

Solid Waste Effects on Environmental Quality in Gosa and its Environs, Abuja, Federal Capital Territory, Nigeria

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Article History	Abstract
Original Research Article	<i>The aim of the study was to examine solid waste effects through the analysis of the quality of soil, water and air in Gosa dumpsite and its environs. The main objective of this research focused on investigating the impact of the dumpsite with regards to soil, water and air quality in the study area. Samples of soil, water and air were obtained during the wet and dry seasons within 1.5 km radius of Gosa dumpsite using standard procedures. Data collection for air samples was by a handheld detection instrument (in-situ) Croweon GASMAN, MSA, ALTAIR 5X (Multi Gas Monitor), Haze-Dust particulate meter and Multifunction Environmental Meter in-situ. Water samples was collected into sterilized bottles and stored in a cooler to maintain temperature and avoid contamination before testing while soil samples were collected using hand-held shovel and packed into zip lock bags. The effects of the dumpsite on soil, water and air quality were measured using mean standard deviation (SD) to determine the difference in parameters for both seasons and Analysis of Variance (ANOVA) was used to find variations between the three (3) points. Results from analysed samples of soil water and air indicates high values beyond acceptable standards by the World Health Organisation (WHO) and Food and Agriculture Organisation (FAO), with evidence of soil contamination and percolation of leachate in the soil and notable concentration of physical, chemical and bacteriological contaminants as well as heavy metals in analysed water samples. I recommend the full mechanization of Gosa dumpsite to a sanitary landfill for better management of waste at the dumpsite and general orientation of the public to encourage waste segregation and adequate waste management systems.</i> Keywords: Effects, Dumpsite, Solid Waste, Environmental Quality, Environs.
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Copyright © 2026 The Author(s): This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License (CC BY-NC) which permits unrestricted use, distribution, and reproduction in any medium for non-commercial use provided the original author and source are credited. Citation: S., Y., Daku, S., Y., Kpalo, A., Y., Agwai, U., A., Sambo & I., M., Sagir (2026). Solid waste effects on environmental quality in Gosa and its environs, Abuja, Federal Capital Territory, Nigeria. <i>UKR Journal of Multidisciplinary Studies</i>, 2(10), 1-7.	

1.1 Introduction

Waste is everybody's business; men, women and children produce waste in nearly every activity. Human faeces, sheets of polythene wrappers, leaves, bottles, tins, paper, food waste, old tires, disposed cartons, scrap metals, electronic gadgets, automobile parts, plastic, chemical waste and clothing materials litter the environment and poses problems beyond the control of various waste management systems, not only in Nigeria but in various countries of the world (Marton et al, 2016). Awake Magazine (2002) reported that most waste components are either not degradable at all or take very long time to

decompose. Solid waste management systems are highly efficient in these parts of the world and Nigeria needs to emulate them as the quantity of waste generation steadily increases at an alarming rate over the years (Floyd and Ekpoh, 2003). Olanike in 2003 opined that the usual methods of waste management in Nigeria are land filling, open dumping, land spread, illegal disposal into water bodies, burning or incineration. Igoni et al (2007) concurred when they further stressed that open dumping is more practiced among Nigerians, where some people employ the services of streams to transport their solid wastes out of

their sight, while others directly dump them by the roadside.

According to Oyekan and Sulyman (2015), insects and vectors that transmit major diseases to the public are usually found in dumpsites, and they include but not limited to rodents, flies, mosquitoes, cockroaches (Oyem et al, 2011). Piles of refuse encourages activities of organisms and vectors and also play vital roles in the transmission of diseases like amoebic dysentery, Lassa fever, plagues, rat bite fever, malaria etc (Adamu et al, 2014). According to Onwughara et al, (2004), crops grown on contaminated soil have the ability to bio-accumulate toxic heavy metals in their tissue, thereby posing potential health risk as this could bio-magnify in a consumer's tissue.

