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Physico-Chemical Characteristics of Water from Hand Dug Wells in Tudun Wada, Kaduna-Nigeria

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I. INTRODUCTION

According to WHO (2007) about 1.1 billion people lack access to an improved drinking water supply. In most cities, towns and villages in Nigeria, valuable man-hours are spent on seeking and fetching water, often of doubtful quality from distant sources (Efe et al., 2005). Tudun Wada is a densely populated district of Kaduna, in north western Nigeria. The high population density, poor sanitation habits and lack of enforcement of environmental sanitation laws have contributed immensely to the pollution of water sources. This problem of acute water supply have resulted in proliferation of hand dug wells with some located within the proximity of soakaways and pit latrines.

The quality of a water resource depends on the management of anthropogenic discharges as well as the natural physico-chemical characteristics of the catchments areas (Efe et al., 2005; Saba and Baba, 2004). Also, depending on the geology of an area, underground waters are typically rich in dissolved solids especially carbonates and sulphates of calcium and magnesium. Other ions may also be present including chlorides and bicarbonates (wikipedia, 2010; Fair and Geyer, 1957). Hence, it is necessary to obtain physico-chemical characteristics of water so as to monitor water quality and to determine the type of treatment that may be required before use (Odigure and Adeniyi, 2001). Therefore, the main objective of this research is to ascertain the quality of water samples from hand dug

wells in Tudun Wada, Kaduna and to recommend measures that would enhance good water quality.

II. EXPERIMENTAL PROCEDURES

The water samples were obtained from five different wells from different parts of Tudun Wada, Kaduna. This includes Mando road, Rigasa road, Jada road, ungwan sanusi and Faskari road denoted as well 1, well 2, well 3, well 4 and well 5 respectively. The well water samples were collected using sterilized plastic containers and were covered to avoid contamination.

III. ANALYSIS OF WELL WATER SAMPLES

pH, temperature, dissolved oxygen and conductivity were measured immediately at the point of sample collection to avoid changes over time. A mercury thermometer was used to determine the temperature of the samples while a digital pH meter (model ELE 3071) was used to measure the pH of the samples. METRO HM 644 conductivity meter was used to measure electrical conductivity. The turbidity of the samples was also determined using a turbidity meter. To determine the total dissolved solids (TDS), about 100 ml of each sample was filtered, and the weight of the filtrate was measured in clean dried evaporating dish of known initial weight. The filtrate was evaporated to dryness on a hot water bath and then cooled in desiccators for about 10 minutes and weighed with its content using an electronic weighing balance (METTLER COLLEGE 30). The total dissolved solid of each sample was calculated using the formula:

$$\text{Total dissolved solids} = (A - B)/V * 100$$

Where A = Final weight of evaporating dish; B = Initial weight of evaporating dish;

V = Volume of water sample taken (ml).

The sulphate, nitrate and chloride content of the various water samples were determined using a programmable spectrophotometer (DR -2000 HACH). Total hardness was determined by titration method. 50ml of water sample was taken into a 250ml conical flask and 2-3 drops of erichrome black T indicator was added. The sample was then titrated against 0.1 EDTA solution (ethylene diamine tetra acetate) until a definite blue colour was obtained. The total hardness was calculated from the formula;

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$$\text{Total Hardness (mg/l)} = \frac{\text{vol. of titrate} \times 0.1 \text{ EDTA}}{\text{Vol. of sample}} \times 10^6$$

IV. RESULTS AND DISCUSSION

Physical characterization of well water samples in Tudun Wada, kaduna suggests the suitability of the water for domestic and other uses. The physical

parameters analyzed in this research include pH, temperature, turbidity, conductivity and total dissolved solids (TDS). The pH of the well water samples was in the range of 6.8 to 7.5 as recommended by the world health organization (1971).

