ISSN 2229-5518

Assessment of the Rate of Contamination of Ground Water within Dumpsite Environment as well as its Health Implications

O. Joy Oladejo

Abstract-Refuse dumpsites are found both within and on the outskirts of cities in Nigeria and due to poor and ineffective management, the dumpsites turn to sources of health hazards to people living in the vicinity of such dumps. Therefore, this paper was designed to determine the frequency and to examine the health implications of contaminations of the experimented water samples at selected dumpsite locations in Nigeria. A Global Positioning System (Garmin GPS 72, RMS 95% typical) was employed to locate 20 specific sample points at 500 m radius from Aba-Eku and Ajakanga dumpsites. Sterilized 75 cl water bottles were used to collect water samples from shallow hand dug wells at an average depth of 8 m. PH meter, conductivity meter, Loviband digital analyzer, turbidity meter, and heavy metal monitoring equipment from Water Corporation of Oyo State Laboratory at Asejire were used to test for the following parameters; pH, Temperature, Conductivity, Total Suspended Solids (TSS), Total Dissolved Solids (TDS), Turbidity, Lead(Pb), Copper(Cu), Iron(Fe), Chloride(Cl-), Ammonium(NH4+), Sulphate(S042-) and Calcium(Ca). The results were then analyzed using Quantum GIS Brighton 2.6 to derive the raster histograms of the sample results in order to determine the level of contamination of the well water. The results show that the level of contamination of each well varies directly on the location of each well. The farther the well is located, the lesser the level of contamination and the closer the well is located, the more the wells are exposed to serious contaminations from the dumpsite. Groundwater intended to be explored at a distance of less than100 m from any dumpsite should preferably be bore-holes or very deep wells.

Keywords- Dumpsite, Contamination, Ground water, Health implication

1 INTRODUCTION

There is no doubt that a dirty environment affects the standard of living, aesthetic sensibilities, health of the people and thus the quality of their lives [3], [8]. Most of the waste dumps are located close to residential areas, markets, farms, roadsides and creeks.

Department of Civil Engineering University of Ibadan, Ibadan, Nigeria
ojoyoladejo@yahoo.co.uk

The composition of waste dumps varies widely, with many human activities located close to dump sites [9].

The high population density and the prevalence of pit latrines can facilitate contamination of the shallow groundwater sources leading to incidents of water borne diseases like abdominal disorders, typhoid fever, dysentery and urinary track infectious that are common in the town.

The community bins and dumping sites become eye sore, cause foul smell, become breeding places for harmful bacteria and attracts disease carrying vectors such as flies, mosquitoes, birds, rats, dogs etc. the situation gets bad-to-worse when this waste enters into water bodies during wet season [5]. Residential areas contaminate groundwater through improper storage and disposal of household chemicals and wastes into landfills, dump sites, latrines and graveyards where they decay and are moved into aquifers by rainwater [2], [4]. Shallow aquifers are most susceptible to such high risks of groundwater contamination from the overlaying unsaturated zones. These pollutions can be reduced through proper waste disposal management practices. Hence, public potable water supplies should be tapped from deep aquifers because they are relatively free from contamination [1]

ISSN 2229-5518

The concept of groundwater pollution has been studied by many scholars; groundwater is polluted when the changes in the water constituents is not desirable and have harmful or negative effects on a specific use.

Sandyarami [7] Opined that groundwater pollution is the change in the properties of groundwater due to contamination by microbes, chemicals, hazardous substance and other foreign particles.

Harter (2008) termed groundwater pollution from the human dimension as undesirable change in the groundwater quality resulting from human activities. Groundwater can be polluted by natural and artificial means including heavy metals [6]. Despite works on open literature, there is still need to further understand the health implication of water near the dumpsites. Therefore, the work assesses contamination of ground water in the environment and its implication on human health.

