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Assessment of Water Supply Quality in Awka, Anambra State, Nigeria

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Abstract

The patronage of water of questionable qualities in the study area due to the failure of the Anambra State Water Corporation to provide potable water supply in Awka and environs prompted this research work. Various water sources patronized in the study area were collected and subjected to physical, chemical and microbial analysis to determine their pollution/contamination status. The work revealed that the surface and borehole/well Water sources are microbiologically polluted. Ca^{+2} *and* Mg^{+2} *levels in water samples were high, this results to hard water.* Fe^{+2} *concentrations in the water samples ranged from 1.20-5.00 mg/l. 100% of samples exceeded the MPL of 0.3mg/l, low pH favours oxidation of ferrous iron to ferric iron, giving an objectionable reddish-brown colour to the water. Iron also promotes the growth of "iron bacteria". Aggressive public awareness of the pollution status, routine check of the water quality and increased sanitary conditions in the study area in order to ameliorate this problem were recommended.*

Key words: Patronage, Contamination, Aggressive, Water Quality

Introduction

Water meant for drinking and cooking should be free from harmful microorganisms, harmful chemicals, suspended materials, undesirable taste, colour and odour (Leton and Umesi, 1990). Drinking water from natural sources is usually polluted as a result of man's activities, thus rendering supplies harmful to the body. This pollution results from eutrophication, introduction of sewage and also toxic wastes from industries into the water body. Pollution can be caused by the addition of harmful or undesirable micro-organisms to the water body (Okafor, 1985). According to UNESCO (2003) report, about 1.2 billion people globally lack safe drinking water, and 50% of the populace in developing countries still has no reasonable access to safe and sustained water supplies. Consumption of contaminated water cause a variety of water related diseases such as typhoid, hepatitis, cholera, acute diarrhea, schistosomiasis and guinea worm. The report estimated that 14.6 million children die annually as a result of water related diseases.

In Awka, the Anambra state capital, access to adequate urban water supply from the state water corporation is a serious problem facing the inhabitants since 1999. Hence, to meet their demand for potable water supply, the inhabitants of this state have survived by constructing water supply systems, reservoirs, wells and boreholes. Others patronize water vendors; rain water collected from roofs, rivers and streams. Proliferation in the use of water from alternative sources, like shallow hand dug wells and boreholes, water from streams and rivers, leading to the utilization of water with questionable qualities for domestic activities. Again, solid wastes are generated at a rate faster than they are disposed of by the designated authorities. Solid wastes are indiscriminately dumped at available empty land, on the streets and in gutters. Also automobile repair shops scattered all over the town generate repulsive and objectionable view sights, which reduces the aesthetic value of the environment. Indiscriminate disposal of used motor oil (condemned oil) and grease in the environment may result to the contamination of water resources and death of aquatic biota. The fertilizers and pesticides used by the farmers to improve crop yield are eventually leached into the rivers and streams where they may contaminate water and facilitate eutrophication (Ikuo, 2014). Industrial effluents and other wastes not properly recycled or treated are discharged into the environment due to inadequate environmental impact monitoring or enforcement in the state. Wastes generated from above named activities one way or the other find a way the hydrological cycle thereby polluting or contaminating water resources (Obiefuna and Sheriff, 2011). This is so because most of the water are not protected or monitored qualitatively, thereby exposing them to varying types of pollutants — both chemical and microbial pollutants. This situation could be attributed to low level of awareness among the inhabitants, non enforcement of water laws and pollution control measures which apply to the water resources in the study area. Therefore, there is the use the water from these sources ignorantly despite the cumulative health implication of such exercise.

The essence of research work is to investigate the pollution of domestic water supply in Awka Capital City. The objectives are as follows: to determine the types and concentrations of pollutants/contaminants present in domestic water sources in the study area, to determine if pit latrine system existing in some parts of the study area affect the quality of domestic water supply, to compare the water quality in the study area with WHO standard with a view to determining their wholesomeness.

