E-Waste in West Africa: Beyond Environmental and Health Risks

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Abstract
The urgency of the problem of electrical and electronic waste (e-waste) is evident worldwide; however, some countries in Sub-Saharan Africa are shouldering a disproportionate burden of a global problem without having the requisite capacity and the technology to deal with it. E- waste contains hazardous substances such as lead, mercury, and hazardous chemicals, such as brominated flame retardants, which are hazardous to the environment, humans, and flora and fauna, if not disposed of properly. The increasing desire to bridge the digital divide coupled with poverty in West African countries have encouraged the thriving market and demand for e-waste.

This paper highlights the problem of e-waste in West Africa and the fact that the challenges and impacts of e-waste go beyond environmental and health risks. It emphasizes the myriad issues and challenges of regulating and governing the menace of e-waste in West Africa. The paper concludes with several recommendations on how West African countries, as a region and as individual countries, can address the challenges and menace of e-waste, while seeking for avenues to tap into its economic potentials.

Keywords: E-waste, environmental pollution, health, poverty, sustainable development

Introduction
The urgency of the problem of electrical and electronic waste (e-waste) is evident worldwide (Smith *et al*, 2006). However, certain developing countries in Asia and West Africa are shouldering a disproportionate burden of a global problem without having the requisite capacity and the technology to deal with it. E-waste is hazardous, complex and expensive to treat in an environmentally sound manner, and there is a general lack of legislation or enforcement surrounding it. Today, most e-waste is being discarded in the general waste stream such as disposal through the garbage collection trucks etc. Of the e-waste in developed countries that is sent for recycling, 80 per cent ends up being shipped (often illegally) to developing countries such as China, India, Ghana and Nigeria for recycling. Within the informal economy of such countries, it is recycled for its many valuable and sellable materials by recyclers using rudimentary techniques.

E-waste such as refrigerators, microwaves, televisions and computers is currently the largest growing source of waste globally (UNEP, 2015). It has a negative impact on human health, the environment, political, and socio-economic issues (UNEP, 2015; Lundgren, 2012; ILO, 2015). The issues and challenges of addressing e-waste are enormous, particularly for developing countries and for the most part, those in West Africa (Lundgren, 2012). Most of the e-waste that comes into West Africa, notably Lagos Nigeria, Accra Ghana, Cotonou Benin Republic, Côte d'Ivoire, Senegal, are imported from developed countries, and disguised as secondhand electrical and electronic goods. However, the biggest challenge is that these goods are often dysfunctional, no longer fit for use, and their safe disposal becomes a challenge because of their diverse composition, and recycling them safely is complex, expensive, and it requires a high level of skill and expertise (Secretariat of the Basel Convention, 2011).

West Africa has therefore become a "pollution haven" where e-waste is disposed of illegally and waste handlers face strong incentives to avoid taxes and regulations. This is especially so where regulations and taxation are non-existing or inadequate. According to Lundgren, "[t]he 'pollution haven' theory states that

pollution-intensive economic activity will tend to migrate to those jurisdictions where costs related to environmental regulation are lowest. This theory overlaps with globalisation and the north–south issues, the debate over the disparate implications for the developed and developing countries, and whether globalization will lead to "industrial flight" from the north and the growth of "pollution havens" in the south" (Lundgren, 2012; Lepawsky & McNabb, 2010).

This article is divided into four sections, section 1 is the introductory part; section 2 provides clarification of key terms used in this paper, the definition and the composition of e-waste; section 3 highlights the issues and challenges of e-waste in West Africa, and section 4 concludes and proffers recommendations for national and regional policymakers and stakeholders in west Africa. The article concludes and makes several recommendations in section 4. It advocates, *inter alia*, the formalization of the informal e-waste sector, introduction and practice of Environmentally Sound Management of e-waste in West Africa, and the introduction of the Extended Producer Responsibility (EPR) for electrical goods and equipments.

Clarifications and Definition of Terms

What is waste?

The definition of waste is multidimensional and it is impossible to press it into one single definitional box. This is because before an item can be classified as 'waste', it has to bear the basic characteristic of waste - has it been discarded? Furthermore, the definition of 'waste is problematic because there are certain categories of waste that are linked to either the properties of the waste itself, such as whether it is hazardous or inactive waste or the producer of the waste, i.e. whether it is a household, commercial, or industrial waste.

