ASSESSMENT OF E-WASTE COLLECTION AND DISPOSAL ACTIVITIES IN GOVERNMENT AGENCIES, BUSINESS AND RESIDENTIAL AREAS IN MINNA METROPOLIS, NIGER STATE

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Abstract: *E-waste and its devastating effects to human existence is one major global concern today. This study was designed to Assess E-waste collection and disposal activities in government agencies, business and residential areas in Minna metropolis, Niger State Nigeria. The research adopted a descriptive survey design. The target population was 226,661 and sample of 311respndents was taken from NESREA 34, NISEPA 53, FME 24, USER 100 and REPAIRERS 100 in Minna metropolis Niger State. A 22 items structured questionnaire items was used for data collection. The instrument was validated by three experts and Cronbach Alfa (K-R20) statistic was used to ascertain the extent of homogeneity of the items and reliability coefficient of 0.89 was obtained. Data was collected and analyzed using statistical package for social science (SPSS version 20), mean and standard deviation were used to answer the research questions, while ANOVA was used to present the hypothesis at 0.05 level of significant. The findings of the study show that, E-waste is sorted out from solid waste at the point collection before disposal, E-waste are dumped indiscriminately along the streets and the individual that generate E-waste are responsible for the disposal. The study recommended among other, that Government should put in place effective monitoring system for management of e-waste in Niger State Nigeria.*

Keywords: E-waste, Electrical & Electronic waste, Nigeria

1. INTRODUCTION

Electrical and Electronics Equipment waste is a global concern that needs to be addressed critically. Electrical and Electronics Equipment (EEE) is any item with circuitry or electrical components that uses electrical power or battery supply in homes, offices and business areas. Morgan (2006) describes e-waste as Waste Electronic and Electrical Equipment (WEEE) that are discarded because they have reached their end of life usage. Due to continuous development and high demand of new models of electrical gadgets, EEE becomes technologically obsolete in a matter of months and this contributes to a great increase in electronic waste, which is a threat to the environment and our health (Greenpeace International 2010). There is dare need for E-waste to be collected properly from the government areas Business and Residential areas. E-waste Collection activities is the way Eol equipment are collected from the users and business areas for proper disposal. There are various possible ways of organizing collection systems, In developed countries, e-waste collection is organized to be collected at a point, where consumers are obliged to hand in their obsolete devices (Huisman*et al.* 2008), the extended producer responsibility plan takes care of the product manufactured by the manufacturers, the users of EEE are meant to return the Eol equipment to the manufacturers, but in Nigeria and Niger State in particular the informal method of collection of E-waste is still in operation. At the residential areas EEE are being used and at the end of their life cycle are discarded and collected by the scavengers and finally brought to small- and medium-sized scrap metal yards, where they are manually dismantled, sorted, stored and sold to traders. Fractions

without value are discarded or burned. This practice exposes the collectors to a lot of health hazard and causes environmental pollution.

Collection of E-waste is considered as a preceding stage to the recycling and refurbishment operation (Blaser & Schluep, 2012). Collection of e-waste and its proper segregation is a challenging task and Niger State Environmental Protection Agency (NISEPA) is in charge of handling this great task also individuals seeking for livelihood go about to pick Eol gargets and other metallic objects from homes and environments. The e-waste collection and disposal activities in Niger State being organized by NISEPA pick up obsolete electrical and electronic products that are disposed from our streets and environment. The informal waste collectors (scavengers) also move round Minna to pick the Eol gadgets with their pushcarts. Most of the collectors buy such e-waste for small amounts of money from businesses or private households. The final effect of the end of life (Eol) gadgets produces a lot of hazardous toxic substance such as Lead, Mercury and Brominated Flame Retardants (BFRs) these constitute a great environmental and health threat. There is therefore need for proper disposal of E-waste.

Disposal practices are operations which include physico-chemical or biological treatment, incineration and deposition of E-waste in secured landfill or dump site. A dump is a piece of land allocated for the public to dispose unwanted waste. Finlay (2013), observed that wastes disposed at landfill are carelessly dumped and are often not closely monitored. Okebukola, (2001), also pointed out that inappropriate disposal of waste is a factor that spreads gastrointestinal and parasitic disease primarily caused by vectors. Nothing is as important as human health, Health is wealth as it is commonly said, healthy people contributes greatly to the wealth of a Nation, it is therefore the responsibility of individuals household, communities, organizations and the government to promote healthy environment by proper disposal of e-waste. The impact of e-waste on human health and environment has a direct link on how they are disposed.

