International Journal of Geology, Earth & Environmental Sciences ISSN: 2277-2081
An Open Access, Online International Journal Available at http://www.cibtech.org/jgee.htm
2021 Vol. 11, pp. 84-96/Adejumo et al.
Research Article

PHYSICOCHEMICAL AND MICROBIAL GROUNDWATER QUALITY ASSESSMENT IN THE VICINITY OF AWOTAN DUMPSITE, IBADAN, SOUTHWESTERN NIGERIA

***S. A. Adejumo, A. O. Oyerinde, and G. K. Adewuyi**
[1,2]*Department of Geology, Faculty of Science, The Polytechnic, Ibadan, Nigeria*
[3]*Department of Surveying and Geoinformatics, Faculty of Environmental Studies, The Polytechnic, Ibadan, Nigeria*
**Author for Correspondence: tundejumo782@gmail.com*

ABSTRACT

Physicochemical and Microbial analyses of groundwater source in the vicinity of Awotan dumpsite in Akowo Asunle area of Apete, Ibadan, Nigeria were conducted to access the quality status of groundwater within the dumpsite environment for its drinking suitability and other domestic purposes. A total of eleven (11) hand dug wells water were sampled; Ten (10) at an average distance of 15m to the refuse dump and one (1) about 700m away serving as control. The water samples were analysed for pH, Temperature, Turbidity, Hardness, Chloride, Total Suspended Solid (TSS), Total Dissolve Solid (TDS), Total Solid (TS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Feacal Coliform Count (FCC) and Total Coliform Count (TCC) in accordance with standard procedure described by American Public Health Association (APHA). The obtained values for each parameter were compared with recommended limits set by World Health Organisation (WHO) and Nigeria Standard for Drinking Water Quality (NSDWQ). The result of this study revealed that the levels of nearly all tested parameters in about 80% of water sampled were far above the respective Maximum Permissible Limit specified by WHO and NSDWQ as standard, except for pH values (6.6-8.4) that fall within the standard limit of 6.5-8.5. In this regard, the recorded high values has clearly indicated unacceptable and alarming physicochemical characteristics and microbial inputs from the dumpsite into the groundwater resource of the area thereby rendering it unfit in its present form for drinking and other domestic usages.

Keywords: *Physicochemical*, Microbial*, Groundwater, Dumpsite*, WHO*, NSDWQ*, APHA**

INTRODUCTION

Nearly all human activities generate waste, and the way in which this is handled, stored, collected and disposed of, can pose risks to the environment and to public health (Zhu *et al.*, 2008). Management of solid wastes in many developing countries is a major challenge because most often, large wastes generated are poorly maintained as surface dumps rather than landfills with resultant impacts on the environment (Ogunseiju *et al.*, 2015).

In most urban cities in Nigeria and other developing nations allocation of land for proper disposal of waste continues to be a major issue due to high population density and intense competition for land for various human usages. Attempts by the various levels of Government's in solving this problem have not yielded any positive results since over 80 % of the budget allocated for waste management is being spent on waste collection alone, leaving only 20 % for actual disposal, which is most often grossly inadequate (Hughes, London, & Farvolden, 1971). The available existing dumpsites usually get filled up rapidly, resulting to the overflow of disposal sites, which eventually are being flushed by run-off water into the surrounding overflow sources (Akoho *et al.*, 2012). In these refuse dumpsites, solid wastes gradually release its initial interstitial water and some of its decomposition by-products into aquifer, through the waste deposit (Abdulrafiu *et al.*, 2011). The leachates generated from the dump site infiltrate the soil and pollute the aquifer in the surrounding areas. Contamination of groundwater often occur in places where the groundwater table is shallow and activities ongoing at that particular area contributes to leaching of contamination to groundwater (Hossein *et al.*, 2011). However, water is not only an essential element for survival of life but also it is an important vehicle for economic development of the nation (Varsha *et al.*, 2013). So it is essential to maintain the sustainability of water by adopting proper management technique in its utilization (Panjiar, 2010). This is particularly important since degraded water quality can contribute to water scarcity as it limits its availability for both human use and for the ecosystem (Murty and Kumar, 2011). However, access to potable water supplies by Government sources in both cities and rural area across the country has ever- increasingly being difficult. Hence, populace only rely on shallow hand dug wells and few available bore hole within the residential and commercial areas in the premises of waste dump site which are highly prone to pollution for domestic uses. Pollution of groundwater sources by leachate from Landfills and/or dumpsites have been recognized years back (Hem, 1989; Butow *et al.*, 1989; Alloway and Ayres, 1997). Landfills have been identified as one of the major threats to groundwater resources (Fatta *et al.*, 1999) Similarly a number of dumpsites have been implicated for bacterial contamination of drinking water (Torres et al, 1991) in some cases, causing poisoning, cancer, heart diseases and teratogenic abnormalities (Sia Su, 2008) while acidification and nitrification of groundwater have been linked to dumpsite around their outlets (Bacud *et al.*, 1994). The introduction of these wastes contaminates the water sources making them unfit for intending purposes (Aboho *et al.*, 2012). It is therefore necessary that the quality of drinking water sourced from aquifer around dumpsite be checked at regular time interval due to various water borne diseases human population suffers upon consumption of contaminated drinking water. Of great health concern is the continuous trend of construction of hand dug wells by the residents of Awotan dumpsite environs in the city of Ibadan being the relatively cheaper groundwater facility alternative for the majority, considering the aforementioned adverse effect upon consumption.

Hence, this study was designed to assess the quality of groundwater around the said dumpsite by physicochemical and microbial water analyses in order to ascertain the contamination levels of hand dug well water sources in the vicinity of the dumpsite.

