CHALLENGES OF E-WASTE POLLUTION TO SOIL ENVIRONMENTS IN NIGERIA – A REVIEW

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ABSTRACT

Hitherto Nigeria has been identified as a major dumping ground for e-waste from developed countries of the world arising from increasing demand for information computer technology (ITC) and other electronic gadgets by the populace especially with the relation of telecom sector since 2001. The term "e-waste" may be applied to electrical and electronic waste material of all categories and includes but not limited to computers, refrigerators, television sets, mobile phones, office electronic devices, entertainment device electronics and electronic toys. Evidently, in addition to human health issues associated with e-waste management, e-waste constitutes a challenge to both developed and developing countries though markedly pronounced in the latter because of the dearth of appropriate technology in handling the menace posed by the discarded waste materials. There is paucity of information in quantitative terms regarding the effect of e-waste on the environment (including the soil fauna and flora) especially in Nigeria. However, e-waste has been implicated as being deleterious to soil quality, soil fauna and flora especially from studies outside Nigeria. In this paper this category of wastes will be assessed and in relation to its possible influence on soil environment in forms including heavy metal pollution. Possible e-waste management strategies will also be highlighted on soil environment with particular reference to Nigeria.

Keywords: E-waste, Pollution, Soil, Environment, E-waste management

INTRODUCTION

Africa has been identified as a dumping ground for toxic chemical and electronic waste from developed countries with as much as 80% of world's high-tech trash ending up in Asia and Africa, with an estimated 65% and 35% getting into China and Nigeria, respectively (Uduma, 2007). The global market of electronic and electrical equipment over the past two decades has continued to expand exponentially with the life span of these products becoming shorter and shorter thus posing a new challenge to business and waste management officials (Bhutta *et al*., 2001; Hilty *et al*., 2004; Hilty, 2005) and indeed the soil and other environments. Electronic waste (sometimes called e-waste, waste electrical and electronic equipment (WEEE) or e-scrap has been defined as `an unwanted electronic or electrical appliance that have been discarded by their original users such as old and outdated computers, laptops, televisions, cellular phones, mp3 players, telecommunications equipment, keyboards, mouse, photocopiers typewriters among others (PPCC, 2006; Ogbomo *et al*.,

2012). Majority of the e-waste contain items that could be recovered and utilized for new products even though electronic equipment contains hazardous material capable of affecting human health and the environment if not properly managed (PPCC, 2006; Ogbomo *et al*., 2012). With the increasing quest for information Communication (ICT) for provision of information Technology (IT) and networking service in addition to the ever increasing demand for electronic gadgets in Nigeria, there is the need to put mechanisms in place to harness and manage properly these material which when obsolete and unserviceable will add to the pool of e-waste in the country. It is against this background that this paper will examine the challenges of e-waste in Nigeria in relation to health issues and soil environments in Nigeria.

MATERIALS AND METHODS

A comprehensive search was made in the internet for reports on e-waste pollution to soil environments from various parts of the world. Such articles were assembled, studied and analyzed vis-à-vis the Nigerian situation as represented in this review.

RESULTS AND DISCUSSION

Category of Waste: Four major types of waste have been identified and they include agricultural waste, municipal solid waste, industrial waste and hazardous waste. There are difficulties however in establishing what constitutes e-waste because of variation of definition from one country to the other.

(a) Agricultural waste: Agricultural waste is a waste generated as a result of agricultural activities which include manure and various wastes from poultry houses, slaughter houses and harvest waste, fertilizer run-off, pesticides that enter into water, air or soils and salt and silt drained from field as opposed to the simpler version by Parker (2002) which defined it is as those liquid or solid waste that result from agricultural practices such as cattle manure, crop residues (for example corn stalks), pesticides and fertilizers. If conceived as 'green waste' it implies only 'biodegradable waste that can be composed of garden waste, such as grass or flower-cutting and hedge trimming.'

(b) Municipal solid waste: The definition of municipal solid waste (MSW) includes all those material used on daily basis and discarded products such as packets, packaging, grass clippings, bottles, furniture clothing, newspaper, food scraps, appliances, paints and batteries usually emanating from homes, hospitals schools and businesses (EPA, 2012) with EPA encouraging practices that reduce the amount of waste needing to be disposed of such as waste prevention, recycling and composting. These wastes are collected municipally. Compared to conventional municipal wastes, certain components of electronic product contain toxic substances which can generate a threat to the environment as well as human health (Woodell, 2008a, b) as evident in the nature of elements or metals ever present in these electrical and electronic products.

