

# Disconnect between policy and practice in developing countries: Evidence of managing e-waste from Nigeria

Johnson Ojiyovwi Okorhi<sup>1,5\*</sup>, Joe E. Amadi-Echendu<sup>1,2</sup>, Helen Olubunmi Aderemi<sup>3</sup>, Roland Uhunmwangho<sup>4</sup> and Anthony Chukwudi Okwubunne<sup>5</sup>

<sup>1</sup>Institute of Engineering, Technology, and Innovation Management, University of Port Harcourt, Nigeria

<sup>2</sup>Department of Engineering and Technology Management, Graduate School of Technology Management, University of Pretoria, South Africa

<sup>3</sup>Department of Management and Accounting, Obafemi Awolowo University, Nigeria

<sup>4</sup>Electrical/Engineering Department, University of Port Harcourt, Nigeria

<sup>5</sup>National Centre for Technology Management (NACETEM), Nigeria

\*Corresponding author email: [johnsonokorhi@gmail.com](mailto:johnsonokorhi@gmail.com)

## Abstract

There are insufficient management functions that begin with planning, institutional arrangements and technical handling of e-waste materials in Nigeria. Modern trends in recycling still fall short of global practices. This study examined Waste Electrical and Electronic Equipment (WEEE) management strategies in Southeastern Nigeria with a view to suggesting appropriate implementable measures. It used an investigative approach through questionnaire administration. Twenty local government areas were purposively selected from five mutually exclusive strata of states. Data from 36 government agencies/offices were analyzed using percentage and linear multiple regression. Results revealed that WEEE management strategies were inadequate. The study concluded that WEEE management strategies were inapt and poorly implemented. Regulatory bodies should therefore urgently embrace and adopt appropriate management strategies, conduct periodic inventories of WEEE types and quantity and encourage the set-up and enforcement of cutting edge standards for modern facilities designated for the disposal of e-waste materials.

**Keywords:** electronic waste, waste electrical and electronic equipment, recycling, waste management theory, management strategies, southeastern Nigeria

## Introduction

Several reported incidents of uncontrolled transboundary movements of hazardous wastes, some of which were declared as economic goods, have their final stop in developing countries (Basel Convention 2011). E-waste materials or Waste Electrical and Electronic Equipment (WEEE) are some of the closest sources for generated hazardous wastes in Nigeria and other West African nations (Öko-Institut and Green 2010). The global concerns about WEEE arose following its proliferation in recent decades and the rapid growth in quantities that require disposal throughout the world. These countries are now facing huge challenges in managing WEEE which are either internally generated or imported illegally (GFMECD 1995). Reports have shown that most consignments of Used Electrical and Electronic Equipment (UEEE) are a combination of less than 25% functional UEEE and over 75% of WEEE (Ayodeji 2011). Anecdotal evidence supports the claims that innovation and rapid changes in technology, planned obsolescence of Electrical and Electronic Equipment (EEE), and low initial cost of near End-of-Life EEE have resulted in the fast-growing surplus of WEEE around the globe. In particular, the quick growth in the ICT sector has led to an improved capacity of EEE and simultaneously decreased products' lifetime, such that the quantity of waste produced is increasing by 10% annually (Ayodeji 2011; Basel Convention 2011).

The provisions of the National Environmental (Sanitation and Wastes Control) Regulation S.I.28 of 2009 stipulates that part of the management strategies should be to promote available policies, strategies, legislations, acts, regulations and guidelines for solid waste (WEEE) man-

agement through the establishment of baseline studies and public health criteria, and spells out the need for a comprehensive monitoring programme incorporating an early warning system for the down-stream users (NESREA 2011). Developing countries, including Nigeria, by virtue of being third world economies are disposed to being major consumers of used electrical electronic equipment. While some studies (Alo 2009; Ayodeji 2011; Oresanya 2011) have been done to cover southwestern and northern Nigeria, there remains a gap in knowledge on the extent of WEEE generation and management in southeastern Nigeria. Furthermore, subjective evidence suggests that used electrical gadgets, electronics and particularly ICT are fast-becoming a veritable and attractive source of income for youths in southeastern Nigeria while there is dearth of knowledge on disposal strategies put in place to combat the growing waste being generated. Basel Convention (2011) and NESREA (2011) noted the inadequate action of management functions that starts with strategic planning, institutional arrangements, and directing and control of WEEE activities in Nigeria, and southeastern Nigeria is no exception. Hence, this article sought to establish that there was significant disconnect between policy and WEEE management strategies in Southeastern Nigeria. The hypothesis H1 – WEEE management strategies in Southeastern Nigeria are adequate – would also be tested.

## Contemporary approaches for e-waste management in Nigeria

WEEE management strategies are tied to resolving e-waste problems through strategic planning, legal and

regulatory frameworks, and public education and participation, institutional arrangements, funding of the scheme, WEEE generation and handling, as well as technical planning and design of WEEE management systems (Table 1). Currently, the plan of action for WEEE management strategies in Nigeria is anchored in any or a combination of four significant regulations namely: the Harmful Waste (Special Criminal Provisions) Act Cap H1 LFN 2004; the National Environmental Protection (Waste Management) Regulations S.I.15 of 1991; the National Environmental (Sanitation and Wastes Control) Regulation S.I.28 of 2009 and the National Environmental (Electrical/Electronics Sector) Regulations S.I. No. 23 of 2011 (Basel Convention 2011). There exists, in each state, an established structure for collecting and disposal of waste. Under this structure, a state, through its 'agency' would collect solid waste (WEEE) under the classified scheme (Federal Environmental Protection Agency (FEPA) 1999; ESWAMA 2004; Basel Convention 2011).

