**Academic Journal of Science, Engineering and Technology**
Vol. 9, Issue 1; January - February 2024;
ISSN: 2837-2964
Impact Factor: 6.67
1252 Columbia Rd NW, Washington DC, United States
https://topjournals.org/index.php/AJSET/index; mail: topacademicjournals@gmail.com

# ASSESSMENT OF THE QUALITY OF HAND DUG WELL USED FOR DRINKING AND AGRICULTURAL ACTIVITIES AT BLAMA, SMALL-BO CHIEFDOM, EASTERN, SIERRA LEONE

**Mohamed Junior Pujeh*, Yahaya Kudush Kawa, Jonathan Kpaka and Umaru Kanneh**
Department of Chemistry, School of Environmental Sciences Njala University, Sierra Leone.
DOI: https://doi.org/10.5281/zenodo.10592703

**Abstract:** This research investigates the microbial and physicochemical characteristics of five local hand dug wells used for drinking and agricultural activities in Blama, Small-Bo Chiefdom, in the Kenema District, Eastern Province of Sierra Leone. These five local hand-dug wells were randomly selected based on the availability of water in them throughout the year. The physical characteristics examined are: pH, turbidity, conductivity, temperature, total dissolve solid (TDS); and the chemical characteristics, such as: Residual chlorine (R. Chorine), magnesium, potassium, nitrite, iron, fluoride, ammonia, copper; and the microbial characteristics include: Total coliforms, fecal coliform and non-fecal coliform. Samples were collected in 500 ml sterilized plastic containers and transported to the laboratory, within 30 min. The results analysed indicate that the physical and chemical characteristic are within the WHO guideline limits for safe drinking water. However, a large amount of non-Faecal coliform was recorded in all the water samples analysed which exceed the World Health Organization standard for non-faecal coliform ((<10), and with no presence of residual chlorine. It can therefore be concluded that the water sample analyzed was potable and fit for drinking and agricultural activities.
**Keywords:** Hand-dug, well, local, safe and sample.

## INTRODUCTION

Globally, 2.2 billion people lack access to safely managed drinking water at home (WHO/UNICEF, 2019). Safe drinking water is defined as "water with microbial, chemical and physical characteristics that meets WHO guidelines or national standards on drinking water quality (WHO/UNICEF, 2019). According to WHO, for water to be qualified as being ―safely managed‖, drinking water must meet three criteria: be accessible on the premises, be available for at least 12 h/day, and be free from Escherichia coli, arsenic, or fluoride contamination. WHO/UNICEF (2017) report stated that an estimated 5.3 billion people had access to safely-managed drinking water, of that number, 1.4 billion used basic services, 206 million used limited services, 435 million used unimproved sources, and the remaining 144 million relied on untreate surface water

According to world Water Development Report (2019) on the disparities between the rich and the poor, on a global scale, half of the people who drink water from unsafe sources live in Africa. In sub-Saharan Africa, only 24% of the populations have access to safe drinking water, and 28% have basic sanitation facilities that are not shared with other households (UNICEF/WHO, 2017). Access to clean and safe water continue to be a major challenge for citizens of Sierra Leone.

The Water Aid (2017) report stated that more than six out of 10 people in Sierra Leone do not have safe water and eight out of 10 people do not have access to a decent toilet. As a result, over 1,200 children under five die each year from waterborne disease in Sierra Leone. A recent publication by World Bank (2020) stated that access to safe water in Sierra Leone was reported at 1 in 2020, according to collection of development indicators. Access to an improved water source is currently defined as the percentage of the population that can obtain at least 20 L/person/day from an ―improved‖ source that is within 1 km of the user's dwelling.

Access to clean and safe water remains an eyesore for rural and urban settlements across Sierra Leone. A lot of people inhabiting in rural communities of Sierra Leone heavily depend on hand-dug well. The preference of groundwater as a source of drinking water in rural areas is because of its relatively better quality than river water (Obiri-Danso et al., 2009).

The country is blessed with six months of wet season and six months of dry season, during wet season (May to October) most people get their drinking and domestic water from the rains which reduced the burden on people in search of water for drinking and domestic purposes. In the dry season (November to April), the availability of potable water sometimes poses a major challenge for most families. The urban settlements such as Bo, Kenema, and Makeni seldomly received potable water from the Sierra Leone Water Company (SALWACO) and Guma Valley Water Company for the capital Freetown.

Water is an essential part of human nutrition and is required for maintenance of personal hygiene, food production and prevention of diseases (Thliza et al., 2015). It is absolutely necessary for most life driven processes (Aroh et al., 2013). Quality water is colorless, tasteless, odourless, as well as free from faecal contamination (Opara and Nnodim, 2014).

