

Effects of Solid Waste Disposal on the Physicochemical Properties of Borehole Water along FUTO Road, Eziobodo, Owerri-west, Nigeria.

Abstract

Borehole water samples were obtained from two boreholes along FUTO road, Eziobodo, and analyzed for the following physico-chemical parameters: pH, electrical conductivity, Turbidity, Nitrate (NO_3^-), Nitrate-Nitrogen (NO_3^- -N), Phosphate (PO_4^{3-}), Phosphorus (P), Total Hardness and Total Chloride using standard methods and compared with the World Health Organization Standards for drinking water. The pH values obtained from analysis of both samples were 5.7 and 6.8 indicating that groundwater in the study area were acidic. The Electrical Conductivity value for both samples was $30\mu\text{S}/\text{cm}$. The samples showed 0.00 for Turbidity. Nitrate values were 38.50mg/l and 36.00mg/l. Nitrate-nitrogen values for both samples were 8.70mg/l and 8.10mg/l. Phosphate values for both samples were 46.80mg/l and 0.60mg/l. Phosphorus values were 15.20mg/l and 0.20mg/l. The Phosphate and Phosphorus values for Borehole Water Sample1 (BHWS1) were above the WHO permissible limits. Total Hardness values for both samples were 0.30mg/l and 0.28mg/l. Total chloride values for both samples were 186.00mg/l and 208.50 mg/l. Generally, the concentrations of the analyzed parameters were within the WHO Standards except for pH, Phosphate and Phosphorus. These results indicated that the water sources were contaminated and unfit for human consumption except when treated. This, therefore, calls for appropriate treatment measures before the consumption of these waters by the populace in order to avoid long term accumulative health problems of these pollutants. Proper waste management strategies such as incineration, composting, should be adopted to avoid indiscriminate waste disposal and unnecessary seepage into the underlying groundwater.

Keywords: borehole water, physicochemical properties, solid waste

Introduction

Solid waste is a part of our everyday lives. This is because we generate wastes from all our day to day activities, such as; cooking, disposal of unwanted items like beverage cans, old furniture, mulch from gardening, etc. These are items that stare us in the face everyday, either in the form of dumpsites, landfills, truck pushers, and even in front of our houses as old and/or forgotten furniture or appliances.

Open dumps have been identified as one of the major threats to groundwater source. Open dumping system of waste disposal is the most common method of waste disposal in Nigeria (Eletta *et al.*, 2005). It is a kind of system where waste is disposed of by infilling depression on land which may include valleys and excavations, without the consideration of the composition of the waste (Chopra *et al.*, 2009). Waste disposed in an open dumpsite can be subjected to infiltration from precipitation. As water percolates through the waste, it picks up a variety of organic and inorganic compounds flowing out of the waste and accumulates at the bottom of the dumpsite. The resulting contaminated water termed leachate can

41 migrate through the soil and eventually contaminate the groundwater if not adequately
 42 managed (Ikem *et al.*, 2002). When a dump is situated close to a water source, it deters
 43 people from going to fetch from it. It also contaminates the water through the infiltration of
 44 leachate from the waste into the soil. The soil possesses filtering properties which help to
 45 lessen the amount of contaminants which descends towards the water table. But, even
 46 though the soil carries out this filtering function, man has got a role to play in lessening the
 47 generation and presence of this leachate.

48 Contamination of water bodies has increasingly become an issue of serious environmental
 49 concern. Availability of clean drinking water is a basic right for all people. Unfortunately,
 50 many of the boreholes offer water which is either unsafe for human consumption or rather
 51 has such unaesthetic quality that no one will want to use. Groundwater is particularly
 52 important as it accounts for about 88% safe drinking water, both in the rural and urban
 53 areas, where population is widely dispersed; and infrastructure needed for treatment and
 54 transportation of surface water does not exist. It has become an important water resource
 55 due to increasing trend of pollution on surface water and this problem is more acute in an
 56 area or areas which are densely populated and inadequately supplied with potable drinking
 57 water.

