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Research Paper

Assessment of Physico Chemical Properties of Domestic Water Sources in Selected Communities In Bayelsa State Nigeria

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ABSTRACT
Water is vital aspect of life therefore, it potability can be overemphasized. This study however was centered to assess physico chemical properties of domestic water sources in Bayelsa State Nigeria. The study was carry out in for communities selected from four Local Government Areas of Bayelsa State, the communities are Alebiri community in Ekeremor L.G.A, Bassambiri in Nembe L.G.A, Beletiama in Brass L.G.A and Sagbama in Sagbama Local Government Area of Bayelsa State. The parameters investigated in this study were; pH, Temperature, salinity, conductivity, turbidity, DO, TDS, TSS, NO3, CL, SO4, HCO3, TA, and TH, Calcium, magnesium and sodium. This were tested using Standard procedures. The study revealed that some of the parameters investigated had their values exceed WHO acceptable limits which supposes that the water sources are not potable and unhygienic for consumption. The study recommends that Potability of water is a factor that requires collective efforts from both parties (government and rural people) in order to ensure that every form of activities contributing to pollution and causing contaminants affecting the water quality of available water supply sources are check mated and effectively controlled and that the government should as a matter of urgency embark on massive water rehabilitation in the study area to ensure that the people have access to multiple water supply as this is the optimal access level every aspiring developing society should thrive to reach according to the WHO international standards as one of the requirements for proper regional development planning.

KEYWORDS: *Water, Quality, domestic, Water Sources, Physico Chemical.*

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I. INTRODUCTION

Water is one of the most abundant substances on earth. However, more than 97.5 % of it is in the oceans while the amount of fresh water that could be easily utilized by man is less than 0.01 % of the total water on earth. Under favorable conditions water bodies can host a large array of microorganisms, plants, fish, waterfowl and other animals (Snyder, 2001). In addition, water has high aesthetic and recreational value. Yet mainly owing to mismanagement of the surrounding watershed water can get highly polluted making it unsuitable for human drinking, harmful for aquatic life and unfit for recreational activities. Apart from meeting basic human needs water is required in large quantities for industry, agriculture, fisheries, power generation and navigation. In fact, water is necessary for the sustenance of all forms of life. It is said that man can live without food for several weeks but only for about ten days without water. It is also required for man's recreational activities such as swimming, skiing, angling and boating. A water source can be considered polluted if its physical, chemical and biological characteristics render it unfit for use (Amarasiri, 2004).

Water is a basic necessity for the sustenance of life. About 70% of the human body is made up of water and coincidentally, more than 70% of the Earth is covered in water. Water sustains life nurtures plants, animals and humans, making the Earth a perfect match for life in general (NASA, 2007). According to Snyder (2001), an adequate standard of living includes a minimum of 13 gallons of water a day for a variety of usages, including hydration and hygiene (Bouguerra 2006; and Stein 2008). Effective management of sanitation also relies on the adequate movement of water to carry wastes away from where people live, through pipes and canals. Thus water is needed to ensure those wastes do not cause illness (UNICEF, 2007). Practicing safe water handling and usage is imperative for health. Waterborne diseases caused by lack of hand-washing and bathing, as well as from contamination of water sources result in millions of preventable deaths over time (McDonald and Douglas, 2003).

Life, health and hygiene all depend on access to quantitative and qualitative supply of drinking water. The adequacy in the supply of improved drinking water determine health; welfare, societal wellbeing and human existence. In spite of this, however, the existing situation of pipe borne water supply in most part of the world is largely inadequate to meet the ever increasing water demands of the population (WWAP, 2003).

