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Electronic Waste Scenario in Nigeria: Issues, Problems And Solutions

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ABSTRACT: *In this paper, the issues of the shipment of "second-hand" used electrical and electronic equipment (UEEE) that are malfunctioning or close to their end-of-life cycle to Nigeria are assessed and the problems resulting from e-waste scenario in Nigeria and the possible solutions are discussed with a view to increasing the awareness towards the mitigation of the e-waste menace. Electronic waste contains hazardous substances such as lead, mercury, beryllium, cadmium, chromium and brominated flame retardants, etc., that can pollute the ecosystems with the attendant environmental health risk to wildlife and humans. The increasing desire to bridge the digital divide coupled with the poor economic condition of most Nigerian citizens have encouraged the striving market of UEEE in Nigeria. Tons of these UEEE enter into the country and within a short time span, hundreds of millions of them become obsolete and discarded every year and they become the source of e-waste loaded with hazardous contaminants. Other factors, especially from the exporting countries end of the e-waste trade, are also discussed and far-reaching recommendations to mitigate e-waste environmental health threat are given.*

KEYWORDS: *electronic waste, Nigeria e-waste management, hazardous e-waste, WEEE, UEEE*

I. INTRODUCTION

The issues and problems posed by electronic waste in Nigeria and the possible solutions to mitigate the associated environmental health risk are the focal aim and objective of this paper. Nigeria is located within the Equator and the Tropic of Cancer on latitude 10^0 North and longitude 8^0 East. Nigeria is surrounded in the north by Niger and Chad and in the east by Cameroun and in the west by Benin Republic (Fig. 1). It occupies an area of 923,768 m^2 made up of landmass of 910,768 m^2 and water area of 13,000 m^2. The Nigerian coastline is 853 km. The seat of government is Abuja. Nigerian has stable democratic system of government and the present President of the country is Dr. Goodluck Ebele Jonathan, GCFR. According to Wikipedia (2012), Nigeria's population is 170 million people with three major tribes, namely: Hausa/Fulani, Yoruba and Ibo. The official business language is English and the currency is Naira (₦) which has an exchange rate of ₦159.98 to US Dollar ($1) as at June 2nd, 2013. The major religions practiced in Nigeria are Christianity and Islam, while there are minor adherents of indigenous religions, Hinduism, Buddhism, Baha'i and other faiths. Nigeria is a tourism and investment destination despite the recent security challenges. Nigeria has 4,660 km of standard/narrow gauges rail network across the entire country. Other modes of transportation are road network of 195,000 km, sea, inland water ways and air transportation. Nigeria has several international sea-ports (Lagos, Port Harcourt, Warri, Calabar, Onne and Sapele) and international air-ports (Abuja, Lagos, Kano, Port Harcourt, Enugu, Kaduna, Maiduguri, Yola, Calabar, Sokoto, Owerri, Jos and Ilorin) and local air-ports (Gombe, Minna, Yola, etc). The temperature ranges from 22 – 36^0c. There is rain forest in the South and savannah vegetation in the Northern part of the country (Wikipedia, 2012).

1.1 What is Electronic Waste?

Electronic waste or e-waste is the disposal of electronic goods such as cell phones, mp3 players, televisions, and computers (Terada, 2012). Alake and Ighalo (2012) defined e-waste as waste electrical and electronic equipment (WEEE) that are non-biodegradable, industrial and synthetic. Obsolete and discarded electrical and electronic equipment at end-of-life stage are also called e-waste (Wikipedia, 2013; Ogungbuyi, 2012; Adediran and Abdulkarim, 2012; Benebo, 2009). Electronic waste is further defined as an unwanted electronic or electrical appliances such as old and outdated computers, laptops, televisions, cellular phones, mp3 players, telecommunication equipment, keyboards, mice, photocopiers, typewriters, etc. (PPCC, 2006 quoted in Ogbomo et al., 2012). Electronic waste has many toxic and hazardous elements/materials that are sources of environmental pollution and contamination of groundwater, surface water, air and soil (Terada, 2012). The risk from e-waste affects the entire ecosystems and it is a major environmental health risk to wildlife and humans (Terada, 2012).

