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**ADDIS ABABA UNIVERSITY COLLEGE OF DEVELOPMENT
STUDIES
CENTER OF ENVIRONMENT AND SUSTAINABLE DEVELOPMENT**

**ASSESSEMENT OF E-WASTE MANAGEMENT IN SELECTED
GOVERNMENT OFFICES IN ADDIS ABABA: THE CASE OF KIRKOS
SUB CITY**

A Thesis Submitted to the School of Graduate Studies of Addis Ababa University
in Partial Fulfillment of the Requirements for the Degree of MASTER OF ARTS
IN ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

By

Mulugeta Siyoum Mengistu

February, 2020

Addis Ababa



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February, 2020

Addis Ababa

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ACRONYMS AND ABBREVIATIONS

AAEPA	Addis Ababa Environmental Protection Authority
AFDB	African Development Bank Group
ARF	Advance Recycling Fee
CPU	Central Processing Unit
CRTC	Computer Refurbishment and Training Centre
CRT	Cathode Ray Tube
CSA	Central Statistical Agency
DMF	Demanufacturing Facility
EEE	Electrical and Electronic Equipment
EoL	End of Life
EU	European Union
FDRE	Federal Democratic Republic of Ethiopia
ICT	Information Communication Technology
ITU	International Telecommunication Union
NGOs	Non-Governmental Organizations
UNEP	United Nations Environmental Program
UNU	United Nation University
US EPA	United States Environmental Protection Authority
StEP	Solving the E-waste Problem Initiative
PAN	Pesticide Action Network
RoHS	Restriction on Hazardous Substances
WEEE	Waste Electrical and Electronic Equipment (E-waste)

ABSTRACT

E-waste is a global, interregional, and domestic problem. E-waste management is a challenging task not only due to its speedily increasing volume but more outstandingly because of its effect on healthy and the environment. The objective of the study was to assesses level of awareness, attitude and practice on e-waste management and examine the influence of demographics, socio-cultural and institutional factors that affect the perception on e-waste management at selected government office level in Kirkos sub city. The data were collected from 367 selected government office employees, which Kirkos sub city were selected by using purposive sampling technique based on the closeness of my working area. stratified random sampling was employed where type (Office managers, government experts, and government employees) were taken as strata are the actors that purposely selected. six people who interviewed in EPA and EFCCC were found relatively small in size and live in scattered areas, I used random sampling method. Descriptive statistics and inferential statistics such as t- test, Pearson chi-square, correlation and Logistic regression model were used to predict the relationship between predictors (independent variables and dependent variables. The descriptive findings show that there is lack of awareness on e-waste management at government office level and photocopiers, printers, laptops, desktops, Computer accessories, TV/Radio, modems constitute the major waste generated by the selected government offices. Though most offices have temporary storage in their office, they did not store wastes separately based on its type. Disposed of e-wastes in unauthorized sites by the employees practiced in Sub City. The inferential analyses show, that, employees age, educational level, location, access to collectors and disposal site service for e-waste are the major factor that affect the government office employees' awareness, attitude and practice of e-waste management. Moreover, the qualitative analyses, using the interview data, show that disposal site, lack of rule, lack of collector, manpower and facilities like container are the other factors. For government office employees facilitating awareness creation programs, prepare rules and regulations and attention to disposal site and collation system are recommended as a solution.

Keywords: *E-waste management, Awareness, Attitude, Practice, Kirkos government offices*

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CHAPTER 1: INTRODUCTION

1.1 . Background of the study

During the last few decades, the electrical and electronics industry has been able to register a significant improvement. The ever-increasing applicability of devices such as laptop computers, mobile phones, personal digital assistants, smart cards, digital cameras, flat screens and touch screen television sets, etc. has become an imminent phenomenon what the world has witnessed as time changes. The consumption and production of electronic waste have been facilitated by rapid economic growth and an increasing urbanization and globalization (Remesh, 2007). The rapid changes in technology and the falling prices of electronic gadgets have had a substantial effect to the exponential growing surplus of electronic waste around the globe (Cynthia, 2017).

In general, almost 80% of the composition of electrical and electronic equipment is made of glass, iron, aluminum, and plastic, out of which certain components are typically used in the electrical and electronic equipment which are of non-hazardous in nature; nevertheless, they become hazardous after they end up in a toxic compound when used in manufacturing of electrical and electronic equipment (UNEP, 2011).

According to (Neyland, 2008), the rate at which E-waste is growing is as threefold faster than any of the other waste streams and likewise the electronic products has been able to exhibit a reduction in their useable lifespan (average electronic lifespan has been shrunked from eight years to two).

On the global scale, a statistical data showed that 44.7 million tons (Mt) e-waste were annually generated from all countries all over the world in 2016, compared to that of 43.8 Mt global quantity in 2015. In addition, the volume of e-waste is projected to peak at 52.2 Mt by 2021(Baldé, 2017).

According to the European Environment Agency and United Nations Environment Program throughout the world, it is estimated that 40-50 million tons of electrical equipment waste is produced per annum It's increasing three times faster than all other types of domestic waste. However out of which only 10% of all this e-waste is collected and taken care of in adequate recycling facilities (LaDou&Lovegrove 2007, Cobbing 2008), " By the year 2011 in Africa

continent, the technology market was expected to grow by over 8% a year for the following three years. The problem is that only around 10% of all this e-waste is collected and taken care of in adequate recycling facilities (UNEP, 2011).

Despite the fact that, Africa as a continent is not spared and does not handle as much e-waste as in technologically advanced countries, however, there are no organized systems which would enable to handle these problem either by recycling it or in the proper management of those e-wastes by devising various mechanism. These global problem is also typically observed in most of sub-Saharan African countries which has become a basic concern. The lack of a consistent e-waste management infrastructure implies that e-waste is collected and recycled in crude methods, causing the release of toxic chemicals to the environment and putting those refurbishing and dismantling e-waste at risk. This would be worsened by the fact these countries commonly have little or sometimes have no e-waste legislation to protect the health of e-waste workers and the adverse effect that would bring on the environment as well (Kaloki, 2014)

E-waste in Africa is growing 20% each year due to rising sales of electronic goods and legal and illegal imports of second hand and surplus equipment” (HP Environmental Compliance, 2009).

In Africa, the exportation of electronics wastes by developed countries to developing countries like Ethiopia, presents the main culprit of all. Electronic equipment and devices are primarily used in offices and by students due to the need to communicate and do research in emerging countries. The rapid economic growth has resulted to an escalation in the generation of electrical and electronic waste (e-waste), coming both from local consumers and recycling of second-hand equipment imported for re-use. Therefore, Solid waste creation and disposal is a distinctly human phenomenon that has threatening effect on both the environment and modern infrastructure in developing countries, one of the biggest encounters facing human beings is the unhealthy and unsafe disposal of solid waste (Joseph, 2006).

Increased electronic equipment use had brought to increased electronic waste. Hence the poor management of the such E-wastes will direct us to pollution, potential problems in public health, and environment.

The same problem has also been exhibited in developing countries like Ethiopia, countries which lacks effective polices and strategies to dealing with e-waste. This shows the ineffective

guidelines to deal with trade and disposal of e-waste in many African countries has exposed the continent to vulnerabilities associated with e-waste.

1.2. Statement of the problem

The disposal of wastes in or on land without careful planning and management would results in a threat to health and the environment which in turn become a serious problem in many countries. Increased use of technology especially ICT in government institutions and offices, low initial cost, unplanned obsolescence of electrical and electronic equipment has led to an e-waste generation problem for Ethiopia. New and better-quality electronics and advanced models e.g. cellular phone and personal computers are being manufactured and available in the market everyday making the previous models technically and technologically outdated and less satisfying to consumers thereby contributing to potential electronic waste stream.

According to the UNU-hosted Solving the E-waste Problem (StEP) Initiative, the Öko-Institut and PAN-Ethiopia, the stored volume of e-waste in Ethiopia is still relatively small (an estimated 4,300 tons of non-functioning computers, televisions, mobile phones and refrigerators) and generally confined to urban areas, particularly the city of Addis Ababa. The report notes that “there are some hints that e-waste is disposed of in an uncontrolled manner”, though most of it is simply stored in households and offices, as it is considered to be an asset rather than waste electrical and electronic equipment to be discarded (Belay, 2013).

Table 1.1 Estimated total stock, by weight (kg), of non-functional equipment in Ethiopia’s 10 largest cities in 2011

Type of equipment	Stock of non-functional equipment in the 10 largest cities of Ethiopia in 2011
Personal Computers	3200 t
TVs	510 t
Mobile phone	3 t
refrigerators	509 t
total	4300 t

Source: PAN 2012

However, as Ethiopia is one of Africa’s most rapidly developing countries, the availability of electrical and electronic equipment will surely increase in the upcoming years, and the relative cost of acquiring it will decrease. As this happens, the Green Paper’s authors predict reduced

willingness by Ethiopians to store non-functioning equipment, thus increasing the volume of e-waste and presenting considerable social and environmental challenges related to its recycling and disposal.

Ethiopia is a favorite destination for used computers which are inexpensive and mostly cost on average \$150. These are used in institutions of learning and internet cafes. The shortcoming of such computers is that they have a shorter shelf life and break down faster than new computers. Institutions of learning among them schools and colleges use a high number of such electronic equipment. This means that they play an essential role to the creation of electronic wastes; however, they don't have effective way of managing them at the end of their useful life. This Electronic waste will pose a great challenge to the Ethiopian government and threatens the health of the people and the environment as 2% of e-waste is toxic.

Table 1.2 Selected ICT development indicators for Ethiopia and other African countries

Indicator	Unit	Year of data	Ethiopia	Djibouti	Sudan	Kenya	Nigeria	Ghana	South Africa
Mobile-cellular telephone subscriptions	per 100 inhabitants	2011	16.67	21.32	56.25	64.84	58.58	84.78	126.83
Annual growth rate of mobile-cellular telephone subscriptions	% (population based)	2006-2011	71.0	31.4	36.4	26.4	21.0	29.3	9.1
Population covered by mobile phone network	%	2008	10	85	66	83	83	73	100
Individuals using the internet	%	2011	1.10	7.00	19.00	28.00	28.43	14.11	21.00
Annual growth rate of individuals using the internet	% (population based)	2006-2011	28.8	40.7	18.6	30.0	38.7	39.0	22.5
Fixed (wired) broadband subscriptions	per 100 people	2011	0.03	1.25	0.04	0.12	0.13	0.25	1.80
Households with a computer	%	2010	1.38	13.01	No data	No data	8.00	9.14	18.33

Source: ITU 2012, UNDP 2010

The above table shows how the ICT sector is increasing from time to time in Africa including Ethiopia. The more the sector increases the higher the e-waste will be so it needs careful e-waste management before things getting worse. Kirkos sub city has different government offices. These governmental offices have embraced ICT in their office so it is requiring a careful

investigation of existing challenges, E-waste management system before it becomes a bigger problem.

1.3. Research questions

The study aimed at addressing the following research questions:

1. What is the level of awareness of e-waste management in government office found in Kirkos Sub City of Addis Ababa?
2. What is the level of attitude towards the e-waste management in the government office found in Kirkos Sub City of Addis Ababa?
3. What is the level of practice in the e-waste management in government office in Kirkos Sub City of Addis Ababa?
4. What are the challenges of e-waste management at government office level in the study area?
5. What types of demographic and institutional factors affecting the awareness, attitude and practice of government offices in e- waste management in the sub city?