The problem in most part of the world may be non-availability of water; however, the Bayelsa case is a problem of too much water but of little potability. The Bayelsa area of Nigeria is a water poor region with an overabundant supply of both surface and groundwater. In spite of this abundance of water, most residents depend on sachet or bottled water (with questionable qualities) imported from other states for drinking water purposes, while water for other domestic uses are mostly purchased from public sale points which are of doubtable quality and prone to contamination. Domestic water is also fetched from contaminated or polluted rivers, creeks and lakes. This brings to mind the inadequacy of discussing water supply problems or water poverty in terms of access and availability alone but also on potability hence the need for this study which is focused on assessing physico chemical properties of domestic water sources in selected communities in Bayelsa State, Nigeria.

II. MATERIALS AND METHODS

This study was carried out in the following communities of Bayelsa State, Nigeria; Alebiri community in Ekeremor L.G.A, Bassambiri in Nembe L.G.A, Beletiama in Brass L.G.A and Sagbama in Sagbama Local Government Area of Bayelsa State.

Major domestic water sources of households were tested for their quality using indicator parameters. These were basically carried out at the water sources of each locality which include boreholes, rivers, streams, traditional ponds and wells.

The quality of the water to which the population is exposed to needs to be ascertained. The use of indicators of contamination is preferred to measurements of individual pathogenic organisms in the water due to the low numbers of concentration and the difficulties and expenses involved in detecting them. Indicators should be selected that are appropriate to the water being studied. For instance, thermotolerant coliforms or *E.coli* are used in assessing the quality of drinking water **(**Blumenthal, Fleisher, Esrey and Peasey, 2001). To test for the quality of water, bacteriological contaminant such as total coliforms and *E.coli and physico*-chemical quality indicators such as total dissolved solids (TDS) and turbidity will be examined.

Temperature, pH and conductivity, were measured on site using a portable multipurpose pH, temperature and conductivity field meter. Total dissolved solids (TDS) will be calculated from the conductivity values obtained. Turbidity also will be determined with aH, ACH 2100P turbidity meter.

Before collection, the mouth of the borehole taps were cleaned with cotton wool, ethanol and allowed to run for two minutes. The bottles were held at the bottom while filling, to avoid contamination of water from the hands and fingers. For e for physiochemical parameters, the bottles will only be thoroughly rinsed with clean water. With the aid of the technical field assistants, borehole technicians, hydro geologists water samples were collected from boreholes, hand dug wells and rivers. The water was labeled at the collection points, preserve in ice packed coolers prior for onward movement to the laboratory for analysis. Sufficient air space was left in the bottles to create space for water expansion.

III. RESULTS AND DISCUSSIONS

Water Quality Analysis Conducted for Water Potability in Ekeremor LGA

Water Potability in Alebiri

The pH mean value ranges between 6.48 in borehole, 6.46 in River and 6.92 in rain water with the highest value of 6.92 present in rain water and lowest value of 6.46 present in river to compare with WHO standard of 6.5-8.0 respectively. Temperature also ranged between 26.6^{0}C in borehole, 27.0^{0}C in river and 26.8 ^{0}C in rainwater. Salinity ranges between 0.06 g/kg in borehole, 0.02 g/kg in river and 0.01 g/kg in rain water with the highest value of 0.06 g/kg present in borehole and lowest value of 0.01 g/kg present in rain water. However, the WHO standard was 0.5 g/kg.

Conductivity ranges between 136.5 (us/cm) in borehole, 86.6 (us/cm) in river and 18.70 (us/cm) in rain water in the study location with the highest value of 136.5 (us/cm) present in borehole and lowest value of 18.70 (us/cm) present in rain water. The WHO standard was between 50-1000 us/cm. Turbidity ranges between 30.85 NTU in borehole, 25.80 NTU in river and 0.40 NTU in rain water with the highest value of 30.85 NTU present in borehole and lowest value of 0.4 NTU in rain water when compared with WHO standard not exceeding 5

NTU. For dissolved oxygen, 6.8 mg/l was measured in borehole, 5.6 mg/l was measured in river while, 7.2 mg/l was measured in rainwater with WHO standard of between 5-9.5 mg/l. Total dissolved solute ranges between 70.00 mg/l in borehole, 43.20 mg/l in river water and 9.40 mg/l in rain water with the highest value of 70.00 mg/l and lowest value of 9.40 mg/l present in rain to compare with WHO standard of 500 mg/l.