Blama is the chiefdom headquarter of Small-Bo, with an estimated population of 8,146, according to Statistics Sierra Leone (SSL, 2021 Population Census of Cities/Towns). Before the start of the civil war in March, 1991, there were pipe borne water facilities at principal roads of Blama. But as a result of the 10-year civil war, most of the government infrastructures and water channels were destroyed, leaving the wreckages as existential evidence of today's monument. The availability of clean and safe drinking water has become a major issue at Blama. At present, the major sources of available drinking water at Blama are hand-dug well, river water, swamp water, hand pump wells and streams. The dug well is a traditional method of withdrawing groundwater from the upper layer of a water table by constructing a well of large diameter, typically lined by concrete rings and enclosed by a concrete slab or metal sheet with ventilation (Howard et al., 2006; Bain et al., 2014).

In rural areas of developing countries, the great majority of health-related water quality problems are the result of bacteriological or other biological contamination (WHO, 1997).

A similar report published by Statistics Sierra Leone (Stats SSL, 2017), with the technical support of UNICEF, conducted a Multiple Indicator Cluster Survey (MICS) to collect internationally comparable data on a wide range of indicators. The survey revealed that almost 90% of the drinking water at household level contained the *E. coli* bacteria, presenting a serious health threat to citizens.

The poor and marginalized people living in rural and peri-urban settlements are most in need for improved and safe drinking water, appropriate forms of sanitation and access to water for other domestic purposes (Crow, 2001). Studies carried out in different areas of the world indicate that most of the sources of domestic water have an alarming level of microbiological pollution (Mpakam, 2009; Oladipo et al., 2009; Prasanna and Reddy, 2009; Kuitcha et al., 2010; Khaniki et al., 2010; Oyedeji et al., 2010). In 2012, there was a cholera outbreak in Sierra Leone, according to WHO report (2012), there was 18,919 cases reported with 273 deaths. Cholera is a water borne disease that is caused by drinking contaminated water. Report from epidemiology (CDC, 2012) research

**Academic Journal of Science, Engineering and Technology**
Vol. 9, Issue 1; January - February 2024;
ISSN: 2837-2964
Impact Factor: 6.67
1252 Columbia Rd NW, Washington DC, United States
https://topjournals.org/index.php/AJSET/index; mail: topacademicjournals@gmail.com

has shown that cholera is predominant in sub-Saharan Africa where clean water and sanitation remains a major problem.


The objective of this study was to examine, the bacteriological and physicochemical characteristics of five local hand dug wells consumed at Blama, Small-Bo chiefdom, in the Kenema District, eastern province of Sierra Leone, and hence find a suitable remedy to help improve the quality of these residential wells and also ensured that water quality test is conducted on all residential wells before it is being consumed.

## MATERIALS AND METHODS

### Description of study area

Blama is the chiefdom headquarter town of Small-Bo, in the Kenema District, Eastern Sierra Leone. It lies approximately 12 miles away from Kenema. It is found on Latitude 7° 52' 29'' N and Longitude 11° 20' 43'' W. Blama is a fairly big town with an estimated population of 8,146 (SSL, 2021 population census of cities). The major activity of the people of this community is farming and animal husbandry. Five hand dug wells drawn from five different locations, were selected for this study. The five hand dug wells were selected for this research base on the availability of water in the well throughout the year. Google map locator was used to map out the sample collection site. The description of the sample collection area is illustrated in Figure 1.

**Figure 1.** A map showing the area of study.

### Description of sampling area

Five local hand dug wells located at Blama, Small-Bo Chiefdom, in the Kenema District were selected for this research at random. The names of the five wells are as follows: 5 Koribondo Road well, 4 Jimmy Section well, 6 Jabbie Street well, 3 Jabbie Street well, and 19 Koribondo Road well. These five hand dug wells were used by the locals of that community for drinking and agricultural activities. The study started in December, 2020, and run through May, 2021, a six months intensive water quality examination. These five hand dug wells were selected for this research based on the availability of water in them throughout the year without drying up.

### Sampling

A sterilized cup with a string tied to the cup was used to collect water from the well. The sterilized container was rinsed three times with the water sample to be tested for. The water sample was centrally poured into the sterilized container (500 ml), to avoid water touching the inside mouth surface of the container, in order to avoid contamination. The water sample was then transported to the laboratory (Directorate of water resources, in the Ministry of Water Resources, Bo City) for physicochemical and bacteriological assessment.

**Academic Journal of Science, Engineering and Technology**
Vol. 9, Issue 1; January - February 2024;
ISSN: 2837-2964
Impact Factor: 6.67
1252 Columbia Rd NW, Washington DC, United States
https://topjournals.org/index.php/AJSET/index; mail: topacademicjournals@gmail.com

**Sample collection and analysis**

***Physical parameters***

The analysis for the physical parameters was conducted according to instructional manual (Wagtech International, We30210).

