Assessment of Water Quality and Sanitation Facilities in Some Selected Schools in Potiskum, North-Eastern Nigeria

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ABSTRACT
An assessment of the groundwater quality and sanitation facilities in some selected schools in Potiskum was carried out. The study was aimed at determining both natural and anthropogenic effects on the physical, chemical and bacteriological composition that may affect the potability of groundwater in the schools. Geology and hydrogeology of the area was studied based on existing literature, water level in wells and boreholes were determined using dip meter. Thirty (30) schools were assessed comprising of twenty (20) primary schools generally with populations of over 2000 pupils and ten (10) secondary schools, two of which are boarding schools. 30 Water samples were taken from wells and boreholes in the schools, physical parameters were measured at the point of water sample collection while chemical analyses were carried out in the laboratory using colorimetry, titrimetry and flame photometry analytical procedures while bacteriological analysis was done using a microscope to count the coliform units. Potiskum is underlain by the Kerri-Kerri Formation and consist of grit, sandstone and clay. Water level ranges from 12 – 18 m, hand dug wells have an average depth range of 15 – 20 m while boreholes have a depth range of 45 – 100 m. The water has a mean temperature of 32°C, pH of 6.75 and Electrical Conductivity of 89.53 mS/cm. Chemical constituents that occur in higher concentration include sulphate (16.98 mg/l), chloride (15.7 mg/l), bicarbonate (15.06 mg/l) and calcium (9.11 mg/l). Trace elements that occur in higher concentration include copper (0.09 mg/l), iron (0.03 mg/l) and chromium (0.03 mg/l). The Piper plot revealed the dominant water type to be Calcium – Magnesium – Sulphate – Chloride water. The Durov and Gibbs plots indicated that hydrochemical process controlling the chemical composition of the water is simple dissolution or mixing. The water also has a high concentration of coliforms which may lead to gastrointestinal problems. Sanitary facilities seen in the selected schools are mainly Ventilated Improved Pit (VIP) latrines, ordinary pit latrines and pour-flush systems with average distance to water points of less than 20 m. This does not comply with the required standard. It could therefore be concluded from field observation of WASH facilities in selected schools in Potiskum that most of the water sources in these schools are in poor condition with the surrounding mostly unkept and wastewater flowing in dirty unplanned drains around the schools. Coliform bacteria are considered "indicator organisms"; their presence in the analysed water samples warns of the potential presence of disease-causing organisms and should alert the relevant authorities responsible for the water to take precautionary action.

1. INTRODUCTION

Water is a necessity for our day-to-day life on planet earth; however not all available waters are in potable condition for use. Therefore, the availability of water as well as its potability for use is matters of utmost concern for man. This water when available in a potable state needs also to be maintained to hinder pollution or contamination and hence all processes that has to do with the search for potable water, its quality and then protection of water resources are vital for human existence (Deming, 2002 & Kwaya *et al.,* 2017).

An estimated 1.9 billion school days could be gained if the Sustainable Development Goals (SDGs) related to safe water supply and sanitation are achieved and the incidence of diarrhoeal and other related illnesses will be reduced (UNICEF, 2017). One way of achieving this is by providing schools with safe drinking water, improved sanitation facilities and hygiene education that encourages the development of healthy behaviours for life. This strategic approach is known as Water, Sanitation and Hygiene Education (WASH) in Schools.

WASH in Schools not only promotes hygiene and increases access to quality education but also supports national and local interventions to establish equitable, sustainable access to safe water and basic sanitation services in schools. Poor sanitation, water scarcity, inferior water quality and inappropriate hygiene behaviour are disastrous for infants and young children and are a major cause of mortality for children under five. An important key to achieving WASH in schools is availability of water in both quantity and more importantly quality.

The poor consequences of Water, Sanitation and Hygiene (WASH) are enormous as mentioned in the WHO/UNICEF Joint Water Supply, Sanitation Monitoring Programme report released in early 2015. The report also revealed the estimates for water Supply and Sanitation showing that 36% of the world's population which is about 2.5 billion people lack access to improved sanitation facilities, and 768 million people still use unsafe drinking water sources. Inadequate access to safe water and sanitation services, coupled with poor hygiene practices, is responsible for high mortality and sickness of thousands of children every day, and leads to poverty and diminished opportunities for thousands more (Lori *et al.,* 2013).

Many schools in Potiskum Local Government Area of Yobe state lack safe water, private toilets and hand washing facilities, which affects enrollment and performance especially in the case of girls. The impact of Water Sanitation and Hygiene (WASH) mostly affects the female gender as they are most susceptible to infections owing to the open nature of their genital. This lack of access to basic sanitation and clean water makes them look for other available options to defecate such as going to the bush and thereby making them vulnerable to sexual abuse and other violence (UNHCR Sexual and Gender Based Violence report, 2018). School children are more likely to be without clean water and are likely not to have access to adequate sanitation due to sometimes their numbers or the poor management of the school.

Therefore, access to sanitation such as proper sanitary facilities and services for safe management and disposal of human urine and faeces can be achieved by improving sanitation facilities and making sure excreta is disposed in situ or treated off-site.