#### **A conceptual model of WEEE management strategies**

A policy is a plan of action toward a set of objective(s). Such a plan is usually backed with a proper road map or strategies to meet the said objective(s). Essentially, developing viable strategies in waste management is developing a broad formula for how an 'agency' delivers on its mandates, what the limit of its goals are, and what policies will be needed to carry out those goals (Porter 1998). Such strategies may have been developed clearly through a strategic planning process or they may have evolved tacitly through the activities of the various functional sectors of the 'agency'.

The conceptual framework was drawn from the major existing policy documents – the Harmful Waste (Special Criminal Provisions) Act Cap H1 LFN 2004; the National Environmental Protection (Waste Management) Regulations S.I.15 of 1991; the National Environmental (Sanitation and Wastes Control) Regulation S.I.28 of 2009 and the National Environmental (Electrical/Electronics Sector) Regulations S.I. No. 23 of 2011 (Basel Convention 2011) – which rely heavily on institutional arrangements for waste management. The authors therefore relied on this to come up with a structure that sees WEEE management as a process starting with strategic planning (backed up with funding) and institutional arrangements involving categorization and measurement. This is important because if WEEE cannot be measured, then it cannot be managed. The institutional arrangements also involve a mechanism for control divided into two: a regulatory arm through the use of policy and liaison offices that interact, collect, sort and dispose WEEE from households, educational institutions, and the industry periodically. They also provide information to the institutional arrangements to help in the review of the strategic plan (Figure 1). This research concept was driven by both the waste management and strategic management concepts. The waste management concept proposes tools to be applied to achieve set objectives (GFMECD 1995; Antony and Pamela 2013) which focus on aversion of waste to protect human health and the environment (Pongrácz 2002). Strategic management is concerned with identifying an

agency's mandates, developing policy(ies) and planning to meet these set goals, as well as identifying and allotting resources toward the implementation of the plan of action (Raduan et al. 2009).

To attain a sustainable environment and a healthier population, a methodological approach for the effective management of WEEE and its developmental strategies must go beyond purely technical considerations to formulate specific objectives and implement appropriate measures (Schübeler et al. 1996). On this premise, the authors attempted to ascertain the connection between the conceptual framework and the status quo in the study area. The crucial question that needed answering was: Is WEEE management purely technical or does it exist just on paper? Specifically, the objectives of this paper were to: (i) determine the existence of strategic planning for WEEE in the area; (ii) determine the level of funding for the WEEE scheme; (iii) determine the institutional arrangements in place for WEEE management; (iv) investigate the level of WEEE generation and handling procedure; (v) examine existing WEEE legal and regulatory frameworks to address the issue of managing e-waste; and (vi) evaluate the extent of public education and participation in WEEE disposal management.

#### **Methodology**

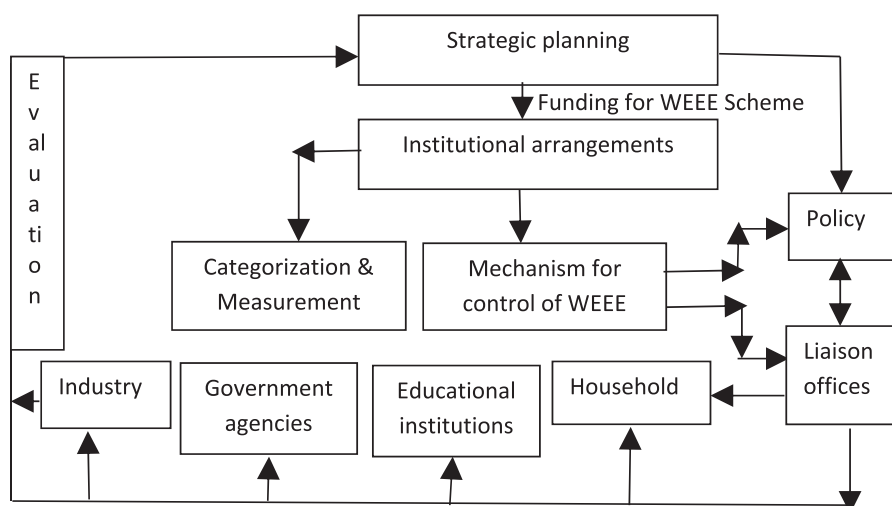
The study was carried out in southeastern Nigeria which comprises five states, namely: Abia, Anambra, Ebonyi, Enugu and Imo States. Together, there were 95 local government areas (LGAs) in these states. The study was purposively carried out in 20 urbanized and densely populated LGAs of these states. The sampling procedure was purposive because certain definite sets of data were required which could not be obtained from just anywhere. Hence, LGAs were selected because they contained the highest concentration and combination (policy and practice divide) of respondents who were readily available and both in a position to and willing to provide the data needed for the study. For even spread in each of the states, one LGA was picked from each of the three senatorial districts that make up a state, and the fourth LGA was chosen as the state's capital. This was because they had higher and actual involvement in generation of WEEE and the implementation of WEEE management strategies. With regards to the policy and implementation of WEEE management strategies, the population of the study in the LGAs consisted of 280 respondents. A sample size calculator developed by Krejcie and Morgan (1970) was used to obtain a sample size of 162 respondents. Furthermore, 200 end-users of EEE/WEEE (a set of 40 end-users from each state participating in the survey) were administered the questionnaire. Furthermore, using the same sampling technique, a total of 40 distributors of EEE/WEEE were administered the questionnaire (eight (8) distributors engaged in the circulation of EEE/WEEE were equally selected from each of the five states).