Total suspended solids ranges between 0.58 mg/l in borehole, 0.88 mg/l in river water and 0.02 mg/l in rain water with the highest value of 0.88 mg/l in River and lowest value of 0.02 mg/l present in rain water. The WHO standard applied was 300 mg/l. Nitric Acid (NO_3) ranges between 0.227 mg/l in borehole, 0.139 mg/l in river water and 0.091 mg/l in rain water with the highest value of 0.227 mg/l present in borehole and lowest value of 0.091 mg/l present in rain water to compare with WHO standard of 50mg/l. Chloride ranges between 51.00 mg/l in borehole, 21.80 mg/l in river and 9.00 mg/l in rain water with the highest value of 51.00 mg/l present in borehole and lowest value of 9.00 mg/l present in rain water to compare with WHO standard of between 100-250 mg/l for drinking water. Sulphate values ranges between 0.54 mg/l in borehole, 0.40 mg/l in river and 3.60 mg/l in rain water with the highest value of 3.60 mg/l present in rain water and lowest value of 0.40 mg/l present in river water. However, the WHO standard was between 250-500 mg/l. Bicarbonate (HCO_3) ranges between 2.00 mg/l in borehole, 0.50 mg/l in river and 1.20 mg/l in rain water with the highest value of 2.00 mg/l in borehole and lowest value of 0.50 mg/l present in river. The WHO standard was not applicable.

Tantalum (TA) ranges between 28.20 mg/l in borehole, 10.00 mg/l in river and 4.00 in rain water with the highest value of 28.80 mg/l in borehole and lowest value of 4.00 mg/l present in rain water. The WHO standard was not applicable. Thorium (TH) ranges between 62.00 mg/l in borehole, 28.00 mg/l in River and 15.00 mg/l in Rain water with the highest value of 62.00 mg/l present in borehole and lowest value of 15.00 mg/l present in rain water. The WHO standard was not applicable. Calcium (Ca) ranges between 25.74 mg/l in borehole, 12.50 mg/l in river and 10.00 mg/l in rain water with the highest value of 25.74 mg/l present in borehole and lowest value of 10.00 mg/l present in rain water to compare with WHO standard of 75mg/l. Magnesium (Mg) ranges between 7.46 mg/l in borehole, 3.28 mg/l in river and 2.58 mg/l in rain water with the highest value of 7.46 mg/l present in borehole and lowest value of 2.58 mg/l present in rain water to compare with WHO standard of 50mg/l. Sodium (Na) ranges between 12.62 mg/l in borehole, 5.64 mg/l in river and 4.32 mg/l in rain water with the highest value of 12.62 mg/l present in borehole and lowest value of 4.35 mg/l present in rain water to compare with WHO standard of 200mg/l. Potassium (K) ranges between 4.54 mg/l in borehole, 2.40 mg/l in river and 1.43 mg/l in water with the highest value of 4.54 mg/l present in borehole and lowest value of 1.43 mg/l present in rain water to compare with WHO standard of 10mg/l. Iron (Fe) ranges between 0.05 mg/l in borehole, 0.02 mg/l in river and 0.01 mg/l in rain water with the highest value of 0.05 mg/l present in borehole and lowest value of 0.01 mg/l present in rain to compare with WHO standard of 0.3 mg/l. Manganese (Mn) ranges between 0.02 mg/l in borehole, 0.01 in river and 0.00 mg/l in rain water with the highest value of 0.02 mg/l npresent in borehole and lowest value of 0.00 mg/l to compare with WHO standard of 0.05 mg/l. The results for total coli form (MPN) count showed 2.26 MPN count in borehole water sources, 114.60 MPN count in river water sources and 22.29 MPN count in rainwater sources. Afari, Mirhossaini, Kamareii and Dehestani determined some physiochemical properties in drinking water samples from the Kohdasht region of the Lorestan, Iran, where drinking water sources are ground water and analyzed the samples as well.

