Innovations

Water Chemical Analyses in Boji - Boji, Agbor, Delta State, Nigeria

Dr . Ejemeyovwi .O. Danny[1] Mr . Oyibu .L. Obaro [2] Mr. Ovwamuedo, Glory[3]

[1](Associate Professor) Department of Geography and Regional Planning,
[2]Department of Science and Laboratory Technology,
[3]Department of Geography and Regional Planning
Delta State University Abraka, Delta State, Nigeria.

Corresponding Author Name**: Ejemeyovwi Danny Ochuko**
ORCID: 0000-0003-2431-9166

Abstract
Issues*: Water is difficult to obtain in Boji - Boji Agbor and its supply is unreliable in the densely populated area of the Niger-Delta, Nigeria. Water pollution in the area resulted from wrong siting of well/borehole close to sewage tank and dumping of refuse/sewage in the water. This study identified various water sources, causes and effects of pollution based on evaluated physical, chemical and biological characteristics.* ***Methods****: The primary sources of data include oral interview and water chemical analyses while the secondary data are published works in journals, textbooks, etc. Six sample point sources from River, well and Boreholenamely Adugbe , Baleke, Charles, Mudia, Odozi and Edike analyzed based on the international standard procedure of water collection storage (stored in a dried disinfected bottle) and immediate refrigeration. These are analyzed in government-approved laboratory with different types of equipment.* ***Findings:*** *The water chemical analyses in Boji - Boji present various substances within, above and below WHO acceptable limits: is summarized as follows: a Above WHO acceptable WHO acceptable Turbidity (34.10mg L^{-1}), DO (38. 0Ca (200) 1500 mg L^{-1}), 12007 mg L^{-1}) and Zn (15.0 mg L^{-1}), Carbonate (0.01 mg L^{-1}) and Nitrate (5.55 mg L^{-1}). b. Within WHO acceptable: Temperature (28.20^{o}C), Hardness (4.00),Total Coliform (Nil) c. Below WHO acceptable standard limits:TSS (3.00 mL), Salinity (38.50 mg L^{-1}), pH (4.65 mg L^{-1}), Copper (1.50 mg L^{-1}), Bicarbonate (6.30 mg L^{-1}) and sulphate (10.15 mg L^{-1}) are obtained.* ***Conclusion:*** *Based on Health data from the General Hospital. Oral interviews conducted, the health problems associated with polluted water in the area are heart and kidney, poor blood circulation, gastroenteritis, respiratory illnesses, complications in childbirth, damage to the nervous system, skin lesions, vomiting, cholera, and damage to the nervous system amongst others.*

Keywords: *1.Water 2. Refuse/Sewage 3. Chemical Analyses 4. Substances 5. Health 6. Problems*

1. Introduction

Mund (2014) and Grafton and Hussey (2011) stated that rivers are fed by the rain water falling down on the earth's surface and the rain water on passing over the surface towards rivers get a number of soluble and insoluble impurities or pollutants embedded in it. Water percolates downward and fills the spaces between the soil particles faults, crevices and cracks of bedrock far below as it sinks into the earth's crust. The zone in which such spaces and cracks are filled is called the zone of saturation and its top level is the water table, Grafton and Hussey (2011) explained that there is a section of the upper part of the earth's crust illustrating the zone of saturation, the water table, the relationship of the water table to the land – surface and some possible developments of lakes, swamps, springs and wells..

There are many ways in which water intended for human consumption get polluted that include: location of wells and boreholes close to sewage tank and indiscriminate dumping of refuse/sewage in water and on land to affects man and his environment naturally, deliberately or accidentally in the contamination of drinking water attributed to water-borne diseases that kill millions of people yearly.. Furthermore, Moss (2008) stated that it impacts the environmental system as a whole as it has physical impacts such as drainage modification of the river channels, catchment area and soil nutrient as it percolates. 0ver 70% of the planet is covered by ocean, sea, river and stream and people act as if the bodies of water serve as a limitless dumpsite for wastes, raw sewage, garbage and spills. This will no doubt overwhelm the diluting capacity of the oceans on which coastal water is eventually polluted