The same sampling procedures were also used in the selection of Monitoring Agencies of EEE/WEEE. A total of 40 respondents from Federal, State and LGA Agencies were randomly surveyed using the questionnaire as well as a guided interview. Two of a set came from each

**Table 1:** Conceptual framework for WEEE management strategies.

ENVIRONMENTAL CONTEXT	POLITICAL CONTEXT	SOCIO-CULTURAL CONTEXT
	Scope (What?)	
	<p><i>OBJECTIVES</i></p> <p><i>PLANNING AND MANAGEMENT</i></p> <ul style="list-style-type: none"> <li>• Strategic planning</li> <li>• Legal and regulatory framework</li> <li>• Public participation</li> <li>• Financial management</li> <li>• Institutional arrangements</li> <li>• Disposal facility siting</li> </ul> <p><i>WEEE GENERATION</i></p>	
	Proponents (Who?)	
	<ul style="list-style-type: none"> <li>• WEEE characterization</li> <li>• WEEE minimization and source separation</li> </ul> <p><i>WEEE HANDLING</i></p> <ul style="list-style-type: none"> <li>• WEEE collection</li> <li>• WEEE transfer, intermediate storage, treatment and disposal</li> </ul> <p><i>GOVERNMENT AGENCIES</i></p> <ul style="list-style-type: none"> <li>• NESREA</li> <li>• State Environment Protection Agencies</li> <li>• LGA Environmental Health office</li> <li>• Nigeria Customs Service</li> <li>• Standards Organisation of Nigeria (SON)</li> </ul> <p><i>BUSINESS SECTOR</i></p> <ul style="list-style-type: none"> <li>• Dealers/Marketers/Retailers</li> </ul> <p><i>INFORMAL SECTOR</i></p> <ul style="list-style-type: none"> <li>• Technicians/Refurbishers/Scavengers</li> </ul> <p><i>END-USERS</i></p> <ul style="list-style-type: none"> <li>• Households, government institutions, industries, private offices,</li> <li>• Communication/entertainment businesses,</li> <li>• Educational &amp; health-care centres</li> </ul> <p><i>EXTERNAL SUPPORT AGENCIES</i></p>	
	Strategic aspects (How?)	
	<ul style="list-style-type: none"> <li>• The Basel Convention Secretariat</li> <li>• StEP (Solving the E-waste Problem) initiative</li> <li>• Bamako Convention</li> <li>• Nairobi Declaration</li> </ul> <p><i>POLITICAL</i></p> <ul style="list-style-type: none"> <li>• Formulation of goals and priorities,</li> <li>• Determination of roles and jurisdiction, and</li> <li>• Establishment of legal and regulatory framework</li> </ul> <p><i>INSTITUTIONAL</i></p> <ul style="list-style-type: none"> <li>• Arrangements and sectorial integration</li> </ul> <p><i>SOCIAL</i></p> <ul style="list-style-type: none"> <li>• Patterns of WEEE usage, generation and disposal of the population, and the associated WEEE management needs and demands,</li> <li>• End-user participation in WEEE management activities, and the</li> <li>• Ethical issues on WEEE workers, both formal and informal</li> </ul> <p><i>FINANCIAL</i></p> <ul style="list-style-type: none"> <li>• Budgeting and cost accounting systems</li> <li>• Resource mobilization for WEEE funding</li> <li>• Cost recovery and operational financing</li> <li>• Cost control</li> </ul> <p><i>ECONOMICAL</i></p> <ul style="list-style-type: none"> <li>• Impact of WEEE management services on the productivity and development of the economy</li> <li>• The economic effectiveness of WEEE management systems</li> <li>• Conservation and efficient use of materials and resources</li> <li>• Job creation and income generation in WEEE management activities</li> </ul> <p><i>TECHNICAL</i></p>	
	ECONOMIC CONTEXT	
	<ul style="list-style-type: none"> <li>• technical planning and design of WEEE management systems</li> <li>• WEEE collection systems</li> <li>• Intermediate storage and transfer systems</li> <li>• WEEE recovery, repair, reuse, recycling and disposal management</li> </ul>	