Bell and McGillivary (2008) give three reasons why the concept of waste has proved difficult to define. Firstly, there is no basic physical characteristic that can be used to describe waste. For instance, can something that has been discarded, such as a laptop, that is placed in a dustbin but which functions perfectly and can be re-used, be classified as waste? Or, should a residue or by-product be classified as waste? Secondly, waste is subjective because one person's waste is another person's raw material. Thirdly, should something that one party puts no value on and discards but another puts value on and is willing to pay for be classified as waste? In other words, there is an implicit connection between waste and the value of worth of an object (Cheyne & Purdue, 1995). However, in all the definitional challenges, it is important to note that 'waste' is not necessarily associated with pollution but all pollution is associated with waste and that the link between waste and environmental harm is that unless waste is managed properly and regulated accordingly, it has the potential of resulting in pollution.

What is Electronic Waste (E-Waste)?

Similar to the definition of waste, there is no standard definition of e-waste (UNEP, 2015). The most widely accepted definition of e-waste was provided by the European Union (EU) as "electrical or electronic equipment, which is waste including all components, sub-assemblies and consumables, which are part of the product at the time of discarding" (Directive 2002/96/EC, 2003). According to Lundgren, the Organisation for Economic Co-operation and Development (OECD) defines e-waste as "any appliance using an electric power supply that has reached it send-of-life" (Lundgren, 2012). More importantly, especially with regards to waste management and regulation, the definitional challenge has the potential to create knowledge gaps in both the quantity of e-waste generation and the source of e-waste.

Composition of E-Waste

The composition of e-waste is very diverse and differs across product lines and categories. According to Smith *et al*, between 1994 and 2003, about 500 million personal computers containing approximately 718,000 tonnes of lead, 1,363 tonnes of cadmium and 287 tonnes of mercury, reached their end-of-life

(Lundgren, 2012: 12; Smith *et al,* 2006). Also, Kamat estimates that 500 million computers worldwide reached the end of the life between 1994 and 2003. The end of life computers are estimated to contain approximately 2,870 tonnes of plastic, 718,000 tonnes of lead, 1,363 tonnes of cadmium and 287 tons of mercury (Kamat, 2915; Pinto, 2008). Overall, it contains more than 1000 different substances which fall into "hazardous" and "non-hazardous" categories.

Electronic waste contains several hazardous substances such as lead, mercury, beryllium, cadmium, chromium and brominated flame retardants, etc., that can pollute the ecosystems with the attendant environmental health risk to wildlife and humans. E-waste also contains industrial chemicals classified as Persistent Organic Pollutants which are chemicals that remain persistent in the environment for long periods, are distributed globally and accumulate in the fatty tissue of humans and animals (Ogunbuyi, 2012: 94). Significantly, for human health and the environment, the toxicity of many of the chemicals in e-waste is unknown. In general, large household appliances represent the largest proportion (about 50 per cent) of e-waste, followed by information and communications technology equipment (about 30 per cent) and consumer electronics (about 10 per cent).

E-Waste in West Africa: Issues and Challenges

The issues and challenges of e-waste in West Africa are multi-dimensional, such as economic social and environmental. Furthermore, in the context of human rights, inefficient waste management systems have a profound effect on the poor. According to a report commissioned by Greenpeace, "[t]he rich countries often legally or illegally divert this problem from their own backyards. The hidden flow of e-waste that causes environmental damage in the backyards and scrapyards of poorer countries." (Cobbing, 2015). So, what is the scale of the problem in West Africa? What are the main issues and challenges? There are three major issues with regards to e-waste and West Africa, namely; (i) West Africa is being used as dumping ground for all kinds of electrical and electronic waste; (ii) the quest to bridge the digital divide[1] has unwittingly led developing countries to embrace e-waste and (iii) the scale and the magnitude of e-waste coming into West Africa and the magnitude of internally generated e-waste is predicted to escalate.