WASH practices in schools can help or contribute to the control of related diseases such as intestinal worms, typhoid, diarrhea and other respiratory tract infections; encourage school attendance, especially of girls and help children to learn more effectively. School children would also learn and practice good hygiene behaviors.

The quality of groundwater in any environment is a function of the geology of the area and/or human activities taking place in such an area (Mohammed *et al.,* 2014). Therefore, knowing the geology of the area is an important first step towards understanding the likely influence of the rock types on the quality of the water and susceptibility to anthropogenic contamination of groundwater.

The study area is located on the western margin of Potiskum Local Government Area of Yobe State, Nigeria. The study area lies between latitudes 11^0 41'06"N and 11^0 45'54"N and longitudes $11^0$02'06"E and 11^0 07'50"E and covers an area of 58 square kilometers with elevation of 100-300m above mean sea level obtained from the Federal Geological Survey of Nigeria, Potiskum Topographical Sheet 86 (Mapaction, Ocha,2017). The study area is accessible through major and minor roads with both motorable and non-motorable footpaths connecting the cities and suburbs. Figure 1 shows the location map of the study area, Potiskum and Yobe State.

1.1. Geology of Potiskum

Potiskum falls within the Gongola Sub Basin of the Upper Benue Trough, the most important formation as far as ground water availability is concerned is the Kerri-kerri Formation.

The Gongola Basin (arm) of the Upper Benue Trough is aN-S trending arm of the 1000 km long Benue Trough. The mechanism of the formation of the Trough dominated most of the early studies carried out in the area and, although, still controversial, the most common is that of an unstable RRF (Rift-Rift Fault) triple junction model leading to plate dilation and the opening of the Gulf of Guinea (Fairhead and Binks,1991). Fairhead and Binks (1991) also suggested that the evolution of the trough could also be as a result of tension resulting in a rift or wrench related fault basin. Mesozoic to Cenezoic magmatism has accompanied the evolution of the tectonic rift as it is scattered all over and throughout in the trough.

The central part of the study area is occupied by the Kerri-Kerri Formation which extends up to the southwestern corner of the area. According to Carter *et al*. (1963) the Kerri-Kerri Formation is believed to have a thickness of about 320m. The Pindiga Formation, Bima sandstone, Yolde Formation and Gombe sandstone, occupy the Northeastern portion of the area and extend down to the Southeastern part. The Pindiga Formation consists mainly of shaly mudstone with intercalation of limestone occurring in some areas. The Pindiga Formation is believed to have a thickness of about 240 m. The Yolde Formation on the other hand has a thickness of about 200m. The Yolde Formation is indeed a transitional sequence between the continental Bima group and the marine deposits of the lower part of the Pindiga Formation. Gombe sandstone consists mainly of grits and clay and is restricted to the western part of the Basin. The Bima sandstone consists of coarse grain sandstone with an overall thickness of about 3500m. The crystalline basement rocks which occupy the extreme western portion of the area consist of scattered remnants of highly metamorphosed sedimentary rocks and diverse, predominantly granitic plutonic masses collectively called older granite (Carter *et al*., 1963).

