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RESEARCH ARTICLE

DETERMINATION OF SOME MINERAL ELEMENTS AND PHYSICAL PARAMETERS OF DRINKING WATER IN BOMO VILLAGE, ZARIA, KADUNA STATE, NIGERIA

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ABSTRACT

Water is essential for life. Drinking water of good quality is of basic importance to human physiology and man's continued existence depends very much on its availability. The provision of potable water to both rural and urban population is necessary to prevent health hazards. Consequent to the potential health hazards that may results from contaminated drinking water, it is therefore imperative to assess the quality of borehole and well water used for consumption and other domestic activities in Bomo village. Mineral elements content were determined using Atomic Absorption Spectrophotometer (AAS) while the physical parameters were measured using standard instruments. The results show that pH values were 5.76 – 7.72, temperature values were ambient. Conductivity values were in the range of 25.30 – 833.0 µS/cm for both borehole and well water. TDS result indicated values of 11.6 – 406.0 mg/l for both borehole and well water. Mineral elements analysis for both borehole and well water indicated the following results: Ca = 0.298 – 68.438 mg/l, Mg = 0.356 – 7.416 mg/l, Zn = 0.029 – 6. 969 mg/l, Cu = 0.027 – 0.168 mg/l, Fe = 0.091 – 2.087 mg/l. All values observed were within the standard limit of WHO.

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INTRODUCTION

Drinking water, also known as potable water or improved drinking water is water that is safe to drink or to use for food preparation, without risk of health problems (Etuk *et al.*, 2018). Water is essential to human life, but many people do not have access to clean potable water and that is why many die of waterborne diseases. Adequate safe and accessible water supply must be available for all human beings on earth which is their right (Tasi'u and Mohammed, 2016). Demand for potable drinking water is increasing worldwide due to increase in population which is growing at a multiple proportion every day (Cabral, 2010). Drinking water of good quality is of basic importance to human physiology and man's continued existence depends very much on its availability (FAO, 1997). The provision of potable water to the rural and urban population is necessary to prevent health hazard (Nikoladze and Alastal, 1989).

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Before water can be described as potable, it has to comply with certain physical, chemical and microbiological standards, which are desired to ensure that the water is potable and safe for drinking (Eze and Madumere, 2012; Tebutt, 1983). Potable water is defined as water that is free from disease producing microorganisms and chemical substances that are deleterious to health. Water can be obtained from a number of sources, among which are streams, lakes, rivers, ponds, rain, springs and wells (Linsely and Franzini, 1989). Scarcity of drinking water especially in rural areas resulted in to directly taken untreated water from rivers, reservoirs, lakes, ponds and shallow depressions among other sources. This problem is more pronounced in developing countries where access to both clean water and sanitation are not the norm (Tasi'u and Mohammed, 2016). Water from these sources can be said to be unfit for immediate consumption without some kind of treatment, consequently, waterborne infections may be common (Cabral, 2010).The waterborne diseases caused by water microorganisms; phytoplankton, bacteria and viruses such as polio, hepatitis, cholera, typhoid, stomach cramps etc. have been well established (Edama *et al.*, 2001), are the major indicators of surface water contamination (Mark *et al.*, 2006).

Groundwater sources are being increasingly used as drinking water yet, testing to see whether the water is of good quality is almost non-existent (Ukpong and Abaraogu, 2015). In order to evaluate the overall quality of natural water, it is important to determine the major ions concentration in the water. Atomic Absorption Spectrophotometer (AAS) and flame photometric analysis have been shown to be acceptable methods for these determinations. Physical parameters like pH, temperature, turbidity, conductivity and total dissolved solids have been found to be important in ascertaining the quality of water for drinking purposes.

The major sources of drinking water in Bomo village are wells and boreholes. However, the quality of water from these sources has not been ascertained. This research will therefore, analyze the presence of some mineral elements namely Cu, Fe, Mg, Ca and Zn and some physical parameters namely pH, temperature, conductivity, Total Dissolved Solids (TDS), and Turbidity which dictate the quality of water from the two main sources in the village. The results will be used in advising the populace of the community on the safety of the water. The aim of this research work is therefore, to determine the concentration of some mineral elements and physical parameters in well and borehole water in Bomo village of Zaria, Kaduna State, Nigeria.