Table 1: Water Potability in Alebiri

	Water Supply Sources			
Parameters	**Borehole**	**River**	**Rainwater**	**WHO***
pH	6.48	6.46	6.92	**6.5-8.0**
Temperature (^{0}C)	26.6	27.0	26.8	**NA**
Salinity (g/kg)	0.06	0.02	0.01	**0.5**
Conductivity (us/cm)	136.5	86.4	18.7	**50-1000**
Turbidity (NTU)	30.85	25.8	0.4	**≤ 5**
DO (mg/l)	6.8	5.6	7.2	**5-9.5**
TDS (mg/l)	70	43.2	9.4	**500**
TSS (mg/l)	0.58	0.88	0.02	**300**
NO_3 (mg/l)	0.227	0.139	0.091	**50**
Cl (mg/l)	51	21.8	9	**100-250**
SO_4 (mg/l)	0.54	0.4	3.6	**250-500**
HCO_3 (mg/l)	2	0.5	1.2	**NA**

TA (mg/l)	28.8	10	4	**NA**
TH (mg/l)	62	28	15	**NA**
Calcium (mg/l)	25.74	12.5	10	**75**
Magnesium (mg/l)	7.46	3.28	2.58	**50**
Sodium (mg/l)	12.62	5.64	4.35	**200**
Potassium (mg/l)	4.54	2.4	1.43	**10**
Iron (mg/l)	0.05	0.02	0.01	**0.3**
Manganese (mg/l)	0.02	0.01	0	**0.05**
Total Coliform (MPN)	2.26	114.60	22.29	**NA**

Source: Researcher's Analysis, 2019; NA – Not Applicable; WHO* - WHO standards

Water Potability in Bassambiri

The water quality analysis for Bassambiri community under Nembe LGA was displayed on Table 4.16. The analysis revealed that pH ranges between 6.63 in borehole, 6.35 in River and 6.92 in rain water with the highest value of 6.92 in rain water and lowest value of 6.35 in well to compare with WHO standard of 6.5 -8.00 respectively. Temperature was 26.8^{0}C in borehole; 27.2^{0}C in well and 27.0 ^{0}C in rainwater. The WHO standard for temperature was not applicable. Salinity ranges between 0.05g/kg in borehole, 0.27g/kg in well and 0.00g/kg in rain water with the highest value of 0.27g/kg and lowest value of 0.00g/kg in rain water. WHO water quality standards was 0.5 g/kg. Conductivity ranges between 168.0 us/cm in borehole, 742.0 us/cm in well and 18.00 us/cm in rain water with the highest value of 742.0 us/cm in well and lowest value of 18.00 us/cm in Rain water. WHO water quality standards was found between 50-1000 us/cm. Turbidity ranges between 0.30 NTU in borehole, 6.36 NTU in well and 0.35 NTU in rain water with the highest value of 6.36 NTU present in well and lowest value of 0.30 NTU present in borehole to compare with WHO standard of 5 NTU. Dissolved oxygen was 6.4 mg/l in borehole, 5.8 mg/l in well and 5.6 mg/l in rainwater with the WHO standard that was applicable was found between 5-9.5 mg/l.