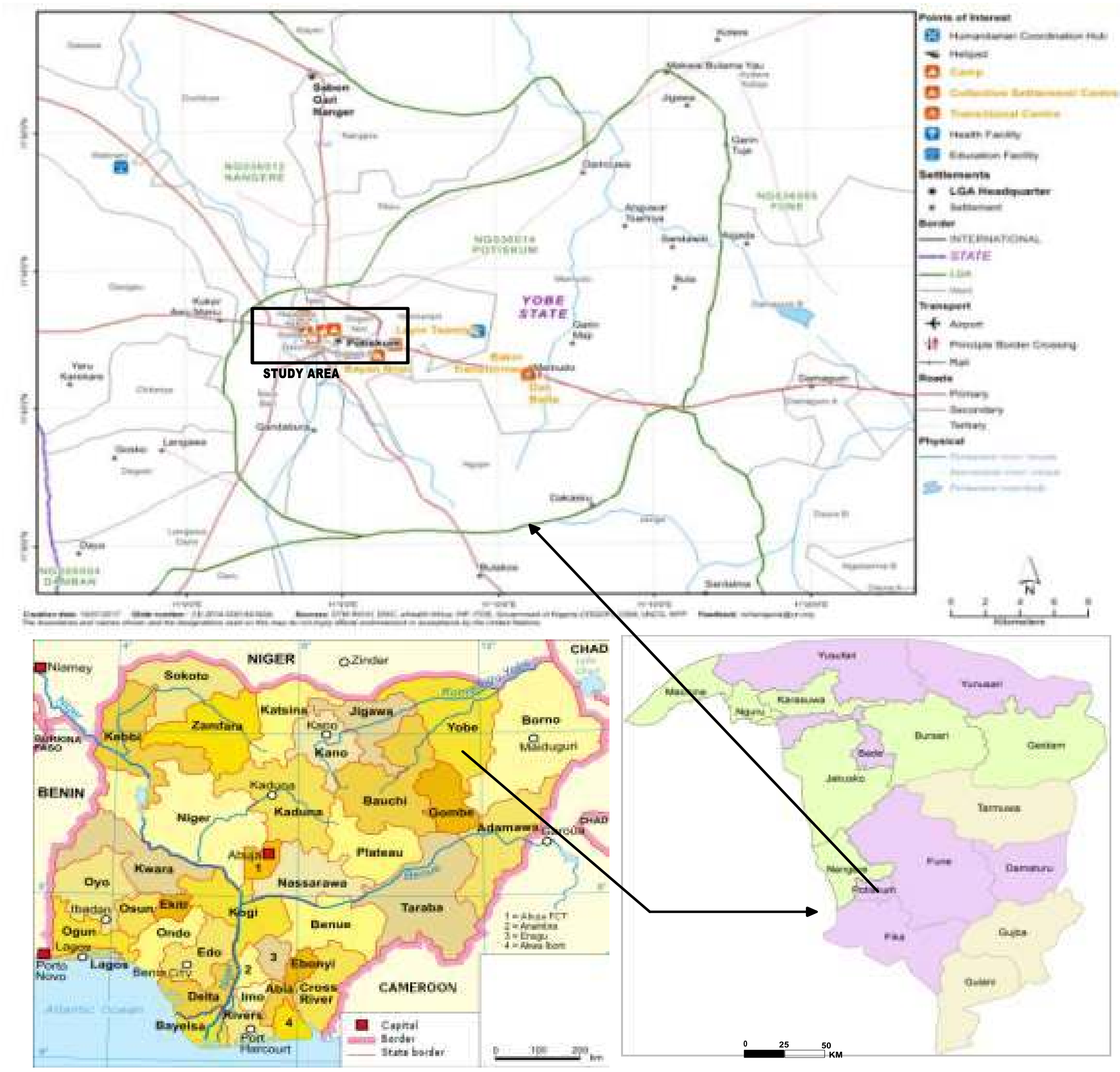

Figure 1: Location of the study area (modified from MapAction, 2017)

2. METHODOLOGY

This research work was carried out in four phases consisting of the Preliminary studies phase, Fieldwork phase, the Laboratory analysis and the data collation, analysis and interpretation phase.

2.1. Preliminary Studies

Various past works related to the study were reviewed in this phase. Maps and various literatures in the form of textbooks, journals, lecture notes and scientific reports were consulted to equip the researcher with all the necessary existing background information on the study area. In this phase also, all necessary preparations needed before proceeding for fieldwork were done; these include reconnaissance survey for familiarity with the study area and also preparing permits for visits to various schools and access to vital information.

2.2. Fieldwork

In this phase, the area was reconnoitered for prospects of noting cut, exposures or cliffs that could be used for geological studies in the area, however none was observed. Schools within the study area were visited. At each school location, the following activities were carried out: taking of the geographical co-ordinates and elevation with the aid of a Global Positioning System (GPS), assessing the state of the water, sanitation and hygiene of the school (type of water supply if any, toilet facilities and sanitation and hygiene condition). Water samples were collected in plastic containers from the available water supply system which included both boreholes and hand dug wells in the selected schools. The plastic bottle was first rinsed with the water to be collected two to three times before the water sample was taken, parameters like the pH, Electrical Conductivity, color and temperature of the water samples were determined at the point of sampling and the water samples were then acidified and placed in a cooler with ice before taking to the laboratory for hydrochemical analysis. The area is mostly flat lying and devoid of any major outcrop and hence there was not any good exposure throughout the study area for a detailed surface geological mapping (logging) since the study area is entirely sedimentary. However, the variation in the layers within the well in form of color, texture and structure were duly observed where well is open and not lined.

Further hydrogeological information on the area was obtained from borehole logs from drillers that constructed some of the boreholes. Information from three boreholes drilled about 300m apart was obtained and logged, lithologic section covering a distance of 1km was drawn based on the borehole logs.

2.3. Laboratory analysis

The water analysis was carried out at the National Water Quality Reference Laboratory, Department of Water Quality Control and Sanitation, Federal Ministry of Water Resources, Gombe State. The physico-chemical and bacteriological parameters were analysed including some heavy metal content.

3. RESULTS AND DISCUSSION

3.1. Geology of the study area

There was no good exposure to enable a detailed logging of the study area; therefore, most of the information on the geology of the study area was taken from previous works on the study area. However, some visual observation of some of the information on the geology of the study area from previous works was done using open wells that were relatively deep. The study area is underlain by the sediments of the Kerri-Kerri Formation which is the topmost lithostratigraphic unit in the Gongola Sub-Basin of the northern Benue Trough. It is characterised by whitish grey sandstones, siltstones and claystones, the predominant lithology in Potiskum area is the sandstones and siltstones. The Geological map of Potiskum and environs modified from the reference map of Potiskum (MapAction, OCHA, 2017).

