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Research Article

ASSESSMENT OF DRINKING WATER QUALITY AND ITS IMPLICATIONS ON THE RESIDENTS OF CORE SLUM IN ADO-EKITI

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ABSTRACT

The work examines the drinking water quality and its implications on the residents of inner city slum of Ado-Ekiti. Reconnaissance survey was carried out to identify drinking water sources in the study area and water samples were purposively drawn from strategically located and most used drinking water sources in the area. The samples drawn were quickly taken to Federal Government Zonal Water Laboratory in Akure for immediate analysis. It was discovered that most residents source their drinking water from unprotected hand-dug- wells. The results of laboratory analysis revealed that water consumed has physical, chemical and microbiological contaminants that make the composite lives of the residents vulnerable to drinking water related hazards. The work also reveals that the water scheme under construction in the state and Ado-Ekiti in particular unexplainably did not cover the slum region. It was therefore recommended that all stake holders should ensure that the slum area is covered by the new water scheme under construction and in the interim, affordable, accessible and acceptable water treatment gargets/tools/materials be provides and environmental education should ensue. The work will be of immense benefits to policy makers, slum dwellers and academic community.

Keywords: Slum Residents, Drinking Water Quality, Vulnerability and Ado-Ekiti.

INTRODUCTION

Water is the second most essential factor for the survival of human beings next to oxygen and it has been and recognized as indispensable factors to sustain life Nyakundi *et al.* (2020) citing Malathy *et al.* 2017 and Naidoo and Olaniran (2013). Worldwide, water is an important component of living beings as it performs unique and indispensable activities Saturday and Runyonyozi (2019). Drinking water is defined as water used for domestic purposes, such as drinking, cooking, and personal hygiene Maswati *et al.* (2020). Drinking water or water used for food production and domestic purposes has an important impact on health, socioeconomic and can cause disease outbreaks and or contribute to background rates of disease manifesting at different time and levels WHO (2020). According to Srinivas and Aruna (2018), increasing urban population growth, industrialization as well as intensive farming activity have led to severe disturbance of drinking water across the world, resulting in limited access to clean and safe drinking water while Omotoso and Oyeniyi (2016) and Lukubye and Andama (2017) opined that the main sources of and reasons for contaminants in the water sources in urban areas are pit latrines, wastewater from residential areas, animal waste, poor location of hand-dug- wells and effluent from sewage system. Saturday and Runyonyozi (2019) cited WHO and UNICEF (2014) reported that more than 700 million people lack access to a safe drinking water globally but in Sub-Saharan Africa, 327 million people are seriously and disproportionately affected by inadequate access to safe drinking water but the number has continued to grow. For instance, the most resent report of Joint Monitoring Committee of UNICEF and WHO (2020) stated that billions of people around the world are continuing to suffer from poor access to water, sanitation and hygiene, according to a new report by UNICEF and the World Health Organization, some 2.2 billion people around the world have not safely managed drinking water services. Nigeria, as a developing nation has failed to provide appropriate sanitation facilities and potable water from improved sources to its populace (Oyedele and Ayodele 2019). Improve drinking water sources includes sources protected by nature by virtue of their construction or other forms of human intervention via scientific or creative ingenuity of people that protect drinking water sources from external contamination particularly feacal contamination; these sources includes pipe water home supply of public stand pipe, borehole water, protected wells, protected spring, rain water and other improved sources while unimproved sources includes raw water / untreated water obtained from open surface like river, lake, stream and water savaged from broken pipes, unprotected spring, canal, irrigation channel, vendor-provided water (cart with tank/drum, tanker truck and water even bottled water but bottled water can be considered 'improved' only if the household use another improved sources for cooking and personal hygiene. A WHO Water Sanitation and Hygiene Reported (2020) Nigerians heavily rely on unprotected water sources like unprotected hand-dug wells, streams, springs and rivers Jagaba *et al.* (2020). Safe drinking water is water considered safe if it meets certain microbiological and chemical standards on drinking water quality guidance provided by the WHO Drinking-water Quality Guidelines (4th edition 2011) while access to safe drinking water is measured against the proxy indicator; the proportion of people using improved drinking water sources WHO (2020). Scholars across time and ages have attempted to study safe drinking water situation and consequences of consuming unsafe drinking water Saturday and Runyonyozi (2019) studied drinking water quality in Kabale Municipality, Uganda and discovered that the main sources of contaminants in these water sources in urban areas are pit latrines, wastewater from residential areas, animal waste and effluent from sewage system and recommended water treatment before consumption. Nyakundi *et al.* (2020) examined drinking water quality inner core of Nairobi and recorded unsatisfactory drinking water quality with (E. coli) contamination of faecal coliforms. Higher salinity

