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SOLID WASTE GENERATION AND DISPOSAL IN OKPA GO-OSOTA RIVER IN DOMA, NASARWA STATE

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ABSTRACT

The rapid increase in urban population is a precursor to an increase in waste generation rates and consequently, indiscriminate solid waste disposal contributing to environmental challenges such as water, soil, and air pollution, blocked water drains, resulting in flooding and water stagnation in drainage paths. The multi – stage research survey was employed for this study. First, water samples were collected (before dumpsites upstream and downstream after the dumpsites) for determination of water quality. One hundred and three (103) questionnaires were administered to the residents in the study area, out of which only seventy (70) were retrieved, which constituted (80%) response rate. The administration of the questionnaires was to illicit respondent's perception on this indiscriminate dumping of waste on these rivers. The results showed that the PH measured upstream (Point A) 6.3 slightly acidic but more acidic downstream (point B) 5.2 compared with the NWQI permissible limit of 6.5 – 8.5. The results also shows that Hardness is generally higher than the maximum permissible limit (150mg/l). Further to this, the results of Nitrates, BOD, and COD is very low because of the presence of abundant micro – organisms existing in this contaminated waters. The Tukey Pos – Hoc analysis for 'within' samples measurements for each point (A and B) average values showed no significance (A = .998, B = .999). However significant difference occurred in average values comparing samples in A1 – A4 and B1 – B4. The study concludes that municipal solid waste generation and control is a serious issue in Doma (Okpa Go-Osota) river; due to its environmental and human health consequence. The solid waste generation and indiscriminate waste disposal on water body in the study area fall below acceptable practice. The study

therefore, recommends that government should make quick efforts to improve present waste disposal and management system of the study area by providing necessary facilities for house to house and street to street waste collections.

Keywords*: River, Disposal, Environment, Chemical Elements, Waste Generation Toxic*.

INTRODUCTION

The rapid increase in urban population is a precursor to an increase in waste generation rates and consequently, indiscriminate solid waste disposal contributing to environmental challenges such as Water, Soil, and Air pollution, blocked water drains, resulting in flooding and water stagnation in drainage paths. In the current world economic paradigms, Sustainable Socio economic development of every community depends much on the sustainability of the environment. The contamination of the environment by anthropogenic practices is globally known to impacts negatively on the environment. The disposal and management of municipal solid waste is a globally challenging issue especially in developing countries due to its adverse environmental effects. Ayuba et al (2013) observed that mankind depends on the environment to sustain their lives and that solid waste is one of the three major environmental problems, other major environmental issues include: Flooding and Desertification in Nigeria and many other developing and even developed countries are threatened by this. Generation of waste is a continuous process in human daily activities. In Nigeria there has been increasing cases of indiscriminate disposal of solid wastes resulting from increasing urban population and urbanization (Jimoh et al 2018). However, one of the major environmental problems faced by developing countries is poor refuse disposal and management (Nwigwe 2008). Solid waste are generated from home, place of work, hospitals, schools, industries among others. Peter et al (2016) observed that in most urban centers in Nigeria, solid wastes are disposed by dumping in open areas as this encourages the growth of disease transmitting organisms to people living around the vicinity. Finance is a major problem of waste control especially for township that are faced with resource shortages and competing demands. As many cities fail to meet minimum acceptance standards with grave adverse effect on the urban environment, public health, quality of life for large city (peter et al, 2016).

Akinola and salami (2001) posited that private sector participation in waste control would be more effective in waste management and that the local government should review its strategy by withdrawal of poor operators from the services, set monitoring team, get rid of cart pushers and make trucks and other equipment available to the operators at subsidized rate. Waste are dumped into the drainages that block the free flow of runoff water and this practice gives rise to flooding and the communities are adversely affected, some people dumped their waste to the road side, thereby reducing the width of the road and aesthetics of the cities and areas especially in Doma. There are heaps of refuse littering, the entire landscape, road sides, Parks, Gardens commercial centers and other land use (Danbuzu, 2011, Imam et al, 2007). The generation and disposal of solid wastes in the world's a problem that continues to grow with urbanization, development of industrialization and growing population (Butu and Bichi, 2013). The problem of solid waste disposal in urban centres in developing countries is a major concern to government and this problem becomes worrisome in Nigeria where municipal waste generation is always on the increase because of increase in population pressure and socio-economics factors (Omole and Alakinde, 2013).