**Source:** Adapted from Okorhi (2015), Assessment of WEEE Management Strategies in South Eastern Nigeria



**Figure 1:** Conceptual framework for the management of WEEE in southeast Nigeria.

LGA. This group included senior/coordinating officers of NESREA, officers of Nigeria Customs, principle officers from Enugu State Waste Management Authority (ESWAMA), ISBST, ASWAMA, ASEPA, EBSEPA as well as LGA Health Officers. The approach of the survey was investigative through questionnaire administration. The research instrument comprised questions delineated to Monitoring and Control Agencies of EEE/WEEE. The agencies surveyed were the National Environmental Standard and Regulation Enforcement Agency (NESREA); Standards Organisation of Nigeria (SON); the Nigeria Customs Service; Enugu State Waste Management Authority (ESWAMA); Abia State Environmental Protection Agency (ASEPA); Anambra State Waste Management Authority (ASWAMA); Ebonyi State Environmental Protection Agency (EBSEPA); the Imo State Bureau for Sanitation & Transport; as well as LGAs Environmental Health Offices. The data collection instrument was subjected to face validity, content validity and pre-testing. The survey considered the strategies for managing WEEE in southeastern Nigeria in line with the four aforementioned national environmental regulations on e-waste. The study specifically assessed the measures employed as management strategies for generated WEEE in line with best practices. Also, innovative approaches drawn from these regulations for sustainable management of WEEE were measured. In the test of our hypothesis, all questions on management/disposal methods were used as dependent variables and all questions to do with laws/legislation, policies and regulations on e-waste were used as independent variables. Data collected were analyzed using ordinary least square regression. The hypothesis test of a mean ( $t$ -test statistics) was used to test the hypothesis. It requires that the following conditions were met: i) the sampling method was purposive sampling; ii) the sample was drawn from a normal or near-normal population.

#### **Ethical considerations**

The research proposal was forwarded to the appropriate research ethics committee at the authors' institutions for

ethical clearance before its actual implementation. Permission was also requested from and granted by the authority of the Local Government Area before carrying out the research at the proposed study area. Informed consent was a prerequisite for participation in the study and collected information was kept confidential.

#### **Results and discussion**

The results presented here are those from the surveyed government agencies engaged in WEEE management and control. However, it is pertinent to mention that the survey revealed that one of these agencies, the Nigeria Customs Service in southeastern Nigeria, had mandates that are insensitive to flows of WEEE. Hence, four (4) of the questionnaires administered to the agency's offices across the five states were returned incomplete, and only thirty-six (36) completed questionnaires from other government agencies at federal, state and local government levels were used for this article. In furtherance of this study, this section presents and discusses data collected on major aspects, giving both descriptive and inferential analyses. First, [Table 2](#) presents the descriptive analysis of the study, and then [Table 3](#) depicts the inferential analysis.

#### **Component 1: WEEE legal and regulatory framework**

The promotion of sustainable strategies, policies, legislations, acts, regulations and guidelines for WEEE management is an inclusive aspect of the planning process. From [Table 2](#), a total of 19 (54.29%) respondents agreed that government promulgates edicts to enforce protection policies against illegal disposal of WEEE. Results from the field survey (54.29%) showed that government supports this process. Likewise, about half (16 or 45.57%) of the respondents also agreed that government actually prepared and developed working and management plans for WEEE to assist stakeholders. This agrees with the empirical evidence (FEPA 1999; NESREA 2007, 2009, 2011) that policies and legislation actually exist in the region to assist in the management

