IMPACT OF MUNICIPAL SOLID WASTES ON UNDERGROUND WATER SOURCES IN NIGERIA

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Abstract:

In Nigeria, the reliance on sanitary landfills is a common phenomenon in the disposal of waste materials. Lack of capital and appropriate technology for environmentally friendly waste management practices has left most places like Lagos 'megapolitan' in Nigeria to rely of landfills for solid waste disposal. And in most cases the landfills are not properly engineered and operated to accepted world standards. The study presents the measurement and analysis of the water samples were collected from two major dumpsites in Lagos, the Olusosun and Solous dumpsites and adjoining areas. Findings revealed samples from Solous dumpsite did not confirm pollution from leachates thereby suggesting that the water from the nearby wells is portable and can be used consumed. On the other hand, analysis of water samples from Olusosun dumpsite and surrounding areas confirmed the presence of feacal coliforms during microbiological analyses, suggesting that the water sample collected from Olusosun is not suitable for consumption. Invariable samples collected from Olusosun dumpsite and adjoining areas should undergo further treatment before consumption due to the presence of other micro organisms.

Keywords: Leachates, groundwater, landfill, municipal solid waste, Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD)

Introduction:

The problems associated with solid waste and its management has been the focus of considerable environmental attention during the last quarter of the twentieth century as communities the world over have begun to recognize the hazards that its management entails. Over many decades, landfilling has been favoured as a method of waste disposal for a number of reasons, often because it is probably the cheapest available method and also as a result of the availability of holes in the ground. Landfiling with municipal solid waste (MSW) is a common practice in many countries of the world. It is used to reclaim 'void spaces' created as a result extractive operations, particularly the reclamation of quarry sites which generate more derelict land than any other form of industrial activity. Properly managed, derelict voids can be reclaimed by a process of sanitary, landfilling, ultimately bringing the land back into productive use and providing much of the needed waste disposal sites (Adesina, 2000). Sanitary landfilling as a technique has replaced the pen tipping which characterized landfill disposal before 1950s. Landfill sites are now commonly 'engineered' and operated so that wastes are placed in layers 1-2m deep and compacted by metal-wheeled vehicles. An uncontaminated cover material, usually soil, is spread over the wastes daily and blowing litter and pests control (Douglas, 1992).

Groundwater forms that part of the natural water cycle present within underground strata or aquifers. Unfortunately, groundwater is all too often considered out of sight and out of mind. Of the global quantity of available freshwater, more than 98% is groundwater stored in pores and fractures of rock strata. Groundwater is also an important source for industry and agriculture uses as well as sustaining rivers experiencing low flows. Groundwater is not only abstracted for supply or river regulated purposes, it also naturally feeds surface-waters through springs and passages into rivers and it is often important in supporting wetlands and their ecosystems. Removal or diversion of groundwater can affect total flow. A reduction in either quality of quantity of the discharging groundwater can significantly influence surface water quality and the attainment of water quality standards. Surface water and groundwater are therefore intimately linked in the water cycle, with many common issues. The protection of groundwater quality is of paramount importance. If groundwater becomes polluted, it is difficult, if not impossible, to rehabilitate. The slow rate of groundwater flow and low microbiological activity limit any self-purification.

The risk of groundwater pollution is increasing both from disposal of waste materials and from widespread use by industry and agriculture of potentially polluting chemicals in the environment. Pollution can occur whether discrete, point sources, such as from the landfilling of wastes. One of the dreaded consequences of rapid urbanization has been the problem of solid waste management, particularly in terms of environmental nuisance combined with the health hazard and its implications. Waste management has therefore become an endemic problem that characterizes Nigerian cities. Coupled with the lack of capital and appropriate technology for environmentally friendly waste management practices has left most state governments like Lagos relying on the use of landfills for solid waste disposal. And in most cases the landfills are not properly engineered and operated to accepted world standards.