Site Description and Geological setting

The Awotan Dumpsite is situated at Akowo Asunle area of Apete along Apete-Akufo Road in the city of Ibadan, Southwestern Nigeria. It lies between Latitudes 7° 27′ 30″N and 7°27′ 57″N and Longitudes 3° 50′ 40″ E and 3°51′ 17″E (Figure 1) and easily accessible by good network of roads and foot paths. The dumpsite is surrounded by both residential and commercial settlements. It occupies an area of 20 hectares receiving around 9,000 tonnes of waste yearly. It has been in existence since 1998 and house almost 137,000 tonnes of waste. The nearest settlement to the dumpsite is about 200 meters away at early stage but presently they are 10meter closer to the dump site due to increase in population. The study area fall within the tropical climatic zone characterized by two distinct seasons; wet which usually begin in April and end in October with an average temperature of 27oC and dry seasons (November to March) with an average temperature of 32 ^{o}C. Topographically the site is gently undulating with isolated iserbergs in few areas. The terrain is generally dominated by Migmatite gneiss and Quartz schist. The vegetation is of tropical rain forest with thick undergrowth while the drainage pattern characteristic of the area is dendritic with unmodified stream channels flowing in the eastward and southward directions. The dumpsite area is drained by Alapata River and its tributaries

Geologically, the study area fall within the basement complex of southwestern Nigeria and characterized by crystalline rocks of pre-Cambian age (Rahaman, 1976). Local geological mapping show that the major crystalline rocks in the study area consist of Migmatised undifferentiated biotite and biotite hornblende gneiss, and Quartzite and Quartz schist belonging to Migmatite - gneiss- quartzite complex (Rahaman, 1976, 1988) (Figure 2) while Quartz and pegmatite occur as vein. The main rock that underlies the dumpsite is the undifferentiated gneiss complex covering about 75% of the total area which is easily recognized by their characteristics alternating parallel light and dark colour bands.It is believed to have resulted from complex association of deformation, shearing and folding, granitization and migmatization processes (Rahaman, 1976). The remaining 25% is covered by Quarzite and quartz schist and form ridges while the undifferentiated gneiss complex occurs mainly as low- lying out crops.

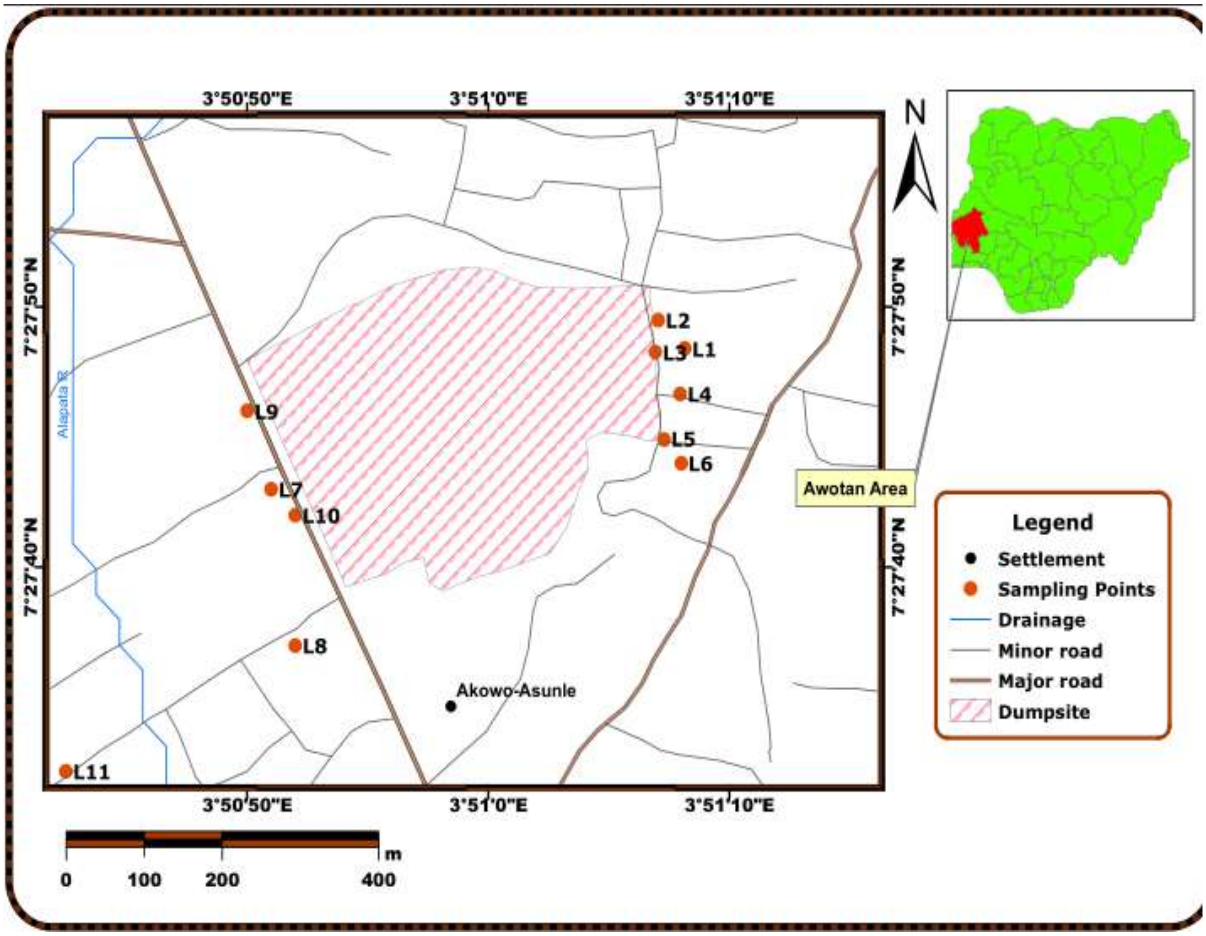

Figure 1: Location map of the study area

MATERIALS AND METHODS

Sample collection

A total of eleven (11) groundwater samples were collected from Ten (10) hand dug wells located at an average distance of 15m to the dumpsite while at about 700m away from the dump one other well was sampled serving as control. The hand dug wells were located at the western and Eastern margin of the dumpsite being at relatively lower elevation and most developed area as at the time of study. Water were fetched directly from the wells into three separate polyethylene sampling bottles labeled A,B,C at each location: 1.5 L for physicochemical parameters as A, 0.75 L for microbial analysis as B, while C is a special BOD bottle for Dissolve Oxygen (DO) and Biochemical Oxygen Demand(BOD) analysis. The BOD bottle sealed the inside environment from atmospheric oxygen. The polythene sample bottles were previously soaked overnight in 15% nitric acid, washed with deionized water (Protanon *et al.*, 2000) and dried at room temperature.

Prior sampling at each location the sampling bottles were also rinsed 3–4 times with the water to be sampled to ensure sufficient flushing. The samples were transported to the laboratory in an ice packed coolers in order to prevent it from to unusual change in water quality that might occur and stored in a refrigerator (4°C) till the time of analysis.