The statistical data of the amount of e-waste that comes into West Africa is unreliable and inconsistent, thereby adding to the challenge of developing a comprehensive framework for addressing the environmental and socio-economic impact of e-Waste (Obaje, 2010: 32).[2] Although China currently receives the highest proportion of all E-Waste globally, about 70 per cent, however, due to the recent tightening of regulations in Asia with regards to the importation and dumping of e-waste, it is estimated that more e-waste will flow into West African countries in the future (Lundgren, 2012: 14). When juxtaposed against the fact that the destination of e-waste has changed from Asia to Africa, it is evident that the problem is exploding, with many dangers for human health and the environment in West Africa.

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[1] The digital divide can be defined as the gap between those who have ready access to computers and the internet, and those who do not.

[2] According to the author, "An estimated 500 containers of "second-hand" electronics are imported to Nigeria every month from Europe with each container holding 500 to 800 computers and monitors representing about 400,000 arrivals every month (Terada, 2012; Puckett et al., 2005). The exporting countries of used electrical and electronic equipment (UEEE) to Nigeria are European Union (45%), USA (45%), remaining 10% from other locations such as Japan, Korea, Malaysia and Singapore (Benebo, 2009; Puckett et al., 2005). On the other hand, Osibanjo and Nnorom (2011) gave different statistical values such as United Kingdom (60%), Germany (16%), China (9%), USA (3%) and others (12%). According to Osibanjo and Nnorom (2011), only 60-70% of non-functional electrical and electronic devices are repairable and reusable, while the remaining 30% of the imported UEEE are non-functional and constitute WEEE. Manhart et al. (2011) corroborated the claims of Osibanjo and Nnorom (2011). However, Amachree (2013) and BIS (2013) maintained that 25% of the imported UEEE to Nigeria are functional, while the remaining 75% are either electronic junk or unserviceable (Puckett et al., 2005) and they are eventually burnt or dumped carelessly." See also O. Ogungbuyi, *et al* (2012).

In considering the issues of e-waste in West Africa, this paper focuses on the issues and regulatory challenges that policy makers, regulators, governments, and other relevant stakeholders will have to consider in order to formulate a sustainable and responsive framework for regulation and management of e-waste. The issues and challenges are myriad and they can be discussed under different categories.[3] Some of them are discussed below.

Poverty, 'Digital Divide' and the 'Digital Dump' Confluence

The need to bridge the digital divide in developing countries is resulting in a state of digital dumping in West Africa. As a result of poverty, the purchasing power of West Africans compels them to buy used electrical and electronic equipment (UEEE) to enable them bridge the digital divide. According to Puckett, "the need to bridge the 'digital divide' only helps to open up 'a digital dump' in developing countries (Puckett et al, 2015). This is because a lot of the UEEE, whether used or end of life, end up in landfills or they are burnt. This mode of disposal, if not properly done, becomes a source of pollution to groundwater, soil, atmosphere and the environment. A three-year undercover investigation by Greenpeace indicated that unfixable UEEE in United Kingdom always end up shipped to Africa, especially Ghana and Nigeria, as second-hand electronic goods. While the local market in Nigeria enables the utilisation of thousands of the unfixable UEEE as spare parts, however, majority of these UEEE are usually dumped as e-waste without any proper recycling and thereby posing environmental and human health threat (Puckett, 2015).

The notorious Agbogbloshie e-waste processing site in Accra Ghana is rated by Pure Earth, (formerly the Blacksmith Institute), as one of the top ten toxic threats to human health in 2013[4] and it is the largest e-waste dump in the world. Ghana imports around 215,000 tonnes of secondhand consumer electronics annually, mostly from Europe and these in turn generates another 129,000 tonnes of e-waste every year (Pure Earth, 2013; Feldt et al, 2014). According to the Pure Earth report, "[A] range of recovery activities takes place in Agbogbloshie, each presenting unique occupational and ecological risks. The primary activity of concern from a public health perspective is the burning of sheathed cables to recover the copper material inside. Styrofoam packaging is utilized as a fuel to burn the material in open areas. Cables can contain a range of heavy metals, including lead. To some extent, these metals can migrate through particulate in the smoke, while significant amounts are also left behind on area soils" (Pure Earth, 2013). A sample of the soil around Agbogbloshie indicated a dangerous level of toxic contaminants such as Lead. The report found lead at levels as high as 18,125 ppm in soil compared to the US EPA standard for lead in soil at 400 ppm. Also, samples taken from workers on the site found aluminum, copper, iron, and lead levels above acceptable levels (Pure Earth, 2013).