MATERIALS AND METHODS

Study Area and Sampling Site: The study was conducted in Bomo Village in Sabon Gari Local Government Area, near Zaria Kaduna State, Nigeria (Figure 1). It is located between latitude $11.8^{o}11^{'}$ N and longitude $7.03^{o}8'$E at altitude of 675 meters. The hottest months are March-April, while the coldest months are December-January. Soil of Bomo Village is a ferruginous tropical soil (Klinkenberg and Higgings, 1998). The people of the village engage mainly in agricultural activities. Their main crops are maize, millet, rice, groundnut, yam and sugar cane.

Sample Collection and Preparation: The samples were collected from different locations of the study area in clean bottles 1L each and taken to Multiuser Research Laboratory, ABU Zaria for analysis. The samples were labelled A1 to A10 for borehole water and B1 to B10 for well water respectively. The samples were preserved using conc. HNO_3.

Methodology: Mineral elements (Ca, Mg, Zn, Cu and Fe) were analyzed using AAS (model number AA240FS, Fast Sequential Atomic Absorption Spectrophotometer) and the physical parameters i.e. pH, turbidity, conductivity, TDS and temperature using pH meter, Session 5 conductivity meter, DR/890 Colorimeter and thermometer respectively.

RESULTS

The result of physical parameters analysed for both borehole and well water is presented in Table 1 and 2 respectively. Table 3 and 4 indicates the result of mineral element concentration for both borehole and well water respectively. Line Graph is used to show the pattern of the results obtained. Figure 2 and 3 represent the physical parameters of borehole and well water respectively, while figure 4 and 5 represent the mineral element content in both borehole and well water respectively.

DISCUSSION

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 by the World Health Organization (WHO). In Nigeria government-owned public water utilities, such as Water Corporations, are statutorily charged with the responsibility of supplying water from conventional water treatment plants that use water from impounded reservoir (dams), flowing streams, lakes and deep boreholes. Meanwhile this analysis was based on the only two sources of water in Bomo village i.e. well and borehole waters. The results of this study for physical parameters indicated values for pH in the range of 5.97 – 6.98 (Table 1) for borehole water and 5.76 – 7.72 (Table 2) for well water. These values are near neutral pH, the optimum pH recommended for drinking water. Temperature values are between 24.80^{o}C to 25.40^{o}C for both borehole and well water. These values observed are ambient and within the recommended temperature value for water bodies. Conductivity values are also in the range 16.70µS/cmto 159.30 µS/cm (Table 1) for borehole water, and61.10 µS/cm to 138.50 µS/cm (Table 2) for well water. Total Dissolved Solid (TDS) level is found to be highest 159.30 mg/l and 406.00 mg/l, lowest 16.70 mg/l and 11.60 mg/l in both borehole and well water respectively (Table 1 and 2). Turbidity values in this study are found to be between below detection limit to 105.00 fau for both the borehole and well water respectively (Table 1 and 2).

The occurrence of mineral elements (metals) in water bodies is either of natural origin such as eroded minerals within sediments, leaching of ore deposits and volcanism – extruded products or of anthropogenic origin such as solid wastes disposal, industrial/domestic effluent, harbor channel dredging etc. Some of the metals are essential to sustaining life and must be present for normal body function and others (heavy metals) may be toxic at elevated concentrations (Akan *et al*., 2010). Calcium is the most common mineral element in the body, it helps in the transport of long chain fatty acids which aid in prevention of diseases, high blood pressure and other cardiovascular diseases (Mohammed, 2013). The level of Ca in this study is found to be highest 25.643 mg/l and 68.438 mg/l, lowest 0.298 mg/l and 1.025 mg/l in both borehole and well water respectively (Table 3 and 4). However, these values are within the recommended value by WHO (2004). Magnesium is an essential mineral element in biological systems. It is present in every cell type in every organism. ATP (Adenosine TriPhosphate), the main source of energy in cells must be bound to a magnesium ion in order to be biologically active. Moreover, many enzymes require the presence of Mg2+ for their catalytic activity including all enzymes utilizing or synthesizing ATP or those that use other nucleotides to synthesize DNA and RNA. In plants, magnesium is necessary for synthesis of chlorophyll and photosynthesis (Mohammed, 2013). The concentration of Mg is found to be highest 2.881 mg/l and 7.416 mg/l, lowest 0.356 mg/l and 0.989 mg/l in both the borehole and well water respectively. Zinc is the least toxic heavy metal and an essential element in human diet as it is required to maintain the functioning of the immune system. Zn deficiency may be highly detrimental to human health than too much of Zn, but high levels of Zn may cause vomiting, renal damage, cramps (Shuaibu *et al*., 2013).