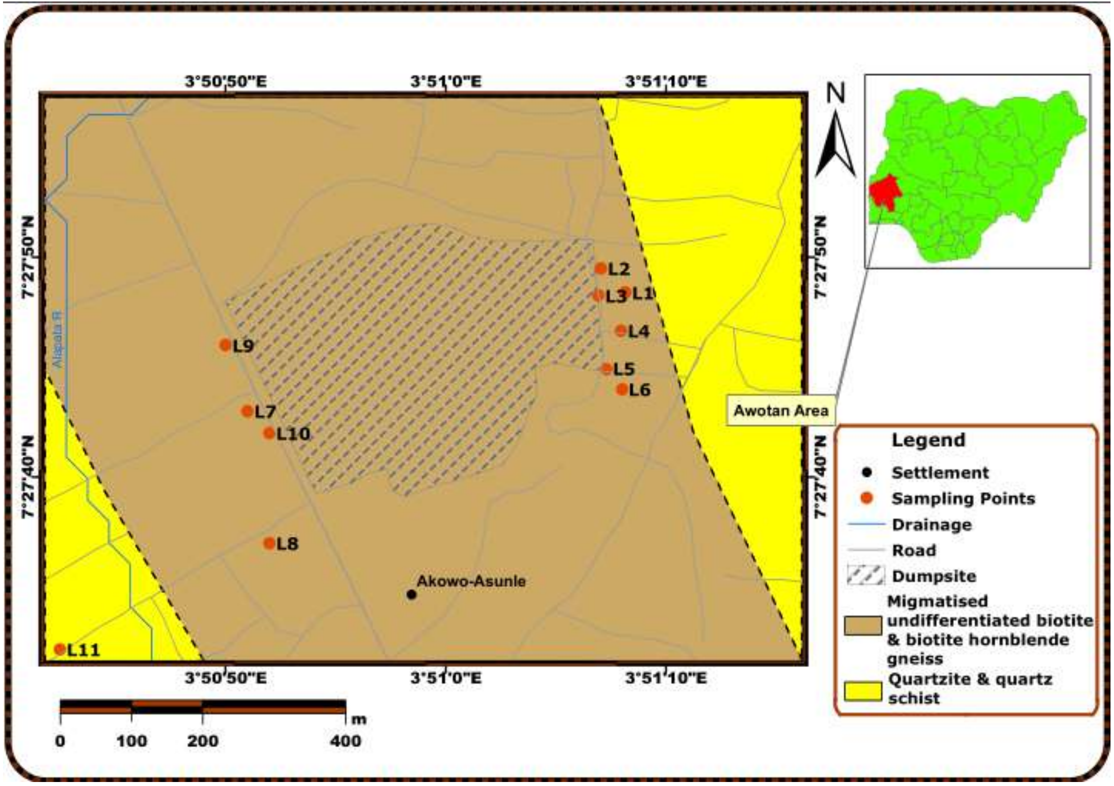

Figure 2: Geological map of the study area

Physicochemical Analysis: The water samples was analyzed for various physicochemical parameters in accordance with standard procedures describe by American Public Health Association (APHA) (APHA, 1992; APHA, 2005; APHA, 2012) and expressed in mg/l. Two physical parameters namely, pH and Temperature were determined and recorded immediately on the field using pHep pocket size pH meter Hanna instrument and mercury- in- glass thermometer respectively. The analysis of other parameters including Turbidity, Hardness, Chloride, Total Suspended Solid (TSS), Total Dissolve Solid (TDS), Total Solid (TS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD) were carried out at The Polytechnic, Ibadan Central Research Laboratory.

Microbial analysis: The microbial analysis of water samples were performed as described for feacal and total coliform counts by APHA 98 at ACE Microlab services limited, Oke Ado, Ibadan. Feacal and total coliform counts were determined using the standard membrane filtration technique. The 100ml water sample was filtered using 0.45mm pore size, 47mm diameter filter membrane as described by APHA 98. The enumeration of Most Probable Number of coliform bacteria was carried out by multiple tube technique.

RESULTS AND DISCUSSION

The results of physicochemical and microbial analyses carried out on water samples collected from hand dug wells within the vicinity of the dump site in the study area are presented in Table 1and 2 as well as in figure 3-12. All the results are compared with World health organization WHO, (2011) Maximum permissible limit and Nigeria standard for drinking water quality NSDWQ, (2015). Table 1 present the physicochemical and microbial parameters values as determined in the laboratory as well as WHO, (2011) Maximum permissible limit and NSDWQ, (2015) while Table 2 shows the range and mean values of all parameters analysed as compared with WHO (2011) standard permissible limit and NSDWQ (2015).

Table 1: Laboratory result of the Physicochemical and Microbial Parameters

Sample location Number	**Distance to dumpsite boundary (m)**	**Physicochemical and Microbial Parameters Analysed**												
		pH	Temp (°C)	Turbidity NTU	Hardness (Mg/l)	TSS (Mg/l)	TDS (Mg/l)	TS (Mg/l)	DO (Mg/l)	BOD (Mg/l)	COD (Mg/l)	Chloride (Mg/l)	FCC MPN	TCC MPN
L1	25	7.4	27.75	10.04	220	298	178	520	2.00	20.75	168.08	255.24	14	175
L2	15	6.6	27.75	1.00	140	300	554	880	1.75	17.50	134.46	198.52	30	275
L3	12	8.3	28.00	2.91	180	144	778	940	3.25	30.25	235.31	283.60	25	175
L4	25	8.1	28.00	1.00	140	294	420	730	0.75	12.50	100.85	198.52	35	80
L5	10	8.2	28.00	3.86	800	120	1648	1790	1.00	42.75	369.78	425.00	7	58
L6	18	7.7	27.80	3.86	260	112	786	910	1.25	25.25	207.70	226.88	5	36
L7	30	8.0	27.75	4.81	320	208	864	1080	1.00	17.75	134.64	340.32	0	0
L8	20	8.4	27.75	12.91	200	300	180	500	1.50	37.05	302.54	311.96	8	28
L9	50	8.0	27.75	3.38	270	264	530	810	1.25	33.50	268.93	255.24	0	0
L10	15	7.8	28.00	4.81	410	122	2512	2620	1.00	29.75	235.31	340.32	12	75
L11 (Control sample)	700	8.7	27.80	1.00	90	104	146	260	7.75	17.25	54.46	170.16	0	0
WHO, 2011		6.5-8.5		1.0	-	30	500			6	10	250	0	10
NSDWQ 2015		6.5-8.5		5.0	150	30	500		14	4	10	250	0	10

Table 2: Range and mean values of analysed parameters compared with WHO, 2011 Maximum permissible limit and NSDWQ , 2015 standard.