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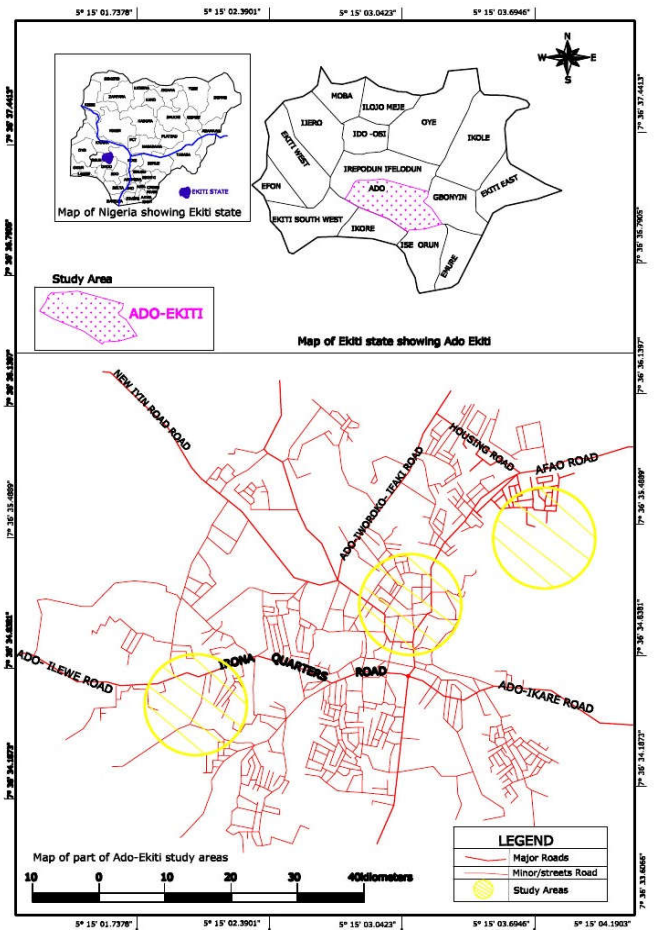
and dissolved oxygen below WHO recommended values for boreholes and households respectively. Niba *et al.* (2019) evaluated drinking water quality in Douala IV Municipality, Cameroon and discovered seasonal variation in the drinking water quality of the residents and established drinking water contamination. The authors concluded by recommending an in-depth study of the geochemical characteristics of ground water. Similarly, Shamimuzzaman (2019) assessed physico-chemical and microbiological quality of water around Dhaka city, the study showed 80% of water samples have different range of contamination; unsatisfactory total aerobic count, presence of fecal substances, E. coli and Vibrio respectively. Giri *et al.* (2020) reviewed a good number of research works on water quality with a special emphasis on high-altitude region and the work revealed groundwater and surface water showed that physicochemical, microbial, minerals, and heavy metals levels were higher than the prescribed limits of WHO and other regulatory guidelines throughout the world and that water quality is also going to deteriorate at high-altitude region as a result of climate change. Prevention of alteration of water quality by inventing some ameliorative measurements was recommended. Rahmanian (2015) stated that contaminants in the water can affect water quality and consequently the human health. As a result of poor access to safe drinking water and water related incidences, 6-8 million people die every year UN (2013). Omotoso and Oyeniyi (2016) citing Nwankwoala (2010) stated that without clean water, peoples' health and livelihood can be severely affected; the education of children (particularly girls) suffer as the daily tasks of survival takes precedence over all other concerns. Consumption of unsafe drinking water places unnecessary burden on the health facilities, economy of individual and the country as a whole. The need to ensure the provision of safe drinking water and protect the composite life of slum dwellers in the core slum of Ado-Ekiti spurs the researcher to embank on this work at this time of economic challenge and corona virus pandemic.