The Study Area

Awka Capital City as an indigenous community comprises of four major clans divided into two sections, together forming thirty-three (33) villages. These clans are Agulu, Amikwo, Ezioka and Amenyi. The four clans can be grouped into two (2) sections namely: Ezi and Ifite . Ezi comprises of Amenyi and Ifite itself, which is made up of Ifite-Awka, Ayom-na-Okpala, Amachala-Udo and Nkwelle. Awka capital city is in Awka South local government area of Anambra State. It lies between latitude 6°06 and 6°15'N and longitudes 7°05'E and 7°15'E. The physical size and structure of Awka capital city makes it suitable to play several roles and serve several functions in the socio-economic and socio-political development of Anambra State especially its administrative functions as the capital city of the State (Nwanna and Ezenagu, 1995). Awka as an administrative, commercial and educational town is a rapidly growing urban center with a large percentage of migrant settlers. There is also an increase in the number of industries, commercial and recreational centres in the town.

The National Population Commission (1991) gave the population of the town as approximately 60,000. The population when projected to 1996 was about 70,000, 2000 was 77,000 and 2005 will be 84,000 at a growth rate of 2.83 percent per annum (Nwanna and Ezenagu, 1995).

Research Methodology

The qualities of water resources in the study area were tested for physico-chemical and microbiological pollution. The samples were drawn from surface and underground water resources. Five (5) samples frok each of the ground and surface water sources were collected for analysis. The sampling locations are depicted thus:

A - ABS, Unizik Temp Sites Area

B - Amikwo, Akwata Area

C - Umudioka, Ezioka, Agulu

D - Nkwelle, Agu-Awka Area

E - Amenyi, ifite Area

From each of the sampling station, random sampling technique was employed in choosing the well and borehole water samples. The chosen boreholes and wells are those located less than 50 metre from pit latrines or soak-away pits. Three water samples were obtained from each section making a total of 15 water samples for each source of interest and 45 samples in total for three sources evaluated.

The water samples were collected in all with the aid of properly washed and sterilized 500ml screw-capped glass bottles. The bottles were lowered into the surface water and well water source by means of a sterilized rope tied round the neck of sample containers. The collected samples were appropriately labeled, packed in a cooler and taken to the laboratory for treatment and analysis. All the samples were taken to the laboratory the same day that they were collected.

Data Analysis

The analysis of field samples required three basic operations.

1) Acquiring the raw samples using representative sampling techniques
2) Preparing the raw samples to convert them to analyzable forms
3) Analysing the prepared samples to determine the parameters of interest.

The result of analysis was affected not only by the raw samples composition but also by the three operations performed to arrive at the results. Therefore care was taken in carrying out these three basic operations so as to reduce the introduction of error in the analysis of data.

As pointed out earlier, the parameters of interest in this water analysis study include the physical, chemical and microbial contents.

Research hypothesis adopted was to scrutinize the significant difference (significant level, a=0.05) between means of the various parameters analysed in the three different water sources in the study area.

Physical, Chemical and Microbial Analysis

The quality of water and its ability to sustain pathogenic microorganism, which infects susceptible human hosts, depends on some physical factors among which are temperature, turbidity, taste and odour etc. Chemical analyses were carried out using the American Public Health Association (APHA) standard methods for examination of water and wastewater (APHA, 2005). The chemical parameters tested were pH, total hardness, sodium (Na^+), Calcium (Ca^{+}), Iron (Fe^{+2}), Copper (Cu^{+2}), Lead (Pb^{+2}), Chloride (Cl^{-}) nitrate (NO_3^{-}), Sulphate ($S0_4^{-}$), Carbonate ($C0_3^{-}$), Bi-Carbonate ($HC0_3^{-}$).

Determination of the coliform organization count as the indicator of faecal pollution was used. The membrane filter technique was employed in this analysis (Fawole and Oso, 2001). This is because it allows for a direct count of coliform colonies, has a high degree of reproductively, possibility of testing relatively large volume of samples and ability to yield definite results quicker than the standard procedure.

Result and Discussions

This work assessed the pollution of domestic water supply in Awka Capital City. The work covered the surface and underground sources of domestic water supply in this area.

