E-Waste Menace in Nigeria and the Way Out of it

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Abstract: Nigeria, with a huge population of about 170 million people, has become a dumping ground for both brand-new and fairly- used imported electrical and electronic products and equipment such as ICT , telecom and household appliances – monitors, computers, TVs, mobile handsets, refrigerators, washing machines, DVD/CD Players, Computer storage media but to mention a few. These electrical and electronic products and equipments become technologically obsolete in a matter of months or years and they become very close to the end of their shell life. Most of the obsolete products and equipment find their way into developing countries like Nigeria, as fairly-used or *tokunbos*, because of the hunger of Nigerians for IT and technological products. At the end of their shell life, they eventually find their way into landfills or dump sites as Electronic Waste (E-Waste) which may pose serious health and environmental hazards to humans, livestock and ecology if not properly managed. This paper reviews the issues relating to E-Waste management in Nigeria. It identifies the sources of E-Waste as well as their components and the dangers in them. This paper finally proffers far-reaching recommendations to the major stakeholders – the regulators (government), the manufacturers (industries), the recyclers, the resellers, and the end-users ,etc. on the best internationally recognised practises on how to handle and manage e-waste in order to make the environment safe for all of us.

Keywords: e-waste, shell life, tokunbo, management, hazards, environment, health, ICT, Telecomm, Nigeria.

I. INTRODUCTION

E-waste or electronic waste is the term that is used to refer to electrical and electronic products that are nearly their end life. These products include used Information Technology (IT) and telecommunication products such as computers, handsets, monitors, televisions, refrigerators, washing machines, etc. They are composed of major heavy metals such as lead, mercury, gold, nickel, cadmium, chromium that are very toxic to the environment and to human health. These poisonous substances cause several health hazards and environment corrosion to the soil. E-waste poses serious danger to Nigeria because Nigeria has become a dumping ground to both brand-new and fairly-used or second-hand products popularly known as '*tokunbo*'. "These imported products, with time, come to the end of their shelf life and are discarded as E-waste. Because these products are not recycled, they are dumped into the environment and they constitute threat to both the environment and human life. These old products can be recycled properly and generate revenue to the Nigerian economy.

Currently, Nigeria has a back log of e-waste that is posing a lot of challenges to the environment and human health. It is a thing of concern that a lot of Nigerians are not aware of hazards associated with e-waste. It is not uncommon to find young men in Nigeria rummaging through waste heaps containing all sorts of waste. Furthermore, waste disposal has become a challenge in Nigeria. In those days Lagos was one huge pile of waste with very large quantities of waste found all over the city. In almost every big city in Nigeria, Lagos, Abuja, Kano, Port Harcourt, Ibadan, Onitsha, Owerri, Enugu, etc, waste disposal is a big challenge which has overwhelmed a lot of state and local governments.

In recent years, advances in consumer electronics and personal computers have spurred economic growth, changed information technology and improved people's lives in countless ways. However, our growing dependence on electronics products both at home and in the workplace has given rise to a new environmental hazard; electronics waste. A recent study shows that electronics already makes up 1% of the known municipal solid waste stream [1]. According to [1], research completed in Europe showed that electronic waste is an epidemic growing at an astronomical three times the rate of other municipal waste. While e-waste cannot be prevented, environmental consequences have driven government policies to explore alternative solutions such as the reuse and/or recycling of older electronics.

According to the U.S. Environmental Protection Agency (EPA), an estimated 30 to 40 million Personal Computers will be ready for "end-of-life management" in each of the next few years. About 25 million TVs are taken out of service yearly. The EPA estimates that in 2005, the U.S. discarded 1.5 to 1.9 million tons (3 billion Ibs.) of computers, TVs,

VCRs, monitors, cell phones, and other equipment. The nation now dumps between 300 million and 400 million electronic items per year, and less than 20% of that e-waste is recycled. E-Waste represents 2% of America's trash in landfills, but it equals 70% of overall toxic waste. Because computer processing power doubles roughly every two years, many old computers are being abandoned. In 2005, Americans discarded 47 million computers, up from 20 million in 1998. It's energy efficient to rebuild old computers, but only about 2% of PCs ever find their way to a second user. Fewer than 20% of cell phones are recycled each year, but if we recycled just a million cell phones, it would reduce greenhouse gas emissions equal to taking 1,368 cars off the road for a year. Flat panel computer monitors and notebooks often contain small amounts of mercury in the bulbs used to light them. Cathode ray tubes in older TVs and computers typically contain large quantities of lead.