The study area

Ado-Ekiti in on Latitude to 6° 27' 14.65 to 7° 38N and Longitude3° 23' to 3° to 27' 40.81E. The city is the capital of Ekiti State, located within the North-Western part of Benin-Owena River Basin Development Area. Since inception as the state capital on October 1th, 1996 the city has assumed a new status as one of the most rapidly urbanizing cities in Nigeria. With her population put at 313,690 by the 2006 census on a density of 410 persons per square kilometer (NPC, 2006). The rapidly growing city houses higher institutions of learning; two universities, and a polytechnic.

Safe Water Situation in the Study Area

Safe water situation in Ado-Ekiti is in a precarious situation, the city does not have functioning water scheme despite her size and the residents either depend on hand-dug-well or borehole sources for their drinking and cooking water. It is not surprising therefore that the present government of Dr Kayode Fayemi declared state of emergency in water sector in July 2019. The governor stated that a good percentage in of the populace do not have access to safe drinking water as reported by Meritime First News Agency on the July 31, (2019). Mr Agbeyo, the General Manager of Ekiti State Water Corporation said the people have depended on streams. The poor resident of the core city center are far more vulnerable to the consequences of intake of unsafe drinking water since the can neither source their drinking water from protective sources nor afford treated water on a regular basis for both cooking and drinking. The residents drink and regularly cook with raw water from unprotected had-dug-wells (see plates 1and 2).



Source; Google Earth, Earth (2020)

Fig. 1. Nigeria, Ekiti State and the Study Area

Plate 1 and 2. Unprotected Drinking Water Sources at Atikanakan area of Ado-Ekiti

Some efforts have been made by successive governments in recent times to address the safe water situation of the resident but with little successes. Balogun reported in The Sun News Paper (Southwest Magazine) on July 5, (2018) that Ado-Ekiti Water Works was started by Senators Babafemi Ojudu, Olu Adetunbi and Tony Adeniyi. The three federal lawmakers embarked on the project in their first tenure. The project was abandoned since they failed to return for second term in 2015. A lot of borehole has been sunk but since there is little or no maintenance plan, they function only for a while. Government have entered into various partnerships, try to fund the state water scheme but all to no avail despite the enormous water resources and dams that dotted the landscape of the state. Currently, the state government is partnering with Word Bank under the third National Urban Water Sector Reform Project to embark on water scheme to the tune of 3.3 billion naira to serve the entire state. Under the arrangement, fund would be made available for the state water cooperation to ensure sustainable water provision. Sagittarius Henan

Engineering is handling the project to be completed by July (2020) and according to plan, places to be covered are Ekute, Onigari GRA, Fajuyi Adebayo and Pathfinder, all in Ado-Ekiti and Iworoko-Ekiti. It will require the laying of pipes of 21.6km from the dams, while the distribution and networking extension within Ado-Ekiti metropolis is going to cover as much as 286.654km. A critical consideration of places to be supplied with water when the project is concluded is the intermediate and sub-urban/ outskirt of Ado-Ekiti and the core where we have the poorest and the vulnerable; who cannot help themselves, the people who actually need the water most are unexplainably cut off of the supply from the planning stage.

MATERIALS AND METHODS

Drinking water sources was purposively selected from the strategically located and the most used drinking water sources that serve many slum residents in the selected core of Ado-Ekiti. The water samples collected were immediately taken to laboratory (Federal Government Zonal Water Resources Laboratory, Akure) for analysis to determine the level of safety or otherwise of both the physical characteristics and microbiological qualities. The results of both were compared with minimum permissible recommended standard of World Health Organisation (WHO) and National Food and Drug Administration Agency (NAFDAC) as well as that of Standard Origination of Nigeria (SON) where necessary to determine their level of safety.