2 MATERIALS AND METHOD

2.1 Study Location

This study was undertaken in two of the recognized dumpsites in Ibadan, Southwest Nigeria; Ajakanga dumpsite located along old Ijebu road, Oluyole Local Government Area covering over an approximate 10.34 hectare area. The second dump site is Afofunra (also known as Aba-Eku) dumpsite. The dumpsite is located along Olunloyo Akanran -Ijebu Igbo road, Ona Ara Local Government Area. It has an area of 9.42 hectares.

Twenty wells were chosen as groundwater sampling points and designated 1-20, for each of the dumpsites. The wells were located down gradient, at a location of 500 m from the dumpsite. Some parameters were evaluated over a 6 month period using standard method and reagent testing method.

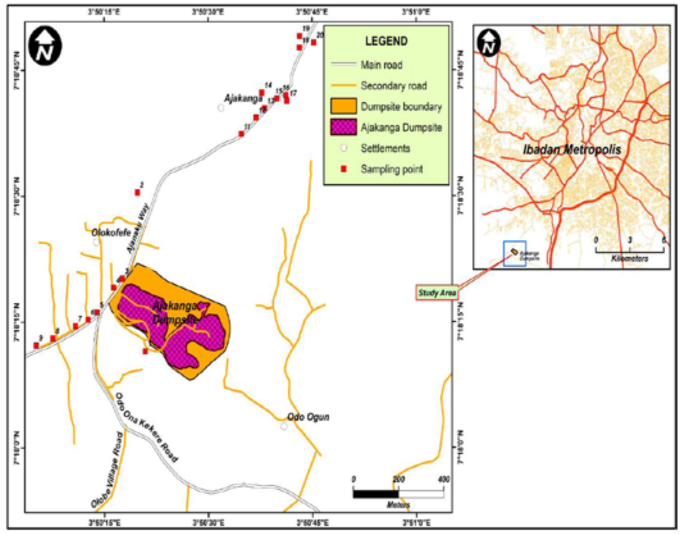

Figure 1: A GIS map of Ajakanga dumpsite

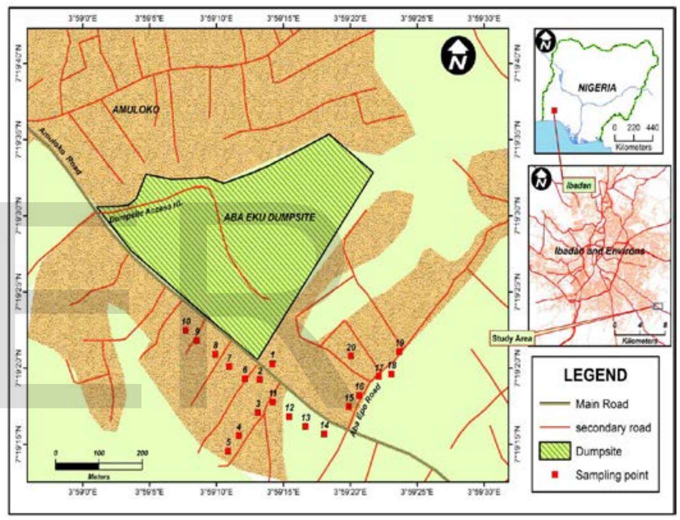

Figure 2: A GIS map of Aba-Eku dumpsite

2.2 Measurement Method

A Global Positioning System (Garmin GPS 72, RMS 95% typical) was employed to locate 20 specific sample points at 500 m radius from the dumpsite down slope, for Aba-Eku and Ajakanga respectively. Sterilized 75 cl water bottles were used to collect water samples from wells at an average depth of 8m. The samples were stored in a refrigerator at 4 °C to ensure that the state of the samples does not change with time before the analysis.

Water quality parameters analyzed in accordance to standard method were pH, Temperature, Conductivity, Total suspended solid (TSS), Total dissolved solid (TDS),

ISSN 2229-5518

Turbidity, Nitrate, Phosphate, Copper, Lead, Iron, Chloride, Ammonium, Sulphate, and Calcium.

After laboratory analysis, the result of Groundwater Quality monitoring conducted for selected well samples was used by the QGIS Brighton 2.6 as a tool to determine the various contamination frequencies with raster histograms. Raster variation has to do with histogram representation of the results derived, so as to actually see the trend between the sampling point's closeness to the dumpsite (i.e. distance) and how high or low the level of contamination becomes when the points are farther or closer to the dump.