Boji - Boji Agbor, is the major urban center in Ika Soth Local Government Area (LGA) of Delta State. Boji - Boji Agbor with a twin sister Boji - Boji Owa with the ancient local name “Orogodo”. It is located between latitude 6^0N and longitude 6^0E and 6^0,17^1 E of Greenwich Meridian. The LGA is bounded on the North and West by Edo State, on the South by Ndokwa west local government area and on the East by Aniocha North and Aniocha South LGA The size of Ika LGA land area is about 436 km^2 with population density of 527.80/Km^2. According to the National Population Commission, Asaba, Delta State, IKA South has Population of 167,060 people in 2006 with a projection of 230,100 in 2016. Boji – Boji Agbor has 45,820 people in 1991, 52,231 in 2006 with a projection of 58,642 in 2016 (NPC, 2016).

Water pollution in Boji - Boji town resulted from wrong siting of wells and boreholes close to sewage tank, dumping of refuse and sewage in surface water that result in seepages to pollutes underground and surface water.

This study is concerned with the causes and effects of water pollution in Boji - Boji Agbor and oral interview revealed that the major causes of water pollution in the area are factors of wrong locating of boreholes close to sewage tanks, pit toilets, dump sites and dumping of refuse and sewage into water bodies. Also, the effects of water pollution in the area are identified with inherent water scarcity problems as truck-loads of sachet water are supplied from neighboring Edo and Anambra States on daily basis due to shortage of water supply within Boji - Boji Agbor.

This is manifested in price hikes as a sachet of water (50 Cl) costs ₦40 in the study area and ₦20 in the neighboring state as the cost implication is a 100% increase of what is obtainable in other parts of the neighbouring States. The other major problem associated with water pollution are health related reported in the General Hospital. These include the heart and kidneys of patients adversely promoted by polluted water consumed regularly. Other ailment reported water are poor blood circulation, skin lesions, vomiting, cholera, malaria, fever, typhoid fever chronic headache, gastroenteritis and damage to the nervous system hence the need for this research.

Objectives of the Study

The aim of this research work is to analyze water supply from various sources in Boji-Boji Agbor, Delta State. Based on this, The objective of this research is to identify the sources of water of pollution in Boji - Boji Agbor, evaluate their Physical, chemical and biological composition/characteristics, determine causes and of water pollution and ascertaining compliance with WHO standards and determining the various sources effects of water pollution in the area to proffer solution and make recommendations on the problems emanating from pollution in the area.

Empirical Literature

This will be presented under the following sub-headings to provide insight into existing literature for knowledge on the subject matter.

Sources and Concentrations of Heavy Metals and Trace Elements

Abraham and Susan (2017) researched on the industrial mining and processing area of Kilembe, Western Uganda whose activities from 1956 to 1982 left over 15 Mt of cupriferous and cobaltiferous pyrite dumped within a mountain river valley in addition to mine water that is pumped to the land surface. This study assessed the sources and concentrations of heavy metals and trace elements in Kilembe mine catchment water. Multi-element analyses of trace elements from point sources and sinks was conducted to included mine tailings, mine water, mine leachate, Nyamwamba River water, public water sources and domestic water samples using ICP-MS. The study observed mean concentrations (mg kg^{-1}) of Co (112), Cu (3320), Ni (131), As (8.6) in mine tailings which are significantly higher than world average crust and are eroded and discharged into water bodies within the catchment. The underground mine water and leachate contained higher mean concentrations (μg L^{-1}) of Cu (9470), Co (3430) and Ni (590) compared with background concentrations (μg L^{-1}) in un contaminated water of 1.9, 0.21 and 0.67 for Cu, Co and Ni respectively. Over 25% of household water samples exceeded UK drinking water thresholds for Al of 200 μg L^{-1}, Co exceeded Winsconsin (USA drinking) water thresholds of 40 μg L^{-1} in 40% of samples while Fe in 42% of samples exceeded UK thresholds of 200 μg L^{-1}. The study revealed natural processes of weathering to have contributed to Al, Fe, and Mn water contamination in a number of the public water sources.

