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African Institute for Science Policy and Innovation International Biennial Conference

Conference Proceedings

VOLUME 1

1st AISPI International Biennial Conference on Science, Technology and Innovation for Sustainable Development, 2019

E-Waste Estimates and Disposal Methods among Households in Selected Local Government Areas in Southwestern Nigeria

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Abstract

This study evaluated e-waste management methods among households in Southwestern Nigeria using selected local government areas. It estimated the quantity of specific e-waste category disposed of by the households, and examined the methods used by them in the disposal of the e-waste. These were with a view to providing reliable data that would guide decision making process towards sustainable e-waste management, particularly at the local level. The study covered the target populations' (that is household) operations between 2013 and 2018. This research employed survey method using both primary and secondary data. The primary data were sourced using a set of questionnaire. Secondary data such as population density of the study area and average weight of some e-waste items were sourced from the National Population Commission (NPC) report and literature, respectively. The questionnaire was administered on 300 households, selected through a multi-stage sampling technique. Data obtained were analysed. The results showed that a total estimated quantity of 32.1 metric tons (Mt) of e-wastes weredisposed of by the households between 2013 and 2018. The total e-waste estimate comprised 21.6 Mt (67.7%), 2.6Mt (8.2%), 5.2Mt (16.3%) and 2.2Mt (6.9%) of large household e-waste, small household e-waste, consumer e-waste and IT/Telecommunications e-waste. The result of the study also revealed that the flow/destination of the e-waste category were largely uncontrolled and informal.

Keywords: Disposal, e-waste, Household, Management, Technique, Method

Selected and peer-reviewed by ASIPI, Obafemi Awolowo University, Ile-Ife, Nigeria.
https://doi.org/10.69798/07470954

INTRODUCTION

E-waste or waste electrical and electronic equipment (WEEE) is a generic term for all electrical and electronic equipment (EEE) (in whole or part) that are no more in use, obsolete, intended to be discarded (or discarded). It refers to electrical/electronic equipment, as well as their components that are unwanted by their owners, without the intent of re-use (Solving the E-waste Problem-StEP, 2014). In fact, these products no longer satisfy the need of its owner (Peralta and Fontanos, 2006); thus, discarded.

Globally, electronic industry is the largest and fastest growing manufacturing industry (Radha, 2002; Department of Information Technology-DIT, 2003); thus, increasing electrical/electronic product consumption. Consequently, e-waste generation may not be unconnected from the expansion of this industry particularly in relation to meeting up with growing insatiable consumers demand and preferences for the products (including Information Technology-IT devices). High technology obsolescence rate of electrical/electronic equipment coupled with the general attitude of consumers to drop old electrical/electronic devices for new ones also exacerbate global e-waste generation issues. Consumers often replace usable electronic equipment with new ones available in the market (Kahhat and Williams, 2009); thus, a contributing factor to growing e-waste volume. Furthermore, globalization in the developing country context also influences individuals' desire to do away with old electrical/electronic technologies for newer and/or more efficient ones.

E-waste is ubiquitous in nature as evidenced in the growing market for electrical/electronic products in different regions of the world (Babu *et al.*, 2007); consequently, growing e-waste volume occasioned by rapid product obsolescence, particularly in the 21st century characterised by rapid technological innovation and global competitiveness. Nonetheless, e-waste is a potential pollutant source (as it contains toxic chemical components) with significant environmental and public health implications (Zhao *et al.*, 2010; Eguchi *et al.*, 2012; Asante *et al.*, 2012). Electrical/electronic waste components/parts also contain precious metals. E-waste is a rich source of resourceful and recoverable materials (Ongodo *et al.*, 2011; Lau *et al.*, 2013 and Menad *et al.*, 2013); thus making it of a potential socio-economic relevance.