The European Union banned e-waste from landfills in the 1990's, and current laws hold manufacturers responsible for e-waste disposal. Large amount of e-waste have been sent to countries such as China, India and Kenya where lower environment standards and working conditions make processing e-waste more profitable. Around 80% of the e-waste in the U.S. is exported to Asia. E-waste legislation in the United States is currently stalled at the state level. So far, just 24 states have passed or proposed take-back laws.

In Nigeria, due to the rapid growing population of the citizens, managing e-waste and other recyclable and non-recyclable components have become a huge challenge to various governments. It is not as if government is not aware of the dangers of e-waste since an agency, the National Environmental Standards and Regulation Enforcement Agency (NESREA) has been set up to police e-waste in the country. NESREA is empowered to enforce all environmental laws, guidelines, policies, standards and regulation in Nigeria as well as enforcing compliance with provisions of international agreements, protocols, conventions and treaties on the environment. The Minister of State for the Environment, Alhaji Ibrahim Jibril stated this at the 11th session of the National Council on Environment held at the June 12, 2017 at the Cultural Centre in Abeokuta [2].

Making his comments following a presentation at the NCE by Christian Wessels of the World Economic Forum on "Solving Nigeria's E-waste Crisis", the minister said,

> *"E-waste is a real challenge and environmental hazard. There is a concerted effort by major players in the world: Phillips, Dell, Microsoft and many others that have come together to take the initiative, knowing they have the responsibility of recycling these products which they initiated in the first place".*

> *"Secondly, we need to know that in Nigeria, you can separate these e-waste into two: the brand-new ones that are imported into the country and are sold and used by all of us, and which ultimately come to the end of their shelf life and are discarded as waste. The second categories are those that imported into Nigeria as second-hand materials."*

> *"These materials contain all kinds of precious metals like gold, nickel, chromium, and the rest. "We are saying that these materials can be recycled and you can get a huge quantity of these metals from them, particularly computers and handsets, and people can make money out of it."*

He pointed out that NESREA has worked on regulations, namely the Extended Producer Responsibility. Concluding his remarks, he asserted that

> *"Let it be known that these e-wastes can no longer be ignored and that we have to address them, and in addressing them, we can actually create wealth out of the waste that is generated."*

The admission by the Honourable Minister of State for Environment shows clearly that Nigerian government is aware of the challenges and risks e-waste poses to Nigerians. He also identified the gains that can come from E-waste if they are properly managed and recycled. In other words, E-wealth can create wealth for Nigerians if managed properly. The major problem, however, is for the government to muster the political will to act and for the citizens to know and play their roles effectively.

II. THE PURPOSE OF THE RESEARCH

The aim of the research is to create awareness of the dangers of improper management of e-waste and to investigate how E-waste can be managed effectively in Nigeria by the major stakeholders – the regulators, the collectors, the

resellers, the aggregators, the recyclers, the manufacturers and the end-users to rid our environment of dangerous substances emanated from E-Waste and convert them into useful products and revenue for Nigeria.

III.   THE RELATED WORKS

The authors in [3] conducted a study on E-waste management in Nigeria. The paper reviewed different issues relating to E-Waste. It identified the sources of E-Waste as well as their components and the dangers in them. Alternative initiatives and means of managing E-Waste both nationally and internationally were highlighted and recommendations were made by the authors on how best to handle E-waste in Nigeria.

The author in [4] presented a report on the E-waste management strategies in India. He identified the sources of E-waste, the chemical constituents and their effects on both the environment and human health. He made far-reaching recommendations on E-waste management techniques that will reduce the amount of E-waste in India cities and made the environment safe for India citizens.

The authors in [5], in their paper, carried out a survey on effective management of e-waste in developing countries with emphasis on the prevailing situation in Nigeria. It emphasized that e-waste management through implementation of EPR, the establishment of product reuse through remanufacturing and the introduction of efficient recycling facilities will go a long way to bring effective e-waste management in Nigeria. The study went further to state that the implementation of a global system for the standardization and certification/labelling of second-hand appliances intended for export to developing countries will be required to control the export of electronic recyclables (e-scarp) in the name of second-hand appliances in Nigeria.