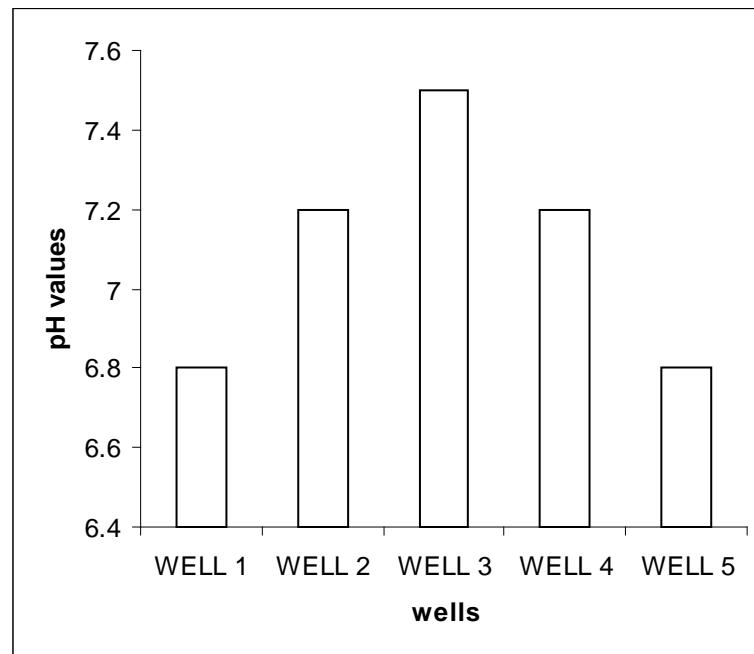


Figure 1: pH values for the various hand dug well samples

The result obtained from the physical analysis shows that the temperatures of the well water are within the range of 24.8 °C to 26°C which is also within WHO acceptable limit of

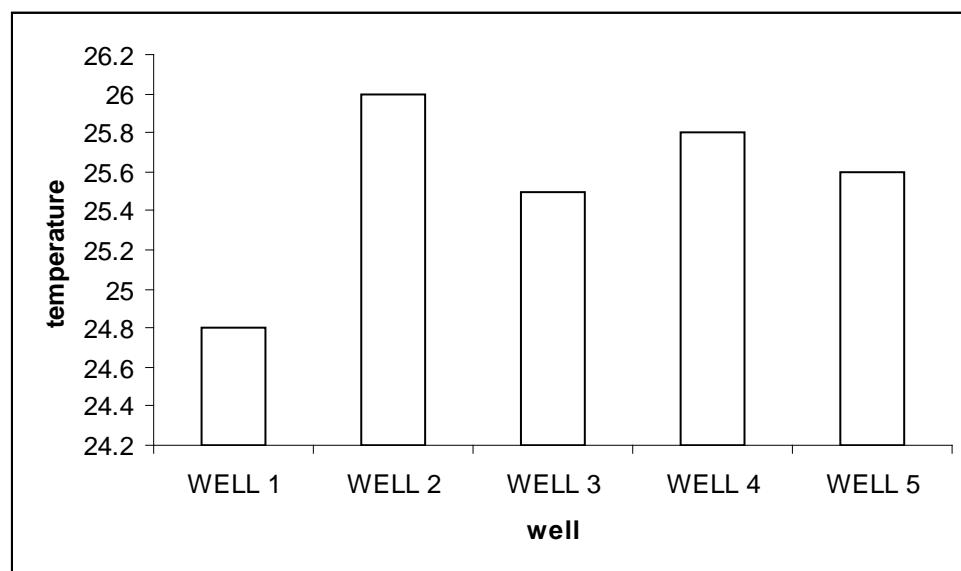


Figure 2: Temperature values for the various hand dug well samples

From figure 3, the turbidity level of the samples ranges from 0.65 NTU in well 3 to 1.2 NTU in well 5 which are all less than the maximum allowable value of 5 NTU stipulated by the World Health Organisation. This shows absence colloidal particles.