3 RESULTS AND DISCUSSION

The results of the laboratory analysis of the water samples from shallow wells around Aba Eku dumpsite with their coordinates are presented in table 1 below. Their corresponding raster variation trend is also indicated

Table 1: Various element and distance away from landfill

Distance. (m)	Pb (mg/L)	Cu (mg/L)	NH_4^+ (mg/L)	Cl^- (mg/L)	Cond. us/cm	PH
32.72	0.003	0.205	0.55	15.08	547	6.2
34.27	0.006	0.221	0.42	13.4	654	6.3
35	0.0049	0.15	0.48	17.8	752	6.4
43.36(MR)		0.281	0.5	7.34	209	6.4
53.95	0.0005	0.093	0.67	24.6	759	6.6
66.82		0.162	0.45	6.28	815	6.5
75.57		0.142	0.5	5.02	375	6.5
80.66	0.018	0.263	0.72	6.89	112	6.7
92.3		0.178	0.78	20.17	572	6.3
98.29		0.425	0.82	16.88	671	6.5
101.6		0.156	1.3	47.64	900	6.8
109.33	0.0095	0.583	0.83	36.49	86	6.9
114.1		0.324	0.99	28.22	801	6.8
141.2		0.145	1.2	52.76	275	6.5
161		0.405	1.4	30.36	498	6.6
164.4		0.611	1.38	27.82	667	6.7
184.7		0.394	1.6	40.86	671	6.7
196.6	0.024	0.542	1.45	49.92	481	6.7
215.64	0.015	0.604	1.72	35.21	819	6.9
233.1	0.019	0.555	1.5	34.81	401	6.8

For this particular dumpsite location (Aba-Eku), the minimum distance covered from the GPS was 32.72 m and the maximum distance covered was 233.1 m

For copper, fig. 3, the high frequencies of contamination of water samples are located at selected wells between 34.27m and 92.3m distances from the dumpsites. Low frequency of contaminated water is located at selected wells between 161m and 233.1m distances from the dumpsite. For ammonium, fig. 4, the high frequencies of contamination of water samples are located at selected wells between 32.72m and 53.95m distances from the dumpsites. Low frequency of contaminated water is located at selected wells between 109.33m and 215.64m distances from the dumpsite. Similar trend was observed in other analysis.

