International Journal of Law
ISSN: 2455-2194, RJIF 5.12
www.lawjournals.org
Volume 3; Issue 2; March 2017; Page No. 07-18

A legal appraisal of the challenges of management of electronic waste in Nigeria

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Abstract

When people make use of Electrical and Electronic Equipment (EEE), after a while, newer technologies arise that make the old ones become technologically archaic thereafter, due to continuous development of newer models. The problem then arises regarding where to keep the old ones. Many of the obsolete equipment either find their ways into developing countries with information technology deficiency or become crushed as recycled newer models of the old electronic equipment. The former consequence of electrical equipment disposal, (E-Waste or Waste EEE) and how it poses severe health and environmental hazards to human lives, plants, livestock, ecology and the ecosystem in the absence of regulation, enforcement and proper management or even constituting severe infraction of human rights of residents in the environment is therefore the focus of this work. This paper therefore examines the delineation of electronic waste, reiterates the national and international issues relating to E-Waste, itemises the sources of E-Waste, the consequences of the indiscriminate dumping of E-Waste and identifies the E-waste management challenges, the components and the dangers of dumping hazardous electronic waste in the environment. It goes further to discuss the alternative mechanisms for managing E-Waste both nationally and internationally and the legal imperatives and frameworks for the prevention and management of E-waste. This paper concludes by making a set of scientific and legal recommendations for the treatment, prevention of dumping and control management of E-Waste in Nigeria with a view to reducing the deleterious consequences of E-waste disposal in the environment.

Keywords: electronic waste, Nigeria, management, challenges, legal framework

1. Introduction

The advent of Electrical and Electronics Equipment (EEE) has infused comfort, convenience and ease to the lives of the users. Electronic technology is not only efficient but also effective in solving basic human problems. They have been useful as tools in Communication systems such as computers, Laptops, mobile phones, Fax machines, radio, television, cameras, *et al*. [1] In fact, the categories of e-waste are not closed [2]. The use of electronic technology also extends to household equipment for undertaking domestic chores like cooking, washing, cleaning, cooling, heating, etc. But these Electrical and electronics equipment, which are in almost every strata of human endeavour become technologically obsolete, thus getting out of vogue as newer models are developed [3]. This is responsible for the proliferation of electronic equipment in developed nations which are mostly technology-producing nations [4]. This rapid technological growth and development that spiralled the continuous production of multifarious electronic equipment for all of human endeavour is not without consequence. The problem that arises is where to keep the older models after [5] outliving its use and the current ones after their technological relevance.

An estimated 20 million to 50 million metric tonnes of E-Waste is reportedly generated worldwide every year [6], and this is assessed by scholars to grow up to about 70 million by 2015 [7]. In the United States for instance, 14 to 20 million personal computers are thrashed as e-waste every year, with an annual increase of 3-5% [8]. Out of this figure, only about 13-18% of it, gets recycled as new products [9]. As a consequence, the disused equipment that have outlived their use and relevance find their way into many places, mostly outside their countries of production, some end up in domestic and industrial landfills where they constitute severe environmental, safety

[1]See Bandyopadyay, A (2008) "Indian Initiatives on E-waste Management: A Critical Review." *Environmental Engineering Science*. Vol.25, issue 10,p 1507. See also "What is E-waste?" Cal Dept. of Resources Recycling and Recovery. Available online at http://www.calrecycle.ca.gov/Elecrtronics/WhatisEwaste/ visited 16th November, 2016. (stating that the definition of e-waste comprises computers, televisions, VCRs, stereos, copiers and Fax machines.) However, the State of California in the US has not been able to determine whether items like Microwave Oven and similar appliances like toasting machine, ovens etc. should be considered as e-waste. See Jing, J (2014) "E-Waste & the Regulatory Commons: A Proposal for the Decentralization of Internal Environmental Regulation." 39 *Brooklyn Journal of International Law*, Issue 3, Article 9, p 1251. Available online at http://brooklynworks.brooklaw.edu/bjil/vol39/iss3/9 Accessed 16th November, 2016.

[2]It includes Cathode Ray Tube (CRT), CRT monitors and LCD (Liquid Crystal Display) monitors. See Chen, A.. *et al* (2011) " Developmental Neurotoxicants in E-Waste: An Emerging Health Concern." *Environmental Health Perspectives*, Vol 119, Number 4, p. 431

[3]Examples abound. When Mobile phones was introduced around year 2002, Nokias 3300, 3310, 2700, 6720, My X2, 2730, Nokia Lumia etc. Blackberry phone metamorphosed through the following: Curve 2, Bolds 2,5 and 7,Z 5,10, Q10 Q30,Passport etc. The phone that is in vogue now is I Phone 7 (which started from 1). This will soon be replaced by another model. See further, Adediran Y. A and Abdulkarim, A.(2011) 'Electronic Waste – A Review of Its Sources, Inherent Dangers and Management'. Proceedings 2011 Annual Conf. and AGM of NSE Environment Division, Lagos, 23-24 Nov. 2011.

[4]Christine Terada, 'Recycling Electronic Wastes in Nigeria: Put-ting Environmental and Human Rights at Risk', 10 *Nw.J. Int'l Hum.Rts*. 154 (2012). <http://scholarlycommons.law.northwestern.edu/njihr/vol10/iss3/2> Accessed 12th June, 2016.

[5]Ibid n (2) 4.

[6]Facts and Figures on E-Waste and Recycling. <http://www.electronic stakeback.comuploads.com> Accessed 12th June, 2016. See further, Whitehouse, T (2012) "E-Waste Exports: Why the National Strategy for Electronics Stewardship Does Not Go Far Enough." *Journal of Energy & Developmental Law*, p 110.

[7]See Mushtaq Ahmed Memon, United Nations Env't Programme, Presentation at United Nations Environment Programme Regional Workshop on WEEE/E- waste Management: Capacity Building Activities by IETC 2 (July 12, 2010) http://www.unep.or.jp/ietc/spc/news-jul10/UNEP_IETC_Ewaste_July2010. pdf. Accessed 16th November, 2016.

[8]Facts and Figures on E-Waste and Recycling. *supra*.

[9]ibid.

breach and health hazards to humans, livestock and the soil. Some others are thrown into incinerators and torched, leading to massive environmental pollution from the fumes created thereby. A large chunk of them are 'exported' to impoverished and technologically-deficient nations, otherwise called developing and under-developed countries [10], like Nigeria, Ghana [11] and other parts of Africa, Asia etc. where, often times, out of ignorance and inadequate regulatory frameworks, the equipment are improperly managed or wrongly handled, thus leading to severe environmental infraction and constituting threat to human health, soil contamination, livestock and destruction of drinking water.

These decommissioned electronic equipment at the end of their productive life therefore constitute Wastes of Electrical and Electronic Equipment (Waste-EEE), otherwise known as Electronic Waste (E-Waste), which unregulated recycling has led to serious environmental degradation and an unjustifiable violation of human rights [12]. The worst hit continents that are unfortunate dump sites for this e-waste are Asia and Africa where exporting is easy, with relaxed labour laws and less stringent import policies [13] and a large community of technology-hungry and poor people. It is only logical that as there is an increasing demand for a global market for new high-technology electronic products, there is a corresponding inverse for the abandonment of the former equipment as abandoned products. The continuous production of these modern new electronic equipment, coupled with the increased number of shorter life span products has equally contributed to the witnessed continuous e-waste explosion in many nations of the world, especially Nigeria, more so that all efforts geared towards recycling the e-waste has majorly led to a largely unregulated, uncoordinated and oftentimes illegal, e-waste trade that encourages the dumping of extremely toxic materials in the guise of technology transfer from privileged, developed countries to developing countries of the world.

This paper therefore critically examines the issues concerning the definition and sources of E-Waste, identifies what constitutes and facilitates its entrance and proliferation to developing countries of the world, discusses the danger, hazardous components and the deleterious effects, the challenges of managing E-Waste in Nigeria, identifies the alternative mechanisms of managing the E-Waste, discusses the national and international intervention for the prevention and control of E-Waste, and concludes by making a set of effective, societal, scientific, economic and legal recommendations for the prevention, control and management of E-Waste in less developed countries, using Nigeria as a benchmark. Specific attention is given to some International Conventions on the prevention of dumping of hazardous waste like the Basel Convention, a multilateral agreement which places restrictions on the transboundary movement of hazardous waste [14], and Nigeria's efforts at managing E-Waste. One prominent limitation to the control and management of E-Waste as identified in this paper is the inability to obtain reliable data on the quantity of E-Waste generated in a nation like Nigeria with data deficiency and census impropriety. More scientific research is therefore advocated to bridge this gap.