The four common methods of e-waste disposal are incineration, land-filling, open dumping and recycling. However, the most practicable option for e-waste disposal in the recent time is the re-use and recycling method (Olakitan *et al* 2012). E-waste is commonly disposed in landfills where no separate collection and recycling systems have been established. The use of a landfill is a conventional method for the disposal of all types of waste, but in the case of e-waste, it must be regarded as environmentally unsuitable. Landfills is not environmental friendly, it causes health hazard to the dwellers in the neighborhood, this is because landfills do not provide real solution to effective disposal of e-waste as expected and the landfills eventually leak, because they were either built prior to the introduction of modern-day designs, or owing to errors in the construction or management of modern-day sites. Owners of modern landfills argue that recently constructed landfills are capable of safely isolating from the environment the pollutants found in electronic (Swana, 2004). Schmidt, (2006) argued that old landfills accepting E-waste will cause groundwater contamination. E-waste can be incinerated if it cannot be recycled and disposed safely in a landfill, owing to excessive toxin. Materials and products that cannot be recovered any more should be disposed adequately. The disposal process is implemented either when the physical value of recovery could not be achieved or when the economic and technological cost would be too high (Fleischmann, 2000).

The consequences of the current disposal practices of e-waste in Nigeria and Minna Niger State involves toxic materials being exposed and it has adverse effects on human health and environment which calls for assessment.

Assessment is the process of collecting facts about the happenings, characteristics and outcomes of a programme or issue in order to make judgment, improve the effectiveness of the programme (Patton, 2008). Lack of proper implementation of the laws and regulations for environmental legislations especially in E-waste have made collection and disposal of E-waste

more complicated. It was on this note that this study assessed E-waste collection and disposal activities in government Agencies, business and Residential areas in Niger State.

1.1 Statement of the Problem

Rapid advancement of technologies has increase E-waste generation in Government Agencies, Business and Residential areas, evidence of this is shown with lots of discarded E-waste being littered around our environment and water ways. E-waste management activities such as collection and disposal according to Terada, (2012) appears to be inefficient and inadequate and therefore pose a huge risk on human health and the environment. Niger State environmental protection agency (NISEPA) saddled with the responsibility of managing e-waste is mostly concerned only in collection and disposal of solid waste. Effort by the regulatory authorities seems to have little or no effect in the management. E-waste regulation seems not to be adequately adhered to, this is obvious going by the increasing amount of e-waste in our environment, and hence this study is set out to assess the E-waste management activities in government agencies, business and residential areas in Niger State, Nigeria.

1.2 Research Questions

1. What are the E-waste collection Activities in government agencies, business and residential areas in Minna metropolis, Niger State?
2. What are the E-waste disposal Activities in government agencies, business and residential areas in Minna metropolis, Niger State?

Hypotheses

Ho_1. There is no significant difference in the mean responses of E-waste regulators, EEE repairers and EEE Users as regards E-waste collection practices in Minna, Niger State

Ho_2. There is no significant difference in the mean responses of E-waste regulators, EEE suppliers and EEE users as regards E-waste disposal practices in Minna, Niger State.

2. METHODOLOGY

The research design used for this study was the descriptive survey research design. The area of this study was Minna Metropolis Niger State, Nigeria. The target population for this study was 226,661 subjects which includes EEE repairers, EEE Regulatory bodies, and EEE Users. Purposive sampling was used to select 100 craftsmen with 10 years and above experience. This is because craftsmen with 10 years and above' experience have more experience on the job. Convenient sampling where used to select 100 EEE users reason been that they are many and they are of the same characteristics. Regulatory bodies NISEPA 53, NESREA 34 and ministry of Environment 24 respondents totaling 311rspondents. A structured questionnaire of five point scale was used and was validated by three experts from Federal University of Technology Minna, reliability coefficient of 089 was obtained using Cronbach Alfa. A 22 items questionnaire was used for data collection. Statistical package for social sciences was used for data analysis (SPSS version 22.00). Mean and Standard deviation were used to answer the research questions. Analysis of Variance (ANOVA) was used to present null Hypotheses at 0.05 level of significance.

2.1 Results

Research Question 1

What are the E-waste collection practices in government agencies, business and residential areas in Minna metropolis, Niger State?