**Total dissolve solid and electrical conductivity**

In the examination of electrical conductivity (µS/cm) and total dissolved solids (mg/L) of the water sample, a digital conductivity with electrode was employed to determine the concentration of TDS and EC after the electrode was switched on and duplicate values recorded. A clean tissue paper was used to wipe the electrode dry before being reused.

**pH**

A digital pH meter with electrode was used to measure the pH. It was done by inserting the electrode into the water sample and the electrode turned on, the values were taken in duplicates.

**Turbidity**

A Photometer, 7100 was used. In the determination of the level of turbidity, a blank solution was prepared to calibrate the photometer. A test tube containing 10 ml of water was placed in the basin and covered with light black cap and power turned on. Duplicate values were recorded. It is measured in nephelometric turbidity unit (NTU).

**Temperature**

The examination for temperature was done by placing the digital thermometer into the water sample and electrode switched on; duplicated values were recorded in °C.

**Chemical characteristics determination**

WAGTECH PHOTOMETER, 7100, was used to investigate the chemical characteristics. Before the analysis, references were drawn from the operational manual. A blank solution (reference, 0.00 mg/L) was first prepared to calibrate the photometer. A test tube containing 10 ml water sample was placed one tablet (chemical), it was then crushed and stirred to allow a homogenous mixture and allowed to stand for 10 min for full colouration. It was then inserted in the cell holder and lid closed. The photometer was adjusted to the appropriate wavelength and power turned on, the concentrate of each sample was recorded in mg/L.

**Microbial determination**

***Total coliform count, E. coli, and faecal coliform***

500 ml of each of the five samples collected from the wells was transported to the water quality directorate for the examination of *E. coli*, faecal coliform and non-faecal coliform. WHO permissible standard for the presence of faecal coliform in water is 0 count/100 ml. The membrane filtration method was used to assess the bacteriological parameters, after the culture media had been produced. The water samples were allowed to pass through a membrane pore space of 0.45 µm, bacteria were trapped on the membrane surface. The membrane was placed in a Petri dish containing ―m-Faecal coliform broth (PARK Scientific Limited)‖ and was incubated at 44°C for 18 to 24 h. Examination was done based on colour indicator, blue-green for *E. coli* and pink for non-faecal coliform colonies.

**RESULTS AND DISCUSSION**

**Academic Journal of Science, Engineering and Technology**
Vol. 9, Issue 1; January - February 2024;
ISSN: 2837-2964
Impact Factor: 6.67
1252 Columbia Rd NW, Washington DC, United States
https://topjournals.org/index.php/AJSET/index; mail: topacademicjournals@gmail.com
Top Academic Journals

The results of the physicochemical and bacteriological parameters of the five hand dug wells used for drinking and agricultural activities were presented in statistical methods (mean, variance, and standard deviation). The results of the various samples are illustrated in Tables 1 to 5.

**Physicochemical parameters**

From the results, the mean temperature of all the water samples was examined. 5 Koribondo Rd (28.62°C), 4Jimmy Section (28.12°C), 6Jabbie Street (28.50°C), 3 Jabbie Street (28.32°C) and 19 Koribondo Road (28.52°C) fell outside the World Health Organization (WHO) permissible limits. WHO does not have any temperature standard for safe water, but recommended that safe water must have a temperature of 25°C at a pH of 7. Environmental factors such as soil nature, the depth of water level and other anthropogenic matters can influence the temperature of drinking water. Weather patterns have also been known to increase or decrease the temperature of water. In water quality examination, temperature plays a pivotal role in influencing both the absorption of chemical and the multiplication of microbial organism.

The mean pH obtained for all the water samples (Tables 1 to 5) was analysed: 5 Koribondo Road (6.67), 4 Jimmy Section (6.64), 6 Jabbie Street (6.30), 3 Jabbie Street (6.55), and 19 Koribondo Road (6.73), fell within the WHO permissible limits, except the 6 Jabbie Street water sample, that recorded a low pH mean value. WHO recommended that drinking water should have pH of 6.5 to 8.5. An increased carbon dioxide concentration may therefore lower pH, whereas a decrease may cause it to rise (WHO, 2003). The pH of most raw water lies within the range of 6.5 to 8.5 (WHO, 2003).