IV.   SOURCES OF E-WASTE

The major sources of e-waste include the following:-
- IT & Telecom equipments
- Large Household appliances
- Small household appliances
- Consumer and Lighting equipments
- Electrical and Electronic tools
- Toys and Sports equipment,
- Medical devices, and
- Monitoring and control instruments.

V.   COMPONENTS OF E-WASTE E

According to [2], E-waste is composed of several major components such as Monitors, TVs, Computers, Telephones including mobile handsets, fax, printers, etc. Also, it includes refrigerators, DVD/VCR Players, CD Players, radios, Hi-Fi sets, etc. It also includes washing machines, dryers, ovens, toasters, vacuum cleaners, toasters, pressing irons, etc. Fig.1 depicts the sources of e-waste according to their percentage composition
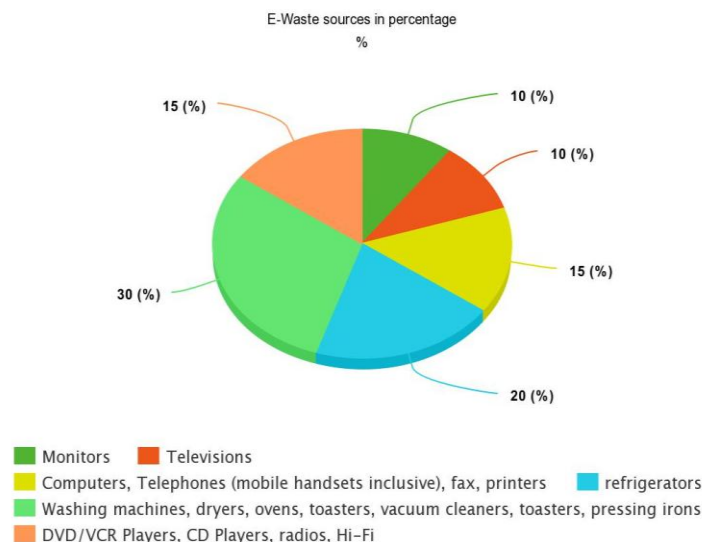

Fig. 1 Composition of E-Waste sources in percentage

VI. CHEMICAL CONSTITUENTS OF E-WASTE

The chemical constituent of E-Waste, which causes hazards to health and environment, is depicted in Table 1.

TABLE I THE CHEMICAL CONSTITUENTS OF E-WASTE [3]

Item	Chemical Constituents
Cathode Ray Tube (CRT) in computer monitors and old TVs	Lead, antimony, mercury, phosphorous
Liquid Crystal Display (LCD) in computer monitors, laptops, smartphones	Mercury
Printed Circuit Boards (PCBs) in computer motherboards, adapter or expansion cards	Lead, beryllium, antimony, BFR
Cooling systems	Ozone depleting substance (ODS)
Fluorescent lamps/bulbs	Mercury, phosphorous, flame retardants
Plastic or PVC products	BFR, phthalate plasticizer
Rubber	Phthalate plasticizer, BFR, lead
Insulation	ODS in foam, asbestos, refractory ceramic fibre
Electrical wiring	Phthalate plasticizer, BFR
Batteries in laptops, inverters, UPSs, mobile phones, Tablets	Lead, lithium, cadmium, mercury

VII. EFFECTS OF E-WASTE ON HEALTH AND ENVIRONMENT

Effects of e-waste on both human health and environment are enormous. According to authors in [4], the major chemical component of e-waste which is lead is very poisonous to both environment and human health. It can cause damage to the central and peripheral nervous system, blood systems and kidney damage. It also affects brain development in children. Chromium causes asthmatic bronchitis and DNA damage. Mercury which is another major component of e-waste can cause chronic damage to the brain and respiratory system. Cadmium causes toxic irreversible effects on human health. It accumulates in kidney and liver and causes neural damage. All these components of e-waste can poisonous the environment- the soil, the water and even the air and make them poisonous to human.