1.4. Objectives

1.4.1. General objective

The general objective of the study was to investigate the awareness, attitude and practice of Government institutions and factors influencing the e-waste management in Kirkos Sub City, Addis Ababa.

1.4.2. Specific objectives

The specific objectives of the study were:

- To assess the level awareness of, attitude towards and practice of Government office employees in e-waste management in Kirkos Sub City of Addis Ababa;
- To investigate the challenges of e-waste management on the part of the Government offices in the Sub City; and
- To identify factors that determine the awareness, attitude and practice of the government offices e-waste management at office level in the Sub City.

1.5. Significance of the study

This study plays a significant role in creating awareness of the uniqueness of e-waste problem in Ethiopia in that E-Waste is relatively new and its quantities are rapidly growing as technology becomes more common. It is hoped that the results from this study form a base for decision makers in formulating strategies towards improving electronic waste management in government offices.

The research explored the government's readiness to manage e-waste, to understand how various factors such as legal requirements, awareness, convenience and financial incentives, government, consumers, cost, manufacturers can impact on collection and the proper management of used and EoL of EEE. It is expected that the findings of this study will contribute to policy formulation among decision makers on sustainable e-waste management and contribute to knowledge pool within which future research can be carried out.

1.6. Scope of the study

The study is focus to Kirkos sub city administration office and woredas employees, Addis Ababa offices found in kirkos and the concerned body on e-waste such as Addis Ababa environmental protection authority and EFCCC. I try to assess the level awareness of, attitude towards and practice of Government office employees in e-waste management in Kirkos Sub City of Addis Ababa, to investigate the challenges of e-waste management on the part of the Government side in selected offices in the Sub City; and to identify factors that determine the awareness, attitude and practice of the government institutions e-waste management at institution level in the Sub City.

1.7. Limitation of the study

It stated that e-waste management is the one that encourage the research across the globe. Especially, in developing nations including Ethiopia, inadequate and inefficient management system of government offices wastes. Even though vastly growing, there is no sufficient data on e-waste in sub city even in the capital city Addis Ababa. However, due to the time and financial constraints of the researcher, this research concentrate on one specific Sub-city. Since the lack of

adequate research works or literatures done in the country most of the literatures reviewed in this study are web based sources.

1.8. Organization of the study

The study comprises of five chapters. The first chapter consists of the introduction part, background of the study followed by statement of the problem, research objective, and significance of the study, scope of the study and limitation of the study. The second chapter focuses on accumulating various theoretical backgrounds followed by empirical findings done on related topics. In chapter three the methodology of the study as how to collect and analyze the data is presented. It includes research design, data type and source, sampling method and size, method of data collection and data analysis techniques. The next chapter provides us the analysis and the interpretation based on the data that has been collected in a way that would give a meaning for the study. Finally, the conclusion is made and the possible recommendations have been forwarded based on the findings of the study.

1.9. Terminology and Operational definition of concepts

Perception: -The ability to see, hears, or become aware of something through the senses:

The normal limits to human perception (Oxford Advanced Learner's Dictionary, 2018).

Attitudes: -defines attitudes evaluative statements which are either favorable or unfavorable concerning objects, people or events. They reflect how one feels about something (Robbins 2001) Cited by (Hannah, 2009).

Practice: -Action undertaken in the management of the as recycling of waste, composing and segregation or separation (Hannah, 2009).

E-waste management-refers to the organization and coordination of collection, transportation, storage, dismantling and recycling and disposal of the obsolete, end-of- life or discarded EEE.

Level of awareness of disposal of e-waste refers to the extent in which the consumers know the various ways of proper disposal of the e-waste generated from their EEE.

Reuse: Extension of the end of life of equipment or component parts to be used for the same purpose for which they were originally conceptualized; this may or may not include a change in ownership of the equipment. This process aims to promote optimal use of available resources, but social or environmental risks associated with poor management should be taken into account.

Recycling and recovery: This process involves the recovery of devices, components and material. The dismantling can be manual or semi-manual. The recovery of materials is part of the WEEE recycling process, especially for metal recovery, which requires specialized facilities and investment.

Final disposition: In the process of final disposal of waste or materials, non-recoverable materials can be disposed of in controlled landfills (dumps) or by incinerating (ITU, 2016).

Woreda: the lowest administrative level in Addis Ababa city administration.

CHAPTER 2: REVIEW OF RELATED LITERATURE

This chapter deals on reviews of related literature. It also presents definition of concepts such as e-waste. The chapter further discusses about theoretical framework related to waste management behavior, the global situation of e-waste, e-wastes management in Ethiopia, awareness, attitude and practice in managing e-wastes, sources and categories of e-wastes, challenges of electronics waste management, effects of e-wastes management, empirical literature conducted elsewhere in the world, and about conceptual framework used in this study.

2.1. The concept of E-waste

The word waste electrical and electronic equipment (WEEE) also called Electronic waste (E-waste) can be defined in different areas some of them are:

Electronic waste (E-waste) is any form of electrical and electronic equipment (EEE) that are old, end of life electronic appliances that have ceased to be of any value to their owners. (UNEP, 2010).

E-waste is a term used to cover items of all types of electrical and electronic equipment (EEE) and its parts that have been discarded by the owner as waste without the intention of re-use (StEP,2014).

The concept e-waste came to light as far back as in 1970s and 1980s following environmental degradation that resulted from hazardous waste imported to developing countries (Zulkifli, 2014). In reaction to hazardous waste importation, the Basel Convention on the control of trans boundary movements of hazardous wastes and their disposal was institution in 1992 to control the situation. Since then many countries have become members of the convention. Although “the Basel Convention does not regulate secondhand items and some e-waste scrap” (Zulkifli, 2014), it has played a role in banning exportation of obsolete products and engineering waste solutions. For example, its theme in 2006 was: creating innovative solutions for the environmentally sound management of electronic waste (Buenker, 2007).

E-waste phenomenon continues to flourish due to rapid adoption and use of ICTs which has contributed to increase in e-waste stream. E-waste is said to be one of the fastest growing waste

streams (Cairns, 2005); growing at a rate of 3–5% per annum i.e., approximately three times faster than an ordinary municipal solid waste (Davis & Heart, 2008). Increase in e-waste stream has attracted the attention of many governments, individuals, and researchers due to its impact on the environment and human health. In Europe, the EU implemented two directives i.e., Directive 2002/96/EC on WEEE and Directive 2002/95/EC.

Besides regulations, researchers have suggested various strategies of mitigating E-waste problems and solutions that lead to Design for Environment or Green IT. Some of the suggested strategies include methods and models for predicting the flow of e-waste and assessing environmental impact of ICTs. (Zulkifli, 2014) it is argued in that a traceability system for tracking/tracing E-waste information is required. Therefore, models like Material Flow Analysis (MFA); a method applied to support the material and substance flow management in the waste (Streicher-porte, 2005) is required for e-waste mitigation.

2.2. E-waste growth

ICT Uptake and Shorter Replacement Cycles Are Contributing to the Growth of E-waste The growing amount of e-waste is the result of several trends. The global information society is growing at great speed. It is characterized by an increasing number of users and rapid technological advances that are driving innovation, efficiency, and social and economic development. By 2017, close to half the world's population uses the internet and most people in the world have access to mobile networks and services. Many people own more than one ICT device, and replacement cycles for mobile phones and computers, and also for other devices and equipment, are becoming shorter. At the same time, disposable incomes in many developing countries are increasing and a growing global middle-class is able to spend more on electrical and electronic equipment, consequently generating more e-waste. Current trends suggest that the amount of e-waste generated will increase substantially over the next decades, and that better data to track these developments are needed. (Baldé, 2017).

Generation of E-waste Has Grown to 44.7 Million Metric Tons All the countries in the world combined generated a staggering 44.7 million metric tons (Mt), or an equivalent of 6.1 kilogram per inhabitant (kg/inh), of e-waste annually in 2016, compared to the 5.8 kg/inh generated in

2014. This is close to 4,500 Eiffel Towers each year. The amount of e-waste is expected to increase to 52.2 million metric tons, or 6.8 kg/inh, by 2021 (Baldé,2017).

2.3 Sources and categories of E-waste

Table 2.1: Categories of E-waste

Categories of E-waste Covered by the EU WEEE Directive	
1.	Large household appliances
2.	Small household appliances
3.	IT and telecommunications equipment
4.	Consumer equipment
5.	Lighting equipment
6.	Electrical and electronic tools (with the exception of large-scale stationary industrial tools)
7.	Toys, leisure and sports equipment
8.	Monitoring and control instruments
9.	medical devices
10.	Automatic dispensers

Source: EU WEE directive

Table 2.2: Electronic product weight estimations

Electronic part	Average product Mass (kg)
CRT Monitors	18.14
CRT TVs	31.75
CPUs	9.98
LCD Monitors	7.26
LCD TVs	13.15
Laptops	3.63
Peripherals	6.80

Source: US environmental protection Agency (US EPA 2007)

2.4. waste generation in Ethiopia

A 1994 study on waste management estimated the per capita waste generation rates in Ethiopia to be between 0.221 and 0.252 kg per capita per day. The total waste generated was about 671 TPD. It was calculated based on the per capita generation rate of 0.22 kg per person per day and a population of three million. However, these estimates are still being used two decades later. As

per a 2014 study by the Ministry of Urban Development and Housing of Ethiopia, the country generates 2.8 million tons of waste every year. (Chandra, 2017)

As the responses from forum for environment Ethiopia assessment study proposes that the nation's scientific and technical capability for the safe way of controlling the waste from any source is unorganized. Trained and skilled personnel are required to manage the wastes especially from the industry, health institutions, municipal solid wastes and some other sectors. Some types of waste items like the electronic wastes are not regulated, and there are no scientific and proper ways of controlling, monitoring and correcting actions.

Ethiopia has an official municipal solid waste policy with proclamation number 513/2007. Under this article, solid waste defined as a matter that is neither gas nor liquid and is removed as undesired. Here also solid waste management is addressed as the process of all steps from the proper ways of collection to the disposals. The urban administration has the responsibility to create a favorable condition to facilitate investment on the delivery of solid waste management sector. There is the involvement of the lower level of government authorities and their local residents in the management cycles, from designing to implementation.

Ethiopia is of the country that has recognized the Basal convention (proclamation No. 674/2010) to apply the right and proper way of managing electronic wastes. According to the forum for environment (Ethiopia) and the Ethiopian federal government's waste policy, there is no specific policy, regulation and principle in the area of electronic waste removal in Ethiopia. This area is the area that needs deep concentration and attention for action.

E-waste in Ethiopia today is generally handled as follows:

- Prolonged storage of e-waste (e.g. office equipment, mobile phones, TVs etc.) in households, offices and governmental premises.
- Formal collection of e-waste from governmental offices and delivery to DMF.
- Informal refurbishing and recycling of waste items and components (e.g. cables, radios etc.) in and around scrap metal markets.
- Uncontrolled dumping of waste items such as batteries, lamps, refrigerators etc.