In most cities of Nigeria refuse disposal and storm waste drainage are inefficient, refuse are disposal indiscriminately and there are inadequate defined channels for storm water drainage. It is very common to find the drainage lines being filled up with refuse after rainfall. The refuse from these roadside dumps are very good pollutants of the stream, groundwater and entire and environment. The ugly scene that welcomes guests as one approach Doma, along General hospital is becoming worrisome. Also, the entire River "Okpa Gi-nagbo roadside, and other major routes in the study area are often blocked and emit toxic and harmful odours. In view of these, there is need to assess the effects of indiscriminate solid waste disposal in Doma. And it aimed at the impacts of indiscriminate waste on river and roadside disposal and make positive contribution and suggestion on waste disposal to avert/tackle further deterioration of the communities/environment. The growth of human population couple with increased economic activities has resulted into high rate of solid waste generation, this calls for careful planning and adequate resources allocation to bridge the gap between the rate of waste general and that of collection &

disposal. The ways to handle and dispose waste varies Consider ably within and between cities, regions and ration and disposal in River ikpa osota (WGD) is on the increase in Doma in Particular and Nigeria in general and it is Compounded by a cycle of poverty, population explosion environmental aware ness, and the end poverty, population explosion decreasing standard of living, poor governance and low level of environmental aware ness, and the end product of goods and services and changing life the and consumption pattern(Abdurazack et al., 2013). Sharma (2009)Classified waste generation as garbage which include man made waste from food waste, from food, rubbish Comprised of non – biodegradable or non – decomposable waste either combustible (such as papers, wood and cloths) or non – combustible (such as metals, glass, ceramics and polythene). Ashes comprised of residues of combustible solid fuels, large wastes are made up of demolition and construction debris and trees, dead animals and finally sewage-treatment comprised of materials and biomass. The current state of plastic bag waste pollution in Nigeria is alarming. Several environmental and choking of animals, such as mosaic litters of pure water sachet in the landscape requires urgent attention (Ogwo et al., 2013). Ad ferns and Awoknnmi (2006) emphasized that the reason for the burning of waste generation is economic and affordability on the part of households, but the act is environmentally unfriendly for the ecosystem. Another reason for waste burning is to house critical hygienic problems, but it's implication is more than mere burning, it causes the emission of toxic substance to the air such as dioxins and furans a cancer inducing compound is released into the atmosphere and other ozone depleting &greenhouse gases (Hassan et al., 2010; Sakawi, 2011). Waste generation i.e. when are properly treated or unattended to for a long time constitute some serious health challenges/hazards, causes unwanted and offensive odour, pollute underground water sources and decreases environmental aesthetics and quality waste generation collected are indiscriminate dumped into water ways or water bodies moved from one rivers to the other manner (Mabogunje,1980). The steady increase in the population and communal crises in villages surrounding Doma town and its environs, resulted in increase in population due to influx of people from these villages and other parts of the state. Since water quality issues are health related issues, the Federal Ministry of Health, collaborating with the Standards Organisation of Nigeria working through a technical committee

of key stakeholders developed this Standard. They are saddled with the responsibility of ensuring safe water for consumption and domestic usage (N.W.Q.S., 2024). However, there is a serious violation in terms of wastes disposal which are directly thrown into the river thereby, polluting it. The prescribed safe water quality ideal for domestic consumption is presented in Table 1and 2 below.

Table 1: National Water Quality Standard for Chemical Parameters

Parameter	Unit	Maximum Permitted	Health Impact	Notes
Aluminum (Al)	mg/L	0.2	Potential Neuro-degenerative disorders	Note 1
Arsenic (As)	mg/L	0.01	Cancer,	
Barium	mg/L	0.7	Hypertension	
Cadmium (Cd)	mg/L	0.003	Toxic to the kidney	
Chloride (Cl)	mg/L	250	None	
Chromium (Cr^{6+})	mg/L	0.05	Cancer	
Conductivity	µS/cm	1000	None	
Copper (Cu^{+2})	mg/L	1	Gastrointestinal disorder,	
Cyanide (CN^{-})	mg/L	0.01	Very toxic to the thyroid and the nervous system	
Fluoride (F^{-})	mg/L	1.5	Fluorosis, Skeletal tissue (bones and teeth) morbidity	
Hardness (as $CaCO_3$)	mg/L	150	None	
Hydrogen Sulphide (H_2S)	mg/L	0.05	None	
Iron (Fe^{+2})	mg/L	0.3	None	
Lead (Pb)	mg/L	0.01	Cancer, interference with Vitamin D metabolism, affect mental development in infants, toxic to the central and peripheral nervous systems	
Magnesium (Mg^{+2})	mg/L	0.20	Consumer acceptability	
Manganese (Mn^{+2})	mg/L	0.2	Neurological disorder	