In view of the inherent challenges and socio-economic implications of e-waste, concerted and co-ordinated effort is required (at all levels) in its sustainable management. However, sufficient knowledge regarding volumes of e-waste, specific composition and destination of the waste is fundamental to developing requisite e-waste infrastructural need (Scott *et al.*, 2014). In fact, accurate and sufficient data on current e-waste management conditions is pivotal to successful implementation of e-waste management plan vis–a-viz collection, transportation, storage and recycling. The information will guide and enhance decision making on the effective and efficient management of e-waste.

In spite of various estimated volumes of e-waste generated annually at the global level, there is still lack of accurate information regarding e-waste data (Scott *et al.*, 2014), particularly in majority of developing countries including Nigeria. In fact, the current quantities of e-waste are grossly underestimated (Ongondo *et.al.*, 2011) and this may present a barrier to its sustainable management in Nigeria; especially at this time that the Nigerian government is making concerted efforts (as evidenced in the growing number of government-approved recycling companies) towards minimizing environmental/public health threat of e-waste and harnessing the economic value of the waste, through recycling. Arguably, the success of already established (e-waste) recycling companies (and even forthcoming ones) largely depends on accurate e-waste information (such as composition, quantity/volume and disposal methods) available at local or national level. Such information, to a very large extent, may determine the 'modus operandi' and further guide operations of the recycling companies. Decision making on sustainable e-waste management policy in Nigeria is also a function of availability of data/information on e-waste management among respective stakeholders.

This study estimated the quantity of specific e-waste category disposed of among households and examined the methods used by the households in the disposal of the e-waste category. These were with a view to recommending appropriate measures that will enhance appropriate e-waste management in the study area.

E-waste Challenges and Opportunities in Developing Country Context

The growing rate of e-waste is nearly three times faster than total municipal waste flow (Arensman, 2000), with an annual increase of 4-5% (Baldé *et al.*, 2017). The waste accounted for more than 5% of the total municipal solid waste stream (UNEP, 2005) and constituted 1-3% of total solid waste worldwide (Robinson, 2009; UNEP, 2007a). Annually, about 50 million tonnes of e-waste is generated around the world (Huisman, 2012). Estimated e-waste volume of 41.8 million metric tonnes (5.9 kg/inhabitant) and 44.7 million metric tonnes (Mt) (6.1 kg/inhabitant) were generated in 2014 and 2016 respectively (Baldé *et al.*, 2015; Baldé *et al.*, 2017). Projection for 2021 is 52.2 million metric tonnes (6.8 kg/Inhabitant); the incessant and growing e-waste volume is a serious source of global concern.

Although, the developed countries including USA and Europe contribute a larger share to the total global estimate (Robinson, 2009); however, there are indications that developing countries including China, India, South Africa, Egypt and Nigeria are at more risk of the growing volume. Developing countries are the largest recipient (more than 80%) of e-waste generated from the developed countries (Hicks *et al.*, 2005). The waste is being imported as Used Electrical and Electronic Equipment (UEEE). Specifically, the European Union member states were the origin of around 77% of UEEE imported into Nigeria (Baldé *et al.*, 2017). Annual estimated volume of 640,000 tonnes of WEEE enters Nigeria through importation from developed countries (Nnorom and Osibanjo, 2008). In the Nigeria case, about 50% of the imported e-wastes are in deplorable condition (Nnorom and Osibanjo, 2008).

In Africa, Nigeria is a leading destination of e-waste imports as well as producer of such (at domestic/national level); consequently, contributing an estimated volume of 1.1 million metric tons to the total e-waste volume in Africa (Nnorom and Osibanjo, 2008). However, the estimated e-waste import in Nigeria may not be accurate, taking into consideration countless numbers and porosity of the Nigerian borders. In actual fact, 35.8 million Mt (80%) of global e-waste generated is not documented and out of which the destination of 34.1 million Mt (76%) of the waste is unknown (Baldé *et al.*, 2017), particularly in majority of the developing countries. The current quantities of e-waste are grossly underestimated (Ongondo *et al.*, 2011). Therefore, there is an urgent need for accurate and reliable e-waste inventory data in Nigeria.