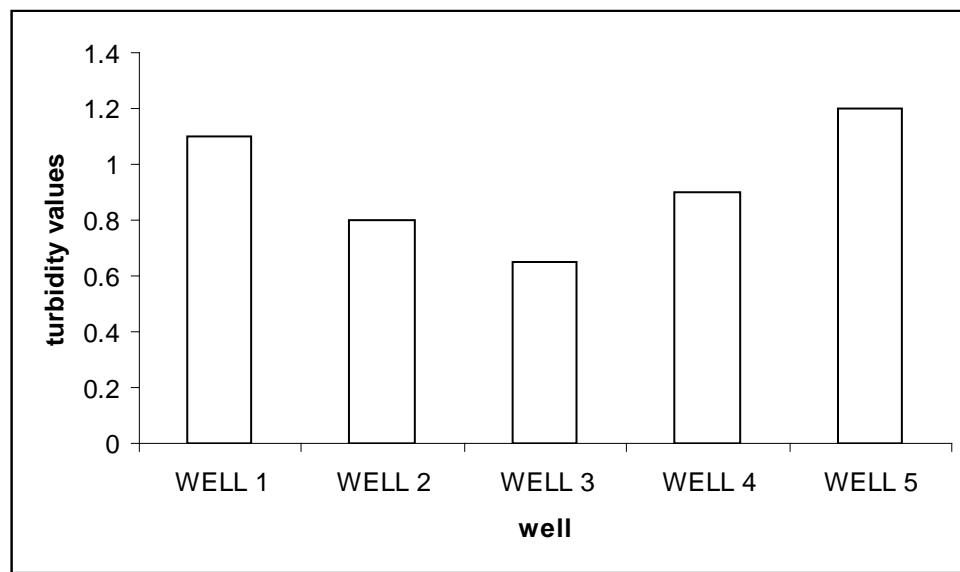


Figure 3: Turbidity values for the various hand dug well samples

The conductivity values of the samples were generally low with the highest value of 0.22 us/cm in well 4 as indicated in figure 4.

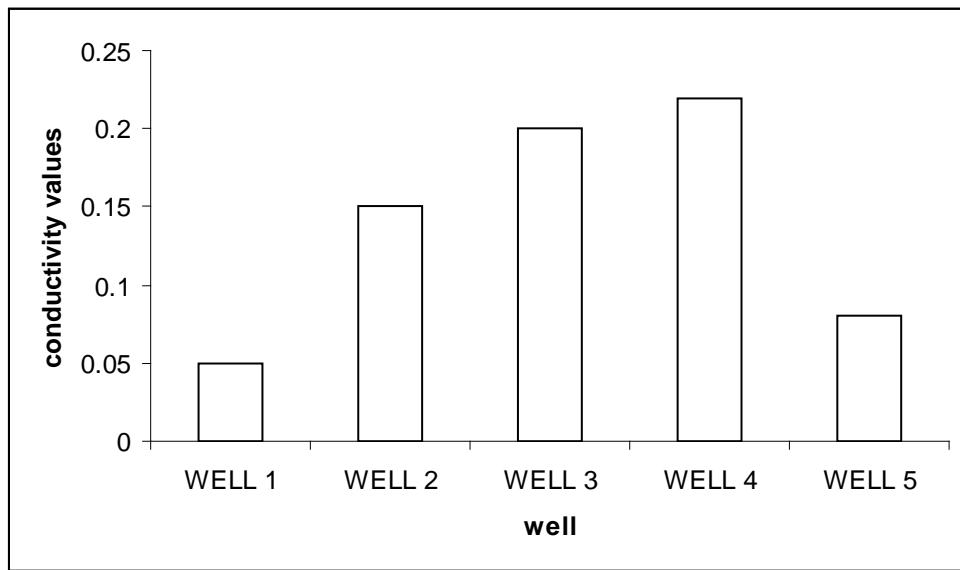


Figure 4: Conductivity values for the various hand dug well samples

The total dissolved solid (TDS) is an indication of the degree of dissolved substances such as metal ions in the water. The TDS values for the samples are less than the maximum permissible level of 500mg/l.