Sewage and Refuse Dumps

The polluted water in Boi Boji Agbor due to refuse dumps are likened to those in New Delhi, India water bodies as stated by Ahmed and Ismail, (2018) and Malaysia by Ab Razak *et al*. (2015) . They specified pollution to include those wastes from industries (like mining and construction), food processing, radioactive wastes from power generating industries, domestic/agricultural wastes and various microbiological agents for the decay of substances. Ab Razak *et al*. (2015)also worked on drinking water, reviewed heavy metal, application of biomarker and health risk assessment focus in Malaysia and concluded that health policymakers should provide mechanisms for encouraging researchers, especially environmental health professionals, by prioritizing national research into water quality and pollution to encourage them to conduct studies on the wellbeing of the people. Also, Remandeep et al. (2017)observed that humans recognize this fact by polluting the rivers, lakes and seas. Subsequently, the population is infested slowly but surely harming the planet where organisms are dying off. Domestic water supply is greatly affected so is our ability to use water for recreational and other purposes. The rationale of the study is to identify several challenges confronting different water supply sources, sanitation and safe drinking water in project area for the water to be purified to remove physical, chemical and biological pollutants as identified by analyses. The research study is conducted to look for more reliable and cheaper way to purify water at affordable cost.(Remandeep *et* al., 2017). In the same vain, Topos, Ram, and Mohammad (2017) carried out a research on the analysis of water quality in urban water supply system of Bangladesh. Some concern chemical, biological and physical parameters were tested for an initial assessment of the water quality of the source water samples collected from nine production well of the area (Pourashava) water supply system indicated a high concentration of the arsenic , iron and in the production of well water. In the whole, urban water supply system in Bangladesh is not satisfactory because it possess human risk. It was therefore suggested as management tool that, government should take necessary steps to reduce the risk of supply of contaminated water (Topos et al (2017). Adesiyan *et al, (2018)* examined the concentrations and human health risk of five heavy metals (manganese (Mn), arsenic (As), chromium (Cr), cadmium (Cd), and lead (Pb)) in selected rivers in Southwest Nigeria. Heavy metals determination was carried out by atomic absorption spectro photometry, after digestion with a di-acid mixture 9:4 (v/v) (nitric acid: perchloric acid). All rivers had higher concentrations of the five heavy metals in the dry season except for As in Dandaru (0.012 mg/L) and Asejire (0.016 mg/L). Manganese was observed to have the highest mean concentration in all the five metals collected in the rainy and dry seasons across the sampled rivers. Observed generally is the annual mean concentration of metals that followed the order: Mn>Cr>Cd>Pb>As in the selected rivers. The human health risk assessment showed that the hazard index and hazard quotient for ingestion of water for Cd and As in the sampled rivers were higher than the acceptable limit of 1.0, indicating carcinogenic risk (CR) via direct ingestion of water. The CR via ingestion for all of the sampled rivers were found to be above the remedial goal target of 1×10^{-6}. The recorded values for chronic daily intake (CDI) were higher for Cr and Mn in all four sampled rivers**.** Thus, the present study showed that it is a driver for carcinogenic risk through ingestion in all of the sampled rivers compared to other metals.

A research on human faecal pollution was demonstrated as the primary pollution in multiparametric monitoring of microbial faecal pollution to reveal dominance of human contamination along the Danube River. Animal faecal pollution was of minor importance or consideration. This study demonstrated the application of host-associated genetic microbial source tracking markers together with the traditional concept of microbial faecal pollution monitoring, based on SFIB which significantly enhances the knowledge of the extent and origin of microbial faecal pollution patterns in large rivers. It therefore constitutes a powerful tool to guide target-oriented water quality management in large river basins. Water pollution was negatively associated with health outcomes, and the common pollutants in industrial wastewater had differential impacts on health outcomes for which small the effects were stronger for low-income respondents according to Igwe *et al. (2017)*.

Theoretical/Conceptual Framework

The work is based on the concept of soil profiling and hydrological cycle (Water Cycle). Water cycle defined as the ceaseless movement of water by evaporation into the atmosphere: by mass transportation as a vapor component of the atmosphere, by precipitation on land and sea, by movement into the grand to become soil moisture and grand water; by runoff in river from land and sea; by discharge of ground water to rivers and lakes and directly to the seas from glaciers and ice caps (Oyebande, 1998). Water constantly flow between hydrosphere, lithosphere and this is known as hydrological cycle or water cycle. In their contributions, Raul, Roshan, George and Amando (1990) explained the hydrological cycle as water in nature is constantly on the move. The principle of hydrological cycle include the processes of precipitation, evaporation, sublimation, transportation and groundwater flow. The processes therefore carry and transport soluble and dissolved substances in water as pollutants and Raul *et.al.*,(1990)stated that it is necessary to plan and construct suitable water supply schemes in order to ensure the availability of sufficient quality and quantity to the various supply section of the community in accordance with their demand requirements