Furthermore, e-waste is quite different from other forms of waste stream. The waste is characterised by different product spectra with varying physical and chemical constituents. The constituent of e-waste is usually a function of the product design and specification. For instance, heavy e-waste items such as refrigerators, freezers, washing machine, dish washer, cloth dryers are chiefly made up of steel with lesser toxic pollutants while IT/telecommunications e-waste items such as mobile phones and laptop computer contains relatively higher concentration of hazardous chemicals and heavy metals (Robinson, 2009). E-wastes are potential pollutant sources that are inimical to environment and public health. About 1,000 toxic substances have been associated with e-waste (Puckett and Smith, 2002); predominantly heavy metals and Persistent Organic Pollutants (POPs) (Saphores and Milovantseva, 2011; Kiddee *et al.*, 2013). Nonetheless, virtually all e-waste categories have socio-economic implications as they contain economically valuable metals including Gold (Au), Silver (Ag) and Aluminum (Al), which can be harnessed (through recycling) for re-use in future production value chain. The recoverable materials value in e-waste was estimated at 48 billion euros (Baldé *et al.*, 2015). Therefore, it is imperative that government, academia and policy makers in Nigeria (a major e-waste junk of developed countries) harness resources and proffer specific e-waste policy intervention towards effective and sustainable e-waste management in the country.

Moreover, poor management of e-waste through indiscriminate disposal is harmful to the ecosystem and immediate environment, thus, a potential source of food contamination (Lincoln *et al.*, 2007; Robinson, 2009; Zhao *et al.*, 2010). Resultant environmental and public health implications of improper e-waste management including haphazard disposal and treatment practices in developing countries have been sufficiently reported (Chan *et al.*, 2007; Huo *et al.*, 2007; Qu *et al.*, 2007; Wang *et al.*, 2009b; Xing *et al.*, 2009; Zhao *et al.*, 2008; Zheng *et al.*, 2008; Ha *et al.*, 2009; Eguchi *et al.*, 2012; Asante *et al.*, 2012). Logically, poor management including disposal and treatment of e-waste can be detrimental. In fact, the socio-economic value of the waste might be technically impossible to achieve in conditions where e-wastes are being disposed indiscriminately and processed through primitive techniques. In view of these facts, research findings on the quantity, composition and disposal (flow pattern) of e-waste emanating from various sources will not only reinforce decision making on e-waste management but also provide sustainable path towards implementation.

Scope of the Study

This study only took into cognizance, e-waste generated (that is disposed of) at household level in Southwestern Nigeria between 2013 and 2018. Furthermore, e-waste category (items) considered for this study were: large household e-waste (freezer, refrigerator, air conditioner and washing machine), small household e-waste (iron, kettle, microwave, toaster and hair dryer), consumer e-waste (radio, VCR player, DVD player, CRT television and flat panel display television) and IT/Telecommunication e-waste (laptop, mobile phones, CRT monitor and flat panel display monitor). The study focused on e-waste assessment using an assessment methodology and its validation in the study area.

E-waste Assessment Methodology: A Literature Review

Due to the rapid growth in e-waste generation and associated problems, assessment tools are being used for informed decision making on sustainable management of e-waste. The tools have proved invaluable in estimating e-waste generation and its environmental impact assessment. Life Cycle Assessment (LCA), Material Flow Analysis (MFA) and survey instrument (i.e. questionnaire) have found immense applications in e-waste management study. Generally, MFA and questionnaire (used in combination or separately) are a major assessment tools used in estimation and quantification of e-waste flow within a defined geographical boundary.

Material Flow Analysis (MFA) is a decision support tool for environmental and waste management (Brunner and Rechberger, 2004) which has also found applicability in e-waste management. MFA has been used to determine the quantity and flow of e-waste; hence, environmental and socio-economic assessment of e-waste can as well be examined.

Shinkuma and Nguyen Thi Minh (2009) used MFA to investigate the flow of e-waste in Asia. They found that secondhand electronic devices from Japan are reused in Southeast Asia (e.g., Vietnam and Cambodia) while most of the e-waste is recycled in Guangdong Province, China, where improper recycling methods were being used. In addition, Yoshida *et al.* (2009) found that the proportion of personal computers sent for domestic disposal and recycling decreased to 37% in fiscal year 2004, while the proportion of domestic reuse and exports increased to 37% and 26%, respectively in Japan.