Parameters	**Range**		**Average Value**	**WHO, 2011**	**NSDWQ, 2015**
	Minimum	Maximum			
pH	6.6	8.4	7.85	6.5-8.5	6.5-8.5
Temperature	27.75	28.0	27.85	-	-
Turbidity	1.0	12.91	4.86	1	5
Hardness	140	800	294	-	150
Total Suspended Solid	112	300	216.2	30	
Total Dissolved Solid	154	2512	845	500	500
Total Solid	520	2620	1078	-	-
Dissolved Oxygen	0.75	3.25	1.48	-	14
Biochemical Oxygen Demand	12.50	42.75	26.71	6	6
Chemical Oxygen Demand	100.85	369.78	215.6	10	10
Chloride	198.52	425	283.56	250	250
Feacal Coliform Count	0	35	13.6	0	0
Total Coliform Count	0	275	90.2	10	10

pH: pH is one of the most important parameters commonly determined to ascertain the quality status of both natural and waste water. Determination of PH is very important because it influences the other physicochemical parameters and the availability of metal ion in the water and waste water (Behailu *et al.*, 2018). It is most important in determining the corrosive nature of water; the lower the PH value the higher the corrosive nature of water (Patil *et al.,* 2012). In the present study, the PH value of samples analysed ranged from 6.6 to 8.4 with a mean value of 7.85 (Table 2). Although the values fall within the acceptable range of 6.5 -8.5 prescribed by WHO (2011) and NSDWQ (2015), the result indicate that the groundwater in the area is slightly acidic to slightly alkaline in nature. This is evident in the location with the least pH value (6.6) where the metal plate on which the storex plastic tank at the top of stanchion is placed had seriously corroded due to falling water when the tank is full as water is being pumped from the well. The slightly acidic nature of water at this location possibly reflect the presence of high levels of free CO_2 in water (Ugbaja and Ephraim, 2019)

Temperature: Temperature control the rate of all biochemical and biological reactions including growth, multiplication, decay, mineralization, production etc (Varsha *et al.*, 2013). The temperature of water samples in the area of study ranges between 27.75°C and 28.0°C with a mean value of 27.85 (Table 2). These measured temperature value is above the approved WHO standard. The water temperature is attributed to the prevailing weather condition during the period of study. The solubility of dissolved oxygen decreases with increases in water temperature and water temperature above 27°C is "unsuitable "for public use (Behailu *et al.*, 2017).

Turbidity: The presence of finely divided solids which are not filterable by routine methods brought about turbidity in water. Turbidity is considered as an important water quality parameter because of pathogenic properties it has on drinking water (Ugbaja and Ephraim, 2019). It has long been known to hinder disinfection by shielding microbes, some of them perharps pathogens (Kazaure *et al.,* 2015). This is the most important significant of turbidity monitoring and therefore it has been an indication of the effectiveness of filtration and coagulation of water supplies (WHO, 2011). The turbidity values obtained for the analysed water samples ranged from 1.0 to 12.91NTU with a mean value of 4.86NTU (Table 2). WHO established that the turbidity of drinking water should not be more than 5 NTU and should ideally be below 1NTU.Considering result of the present study, most water sampled are not suitable for drinking purpose being possessing turbidity value above the recommended limit by WHO and NSDWQ (Table 1 and figure 3). Although turbidity per se (e.g. from groundwater minerals or from post-precipitation of calcium carbonate from lime treatment) is not necessary a threat to health, it is an important indicator of the possible presence of contaminants that would be of health concern, especially from inadequately treated or unfiltered surface water (WHO) as well as those of present study. Therefore filtration (before disinfection) treatment of groundwater of raised turbidity in this area is strongly recommended to achieve low turbidity and ensure microbially safe water for populace consumption.

Hardness: Hardness of water is a result of the geology of the area with which the water is associated. It may affect the water taste as well as influencing its lathering ability when used (Gupta *et al.*, 2009). Hardness in groundwater is mainly contributed by bicarbonate, carbonates, sulphates and chlorides of calcium and magnesium (Varsha *et al.*, 2013). As such the principal hardness causing ions are calcium and Magnessium. The ranges of values of hardness obtained for this work as shown in (Table 2) is between 140 and 800mg/l with a mean value of 294mg/l. When compared with the maximum permissible limit of WHO, this mean value is above the standard limit. Using the water classification system on the basis of total hardness by Durfor and Becker, 1964, about 70% of sampled water are very hard, 20% hard and 10% moderately hard. This indicates that none of sampled water is soft. The geological formation of the study area could have greatly contributed to this high value of hardness recorded (Gupta *et al.*, 2009, WHO, 2011).

Total Dissolved Solid: TDS comprises inorganic salts (principally calcium, magnesium, potassium, sodium, bicarbonate, chlorides and sulphate) and small amount of organic matter that are dissolved in water (Akubuenyi *et al.*, 2013).TDS value depend on climate, the host rock and the resident time of the groundwater in the geological matrix (Behailu *et al.*, 2017). The concentration of TDS in the analysed water samples varied between a minimum of 154mg/l to a maximum of 2512mg/l with a mean value of 845mg/l (Table 2 and figure 5). The maximum permissible for TDS of drinking water as specified by WHO (2011) is 500mg/l. The mean TDS value obtained for this work is above the recommended standard. Close observation also show that most well that are much nearer to the dumpsite (< 20 m) (table1) displayed values far above the acceptable limit. This high value could be traceable to leaching substances from the dumpsite percolating the soil by rain water hence increasing the level of solution ion in the nearby groundwater system. Therefore it became necessary to subject well water from this area to required treatment before their consumption

Total Suspended Solids: TSS is solids that cannot pass through a sieve of 2micrometers and yet are indefinitely suspended in the solution (Shalom *et al.*, 2011). They are a significant factor in observing water clarity (WHO). The more solid present in water, the less clear the water will be. The TSS of groundwater sampled in the study area ranges between 112 to 300mg/l with a mean value of 216.2mg/l (Table 2). All analysed water samples possess TSS far above the permissible limit of 30mg/l recommended by WHO and NSDWQ as standard (Table 1 and figure 6). The higher the mineral content ,the more the suspended solid present in the water (Ugbaja and Ephraim,2018). This indicate the presence of variety of material such as silt and clay particles, plankton, algae fine organic debris, and other particulate matter in the water within the studied area.

