# THE GLOBAL ENVIRONMENTAL HAZARD OF E-WASTE AND ITS THREAT TO HUMAN SECURITY: A CASE STUDY OF AGBOGBLOSHIE E-WASTE DUMPSITE

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# DECLARATION

I hereby declare that this dissertation is an original research conducted by me under the supervision of the undersigned, and has not been submitted by anyone for any academic award in this or any other university. All references in the work have been fully acknowledged.

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# DEDICATION

*This dissertation is dedicated to the Almighty God and to my Country, Ghana.*

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# ABBREVIATIONS AND ACRONYMS

| | | |
|---|---|---|
| BFR | - | Brominated Flame Retardants |
| CEPS | - | Customs, Excise and Preventive Service |
| CFCs | - | Chlorofluorocarbons |
| CRT | - | Cathode Ray Tube |
| DVD | - | Digital Video Disc |
| EEE | - | Electronic and Electronic Equipment |
| EPA | - | Environmental Protection Agency |
| EPR | - | Extended Procedure Responsibility |
| EU | - | European Union |
| E-WASTE | - | Electronic Waste |
| FVC | - | Forced Vital Capacity |
| GIZ | - | The Deutsche Gesellschaft für Internationale Zusammenarbeit |
| GNCPC | - | Ghana National Cleaner Production Centre |
| HCFCs | - | Hydrochlorofluorocarbons |
| HQ | - | Hazard Quotient |
| ICT | - | Information Communication Technology |
| MESTI | - | Ministry of Environment, Science, Technology & Innovation |
| MMDAs | - | Metropolitan, Municipal and District Assemblies |
| MoH | - | Ministry of Health |
| MSWM | - | Municipal Solid Waste Management |
| NEAP | - | National Environmental Action Plan |
| NGOs | - | Non-Governmental Organizations |
| OECD | - | Organization for Economic Co-operation and Development |
| PBDE | - | Polybrominated Diphenyl Ether |

| | | |
|---|---|---|
| PCB | - | Polychlorinated Biphenyl |
| PCDD/Fs | - | Polychlorinated Dibenzo-p-dioxins and Dibenzofurans |
| PPE | - | Personal Protective Equipment |
| PPP | - | Public-Private Partnership |
| PVC | - | Polyvinyl Chloride |
| UK | - | United Kingdom |
| UN | - | United Nations |
| UNEP | - | United Nations Environmental Programme |
| USA | - | United States of America |
| VCM | - | Vinyl Chloride Monomer |
| WEEE | - | Waste of Electric and Electronic Equipment |

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# ABSTRACT

The rapid and intense digitization of most developing economies has set these nations on a course towards becoming the most prolific source of e-waste generation in the coming years. The adverse implications for health due to exposure to hazardous e-waste have long been recognized. However, questions remain regarding the efforts made by relevant Ghanaian authorities in implementing the key international convention on e-waste in Ghana and also, the effect e-waste has on people living in and around Agbogbloshie dumpsite. A descriptive study was carried out with the aim of assessing the extent the global e-waste problem is negatively affecting the environment and the workers and dwellers in and around Agbogbloshie e-waste dump site. This study involved 30 participants from the Agbogbloshie community in Accra, Ghana, and subject matter experts. The results showed that e-waste workers and permanent residents had common environmental exposures and hence, shared respiratory and other health symptoms. Findings also revealed that Government and other agencies have since made considerable efforts to ensure the problem of electronic waste is effectively managed. However, a lot more remains to be done in that regard. The researcher suggested that there should be immediate policy development and law enforcement on a ban of crude e-waste recycling practices such as open-air burning which poses environmental and human health hazards. Also, both e-waste workers and permanent residents should be educated on the hazards and risk associated with their work or otherwise, stays in the Agbogbloshie community and how they can minimize exposures. Lastly, the researcher recommended that there is the need to adopt modernized and less hazardous e-waste recycling practices to help minimize exposure levels and hence protect both workers as well as vulnerable populations nearby.

# CHAPTER ONE

# INTRODUCTION

## 1.1 Background to the Study

The impact of technology in the fabric of human society is immeasurable. Society has become dependent on the use of electronic gadgets and appliances as they continuously ease and improve our living conditions. A United Nations Environment Program (UNEP) 2015 report classifies the electronic industry as one of the largest and fast-growing industries whiles simultaneously generating the most e-waste of electronic gadgets and appliances globally in the region of millions of tonnes annually.

In his book titled "The Fourth ($4^{th}$) Industrial Revolution", Schwab (2016) lays out how the boom in technology has presented a variety of prospects to humankind. Households, health, welfare institutions, education, commerce and trade are employing numerous electronic products for different purposes. The interest in this these electronic products can be attributed to their continually escalating affordability which is as a result of increase in the number of buyers and users of electronic products. With this increasing affordability, the rate of technological replacement invariably has also increased. Smaller sizes, newer designs and more user-friendly electronic products are offered on the market. Majority of the products are either upgraded with new features while the inoperative and dated products become redundant to the environment.

The International Solid Waste Association (ISWA), Vienna; United Nations University (UNU), Tokyo; and the International Telecommunication Union (ITU), Geneva jointly issued a report on "*The Global E-Waste Monitor 2017"* which highlights that global e-waste generated in 2016 stood at 44.7 million metric tons. The report showed the 2016 figures to be

an 8 percent increment (of 3.3 million metric tons) from 2014. The continuous growth in e-waste generation is disproportional to the quantum recycled with only approximately 20% of e-waste recycled through the appropriate channels. The cumulative weight of gadgets such as mobile phones, television sets, refrigerators, computers and solar panels equate in weight to 1.23 million 18-wheel 40-ton trucks, fully loaded. If this figure is not alarming enough, analysts forecast e-waste will rise further by 17 percent to 52.2 million metric tons by 2021. The public has always been aware of the hazardous risk posed to humans by discarded gadgets nonetheless, there is a potential economic value for components in discarded electronics which can be recycled (Perkins, Drisse, Nxele, & Sly, 2014).

E-waste recycling is capital intensive given the volumes of waste generated or dumped on the sites which need to be sifted through, destroyed and recycled in an acceptable manner. However, dumpsites in developing countries such as Guiyu and Agbobloshie in China and Ghana respectively, recycling is managed on a small scale, usually by individuals and families who live in close proximity to the dumpsite. Their decision to be situated close to dumpsites is attributed to the economic activity on the sites which involves the extraction of copper wires from the electronic gadgets (Setiawan & Hapsari, 2018). To combat issues and risks of e-waste, particularly in developing countries, the international community has provided guidance into e-waste management. Countries most affected by dumping of electronic gadgets have been encouraged to adopt and enforce legislative policies of the 1989 Basel Convention which oversees the Control of Transboundary Movements of Hazardous Wastes and their Disposal. This international body enforces the current agreement and policy document responsible for the recovery, recycle and disposal of e-waste.

In January 1991, 12 African countries convened in Mali to formalize a treaty which prohibits the import of hazardous radioactive waste and by-products. This convention lobbied for the Ban on the Import into Africa and the Control of Transboundary Movement and Management of Hazardous Wastes, a much tougher stance than that of the Basel Convention.

At the national level, Ghana's parliament in July 2016, passed the Hazardous and Electronic Waste Control Management Bill, 2016 into Law. Act 917 emboldens government to control, manage and dispose of hazardous electrical and electronic waste. This law is to complement the two key international and regional conventions, stated earlier.

Electronic waste (E-waste) products are made of complex amalgams of plastics and chemicals, most of which can render damaging effects to both human and environmental ecosystems especially in emerging countries noted to be global e-waste dumpsites (Leung, Duzgoren-Aydin, Cheung, & Wong, 2008). Improper handling of e-waste recycle process is associated with the release of pollutants that can be detrimental to human health. These health effects may not only be limited to the individuals directly involved in these e-waste activities but also, vulnerable residents nearby. Agbogbloshie in Accra, Ghana has the world's largest e-waste dumpsite which receives over 150,000 tonnes annually. Managing e-waste is a big challenge in countries around the globe including Ghana. This e-waste menace is one that ought to be taken head on due to its harmful nature.

## 1.2 Statement of the Problem

The environment is an asset. In recent decades, the problems e-waste pose to the environment has been of worrying concern to the international community. For this reason, Japan, United States (US), European Union (EU) and other developed industrialised countries sought to propose regulatory framework on electronic waste whiles establishing the electronic waste retrieval and recycling systems. In reality, nonetheless, some industrialised countries did not have the required capacity to accommodate the quantum of electronic and electrical waste they generate (White, 2008). As a result, these countries export their Waste Electronic and Electrical Equipment (WEEE) or E-waste to developing countries where laws are lax in the sector of security, health and environment (Olowu, 2012).

The world, in the 21st century, can hardly live without Electronic and Electrical Equipment (EEE). With this growing appetite for electrical and electronic products, added together with rapid innovation and the shorter lifespans of these products, e-waste is a growing waste typology. The rise in dumping has generated concerns of probable harmful effects of the waste on the environment and human health (UNEP, 2015).

A report by the Global E-waste Monitor (2017) asserts that population increase, urbanisation, economic growth, and lifestyle orientations of developing countries have tripled their production of electronic waste within the last decade. Waste from electronic components can be categorised into hardware that is non-biodegradable and chemical substances which are environmentally hazardous to human health. The rate of global waste volumes poses a serious challenge to human and environmental existence (Setiawan & Hapsari, 2018).

Ghana's Agbogbloshie e-waste dumpsite results from the world's increasing demand for new and advanced electronic equipment leading to the disposal of older equipment. A significant proportion of this electronic waste is sent, often illegally, from the West to developing countries like Ghana. It is against this background that a study of this nature is important to highlight the extent at which the global e-waste problem is negatively affecting the Ghanaian ecosystem, as well as the workers and dwellers in and around Agbogbloshie e-waste dumpsite who are culprits and victims of this lingering problem.

## 1.3 Research Objectives

- To ascertain the efforts made by relevant Ghanaian authorities in implementing the key international convention on e-waste, the Basel Convention and managing the growing menace of e-waste in the country.
- To examine the current situation of the e-waste problem at the Agbogbloshie e-waste dumpsite.
- To examine the effect the global hazard of e-waste has had on the people at Agbogbloshie e-waste dump site and its immediate environs.
- To determine the awareness of scrap dealers at Agbogbloshie e-waste dump site of the implications of their activities on their health and the environment.

## 1.4 Research Questions

- What efforts have the relevant Ghanaian authorities made in implementing the key international convention, the Basel Convention and managing its growing menace in the country?
- What is the current situation of the e-waste problem at the Agbogbloshie dumpsite?

- What effect has the global hazard of e-waste had on people at the Agbogbloshie e-waste dump site and its immediate environs?
- What is the awareness of scrap dealers at the Agbogbloshie e-waste dump site of the implications of their activities on their health and the environment?

## 1.5 Scope of the Study

This study focused on the growing international hazard of electronic waste threat posed to scrap dealers and dwellers at Ghana's largest dumpsite in Agbogbloshie. It also focused on the policies introduced by the Government to mitigate this problem since 2016 till date. This timeframe was chosen because the legislation on e-waste in Ghana was passed by Parliament, in 2016. This is the Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917).

