EVALUATION OF SOLID WASTE REDUCTION PRACTICES IN KADUNA METROPOLIS

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ABSTRACT: Solid waste reduction practices is the current thinking in the global phenomenon. Though, the practice is still a challenge in the third world nations due to high generation capacity of the waste in most urban areas. Solid waste reduction practices is one of the approaches of solid waste management. Though, the approach aims at ensuring that waste is not generated at all, the approach is still not domesticated in most environmental policies in the developing countries. Kaduna State is exceptional in this case. The state has domesticated the approach as one of the solid waste management practices in the state. The study aims at evaluating the solid waste reduction practices in the metropolis with the view of giving recommendations for improvement. The study divided the urban area into five districts and correlation analysis technique was used as a criteria for establishing the rate of reduction of the solid waste management practices in the metropolis. At the end of the study, it was revealed that Over 17.1% of households are already practicing solid waste reduction by ensuring that waste is not generated at all. Among this, Barnawa District was revealed to be the highest rate of involvement in Solid waste reduction practices in the metropolis. This was the fact that the inhabitants of the area are of high income group and have high knowledge in the solid waste reduction as a management practices of the metropolis compare to other districts. Nevertheless, study established that educational and economic status of any area has effect in the practices of solid waste reduction in their area. Based on the established facts of the study, it was recommended that there is the need for an increased awareness of the practice of solid waste reduction in the metropolis and there is also the need for the establishment of national government policy for waste reduction in the country in general and also there should also be provision of facilities that support the practice among others in the metropolis.
Keywords: Solid Waste, Reduction Practices

INTRODUCTION

Solid waste reduction practices is one of the solid waste management practices that enures that solid waste is not generated at all in the urban area. It is an approach that ensure that waste is sorted and managed from the source. This is a contemporary paradigm shift in waste management as it regard wastes management in urban areas asides reused and recycling. Nzeadibe (2009) exonerated that one of the approaches to ensure effective waste management is solid waste reduction. Friends of the Earth have long

campaigned for increased Reuse and Recycling and more recently for laws requiring better door step recycling collections from the source which is solid waste reduction (Friends of the earth, 2008).

Waste Reduction is one of the components of the currently promoted waste management hierarchy. Resource recovery is the effective way to reduce the need for landfill areas and to save natural resources which is the thrust of this study. The study aims at analysis the solid waste reduction practices in Kaduna Metropolis with the view of giving recommendations for improvement for the management of the urban area. Kaduna urban area is a state capital of the Kaduna State and one of the third hierarchy of urban areas in Nigeria. The urban area housed approximately three millions people and generates a huge tons of solid waste which management of this generated becomes a problem and the problem has generated a thread up effect to the environmental sustainability. As a result of that, the state government through the national policy for environment establishes the state environmental protection authority known as Kaduna Environmental Protection Authority (KEPA). On its approach to environmental management of the urban area, KEPA adopted the principle of reuse, recycling and reduction of waste management in the urban area. Among the approaches, solid waste reduction was given priority as it ensures that waste is generated at all which has a positive effect in reducing the cost collection of the waste and recycling especially when man power and technology the conversion of the waste to other uses is not attainable. Subsequently, this approach considerably become an integral part of the design of new solid waste management practices in the state. Although, this consideration has no formal integration in Solid Waste Management schemes of cities in third world countries, its informal manifestation is visible at home and the community level, where participation can be characterized along age, income and gender. Nevertheless, this approach calls for this study. To achieve the success of this study, the following objectives were outlined ; to examine the scale and pattern of waste Reduction, in Kaduna urban area; and to establish the contributions and implications of this practice in the metropolis. Nevertheless, the study was able to provide answers to the following questions; what is the scale and pattern of solid waste reduction in Kaduna Urban area and what are the contributions and implications of this practice in the metropolis.