The information for Total dissolved solids showed concentration values ranges between 84.00 mg/l in borehole, 376.0 mg/l in well and 9.60 mg/l in rain water with the highest value of 376.0 mg/l present in well and lowest value of 9.60 mg/l present in rain water to compare with WHO standard of 500mg/l. Total suspended solids ranges between 0.20 mg/l in borehole, 1.42 mg/l in well and 0.03 mg/l in rain water with the highest value of 1.42 mg/l in well and lowest value of 0.03 mg/l in rain water. The WHO water quality standard applicable was 300 mg/l. Nitric Acid ranges between 0.216 mg/l in borehole, 0.286 mg/l in well and 0.076 mg/l in rain water with the highest value of 0.286 mg/l present in well and lowest value of 0.076 mg/l present in rain to compare with WHO standard of 50mg/l. Chloride ranges between 14.00 mg/l in borehole, 60.00 mg/l in well and 13.00 mg/l in rain water with the highest value of 60.00 mg/l present in well and lowest value of 13.00 mg/l present in rain to compare with WHO standard of 100-250 mg/l. Sulphate ranges between 4.80 mg/l in borehole, 8.65 mg/l in well water and 3.85 mg/l in rain water with the highest value of 8.65 mg/l present in well and lowest value of 3.85 mg/l present in rain water. The WHO water quality standards applicable was between 250-500 mg/l. Bicarbonate ranges between 1.40 mg/l in borehole, 4.50 mg/l in well and 1.40 mg/l in rain water with the highest value of 4.50 mg/l in well and lowest value of 1.40 mg/l in both borehole and rainwater. The WHO standard was not applicable. Tantalum ranges between 13.00 mg/l in borehole, 70.00 mg/l in well water and 4.00 mg/l in rain water with the highest value of 70.00 mg/l present in well and lowest value of 13.00 mg/l present in borehole. The WHO standard was not applicable. Thorium ranges between 49.00 mg/l in borehole, 38.00 mg/l in well and 20.00 mg/l in rain water with the highest value of 49.00 mg/l present in borehole and lowest value of 20.00 mg/l present in rain water. WHO water quality standards was not applicable.

Calcium ranges between 10.42 mg/l in borehole, 40.44 mg/l in well and 6.82 mg/l in rain water with the highest value of 40.44 mg/l present in well and lowest value of 6.82 mg/l in rain water to compare with WHO standard of 75mg/l. Magnesium ranges between 2.40 mg/l in borehole, 5.60 mg/l in well and 1.85 mg/l in rain water with the highest value of 5.60 mg/l in well and lowest value of value of 1.85 mg/l in rainwater to compare with WHO standard of 50mg/l. Sodium ranges between 6.54 mg/l in borehole, 7.50 mg/l in well and 4.25 mg/l in rain water with the highest value of 7.50 mg/l in well and lowest value of 4.25 mg/l in rain water to compare with WHO standard of 200mg/l. Potassium ranges between 1.68 mg/l in borehole, 3.36 mg/l in well and 1.58 mg/l in rain water with the highest value of 3.36 mg/l in well and lowest value of 1.58 mg/l in rain water to compare with WHO standard of 10mg/l. The concentration of Iron in water sources ranges between 0.15 mg/l in borehole, 0.32 mg/l in well and 0.01 mg/l in rain water with the highest value of 0.32 mg/l in well water and lowest value of 0.01 mg/l in rain water to compare with WHO standard of 0.3mg/l. Manganese ranges between 0.01 mg/l in borehole, 0.02 mg/l in well and 0.00 mg/l in rainwater with the highest value of 0.02 mg/l present in well and lowest value of 0.00 mg/l present in rain water to compare with WHO standard of 0.5mg/l. The results for total coli form (MPN) count showed 3.46 MPN count in borehole water sources, 12.28 MPN count in well water sources and 3.06 MPN count in rainwater sources.

Table 2: Water Potability in Bassambiri

	Water Supply Sources			
Parameters	**Borehole**	**Well**	**Rainwater**	**WHO***
pH	6.63	6.35	6.15	**6.5-8.0**
Temperature (^{0}C	26.8	27.2	27.0	**NA**
Salinity (g/kg)	0.05	0.27	0.0	**0.5**
Conductivity (us/cm)	168	742	18	**50-1000**
Turbidity (NTU)	0.3	6.36	0.35	**≤ 5**
DO (mg/l)	6.4	5.8	5.6	**5-9.5**
TDS (mg/l)	84	376	9.6	**500**
TSS (mg/l)	0.2	1.42	0.03	**300**
NO_3 (mg/l)	0.216	0.286	0.076	**50**
Cl (mg/l)	14	60	13	**100-250**
SO_4 (mg/l)	4.8	8.65	3.85	**250-500**
HCO_3 (mg/l)	1.4	4.5	1.4	**NA**
TA (mg/l)	13	7.00	4	**NA**
TH (mg/l)	49	38	20	**NA**
Calcium (mg/l)	10.42	40.44	6.82	**75**
Magnesium (mg/l)	2.4	5.6	1.85	**50**
Sodium (mg/l)	6.54	7.5	4.25	**200**
Potassium (mg/l)	1.68	3.36	1.58	**10**
Iron (mg/l)	0.15	0.32	0.01	**0.3**
Manganese (mg/l)	0.01	0.02	0.0	**0.05**
Total coli form (MPN)	3.46	12.28	3.06	**NA**

