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Research Article

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Assessment of Borehole Water Quality in Guru Village a Sub - Hurb Area of Bauchi Metropolis, Bauchi State

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Abstract Water for drinking and domestic use is difficult to assess in Guru town, a rocky sub-hurb area of Bauchi metropolis, only in raining season can they get water from hand dug well and flowing streams but dries up during the dry season. A borehole was dug in the community and this study is to examine the water quality. Water collected using sterilized plastic bottles from the drilled borehole. Laboratory analyses of the sample includes parameters such as temperature, taste, odour, colour, pH, turbidity, iron, lead and nitrate. The total bacterial count were carried out in Bauchi State Rural Water Supply & Sanitation Agency (RUWASSA), using standard procedures in line with World Health Organization (WHO) and Nigerian Industrial Standard (NIS, 306:2008) for potable water. The results revealed all of the parameters examined did fall within the permissible limits of W.H.O and NIS. There was no trace of lead in all the samples and the SO_4 met the limits required, for turbidity four samples fell within the required limit, the PH values was 7.2, also the total dissolved solid (TDS) was 170 mg/l which meet the WHO and NIS. All the Chemical parameters such as the Magnesium (Mg), Iron (Fe), lead (Pb), total hardness (as $CaCO_3$), and Copper (Cu) of the sample fell within the limits of the standards. The study revealed that the water in the area is portable and fit for drinking, domestic uses and the analysis are within the accepted limit.

Keywords Borehole, Water sample, Analysis, WHO, NIS

1. Introduction

Water is essential for human existence, and its importance for individual health and the wellbeing of a nation cannot be under estimated. Notwithstanding, many people in developing countries do not have access to safe and clean drinking water or to adequate amounts of water for basic hygiene. This situation can lead to variety of health problems [1].

Water is a chemical compound and may occur in a liquid form or in a solid form or in a gaseous form. All these forms of water are extremely useful to man, providing him with luxuries and comforts in addition to fulfilling his basic necessities of life [2]. Only 2.5% of the earth's water is fresh water and 98.8% of that water is in ice and ground water, less than 0.3% of all is in rivers, lakes and the atmosphere [3]. Water is accessed by through its storage facilities on the surface, underground and in the atmosphere. Groundwater is an important source of water stored in aquifers. Aquifers are permeable pervious and porous rocks, with connected pore spaces that allow water to flow through them. Aquifers can either be confined or unconfined. In confined aquifers, water flow is restricted but it flows freely in unconfined aquifers. Groundwater is replenished by infiltration and percolation of precipitation; and from seepage of stream water into the groundwater storage system [4].

Considering the increasing demand for portable water, it has become necessary to pay close attention to the quality of water that is used either for domestic or industrial use. Water as a universal solvent reacts with minerals in rocks and changes its constituents as it seeps through the aquifer. When these changes occur beyond set limits, groundwater is considered to be polluted or contaminated by the element or substance in it.

Groundwater gets polluted when it comes in contact with either the point or non-point pollution sources. Point pollution areas include; municipal landfills, leaky sewer line, spills from industrial waste, underground injection wells, latrines and grave yards. The non-point sources of pollution include; spray of fertilizers, pesticides and herbicides on agricultural land and through acid rain [4-5].

Housing area contaminate groundwater through improper storage and disposal of household wastes into landfills, dump sites, latrines and grave yards where they decay and are moved into aquifers by rainwater. These pollutions can be reduced through proper waste disposal management practices. Hence public portable water supplies should be tapped from deep aquifers because they are relatively free from contamination [5].

Consumption of water contaminated by disease causing agent (pathogens) or toxic chemicals can cause health problems such as diarrhoea, cholera, dysentery, and cancer and skin diseases. Also inadequate amounts of water for basic hygiene can contribute to poor hygiene practices, which in turn can lead to skin and eye diseases [1]. Groundwater quality assessment examines "the chemical, biological and physical qualities of the water" including temperature, turbidity, colour, taste and odour [4-5].

The water meant for drinking and domestic purpose must meet laid down local and international standards, otherwise the consumer stand the risk of water borne diseases [6]. World Health Organization [W.H.O] and Nigerian Industrial Standard (NIS 306:2008) was used in this research work to ascertain the level of availability of portable water for drinking and domestic use. The area of this research work has been going through challenges of assessing clean water for their daily use, they only depend on raining season to store and flowing stream. This work is necessitated by the fact that the availability of portable water have become a global issue especially in rural areas of developing countries and hence then need to rise to the challenge is imperative via this study.

2. Materials and Methods

Guru is a rocky sub-hurb town located near the Jos – Bauchi highway in Bauchi, the State capital of Bauchi State. It is about 11 kilometres from Bauchi town.

2.1. Water Sample Analysis

2.1.1. Water Sampling

Samples of the borehole water were taken from the drilled borehole which was properly labelled 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 sample of the water collected reached the place of analysis at Bauchi State Water Supply & Sanitation Agency (RUWASSA) in Bauchi town, Bauchi State.