Table2.3: Ethiopian policies and regulations related to waste management and environmental protection

<i>Policy item</i>	<i>Main theme</i>	<i>Remarks</i>
<i>Article 44 of the Constitution of Ethiopia</i>	<i>Environmental Rights</i>	<i>All persons have the right to live in a clean and healthy environment</i>
<i>The Health Policy of 1993</i>	<i>health system issues</i>	<i>Very few items are related to solid waste problems in terms of environmental hygiene</i>
<i>Establishment of EPA in 1995</i>	<i>The need for an independent body dealing with environment</i>	<i>National government body responsible for the environment</i>
<i>Environmental Policy of Ethiopia, 1997</i>	<i>High priority for waste Management</i>	<i>Community participation and environmental economics in development activities</i>
<i>Environmental Pollution Control Proclamation of 2002</i>	<i>The management of Municipal Waste</i>	<i>All urban administrations shall ensure the collection, transportation, and appropriate recycling, treatment or safe disposal of municipal waste through the institution of an integrated municipal waste management system</i>
<i>Solid Waste Management Proclamation No. 513/2007</i>	<i>Promotes waste as a resource</i>	<i>Enhance at all levels capacities to prevent the possible adverse impacts while creating economically and socially beneficial assets out of solid waste</i>
<i>Addis Ababa City Solid Waste Management Regulation, 2004</i>	<i>Solid waste management</i>	<i>Addis Ababa solid waste management, collection and disposal system</i>

Source: PAN-Ethiopia, 2012

2.6. Health and environmental hazard

2.6.1. Toxicity of e-waste

Toxic elements account for about 2% of the total weight of E-waste; Secondly, the majorities of materials have an economic value and therefore a considerable recycling or reuse potential (i.e. copper, aluminum, gold, nickel). While the toxic elements are of low risk during the use phase of equipment; these substances can become harmful in the end-of-life phase. Different toxic chemicals are used in the manufacturing of electrical and electronic equipment such as plastics, gallium, nickel, mercury, aluminum, vanadium, beryllium, lead, chromium, cadmium, and arsenic (Robinson, 2009; Van de Merwe, 2009). If these products are not disposed of properly and are landfilled, toxic components can leach into soil, and ground water (Rushton, 2003).

A computer monitor contains 6.3% lead, which if not well contained and recovered, infiltrates the water, soil, and/or air system as a result of burning of wastes. The amount of pollutants in a computer is much higher in than in other EEE such as washing machines and refrigerators (Barba-Gutierrez et al., 2007). Poor conventional methods of disposing e-waste, which are mainly open dumping and open burning results in to oxidation of plastics made of plastics of BFR, this releases dioxins, furans and toxic Respiratory Suspended Particles that cause risks to human health upon exposure and alters environmental systems. Most risks arise during the uncontrolled e-waste recycling activities that occur in developing countries, and are results of the rudimentary methods used. These include manual disassembly and sorting; heating and acid leaching of printed circuit boards (PC-boards); shredding, melting and extrusion of plastics; open burning of plastic coated wires and other components; and sweeping and collection of toners from toner cartridges.

Table 2.4: Hazardous compounds that may be present in (EEE) and e-waste, as well as those that may be formed during end-of-life treatment of the e-waste.

Hazardous compound	In electrical and electronic equipment (EEE) and e-waste
metals	
Antimony(Sb)	Semiconductors(sbH3)Flame retarded plastic, CRT glass, Pb-acid batteries
Arsenic(As)	LEDs, laser diodes and solar cells
Chromium(Cr)	Coating on metal surfaces, steel alloys
Copper(Cu)	Wires, cables, PC boards, switches, relays, electromagnetic motors
Mercury(Hg)	Hg-batteries, cold cathode lamps, switches, relays, thermostats, sensors, medical and telecom equipment
Nickel(Ni)	Ni-Cd batteries, electron guns of CRTs
Selenium(Se)	Photocopying machines, photocells, light meters, solar cells, rectifiers and x-ray cameras
Tin and organo-tin	Stabilizers in PVC, glass coatings
Zinc(Zn)	in luminescent pigments of CRTs

Source: Swedish environmental protection agency (2011)

The main environmental issue concerning of electronic waste management is the uncontrolled release of hazardous substances into the environment as well as sub-optimal use of recyclable materials. Improper disposal can be extremely hazardous to the environment and health. Some of the health hazards include a number of ailments as a result of contact with toxins such as dioxin, cadmium, mercury, furans, and lead among others, emitted in landfills or incineration processes. E-waste Recycling process can also result to Emission and effluents therefore care should be taken during the process.

Upon incineration of e-waste, toxic chemicals such as dioxins and polycyclic aromatic hydrocarbons can be produced (Rushton, 2003). These hazardous materials may cause a wide range of negative health impacts including brain damage, kidney problems, lung cancer, skin ulcers, birth defects, and death (Babu, 2007).

Discarded electronics contain a variety of toxic metals, including lead, cadmium, mercury, Chromium, and polyvinyl chlorides, and thus the disposal of electronics pose a significant Environmental and health risk when not properly handled. Although e-waste represents less than

2% of landfill mass; it contains 70% of the hazardous waste in heavy metals (Jiang et al). The Following hazardous components can be found in e-waste (Namias, 2013).

2.6.2. Health effects of e-waste

Upon incineration of e-waste, toxic chemicals such as dioxins and polycyclic aromatic hydrocarbons can be produced (Rushton, 2003). These hazardous materials may cause a wide range of negative health impacts including brain damage, kidney problems, lung cancer, skin ulcers, birth defects, and death (Babu et al.,2007). The categories of E-waste according to AU WEE directive are;

Table 2.5: some of hazardous materials found in E-waste

Material	Location	Health impacts
aluminum	CRT, used in printed wiring board as conductors and connectors	Skin rash, skeletal and respiratory problems, associated with Alzheimer's disease
arsenic	Printed wiring board	Allergic reactions, vomiting, abnormal heart rhythm, increase the risk of cancer
beryllium	Used in circuit board as conductors and connectors	Long disease, allergic reactions, increase the risk of cancer
Brominated flame retardants: PBB and PBDE	Plastics, printed circuit boards, components, cables	Increase the risk of cancer in the digestive lymph systems
cadmium	plastics	Affects the kidneys
Chromium IV	Decorative, housing of the computer	Strong allergic reactions, ulcer, liver and kidney damage, increase risk of cancer
gallium	Semiconductors, printed wiring board	increase risk of cancer
mercury	printed circuit boards, batteries, CRT, printed wiring	Chronic brain, kidney, lung and fetal damage, allergic reaction,

		increase risk of cancer
nickel	printed wiring board, CRT	respiratory problems, increase risk of cancer
silica	Glass, CRT, printed wiring board	respiratory problems, increase risk of cancer
vanadium	CRT	Lung and throat irritations

Source (Van de Merwe, 2009)

2.7. Trans- boundary movements of e-waste

Trans- boundary movement of e-waste mainly from developed countries to still takes place. Both exporting and importing of e-waste is illegal in many countries –goes against the principal of environmental justice. Trans- boundary movement of e-waste specially to developing countries like Ethiopia is particularly dangerous because such countries often may not have the capacity to recycle and dispose the waste in an environmentally sound manner.

2.8. Empirical Literatures

There have been working papers done on the E-waste management at different times. Hence this study wants to review some of the dissertations which have been made on the related topics along with its findings.

The study by the title of “Assessment of E-waste management practice: evidence from Addis ketema sub city” which has been done by Rehima (2016) is being able to identify the problems encountered in Addis Ketema sub city and forwarded the possible recommendations for awareness, attitude and practice of household on e-waste management. The research took a form of quantitative and qualitative data study design which gathers data from primary and secondary sources where the primary data is gotten through open ended and close ended questionnaires from 150 households and through structured and semi structured interview that has been made with the concerned stakeholders.

Theodores (2010) has made a study on the title Assessment of Electronic Waste Management Case study of some TVET Colleges in Addis Ababa. Raw data was condensed, analyzed both quantitatively and qualitatively. The data gathered from 28 respondents. Descriptive statistics

was used to questions demanding quantitative measurements like the number of working, EoL and donated Computers. On the other hand, narration was used to qualitative measurements.

Finally, he concluded that the current trend of lifecycle management (from the point of purchasing to the EoL management) of EEEs in the target institutions is environmentally unsound. Unless arrested, it will result very huge accumulation of e-waste and will contribute its negative externality to the problem of solid waste in city of Addis Ababa. E-waste will be a huge problem in the future, given the rise in consumption trend of the target institutions and the general importation trend of the country. It is, therefore, imperative that measures are put in place to address the emerging challenge.

Okoye and Odoh (2013) Assessment of the level of awareness of E- Waste Management and Concern for the Environment amongst the populace in Onitsha, Southeastern Nigeria. The study was collected through the distribution of 176 well-structured questionnaires distributed among different respondents. Data Analysis are demographic information of respondents. Statistical approach adopted for the analysis of the respondents was Likert Scale Analysis in which responses were coded using figures to quantify the responses. Means of coding values were used as critical region and mean responses were compared with the critical region to determine the hypothesis to accept. Also, charts were used for better understanding of available data, as well as, the demographic information of respondents. The factors are grouped with sex, age, marital status and educational qualification as factors to be considered.

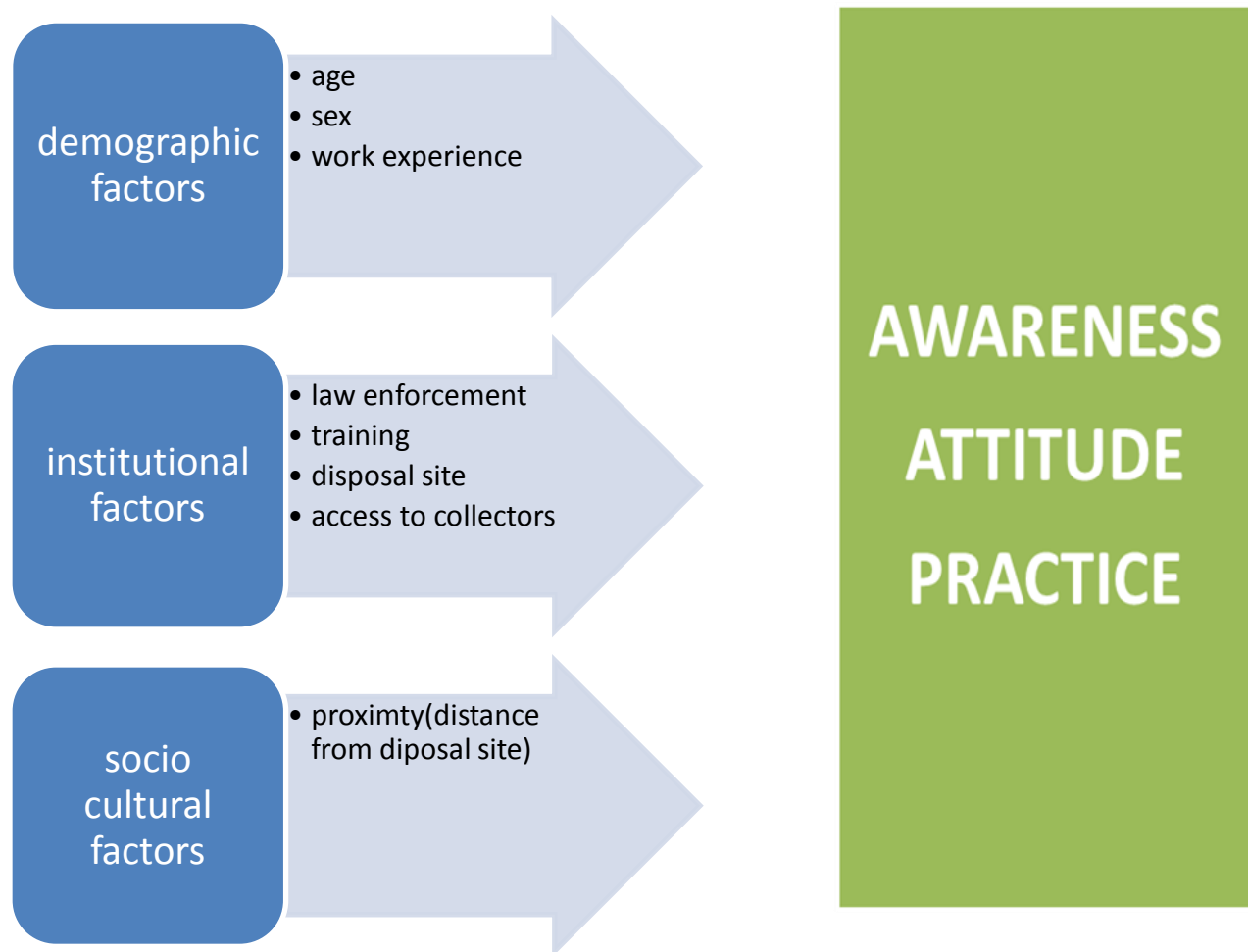
He concludes that E- waste must be generated because of the need to key into the technological age. However, it is both valuable as source for secondary raw material, and toxic if treated and discarded improperly. Hence, recycling of such wastes, thus assumes significant importance from the commercial standpoint while proper disposal is crucial from the health and environment point of view. From the foregoing, the facts on ground is a clear indication that while most of e - waste are being brought down to developing countries in addition to the ones on ground, people are yet to appreciate the difference between the regular municipal solid waste and e -waste, the potential benefits of recycling e -waste and the health implication of not handling them well. This therefore calls for a serious environmental sensitization campaign whereby if the recommended awareness model is adopted, it will go a long way into awakening both the people and the government on this environmental challenge.