## 1.6 Rationale of the Study

Waste of Electric and Electronic Equipment (WEEE) or e-waste is an environmental threat and its effect is not only a one-dimensional issue. The illegality of exporting e-waste from developed to developing countries poses a health risk. As a result, mismanagement of e-waste and improper recycling practices requires a comprehensive review to the problem. This dissertation seeks to enrich existing literature, contribute to policy, practice and future studies on the approaches to e-waste from a human security framework as an effort to broadly analyse the impact of e-waste on individuals and the environment.

## 1.7 Conceptual Framework

The conceptual underpinning of this study is human security. Human security is people-centered; institutions focus their attention on people and their communities worldwide. This emphasis on human beings separates human security from the goal of defending nineteenth and twentieth century state territories that dominated security policies. Human security changes focus on gender, race, religion, ethnicity, citizenship or other distinctive features of people (Alkire, 2003).

The 1994 Human Development Report (HDR) lists the elements of human security as:

(i) a universal concern;

(ii) the components of human security are interdependent;

(iii) human security is easier to ensure through early prevention than later intervention, and;

(iv) human security is people centered. The report states that:

> Human security can be said to have two main aspects. It means, first, safety from such chronic threats as hunger, disease and repression. And second, it means protection from sudden and hurtful disruptions in the patterns of daily life – whether in homes, in jobs or in communities. Such threats can exist at all levels of national income and development (p. 23).

The Commission on Human Security (2003), in its final report "*Human Development Now*" defines human security as:

> … to protect the vital core of all human lives in ways that enhance human freedoms and human fulfilment. Human security means protecting fundamental freedoms; freedoms that are the essence of life. It means protecting people from critical (severe) and pervasive (widespread) threats and situations. It means using processes that build on people's strengths and aspirations. It means creating political, social, environmental, economic, military and cultural systems that together give people the building blocks of survival, livelihood and dignity (p. 4).

From the above definition, the concept of 'human security' addresses security debates at a national perspective to people as prospective victims; beyond physical violence as the only

appropriate threat; and beyond physical harm as the only appropriate harm. The seven dimensions of human security based on the 1994 Human Development Report (HDR) include economic security, food security, health security, environmental security, personal security, community security, and political security. There has been sustained achievements in this field although there has been wide criticism by academics across the spectrum from global governance to peacekeeping (Paris, 2004; Chandler, 2008).

Human security's most prominent criticism has to do with its conceptual ambiguity and absence of a precise definition. Paris (2001) has argued that human security can be equated to similar vague concepts such as "sustainable development" – "everyone is for it, but few people have a clear idea of what it means." Similarly, Newman (2010) refers to the concept as attractive but analytically weak. Krause (2013) defined human security as "a loose synonym for 'bad things that can happen'," and both Buzan (2004) and Martin and Owen (2010) make a significant point by characterising human security extensively under seven segments. This distinguishes the term from human rights which invariably presents a practical dilemma for policymakers charged with allotting scarce resources. Some human security critics such as McCormack (2008) have asserted that the notion of human security pathologises and disempowers fragile and undeveloped states and opposes the counter-narrative of those proponents who portray human security as emancipatory.

E-waste is a threat to human security as the chemical substances and certain components are flagged as harmful (Setiawan & Hapsari, 2018). In addition to humans, livestock and the environment are also affected by these toxins waste. The ecological hazard of e-waste poses threat to three areas of human security, namely food security, health security, and environmental security is an increasing threat. Indiscriminate activities of e-waste scrap

dealers at Agbogbloshie raise concern about pollution of the area's air, water and soil. Therefore, it is of extreme importance than this problem is addressed within the scope of human security framework.

## 1.8 Literature Review

### 1.8.1 Electronic Waste

Electronic waste is a well-researched area within extant literature. Several researchers such as Cobbing, M. (2008) and Bily, C.A. (2009) have extensively written on the causes and effect of indiscriminate e-waste disposal. The Organization for Economic Co-operation and Development's (OECD) as cited in Bandyopadhyay (2008), defined e-waste as – 'any appliance using an electric power supply that has reached its end-of-life' – is most aptly indicative of the massive open-ended scope of commodities that actually qualify as e-waste.

According to Huisman, J. et al. (2008), e-waste comprises plastics, glass, metals, and other elements of the periodic table. Another description of e-waste is "discarded electrical or electronic equipment" (Liu & Themelis, 2014). These researchers argue that, the nature of e-waste is made up mostly of a particular form of waste flow in terms of variation in products and a majority of e-waste becomes hazardous upon expiring due to the presence of heavy metals such as mercury, arsenic and lead. Many researches into e-waste according to Kwak et al. (2011) were focused on the components of the e-waste, neglecting the adverse effect it poses on the environment and this has made it very difficult to improve design methods for e-waste recovery. Thus, Cui & Forsbegg (2003) noted that, it is very expedient to proceed after identification of quantifiable valuable materials and hazardous substances. This will help develop a cost-effective and environmentally friendly recycling system, whilst gaining a better understanding of the physical characteristics of the waste stream.

E-waste has a growing market with figures indicating that in 2017, 72 billion tons of e-waste was estimated as annually generated worldwide (Duan et al, 2013). The fourth industrial revolution, also known as the age of technology, has brought with its considerable changes in the quality and quantity of e-waste with the former now compromised due to the hazardous substances used and the latter increasing far beyond what can be managed (Pellow, 2007). He further argues that certain e-waste components are highly toxic and cause all manner of destruction to the wellbeing of humans and/or to the environment when improperly disposed of. Thus, e-waste in its entirety is considered dangerous. Similarly, Duan et al, (2013) stated that, chemical compounds like chlorofluorocarbon and lead and other heavy metals are examples of such substances. Therefore, inappropriate e-waste disposal affects drinking water, crops and disrupts ecosystems thus posing direct destruction to natural environment and human health by causing causes large scale pollution of water, air and the soil. Electronic waste dismantling working conditions in South East Asia and West Africa are extensively documented as being unsafe (Bisschop and VandeWalle, 2013).

The e-waste trade is regulated through multilaterally sanctioned environmental accords as a result of the hazards from inadequately disposed of or poorly recycled waste (Holley et al. 2012). The most likely trade flows to develop from this inadequate disposal or recycling are from privileged countries such as, Australia, EU and the USA, to less privileged areas such as, South America, Asia, Africa and South-East Asia (Huang et al, 2014). The illegal disposal and trade in harmful waste has in fact been recognized as the foremost example of environmental crime (Lepawsky & McNabb, 2010). For instance, the EU considers disposing of toxic waste overseas to non-EU countries with less sturdy disposal standards as illegal. Studies done by Baird et al. (2014) revealed that, an estimated 20% of the one out of five exported shipping containers from the EU contain waste violating administrative

requirements for waste trading of and constitute export bans. Available data on the illegal waste trade point to the fact that control mechanism is inadequate to combat the extent of trade and smuggling of hazardous waste (Bisschop, 2012).

### 1.8.2 Importance of Recycling E-Waste

According to Zhang, Schnoor & Zeng (2012), reduced lifespan and society's growing attraction for technology has resulted in a much swifter progression in the magnitude of archaic and redundant electronic devices known generally as e-waste. Although they are known to be harmful waste products, these discarded Electronic and Electrical Equipment (EEE) include valuable components which when recycled have economic value (Perkins et al, 2014). Studies by Akormedi et al, (2013) found that hazardous chemicals and toxic heavy metals found in e-waste consist of copper, silver, gold and elements including palladium and indium which can be recycled and recovered, thereby acting as an invaluable resource for other industries obtaining secondary raw materials.

Such precious metals could be utilized in the manufacturing of new products. This is an exercise that would contribute to the preservation of energy, natural resources and reduce greenhouse gas emissions and contamination through the extraction of fewer raw materials from the ground. The recycling of electronic waste is a source of financial reward for both the workers and the country as a whole. About 121,800 to 201,600 representing between 0.4% to 1.72% of the urban population benefit directly or indirectly from e-waste activities. An estimated 105 to 268 million US dollars accrue to the national economy annually (Amoyaw-Osei et al, 2011). Most privileged countries have thus instituted laws to regulate and scrutinize electronic waste discarding (Sthiannopkao & Wong, 2013).

### 1.8.3 Effects of Improper E-waste Recycling on Health

According to Liu et al (2008), electronic and electrical equipment (EEE) such as computer monitors, video and TV sets employ cathode ray tubes (CRTs), with considerable lead volumes and exposure to these resources in the long-term can cause infection in the nervous system, destruction to the kidney, the endocrine system, bones and the respiratory system. A research paper done by Zheng et al (2008) also revealed similar findings. Human wellbeing is gravely in jeopardy from contact with improperly disposed e-waste through skin absorption, inhalation and dust ingestion (Leung, Duzgoren-Aydin, Cheung, & Wong, 2008).

Several researches have found a correlation between e-waste exposure to physical health, including changes to cell functioning, reproductive health, thyroid function, lung function, growth and e-waste (Grant et al, 2013). Effects of the exposure of e-waste on physical health have also been observed along with an increase in stillbirth (Bach et al, 2015; Xu, Zeng, Boezen, & Huo, 2015), birth length and spontaneous abortions (Bach et al, 2015). To establish the association between functioning of school children's lungs and heavy metals exposure, research carried out at a dismantling site for e-waste indicated a lower forced vital capacity (FVC) than those living in a control town with no indication of e-waste recycling activities (Sthiannopkao & Wong, 2013).

Similarly, the studies reviewed by Song & Li (2014) showed that occupational exposure of e-waste workers and contamination of neighbouring communities was mainly the result of hazardous compounds released from informal e-waste recycling processes. The fine dust particles generated by the combustion is strongly associated with pulmonary and cardiovascular diseases, whiles the larger coarse dust particles which generally cannot reach the human lungs, irritate the eyes, nose and throat.

### 1.8.4 Legislation on E-waste

Promulgation of the Basel and Bamako Conventions, both aimed at the control of trans-boundary hazardous waste movements as well as its disposal came as a direct impact of toxic waste dumps by industrialized nation states in developing countries and African countries (Honorine, 2010). In addition to ratifying these conventions, Ghana also has the 1992 Constitution and the Hazardous and Electronic Waste Control and Management Act, 2016 (Act 917), providing a largely encompassing set of protections for the environment. In Article 36 (9) of the 1992 Constitution of Ghana, under the Directives of Principles of State Policy, the mandate for Economic objective and Development lays responsibility on the State to:

> …take appropriate measures needed to protect and safeguard the national environment for posterity; and shall seek cooperation with other States and bodies for purposes of protecting the wider international environment for mankind.

The adoption of the National Environmental Action Plan (NEAP) in 1991 outlined Ghana's policy on the environment, which was targeted at catalyzing a considerable and measurable augmentation in the quality of life and living conditions and physical surroundings of future and present generations. The State is required by this policy to put in place apt procedures directed at curtailing the use of and importation potentially toxic substances (which include EEE) as well as pollution control.

## 1.9 Research Methodology

This section focuses on the research methodology adopted in this study. Research design is a simple plan which explains the linkage of questions the researcher poses to the available data, tools and procedures engaged (Punch, 2005). A structured design is consistent in results and validity of research conducted (Berg, 2001).

