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Full Length Research Paper

Electronic Waste Disposal: An Emerging Environmental Challenge in Enugu, Nigeria.

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Abstract
One of the indices of modern life in every human society today is the presence of electronic gadgets, ranging from fridges, televisions, computers to mobile phones. Although these gadgets have socio-economic value to this modern era, their use associated with the problem of improper disposal of electronic waste. Despite the efforts of the federal government of nigeria at redressing improper dumping of e-waste, the problem is increasing in enugu in heaps and bounds. The aim of the study is to identify the root causes of improper disposal of e-waste with a view to recommending appropriate modern methods for effective disposal of e-waste in enugu urban.

Keyword: *Electronics, devices, e-waste, disposal, waste management, enugu*

Introduction

Over the years, there has been a rapid rate in importation of electronic devices to developing countries, including Nigeria. This is largely as a result of growing sophisticated lifestyle and the socio-economic value attached to these electronic devices in modern society. These devices are fridges, cookers, television, radios, and computers, among others. Despite the high economic and social values of these electronic gadgets, there are serious problems associated with their uses in both households and offices. One of these problems is improper disposal of waste products of electronic equipment. Electronic or e-waste contain over 1000 different substances many of which are toxic and potentially hazardous to the environment and human health if they are not handled in an environmentally sound manner (MOEF, 2011).

Some studies on e-waste coronate this fact. Previous studies on e-waste in India showed that cyclogenetic damage effects have been found among the residents who live in the polluted areas (Sivakumar, et al, 2011). Similarly, improper disposal of e-waste poses both health and environmental problems in Gaborone city, Botswana (Mburu and Teduotso, 2013). In Nigerian cities, improper disposal of e-waste poses significant threat in form of pollution to soil biota, soil quality and underground water (Ewuim et al, 2014). For Instance, Babatunde et al (2014) noted that majority of phone users in Lagos indiscriminately dispose phone or battery thereby causing health and environmental hazards. Okoye and Odoh (2014) studied the mode of e-waste disposal and revealed that people dispose e-waste along side municipal waste with the danger of air and soil pollution associated with it in Onitsha.

In a bid to redress the problem, the Federal Government of Nigeria promulgated Decree 42 of 1988 to forestall dumping of electronic waste like it happened in Koko town in Nigeria in early '80s. In 2007, the Federal Government also established the National Environmental Standards and Regulations Enforcement Agency to implement all environmental laws, including monitoring and control of electronic waste in the country. In spite of the efforts, many users of electronic gadgets are unaware of the law, regulating e-waste disposal to obviate consequences of accumulation. Worst still, the existing, waste management agencies in Nigeria lack appropriate infrastructure and modern method for effective disposal of e-waste. It is noteworthy that improper e-waste disposal is harmful to the environment because of its chemical components.

Improper disposal of e-waste causes irreversible environmental damage by pollution water and soil and contaminating air (Soaji, 2012). It is against this backdrop that this study aim to identify the root cause or causes of improper disposal of e-waste in Enugu. The outcome of the study will help policy makers to plan and adapt to appropriate changes in technology for effective e-waste disposal in Nigeria.

Materials and methods

Study area

Enugu was used as a case study because it has similar physical, social, economic and cultural characteristics with other cities in Nigeria. Enugu is the capital of Enugu State in the South-Eastern region of Nigeria. Enugu has approximately between Latitude 6^{o}, 28^{I}N, and between Longitude 7^{o} 30^{I} and 80 19^{I}E. Located at the Udi Escarpment, it covers a land mass of about 72.8 square kilometers. Enugu metropolis comprises Enugu North, Enugu South and Enugu East Local Government Areas. The National Population Commission put the population of Enugu at 772,664in 2006. At present, the population is estimated to be over one million. The economy is driven by commerce and small-scale industry. Increasing number of traders deal in second hand electronic items that are sold to general consumers in the city. These items have brought about large volumes electronic wastes which are not properly handled and disposed.