From Tables 1 to 5, the mean electrical conductivity and the total dissolved solids for all the water samples were analysed: 5 Koribondo Road (129.38 µS/cm, 63.63 ppm), 4 Jimmy Section (145.07 µS/cm, 72.72 ppm), 6 Jabbie Street (158.52 µS/cm, 79.30 ppm), 3 Jabbie Street (114.85 µS/cm, 57.08 ppm), and 19 Koribondo Road (95.03 µS/cm; 47.08 ppm) fell within the WHO permissible limits. WHO recommended standard for electrical conductivity and the total dissolved solids in drinking water is <450 µS/cm and <248 ppm, respectively.

From Tables 1 to 5, the mean Turbidity value for all the water samples examined was: 5 Koribondo Road (0.04 NTU), 4 Jimmy Section (0.04 NTU), 6 Jabbie Street (0.69 NTU), 3 Jabbie Street (1.04 NTU), and 19 Koribondo Road (0.38 NTU) fell within the WHO acceptable limits. WHO standard for turbidity of acceptable water drinking was <5.0 NTU.

From Tables 1 to 5, the chemical characteristics for all the water samples examined fell within the WHO permissible limits for safe water. The chemical characteristics for the various wells were as follows: 5 Koribondo Road (R. Chlorine 0.00 mg/L, Magnesium 6.33 mg/L, Potassium 1.73 mg/L Nitrite 0.11 mg/L, Fluoride 0.01 mg/L, Iron 0.02 mg/L, Ammonia 0.00 mg/L, Copper 0.00 mg/L); 4 Jimmy Section (R. Chlorine 0.00 mg/L, Magnesium 11.33 mg/L, Potassium 2.52 mg/L, Nitrite 0.06 mg/L, Fluoride 0.01 mg/L, Iron 0.01 mg/L, Ammonia 0.00 mg/L, Copper 0.00 mg/L); 6 Jabbie Street (R. Chlorine 0.00 mg/L, Magnesium 11.67 mg/L, Potassium 2.30 mg/L, Nitrite 0.32 mg/L, Fluoride 0.06 mg/L, Iron 0.00 mg/L, Ammonia 0.00 mg/L, Copper 0.00 mg/L); 3 Jabbie Street (R. Chlorine 0.00 mg/L, Magnesium 2.27 mg/L, Potassium 1.07 mg/L, Nitrite 0.28 mg/L, Fluoride 0.00 mg/L, Iron 0.00 mg/L, Ammonia 0.00 mg/L, Copper 0.00 mg/L); 19 Koribondo Road (R. Chlorine 0.00 mg/L, Magnesium 12.33 mg/L, Potassium 2.07 mg/L, Nitrite 0.52 mg/L, Fluoride 0.01 mg/L, Iron 0.01 mg/L, Ammonia 0.00 mg/L, Copper 0.00 mg/L). All the chemical parameters analysed are within the WHO limits.

**Microbial parameters**

***E. coli and faecal coliform***

**Academic Journal of Science, Engineering and Technology**
Vol. 9, Issue 1; January - February 2024;
ISSN: 2837-2964
Impact Factor: 6.67
1252 Columbia Rd NW, Washington DC, United States
https://topjournals.org/index.php/AJSET/index; mail: topacademicjournals@gmail.com
Top Academic Journals

Tables 1 to 5 show no presence of *E. coli* and faecal *c*oliform in all the water samples examined, 5 Koribondo Road (0.00 cfu/100 ml, 0.00 cfu/100 ml), 4 Jimmy Section (0.00 cfu/100 ml, 0.00 cfu/100 ml), 6 Jabbie Street (0.00 cfu/100 ml, 0.00 cfu/100 ml), 3 Jabbie Street (0.00 cfu/100 ml, 0.00 cfu/100 ml), 19 Koribondo Road (0.00 cfu/100 ml, 0.00 cfu/100 ml).