Table 2 - Inorganic Constituents

Parameter	Unit	Maximum Permitted	Health Impact	Notes
Mercury (Hg)	mg/L	0.001	Affects the kidney and central nervous system	
Nickel (Ni)	mg/L	0.02	Possible carcinogenic	
Nitrate (NO_3)	mg/L	50	Cyanosis, and asphyxia ("blue-baby syndrome") in infants under 3 months syndrome") in infants under 3 months	
Nitrite (NO_2)	mg/L	0.2	Cyanosis, and asphyxia ("blue-baby syndrome") in infants under 3 months	
pH	-	6.5-8.5	None	
Sodium (Na)	mg/L	200	None	
Sulphate (SO_4)	mg/L	100	None	
Total Dissolved Solids	mg/L	500	None	
Zinc (Zn)	mg/L	3	None	

Note 1: Parameter to be monitored only if aluminum chemicals are used for water

Source: NWQS, 2007

STUDY AREA

Study Area (Doma Local Government) has a total land area of 5640km.The population census of 1971 gave its population of about 50,000 and that population of 55,000 (NPC, 2006) 138,991. The Local Government Area is made up of three districts are Doma, Rukubi and Agbashi. Doma districts cover a land of about 1204km^2, and has an estimated population of about 138,991 people 2006 census. Doma Local Government Area is situated between Latitude 8.24°N and 8°5^{1}N and Longitude 6°E and 6°30^{1}E. The Local Government shares boundaries with Lafia the State Capital in the West and Nasarawa Eggon Local Government in the West.

Figure 1: Map cf Nigeria Showing Nasarawa Stat e

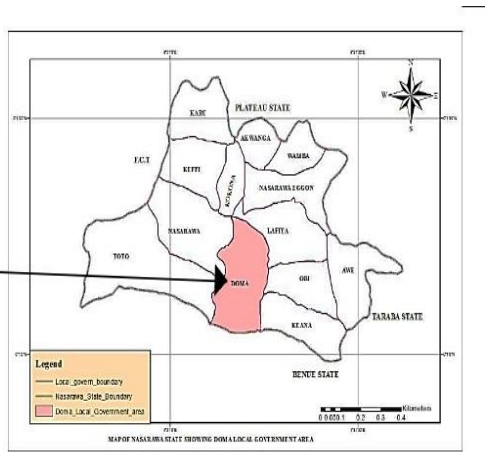

Figure 2: Nasarawa State Showing Doma Local Gover nment Survey Department Area Source: Lands Doma L.G.A

The location of the study areas observed on the geological map of Nigeria; clearly show that, the entire Local Government is a zone of cretaceous sediments (sedimentary Basin) that had been deposited during marine transgression in about 130 million years ago. The commonest minerals found within the study area Galena. Limestone clay, chloride, Sepheterite sodium and Barite. The relief of the area is generally characterized by low land area. The low land area is about 100 – 200 meters above the sea level, although exists a kind of spatial variation in the surface area. This kind relief form bears much greatly influence on the drainage pattern of the study areas. The study area is characterized by streams and rivers. This river and stream dried off their water during the dry season and while the wet season,

the swell off their water or increase their volume of water content. This in turn have a negative impact of economic base of the people in a study area such as fishing and irrigation activities. The rest of the areas is marked by dense vegetable cover. The area has a mean annual rainfall of about 200mm to 300mm and higher temperature exceeding 70°c with relatively high humidity throughout the year justified that the area has in the southern Guinea savannah. Geology, the location of the study area observed on the geological map of Nigeria, clearly show that, the entire Local Government is a zone of cretaceous sediments (Sediment Basin) that had been deposited during the marine transgression in about 130 million years ago. The commonest minerals found within the study area Galena, Limestone Clay, Chloride, Sepheterite, Sodium and Barite. The soils of the study areas are basically tropical ferruginous soil that is slightly acidic reddish brown is Colour sand clay loam texture. Wikipedia (2024). Doma Local Government Council.