assessments do not guarantee to conclude about the factors of awareness, attitude and practice on e-waste management at government office level. It implies that, the studies conducted in other specific area do not guarantee to conclude about the picture of the rest parts of the world, especially at government office level. Hence, whether the identified factors are significant or not depend on the existing situation of the given particular area. In other words, the poor performance of each Sub City or nation e-waste management has its own main contextual factors or causes.

So, this thesis is intended to fill the current literature gap related to the motive why the Kirkos sub city government offices dispose their e-wastes improperly, context specific factors of the study area. this work contributes to fill the research gap on e-waste management existed at government office employees on e-waste management.

2.9. Conceptual Framework

Figure 2.2. Conceptual framework



2.10. Theoretical framework

Theory of reasoned action (TRA) and theory planned behavior (TPB) are used in this study on solid waste management as a framework in understanding, explaining and predicting behavior. These theories are also useful as a guide for designing intervention strategies to maintain or change a particular behavior. The theory is based on the assumptions that individual behavioral intentions are directly associated with their attitudes. The theory of reasoned action views an individual's intention to perform or not to perform as an immediate determinant of the action. This behavioral intention has two determinants: (a) attitude towards the behavior, and (b) the subjective norms. (Ajzen and Fishbein 2008) argue that the beliefs related on attitude towards the

behavior are called behavioral beliefs, while normative beliefs are for the subjective norms. The theory planned behavior further views an individual's determination is influenced by attitude, social support and perceived behavioral control. Thus, it is best to examine human behavior related to their awareness of, attitude towards and practice of e-wastes management are voluntary and under an individual control (Gamba and Oskamp, 2004).

CHAPTER 3: METHODOLOGY

This section aims to explain how the cases and respondents were selected. The data collection and analysis methods used are also explained. In order to arrive at reliable findings; the researcher applied the field and desk surveying method and then collected various types of data related to the study under consideration. Review of available literature and documents, collection and analysis of both primary and secondary data would have been carried out. Interviews and discussions with relevant officials of the government and individuals in person would have been also held.

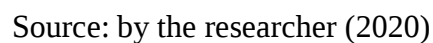
3.1. Study Area Description

Addis Ababa is a seat for Federal Democratic Republic of Ethiopia (FDRE) and is a diplomatic capital and head quarter for different organizations. Geographically, Addis Ababa is located between 9°1'48"N and 38°44'24"E and covers an area of 540 km². There are 10 sub-cities (*Kifleketema*) and about 99 Kebeles (*smallest administration units*) with a population of about 3.5 million with 3.8 percent annual growth rate, density of 5936.2/km² (CSA, 2007).

Kirkos sub city is one of the ten sub cities of Addis Ababa, the capital of Ethiopia. As shown the fig.3.1, Kirkos sub city is located at the center of Addis Ababa. National sport and sport and cultural facilities such as Addis Ababa stadium and Meskel square are located in the sub city. The sub city hosts international offices such as the office for Organization for African union (OAU) and the United Nations Economic commission for Africa (ECA). Kirkos sub city covers a surface area of 1,472 Hectare. And has a population size of about 220,991. The sub city is one of the densely populated sub cities in Addis Ababa with a population density of 150 per hectare. (CSA, 2007)

In addition, in this sub-city there are also 31 historical heritages, 29 Federal offices, 18 Addis Ababa city governmental offices, 11 offices of Oromia National and regional government, 10 governmental development agencies, Palace, UN main office, Economy commission of Africa (ECA). Meanwhile, there are 15 embassies, 2 parks, 15 hotels which has stars and 12 normal hotels, 4 Orthodox, 5 Muslim, 16 Protestant, and 2 Catholic institutions.

Figure 3.1 map of Kirkos Sub-City Administration



The study employed explanatory and descriptive research design. Research design provides the framework for the collection and analysis of data (Bryman & Bell, 2011) or it can alternatively have defined as the plan and structure of investigation so conceived as to obtain answers to research questions (Cooper & Emory, 1995). This means it just gives us the procedure necessary for obtaining the information needed to solve the research problems.

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interest in the research (Hair et al., 2011). Hence descriptive research design has been used to describe or portray the reality of the situations which enables to express level of awareness, attitude and practice on e-waste management in Kirkos sub city selected offices. Moreover, explanatory research design enables to examine the relationship between and among variables and hence quantitative research method is employed.

3.3. Nature and Sources of Data

3.3.1. Types of data

Two types of data were collected. These were primary and secondary data. The primary data which was collected from the field gave the first hand information about the extent of e-waste management issues experienced in Kirkos sub City. Secondary data was acquired from archived in documented information such as technical reports and archival retrieval.

3.3.2. Sources of Primary Data

Primary data sources include Kirkos sub city government institutions, and resource persons such as the Addis Ababa environmental protection authority, Kirkos sub city administration office, among others. The above provided the baseline data for the research study in the field.

3.3.3 Sources of Secondary data

Secondary data obtained from various sources which include reference books (published), information from government bodies such as from relevant line ministries charged with responsibilities of executing various government policies necessary in waste management in Ethiopia, relevant reference publications, maps, national waste management plans, policies and data from websites in the internet will also be used.

3.4. Population, Sample Size and Sampling Technique

3.4.1 Population and Sampling Technique

Kirkos sub city is one of the ten sub cities' in Addis Ababa and has a population size of about 3.5 million. (CSA, 2007). There are 7671 government employees in Kirkos sub city from which 3349 were males and the remaining 4322 were females. Sample of 367 respondents is selected from which 311 Government employees, 32 government experts and 24 managers using random sampling method. The number of managers and experts working in Kirkos sub city were small in size and difficult to access, most of them who were available during the interview time were

included in the sample. The structured questionnaires were distributed for 381 respondents; from which 14(3.7%) are not respond the questionnaire paper and the remaining 367(96.3%) respond the questionnaire paper, as selected sample respondents.

Table 3.1 Actors and number of samples taken for the study

sectors	Number of employees	Number of sample taken	Number of questionnaire distributed and collected
Kirkos sub city administration the 4 pools & woredas employees	7103	353	341
Addis Ababa offices in kirkos	568	28	26
Total	7671	381	367

Source: Survey result, 2020

Given the available resources, the scope of the research and the importance of increasing and diversifying sample sizes, a sample size considered to be representative was taken from the case study area. A multi-stage sampling technique was used to select the case study areas. At the first stage, Kirkos sub city was selected by using a purposive sampling technique based on the closeness of my working area.

Basically, a stratified random sampling was employed where type (Office managers, government experts, and government employees) were taken as strata are the actors that purposely selected. Accordingly, the sampled employees who worked in the sub city were selected randomly. The number of government officials working in the sub city were large in size and difficult to accessed, some of them who were available during the interview time were included in the sample; whereas the number of people who interviewed in EPA and EFCCC were found relatively small in size and live in scattered areas. Thus, random sampling method was found appropriate and applied for those in this research works.

3.4.2. Sample Size Determination

The study was conduct at governmental office level based on sample of respondents. In order to determine sample size, which is required for this study, the researcher used scientific statistical method as (Cochran1963:75) shown below.

Table3.2 Sample size for $\pm 3\%$, $\pm 5\%$, $\pm 7\%$ and $\pm 10\%$ Precision Levels Where Confidence Level is 95% and $P=.5$.

Size of Population	Sample Size (n) for Precision (e) of:			
	$\pm 3\%$	$\pm 5\%$	$\pm 7\%$	$\pm 10\%$
500	a	222	145	83
600	a	240	152	86
700	a	255	158	88
800	a	267	163	89
900	a	277	166	90
1,000	a	286	169	91
2,000	714	333	185	95
3,000	811	353	191	97
4,000	870	364	194	98
5,000	909	370	196	98
6,000	938	375	197	98
7,000	959	378	198	99
8,000	976	381	199	99
9,000	989	383	200	99
10,000	1,000	385	200	99
15,000	1,034	390	201	99
20,000	1,053	392	204	100
25,000	1,064	394	204	100
50,000	1,087	397	204	100
100,000	1,099	398	204	100
>100,000	1,111	400	204	100
a = Assumption of normal population is poor (Yamane, 1967). The entire population should be sampled.				

According to the table, the sample size was calculated and determined with some degree of precision for general population.

Accordingly, based on the above-stated table, the calculated sample size is 367 respondents in the sub city who are working in sampled government offices.

3.5. Instruments of Data Collection

3.5.1. Questionnaire

Questionnaires (both open and closed ended) questions were designed, pre-tested and later it was administered to the sampled government offices. The government office employees to whom the questionnaire were administered. This was done in a bid to collect information as per the objectives of the study.

3.5.2. Interviews

This method involved collection of data through face to face interaction with officers from various office managers such as Addis Ababa environmental protection authority, ICT officers in Kirkos sub city administration and EFCCC and They were 6 in number they were selected using convenient sampling method. key informant interview(KII) was used by preparing open ended questions.

3.5.3. Documentary analysis matrix

This research instrument was used to analyzed pertinent documents. In this case, those quantitative and qualitative data were supplemented by the secondary data generated form the analyses of published and unpublished materials which are available in the form of books, journal articles, research papers and other relevant documents.