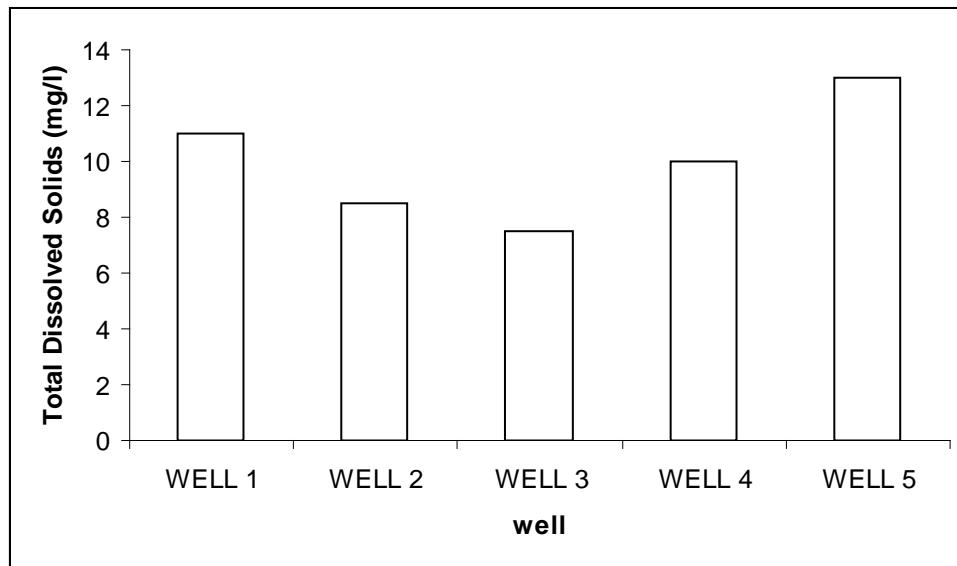


Figure 5: Total Dissolved Solids values for the various hand dug well samples

The presence of some compounds such as bicarbonates of calcium and magnesium and sulphates, chlorides, nitrates of calcium and magnesium makes the water not to foam lather readily, such water is said to be hard. Well 1 has a high value of total hardness of 232 mg/l as compared to other samples

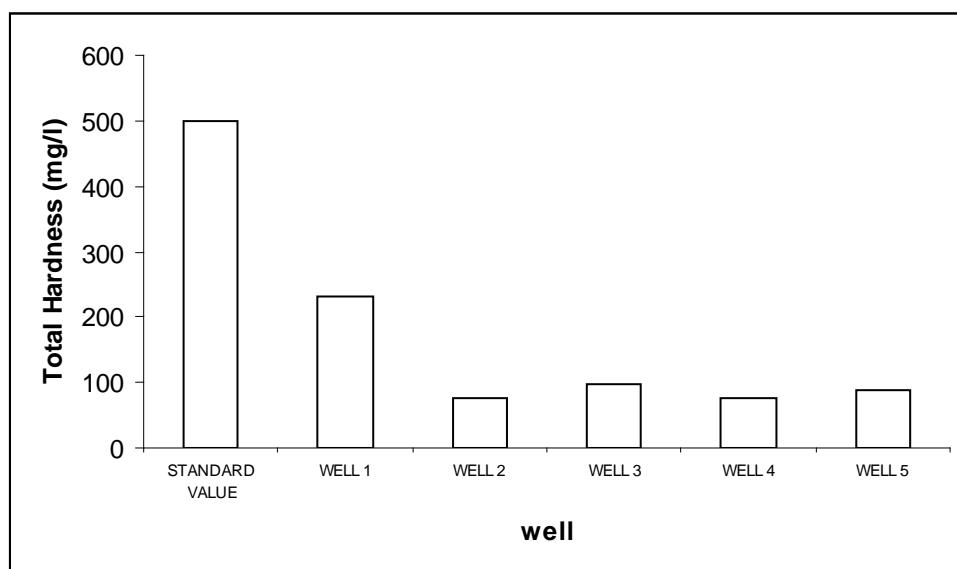


Figure 6: Total hardness values for the various hand dug well samples

The Sulphate and nitrate concentrations in water from well 1 were also observed to be 23.2 mg/l and 53 mg/l respectively which are above the maximum permissible level for sulphate and nitrate. This is clearly indicated in figure 7 and 9.