### 1.9.1 Research Approach and Design

The three (3) main approaches to research are quantitative, qualitative and mixed methods. A quantitative approach is a systematic procedure whereby numerical data obtained are used to extract information (Burns & Grove, 2005). Qualitative research on the other hand is descriptive and subjective approach to experiences, inferences and meaning (Burns & Grove, 2009). Qualitative studies allow researchers to explore behaviours, perspectives and feelings, experiences in depth, quality and complexity of a situation through a holistic framework (Holloway & Wheeler, 2002). Lastly, the mixed method involves integrating both quantitative and qualitative methods in the study.

In order to address the objectives of the study, a qualitative research approach was employed to ascertain the needed information from respondent. The qualitative approach relied on the use of interviews, focus group discussions and observations to gather data. The study required the researcher to be present at the e-waste site to observe and conduct focus group discussions with the residents as well as e-waste workers at Agbogbloshie. As such the qualitative descriptive approach to research was found appropriate to help the research achieve its objectives. The study also adopted purposive sampling, a non-probability sampling technique, as the method and means used to acquire data from artisans at the Agbogbloshie e-waste dumpsite, resource persons and staff from relevant government agencies. This sampling method, also referred to as judgment sampling is a sampling approach that selects respondents based on certain characteristics they possess. This sampling method was adopted because it helps the researcher consider observations that are most relevant to the study. It is also the most appropriate sampling technique due to constraints due to time and logistics.

### 1.9.2 Sources of Data

Data gathered proves vital in confirming the theoretical framework of study employed. It is important that the selective manner of obtaining data is done appropriately and with sound judgment (Bernard, 2002).

In the bid to achieve the above objectives and provide the required responses to the research questions, both primary and secondary data were used. Primary data was collected through an intensive field work of conducting unstructured interviews with 25 respective respondents at the Agbogbloshie e-waste dumpsite and its environs. Also, primary data was gathered through observation of activities at the dumpsite and focus group discussions with 5 respondents drawn from various diverse background. The interviewer made contact with a focal person at the dumpsite who provided the respondents for the focal group discussions. Semi-structured interviews were conducted with various experts and professionals who have in-depth knowledge of the study area. The sample size of the study was 30 respondents. As Creswell (2008) asserted, the sample size of qualitative research method could be drawn within 5 to 30 respondents in order to achieve data saturation.

Secondary data were collected from books in the library, reports; both published and unpublished, journal articles, books, news websites and other relevant sources. These secondary sources provided the meaning and relevance of concepts embodied in the research topic.

### 1.9.3 Data Analysis

The data collected were transcribed and coded for analysis. Thematic analysis approach was adopted in analyzing the transcribed data during the study. Thematic analysis is defined by Braun & Clarke (2006) as “a process of finding, examining and giving details of patterns

(themes) within data and also disclose various parts of the research topic". He suggested that this type of analysis is often used when there is no specific theory informing the research design. This implies thematic analysis is appropriate for studies with dispersed results and there has not predetermined variables or constructs. A theme usually refers to a pool of linked groups that communicate similar meanings and usually comes through the inductive analytic process which is a character of the qualitative style. The themes for the study were developed in line with the research questions. Coding and data analysis were done manually. Finally, generalization and conclusions were made from the themes about the electronic waste and its impact on people as well as the environments and interpreted in light of extant literature.

### 1.9.4 Ethical Issues

In this study, the researcher took into consideration ethical issues such as invasion of privacy, confidentiality, anonymity of respondents, informed consent and plagiarism. For instance, on informed consent, permission was sort from the various heads of the institutions before interviews were administered. Also, for the purpose of privacy and confidentiality, the names of respondents were eliminated from the report.

## 1.10 Arrangement of Chapters

The research constitutes four chapters, outlined as follows;

Chapter One (1) - Introduction.

Chapter Two (2) - Overview of the Global E-Waste Hazard.

Chapter Three (3) - Agbogbloshie E-Waste Dumpsite and its Threat to Human Security.

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# CHAPTER TWO

# AN OVERVIEW OF THE GLOBAL E-WASTE HAZARD

## 2.0 Introduction

As stated by Widmer et al (2005), the definitions in the Directive 2002/96/EC of the European Parliament and of the Council on 27 January 2003, on waste electrical and electronic equipment (WEEE) (European Union, 2003), indicate that WEEE consists of ten groupings. These ten categories are listed as follows: Sports paraphernalia; medical gadgets (excluding every tainted and implanted artifact); automatic dispensers, monitoring and control instruments; equipment for IT and telecommunications; equipment for consumer leisure; equipment for lighting; tools for electrical and electronic (except those of extensive immobile industrial gear); and small and large household appliances and toys. This categorization appears to be on course to being a generally accepted standard (Widmer et al, 2005). Of the WEEE generated from the ten categories, approximate 95 percent are accounted for by consumer equipment categories, miniature household appliances, large household appliances and equipment for IT and telecommunications (Widmer et al, 2005).

The year 2016 alone saw the generation of about 41.8 metric tonnes of electronic waste due to the remarkable swiftness of modernization, availability and accessibility of electronic products as well as the rate at which they turn obsolete in a persistently expanding universal consumer market (Balde et al, 2017). E-waste is currently the top expanding sector of global waste production and taking into account the current pattern towards the computerization of nearly all possible consumer commodities, or ubiquitous computing, the generation of e-waste is likely to keep escalating (Houber, 2010).

Rapid and intense digitization of most economies on the rise has set them on a course ranking as the most prolific generators of electronic and electrical waste in the foreseeable future (Olowu, 2012). This indicates that the greatly politicized and historical issue of North-South trading of e-waste should be considered an incomplete narrative on e-waste globalization; a phenomenon that is a modern-day environmental crisis influenced significantly by South–South and regional intricacies.

Although no worldwide consensus has been reached on the legal criteria for defining e-waste, it is the generally applied expression for post-consumer or end- of-life electronics, additionally known as waste electrical and electronic equipment. Every country institutes individualized record of end-of-life goods that meet the requirements of e-waste. For all intents and purposes e-waste consist of various kinds of leisure and technologies for communication (computers, mobile phones, laptops, headphones and video game consoles) as well as various types of common household appliances and professional-use technologies, (e.g., medical instruments and devices with national and sub national characterizations of what can be considered as e-waste) (Khan, 2016). The exemption of definitive, law backed parameters make the definition of e-waste in absolute terms, or its diminution to a comprehensive list of products for consumer impossible, as the integration of electronics into commodities that were not traditionally computerized increases to include a wider range of products.

The latest types of electronic appliances innovated are incessantly idealized and positioned on the international market to take care of newly emerging human needs. With the consideration of the Organization for Economic Co-operation and Development's (OECD) (2001) definition of e-waste which is most fittingly indicative of the substantial open-ended reach of

e-waste and commodities that actually qualify as e-waste, the definition stands as *"any appliance using an electric power supply that has reached its end-of-life".*

In spite of e-waste toxic components, there remains an elevated demand on the international market for electrical appliances and electronic gadgets that has reached its end-of-life. Worldwide trade patterns of e-waste movement have, in fact, been documented extensively by environmental sociologists like Edumadze et al. (2013) and transnational nongovernmental organizations (NGOs) as early as the 1990s and in recent times, by regional and national governmental bodies as well as international institutions.

## 2.1 State of E-Waste Situation Globally

Africa generates 1.9 million tons of waste annually, a figure regarded as exceptionally little for its resident population. Countries such as the UK and Germany turn out almost as much waste as the whole of Africa even with their much smaller populations. Many of these nations have problems with storage and discarding of e-waste and rather than deal with it themselves, they resort to exporting it outside their borders to sovereign states and areas. The issues this causes are typified by what is currently being witnessed in certain parts of Western Africa (Cobbing, 2008).

Reports posit that e-waste worth nearly $19bn and constituting about 90% of the entirety of the world's e-waste production is discarded or trade illegally per annum (Chi et al., 2011). Ten thousand's (10,000) tonnes of waste with no satisfactory infrastructure for its management are produced daily in Ghana. According to Oteng-Ababio (2012), waste generation per capita for Kumasi and Accra are quoted as 0.77 kg and 0.51kg respectively with the private sector amassing about 1,000 and 1,800 tonnes of SW in Kumasi and Accra

respectively. A public-private partnership (PPP) type of Municipal Solid Waste Management (MSWM) has also been in effect in the country for over a decade (Oteng-Ababio, 2007). Through its municipal and district assemblies, the local government accepts liability for Municipal Solid Waste Management (MSWM). Metropolitan, Municipal and District Assemblies (MMDAs) are also recently tasked with the iteration of 15 waste scavengers, pickers or collector to transport and dispose of waste following the provision of the sites for landfills as well as transfer stations for waste collected by privately owned Municipal Solid Waste Management (MSWM) firms. An estimated 60 percent of the waste generated in Ghana is collected by both informal and formal SW managers (Huober, 2010). Residual waste is usually deposited in open public access places such as in gutters, lorry stations, water bodies and so forth resulting loss of lives and properties through exacerbated conditions of flooding, pollution and other environment-associated calamities as well as in devastation of cities' aesthetic ( Rockson et al., 2013).

Notwithstanding challenges yet to be cited, the challenge of full assimilation of informal MSWM sectors in the general Municipal Solid Waste Management (MSWM) practice of Ghana endures (Oteng-Ababio, 2010; Rockson et al., 2013). Foremost problems city authorities have encountered in tackling the challenges faced by Municipal Solid Waste Management (MSWM) in Ghana include, but are not limited to: indiscriminate and irresponsible dumping by the citizenry; limited number of waste management experts; lack of disposal sites and waste treatment plants that are properly engineered; inappropriate technical know-how; feeble enforcement of regulations for the environment; and weak financial capacity of authorities (Huober, 2010).

The management of electronic waste is an issue that has developed into a major environmental research with public discourse centered on all around the globe. Electrical and electronic equipment (EEE) because of the information communication technology (ICT) revolution, has become a way of life. The industry for ICT is estimated to be one of the world's leading industries in terms of augmenting productivity in the various sectors of national economies around the globe, revenue generation and job creation (Kawakami & Sturgeon, 2010; Oteng-Ababio, 2012). Between the years 2000 and 2009 alone, mobile telephone usage in Ghana shot up from about 9,000 to 15,000 (Oteng-Ababio, 2012).

Globally, the use of refrigerators, televisions and radios has also been on the rise (Widmer et al., 2005). The mounting consumption and demand for electrical and electronic equipment (EEE) globally has however led to the generation of high rates 16 types of e-waste. Although EEE consumption is high, the misapplication and misuse of EEE also condenses the timeframe within which most EEE arrive at their end-of-life. The deliberate efforts by manufacturers of EEEs to abbreviate the postproduction life spans of the commodities they manufacture also largely contributes to elevated quantity of e-waste generated per annum globally (Remesh et al., 2007; Oteng-Ababio, 2012).

About 50 million tonnes of electronic waste is produced worldwide annually. The volume of electronic waste can fill trucks stretching halfway across the earth (Nordband, 2009). There are however disparities in the contributions of diverse regions of the world to the annually generated 50 million tonnes of e-waste with Europe and the United States of America (USA) supplying the principal share of e-waste in contrast with the rest of the world (Remesh et al., 2007).