3.6. Methods of Data Analysis and Presentation

Data were analyzed quantitatively and qualitatively. The descriptive were used to analyzed quantitative data. The qualitative method of analysis was applied for the data that were collected by using interview. Quantitative way of analysis also applies for the data which are collected from government institutions through structured questionnaire. Statistical Package for Social Sciences (SPSS) version25 was used for quantitative data analysis.

All the data were processed and analyzed using appropriate statistical tools to fulfill the Objectives of the study. The quantitative data were analyzed using descriptive statistics like frequency, percentages, pie charts, tables, and the statistical analysis is chi-square test, T-test, correlation and regression logistic model.

Logit model

Following the concept of the model from (Green, 2003) and (Gujarati, 1995), the Logit model for Electronic waste awareness, attitude and disposal practice at government institution level determinants can be specified as below:

$$(1) \quad P(y_i=1) = \frac{1}{1+e^{-(\beta_i x_i)}}$$

$$(2) \quad p(y_i=1) = \frac{1}{1+e^{-z_i}}$$

Where: $P(y_i=1)$ is the probability that a government institution had awareness, favorable attitude and dispose their wastes legally, Z_i = the function of a vector of explanatory variables), e -represents the base of natural logarithms and equation is the cumulative distribution function. If $P(y_i=1)$ is the probability of choosing to dispose legally, then $1 - P(y_i=1)$ represents the probability that the government institution lack awareness or unfavorable attitude and/or choose to dispose illegally and is expressed as:

$$(3) \quad 1-P(y_i=1) = 1 - \frac{1}{1+e^{-z_i}} = \frac{1}{1+e^{-z_i}}$$

$$(4) \quad \frac{p(y_i=1)}{1-p(y_i=1)} = \frac{1+e^{z_i}}{1+e^{-z_i}} = e^{z_i}$$

Equation (4) simply is the odds ratio, the ratio of the probability that a government institution will be disposed legally to the probability that it will be disposed illegally. Taking the natural log of equation (4), we obtain

$$(5) \quad L_i = \ln \frac{P(y_i=1)}{1-P(y_i=1)} = Z_i$$

Where: L_i is the log of the odd ratio which is not only linear in the explanatory variables but in the parameters also. Thus, introducing the stochastic error term (u_i) the logit model can be written as

$$(6) \quad Z_i = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + u_i$$

Where X 's = are explanatory variables that determines the government institution level solid waste disposal system, the general model has a form of

$$Y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_n x_n + u_i \dots \dots \dots \text{Equation (1)}$$

$$\text{OR } \pi_i/1-\pi_i = \beta_0 + \beta_1x_1 + \beta_2x_2 + \dots + \beta_nX_n + U_i$$

Y is the awareness, attitude and practice of government

X₁ is sex of the government institution

X₂ is age of the government institution

X₃ is educational status of the government institution

X₄ is size of the government institution

X₅ is main road (location) from office

X₆ is collector of the government institution

X₇ is enforcement of government

X₈ is disposal site service of the government institution

X₉ is dummy variable taking the value of 1 if the respondents who get training and 0 Otherwise

$\beta_1, \beta_2, \beta_3, \beta_4, \beta_5, \beta_6$ and β_7 are slopes or regression coefficients that represent the contribution of each independent variable to the prediction of the dependent variable.

β_0 is the constant or intercept.

3.7. Working hypothesis and variable specification

Dependent variable is a variable being tested and measured in a scientific experiment.

Awareness: government institution perception about EEE and e-waste if there is any problem in EEE junior or senior employee of the institution, formal and informal e-waste collectors and repairs when restore or to solve the problem of the electrical and electronic equipment aware of to use personal protective equipment. Government institution knows how about e-wastes storage on their temporary storage inside the office separately without contaminated the environment and human health or not merge together with municipal solid waste hand over to that e-waste give for waste collectors.

Attitude: it is the government institution feeling about EEE and e-waste. If there is any problem in EEE junior or senior employee of the institution, formal and informal e-waste collectors and repairs when restore or to solve the problem of the electrical and electronic equipment favorable attitude to use personal protective equipment. Government institution outlook about e-wastes storage on their temporary storage inside the office separately without contaminated the environment and human health or not merge together with municipal solid waste hand over to that e-waste give for waste collectors.

Practice if there is any problem in EEE junior or senior employee of the institution, formal and informal e-waste collectors and repairs when restore or to solve the problem of the electrical and electronic equipment to use personal protective equipment. Government institution and repairs are expected to store e-wastes on their temporary storage inside the office separately without contaminated the environment and human health or not merge together with municipal solid waste and hand over to those formal and informal waste collectors. Formal and informal e-waste collector dispose the waste to disposal site of e-waste without contaminated the environment and health in general.

Independent variable is a variable that is changed or controlled in a scientific experiment to test the effects on dependent variable.

- **Education:** - It was measured as the number of years stayed in school. It is expected to have a positive effect on the disposal practice without contamination of the institution and its surrounding environment.
- **Experience:** - It is a continuous variable expected to negatively influence the e-waste management practice at government institution level.
- **Sex:** -this is a dummy variable, which takes one if sex respondent is female, zero otherwise. Mostly electronic equipment's are maintained by men and women are responsible as a facilitator during maintaining of it.
- **Access to collectors:** - This is a dummy variable, which take zero if the access of institution to get service of waste collector is none at all; 1 if there is no enough access; 2 if there is enough access. The government institutions may collect their wastes properly. However, if they don't have an access to get the service of door to door collector, they may be forced to donate for primary schools or store it. Therefore, it is expected to have positive effects on practice of e-waste disposal at government institution level.
- **Training:** - it is a dummy variable expected to positively affect the awareness, attitude and disposal practice of the given government institutions. it was coded as 1 if the respondent receiving training or information from the municipality stakeholder about how they are going to collect and dispose their waste in particular and the consequence of inappropriate management of wastes on the environment and their health in general;0 otherwise.

- **Need of e-waste disposal site service:** -It is a dummy variable expected to positively affect the disposal practice of the given government institution. Which take 1 if there is access of disposal site;0 otherwise. The collector, repairers and government institution may collect their waste properly if they have enough access to disposal site. However, if they don't have an access to dispose the waste somewhere. It is expected to have an effect on e-waste disposal at collector, repairer and government institution level.
- **Size of institution:** - it is a continuous variable expected to negatively influence the management practice of government institution e-wastes. As the size of government institution become broader the e-waste generated at government institution level would be higher and may initiate to dispose that much amount of e-wastes informally. The place where they could easily access without considering the appropriateness of e-waste disposal site and their practice.
- **Location (distance from the main road) :-**It was regress by using the distance between the government institution and the main road in terms of meter. It is hypothesized that when government institution is far away from the main road, they might be motivated to dispose their waste informally.
- **Government enforcement:** - it is the dummy variable expected to affect the awareness, attitude and disposal practice of the government institutions. it was coded as 1 if the respondent observation on the enforcement of government on the rule and regulation on hazardous waste management;0 otherwise.

Table 3.3: Summary of explanatory variables and hypotheses

Variables	specification	Category of variables	Expected effects on the EWM
employees educational level	The number of years stayed in school	dummy	+
Experience	years	continuous	+
Sex	if sex respondent is female=1 male=0	dummy	+
Access to collectors:	If enough access =2 If not enough access=1 If none at all =0	dummy	-
Training	If the institution has training=1 if not =0	dummy	+
Need of e-waste disposal site service	If there is access =1 If not =0	dummy	-
Size of office	Number of employees	dummy	-
Location (distance from the main road)	If the distance from main road is: less than 100m=1 (101-600) m=2	continuous	-
Government enforcement:	If there is gov't enforcement=1 If not=0	dummy	+

3.8. Ethical considerations

While collecting the data, the respondents were assured of their privacy and confidentiality of the information given. Privacy was ensured by not recording the names of the respondents anywhere. It ensured this privilege was not abused and that respondents understood that their responses would be used purely for academic purposes and nothing else.

3.9 Research Matrix

Table 3.4: Research Matrix

Objectives	Type of data	Sources of data	Research tool
To assess the level awareness of, attitude towards and practice of Government offices employees in e-waste management	Primary Secondary	Interviews Literature review	Questionnaires Interview guides Books, journals
To investigate the strengths and challenges of e-waste management on the part of the Government offices in the Sub City	Primary	institutional interviews, Resource persons	Questionnaires, Interview guides Observation guides
To identify factors that determine the awareness, attitude and practice of the government offices e-waste management at government level in the Sub City.	Primary	institutional interviews Resource persons	Questionnaires, Interview guides

CHAPTER 4: RESULTS AND DISCUSSION

4.1. The Socio-demographic characteristics of study participants

Socio-demographic characteristics		n (367) Frequency %
Sex	Male	238(64.9)
	Female	129 (35.1)
Educational level	Illiterate	9(2.5)
	Certificate	34(9.3)
	Diploma	61(16.6)
	degree	237(64.6)
	masters	26(7.1)
Work experience	1-3 years	61(16.6)
	4-6 years	185(50.4)
	7-9 years	93(25.3)
	More than 10 years	28(7.6)

Source survey result (2020)

4.2. Level of Awareness, Attitude and Practice on e-waste management in the government office level

4.2.1. Awareness on e-waste management in the government offices

Awareness creation activity requires appropriate approach with continuous effort. The approach may vary according to the different backgrounds of stakeholders like educational level, culture, language, understanding capacity of individuals, attitudes, interest, the nature of the waste and etc. the fact that stakeholders are informed about the issue does not guarantee their action accordingly. On the other hand, although stakeholders know and want to act positively, the mechanisms may not be available to help them implement what is required. In this study reveals the majority of the government employees (69.2%) lack of awareness of e-waste management and (30.8%) of government employees they have awareness on e-waste management. The disposal knowledge of the government employees was asked to the respondent only 38.4% the respondent of were know the disposal method of e-waste. Preventing waste in the first place is usually preferable to any waste management option including reuse and recycling. Recycling electronics avoids pollution and the need to take out valuable resource. It also reduces the energy used in new product manufacturing. 38.7% of the respondent they know the advantage of reducing waste were as 61.3% is not. Respondents who had information about e-waste and its management were asked how they got such information or orientation. The ways how these respondents got information from 27 respondents, who had information, 48.1% revealed that they got information from the health centers and 40.7% from solid waste management expert and other means.

Table:3.5 Question of awareness on e-waste management

Question of Awareness	Yes	No	Total
Do you have awareness on e-waste management	107(29.2%)	260(70.8%)	367(100%)
Do You know the advantage of reducing waste	142(38.7%)	225(61.3%)	367(100%)
Are who discuss with other how can you reduce e-waste	131(35.7%)	236(64.3%)	367(100%)
Lesson taking associated with e-waste management	27(7.4%)	340(92.6%)	367(100%)

Source: survey result 2020

There are hazardous materials such as lead, mercury and hexavalent chromium, in circuit boards, batteries, and color cathode ray tubes (CRTs). Televisions and CRT monitors contain four pounds of lead, on average (the exact amount depends on size and make). Mercury from electronics has been cited as a leading source of mercury in municipal waste. In addition, brominated flame retardants are commonly added to plastics used in electronics. If improperly handled, these toxics can be released into the environment through incinerator ash or landfill leachate (Sepulveda, et al, 2009). The study survey result stated as in the table 4.2 that majority of respondent they were not know about the toxicity of electronic component and effect on environment and human health. There are hazardous materials such as lead, mercury and hexavalent chromium, in circuit boards, batteries, and color cathode ray tubes (CRTs). Televisions and CRT monitors contain four pounds of lead, on average (the exact amount depends on size and make). Mercury from electronics has been cited as a leading source of mercury in municipal waste. In addition, brominated flame retardants are commonly added to plastics used in electronics. If improperly handled, these toxics can be released into the environment through incinerator ash or landfill leachate (Sepulveda, et al, 2009). The study survey result stated as in the table 4.3 that majority of respondent they were not know about the toxicity of electronic component and effect on environment and human health.