(c) Industrial waste: Industrial waste or trade waste (as it is sometimes called) is defined as a category of waste generated from industrial processes (with the wastewater from a business or industrial premises) like mills, mines and factories and many include slag and fly ash. The nature of waste generated from industrial activities depends on the type of industry and may include waste wood, waste paper, waste steel, waste metals of one kind (e.g. iron, aluminum and tin). Industrial waste play a major role in groundwater pollution in form of toxins while some of them e.g. asbestos can be carcinogenous if taken with groundwater by homes.

(d) Hazardous waste: A hazardous waste is one that is potentially deleterious or dangerous to public health or the environment. Such wastes which can be in liquid, gaseous or solid state or even sludge are generated from commercial products or are by-products from manufacturing processes. EPA (2012) listed hazardous wastes to include: listed wastes, waste from common manufacturing processes,

wastes from specific industries and wastes from commercial products.

Characteristic Waste: These wastes include the ones listed above but can exhibit ignitability, corrosivity, reactivity or toxicity.

Universal Waste: These include mercury-containing equipment, pesticides and batteries.

Mixed Waste: Waste that contains both hazardous waste substances and radioactive materials. Incidentally, electronic waste (or e-waste) in the long run has been categorized as hazardous.

Categories of E-waste: E-waste according to Ohio E-waste Recycling (2009) has been grouped into three: large house appliances (e.g. refrigerators and washing machine, information technology (IT) and telecom (e.g. personal computers, laptops, monitor, consumer equipment, radios, television, e.t.c (Figure 1).

Figure 1: E-waste found in dump sites (BAG, 2014)

Ohio E-waste Recycling (2009) noted that each of these have twenty-six common components that can be found in tem-metal, motor/compressor, cooling, plastic, insulation, glass. Liquid crystal display (LCD), rubber, writing/electrical, concrete, transformer, magnetron, textile, circuit board, fluorescent lamp, incandescent lamp, heating element, thermostat, batteries, external electric cables, refractory ceramic fibres, radioactive substances and electrolyte capacitors (over LD 25mm) among others.

The composition of e-waste is variable but contains more than 1000 different substances categorized as hazardous and non-hazardous and contains ferrous and non-ferrous metals, plastics, glass, wood and plywood, printed circuit boards, concrete and ceramics, rubber and other items.

Iron and steel constitute about 50% of the WEEE (Waste Electrical and Electronic Equipment) followed by plastics (21%), non-ferrous metals (13%) among others. Non-ferrous metals include aluminum and copper, silver, gold and platinum. The presence of elements like lead, mercury, arsenic, cadmium, selenium and hexavalent chromium and flame retardants beyond threshold quantities in WEEE/e-waste implicates them as hazardous waste (Ohio E-waste Recycling, 2009).

E-waste and the Nigeria Situation: The problem of e-waste and its management is not only global but its own environmental implications. A major driver of the growing e-waste problem is the short life span of most electronic products – less than two years for computers and cell phones (Macauley *et al.,* 2003; Denga *et al.,* 2006; Bhutta *et al.,* 2011). In tackling the problem of e-waste the European Union (EU), Japan, Taiwan, South Korea and several states of the United States have introduced legislation making producers take responsibility of products reaching the end of their lives, with 65% of the United States being currently covered by some sort of state e-waste recycling law (ETC, 2012; Terada, 2012). The problem of e-waste in relation to human rights has been copiously discussed by Terada (2012). Apart from Rotterdam convention and the Stockholm conventions, the Basel convention (for the control of transboundary movements of hazardous wastes and their disposal) and the Bamako convention (on the ban on the import into Africa and the control of transboundary movement and management of hazardous wastes within Africa) have been put in place by the United Nations all in a bid to deal with the problems of e-waste. Even though the Basel Convention banned the export of hazardous

waste to poorer countries since 1992, the practice continues (Woodell, 2008a, b).