58 The availability of groundwater is neither unlimited nor is it protected from deterioration.
 59 Man, through a variety of activities like indiscriminate dumping of refuse, and modern
 60 technologies, is dramatically changing the characteristics of groundwater system (Musa,
 61 2014). Ground water pollution could be avoided when borehole wells are located far from
 62 any source of potential pollution. Good well design is also important in the prevention of
 63 underground water pollution. During the construction process of a borehole, drilling fluids,
 64 chemical casings and other materials may find their way into the well thereby polluting the
 65 water. An open hole during the construction stage can also be a direct route for
 66 contaminants from the surface to the aquifer thereby providing an ideal opportunity for
 67 chemical and bacteriological pollution to occur. Lasting damage can be avoided if the well is
 68 completed, disinfected and piped within a short space of time. The possibility of
 69 contamination increases if there is a lengthy delay in completing the well. Even if no sources
 70 of anthropogenic contamination exist, there is potential for natural levels of metals and
 71 other chemicals to be harmful to human health. This was highlighted in Bangladesh where
 72 natural levels of arsenic in groundwater were found to be causing harmful effects on the
 73 population (Anawara *et al.*, 2014). Unfortunately, this problem arose because groundwater
 74 was extracted for drinking without a detailed chemical investigation.

75 Water quality refers to the chemical and physical characteristics of water. It is the measure
 76 of the condition of water relative to the requirements of one or more biotic species and/or
 77 to any human need or purpose (Diersing, 2013). The quality of groundwater is influenced by
 78 various factors. These factors are both natural and human. The parameters affecting
 79 groundwater quality are the geologic nature of the aquifer, the socio-economic activities
 80 around groundwater source; physical, chemical and biological properties of various waste
 81 waters.

82 As rain drops and infiltrates into the soil, harmful substances from dumpsites, landfills finds
 83 their way into boreholes, hence polluting the water body and making it unfit for domestic
 84 and other purposes. A plume of contamination occurs whenever a reasonable permeable

material exist below the soil strata. Organic contaminants called leachate drains into groundwater where there is no base lining and carries along with it anions and cations of iron and manganese which contaminates borehole water easily (Eni *et al*, 2014). A release of leachate to groundwater presents several risks to human health and damages to the environment. The amount of leachate produced from a dumpsite depends on the amount and distribution of rainfall, evaporation from soil cover and thawing. This process of infiltration aids the movement and transport of contaminants that have accumulated from the dumpsite. The dumpsite through the process of percolation and infiltration contaminates the groundwater in an area. This agrees with Cunningham & Cunningham (2005), who opined that water dissolves biodegradable materials in solid wastes and even some industrial wastes; it mixes with these wastes and contaminates the groundwater through infiltration and recharge process. They also affirmed that dumping of wastes close to recharge zones or on recharge zones leaks through and contaminates the aquifer.

Most Nigerian cities are epitome of urban decay and characterized by poor housing, sanitation and public health infrastructure (Akinbiyi, 2014). The erratic growth of housing units coupled with rapid population explosion has resulted in environmental health hazards (Adefemi & Awokunmi, 2015). In rural Nigeria today, the volume of waste generated is much lesser than what is obtainable in the urban areas. This is because of the population explosion of people in the urban areas. But Eziobodo, the study area, has experienced a steady growth in population over the years due to the presence of the university community. This population growth comes with increased construction of hostels which leads to loss of arable land, more drilling of boreholes which could lead to the lowering of the water table, and the problem of waste disposal.

The major means of waste disposal in FUTO road, Eziobodo, is by dumping and periodic burning of the refuse. Every form of waste is dumped at a particular point. Be it paper, food wastes, clothes, broken furniture, plastics, aerosol cans. This shows that no sorting of waste is carried out, no composting of biodegradable waste is carried and evacuation of waste by authorities for proper disposal is not carried out.

The problem of groundwater pollution in several parts of the country has become so acute that, unless urgent steps for detailed identification and abatement are taken, extensive groundwater may be damaged (Uduji, 2014). The availability of groundwater is neither unlimited nor is it protected from deterioration. Man, through a variety of activities like indiscriminate dumping of refuse, and modern technologies, is dramatically changing the characteristics of groundwater system (Madu, 1999).