Data Presentation and Analysis

Table 1 describes and compares the laboratory result obtained from water samples taken from selected Atikankan, Igbeyin, Olorogbo, and Irona slum areas of Ado-Ekiti with NAFDAC, SON and WHO recommended standards. The characteristics and constituents of water sampled from the study area analysed and compared in other to be able to deduce possible variation that may cumulate in poor safety levels as well as vulnerability of the residents who consume the water from the samples sources.

The samples have clear appearance, they are Odourless (ODL), they possess expected average temperature where living organisms can survive and multiply in, and the samples also possess tolerable levels of Conductivity, Magnesium $CaCO_3$ Total Dissolved Solids (TDS), Nitrate (NO_3), Magnesium (Mn) and Chromium (Cr^{6+}),

Four of the samples (ii 12.00, iii 6.00, iv 4.00, & v 2.00) are highly turbid; compared with 1.5 NTU WHO maximum permissible. Those samples are characterised by suspended particles that serve as shelter and food for pathogen, reduce the potency of disinfectants because the microorganism can hinge on them hence making the water consumers susceptible to problems associated with water safety. Excessive iron in water does not actually potent health risks but affects water taste, Colour and aesthetic quality as a result; consumers will naturally be discouraged and seek drinking water from other unsafe sources possibly with clearer colour and Taste. Alkalinity is high in one of the samples, though this does not potent any risk, but in association with high pH values, hardness and total dissolved solids brings corrosion on water distribution infrastructure (were available). Magnesium (Mg^{2+}) is also high in three samples (22.0 in iii, 27.8 in iv, and 38.6 in v). This may lead to impaired renal function, death in children among others. Chloride (Cl-) in higher than expected in two samples (i 280 and ii 300mg/L) as against (250mg/L), this implies that the water may be too tasty and consumer may doubt the sources and prefer water of better taste. The Total Coliform in all samples (i 31, ii 46, iii 26, iv 18 & v 21) indicate presence of pollutants but that of E-coli in two of the samples confirms the presence of pathogen and sure vulnerability of the consumers to waterborne diseases.

Detailed Discussion and Implications of the Drinking Water Conditions

***Appearances or Colours of the Water Samples*:** All samples are clear because they are from underground sources. Underground water is naturally filtered. Colour is more commonly found in surface water while it is virtually non-existent in underground water unless it results from natural metallic ions Iron (Ne) and manganese (Mn).

Table 1. Comparison of Laboratory Analysis of Water Samples with WHO, NAFDAC and SON and Recommended Standards

S.N.	Parameters	Units	I	II	III	IV	V	Nafdac Max.ald	Son Standard	WHO Max.Perm	Remark
1	Appearance	Clear	clear	clear	clear	clear	clear	Unobje	15TCU	Unobjec	✓
2	Odour	ODL	ODL	ODL	ODL	ODL	ODL	Unobje	Unobje	Unobjec	✓
3	Temperature	^{0}C	28.8	28.9	29.1	29.6	29.1	NS	NS	NS	
4	ph.	pH	7.31	7.16	7.13	6.74	7.03	6.50-8.5	6.50-8.5	82-8.8	✓
5	Turbidity	NTU	0.00	12.0	6.00	4.00	2.00	5.0	5.0	1.5	×
6	Conductivity	µs/cm-1	164	122	148	172	179	1000	1000	1200	✓
7	Total Dis. Solid	mg/L	110	81.7	99.2	115	120	1000	1000	1500	✓
8	Total Hardness $CaCo_3$	mg/L	374	278	310	658	324	100	100	500	×
9	Cal. Hardness $CaCO_3$	mg/L	284	240	220	544	166	150	150	NS	
10	Mag. Hardness $CaCO_3$	mg/L	90.0	38.0	90.0	114	158	20	20	20	×
11	Nitrate (NO_3	mg/L	3.00	7.00	2.45	4.28	3.23	10	10	50	✓
12	Irion (Fe)	mg/L	0.06	0.02	0.04	0.06	0.07	0.3	0.3	0.1	×
13	Alkalinity	mg/L	112	70.0	76.0	66.0	80.0	100	100	100	×
14	Magnesium (Mn)	mg/L	0.08	0.09	0.12	0.09	0.10	03	0.2	0.5	✓
15	Calcium	mg/L	114	96.2	88.2	218	66.5	75	NS	NS	
16	Magnesium(Mg2+)	mg/L	2.0	9.27	22.0	27.8	38.6	20	20	20	×
17	Chloride (Cl-)	mg/L	280	300	120	240	218	100	250	250	×
18	Sodium (Na)	mg/L	182	200	78.0	156	142	-------	200	NS	
19	Bicarbonate (HCO_3)	mg/L	112	70.0	76.0	66.0	80.0	250	250	270	✓
20	Chromium (Cr^6+)	mg/L	0.01	0.00	0.00	0.00	0.01	0.5	0.5	01	✓
21	Total coliform	Cfu100	31	46	26	18	21	0	10	0	×
22	E-coli	Cfu100	1	0	0	1	0	0	0	0	×