Landfill practices because of its cost effectiveness have become the most favourable choice particularly in Lagos, after previous attempt at incineration failed. The untreated rubbish being placed in the landfill voids comprises biodegradable solids such as vegetable, paper and metal, inert solids such as glass and plastics and other unclassified materials constitute a great threat to underground water quality. Such contamination occur through leakage; which is formed when rain water infiltrates the landfill and dissolves the solute fraction of the waste and the soluble product formed as a result of the chemical and biochemical processes occurring within the decaying wastes. The resultant effluent will however impose their Chemical Oxygen Demand (COD) and Biochemical Oxygen Demand (BOD) on the ground water. Recent studies have shown that the COD and BOD of such wastes may be in the region at 12,000mg/L and 700mg/L respectively with the concentration of inorganic chemical substances like ammonia, iron and manganese varying according to the hydrology of the site and chemical and physical conditions within the site.

The concentration according to in recently emplaced wastes has been put as: Sulphate 460mg/L, Magnesium 390mg/L, Chloride 2100mg/L, Iron 160mg/L, Sodium 2500mg/L and Calcium 1150mg/L. Also a tip of 1000m^3 of rubbish has been calculated to yield 1.25 tonnes of potassium and sodium, 0.8 tonnes of calcium and magnesium, 0.7 tonnes of chloride, 0.19 tonnes of sulphate and 3.2 tonnes of bicarbonate (Brown et al, 1992). Thus, it can be appreciated that disposal of waste in landfill sites can produce large volumes of effluents with a high pollution potential. For this reason, the location and management of these sites must be carefully controlled. Such measure is becoming increasingly necessary in Lagos, where landfill method is widely used (*Groundwater Resource in Lagos State.*, undated), with living residences fast developing in the vicinity of the landfills and in some situation share fences with landfill sites and water supplied from shallow and deep wells/boreholes) to find immediate present and future solutions to the landfilling resultant problems. It is against the foregoing that study sought a review of groundwater pollution from waste disposal site in Lagos, with a particular focus on the two major landfill sites, which are Olusosun and Solous sites. The study therefore intends to measure and analyze the impact of landfilling leachates on underground water, with a view to ascertaining whether the leachates from the landfill site have polluted underground water or not and consequently proposed new provisions for future site selection.

Statement of the Problem

It has been postulated that the cause of the third world war could be water (Gore, 1992). Flowing from this postulation, it is argued that the inadequate amount of freshwater source and the lack of it will lead nations against each other. In Nigeria, the reliance on sanitary landfills is a common phenomenon in the disposal of waste materials. However, literature is sparse on the impact of these sanitary landfills on underground water. In view of this fact, this study therefore will focus on the impact of sanitary landfills on underground water in Lagos State of Nigeria.

Study Area

Lagos metropolis is situated on latitude 6.5^0N and longitude 3. 5^0N and spreads from Victoria Island in the South to Ketu and Agege Area in the North as well as from Ikoyi in the East to Ojo in the West, occupying an area of about 400 square kilometers. Average annual precipitation is above 1700mm and serves as major groundwater replenishment (Longe, Malomo, & Olorunmiwo, 1986) There are two principle climatic seasons: namely, dry season lasting from November through March and rainy season from April to October. Lagos has a population of about 16 million people. As a result of the huge population, the annual waste generated increase by 50%. This implies that the rate of waste generation far exceeds population growth. The average persons per square kilometer in Nigeria is about 85, but in Lagos State there are about 2,200 persons per square kilometer, where as the pressure exerted physically on the existing land grew in geometric progression available land itself was growing by arithmetic progression. This process is mainly due to the rapid rate of urbanization and lack of adherence to sound physical planning and development practices.

Research Questions

The reliance on the underground water reservoirs did not assume so much importance, until the introduction of Federal Government Borehole Water Programme with the result that there is a heavy dependence on ground water resources all over the country. Ironically little is known about the quality of groundwater nationwide. Also studies in sources of groundwater contamination and pollution are scanty. It is against this background that the present study is exploring:

(1) Traces of heavy metals e.g. lead, mercury, cadmium, etc. in ground water 500 meters square of Olusosun Landfills.

(2) To compare the quality of ground water 500 meters square of Olusosun landfills with that of Shagari Estate (A Zone) Ipaja Road.

(3) To ascertain if the quality of underground water of both areas is in consonance with WHO water quality standards.

(4) To determine the level of leachates contamination of ground water resources within the vicinity of Olusosun landfill

Delimitation of Study

This study was delimited to the settlements and areas around the Solous and Olusosun landfills areas of Lagos State. Water samples were randomly collected from underground water sources such as wells and boreholes. The water was collected from 199 sq. meters – 1000 square meters distance from the Solous and Olusosun landfill sites.