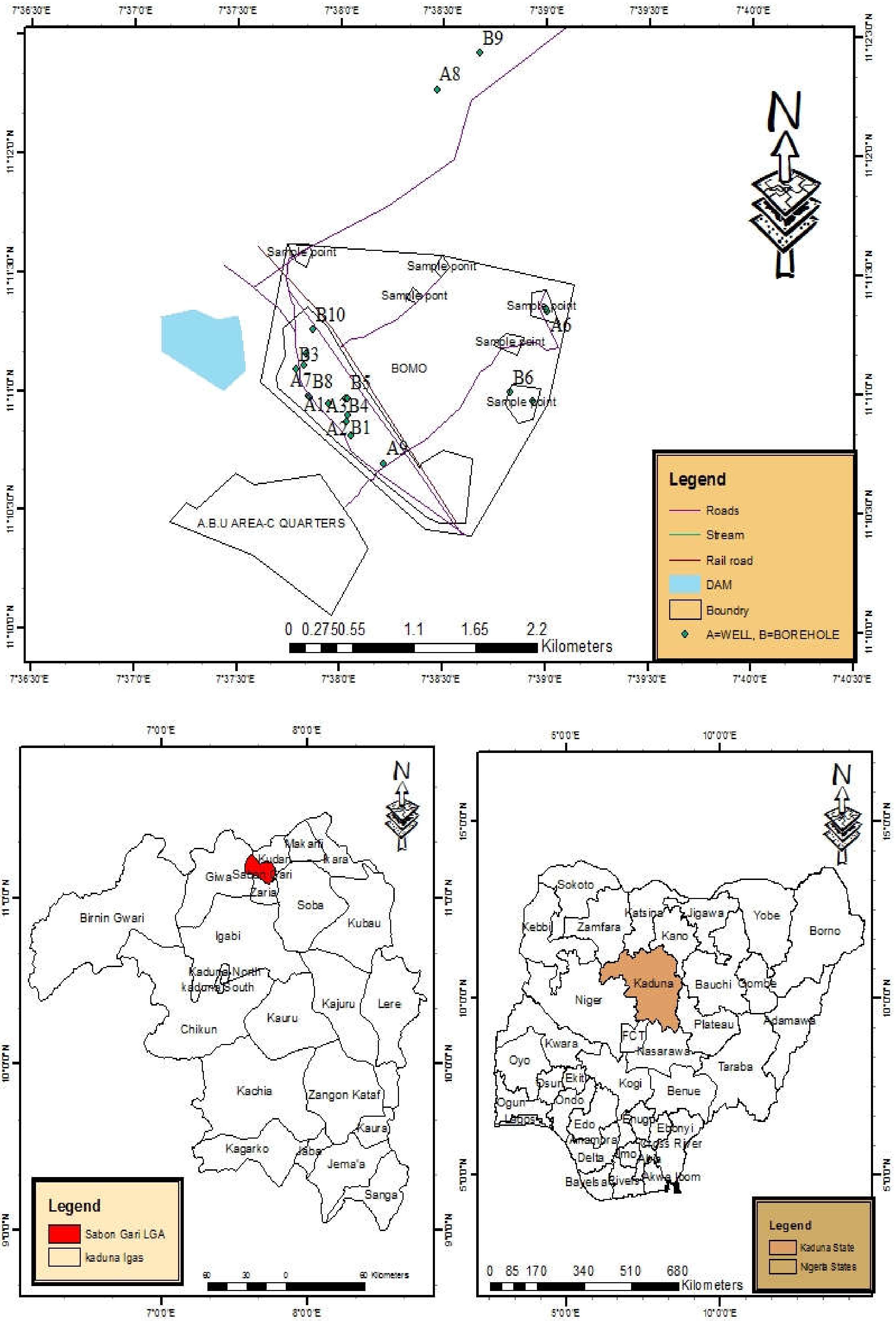


Fig.1 Map of Bomo Village of Sabon Gari Local Government Area, Kaduna State, Nigeria