The following points summarize the effects of E-waste to the environment and human life:

1. **Pollution of ground water**. This pollutes or contaminates ground water which is the source of drinking water for human beings. Lead in drinking water can lead to lead poisoning.
2. **Acidification of soil**. This causes the pH of the soil to be acidic and therefore not suitable for the growth and survival of some species of plants and crops.
3. **Emission of toxic fumes and gases**. This causes serious health challenge to human health if these poisonous gases are inhaled. Asthma and other respiratory diseases will come up.
4. **Release of carcinogenic substances into the atmosphere**. This causes cancer and cancer-related ailments to human.

VIII. STAKEHOLDERS AND THE MANAGEMENT OF E-WASTE

According to the authors [3], efficient management of e-waste in Nigeria should involve all the major stakeholders in the e-waste life cycle. - the government (the regulator), the industries (manufacturers), and the citizens (end-users). Other stakeholders may include- the suppliers, collectors, recyclers, and the aggregators.
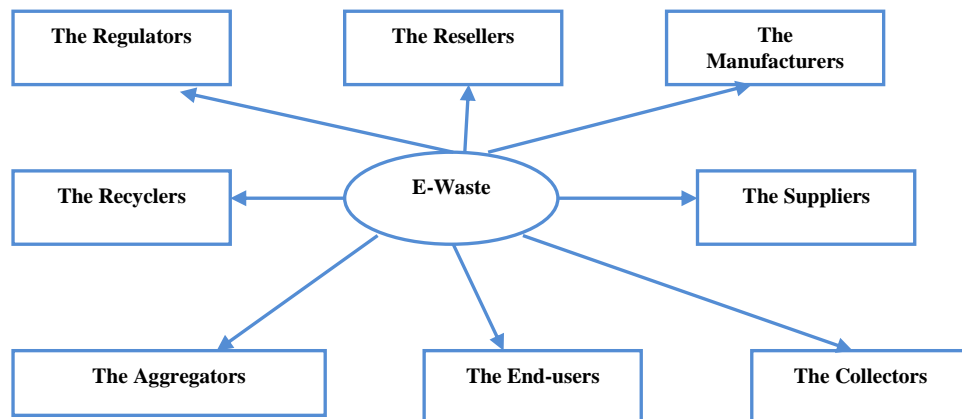Fig.2 depicts the stakeholders involves in E-waste management life cycle.

Fig. 2. The E-Waste management stakeholders

A. Responsibilities of the Regulators (Government)

In Nigeria, the Federal government is the chief regulator of importation, distribution and recycling of E-products. FG agencies such as - Federal Environmental Protection Agency (FEPA), National Environmental Standards and Regulations Enforcement Agency (NESREA), National Emergency Management Agency (NEMA), National Space Research and Development Agency (NASRDA), Standard Organisation of Nigeria (SON) and Nigeria Customs Service (NCS) are there to collaborate and do the needful to checkmate rampant importation, distribution and recycling of E-waste. FG can use NCS and SON to stop importation of sub-standard used IT products into the country. FEPA can regulate the industries (manufacturers) so that they will not dispose toxic e-waste into the environment without going through recycling stage. NESREA can monitor and regulate recycling of E-waste proper.

1. The State governments should set up regulatory agencies in all the 36 States under the office of the governor or under the Ministry of Environment to oversee strict compliance to e-waste disposal and management.

2. Also the Minister of FCT should set up an Agency to oversee it in the FCT, Abuja.

3. The Federal government should have Director General overseeing e-waste management under the Office of the Minister of the Environment. He or she should liaise with the directors in the 36 States and FCT for effective implementation and enforcement of e-waste recycling strategies. The Federal Government of Nigeria has already done this; the National Environmental Standards and Regulation Enforcement Agency (NESREA) has been set up to police e-waste in the country but it should be given more funds and mandate to carry out its tasks.

4. The National assembly should pass a bill on e-waste and hazardous substances management to give a bite to the fight against rampant dumping of e-waste in Nigeria.

5. The government should invest heavily on R&D in hazardous waste management.

6. There should be strict regulations against dumping e-waste anyhow. Heavy fines should be imposed on industries that flout these regulations.

7. Non-governmental organizations (NGOs) should be encouraged by government to educate the citizens and carry out enlightenment campaigns on the dangers of improper disposal and management of e-waste.