Regarding the management of electronic waste, the developed world is further advanced; adopting superior management practices for hazardous waste than the developing world, although exhibits the ignominious proclivity exportation of its e-waste to the latter countries. In developed nations, systems of management for e-waste are formalized with suitable mechanisms for recycling and collection in situ. E-waste industry activities in developed countries are guided by stringent policies and laws to protect the environment and to promote treatment of e-waste under conditions that are organized, hygienic and safe (Widmer et al., 2005).

The United States of America's primary system of e-waste disposal is the use of landfill sites, although this is not the most sustainable or acceptable practice. Kahhat et al., (2008). It however emphasizes the fact that there exists in the USA, an e-waste free market not propelled by regulation, but by profit amassed from the recovery and collection of materials from these wastes that are reusable. Developing country markets are consequently opened to access e-waste generated in the USA by virtue of this second practice. Certain individuals avoid the effective approach to managing e-waste in the USA by exporting their electronic waste to developing sovereign states (Kahhat et al., 2008). A few studies have shown that about 85-80% of generated e-waste from the USA is discarded in harbors, landfills centers and scrap yards, in developing countries (Kahhat et al., 2008).

The e-waste burdens of South Korea, Japan and Europe, are eased by their Extended Procedure Responsibility (EPR) models and take- back system. A lot of this e-waste however still meanders its way into the harbors and ports of several developing countries. Japan's management system for e-waste is directed by the 'Law for Effective Resource Utilization' which began working 2001 and a law enacted in 1998: the 'Home Appliance Recycling

Law'. Switzerland and South Korea have utilized the EPR law since 1990 and 2003 respectively (Kahhat et al., 2008). Switzerland's approach to the management of e-waste has been adjudged the world's best in the world. Importers, manufacturers and producers of EEE in European countries are under the EPR, are held principally liable for post consumption afterlives substances of EEE, their consumption and production. All countries that practice EPR have the below listed five characteristics in common (Widmer et al., 2005): A system that; (I) ensures compliance; (II) is all encompassing, extending to all e-waste stakeholders namely consumers, managers, producers and authorities; (III) adopts sustainable methods of funding itself; (IV) has legal regulations detailing how e-waste management must be done and (V) has manufacturers who are largely responsible for managing the system.

Sinha-khetriwal et al. (2005) put forward that all loopholes of consequence in the EPR system, where applicable, must be correctly sealed in accordance with the reduction of e-waste resource loss and promotion of sustainability with regards to environmental protection. European Union Waste Electronic and Electrical Equipment (EU WEEE) Directive has been adopted by 25 states in the European Union (EU) region to regulate EEE e-waste treatment and treatment financing; collection; recovery; product design; as well as EEE use education and creation of awareness (Kahhat et al., 2008). This directive or guideline is primarily centered on promoting conservation and material recovery through recycling and reuse.

Several countries in Europe and some states in USA persist in passing their e-waste through back channels to landfill sites in Africa and Asia for informal management or treatment even with these measures put in place in developed countries to better manage e-waste (BAN/SVTC, 2002). Developed countries sometimes send developing countries e-waste disguised as charitable contributions for the latter countries (Grant & Oteng-Ababio 2012).

As stated by Carisma (2009), e-waste located in the Philippines originates from international, regional and local sources. Another major e-waste dumping site for western countries like the USA is India (BAN/SVTC, 2002). It is now a commonplace phenomenon to dump e-waste in Ghana, Nigeria, Congo, Ivory Coast and other developing countries (Huober, 2010; Widmer et al., 2005; Nordbrand, 2009). The most common method for managing electronic waste in developing countries is informal, and is primarily typified by lack of waste management infrastructure, suitable policy, legislation and regulatory instrument (Oteng-Ababio, 2012b; Nnorom & Osibanjo, 2008, Carisma, 2009).

Carisma (2009) sheds light on the circumstances concerning the practice managing electronic waste in the Philippines. Philippine's national economy is extremely reliant on the industry for electronics but the practice of e-waste management is not directed by the Basel convention as applied by India and Ghana. The country is also lacking in infrastructure adequate enough to handle the e-waste volume generated. There is also a low awareness of environmental issues as is present in other developing countries. The following have emerged as primary stakeholders of the existing informal-formal e-waste management practices in the Philippines by taking advantage of a supply of e-waste from both local and international sources and availability of cheap labor: finished electronic importers, manufacturers, hazardous waste treaters, e- waste importers and backyard recyclers as well as second hand dealers or refurbishes, advantage of the. In the Philippines, the informal e-waste industry is principally responsible for recycling.

Nigeria's e-waste sectors functions more as a scrap dealing industry with no structured infrastructure or system as in Ghana (Nordband, 2009). In both countries the e-waste sectors operate mostly in open spaces at the landfill sites or small workshops (Prakash et al., 2010).

No formalized system exists for treatment, disposal, collection and transportation of Ghana's e-waste. All these activities are managed by the informal sector itself. Following the recovery of resourceful e- waste parts, the unwanted remnants are haphazardly discarded into the environment.

A general feature of the effective management of electronic waste in developing and developed countries is recycling (Widmer et al., 2005). Recycling in every country is done by the informal and formal sectors respectively. Sustainable recycling of e-waste is described to be economically viable, socially acceptable and environmentally friendly as practiced within some developed countries (Rockson et al, 2013). E-waste recycling in developing world is described as unsafe, unhygienic and resultantly unsustainable (Prakash et al, 2010; Oteng-Ababio, 2012) usually leading public health challenges, environmental contamination and social outcry (Koranteng & Darko, 2012).

## 2.2 Global Generation of E-waste (Causes of E-Waste)

E-waste is generated as the result of electronics and electrical equipment (EEE) becoming obsolete upon getting to its end-of-life phase. Electronic waste is a global issue and projections indicate that e-waste generated per annum numbers approximately 20-25 million tons of electronic waste with industrialized countries contributing a greater proportion (Robinson, 2009). Third world countries with high relatively levels high second hand EEE importation, such as Nigeria and Ghana, produce relatively large e-waste volumes. This occurs as a result of the import of ill-functioning and faulty equipment, some of which have reduced lifespans when contrasted with EEE that is new (SBC, 2011). For the regulation of importation of end-of-life and used EEE into Ghana, Amoyaw-Osei et al., (2011), conducted a study on e-waste country assessment between 2009 and 2011 in Ghana. Research participants included EEE consumers, recyclers, collectors, importers and distributors,

repairers, dismantlers and assemblers. Indications from the results were that Ghana's EEE imports in 2009 totaled 215,000 tons with a 9 kilogram import per capita. Almost 70% of this figure was second hand EEE and the remaining 30% new products. An approximate 15% of the second hand imports were also projected to be unsellable (i.e. outdated, broken or would not respond to power,) and a significant portion of this was fated to end up in informal recycling. Of the total imports 20%, were recorded as serviceable to get them functioning (Amoyaw-Osei et al., 2011).

From the preceding statements, it could be inferred that two main categories of electronic waste are created in third world countries, namely, internally generated resulting from the use of new electronic gadgets and second-hand equipment as well as the express import of developed countries' e-waste. Additionally, nations that import large quantities of used EEE will probably generate and accumulate larger quantities of electronic waste in their nations.

### 2.3 The Hazard of E-Waste

E-waste is constituted of both non-hazardous and hazardous material. Above acceptable thresholds in e-waste, the following elements are classified as hazardous flame retardants: lead arsenic, selenium, chromium, cadmium, hexavalent, and mercury (Jafarzadeh-Ghoushchi & Dorosti, 2017). E-waste also contains metals categorized as non-ferrous and ferrous, glass, plastics, wood, printed circuit boards, rubber, ceramic, concrete and so forth. Iron and steel comprise about half of e-waste, trailed by plastics (21%), non-ferrous metals (13%) and other constituent like gold, platinum, silver and palladium, categorically called precious metals (Robinson, 2009). The non-ferrous metals are copper and aluminum. Iron, aluminum, gold, copper and the other metals forms 60 percent of e-waste constituents with pollutants taking

2.7 percent (Robinson, 2009). E-waste workers are often exposed to diseases that are likely to affect their reproductive, neurological, skin and cardiovascular systems.

Complex mixtures of several hundred of materials are amalgamated to create electronic devices. Mobile phones, for instance, contain between 500 and 1000 constituents. Quite a number of the elements comprising the devices contain hazardous chemicals, such as brominated flame-retardants (BFRs) including toxic heavy metals such as mercury, lead, beryllium and cadmium. Polluting PVC (Polyvinyl Chloride) plastic is also often used (Tsydenova & Bengtsson, 2011). The term BFRs encapsulate an extensive assortment of brominated chemicals incorporated into materials both to slow their rate of combustion and hamper their ignition. More than a few of these compounds are known to be highly resistant to degradation in the environment and thus, are able to bioaccumulate while also being identified as having toxic properties (Tsydenova & Bengtsson, 2011).

PVC is a widely used and moderately inexpensive chlorinated plastic. Its naturally rigidity and the inclusion of diverse chemical additives, comprising plasticizers make it soft and flexible. It is usually utilized in the industry for electronics, primarily in the capacity outside layer for electrical cables and an insulator. Its manufacturing process includes the use of hazardous raw materials, including VCM (vinyl chloride monomer), the basic carcinogenic, explosive and greatly toxic building block of plastic. PVC presents problems as a product of both its chlorine content when it enters the waste stream (Zhou et al., 2019).

Currently, solid waste is integrated with e-waste disposal and presents a colossal menace for degradation of the environment with far more catastrophic effects than anticipated (Blackman Jr., 2001) E-waste that used as landfill contaminates air soil and water. Electronic waste

notably pollutes water resources in proximate regions such as wells, rivers, and others. The pollution of air occurs as a direct consequence of setting ablaze e-waste and emission of gases. E-waste collection, separation and discarding can be attributed to the majority of the informal entities (Maczulak, 2010).

The informal sector processes about 95 percent of regional e-waste. With many children and women collecting the adverse repercussions of e-waste on human health are extensively noticed. Several e-waste chemicals noted as present in waste landfills including but not limited to mercury, copper and lead, typically found in televisions and computer screens are poisonous. They potentially culminate in fatal diseases like kidney failure, thyroid, hormone damage and disruption, cancer, and affect the e-waste in the urban areas. Women and children in societies that do not prioritize their education are more likely to be illiterate and consequently have little to no understanding of electronic waste. They gather e-waste and trade it to retailer who in exchange pay them what is usually a paltry sum of money to be used to as a livelihood source. Waste pickers are typically from underprivileged sections of society and are therefore more likely to work at a lower wage. There is no medical allowance or compensation for injury and often, the waste pickers are not aware that such rights are due them. They do not prefer wearing masks and hand gloves while handling e-waste and are thus faced with high health risk due to exposure to dangerous and slow poisoning chemicals. Factors such as lack of complaint, high unemployment rate, lower labor costs, and migration are the motives of the waste pickers working in the industry for waste collection.

Electronic waste management is reliant on the stance of the citizenry but there is a lack of awareness among city residents poses a major hurdle to keeping a system e-waste management in order (Ciocoiu et al, 2011). Consumer behavior can impact e-waste through

environmentally conscious operation of products, careful maintenance and disposal and the use of environmentally friendly products. Product supplies can also affect the generation of e-waste by purveying environmentally friendly components and materials. Manufacturers can contribute by decreasing the impact their products have on the environment through manufacturing process, product system support, product delivery, material choice and product design.