Similarly, test carried out on soil samples at e-waste dump sites in Lagos, Benin, and Aba cities in Nigeria indicates high concentrations of copper, nickel, zinc and lead far in excess of European Union limits. Flora and fauna and nearby surface waters in e-waste disposal sites were also found to be contaminated by heavy metals (Osibanjo, 2009). Exposure to lead negatively affects the hematological system, the central nervous system and the renal system. Exposure to mercury affects the sensory, visual and auditory functions and those concerned with co-ordination. Long-term exposure to cadmium affects the kidney.

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[3] Some of the issues that will not be discussed in the paper includes the following: It encourages criminal activities; security implications with regards to data on computers etc; labour issues including occupational hazards and exposures and lack of labour standards.

[4] Pure Earth is an international non-profit organization dedicated to solving pollution problems in low- and middle-income countries, where human health is at risk. See http://www.worstpolluted.org/projects_reports/display/107 (02/3/2016).

Sites like Agbogbloshie abound all over West Africa and this could be attributed to the fact that there are neither organised e-waste collection centers nor e-waste management infrastructure.

The Race to the Bottom theory[5] escalates the issue of e-waste in West Africa where lower environmental and labour standards and regulations usually obtains. However, research has shown that the issue is not with a lack of environmental regulations, but a lack of implementation and coherence of the existing environmental regulations and standards. Therefore, with the recent tightening of regulations in Asia, it is estimated that more e-waste will flow into West African countries in the future (Lundgren, 2012: 14). Therefore, it is estimated that in the very near future, West African countries, notably Nigeria and Ghana, will be shouldering a disproportionate burden of a global problem without having the governance and management structures, capacity, expertise and technology to deal with it.

Risks to Human Health, Environment and other Socio-Economic Issues

E-waste is a complex and difficult form of waste to recycle. It poses threats to human health and the environment in developed countries, despite the fact that the recycling facilities in those countries use state-of-the-art facilities and they operate in formal sectors where standards, guidelines and health and safety standards are set. The high risk involved in e-waste is more profound for developing countries where the 'recycle process' usually occurs in the informal setting without the required expertise, training, protective and safety wears, abuse of labour standards and rights, use of child labour, abuse of fundamental human rights, unsafe disposal of end of life waste, etc. (Terada, 2012). According to Lundgren, problems such as elevated concentrations of heavy metals in the air have been found in state-of-the-art facilities in developed countries, and workers and local residents are exposed to toxic chemicals such as lead, copper, and cadmium through inhalation, dust ingestion, dermal exposure and oral intake.(Lundgren, 2012: 14). For example, metal that should be incinerated are burnt in the open in developing countries, leading to unhealthy exposure to hazardous substances, release of dioxins and other harmful chemicals (Lundgren, 2012: 18).

The greater challenge and fallout from this is that e-waste workers in the informal sector in developing countries are not the only ones exposed to these hazardous substances. The surrounding community, women, and children are affected as well. The local communities are exposed to toxic chemicals through inhalation, dust ingestion, dermal exposure and oral intake. E-waste therefore constitutes not only a significant global environmental and health challenge, with implications far broader than occupational exposure and involving vulnerable groups and generations to come (Lundgren, 2012)but also leads to infringements of fundamental human rights such as the right to life, right to a healthy environment etc. (Terada, 2012: 154).

Threat to Sustainable Development and the Attainment of Sustainable Development Goals

Goal 12 of the Sustainable Development Goals (SDGs) advocates the adoption of sustainable consumption and production patterns.[6] Target 12.4 states that by 2020, countries should achieve environmentally sound management of chemicals and all wastes throughout their life cycle, in accordance with agreed international frameworks, and significantly reduce their release to air, water and soil in order to minimize their adverse impacts on human health and the environment. E-waste has the potential of generating economic advantages because the components of some of the electrical equipments contain valuable materials such as gold and copper. However, if the economic potential of e-waste is not

[5] This means that increased competition for trade and foreign direct investment could lead to the lowering of environmental and labour standards and regulations. This is because the general view is that high rates of corporate taxation, strict labour laws, or rigorous environmental protection lower profit rates.