Fig. 1. Location map of Nigeria (Source: Magellan, 1992)

1.2 What is Electronic Waste Management?

Most of e-waste substances consist of appliances which use electricity which have reached the end of their life tenure. Such appliances include computers, refrigerators and other forms of consumer electronics. Many of such appliances retain some value even when they are discarded and may also be hazardous to health due to the various components of which they are made of. Many computers, LCD screens, cooling appliances, mobile phones may consist of precious metals, plastics with brominated flame retardant, chlorofluorocarbons (CFC) foam and other materials. Thus, e-waste management consists of the effective recovery of all reusable materials from WEEE and the safe disposal of the hazardous substances in them to prevent their contamination of the environment (Waste Management, 2011). Electronic waste contains valuable metals such as iron, aluminum, nickel, copper and precious metals such as gold, silver and platinum-group metals (PGM): platinum, palladium, rhodium, ruthenium, iridium and osmium (Wikipedia, 2013; Ogungbuyi et al., 2012). According to Manhart et al. (2011), 5.23 Kg of silver, gold and palladium can be recovered from a desktop computer in comparison to the same amount of metals in primary mining operation which has serious environmental implication. The failure to effectively manage e-waste leads not only to adverse environmental impacts but also to the depletion of potentially valuable resource base for secondary equipment (Opara, 2013).

II. ISSUES

An estimated 500 containers of "second-hand" electronics are imported to Nigeria every month from Europe with each container holding 500 to 800 computers and monitors representing about 400,000 arrivals every month (Terada, 2012; Puckett et al., 2005). The exporting countries of used electrical and electronic equipment (UEEE) to Nigeria are European Union (45%), USA (45%), remaining 10% from other locations such as Japan, Korea, Malaysia and Singapore (Benebo, 2009; Puckett et al., 2005). On the other hand, Osibanjo and Nnorom (2011) gave different statistical values such as United Kingdom (60%), Germany (16%), China (9%), USA (3%) and others (12%). According to Osibanjo and Nnorom (2011), only 60-70% of non-functional electrical and electronic devices are repairable and reusable, while the remaining 30% of the imported UEEE are non-functional and constitute WEEE. Manhart et al. (2011) corroborated the claims of Osibanjo and Nnorom (2011). However, Amachree (2013) and BIS (2013) maintained that 25% of the imported UEEE to Nigeria are functional, while the remaining 75% are either electronic junk or unserviceable (Puckett et al., 2005) and they are eventually burnt or dumped carelessly. There is data inconsistency and scarcity, moreover, data of imported UEEE via roads and air transportation media could not be obtained. Electronic waste is one of the fastest growing global waste streams and it is a source of major concern because it has growth rate of 3-5% per annum, thus making it three times faster than normal municipal solid waste (Ogungbuyi et al., 2012).

In 1999, only 35,000 Nigerians had access to mobile telephone lines but by the end of 2004, the numbers increased to over 9.1 million (Puckett et al., 2005). According to NCC (2013), Nigerian teledensity was 75.17% with subscribers' statistics of 105,239,815 in August 2012. In June 2013, Nigerian teledensity rose to 85.97% with 120,362,218 subscribers. On the other hand, the *Nigerian Guardian* (2013) reported that the installed capacity of all telecommunication providers in Nigeria was 226.6 million in January 2013 while the values rose to 234.1 million in July 2013. In addition, there is stupendous increase in Internet connectivity in Nigeria today, thereby accelerating the ever rising demands for ICT devices in Nigeria. Majority of the

Nigeria's populace are poor and so they always go for the UEEE to enable them bridge the digital divide. The issue is that most of the UEEE shipped into Nigeria are close to their end-of-life cycle and within a short time they become obsolete, unusable and discarded and then end up as e-waste without proper recycling.

III. PROBLEMS

In June 1988, 4,000 tons of e-waste including hazardous polychlorinated biphenyl (PCB) were discovered in drums in Koko area of Delta State, Nigeria and those toxic, hazardous wastes were known to the Nigerian government after nine months (Puckett et al., 2005; Terada, 2012). Those tons of e-waste came into Nigeria from Italy and they were finally repatriated back, however, the landlord of the field in which the tons of hazardous e-waste were dumped was adversely affected and died of cancer resulting from his exposure to them (Puckett et al., 2005). Electronic waste is a problem in Nigeria today because in most Nigerian cities, e-waste is dumped alongside with hospital and other municipal wastes. Because there is very low level of awareness of the hazards and health risk associated with e-waste, little children (child-laborers) and adult scavengers are seen in the dumps recklessly recovering items at great risk to their health.