✓Acceptable; ×Not Acceptable

Source: Author's Compilation (2020)

Despite the acceptable appearance of water samples, laboratory tests still clearly show that they have particles and bacteria. This implies that water samples with good or clear appearances may not be necessarily safe.

***Taste and Odour in drinking water samples*:** All water samples are tasteless and odourless. Taste could be caused by Total Dissolved Solids (TDS), Iron (Ne), Copper (Cu^{+2}), Manganese (Mn), or Zinc (Zn). Magnesium (Mg^{+2}) Chloride (Cl) and Magnesium Bicarbonate (HCO_3) are significant in terms of taste. Fluoride may also cause a distinct taste. Taste and Odour problems of many different types can be encountered in drinking water. Biological growth may result in taste. Similarly, where and when water is treated, tastes and odours may be reactions from treatment with chemicals (Chlorine), or from the distribution system and/or in the plumbing fixtures Niba *et al.* (2019). They may also result when chlorides are 500 mg/L or above in drinking water. Odourlessness and tastelessness do not and cannot guaranty water safety because many water samples are not safe and their consumers are vulnerable to unsafe water related problems in all.

***Temperature of the water samples*:** Temperature is simply the degree of hotness or coldness. It is affected by season, time, atmospheric condition, place and depth. It influences the type and rate of dissolution of minerals or chemical releases in water as well as electrical conductivity. According to the laboratory results, all water samples maintain the expected average consistent with geography of the study area even when WHO did not state any figure but literature review pointed to average of (15^0C) according to Hugh *et al.* (2005) and Zane (2006). The range as dictated by the environment and revealed by laboratory results temperature ranges between 26.1-29.6^{0}C. This implies that the temperature is relatively high; hence, organism can live and multiply easily in all the water samples due to the relatively high temperature thereby increasing the degree of susceptibility of water consumers drinking water sampled from the study areas.

***pH in drinking water samples*:** pH is a measure of acidity and alkalinity of water. This measure ranges from 0-14. The lower the pH value the more acidic the water is. All water samples possess the expected and acceptable values of pH of (8.2-8.8) according to WHO recommended standard.

***Turbidity*:** Turbidity is the measure of clarity of a liquid. It implies the presence of suspended solids or particles, cloudiness or haziness in water that are usually invisible to naked eyes, Zane (2006). These particles usually include silt, clay, finely divided inorganic and organic matter, algae, soluble coloured organic compounds as well as other microscopic compounds etc. Turbidity could be caused by human activities like construction leading to erosion and effluents especially in highly urbanized zones like the study area A United State Government Report on urban growth (USSG) (2016). Level of suspended particles in underground water could be a factor of nature of aquifer from which the water came, the extent of exposure and frequency of the water source to external contacts, the depth and frequency of disturbance as well as the quantity of water at the source or even result from the effects of disinfectants or water treatment efforts www.http//water turbidity, www.http//what is turbidity. Presence of turbidity in drinking water may not be of direct health risk but raises health concerns; it provide food and shelter for pathogen thereby promoting its growth in the distribution system leading to waterborne diseases which have caused significant cases of gastroenteritis, Ogbuagu *et at* (2006), Olusoji (2010) and Emmanuel (2014). It also provides shelter for microbe by reducing their exposure to attacks during disinfectants while water is been treated. Particulate also provided attachments to heavy metals such as cadmium, mercury and lead and many toxic organic contaminants and pesticides SON (2007). It also reduces people's accessibility to drinking water because it makes the appearance of drinking water unappealing; hence, people make efforts to get clearer water even if they have to be from more doubtful sources with additional stress and cost. Unfortunately, water samples from the study area are characterised by particles, as revealed by laboratory analysis appendix (see Tables 1). The global (WHO) and national (SON) recommended highest permissible level of turbidity in drinking water is 1.5 Nephelometric Turbidity Units (NUT) the mentioned samples are all above this maximum permissible level at different rates.

