The International Journal Of Engineering And Science (IJES)
||Volume||2 ||Issue|| 11||Pages|| 01-04||2013||
ISSN(e): 2319 – 1813 ISSN(p): 2319 – 1805

# Assessment of Water Quality of Hand-Dug Wells in Zaria LGA of Kaduna State, Nigeria

By

Samuel Yakubu

*Department of Geography, Osun State University, Okuku Campus, Nigeria*

**ABSTRACT**

*This study assessed the water quality of some hand-dug wells in Zaria Local Government Area of Kaduna State, Nigeria. Water samples were collected from eight (8) different wells at strategic positions and determined to ascertain how safe the water is for directly human consumption without treatment. The physical and chemical parameters assessed include temperature, pH, total hardness, biochemical oxygen demand (BOD), nitrate, manganese, iron, copper, zinc, lead and nickel. The result revealed high variation between the WHO standard for potable water and the obtained values. The implication is that water from most wells in the study area is not in any way safe nor suitable for direct human consumption. Closeness of wells to refuse dumpsites was blamed for the increase levels of concentration of pollutants. To avoid further pollution of groundwater, the study therefore recommends that the site for well should be at least 30m away from source of contamination most especially refuse dumpsite, the surrounding environment of the existing wells should be kept clean and tidy to avoid or reduce contaminations, disinfection of wells water by chlorination and continuous monitoring to determine any change in the level of pollution at the sources.*

***KEYWORDS****: water quality, pollutants, hand-dug wells, suitability*

Date of Submission: 05 November, 2013 — Date of Acceptance: 30 November 2013

## I. INTRODUCTION

Water is a resource that is both invaluable and vital to the existence of all living organisms, but this valued resource is increasingly being threatened as human populations grow and demand more water of high quality for domestic purposes and economic activities. Water value is linked to the provision and quality of ecosystems service. According to Annan, (2003) ‘‘portable water is precious, we cannot live without it and human activities have profound impact on the quality and quantity of water available’’. Domestic water is used for drinking, cooking, bathing and cleaning, however, access to safe drinking and sanitation is critical in terms of health. For instance, unsafe drinking water contributed to numerous health problems in developing countries such as the one billion or more incidents of diarrhoea that occur annually (Mark et al., 2002). While water may appear to be clear and pure, and has no specific taste or odor, it may contain elements that can have undesirable effects on health.

Water is classified under two main categories based on its location and these are surface and ground water (Appelo and Postma, 2005). The quality of any body of surface or ground water is a function of either or both natural influences and human activities. Without human influences, water quality would be determined by the weathering of bedrock minerals, atmospheric processes of evapotranspiration, and the deposition of dust and salt by wind. Others include, the natural leaching of organic matter and nutrients from soil, hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water (UNEP, 2006).

Contrary to widely held theoretical view of groundwater being the “safest” water, wells are found to be polluted in terms of temperature, mineral contents, particles solute, organic matter and bacterial concentration. The quality of groundwater is determined by testing various parameters of interest on which results is compared with the standard qualities required for water intended for human consumption and use (Appelo and Postma, 2005).

A well is an excavation or structure created in the ground aquifers. The well water is drawn by a pump, or using containers such as rubber or iron bucket that are raised by hand. Well can vary greatly in depth, water volume and may require treatment to soften it. Several studies such as Dada (1988), Abdullahi (1989), Akungbo (1990), Gideon (1999), (Folorunsho, 2010), Adediji and Ajibade, (2005) among others showed the relationship between ground (well) water quality and refuse dumpsites. For instance, Dada (1988) studied the faecal pollution of well water in Zaria city; Abdullahi (1989) worked on the isolation and identification of *salmonella typhoid and vibro-cholerae* from wells in Zaria. Ariziki (1991) in his study of some physiochemical and bacteriological qualities of shallow wells in Samaru, Zaria observed that polluted water wells of Samaru were due to poor location of such wells. Gideon (1999) studied the quality of water in wells found in Samaru, Zaria and observed that all the wells were polluted with pollution strength varying with locational qualities, land use and well construction design. He also observed seasonal variation in the pollution which he attributed to high total bacteria count levels in wells. Inadequate access to portable water is closely associated related to poverty (Taylor *et al*, 2002). In Ghana for instance, only 6% of the poorest wealth quintile had indoor piping compared with 78% of the wealthiest (Songsore and McGranahan, 1993).