MFA in combination with other methods have also been used to estimate possible quantity of e-waste generated in a specific geographical boundary. Liu *et al.* (2006a), Jain and Sareen (2006), Osibanjo and Nnorom (2008) and Steubing *et al.* (2010) have investigated e-waste generation using MFA. Liu *et al.* (2006a) and Jain and Sareen (2006) applied market supply method using the average lifetime of electronic product and regional production and sales data for e-waste generation. Steubing *et al.* (2010) used the MFA and survey method to estimate e-waste generation in Chile.

Due to lack of data on sales and consumption of electric and electronic equipment in Nigeria, Osibanjo and Nnorom (2008) used questionnaire surveys to estimate quantities of e-waste in Nigeria. They found that in near futures, e-waste generation will increase in China, India, Nigeria and Chile (Osibanjo and Nnorom, 2008). Liu *et al.* (2009) has also reported (using MFA and questionnaire) that the quantity of e-waste will double from 2005 to 2010 and increase by 70% for obsolete devices by 2020. The volume of e-waste will increase four to five times during 2010–2019 in Chile (Steubing *et al.*, 2010).

Yoshida *et al.* (2009) analyzed the flow of used PCs in Japan using the MFA. The authors developed a method to estimate the material flow of used PCs and reported that 3.92 million and 4.88 million used PCs were discarded in 2000 and 2001 respectively. Chung *et al.* (2011) also used the MFA and questionnaire to investigate the quantity of some e-waste categories generation in Hong Kong. The authors reported that a total quantity of 80,433 tons (11.5 kg/capital) of the e-waste categories was generated in 2011.

Taghipour *et al.* (2012) has also used the MFA tool to investigate e-waste generation and disposal pattern in Tehran and Tabriz cities of Iran between the periods of 2008-2010. The authors' finding revealed that 115,286, 112,914, and 115,151 metric tons of e-waste in 2008, 2009 and 2010, respectively were generated in the study area.

Alavi *et al.* (2015) applied the use and consumption method and questionnaire survey to investigate the quantity of e-waste generation, disposal and collection pattern among 400 households in Ahraz (a major city in Southwestern Iran). The result of their study revealed that 2,157,742 units (9952.25 metric tons per year) of e-waste were disposed of among households in the study area.

Literature has sufficiently shown various e-waste estimations using different assessment methodology, however, not in the Nigerian context and in particularly as it concerns estimating e-waste generated at household level. So far, there is little or no reliable information on e-waste quantity disposed of, and as well methods used in the disposal of the e-waste at household level. This study utilized questionnaire survey only because of the lack of data on sales and consumption of electrical and electronic products in Nigeria.

RESEARCH METHODOLOGY

The study utilized primary and secondary data. Primary data were collected using a set of structured questionnaire designed to collect information at household level. Oral guided interview was also conducted in the course of questionnaire administration. The questionnaire was administered on 300 households, selected through a multi-stage sampling technique. In the first stage, two states - Lagos and Oyo States were purposively selected from the six states in Southwestern Nigeria – being the two most populated states and major commercial/business hub in the region. In the second stage, stratified sampling technique was used to divide the twenty (20) and thirty three (33) local government areas (LGAs) in Lagos and Oyo States, respectively into existing senatorial districts – three per state; then an LGA with the highest population density was purposively selected from each stratum per state. A total of six (6) LGAs comprising three (3) LGAs from each of the states were used for this study. Fifty (50) households were randomly selected from the six (6) LGAs, making 300 housing units. The questionnaire elicited information on the socio-demographic background of the households, quantity of specific e-waste category disposed of and methods employed by the households in the disposal of the e-waste category. Secondary data such as population density of the study area and average weight of some e-waste item were sourced from the National Population Commission (NPC) report and literature, respectively. Data obtained were analyzed using descriptive statistics and calculations - based on average weight of e-waste item and quantity disposed.