METHODOLOGY

This study was conducted on Okpa Go-Osota River in Doma Local Government. The multi – stage research survey was employed for this study. First, water samples were collected (before dumpsites upstream and downstream after the dumpsites) for determination of water quality as a result of contamination from these wastes. From point (A_1) Arumagye River, Okpa Gi-Nagbo River to Osota River at point (A_4) respectively. The water samples collected were subjected to laboratory analysis for some selected physiochemical properties common to solid wastes contamination such as PH, BOD, COD, Total Dissolved Solids, Nitrates, Nitrites, Ammonia, etc. Secondly, a total of One hundred and three (103) questionnaires were administered to the residents in the study area, out of which only seventy (70) were retrieved, which constituted (80%) response rate. The administration of the questionnaires was to illicit respondent's perception on this indiscriminate dumping of waste on these rivers and how it affect their socio – economic lives. A simple Random sampling technique was adopted to select the sample. The data obtained were subjected to statistical analysis after tabulations using the statistical software SPSS version 26. The General Linear Model (Univariate Analysis) was conducted to compare the concentrations of these contaminants before the dumpsites (A1 – A4) and after the dumpsites (B1 – B4) to ascertain

whether these solid wastes have significant increase in pollution of the affected rivers.

Results of Findings

The study focused on solid waste generation on Okpa Go-Osota River, and these settlements along the areas are major contributors of solid wastes to this riverine areas. The results obtained were analyzed and presented as follows;

Responses on Indiscriminate Dumping of Refuse in the Study Area.

Respondents were asked to indicate reason for illegal solid waste disposal (Table 3) slightly half of the respondents were of the view that the main reason for the solid waste disposal in their area was the inadequate or lake of waste collection facilities that were not provided by government.

Table 3: Reason for Indiscriminate Dumping of Refuse

Variable	Frequency	percentage %
Inadequate waste collection facilities	30	42.86
Lack of enforcement of environment and sanitation laws	10	14.29
Absence of timely information on sustainable disposal option	10	14.29
Distance to dump site	20	28.57
Total	**70**	**100.00**

Source: field survey 2024

The results of Table 3 indicates that lack of specified collection centers and facilities is the measure cause of indiscriminate solid wastes in these rivers (42.86%). Other reasons include distance to dumping sites 28.57% and lack of enforcement of environmental sanitation laws in the area. The implication of these setback is that inhabitants here are dumping their waste at their convenience not minding the harmful impacts on their social wellbeing. A typical dumpsite at Okpa Go – Asota River is shown in figure 3 below.

Figure 3: Heap of Solid Waste Generated along the Okpa Go-Osota River

Socio-Economic characteristics of the Respondents

Table 4: Age Bracket of the Respondents

Age (Years)	No. of Respondents	Percentage %
20-30 years	28	40
31-40 Years	28	40
41-50 Years	14	20
51 Years and above	-	-

Source: Field survey, 2024.

Table 4 indicates that 40% of the respondents are in the age bracket 20-30 years while another 40% are within the age bracket of 31-40 years 20% are within the age bracket of 41-50 years. This implies that the respondents even though are adults, are also involved in indiscriminate dumping of waste. It thus implies that there is a serious need for environmental education in the study area in regards to their social wellbeing through proper wastes disposal methods.

Types of waste generated.

Table 5: Major Types of Waste Generated

Items	**Respondents**	**Percentage %**
Solid waste	42	60
Liquid waste	21	30
Industrial waste	7	10
Total	**70**	**100**

Source: Field survey, 2024.

Table 5 below shows that waste (60%) is most generated waste, followed by liquid waste (30%) and industrial waste (10%). It is clearly shown from the table that solid waste is most generated type of waste, a typical heap of waste is also presented here in figure 4.

Figure 4: Heap of Solid Waste Generated covered the bridge of Okpa Go-Osota River

Table 6: Methods of Disposing Solid Waste

Items	Respondents	Percentage %
Open dump	32	46
Burning	18	26
Incineration	8	11
On river body's	12	17
Total	**70**	**100**

Source: Field survey, 2024.

Table 6 revealed the attitude of the people to poor/illegal disposal of refuse and poor and ineffective services rendered by the waste agencies. 46% of the respondents disposed their refuse in open dumps, 26% burnt theirs within the river line while 12% dispose theirs along major roads and paths. 11% disposed their refuse in an incinerator, see figure 5 and 6.