Source: Researcher's Analysis, 2019; NA – Not Applicable; WHO* - WHO standards

Water Potability in Beletiama

The water quality analysis conducted in Beletiama community water sources in river, borehole, and well sources was displayed on Table 4.19. The analysis revealed that the concentration of pH values ranges between 6.38 in river, 633 in well and 6.28 in borehole with the highest value of 6.38 present in river and lowest value of 6.28 present in borehole to compare with WHO standard of 6.5-8.0 respectively. Temperature was 27.2^{0}C in river; 27.0^{0}C in well, and 27.0^{0}C in borehole. The WHO standard for temperature was not applicable. Dissolved oxygen was 5.60 mg/l in river, 4.80 mg/l in well and 5.20 mg/l in borehole, with the highest value of 5.60 present in river and lowest value of 4.80 present. The WHO standard applied for water quality was between 5-9.5 mg/l.

Salinity ranges between 0.08 g/kg in river, 0.11 g/kg in well and 0.06g/kg in borehole with the highest value of 0.11g/kg present in well and lowest value of 0.06 present in borehole. WHO standard applicable was 0.5 g/kg. Conductivity ranges between 196.0 in river, 196.1 in well and 165.9 in borehole with the highest value of 196.1 present in well and lowest value of 165.9 present in borehole. The WHO water quality standard applicable was found between 50 and 1000 us/cm.

Turbidity ranges between 22.80 in River, 19.97 in well and 15.58 in borehole with the highest value of 22.80 present in river and lowest value of 13.97 present in well to compare with WHO standard of 5 NTU. Total dissolved solids ranges between 98.00 in River, 98.50 in well and 83.0 in borehole with the highest value of 98.00 present in river and lowest value of 83.00 present in borehole to compare with WHO standard of 500mg/l.

Total suspended solids ranges between 2.30 in river, 1.40 in well and 1.65 in borehole with the highest value of 2.30 value present in river and lowest value of 1.40 present in well. The WHO standard applicable was 300mg/l. Nitric Acid ranges between 0.284 in river, 0.272 in well and 0.187 in borehole with the highest value of 0.284 present in river and lowest value of 0.187 present in borehole to compare with WHO standard of 50mg/l

Chloride ranges between 12.00mg/l in river, 14.00mg/l in well and 12.00mg/l in borehole with the highest value of 14.00mg/l present in well and lowest value of 12.00mg/l present in both river and borehole to compare with WHO standard of between 100-250mg/l. Sulphate ranges between 2.48mg/l in river, 2.70mg/l in well and 1.85mg/l in borehole with the highest value of 2.70mg/l present in well and lowest value of 1.85mg/l present in both borehole. The WHO standard applicable was between 250-500mg/l.