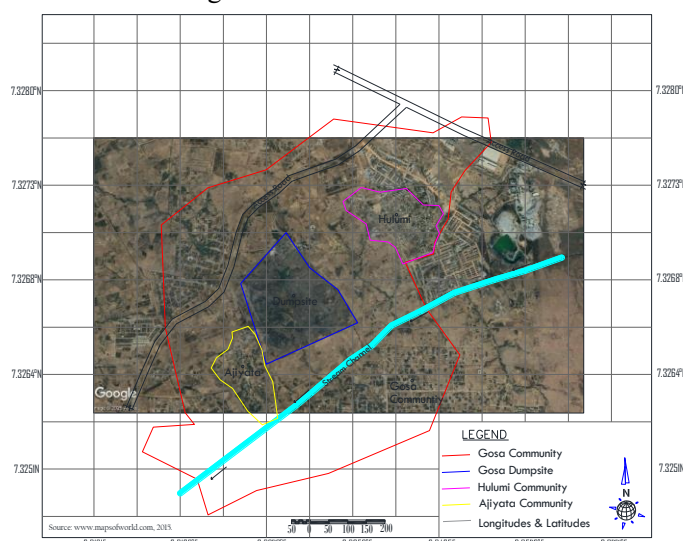
Most of the challenges facing the environment today can be changed by “a change in thought and action”. Human beings are the creators and utilizers of all social systems (Jaiyeoba, 2002). We fashion the technology, formulate the regulations, channel our energies for productive purposes and it is our ideas, aspirations, understanding, opinions, decisions, attitudes and sentiments that determines how these functional elements work and why they often fail...” Majority of studies has focused mainly on plastic waste which is one of the prevalent non-biodegradable

wastes/materials found in the environment and in some instances, for this research, a study of the effects of general waste disposal on the environment have been made using Gosa dump site in the Federal Capital Territory, Abuja as case study.

1.2 Study Area

1.2.1 Gosa Dumpsite in Abuja, the Federal Capital Territory

Gosa dump site is currently the only authorized dump site in Abuja, the Federal Capital Territory for the “receipt of solid non-hazardous wastes”. It was originally intended to be designed and operated as a sanitary landfill, meeting international norms but at the moment, it is operated as an open dump. At the time of this research, few of the most basic requirements are being met at the dumpsite, which is operated as an open dump with wastes scattered across the site. The actual size of the dumpsite is about 500 hectares however only about 91 hectares of the area is currently in use with no cover material available or being applied on a daily or even monthly basis at the site. The identified sample locations (Ajiyata village, Gosa dumpsite and Hulumi village) lie within 1.5 km radius of the dumpsite.



Source: www.mapsofworld.com, 2015

1.3 Materials and Methods

In addressing necessary framework for the research problem, various techniques for environmental sampling and analysis of water, air and soil were adopted. A combination of field studies, maps, laboratory testing and analysis, satellite imagery, review of related literature, internet searches, questionnaires and interaction with community heads, used to gather data for this survey.

Samples of water, air and soil were collected from three (3) points within 1.5-kilometer radius around Gosa dumpsite during the wet and dry season. The first location is Hulumi village which is about 1.35km kilometers to the dump site

at an elevation of 397m, the second location is the Gosa dumpsite at an elevation of 402m and the third location is Ajiyata village which is about 1.41km away from the dumpsite at an elevation of 387m, all within a 1.5 km radius.

Population sampled for this research include physical, chemical and bacteriological parameters from soil and underground water (bore hole) samples while parameters obtained for air quality include temperature, methane (CH₄), carbon monoxide (CO), sulphur dioxide (SO₂), ammonia (NH₃), hydrogen sulfide (H₂S), oxygen (O₂), nitrogen dioxide (NO₂).

Air samples were taken by drawing air sample into an analyser to determine the concentration of pollutants in the air in situ. 100 g of composite soil samples were taken at a depth of 30cm, packed in a foil paper and wrapped in polythene bags, transported to the laboratory, air dried at <40°C and stored below 4°C for analysis.

A handheld detection instrument (in-situ) was used to measure for Carbon Monoxide (CO), Ammonia (NH₃), Sulphur dioxide (SO_x), Hydrogen sulphate (H₂S), Nitrogen dioxides (NO₂), using the field as measurement, Croweon GASMAN for collection of data. Oxygen (O₂), Methane (CH₄) and Hydrogen was measured using MSA, ALTAIR 5X (Multi Gas Monitor) was used, Haze-Dust particulate meter in-situ for Suspended Particulate Matter (SPM) while Multifunction Environmental Meter in-situ was used for noise level, relative humidity and temperature.