Table:4.3 Respondent who aware on Electronic equipment damage that contain toxic component that damage the environment

Electronic equipment that contain toxic component that the environment	Yes	I don't no	Total
Are you aware of any dangers inherent in improper handling and disposal of E-wastes?	131(35.7%)	236(64.3%)	367(100%)
Do you know that some Components of electronic devices contain toxic materials	136(37.1%)	231(62.9%)	367(100%)
Toxic/hazardous materials require special treatment for environmentally sound disposal	122(33.2%)	245(66.8%)	367(100%)
method of disposal of electronic waste have any impact on the environment	175(47.7%)	192(52.3%)	367(100%)
contact with dismantled electronic waste have a negative impact on your health	23(6.3%)	344(93.7%)	367(100%)

Source: survey result 2020

Table: 4.4 Contact with dismantled electronic waste a negative impact on health

Question	I don't know	Very low	Low	Medium	High	Very high
health hazard Headache	351(92.9%)	1(3.7%)	4(14.8%)	5(18.5%)	17(63%)	-
health hazard Body Pain	351(92.9%)	-	-	16(59.3%)	6(22.2%)	5(18.5%)
health hazard Dizziness	351(92.9%)	-	9(33.3%)	7(25.9%)	2(7.4%)	9(33.3%)

Source: survey result 2020

On the case of cause of e-waste management problem in the country there are many. But according to the survey on the study area lack of awareness, lack of responsibility and weak

regulation are the dominant one. From 367 respondents for each variable, for lack of awareness 213(58%) and 67(18.3%), for lack of responsibility 176(48%) and 148(40.3%), for weak regulation 192(52.3%) and 126(34.3%), and carelessness of the respondents 185(50.4%) and 123(33.5%) of the government institution employees strongly agree and agree respectively. See table 4.5.

Table 4.5 Cause of e-waste management problem in the Sub city

causes	Lack of awareness	Lack of responsibility	Weak regulation	carelessness
Strongly disagree	27(7.4%)	4(1.1%)	10(2.7%)	21(5.7%)
disagree	40(10.9%)	32(8.7%)	31(8.4%)	29(7.9%)
Neither	20(5.4%)	7(1.9%)	8(2.2%)	9(2.5%)
agree	67(18.3%)	148(40.3%)	126(34.3%)	123(33.5%)
strongly agree	213(58%)	176(48%)	192(52.3%)	185(50.4%)
Total	367(100%)	367(100%)	367(100%)	367(100%)

Source: survey result 2020

4.2.2. Attitude of government institution employees on e-waste management

In most case attitude of the people affects the waste management as well as the environment, table 4.6 show that 35.4% of the employees were not worried about the environment, while 46.9%, 17.7% gave worried and very worried responses respectively. this implies that significant number of government employees were positive attitude to protect the environment.

Table 4.6: The respondent who concerned about the environment

Respondent who concerned about environment	Frequency	Percent
Not concerned	127	34.6
concerned	168	45.8
Very concerned	72	19.6
Total	368	100

Source: survey result 2020

Table:4.7: Attitude of respondent on e-waste management

Question of on e-waste management	strongly disagree	disagree	fair	Agree	strongly agree
E-wastes are Useful	45(12.9%)	33(9%)	76(20.7%)	50(13.6%)	163(44.4%)
AAEPA office is responsible for proper e-waste management	39(10.6%)	50(13.6%)	64(17.4%)	164(44.7%)	50(13.6%)
Gov't institutions are responsible for e-waste management	27(7.4%)	24(6.5%)	90(24.5%)	121(33%)	105(28.6%)
Repairer and e-waste collectors have responsibilities for e-waste management	40(10.9%)	78(21.3%)	62(16.9%)	156(42.5%)	31(8.4%)
upset when you have seen people damped the e- waste in the river, road and other place	31(8.4%)	32(8.7%)	108(29.4%)	102(27.8%)	94(25.6%)
Improper waste disposal is a threat to the environment	31(8.4%)	38(10.4%)	87(23.7%)	104(28.3%)	107(29.2%)

Source: survey result 2020

In different literate attitude most of the time there is significant relationship with waste management. The study result in the table 4.7 show that 164(44.7%) and 50(13.6%) of the

responded they agree and strongly agree on government of Addis Ababa Environmental Protection Authority office were responsible for government office e-waste management 64(17.4%) responded neutral were as 50(13.6%) and 39(10.6%) of respondent they were disagree and strongly disagree on AAEPa is not the only responsible on e-waste management .The survey result show that the aware government employees the responsibility is for different stakeholder but none aware of e-waste management is respond that the sole responsible for government .This implies that the aware government employees have favorable attitude but others are not.

On the case of government office responsibility 121(33%) and 105(28.6%) of the responded they agree and strongly agree on responsibility of the institution(office) on proper e-waste management 90(24.5%)of respondents respond fair were as 24(6.5%) and 27(7.4%) of respondent they were disagree and strongly disagree on government institution were not the responsible on e-waste management. The survey result show that majority responded the government institutions (offices) were the responsibility to manage e-waste had favorable attitude but some them are none unfavorable attitude on responsibility of e-waste management. This implies that the significant number of government employees have positive attitude but some of them is negative attitude on responsibility of e-waste management.

On the question of upset when you have seen people dumped the e- waste in the river, road and other place, 102(27.8%) and 94(25.6%) of the responded they agree and strongly agree on improper disposal e-waste they were upset the respondent this implies that positive attitude on e-waste management 108(29.4%) of the respondents responded fair were as 32(8.7%) and 31(8.4%) of respondent they were disagree and strongly disagree on government employees were not worried about seeing improper disposal of e-waste management. The other question is improper e-waste disposal is a threat to environment, 104(28.3%) and 107(29.2%) of the responded they agree and strongly agree they were said that improper disposal of e-waste is threat for environment and human health 87(23.7%)are fair response were as 38(10.4%) and 31(8.4%) of respondent disagree and strongly disagree. This implies that there is significant positive relationship between attitude and e-waste management.

4.2.3. Generation and Practice of government offices on E-waste management in Kirkos Sub city

4.2.3.1. Generation of E-waste management

Current situation of government institution(office) e-waste management is designed to analyze and briefly describe how e-waste management is practiced in the city, particularly e-wastes which are generated from government institutions. The survey result indicates that the institutions e-waste generation in Kirkos is photocopiers, printers, Fax machines, laptops, desktops, Computer accessories, TV/Radio, modems and its wastes.

According to survey result in the table 4.8 computer and computer related parts (hardware inputs outputs) electronic components were higher in generation in government institutions(offices) compared to other electronics.

Table:4.8: Generation of e-waste in the last five years in office

Generation of e-waster	yes	no	Number of items on average	reparable	Non-reparable	both	Total respondents
photocopiers	278(75.7%)	89(24.3%)	7	203(76.9%)	41(20.4%)		367 (100%)
printers	205(55.9%)	162(44.1%)	8	160(79.6%)	41(20.4%)		367 (100%)
Fax machines	29(7.9%)	338(92.1%)	12	5(13.9%)	31(86.1%)		367 (100%)
laptops	322(87.7%)	45(12.3%)	26	140(49.6%)	142(50.4%)		367 (100%)
desktops	286(77.9%)	81(22.1%)	45	138(48.9%)	144(51.1%)		367 (100%)
Computer accessories	303(82.6%)	64(17.4%)	-	82(27.1%)	43(14.2%)	178(58.7%)	367 (100%)
TV/Radio	149(40.6%)	218(59.4%)	3	126(85.1%)	22(14.9%)		367 (100%)
modems	192(52.6%)	174(47.4%)	2	37(19.4%)	154(80.6%)		367 (100%)
others	37	-	-	21(56.8%)	16(43.2%)		367 (100%)

Source: survey result 2020

4.2.3.2. Disposal Practice of e-waste management

In this study, the respondents were asked how they observed the problem of e-waste Management. From 367 respondents 318 or 86.6 percent of them were said that there is a problem of the disposal of e-waste management. The question answered who said Yes the researcher raised how observed the problem. Most of the respondents informed that they just kept in stores, give them for government property disposal agency, sell to repairers and burning with other waste.

The researcher found that there are serious drawbacks in the practice of proper e-waste management in the government offices. This may be due to insufficient awareness and carelessness from different stakeholders. In this study survey result, due to inadequate waste collection services and lack of awareness, wastes were kept at store, open space and/or burned openly with other solid waste. Such actions contribute a lot to environmental pollution and human health problems because e-waste have different hazardous chemicals.

Figure 4.1: methods of disposal of e-waste practiced in government offices



The fig 4.1 From those respondents those who keep at store is 174 (47%), sell to repairer or recycler is 62(17%), burning with other waste 36 (10%), dumped in designated places 33(9%) dump it with other wastes 25(7%), other means 24 (6%), and dump in the river 13 (4%). From this we can understand that because of unavailability of disposal site and inadequate e-waste

collection system, most of the government employees forced to dispose their wastes un wisely. According to the researcher's personal observation and the responses from interviewees, the employees have low awareness about e-waste. The waste collectors are not properly managed.

4.2.3.3. Solid waste separation practice of e-waste management at government office level

Significant number of the respondents 140(38.1%) confirmed that solid waste separation issue did not apply in their office. 227(61.9%) from 367 respondents stated that they collect and stored their solid waste separately based on its nature.

Respondents who did not apply solid waste separation based on its nature issue were asked why they did not practice it. The respondents given reasons for not applying waste separation in their office were different. According to table 4.9 38% from 367 respondents stated that they collect and stored their solid waste separately based on its nature but 62% of employees do not separate according to the nature and categories of the waste. 42.7% of respondents said that their reason is lack understanding or knowledge about solid waste separation,18.1% of government employees do not think that it is not their responsibility and 39.2% of the employees they are not considering the importance of waste separation was the main reasons of the respondents.

Table4.9: reasons why the government office employees did not separate their waste at source

Reasons for not separate waste from the source	frequency	percentage
I don't have the understanding about waste separation	97	42.7
I do not consider it is my responsibility	41	18.1
I did not visualize the importance of separation	89	39.2
total	227	100

Source: survey result 2020

4.3. Strength and Challenge of E-waste management

4.3.1. Strength of E-waste management in Study Area

The government of Ethiopia has adopted the International Environment Convention which is the basal convention on the control of transboundary movement of hazardous wastes and their disposal 1992. According to expert interview the Ministry of Environmental, Forest and climate change of Ethiopia has formulated a new rule and regulation on Management and Disposal of Electrical and Electronic Waste under the Environmental Pollution Control Proclamation. Another one different development organization like Pesticide Action Network(PAN) Ethiopia and United Nations Industrial Development Organization(UNIDO) there were doing about generation and e-waste management project with the Ministry of Environment Forest and Climate change .This program initiated for another development organization to do the management of e-waste for protecting the faster growing technology before damaging the environment and human health and also raised awareness for different stakeholder. Another strength was some of the respondent of repairer they were start to used protective equipment for their health.