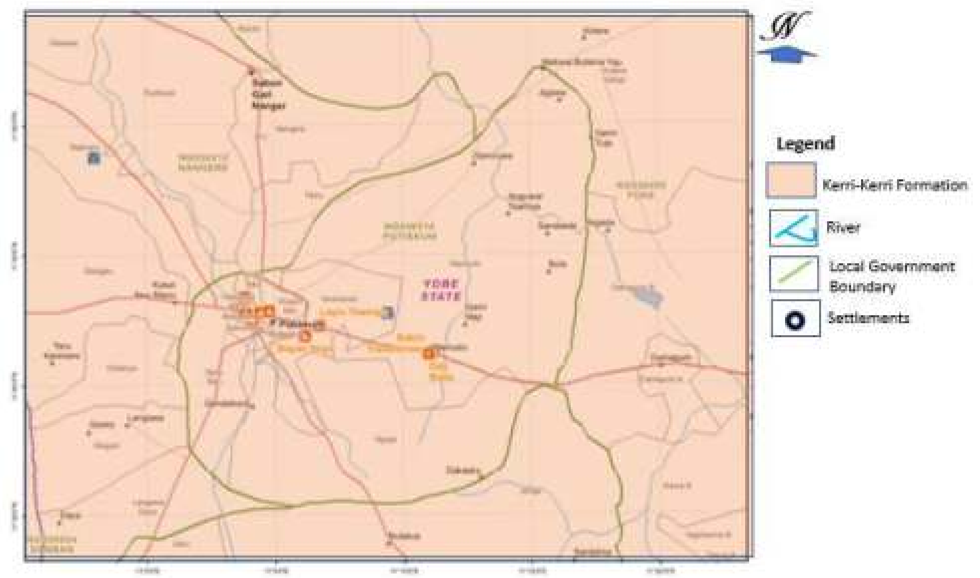

Figure 2: Geological Map of Potiskum (modified from MapAction, 2017)

3.2. Hydrogeology of the study area

Groundwater occurrence in the area is in the porous and permeable sandstone and silty sand that constitutes the Kerri-Kerri Formation and the Gombe sandstone Formation. Figure 3 is the geologic section based on the borehole logs. The topmost layer consists of brownish silty sand underlying which is the medium to fine grained silty sandstone to a depth of about 15 – 20m underlying the medium to fine grained silty sandstone layer is the coarse grained slightly clayey sandstone to a depth of 25 – 35m, clay and sandy clay to a depth of 35 – 45m, compacted ferruginized sandstone to a depth of 45 – 55m and sandstone that represents the main aquifer occurring from about 55 – 65m and beyond.

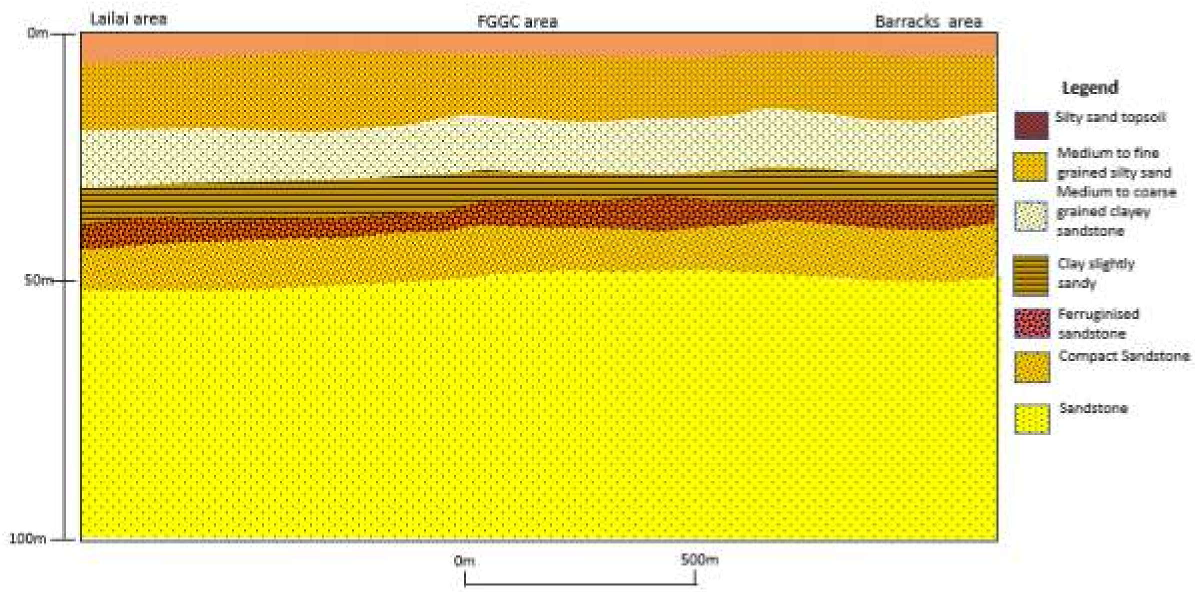

Figure 3: Lithologic section in a part of Potiskum

3.3. Physical and chemical Characteristics of groundwater in Potiskum schools

Tables 1 and 2 are the descriptive statistics of the physical and chemical composition of water sources in Potiskum schools.