2. What is e-waste?

Scholars are unanimous that there seems to be no universally acceptable, internationally standardized and agreeable definition of E-Waste [15], but they are *ad idem* as to what constitutes it. It is therefore not surprising that each nation and organization come up with their respective definitions in accordance with what they presume are the components of E-Waste [16]. According to the European Union (EU) Initiative [17], waste is "*any substance or object which the holder disposes of, or is required to dispose of pursuant, to the provision of national law in force"* [18]. To Lewis [19]. "*e-waste is obsolete electronics or electronics that reach the end-of-life*." While not too different from this definition, California Department of Resources Recycling and Recovery define e-waste as "*loosely applied to consumer and business electronic equipment that is near or at the end of its useful life* [20]." Erasmus [21] was more explicit when he define e-waste as "*electrical or electronic equipment which is waste, including all components, subassemblies and consumables which are part of the product at the time of discarding. It includes computers and entertainment electronics consisting of harmful and toxic components."*

E-waste consists of primarily mobile phones, computers, communication equipment, entertainment electronic gadgets, household electronic appliances, audio-visual equipment and other valuable items or less functional and durable electronic gadgets that are no longer in use by their original owners. As observed by Terada, E-waste is the disposal of electronic goods that are no longer in good use like mobile phones, old television sets, mp3 players, radio sets, laptops, computers and other electronic gadgets [22]. "E-Waste" is thus, the general term used to describe old, end-of-life, out-of-use or discarded appliances which contain electrically powered components [23].

[10] See Puckett, J *et al* (2005) *The Digital Dump: Exporting Re-use and Abuse to Africa*. Available online at http://www.ban.org/library/TheDigitalDump.pdf Accessed 16th November,2016; Simpson, J. (2006) *Toxics Alert : Africa Emerging as E-waste Dumping Ground.* Available online at http://enews.toxicslink.org/newsview.php?id=3 (Study by Basel Action Network (BAN) revealed that a minimum of 100,000 used and obsolete computers are entering the Nigeria port of Lagos. In fact, most of them are not allowed by the purchasers to have them tested to confirm whether they are functional of not. This is referred to as "No Testing" and their prices are ridiculously low compared to the "Tested" ones.

[11] See Amoyaw-Osei, Y. *et al* (2011) *Ghana E-waste Country Assessment. SBC E-Waste Africa Project*. Available online at http://www.ewasteguide.info/files/Amoyaw-Osei_2011_GreenAd-Empa.pdf. Accessed 16th November,2016.

[12] Puckett. J et al.,(2002) 'Exporting Harm: The High-Tech Trashing of Asia, Basel Action Network' (2002), <http://www.ban.org/E-Waste/technotrashfinalcomp.pdf > Accessed 18th July, 2016.

[13] Crossman E (2010) "Not in Our Backyard: Exporting Electronic Waste" in *High Tech Trash: Digital Devises, Hidden Toxics, and Human Health*, London, Island Press, p 182 at 185;

[14] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, opened for signature Mar. 22, 1989, 28 I.L.M.657,<http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx> [hereinafter Basel Convention]. Accessed 15th July, 2016.

[15] See Adediran, Y.A and Abdulkarim, A. (2012) "Challenges of Electronic Waste Management in Nigeria." *International Journal of Advances in Engineering & Technology*, Vol 4,Issue 1,p 640 at 641.

[16] See Ndor, J.J (2013) "E-Waste Management in Academic Institution in Nigeria: A Case for University of Jos." *International Journal of Emerging Knowledge*, Vol. 1(3). P 57

[17] Electrical and Electronic Equipment, United Nations Environmental Programme 2004 Report.

[18] UNEP (2007) *E-Waste: Volume I Inventory Assessment Manual.* United Nations Environment Programme, p 123

[19] Lewis, J (2008) " E-Cemeteries: Where Electronic Waste Never Dies" 13 *Pub, Int L. Rep*, p 177

[20] UNEP (2007) *supra*

[21] Erasmus, J (2009) "E-waste Pilot Project." Available online at http://www.mediaclubsouthafrica.com/index.php?option=com_content&view=article&id=997:e- waste-260209&catid=45:economynews&Itemid114. Assessed 17th November, 2016.

[22] Terada, C. *supra*, p 155

[23] Facts & Figures of E-Waste: E-Waste Definition, E-Waste Guide Info<http://ewasteguide.info/introduction/e-waste> Accessed July 31, 2016.

Most of the world's hazardous waste is produced by industrialized market economies and transferred to less developed nations [24]. This plays out easily because when consumers in developed countries are no longer interested in their electronic gadget, they are left with no choice other than to discard or recycle their electronic goods, but because of the huge cost of undertaking an environmentally safe and healthy, domestic and industrial recycling, they are often shipped either directly, or indirectly through commercial agents to less developed countries with less stringent labour, import and environmental laws and policies [25].

E-waste reportedly includes small and large household appliances like Vacuum cleaners, sewing and knitting machines, weaving textile appliances, toasters, fryers, pressing iron, grinders, opening, sealing and packaging appliances, knives, hair cutting, drying and shaving devices, clocks, watches, refrigerators, freezers, washing machines, clothe dryers, microwaves, heating appliances, radiators, exhaust ventilation and conditioning equipment, Information Communication and Telecommunication equipment like mainframes, microcomputers, printers, PC (desktop, notebooks, laptops), photocopiers, typewriters, fax and telex equipment, telephones, consumer equipment like radio and television sets, video cameras/decoders, Hi-fi recorder, audio amplifiers, musical instruments and other medical electronic surgical equipment [26].

3. E-waste components and its inherent danger on man and the environment

As stated earlier, there is a correlation between technological advancement resulting from the technological obsolescence of electrical electronic products and the quantum of generated E-Waste. Due to the fact that it is often cheaper, easier and more convenient to change malfunctioning or obsolete equipment in developed, technologically advanced countries than to fix them, many electronic users elect to exchange their former soon-to-be-shipped gadgets for newer ones [27]. While electronic products may contain reusable and valuable materials, many of the components in E-Waste are, however, very hazardous and toxic and therefore, not environmentally safe [28].

After the offshore sale to salvage companies in developing countries that have relaxed importation policies and environmental regulations, the disused electronic devices are often broken down, whilst scrap merchants extract the valuable elements like gold, lead, copper, and other metals and sell them for value whilst releasing significant quantities of toxins made of heavy metals and organic compounds into the surrounding atmosphere and into the soil and water bodies [29]. The hazards to human and animal health arise from over 1,000 several chemical substances composed in e-waste, many of which are very toxic [30]. Toxic heavy metals found in e-waste include but not limited to: copper, beryllium, lead, tin, cadmium, brominated flame retardants, antimony, barium, and mercury [31].

The cathode ray tube (CRT) [32] of a TV or computer monitor, for instance, contains lead, phosphorous and antimony in significant proportions, while circuit boards in different electric products contain lead, beryllium, antimony and brominated flame retardant (BFR). Also, a mobile phone contains 19% copper and 8% iron [33]. Other toxic substances contained in many other electronic items are cobalt, manganese, barium, antimony trioxide, cadmium, brome and selenium. Mercury, for example, causes severe harm to humans and it is contained in many electronic products, as an estimated 22 percent of the yearly world consumption of mercury comes from electrical and electronic equipment [34]. Mercury is especially harmful because of the easy accumulation in living organisms and the concentration through the food chain when it mixes with water and becomes methylated mercury, which is injurious to human health. Mercury also damage important organs like the kidneys, lungs and the brain on exposure [35].