B. Responsibilities of the industries (the Manufacturers)

The following are the recommended responsibilities of the industries.
1. Industries should imbibe good management options of e-waste recycling such as label materials to assist in recycling
2. Adopt green packaging options to reduce quantity of e-waste in their products
3. They should adopt waste minimization techniques to reduce quantity of toxic substances' in the products

C. Responsibilities of Responsibilities of the citizens (the end users)

The citizens should know the dangers of e-waste and how to avoid it. They should avoid the use of products that have more constituents of toxic substances than the ones that have less. They should use recycled contents that are energy efficient that utilize minimal packaging and offer take back options.

D. Responsibilities of the Recycler

The recyclers are the people that convert the E-waste to wealth. They recycle or convert the old discarded products into raw materials for the manufacture of other useful products. For instance some of the E-waste contains gold, chromium which are precious metals; they can be used to produce jewelleries. This stakeholder works with the collectors who go to dump-sites and end-users' homes to collect these wastes at a minimal fee or even for free.

E. Responsibilities of the Collector

This stakeholder works with the grassroot people who go to dump-sites and end-users' homes to collect these wastes at a minimal fee or even for free. If you to the major dump sites in Nigerian major towns and cities, you will see these people (both young and old) picking dumped items from dump and garbage sites. The Collectors collect the e-waste materials and then sell to the recyclers.

F. Responsibilities of the Reseller

Resellers are sellers of office equipment in developed countries. Most of these office equipment become obsolete within few years after manufacture. Most of them that have just few years towards the end of their shell life are imported into the country and sellers sell them as if they are still worth it. Photocopiers, computers, monitors, printers and fax machines are typical examples of electronics equipment that 'run' quickly into such technological obsolescence. In the developed world, such equipment are donated to schools and charities for use or resale, while the dysfunctional ones are shipped to poor developing countries where they eventually become E-waste.

IX. MANAGEMENT METHODS OF E-WASTE

The efficient management of E-waste may include the following practices or methods:

1. **Inventory Management**. This involves industries taking stock of the amount of E-Waste generated in the country. There is a serious constraint in obtaining reliable data on the   amount of E-waste generated in Nigeria and other developing countries. For example, It is difficult to calculate the amount of sales or imports of electrical and electronic products, the amount of discarded or disposed products, the amount of these products that are recycled and so on. This makes any E-waste inventory model developed for developing countries to lack merit.

2. **Production-process modification**. A product can be modified during refurbishing so that its life span can be elongated and reduces the possibility of being disposed off as E-waste.

3. Volume reduction. Volume reduction entails minimizing the amount or percentage of hazardous substances by volume in product raw material mix during design and manufacturing.

4. **Recovery and Reuse.** Reuse**,** in contrary to recycling, extends the lifespan of a device before eventual recycling. Recovery entails converting useful components of the E-waste to produce other important products. Most electronic devices contain a variety of materials, including precious metals such as gold, chromium that can be recovered for future uses.

5. **Recycling**. Recycling involves conversion of harmful components of E-waste into harmless/useful outputs. There are four main steps involved in the recycling of E-Waste, viz: collection, transportation, treatment, and disposal.

6. **Sustainable product design**. This entails a type of product design that ensures the longevity of product after manufacture so as to increase the shell life of products before they are disposed off as E-waste. For example, if a product can last 5 years, its life span can be extended to 8 years so that it will add to the challenge of E-waste.

The best way to manage E-waste is to Reuse, Reduce and Recycle.

X. CONCLUSION

Nigerian population is growing at a tremendous rate, so also is the rate at which refuse and e-waste are generated on daily basis. If something is not done urgently by the stakeholders, especially the government, to reduce the rate of generation or re-convert/recycle of these wastes into useful alternative products the environment and lives of the citizens can be threatened by the dangerous constituents of these wastes.

The chemicals that make up e-waste are harmful if inappropriately recycled or disposed. They cause health conditions such as cancer, genetic mutations, birth defects, various organ damage and failure. E-waste chemicals have been found throughout the human body and environment in Nigeria. This is because some workers and their families go home to and those living within about two miles of a crude e-waste site.

This paper identified poverty, ignorance and government inactions as the three major reasons why e-waste risks are on the increase in Nigeria. People that are crudely recycling e-waste by going to dump sites to pick them up only consider short- term monetary gains, before they consider their health, the quality of their environment, or the lives of future generations. The Federal and State governments must promulgate a bill to stop importation of dangerous e-waste and toxic substances in the country in the name of ICT products as well as introduce stringent and safe measures of disposing and recycling e-waste products.

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