**Table 2:** Policy instrument for WEEE by monitor and control agencies.

	Q/N	Policy instrument: <i>Does your agency:</i>	To Very Great Extent		To Great Extent		To Small Extent		To Very Small Extent		Not At All	
			N	%	N	%	N	%	N	%	N	%
LEGAL AND REGULATORY FRAMEWORK	1	Promote strategies/policies/legislations/acts/regulations for WEEE management	6	17.14	19	54.29	8	22.86	0	00.00	2	05.71
	2	Promulgate edicts to enforce protection policies against illegal disposal of WEEE	7	20.00	12	34.29	2	05.71	7	20.00	7	20.00
	3	Enact appropriate legislation on grading rules, waste minimization and so on to back e-waste management strategies	6	17.14	13	37.14	8	22.86	2	05.71	6	17.14
	4	Has the provisions of Harmful Wastes Act, promulgated after the Koko waste saga in 1988 been an effective legislative instrument for the control of flow of e-waste in South Eastern Nigeria.	0	00.00	9	25.71	1	02.86	17	45.57	8	22.86
	5	Does the political system during strategy implementation affect the implementation process?	1	02.86	12	34.29	11	31.43	5	14.29	6	17.14
STRATEGIC PLANNING	6	Are the strategies for implementation appropriate?	2	05.71	8	22.86	8	22.86	13	37.14	4	11.45
	1	Provide e-waste management tenets in written codes	4	11.45	4	11.45	5	14.29	5	14.29	17	45.57
	2	Prepare and develop working and management plans to stakeholders	6	17.14	17	45.57	10	28.57	1	02.86	1	02.86
	3	Execute management provisions of the workman's plan	1	02.86	11	31.43	9	25.71	7	20.00	7	20.00
	4	Carry out periodic inventory surveys on types of e-waste generated in the region	1	02.86	3	08.57	5	14.29	16	45.71	10	28.57
	5	Collect, Collate, Process and Store statistics on generated e-waste	3	08.57	1	02.86	0	00.00	10	28.57	22	62.86
PUBLIC EDUCATION & PARTICIPATION	6	Have adequate periodic documentation on e-waste quantity and budgeting to support management process	1	02.86	3	08.57	3	08.57	10	28.57	18	51.43
	7	Monitor and protect the environment against illegal e-waste dumping	9	25.71	11	31.43	3	08.57	4	11.45	8	22.86
	1	Educate the public on e-waste management scheme	7	20.00	11	31.43	2	05.71	2	05.71	13	37.14
	2	Are all sectors of the populace adequately carried along during implementation of strategies?	2	05.71	9	25.71	14	40.00	5	14.29	5	14.29
INSTITUTIONAL ARRANGEMENTS	3	Does all sectors always comply with the strategies employed?	0	00.00	2	05.71	9	25.71	15	42.86	9	25.71
	1	Establish a competent body to implement e-waste management strategies	4	11.45	4	11.45	8	22.86	4	11.45	15	42.86
	2	Improve management capability of special waste (e.g. E-waste) unit through training and manpower development	2	05.71	6	17.14	7	20.00	4	11.45	16	45.71
	3	Provide training facilities for e-waste management personnel	3	08.57	7	20.00	0	00.00	0	00.00	25	71.43
	4	Provide support services to control illegal e-waste importation and distribution practices	7	20.00	13	37.14	5	14.29	5	14.29	5	14.29
	5	Take punitive action against defaulters	17	45.57	8	22.86	4	11.45	3	08.57	3	08.57
	6	Monitor the sources of e-waste into South Eastern Nigeria	2	05.71	8	22.86	5	14.29	6	17.14	14	40.00
	7	Coordinate environmental sanitation activities on generators (especially EIA and EAR)	1	02.86	4	11.45	4	11.45	5	14.29	21	60.00
FUNDING OF SCHEME	8	Maintain abandoned land-based e-waste dump	1	02.86	3	08.57	1	02.86	2	05.71	28	80.00
	9	Carry out Environmental Impact Assessment (EIA) on existing or abandoned dumpsites	0	00.00	6	17.14	3	08.57	11	31.43	15	42.86
	1	Provide monetary support for e-waste management	0	00.00	2	05.71	1	02.86	7	20.00	25	71.43
	2	Assess the adequacy of monetary support to take care of logistics	2	05.71	1	02.86	0	00.00	11	31.43	21	60.00

	Q/N	Policy instrument: <i>Does your agency:</i>	To Very Great Extent		To Great Extent		To Small Extent		To Very Small Extent		Not At All	
			N	%	N	%	N	%	N	%	N	%
			WEEE GENERATION AND HANDLING	1	Establish and manage e-waste Recycling facilities	3	08.57	4	11.45	2	05.71	6
	2	Encourage the Reuse; source Reduction, Recycling, Repair, Recovery, Landfill and Incineration of waste electrical/electronic equipment (WEEE or e-waste)	7	20.00	19	54.29	3	08.57	0	00.00	6	17.14
	3	Efficiently manage e-waste collection, segregation and final disposal activities	3	08.57	7	20.00	4	11.45	6	17.14	15	42.86
	4	Provide technical assistance in the evacuation and final disposal of e-waste	3	08.57	13	37.14	5	14.29	6	17.14	8	22.86
	5	Provide technical advice to generator of e-wastes on appropriate intermediate conversion techniques/technologies	2	05.71	4	11.45	7	20.00	6	17.14	16	45.71
	6	Coordinate the activities of municipal refuse (special waste) collection and final disposal	5	14.29	11	31.43	0	00.00	1	02.86	18	51.43
	7	Set-up and enforce standards for modern facilities for the disposal of e-wastes	6	17.14	14	40.00	7	20.00	5	14.29	3	08.57
	8	Build recycling plants, landfill, incinerators and acquire technologies for the purpose of e-waste disposal	2	05.71	7	20.00	0	00.00	1	02.86	25	71.43
	9	Control dumpsites activities and locations for disposal of e-waste	4	11.45	13	37.14	1	02.86	3	08.57	14	40.00

(Total number (N) of respondents = 36);

**Source:** Authors' field survey, 2015

**Table 3:** Summary of statistical test for hypothesis  $H_0$ .

REGRESSION /MISSING LISTWISE /STATISTICS COEFF OUTS R ANOVA /CRITERIA = PIN(.05) POUT(.10)  
/NOORIGIN /DEPENDENT PromoteStrate4WEEEmgt /METHOD = ENTER  
ExeMgtProvOfDWorkmanPlanproMgtCapaOfSpeciWasteUnitThroTrainNManpDev  
BuiLandfIncineNAdEqTechnoForDPurpOfEwastDispo.