Water samples were collected at the three points into 75cl table water bottles, wellrinsed, filled, labelled and sorted in a cooler for preservation and then transported to the laboratory for analysis. Physical parameters such as conductivity (µs/cm), total dissolved solids mg/l) and temperature (0°) was measured using electrometry method, Nephelometry method was used for Turbidity (NTU) while total suspended solids (mg/l) was measured using Gravimetry Method. In analysing chemical parameters, Reflux method was used to analyse chemical oxygen demand (mg/l), Incubation was used to analyse Biochemical oxygen demand (mg/l), Total alkalinity (mgCaCO₃/l) and Ammonia (mg/l) was analysed using Colorimetry method, the Drop Count Titration method was used for Total hardness (mgCaCO₃/l), Calcium (mg/l) and

Carbonate (mg/l) while Nitrite, (mg/l), Nitrate (mg/l), Sulphate (mg/l) and Total chlorine (mg/l) was analysed using the photometry method. Heavy metals was analysed using Pour plating for Total coliform count, Heterotrophic, Pseudomonas, Salmonella, Shigella and Proteus all (CFU/100ml) and Spectrophotometry for Manganese, Cadmium, Copper, Iron total, Nickel, Zinc and Lead all in mg/l.

To investigate the impacts of solid waste on soil water and air at the study area, information on operations at Gosa dumpsite was obtained to assess its effects on the environment.

1.4 Results and Discussion

1.4.1 Analysis of Soil, Water and Air Quality in the study area

In analysing the quality of air, soil, and water in the study area, the mean standard deviation (SD) was used to determine difference between parameters at both wet and dry season while Analysis of Variance (ANOVA) was used to find variations between and within the three (3) points.

i. Soil quality

Heavy metals and physiochemical parameters were tested for soil quality in Hulimi, Gosa and Ajiyata communities for both wet and dry season, The mean standard deviation (SD) for most analysed parameters as shown on the table below are higher than the WHO/FAO standards at both wet and dry seasons with very few falling within or below the acceptable standards.

Table 1: Results of Physicochemical Parameters of Soil Samples

Mean Results of Physicochemical Parameters of Soil Samples							
	Ajiyata Village		Hulumi Village		Gosa dumpsite		
Location Parameters	Mean	SD	Mean	SD	Mean	SD	STD (WHO/FAO)
Ph	7.5000	0.70711	7.3000	0.70711	7.9000	0.98995	6-9
Temperature 0°	34.0000	3.53553	35.0500	4.17193	34.4000	3.53553	NS
Electrical conductivity (µs/cm)	625.5000	712.056	108.0000	15.55635	390.0000	9.89949	NS
Sand	52.47000	1.52735	50.9600	0.60811	43.1900	9.85707	2.0-0.05
Silt	29.3600	4.82247	27.6450	7.24784	36.6750	9.77929	0.05-0.002
Clay	13.9600	2.65872	18.0450	3.11834	16.2450	5.42351	<0.002
Porosity (%)	45.0000	11.78040	39.9950	9.42573	56.6650	0.00707	0.1
Moisture content	5.3850	0.47376	4.2650	0.21920	6.2150	0.16263	NS
Bulk density g/dm ³	0.8150	0.40305	0.5850	0.00707	0.7520	0.26587	NS
Total organic matter	1.5150	0.16263	1.1600	0.39598	5.0500	3.88909	NS
Available phosphorus	9.5000	0.55154	8.5700	0.45255	11.4050	0.99702	7.83
Total nitrogen (N)	0.4450	0.07778	0.3500	0.08485	0.5100	0.05657	0.098
Sodium (Ng)	0.8350	0.12021	0.5800	0.09899	1.1350	0.26163	0.169
Potassium	1.9100	0.02828	1.7400	0.07071	2.6450	0.94045	0.25
Magnesium (Mg/l)	1.9600	1.56978	1.2400	0.19799	3.6600	1.35765	1.10
Calcium (cu)	6.6450	1.46371	8.4350	0.85560	7.3000	0.84853	1.60

Source: Researcher's Field Survey, 2023

The one-way analysis of variance (ANOVA) shows that there was a statistically significant variations in physicochemical parameters of analysed borehole during the wet season at $p > 0.05$ level, $F(2, 45) = 0.512$, $p = 0.602$ and $p > 0.05$ level, $F(2, 45) = 0.584$, $p = 0.562$ during the dry season.