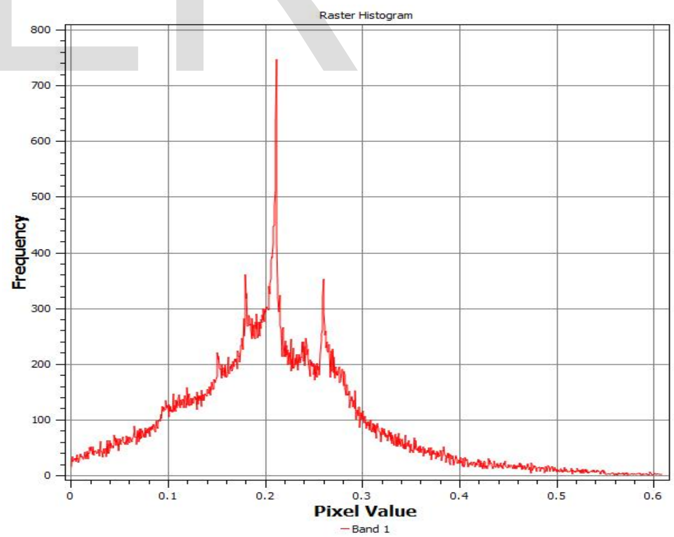

Fig. 3: Raster variation trends for Copper

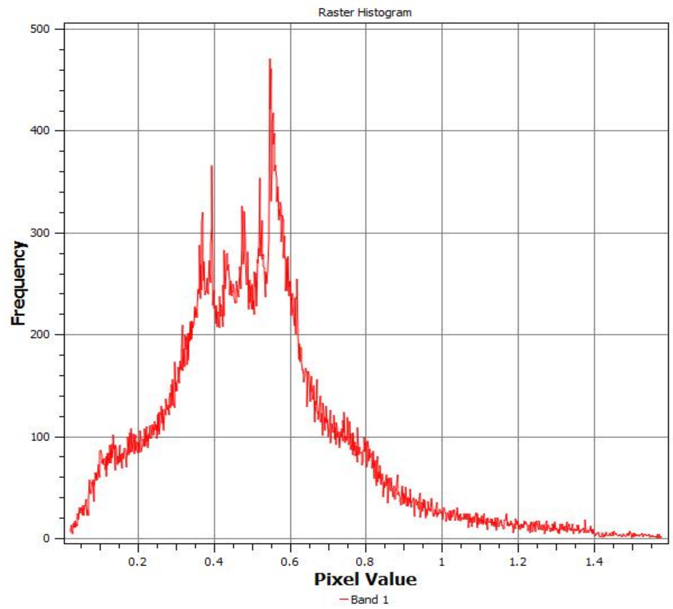

Figure 4: Raster variation trends for Ammonium

Table 2: Various element and their distances away from landfill

Dist. (m)	TDS (Mg/L)	TSS Mg/L	Fe Mg/L	Ca Mg/L	$S0_4^{2-}$ Mg/L
32.72	322	24	0.181	3.02	22.61
34.27	288	27	0.134	5.76	23.32
35	381	26	0.122	4.34	24.51
43.36(MR)	315	32	0.141	3.66	36.81
53.95	360	25	0.202	6.14	18.53
66.82	273	19	0.198	7.76	29.4
75.57	194	22	0.052	6.78	32.44
80.66	209	21	0.182	11.81	8.62
92.3	262	28	0.052	3.56	26.74
98.29	292	30	0.081	3.9	19.81
101.6	403	36	0.286	8.23	46.33
109.33	190	12	0.22	8.95	9.94
114.1	170	13	0.293	7.44	39.11
141.2	470	38	0.344	9.81	58.77
161	150	34	0.254	14.89	55.88
164.4	498	33	0.426	13.02	44.04
184.7	90	14	0.009	10.76	53.24
196.6	510	15	0.314	14.04	50.82
215.64	546	11	0.29	15	60.52
233.1	550	10	0.332	15.72	62.74