Table 1: Statistical summary of Physical Parameters of groundwater in schools in Potiskum

	Temp. (°C)	pH	EC (µS/cm)
Mean	32.04	6.03	89.49
Standard Error	0.43	0.16	0.90
Median	31.90	6.00	89.80
Mode	31.50	5.40	90.50
Standard Deviation	2.31	0.86	4.85
Sample Variance	5.31	0.74	23.55
Kurtosis	-0.34	-0.56	-0.43
Skewness	0.31	-0.14	-0.27
Range	8.70	3.20	16.90
Minimum	27.80	4.30	80.20
Maximum	36.50	7.50	97.10
Sum	929.20	175.00	2595.20
Count	29.00	29.00	29.00
Confidence Level (95.0%)	0.88	0.33	1.85

Table 2: Statistical Summary of chemical composition groundwater in the schools (mg/l)

	Ca	Mg	Na	K	Mn	As	Cu	Fe	Cr	Cl	SO_4	PO_4	HCO_3	NO_3
Mean	9.09	0.66	2.50	3.34	0.01	0.01	0.09	0.03	0.03	15.70	16.98	0.13	15.07	0.16
Max	24.10	2.49	4.70	7.02	0.10	0.20	0.30	0.20	0.10	24.20	22.10	0.37	45.80	0.90
Min	1.10	0.00	1.91	0.93	0.00	0.00	0.00	0.00	0.00	10.60	8.10	0.00	0.00	0.05
SD	8.31	0.92	0.92	1.59	0.02	0.05	0.11	0.05	0.04	3.99	3.71	0.14	10.63	0.19

Table 3 (A): Statistical summary of chemical composition of groundwater in schools in Potiskum

	Ca	Mg	Na	K	Mn	As	Cu	Fe
Mean	9.35	0.68	2.51	3.32	0.01	0.01	0.09	0.03
Standard Error	1.52	0.17	0.16	0.28	0.00	0.01	0.02	0.01
Median	4.80	0.49	2.06	2.91	0.00	0.00	0.09	0.02
Mode	2.40	0.00	2.06	2.91	0.00	0.00	0.00	0.02
Standard Deviation	8.16	0.90	0.88	1.48	0.02	0.04	0.11	0.04
Sample Variance	66.64	0.81	0.78	2.20	0.00	0.00	0.01	0.00
Kurtosis	-0.70	0.33	2.01	0.00	20.55	27.65	-0.49	16.34
Skewness	0.83	1.34	1.79	0.25	4.29	5.21	0.90	3.72
Range	23.00	2.49	2.79	6.09	0.10	0.20	0.30	0.20
Minimum	1.10	0.00	1.91	0.93	0.00	0.00	0.00	0.00
Maximum	24.10	2.49	4.70	7.02	0.10	0.20	0.30	0.20
Sum	271.10	19.76	72.92	96.39	0.21	0.29	2.70	0.89
Count	29.00	29.00	29.00	29.00	29.00	29.00	29.00	29.00
Confidence Level(95.0%)	3.105	0.343	0.336	0.564	0.007	0.014	0.040	0.014

Table 3 (B): Statistical summary of chemical composition of groundwater in schools in Potiskum

	Cr	Cl	SO4	PO4	HCO3	NO3	Total Coliform
Mean	0.03	15.76	16.98	0.13	15.06	0.16	10.52
Standard Error	0.01	0.71	0.64	0.03	1.74	0.03	0.63
Median	0.00	14.20	17.20	0.00	12.30	0.14	10.00
Mode	0.00	14.20	19.20	0.00	12.30	0.14	10.00
Standard Deviation	0.05	3.83	3.46	0.14	9.36	0.15	3.37
Sample Variance	0.00	14.65	11.97	0.02	87.65	0.02	11.33
Kurtosis	-0.95	0.69	0.01	-1.96	7.28	23.12	2.27
Skewness	1.06	1.18	-0.91	0.16	2.53	4.58	-1.14
Range	0.10	13.60	14.00	0.37	45.80	0.85	15.00
Minimum	0.00	10.60	8.10	0.00	0.00	0.05	0.00
Maximum	0.10	24.20	22.10	0.37	45.80	0.90	15.00
Sum	0.80	456.90	492.30	3.78	436.80	4.59	305.00
Count	29.00	29.00	29.00	29.00	29.00	29.00	29.00
Confidence Level(95.0%)	0.0173	1.45608	1.31625	0.0528	3.5611	0.0571	1.28036

3.4. Groundwater Characterization

Figure 4 shows the characterization of the groundwater using Piper (1964) while Figure 5 is the Gibbs plot that was used to determine the geochemical evolution of groundwater in Potiskum area.

Based on the Piper plot (Figure 4) the water characterizes primarily as Calcium – Magnesium – Sulphate – Chloride water and secondarily as Sodium – Sulphate – Chloride water. While the Durov plot shows that control of hydrochemical processes taking place in the groundwater is as a result of simple dissolution of both geological and anthropogenic materials the water comes in contact with. Based on the Gibbs plot (Figure 5) the primary sources of chemical constituents in the water is as a result of precipitation dominance implying that percolating rainwater is responsible for dissolving chemical components from both the surface and weathered potion of the rocks into the groundwater system. The secondary source is as a result of dissolution of materials out of the rocks into the water and also by ion exchange.