Table 2: Results of Heavy Metals Analysis of Soil Samples

Mean Results of Heavy Metals Analysis of Soil Samples							
	Ajiyata Village		Hulumi Village		Gosa dumpsite		
Location Parameters	Mean	SD	Mean	SD	Mean	SD	STD (WHO/FAO)
Lead (Mg/l)	1.5100	0.69296	0.41	0.551	2.0850	1.11016	0.5
Cadmium (Mg/l)	1.0150	0.30406	0.00	0.000	2.4800	1.97990	0.01
Manganese (Mg/l)	1.2000	0.05657	0.00	0.000	1.8550	0.07778	0.2
Copper (Mg/l)	1.2400	0.28284	0.54	0.764	5.0200	0.02828	1.5
Iron (Mg/l)	4.9500	0.21213	0.55	0.071	35.0500	3.04056	1.5
Nickel (Mg/l)	0.3550	0.04950	0.00	0.000	1.7500	0.21213	0.1
Zinc (Mg/l)	2.4250	0.12021	1.00	0.00	2.9000	0.42426	50

Source: Researcher's Field Survey, 2023

A paired- samples t-test was conducted to evaluate the mean difference between heavy metal parameters of soil sample during wet and dry seasons in Ajiyata village in Table 4.54. There was a statistically significant mean difference from wet season ($M = 1.72$, $SD = 1.52$) to dry season ($M = 1.91$, $SD = 1.51$), $t(6) = -1.09$, $p > 0.005$ (two-tailed). The mean decrease in heavy metal parameters between wet and dry seasons was -0.184 with a 95% confidence interval ranging from -0.598 to 0.228 .

ii. Air quality

Results for air analysis shows that the mean decrease in air quality parameters between wet and dry seasons for Ajiyata village was -0.565 with a 95% confidence interval ranging from -3.81 to 2.68 , -0.909 with a 95% confidence interval ranging from -2.11 to 0.288 for Hulumi village and -2.57 with a 95% confidence interval ranging from -9.32 to 4.17 for Gosa dumpsite (see table 3 below).

Table 3: Results of Air Quality Analysis

Mean Results of Air Quality Analysis							
	Ajiyata Village		Hulumi Village		Gosa dumpsite		
Location Parameters	Mean	SD	Mean	SD	Mean	SD	STD (WHO/FAO)
Particulate matter $\mu\text{g}/\text{m}^3$	0.09	0.12	0.19	0.071	0.25	0.049	0.25
Noise dB	55.5	6.364	66	2.687	64.9	6.93	60
Relative humidity (%)	48.5	9.192	59.3	0.283	53.5	2.121	37
Temp $^{\circ}\text{C}$	31.5	0.707	30.35	0.354	31	1.414	< 40
CH ₄ ppm	12.5	0.707	8.5	3.536	104.5	21.92	0.6
CO ppm	3.5	0.707	4.5	0.707	12.5	2.121	10
SO ₂ ppm	0.06	0.014	0.01	0	0.06	0.014	0.01
NH ₃ ppm	0	0	0.02	0.007	0.06	0	0.05
H ₂ S ppm	0	0	0	0	0	0	0.05
O ₂ ppm	20.6	0	20.8	0	20.6	0	20.9
NO ₂ ppm	0.08	0.014	0.05	0.07	0.08	0.014	0.06

Source: Researcher's Field Survey, 2023

The one-way analysis of variance (ANOVA) shows that there was a statistically significant variations in the air quality in the study area between parameters in at $p > 0.05$ level, $F(2, 30) = 0.416$, $p = 0.663$. Since the calculated value (0.663) is greater than the p-value (0.05) during the wet season and at $p > 0.05$ level, $F(2, 30) = 0.501$, $p = 0.611$ during the dry season indicating that the calculated value (0.611) is greater than the p-value (0.05).

iii. Water quality

To test for water quality, the physiochemical, bacteriological and heavy metal parameters were tested for in the water samples collected at the three (3) points. Results of the analysis indicates that the mean decrease in physicochemical parameters between wet and dry seasons was -18.43 with a 95% confidence interval ranging from -37.26 to 0.413 , -82.55 with a 95% confidence interval ranging from -181.24 to 16.15 and -63.51 with a 95% confidence interval ranging from -145.99 to 18.97 and for Ajiyata, Hulumi and Gosa respectively (see tables 4 – 6).