Significance of the Study

The quality of environment can be expressed in terms of the air we breathe, the food we eat, the water we drink, and the house we live as well as the non-contamination of our beautiful environment through sustainable living. No doubt, the antithesis of this is the unwholesome dumping of unsorted and untreated waste material into landfills and wide spaces in the ground. Landfills are supposed to be sited away from residence because of the inherent environmental nuisance and poor aesthetic value associated with its operation. But in Lagos, landfills are virtually sharing fences with residential houses. Because of many toxic materials or pollutants released by leachates into the groundwater which are not readily removable by the conventional water treatment process. It is essential to carry out an intensive study at monitory the nature and extent of such pollution on ground water quality. Such study will among other things, help to produce data that will be useful in the:

(a) Siting and construction of sanitary landfills. Particularly in rapidly growing Urban Areas. Such that the disposal of waste do not constitute health hazard.

(b) Monitoring the quality and nature of the groundwater reservoirs in the vicinity of the site.

(c) Determination of the ideal treatment that can be applied where ground water resources are contaminated.

(d) Legislation to control types of solid waste disposal and thus guarantee quality controls of groundwater reservoirs as well as surface water.

Materials and Methods

Samples: Leachates and groundwater samples were collected from Olusosun and Solous landfills and adjoining areas for laboratory analysis. The samples were collected before the beginning of the raining season to forestall possible dilution from per collating rainwater. Leachates samples were scooped from the Southern base (downstream) of the landfills from a narrow clay void. While three water samples distance were obtained randomly at intervals distance of 80 – 100 meters from the landfill down gradient. All the well depth shows water extraction from the first and second aquifer horizon. A comprehensive physico-chemical and biological test was conducted at the Lagos State Environmental Protection Agency (LASEPA) laboratories to determine the level of water pollution indicator parameters. The leachates sample was tested at the waste water laboratory. The groundwater samples were tested in the portable water laboratory to ascertain their portability, while the Feacal Coliform test was carried in the microbiology laboratory. In order to avoid staleness of samples, some of the pollution indicator parameters analyzed was conducted within five hours of its collection. The Statistical Package for Social Sciences (SPSS) was relied on for the statistical analysis for the hypothesis testing.

Results and Discussions

The results of this study presents the detailed assessment of groundwater quality of the wells from both areas that is, Oregun and Ojo. Taking into consideration the pollution indicator parameter in Table 4 of both areas revealed among others that the temperature for the groundwater of both areas shows an average of 30^0C, which is within the stipulated world health organization (WHO) standard. The groundwater P. H. for Oregun wells is in the average of 6, while that of Ipaja average about 5.8. The P. H. for both areas does not meet WHO standard. While, water for both areas is odourless and the turbidity is clear for Ipaja well water and cloudy for only well A of Oregun Wells. This can be adduced to the close proximity of the well (Well A) to the landfill site. The presence of total suspended solids (TSS) for both areas averaged about 34mg/l. The total acidity for Oregun wells, average about 26mg/l while Ipaja is about 35mg/l on the average. The total alkalinity for Oregun and Ipaja wells are 5mg/l and 15mg/l respectively.

Experiment 1Analysis of Sample Wells:

Table: 1. Physico-chemical parameter of well samples

PARAMETER	*SAMPLE WELL*				**CONTROL WELL**	**WHO STANDARD**
	A	B	C	D		
Appearance	Clear	Clear	Clear	Clear	Clear	Clear
Temperature (c)	28	30	25	29	30	35-40^{0}C
PH	6.5	6.5	5.0	5.5	7.0	7 – 8.5
Total Solids (mg/c)	2320	980	356	286	587	2030.00mg/l
Turbidity	1.08	1.07	1.03	1.01	Clear	N/S
Total Acidity	7	15	13	10	35	N/S
Total Alkalinity	40	50	45	38	5	N/S
Chloride mg/l	2	10	8	5	16	250.00mg/l
Nitrate mg/l	5.6	1.8	1.6	1.5		
Phosphate mg/l	0.06	2.09	0.8	0.7		
Sulphate mg/l	Nil	2	2	2	6.2	
COD mg/l	17	16	15	12		
Copper mg/l	0.02	0.02	0.02	0.02		
Iron mg/l	0.09	0.06	0.06	0.05		
Total Plate Count	28	28	28	28		
Confirmation	-ve	-ve	-ve	-ve	-ve	-ve

MPN						

Table: 1 shows the physico-chemical characteristics of the wells and the control well samples.