The Institute for Environment and Sanitation Studies (2011), identifies e-waste to contain a poisonous cocktail of chemicals such as cadmium, arsenic, 18 chromium, lead and copper. These are chemicals acknowledged to have severe adverse repercussions for the environment and health. Arsenic for instance may encumber the factors that trigger cells to grow and disrupt cell communication, perhaps contributing to diabetes, cancer and cardiovascular disease in the event of exposure in low, chronic doses. The body's ability to metabolize calcium is affected by cadmium leading to severely weakened fragile bones as well as bone pain. Chromium on the other hand is potentially carcinogenic and can cause rashes and skin irritation. Whereas lead can cause an entire array of health issues counting the impairment of verbal and cognitive functions, and in the long run even induce paralysis, coma and death, copper irritates the lungs and throat while also affecting other body systems such as the liver and kidneys.

The appropriate disposal of the e-waste is for the global environmental community of paramount concern owing to the hazardous content it contains. Song & Li (2014) as a result of this probed and conducted a study into metal pollution in the area neighboring an unsophisticated Chinese e-waste processing facility. Common vegetable samples were collected as well as samples of soil from nearby vegetable gardens and those of nearby paddy

pastures as well as locations where electronic waste is incinerated in the open air and examined for concentrations in heavy metals. The results revealed that the soils of prior burning sites had the highest concentrations of Cu, Cd Zn, and Pb with mean values of 11,140, 17.1, 3690, and 4500mgkg−1, respectively. Relatively high concentrations of Cd and Cu were found. Most of the samples had levels of Pb and Cd that far exceeded the permitted level for food in China. The results suggest the e-waste at the sites is polluting the soil and the crops.

About one-in-four Americans lives within four miles of a hazardous waste site as determined by the Environmental Protection Agency. Consequently, findings both from studies of electronic waste dumpsites and state-based surveillance program have shown heightened probability of declines in the birth weight of newborns whose parents lived near e-waste sites. Asante et al (2011) found startlingly high mean levels and ranges of PCBs in the breast milk of new mothers and PBDEs. There were significant upsurges in PCB and PBDE concentrations over time. The projected hazard quotient indicated the threshold of 1 for PCBs being exceeded by all mothers, indicating probable health risk for their offspring. These results were associated with poor electronic waste management in Ghana.

Additional research which used data on reproductive results surveillance systems from five European countries as well as New York and California disclosed heightened probability of malformations of a congenital nature among babies with parents residing within proximity of sites for hazardous waste. Heart defects as well as those of the oral cleft palate, and neural tube were the most recurrently reported malformations (Billy, 2009). Congenital malformations of the heart were in addition detailed as present in infants born to parents that had been exposed to volatile organic compounds in drinking water that was contaminated by

a hazardous waste site in Tucson and trichloroethylene (Jafarzadeh-Ghoushchi & Dorosti, 2017). Diminished fertility was also recorded in several female smelter personnel and persons who suffered exposure to large amounts of lead in soil and to ambient air from a primary smelter that was later converted to a site hazardous waste were (Chi et al, 2011).

The most sustainable answer to the preclusion of undesirable reproductive effects from exposure to hazardous substances released from e-waste sites is unquestionably the environmental remediation of such sites. The process will ensure surface or groundwater water, chemical hazards and contaminated soil are detached from the dumpsite or treated to assist in curtailing any human exposure, thereby averting adverse outcomes on the health of individuals residing near the site (Bily, 2009).

## 2.4 Efforts of Development Partners and Governments to End E-Waste

The deep-seated intricacies of the methods of manufacturing, utilization, discarding and recycling expose the need to regulate and study the dangers of e-waste, however, it is clearly a myopic perspective to view e-waste solely as a harmful result of consumption. This approach disregards the true system of e-waste international flows, like the thousands of informal workers in developing countries who depend on e-waste as a sole source of livelihood. E-waste typifies some of the modern dangers from which society should be protected, yet the issue of e-waste is painted exclusively as an environmental hazard ignoring that economically, culturally and socially, it is not considered as a threat, but used and understood by societies as a source of livelihood. The many aspects of e-waste must thus suffuse social and environmental discourse with respect to the prohibition and regulation of its transnational movement. Persons and places live along the length of the value chain of e-

waste that continue to be excluded from universal comprehensions of production processes, notwithstanding their vital role in the universal manufacturing financial system.

Modern-day perspectives on sustainability that reorient our comprehensions of waste from redundant garbage to a coveted resource coerce governments into guaranteeing the environmental supervision of e-waste, partly through the improved regularization or reinforcement of the recycling and waste management industries. Formalization efforts led by various governments, have concentrated primarily on protecting the environmental and economic benefits of e-waste, to the detriment of the informal economy which has been sidelined. Contrary to their stated concerns for human health and environmental protection, regulations surrounding e-waste have been centered on the waste article, instead of the e-waste workers or the existing social concerns which have been raised from, and are inextricably linked to the concept of e-waste. The novel and potential regulations surrounding e-waste offer practical sentiments of the way in which legal enactments may be inconsistent with the needs of the casual economy, ignoring the claims of the informal economy to these waste resources. (Chi et al., 2011)

Setting aside the complex, interloping and inherent plurality of the worldwide e-waste scene, there is a need to develop a universal agreement within the international community against the international transfer of harmful wastes especially to countries that are unable to manage these grades of waste through environmentally friendly approaches. Although this has been incorporated into international law through the enacting of the Basel Convention and other regional treaties and nationwide legislations, only marginal success has been recorded in the prohibition of e-waste trading especially to underdeveloped countries which lack the necessary infrastructure to safely process these types of waste (UNEP, 2015).

It is imperative to note that one of the largest producers of e-waste, the United States of America, has failed to enforce the Basel Convention is currently not regulating e-waste at the federal level. On the other hand, the EU in its efforts to curtail the export of e-waste to African countries has ratified the Basel Ban Amendment, the Basel Convention and imposed more stringent regulations on its member states (Chan & Wong, 2013). Still, definitional ambiguities enclosed in the Basel Convention which qualifies electronic wastes as hazardous or not based on their use, have enabled traders worldwide to move colossal amounts of e-waste internationally, with no effectual social or environmental constraints.

## 2.5 Regional Treaties and International Treaties adopted to end E-Waste in Africa

Formerly, regulations surrounding e-waste have been prompted by and concentrated on the need to safeguard the environment. Recent e- waste strategies have however been enforced and adopted due to concerns for human health. The 1989 Basel Convention, which 181 countries have ratified, prohibits e-waste exportation. This convention, however, despite export regulations, contains a loophole that allows international transfer of e-waste under the condition that these materials will be “re-used”. As a result, large amounts of EEE which are close to the end of their useful lives are exported. Such dated electronic goods are left with very little or no remaining life, upon reaching the borders of the importing country. The resulting situation sees the electronics labeled for “reuse” contribute to the e-waste problem of these importing countries (Lancet, 2013). The Waste Electrical and Electronic Equipment Directive within the EU necessitates that importers, as well as producers within member states, ensure environmentally friendly processes are used in disposal of e-waste and that companies to reclaim their products from consumers for safe disposal (Widmer et al., 2005).

In 1988 a key step in the development of e-waste regulations was taken when 4,000 tons of e-waste was exported from Italy to Koko Port in Nigeria. The Harmful Waste Decree 4, was then enacted, criminalizing the negotiating, dumping, transportation, selling, buying, or trading of hazardous waste in and out of Nigeria. Failure to comply with this regulation is punishable by a life sentence in prison. This made Nigeria, the first country in African to adopt the Basel Convention agreement, having had notable influence on the text. However, notwithstanding these actions, the country still faces a considerable threat from e-waste. There has also been the enacting of the Bamako Convention which aims to manage hazardous waste within Africa, ban the imports of e-waste into Africa and to regulate the movement of e-waste within the continent (Ongondo et al., 2011).

## 2.6 International Treaties on E-Waste

Worldwide, fears concerning the disposal of hazardous wastes and transboundary movement significantly increased in the late 70s and early 80s of the 20$^{th}$ century. As predicted, the main concern was the export of harmful wastes from developed countries to insufficiently prepared sites in developing countries for a cheap cost (Duffert et al., 2009). Fueled by this the importance of formulating and enacting regulations became more apparent, resulting in the United Nations developing the Basel Convention, a revolutionary worldwide convention to control the international movement and disposal of e-waste (United Nations, 2012). African countries led by the Organization of African Unity (OAU) adopted the Bamako Convention in 1991, convinced that the Basel Convention neglected to protect their interests or consider their peculiar circumstances (United Nations, 2012).

The dilemma of transboundary movement of hazardous waste products (including nuclear wastes), particularly its import into Africa was the subject of several statements issued by

continental African conferences and organizations (Lundgren, 2012), as well as multiple resolutions of the Council of Ministers of the Organization of African Unity. The year 1988 saw the Organization of African Unity Council of Ministers pass *Resolution 1153* [hereinafter 'the Cairo Guidelines'] which condemned the export of nuclear and industrial waste into Africa as 'a transgression against Africa as well as the African people (Widmer et. al., 2005). States were also called upon to place a ban on the imports and to adhere to the Cairo Guidelines. The Organization of African Unity prior to the implementation of the Basel Convention, formally accepted that the Convention did not provide adequate protection for African (Schluep et al., 2009). African nations had, in fact, sought an absolute prohibition or an embargo on the movements of harmful waste across its boundaries.

Reflected in the preamble to the Council of Ministers *Resolution 1199(XLIX) is* the African states' position. It articulated unease that the "Global Convention for the Control of Transboundary Movement of Hazardous Wastes" draft was merely targeted at the management or regulation, rather than the prohibition of the international transfer of these harmful materials, unlike the Ministers Council Resolution developed by the Organization of African Unity Council *CM/Res.1153 (XLVIII)* which determined that discarding of hazardous wastes is a transgression against the continent and the people of Africa.

Further, the decree acknowledged that the monitoring system 'dump watch' was a failure, for all international transfers of waste considered hazardous, especially into Africa, as well as the lack of financial and technical support to enable environmentally friendly and safe way of discarding of harmful material in the importing countries. All African countries were then called upon to immediately arrive at an agreement to resolve the shortcomings in the

Convention draft and to guarantee their solidarity remains undisrupted until the adoption of the draft Convention (Schluep et al., 2009).

## 2.7 Conclusion

The generation of e-waste has increased significantly as a result of "e-waste globalization", especially the intense digitization of developing countries. The generation of over 1.9 million tons of e-waste in Africa alone and 50 million tons globally, has led to many challenges in its management. Developed countries have found advanced and less destructive ways of disposing of e-waste with their Extended Procedure Responsibility (EPR) measures or sending them to less developed countries where less advanced recycling and disposal methods are adopted. Though there are non-hazardous forms, the majority of e-waste generated pose health threats to handlers and people within its vicinity, making the disposal of the e-waste a high priority concern for the global environmental community. Many countries have taken advantage of the "loophole" in regulatory treaties such as the Basel convention to export e-waste outside their borders to developing countries mostly in Africa. Therefore, a priority of African countries is to develop a convention prohibiting the dumping of e-waste within their borders.