Total Solid: Total solids are the combined content of all the organic and inorganic substances contained in a liquid which are present in ionized molecular or microgranular form (Beychok *et al.*, 1967). It is a measure of the suspended and dissolved solids in water. Total Solid (TS) in the analysed sampled water is of minimum of 480 mg/l and a maximum of 2620mg/l with a mean value is 967.3mg/l (Table 2) while the value recorded at the control location, about 700m away from the dumpsite is as low as 260mg/l. A high concentration of TS as recorded for almost all water samples in the present study will make drinking water unpalatable and might have an adverse effect on people who are not used to drinking such water (APHA, 1992).

Chloride: Chloride is important qualities that affect the aesthetic property of water including taste and if present in high concentration render it unsuitable for drinking purpose (Abdulrafiu *et al.*, 2011). Chloride may naturally present in groundwater and may also originate from diverse sources such as weathering, leaching of sedimentary rocks and infiltration of sea water etc.(Varsha et al.,2013). The chloride concentration of sampled water in the area under study ranged from 198.52 to 425mg/l with a mean of 283.56mg/l (Table 2). The majority (about 70%) of groundwater sampled with the exception of control and two other relatively far samples, in the area are characterized by chloride concentration much far above the 250mg/l recommended by WHO, 2011 and NSDWQ,2015 as maximum permissible limit for drinking water (Table 1and figure 7). This could possibly be due to acute chloride toxicity from the nearby dumpsite hence causing contamination of the groundwater system. (Kazaure *et al.*, 2015). Excess chloride concentration in water increases rate of corrosion of metal in the distribution system depending on alkalinity of the water

Chemical Oxygen Demand: Chemical oxygen demand is a measure of oxygen equivalent of the organic matter in a water sample that is susceptible to oxidation by a strong chemical oxidant such as dichromate. COD measurement are commonly made on samples of waste water treatment facility or of natural water contaminated by domestic or industrial waste (Tasnin, 2015). Their reliability is important to protect the environment and to guarantee the economical sustainability of treatment facility (Guoging *et al.*, 2011). The COD content of the water samples from the area investigated ranges between 100.85 to 369.78mg/l with a mean of 215.6mg/l (Table 2). These showed that all the analysed water samples were found to be characterized by COD value far higher than 10mg/l maximum permissible limit specified by WHO for drinking water (Table 1 and figure 8). The higher the COD, the higher the amount of pollution in the water sample (Trivedy and Goel., 1984). Therefore, the observed higher COD value in this present study is an indicative of severely polluted water which could be traceable to the migrating leachates from the dumpsite which infiltrate through the soil into the surrounding groundwater system in the area.

Biochemical Oxygen Demand: BOD is another important parameter in groundwater quality assessment. It is the amount of oxygen required for the biochemical decomposition of organic compound and oxidation of certain inorganic materials (Iron, sulfites).Increased oxygen consumption pose a potential to variety of aquatic organism, including fish (APHA, 1998). It is therefore important to monitor organic pollution in the area of study to identify area posing a threat to health, to identify sources of contamination, to ensure adequate treatment and provide for decision to enhance water sustainability. The BOD values of the groundwater investigated ranged from 12.5 to 42.75mg/l with 26.71mg/l mean value (Table 2). The maximum permissible limit recommended by WHO and NSDWQ is 6mg/l. The values obtained for all water samples exceed the limit set when compared.(Table1 and figure 9). The presence of high BOD in water may indicate feacal contamination or increase in particulate and dissolved organic carbon from non human and animal sources that can restrict water use and development, necessitate expensive treatment and impair ecosystem health (APHA 1998). Thus, the there is an indication of feacal contamination of groundwater in the area possibly from the nearby refuse dump site, hence adequate water treatment is greatly called for in the area.

Dissolved Oxygen: This is also one of the most important parameters in assessing water quality being a better general environmental monitoring indicator. Its correlation with water body gives direct and indirect information e.g. bacteria activity, photosynthesis, availability of nutrient, stratification etc (Patil *et al.*, 2012). The concentration of DO in the water sampled ranged from 0.75 to 3.25mg/l while the mean value is 1.48mg/l. These values when compared with 14mg/l NSDWQ threshold value are far below the recommended value. Higher concentration of DO provide better water quality (Varsha *et al.*, 2013). The observed low DO value in the present study possibly reflects early indication of undesirable condition in the physical, chemical and biochemical factors within the water bodies (Ugbaja and Ephraim, 2018).

Feacal Coliform Count: Prior to using any new drinking water sources it should be examined for the presence of fecal bacteria (WHO 1992, 1996,). As such subjecting water sources to microbial analysis is vey essential. Fecal coliform bacteria in water samples are regarded as an indicator of a potential contamination by human use (Janet, 1998). The result of the water analysis carried out in the present study showed that the feacal coliform count ranges between 0 and 35MPN with a mean value of 13.6MPN (Table 2). The maximum permissible limit of zero TCC per 100ml of water is recommended by WHO,2011.Most water samples (about 80%) analysed, showed higher value than the maximum contamination level (MCL) for coliform bacteria specified for drinking water (Table 1 and figure 10). Observation also showed that water from all locations nearest to the refuse dumpsite possesses higher value while the control location and two other relatively far locations meet the zero WHO standards.

Total Coliform Count: Monitoring for the presence of pathogenic bacteria is an essential component of any water quality assessment where water use directly or indirectly leads to human ingestion (WHO 1992, 1996). The total Coliform count for the analysed water in the present study ranged from 0 – 275 MPN with a mean of 90.2MPN (Table 2). This showed an exceedingly high value compared with the WHO, 2011 and NSDWQ, 2015 specified zero standard maximum contamination level. Going by this result, it doesn't only exceed the specified limit by regulatory body but shows an alarming high presence of pathogenic bacteria input into the groundwater system, which is a potential health threat to the populace relying on the hand dug well in the vicinity of the dumpsite for consumption. Since only 30% of the sampled water (control inclusive) complies with WHO and NSDWQ standard for drinking water (Table 1 and figure 11). This alarming value possibly arises due to proximty to dumpsite. Groundwater are found to be contaminated due to improper construction, shallowness around waste, proximity to toilet facilities, sewage, dumpsite and various human activities around the well (Bitton, 1994).