***Non-faecal coliform***

The results from Tables 1 to 5 show a high mean value of

**Table 1.** Hand dug well at 5 Koribondo Road, Blama.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Standard** | | | | | | | | | | |
| **Parameter** | **Mean** | **Variance** | **WHO** | | | | | | | | |
| **Dec.** | **Jan.** | **Feb.** | **March** | **April** | **May** | **deviation** | | | | | |
| Temperature (°C) | 28.20 | 26.90 | 30.00 | 29.60 | 28.60 | 28.40 | 28.62 | 1.21 | 1.09 | No value | < 450 |
| pH | 6.19 | 7.74 | 6.80 | 6.52 | 6.72 | 6.02 | 6.67 | 0.37 | 0.61 | 6.5-8.5 | < |
| Conductivity (µS/cm) | 94.00 | 163.9 | 173.00 | 76.30 | 94.00 | 175.10 | 129.38 | < 5 | 49.54 | 7.04 | |
| TDS (ppm) | 47.00 | 81.80 | 86.40 | 38.10 | 47.00 | 81.50 | 63.63 | 474.57 | 21.78 | 248 | < 200 |
| Turbidity (NTU) | 0.00 | 0.00 | 0.00 | 0.24 | 0.00 | 0.00 | 0.04 | 0.08 | 0.28 | | < 6 |
| R. Chlorine (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.3-0.5 | < 3.0 |
| Magnesium (mg/L) | 6.00 | 6.00 | 8.00 | 0.00 | 8.00 | 10.00 | 6.33 | 11.87 | 3.44 | | < 1.5 |
| Potassium (mg/L) | 2.00 | 2.12 | 2.14 | 2.14 | 0.00 | 2.00 | 1.73 | 0.73 | 0.85 | | < 0.3 |
| Nitrite (mg/L) | 0.12 | 0.12 | 0.14 | 0.02 | 0.14 | 0.12 | 0.11 | 0.00 | 0.02 | | |
| Fluoride (mg/L) | 0.02 | 0.00 | 0.00 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.02 | | < 1.0 |
| Iron (mg/L) | 0.03 | 0.02 | 0.01 | 0.02 | 0.02 | 0.01 | 0.02 | 0.00 | 0.01 | | |
| Ammonia (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | No value | |
| Copper (mg/L) | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | |
| *E. coli* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 cfu/100 ml | |
| *F*aecal coli | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 cfu/100 ml | |
| Non-Faecal coli | 12.00 | 12.00 | 16.00 | 14.00 | 14.00 | 12.00 | 13.33 | 2.67 | 1.63 | <10 cfu/100 ml | |

**Table 2.** Hand dug well at 4 Jimmy Section, Blama.

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **Month** | **Standard** | | | | | | | | | | |
| **Parameter** | **Mean** | **Variance** | **WHO** | | | | | | | | |
| **Dec.** | **Jan.** | **Feb.** | **March** | **April** | **May** | **deviation** | | | | | |
| Temperature (°C) | 28.10 | 26.20 | 30.00 | 28.80 | 28.10 | 27.50 | 28.12 | 1.61 | 1.27 | No Value | < |
| pH | 5.68 | 7.74 | 6.74 | 6.86 | 6.68 | 6.14 | 6.64 | 0.49 | 0.69 | 6.50-8.5 | < |
| Conductivity (µS/cm) | 172.10 | 135.4 | 111.80 | 145.90 | 172.00 | 133.20 | 145.07 | 466.31 | 21.59 | 450 | < |
| TDS (ppm) | 86.60 | 67.60 | 55.90 | 73.10 | 86.60 | 66.50 | 72.72 | 146.65 | 12.11 | 248 | < 200 |
| Turbidity (NTU) | 0.00 | 0.00 | 0.00 | 0.23 | 0.00 | 0.00 | 0.04 | 0.01 | 0.09 | 5.0 | < 6.0 |
| R. Chlorine (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.30-0.50 | < 3.0 |
| | | | | | | | | | | | < 1.5 |
| | | | | | | | | | | | < 0.3 |
| | | | | | | | | | | | < 1.0 |

**Academic Journal of Science, Engineering and Technology**
Vol. 9, Issue 1; January - February 2024;
ISSN: 2837-2964
Impact Factor: 6.67
1252 Columbia Rd NW, Washington DC, United States
https://topjournals.org/index.php/AJSET/index; mail: topacademicjournals@gmail.com

**Table 3.** Hand dug well at 6 Jabbie Street, Blama.

| Parameter | Month | | | | | | Mean | Variance | Standard. Deviation | WHO |
|---|---|---|---|---|---|---|---|---|---|---|
| | Dec. | Jan. | Feb. | March | April | May | | | | |
| Temperature(°C) | 28.20 | 26.30 | 30.10 | 29.40 | 29.20 | 27.80 | 28.50 | 1.86 | 1.36 | No value |
| pH | 5.15 | 7.66 | 6.56 | 5.68 | 6.74 | 6.01 | 6.30 | 0.77 | 0.88 | 6.5-8.5 |
| Conductivity (µS/cm) | 168.60 | 160.50 | 148.30 | 154.30 | 168.60 | 150.80 | 158.52 | 77.79 | 8.82 | < 450 |
| TDS (ppm) | 84.30 | 80.30 | 74.10 | 77.20 | 84.30 | 75.60 | 79.30 | 19.23 | 4.38 | < 248 |
| Turbidity (NTU) | 2.00 | 2.00 | 0.00 | 0.18 | 0.00 | 0.00 | 0.69 | 1.20 | 1.09 | < 5.0 |
| R. Chlorine (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.3-0.5 |
| Magnesium (mg/L) | 10.00 | 12.00 | 14.00 | 12.00 | 12.00 | 10.00 | 11.67 | 2.27 | 1.51 | < 200 |
| Potassium (mg/L) | 2.20 | 2.20 | 2.40 | 2.40 | 2.42 | 2.20 | 2.30 | 0.01 | 0.11 | < 6.0 |
| Nitrite (mg/L) | 0.02 | 0.02 | 0.02 | 1.22 | 0.42 | 0.22 | 0.32 | 0.22 | 0.47 | < 3.0 |
| Fluoride (mg/L) | 0.21 | 0.11 | 0.01 | 0.00 | 0.01 | 0.01 | 0.06 | 0.01 | 0.08 | < 1.5 |
| Iron (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | < 0.3 |
| Ammonia (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | No value |
| Copper (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | < 1.0 |
| *E. coli* | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 cfu/100 ml |