Electronic waste contains several hazardous substances such as lead, mercury, beryllium, cadmium, chromium and brominated flame retardants, etc., that can pollute the ecosystems with the attendant environmental health risk to wildlife and humans (Itua, 2013; Opara, 2013; Ogungbuyi et al., 2012). Table 1 shows hazardous substances in e-waste items. The main destination of e-wastes is the landfill, where they become a source of pollution of groundwater and soil with toxins and heavy metals. In the advent of their being incinerated, they pollute the atmosphere with dioxins and furans and leave behind hydrocarbon ash on the soil. According to Opara (2013), it costs about "€3.50 (US$5.30 or ₦848.00)" to properly dispose an old cathode ray tube (CRT) monitor in Germany but it costs only about "€1.50 (US$2.27 or ₦363.43)" to place it on a container ship to Nigeria or Ghana. Thus the purported "'building bridge over the digital divide' serves as a cover of the actual 'bridge that double as toxic waste pipelines' to some of the poorest communities and countries in the world" (Puckett et al., 2005). According to Puckett et al. (2005), the so-called 'digital divide' only helps to open up 'a digital dump' in developing countries, especially Nigeria. In most cities in Nigeria there are neither organized e-waste collection centers nor e-waste management infrastructure. Figures 1 - 3 are photographs of stockpiled WEEE in some Nigerian office environments. The WEEE in private homes is unavailable because of lack of accessibility.

Table 1. Hazardous Substances in E-Waste Items (Source: MoEF, 2008; ENVIS, 2008; UNEP, 2007b quoted in Adediran & Abdulkarim, 2012; Puckett et al, 2005)

ITEM	HAZARDOUS SUBSTANCES
Cathode Ray Tube	Lead, antimony, mercury, phosphorus
Liquid Crystal Display	Mercury
Circuit Board	Lead, beryllium, antimony, organohalogen compounds, brominated flame retardants (BFR)
Fluorescent Lamp	Mercury, phosphorus, BRFs
Cooling Systems	Ozone depleting substances (ODS)
Plastics	BRFs, phthalate plasticizer, polychlorinated biphenyl (PCB)
Insulation	ODS in foam, asbestos, refractory ceramic fibre
Rubber	Phthalate plasticizer, BRF, lead
Electrical wiring	Phthalate plasticizer, BRF
Batteries	Lead, lithium, cadmium, nickel, mercury
Drum	Sellenium

(1:– Wired Circuit Boards; 2 and 3:– CRT TVs and Casings)
Figs. 1 - 3. Stockpiled WEEE in Nigerian office environments in Kwara and Delta States)

IV. SOLUTIONS

Three-year undercover investigation by Greenpeace (2009) indicated that unfixable UEEE in United Kingdom always end up shipped to Africa, especially Nigeria as 'second-hand electronic goods'. While the local expertise capacity in Nigeria enables the utilization of thousands of the unfixable UEEE as spare parts, however, majority of these UEEE are usually dumped as e-waste without any proper recycling and thereby posing environmental health threat. Most of the e-waste comes from developed countries (Harder, 2005). According to *ABC News* (2006), Americans bought an estimated US$125 billion worth of consumer electronics: computers, monitors, cell phones, televisions, etc. in 2005. Hundreds of millions of them becoming obsolete every year and become source of e-waste which are loaded with hazardous contaminants. According to Terada (2012), the developed countries aware of the risks and health hazards to humans and environmental health coupled with the higher cost of safer recycling and the stringent regulations in their home countries find it easier to ship their e-waste to developing countries where there are lax regulations and cheap labor. To prevent this environmental injustice, the Basel Convention came into existence. The Basel Convention placed ban on import and control of transboundary movement and management of hazardous e-waste. The Basel Convention was adopted in 1989 and entered into force on May 5, 1992 and amended in 1995 (Terada, 2012; Ogungbuyi et al., 2012; Puckett et al., 2005). The Basel Convention does not contain any explicit enforcement provisions because it is assumed that the national laws of the parties should complement it. In September 2010, 178 nations, including industrialized countries such as Japan, European Union and the United Kingdom, were parties to the Basel Convention. However, USA, the world's highest producer of e-waste, has not ratified the Basel Convention and by such action or inaction has indirectly promoted the dumping of toxic e-waste on developing countries (Terada, 2012; Puckett et al., 2005). For instance, under the Basel Convention used electrical and electronic equipment (UEEE) that is functioning and intended for re-use is not considered to be an e-waste, regardless of whether it is hazardous or not (Puckett et al., 2005). That can give leverage to unscrupulous exporter, who can capitalize on such provision to dump near end-of-life UEEE on developing countries, except where proper testing to ascertain the functional state of the UEEE, certification and labeling have been carried out.