Experiment II

Table: 2 – Leachate Quality Analysis

PARAMETER SAMPLE	**LEACHATE**
Appearance	Dark
Temperature	30
PH	5.5
Total	7062
Turbidity	1608
Total Acidity	68
Alkalinity	1200
Chloride	1616
Nitrate	13
Phosphate	6.76
Sulphate	175
COD	1600
Copper	c0.06
Iron	7.84
Total Plate Count	9

Table: 2 shows the physio-chemical characteristics of the leachate sample.

Table: 3

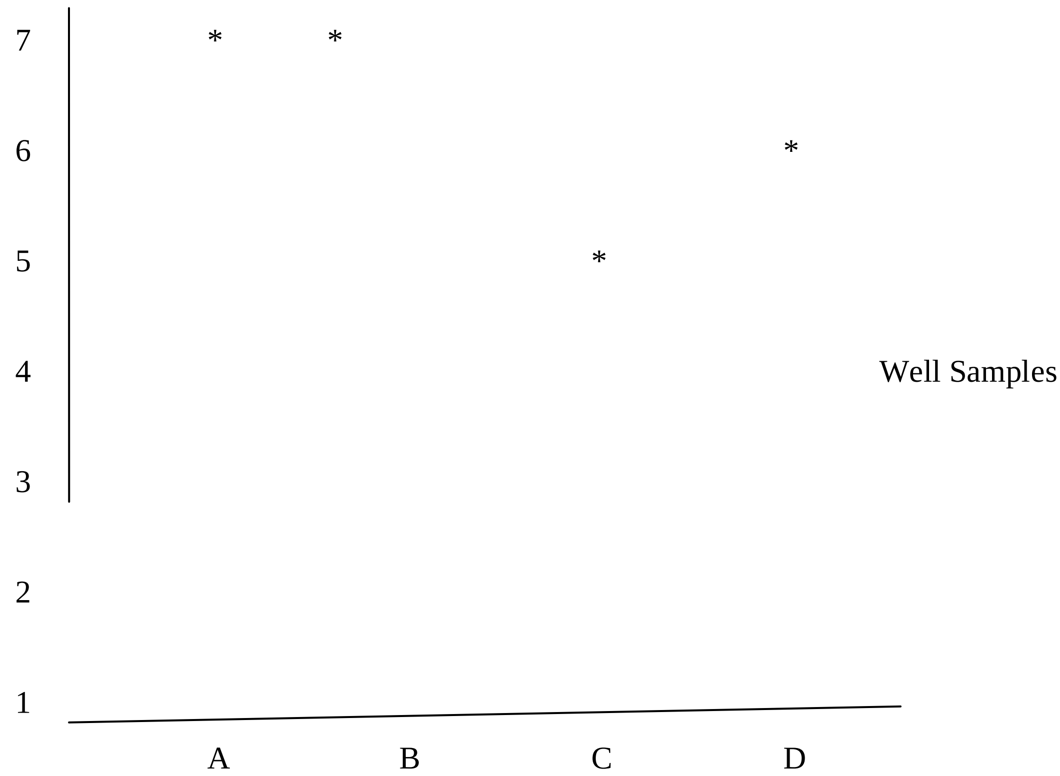
PARAMETER	**LEACHATES**	**LASEPA STANDARD**
Appearance	Dark	Clear
Temperature	30^0C	34 - 45^0C
P. H.	9	6 – 8
Total Solids	180, 272	2030mg/l

Total Acidity	400	NS
Total Alkalinity	2500	NS
Chloride	1992	250mg/l
Nitrate	80	NS
Phosphate	0.22	NS
Sulphate	Nil	NS
Chemical Oxygen Demand	15800	200mg/l
Biological Oxygen Demand	1200	50mg/l
Zinc	Na	1.00mg/l
Copper	0.28	C1.00mg/l
Iron	182	10.00mg/l
Chromium	Nil	1.00mg/l
Total Coliform Count	NA	150MPN/100ml
Confirmatory Feacal		
Coliform Test	Positive	Nil

NA – Not Analyzed NS – Not Specified

Table 3 shows a comprehensive physicochemical analysis of Oregun landfill leachates characteristics. The analysis was done whether inorganic and organic compounds found in wells in Oregun landfill site can be attributed to leachates from the landfill.