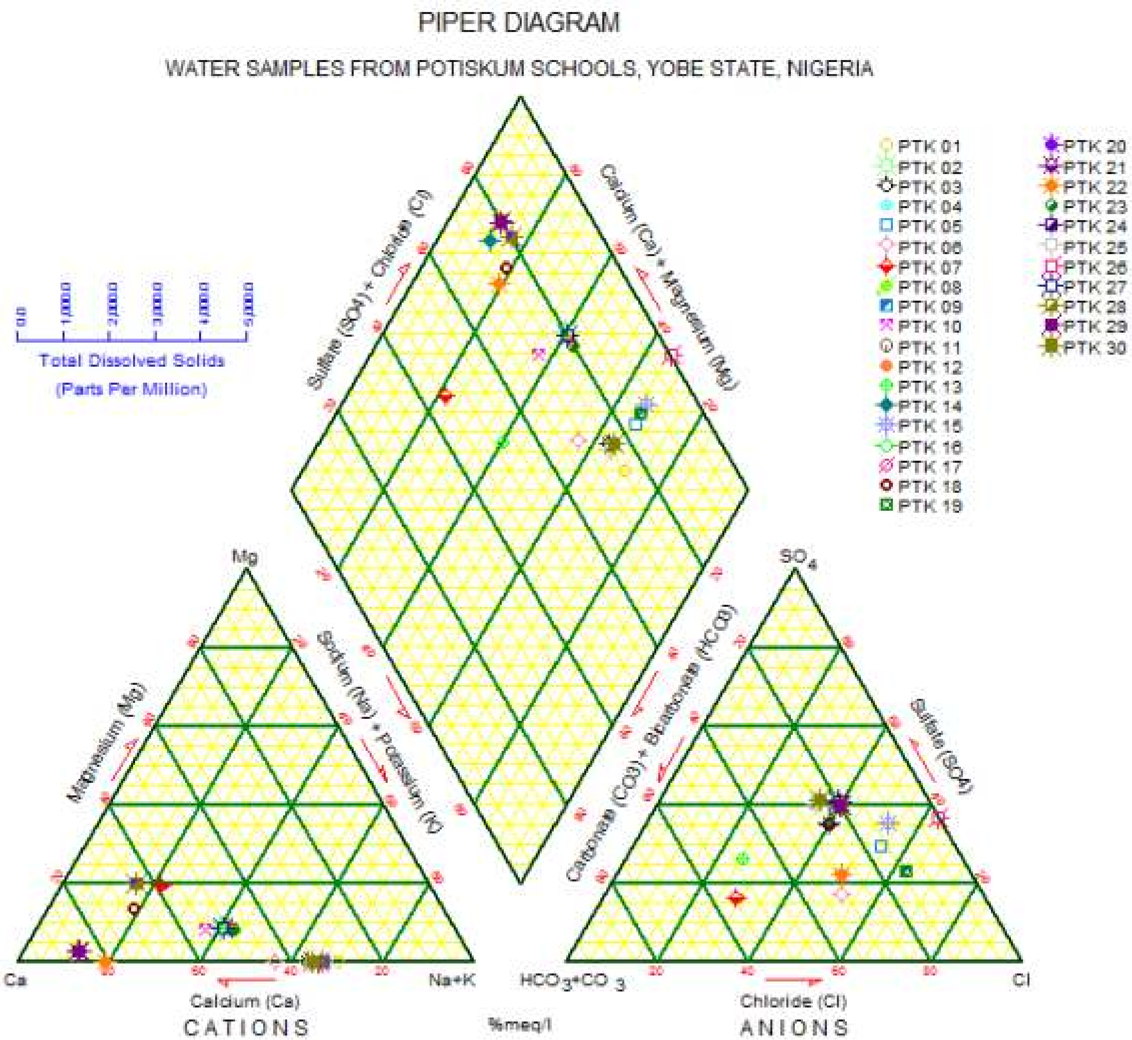

Figure 4: Groundwater characterization in schools in Potiskum using Piper (1964)

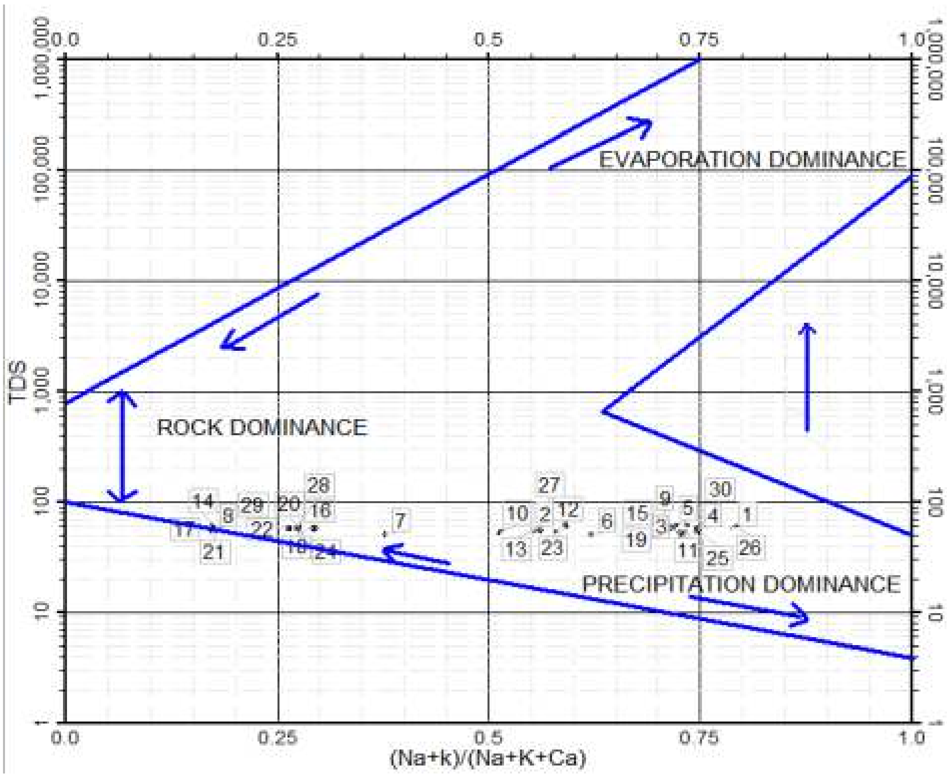

Figure 5: Groundwater evolution in Potiskum using the Gibbs plot (1970)