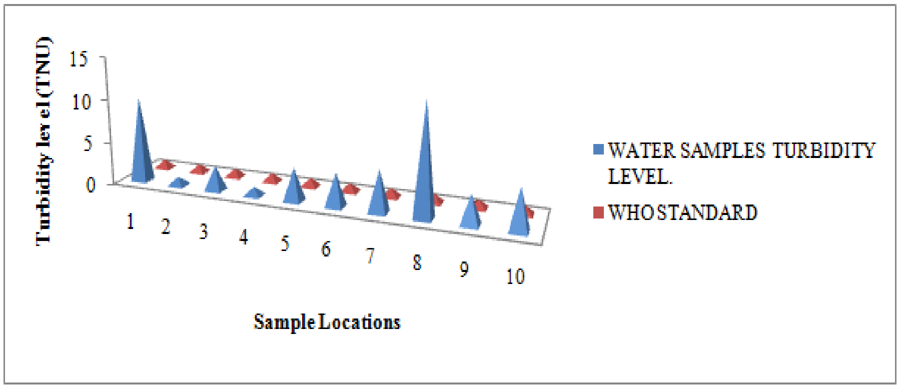

Figure 3: Water samples turbidity level compared with WHO standard

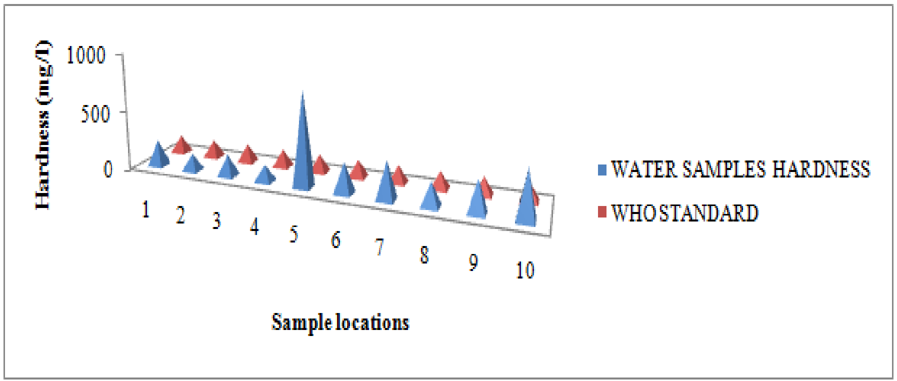

Figure 4: Water samples hardness compared with WHO standard

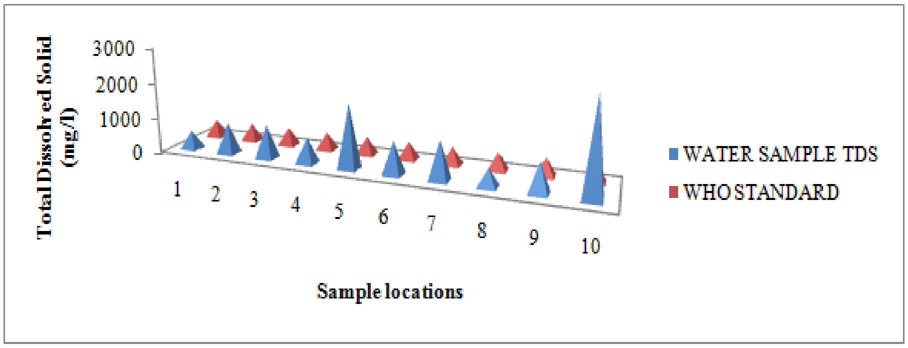

Figure 5: Water samples TDS compared with WHO standard

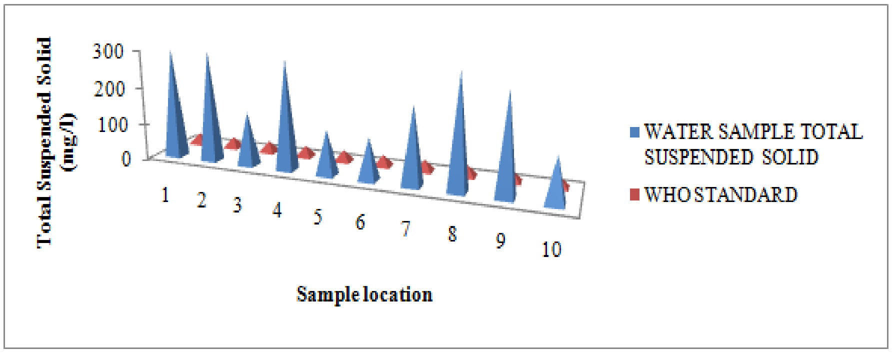

Figure 6: Water samples TSS compared with WHO standard

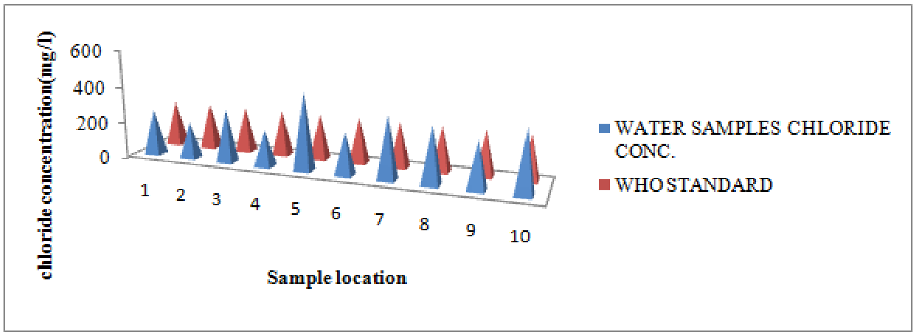

Figure 7: Water samples Chloride concentration compared with WHO standard

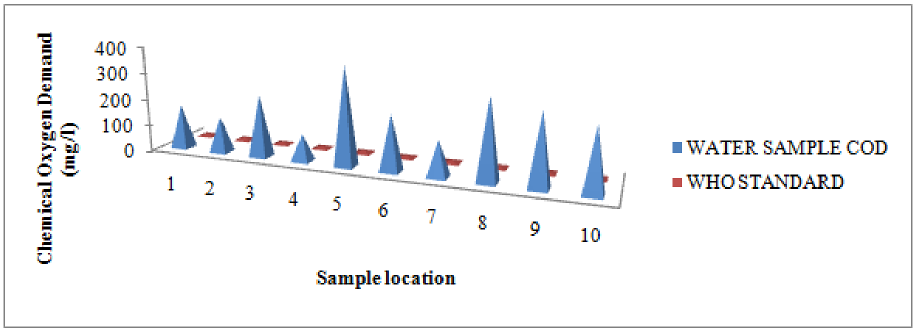

Figure 8: Water samples Chemical Oxygen Demand compared with WHO standard

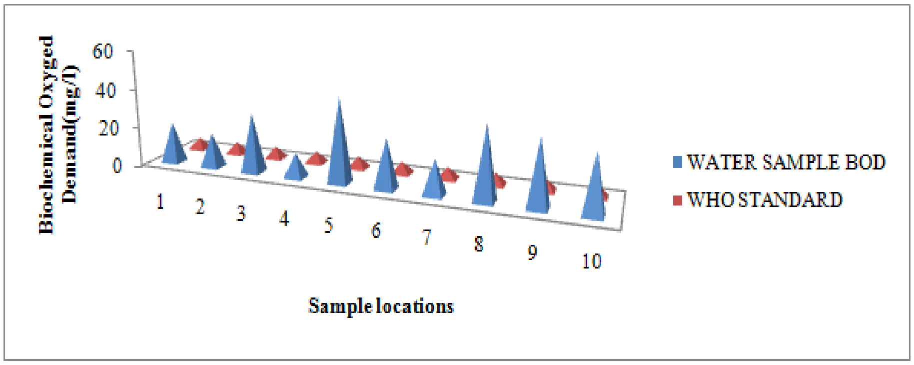

Figure 9: Water samples Biochemical Oxygen Demand compared with WHO standard

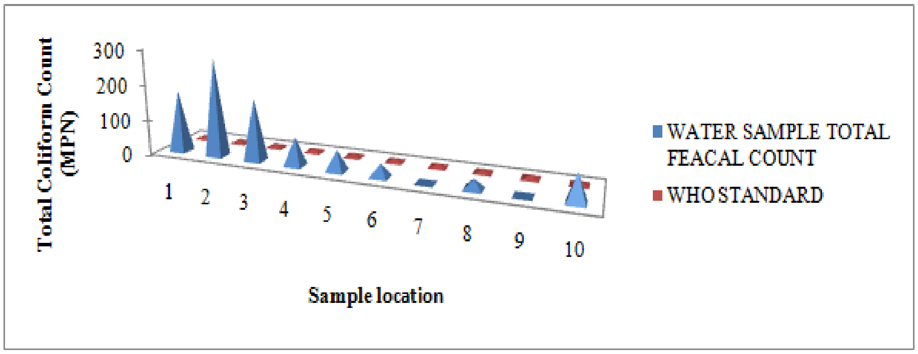

Figure 10: Water samples Total Coliform Count compared with WHO standard

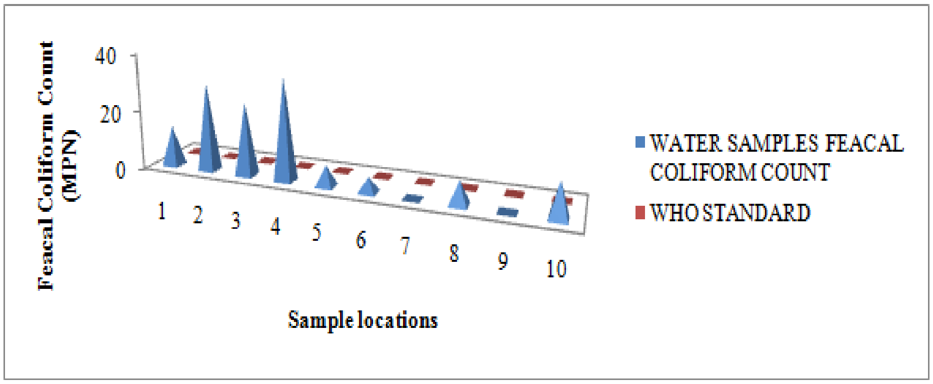

Figure 11: Water samples Feacal Coliform Count compared with WHO standard

CONCLUSION

The result of the study revealed that, the values of water quality parameters tested; Temperature, Turbidity, Hardness, Chloride, Total Suspended Solid (TSS), Total Dissolve Solid (TDS), Total Solid (TS), Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), Chemical Oxygen Demand (COD), Feacal Coliform Count (FCC) and Total Coliform Count (TCC) in majority (about 80%) of water samples were found to be above the Maximum Permissible limits recommended by both international and local water quality standard. The only