Table 1: Result of water quality parameters analysed

	Ground					*Well water*					*River*						
Parameters	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	WHO	NSDWQ
Specific Gravity	2.2	1.9	2.0	2.0	2.0	2.1	2.2	2.1	2.1	2.1	2.3	2.3	2.3	2.3	1.4	1.0	NG*
Temperature °C	20.0	21.0	23.0	20.0	27.0	19.0	26.0	27.0	26.0	24.0	29.0	28.0	27.0	28.0	26.0	25*	NG*
pH	5.9	5.8	6.0	6.0	6.0	5.9	6.0	6.0	6.0	6.0	6.0	6.0	6.5	6.0	6.7	6.5-8.5*	6.5-8.5
Colour (Hazen Unit)	4.5	4.3	4.0	4.5	5.9	4.8	10.5	6.5	5.0	5.6	6.8	6.4	5.0	5.2	5.2	5.0	15.0
Turbidity (NTU)	0.6	0.5	0.5	0.5	0.5	20.0	4.0	0.5	0.5	0.5	23.0	21.0	21.0	20.0	20.0	5.0	5.0
Conductivity (Mho/cm)	12.5	13.0	8.0	11.0	9.0	17.0	12.0	12.0	11.5	12.5	15.0	15.0	14.5	15.0	17.0	20*	NG*
TSS (mg/L)	680.0	60.0	80.0	100.0	110.0	120.0	980.0	220.0	540.0	380.0	1130.0	1020.0	640.0	680.0	940.0	500*	NG**
TDS (mg/L)	220.0	120.0	118.0	310.0	120.0	140.0	140.0	630.0	360.0	6.8	550.0	510.0	380.0	360.0	620.0	500*	500.0
TS (mg/L)	900.0	180.0	198.0	410.0	230.0	260.0	1120.0	860.0	900.0	840.0	1680.0	1530.0	720.0	1040.0	1560.0	500*	NG**
Chloride, Cl^- (mg/L)	202.4	56.8	78.1	47.2	50.9	71.0	149.1	67.5	142.0	84.0	70.2	53.3	53.3	78.1	21.3	250*	250.0
Sulphate, SO_4 (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200*	100.0
Nitrate, NO_3^- (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.2	0.0	0.1	0.0	0.0	45*	50.0
Bicarbonate, HCO_3^- (mg/L)	445.3	308.1	366.0	210.5	240.2	292.8	508.4	491.1	396.5	250.8	103.2	94.6	3.1	6.1	39.7	500*	NG**
Carbonate, CO_3^- (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	87.1	78.0	114.0	54.0	48.0	500*	NG**
Calcium, Ca^{+2} (mg/L)	210.5	28.1	130.3	56.1	45.4	48.1	84.2	51.1	362.9	45.8	75.3	68.1	82.2	42.1	204.4	75*	NG**
Iron, Fe^{+2} (mg/L)	4.9	3.7	2.5	1.2	1.8	2.5	3.7	4.9	2.5	2.3	5.0	1.9	2.4	1.2	5.4	0.3	0.3
Manganese, Mn^{+2} (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.2
Magnesium, Mg^+ (mg/L)	0.0	0.0	0.0	0.0	0.0	18.2	25.5	12.2	80.3	17.6	9.1	6.1	43.8	25.5	60.0	30.0	0.2
Lead, Pb^{+2} (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Copper, Cu^{+2} (mg/L)	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	1.0
Total Coliform (cfu/100)	0.0	0.0	0.0	0.0	0.0	40.0	49.0	48.0	52.0	55.0	200.0	153.0	180.0	58.0	42.0	0.0	10.0

NG* = WHO (2011) is silent on these as values occurs in drinking water at concentrations well below those at which toxic effects may occur. WHO (2008) is depicted.
NG** = No value obtained