**Regression**Variables entered/removed<sup>a</sup>

Model	Variables entered	Variables removed	Method
1	Build landfill, incinerators and adequate technologies for the purpose of e-waste disposal? Execute management provision of the workman's plans? Improve management capability of special waste unit through training and manpower development?	.	Enter

<sup>a</sup>Dependent variable: Promote strategies for WEEE management?<sup>b</sup>All requested variables entered.**Model Summary**

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	0.693 <sup>a</sup>	0.481	-1.077	10.68693

<sup>a</sup>Predictors: (Constant), Build landfill, incinerators and adequate technologies for the purpose of e-waste disposal? Execute management provision of the workman's plans? Improve management capability of special waste unit through training and manpower development?**ANOVA<sup>a</sup>**

Model		Sum of Squares	Df	Mean Square	F	Sig.
1	Regression	105.789	3	35.263	0.309	0.830 <sup>b</sup>
	Residual	114.211	1	114.211		
	Total	220.000	4			

<sup>a</sup>Dependent variable: Promote strategies for WEEE management?<sup>b</sup>Predictors: (Constant), Build landfill, incinerators and adequate technologies for the purpose of e-waste disposal? Execute management provision of the workman's plans? Improve management capability of special waste unit through training and manpower development?**Coefficients<sup>a</sup>**

Model		Unstandardized coefficients		Standardized coefficients		Sig. (p)
		B	Std. Error	$\beta$	t	
1	(Constant)	3.759	12.482		0.301	0.814
	Execute management provision of the workman's plans?	1.700	1.799	0.838	0.945	0.518
	Improve management capability of special waste unit through training and manpower development?	-1.825	3.052	-1.024	-0.598	0.657
	Build landfill, incinerators and adequate technologies for the purpose of e-waste disposal?	0.518	1.332	0.608	0.389	0.764

<sup>a</sup>Dependent variable: Promote strategies for WEEE management?

of WEEE. Yet, only 11 (31.43%) respondents slightly agreed that the execution of management provisions of the workman's plan to cater for WEEE was being implemented. Together, the strategies for implementation were considered inappropriate by 25 (71.43%) respondents (from a breakdown reflecting 8 (22.86%) to a small extent, 13 (37.14%) to a very small extent and 4 (11.45%) not at all). It is worth noting that the policy could be considered inappropriate because implementation was faulty (eWASA 2009; Horne and Gertsakis 2006; Garrett 2009).

**Component 2: Strategic planning for WEEE**

The National Environmental (Electrical/Electronics Sector) Regulations, 2011 clearly provides e-waste management tenets in written codes. However, evidence from the field suggested that only 4 (11.45%) respondents

strongly affirmed to be conversant with the rules of managing WEEE. This is most worrisome when 16 (45.57%) WEEE managers at state and local government level complained of vague knowledge of the contents and the existence of e-waste regulations/guidelines like the National Environmental (Electrical/Electronics Sector) regulations. Most peculiar in this regard were the Environmental Health Officers who oversee waste management activities at the grassroots level. It is noteworthy to mention that the collection, collation, processing and storage of statistics on generated e-waste in the region was impracticable, according to a large number of respondents 22 (62.86%). This was not surprising as Enugu State Waste Management Authority Law was deemed fit to be enacted in 2004 (ESWAMA 2004); that is 13 years ago, which means it is overdue for a review. Such a review, if performed, would promote sustainable strategies that would identify

seasonal waste and projected periodic volume. This was corroborated by 18 (51.43%) respondents who affirmed that the periodic documentation on e-waste quantity and budgeting to support the management process are inadequately carried-out.

#### **Component 3: Public education and participation**

In order to attain an effective implementation process, public education and participation were highly encouraged in the plan of action. Although a total of 18 (51.43%) respondents affirmed that government indulged in the sensitization process of stakeholders, more than half of them (19 or 54.29%) slightly agreed that all sectors of the populace were adequately carried along during the implementation of WEEE strategies, while 68.57% of population barely complied with employed strategies. According to the respondents, the means of education was mostly through radio (17 or 48.57%), television (5 or 14.29%), posters (5 or 14.29%), handbills/flyers (5 or 14.29%) and others (mobile advertisements/campaigns totalling or 8.57%). As noted in previously, though legislation for WEEE management exists (FEPA 2007; NESREA 2007, 2009, 2011), implementation has been noted to be faulty (Horne and Gertsakis 2006; Garrett 2009; EWASA 2004). Moreover, much cannot be expected from legislation that was enacted 13 years ago (ESWAMA 2004), as it requires revision.

#### **Component 4: Institutional arrangements**

As part of the value-chain for WEEE management strategies, the institutional arrangements cover coordination of WEEE activities, manpower development and support services, as well as government supervisory roles on the implementation and evaluation processes. Fifteen of the respondents (42.86%) strongly disaffirmed the existence of any established competent body or unit for the specific implementation of e-waste management strategies. More interestingly, 25 field results respondents (71.45%) suggested that there are no provisions for training facilities for e-waste management personnel. Though, a total of 20 (57.14%) respondents affirmed government's provision of support services to control illegal e-waste importation and distribution practices in the study area, it rarely monitored the sources of e-waste coming into the region. In addition, the coordination of activities for municipal e-waste collection and final disposal was poorly implemented, according to 21 (60%) respondents. Together, 28 (80%) respondents agreed that, in the long term, government does not maintain abandoned land-based e-waste dumps.