Contaminated water prevents drinking and cooking with it. It becomes a means of infections transport and can greatly contribute to cases of cholera and tuberculosis. It causes dependence on treated water from water treatment outfits, on bottled water, sachet water even though some of these outfits do not treat their water. Boreholes are very important to students and indigenes alike, hence their existence. This study was carried out to critically assess the effects of solid waste from dumpsites, which abound in FUTO road, Eziobodo, on borehole water quality.

Materials and Method

Study area

The study was carried out in Eziobodo which lies on Latitudes $5^{\circ}27'N$ and $5^{\circ}31'N$ and between Longitudes $7^{\circ}0'30''E$ and $7^{\circ}4'E$ of Greenwich meridian. The study area is characterized by two seasons; rainy season and dry season. The rainy season begins in April and lasts till October, with annual rainfall varying from 1500mm to 2251mm. An average annual temperature above $20^{\circ}C$ creates an annual relative humidity of 75% with humidity reaching 90% in the rainy season. The dry season experiences two months of harmattan from late December to late February.

The Eziobodo autonomous community is a university town in the Owerri-west local government area, Imo state. About 70% of the present permanent site of the Federal University of Technology, Owerri (FUTO) catchment area is in the land of Eziobodo. The presence of the university community has greatly affected the land use in the study area in various ways. One of such ways is in the construction of hostels. Due to the inability of the university to provide adequate accommodation for all of its students, an upsurge in the construction of off-campus hostels has been recorded.

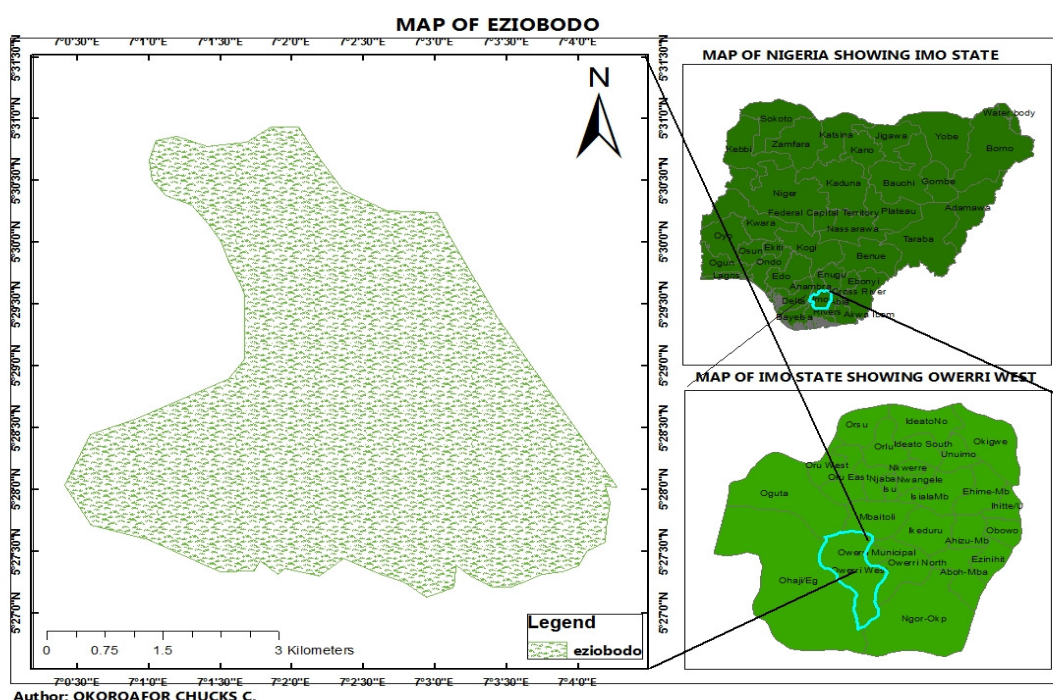


Fig. 1: Map of Study Area.