Mercury often found in Fluorescent lamps, LCD monitor, switches, flat panel screens causes the impairment of neurological development in foetuses and small children, and causes tremors, emotional changes, cognition, motor function, insomnia in man [36]. Chromium found in untreated and galvanized steel plates, decorator or hardener for steel housing causes health danger like Asthmatic bronchitis, skin irritation, ulceration, respiratory irritation, perforated eardrums, kidney damage, liver damage, pulmonary congestion, oedema, epigastric pain, erosion and discolouration of the teeth, motor function whilst Lead contained in CRT of TV, computer monitor and circuit boards causes Probable human carcinogen, damage to brain and nervous systems, slow growth in children, hearing problems, blindness, diarrhoea, cognition, behavioural changes (e.g. delinquent misbehaviour), physical disorder [37].

Beryllium, for instance, is often used in computers on finger clips and motherboards and to enhance the tensile strength of connectors whilst the electric conductivity is maintained [38]. Beryllium is often classified as a human carcinogen because of its capacity to cause cancer of the lungs, due to the fumes ingested via inhalation. Factory workers, on consistent exposure to the chemical can develop another form of lung disease called beryllicosis [39]. All these underscore the inherent danger that bely the continuous toleration of e-waste by man.

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[24] Jim Puckett, et al.

[25] See Olowu, D, (2012) "Menace of E-Wastes in Developing Countries: An Agenda for Legal and Policy Responses" 8/1 *Law and Development Journal*, 61 at 62

[26] Lawrence Chidi Anukam, 'E-Waste Control: Nigeria's Experience'. Director General/CEO NESREA's Presentation at the 2nd INTERPOL Environmental Compliance and Enforcement Conference, INTERPOL Complex, Singapore, 16-18 November, 2015.

[27] Ibid n (2) 7.

[28] V. Gupta, *et al*, (2008) 'E-waste – A Waste or a Fortune?' *Current Science*,. Vol 94, no 5, 555.

[29] Ibid n (8) 14.

[30] Jim Puckett, Ibid.

[31] 'Promote Good Laws: State Legislation', Electronics Takeback Coalition. <http://www.electronicstakeback.com/promote-good-laws/state-legislation> Accessed 7th August, 2016.

[32] CRTs refer to the video display components of older non-flat screen televisions and computer monitors. They contain glass tubes made with harmful levels of Lead and Barium. See Kutz, J, (2006) "You've Got Waste: The Exponentially Escalating of Hazardous E-Waste." 17 *Vill. Envtl. L.J*. p 307 at 308.

[33] See Nnorom.I.C. and Osibanjo,O (2008) "Overview of Electronic Waste (E-waste) Management Practices and Legislations and Their Applications in Developing Countries." 52 *Resources Conservation & Recycling*, p 843; Junaida, A.K (2010) "Electrical and Electronic Waste Management Practice by Households in Shah Alam, Selangor, Malaysia," 1(2) *International Journal of Environmental Sciences*, p 132.

[34] Ibid.

[35] See Krueger,J (2001) "The Basel Convention and the International Trade in Hazardous Wastes" in Olav,S.S and Thommessen,O.B (eds) *Yearbook of International Co-operation on Environment and Development 2001/2002* London,Earthscan, p 44.

[36] Electrical and Electronic Equipment, United Nations Environmental Programme 2014 Report.

[37] Effects of E-Waste on humans [UNEP, 2007 Report on the Dangerous Effect of E-Waste on Human Lives.]

[38] Ibid.

[39] Ibid.

Another foremost danger of mercury is to developing foetuses, which are highly susceptible to mercury poisoning through undue exposure to the element by their mothers [40]. The harmful consequences of beryllium and mercury are just two instances of the health hazards posed by the component of E-Waste. E-waste poses grave risks to the human environment, thus causing monumental air pollution, ground water pollution through acidified river banks and contaminated soil. The entire ecosystem is affected by the environmental hazard caused by the content of e-waste component, this in turn poses severe health risks to human life and wildlife conservation. This is why e-waste is thus posited to be inexorably linked with the environmental and human health hazards of human life.

The dumping of e-waste in Nigeria's environment has negative and deleterious consequences on the health of the inhabitants, such as releasing leaching toxins into the soil, air and groundwater environment which later find their way into crops, animals and human body systems, thus causing severe damage from contamination and pollution of the immediate environment [41]. Medical experts equally opined that undue exposure to the dangerous substances that comprise the e-waste can cause severe damage to the central nervous system, the blood, the DNA, the immune systems, the lungs, the kidneys, the liver, the brain and can equally lead to respiratory and skin disorders and cancer of the vital organs and also impede regulatory hormones, whilst altering brain functionality and organ development. It is against this background that the continuous dumping of hazardous e-waste in Nigeria, Africa and some less developed parts of Asia under the guise of international trade and continuous use by excited and overzealous consumers of overused, disused, discarded and abandoned electronic waste from developed countries must be condemned.

Beyond the hazardous effects of e-waste, their leach on the soil owing to the presence of mercury, cadmium, lead and phosphorus in it is capable of causing unbridled fire outbreak, leading to deleterious fumes [42]. The uncontrolled burning of e-waste in open air [43], disassembly, wrongful leakage of electronic composite material and improper disposal can cause a number of environmental problems such as groundwater contamination, atmospheric pollution, and occupational and safety effects among those directly or indirectly involved in the processing of E-Waste [44].

Apart from the lack of awareness on the part of government through its environmental regulatory agencies on the inherent danger of dumping e-waste and the technological industry's active connivance to continue an unfettered dumping of e-waste on her national shores without deliberately considering alternative mechanisms like recycling, the focus of government on realising revenue on import and excise duties without considering the danger of dumping the old electronic waste remains its greatest incitement and indictment. Irrespective of the deleterious consequences of E-waste, it can be valuable as source for secondary raw material for other electronic products, it is the improper treatment and wrongful disposal that causes risks to human life [45]. Thus, in proffering technical alternatives to the problem of dumping, an effective, functional, enforceable and workable legal framework that can enable a coordinated e-waste collection system must be put in place [46].

Uncontrolled burning, disassembly and disposal are causing environmental and health problems, including occupational safety and health effects amongst those involved directly due to the methods of processing the waste [47]. However, electronic waste processing systems have matured in recent years following increased regulatory, public and commercial scrutiny, and a commensurate increase in entrepreneurial interest. But one challenge is still staring at every one of us: What happens when materials cannot or will not be reused, conventional recycling or disposal via landfill often follow? Standards for both approaches vary widely from jurisdiction to jurisdiction, whether in developed or developing countries of the world. The complexity of the various items to be disposed of, cost of environmentally sound recycling systems and the need for concerned and concerted action to collect and systematically process equipment are the resources most lacked especially in developing countries like Nigeria. Many of the plastics used in electronic equipment contain flame retardants [48]. These are generally halogens added to the plastic resin, making the plastics difficult to recycle. Almost all electronics contain lead and tin (as solder) and copper (as wire and printed circuit board tracks), thus making recycling impossible.

4. Alternative e-waste management mechanisms

There are a number of e-waste management initiatives, both at the local and global frontiers. Because of the seeming ignorance of many Nigerians, as well as other less-developed countries regarding the deleterious consequences of e-waste, many economic opportunity-seeking hustlers, both young and old scavengers often rummage through solid waste heaps at dumpsites without any consideration of the health and safety consequences of living on such dangerous means of livelihood. The alternative mechanisms of managing E-Waste, especially in more environmentally safe and healthy ways in compliance with the widely recognised clichés of (3Rs), namely: reducing, reusing and recycling. This paper therefore seeks to identify some measures that have been put in place to manage E-Waste by international bodies, organisations and agencies, and also summarizes some features of these mechanisms. These initiatives recognize the fact that there remains a huge gap

[40] Ibid.

[41] Chen, A. et al, (2011) 'Developmental Neurotoxicants in E-Waste: An Emerging Health Concern: Environmental Health Perspectives'. Vol 119, *Environmental Health Perspectives*, No 4, April, pp 431-438.

[42] Freeman M. H. (1989). *Standard Handbook of Hazardous Waste Treatment and Disposal*, USA McGraw-Hill Company, p ??

[43] Research has shown that the bodies of those who live near the e-waste dump sites are susceptible to high risk of cancer-causing dioxins. For detail study of this, see Chan, J.K.Y *et al* (2007) "Body Loadings and Health Risk Assessment of Poly-chlorinated Dibezo-p-dioxins and Dibezofurans at an Intensive Electronic Waste Recycling Site in China," 41 *Envtl. Sci. & Tech.* p 7668 at p 7672. Here, the researcher found that breast milk of women that worked in electronic waste recycling centers had more than two times the concentration of dioxins than do women working in a control site and that their placentas had nearly three times the concentration of dioxin than do women at the control site.