#### **Component 5: Funding of WEEE scheme**

One of the common constraints for many waste management programmes is funding of the scheme. Appropriations for waste management are often derived from a review of sources of funding and any additional funding proposed to be provided by governments. Some aspects considered in financing WEEE schemes include budgeting and cost accounting systems, resource mobilization for WEEE funding, cost recovery and operational financing, as well as cost control. Twenty-five (71.43%) respondents suggested that government has ceased to fund WEEE

management schemes in southeastern Nigeria. This is probably because of the assumptions that monetary appropriations for waste management are seemly inestimable: an investment without immediate monetary rewards. Of the periodic appropriated funds for WEEE schemes, 21 (60.00%) respondents strongly agreed that the monetary provisions are inadequate to support and cater for logistics.

#### **Component 6: WEEE generation and handling**

Part I – General Provisions, Section 2, Sub-section 3 of the National Environmental (Electrical/Electronics Sector) Regulations S.I. No. 23 of 2011 demands that the principles of these regulations should be anchored in the 5Rs (which are: Reduce, Repair, Re-use, Recycling and Recover) as the primary drivers of the sector and should encompass all the categories of Electrical and Electronic Equipment listed in Nigeria. Together, 26 (74.39%) respondents affirmed that government encouraged management methods like the Reuse, Reduction, Recycling, Repair, Recovery, Landfilling and Incineration of WEEE. Nonetheless, 20 (57.14%) respondents disagreed on the existence of formal recycling facilities for e-waste in parts of southeastern Nigeria. Moreover, although Part III: E-waste – Control, Section 34, Sub-section 4 of the regulations emphasizes the establishment and management of e-waste recycling facilities for the collection and treatment of WEEE, 25 (71.43%) respondents said that the government is yet to build such facilities or acquire relative technologies for the purpose of e-waste disposal in the study area. However, 20 respondents from field results (57.14%) suggested that government has set up and enforced standards for modern facilities for the disposal of e-wastes. Observations showed that WEEE is managed together with general municipal solid wastes. Only 6 (17.14%) respondents agreed that government provided technical advice to generators of e-wastes on appropriate intermediate conversion techniques/technologies, and 15 (42.86%) respondents said that the collection, segregation and final disposal activities for e-waste are ineffectively managed by the existing system. Also, 18 (52.43%) respondents attested to the non-existence of arrangements for the specific collection and final disposal of WEEE.

#### **Inferential analysis (Multiple linear regression)**

Table 3 shows analysis on hypothesis  $H_0$ : WEEE management strategies in southeastern Nigeria were not adequate. A linear multiple regression test was carried out on questions relating to the legal and regulatory framework, strategic planning, institutional arrangements, WEEE generation and handling. The comparable values for regression inferential statistics are the standardized coefficients (Beta,  $\beta$ ) which results for  $H_0$  are  $\beta_1 = 0.838$ ,  $\beta_2 = -1.024$  and  $\beta_3 = 0.608$ . We deduced results for two of the three questions as insignificant since the calculated Beta coefficient values,  $\beta_2 = -1.024$  and  $\beta_3 = 0.608$ , respectively, are less than the comparable  $p$ -values tabulated. Hence, we accept the alternative hypothesis  $H_1$ : WEEE management strategies in southeastern Nigeria are inadequate. This finding agrees with the Basel Convention Report: Where are WEEE in Africa? (Basel Convention 2011).



## Conclusion and policy recommendations

Following data collected and analyzed, the study revealed that the political structure for devising sustainable strategies and provision of logistical infrastructure are lacking to effectively manage WEEE. Consumers would rather stockpile e-waste before disposal. It was also shown that WEEE are not stratified before final disposal unto waste streams. Formal recycling is yet to gain ground in the study area. The tested hypothesis has proven that the monitoring and control agencies relied mostly on the same poorly structured management strategies supposedly meant for general municipal solid wastes in managing WEEE. Therefore, the study concluded that WEEE management strategies in Nigeria are inapt and poorly implemented. From the findings generated, the following recommendations were made. First, the regulatory bodies such as the Enugu State House of Assembly and Enugu State Waste Management Authority should urgently embrace and adopt appropriate management strategies contained in the recent National Environmental (Electrical/Electronics Sector) Regulations S.I. No. 23 of 2011. Secondly, it is recommended that during the implementation process, the adopted management strategies should be separated from those used for general municipal solid waste, and e-waste should be categorized. This is because e-waste is globally classified as hazardous waste and therefore needs to be strategically handled and disposed. Finally, government should set-up and enforce standards for frontier facilities (recycling plants, landfills, incinerators, etc.) for the specific disposal of e-wastes.

## Disclosure statement

No potential conflict of interest was reported by the authors.

