of nitrate ions which is dangerous to health, it also have high Turbidity and is bacteriologically contaminated also it has excess level of manganese ions which might be as a result of dissolve solid. The contamination could also be attributed to leachates migrating from dilute and dispersive sites. Water from these wells can be used for irrigation purposes, while wells water sample A D and E from the Polytechnic community met the standard for consumption, it become imperative to recommend that the water is safe for drinking and the number of wells be increased to meet the ever increasing need of the Polytechnic's population The wells should be properly ringed and covered so as to prevent contamination. The distance of the wells from pit latrines and soak away should be maintained atleast 15m apart

Recommendations

Particularly for the wells at BirshiGandu the following measures are recommended:

- Proper water treatment should be carried out on the well to make it fit for human consumption.
- Wells should be at least 15 meters away from pit latrine.
- The well should be properly ringed and the upper part should be raised 3 foot above ground level.
- There should be a proper cover for the wells.
- Animal waste and other contaminants should be cleared away from well area.
- Drilling of borehole water is also recommended for the study area.

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Table1: Result of well water Analysis Samples

S/No	Parameters	Sample A	Sample B	Sample C	Sample D	Sample E	Standard WHO/NSDWQ
1.	Temperature °C	27.2	28.6	28.5	28.5	27.9	-
2.	pH	6.78	6.61	6.13	6.30	6.86	6.5 - 8.5
3.	TDSmg/l	100	112.8	31.1	100	89.8	< 500
4.	Conductivity ms/cm	0.41	0.22	0.06	0.43	0.43	100 - 120
5.	Turbidity(NTU)	5.7	170	20	19	15	5 – 25
6.	Color	51	636	113	116	50	50
7.	Odor/taste	acceptable	Faint	Faint	acceptable	acceptable	unobjectionable
8.	Nitrate(NO_3) mg/l	0.35	0.51	0.21	0.25	0.15	0.50
9.	Cyanide (CN) mg/l	0.002	0.026	0.005	0.006	0.003	< 0.05
10.	Hardness mg/l	0.76	2.59	1.07	1.19	0.93	30 – 50
11.	Mn mg/l	0.497	1.072	0.928	0.842	0.763	0.05 - 0.50
12.	O_2^-mg/l	6	7.1	2.5	3.2	5	6
13.	Fe^{2+}mg/l	0.10	0.70	0.14	0.14	0.07	1.0
14.	Free chlorine	0.06	0.39	0.11	0.13	0.07	-
15.	Total chlorine	0.08	0.46	0.11	0.17	0.07	-
16.	Residual chlorine	0.02	0.07	Nil	0.04	Nil	0.3
17.	Suspended solid	25	99	36	42	70	-
18.	Bacterial countcfu	78	150	127	100	30	100
19.	Total coli form (E.Coli)	2	6	4	2	2	10
20.	COD	12	55	15	14	10	1.2
21.	BOD	9	21	10	8	5	2 – 6
22.	Al^+	-	-	-	-	-	0.6 - 1.0

Source of table: LABORATORY RESULTS/WHO/NSDWQ STANDARD

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