Analysis were carried out for physical, chemical and bacteriological the laboratory for the following properties: colour, appearance, taste/odour, pH scale, Total dissolve solids, conductivity and turbidity e.t.c.

2.1.2. Determination of colour

Chemical substance were used to determine the colour where 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 tubes were filled to the mark with the water sample to be tested. The colour was compared with the standards prepared above, by looking vertically down through the tubes on a white surface.

Calculation:

Colour of water $=\frac{Mlofstandardplatinumsolution X 500 on\ (Hazeunit)}{Mlofsample}$

2.1.3. Determination of appearance using clean glass

The water appearance on the water samples were carried out by the aid of clean glass, the sample were observed as clear, sparkling and cloudy, the result obtained is shown in table 1.

2.1.4. Determination of Taste/odour 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 odour and any distinctive odours were noted.

The result is shown in table 1. However, taste and odour are the most difficult physical characteristics to measure in any numerical sense because of personal factors related to taste and odour, atmospheric condition of impurity, temperature and humidity [7].

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. pH is one of the most important operational water quality parameters, supposing, pH is above 7, this will indicate that water is probably hard and contains calcium and magnesium [6].

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. In most waters, turbidity is due to colloidal and extremely fine dispersions [8].

2.1.7. Determination of conductivity using Electrical conductivity meter

Each sample of 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, and the result obtained is shown in table 1.

2.1.8. Determination of Temperature

The water sample temperature was measured 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.

2.1.9. Determination of bacteriological Analysis

The water samples for bacterial test were collected in a sterilized bottle; 1ml of the sample was withdrawn and dispersed in tube labelled 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 45^{o}C and was poured into the Petri dish and gently rotated to have equal spreading of the samples. This was allowed to solidify before incubating at 37^{o}C for 24 hours and the visible colonies were counted in a calorie counter, the result obtained is shown in table 1.

2.1.10. 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 Bassinette [9]. The water samples were diluted serially according to standard method APHA, [10], dilutions of the samples at 1.100 were made serially diluted to three folds (10-3), with distilled water as described by Dukka [11]. 1 ml at the 3rd diluents of each sample was introduced into sterile plates. Nutrient agar was poured and swirled gently for proper mixing, the plate were allowed to solidify and incubated at 37^{o}C for 24 hours, and colonies were then counted.

2.1.11. 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.

2.1.12. 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 colour development, the produced was directly proportional to the iron concentration was 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.

3. Results

The result of the sample is shown in table 1, in the appendix with borehole water samples with WHO and NIS.

Table 1: Analyzed Sample

Parameters	Borehole water results	NSDWQ*MPL	WHO
Appearance	Unobjectionable	Unobjectionable	Unobjectionable
Tempt ^{0}c	25.6	6.5-8.5	6.5-8.5
Turbidity (NTU)	2	5	5
pH	7.2	6.5-8.5	6.5-8.5
Taste	Unobjectionable	Unobjectionable	Unobjectionable
Odour	Unobjectionable	Unobjectionable	Unobjectionable
Electrical Conductivity(uS/cm)	340	1000	1000
TDS mg/l	170	500	500
Total hardness, $CaCo_3$ mg/l	110	150	150
Magnesium, Mg^{2+} mg/l	0.15	0.20	0.20
Lead, Pb^{2+} mg/l	0.00	0.001	0.01
Copper, Cu^{2+} mg/l	0.00	1.0	1
Total Iron, Fe^{2+} mg/l	0.064	0.3	0.3
Zinc, Zn^{2+} mg/l	0.21	3	3
Sulphate, So_4^- mg/l	28	0/100	0/100
Chloride, Cl^- mg/l	54	250	250
Total Coli form (cfu/100ml)	0	10	10
Faecal Coli form (cfu/100ml)	0	0	0
E. Coli(cfu/100ml)	-	0	0

Source: RUWASSA Laboratory Analysis.

NSDWQ*MPL: Nigerian Standard for Drinking Water Quality Maximum Permissible Level

4. Discussion

From table 1 the physical, chemical and bacteriological analysis of the sample water all fell within the required standard of both the WHO and NIS ranging from turbidity, TDS, taste, odour pH and colour.

The chemical parameters such as the Mg, Ca, Pb, Na, SO_4, Zn and Fe all fell within the safety limit of the required standard as well.

The Total Coli form, Faecal Coli form and E. coli did not pose a threat as none was trace in the sampled water.

The results shows that the water is okay and being the first borehole to be dug in the area will give in more drive to locate another one within the area and if possible more to serve the community, as the area is growing by day.

5. Conclusion

This research has provided data on the level and safety of the drilled water quality in a Guru town, a sub-hurb area Bauchi town, Bauchi state. The study has being able to address issue of getting water for drinking and domestic use in the area that has largely depend on rain water and flowing streams during raining season. It has given hope of getting water and of drilling more borehole in the rocky area. I recommend the government and agency involved water supply to come to this community and help them with more borehole.

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