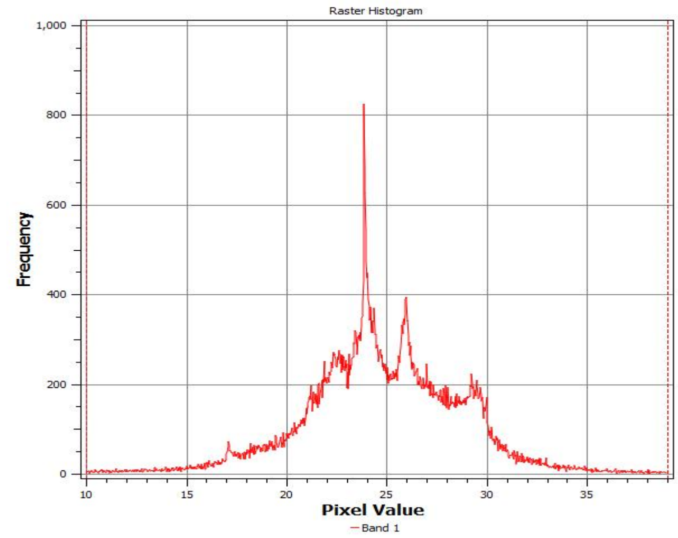

Fig. 5: Raster variation trends for TSS

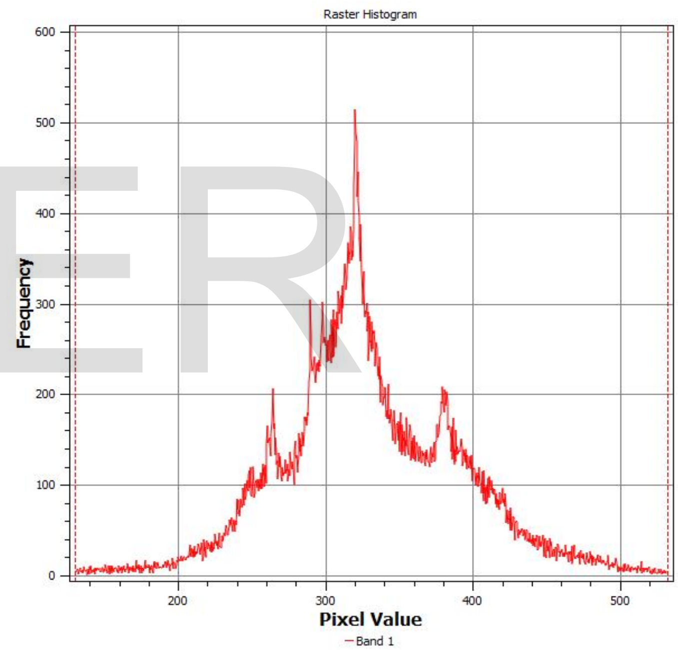

Fig.6: Raster variation trends for TDS

ISSN 2229-5518

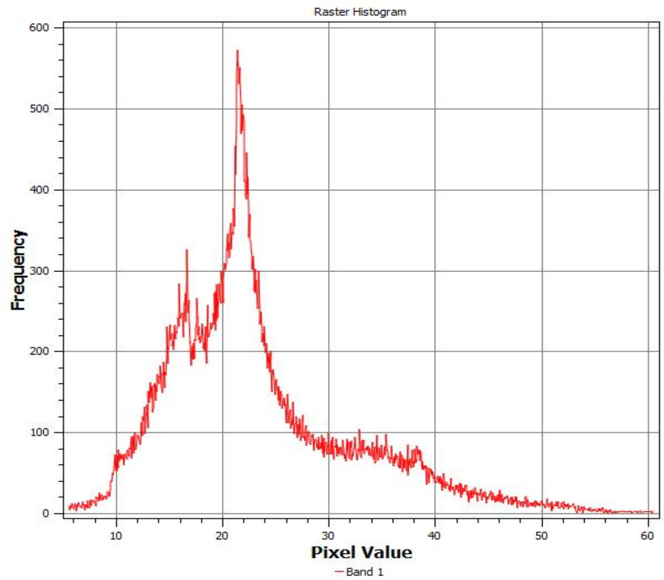

Fig.7: Raster variation trends for Sulphate

For TSS, fig.5, the high frequencies of contamination of water samples are located at selected wells between 32.72m and 92.30m distances from the dumpsites. Low frequency of contaminated water is located at selected wells between 98.29m and 233.1m distances from the dumpsite. For sulphate, fig.7, the high frequencies of contamination of water samples are located at selected wells between 32.72m and 53.95m distances from the dumpsites. Low frequency of contaminated water is located at selected wells between 92.30m and 215.64m distances from the dumpsite. Similar trend was observed in the other analysis.

Table 3: Various element and their distances away from landfill

Dist. (m)	Cu Mg/L	Fe Mg/L	Cl^- Mg/L	NH_4^+ Mg/L	$S0_4^{2-}$ Mg/L	Ca Mg/l
240.7	0.145	0.023	18	0.25	3.02	18.51
245.25	0.154	0.01	18.57	0.3	4.23	33.2
249.62	0.131	0.015	18.78	0.19	14.55	36.5
253.6			14.64	0.52	15.62	15.8
254.5			15	0.44	17.81	11.76
255.02		0.06	11	0.76	45.9	8.03
316.44		0.05	14.01	0.65	29.62	40.7
364.82			6.02	0.84	33.8	45.81
426.32	0.05	0.1	4.11	1.14	1.04	65.12
471.52	0.1	0.17	5.21	1.23	0.14	50.82
74.26	0.142	0.033	19.42	0.2	8.72	28.14
88.71	0.151	0.042	21.07	0.18	10.25	26.4
140.15		0.053	22	0.95	18.76	34.8
147.11		0.48	24	0.009	12.55	27.56
176.8		0.145	38	1.34	21.52	32.14
178.22		0.13	36	0.05	16	25.41
180.52			28	0.09	30	27.82
201.72			25	1.76	0.1	4.13
233.21	0.25	0.009	32	1.02	35.82	3.95
247.13	0.21	0	30	1.4	28.7	9.82