Figure 1: PH Variation against Samples



Note: The PH of the groundwater was not really acidic. The values ranged between 7 and 5.

These still falls within WHO standard of not exceeding 20mg/l. The chloride content of the water in both areas is 21.3 and 23mg/l on the average also falls within WHO standard of 250mg/l maximum. The total hardness of Oregun wells averages about 42.6mg/l. while that it Ipaja, averages about 54mg/l respectively is also within WHO standard of 100mg/l. The residual chlorine content of both areas is 0.23 mg/l. for Oregun and 0.13mg/l for Oregun. This falls within the stipulated WHO standard of 0.4mg/l (maximum). Total solid for Oregun Wells is in the average of 118mg/l. While that of Ipaja is in the average of 312mg/l. Both measures still falls within allowable limit of WHO. The iron content for Oregun Wells is 0.10mg/l on the average. And 0.04mg/l for Ipaja Wells. They both fall with the allowable limit specified by WHO. Phosphate content for Oregun wells is about 0.08mg/l on the average while Ipaja is about 0.06mg/l on the average. Both areas fall within WHO standard of 5mg/l. There is total plate count of 1000 in each of the Wells in Oregun indicating heavy presence of microbes in the water.

While Ipaja Wells has over 1000, 100 and 160 for its samples Wells. This total count is at variance with World Health Organization (WHO) standard at zero plate count. The total Coliform count of 95.3 cfu/ml for Oregun and 29.6 cfu/ml for Ipaja respectively indicates the presence of Coliform bacteria. This does not conform to World Health Organization (WHO) standard of zero Coliform count. This test suggests the presence of human feaces in the groundwater. It is positive in Oregun Wells and negative in Ipaja Wells.

Table 4

	1 (OREGUN)			**2 (SOLOUS) OJO**			
PARAMETERS	**Sample (A)**	**Sample (B)**	**Sample (C)**	**Sample (A)**	**Sample (B)**	**Sample (C)**	**WHO STANDARD**
*Temperature	30^0C	30^0C	30^0C	30^0C	30^0C	30^0C	30-40^0C
*P. H.	6.5	5.5	6.0	6.5	6.5	5.0	6.5-8.5
Odour	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless	Odourless
Turbidity	Cloudy (0)	Clear	Clear	Cloudy	Clear	Clear	Clear
TSS mg/l	35	36	31	39	33	30	Not specified
Total Acidity mg/l	17	46	14	15	13	10	Not specified
Total Alkalinity mg/l	5	10	10	40	45	38	200mg/l
Chloride	5	43	16	10	8	5	250mg/l

mg/l							
*Total Hardness mg/l	40	50	38	60	52	50	100mg/l
Residual Chloride mg/l	0.3	0.2	0.2	0.2	0.1	0.1	0.4mg/l (max)
Nitrate mg/l	NA	NA	65	5.6	1.8	1.6	10mg/l
Total Solid mg/l	41	247	67	2320	980	356	1000mg/l
*Iron PPM	0.22	0.07	0.02	0.09	0.06	0.02	1.0PPM
Phosphate mg/l	0.05	0.13	0.06	0.06	2.09	0.8	5mg/l
Total Plate Count	TNTC	TNTC	TNTC	TNTC	TNTC	TNTC	Nil
Total Coliform Count efu/ml	146	140	146	140	140	120	Nil
Confirmatory Feacal Coliform Test	+ve (1)	+ve	+ve	+ve	-ve	-ve	Nil

NA - Not analyzed

TNTC - Too Numerous to Count (Over 1000)

Table 4 shows a detailed ground water quality of the sample wells. Wells 1A, 1B and 1C are wells from Oregun landfill neighbourhood at varying distance from the landfill site; 30, 120 and 20 meters respectively while, wells 2A, 2B and 2C (controls) are wells from Shagari Estate (A Zone). Those wells will act as control wells.