[44] Weil N. 'E-Waste Dumping Victimizes Developing Nations, Study Says. IDG/PC World News 2015 Report'.

[45] Ibid.

[46] Although Nigerian Government promptly responded to the issue of the waste dumped at Koko in the old Bendel State of Nigeria in 1988 by enacting the Harmful Waste (Special Criminal Provisions etc) Act, Cap H, 1, LFN,2004 which started as a Decree before its conversion to an Act. The Act in Section 6 thereof provide life imprisonment as a punishment for the violators of the law. It may interest to note that about 25 years after, there has been no conviction for violators of this law.

[47] MoEF C. Guidelines for Environmentally Sound Management of E-waste. Ministry of Environment and Forests, Delhi, India; March 12, 2008. 84.

[48] See Silicon Valley Toxics Coalitions (2006) " Just Say No to E-Waste: Background Document on Hazards and Waste from Computers" U. ARK., http://www.cmase.uark.edu/teacher/Environmental_Ed/2006%20E- Waste%20Info/E-Waste/Just%20Say%20No%20-%20E- Waste%20Backgrounder.pdf

between E-Waste management's institutional mechanisms, legal framework, environmental policies and infrastructures in developed and developing countries.

G-8's 3Rs were agreed upon by the G8 leaders in Tokyo in April 2005 and works closely under the Basel Convention with a commitment to do the 3Rs: Reduce, Reuse and Recycle electronic waste [49]. There is also 'Solving the E-Waste Problem', (StEP) which is an offspring of UN University, UNEP and UNCTAD program. Their primary role is to provide analysis and dialogue to reduce environmental risk and enhance development. Its primary objective is to optimize the life cycle of EEE [50]. The UNEP/DTIE ((IETC) equally engenders the Implementation of Integrated Solid Waste Management (ISWM) Project based on the 3Rs and covers all types of wastes in integrated manner and supports a city-level E-Waste assessment study for Mumbai and Pune in India. One other important international initiative is the GeSI, (Global e-Sustainability Initiative). This consists of ICT service providers and suppliers, supported by the United Nations Environmental Programme, UNEP and the International Trade Union, ITU. Its major objectives include sharing experience and knowledge, working with stakeholders, harnessing private sector operations, raising awareness and engaging in research and benchmarking [51].

5. International legislative intervention

5.1 The Basel convention on the control of transboundary movements of hazardous wastes and their disposal (otherwise known as the Basel convention.)

One prominent international intervention mechanism that seeks to prevent and control the dumping of waste is the Basel Convention [52]. It is an international treaty designed to reduce the movement of hazardous waste (excluding radioactive waste) between countries and particularly seeks to prevent the transfer of harmful waste from developed to less developed countries [53]. The Convention entered into force on May 5, 1992 [54], It became amended in 1995 and prohibits the export of hazardous wastes for any purpose whatsoever from nations that are listed in a proposed new annex to the Convention to all other Parties of the Convention [55]. This Convention which was originally made in the year 1989 is essentially committed to setting up a cohesive, all-encompassing international framework for reducing the generation, promote the restriction and engender the regulation of the transboundary movements of hazardous wastes from one nation to another [56].

One core objective of the Convention is to promote "environmentally sound management" (ESM) that seeks to protect human health and the environment by reducing harmful waste production whenever and wherever possible and practicable. Several nations especially, the developed countries have signed the Treaty. The United States, for instance, signed the Convention but did not ratify it for obvious reasons as one of the most liable nations responsible for the production and exportation of the world's e-waste to less developed nations of the world [57]. What the U.S. did was to enter into one multilateral agreement and many other bilateral agreements regulating the transboundary transition of waste for recovery purposes [58]. Whether the United States would eventually ratify the Convention remains uncertain, even though a 1998 report [59] suggested that the U.S. was interested in ratifying the original treaty while ignoring the Basel Ban amendment [60]. As at the time of writing this paper, there are less than 190 countries who are parties to this Convention, including many of the highly industrialized nations like the United Kingdom, the EU countries, Japan, and others. The ratification of the Treaty together with its amendment by the U.S is, however, desirable in line with the enactment of enabling e-waste dumping prevention legislation in order to put a stop to the unethical practice of ferrying waste through unregulated trade mediums to developing and less developed nations of the world [61].

The Basel Convention provides that each Party shall take the appropriate measures to ensure that the transboundary movement of hazardous wastes and other wastes is reduced to the minimum consistent with the environmentally sound and efficient management of such wastes, and is conducted in a manner which will protect human health and the environment against the adverse effects which may result from such movement [62]. One major discontent with the Convention that makes legal analysts and International law scholars to deem the Treaty as largely ineffectual is that whilst it declares illegal hazardous waste trafficking, criminal, it makes no clear enforcement provisions against the culprits [63]. However, parties to the Convention must know the import bans of other parties.

Sequel to the adoption of the Basel Convention in 1989, many signatory nations raised their voice to condemn the Convention for making the trade of e-waste legitimate by law, rather than

[49] UNEP (2007a): E-Waste: Volume I Inventory Assessment Manual. United Nations Environmental Programme.

[50] Ibid.

[51] Ibid.

[52] For detail reading on the origin, development, prospect and pitfalls of the Basel Convention, see Waugh, T, (2001)"Where Do We Go From Here? Legal Controls and Future Strategies for Addressing the Transportation of Hazardous Wastes Across International Borders." 11 *Fordham Environmental Law Journal*, 477; Gwam, C.U. (2004) "*Travaux Preparatoires* of The Basel Convention on the Control of Transboundary Movement of Hazardous Waste and Their Disposal." 18 *Journal of Natural Resources & Environmental Law*, p 1, Kummer, K (1998) "The Basel Convention: Ten Years On." Vol. 7 *Review of European Community& International Environmental Law*,p 3

[53] The Origins of the Basel Convention. <http://www.basel.int/convention/basics.html> Accessed 27th August, 2016.

[54] The 1992 Basel Convention. It should be noted that the World Trade Organization (WTO) is mandated under paragraph 31(i) of the WTO Doha Ministerial Declaration to consider the relationship between WTO rules and "specific trade obligations" set out in Multilateral Environmental Agreements (MEAs). The WTO is mandated under paragraph 31(ii) of the1992 so to do.

[55] Ibid.

[56] Ibid.

[57] See Ogunseitan, O.A. *et al* (2009) "The Electronics Revolution: From E-Wonderland to E-Wasteland." Science. Vol. 326, p670. Available online at, available at LexisNexis Advance, http://www.lsi.usp.br/~acseabra/grad/2613_files/The%20Electronics%20Revolution-%20From%20E-Wonderland%20to%20E-Wasteland.pdf. Accessed 11th November,2016. See also Bennion J, 'Drowning in Electronics: Where the Law Stands on E-Waste, PBS' <http://www.pbs.org/frontlineworld/stories/ghana804/resources/ewaste.html> Accessed 11th August, 2016.

[58] Chapter V-Basel Convention, Environmental Protection Agency, EPA, <http://www.epa.gov/osw/hazard/international/chap5.pdf> Accessed 12th September, 2016.

[59] 'Why the U.S Must Ratify the Entire Basel Convention (or not at all)', Basel Action Network, Ban. <http://www.ban.org/Library/briefing2.html> Accessed 13th September, 2016.

[60] Ibid.

[61] Within the United States, only 19 states have e-waste laws (14 others pending). Among the states that have legislation for e-waste, most do not have sufficient wherewithal in terms of infrastructural facilities as well as strong financial base to combat the problem of implementation and enforcement of e-waste legislation. See Ogunseitan, *supra* at p 670.

[62] Ibid n (9).