Magnesium (mg/L) 12.00 10.00 10.00 12.00 10.00 14.00 11.33 2.67 1.63
Potassium (mg/L) 2.64 2.66 2.60 2.60 2.40 2.20 2.52 0.03 0.18
Nitrite (mg/L) 0.06 0.06 0.10 0.06 0.04 0.02 0.06 0.00 0.03
Fluoride (mg/L) 0.01 0.01 0.00 0.01 0.00 0.00 0.01 0.00 0.01
Iron (mg/L) 0.01 0.01 0.00 0.00 0.01 0.00 0.01 0.00 0.00
Ammonia (mg/L) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 No value
Copper (mg/L) 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00
*E. coli* 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0 cfu/100ml
*F*aecal coli 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0 cfu/100ml Non-faecal coli 16.00 14.00 14.00 16.00

**Table 4.** Hand dug well at 3 Jabbie Street, Blama.

| Parameter | Month | | | | | | Mean | Variance | Standard deviation | WHO |
|---|---|---|---|---|---|---|---|---|---|---|
| | Dec. | Jan. | Feb. | March | April | May | | | | |
| Temperature (°C) | 28.30 | 26.10 | 30.00 | 29.40 | 28.60 | 27.50 | 28.32 | 2.00 | 1.42 | No value |
| pH | 5.63 | 7.59 | 5.97 | 6.76 | 6.63 | 6.70 | 6.55 | 0.47 | 0.68 | 6.58.5 |
| Conductivity(µS/cm) | 151.00 | 107.10 | 106.60 | 56.20 | 151.00 | 11720 | 114.85 | 1237.42 | 35.18 | < 450.0 |
| TDS (ppm) | 75.50 | 53.90 | 53.10 | 28.10 | 75.50 | 56.40 | 57.08 | 308.97 | 17.58 | <248 |

16.00 14.00 15.00 2.40 1.55 <10cfu/100ml

Faecal coli 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0.00 0 cfu/100 ml Non-Faecal coli 14.00 12.00 14.00 14.00

12.00 12.00 13.00 1.20 1.09 <10 cfu/100 ml

Turbidity (NTU) 2.00 2.00 2.00 0.26 0.00 0.00 1.04 1.11 1.05 <5o.

**Academic Journal of Science, Engineering and Technology**
Vol. 9, Issue 1; January - February 2024;
ISSN: 2837-2964
Impact Factor: 6.67
1252 Columbia Rd NW, Washington DC, United States
https://topjournals.org/index.php/AJSET/index; mail: topacademicjournals@gmail.com
Top Academic Journals

| | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| R. Chlorine (mg/L) | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.3-0.5 | |
| Magnesium (mg/L) | | 16.00 | 14.00 | 12.00 | 14.00 | 14.00 | 12.00 | 13.67 | 2.27 | 1.51 | <200.0 | |
| Potassium (mg/L) | | 2.46 | 2.70 | 0.00 | 2.74 | 2.24 | 2.20 | 2.06 | 1.07 | 1.03 | | < 6.0 |
| Nitrite (mg/L) | 0.06 | 0.16 | 0.14 | 1.14 | 1.16 | 0.16 | 0.47 | 0.28 | 0.53 | | | < 3.0 |
| Fluoride (mg/L) | | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.00 | 0.00 | | < 1.5 |
| Iron (mg/L) | 0.04 | 0.02 | 0.01 | 0.01 | 0.02 | 0.01 | 0.02 | 0.00 | 0.01 | Ammonia | | < 0.3 |
| (mg/L) | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | | No value |
| Copper (mg/L) | | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | | < 1.0 |
| *E. coli* 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 cfu/100 ml | | | |
| Faecal coli | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0 cfu/100 ml | | |
| Non-faecal coli | | 12.00 | 12.00 | 12.00 | 14.00 | 12.00 | 12.00 | 12.33 | 0.67 | 0.82 | <10 cfu/100 ml | |

to exist and grow in soil and water environments and is therefore considered a poor parameter for measuring the presence of pathogens (Stevens et al., 2003). Total coliform bacteria are not acceptable indicators of the sanitary quality of rural water supplies, particularly in tropical areas where many bacteria of no sanitary significance occur in almost all untreated supplies, (WHO, 1997).