Figure 5: Contaminated Water in Okpa Go-Osota River by Solid Waste Generated

Figure 6: Another heap of Solid Waste Generated covered the bridge of Okpa Go-Os

Table 7 Availability of waste management Agencies

Items	Respondents	Percentage %
Yes No	56 14	80 20
Total	**70**	**100**

Source: Field survey, 2024.

Table 7 shows that 80% of the respondents are aware of waste management agencies while 20% are not aware. This indicates that there are agencies in charge of solid waste management in the study area, however, these agencies from all indications are not serving the purposes of the tasks assigned to them.

Table 8: Effectiveness of service rendered by the Agencies

Items	Respondents	Percentage %
Effective Not effective Indifferent	14 42 14	20 60 20
Total	**70**	**100**

Source: Field survey, 2024.

Table 8 reveals that the services rendered by the waste management agencies are not effective. The implication of this is that, heaps of solid

wastes would continue to accumulate in the study area and disease associated with solid wastes pollutants would also persist in the study area.

Impact of indiscriminate dumping of solid waste on water/river bodies

The effect of illegal solid waste disposal and dumping of refuse on paths and river bodies was also examined and presented in Table 9.

Table 9: Effects of Illegal Solid Waste Disposal on Rivers and Path Ways

Items	Respondents	Percentage %
Offensive Odour on the water	21	30
Presence of disease causing insects	21	30
Contaminated water	28	40
Total	**70**	**100**

Source: Field survey, 2024.

The response revealed the areas of negative impact which include; offensive odour (21%); presence of disease causing insects (21%); contaminated water (28%); the most felt negative effect is that of offensive odour. This implies that solid waste generation and disposal in Okpa Go-Osota River and paths has negative effects on the human health of the residents. In figure 6 and 7, the dumpsites here in the rainy season releases dirty water seeping through this solid wastes and drains into the river thereby polluting it. Further to this, the decomposing organic wastes releases offensive odours that are unbearable making the water very harmful for domestic use for all inhabitants located downstream from the study area.

Figure 7: Another mountain of complex Solid Waste in Okpa Go-Osota River

Table 10: Control of Illegal Solid Waste Disposal on water

	Mean	Rank
There should be penalty for offenders	3.81	1st
Sensitization programmes should be conducted	3.50	2nd
Offenders should be prosecuted Offenders should pay fines	3.44 3.01	3rd 4th

Source: Field survey, 2024.

Table 10 shows the ranking of responses on the control for indecent solid waste disposal in the study area. The respondents opines that there should be penalty for offenders (3.81) which ranked first, followed by conducting awareness/sensitization programmes through the media (3.50) which ranked second.

Figure 8: Contaminated Water in Okpa Go-Osota River by Solid Waste Generated

Physiochemical Analysis results from Samples collection at Points A1 – A4 and Points B1 – B4

Results obtained from laboratory analysis of samples collected from river before the dumpsites and after the dumpsites are presented in Table 11.

Table 11: Results of Sampled Physiochemical Water Parameters before Dumpsites (A1 – A4) and after Dumpsites (B1 – B4)

Parameter	A_1	A_2	A_3	A_4	B_1	B_2	B_3	B_4	Measure
Temperature	29	29.8	30	30	29.1	28	28.2	28.8	°C
P^H	6.4	6.1	6.0	6.8	6.1	4.3	4.1	5.8	
D.O	1.2	2.2	2.0	1.9	2.9	3.0	4.0	4.2	mg/l
Hardness	172	170	167	165	270	380	350	370	mg/l
TDS	100	96	105	110	400	450	500	490	mg/l
Ammonia	0.25	0.5	1.1	1.00	2.90	3.00	3.5	3.2	mg/l
Nitrate	1.0	0.9	0.2	0.3	1.9	2.0	2.0	2.2	mg/l
BOD	0.1	0.1	0.2	0.3	0.4	0.3	0.3	0.4	mg/l
Nitrite	0.2	0.3	0.2	0.2	0.7	0.9	1.00	1.1	mg/l
COD	0.2	0.3	0.2	0.1	0.4	0.5	0.4	0.5	mg/l

Where:

BOD – Biological Oxygen Demand
D.O – Dissolved Oxygen
TDS – Total Dissolve solid
COD – Chemical Oxygen Demand
mg/l – Milligram per liter
°C – Degree Celsius

The results in Table 11 shows that there are variations in concentrations in the physiochemical properties tested between points A and B. These results were subjected to SPSS analysis and results of variation is presented in Table 12.