SAMPLE COLLECTION

Two sample points were located in the study area; Mothers lodge (BHW1) and Okochi lodge (BHW2). Borehole water samples for the study were collected from these points during the

rainy season when there was a rise in water table. This was to enable the researcher determine if increased infiltration due to increase in rainfall would have any impact on the results. Two samples were collected from each borehole i.e. a sample was collected from the boreholes in the morning and another in the evening.

Water samples were collected directly from the taps at the boreholes into clean polyethylene bottles which were rinsed with the borehole water to be collected. The water samples were labeled with masking tapes showing time and location of sampling, and promptly sent to the laboratory for preservation and subsequent analysis.

Water quality parameters analyzed using standard methods include turbidity (NTU), electrical conductivity ($\mu\text{S}/\text{cm}$), pH, total chloride (mg/L), nitrate as nitrogen (mg/L), nitrate (mg/L), total hardness (mg/L), phosphate (mg/L) and phosphorus (mg/L).

Results and Discussion

The mean values of the physicochemical analysis are presented below in Table 1. The pH values for BHW1 was slightly acidic but fell within the WHO limits for drinking water, making it acceptable. But, BHW2, with its value of 5.7, fell out of the WHO permissible limits due to its acidic value. These results showed that the groundwater in the study area was acidic. Turbidity values for both water samples recorded 0.00, indicating that the water samples were clear and free from suspended particulate matter. Electrical conductivity values for both samples were 30.00 $\mu\text{S}/\text{cm}$. This value fell below the WHO standards making it unobjectionable.

Table 1: The physicochemical parameters, Mean values of samples and WHO standards

S/N	PARAMETER	BHW 1	BHW 2	WHO STANDARDS
1	pH	6.80	5.70	6.5-8.5
2	Conductivity, $\mu\text{S}/\text{cm}$	30.00	30.00	100
3	Turbidity, NTU	0.00	0.00	5
4	Nitrate (NO_3^-), mg/L	38.50	36.00	50
5	Nitrate-Nitrogen (NO_3^--N), mg/L	8.70	8.10	10
6	Phosphate(PO_4^{3-}), mg/L	46.80	0.60	5
7	Phosphorus(P), mg/L	15.20	0.20	0.3
8	Total Hardness, mg/L	0.30	0.28	100
9	Total Chloride, mg/L Cl^-	186.00	208.50	250

Nitrate values for both water samples fell below the WHO permissible limit, as BHW1 and BHW2 recorded 38.50 mg/L and 36.00 mg/L respectively, making them unobjectionable. Nitrate-nitrogen values for BHW1 and BHW2 were 8.70mg/L and 8.10mg/L, which fell below WHO limit. Phosphate value for BHW1 was 46.80 mg/L which was extremely high. This value is higher than the WHO limit of 5mg/L. BHW2 recorded a value of 0.60mg/L.

Phosphorus values were 15.20mg/L and 0.20mg/L for BHW1 and BHW2 against the WHO limits of 0.3mg/L. BHW1 recorded a value higher than the limit. Total hardness values fell below the WHO limit. BHW1 and BHW2 recorded values of 0.30mg/L and 0.28mg/L respectively. Total chloride values for BHW1 was 186.00mg/L and 208.50mg/L for BHW2. These values fell below WHO limits making them unobjectionable.

Conclusion

Water is very essential for man and, it is being increasingly stressed through the action or inaction of man leading to either a temporary or permanent impairment of water quality. Impairment resulting from the presence of foreign substances (organic, inorganic, bacteriological or radiological) tends to degrade the quality of water. The cause of pollution typically lies with man while the spread is generally driven by natural means hence the study looking into the effects of dumpsites on borehole water quality. The study showed that there is need for better waste disposal means in Eziobodo. Since earth surface is acting as an effective filtrate to filter out particulate matters like leaves, soils, bugs, dissolved chemicals, there is need to have a programme of effective monitoring of ground water quality and employ better waste management practices in the area. Use of incinerators, composting should be considered by the local authorities.

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