Iron (Fe): Irion as an element is naturally occurring and required constituent of drinking water. It gets to drinking water from water bearing strata underground and iron bearing bacteria. Presence of iron in drinking water do not potent health risk but only reduces aesthetic quality of drinking water because orange or brawn stain on pipes and plumbing system. It also induces bitter metallic tastes in drinking water especially when the quantity of iron is higher than global (WHO), and national (NAFDAC) and (SON) recommended standards of 0.3 and 0.1 Mg/L Milligram per litter. Fortunately, all samples have acceptable quantity of Iron (Fe) in them.

Conductivity: This is a measure of ability of water to conduct electricity. It shows the origin of water and indicates level of its salinity. Measurement of conductivity in water is necessary because it measure Total Dissolved Solid (TDS). High rate of conductivity in drinking water has implications on consumers' health. Disturbance of water balance in children under one year, it may increase the blood pressure and renal failure of heart patients. Water with high level of conductivity is not good for patients on salt restriction; heart and renal failure WHO (2016), Derara *et al.* (2017). Residents of the study area are not vulnerable to the effects of high conductivity in their drinking water because all the water samples fall within the recommended limits.

Water Hardness: (Magnesium and Calcium Hardness ($CaCO_3$) Sources: Magnesium and calcium are chemical elements that occur naturally in drinking water. They get to drinking water through the aquifers as water flows through the ground natural components of the rock are dissolving and flow with the water. Those materials make water hard WHO (2016). Water hardness is indicated by taste and precipitation of soap scum and the need for more soap to ensure thorough cleaning Essien *et al.* (2014). Consumers take notice of hardness in water and the degree of response or/and acceptability is always different from communities and individuals. Water hardness in excess of 200mg/L results in scale deposition in treatment and distribution network as well as plumbing fixtures. WHO did not attach specific health risks to water hardness but Bill (1999) and Brian (2017) have discovered serious health effects of water hardness, they include; bathing with hard water reduces the potency of the active ingredients in the soap, this often results in leaving firm of sticky soap curd on the skin. The firm may prevent removal of soil and bacteria curd from skin which interferes with the return of skin into normal slightly acidic condition. It also leads to irritation. Soap curd on hair may make it dull, lifeless and difficult to manage. Calcium and Magnesium are part needed by human body system but their excessive consumption may result in impaired renal function and death in extreme cases. It could therefore be deduced that water hardness results in health and cost consequences, make drinking water unappealing thereby stresses drinking water accessibility of the consumers in the study areas.

Total Dissolved Solids: (TDS): Dissolved solids refer to any minerals, salts, metals, cations or anions dissolved in water. Total

dissolved solids (TDS) comprise inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonates, chlorides, and sulfates) and some small amounts of organic matter that are dissolved in water. TDS in drinking-water originate from natural sources, sewage, urban run-off, industrial wastewater, and chemicals used in the water treatment process, and the nature of the piping or hardware used to convey the water; the plumbing. Excessive (TDS) is more of an aesthetic rather than a health hazard. An elevated TDS indicates corrosive, salty or brackish taste, scale formation, and interferes and decrease efficiency of hot water heaters. It may also show the traces of nitrate, arsenic, aluminum, copper, lead. High total dissolved solids may affect the aesthetic quality of the water; interfere with washing clothes and corroding plumbing fixtures (were used). All these may have implication on acceptability; therefore water consumers may prefer any softer water even if drawn from doubtful sources.