Soil Profiling Concept

Soil is the end product of weathering influenced by climatic variables of temperature, precipitation, relief (slope), organisms (flora and fauna), parent materials (original minerals), also referred to as any kind of loose unconsolidated earth material but, geologists commonly use the term soil for a layer of weathered, unconsolidated material on top of the bed rock. Soil formation takes a lot of time and the rate is controlled by distinctive factors such as rainfall, temperature and to a large extent the type of weathered bedrock to form soil. High temperature and abundant rainfall speed up the rate of soil formation and a fully developed soil that supports plant growth takes hundreds and thousands of years to form. As soils mature, distinct soil horizons appear in them and can be distinguished from one another by colour, appearance, layers and chemical composition.

This horizon contains decomposed plants materials, or humus and contributes to the formation of organic acids that accelerates leaching in the underlying A horizon. Boundaries between soil horizons are usually transitional rather than abrupt and range from the 0 horizon (dark colored soil layer that is rich in organic materials) that forms just below surface vegetation. The A horizon or zone of leaching characterized by downward movement of water is part of rain fall on the ground percolates and infiltrates downward through the soil to leach, or carry dissolved chemicals downwards to lower levels in the soil profile. In a humid tropical climate, iron oxides and dissolved calcite are typicallymost leached down, clays are also transported downwards. Leaching may make the A horizon pale and sandy but the upper part is often darkened by humus presence,

Methodology

Water samples for this study are collected from the following sample points: 1) Adugbe (2) Baleke (3) Charles, (4) Imudia (5) Odozi and (6) Edike. There is temporal consideration as the water samples were collected. This is when the water is not highly concentrated due to extreme evaporation in the dry season or highly neutralized from much rainwater during the wet season respectively. To this end, 4 samples Are collected bi-weekly for three months for each of the two seasonal periods, on which, the average sampled values at a particular point source are derived for representative samples taken from the entire chemical analyses.

The parameters tested for include: PH, Temperature, Total Dissolved Solid, total use, total hardness, Bicarbonate, Nitrate, Sulphate, Calcium, Iron, Lead, Cadmium, Copper, Zinc, magnesium and total coliform count.

Sample Collection:
The water sample containers (white rubber kegs) were cleaned with $2HN0_3$, (Trioxonitrate v acid), acetone and distilled or deionized water, thereafter the containers were air-dried. The procedure was followed to remove traces of adhering elements or contaminants in samples. On arrival from collection sites, the samples were at once refrigerated between 0-4°C.

Results
The Methods of physical, chemical and biological analyses of the water sample follow the UN analytical methods in a government-approved laboratory (Timiebi Technical company, Ughelli). The chemical characteristics of water are numerous. Most substances dissolve in and react with water are used as chemical water quality characteristics test. Hundreds of other chemicals might be tested for or monitored but only the most relevant few are routinely carried out for time and cost-effectiveness and also, because of exorbitant cost in such analysis in Nigeria. But, the availability of abundant supply of water from surface or underground sources is one of the major factors influencing the pattern of portability and industrial location in the country. The data in Table 1 shows the result of laboratory water samples analyses of data collated for the various samples. The analyzed water data specified the various substances found and their implications are further presented side by side with WHO reference standards for easy reference and comparison are presented in order of sample points listed as follows: (1) Adugbe (2) Baleke (3) Charles, (4) Imudia (5) Odozi and (6) Edike ts summarised as follows: a. Above WHO acceptable Turbidity (34.10mg L^{-1}), DO (38. 0Ca (200) 1500 mg L^{-1}), 12007 mg L^{-1}) and Zn (15.0 mg L^{-1}), Carbonate (0.01 mg L^{-1}) and Nitrate (5.55 mg L^{-1}). B. Within WHO acceptable Within WHO acceptable Within WHO acceptable: Temperature (28.20^{o}C), Hardness (4.00), Total Coliform (Nil) , c. Below WHO acceptable Standard limits:TSS (3.00 mL), Salinity (38.50 mg L^{-1}), pH (4.65 mg L^{-1}), Copper (1.50 mg L^{-1}), Bicarbonate (6.30 mg L^{-1}) and sulphate (10.15 mg L^{-1}).