# CHAPTER THREE

# AGBOGBLOSHIE E-WASTE DUMPSITE AND ITS THREAT TO HUMAN SECURITY

## 3.0 Introduction

This chapter discusses the impact the global hazard of e-waste has on people at the Agbogbloshie dumpsite and its immediate environs. It also presents the efforts the relevant Ghanaian authorities have made in implementing the Basel conventions and managing the growing e-waste menace in Ghana. Lastly, the study highlights the level of awareness and opinions for scrap dealers at the Agbogbloshie dumpsite of the implications of their activities on the environment.

## 3.1 Efforts made by relevant Ghanaian Authorities in implementing the Basel Convention and managing the growing E-waste menace in the country?

The researcher attempted to ascertain the efforts made by relevant authorities in Ghana towards managing the menace of electronic waste in the country. Findings revealed that there is currently no efficient and sustainable recycling system for the management and disposal of electronic waste. The Government of Ghana has acknowledged this setback and implemented the "Hazardous and Electronic Waste Control and Management Act 2016 (ACT 917), thus creating the legal framework for more sustainable e-waste management". The Government and other agencies have since made considerable efforts to ensure the problem of electronic waste is effectively managed. However, a lot more remains to be done in that regard. The Ministry of Health (MoH) and the Ministry of Environment, Science, Technology & Innovation (MESTI), are the two government institutions responsible for policy direction which impacts on environs such as Agbogbloshie e-waste dumpsite. These institutions are supported by parastatal agencies such as the Environmental Protection Agency (EPA) and

other micro-level units purposely established to enforce those policies. One such unit developed by the EPA in 2012 is the Ghana National Cleaner Production Centre (GNCPC). An Environmental Officer at the EPA noted that the EPA in collaboration with other government agencies are committed to developing infrastructure and systems that will help fix the e-waste problem and its repercussions. In his submission he noted that:

> We as a body are committed to developing and implementing projects as well as activities that will promote resource efficiency and cleaner production activities in areas of energy, water, and raw material efficiency and waste management practices in industries that result in reduced manufacturing cost, lower pollution and improved health and safety performance.

A representative of the Ghana National Cleaner Production Centre (GNCPC) explained why the Agbogbloshie area has not been completely shut down? His response bordered on the financial implications to those directly affected. To effectively shut down the area means stripping citizens away from their livelihood. He reckons the major problem is their method of handling, processing, safety and level of exposure with which the agency has proactive countermeasures which will not affect the inhabitants or the environment but simultaneously generate income for workers. Pragmatically, the agency has intervened through education and training on how to properly dismantle and dispose these electronic gadgets and provide support with safety gear for workers on the site. They are taught the differentials of components which have resale value greater than the copper wires they normally exploit in the electronics.

In the representative of GNCPC statement, he noted that:

> It is as easy for anyone who doesn't understand to say shut the place down. It is the matter of bread and butter issue. I can comfortably go and sit in my office and at the end of every month, the Government pays me. Somebody cannot be guaranteed one square meal. That is why those people are there, making a living for themselves and to cater for their families. The only wrong thing they're doing there is the way they handled the material they burn. So rather than shut the place down, we must have a way of doing it that will not affect anybody and then we can co-exist. The environment will be safe, innocent people will be safe and they can still make their money.

The President of Ghana, Nana Addo Dankwa Akufo-Addo, in August 2018, proffered a solution when he announced plans to construct an integrated e-waste recycling facility in Agbogbloshie. The facility is envisaged to be as grand as it sounds. It is said to have 3 major lines of recycling for electronic gadgets, refrigerators and car tires respectively. With an additional proposed line to be added soon.

The coordinator of the national e-waste project suggested that:

> the e-waste facility is going to have 3 major lines. We expect to have a 4th line which will come later. But from the word go, it's going to have 3 lines; the first line waste computer and electronic items which are the computers, fax machines, phones, etc which will be recycled in an environmentally friendly way. The second line will focus on the recycling of refrigerators and the 3rd line will focus on an old car tyre. Based on the timelines we have, we are looking at kick starting it in August this year, and I'm using August because I like to give projections that are achievable.

Additionally, the Government of Ghana announced during the presentation of the 2020 budget that, plans have been initiated by the Ministry of Environment, Science, Technology, and Innovation to set up a training center and health post near Agbogbloshie to improve the dismantling and recycling of e-waste products. Such efforts are aimed at reducing the implications e-waste poses to human health and the environment. The proposed center known as Hand Over Centre is to commence in the year 2020. The generation rate of e-waste indicates that a better management system of e-waste that can handle large quantities of waste needs to be implemented. This could be achieved by the provision of an improved method of disposing of e-waste instead of directing the majority of the waste to the informal sector, which has limited technology to process the waste. Also, recycled e-waste materials that are sent to industries for further processing should not only be available to steel companies for iron rods and sheets. Aluminum, plastic and other materials should be made available to other industries with expertise to process them to avoid the further generation of waste.

The Deutsche Gesellschaft für Internationale Zusammenarbeit (GIZ), a German corporation has been championing the environmentally sound disposal of recycling e-waste. Head of the E-waste program at GIZ suggested the removal of the young men at Agbobloshie will not necessarily solve the problem. As reiterated by earlier interviewees, the issue has to do with health, safety and education surrounding the disposal of electronic components such as battery capacitors, oils retained in some appliances and copper from cables. The right infrastructure to tackle the issue is non-existent which makes it a difficult task to reduce the amount of pollution which occurs in the area. The corporation is ready to assist in training and will introduce a special program tailored to curtail major health implications from Agbogbloshie. They further seek to incentivize workers on the field not to burn cables but tender it to the local recycling market to catalyze the introduction of the recycling process in that area. In an interview with the director of the e-waste program at GIZ. He noted that:

> GIZ will introduce a special program where the major health problems of Agbogbloshie will be curtailed, and introduce an incentive system to pay the workers an attractive amount for the cables to not burn them anymore, and then tender it to the local recycling market to catalyze the introduction of further formal recycling processes in that area.

### 3.2 E-waste & Current situation at the Agbogbloshie Dumpsite

Agbogbloshie has gained international notoriety as the largest e-waste site in the world. Over the decades, Ghana has watched helplessly as the slum shot into International limelight. Almost every government for the past two (2) decades has professed one solution or another to the Agbogbloshie menace.

The researcher attempted to find answers to the second research question which seeks to examine and report on the current situation of the e-waste problem at the Agbogbloshie dumpsite. The findings revealed that about 150,000 tonnes of metal is estimated to be brought to the Agbogbloshie dumpsite every year. Out of this figure, over 25% is electronic waste.

Based on the discussions so far on the subject, the solution to Ghana's e-waste problem seems to lie way outside the country's borders. This means that a lot of work needs to be done at the port of entry. From the foregoing, it is obvious that the Agbogbloshie menace ought to be taken head-on due to its harmful nature. But there are still challenges in the execution process.

The thick black smoke that billows from the site every day is a reminder to the nation that deep in the bowels of the nation's capital, some tens and thousands of Ghanaians are wasting away. Indeed, despite the huge anticipated economic benefits associated with their work, the scrap dealers themselves believe a solution ought to be found.

Informal e-waste recycling processes are associated with the release of pollutants that can be detrimental to human health. These health effects may not only be limited to the individuals directly involved in these e-waste activities but also, vulnerable residents nearby. A clear understanding of the health effects of these crude practices could infer the appropriate actions by policymakers and law enforcers to ensure sanity in our communities.

A descriptive study was conducted with the aim of assessing the extent to which the global e-waste problem is negatively affecting the environment and the workers and dwellers in and around the Agbogbloshie e-waste dumpsite. This study involved participants from the Agbogbloshie community in Accra, Ghana. An interview guide was used as the research instrument. The results showed that e-waste workers and permanent residents had common environmental exposure and hence, shared similar respiratory and other health symptoms.

### 3.2.1 Modes of Transport of E-waste

The researcher observed that tricycles and manual trucks are normally used in transporting e-waste. Most of the dealers own them and can move easily through neighbourhoods to collect e-waste items, but have lesser daily, weekly, and annual flow rates due to their volumes. For instance, in an interview with a scrapyard supervisor, he revealed that:

> The boys bring them on trucks and other small tricycles. When the machines are brought, we dismantle them, extract the motherboards and separate the aluminum from the boards.

He also noted that:

> After dismantling an appliance like a laptop, the board contains capacitors, etc. And these are sent raw to the whites and they recycle them. The extracted aluminum is weighed and sold to the scale dealers.

Even though it did not look it, the scrap yard is well partitioned with sections for burning, extraction, dismantling, weighing packaging, selling and transportation. But the first port of call for arriving goods is the dismantling section, where even the biggest vehicle is reduced to nothing with hours.

This observation suggests that annual flow rates will increase considerably with a few more trailers and articulated trucks transporting e-waste materials into the dumpsite. However, these modes of transport with greater volumes will be better regulated compared to several manual trucks, bicycles, motorbikes or transport by hand carrying within a day. Unlike the trucks which have buckets for storing waste materials, and not easily visible to the public, materials transported by hand carrying, manual trucks, motorbikes are visible and can even be touched by passers-by. In this way, materials do not have direct contact with people other than the workers in the community since there is a market with several buyers and sellers on the same road.

The relevance of identifying the modes of transport is that it is the first step to describing e-waste at the Agbogbloshie dumpsite which is essential for proper management of e-waste.

The findings were consistent with the results reported in a study by Batteiger & Sekyere (2018) who reported small trucks, bikes, motorbikes, and hand carrying as part of the modes of transporting e-waste to and from the dumpsite.

### 3.2.2 Masses of E-waste Items at the Agbogbloshie Dumpsite

The researcher observed that DVD players and other electronic appliances that had reached their end-of-life were often dumped at the site compared to other components. However larger household appliances were in greater quantities as compared to other types of e-waste materials. Similarly, the densities of large household appliances are lower than densities of other components. This observation suggests that waste management options such as landfilling will have to be reconsidered as an option for disposing of waste at landfill sites must be closed over short periods. Therefore, management options such as recycling must be fully adopted to reprocess waste materials into finished products.

The e-waste items found at the dumpsite can be categorized under ten groupings (Gaidajis, Angelakoglou & Aktsoglou, 2010). Eight of the groupings were found at the dumpsite except for medical devices and monitoring and control instruments This means that the majority of waste stream components that end up at Agbogbloshie are either small and large household appliances, lighting equipment, consumer equipment IT and telecommunication devices, electrical or electronic gadgets, or automatic dispensers.

Thus, issues pertaining to infections from exposure to medical devices are minimal. In an interview with a scrap dealer he pointed out that when the devices, particularly laptops are brought, it gets dismantled and the aluminum metal is extracted and separated from the boards. When rummaging through the boards, they are focused on retrieving items like capacitors. These elements are returned for recycling whiles the aluminum is weighed and sold to the dealers. The price of aluminum is insufficient citing aluminum in a single laptop will not amount to GHS 1, therefore for a dealer to earn the barest minimum enough he will need to extract significantly more from a larger number of laptops dumped. When it comes to the other components of the laptop they are disregarded as rubbish and burnt to avoid congestion. The weighing of aluminum in e-waste items are consistent with a study by (Asante et al., 2012) which further breaks down the key components extracted from each e-waste item. However, the findings are imperative to knowing the densities of the e-waste items that arrive at the dumpsite. This knowledge is further used in identifying the quantities of e-waste that arrive at the dumpsite.