[63] Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, opened for signature Mar. 22, 1989, 28 I.L.M.657,<http://www.basel.int/TheConvention/Overview/TextoftheConvention/tabid/1275/Default.aspx> [hereinafter Basel Convention]. Accessed 15th July, 2016.

criminal [64]. As a consequence, a conglomeration of these countries, alongside the non-profit environmental protection organization, Greenpeace, reached by consensus the Basel Ban at the 2nd Meeting of the Conference of the signatory Parties in 1994, whilst defying the vehement opposition from global power nations like the U.S., Australia, Japan, United Kingdom, Germany and Canada [65]. The Basel Ban was designed to arrive at the full implementation of the Basel Convention and requires all member states to prohibit the exportation and dumping of hazardous wastes for recovery and final disposal except to OECD countries, whilst banning the export of wastes intended for recovery and recycling [66]. Even though the Ban was passed by a consensus of the Basel Convention parties, it does not become a law in force in the member states until it is ratified by 62 of the Basel Parties [67]. At the time of writing this paper, the required State Parties to enable the Convention to enter into force has not been met.

The Basel Convention is particularly important to Nigeria because of the June 1988 Koko incident where ships numbering about 5 transported 8000 barrels of hazardous waste, weighing some 3800 tons, including polychlorinated biphenyl (PCB) journeyed from Italy to the Nigerian town of Koko in the old Bendel state. Nigerian port officials were reportedly bribed to allow the shipment by the Italian businessmen [68]. Whilst it took over nine months for the Nigerian government to discover the harmful drums, which underscores and restates the porousness of the Nigerian security system, the cost of clean-up was well over one million U.S dollars. This was after dockworkers had complained of illnesses stemming from the lack of basic equipment, including protective masks and boots to handle the hazardous waste. The wastes were repatriated to Italy. However, it was learnt that the landlord of the field in which the wastes were dumped eventually died of Cancer of the throat as a result of the waste [69]. It is believed that this is one prominent incident too many that led to the making of the Convention as it came to force a year after the Koko incident. Similarly, it was this incident that led to the establishment of the Federal Environmental Protection Agency [70] and the promulgation of the Harmful Waste (Special Criminal Provision etc,) Act. [71] Apart from the Koko incident, there is the Probo Koala case in Ivory Coast [72]. This international intervention is one of the bold attempts made to control international flow, dumping, export and transport of wastes to the detriment of developing countries [73]. Instructively, the Basel Convention set up the Mobile Phone Partnership Initiative (MPPI), the Global Partnership on E-Waste, (GPE) and the Global Partnership on Computing Equipment, (GPCE) as part of its mechanisms for e-waste management and disposal [74].

5.2 Bamako Convention

By virtue of Article 11 of the Basel Convention, The Bamako Convention on the Ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa was adopted on January 29, 1991 in Bamako, Mali and came into force on April 22, 1998 [75]. As at April 2016, 35 African countries had signed the Convention and 25 had ratified it whilst 25 others had deposited it [76]. A comparison between the Basel and Bamako Conventions shows that the Bamako Convention has a more effective, effectual and restrictive framework for regulating the transboundary e-waste trade and trafficking [77]. In general, the Bamako Convention articulates more specific, active guidelines for both sides of the trade than the Basel Convention. For instance, the Bamako Convention recognizes strict liability for hazardous waste generators for damage caused by their wastes, while the Basel Convention preferred to defer addressing the issue [78].

The Bamako Convention provides that all Parties shall take appropriate legal, administrative and other measures within the area under their jurisdiction to prohibit the import of all hazardous wastes, for any reason, into Africa from non-Contracting Parties. Such import shall be deemed illegal and a criminal act [79]. This is a more precise provision and an improvement over the ambiguous and clumsy provision of the Basel Convention. Equally, the Convention provides that each Party shall introduce "appropriate national legislation for imposing criminal penalties on all persons who have planned, carried out, or assisted" in illegal importing of hazardous waste [80].

It is disheartening to note that despite the Koko incident in Nigeria, the country is yet to ratify the Bamako convention even though she is a Party to the Basel Convention and had signed the Bamako Convention since February 2008. The Bamako Convention made the trade of hazardous e-waste prohibited and as such declared illegal in sub-Saharan African countries, yet the e-waste trade continues unabated in Nigeria for pecuniary and survival reasons. It was reported that an estimated over 1000 containers of second-hand electronics are imported to Nigeria every month from Europe, with each container holding more 1500 computers [81]. It is noteworthy that about three-quarters of these imported products are abandoned, out-of-use junks that cannot be reused and are

[64] What is the Basel Ban?, Basel Action Network, Ban <http://www.ban.org/about_basel_ban/what_is_basel_ban.html> Accessed 18th September, 2016

[65] Ibid.

[66] The Basel Convention Ban Amendment, BASEL CONVENTION. <http://www.basel.int/pub/baselban.html> Accessed 19th September, 2016.

[67] Ibid.

[68] Wylie Donald J, (1992) 'The Bamako Convention as a Solution to the Problem of Hazardous Waste Exports to Less Developed Countries', 17 *Colum. J. Evtl. L.* 419 at 431.

[69] See Obaje, S.O (2013) "Electronic Waste Scenario in Nigeria: Issues, Problems and Solutions." *International Journal of Engineering Science Invention.* Vol 2 Issue 11, p31 at 36; See also Puckett, J *et al* (2005) supra, p 7

[70] Cap 131 Laws of the Federation of Nigeria, 1990; Cap F 10, LFN 2004

[71] Cap 165 LFN, 1990; Cap H1, LFN 2004.

[72] Bamako Convention COP 1- UNEP. <http//www.unep.org>delc>BamakoConvention>

[73] International Initiatives on E-Waste Management. United Nations Environmental Programme, UNEP Report 2015.

[74] Ibid.

[75] Bamako Convention. Art. 21; List of Countries Which Have Signed, Ratified and Acceded to the Bamako Convention, AFRICAN UNION. <http://www.africaunion.org/root/au/Documents/Treaties/List/Bamako%20Convention.pdf> Accessed 11th September, 2016.

[76] Nigeria and Ghana have not signed nor ratified talk less of domesticating the Convention in accordance with their Constitutions. For example, by virtue of Section 12(1) of the Constitution of the Federal Republic of Nigeria 1999 as amended, No treaty will have a force of Law in Nigeria until such has been transformed. See the list of Countries that have signed the Bamako Convention. Convention De Bamako Sur L'Interdiction <http://www.au.intdefault>files>treaties>Bamako.pdf> Accessed 12th September, 2016.

[77] Wylie D. J, (1992). 'The Bamako Convention as a Solution to the Problem of Hazardous Waste Exports to Less Developed Countries', 17 *Colum. J. Envtl. L.* 419, 431

[78] Ibid.

[79] Article 4 of the Bamako Convention.

[80] Article 9 of the Bamako Convention.

[81] Nigeria: A great haven for the collection of the world's electronic waste. Telegraph Report May 2016.

consequently dumped in landfills as e-waste [82]. It is regrettable that this trend might continue If Nigeria fails to take a decisive step to nip it in the bud by enacting a robust and comprehensive e-waste dumping prevention legislation coupled with enforcement protocols on both ends of the e-waste trade channels, whilst ratifying the Bamako convention.

6. Evaluation of the e-waste challenge in Nigeria

As stated earlier, even though Nigeria ratified the Basel Convention on May 24, 2004, it is yet to ratify the Bamako Convention. This might be partly responsible for why the country remains a viable dump site for e-waste from American, European and Asian markets [83]. Even though the reason Nigeria is yet to ratify the Bamako Convention is not certain, it might not be unconnected with the fact that Bamako has a more stringent set of regulations than the Basel convention which it ratified and thus might not want or be ready to implement the rules set out in the Bamako Convention that could readily indict her [84]. Torrents of thick black clouds of unsafe smoke hang over Nigeria's dumps, as the choking stench of burning plastic fills the air in major cities of the country [85]. Lagos state is perhaps Nigeria's commercial nerve centre and technology haven and it does not have a computer recycling facility, this makes e-waste to be easily dumped in several sites spread across the nooks and cranny of the city [86]. At these dump sites spread across all the corners of Nigerian cities, people rummage through stacks of heavy bay of hazardous e-waste and slicks of oily water like desperate scavengers with permanent scowls on their hungry faces to search for any valuable components from the dumped electronics so they can sell them to earn a living. The cables are burnt and the wires melted in order to recover reusable metals like copper wire and in the process, deleterious and harmful chemicals are thereby released into the surrounding atmosphere [87]. From Yaba to Ikeja Computer Village in Lagos, hundreds of thousands of vendors ply their trade of repairing and selling second-hand electronics, majority of which are irreparable electronic junk, thus making e-waste a fledgling trade in Nigeria [88]. In Westminster in Apapa, Lagos, particularly at Ibru warehouse, 50 containers of used computers are said to be deposited every week. This trade is simultaneously booming in Alaba International market Ojo. Lagos and Ladipo in Oshodi [89].