exception is pH values which all fall within the acceptable range of 6.5-8.5 for drinking water. Since the physicochemical characteristics and microbial levels of the control sample fall within the limit regulated by WHO and NSDWQ, it is evident therefore that the refuse dumpsite situated in the area has negatively impacted on the groundwater source in the immediate environment causing serious pollution. The continuous pollution of the water source by the dumpsite is believed to result to some health threat to the populace relying on this water source being unfit and unsafe in its present form for drinking and other domestic purposes as revealed in the investigation results.

REFERENCES

Abdulrafiu OM. Adeleke AK. and Lateef OG (2011). Quality assessment of groundwater in the vicinity of dumpsites in Ifo and Lagos, Southwestern Nigeria. *Advances in Applied Science Research*, **2** (1) 289-298.

Akoho SY, Anhwange BA, Onianwa PC and Ekanem EO (2012). Assessment of Surface Water Quality around Dumpsites in the City of Ibadan Metropolis, Oyo State, Nigeria. *International Journal of Chemistry*. **4**(1).

Akubuenyi EO, Uttah EC, Enyi-Idoh KH (2013). Microbiological and Physicochemical assessment of major sources of water for domestic use in Calabar metropolis, Cross river state in Nigeria. *Transitional Journal of Science and Technology*.

Alloway BJ, Ayres DC (1997). Chemical principles of environmental pollution, In: Wastes and their disposal, 2nd ed., *Blackie Acad. Professional, London*, UK 353-357.