RESULTS AND DISCUSSION

Distribution of Respondents in the Study Area

The distribution of household respondents by state is presented in Table 1. Three hundred questionnaires were randomly and equally administered among households in the selected LGAs in Lagos and Oyo States. A total of two hundred and forty-two (242) questionnaires were retrieved, representing 80.67% of the total (300) administered.

Socio-demographic Characteristics of Households Representatives for the Study

The socio-demographic characteristics of household representatives are presented in Table 2. The gender distribution of the respondents in the two states (that is the study area) showed that 58.7% were males; an indication that the household representative for this study is male dominant. The age distribution of respondents revealed that the largest shares of total household respondents' age group were within the age of 31-40 years, constituting 42.4% and the least being respondents above 60 years (3.4%).

Table 1: Distribution of Respondents by States

S/N	Sample Areas	No of Questionnaires Administered (%)	No of Questionnaires Retrieved (%)
i)	[a]Alimosho L.G.A	50 (16.66)	42 (17.3)
ii)	[a]Surulere L.G.A	50 (16.66)	35 (14.5)
iii)	[a]Kosofe L.G.A	50 (16.66)	44 (18.2)
iv)	[b]Egbeda L.G.A	50 (16.66)	42 (17.3)
v)	[b]Saki West L.G.A	50 (16.66)	37 (15.4)
vi)	[b]Ibadan North East L.G.A	50 (16.66)	42 (17.3)

[a] *Selected L.G.A. in Lagos State Senatorial Districts;*
[b] *Selected L.G.A. in Oyo State Senatorial Districts*

Table 2: Socio Demographic Characteristics of Respondents

Variables	Frequency (%)
Gender	
Male	142 (58.7)
Female	100 (41.3)
Total	**242**
Age Group	
< 20yrs	10(4.2)
20-30yrs	41(17.4)
31-40yrs	100(42.4)
41-50yrs	50(21.2)
51-60yrs	27(11.4)
>60yrs	8(3.4)
Total	**236**
Highest Qualifications	
No formal Education	1(0.4)
Junior Secondary	2(0.8)
Senior Secondary	31(13.1)
OND/HND/B.Sc.	130(55.1)
M.Sc. / M. Phil/PhD	72(30.5)
Total	**236**
Household Role	
Husband	108(46.4)
Housewife	73(31.3)
Others	52(22.3)
Total	**233**

The literacy level of the representatives (measured by highest educational attainment) in the study area indicated that 85.7% of them had post-secondary school education; an indication that a substantial share of the respondents had requisite knowledge base, in diverse fields of study. About 55.1% and 30.5% of the total respondents had OND/HND/B. Sc. and M. Sc. / M.Phil/PhD qualifications, respectively. The household role of respondent distribution in the study area showed that 46.4% of households' representatives were husbands.

This sub-section discusses the background characteristics of household distribution in the study area and is as shown in Table 3. The Table revealed that the household size distributions were dominated with a family size of 4 constituting 32.3% and the least being household size of more than 7 which constituted 3.2% of total household respondents. Furthermore, the table also shows that 68% of the total household respondents have either 1 or 2 household members in active job. This constituted the largest share of this distribution and the least share was 5%, representing more than four household members in active job.

Table 3: Socio Demographic Characteristics of Households

Variables	**Frequency (%)**
Household size	
1	12(5.5)
2	19(8.8)
3	20(9.2)
4	7032.3)
5	41(18.9)
6	28(12.9)
7	20(9.2)
>7	7(3.2)
Total	**217**
No of Household Workers	
1 or 2	149(68.0)
3 or 4	59(27.9)
>4	11(5.0)
Total	**219**
Total Occupation Density	
Civil Servant	201(44.5)
Self Employed	138(30.5)
Private/Non-profit org.	92(20.4)
Retired	21(4.6)
Total	**452**
Monthly Income	
<50,000	13(5.5)
50,000-100,000	38(16.1)
100,000-150,000	65(27.5)
150,001-200,000	68(28.8)
200,001-250,000	34(14.4)
250,001-300,000	7(3.0)
300,001-350,000	9(3.8)
300,001-350,000	2(0.8)
Total	**236**

Moreover, the total occupation distribution (in terms of the number of counts per occupation category) reveals that 44.5% of the total household members in active job were civil servants, which constituted the largest share of households' member occupational background, and the least share was 4.6%, representing retirees.