Table 1. Physical Parameters of Borehole Water in Bomo

Physical Parameters	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
pH	6.98	6.82	6.31	6.54	6.88	6.51	6.29	5.97	5.97	6.14
Temperature (°C)	25.40	25.30	25.10	25.20	25.20	25.20	25.10	25.10	25.00	25.00
Conductivity(µS/cm)	109.8	49.40	62.70	91.30	332	111.2	140	100.4	36.00	37.00
TDS (mg/l)	51.80	23.10	29.50	43.00	159.3	52.60	66.30	47.60	16.70	17.20
Turbidity (fau)	4.00	14.00	2.00	ND	ND	ND	ND	4.00	36.00	3.00

Key: TDS = Total Dissolve Solid, ND = Not Detected

Table 2. Physical Parameters of Well Water in Bomo

Physical parameters	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
pH	6.32	6.52	7.72	5.98	6.19	6.75	6.77	6.04	6.33	5.76
Temperature(°C)	25.10	25.20	25.10	25.10	25.00	25.00	25.00	24.90	24.90	24.80
Conductivity (µS/cm)	138.5	833	65.60	200	25.30	207	126.7	98.80	61.10	108
TDS (mg/l)	65.80	406	30.90	95.70	11.60	99.20	60.30	46.90	28.80	51.60
Turbidity (fau)	16.00	8.00	17.00	6.00	5.00	105	9.00	7.00	24.00	11.00

Key: TDS = Total Dissolve Solid.

Table 3. Mineral Elements Content of Borehole Water in Bomo (mg/l)

ELEMNTS	A1	A2	A3	A4	A5	A6	A7	A8	A9	A10
Ca	3.444	1.848	1.129	1.868	25.643	1.314	0.339	2.921	0.298	0.917
Mg	1.956	0.757	0.356	0.636	2.881	1.252	1.558	0.695	0.416	0.839
Zn	0.636	0.908	0.756	0.147	0.173	2.057	0.654	0.200	0.029	1.021
Cu	0.168	0.107	0.072	0.086	0.030	0.091	0.059	0.066	0.040	0.067
Fe	0.115	0.197	0.166	0.175	0.172	0.091	0.178	0.303	2.087	0.116

Serial number of borehole water = A1, A2, A3, A4, A5, A6, A7, A8, A9, and A10
Ca = CalciumMg = MagnesiumZn = ZincCu = CopperFe = Iron