Bicarbonate ranges between 1.20 in river, 1.40 in well and 1.20 in borehole with the highest value of 1.40 present in well and lowest value of 1.20 present in both borehole and river. Note: WHO standard not applicable. Tantalum ranges between 7.00 in river, 7.00 in well and 6.00 in borehole with the highest value of 7.00 present in both river and well and lowest value of 6.00 present in borehole. Note: WHO standard not applicable. Thorium ranges between 21.00 in well, 20.00 in river and 18.00 in borehole with the highest value of 21.00 present in well and lowest value of 18.00 present in borehole. Note: WHO standard not applicable. Calcium ranges between 7.96 in river, 9.50 in well and 7.86 in borehole with the highest value of 9.50 present in well and lowest value of 7.86 present in borehole to compare with WHO standard of 75mg/l. The values of Magnesium ranges between 2.72 in river, 3.00 in well and 2.46 in borehole with the highest value of 3.00 present in well and lowest value of 2.46 present in borehole to compare with WHO standard of 50mg/l

Sodium ranges between 4.78 in river, 4.88 in well and 4.38 in borehole with the highest value of 4.88 present in well and lowest value of 4.38 present in borehole to compare with WHO standard of 200mg/l**.** Potassium ranges between 0.85 in river, 1.20 in well and 0.78 in borehole with the highest value of 1.20 present in well and lowest value of 0.78 present in borehole to compare with WHO standard 10mg/l**.** Iron ranges between 0.12 in river, 0.20 in well and 0.14 in borehole with the highest value of 0.20 present in well and lowest value of 0.12 present in river to compare with WHO standard of 0.3mg/l**.** Magnesium ranges between 0.018 in river, 0.020 in well and 0.024 in borehole with the highest value of 0.024 present in borehole and lowest value of 0.018 present in river to compare with WHO standard of 0.5mg/l. The results for total coliform (MPN) count showed 22.29 MPN count in borehole water sources, 114.60 MPN count in river water sources and 50.60 MPN count in well water sources. The results of the study were found to be within permissible levels recommended by WHO, 2015.

Table 3: Water Potability in Beletiama, Brass LGA

	Water Supply Sources			
Parameters	**River**	**Well**	**Borehole**	**WHO***
pH	6.38	6.33	6.28	**6.5-8.0**
Temperature (^{0}C)	27.2	27.0	27.0	**NA**
Salinity (g/kg)	0.08	0.11	0.06	**0.5**
Conductivity (us/cm)	196.0	196.1	165.9	**50-1000**
Turbidity (NTU)	22.80	13.97	15.58	**≤ 5**
DO (mg/l)	5.60	4.80	5.20	**5-9.5**
TDS (mg/l)	98.00	98.50	83.0	**500**
TSS (mg/l)	2.30	1.40	1.65	**300**
NO_3 (mg/l)	0.284	0.272	0.187	**50**
Cl (mg/l)	12.00	14.00	12.00	**100-250**
SO_4 (mg/l)	2.48	2.70	1.85	**250-500**
HCO_3 (mg/l)	1.20	1.40	1.20	**NA**
TA (mg/l)	7.00	7.00	6.00	**NA**
TH (mg/l)	21.00	20.00	18.00	**NA**
Calcium (mg/l)	7.96	9.50	7.86	**75**
Magnesium (mg/l)	2.72	3.00	2.46	**50**
Sodium (mg/l)	4.78	4.88	4.38	**200**
Potassium (mg/l)	0.85	1.20	0.78	**10**
Iron (mg/l)	0.12	0.20	0.14	**0.3**
Manganese (mg/l)	0.018	0.020	0.024	**0.05**

Total coli form (MPN)	22.29	114.60	50.60	**NA**

Source: Researcher's Analysis, 2019; NA – Not Applicable; WHO* - WHO standards

Water Potability in Sagbama

The water quality analysis conducted in Sagbama recorded for seven parameters was displayed on Table 4.20. It was revealed that pH ranges between 6.99 in river, 6.32 in borehole and 5.90 in rain with the highest value of 6.99 present in river and lowest value of 5.90 present in rain to compare with the WHO standard between 6.5-8.0 levels. Temperature was 26.5^{0}C in river; 26.6^{0}C in borehole, and 26.0^{0}C in rainwater with the highest value of 26.6 in borehole and lowest value of 26.0^{0}c in rain water. The WHO standard for temperature was not applicable. Dissolved oxygen was 7.99 mg/l in river, 8.11 mg/l in borehole and 8.24 mg/l in rainwater with the highest value of 8.24 in rain water and lowest value of 7.99 in river. The WHO standard applied for water quality was between 5 and 9.5 mg/l.