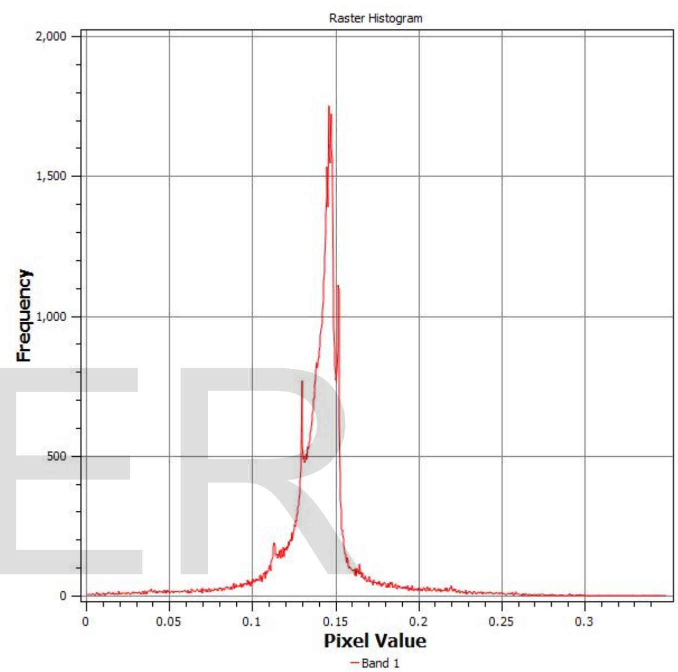

Fig.8: Raster variation trends for Copper

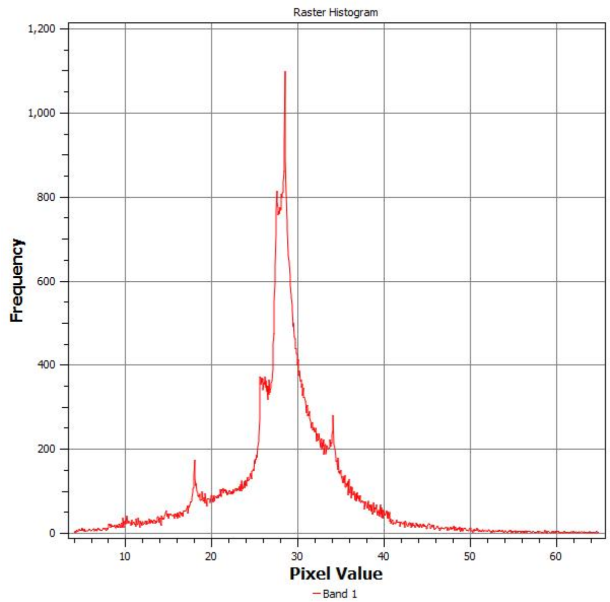

Fig. 9: Raster variation trends for Calcium

For Ajakanga dumpsite location, table 3, the minimum and maximum distances covered from the GPS are in 5 different categories/sections; 74.26 & 176.8m, 178.22m & 247.13m, 240.7m & 254.5m, 255.02m & 471.52m.

For Copper, fig. 8, the high frequencies of contamination of water samples are located at selected wells between 74.26m and 88.71m distances from the dumpsites. Low frequency of contaminated water is located at selected wells between 233.21m and 426.32m distances from the dumpsite. For calcium, fig. 9, the high frequencies of contamination of water samples are located at selected wells between 74.26m and 147.11m distances from the dumpsites. Low frequency of contaminated water is located at selected wells between 201.72m and 426.32m distances from the dumpsite.