Studies on solid waste management are varied between performances of solid waste management scheme. (Mohammed, 2009; Agbesola, 2013; and Ogwuleka 2009; Wilson et al, 2006; Adu, 2012 and Nzeadibe, 2010); design and implementation of waste management programmes (Uwadiegwu 2013, Peter, 1996); and participation or framework of solid waste management (Ukoje 2011). Conventional study on solid waste management has a very wide scope and range and studies on some of them has been carried out in the areas of waste generation, disposal, collection, treatment and disposal which study on this has not been carry out. Study on solid waste reduction practices is one of the components of the current thinking in solid waste management as a sustainable way to manage the ever growing solid waste generation in the urban area.

Description of Kaduna Urban Area

As revealed in figure 1.2, Kaduna Urban area is a state capital of Kaduna State and is one of the third hierarchy of urban area in Nigeria aside Abuja, Lagos, Port-harcourt and Kano. The urban area is located within latitude 10° 34"N and 10°65"N and longitude 7° 33"E and 7° 77"E of the green Witch meridian.
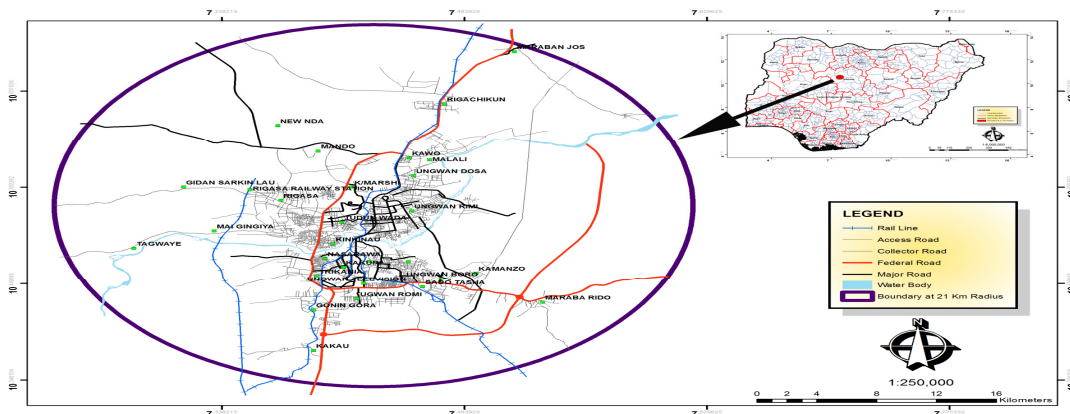

Figure 1.2: Locational Description of Kaduna Urban Area
Source: Field Survey, 2019

REVIEWS OF LITERATURES
Concept of Solid waste

Solid waste is defined as any waste that is dry in form and is discarded by people as unwanted. Burner et al 2002 mention two alternative definitions for solid waste. First, that they are wastes which are produced by private households (residual source), small trade, working places of the tertiary sector

(commercial source), open areas and which are collected by private authorities. Second, that they are wastes generated from residences, community establishments, institutions and to a limited extent industrial facilities. In the context of Integrated Solid Waste Management, waste is regarded both as a negative and as a useful material providing a potential source of income. This real value of waste in many low-and middle-income countries in the South is confirmed by the huge informal sector that live from waste collection and recovery. (Klundert*et al* 2001) categorized solid waste into human activities which includes domestic, commercial, industrial, agricultural, wastewater treatment, etc. meanwhile, World Bank, 1999 classified waste into: Residential waste or domestic waste is generated from households; Agricultural solid wastes could include food residues; Commercial wastes; Industrial waste; Institutional solid waste is produced from public or government institutions, offices, schools, universities, religious institutions, sporting fields, etc. It can be very mixed in its components; and Healthcare waste.

Concept of Solid waste management

Solid waste management is understood as supervised handling of waste materials from source through recovery processes to disposal and, it involves control of generation, storage, collection, transportation, processing and disposal of solid waste with the aim of protecting environment thereby enhancing environmental quality, human health and preservation of natural resources. Solid waste management is the system or procedure of collection, transport, processing, recycling or disposal and monitoring of waste materials. In some instances, waste management is also carried out to recover resources from it. Municipal solid waste management (MSWM) Refers to the collection, transfer, treatment, recycling, resources recovery and disposal of solid waste in urban areas. Conventional Solid waste management can be classified into five main stages. These stages are also referred to as the functional elements of solid waste management. These include onsite handling, storage and processing; Collection; Transfer and transport; Resource recovery and processing; and Disposal.