3.5. Bacteriological Composition

The microbial components that were determined for water sources in schools in Potiskum consist of Total Coliform, *Escherichia Coli* and Faecal Streptococci. Results show that the water is free from both E. Coli and Faecal Streptococci but has suffered a high level of pollution from Total Coliforms which has a mean of 10.4cfu as against a maximum permissible limit of 10.0cfu by both international and local standards. The affected water sources are the shallow hand dug wells which are located not far from sewage disposal system.

3.6. State of WASH facilities in schools

Facilities observed in all schools visited include provision of motorised boreholes and hand dug wells for water supply, water cistern latrines for staff quarters while dormitory and classroom areas have Ventilated Improved Pit (VIP) latrines or ordinary pit latrines. Water storage facilities are un-Plasticised0 Polyvinyl Chloride (u-PVC) tanks usually mounted on concrete stands with fetching points spread close to the source. Most of these water sources are in poor condition with the surrounding mostly unkempt and wastewater flowing in dirty unplanned drains around the facility.

3.6.1. Principal challenges in providing adequate facilities in a sustainable manner

Results from Focused Group Discussions (FGD) involving staff, students and management of the schools indicated that the challenges in providing adequate facilities for WASH is hampered mainly by low finance, improper planning and education. As a result of the local geology and inadequacy of the public water supply all the water needs of the schools are dependent on groundwater through the provision of boreholes and hand dug wells. Hand dug wells are shallow and cannot be used for drinking easily without treatment, boreholes are therefore the best alternative. The cost of drilling motorised boreholes is high and the cheaper hand pump boreholes cannot be installed due to the depth required to reach the aquifer (> 60m, which is the optimal for hand pump). Since sanitation facilities are linked to water supply, design and construction of these facilities is such that minimal water will be required for use. These resulted into construction of ordinary pit latrines and Ventilated Improved Pit (VIP) latrines. These still remain at the bottom of the sanitation ladder; the hope is that with improvement in water supply it should be scaled up to pour flush latrines for the school area.

3.6.2. Existing WASH practices within the schools

Information on existing WASH practices in the schools was derived from Focused Group Discussion and direct observations. Water supply is mostly from motorised boreholes and hand dug wells. Sustainability of the boreholes are mostly hampered by inadequate power supply which make pumping of the wells to be dependent on whenever there is electricity from the public power supply. Some schools had hand dug wells which are used for washing and other utility but not for drinking. While pit latrines are available, they are mostly clean and unkempt which makes using the facilities to be uncomfortable. As a result of the state of the latrines, Open Defecation (OD) is still practiced in most of the schools. Hand wash facilities are completely absent in all the schools visited except in staff quarters where hand wash basins are part of the components in the toilet system. Most students are totally unaware of basic sanitation and hygiene education including Menstrual Hygiene Management (MHM) for the females.

3.6.3. Available capacities for delivering WASH education, as well as capacity needs

The management and staff of the schools constitute the first line of communication between the general community and the schools. Presently the Members of staff are not well informed and educated on WASH. Despite the existence of health science and civic education as part of the educational curriculum in Nigeria, effective teaching and learning does not explicitly take the effects of improper sanitation on the overall well-being of the individual.

The main players involved in the sector are government at all levels, Federal, State and Local, Donor Agencies and Non-Governmental Organisations (NGOs).

4.0 DISCUSSION

Mean values and statistical summary for the results of physical parameters of groundwater in all the schools studied is shown in Table 4.3. Electrical Conductivity ranges between80 to97 µS/cm which is indicative of potable water with low dissolved solids. The temperature of the water ranges from 27.8 to 36.5˚C while the pH ranges from 4.3 to 7.5 which are indicative of slightly acidic to neutral water.

Results of the chemical composition of groundwater in the schools show the mean concentration of major constituents of the water (anions and cations) and the heavy metals. Calcium represents the cation with the highest concentration range of 1.6 – 24.10 mg/l (mean of 9.11mg/l). Anions with the highest concentration are sulphate with a range of 8.10 – 22.10mg/l (mean of 16.98mg/l), chloride ranges from 10.6 – 24.2mg/l with a mean of 15.71mg/l while bicarbonate has a concentration range of 0 – 45.8mg/l with a mean of 15.01mg/l. Heavy metal with the highest concentration is copper with a range of 0 – 0.3mg/l and a mean of 0.095mg/l, iron and chromium occur in almost the same concentration in the water.