Conductivity ranges between 85.1 us/cm in river, 144.5 in borehole and 25.6 in rain water with the highest value of 144.5 present in borehole and lowest value of 25.6 present in rain. The WHO standard applicable was between 50-1000 us/cm. Salinity ranges between 40.0g/kg in river, 41.0g/kg in borehole and 11.4g/kg in rain with the highest value of 41.0g/kg present in borehole and lowest value of 11.4g/kg present in rain. The WHO water quality standard applicable was 0.5 g/kg.

TDS ranges between 76.4 in river, 80.4 in borehole and 82.7 in rain water with the highest value of 82.7 present in rain water and lowest value of 76.4 present in river. WHO standard was not applicable. Turbidity ranges between 38.4 in river, 0.42 in borehole and 0 in rain water with the highest value of 38.74 present in river and lowest value of 0 present in rain water to compare with the WHO standard of NTU. The results for total coli form (MPN) count showed 2.26 MPN count in borehole water sources, 112.26 MPN count in river water sources and 3.93 MPN count in rain water sources. The results of the study were found to be within permissible levels recommended by WHO, 2015.

Table 4: Water Potability in Sagbama, Sagbama LGA

	Water Supply Sources			
Parameters	**River**	**Borehole**	**Rainwater**	**WHO***
pH	6.99	6.32	5.90	**6.5-8.0**
Conductivity (us/cm)	85.1	144.5	25.6	**50-1000**
Temperature (^{0}C)	26.5	26.6	26.0	**NA**
Salinity (g/kg)	40.0	41.0	11.4	**0.5**
DO (mg/l)	7.99	8.11	8.24	**5-9.5**
TDS (mg/l)	76.4	80.4	82.7	**500**
Turbidity (NTU)	38.74	0.42	0.0	**≤ 5**
TSS (mg/l)	0.10	2.30	0.20	**300**
NO_3 (mg/l)	0.083	0.229	0.332	**50**
Cl (mg/l)	6.50	13.45	45.12	**100-250**
SO_4 (mg/l)	8.22	0.69	6.64	**250-500**
HCO_3 (mg/l)	6.33	0.59	8.42	**NA**
TA (mg/l)	5.65	10.89	26.74	**NA**
TH (mg/l)	13.33	45.10	51.12	**NA**
Calcium (mg/l)	11.84	33.87	60.10	**75**
Magnesium (mg/l)	3.05	4.58	13.22	**50**
Sodium (mg/l)	4.30	1.40	18.22	**200**

Potassium (mg/l)	6.56	10.77	12.89	**10**
Iron (mg/l)	0.03	0.41	0.55	**0.3**
Manganese (mg/l)	0.01	0.01	0.02	**0.05**
Total coli form (MPN)	2.26	112.26	3.93	**NA**

Source: Researcher's Analysis, 2019; NA – Not Applicable; WHO* - WHO standards

IV. CONCLUSION AND RECOMMENDATION.

The study however has revealed the status of domestic water sources in the selected communities in Bayelsa State. It has shown that for some of the parameters investigated that their values exceed WHO acceptable limits which supposes that there are not potable and unhygienic for consumption. On a clear not the study has revealed the need to evaluate the status of domestic water sources as good numbers of the population depends on this sources of water for their existence, hence the following recommendations are made;

1. Potability of water is a factor that requires collective efforts from both parties (government and rural people) in order to ensure that every form of activities contributing to pollution and causing contaminants affecting the water quality of available water supply sources are check mated and effectively controlled.
2. The government should as a matter of urgency embark on massive water rehabilitation in the study area to ensure that the people have access to multiple water supply as this is the optimal access level every aspiring developing society should thrive to reach according to the WHO international standards as one of the requirements for proper regional development planning.

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