The monthly household income (that is aggregate) distribution also showed that 28.8% of the total household respondents earned between #150,000-200,000 and this represented the largest share of the household monthly income group. The lowest percentage was 0.8%, representing household monthly income group of 300,001-350,000.

Estimated (in metric tons) E-waste Categories Disposed of by Households in the Study Area

This section discusses investigation into the total estimates (in metric tons-Mt) of e-waste categories disposed of in the study area between 2013 and 2018. Table 4 showed that a total estimated quantity of 31.6 Mt of e-waste was disposed of by households in the study area. This constituted 68.4%, 8.2%, 16.5% and 6.9% of large household e-waste, small household e-waste, consumer e-waste and IT/Telecommunication e-waste respectively.

E-waste Disposal Methods among Households in the Study Area (2013-2018)

This section discusses the methods used by households in the study area to dispose of e-waste, and expressed as a percentage of total household respondents (N=242) (as shown in Table 5). Discussion in this section is explicitly on the choices of disposal methods for each e-waste category, among households in the study area.

The table reveals that the second hand market was the most predominant choice of e-waste disposal method among household in the study area. The table also shows that 64.1%, 44.6%, 62.4% and 74% of the total household respondents (N= 242) disposed of their large household, small household, consumers' and IT/Telecommunications, respectively by selling to designated domestic e-waste markets as UEEE.

Table 4: Estimated e-waste categories by State

Estimated E-waste (metric tons) E-waste Category	Total Estimate (%)
*Large Household	21.6 (68.4%)
*Small Household	2.6 (8.2%)
*Consumer	5.2 (16.5%)
*IT/Telecommunication	2.2 (6.9%)
Total/State (%)	**31.6 (100)**

**Refer to Appendix I for the breakdown*

Moreover, e-waste trade at individual/family level also accounts for a sizeable percentage of households' choice of disposal. About 28.1%, 24.8%, 25.6% and 48.8% of the total households sold their large household, small household, consumers' and IT/Telecommunications e-waste categories, respectively to individuals/family friends.

Moreover, 32.6% and 25.2% of households in the study area disposed of their small household and consumer e-waste categories with household wastes compared to a percentage share of 6.6% and 9.5% for large household and IT/Telecommunications e-waste categories respectively. E-waste categories/items disposed with household wastes are either irreparable or condemned (Osibanjo and Nnorom, 2008). However, the disparity in the percentage of e-waste category that ends up being disposed of with household waste could

Table 5: Household percentage share per disposal method per e-waste category in the study area

	Number of Households (%)			
Methods	**Large Household**	**Small Household**	**Consumers**	**IT/Telecom**
A	16 (6.6%)	79 (32.6%)	61 (25.2%)	23 (9.5%)
B	155(64.1%)	108 (44.6%)	151(62.4%)	179 (74.0%)
C	65 (26.9%)	106 (43.8%)	143(59.1%)	37 (15.3%)
D	13 (5.4%)	31 (12.8%)	26 (10.7%)	10 (4.1%)
E	3 (1.2%)	32 (13.2%)	45 (18.6%)	8 (3.3%)
F	68 (28.1%)	60 (24.8%)	62 (25.6%)	118 (48.8%)
G	30 (12.4%)	26 (10.7%)	34 (14.0%)	23 (9.5%)
H	39 (16.1%)	50 (20.7%)	54 (22.3%)	15 (6.2%)

A (with household waste); B (sold to second hand market); C (given/sold to scrap dealers); D (handover to formal e-waste collectors); E (thrown into dumpsite); F (sold to individual); G (donation) and H (store/keep at home).

be caused by relatively large sizes/weight and salvage (end of life) value of large household and IT/telecommunication e-waste, respectively. Large household e-waste items are generally weightier and as such difficult to transport to dumpsite.