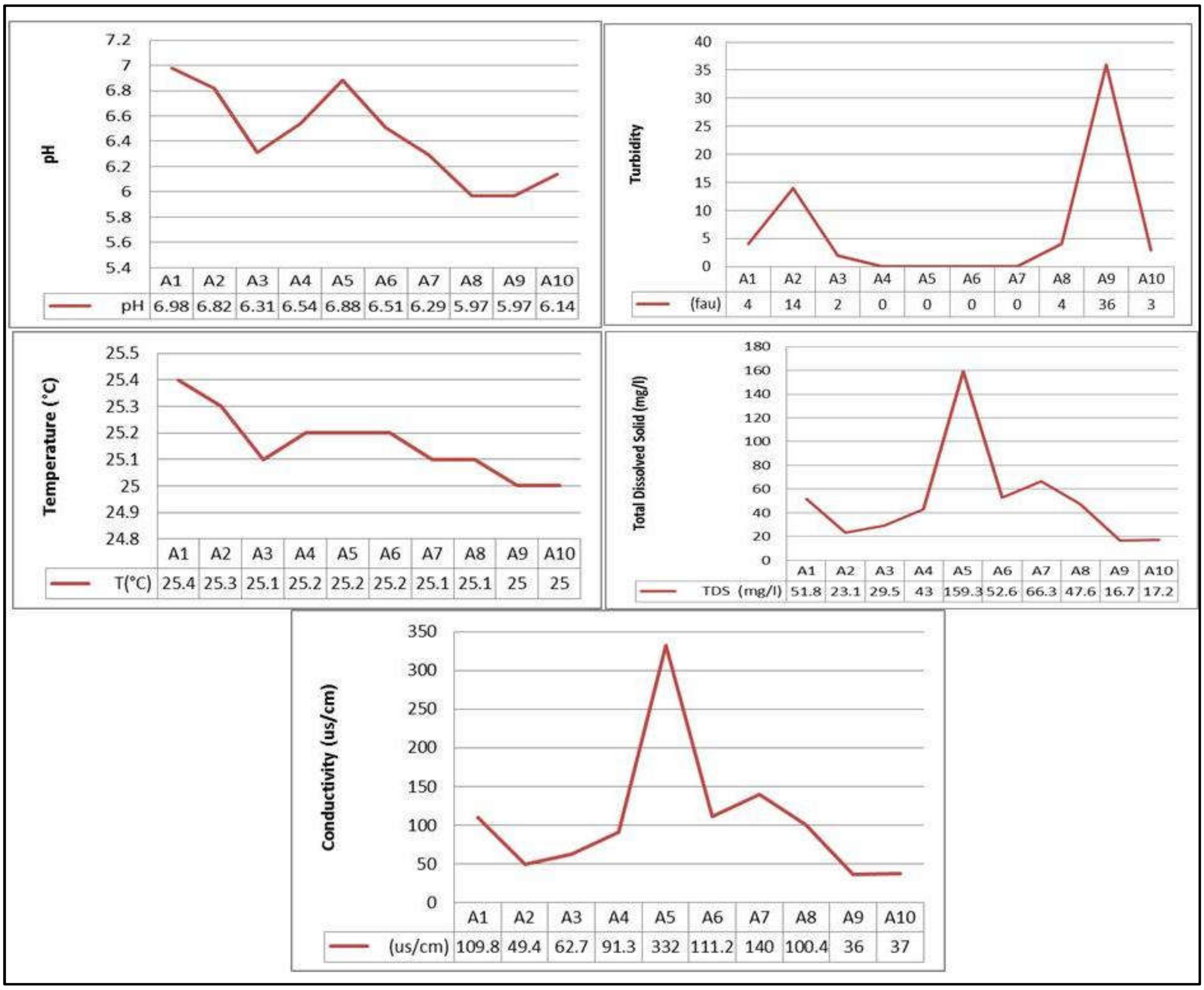