APHA, (1992). Standard methods for the examination of water and waste water. 18th ed., Greenberg, A. E.; Clesceri. Eaton, A.D.(editors). Washington, D C.

American Public Health Association (APHA) (1998). Standard Methods for Examination of Water and Waste Water, 20th Ed. Washington D C, *American Public Health Association*.

American Public Health Association (APHA) (2005). Standard methods for the examination of water and waste water, 21st Ed. Washington, D C, *American Public Health Association*.

American Public Health Association (APHA) (2012). Standard Methods for Examination of Water and Waste Water, 22nd Ed. Washington D C, American Public Health Association.

Bacud L, Sioco F, Majam J (1994). A descriptive study of the water quality of drinking wells around the Payatas dumpsite, *Unpublished BSc Thesis, University of the Philippines College of Public Health*.

Behailu TN, Badessa TS and Terrodros BA (2017). Analysis of physical and chemical parameters in groundwater consumed within Konso area, Southwestern Ethopia. *African Journal of Environmental Science and Technology*.

Beychok M (1967). Aqueous waste from petroleum and petrochemical plants (1st edition eds.) John Wiley & Sons.

Bitton, G (1994). Waste water Microbiology, Gainesville, New York Willey-Liss 118p.

Butow E, Holzbecher E, Kob E (1989). Approach to Model the Transport of Leachates from a Landfill Site including Geochemical Processes, Contaminant Transport in Groundwater. Kobus and Kinzelbach, Balkema, Rotterdam pp. 183-190.

Durfor CN and Becker E (1964). Public water supplies of the 100 largest cities in the United States. In Geological Survey Water Supply, U.S. Government Printing Office, Washington, Paper No. 1812, pp. 364.

Fatta D, Papadopoulos A, Loizidou R (1999). A study on the landfill leachate and its impact on the groundwater quality of the greater area. *Environmental Geochemistry and Health,* **21**(2), 175-190.

Guoqing WU, Weihong BI, Jiaming LV and Guangwei FU (2011). Determination of chemical oxygen Demand in water using infra red transmission and UV absorbance method. *Chinese Optics letters* 09 (si): 3010705.

Gupta DP, Sunita and Saharan, JP (2009). Physicochemical analysis of groundwater of selected area of Kaithal City (Haryana) India. *Researcher,* **1**(2) 1-5.

Hem, JD (1989). Study and interpretation of the chemical characteristics of natural water, US Geological Surveys, Water-Supply Paper, 2254.

Hossein M, Bujang B, Huat K, Afshin A, Sina K, Thamer A and Mohammad A (2011). Groundwater quality assessment of Labuan Island. *International Journal of the Physical Sciences* Vol. **6**(16), 3943-3951

Janet HV (1998). An analysis of Feacal coliform bacteria as a water quality indicator. PhD Dissertation, Department of Science studies, faculty of the graduate college, Western Michigan University, Kalamazoo, Michigan.

Kazaure SZ, Isa HA, Mohammed Y, Namadi MM (2015). Comparative analysis of physicochemical parameters and heavy metal of public water supply in Kaduna Metropolis. *Journal of Applied Chemistry*, **8**(11) 21-26.

Murty MN and Kumar, S (2011). Water Pollution in India-An Economic Appraisal, India Infrastructure Report.

Nigeria Standard for Drinking Water Quality (**NSDWQ) (2015).** Nigeria Standard for Drinking Water Quality, Nigeria Industrial Standard, Approved by standard Organization of Nigeria Governing Council. ICS 13.060.20

Odukoya O, Bamgbose O, Arowolo TA (2001). Heavy Metals in Top Soils of Abeokuta Dumpsites. *Global Journal of Pure and Applied Science*, **7** 467 – 472.

Ogunseiju P, Ajayi TR and Olarewaju VO (2015). Geochemical assessment of the impact of an active open dumpsite on soil in Ibadan, Southwestern Nigeria. *Ife Journal of Science*, **17**(3).

Panjiar, UN (2010). Efficient Water Management: Challenges and Initiatives. *Yojana*, 54, 5-8.

Patil PN, Sawant DV, Deshmukh RN (2012). Physico-chemical parameters for testing of water – A review, *International Journal of Environmental Sciences,* **3**(3).

Protano G, Riccobono F, Sabatini G (2000). Environmental Pollution, 110, 451.

Rahaman, MA (1976). Review of basement Geology of Southwestern Nigeria. In: Kogbe C A, editor. Geology of Nigeria, 2nd Ed. Lagos: Elizabethan Publishers.

Shalom NC, Obinna CN, Adetayo YO and Vivienne NE (2011). Assessment of water quality in canaan land, Ota, Southwestern Nigeria. Agriculture and Biology journal of North America pp577-583.

Sia Su GL (2008). Assessing the Effect of a Dumpsite to Groundwater Quality in Payatas, Philippines, *American Journal of Environmental Sciences* **4**(4) 276-280.

Tasnin (2015). Estimation of chemical Oxygen Demand in water using UV-VIS Spectroscopy. *M.Sc. Thesis, Faculty of Applied Sciences, Simon Fraser University*.

Torres E, Subida R, and Rabuco L (1991). Health Profile of Child Scavengers in Smokey Mountain, Balut, Tondo, Manila, German Agency for Technical Cooperation/International. Labor Organization/College of Public Health, University of the Philippines Manila.

Trivedy and Goel (1984). Chemical and biological method for water pollution studies. Environmental Publication.

Ugbaja AN, and Ephraim BE (2019). Physicochemical and Bacteriological parameters of surface water quality in part of oban Massif, Nigeria. *Global Journal of Geological Sciences* Vol. **17**, 13-24.

World Health Organisation (WHO), (2011). Guidelines for drinking water quality.4th Ed. *World Health Organisation, Geneva, Swizerland* 173, 14-22

World Health Organisation (WHO) (1996). Guidelines for drinking water quality: health criteria and other supporting information, **2**, World Health Organisation, Geneva, Switzerland.

WHO, (1992). Guidelines for drinking water quality: health criteria and other supporting information, **2**, *World Health Organisation, Geneva*.

Zhu D, Asnani PU, Zurbrugg C, Anapolsk S, and Mani S (2008). Improving Solid Waste Management in India: A Sourcebook for Policy Makers and Practitioners. *World Bank Publication, Washington*, DC., USA.