Hytothesis testing

In testing the hypothesis formulated in the course of the study Chi-Square Test and Correlation will be employed. The essence of the chi-square test is to evaluate and ascertain whether or not value of parameters from groundwater in Oregun landfill neighbourhood differ significantly from groundwater parameter values of 'A Zone' Shagari Estate, Ipaja. Whereas the essence of the correlation is to determine if there is significant relationship between the quality of groundwater in Oregun landfill neighbourhood and distance from the landfill, down the gradient.

Hypothesis (1)

H_0: There is no significant difference in ground water quality of Oregun landfill neighbourhood and 'A Zone', Shagari Estate, Ipaja.

H_1: There is a significant difference in ground water quality of Oregun landfill neighbourhood and 'A Zone' Shagari Estate, Ipaja.

To ascertain this hypothesis, samples 1A and 2A, 1B and 2B, 1C and 2C where used as observed and expected frequencies for the test. And the significant level used is 0.05 that is, it is significant at or above 0.05.

Table: 5 Chi-square test

SAMPLE 1A and 2A	Value	DF	Significance
Pearson chi-square	191.000	168	.099
Likelihood Ratio	79.359	168	1.000
Linear-by-linear			
Association	11.416	1	.001
No. of Valid Cases	16		

Since Table 5 shows a significant level of .099 for Pearson chi-square which is more than the minimum significant level of 0.05 for SPSS (Chi-Square).

The null hypothesis (H_0) is rejected the and the H_1 which states that, there is a significant difference in groundwater quality of Oregun landfill neighbourhood and A Zone, Shagari Estate, Ipaja.

Table 6: Chi-square test

Sample 1B and 2B	**Value**	**DF**	**Significance**
Pearson chi-square	212.000	196	.206
Likelihood Ratio	83.178	196	1.000
Linear-by-linear			
Association	3.070	1	.080
No. of Valid Cases	16		

Table 6 shows a significant level of .206 for Pearson chi-square which is more than the minimum significant level of 0.05 (Chi-Square). The hypothesis is therefore reject the H_0 and accept H_1 which states that, there is a significant difference in groundwater quality of Oregun landfill neighbourhood and A Zone, Shagari Estate, Ipaja.

Table 7: Chi-square test

Sample 1B and 2B	**Value**	**DF**	**Significance**

Pearson chi-square	221.000	196	.106
Likelihood Ratio	86.965	196	1.000
Linear-by-linear			
Association	9.278	1	.002
No. of Valid Cases	17		

Table 7 shows a significant level of .106 for Pearson chi-square which is more than the minimum significant level of 0.05 (Chi-Square). The hypothesis is therefore reject the H_0 and accept H_1 which states that, there is a significant difference in groundwater quality of Oregun landfill neighbourhood and A Zone, Shagari Estate, Ipaja.

Hypothesis (II)

H_0: There is no significant correlation between Oregun Landfill neighbourhood groundwater quality and distance from the landfill, down gradient.

H_1: There is no significant correlation between Oregun Landfill neighbourhood groundwater quality and distance from the landfill, down gradient.

To ascertain this hypothesis, samples 1A, 1B and 1C where correlated. The significant level for (correlation 2 – tailed is significant at or above 0.01.

Table 8

Samples 1A, 1B and 1C SPSS (Correlation)

		SAMPLE 1B Oregun well Sample 1b	**SAMPLE 1A Oregun well Sample 1a**	**SAMPLE 1C Oregun well Sample 1c**
Sample 1B Oregun well sample 1b	Pearson Correlation Sig. (2-tailed)	1.000 16	.978 .000 16	.983** .000 16

	N			
Sample 1A Oregun well sample 1a	Pearson Correlation Sig. (2-tailed) N	.978 .000 16	1.000 16	1.000** .000 16
Sample 1C Oregun well sample 1c	Pearson Correlation Sig. (2-tailed) N	.983 .000 16	1.000 .000 16	1.000 16