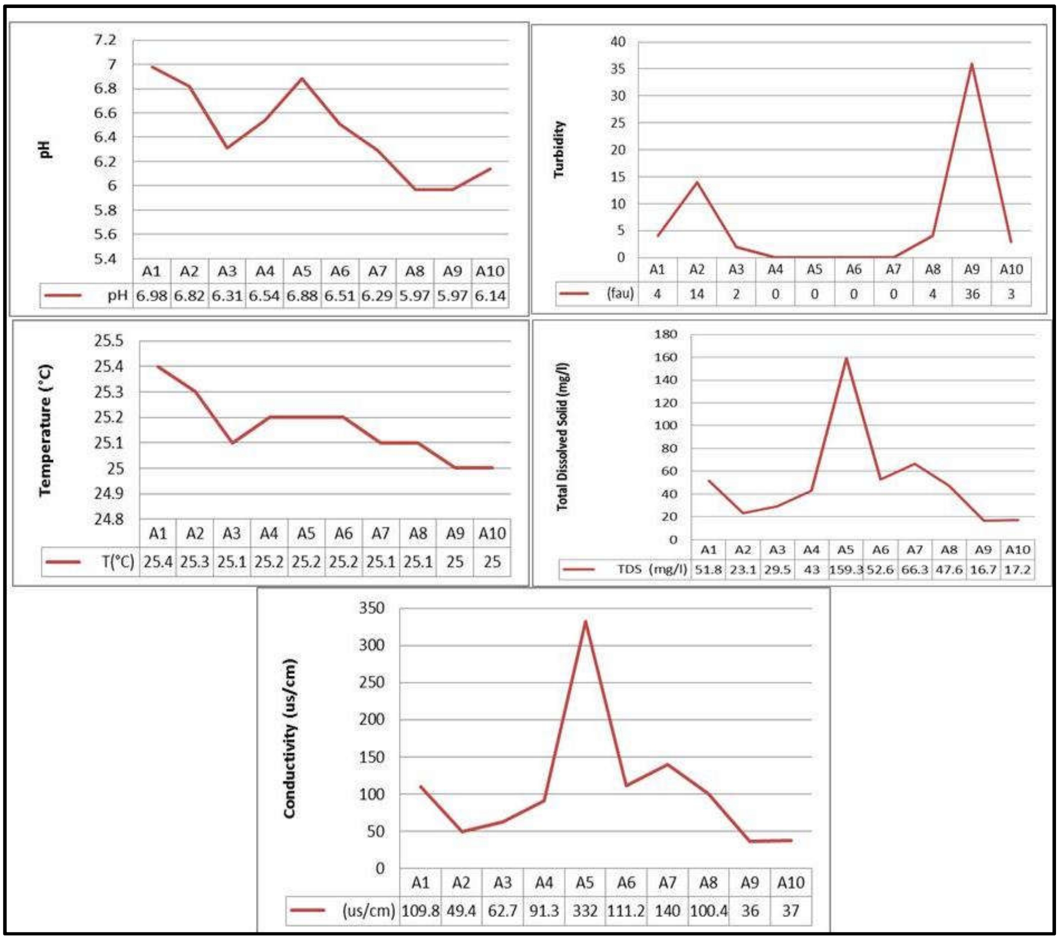