4.3.2. Challenge of E-waste management in Study Area

The environmental degradation challenge was different and e-waste is new and faster growing waste in the world. According to the respondent of the government offices, interview guide and personal observation: lack of awareness, disposal site, absence of specific e-waste law, lack on data, shortage of manpower and absence of e-waste collector were the prior challenge of e-waste management in the study area. According to the respondent from the offices, interview and personal observation that there were lack of awareness. And anybody told them about e-waste is hazardous or toxic as well as any other information directly related rather informed about other issues.

The other one there were one system for collecting method of e-waste. Questioner guide of respondents from government institutions responded that there is no proper storage facility for e-waste in particular rather they inform the agency come and collect trucks and other big

properties. Almost significant number of the respondent and discussion there were not disposal site alternative to drop e-waste separate place.

Interview guide from the staff member Addis Ababa environmental protection Authority and solid waste management of the Sub city respond about the challenge of e-waste there were not specific law and regulation as well as lack strategies and proclamation how to manage electronic waste(e-waste). there is lack on manpower such as management expert for hazardous waste in general e-waste specifically.

This can be expressed by the contamination of human, surface and ground water through leaching, soil contamination through direct waste contact or leaching, air pollution by burning of wastes this lead to environmental degradation and impact on human health.

4.4. Factor that Affect Awareness, Attitude and Practice of Government office

4.4.1. E-Waste Management: Descriptive Analysis

In this section, the researcher used various statistical tools in order to test the relationship between independent variables and dependent variable. T- test was applied to determine the relation or association between the dependent variable and continuous independent variables (employees age, and Main road from the office (location)). Chi-square tests were performed to find out the relations or strength of association between awareness, attitude and practice of the institution e-waste management and categorical independent variables (employees sex, educational level of the employees, the enforceability of the hazardous waste laws and regulations, the training or lesson taking employees about e- wastes, perception of disposal site, and institutions access to private waste collectors services). Since some of the determinant factors are more of qualitative such as manpower, and waste collection facilities, they are discussed or analyzed qualitatively. Therefore, for triangulation purpose the data collected from the staff of solid waste management sector are analyzed using both qualitative and quantitative methods of analyses.

4.4.1.1. Demographic Factors

Demographic factors are one of influence factor on government institution e-waste management practices. Since it mainly focused on people's awareness, attitudes and the patterns of waste handling with sex, educational status, and work experience of government employees towards e-waste management practice.

Sex of employees -employees sex is indicated as one of demographic factor that influence the status of government office waste management system. Employees sex is factors on awareness, attitude and practice of e-waste management at government office level. From 367 respondents the employees are 238(64.9%) of them are male and 129(35.1%) respondents are female government workers. Table 4.10 indicate the government office survey indicates there is relationship between employees' sex and awareness, attitude and practice of e-waste management. Majority of the respondents (64.9%) are male employees. However, a comparison made between offices, who aware on e-waste management and lack on e-waste management, positive attitude and negative attitude, good practice and poor practice with regard to sex revealed that relatively. For instance, the awareness of employees with sex were 37.8% of employees who aware on e-waste management is found to be male employees, whereas, 15% female employees. 62.2% male employees and 85% of female there is no awareness on e-waste management. According to the data there is relationship between awareness and employees sex. A result of chi-square statistics also verifies the existence of significant relationship between offices awareness and attitude on e-waste management at 1% and 5% significant level respectively. The result that the sex of averagely large number of employees who aware on e-waste management are male and lack on e-waste management is female government employees.

Table4.10: Sex of employees

Awareness on sex	awareness	No awareness	Total (Frequency and %)	Chi-Square	P Value
Male	91(38.2%)	147(61.8%)	238 (64.9%)	9.134	.003
Female	7(21%)	102(79%)	129(35.1%)		
Total	98(32.2%)	249(67.8%)	367 (100%)		
Attitude on sex	Favorable	Unfavorable	Total	Chi-Square	P Value
Male	181(76%)	57(24%)	238 (64.9%)	4.714	.030
Female	72(56%)	57(44%)	129(35.1%)		
Total	253(61%)	114(31%)	367 (100%)		
Practice on Sex	Good practice	Poor practice	Total	Chi-Square	P Value
Male	82(34.5%)	156(65.5%)	238 (64.9%)	1.080	.299
Female	36(28%)	93(72%)	129(35.1%)		
Total	118(32.2%)	249(67.8%)	367 (100%)		

Source: survey result 2020

Educational Level of government employees -The educational level of sample respondents ranges from illiterate to masters' level. Table 4.11 indicate that from the total of 130 respondents 2.3% are illiterate, 7.7% have certificate, 17.7% have diploma, 66.2 % have university degree and 6.2% have masters. Moreover, the researcher made a comparison between the government employees education level and its awareness on e-waste management. when the employees educational level improves, the awareness of government employees' e-waste management level also improves. The result shows from the total samples the awareness of e-waste management is improved from illiterate to higher education. In the government institutions, 3(30%) of certificate, 10(43.5%) of diploma, 20(23.3%) of degrees, 7(87.5%) of masters' government employees are aware about e-waste management. whereas, 3(100%) of illiterate, 7(70%) of certificate, 13(56.5%) of diploma and 66(76.7%) of degrees of government employees have no awareness. Furthermore, when the educational status of the government employees is compared with government employees sex, males are better educated than

females. Overall, the trends between government institution educational level and the awareness, attitude and practice of e- waste management at government institution level there is a relationship. As shown in the table 4:11, indicate that the awareness, attitude and practice with education level there is significant relationship between them. The finding from government institution survey is further strengthened by Pearson chi-square test demonstrating a significant relation at 1% level between educational level and awareness and attitude were as 5% relation between practice on e-waste management and government employees educational level.

Table4.11: government employees' educational status of awareness, attitude and practice

awareness	Awareness	No awareness	Total (Frequency and %)	Chi-Square	P Value
illiterates	—	9(100%)	9(2.5%)	31.402	.000
certificates	10(30%)	24(70%)	34(9.3%)		
diplomas	26(43%)	35(57%)	61 (16.6%)		
degrees	56(23.6%)	181(76.4%)	237(64.6%)		
masters	23(88.5%)	3(11.5%)	26(7.1%)		
Total	115(31.3)	252(68.7%)	367 (100%)		
Attitude	Favorable	Unfavorable	Total	Chi-Square	P Value
illiterate	3(33.3%)	6 (66.7%)	9(2.5%)	27.479	.000
certificates	21(61.8 %)	13 (38.2%)	34(9.3%)		
diplomas	35 (57.4%)	26 (42.6%)	61 (16.6%)		
degrees	160(67.5%)	77(32.5%)	237(64.6%)		
masters	20(76.9%)	6(23.1%)	26(7.1%)		
Total	239(65.1%)	128(34.9%)	367 (100%)		
Practice	Good practice	Poor practice	Total	Chi-Square	P Value
illiterate	2(22.2%)	7(77.8%)	9(2.5%)	8.268	.041
certificates	13 (38.2%)	21(61.8 %)	34(9.3%)		
diplomas	21(34.4%)	40(65.6%)	61 (16.6%)		
degrees	77(32.5%)	160(67.5%)	237(64.6%)		
masters	3(11.5%)	23(88.5%)	26(7.1%)		
Total	116(31.6%)	251(68.4%)	367 (100%)		

Source: survey result 2020

Experience of government employees- The selected government employees constitutes various experience groups from the minimum of one to the maximum of fourteen years. Besides, the mean experience of government employees who had awareness and lack of awareness, on e-wastes management is found to be 34.63 and 41.43years respectively. Further the t-test also shows that there is significant relationship between employees' awareness and employees age. Table:4.12 as per the data obtained from statistical tests, employees age and awareness on e-waste management have a significant negative relationship at 1% level. It implies that when the employees age increases the awareness of government employees on e-waste management would be decreases.

Table 4.12: experience of government employees

Awareness	N	Mean	Std. Deviation	t-test	P-value
Yes	111	34.63	9.764	-3.814	.000
No	256	41.43	9.923		
Attitude	N	Mean	Std. Deviation	t-test	P-value
Yes:	249	38.56	10.666	-1.5.4	.135
No	118	41.21	9.485		
Practice	N	Mean	Std. Deviation	t-test	P-value
Yes:	92	39.24	11.124	-.178	.859
No	275	39.57	10.039		

Source: survey result 2020

4.4.1.2. Socio –Cultural Factors

Socio-cultural factors are one of influence factor on government employees waste management practices. Since it mainly focused on people's awareness, attitudes and the patterns of waste handling, specifically, on the distance of the office's or location from the main road, government institutions' awareness, attitude and practice towards solid waste in general and e-waste in specific management practice.

Distance from the Main Road (Location) -The distance of institutions (offices) from the main road expected to have an impact on awareness, attitude and practice on e-waste management at institution(office) level. It implies that the far the distance of office buildings from the main

road, the lower level of awareness, attitude and practice. The total sample government employees, who aware of e-waste management were working 5-70 meters near from the main road or storage house, whereas, from those none aware of e-waste management groups were living 3-100meters were working far from the main road. The highest the distance in meter the less too aware of e-waste management. The other implication is when the employees working location far from the center, the employees might be encouraged to dispose wastes on free space, on corridors or in the compound. In other words, the far areas by itself invite the employees to dispose their wastes in careless way. Moreover, table 4.13 a t-test shows that a significant negative relation awareness with distance from the main road of the institution(office) at 1% level were as practice to distance from the main road of institution(office) at the 5% level.

Table4.13: Main road(stores) from office buildings

Awareness	N	Mean	Std. Deviation	t-test	P-value
Yes	111	83.72	153.485	3.758	.000
No	256	210.57	190.142		
Attitude	N	Mean	Std. Deviation	t-test	P-value
Yes:	249	123.07	154.114	1.942	.054
No	118	270.58	211.080		
Practice	N	Mean	Std. Deviation	t-test	P-value
Yes:	92	87.98	131.530	2.543-	.012
No	275	207.74	197.467		

Source: survey result 2020

4.4.1.3. Institutional Factors

There are different problems that influence e-waste management in the government institution (office). Institutional factors are the main that highly influence e-waste management. In this section, the researcher investigated the influence of institutional factors on awareness, attitude and practice of e-waste management; particularly, it includes law and law of enforcement, Training or information for different stakeholder and accessibilities of e-waste collectors.

Law and Law of Enforcement-This variable law and law of enforcement is expected to have a positive relation with the awareness on e-waste management at government institution (office)

level. The government of Ethiopia has adopted the International Environment Convention which is the basal convention on the control of transboundary movement of hazardous wastes and their disposal 1998, and has issued policy, proclamations, laws and regulations on the general solid waste management and protection of the environment. The Addis Ababa city government has also issued regulation in conformity with the federal proclamations' objective to protect the environment, and to ensure the sustainable requirements of health, social and economic issues. According to expert interview the Ministry of Environmental, Forest and climate change of Ethiopia has formulated a new regulation on Management and Disposal of Electrical and Electronic Waste under the Environmental Pollution Control Proclamation. In other words, if the employees have awareness on the existence of solid and hazardous waste related laws and regulation and also the municipality apply it, at least the rate of unauthorized site disposal would be minimized. Therefore, to know whether the employees were aware about the existence of solid and hazardous waste related laws and regulations in the town and to what extent in which they are enforced or applied in to ground, selected respondents were asked questions.