Water Pollution Problem

In Awka town which serve as commercial, educational and administrative seat of Anambra state, the rate of population and urban development is increasing rapidly thereby giving rise to rapid urbanization and urban sprawl. There is also an increase in the number of industries, commercial and recreation centres in the town. Environmental problems in this town ranging from flooding, silting and eutrophication of streams, inadequate solid waste management problems and discharge of unhealthy effluents and used motor oil into the environment. People dispose of their solid waste indiscriminately into flood channels along the streets in open dumps, in market places and even highways. Despite this some households in the study area still make use of pit latrine system despite the sanitation implication of this exercise. Also, animal wastes and waste water from some abattoirs in study area are directly discharged into the nearby surface water sources; see Fig. 1. A major challenge in the study areas is the sharp practice of the Soak-Away cleaners or evacuators who drain and dispose of sewage from filled soak away pits; it is surprising to discover that some of these people do not dilute or treat the sewage before disposal, they rather dump it into trenches even on land surface in some bushes in and around the study area. When rain falls, runoff water carries some of the waste into surface water sources thereby causing pollution (Danquah, 2010). Also during infiltration of soil water, some pollutants are carried across the soil barriers into underground water sources where they equally pollute or contaminate the ground water resources. Ground water sources like wells and boreholes are likely to be polluted by leachates from pit latrines existing in the study area (WHO, 2004).

More so, the patronage of some water of questionable qualities by the inhabitants of the study area, due to non-sustainable urban water supply, has exposed the users to health and economic problems.

From Table 1, majority of parameters bordering on chemical wholesomeness of water resources in the study area were discovered to be within the WHO guideline except Ca^{+2}, Mg^{+2} and Fe^{+2}. From Fig. 2, Fe^{+2} concentrations in the water samples ranged from 1.20-5.00 mg/l. 100% of samples exceeded the MPL of 0.3mg/l, low pH favours oxidation of ferrous iron to ferric iron, giving an objectionable reddish-brown color to the water. Iron also promotes the growth of “iron bacteria”

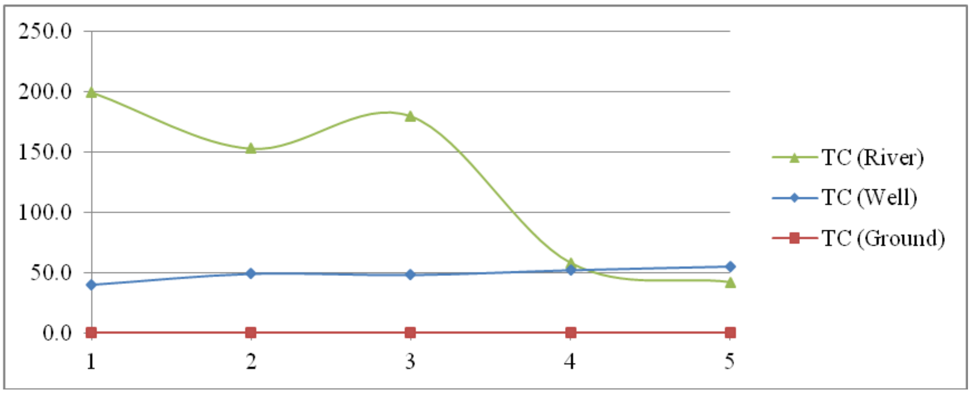

Figure 1: Coliform count in water sampling points

Borehole water sources were most portable, followed by well water sources, and then, surface water sources. This argument is supported by Hypothesis I. However, surface water and well water sources suffer contamination by microorganisms indicative of pollution by human or animal waste.

Finally, this research work equally revealed that pit latrine system of toilets still existing in some parts of the study area has not polluted or contaminated underground water sources. This is evident by the complete absence of nitrates in both well and borehole water in the analysed sample.

However, there is a general trend of bacteriological pollution of well water sources in the area. This could be attributed to poor and unhygienic handling and utilization of wells and fetchers used in drawing water from wells.

Furthermore, hypothesis postulated was to analyse the deviation level among parameters of the various water sources, the student t-test was employed.