Nitrate (O_3): Nitrate is naturally formed when nitrogen and oxygen/ozone combines, Nitrates are also made in large amounts by plants and animals. It is essential for all living things, but high levels of nitrate in drinking water can be dangerous to health, especially for infants and pregnant women. Nitrate can occur naturally in groundwater at a level that does not generally cause health problems. High levels of nitrate in well water often result from improper well construction, well location, overuse of chemical fertilizers, or improper disposal of human and animal wastes.

Sources of nitrate that can enter well include fertilizers, septic systems, animal feedlots, industrial wastes, and food processing waste. Unprotected hand-dug-wells may be more vulnerable to such contamination after flooding, particularly if the wells are shallow or have been submerged by floodwater for long periods of time. This condition results when nitrate is converted to nitrite in the infant's body. Nitrite then interferes with the oxygen carrying capacity of the blood. Symptoms include shortness of breath and blueness of the skin (methemoglobinemia). This is an acute disease in which symptoms can develop rapidly in infants from very minor exposure.

Manganese (Mn): Manganese is a mineral that naturally occurs in rocks and soil and is a normal constituent of the human diet. It exists in well water as a naturally occurring groundwater mineral, but may also be present due to underground pollution sources. Manganese may become noticeable in tap water at concentrations greater than 0.05 milligrams per liter of water (mg/l) by imparting a colour, odour, or taste to the water SON (2007). However, health effects from manganese are not a concern until concentrations are approximately 10 times higher but no such case in the water samples from the study area.

Sodium and Chloride; "salt": Almost all natural waters contain chloride and sulfate ions. Their concentrations vary considerably according to the mineral content of the earth in any given area. In small amounts they are not significant. In large concentrations they present problems. Usually chloride concentrations are low. Sulfates can be more troublesome because they generally occur in greater concentrations WHO/SDE/SH (2014). Low to moderate concentrations of both chloride and sulfate ions add palatability to water. In fact, they are desirable for this reason. Excessive concentrations of either, of course, can make water unpleasant to drinking. Water with high sodium chloride will taste unpleasantly. It is also highly corrosive and can damage plumbing, causing toxic metals to leach into the water. Water that is high in sodium chloride can damage appliances and hot water heaters over time United States Environmental Protection Agency US-EPA (2015). Drinking water with sodium chloride can contribute to high blood pressure and affect those with heart problems, affect patients with hypertension or cardiovascular disease Hazen (2010).

Alkalinity and Bicarbonate: Alkalinity is the measurement of the ability of water to neutralize acid. Bicarbonate (HCO_3) ions are the principal alkaline constituents in almost all water supplies. Different types of rock, soil, and industrial manufacturing can change the alkalinity in groundwater. Alkalinity in drinking water supplies seldom exceeds 300 mg/L. Alkalinity in water is needed in boiler feed water, cooling tower water, and in the beverage industry. Alkalinity neutralizes the acidity in fruit flavors; and in the textile industry, it interferes with acid dying. Excessive alkalinity in water can cause digestive discomfort and illnesses. It is not safe in high doses and should not be used for long periods of time. Individuals who have edema, liver disease, kidney disease, or high blood pressure are more vulnerable. It can also cause cramping of the stomach and increased thirstiness, only one sample is free from the two elements, therefore, the slum residents consuming such water are vulnerable and USGS (2015) and USGS (2015).

Chromium (Ca^{2+}): Chromium is a mineral our bodies use in small amounts for normal body functions, such as digesting food. It is an Odourless and tasteless metallic element found naturally in rocks, plants, soil volcanic dust and animal. The most common form of chromium in natural water is trivalent (Chromium -3) and Hexavalent (Chromium -6). Continuous consumption of chromium beyond the permissible level increases the level of ion in the body. Chromium-6 in drinking water shows clear evidence of carcinogenic activity in laboratory animals and increases the risk of gastrointestinal tumors USGS (2015). Continued exposure to C hromium-6 could result in allergic dermatitis (skin reactions) Rachel (1999). Ingestion of 1–5 g of chromate results in severe acute effects such as gastrointestinal disorders, hemorrhagic diathesis, and convulsions. Death may even occur following cardiovascular shock (US-EPA 2010). Three samples from samples show presence of Chromium in the drinking water beyond the recommended level making the consumers of water vulnerable to the said consequences.