Furthermore, a share of households in the study area adopted scrap dealers/scavengers as the choice of e-waste disposal method. Thus 26.9%, 43.8%, 59.1% and 15.3% of the households disposed of large household, small household, consumers and IT/Telecommunications e-waste categories respectively by either giving or selling to scrap dealers/scavengers. The locally made carrier (that is cart) used by the scrap dealers/scavengers enhanced the flow and movement of these e-waste categories (irrespective of sizes/weight). In this case, the monetary value of the e-waste category at the end of useful life may account for the high percentage share of households that adopted this e-waste disposal means.

Another 5.4%, 12.8%, 10.7% and 4.1% of total household respondents used formal e-waste collectors (government or private) to dispose of large household, small household, consumer and IT/Telecommunication e-waste categories, respectively. However, 16.1%, 20.7%, 22.3% and 6.2% of total household respondents respectively had large household, small household, consumer and IT/Telecommunication e-waste categories stored/kept at home.

CONCLUSION

The study concluded that a substantial amount of e-waste volumes were generated in the study area during the period (2013-2018). However, in terms of the relative weight (Mt) of the e-waste categories considered for the study, large household e-waste constituted the largest share. IT/Telecommunication e-waste category constituted the largest units of the share of e-waste category generated in the study area. In any case, this has implication for sustainable e-waste management plan in the study area particularly as it concerns storage, transportation and recycling. Generally, large volumes of the e-waste categories generated in the study area were disposed through informal methods.

Recommendations

i. Adequate measures should be put in place towards achieving households' co-operation and willingness to dispose e-waste items through formal method.

ii. Households, particularly at local levels should be oriented and sensitized on the socio-economic and environmental implications of informal e-waste disposal methods.

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APPENDIX I

Estimations for Large Household E-waste Items in the Study Area

E-waste Unit /Qty in ton disposed (%)*	
Items (Av. Wt. in kg)[b]	**Unit Qty (%)**
Refrigerator (35)	98/3.4 (15.7)
Air Conditioner (55)	139/7.7 (35.6)
Washing Machine (65)	102/6.6 (30.6)
Freezer (35)	111 / 3.9 (18.1)
Total	**450 / 21.6**

Adapted from Cobbing, 2008

Estimations for Small Household E-waste Items in the Study Area

Items (Av. Wt. in kg)[b]	**Total Unit Qty (%)**
Iron (1)	270/ 0.27 (10.4)
Kettle (1)	154 /0.15 (5.8)
Microwave (15)	132/1.98 (76.2)
Toaster (1)	138 /0.138 (5.3)
Hair Dryer (1)	53/0.053 (2.0)
Total	**747/2.6**

Adapted from Cobbing, 2008

Estimations for Consumer E-waste Items in the Study Area

Items (Av. Wt. in kg)[b, c]	**Total Unit Qty (%)****
CRT Television (31.8)[c]	62/1.97 (37.5)
Radio (2)[b]	202 / 0.40 (7.6)
VCR Player (5)[b]	127/0.64 (12.2)
DVD Player (5)[b]	219/1.1 (20.9)
Flat Pane TV (12.6)[c]	92/1.16 (22.1)
Total	**702 / 5.2**

Adapted from Cobbing, 2008[b] and F. Wang *et al.*, 2013[c].

Estimations for IT/Telecommunication E-waste Items in the Study Area

Items (Av. Wt. in kg)[b, c]	**Total Unit Qty (%)****
Laptop (3.7)[c]	219 /0.82 (38.1)
Mobile phone (0.1)[b]	747/0.0747 (3.5)
CRT Monitor (19.4)[c]	44/0.85 (39.5)
Flat Panel Monitor (6.5)[c]	62/0.40 (18.6)
Total	**1072/2.2**

Source: Adapted from Cobbing, 2008[b] and F. Wang *et al.*, 2013[c]