Table 4: Results of Physicochemical analysis of Borehole Water Sample

Mean Results of Physicochemical analysis of Borehole Water Sample							
	Ajiyata Village		Hulumi Village		Gosa dumpsite		
Location Parameters	Mean	SD	Mean	SD	Mean	SD	STD (WHO/FAO)
Temperature o°	27.0500	4.17193	27.60	1.838	27.5000	1.69706	< 40
Ph	7.0950	0.99702	7.05	0.785	7.0500	0.77782	6-9
Odour	-	-	-	-	-	-	-
Dissolved oxygen (Mg/l)	8.3150	1.02530	8.05	0.820	8.0500	0.82024	2-8
Electrical conductivity(μs/cm)	248.0000	50.91169	578.00	233.345	598.0000	261.62951	1000
Total Dissolved Solid (Mg/l)	0.0118	0.00021	297.50	109.602	308.5000	125.15790	500
Turbidity (NTU)	2.9000	1.13137	2.50	0.283	3.8000	1.55563	5
Total Suspended Solid (Mg/l)	0.0118	0.00021	0.01	0.008	0.0132	0.00247	30
Total Hardness (Mg/l)	145.5200	12.10567	462.24	314.747	633.4400	72.634	200
Total Alkalinity (Mg/l)	22.5000	10.60660	20.00	7.071	27.5000	10.60660	100
Magnesium (Mg/l)	34.2400	0.00000	94.16	60.528	128.3850	12.08445	50
Calcium (Mg/l)	111.2800	12.10567	368.08	254.219	505.0400	60.52834	150
Carbonate (Mg/l)	46.8000	4.52548	188.60	196.010	144.9000	134.20887	NS
Total Chlorine (Mg/l)	0.9935	1.40502	0.00	0.000	1.8955	0.26234	0.2
Sulphate (Mg/l)	10.0000	0.00000	11.50	2.121	12.6500	3.74767	500
Phosphate (Mg/l)	0.9630	1.02813	0.60	0.849	1.5970	1.50331	5
Nitrate as Nitrogen (Mg/l)	7.5000	6.36396	5.50	6.364	9.8500	5.86899	20
Nitrate as Nitrogen (Mg/l)	8.2850	11.61776	2.50	3.536	10.0630	14.05304	1
Ammonia as Nitrogen (Mg/l)	54.0000	67.88225	11.50	9.192	42.5000	53.03301	10
Biochemical oxygen demand	85.2900	97.28375	359.40	460.185	353.4000	468.67037	7.5
Chemical oxygen demand	50.5000	28.99138	81.50	79.903	61.0000	36.76955	30

Source: Researcher's Field Survey, 2023

The one-way analysis of variance for the physiochemical parameters analysed during the wet season shows that there was a statistically significant variations in bacteriological parameters of analysed borehole at $p > 0.05$ level, $F(2, 57) = 0.105$, $p = 0.900$. While for dry season, it shows that at

$p > 0.05$ level, $F(2, 57) = 1.546$, $p = 0.222$. Since the calculated (0.900 and 0.222 respectively) is greater than the p-value (0.05), it is indicative of a significant variation between physicochemical parameters of borehole water sampled at both seasons in the study area.

Table 5: Results of Bacteriological analysis of Borehole Water samples

Mean Results of Bacteriological analysis of Borehole Water samples							
	Ajiyata Village		Hulumi Village		Gosa dumpsite		
Location Parameters	Mean	SD	Mean	SD	Mean	SD	STD (WHO/FAO)
Total coliform (ML)	800.00	169.710	802.950	1127.198	1600.000	0.0000	1.8
Heterotrophic bacterial (ML)	2.6000	0.845	1.5000	0.14142	2.5000	0.28284	0.0
Salmonella (ML)	1.7800	0.5374	1.0000	0.00000	1.5750	0.17678	0.0
Shigella (ML)	3.2500	1.6264	2.8500	2.19203	4.25000	2.47487	0.0
E- coli (ML)	1.5500	0.6364	1.8500	0.91924	3.2000	1.41421	0.0
Proteus (ML)	2.1000	0.1414	1.7000	0.70711	3.1500	1.62635	0.0
Pseudomonas (ML)	1.7000	0.8485	1.9000	0.70711	2.6000	0.56569	0.0

Source: Researcher's Field Survey, 2023

The ANOVA shows that there was a statistically significant variations in bacteriological parameters of analysed borehole at $p > 0.05$ level, $F(2, 18) = .078$, $p = 0.925$ during the wet season and $p > 0.05$ level, $F(2, 18) = 0.642$, $p = 0.538$ during the dry season. With the calculated values (0.925

and 0.538 for both seasons) is greater than the p-value (0.05), we can then conclude that there is a significant variation between bacteriological parameters of borehole water sampled during the wet and dry season in the study area.