[6] Transforming our world: the 2030 Agenda for Sustainable Development, A/RES/70/1

adequately harnessed, it threatens the sustainable use of natural resources; it poses a threat to public health, the environment, and therefore, the attainment of sustainable development goals in Africa.

According to Osibanjo (2009), there is a connection between environmentally sound management of wastes and pollutants, and the unregulated influx of e-waste, which in turn threatens the attainment of the sustainable development goals. Although UEEE is critical to bridging the digital divide and improving the socio-economic development of Africa, however, a large percentage of the UEEE that is imported into Africa are not functional or repairable. Studies indicate that most of the UEEE exported to Africa are hazardous wastes with concentrations far higher than the permissible levels in developed countries, thereby threatening the environment and also resulting in several other socio-economic challenges such as threat to public health (Osibanjo, 2009).

Challenges

There are various challenges in the effective management of e-waste. Some of the challenges are global in perspective while others are regional or particular to a nation depending on individual circumstances. For instance, with regards to a global challenge, the unwillingness of consumers to return and pay for the disposal of their discarded electronic products in accordance with the Polluter Pays Principle and the responsibility of producers in accordance with the extended producer responsibility, is one that cuts across virtually every nation. With particular reference to West Africa, some of the challenges include paucity of reliable statistical data on the volume of e-waste that ends up in West Africa; importation of e-waste disguised as a secondhand electronic equipment; lack of awareness of the dangers of the improper disposal of e-waste among consumers at large and particularly in the local community where the collectors and recyclers operate; lack of awareness of the potential health hazards of e-waste among collectors and recyclers; lack of funds and sometimes political will to formalise e-waste recycling; the absence of adequate recycling infrastructure or appropriate management of e-waste; and the absence of a coherent national and regional regulatory framework for the regulation of e-waste in West Africa.

Institutional and Regulatory Challenges for the Management of E-Waste in West Africa

There are several international, regional and multilateral agreements on the control of hazardous and other types of waste. The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (1673 UNTS 126; 28 ILM 657 (1989), Rotterdam Convention on the Prior Informed Consent Procedure for Certain Hazardous Chemicals and Pesticides in International Trade (2244 UNTS 337 / [2004] ATS 22/ 38 ILM 1 (1999), and Stockholm Convention on Persistent Organic Pollutants (2256 UNTS 119; 40 ILM 532 (2001), regulates the shipping of waste and their disposal in international law. In addition to these, there are various regional conventions seeking to regulate hazardous waste movements, such as the Bamako Convention on the Ban of the Import into Africa (UNEP, 2011) and the Nairobi ministerial declaration on the environmentally sound management of electronic and electrical waste within Africa (UNEP, 2006).

The Basel Convention controls the transboundary movement of hazardous wastes and their disposal, and is the most significant multilateral environmental agreement (MEA) in relation to tackling the environmental challenge. However, the effectiveness of the Basel Convention is limited due to issues such as: the general and often ambiguous definitions of fundamental terms, such as 'hazardous waste' and 'environmentally sound management'; the fact that UEEE, near end of life EoL, and e-waste are shipped as secondhand products rather than wastes and which takes the equipments out of the purview and not subject to Basel Convention control. For example, EEE and e-waste are not shipped as wastes, but as second hand products. Therefore, technically they do not fall under the control and regulation of the Basel Convention. However, many of these products are near their end-of-life. Therefore, African countries with limited capacity and resources, are left to struggle with the challenge of dealing with e-waste in an environmentally sound manner. According to Osibanjo (2009), “there are no common understanding,

definition, and classification at the international level, of what electronic waste and parts are to be regulated under hazardous waste law, rules and procedures, while each country decides on its own."