Figure 2. Line graph showing Physical Parameters of Borehole Water in Bomo Village.



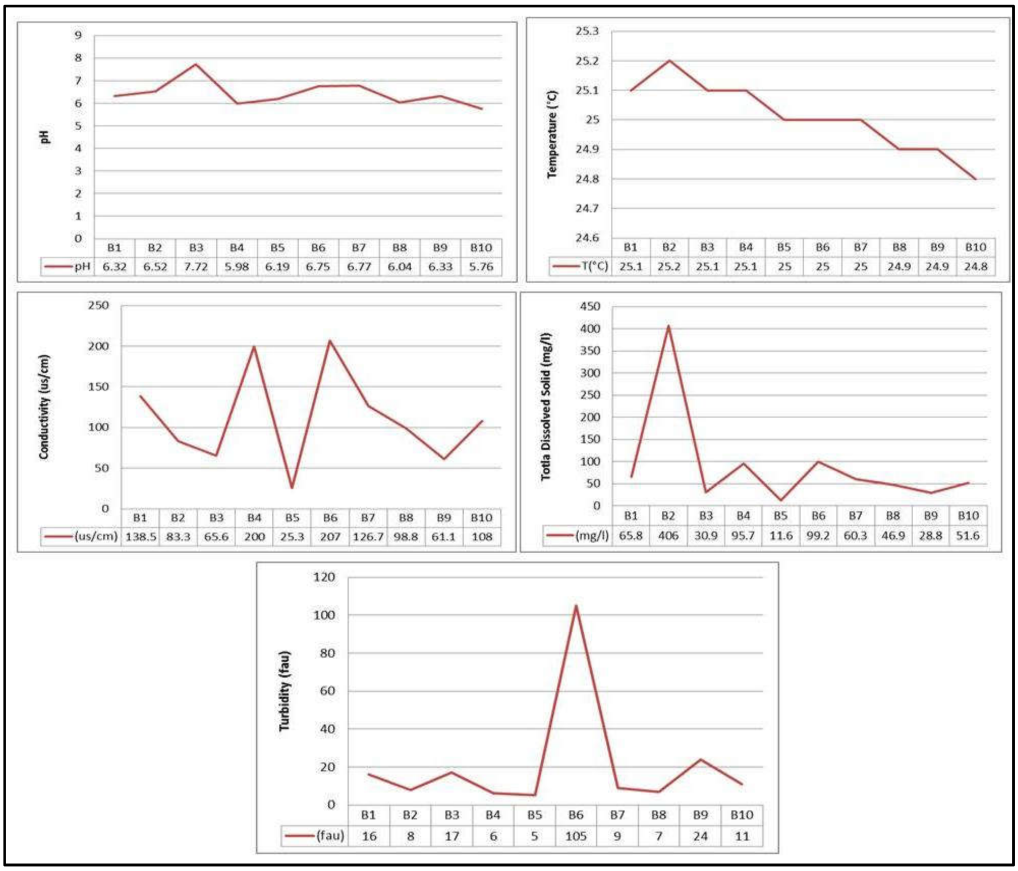


Figure 3. Line graph showing Physical Parameters of Well Water in Bomo Village

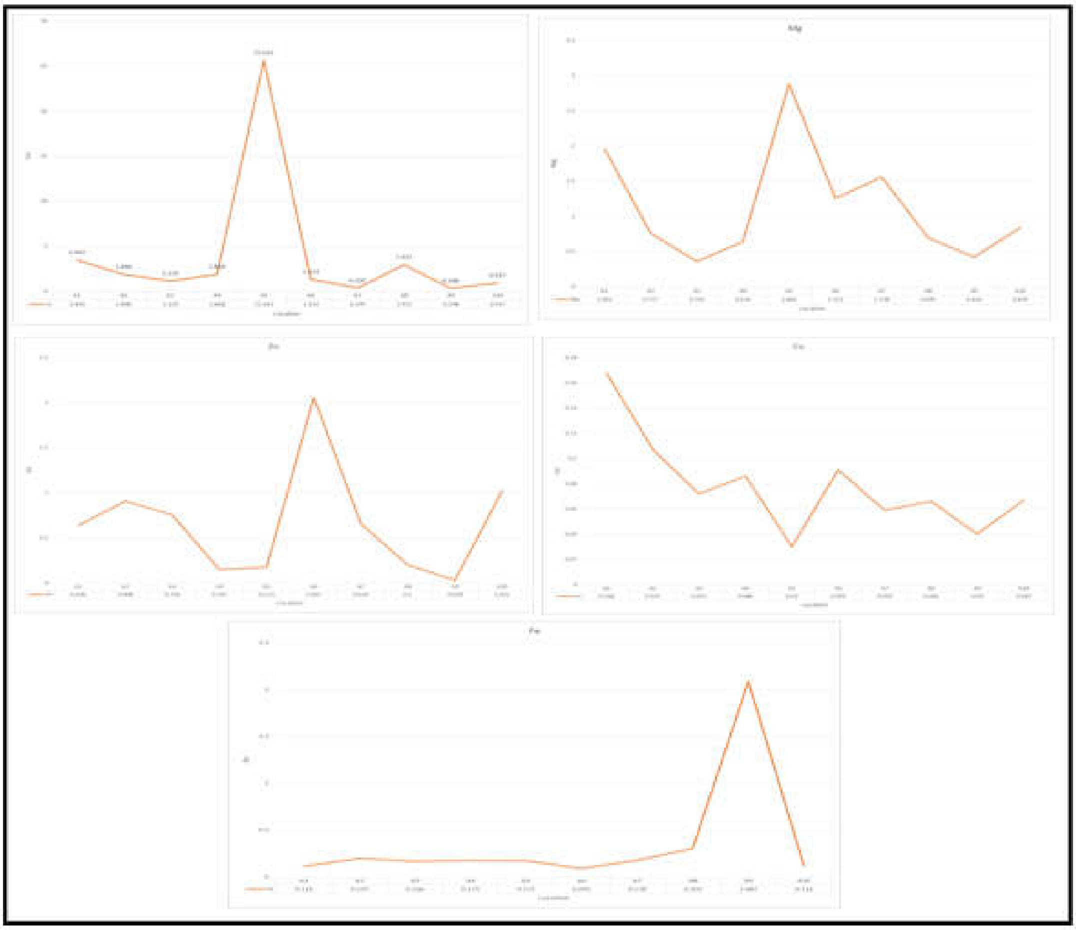


Figure 4. Line graph showing Mineral Elements Content of Borehole Water in Bomo Village