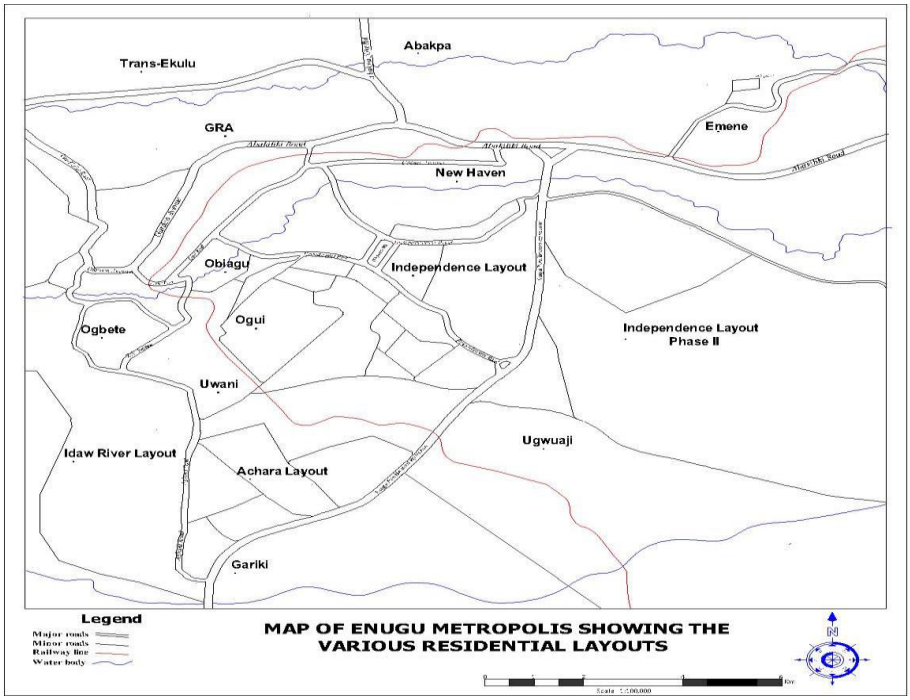

Fig 1. Study area

Legend: *Major Road ; Water Body; Minor Road; Railway Line*

Methodology

Secondary and primary data were used in the study. Secondary data were alienated from official records pertaining to electronic waste in developed and developing countries. Primarily data were collected through field observation, interview and questionnaire. From field observation, 20 repairers of electronic products were identified in Enugu. Interview was conducted with the public relation officer (PRO) in the Enugu State Waste Management Authority on matters relating to e-waste disposal in Enugu. Using convenient sampling technique, a sample size of 180 respondents (household heads) were administered with questionnaire in selected six neighborhoods. The 24 constituents' neighborhoods in Enugu were stratified into three residential areas, namely high, medium and low densities. Using simple random technique, two neighborhoods were randomly selected from each stratum. The selected six neighborhoods are Emene and Abakpa, Uwani and Achara Layout and Trans-Ekulu and Independence Layout for high, medium and low densities respectively. Applying simple random sampling, 30 copies of questionnaire were administered in each of the selected six residential densities. Purposive sampling technique was used to sample the identified 20 repairer of electronic products in Enugu. A total of 200 copies of questionnaires were administered in the city. The map above shows the various residential densities where samples were drawn from the map of Enugu Metropolis.

Results and analysis

The results show the classification of electronic waste commonly generated and disposed in Enugu. Table 1 shows that mobile phones constitute 90 percent and closely followed by television sets, which amount to 89 percent. Computers, refrigerators, radios, air conditioners and photocopying machines constitute 88 percent, 85 per cent, 73 per cent, 72 per cent and 66 percent respectively.

The results of the study also reveal that 85 percent of the respondents sampled in high and medium density areas generate e-waste while 59 per cent of them in low density area do the same in Enugu. Field observation indicates that increase in population and changes in living style due to technological advancement are responsible for increasing generation of e-waste in Enugu (see table 2).

Table 1: Classification of e-waste in Enugu.

Categories	Uwani		Achara Layout		Abakpa		Emene		Transekulu		Independence Layout		Av Percent
Computer Waste	28	93%	27	90%	21	70%	27	90%	29	96.7%	27	90%	88%
Television Waste	24	80%	22	73.3%	28	93%	26	86.7%	27	90%	28	92%	89%
Cell phone Waste	27	90%	28	93%	26	86.8	29	96.7%	25	83.4%	26	86.7	90.4%
Refrigerator Waste	26	86.7 %	22	73.3%	25	83.3%	26	86.7%	27	90%	27	90%	85%
Radio waste	24	80%	26	86.7%	29	96.7%	27	90%	25	83.3%	26	86.7%	73%
Air Condition Waste	21	70%	24	80%	18	60%	15	50%	24	80%	28	93%	72%
Photo-copying Machine Waste	15	50%	17	56.7%	22	73.3%	18	60%	22	73.3%	24	80%	66%

Source: Researcher's Field Survey (2017).

Table 2: Household that generates e-waste in Enugu Metropolis per Annum

Response	Uwani		Achara Layout		Abakpa		Emene		Transekulu		Independence Layout	
Yes	25	83%	28	87%	22	73%	29	97%	17	57%	18	60%
No	5	17%	4	13%	8	27%	1	3%	13	43%	7	22%
No Response	-	-	-	-	-	-	-	-	-	-	5	18%
Total	**30**	**100%**	**30**	**100%**	**30**	**100%**	**30**	**100%**	**30**	**100%**	**30**	**100%**

Source: Researcher's Field Survey (2017).