Other issues include: absence of an enforcement mechanism to ensure that hazardous waste traders are made accountable; the adoption of a limited ban, rather than a total ban on hazardous waste exports and the provision for separate agreements under Article 11 and the loopholes which it provides to permit hazardous waste exports for recycling. These and other issues impact on its potential to discourage the influx of e-waste into developing countries and to achieve sound environmental management of hazardous waste. Furthermore, a number of key players that are important for stemming the tide of e-waste to Africa have not ratified the Basel Convention, for example, the United States, the world's largest generator of hazardous waste.

The Bamako Convention is a treaty of African nations prohibiting the import into Africa of any hazardous (including radioactive) waste. The convention came into force in 1998. The Bamako Convention is a regional convention that was necessitated because of the failure of the Basel Convention to prohibit trade of hazardous waste to less developed countries (LDCs) and the realization that many developed nations were exporting toxic wastes to Africa.[7] For instance, Article 11 of the Basel convention allows parties and non-parties to the Basel Convention to enter into bilateral, multilateral and regional agreements with regards to the trans-boundary movement of hazardous wastes or other wastes. The Bamako convention uses a format and language similar to that of the Basel convention, but its language is much stronger in prohibiting all imports of hazardous waste and it does not make exceptions on certain hazardous wastes, like those for radioactive materials, made by the Basel convention.

A large number of West African countries have ratified the Basel Convention, such as Nigeria, Ghana, Benin, Cameroon, etc. (Secretariat of the Basel Convention, 2011), but the same is not true for domestication of the Convention and other regional conventions into national laws and regulations. Furthermore, most countries in West Africa lack national regulations to manage and govern the importation of UEEE and e-waste. For instance, although Ghana has a Bill titled 'Electronic Waste (Disposal and Recycling) Regulations,' that seeks to control and manage hazardous and e-waste, this Bill is still pending before parliament. The legal framework is somewhat more defined in Nigeria. The Harmful Waste (Special Criminal Provisions) Act, (Special Criminal Provisions) Act, Cap H1, 2004, prohibits the carrying, depositing and dumping of harmful waste on any land and territorial waters of Nigeria, and the National Environmental protection (Management of Solid and Hazardous Wastes) Regulations 1991.

Conclusion and Recommendations

The responsible and effective management of e-waste is essential for Africa, the rest of the world and the attainment of important international targets such as the SDGs. It is a contradiction in terms because it has both valuable and harmful effects. Certain countries in West Africa are particularly vulnerable and at risk from the menace of e-waste. This is particularly so because these countries have weak institutional and regulatory frameworks to address the challenges posed by e-waste, and they lack the required technical capacity and the financial resources. Therefore, West African states must co-operate with one another and work towards a complementary system in the regulation and management of e-waste in the region, in order to jointly proffer workable and implementable solutions and strategies. Therefore this paper makes the following recommendations:

I. Formalization of the informal sector through incentives and instituting fiscal policies that can encourage this. The formalisation process may include facilitating the formation of collectives such as association, small business or cooperative, capacity building, development of appropriate

[7] The Koko incident in Nigeria comes to mind.

legal frameworks and a monitoring scheme. There should be an ongoing interaction between the formal and informal sector. This can be achieved through comprehensive health and occupational safety trainings, and capacity building of workers and community members to reduce the risk of heavy metal exposure

II. The loophole in the Basel Convention with regards to near end of life UEEE should be addressed by the international community

III. Encourage Environmentally Sound Management (ESM) of waste in West Africa. ESM ensures that wastes, used and scrap materials and other hazardous waste are managed in a manner that will save natural resources, and protect human health and the environment against adverse effects that may result from such wastes and materials.

IV. Establish Extended Producer Responsibility (EPR) for electrical goods and equipments that will require manufacturers to 'take back' or 'buy back' their electronic products.

V. Develop regional and national regulations and institutional frameworks for implementation of Extended Producer Responsibility in Africa and other developing countries. This is essential in view of the fact that most developing countries lack basic or state-of-the-art recycling and waste disposal facilities.

VI. West African states should individually adopt a 'National Action Plan' on the management of e-waste. The 'National Action Plan should solicit and encourage stakeholder participation and also participation from other relevant Regulatory Agencies.

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