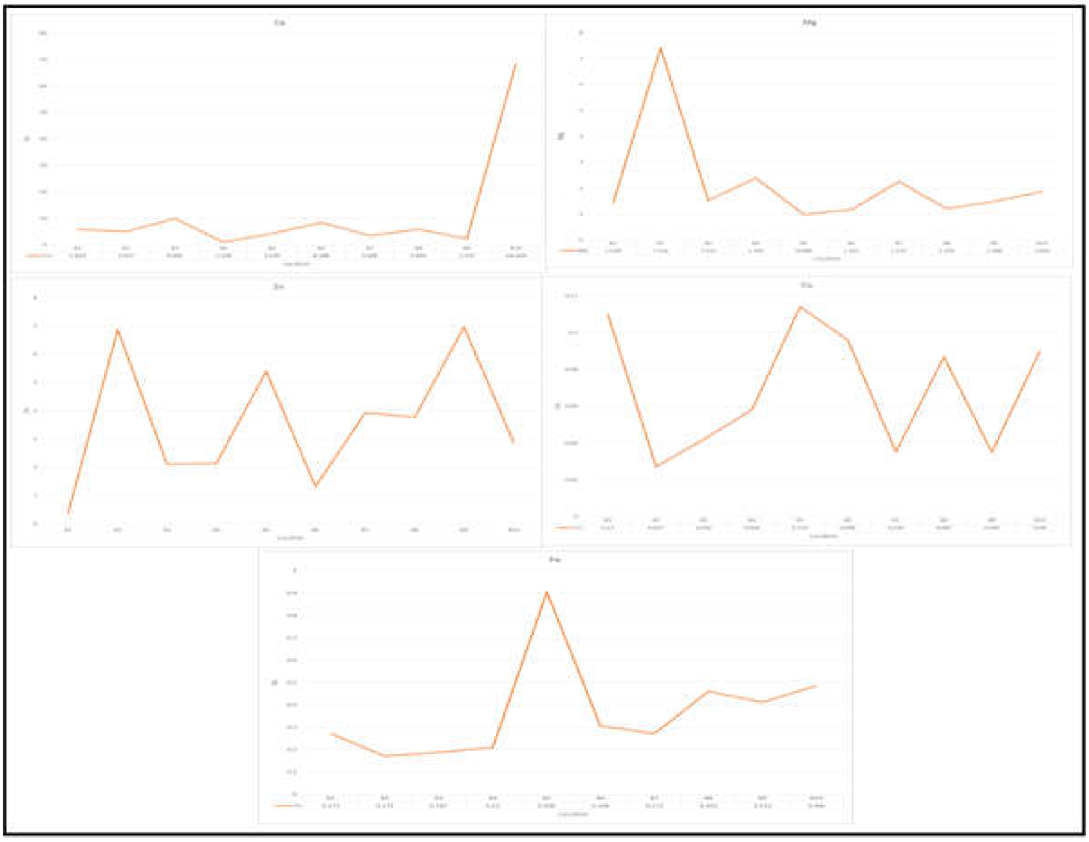


Figure 5. Line graph showing Mineral Elements Content of well Water in Bomo Village

Table 4. Mineral Elements Contents of Well Water in Bomo (mg/l)

ELEMENTS	B1	B2	B3	B4	B5	B6	B7	B8	B9	B10
Ca	5.824	4.957	9.901	1.028	4.185	8.388	3.489	5.844	2.297	68.438
Mg	1.428	7.416	1.522	2.391	0.989	1.161	2.257	1.205	1.486	1.854
Zn	0.347	6.868	2.110	2.133	5.397	1.323	3.925	3.765	6.969	2.869
Cu	0.090	0.110	0.027	0.042	0.058	0.114	0.096	0.035	0.087	0.035
Fe	0.485	0.271	0.171	0.187	0.210	0.906	0.306	0.272	0.461	0.412

Serial number of well water = B1, B2, B3, B4, B5, B6, B7, B8, B9 and B10
Ca = CalciumMg = MagnesiumZn = ZincCu = CopperFe = Iron

Highest level of Zn 2.057 mg/l and 6.969 mg/l, lowest levels 0.029 mg/l and 0.347 mg/l were observed in both borehole and well water respectively (Table 3 and 4). These values are within the standard limit of 123 µg/g recommended by WHO (2004). Copper is the most abundant element among the heavy metals. It is essential to all living organisms as a trace dietary mineral element. It is a key constituent of the respiratory enzyme complex cytochrome c oxidase which is required in aerobic respiration. Cu is also a component of the protein hemocyanin which is the oxygen carrier in most mollusks and arthropods (Mohammed, 2013). The concentration of Cu in this study is found to be highest 0.168 mg/l and 0.114 mg/l, lowest 0.030 mg/l and 0.027 mg/l in both borehole and well water respectively (Table 3 and 4). These values are within the recommended value of 25 µg/g (WHO, 2004). Iron (Fe) is essential for the synthesis of chlorophyll and activates a number of respiratory enzymes in plants. High level exposure to iron dust may cause respiratory disorder such as chronic bronchitis and ventilation difficulties (Shuaibu *et al*., 2013). The highest value 2.087 mg/l and 0.906 mg/l, lowest 0.091 mg/l and 0.171 mg/l were observed for both the borehole and well water respectively (Table 3 and 4).

Conclusion

The result of the samples of water analyzed from this study showed that the level of mineral elements such as calcium (Ca), magnesium (Mg), copper (Cu), Zinc (Zn) and iron (Fe) and physical parameters such as Temperature, pH, Turbidity, Conductivity and Total Dissolve Solid were found to be within he recommended standard given by World Health Organization (WHO). However, it is therefore recommended that both the borehole and the well water can be used for domestic activities and safe for drinking since the level of the parameters analyzed were within the recommended values.

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