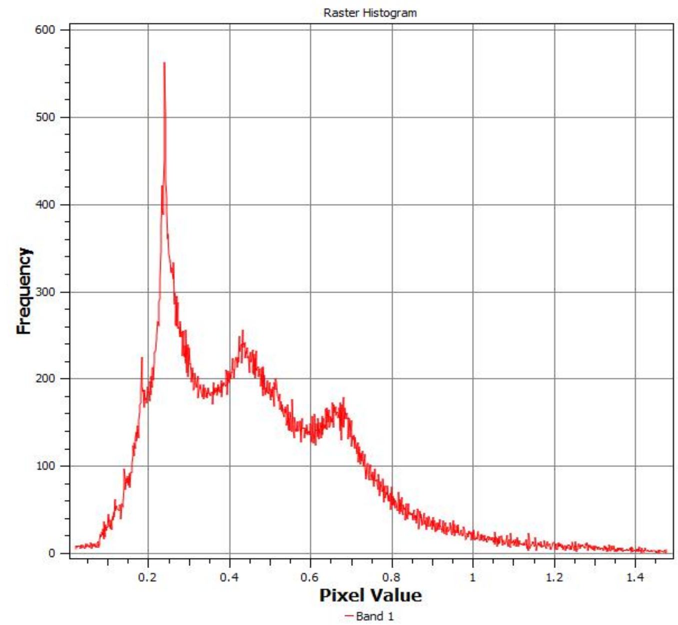

Fig. 10: Raster variation trends for Ammonium

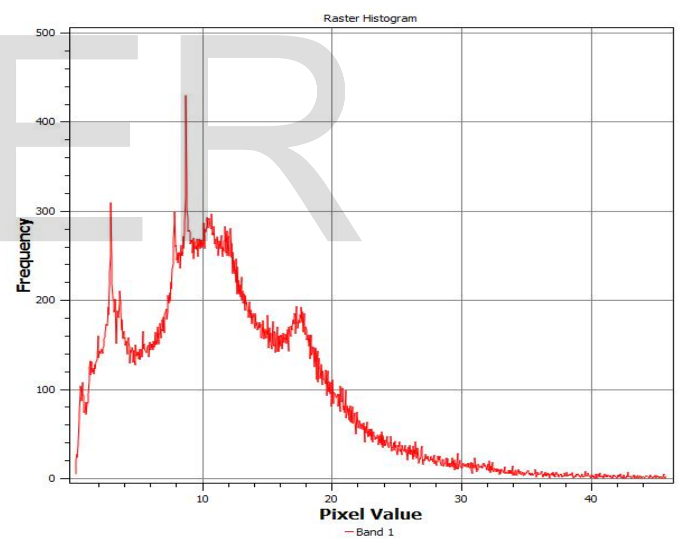

Fig. 11: Raster variation trends for Sulphate

For Ammonium, fig. 10, the high frequencies of contamination of water samples are located at selected wells between 74.26m and 180.52m distances from the dumpsites. Low frequency of contaminated water is located at selected wells between 201.72m and 255.02m distances from the dumpsite. For Sulphate, fig. 11, the high frequencies of contamination of water samples are located at selected wells between 74.26m and 240.7m distances from the dumpsites. Low frequency of contaminated water is located at selected wells between 176.8m and 255.02m distances from the dumpsite. The same explanation holds for other elements.

Table 4: Various element and their distances away from landfill

Dist. (m)	Cond. (us/cm)	PH	TDS Mg/L	TSS Mg/L	Turb. (NTU)
240.7	887	6.4	440	38	4.87
245.25	694	6.4	306	37	4.56
249.62	991	6.6	389	28	4.21
253.6	247	6.5	580	40	3.22
254.5	727	6.4	340.7	36	2.36
255.02	592	6.7	250	22	1.54
316.44	715	6.7	600.8	19	1.73
364.82	650	6.6	630	68	3.02
426.32	689	6.8	708.23	60	2.89
471.52	678	6.9	712.04	65	2.64
74.26	804	6.1	420	64	5.7
88.71	950	6.3	550	60	5.86
140.15	370	6.2	582	68	4.97
147.11	460	6.4	460	54	6.28
176.8	411	6.3	200	47	5.98
178.22	396	6.5	107	49	5.72
180.52	815	6.5	242.5	35	6.04
201.72	760	6.4	200.2	30	6.52
233.21	925	6.8	181.3	24	6.44
247.13	570	6.7	612.04	25	6.39