As a global super power, responsible for producing majority of the world's e-waste (Bennion, 2011; Terada; 2012) the United States must establish legislation and ratify the Basel convention and its amendment in order to halt the unethical practice of sending waste through regulated channels to developing countries (Terada, 2012). Nigeria, on the other hand, a party to the Basel convention, signed the Bamako convention (Terada, 2012). According to TI (2012), China's Guiyu breaks down, much of the world have discarded electronic slowly, poisoning itself in the process. In the Getty reportage, the city of Guiyu is home to 5500 business devoted to processing discarded electronics (known as e-waste), with the region dismantling 1.5m pounds of junked computers, cell phones and other devices yearly (TI, 2012), and may be the largest e-waste site in the world. China receives up to 80% of its toxic electronic waste from the United States (Allen, 2008). An estimated 45% of Nigeria's e-waste imports comes from the U.S and another 45% from the EU (Terada, 2012), with Ikeja Computer village, near Lagos being the site where thousands of vendors repair and sell used electronics (Schmidt, 2006; Terada, 2012), pending possible relocation to a complementary site at Kontaangogowa in Iyaje Local Government Area. Apart from Alaba market and Ikeja computer village, West minister market and Lawanson market constitute hub for imported second-hand equipment and used EEE (Manhart *et al*., 2011). Unfortunately Lagos, for instance lacks computer recycling facility, so that e-waste is dumped in several sites spread around the city (Terada, 2012).

In Nigeria, information on the implications of improper and indiscriminate dumping of e-waste at various dump sites including the impact on soil environment as it affects the soil biota and their biodiversity and other soil resources is very scanty. There is paucity of data on post impact of e-waste from environmental studies in African region (Osibanjo and Nnorom, 2007). Manhart *et al*. (2011) also noted that in Lagos, data collection in the size and economic importance of e-waste related activities is very difficult, even though the general estimate supported by all stakeholders is that there are several thousands of informal scrap metal collectors and recyclers operating and partly or fully working with e-waste.

In the long run the disposal of e-waste through land fill or even incineration raises serious environmental issues (Oboro, 2011). Large parts of ground water in Nigeria have also become polluted and unsafe for human consumption due to indiscriminate disposal of e-waste, with Nigeria "seriously falling behind in or implementing international environmental treaties because of lack of national framework policy and programme to implement them" (Joshi, 2007).

Studies carried out by the Ministry of Environment in Nigeria suggests that basic components are being recovered and then smelted in people's backyard which poses a huge risk of lead poisoning (Terada, 2012). Apart from negative health consequences Ogbomo *et al.* (2012), studies in Nigeria (Ukem, 2008) noted that indiscriminate dumping of e-waste cause environmental pollution. Based on heavy metal content of e-waste, studies in Nigeria indicate that heavy metal can cause surface and ground water pollution (Ikem *et al*., 2002; Joshi, 2007). Studies elsewhere indicate that e-waste emerging as an environmental health issue in developed and developing countries, the current management practices apart from being capable of causing unintended developmental neurotoxicity in vulnerable populations (Chen *et al.,* 2011), residues and wastewater produced by e-waste disassembling discharged into water through dirty irrigation and slag heap resulted in heavy metal pollution in several polluted areas. The amount of soil animals and groups were rare while there was a high density diversity of soil animal in slightly polluted areas, as a result of heavy metal toxicity by e-waste disassembly plant (Chen *et al*., 2011).

Options for Salvaging the Soil: In the light of the need to save Nigeria soil environment, the following options are implicit: (i) Importation of e-waste into the country should

be discouraged by the governments to prevent the country from serving as a dumping ground, (ii) Nigeria should endeavour to put in placed necessary framework for implementing the Basel and Bamako Conventions, (iii) recycling of e-waste to recover valuable mineral components, (iv) legislation on e-waste should be put in place and enforced on the stakeholders, (v) disposal of existing e-waste through incineration or in landfills which raise environmental and health issues should be banned as in developed economies, (vi) regulatory bodies like Nigeria Environmental Standards and Regulations Enforcement Agency (NESREA) should ensure compliance to the quality of electronic products that enter Nigeria, (vii) appropriate legislation aimed at reducing environmental (and soil) degradation from e-waste menace should be enforced, (viii) as the country strive to achieve teledensity of 100% in 2020 from the current level of 45% environmentally friendly measures should be put in place to handle follow-up environmental issues that are likely to arise, (ix) research to assess the impact of e-waste on the environment should be encouraged to equip the government and populace with adequate data and (x) mass education and awareness should be created by regulatory bodies and government on inherent dangers of poor e-waste management on the environment.

Conclusion: The problem of e-waste is not only a global issue but constitutes environmental and health issues in Nigeria. Both developed and developing countries should enforce the protocols and treaties on e-waste transboundary movement. Nigeria needs to enact and enforce legislation on e-waste management in addition to adopting standard recycling options, recovery and reuse of so-called valuable components. Non-tolerance of e-waste by Nigerian will contribute positively towards abating e-waste transboundary trade, and promote healthy soil environment since studies in Nigeria and elsewhere indicate that e-waste poses significant threat in form of pollution to soil biota, soil quality and soil water resources including surface and underground water.

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