Various shallow wells have been sunk in the study area due to inadequate potable water supply. Water consumed plays a key role in determining the physical, mental and social health of any one (Yakubu and Baba, 2010). While human senses can only analyze the aesthetic quality of water, it cannot go beyond that to ascertain the chemical quality of drinking water. As a result, the overall process of evaluating the physical characteristic and elemental concentration of heavy metals contained in drinking water is expedient.

The objective of the study is to determine some physical and chemical characteristics of well water consumed and to compare the parameters with the WHO standards in order to evaluate any possible health effect on the consumers. This is very important because drinking water quality guidelines and standards are designed to enable the provision of clean and safe water for human consumption, thereby protecting human health as well as the environment. The guidelines are usually based on scientifically acceptable levels of toxicity to either humans or aquatic organisms. Water quality is not static over time, rather, it vary in both time and space and requires routine monitoring to detect spatial patterns and changes over time.

## II. METHODOLOGY

**The study area**

The study area is Zaria which lies on latitudes 11° 07"N and 12° 00''N, and longitude 07° 44"E and 8° 00"E. Located at a distance of about 962 kilometers from the Atlantic Ocean, it is about 80 kilometers from Kaduna (the state capital). Zaria lies at a height of about 700 metres above sea level and is part of the Hausa High Plains of the northern Nigeria. The area falls within the tropical wet-dry climate and experiences two distinct seasons namely; the wet and dry seasons which are caused by the movement of the Inter-Tropical Discontinuity (ITD) under the influence of two major air masses namely the tropical continental (cT) and the tropical maritime (mT). It has a mean annual rainfall of about 800mm, concentrated in a wet season between April and October (Yakubu, 2009). The temperature is high throughout the year, with the monthly mean rising from January ($21^0$C) and attaining a maximum in April ($29^0$C). A decade mean annual temperature (1999-2008) is $26^o$C (Yakubu, 2009). Zaria is drained majorly by Galma River with three other rivers as its tributaries which are River Kubanni, Shika and Saye.

**Data collection and Analysis**

Water samples were collected from eight (8) wells (w1-w8) in households at specific locations. The wells were basically considered as of small, medium and large sizes given the common sizes of wells in most homes in the study area. A small plastic bottle of one (1) litre capacity rinsed with distilled water was used to collect water samples. Water sample collected from each well was taken to the laboratory for analysis the same day for the following parameters: temperature, pH, total hardness, BOD, nitrate, copper, iron, manganese, zinc, lead and nickel using standard laboratory techniques. The analysis was carried out at the Centre for Energy Research and Training (CERT), Ahmadu Bello University, Zaria, Nigeria. The results obtained were compared with the secondary data gotten from publications of the World Health Organization (WHO) Standard to ascertain conformity with the national and international guidelines.

**Results and Discussion**

From the analysis of the samples, variations in the levels of both physical and chemical concentration were observed. The values of each of the parameters examined from well 1 to well 8 are tabulated in table 1. However, Table 2 which is the summary of data in Table 1 shows the variation in terms of range, mean level of concentration of each parameter examined, WHO standard and deviation from the standards.

From Table 2, the results show that most parameters tested were either above or below the international and national standards with the exception of pH, which fall within the range. The mean value of temperature for instance is 25.3 which is above the WHO standard. A high temperature causes thermal pollution and adversely affects aquatic life. More so, a rising water temperature lowers the viscosity of water and so causes faster settling of solid particles. Total hardness has the mean concentration of 197.9mg/l higher than the 100mg/l WHO standard. This excess according to Appello and Postma (2005) causes cataract, diuretics disease and diarrhea in man and scouring disease among livestock.