Table 1: Mean with standard deviation of regulatory bodies, EEE Repairers, and EEE Users on the E-waste collection practices

SN	ITEM	REGULATORY BODIES		USERS		REPAIRERS		AVERAGES		REMARK
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	
1	E-waste is separated from other waste at the point of collection before disposal.	3.53	1.01	3.26	.96	3.34	.75	3.38	.91	Agree
2	Door to door collections are used in collecting e-waste in the State.	3.41	1.05	3.33	.74	3.09	.82	3.28	.87	Agree
3	There is lots of refuse collection centers close to government, business and residential areas.	3.69	1.07	3.13	.92	3.00	.89	3.27	.96	Agree
4	All e-waste is collected in dustbins in homes, offices and business centers.	3.59	1.11	3.28	.87	3.04	.85	3.30	.94	Agree
5	Proper monitoring of e-waste collection in Niger State is carried out.	3.42	1.07	3.01	.87	3.05	.70	3.16	.88	Agree
6	Landfill site is earmarked for e-waste collection.	2.80	1.20	2.88	.94	2.98	1.04	2.89	1.06	Disagree
		REGULATORY BODIES		USERS		REPAIRERS		AVERAGES		REMARK
SN	ITEM	Mean	SD	Mean	SD	Mean	SD	Mean	SD	
7	There is repacking facility after collection in the state.	2.84	.93	3.06	.77	2.98	.67	2.96	.79	Disagree
8	Waste collectors in the State pick up e-waste daily and on time.	3.50	1.08	3.20	.83	3.18	.86	3.29	.92	Agree
9	Standard vehicle is used by Niger State environmental protection Agency, (NISEPA) for transporting generated e-waste to the final site	3.38	1.24	3.22	.85	3.07	.74	3.22	.94	Agree
10	Inventory of e-waste are kept properly by the regulatory Agencies	3.09	1.11	2.98	.87	2.89	.91	2.99	.96	Disagree
11	Documented procedures for monitoring e-waste collection are kept by the Regulatory Agency.	3.25	1.22	3.00	.97	3.00	.76	3.08	.98	Agree
12	There is regular training of personnel in e-waste management.	2.77	1.26	2.94	.81	3.09	.72	2.93	.93	Disagree
	GRAND MEAN	**3.27**	**1.11**	**3.11**	**.87**	**3.06**	**.81**	**3.15**	**.93**	**Agree**

KEY: SD = Standard Deviation, EEE = Electrical Electronic Equipment

Result in Table 1 show that the mean of items 1, 2, 3, 4, 5, 8, 9, 11 are within 3.08-3.38 which is an indication that these are collection practices carried out in the study area. Mean of items 6, 7, 10 &12 ranges between 2.89 - 2.99 indicating that these collection practices are not carried out. The standard deviation values for 8 items in table 4.1ranges from .87 -.98 indicating that the responses of the respondents are close to each other which imply that the respondents have similar opinion on the collection practices in Minna, Niger State. SD for other items which ranges from .79 - 1.06 indicates that the respondents are of different opinion with regards to collection practices in Niger State. Meanwhile, the grand mean of all the respondents is 3.15

which signify that most respondents agreed with the collection practices in management of E-waste in Minna Niger State.

Research Question 2: What are the E-waste disposal practices in government agencies, business and residential areas in Minna metropolis, Niger State?

Table 2: Mean with standard deviation of government regulatory bodies, EEE repairers, and EEE users on E-waste disposal practices

SN	ITEM	REGULATORY BODIES		USERS		REPAIRERS		AVERAGES		REMARK
		Mean	SD	Mean	SD	Mean	SD	Mean	SD	
1	E-waste is disposed along with other waste in the landfills.	3.62	1.28	3.45	.76	3.54	.91	3.54	.98	Agree
2	Special dumpsite is allocated for disposal of E-waste.	2.98	1.13	3.02	.81	2.95	.84	2.98	.93	Disagree
3	Individuals and organizations can freely dispose there e-waste at the dustbin.	3.92	.82	3.21	.93	3.41	1.09	3.51	.95	Agree
4	E-waste is dumped indiscriminately along the streets.	3.36	1.07	3.24	.99	3.29	1.06	3.30	1.04	Agree
5	State environmental agency monitors e-waste disposal practices.	3.36	1.07	3.10	.78	2.80	.84	3.09	.90	Agree
6	Relevant industrial technological device are used for recycling e-waste.	2.73	1.04	2.99	.84	2.89	.87	2.87	.92	Disagree
7	There is proper labeling of items after sorting.	2.72	.97	2.78	.86	2.96	.91	2.82	.91	Disagree
8	E-waste is disposed within government, business and domestic areas.	3.36	1.01	3.09	.81	3.36	1.03	3.27	.95	Agree
9	The persons that generate e-waste are the one that is responsible for the disposal.	2.87	1.06	3.14	.83	3.34	.82	3.12	.90	Agree
10	E-Waste is disposed by licensed agency.	3.08	1.29	2.79	1.07	2.87	.95	2.91	1.10	Disagree
	GRAND MEAN	**3.20**	**1.07**	**3.08**	**.87**	**3.14**	**.93**	**3.14**	**.96**	**Agree**