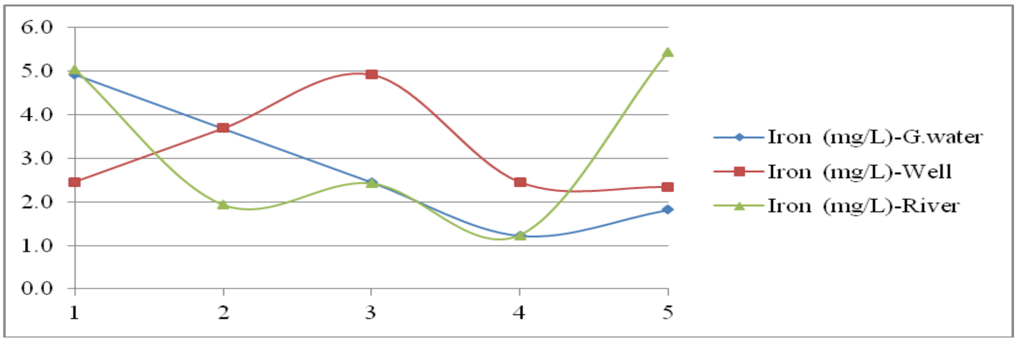

Figure 2: Concentration of Fe^{+2} in water sampling points

Table 1: Arsenic concentration in sampling points within Onitsha metropolis

S/No	Parameters	F-Pr	Decision
1	Specific Gravity	<0.001	S
2	Temperature ^{O}C	0.004	S
3	pH	0.014	S
4	Colour (Hazen Unit)	0.090	NS
5	Turbidity (NTU)	<0.001	S
6	Conductivity (Mho/cm)	0.001	S
7	TSS (mg/L)	0.007	S
8	TDS (mg/L)	0.020	S
9	TS (mg/L)	0.002	S
10	Chloride, Cl^- (mg/L)	0.288	NS
11	Nitrate, NO_3^- (mg/L)	0.076	NS
12	Bicarbonate, HCO_3^- (mg/L)	<0.001	S
13	Carbonate, CO_3^- (mg/L)	<0.001	S
14	Calcium, Ca^{+2} (mg/L)	0.904	NS
15	Iron, Fe^{+2} (mg/L)	0.599	NS
16	Magnesium, Mg^+ (mg/L)	0.627	NS
17	Total Coliform	0.002	S

S – Significant difference exists (F-Pr<0.05)

NS – No significant difference exist (F-Pr>0.05)

The qualities of the water sources are determined by the concentration of the indicator parameters present in them. Hence, difference in the means of the parameters tested indicates a difference in the water quality from the various sources. Significant difference exists in the mean of 6 parameters (35.29%) while 11 parameters (64.71%) differ significantly. This further confirms variations between 3 water sources.

Conclusion and Recommendations

Surface and Well water sources in the study area contain high coliform counts with respect to the WHO guidelines. This indicates that these water sources are bacteriological polluted. This can be attributed poor and unhygienic handling of wastes, careless utilization of wells and fetchers. The patronizers of these water sources are unaware of this situation and hence do not take precautionary measures to abate it or its consequences.

1. There is need for aggressive public awareness by way of organizing seminars, putting up educative jingles in the media and the inclusion of environmental education in school curricula. It is believed that if the populace is aware that aesthetically attractive and colourless water can be unsafe for human consumption, and that all water sources need to be further treated locally by boiling and filtration before use, and food items like meant, fish and vegetables properly cooked, the incidence of water related diseases will further be reduced.

2. Routine checks of the quality of the domestic water supply in the study area are advocated for, so as to ascertain its pollution status. This situation should be communicated to inhabitants each time it is checked so that necessary precautions should be taken by the users.

3. Both the three tiers of government, non-governmental agencies and international organizations should join hands together to ensure that adequate and safe drinking water are provided for as many people as possible. Also grants received from international donors such as World Bank assisted water projects should be maximally and efficiently utilized.

4. Additional efforts should be made by the government and other stakeholders in the state to eliminate completely the remaining pit latrine toilet systems still existing in the study area as these are potential sources of underground water pollution. This can be done effectively by giving grants and loans to landlords with which to replace the obsolete toilets in their houses.

5. It is also very important to monitor the location of wells especially with regard to potential sources of contamination like soak away pits and pit latrines since they form the major pollutants of groundwater. Wells should be protested with parapets and provided with facilities for the extraction of water from the pit. Also high sanitary conditions should be established around well site surroundings and fetchers should be kept clean and dry so as to reduce the introduction of coliform organisms into the water.

6. Riparian laws should be enforced to protect and manage our streams and other water sources from being polluted. This law will equally regulate the sitting of wells and boreholes in places otherwise not suit able for such facilities.

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