Table 1: Values of Well Water Sample

| Parameter | W1 | W2 | W3 | W4 | W5 | W6 | W7 | W8 |
|---|---|---|---|---|---|---|---|---|
| Temperature ($^oC$) | 24.0 | 25.5 | 25.8 | 24.4 | 26.9 | 25.6 | 26.9 | 23.8 |
| pH | 7.8 | 7.5 | 6.8 | 8.0 | 7.4 | 7.8 | 7.3 | 7.0 |
| Total Hardness | 200 | 182 | 150 | 302 | 242 | 132 | 250 | 125 |
| BOD | 15 | 20 | 18 | 20 | 16 | 18 | 21 | 12 |
| Nitrate (mg/l) | 1.2 | 1.8 | 1.5 | 1.7 | 2.0 | 1.7 | 1.6 | 1.5 |
| Manganese (mg/l) | 2.02 | 0.84 | 1.03 | 0.42 | 0.80 | 2.33 | 1.80 | 2.20 |
| Iron (mg/l) | 3.20 | 1.14 | 5.25 | 2.88 | 1.90 | 4.20 | 3.50 | 0.72 |
| Copper (mg/l) | 2.10 | 2.40 | 1.80 | 0.82 | 4.30 | 1.44 | 2.51 | 1.80 |
| Zinc (mg/l) | 0.52 | 0.18 | 1.21 | 0.56 | 2.11 | 1.42 | 1.90 | 1.12 |
| Lead (mg/l) | 0.1 | 0.07 | 0.5 | 0.03 | 0.08 | 1.00 | 0.04 | 0.85 |
| Nickel (mg/l) | 0.04 | 0.05 | 0.07 | 0.12 | 0.06 | 0.09 | 0.02 | 0.03 |

Note: W = well

Table 2: Suitability of drinking water quality

| Parameters | Range | Mean | WHO Standard (2004) | Deviation |
|---|---|---|---|---|
| Temperature | 22.6 - 8.0 | 25.3 | 23.5 | +1.81 |
| pH | 6.8 – 8.0 | 7.45 | 6.5 - 8 | +0.95, -0.55 |
| Total Hardness | 125 - 302 | 197.9 | 500 | -302.3 |
| BOD | 12 - 21 | 17.5 | 10 | +7.5 |
| Nitrate | 1.2 – 2.0 | 1.63 | 1.5 | +0.13 |
| Manganese | 0.42–2.33 | 1.43 | 0.4 | +1.03 |
| Iron | 0.75-5.25 | 2.85 | 0.3 | +2.55 |
| Copper | 0.82-4.30 | 2.15 | 1.0 | +1.12 |
| Zinc | 0.18-2.11 | 1.13 | 5.0 | -3.88 |
| Lead | 0.04-1.0 | 0.33 | 0.01 | +0.32 |
| Nickel | 0.02-0.12 | 0.06 | 0.02 | +0.04 |

Field observation, the contamination or high levels of heavy metal content observed in the selected wells could be attributed to the indiscriminate dumping of refuse around most of the wells, which could leached down from the surface. Several other studies such as Akungbo (1990); Ariziki (19991), Gideon (1999), (Folorunsho, 2010) revealed that refuse dumps distance is not the only factor responsible for the level of concentration of pollutants in wells. Other factors such as nature of the geologic material developed on the poorly weathered crystalline basement complex rocks, poor drainage and sewage systems, discharge from industries and application of fertilizers could also be responsible for the level of pollution in the well water.