Table 2, shows the mean and standard deviation on the disposal practices in E-waste management. The mean of items 1, 3,4,5,8, and 9 ranges between 3.09 - 3.54. This shows that these are the disposal practices in the study area. Items 2, 6, 7, and 10 where rejected because their means lies between 2.82 - 2.98 in essence, these were never practiced. Meanwhile, the grand mean show that almost all the respondents agree on the items raised. The standard deviation value of 6 items in table 4.2 ranges from .95 -1.10 which can be inferred that the respondents were closer to each other in their responses.

2.2 Hypothesis
HO_1 There is no significant difference in the mean responses of E-waste regulators, EEE repairers and EEE Users as regards E-waste collection practices in Minna, Niger State

Table 3: Analysis of variance of the mean responses of E-waste regulators, EEE repairers, EEE Users as regards E-waste collection practices in Minna, Niger State

	Sum of Squares	do	Mean Square	F	Sig.
Between Groups	1.587	2	.794	3.632	.028
Within Groups	47.196	216	.218		
Total	48.783	218			

Table 3 shows the one-way between-groups analysis of variance that was conducted for the mean responses of E-waste regulators, EEE repairers, EEE Users as regards E-waste collection practices in Minna, Niger State. The result of the analysis showed an f-ratio of 3.632 and a significance criterion (sig) of .028 which is less than the p-value of .05. Therefore the null hypothesis was rejected. Hence, there is a significant difference in the mean responses of E-waste regulators, EEE repairers, EEE Users as regards E-waste collection practices in Minna, Niger State.

Table 4: Post-hoc comparisons using Tukey HSD test on the difference in the mean responses of E-waste regulators, EEE repairers and EEE Users as regards E-waste collection practices in Minna, Niger State

(I) Group	(J) Group	Mean Difference (I-J)	Std. Error	Sig.	95% Confidence Interval Lower Bound	95% Confidence Interval Upper Bound
REGULATORY BODIES	USER	.16444	.07497	.075	-.0125	.3414
	REPAIRER	.21330*	.08553	.036	.0114	.4152
USER	REGULATORY BODIES	-.16444	.07497	.075	-.3414	.0125
	REPAIRER	.04887	.07816	.806	-.1356	.2333
REPAIRER	REGULATORY BODIES	-.21330*	.08553	.036	-.4152	-.0114
	USER	-.04887	.07816	.806	-.2333	.1356

*. The mean difference is significant at the 0.05 level.

Table 4 shows the result of the Post-hoc comparisons using the Tukey HSD test on the difference in the mean responses of E-waste regulators, EEE repairers and EEE Users as regards E-waste collection practices in Minna, Niger State. The results indicated that the mean response for regulatory bodies (whose mean difference was -0.16444, and a significance criterion (sig.) of 0.75) was significantly different from the mean response for repairers (whose mean difference was 0.21330 with a sig of 0.036). However, the mean responses for users did not differ significantly from either the mean responses regulatory bodies or repairers.

2.3 Hypothesis Testing
H_{O2} There is no significant difference in the mean responses of E-waste regulators, EEE suppliers and EEE users as regards E-waste disposal practices in Minna, Niger State.

Table 5: Analysis of variance of the mean responses of E-waste regulators, EEE repairers, EEE Users as regards E-waste disposal practices in Minna, Niger State.

	Sum of Squares	do	Mean Square	F	Sig.
Between Groups	.573	2	.287	1.474	.231
Within Groups	42.018	216	.195		
Total	42.591	218			

Table 5 shows the one-way between-groups analysis of variance that was conducted for the mean responses of E-waste regulators, EEE repairers, EEE Users as regards E-waste disposal practices in Minna, Niger State. The result of the analysis showed an f-ratio of 1.474 and a significance criterion (sig) of .231 which is greater than the p-value of .05. Therefore the null hypothesis was accepted. Hence, there is no significant difference in the mean responses of E-waste regulators, EEE repairers, EEE Users as regards E-waste disposal practices in Minna, Niger State.