Total coliform and E. coli (Escherichia coli): Total coliform is a large collection of bacteria/organisms found in the environment, intestine and feaces of warm blooded mammals. They may be found in drinking water without causing illness but their presence is a clear indication of the water source vulnerability to contamination by more harmful microorganisms (WHO 2016). Total coliform is present in all the samples; this implies that all the drinking water samples' sources are susceptible to pollution by harmful pathogen thereby exposing the lives of water consumers to danger.

E-coli (Escherichia coli): are special member of bacteria found in well waters; it is the only member of coliform bacteria that is found only in human intestine. It is an indicator to measure the level of pollution and sanitary quality of water source and its presence indicates resent fecal contamination and presence of disease causing pathogen such as bacteria, viruses and parasites United States Government USGS (2015), New York City Department of Health NYSDH (2016). One of the really harmful pathogen is (E.coli 0157:H7) that has led to epidemic in Europe and North America in the past US-EPA (2015). The sources of these bacteria are septic tanks or pit latrines, leaching of animal manure/droppings and runoff entering into the wells because of poor construction or maintenance.
By any standard, E-coli and total coliform should not be in drinking water as made clear by many international and national. Only Standard Organization of Nigeria allows 10cfu/100 of a Total Coliform in drinking water but did not allow/permit E-coli in drinking water. The water borne illness caused by these bacteria vary because the

parasites also vary and they include diarrhea, nausea, vomiting, eyes, skin and nervous system or liver and the effects may be severe, chronic or fetal, it can even be epidemic in nature. Results obtained from water sampled from the study area reveals the presence of E-coli, an evidence of presence of disease causing pathogen in the drinking water samples.

Summary, Conclusion and Policy Implications

The residents of the study area source their drinking water mainly from unprotected hand-dug-wells. Since Ado-Ekiti is not having functional water scheme except the one embarked upon by the current Fayemi administration of (2020). The quality of the drinking water has physical contaminants that impact on physical appearance and other physical properties. The water samples also have chemical contaminants that may be from anthropogenic or natural sources include Chloride (Cl-), Magnesium(Mg2+), Bicarbonate (HCO_3), Chromium ($Cr^{6+,}$), Calcium and Magnesium Hardness ($CaCO_3$), Sodium (Na), Inorganic contaminants, Total Dissolved Solids (TDS) and Biological / microbiological contaminants as occur in the samples and indicated in the samples Total Coliform and E**-**coli (Escherichia coli). The residents are exposed to fatal consequences of continuous consumption of contaminated water. The residents are poor slum dwellers and unable to access and afford drinking water from protected or safe sources. The past efforts and current moves to provide drinking water for the populace technically and unexplainably excluded the cure city slum dwellers and if no action is taken to address this anomalies, the lives of residents would continue to be in susceptible to avoidable financial burden, sicknesses, unnecessary stress on the few ill equipped heath facilities and avoidable deaths. As it is now, government must include the cure slums in the planning of pipe laying of the current waters scheme in Ado-Ekiti; Atikankan, Ologuro, Okeisa Market area and Irona among others. To achieve this, opinion leaders, community leaders, representatives of slum dwellers, opposition political party, traditional rulers and all other concerned citizens should mobilize and prevail on government. Secondly, since the housing condition of the poor slum dwellers may not support household/or yard supply, the government must make provision for adequate un-metered stand pipes proportionally and strategically located in the inner slum neighbourhood. Thirdly, in the interim, simple, affordable and acceptable water treatment garget / tools could be provided and slum resident educated on the uses and benefits. Finally, environmental education and public enlightenment may help in sanitation, personal hygiene as well as safe water situation so as to preserve the valuable lives of slum residents

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