The health risk with manifesting symptoms of acute toxicity is only associated with known exposure and or ingestion. While heavy metals reaching toxic levels have health risks associated with it, some symptoms associated with this health risk are experienced by some consumers and it is an indication that ill-health affect efficiency in one way or the other (Yakubu and Baba, 2010). Similarly, Okechukwu *et al* (2012) reported rampant cases of water borne diseases like typhoid fever in some hospitals in Nsukka metropolis. It is obvious that this common resource - water brings with it the blessing of continual survival but where carelessly handled is accompanies with it a silent epidermic, capable of hindering the attainment of individual's goal, wrecking havoc to the society' potential labour force and thus becomes the bane of national development.

## III. CONCLUSION

From the study, it is observed that the water quality of the eight wells present a vivid picture of the nature of pollutants found in the well water where many consumers relay on. Based on the WHO standard for safe drinking water, most of the wells are in critical state of pollution. This means that water from most wells is not in any way suitable for direct consumption as practiced in the area. However to avoid further pollution of groundwater, the study therefore recommends that the site of any well to be dug should be at least 30m away from any source of contamination, the surrounding environment should be kept clean and tidy to avoid or reduce contaminations from dirt around the wells, disinfection of wells water by chlorination and continuous monitoring to determine any change in the level of pollution at the sources.

## REFERENCE


[1] Adediji, A. and Ajibade, L.T. (2005). Quality of Well Water in Ede Area, Southwestern Nigeria. J. Hum. Ecol.,17(3): 223-228.

[2] Akungbo, A. (1990) Pollution of water in Samaru, Unpublished Dissertation Department of Geography Ahmadu Bello University Zaria, Nigeria.

[3] Annan, K. (2003) On: World Water Day, Special United Nation Report, March, 2003

[4] Appelo, C.A.J. and Posma, D.C. (2005). Geochemistry of Groundwater and Pollution Published by Balkema,Leiden.

[5] Ariziki, A.L. (1991) Some Bacteriological and Physiochemical Qualities of Shallow wells in Samaru, Zaria, Unpublished Dissertation Department of Geography Ahmadu Bello University Zaria, Nigeria.

[6] Folorunsho, J.O. (2010). An assessment of the quality of water in shallow wells in Sabon-Gari, Zaria, Kaduna State. The Zaria Geographer, 18(1); 71-82.

[7] Gideon, R.K. (1999). An Assessment of Current Level of Pollution of Hand-dug wells in Samaru Zaria, Unpublished Dissertation Department of Geography Ahmadu Bello University Zaria, Nigeria.

[8] Mark, W.R., Ximing Cai and Sarah A.C. (2002): World Water and Food to 2025: Dealing with Scaraty. International Food Policy Research Institute, NW, Washington, DC, USA.

[9] Okechukwu M.E., Ogwo V., Onuegbu C.U. and Mbajiorgu C.C. (2012). Water Quality Evaluation of Spring Waters in Nsukka, Nigeria. In Hydrology for Disaster Management; Special Publication of the Nigerian Association of Hydrological Sciences, pp 224-230.

[10] Songsore, J. and McGranahan, G. (1993). Environmental, Wealth and Health: towards an Analysis of Intral-urban Differentials within the Greater Accra Metropolitant Area, Ghana. Environment and Urbanization 5, pp 10-34.

[11] Taylor, P. Boussen, C.R., Awunyo-Akaba, J. and Nelson, J. (2002). Ghana Urban Health Assessment. Environmental Health Project Activity Report No. 114, Washington DC. USAID.

[12] United Nations Environment Program (UNEP) (2006). Water Quality for Ecosystem and Human Health, United Nations Environment Program/Global Environment Monitoring System (UNEP/GEMS) Program 2006, pp 1-132.

[13] World Health Organization (WHO) (2004). Standard for drinking water.

[14] Yakubu, S. (2009). Effects of municipal soil waste application on soil properties and crop qualities in Zaria urban area northern Nigeria. PhD. Thesis, Dept of Geog. University of Abuja.

[15] Yakubu, S. and Baba, B. (2010). Assessment of water quality consumed by students and its health implications on their academic performance. Journal of Studies in Science and Mathematic Education, 1(1), 103-111.