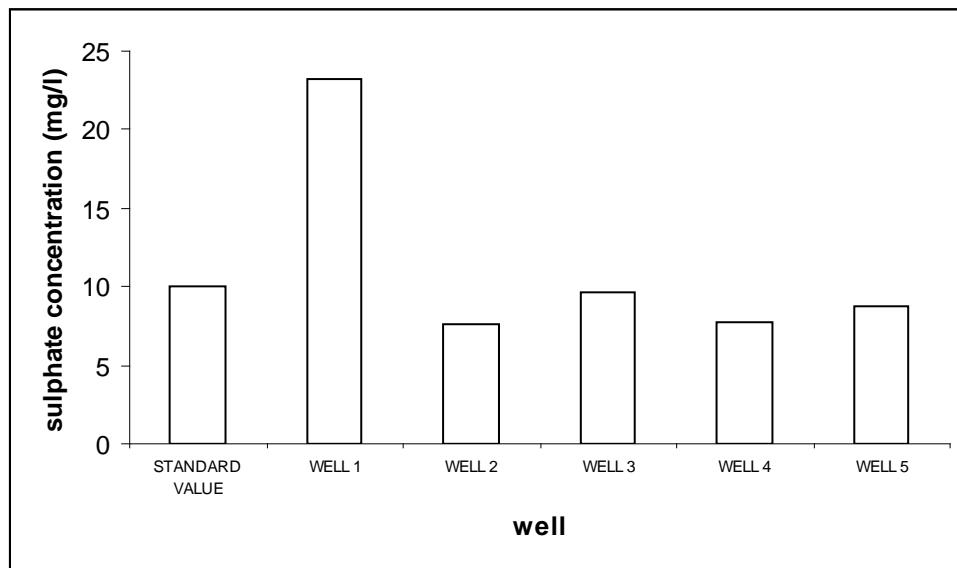


Figure 7: Sulphate concentration for the various hand dug well samples

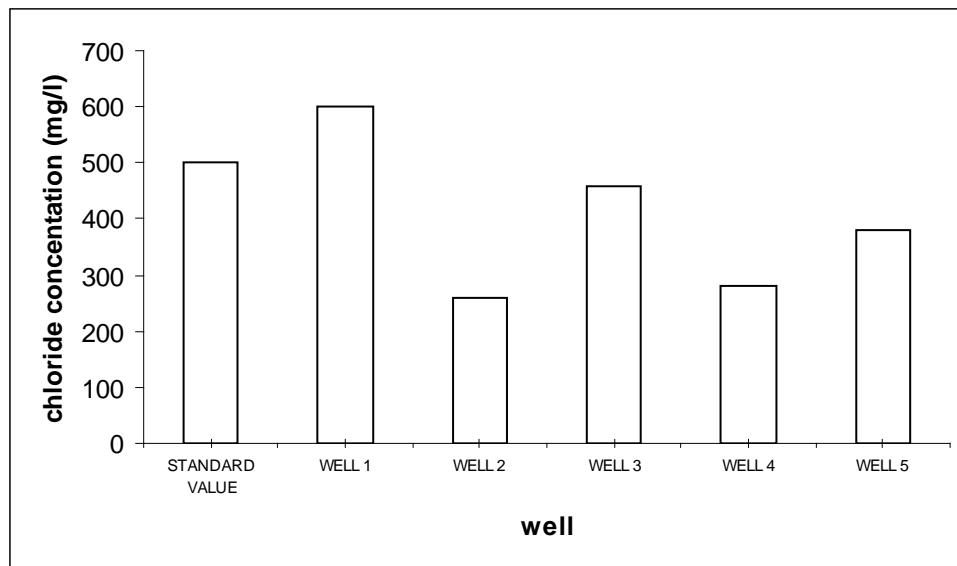


Figure 8: Chloride concentration for the various hand dug well samples

This may due to the geological nature of the area. However, samples from the other wells have values below the permissible level.

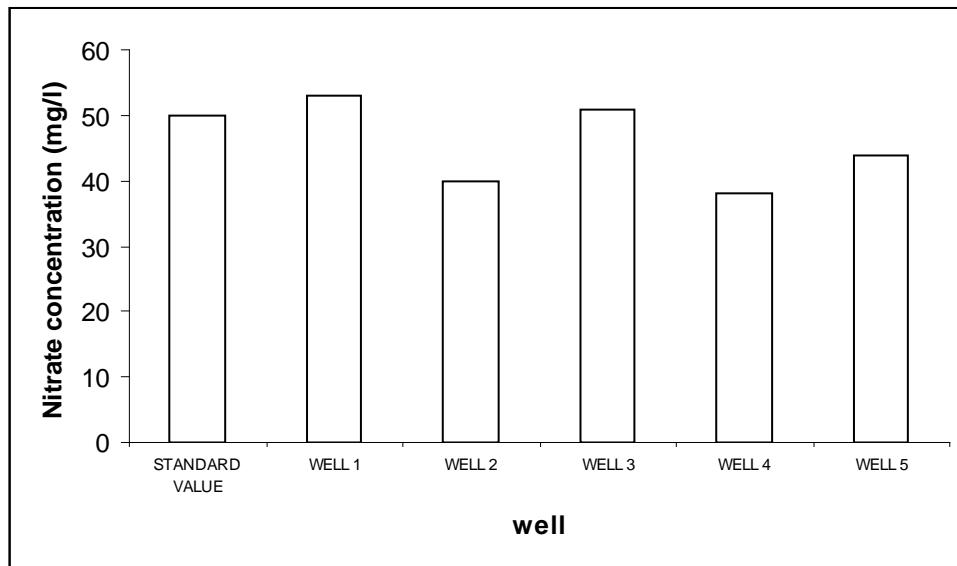


Figure 9: Nitrate concentration for the various hand dug well samples

V. CONCLUSION

The results show high level of total hardness, nitrate and sulphate concentration in well water from Tudun Wada Kaduna. Therefore it can be concluded that there is need to subject well water in Kaduna to modern treatment process to improve its suitability for domestic and other uses.

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