The absence of computer-recycling facilities and lack of an effective e-waste management mechanism, inadequate efforts by regulatory agencies and important stakeholders like the Standards Organization of Nigeria (SON), the Federal Environmental Protection Agency, (FEPA), the National Environmental Standards and Regulations Enforcement Agency, (NESREA), the National Emergency Management Agency, (NEMA), the National Space Research and Development Agency, (NASRDA), Nigeria Customs Service, (NCS) and the Computer Professionals Registration Council of Nigeria (CPN) have all led to the ineffective control of the e-waste trade.

One major contributing factor to the continued proliferation of e-waste in Nigeria as noted earlier is the technological innovation and the dynamic switch from analogue to digital displays of many electronics, thus leading to the disposal of the old ones [90]. For instance, the advent of flat screen Televisions have created a flood of old televisions and computer monitors into ports both within and outside [91]. Exporters and Salvage merchants have devised clever ways of avoiding disposal costs-they mix electronic bad parts with the good and new products, thus making it increasingly difficult, If not impossible for the authorities to track the actual content of imported items brought into Nigeria [92].

Interestingly, about 45 percent of Nigeria's total e-waste imports is shipped from the U.S. and another 45 percent is shipped from the EU, out of which least one third of the contents of each shipping container is spoilt beyond use, repair and consequently transferred to dump sites [93]. The Nigerian Ministry of Environment stated that basic components such as lead are being recovered and then smelted in people's backyards, which constitutes severe risk of lead poisoning and the presence of excess heavy metals in the soil, as well as in plants. There is equally the danger of unregulated e-waste disposal which causes illness in grazing animals [94], and contaminate drinking water and edible plants.

Dumping of E-waste in Nigeria is a regrettable reality. According to a recent article, thousand tons of harmful waste were reported dumped illegally from Scotland in Africa and Asia every year through organized criminal cabals [95]. In a bid to crack down on their illegal activity, the Scottish Environment Protection Agency, SEPA had to stop eight major shipments by using native intelligence gathering, surprise checks at ports and unannounced inspections of waste firms and it yielded positive results [96]. In Scotland, approximately 100,000 tons of old computers, televisions, mobile phones and other electrical products are reportedly thrown away each year, and mostly unaccounted for upon disposal [97]. Often times, the illegal exports are mischievously portrayed as legitimate recycling operations, with e-waste secretly tuck behind properly arranged and functioning computer and television sets [98].

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[82]Red Alert on Electronic Waste. <http://www.ban.org/ban_news/2005/051227_nigeria.html> Accessed 7th October, 2016.

[83]Aginam E, (2010) ""Nigeria: E-Waste Concern Re-Echoes at Clean Environment Forum, *Vanguard* (Aug. 17,). <http://allafrica.com/stories/201008180100.html> Accessed 21st June, 2016. See further McIntire, E "The International Tribunal for E-waste: Ending the Race Towards Lethal Fallout" Vol.5(1) *Seattle Journal of Environmental Law*. P 98. Available online at http://digitalcommons.law.seattleu.edu/sjel/vol5/iss1/4. Visited 10th November, 2016.

[84]See Donald, W.J *supra*, p.419

[85]Matt Ford, Sifting through the Mounting Problem of E-Waste. CNN, <http://articles.cnn.com/200908-02/tech/e-waste.recycling_1_e-waste-greenpeace-report-greenpeace-study?_s=PM:TECH> Accessed 3rd October, 2016.

[86]Liz Carney, Nigeria Fears E-waste 'Toxic Legacy,' BBC NEWS (Dec. 19, 2006), <http://news.bbc.co.uk/2/hi/africa/6193625.stm> Accessed 3rd October, 2016.

[87]Ibid.

[88]See Schmidt, C.W. (2006)" Unfair Trade E-waste in Africa," 114 *Envtl Health Persp.* A233, available at http://www.ncbi.nlm.nih.gov/pmc/articles/PMC1440802/.

[89]See Puckett. J. *et al* (2005) *The Digital Dump*, supra at p.12

[90]See Edwards, R (2010) "Exposed: Scotland's Toxic Waste is Poisoning Africa and Asia", *Sunday Herald.* Sept,26, Available online at < http://www.ban.org/ban_news/2010/100926_poisoning_africa_and_asia.html.>

[91]Third World Network. 1991. Toxic Terror: Dumping of Hazardous Wastes in the Third World.

[92]Nigeria: E-Waste Remains a Challenge to Regulatory Agencies, EWASTEGUIDE. INFO (Apr. 4, 2008), <http://ewasteguide.info/e-waste-remains-a-challenge.html> Accessed 20th September, 2016.

[93]Milmo, C, "Dumped in Africa: Britain's Toxic Waste," *The Independent*. <http://www.independent.co.uk/news/world/africa/dumped-in-africa-britain8217s-toxic-waste-1624869.html> Accessed 25th September, 2016.

[94]Rob Edwards, Exposed: Scotland's Toxic Waste is Poisoning Africa and Asia, Sunday Herald. <http://www.ban.org/ban_news/2010/100926_poisoning_africa_and_asia.html> Accessed 20th September, 2016.

[95]Ibid.

[96]Ibid n (70) 5.

[97]Ibid.

[98]Ibid.

The continued transboundary movement of e-waste into Nigeria is therefore not in compliance with Basel convention's stipulation of an "environmentally sound management". It is therefore illegal for all Basel Parties to import waste from the U.S. since it is not a valid party to the Convention [99], since Article 4 (2) (h) (5) provides that a Party shall not permit hazardous wastes or other wastes to be exported to a non-Party or to be imported from a non-Party [100].

The fact that the trade channel is bi-partite demonstrates the urgent need for enforcement action to be made both within and outside Nigeria to the exporting country. Dismantled electronic gadgets must be subject to strict regulation and scrutiny on both routes of the trade zone, thus forcing countries to collaborate with one another in order to enforce international treaties and national laws relating to e-waste disposal. A cursory incursion into Nigeria's current political, social, legal, and economic situation may give insight into the reasons illegal e-waste trade has found a relatively comfortable climate in Nigeria. Poverty and Corruption are two of the most motivating factors. These two inexorably linked hydra-headed monsters mixed with the absence of political will to tackle corruption, insist on what is right, gross insensitivity, leadership failure and incompetence, absence of legal enforcement against corruption, and a culture of tolerance for corruption all add to the country's corruption and increased impoverishment of the inhabitants. With debilitating economic crisis, leading to a decrease in foreign investment, a corresponding increase in unemployment and mass poverty, it is only normal that the system encourages cutting corners and the people key into it in order to survive and eke out a living [101].

With Nigeria's position as notably one of Africa's wealthiest nations, the largest producer of oil in Africa and the fifth largest producer of oil in the world [102]. There have been repeated allegations of extensive pollution, continuous damage to the environment, corporate failure, sharp practices, bad practice, serious government neglect and bribe-collection by security forces, the judiciary and springing up of armed groups in Nigeria. This is applicable to almost every sector of the Nigerian economy.

Thus, considering the history and prevalence of corruption in every strata of existence, the inability to instantly effectively control the illegal e-waste trade in Nigeria is quite understandable. Illegal e-waste trade can therefore not be effectively tackled without a prompt national legislation and a strong, stable, reliable enforcement mechanism. The undue focus and reliance on the Nigerian oil industry is another veritable reason responsible for the unjustifiable abandonment and neglect of the other critical sectors of the economy and the consequential lack of effective government regulation. Even though the issues facing Nigeria are more than enumerated above, the itemised challenges have however painted the ugly picture of the challenges combatting the effective management and control of e-waste proliferation in the country.