3. DISCUSSION OF FINDINGS

Finding on research question 1 reveals that E-waste are separated from other waste at the point of collection before disposal. In addition to this, the null-hypothesis which was tested at 0.05 level of significance revealed that there is a significant difference in the mean responses of E-waste regulators, EEE repairers, EEE Users as regards E-waste collection practices in Minna, Niger State. A post-hoc comparisons using the turkey HSD test was conducted and it revealed that significant difference was in the mean responses of regulatory bodies. These findings are in consonance with the findings by Sharma (2015) who reported that recovery of metals and other perceived working parts such as memory chips, Integrated Circuits (IC), aluminum, copper and steel from an obsolete EEE has to undergo dismantling and separation and the extracted materials are then sold to traders. The informal waste collectors (scavengers) use to move round Metropolis to pick the Eol gadgets with their pushcarts. Most of the collectors buy such e-waste for small amounts of money from businesses or private households. Due to the insufficient means and facilities used for waste transportation there is limit of the amount of waste that can be transported to the dumpsites per day. This may be responsible for the separation at the point of collection before disposal.

The finding also revealed that waste collection is on daily basis and waste collection centers are kept close to government, business and residential areas. This finding is in line with the report by Oteng-Ababio (2012) who stated that despite the effectiveness of the formal sector, the informal sector operators dominate the e-waste management sector and they have active strong networks, employ very cheap labor and are able to access areas, communities and door to door collection of e-waste paying for the waste they collect. This statement is evident because the waste collectors are everywhere on the street picking the waste without much control from government. The result of the analysis in hypotheses 1 showed that there was significant difference in the mean responses of E-waste regulators, EEE repairers, EEE Users as regards E-waste collection practices in Minna, Niger State.

The finding on the E-waste disposal practices in government agencies, business and residential areas, research question 2, revealed that E-waste is disposed along with other waste in the landfills by Individuals and organizations. E-wastes are dumped indiscriminately along the streets of Minna. This is in agreement with Finlay (2013) who reported that wastes disposed at this landfill are carelessly dumped and are often not closely monitored. Okebukola (2001) also observed that inappropriate disposal of waste is a factor that spreads gastrointestinal and parasitic disease primarily caused by vectors. This may be responsible for the negative impact of e-waste on human health and environment which has a direct link on how they are disposed. Schmidt (2006) argued that old landfills accepting E-waste will cause groundwater contamination, he stated that E-waste can be incinerated if it cannot be recycled and disposed safely in a landfill, owing to excessive toxin.

Findings emanating from table 2 revealed that E-wastes are dumped indiscriminately along the streets and the persons that generate e-waste are responsible for the disposal. NISEPA (2010) reported that this is not a good development because of the various health implications attached to e-waste. Open dumpsites are usually found in developing countries that do not have the landfill/incineration infrastructure, Niger State falls under the category among other

countries that have institutional, legal and financial challenge and weak administrative structures which results in open dumpsites. This finding is also in agreement with that of Musa, Saidu and Musa (2016) who stated that NISEPA and other stakeholders responsible for waste disposal should be more dedicated in the fight to minimize waste in the city, and government should provide more funds and employ some current measures in collecting and disposing of waste. Mavropoulou (2015) argued that open dumpsites needs large land designated for the dumping of municipal waste, hazardous e-waste and other types of waste. The result of the analysis of hypotheses 2 showed that there is no significant difference in the mean responses of E-waste regulators, EEE repairers, EEE Users as regards E-waste disposal practices in Minna, Niger State. The opinion of the respondents are close, this may be due to the way E-waste are seen littered around the streets and corners of metropolis.

4. CONCLUSION

The high demand for electrical and electronics equipment globally contributes to a great increase in electronic waste, which constitute a threat to the environment and our health. Several attempts has been made towards zero E-waste community but have not yielded satisfactory result. Consequently, this study assessed the E-waste collection and disposal activities in government Agencies business and residential area in Niger State Nigeria. The study found out that E-waste is not collected and disposed adequately in Niger State.

4.1 Recommendations

The following recommendations were made based on the findings of the study:
1. Environmental agencies should make sure that E-waste is separated at the point of collection before disposal and Collection of e-waste should also be on daily basis while waste collection centres should be kept close to government, business and residential areas.
2. E-waste regulators should make sure that E-wastes are not dump indiscriminately along the streets and the individual that generate e-waste should be responsible for the disposal

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