An exception is *E. coli*, a thermotolerant coliform, the most numerous of the total coliform group found in animal or human faeces, rarely grows in the environment and is considered the most specific indicator of fecal contamination in drinking-water (WHO, 2004). The presence of *E. coli* provides strong evidence of recent fecal contamination (WHO, 2004, Stevens et al., 2003).

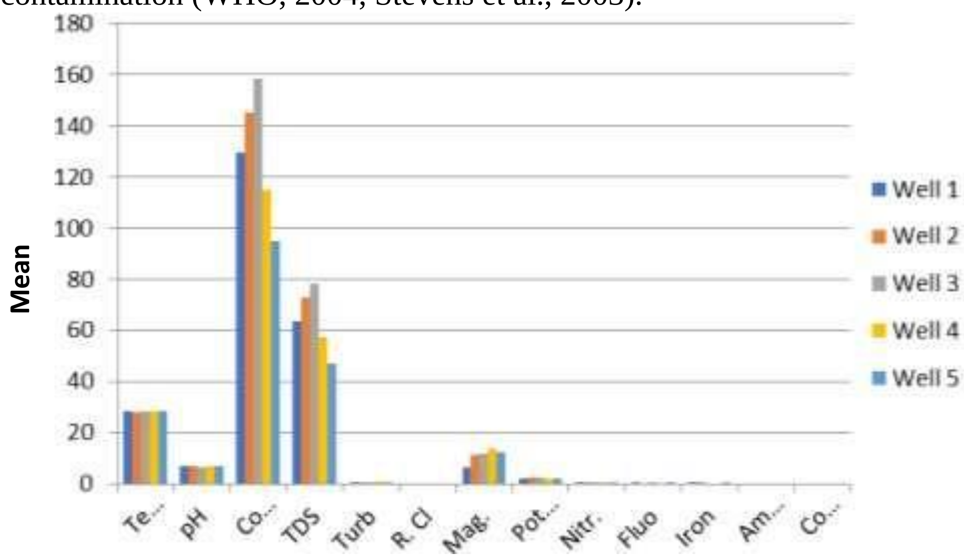


**Figure 3.** The mean physicochemical parameters of the five hands-dug well.

From Figure 2, the highest conductivity and Told Dissolved Solid was recorded by Table 3 (Hand dug well at 6 Jabbie Street, Blama) followed by Table 2 (Hand dug well at 4 Jimmy Section, Blama). The highest pH was recorded by Table 5 (Hand dug well at 19 Koribondo Road, Blama) and the lowest by Table 3 (Hand dug well at 6 Jabbie Street, Blama). All the chemical parameters measured fall within the WHO permissible standards.

**Academic Journal of Science, Engineering and Technology**
Vol. 9, Issue 1; January - February 2024;
ISSN: 2837-2964
Impact Factor: 6.67
1252 Columbia Rd NW, Washington DC, United States
https://topjournals.org/index.php/AJSET/index; mail: topacademicjournals@gmail.com

From Figure 3, the highest non faecal coli was recorded by Table 2 (Hand dug well at 4 Jimmy Section, Blama), followed by Table 1 (Hand dug well at 5 Koribondo Road, Blama), the lowest was recorded by Table 5 (Hand dug well at 19 Koribondo Road, Blama). All the non faecal coliform recorded for the five wells fell above the WHO permissible bracket (non-faecal coliformis <10 cfu in 100 ml. The high level of non-faecal coliform in all the five samples could be as a result of contaminated water or animal waste that moves quickly down the groundwater, resulting in the variation of non-faecal coliform level.

**Conclusion**

The objective of this research is to determine the potability of five hand dug wells used for drinking and agriculture activities in Blama, Small-Bo chiefdom, Kenema District, Eastern, Sierra Leone. In as much as safe drinking water plays a fundamental role in the life of all living organisms, it is therefore incumbent on us all to maintain its hygienic component properly. From the results of the analysis, it can be said that the physicochemical and microbial parameters of all the water samples examined are within the WHO permissible limits, except for the non-faecal coliform presences in all the water samples analysed which exceed the WHO limits and the lack of residual chlorine in all the water samples. It can therefore be concluded that all the water samples examined are safe and fit for drinking.

**CONFLICT OF INTERESTS**

The authors have not declared any conflict of interests.