Methods of Solid Waste Management

The four most common methods of municipal solid waste management are land filling, incineration, composting and anaerobic digestion. Incineration,

composting and anaerobic digestion are volume reducing technologies; ultimately, residues from these methods must be land filled (Seo et al 2004). Land filling is the only true "disposal" method of managing MSW. Incineration is the high-temperature combustion of wastes (EPA 1995b). Composting is the biological decomposition of biodegradable solid waste under controlled, predominantly aerobic conditions. Composting can be done at small-scale on-site facilities or at large-scale commercialized facilities that handle high volumes of organic material. Anaerobic digestion use natural microbial organisms to decompose the organic fraction of Solid Waste (Seo et al. 2004). The non-organic fraction must be land filled or incinerated. These methods reduce the volume of waste that must be land filled, and end products can potentially be used as agricultural fertilizers, or processed into fuels for motor vehicles (Sonesson et al. 2002). However, like incineration, project implementation can be too expensive for poor communities.

Integrated Approach and Hierarchy in Solid Waste Management
The hierarchy ranks waste management operations according to their environmental or energy benefits. In virtually all countries, the hierarchy is shown below, with the first entries having higher priority than those below them. The waste hierarchy is accepted as a key element in integrated SWM. The hierarchy is based on environmental principles which propose that waste should be handled by different methods according to its characteristics, i.e. a certain amount should be prevented either by reducing the content of waste or by reusing the waste; another share of the waste stream should be converted into secondary raw materials; some parts can be composted or used as source of energy, and the remainder may be land filled Zareena (2005)

Table 2.5: Waste Management Hierarchy

Goal	Attributes	Outcome
Reduce	Preventive	Most desirable
Reuse	Predominantly ameliorative Part preventative	
Recycle	Predominantly ameliorative Part preventative	
Treatment	Predominantly ameliorative Part preventative	
Disposal	Assimilative	Least desirable

Source: Schall, 1995

RESEARCH METHODOLOGY

Research Design for the Study

The paper made use of the maxlock classification of Kaduna metropolis into five districts; Kawo, TudunWada, Doka, Makera and Barnawa.The households in Kaduna metropolis made up the sample frame for this study. The metropolis was divided into five districts namely; Kawo, Tudun Wada, Doka, Makera and Barnawa districts. The total population of Kaduna metropolis is 2 148 035 as projected to 2013 which is equivalent to 268504 households based on an estimation of eight (8) persons per household. Each district is made up of wards. The population and total number of households was further divided across the five districts as shown in Table 3.2 below.

Instruments for Data Collection

The instrument for data collection for the study comprises of physical survey and observations, personal interview and questionnaires. Questionnaires were used to collect data from households and the aim is to collect data on scale of solid waste reduction in terms of their participation. Physical survey and observation was also used, the method was used for the purpose of determining the location of the various solid waste management activities and the stakeholders under study within the study area and the stakeholders include the location of recycling markets, middlemen, itinerant workers, dumpsites etc. Further Observation was carried out at the course of this research for the purpose of studying and determining the operational pattern of waste reduction. Meanwhile personal interview survey was also used. It involves talking to people at the point of their activity.

Table 3.2 Household Questionnaire Administration

Districts	Projected population 2016	Percentage	No. of Household
Kawo	510 259	24	63782
Tudun Wada	322774	15	40347
Doka	727075	34	90884
Makera	305904	14	38238
Barnawa	282023	13	35253
Total	2148035	100	268504

Source: NPC 2006 and Field Survey 2019

Sample Size and Sampling Technique

The questionnaire was administered across selected wards from each district. The sample size that was taken for this study was 0.2% of the total households in Kaduna Metropolis, which gave a total of 537 questionnaires for administration across the five districts revealed in table 3.3. Each district was administered a proportion of the total questionnaire in relation to the size of its population as shown in table 3.3.