Table 6: Results of Heavy Metal analysis for Borehole Water Samples

Mean Results of Heavy Metal analysis for Borehole Water Samples							
	Ajiyata Village		Hulumi Village		Gosa dumpsite		
Location Parameters	Mean	SD	Mean	SD	Mean	SD	STD (WHO/FAO)
Lead (Mg/l)	0.51	0.692	0.41	0.551	0.51	0.692	0.05
Cadmium (Mg/l)	0.00	0.000	0.00	0.000	0.50	0.707	< 1
Manganese (Mg/l)	0.00	0.000	0.00	0.000	0.00	0.000	0.2
Copper (Mg/l)	0.54	0.7644	0.54	0.764	1.04	0.057	0.1
Iron total (Mg/l)	0.00	0.000	0.55	0.071	0.55	0.071	1.5
Nickel (Mg/l)	1.00	0.000	0.00	0.000	0.00	0.000	0.05
Zinc (Mg/l)	0.50	0.707	1.00	0.00	1.00	0.000	< 1

Source: Researcher's Field Survey, 2023

The ANOVA for heavy metal analysis, shows that at $p > 0.05$ level, $F(2, 18) = .314$, $p = 0.734$ during the wet season and at $p > 0.05$ level, $F(2, 18) = .384$, $p = 0.687$ during the dry season. Since the calculated value 0.663 at both seasons is greater than the p-value (0.05), we can then conclude that there is a significant variation between heavy metal parameters of sampled borehole water in the study area.

1.5 Impact of existing activities at Gosa dumpsite on the environment

The growing number of waste pickers living on the dumpsite in deplorable living conditions as observed during the course of visit to the site is worrisome. The dumpsite in itself does not only pose a risk to the rising waste picking community present at the dumpsite, but also surrounding communities like Hulumi and Aajiyata due to its proximity to the dumpsite.

1.5.1 Impact on Soil Quality

With the accumulation of non-biodegradable waste over time at Gosa dumpsite, areas where these wastes are buried shows scanty growth of plants by migration of contaminants and percolation of leachate into the soil thereby affecting soil strength and stability.

1.5.2 Impact on Air

Activities at the dumpsite as well as constant sparkling and ignition of dumped wastes at the dumpsite results in rising dust and smoke fumes, especially during the dry season which spreads around neighbouring dwellings. The presence of foul and stale odour at the study area is also an issue of concern as shown in analysed samples for air quality which indicates levels higher than acceptable standards by World Health Organisation (WHO) and Food and Agriculture Organisation (FAO).

1.5.3 Impact on Water

From analysis of physical, chemical, bacteriological components as well as heavy metals of waster samples from

the study area, it is evident that the dumpsite is negatively impacting water quality around the environment due to the high levels of contamination recorded. This in itself does not only pose a risk to the rising waste picking community present at the dumpsite but also surrounding communities like Hulumi and Aajiyata due to its proximity to the dumpsite.

1.6 Conclusion and recommendations

Findings in this study indicates that environmental indicators like soil, water and air at Gosa and its environs are currently being affected by the activities at the dumpsite. This has to a large extent affected the environmental quality at the dumpsite and its environs. Most of the parameters tested indicates high levels way above acceptable standards even though the dumpsite is operating far below its capacity at the moment. The need for a modern and mechanized dumpsite within the Federal Capital City (FCC) cannot be overemphasized. Certain pollutants were identified as being responsible for the increasing negative impact of activities of Gosa dumpsite and environs include but not limited to leachate, heavy metals trapped in the soil beneath dumpsite, fumes from burning of solid wastes and other poisonous contaminants.

Also, the inadequacy of waste collection and management systems in place within the Federal Capital city (FCC) results in most areas depending on crude methods of managing and disposing wastes thereby not only is the dumpsite and its environs at risk of negative impact of waste, but the Federal Capital Territory as a whole.

Gosa dumpsite is located within Gosa district which from the Abuja Master Plan is proposed for High Density Residential developments, an indication I observed during the course of this research to be true with the increasing level of upcoming estate developments around the dumpsite. Also, the growing number of waste pickers living on the dumpsite in deplorable living conditions as observed during the course of visit to the site is worrisome. There is urgent need for the management of Abuja Environmental

Protection Board (AEPB) to consider immediate mechanization of the dumpsite to a full sanitary landfill where dumped waste will be processed and treated as a way of mitigating further distortion to the environment, within and around the dumpsite, with increasing residential and industrial developments rapidly coming up around the neighbourhood.

Lastly, the need for general orientation by concerned agencies on the need for waste segregation is of utmost important as this could serve as a means of reducing the effect of solid non-biodegradable wastes poses to the environment. It could also encourage massive recycling and reuse of items as a way of saving the environment which is being invaded by these items in quantum.

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