7. National domestic intervention for e-waste management

Perhaps the most important domestic legislation in Nigeria for the prevention and control of dumping hazardous waste in Nigeria is the Harmful Waste Special Criminal Provisions' Act of 1988. It was formerly a Decree that came in the wake of the Koko incident. It outlaws and prohibits the dumping of hazardous waste into the inland waterways or exclusive economic zones of Nigeria [103] It also prescribed life imprisonment for any person who engages in trade in Harmful waste [104]. Beyond this specific Act, there seems to be no serious initiative in Nigeria regarding the management of E-Waste. There are, however, some government organisations saddled with the direct or indirect regulation and management of E-Waste in Nigeria, namely:

- 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)
- Nigeria Customs Service (NCS)

8. Challenges facing e-waste management in Nigeria

In Nigeria, there is lack of a comprehensive, robust and specific e-waste management, control and regulation legislation in Nigeria to regulate, control and prohibit the flow of used consumer electronic products within Nigeria [105]. Coupled with this, a proposed Electronic Waste Bill, which will address the ban or reduction of e-waste importation into the country is being considered by the Nigerian legislature [106]. If passed to Law, it will probably give teeth to the ineffectual Basel and Bamako Conventions in Nigeria. The situation in Nigeria is a direct opposite of what transpires in China. In the Peoples Republic of China, there are abundant Laws and regulations to tackle the problem of e-waste [107] the albatross, however, lies in the fact that these laws are enacted without adequate resources allocated for enforcement [108].

The refusal to regard and designate disused electronics products as contraband by the Nigeria Customs Service, NCS, rather than charging appropriate duties and taxes on them by the agency as a revenue-generation channel for the Nigerian government is another problem identified as fuelling the 'boom' of e-waste market [109].

Lack of public awareness by manufacturers and consumers on the inherent dangers of handling and trading in E-Waste which is often regarded as a business opportunity. As a matter of fact, Ogungbuyi, O *et al.*, [110] found that the e-waste sector provided thousands of people with jobs, in spite of the health and environmental risks the operations pose. Majority of those affected are recent rural migrants who may be university graduates or who possess no special skills that come to the city

[99] Basel Convention.
[100] Basel Convention.
[101] See Ogungbuyi, O. *et al* (2012) *E-Waste Country Assessment Nigeria*. e-waste Africa project of the secretariat of the Basel Convention. Retrieved from http://www.basel.int/Portals/4/Basel%20Convention/docs/eWaste/EwasteAfricaNigeria- Assessment.pdf. Accessed 11th November, 2016.
[102] AMNESTY INTERNATIONAL, AI. Nigeria: Petroleum, Pollution and Poverty in the Niger Delta, 29.
[103] Section 1, Harmful Waste Special Criminal Provisions' Act of 1988.
[104] *ibid* Section 6 thereof
[105] See Terada, op cit,p169
[106] See Olubunmi, A (2010) "Group Urges Assembly to Pass the E-Waste Bill." P.M. News, Oct.29. Available http://pmnewsnigeria.com/2010/10/29/group-urges-nassembly-to-pass-the-e-waste-bill/.
[107] For related national laws see http://www.ilo.org/safework/info/WCMS_112575/lang--en/index.htm
[108] See Lundgren, K. (2012) *The Global Impact of E-Waste: Addressing the Challenge.* Geneva, ILO Office, p 39.
[109] Nigeria Customs Service Report on Challenges and Prospects, 2015.
[110] Ogungbuyi, O supra at p82

in search of non-existent greener pastures [111].

There is the absence of E-Waste recycling facilities [112] and technological aid equipment in the country which would have either promoted the use of E-cycling or recycling of EEE or reduced our dependence on scrap electronics. Poor corporate social responsibility on the part of industries and other stakeholders on the management of E-Waste was equally identified. There is also rapidly increasing e-waste volumes, both domestically generated as well as through imports. Imports are often disguised as second-hand computer donations for charity towards bridging the digital divide or simply as metal scrap [113].

Rapid technology change, low initial cost and even planned obsolescence have resulted in a fast growing problem around the globe. Technical solutions are available but in most cases a legal framework, a collection system, logistics and other services need to be implemented before a technical solution can be applied [114].

Uncontrolled burning, disassembly, and disposal that causes severe environmental and health problems, including occupational safety and health effects among those directly involved, due to the methods of processing the waste is another major challenge [115].

Trade in electronic waste is controlled by the Basel Convention. However, the Basel Convention specifically exempts repair and refurbishment of used electronics, thus leaving a lacunae in the Law.

A major challenge remains when materials cannot or will not be reused, conventional recycling or disposal via landfill often follow. Standards for both approaches vary widely by jurisdiction. The complexity of the various items to be disposed of, cost of environmentally sound recycling systems, and the need for concerned and concerted action to collect and systematically process equipment are the resources most lacked. Many of the plastics used in electronic equipment contain flame, retardants and contain halogens added to the plastic resin which may prove difficult to recycle.

Insufficient data. Most developing countries do not have the accurate estimates of the quantity of e-waste generated or recycled per annum [116], to be able to effectively clean them out per time. The insufficiency or inaccurate data collection is caused by the clandestine nature of the waste coupled with the porous nature of Nigeria's border. More importantly, data of imported E-waste via roads and air transportation media could not be obtained [117], Smuggling of e-waste into the country further compounded the generation of adequate data of wastes that are imported into the country [118], Widespread e-waste recycling in the informal sectors making use of pedestrian techniques like acid leaching and open air burning is capable of causing severe environmental and atmospheric damage.

The undue exposure of E-waste workers with inadequate knowledge of toxins in e-waste and resultant health hazards. Inefficient recycling processes result in substantial losses of material value. 'Cherry-picking' by recyclers who recover precious metals and improperly dispose the discarded junks [119]. Lack of the will and wherewithal to follow up on initiatives. Attempts have been made by NESREA by sponsoring international conferences on E-Waste control but there appears not have been any serious follow-up since then [120]. Some attempt is also being made by the Basel Convention office in Nigeria though its general focus is on solid waste.

Another challenge is the inability of government to recognise and combat the danger composed in e-waste. At a particular conference [121], through its communiqué, it was identified that the inherent dangers posed by E-waste whose quantity is continually increasing at a fast rate while the governments at all levels are doing little or nothing to address the deplorable situation. Since the Government plays a dual role: as generators and as regulators, they are saddled with the challenge of compromising on environmental standards for pecuniary gains.

In spite of the enumerated challenges, the new standard of electronic use and according to the Bamako convention is not only aimed at extending electronics' useful life, but also making them easier to recycle, in ways every stakeholder should be able to accept [122].

As one scholar rightly observed, there are too numerous legislations that are related to environmental issues in general and there appears to be proliferation of legislation on e-waste and other related matters [123]. This has yielded unsatisfactory outcomes and has created adverse effects [124]. These laws at times overlap or conflict. It has been suggested that these fragmented laws can be merged into one single law as a "packaged deal" (like the Law of the Sea Convention III) which will address in a holistic manner all the issues pertaining to environmental law including e-waste [125].

9. E-cyling of e-waste as a suitable alternative to e-waste trade, trafficking and dumping

E-cycling is the technological practice of reusing, or distributing for reuse, electronic equipment and components rather than discarding them at the end of their life cycle [126]. According to Gartner Group research, over four million

[111] Ibid, Emphasis added

[112] See Okorhi, O.J, *et al* (2015) "Technology Paradigm for E-Waste Management in South-Eastern Nigeria." *International Association for Management of Technology (AIMOT, 2015) Conference Proceedings*, p 802.

[113] Where Does E-Waste End Up?, Greenpeace (2009). Available online at www.greenpeace.org/international/en/campaigns/toxics/electronics/the-e-waste-problem/where-does-e-waste-end-up/.

[114] http://www.experiencefestival.com/a/E-waste_-_Trends_in_e-waste_recycling/id/1344880

[115] Ibid n 20.

[116] Scholars were of the view that in Nigeria, information on dumping of e-waste at the dump sites is very scanty and in Lagos, collection of data on the size of e-waste is very difficult owing to the availability of several informal scrap collectors and many obscure dump sites. See Ewuim, S.C *et al* (2014) " Challenges of E-Waste Pollution to Soil Environments in Nigeria – A Review" *Animal Research International*, 11(2), p 1976 at 1979

[117] See Olowu, D supra, p 63; See also Obaje, S.O supra at p 32

[118] See Waste Management World,(2011) 'Undercover Investigations into E- waste Smuggling', 16 May, available at http://renewable-energy-database.com/index/display/article-display/1498817050/articles/waste-management-world/markets-policy-finance/2011/05/ UndercoverInvestigationsintoElectronicwastes_Smuggling.html.

[119] Ibid.