Table 3.3 Selected Wards for Household Questionnaire Administration

Districts	Ward selected	No. of Household	No. of Administered Questionnaires
Kawo	Unguwansarki, Abakpa	63782	129
Tudunwada	Kurminmashi, Kabala west	40347	81
Doka	Kabala costain/ Doki, Unguwanrimi.	90884	182
Makera	Gonin Gora, Kakuri	38238	75
Barnawa	Narayi and sabontasha	35253	70
Total		268504	537

Source: Field Survey, 2019

Data Required and Sources

The data required for the study were obtained from both the primary and secondary Sources. Five categories of data on waste reduction activities that occur at various scales and by different stakeholder groups was used. The stakeholders include; Households and waste collectors. While Secondary Data was also sourced through Maps, review of relevant literature, which includes unpublished and published material such as textbooks, journals, pamphlets, unpublished thesis, projects and internet source.

Table 3.4: Data Required and Sources for the Study

Data Type	Data Required	Data Description	Sources
Secondary	Information on the study area	Map of Kaduna metropolis to show the spatial scope of the study and Population of the study area.	Google maps and National population commission.
	Theoretical framework	Review of relevant literature on the concept of solid waste management, best practices and models that promote waste reduction, reuse and recycling activities.	Textbooks, published and unpublished journals, the internet etc.

Primary	Solid waste management practice	Generation Reduction	Households Institutions
	Activities by stakeholders	Socio economic profile of participants Natures of waste reduction Scale pattern	Households and institutions etc.
	Implication	Economic implications Environmental implications Social implication	Households, waste collectors, artisans and middlemen

Source: Field Survey, 2019

Data Analysis and Presentation

Analysis of the data collected was done using both descriptive statistical tools and inferential statistical methods. The descriptive statistical tool used for the study include percentages, frequency table and mean score while inferential method used include correlational analysis which SPSS 20 was used. The frequency table was used to show the distribution of those who are engaged in the practice of solid waste reduction and those who are not across the five districts and also their percentages while the mean score was calculated to determine the average percentage of those involved in the practices in Kaduna metropolis. The method was also used to show the distribution of the income and educational level of households. The correlation analysis technique was used to determine the existence of any relationship between the level of participation and the socio economic factors (income and education) of the participant of the solid waste management of the study area. Correlation Analysis is a process of showing the strength of linear relationship between variables. The quantitative index that measures the pattern of variation of one variable vis-a-vis the other is called the correlation coefficient. The values presented were tested at 0.05 percent significance level. Data used on this study were presented using tables and charts. Maps were used to present spatial patterns and scale across the five districts of the metropolis.

ANALYSIS AND PRESENTATION OF RESULT AND FINDINGS
Solid Waste Reduction

The study shows generally that solid waste reduction amongst households is insignificant. In table 4.1, it is shown that only an average of 17.1% of households is involved in the practice. Suggesting that, a greater percentage
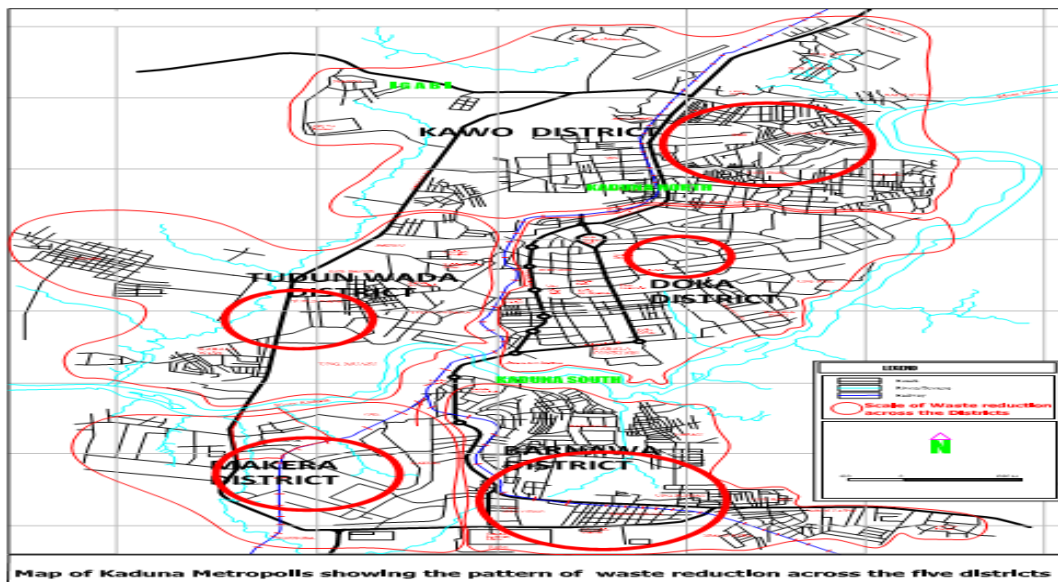
of the population make no conscious effort at minimising waste generation. Households reduce waste mainly through their buying habits by engaging in bulk purchases, avoiding packaging as much as possible, and through purchase of reusable items. At the institutional level, waste reduction occurs through the paperless policy and e-transactions of several public and private organisations especially in the banking sector. The survey, for instance shows that many public institutions (NECO, WAEC, JAMB etc) now use electronic communication and online application templates to screen applicants and conduct examinations as means of waste reduction.