The quality of water is a function of the physical, chemical and bacteriological composition of the water. Almost all the analyzed parameters were found to fall within the NSDWQ (2007), WHO/UNICEF (2015) and WHO (1997, 2006 & 2011) standards for all the sample locations (schools). In summary, 22 schools out of a total of 30 had either the pH or Total coliform or both not falling within the permissible limits (11 of which had issues with the pH only, 5 had issues with Total coliform while 6 had issues with both). The low pH may be attributed to an increase in carbon dioxide concentration associated with biological activity resulting from the presence of microorganisms, which lowers pH since pH is controlled by the carbon dioxide – bicarbonate – carbonate equilibrium. The pH of most drinking water lies within the range 6.5–8.5. Most chemical reactions start to take place under particular pH and temperature conditions, low pH will lead to mobilization of other elements out of the environment and into the water leading to increased contamination and eventual pollution of the water. Although pH usually has no direct impact on water consumers, it is one of the most important operational water quality parameters.

Sulphate represents the chemical component with the highest concentration with a mean of 16.98mg/l) followed by chloride with a mean of 15.71mg/l, and bicarbonate 15.01mg/l. Heavy metal with the highest concentration is copper with a mean of 0.095mg/l, iron and chromium occur in almost the same concentration in the water.

Comparison of all analysed parameters with national and international standards (NDWQS, 2007 and WHO, 2011) respectively shows that all the parameters are within the Minimum Permissible Limits and consider the water as potable. However, elevated concentration of Chloride, Phosphate and Bicarbonates shows influence of anthropogenic sources which might lead to eventual contamination of the water and thereby impairing its potability if not contained with.

Piper trilinear diagram is used to categorize the water facies on the basis of dominant ions (Piper, 1944). In piper diagram, major ions are plotted in two base triangles as major cations and major anions. Piper trilinear diagram is used to categorize the water facies on the basis of dominant ions. Analysis of Piper diagram reveals that the water is the Calcium – Magnesium – Sulphate – Chloride type.

From the Durov plot, 53.34% of the water samples plotted in the region indicating no dominant anion or cation, 23.33% plotted under water type with dominant SO_4^{2-} and the remaining 23.33% indicated water type dominated by Ca and HCO_3 ions. It is also apparent that the basic hydrochemical processes controlling the composition of the water samples is dominantly simple dissolution. This makes it clear that anthropogenic factors play a dominant role in the contamination of the water samples especially where the bacteriological component of the water is found wanting. This calls for urgent attention for improvement of WASH facilities in Potiskum schools.

Gibbs (1970) proposed two diagrams to understand the hydrogeochemical procedures with reverence to atmospheric precipitation, rock–water interaction, and evaporation over the administration of geochemistry of groundwater. Gibbs plots are the graph of ratio of cations [(Na + K) / (Na + K + Ca)] and anions [Cl/(Cl + HCO3)] against TDS. Interpretation of the Gibbs plot indicates that about 60% of the samples are from precipitation dominance while the remaining 40% of the samples is from rock dominance. It can therefore be deduced that the chemistry of groundwater from shallow sources is dependent on the precipitation while in deeper levels the rock–water interface is the key procedure that controls the chemistry of groundwater. The zones that show more of precipitation dominance represent areas that are more susceptible to pollution of the water from shallow sources, like unplanned pit latrines, septic tanks, wastewater etc. this indication is shown in the interpretation of the Durov plot where the basic hydrochemical processes controlling the composition of the water samples is dominantly simple dissolution or mixing with few samples indicating ion exchange.

5.0 CONCLUSION

Comparison of all analysed parameters with national and international standards (NDWQS, 2007 and WHO, 2011) shows that all the parameters are within the Minimum Permissible Limits and consider the water as potable. The microbial component present in the water is basically Faecal Coliforms; the presence of these in the water indicates contamination from nearby shallow sources which was found to be pit latrines and poorly constructed septic systems.

Groundwater in Potiskum generally classified as Calcium – Magnesium – Sulphate - Chloride water. The chemical composition of the water is controlled to a large extent by precipitation and anthropogenic processes and to a smaller extent by the local geology. It is also apparent that the basic hydrochemical processes controlling the composition of the water samples is dominantly simple dissolution or mixing with few samples indicating ion exchange. This makes it clear that anthropogenic factors play a dominant role in the contamination of the water samples especially where it is in close proximity to potential contamination sources.

From the research carried out, only eight (8) out of a total of thirty schools that were investigated in Potiskum had adequate water supply and storage systems with a healthy hygienic conditions of toilets, septic tanks and environment; eleven (11) had good water supply and storage system but poor hygiene conditions and sanitary facilities as well as the general environment while the remaining eleven (11) have very poor water supply and storage systems, hygiene and sanitation conditions and the general environment. This is a clear indication that facilities for WASH are inadequate in most of the primary and secondary schools that were assessed in Potiskum.

In essence, WASH in Schools is a pathway to healthier schools and healthier, better performing children. Sustainable WASH in Schools programmes require the involvement and political leadership of ministries of education as well as related ministries such as health, public works, finance, local governance and water authorities. Without the political commitment evidenced in policies, standards and budgets, WASH in Schools remains externally subsidised. Such small-scale interventions cannot move beyond the pilot stage. If faith-based and private schools do not fall under national policies, mechanisms must be found to promote WASH in those schools as well.

In the past, these were considered schools for the privileged and did not generally require development interventions.

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