The results indicate that majority of the respondents sampled practice improper e-waste disposal in Enugu. Table three shows that average of 43 percent and 35.2 per cent of the respondents across the three categories of the residential densities practice open dumping and selling of e-waste items responsible. It is important to note that open dumping of e-waste is hazardous to human health and the environment.

Table 3: Existing Methods of e-waste disposal in Enugu Metropolis

Methods	Uwani		Achara Layout		Abakpa		Emene		Transekulu		Independence Layout	
Opening Dump	12	40%	15	50%	15	50%	7	21%	14	47%	15	50%
Bumming	-	-	-	-	-	-	3	10%	-	-	1	3%
Burying	-	-	-	-	-	-	-	-	1	3%	-	-
Selling at give away price	11	37%	9	30%	15	50%	11	37%	6	20%	11	37%
Others	3	10%	4	12%	-	-	9	30%	-	-	-	-

Source: Researcher's Field Survey (2017).

The results also show the level of awareness of health and an environmental consequence of improper e-waste is very low in Enugu. Table four reveals that average of 28 percent of respondents sampled across the three categories of residential neighbourhoods attest to the fat. The low level of awareness of proper e-waste disposal may have contributed to increasing health and environmental problem in the city.

Table 4: Residents awareness of the Health Risk Associated with e-waste in Enugu Metropolis

Response	Uwani		Achara Layout		Abakpa		Emene		Transekulu		Independence Layout	
Yes	11	37%	9	30%	8	26%	7	22%	5	17%	6	20%
No	19	63%	21	70%	22	74%	23	78%	25	83%	24	80%
Total	**30**	**100%**	**30**	**100%**	**30**	**100%**	**30**	**100%**	**30**	**100%**	**30**	**100%**

Source: Researcher's Field Survey (2017).

In the study, interview was conducted with the Public Relations Officer in the Enugu State Waste Management Authority, which is saddled with the responsibility for solid waste management in Enugu. The result showed that the Authority's services have not covered e-waste dispose electronic waste in an unplanned manner in the face of increasing industrials and commercial activities.

Discussion

The result of data analysis suggested that mobile phone is highest among the identified type of e-waste that is commonly generated in Enugu. For instance, it shows that mobile phones constitute 90 percent while only 10 percent of other types of e-waste are generated in the city. Similarly majority of people indiscriminately dispose electronic waste in Enugu. This implies that open dumping of e-waste as indicated in table three poses health and environmental risks. The result of the analysis also shows that there is low level of awareness of the health and environmental hazards as a result of improper e-waste disposal in Enugu. Table four shows that majority of people in the city are ignorant of the health risk associated with improper disposal of e-waste. Regrettably, ESWAMAs statutory responsibility has not extended to e-waste disposal in Enugu.

Conclusion

The study identified that electronic waste disposal is fast becoming a serious problem in Enugu. The results of the study showed that there is high ignorance of the environmental risks associated with improper disposal of e-waste in Enugu. The results also revealed that ESWAMA is ill-equipped to embark on modern or scientific method of e-waste disposal in the city. Therefore, the study recommended among others, a vigorous public awareness campaign, aimed at conscientizing dealers and consumers on proper disposal of electronic waste. The commendations are considered important steps in preparation of environmental management policy with emphasis on redressing electronic waste in Nigerian cities.

Recommendations

Electronic waste is not efficiently managed until it is finally disposed of. To this end, some preparatory work is necessary in planning and designing e-waste collection system in order to make the disposal become simpler to deal with. Such preparatory work will require analyzing and classifying samples of the main types of e-waste generated in the city. This would help the city waste management agencies in determining the most appropriate disposal methods and possibility of recycling.

Interview conducted revealed that the Enugu State Waste Management Authority (ESWAMA) has not provided infrastructure for collection and disposal of e-waste in Enugu. This implies that an efficient e-waste disposal system is not in place in Enugu. Therefore, ESWAMA should as a matter of expediency, evaluate the existing waste management system with a view to identifying its weakness. The purpose would be to devise an improved e-waste disposal system in a sustainable manner.

Majority of the people in Enugu are not aware of proper handling and disposal of electronic waste. There is need for dealers in second hand electronic devices and the general consumers to be regularly sensitized on e-waste handling and disposal practice. This would go a long way to mitigate the adverse environmental and health effects that may result from improper disposal of e-waste.

Enugu and indeed, other Nigerian cities are experiencing influx of population changes in life system and technological development. It is therefore necessary that the National Agency hasten to pass laws that will regulate electronic waste in the country. Enforcement of such laws must be professionally done in line with international best practices. Equally important is that all stakeholders including universities and research institutions that rely on electronic devices for data collection and processing must show leadership in effective e-waste disposal methods.

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