### 3.2.3 Reporting of E-waste at Agbogbloshie Dumpsite

The net inflow rate of e-waste products at the Agbogbloshie dumpsite was observed to be higher than the net outflow rate. This difference is a result of the recycling process used at the site to process waste materials. The crude method used does not allow for all the elements in a material to be dismantled properly because the tools used are not technologically advanced. Another reason may be that probably not all elements in a material may be useful to the e-waste workers, and as such are left unattended to. It is so in the case of refrigerators. It was observed that some parts like the Styrofoam in refrigerators were left as rubbish on the floor after dismantling the refrigerators or used as fires for burning electric cables to recover copper.

Steel companies in Tema industrial area were identified as an outlet point for receiving recycled waste materials from Agbogbloshie. One of the trucks carrying processed materials was joined to one of the companies in Tema by name Ferro Fabrik. It was reported that raw materials received were from scrap dealers from different parts of the city. However, Agbogbloshie is one of their major sources with just a large truck arriving on a daily basis or sometimes no materials arrive from there. Magnetic equipment picks all materials containing iron upon arrival and discard other non-ferrous materials such as aluminum, lead, and plastics. The iron is further processed by melting into pellets and rolled into rods for sale. The outflow rate from Agbogbloshie can be determined from this observation to be much lower than the inflow rate of approximately 25,777 cubic meters per annum. Also, this observation from the company indicates how much more waste materials are created as all materials are not recycled and efficiently used. Perhaps, there are no industries to receive materials from the informal sector to further process.

E-waste materials are recycled by burning with fuels such as discarded car tyres, petrol or diesel to obtain metals such as copper, aluminum, iron, gold, and silicon. Thus, observations made were that the sector focuses mainly on metallic components. Plastics are mostly not accounted for as plastic casing of system units was seen on one occasion leaving the site during the study.

The observations made of the e-waste at Agbogbloshie dumpsite relates to results reported by other studies (Mmereki, Li, & Wang, 2012; Gomes, Souza, Yamane, & Siman, 2017).

## 3.3 Effect of E-Waste on Health of Workers and Residents at Agbogbloshie and Environs

The researcher attempted to meet the third research question which seek to examine the effect the global hazard of e-waste has had on people at the Agbogbloshie e-waste dumpsite and its immediate enviorons. The findings of which are presented below.

### 3.3.1 Effect of E-waste on Human Health

Findings revealed that the toxic effects associated with electronic waste can be aggravated throughout an individual's lifetime and across generations. Health problems including diseases and conditions associated with the skin, stomach, respiratory tract and other organs are prevalent amongst e-waste workers. They noted been confronted with cases of newborn defects, blood diseases, respiratory defects, malfunctioning of the immune system and the kidneys, tuberculosis, and other blood diseases. These findings are consistent with that of Prakash, Manhart, Amoyaw-Osei, & Agyekum, (2010).

The challenge with Agbogbloshie is that the health risk does not only affect persons working in the scrap yard. A Medical Officer at the Ghana Health Service explains that even people that live miles away are at risk.

The Medical Officer noted that:

> Apart from entering the body by inhalation, you can also get some of them entering your body through the dermal contacts as they are processing the e-waste for recycling. It also enters the food chain one way or the other, because of the contamination of the topsoil and you see that at the markets, they have all sorts of food being sold there, and people are eating all over the place. The air carrying all the particles settles on the food. From monitoring that the EPA has been conducting as far as air pollution is concerned, the whole area of Agbogbloshie market and Fadama area, the air quality is poor. So, we can expect that, people living within a certain radius of that place will be exposed to these pollutants, especially the ones in the air.

This study's findings are consistent with that of Song & Li (2014) which suggested that occupational exposure of e-waste workers and contamination of neighbouring communities were mainly the result of hazardous compounds released from informal electronic waste recycling processes. The fine dust particles generated by the combustion is strongly associated with pulmonary and cardiovascular diseases, whiles the larger coarse dust particles which generally cannot reach the human lungs, irritate the nose, eyes, and throat. Again, electronic waste workers might be exposed to Polybrominated Diphenyl Ethers (PBDEs) and dioxins as a result of atmospheric emissions. Food items sold near the dumpsite at Agbogbloshie can easily encounter the contaminated metallic dust containing PBDEs that are transported into areas outside the e-waste recycling site.

Furthermore, other studies conducted among residents around the e-waste site showed high amounts of Polychlorinated Biphenyls (PCBs) and Brominated Flame Retardants (BFRs) in breast milk as well as heavy metals and OH-metabolites of aromatic hydrocarbons in urine (Asante et al., 2012). Wittsiepe et al. (2015) established a clear effect on the PCDD/F blood levels of e-waste workers which was a result of long periods of exposure to harmful components of e-waste materials.

Agbogbloshie site is not only used for dismantling scrap metals, but squatters here also rear livestock which encounter these toxins. A recent publication in the Guardian newspaper (2019) revealed the contents of the report by two environmental groups which suggested that chicken eggs laid within Agbogbloshie environs contain very dangerous levels of dioxin and chlorinated biphenyls and other harmful constituents. Scholars from two groups Pin and Paso Action Network in 2018 conducted a study on the eggs laid in Agbogbloshie. The results showed that the eggs laid within the locality far exceeded the chlorinated dioxins limits set by

the European Safety limits over 220 times. Such dioxins are very harmful, regardless of the concentration levels. High concentrations of other harmful substances were also found.

These findings are corroborated with concerns raised by the Medical Officer at the Ghana Health Services.

The Medical Officer indicated that:

> Another source of pollution that needs to be mentioned is groundwater contamination. I mean like that area you see sometimes cattle grazing there. With all this soil and grass contamination, meat and milk products from these cattle are of health concern. And like I said you have a lot of pregnant women, and in pregnancy, the fetus is very vulnerable to these toxins. Also, many of these heavy metals that are also released from the burning process, contains lead, mercury, aluminum, arsenic, cadmium and nickel all these go into air.

The human body has very low levels of heavy metals even though, in the earth's crust, they are widely distributed. Hence, exposure to even traces within environment, can pose severe health threats to human life. They have an effect on human health when the body is exposed to such substances, or the human body comes into contact with contaminated food, water or air. Virtually all heavy metals are toxic in large quantities even though cadmium and arsenic, together with lead and mercury, have been recognized as most likely to have severe health implications for humans (Hu, 2000). Coming into contact with one contaminant of heavy metal is usually followed by being exposed to others and hence, multiple cases of contamination might occur in a population that is close to high levels of such substances.

Inhalation of fumes during burning operations is the most common source of acute exposure to these heavy metals leading to their absorption through the respiratory tract. Blood lead levels are an indication of a recent exposure. Even though some organs seem particularly susceptible to specific heavy metals, the possible associations between arsenic lead and mercury and cardiovascular diseases and related deaths have been recognized for many years (Solenkova, Newman, Berger, & Thurston, 2014). Responses from the respondents suggested

a high prevalence of cardio-respiratory symptoms and diseases such as chronic cough, abnormal chest sound, shortness of breath, hypertension, carotid atherosclerosis, and ischemic heart disease exist among subjects who are highly exposed to the working conditions at the Agbogbloshie dumpsite. These findings are consistent with that of Asante et al. (2012).

The researcher spoke with a Medical Consultant from the Ghana Health Service who admitted that:

> Scrap dealing is a very hazardous business scrap dealers are engaged in. The process of recycling exposes not only the dealer but individuals who work in the vicinity. Not far off from the dumpsite is the densely populated Agbogbloshie market and a squatter community nearby. The harmful effect of burning relatively close to the squatters and market is the air pollution and other organic pollutants it creates which can remain in the environment and air for decades known as carcinogenic chemicals which can cause cardiovascular respiratory diseases, skin and eye infection. A Side inhaling, a person can get infected through dermal contacts as they are processing the recycling of waste. The net effect of air pollution impacts the environment and food products sold in the market nearby. The Environmental Protection Agency (EPA) is concerned with the air quality surrounding the Agbogbloshie market and Fadama area and also concerned about the exposure to residents within a certain radius.

### 3.3.2 Effect of E-Waste on the Environment

The researcher also found that besides air pollution the soil and water bodies are also contaminated as explained by an official of the Ghana health service. Toxins from the air settle on the ground or in water bodies, there is visible cattle grazing in the environs. Cattle feed of the grass, soil, and drinks from water bodies which are contaminated so imagine the quality of meat and milk served when such animals are slaughtered and processed. Any individual who consumes such tainted produce can get easily infected. Spare a thought for pregnant women who may consume and infect their unborn children through the fetes. The impact on the environment directly affects human life and existence.

Depending on the kind of operations the e-waste workers involved in, huge variations can exist in the levels of risk and hazards posed to the environment (Liu et al, 2009). Several studies from China provide evidence suggesting that the elementary recycling methods, together with the several tonnes of e-waste processed, have already ended in adverse impacts on the environment, including contaminated soil and surface water (Tsydenova & Bengtsson, 2011). Harmful substances were discovered in soil, dust, air, water and sediment samples from electronic waste dumpsites worldwide, in tremendously high concentrations. This is due to reckless burning and processing of electronic waste.

At Agbogbloshie, the burning of this electronic waste is often carried out directly on a bare ground which releases toxic substances directly into the soil. The main fuel for fires at this site is polyurethane-based insulating foam obtained from disassembled refrigerators and sometimes threadbare car tyres, both of which constitute acute chemical hazards and pollution of the burning sites in the long-term. Research findings by International Pollutants Elimination Network (IPEN) & Basel Action Network (BAN) (2019), showed that soil and ash samples retrieved from the burning sites in Agbogbloshie displayed extremely high levels of lead, copper, tin, antimony, cadmium and as compared to those typically seen in uncontaminated soil.

Other studies carried out at the recycling site also showed increased concentrations of chromium, cadmium, and lead in the soil. The concentrations of some of these metals found were over 50 times more than the maximum permissible exposure limits established by the World Health Organisation (Velma, Vutukuru, & Tchounwou, 2009).

Additionally, it was observed that pollutants travel long distances, and this can mean a risk of marginal exposure even in secluded zones. Air pollution stemming from burning activities appears to be the major cause of this marginal exposure. These findings are similar to that of Sepúlveda et al. (2010). Inappropriate burning of e-waste materials containing chlorine and copper, release dioxins and furans in the form of fine ashes to places around the burning sites. This leads to air and surface soil pollution. During the wet season, most parts of the recycling site become flooded with heavy rains which are likely to wash off the surface dust, contaminated soil and leachate from landfills into the nearby gutters, and the Odaw River which eventually runs off into the Atlantic Ocean.

Informal e-waste recycling activities also create an avenue for an "environment-to food-chain contamination", as such contaminants may be stored up in pastoral lands and ingested by grazing livestock. Most of these chemical contaminants of concern, however, have slow digestion rates in animals, and hence, can bioaccumulate in tissues and be released via edible products such as milk and eggs. The menace of E-waste, therefore, constitutes such a huge worldwide health and environmental emergency, with consequences that transcend that of mere e-waste workers, involving residents and future generations.