Table 1: Results of Laboratory Analysis of Water Samples

Tested Parameters	**WHO's Max Acceptable Limit**	**Adugbe**	**Baleke**	**Charles**	**Imudia**	**Odozi**	**Edike**
Total Hardness (Mg. e.g. $Caco_{3/1}$	500.0	2.11	4.95	2.54	6.33	3.45	4.00
Turbidity (NTU)	5.00	.53	.37	.09	.13	2.16	1.17
Salinity	200.00	17.75	28.40	17.40	17.45	22.40	25.45
DO (Mg/1)	5.00	5.20	5.26	5.31	5.35	22.40	25.45
TSS (Mg/1)	.00	1.50	1.35	1.20	2.00	1.00	1.00
TDS (Mg/1)	500.00	9.35	10.05	10.05	9.65	9.25	11.65
Temp.	.00	28.30	20.10	20.10	28.18	20.15	20.10
Ph	7.50	3.54	3.60	3.60	3.68	3.61	3.60
Microbiology							
Total Coliform CFU/100ml	.00	.00	.00	.00	.00	.00	.00
Metal							
Magnesium (Mg/1)	50.00	.17	.40	.21	1.75	0.10	.18

Zinc (Mg/1)	5.00	.03	.07	.03	.01	.03	.02
Cadmium (Mg/1)	.05	.01	.01	.01	.01	.02	.02
Lead (Mg/1)	.00	.01	.01	.08	.01	.07	.01
Iron (Mg/1)	.05	.01	.06	.01	.01	.01	.01
Calcium (Mg/1)	.03	.01	.12	.01	.03	.26	.90
(Mg/1)	75.00	.56	1.33	.067	.48	.97	.62
Anions							
Bicarbonate (Mg/1)	500.00	6.00	6.00	6.00	6.00	4.00	4.00
Nitrate (Mg/1)	.00	.39	2.55	1.80	.11	1.56	2.55
Sulphate (Mg/1)	200.00	1.20	1.00	.50	.60	1.00	1.80
Carbonate (Mg/1)	500.00	.01	.01	.01	.01	.01	.01

Source: Fieldwork, 2020

The result of the laboratory water test analysis as shown in Table 1 is discussed in the sub-headings below:

Total Hardness

The value of WHO standard is 500mg/1. The value for the points are less than WHO standard, this indicates that the value hardness is mild.

Turbidity

The standard for WHO is 5ntu. All the values for the different points are lower than the WHO standard.

Salinity

The WHO maximum acceptable limit is 200mg/1. From the result of the analysis, the value from all the points are less than the WHO standard. This indicates that the water from the different points are of average (mild) salinity.

Dissolved Oxygen

The WHO maximum acceptable limit is 5.00mg/1. From the result of the analysis, it shows that the value for dissolved oxygen at the different points are higher than WHO standard. The implication of this is that it will prevent light from deeper waters and it will also course the death of fishes and other aquatic lines.

Total Suspended Solid (TSS)

The value for WHO standard for total suspended solid is 0.00, from the result of the analysis it shows that there are some suspended solid in different point recorded in the range of <1.50 and 2.00mg/1.

Total Dissolved Solid (TDS)

The maximum allowance and acceptance from WHO standard is 500mg/1 indicating that there are not much dissolved solids at the different points.

Temperature

The standard from temperature from WHO is not available. However, the temperature recorded ranges between 20.10^{0C} to 28.30^{0C}.

pH

The maximum acceptable limit from WHO is 7.50. The result of water analysis from borehole 1 to borehole 6 falls between the range of 3.54 to 3.68. This indicates that the water is acidic. This also shows that all the boreholes are very acidic and are not good for consumption.

Total Coliform

The value for the coliform count from WHO is nil. From the result gotten from the analysis, it is also nil. This shows that there are no microbiological lives in the water.

Magnesium

The maximum acceptable limit for magnesium is 50mg/1. The value from the different points in less than that of WHO standard. This shows there is little concentration of zinc in the water.