Table 4.1: Households Solid Waste Reduction in Kaduna Metropolis

District	Those who reduce	%	Those who do not reduce	%
Kawo	18	14.4	107	85.6
Tudun Wada	11	14.1	67	85.9
Doka	19	10.7	158	89.3
Makera	10	14.3	60	85.7
Barnawa	31	44.3	39	55.1
Total	89	17.1	431	82.9

Source: Field Survey, 2019

Map of Kaduna Metropolis showing the pattern of waste reduction across the five districts

Source: Field Survey, 2019

Determinants of Solid Waste Reduction Practices
In this section, the pattern and scale of the practice of the waste management hierarchy across the districts is explained. The objective is to

isolate the primary determinants of household involvement in waste Reduction. Two factors are used to establish relationship. These are income and educational level revealed in table 4.2. In the subsections below therefore, the scale of solid waste reduction practice in the districts is correlated against the two factors and explanations subsequently provided. Findings from the study in table 4.2 shows that Barnawa district with the highest number of households engaged in waste reduction is primarily a high income area. It also has significant number of educated persons with 62.9%. This is contrary to what is obtained in other districts (Makera and Tudun Wada) where income and educational attainment is low.

Table 4.2 Income and Educational Level of Households Across the Districts

INCOME LEVEL										
Level	Kawo		Tudun Wada		Doka		Makera		Barnawa	
	No	%	No	%	No	%	No	%	No	%
Below 10000	15	12	16	20.2	12	6.8	7	10.2	2	2.9
11000-20000	17	13.6	8	10.1	32	18.1	32	45.3	5	7.1
21000-30000	39	31.2	22	28.7	45	25.4	17	24.2	9	12.9
31000-40000	35	28	20	25.8	30	16.9	8	11.2	23	32.9
41000 above	19	15.2	12	15.2	58	32.8	6	9.1	31	44.2
Total	125	100	78	100	177	100	70	100	70	100
EDUCATIONAL LEVEL										
Level	No	%	No	%	No	%	No	%	No	%
Quranic	23	18.4	9	11.4	15	8.5	6	8	2	2.9
Adult	16	12.8	6	7.7	20	11.3	7	10	8	11.4
Primary	39	31.2	25	32.1	38	21.4	18	27	5	7.1
Secondary	37	29.6	30	38.5	61	34.5	28	40	11	15.7
Tertiary	10	8	8	10.3	43	24.3	11	15	44	62.9
Total	125	100	78	100	177	100	70	100	70	100

Source: Field Survey, 2019

Correlation Between Income and Educational Level and Solid Waste Reduction

The correlation statistical analysis technique was employed to establish whether a relationship exists between income, education and waste reduction across the districts. This was done in other to measure the strength of the relationship between the practices of waste reduction and each of the factors (income and educational level). The values presented were tested at 0.05 percent significance. At the end of the analysis, the result in table 4.3 showed that the correlation between solid waste reduction and household income is

insignificant with a correlation value of 0.029 and a P value of 0.012 which is more than the alpha significance value of 0.005. This implies that household income does not influence the practice of waste reduction. The results obtained for the correlation between Educational level and the practice of waste reduction showed that there is a high positive correlation with a correlation value of 0.81 and a P value of 0.002 which is less than the alpha significant value of 0.005. This implies that households whose educational level is high especially up to tertiary level are more likely practice waste reduction.