From all the results derived above, if we compare the outcome of the raster variation with each of the corresponding parameters in the table guiding each one, we would clearly see that there is a correlation with each of the wells and their location around the dumpsites. In other words, the level of contamination of each well varies directly on the location of each well. The farther the well is located, the lesser the level of contamination and the closer the well is located, the more the wells are exposed to serious contaminations from the dumpsite.

Health related issues associated with living close to the dumpsite include inhalation of odour; continuous inhalation of the gas seriously impairs the body and results in body destruction. Also, malaria, Typhoid, Dysentry and yellow fever could result from dumpsite.

4 CONCLUSIONS

Refuse dumpsites are found both within and on the outskirts of cities in Nigeria and due to poor and ineffective management, the dumpsites turn to sources of health hazards to people living in the vicinity of such dumps. Therefore, this paper was designed to determine the frequency and to examine the health implications of contaminations of the experimented water samples at selected dumpsite locations in Nigeria. A Global Positioning System (Garmin GPS 72, RMS 95% typical) was employed to locate 20 specific sample points at 500 m radius from the dumpsite down slope, for Aba-Eku and Ajakanga respectively. Sterilized 75 cl water bottles were used to collect water samples from shallow hand dug wells at an average depth of 8m. PH meter, conductivity meter, Loviband digital analyzer, turbidity meter, and heavy metal monitoring equipment from Water Corporation of Oyo State Laboratory at Asejire were used to test the following parameters; pH, Temperature, Conductivity, Total Suspended Solids(TSS), Total Dissolved Solids(TDS), Turbidity, Lead Copper, Iron, Chloride, Ammonium, Sulphate, Calcium. The results were then analyzed using Quantum GIS Brighton 2.6 to derive the raster histograms of the sample results to determine the level of contamination of the well water. The results show that the level of contamination of each well varies directly on the location of each well. The farther the well is located, the lesser the level of contamination and the closer the well is located, the more the wells are exposed to serious contaminations from the dumpsite. Groundwater intended to be explored at a distance of less than 100 m from any dumpsite should preferably be bore holes or very deep wells.

REFERENCES

[1] G. Achary 'Studies on Groundwater pollution due to iron content, International Journal of Multidisciplinary and Current Research'. Volume 2, 2014

[2] T. Harter 'Groundwater Quality and Groundwater Pollution'. Agriculture and Natural Resources 2008 (ANR) http://anrcatalog.uncavis.edu (retrieved 14/10/2014)

[3] J Koehn, "Waste Management in Nigeria Local Governments", International Conference on Energy, Environment and Disasters- Charlotte, N. USA- pp 76-96. 1992

[4] Lenntech 'Water Treatment and purification holding; sources of groundwater pollution'. 1992

[5] NISER, 'West disposal and recycle in Nigeria: ECOWAS monitoring group (ECOMOG), Sierra Leone', pp35. 1981

[6] D. Sarala, and T.S.R Mageswari 'Metal Pollution Assessment in Groundwater', Bulletin of Environment, Pharmacology and Life Sciences, Vol 2 (12), 2013

[7]N Sandhyarami, 'Groundwater Pollution, buzzle.com.http://www.buzzle.com/articles/ groundwaterpollution. 2009. Html (Retrieved 11/11/2014

[8] G. E., Stren, V. P Michael,. and G. Walter, Waste Management in Nigeria: A comparative Analysis in Atsegbua L.A(ed) Selected Essay in Petroleum and Environmental Laws, Benin City, New Era, 12-13. (2005):

[9] World Bank, (1992): Improvising municipal solid waste management in India", the work bank.