[120] Lawrence Chidi Anukam, 'E-Waste Control: Nigeria's Experience'. Director General/CEO NESREA's Presentation at the 2nd INTERPOL Environmental Compliance and Enforcement Conference, INTERPOL Complex, Singapore, 16-18 November, 2015

[121] Nigerian Society of Engineers (NSE)'s Environment Division Conference Papers. November 9-10, 2010, Abuja on the theme: 'Environmental Impact of Telecommunication Projects in Nigeria'.

[122] Bamako Convention on the Ban of the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes within Africa, opened for signature Jan. 30, 1991, 30 I.L.M. 773, <http://www.africaunion.org/root/au/documents/treaties/Text/hazardouswastes.pdf> [hereinafter Bamako Convention]. Accessed 21st August, 2016.

[123] See Nwufor, C.C. (2010) "Legal Framework for the Regulation of Waste in Nigeria." *African Research Review*, Vol. 4(2), p 491

[124] See Teneda *supra*

[125] See Babatunde, I.O (2010) *A Critical Analysis of the Framework for the Protection of the Marine Environment in International Law*, Unpublished Ph.D Thesis at p 390

[126] Electronics Takeback Coalition (2010): Facts and Figures on E-waste and Recycling. <http://www.electronicstakeback.com> Accessed 15th October, 2016.

computers were replaced, worldwide, between 2004 and 2009 and another ten million replaced in the next succeeding eight years [127]. Discarded electronics and electronic components (e-waste) are creating a serious problem because of toxic elements involved in their manufacture. In the vast majority of cases, discarded computers and other electronic devices, such as cell phones, are functional and could be passed on to another individual or organization. In most cases, even non-functioning devices can be repaired and resold or donated to those in need. E-cycling has been harped as the effective elixir to combatting the dangers of e-waste [128].

E-cyling which is the process of recycling the components of metals contained in used or discarded electronic equipment, comprising mostly cyclable gadgets like computers, televisions, microwave ovens, vacuum cleaners, mobile phones, telephones, stereos and DVDs. The need for e-cycling facilities has heightened in recent times because of the fast way technology become obsolete. The major undoing and downside of e-cyling is the fact that only about 4% of the world's waste is said to be electronic [129]. Thus, e-cycling is not a substantially effective waste-disposal mechanism. Equally, the disassembly process for WEEE is dangerous because of the heavy metals of which the electronic products are composed. Only between 1-5% of the original cost of materials can be also retrieved [130] whilst most part of the e-waste is not being recycled as promised but sold overseas as spare parts to salvage brokers and scrap merchants.

In the developed countries of the world, e-waste processing involves dismantling the equipment into various parts – metal frames, power supplies, circuit boards, and plastics, which are separated, often by hand. Alternatively, material is shredded, and sophisticated expensive equipment separates the various metal and plastic fractions, which then are sold to various smelters and or plastics recyclers. However a typical electronic waste recycling plant combines the best of dismantling for component recovery with increased capacity to process large amount of electronic waste in a cost effective manner. The hazardous smoke and gases generated by these processes are captured, contained, and treated to ensure that they do not become a threat to the environment [131]. Regrettably, Nigeria and most developing countries of the world are yet to get to this advanced and sophisticated level of waste disposal, their e-waste disposal method is pedestrian [132], as individual traders buy these wastes, collect components for reuse and burn the remains in incinerators, dump sites and landfills which end up polluting the environment. Developed Recycling as is practised in the developed countries of the world is largely unknown to Nigeria.

10. Recommendations

Having identified the issues, the danger and the challenges, the following recommendations are hereby proposed to combat the challenges of e-waste management in Nigeria.

There is an urgent need for public policy that will favour an effective e-waste management, prevention and control in Nigeria: Policy-makers and Legislators must endeavour to make effective laws that will make e-waste trade unattractive and sanctionable.

Existing laws concerning e-waste disposal be reviewed and revamped. A comprehensive law that provides e-waste regulation and management and proper disposal of hazardous wastes is required. Such a law should empower the agency to control, supervise and regulate the relevant activities of government departments. Under this law, the agency concerned should collect basic information on the materials from manufacturers, processors and importers and to maintain an inventory of these materials. The information should include toxicity and potential harmful effects, identify potentially harmful substances and require the industry to test them for adverse health and environmental effects, control risks from manufacture, processing, distribution, use and disposal of electronic wastes.

The Federal ministry of Environment should liaise with other ministries, departments and agencies like the Ministry of Communications, Ministry of Health, Nigerian Customs Service, Nigerian Ports Authority, Nigerian Immigration Service, NITDA and the Ministry of Finance to ensure harmonized laws for the prohibition of unregulated e-waste trade and disposal.

An earnest Production-process modification is hereby highly recommended as desired. Electronic manufacturers should be mandated to make changes in their production processes in order to reduce waste generation. This reduction can be accomplished by changing the materials used to make the product or by the more efficient use of input materials in production process or both.

Potential waste minimization techniques can also be adopted and broken down into categories and each category of stakeholders identified to have their own role to play effectively and efficiently to manage electronic waste in Nigeria.

Government should provide regulatory framework, through empowerment of relevant agencies, in form of laws, control mechanisms and procedures to manage E-Waste.

Fixed (permanent) E-Waste collection facilities should be installed at accessible and well-identifiable locations. Usage of such facilities should be enforced.

E-Waste take-back programmes should be established with manufacturers and sellers. And consumers should be encouraged to make use of the programme.

Advance disposal fees for E-Waste should be implemented and collected at the point of sale with the aim of using the proceeds to support management and eventual disposal at equipment's end of life.

The 'polluter pays' principle should be adopted, while the possibility of extended producer-responsibility should also be considered. At least the developed countries that are responsible for the generating of the e-wastes should be ready to pay heavily for the wastes generated and moved across their national boundaries.

Establishment of E-Waste recycling facilities should be encouraged with adequate incentives from government.

Substantial progress would be made in recommending to governments at all levels the need to legislate on E-Waste management and disposal.

[127] Gartner Group Research on Recycling and E-cycling. GRTSY 101.
[128] Ibid.
[129] Electronics Takeback Coalition (2010): Facts and Figures on E-waste and Recycling. <http://www.electronicstakeback.com> Accessed 15th October, 2016.
[130] Ibid.
[131] Ibid.
[132] See Williams, E (2005) "International Activities on E-Waste and Guidelines for Future Work." Being Third Workshop on Materials Cycles and Waste Management in Asia, National Institute of Environmental Sciences; Tsukuba, Japan.

Use of renewable materials and energy: Bio-based plastics are plastics made with plant-based chemicals or plant-produced polymers rather than from petrochemicals should be used. Bio-based toners, glues and inks are used more frequently and should be discouraged whilst Solar computers should be explored even though they are currently very expensive to produce. Use of non-renewable materials that are safer: Because many of the materials used are non-renewable, designers could ensure the product is built for re-use, repair and/or upgradeability.

Governments at all levels should set up regulatory agencies in each state and LGAs vested with the responsibility of co-coordinating and consolidating the regulatory functions of the various government authorities regarding hazardous substances. Governments should be responsible for providing an adequate system of laws, controls and administrative procedures for hazardous waste management.

The encouragement of the beneficial reuse of 'e-waste' and related business activities must be explored whilst programs to promote recycling among citizens and businesses should be set up.

Governments must encourage research into the development and standard of hazardous waste management, environmental monitoring and the regulation of hazardous waste-disposal.

Governments should enforce strict regulations against dumping e-waste in the country by outsiders. Where the laws are flouted, stringent penalties must be imposed. In particular, custodial sentences should be preferred to paltry fines, which these outsiders / foreign nationals can pay.

Governments should enforce strict regulations and heavy fines levied on industries, which do not practice waste prevention and recovery in the production facilities.

11. Conclusion

E-Waste (or Waste-EEE) is increasing causing concern all over the world because of its hazardous effects on humans, livestock and the ecology if improperly disposed of. E-Waste management has therefore become a topical issue, particularly because such waste now easily find their way into developing countries where they are carelessly and uncontrollably dumped in landfills. Consequently, everyone is a stakeholder in the generation of E-Waste as consumer, seller, producer, importer, etc. Therefore, effective and efficient management of E-Waste concerns everyone who must play his role in order to make the environment safe and healthy.

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