Copper (cu)

The maximum acceptable value for copper is 0.05mg/1. From the result, the value of copper in all the different points are less than the WHO standard. This shows that there is a little concentration of copper in water.

Cadmium (cd)

The maximum acceptable limit for cadmium is 0.01, the result of the analysis has value for cadmium from the different points to be less than WHO standard. This shows that, there is very little concentration of cadmium in the water, which is of insignificant value.

Lead (pb)

The maximum acceptable limit for lead is 0.05mg/1. The result of the analysis showed that there is the presence of lead in Baleke and Imudia.

Iron (fe)

The maximum acceptable limit for iron is 0.03mg/1. The result from the analysis shows that there is low/little concentration of iron in the water except for Baleke, Odozi and Edike with a maximum concentration of 0.12, 0.26 and 0.90 respectively.

Bicarbonate ($C0_2$)

The value for WHO standard is 500mg/1, the value for all the points are less than that of WHO. This indicates that there is little bicarbonate in the water.

Carbonate ($C0_3$)

The value of WHO standard for carbonate is 500mg/1. The result of the analysis shows that the value of carbonate present in tMhe water from the different points are lower than the WHO standard.

Sulphate

The maximum acceptable limit is 200mg/1. The result of the analysis shows that there are little quantity of sulphate in the water because the value from the different points are low compare to that of WHO standard.

Discussion of Findings

The water chemical analyses in Boji - Boji present various substances within, above and below WHO acceptable limits. The findings indicate major problems associated with harmful substances found if polluted water is consumed regularly. Based on Health data from the General Hospital and Oral interview conducted, the health problems associated with contaminated water in the area resulted in the heart and kidney adversely affected, poor blood circulation, gastroenteritis, complications in childbirth, damage to the nervous system, skin lesions, vomiting, cholera, and damage to the nervous system. Others reported include: Diarrhoea, Dysentery, Anaemia, Malaria fever, Yellow fever, Typhoid fever, Cholera, Dengue, chronic Headache, and Odour. Moreover, Igwe *et. al., (*2017) further stated the various ways in which water is put to use that include industrial, farming, domestic and human consumption. They include free from organisms and chemical substances, not in large concentrations enough to adversely affect health positively. Adejumoke *et al,.(*2017) studied pollution effects, prevention and climate impact indicated that water environment treatment led to improved health outcomes and water is a very important resource both to man, plants and animals in water-deficient areas. This research method involves physical, chemical and biological water analyses in line with the study conducted by Joshua and Nazru.*(*2015) on the pollution situation of Turag River in Dhaka, Bangladesh and the health problem of the surrounding residents. Owa, *(*2012) presented in this paper details on water pollution various sources, effects, control and management Rene *et al.* (2010) also stated the major challenge that humanity is facing in the twenty-first century on water pollution are mainly groups of aquatic contaminants, their effects on human health, and various approaches to mitigate pollution of the freshwater resource have been carried out. The results of the research reflect the work to ascertain the pollution situation of the Turag River in Dhaka, Bangladesh together with the health problem of the surrounding residents. Like Bomadi Rivers, the results clearly stated that the water quality of the Turag River may not be in a position to sustain aquatic life as they are also not suitable for domestic purposes. The maximum recorded values of pH, colour, turbidity, Biochemical Oxygen Demand (BOD5), Hardness, Total Dissolved Solids (TDS),Chloride (Cl^-), Carbon-Dioxide (CO_2) and Chemical Oxygen Demand (COD) are 7.1 mg L^{-1}, 625 ptcu, 97.2, 4.65, 1816, 676, 5, 15.5, and 78 mg L^{-1}, respectively. The maximum concentration of turbidity, BOD, hardness, TDS, and COD found in the Turag River is much higher than the permissible limit. The study also provides medical evidence that local communities are suffering from a variety of health problems including skin, diarrhoea, dysentery, respiratory illnesses, anaemia and complications in childbirth. Yellow fever, cholera, dengue, malaria and other epidemic diseases are also found in this area. Furthermore, people are suffering from odour pollution and respiratory problems too[10].

There is no viable policy implementation on water pollution in Nigeria, hence the need for articulation of presentation by Andreea-Mihaela,*(*2018) aon water pollution challenges and policies future direction in Malaysia. The reiterated the necessity of the implementation of the WHO policies to improve water quantity and quality despite the progress made in improving stream qualities *(*2015).