Table 12: Tests of Significance - Between-Subjects Effects

Dependent Variable: values

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	894741.915[a]	9	99415.768	21.110	.000
Intercept	268024.916	1	268024.916	56.913	.000
item	894741.915	9	99415.768	21.110	.000
Error	329657.821	70	4709.397		
Total	1492424.653	80			
Corrected Total	1224399.736	79			

R Squared = .731 (Adjusted R Squared = .696)

The results of statistical analysis in Table 12 indicates that for all the samples parameters tested, there is significant difference (p = .000) between samples taken from Points A and Points B. The implication of this outcome lies in the higher concentrations of parameters measured downstream compared with the upstream parameters before the dumpsites.

Pos – Hoc Tukey HSD[a,b]			
		Subset	
item	N	1	2
bod	8	.2625	
cod	8	.3250	
nitrite	8	.5750	
nitrate	8	1.3125	
ammonia	8	1.9313	
dissolved oxygen	8	2.6750	
ph	8	5.7500	
temperature	8	29.1125	
hardness	8		255.5000
tds	8		281.3750
Sig.		.998	.999

Means for groups in homogeneous subsets are displayed. Based on observed means. The error term is Mean Square (Error) = 4709.397.
a. Uses Harmonic Mean Sample Size = 8.000. b. Alpha = 0.05.
The Tukey Pos – Hoc analysis for 'within' samples measurements for each point (A and B) average values showed no significance (A = .998, B = .999). However significant difference occurred in average values comparing samples in A1 – A4 and B1 – B4 respectively.

Table 13: Average Values of Measured Parameters and Standard Permissible Limits

s/no	Parameters	Point A (Average)	Points B (Average)	NWQI (Permissible Limits)
1	Temperature	29.70	29.50	
2	P^H	6.3	5.2	6.5 – 8.5
3	DO	1.8	3.5	4.0 (min)
4	Hardness	168.5	343	150
5	TDS	328.5	460	500
6	Ammonia	0.71	3.15	2.0
7	Nitrate	0.61	2.02	40 mg/l
8	BOD	0.17	0.35	6.0
9	Nitrite	0.23	0.93	0.5mg/l
10	COD	0.20	0.45	3.0

Source: author's samples analysis, 2024

The results of table 13 showed that the PH measured upstream (Point A) 6.3 slightly acidic but more acidic downstream (point B) 5.2 compared with the NWQI permissible limit of 6.5 – 8.5. The results in Table13 also shows that Hardness is generally higher than the maximum permissible limit (150mg/l). Further to this, the results of Nitrates, BOD, and COD is very low because of the presence of abundant micro – organisms existing in this contaminated waters.

CONCLUSION

Municipal solid waste generation and control is a serious issue in Doma (Okpa Go-Osota) river; due to its environmental and human health consequence. The solid waste generation and indiscriminate waste disposal on water body in the study area fall below acceptable practice. Where a lots

of waste materials constitute physical nuisance to the water body and environment. Thus, the non-biodegradable substances/materials contain high levels of toxicity of chemical elements and some have been implicated in human body. The biodegradable component/content of the solid waste disposed some at the Okpa Go-Osota are food remains, yard wastes, kitchen consumables and cartons from packaging. The higher concentrations of pollutants downstream after dumping site indicates that these solid wastes is a potential danger to the downstream communities using water from these rivers for their domestic activities. The inhabitants in the study area also suffers from air pollution as a result of offensive odour from decomposing organic matters from dumpsites.

RECOMMENDATION

Based on the above findings, this research proposes the following recommendations that can go a long way to solve this persistent problem in the study area;

1. Residents should be made to pay for the collection of the solid waste they generate.
2. Government sanitary enforcement bodies should propose training of their staff that will educate the residents and also enforce the sanitary laws.
3. Government should make quick efforts to improve present waste disposal and management system of the study area by providing necessary facilities for house to house and street to street waste collections.
4. Public enlighten and awareness programmes should be carried out frequently by the Government through various media to sensitize the people on health implications and environmental dangers of solid waste generation and offenders should be penalized as this will reduced/eradicate the habit of illegal poor/indiscriminate disposal of refuse.

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