Table 4.3 Correlation Between Income and Educational Level and Solid Waste Reduction

	Reduction	income
	-0.193	0.29
Pearson Correlation	0.012	1.000
Sig. (1-tailed)	0.177	0.177
	Reduction	Education
	1.000	0.81
	0.002	1.000
Sig. (1-tailed)	0.000	0.000

Source: Author's Computation Using SPSS 20

SUMMARY
From the survey conducted across the five districts of Kaduna metropolis and also across the various participants, the practice of solid waste reduction is active at various scales and pattern; these can serve as a platform on which sustainable solid waste management can be achieved. The study revealed that Over 17.1% of households are already practicing solid waste reduction by ensuring that waste is not generated. The experiences of these households even though few in number, can provide lessons that can be used to promote waste reduction in Kaduna metropolis.

CONCLUSION
The practice of the waste Reduction is globally considered as the most sustainable alternative in waste management, it also has significant implication on the environment. The practice has the potential of cutting down Government budgetary spending on solid waste management, thereby making funds available to other critical sector of the economy. E-governance practices will also cut down on spending on administration by both the government and private sectors. Furthermore, the practice of solid waste

reduction has great implication on the environment as it reduces the need for landfills and also the rate at which resources are consumed which is growing at a rate that is not sustainable. This study has confirmed this practice in Kaduna metropolis. It has also shown where the city is with respect to this practice.

RECOMMENDATIONS

Based on the established facts on the solid waste reduction practices in Kaduna State, the following recommendations were given for improvement in the solid waste management in the state and the country in general.

Need for National Government Policy on Waste Reduction

Government should encourage manufacturing companies in Kaduna to cut down on the volume of their packaging of items, in order to reduce the volume of waste generation. The government should also ensure that all its agencies, ministries and parastatals comply with the e-governance principle. Where most of its activities and communication are done online there by cutting down on the volume of paper waste generation. Likewise all applications and registration e.g. certificate of occupancy, civil service application etc. Also, these practices are important sources of employment for scavengers, middlemen, artisans and retailers of recycled product which is support by the increasing solid waste generation. To sustain this potential, the government of Kaduna state should support solid waste recycling through incentives such as lower tax rates and also provision of infrastructure such as roads etc. to support the establishment recycling industries.

Programmes and Incentives

The Kaduna state Government through its agencies (the Ministry of Environment and Kaduna Environmental Protection Agency) and the local government should initiate a "zero waste" program. This programme should be pursued by giving the proper incentives to waste management companies and convenient options to consumers and business to encourage them to divert waste through a recycling system. The government should also establish a reward system with the city's waste management contractors to reward them for reducing the amount of waste that is sent to landfills rather than paying by the pound for waste disposal. This will encourages the companies to develop reduction, reuse and recycling programs that will be

attractive to consumers thereby making them participate more in these practices.

Need for Better Packaging Materials

Plastic bags are often the focus of waste reduction initiatives. Usually, shoppers expect to receive a plastic bag with every purchase. The weight of these bags is small, but they may be regarded as a priority for waste reduction because of the nuisance and the visual impact of plastic bags transported by the wind. The consumption of plastic bags by livestock is a cause of concern in some countries, because it is the cause of many animal deaths. Awareness campaigns to persuade the public to reuse plastic bags or to take their own robust and reusable (cotton or polypropylene) bags when they go shopping. Secondly, supermarkets should charge for plastic bags and encourage shoppers to purchase strong reusable bags. Also, the use of strong paper bags instead of plastic bags and government should ban the use of very thin plastic bags (which are considered to cause most problems) or of all types of "one trip" plastic bags. Others should include the use of bags made of biodegradable plastic (which is not reducing the number of bags but instead reduces the pollution potential) and shoppers should urged to select goods with less packaging.

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