The recommendations emanating from this work are as follows: that the government should set up a body to monitor the environment and penalized those who pollute the environment. Individuals should be educated on the possible implications of polluted water sources available to them and the dangers posed by using polluted water. There should be periodic education on the need to purify the water available to them before usage especially for potable means.

Conclusion

Based on the above findings of this study, the following conclusions are drawn. Water pollution in Boji – Boji Agbor results from human activities ranging from bad social/domestic habits to wrong siting of borehole and wells close to sewage tank. The activities of man in the environment result in pollution of the water resources, health problems and shortage of potable water supply. In line with Environmental Protection Agency, water pollution in the area degrades surface waters making them unsafe for drinking, fishing, swimming, and domestic and industrial uses. However, pollution is a cankerworm that has continued to pose a serious threat to human developmental activities, in a process of not making life more meaningful. If this situation is left unchecked, it will cause more harm to the people in the area.

References

1. *Ab Razak NH, Praveena SM, Aris AZ, Hashim Z (2015) Drinking water studies: a review on heavy metal, application of biomarker and health risk assessment (a special focus in Malaysia) J. Epidemiol Glob Health 5:297–310.*
2. *Abraham .M.R. and Susan. T.B. (2017). Water contamination with heavy metals and trace elements from Kilembe copper mine and tailing sites in Western Uganda; implications for domestic water quality. Chemosphere. 169:281–287.*

3. *Adejumoke. A. Adebesin. B. O. Oluyori. A. P. Adelani-Akande. T. A. Dada. A. O. Oreofe. T. A. Babatunde I. (2017). Water Pollution: Effects, Prevention, Climatic Impact. DOI: 105772/intechopen.72018.*
4. *Adesiyan. I.M. Bisi-Johnson. M, Aladesanmi. O.T, Okoh. A.I. Ogunfowokan. A.O. (2018). Concentrations and human health risk of heavy metals in Rivers in Southwest Nigeria. J Health Pollut. 8(19):180-907.*
5. *Ahmed. S. and Ismail. S. (2018). Water Pollution and its Sources, Effects & Management: A Case Study of Delhi. 7:25-42.*
6. *Andreea-Mihael. A. (2018). Water Pollution and Water Quality Assessment of Major Transboundary Rivers from B,nat (Romania)*
7. *Igwe. P.U. Chukwudi. C.C. Ifenatuora. F. C.Fagbeja. I.F. and Okeke. C.A. (2017). A Review of Environmental Effects of Surface Water Pollution. Int. J. Adv. Eng. R. Scs.*
8. *Joshua. N. H, M. Nazrul. I. M. (2015). Water Pollution and its Impact on the Human Health, Dhaka, Bangladesh. J. Env.Hum. 2: 80–99.*
9. *Moss. B. (2008). Water Pollution in Agriculture: Philosophical Transactions of the Royal Society of London. Series B, Biological: Pages 128.*
10. *Mund, J.P. (2014). Capacities for megacities coping with water scarcity.(PDF) UN-water decade program on capacity development.*
11. *Oyebande, L. (1998). The Water Cycle; Carrier of Health and Wealth. How sustainable is it? An Inaugural Lecture Delivered at the University of Lagos on Wednesday, 20th May, 1998.*
12. *Rafia. A. Muhammad. M. Rulia. M. (2014). Water Pollution: Challenges and Future source Direction for Water Resource Management Policies in Malaysia.*
13. *Ramandeep. S. G. (2017). Water Pollution: Impact of Pollutants and New Promising Techniques in Purification Process 5:103-109.*
14. *Raul, A. Roshan, B., George, C. & Armando P. (1990). The Environmental and its Resources. Gordon and Beach, Science Publishers (New York, London and Paris).*
15. *René. P. Schwarzenbach. 1. Thomas E. Thomas. B. Hofstetter. U. Gunten. V. and Bernhard. W. G. (2010). Water Pollution and Human Health. Annual Review of Environment and Resources. 35:109-136.*
16. *Topos, K. Ram P. & Mohammad M.K, (2017). Analysis of water quality in urban water supply system of Bangladesh. Journal of environmental and analytical toxicology Vol. 7 No4.*