**REFERENCES**

Aroh KN, Eze EM, Ukaji D, Wachuku CK, Gobo AE, Abbe SD, Teme SC, Igoni AH (2013). Health and environmental components of sachet water consumption and trade in Aba and Port Harcourt, Nigeria. Journal of Chemical Engineering and Material Science 4(2):13-22.

Bain R., Cronk R, Wright J, Yang H, Slaymaker T, Bartram J (2014). Fecal contamination of drinking-water in low-and middle-income countries: a systematic review and meta-analysis. PLoS medicine 11(5):e1001644.

Crow B (2001). Water: gender and material inequalities in the global South.

Howard Ahmed G, Shamsuddin MF, Mahmud AF, Deere SGD (2006). Risk assessment of arsenic mitigation options in Bangladesh. Journal of Health, Population and Nutrition 24(3):346-355

Jeremiah KT, Jonathan AQB (2018). Bacteriological contamination of groundwater in relation to septic tanks location in Ashanti Region, Ghana.

Kuitcha D, Ndjama J, Tita AM, Lienou G, Kamgang K, Beyala V, Ateba BH, Ekodeck GE (2010). Bacterial contamination of water points of the upper Mfoundi watershed, Yaounde, Cameroon. African Journal of Microbiology Research 4(7):568-574.

Khaniki GRJ, Zarei A, Kamkar A, Fazlzadehdavil M, Ghaderpoori M, Zareim A (2010). Bacteriological evaluation of bottled water from domestic brands in Tehran markets in Iran. World Applied Science Journal 8(3):274-278.

Mpakam HG (2009). Vulnérabilité à la pollution des ressources en eaux à Bafoussam et incidences socio-économiques et sanitaires:

modalités d'assainissement.Th. Doct. PhD, Univ. Yaoundé I. P 267.

Opara AU, Nnodim J (2014). Prevalence of Bacteria in bottled and sachet water sold in Owerri metropolis. International Journal of Science Innovations and Discoveries 4(2):117-122.

Oladipo IC, Onyenike IC, Adebiyi AO (2009). Microbiological analysis of some vended sachet water in Ogbomoso, Nigeria African Journal of Food Science 3(12):406-412.

Obiri-Danso K, Adjei B, Stanley KN, Jones K (2009). Microbiological quality and metals in wells and boreholes water in some peri-urban communities in Kumasi, Ghana. African Journal of Environmental Science And Technology 3(3):059-066.

Oyedeji O, Olutiola PO, Moninuola MA (2010). Microbiological quality of packaged drinking water brands marketed in Ibadan metropolis and IleIfe city in South Western Nigeria. African Journal of Microbiology Research 4(1):096-102.

Prasanna RB, Reddy MS (2009). Bacteriological examination of drinking water with reference to coliforms in Jeedimetla, Hyderabad, India. African Journal of Biotechnology 8(20):5506-5507.

Stevens M, Ashbolt N, Cunliffe D (2003). Recommendation to change the use of coliform as microbial indicators of drinking water quality. Australia Government National Health and Medical Research Council.

Thliza LA., Khan AU, Dangora DB, Yahaya A (2015). Study of some bacterial load of some brands of sachet water sold in Ahmadu Bello University (Main Campus), Zaria, Nigeria. International Journal of current Science 14:91-97.

Sierra Leone (Stats SSL) (2017). Multiple Indicator Cluster Survey. https://www.unicef.org/sierraleone/media/391/file/SLMICS-Report-

2017.pdf.pdf

Sierra Leonean (2012). Cholera outbreak- Wikipedia. https://en.wikipedia.org/wiki/2012_Sierra_Leonean_cholera_outbreak

CDC (2012). Treatment and prevention in Sierra Leone Zainab Blell mph student. https://slideplayer.com/slide/12371900/

World Bank (2020). Report on access to water in Sierra Leone. WHO/UNICEF ( 2019). Joint Monitoring Programme (JMP) for Water Supply, Sanitation and Hygiene.

**Academic Journal of Science, Engineering and Technology**
Vol. 9, Issue 1; January - February 2024;
ISSN: 2837-2964
Impact Factor: 6.67
1252 Columbia Rd NW, Washington DC, United States
https://topjournals.org/index.php/AJSET/index; mail: topacademicjournals@gmail.com

WHO/UNICEF (2017). Joint Monitoring Programme. progress on household drinking, sanitation and hygiene (2000-2017).

World Health Organization (WHO) (2004). Guidelines for drinking water quality, 3rd ed. Volume 1. Recommendations. World Health Organization – Geneva.

World Health Organization (WHO) (2003). Guidelines for drinking-water quality, 2nd ed. Vol. 2. Health criteria and other supporting information. World Health Organization, Geneva, 1996.World Health Organization (1997). Guidelines for drinking-water quality —2nd ed. Geneva.