### 3.4 Opinions and Awareness of Scrap dealers at Agbogbloshie E-waste Dumpsite of the Health and Environmental Implications

To answer the final research question which attempted to determine the awareness of scrap dealers at the Agbogbloshie dumpsite on the implication of their activities on their health and the environment, the researcher found that e-waste workers were mainly young Ghanaian men between the ages of 17 to 35, single and had little or no formal education. Electronic waste recycling work in Ghana is a male dominated activity due to the physical strength

required and that most of the e-waste workers who burned materials were young men in their late teens and early twenties, quite youthful with no or low formal education and thus have reduced employability.

From the interviews conducted, the researcher gathered that respondents often had very little or no knowledge on the severity of the health implications the working conditions at the dumpsite posed to them. By merely observing, one could easily tell that these workers idea of what a standard Personal Protective Equipment (PPE) is far from what they were using. For instance, some workers who said they used safety boots were wearing ordinary canvas or sneakers to the dumpsite. This observation brings to bare the need for educating especially e-waste workers on the health-related hazards and risk associated with their work as well as how to prevent them.

A young man interviewed, has been burning wires since 2006. He admitted he knows the fumes are dangerous to his health, but that is his only source of income so he'll continue till he finds something else to do. When asked if he wears a mask, he insists he has one in his bag even though he isn't wearing. All the other respondents that were interviewed were observed to not have masks on. He insisted that everyone was given one but they may have been misplaced. When asked if people fell sick from the burning they did, he responded he didn't know.

The first young man noted that,

> I have been burning wires since 2006 when I came from the north. They tell us the smoke is dangerous but we have to eat. I have a mask but I don't always wear it.

Another young man has been working at Agbogbloshie for about 5 years. He makes an average of 50 cedis a day and 20 cedis extra on a good day out of which he uses to take care

of his wife, child and aged parents back home. He relocated from the northern part of Ghana to Accra in search of greener pastures because he faced some challenges furthering his education. He acknowledges that scrap dealing is hard work and that it results in body pains. He suggested he would like to stop this scrap work but he needs 1000 cedis as seed capital. But this amount would be nearly impossible to raise with his current earnings.

The young man noted that:

> I have been doing this job since 2013. I came from Bawku to Accra to find a better life. Because of no job, this is what I do" I make between 30 to 70 cedis. The work is not easy and safe, but I have to get money so I can look after wife, child and aged parents at Bawku. This work always makes me cough and give me body pains but I have to do it.

A significant number of community residents living near waste disposal incinerators gave accounts of morning cough and phlegm production as self-reported respiratory symptoms. As it's consistent with the findings of Wichmann et al. (2006). This increase in prevalence rates of respiratory symptoms at Agbogbloshie could be attributed to the persistence of air pollutants especially dust and smoke within the community over the period. The landscape at Agbogbloshie is such that depending on the wind direction, one can almost always experience dust particles adhering to the body and hence, a high chance of inhaling these particles.

These findings are consistent with previous studies (Akormedi, Asampong & Fobil, 2013), which found that the majority of e-waste workers did not use respiratory protective equipment and had poor knowledge of respiratory hazards associated with their work.

Finally, the current mayor of Accra also noted the importance of tackling the problem of e-waste as it threatens the lives of about 100,000 people that live in and around Agbogbloshie.

In his submission, he noted that:

> As at 1992 the population of Agbogbloshie was less than 1500. Today we are talking of a population of over 100,000. That's a huge number and if we had been able to deal with the immigration issue as a 1990s wouldn't have been running into challenges that we are facing now. Out of these 100,000 people, the greater number of which are women and children are at the receiving end of the adverse effects and risk e-waste poses to human health and the environment. E-waste pollutes both the land and water bodies and its effect are often severe and long term.

# CHAPTER FOUR

# SUMMARY OF FINDINGS, CONCLUSIONS AND RECOMMENDATIONS

## 4.0 Introduction

The research was carried out within the context of Electronic waste and its negative impact on people and the environment in and around Agbogbloshie. The rapid and intense digitization of most developing economies has set these nations on a course towards becoming the most prolific source of e-waste generation in the coming years. The adverse implications for health due to exposure to hazardous e-waste have long been recognized. It is a well-known fact that informal e-waste recyclers are exposed to environmental pollutants which have potential negative impacts on their health.

This study focused on the growing international hazard of electronic waste and the threat it poses to the artisans at the Agbogbloshie dumpsite. The objectives of the research were to ascertain the efforts made by relevant Ghanaian authorities in implementing the key international convention on e-waste, the Basel Convention and managing the growing e-waste menace in the country. Secondly, to examine the effect the global hazard of e-waste has had on people at the Agbogbloshie e-waste dump site and its immediate environs and lastly, the study highlights the level of awareness and opinions of scrap dealers at the Agbogbloshie e-waste dump site of the implications of their activities on the environment.

A qualitative research was carried out with the aim of assessing the extent the global e-waste problem is negatively affecting the environment and the workers and dwellers in and around Agbogbloshie e-waste dump site. This study involved 30 participants from the Agbogbloshie e-waste dumpsite and environs in Accra, Ghana and, various subject matter experts. An interview guide was used as a research instrument to collect data on the individual and

environmental exposures, minimizing the influence of information bias. The main challenges were the unavailability of some of the e-waste workers and language barrier since most were Dagombas from Northern Ghana. To overcome this hurdle, a native Dagomba was employed to assist with interpretation of interview and general communication. The results showed that e-waste workers and permanent residents had common environmental exposures and hence, shared respiratory and other health symptoms**.**

## 4.1 Summary of Research Findings

The following findings were derived from the study based on the analysis of data gathered from secondary and primary sources:

- On research objective/question one (1), these are the main findings:

Ghana lacks a sustainable and efficient system for recycling e-waste. This has caused the Government in conjunction with other agencies to implement policies as well as initiatives to alleviate the problem of e-waste in the country. Such efforts include Ghana National Cleaner Production Centre (GNCPC), 3-line integrated e-waste recycling facility in Agbogbloshie, Hand Over Centre and Special programs the GIZ to educate and incentives the management of e-waste in the country.

- On research objective/question two (2), these are the main findings:

The study revealed that the main mode of transporting e-waste to the dumpsite were via small trucks, bikes, motorbikes, and by hand carrying. Waste transported mainly composed of large household appliances, DVD players and other electrical components. Scrapyard workers reported that the components brought are mostly dismantled and aluminum is sold to dealers, while the others are either exported for recycling or burnt. The use of crude recycling

methods at the site meant that dismantling is not very effective causing net inflows to be less than net outflow. Another reason for the imbalance inflows is as a result of some components being useless and therefore left lying aside. Recycled materials are mostly transported to companies in Tema where they are used in their processing activities.

- On research objective/question 3, these are the main findings:

The toxic nature of what is happening at the site has resulted in many health conditions for residents. These include new born defects, blood diseases, respiratory defects, malfunctioning of the immune system and the kidneys, tuberculosis, and other blood diseases. Also, the burning of different components in the area results in the inhalation of a mixture of these heavy metals, which according to Solenkova et al. (2014) results in cardiovascular diseases and related deaths. This was evidenced in the area by the large number of respondents who reported illnesses such as chronic cough, abnormal chest sound, shortness of breath, hypertension, among others.

The environmental impact of dumping in the area cannot be overemphasized. The dumping results in contamination of the soil and the burning to recycle results in air pollution. Pollutants from the air end up in water bodies. This results in complications for the cattle and other livestock drinking from these waterbodies, leading to health defects in individuals who consume these products.

- Finally, on the fourth research objective/question, the key findings are summed up as follow:

Agbogbloshie e-waste dump site is mainly characterised by young Ghanaian men. This is mostly because of the physical strength required to perform activities in the area. These men

are typically illiterates from poor backgrounds. It was observed that a large proportion of these workers are ignorant about the health consequences of their activities in the area. As a result of this they weren't adequately protected from the chemicals and hazardous materials in the area as they had no masks, protective boots etc. A few number of workers who knew of the adverse effects of working in the area, however, had no other employment opportunities and working on the site was their only chance of earning a living. This finding is similar to the study of Akormedi, Asampong, & Fobil, (2013) who found that workers did not use respiratory protective equipment and had poor knowledge of respiratory hazards associated with their work. Residents on the other hand reported knowledge and observances of respiratory problems like morning coughs which were as a result of dust and smoke from the area.

## 4.2 Conclusion

The following are the conclusions drawn from findings made in this study in relation to the specific objectives of the study:

Based on key findings of the research on objective/question 1, the researcher concludes that, Several units like the GNCPC, 3-line integrated e-waste recycling facility, Hand Over Centre and Special programs have been put in place to tackle and manage the problem of e-waste, however efforts have been unsuccessful as a shutdown of the site will result in a high rate of unemployment. These organizations have therefore focused their efforts on providing education to workers on how to effectively recycle and dispose of e-waste and on health and safety precautions.

On research objective/question 2, the study concludes that the e-waste dumped at Agbogbloshie mainly consists of large household appliances, DVD players and other

electrical components. As a result of the use of primary recycling methods, the air, land, and water in the area is contaminated by chemicals and a mixture of metals such as lead and zinc. In addition to this, there is an imbalance between inflows and outflows of e-waste mainly as a result of the use of simple recycling methods.

On research objective/question 3, the study concludes that the current situation at Agbogbloshie poses serious health implications for e-waste workers and residents who come into contact with these pollutants through inhalation and dermal contact. In addition, the unsustainable approach to recycling e-waste results in contamination of the soil and the burning to recycle results in air pollution.

Finally, this research concludes that most workers are illiterates and do not fully comprehend the effects of these pollutants on them and therefore failed to put on safety gear. The few workers who know about it continued to work in the area as a result of the lack of other opportunities to earn money. Residents however complained as they have observed the negative impact of these occurrences on their respiratory health.

### 4.3 Recommendations

Based on the study results, it is recommended that:

- There should be effective law enforcement and implementation of the ban of crude e-waste recycling practices such as open-air burning which poses environmental and human health hazards. Also, there is the need to adopt modernized and less hazardous e-waste recycling practices to help minimized exposure levels and hence protect both workers and vulnerable populations nearby.

- Again, the training programs and workshops for e-waste scrap workers on the hazards and risk associated with the activities of e-waste workers at the Agbogbloshie dumpsite must be regular and enhanced. Characterization of e-waste items revealed the nature of current electrical and electronic equipment manufactured. Their physical characteristics and chemical composition were considered. Based on this review, e-waste workers should be further educated on the hazards associated with the materials they handle, and as such be trained by resource persons such as government officials from the health sector on health and safety measures that will protect them, others and the environment from hazardous contaminants present in the waste stream components.

- The surveillance by authorities of the Accra Metropolitan Assembly within the Agbogbloshie dumpsite and its surrounding communities must be intensified in order to timely identify and investigate possible health threats.

- A state of the art and properly engineered e-waste recycling facility with all the standard safety mechanisms must be constructed at the Agbogbloshie dumpsite to avoid the release of harmful contaminants into the environment. Also, there should be provision of an improved technology with training for the e-waste workers on how to use the technology. This is to ensure majority of the waste stream component are recycled for further processing. Thus, reducing the health risks and environmental hazards associated with the crude methods for recycling e-waste used by the e-waste workers.

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