Another Convention called the Bamako Convention was adopted on January 29, 1991 and entered into force on April 22, 1998. The Bamako Convention placed ban on the import and the control of transboundary movement and management of hazardous e-waste within Africa and unlike the Basel Convention, it articulated more specific and active guidelines for both sides of the e-waste trade. In March 2010, 33 African countries signed the Bamako Convention, while 24 of them ratified it (Terada, 2012). Nigeria signed the Bamako Convention in February 2008, but has not yet ratified it; while it not only signed but has also ratified the Basel Convention since May 24, 2004 (Terada, 2012; Puckett et al., 2005). It is strongly believed that one of the major components of the solution to the control of transboundary movement of e-waste from USA, European Union, Asia, etc. to Nigeria requires Nigeria's immediate ratification of the Bamako Convention alongside an effective and efficient enforcement regime of the regulations.

The National Environmental Standards and Regulations Enforcement Agency (NESREA), an Agency of the Federal Ministry of Environment, is responsible for the enforcement of all environmental laws in Nigeria (Amachree, 2013). While NESREA's work is commendable, there is still much room for more work towards the effective solution to the e-waste scenario in Nigeria today. NESREA working with certain stakeholders have put efforts toward creating awareness about the e-waste issue but it is grossly insufficient. In 2009, NESREA sponsored an international conference on e-waste control titled "The Abuja Platform on E-Waste". In February 24-25, 2011, the 1st Eko international summit on e-waste was held in Lagos, Nigeria. The communiqué of the Summit drew the attention of the Federal Government to not only encourage but also enforce collection, recovery, re-use and recycling (3R's) of e-waste management (Eko Declaration, 2011). In November 2010, the Environment Division of the Nigerian Society of Engineers organized a conference in Abuja, Nigeria, titled "Environmental Impact of Telecommunication Projects in Nigeria". The conference called on government in all levels to legislate on e-waste management. In May 2011, "The National Environmental (Electrical/Electronic Sector) Regulations 2011" was gazette in Federal Government Gazette No. 5, Vol. 98. In the gazette, the 3R's of waste management were expanded to 5R's, namely: Reduce, Repair, Reuse, Recycle and Recover. Among other issues such as "Extended Producer Responsibility Programme" to buy-back WEEE is well captured in Schedule VIII of the Regulations. While the fines and punishment for offenders (individuals and corporate) are well articulated and the Regulations very laudable, however, much is required for the full effective implementation and enforcement regime.

Letsrecycle (2013) reported a success story of NESREA in impounding two containers from France identified to contain UEEE without exporter's test certification at Tin Can Island, Lagos, Nigeria. While the efforts and action of NESREA is laudable, however, how do we effectively manage the excessive tons of e-waste already within Nigeria?

V. CONCLUSION AND RECOMMENDATIONS

The NESREA Regulations 2011 is a laudable legislative document which is line with and complements the Basel Convention. Nigeria is presently a major destination for e-waste from USA, European Union, Asia, etc. Nigeria must, as a matter of urgency, ratifies the Bamako Convention so that the nation can have more stringent enforcement regime. While the efforts of NESREA is commendable, countrywide survey research for this paper revealed gross lack of awareness on the e-waste menace both within the literate and illiterate members of the Nigeria's populace.

Against this backdrop, the following far-reaching recommendations are proffered:

a) All stakeholders (government, industry, environmental groups, and citizens) must work in cooperative collaboration with NESREA to effectively manage and mitigate the problems of e-waste in Nigeria.
b) Nigeria should immediately ratify the Bamako Convention and entrench stringent enforcement regime of the National Environmental (Electrical/Electronic Sector) Regulations 2011 and the Nigerian Decree of 1988 prohibiting all imports of hazardous wastes.
c) The "Extended Producer Responsibility Programme" to buy-back WEEE should be fully enforced internationally.
d) Producer companies should use non-toxic raw materials in the manufacture of EEE to reduce the production of e-waste.
e) Develop national database infrastructure on e-waste management in Nigeria.
f) Full enforcement of the proof of testing and categorization with respect to the Basel Convention on transboundary movement and management of e-waste.
g) All members of the Organization for Economic Cooperation and Development (OECD) and the European Union countries should implement in full the Basel Convention.
h) The USA should be made to comply with OECD Council Decision regarding export of hazardous e-waste.
i) Ban all import of UEEE labeled for repair or refurbishing in developing countries.
j) All exporting countries should enforce control and ratify the Basel Convention in promotion of human and environmental justice and fairness to achieve a win-win scenario in bridging the digital divide.
k) Increase the tempo of the awareness campaigns in local and indigenous languages on the dangers of e-waste to human and environmental health.
l) Create incentives to encourage citizens to shun e-waste and willingness to release all e-waste in their possession.
m) Develop local capacity for the recovery of copper, steel, lead, silver, gold, platinum group metals, plastics, etc. from e-waste.
n) Develop national e-waste collection centers and e-waste management infrastructure in Nigeria.

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