**Correlation is significant at the 0.01 level (2 – tailed)

Discussion of Results and Conclusions

The quality of ground water depends upon several factors such as chemical composition of the aquifers – climatic conditions prevailing during formation and quantum of water available in the aquifer and its rate of circulation. Apart from these, activities of micro-organisms, temperature and pressure are responsible for the chemical characteristics of groundwater (Ibiyemi, 2000). Aquifers are permeable because the particles, which they are composed of such as gravel or sand, are not packed together so tightly as to leave no spaces between them (Allaby, 1996). It is through these spaces that water as well as leachate passes through (Coode, 1997). Also noted that most groundwater originate as rain which infiltrate through the soil into the flow system, in underlying geological conditions. Consequently, the moisture content of waste materials is increased and overall rate of its decomposition is enhanced so that leachate may then percolate (A. O. Ibiyemi, 2000). It is therefore not surprising that the well samples have a mean PH Value of 5.88 units which is acidic. Adeniyi (1986) found out that the presence of organic matter content may influence low P.H. value. Organic matter lock-up substantial amounts of calcium, sodium and magnesium in exchange for free hydrogenous substance which is acidic.

Also, the P.H. values of samples are lower than the WHO recommended values of 7-5 units. Regarding the consumability of the well samples, it may have direct impact on human health. High concentration of chloride gives an undesirable taste to water. Taste thresholds for chloride (for example; Na, K, La, Cl.) are in the range of 200 – 300mg/l. High chloride concentration is corrosive to metals particularly at low alkalinity (Coode, 1997). The water samples have low alkalinity and the leachates may corrode metals or other materials because of its chloride contents (1616mg/l). The toxicity of nitrates is demonstrated by vasolidatory/ cardiovascular effect of high doses and methaemo globinaemia at lower doses especially in the case of infants.

The levels of nitrates in the samples are generally low and may not constitute any danger to human health. However, it was discovered that the level of nitrate was decreasing as we move away from the landfill site, which explains the relatively high level of nitrate in the well sample A (See Table 4.1). Iron is essential in human diet because of its association with blood hemoglobin, and drinking water is not considered to be an important source of iron. At level 0.3mg/l., the presence of iron causes stains to laundry and plumbing fixtures and causes undesirable taste (Uchegbu, 1998). Although, natural occurring groundwater is safe and free of bacteria unless contaminated by humans (A. O. Ibiyemi, 2000; A.O Ibiyemi, 2001) the level of iron in the samples is found to be below 0.03mg/l. The MPN/100ml in the samples is higher than the recommended WHO standard, and this may be the resultant effect of leachates percolation into the groundwater but there is no conclusive evident.

The results further showed that the P.H. value of the well samples (5.85) is acidic and is less than the recommended WHO limits of 7–8.5. This suggests that there could be harmful effects as a result of consumption of the well sample, especially, where the sampled wells are depended upon by the communities residing around the landfill site. The increased PH conclusively can be linked to the leachate arising from the landfill site. The control well maintains a PH value of 7.0 units which indicates that it is free from the leachates flow. Thus, it can be concluded that the leachates arising from the landfill site is responsible for the acidic level of the sample wells. In the study, we have been able to see that landfilling activities impact negatively on not only groundwater quality (Iwugo, 1986). But other environmental quality indicator parameters like odour, fire, surface water, aesthetics etc. This has been so because the landfill is yet to be operated sanitarily. The situation is further compounded by almost complete jettison of Lavalin's study report on Oregun site (Lavalin International Inc., Feb. 1992). Which would have reasonably ensured a well-engineered sanitary landfill? Although some sections of the report on leachates migration and mitigation to underground aquifers, does not actually conform with what is obtainable in the site as regards groundwater consumption.

Conclusions

Wells and boreholes in the surrounding of Solous landfill site must be monitored and new boreholes and wells should be sampled on a regular basis. Government should ensure that new landfills are sited far away from residential areas since our people depend mostly on well water. More research work suggests that should be commissioned by LASEPA, LAWMA and LSWC on leachates flow control pattern, in the surroundings of Solous landfill site and indeed other landfill sites in the state n order to ascertain levels of significance of concentration and suggest anticipatory mitigating measures. Furthermore, there is a serious departure from the original design and operational modules stipulated by Lavalin's study. To ensure an environmentally sound landfilling practice, the study document of Lavalin has to be revisited and adopted. Moreso, proper water and gas monitoring and reporting programme has to be put in place. So that landfills activities and development can be monitored on the routine basis and documented regularly.

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