## References

- Alo, B. I. 2009. "Best Available Environmentally Sound Management Practices in E-Waste Control." In *Proceedings of the International Conference on E-Waste Control Abuja, Nigeria: The Abuja Platform on E-Waste*. Abuja: National Environmental Standards and Regulations Enforcement Agency (NESREA).
- Antony, Sije, and Awuor Ochieng Pamela. 2013. "Cell Phone Disposal and Strategic Evaluation of Electronic Waste Management in Kenya, A Case of Mobile Phone Dealers in Kisumu County." *European Journal of Business and Innovation Research* 1 (4): 1–8, December 2013.
- Ayodeji, Odeyingbo Olusegun. 2011. "Assessment of the Flow and Driving Forces of Used Electrical and Electronic Equipment Into and Within Nigeria." Master Thesis., Environmental and Resource Management. BTU Cottbus, 1–104. Accessed January 21, 2013. [isp.unu.edu/publications/scycle/files/master-thesis-olusegun.pdf](http://isp.unu.edu/publications/scycle/files/master-thesis-olusegun.pdf).
- Basel Convention. 2011. *Where are WEee in Africa? Findings From the Basel Convention*. E-waste Africa Programme. Secretariat of the Basel Convention (SBC). 1–50. Accessed January 4, 2013. [www.basel.int](http://www.basel.int)
- FEPA (Federal Environmental Protection Agency). 1999. *National Policy on Environment*. Abuja: Federal Environmental Protection Agency, 34–35.
- ESWAMA. 2004. "The Enugu State Waste Management Authority Law, 2004: A Law to Dissolve The Enugu State Environmental Protection Agency and to Establish the Enugu State Waste Management Authority and Other Matters Connected Thereto." *Enacted Today*, 29th July, 2004 by The Enugu State Third House of Assembly. Enugu State Government 2004, No. 8.
- eWASA. (E-Waste Association of South Africa). 2009. "Towards Sustainable Environmentally Sound e-Waste Management." In *Proceedings of the International Conference on E-Waste Control Abuja, Nigeria: The Abuja Platform on E-Waste*. Abuja: National Environmental Standards and Regulations Enforcement Agency (NESREA).
- Garrett, P. 2009. *National first: new waste policy and new recycling schemes for TVs, computers and tyres – media release*. Retrieved from <http://www.environment.gov.au/minister/garrett/2009/mr20091105a.html>
- GFMECD. 1995. *Environmental Handbook Documentation on Monetary and Evaluating Environmental Impacts*. Volume 1. GmbH, Eschborn: Deutsche Gesellschaft für Technische Zusammenarbeit. 320–391.
- Horne, R. E., and J. Gertsakis. 2006. *A Literature Review on the Environmental and Health Impacts of Waste Electrical and Electronic Equipment*. Melbourne: RMIT University, prepared for the Ministry for the Environment, Government of New Zealand.
- Krejcie, R. V. and Morgan D. W. 1970. "Determining Sample Size for Research Activities." *Educational and Psychological Measurement*. 30: 607–610. Retrieved from [http://home.kku.ac.th/sompong/guest\\_speaker/KrejcieandMorgan\\_article.pdf](http://home.kku.ac.th/sompong/guest_speaker/KrejcieandMorgan_article.pdf) (Accessed 2 February 2013).
- NESREA. 2011. The National Environmental (Electrical/Electronic Sector) Regulations S.I. No. 23 of 2011, Federal Republic of Nigeria Official Gazette No. 50 Lagos – 25th May, 2011, The Federal Government Printer, Lagos, Nigeria. FGP75/72011/400(OL47).
- Okorhi, Ojiyovwi Johnson. 2015. "Assessment of Waste Electrical and Electronic Equipment Management Strategies in South Eastern Nigeria." Doctoral Thesis., Institute of Engineering, Technology, and Innovation Management, University of Port Harcourt, Nigeria, 1–180.
- Öko-Institut and Green Advocacy Ghana. 2010. *Socio-economic Assessment and Feasibility Study on Sustainable e-Waste Management in Ghana*. Report Commissioned by the Inspectorate of the Ministry of Housing, Spatial Planning and the Environment of the Netherlands (VROM-Inspectorate) and the Dutch Association for the Disposal of Metal and Electrical Products (NVMP). Freiburg, Germany: Institute for Applied Ecology and Green Advocacy Ghana.
- Oresanya, Ola. 2011. "E-Waste Management in Lagos State: The LAWMA Experience." Paper presented at the Two-day International Summit on Regulations & Management of E-Waste in Nigeria (Eko e-Waste Summit). Retrieved from <http://www.lawma.gov.ng> (Accessed 20 November, 2015).
- Pongrácz, Eva. 2002. "Re-Defining The Concepts of Waste and Waste Management: Evolving the Theory of Waste Management." Academic Dissertation to be presented with the assent of the Faculty of Technology, University of Oulu. ISBN 951-42-6821-0. <http://herkules.oulu.fi/isbn9514268210/>
- Porter, M. E. 1998. *COMPETITIVE STRATEGY: Techniques for Analyzing Industries and Competitors: with a new introduction – Michael E. Porter*. New York: The Free Press, A Division of Simon & Schuster Inc.
- Raduan, C. R., U. Jegak, A. Haslinda, and I. I. Alimin. 2009. "Management, Strategic Management Theories and the Linkage with Organizational Competitive Advantage From the Resource-Based View." *European Journal of Social Sciences* 11 (3): 1–16.
- Schübeler, Peter, Karl Wehrle, Jürg Christen, and SKAT. 1996. "Conceptual Framework for Municipal Solid Waste Management in Low-Income Countries." Working Paper No. 9. UNDP/UNCHS/WORLD BANK-UMP/Swiss Agency for Development and Cooperation (SDC). SKAT (Swiss Centre for Development Cooperation in Technology and Management), 1–55.