Table4.14: Respondent awareness on policy, regulation and rules of waste and Environmental pollution control of waste

Question	Yes	No	I don't know	Total
Do you know policy of environment	81(22.1%)	286(77.9%)	—	367(100%)
Are you aware of government regulation on waste management	13(3.5%)	354(96.5%)	—	367(100%)
Do you have rules guiding your activities in your office?	230(62.7%)	137(37.3%)	—	367(100%)
Are the rules compliance with government regulation for waste management?	14(6.1%)	124(53.9%)	92(40%)	367(100%)

Source: survey result 2020

Government employees' awareness about the existence of wastes related policy and regulation and its enforceability was one of the researcher question. Table 4.14 about 77.9% of the respondents respond that they did not know even whether the waste related laws and regulations

are available in the country or in Addis Ababa. The rest 22.1% of the selected employees stated that they knew about the presence of laws and regulation. Besides, the sample respondents who said “yes” (those who are aware about the availability of waste related law and regulation) were asked how they evaluate the practice enforceability of laws and regulation in their office. The respondents also asked about whether there are guidelines related to waste management and compliance with the government rules 62.7% of the respondents respond that there are no rules in their office and 37.3 % they don’t know whether there is regulation or not.

Table :4.15 shows that from the total respondents only 70 % of them stated that the enforceability of regulation is weak. It implies that they did not observe any penalty related action, which is taken by the municipality because of illegal solid waste in general or e-waste in specific disposal practice. The staff members were also asked these two questions via interview (i.e. the availability of law and its enforceability). Their responses were: Environmental pollution control proclamation were designed or developed since 2002. With regard to its enforceability, in principle, it has two steps: warning and then penalize the violator of laws. According to the response of the interviewees, this enforceability of regulations is now a day better than the previous but in the case of e-waste there is lack availability of law and enforceability. From this one can understand that since awareness creation and improper disposal of on the existence of waste laws and regulation and its enforceability are very poor, it is one of a serious cause or constraint for the performance of e-waste management in the study area.

Table 4.15: Gov’t regulation or enforcement on e-waste management

How effectively are the rules enforced?	frequency	percentage
Very weak	12	3.3
weak	258	70.3
fair	97	26.4
total	367	100

Source: survey result 2020

On the case of lesson associated with e-waste management table: 4.16 indicate that the significant number of the respondents were not lesson taking about any e-waste management (92.3%) and very small number of government employees who were taken the lesson (7.7%).

As far as, the general solid waste is concerned, in the city of Addis Ababa a lot of awareness rising activities are taking place through television, radio and by solid waste management expert to sound solid waste management but not to any specific hazardous waste like E-waste. However, their impact in terms of creating critical mass that can take action on the ground is minimal. The finding from government employees survey is further strengthened by Pearson chi-square test demonstrating a significant positive relation at 1% on lesson taking on e-waste management with awareness, attitude and practice on e-waste management.

Table4.16: Comparison between Lesson associated with awareness, attitude and practice of e-waste management

Awareness	Taking training	Not taking training	Total (Frequency and %)	Chi square	P-value
Yes	19(70%)	6(30%)	27(7.4%)	16.031	.000
No	59(17.4%)	281(82.6%)	340(92.6%)		
Total	78(22%)	287(78%)	367(100%)		
Attitude	Favorable	Unfavorable		Chi square	P-value
Yes	22(81.5%)	5(18.5%)	27(7.4%)	.257	.462
No	225(66.2%)	115(33.8%)	340(92.6%)		
Total	247(67.3%)	120(32.7%)	367(100%)		
Practice	Poor practice	Good practice		Chi square	P-value
Yes	16(59.3%)	11(40.7%)	27(7.4%)	4.135	.032
No	78(23%)	262(77%)	340(92.6%)		
Total	94(25.4%)	273(74.6%)	367(100%)		

Source: survey result 2020

Accessibility of E-Waste Collectors Service- Currently, there are formal e-waste collection systems in Ethiopia. Computer Refurbishment and Training Centre (CRTC) takes back

computers that it distributes in Ethiopia. Once one of the end-of-life computers is brought back to the Centre, it will be sent to the DMF for dismantling. According to the interview from CRTC employee this center receives from offices of the federal government delivered used and obsolete office equipment to the DMF like devices such as computers, TVs, uninterruptible power supplies, mobile phones, typewriters, printers and copy machines and etc. Besides this the center the end-of-life EEE of receives from different development organization. But the institutions(offices) end-of-life EEE or workless e-waste does not take away from offices. There is no significant informal e-waste collection developed in Kirkos government offices. The facts that general e-waste volumes – in particular from Kirkos government offices are still high. Even if by lack of awareness the employees generally do not give away obsolete devices for the CRTC because they are still considered as valuable for technicians in the office and the CRTC workers takes what need and informed to take.

Table 4.17: are the existing e-waste collectors enough?

are the existing e-waste collectors enough?	Frequency	Percent
Yes	82	22.3
No	285	77.7
Total	367	100

Source: survey result 2020

According to the table:4.17 number of existing e-waste collectors at government institution (office) 77.7% of the respondents stated that it is not enough. But 22.3 % of them said that they are adequate in number. Besides, the respondents who said “Yes” also stated that: CRTC or DMF e-waste collectors are not well organized to handle the whole government offices of the city and also they were not informed by the employees properly on time plus not prepared as the working or obsolete (e-waste) equipment.

Table 4.18: Separate disposal site service need for e-waste management

Variable	Yes	No	awareness		Attitude		Practice	
			Chi square	P value	Chi square	P value	Chi square	P value
Separate disposal site service need for e-waste management	306(83.4%)	61(16.6%)	5.099	.008	4.198	.013	18.189	.000

Source: survey result 2020

There is no hazardous waste disposal site within Ethiopia. Cement kilns represent the only potentially-feasible and domestically-available hazardous waste disposal capacity. As the kilning stage requires very high operating temperatures, the process could theoretically be used to destroy certain types of organic pollutants contained in some e-waste fractions (Manhart et. al, 2013). Table 4.20 the survey indicates that 83.4 % of government employees were said there is need of separate disposal site for e-waste while 16.6% of government employees there don't need for e-waste disposal site. there reason were they don't have the understanding and the use of separating them.

Source of Information- Information related question also raised to questioner for government employees and the staff members of solid waste sector by means of interview. According to the table:4.22 92.3% of the respondents they were not got information about e-waste management. And 7.7% of government employees were the source of information is from health institution, meetings, experts and other means like media and books. The findings from these staff members also confirmed that the government by itself did not provide any information or orientation to. The main reason of the municipality for not delivering information to the employees by its staff was lack of attention and manpower. On the other hand, the government employees are facing awareness or understanding related problem. Therefore, in order to solve these results, it is important to discuss from different stakeholder about information of e-waste management, specifically, for IT specialists of the offices.

Table4.19: source of information about EWM practice

source of information about EWM practice	Frequency	Percent
They have no awareness	340	92.6
From health institution	13	48.1
From meetings	3	11.1
experts	6	22.2
Other means	5	18.5
Total	367	100

Source: survey result 2020

Awareness, attitude and practice of electrical and electronic waste management

Econometrics Analysis

Based on the bivariate result, those variable had significant association with awareness attitude and practice of e-waste management. Variable entered in to the model include sex, age, education, main road from office area, training about e-waste management, disposal site, enforcement of government and private e-waste collector service. Among the variable include in the binary logistic model, as show in Table: For awareness Age, education level of the government employees, main road from office and access of disposal site for attitude, education, main road from office, access to disposal site, enforcement of government and for practice main road from resident area, disposal site, and private e-waste collector service had significant relationship on awareness, attitude and practice of e-waste management in study area.

Multicollinearity effect and goodness of fit

Multicollinearity is the inter correlation of independent variable that can lead the predictor variable to biased estimates and inflated the standard error. In the Model, it can be assessed using

tolerance and Variance Inflation Factor (VIF), which build in the regression of each independent variable in the equation (Garson 2009). Thus in this study the test result was insignificant and model adequately fit the data.

Multicollinearity test had been taken to check between interpreting the result. Multicollinearity refers to excessive correlation of the predictor variables, as common when tolerance is less than 0.2 the problem with multicollinearity is indicted, whereas, when VIF (variance Inflation Factor) is greater than 4 indicate that there is a multicollinearity problem). As indicated in appendix table, the VIF and the tolerance of all variables are less than 4 and greater than 0.2 respectively this show that there is no multicollinearity problem and we can proceed to interpret the result (Garson,2009)

The overall model goodness fit a binary logistic regression can be assessed using the Hosmer and Lemeshow test. A finding of non-significant of this test shows that the model adequately fit the data. If the Hosmer and Lemeshow goodness fit test statistic is greater than 0.05, the models estimates fit the data an accept able level. But if the significant of the testis small ($P < 0.05$), then the model does not adequately fit the data (Garson,2009). Thus, in this Study the test result was significant and model adequately fit the data. Table:4.1 Result of model on awareness, attitude and practice

Result of logistic regression analysis of Awareness on E-waste management

The analysis test result revealed that the predator variable that significant effect on awareness of e-waste management were found to be

Age of government employees

Education of government employees

Distance from the Main Road (Location)

Electronic and Electrical waste disposal site

Table:4.20 Logit result of awareness on e-waste management

Variable	Awareness		
	B	Sig	Exp(B)
Sex			
Male(RC)			
Female	-1.117	.114	.327
Age	-.103	.003	.902
illiterate	-1.575	.206	.207
certificates	-4.414	.004	.012
diplomas	-.783	.310	.457
degrees	-2.32	.004	.012
masters		.021	
Fmis	-.112	.514	.894
Mainro	-.005	.013	.995
Private e-waste collectors			
Yes	.556	.419	1.744
No(RC)			
Training			
Yes	2.230	.103	9.303
No(RC)			
Government enforcement			
Yes	.749	.404	2.115
No(RC)			
Access of disposal site			
Yes	2.618	.002	13.715
No(RC)			
Incomhh	.000	.152	1.000
Constant	3.181	.019	24.064

Source: survey result 2020

Sig at P<0.05 sig at P< 0.01 sig at P< 0.001

Age of Employees had significant association with awareness on e-waste management. As the respondent age increases the, awareness of e-waste management decreases. According to the table 4.21 can be interpreted as increase the age of employees increase by one year the possibility of awareness of e-wastes management decreases by 6.2%. This is may be due to their education level among the employees.

Education of Employees - Education level was found to be statistically significant factor for awareness of e-waste management. As the multivariate analysis result indicate on table 4.2, the likelihood of e-waste management awareness among of certificates was 67.3 percent less likely to be aware of e-waste management as compared to higher education. In other word, higher education more likely to be aware of e-waste management. As respondent educational level is increases, the awareness of the employees is increases. In light of this, it was estimated that office with more educated individual have a chance of awareness its e-waste than uneducated one. As hypothesized, the coefficient of government education in the model result was found to be significant at 1% level. It indicated that more educated employees are better awareness and management of their e-wastes than the rest. This result fits to this existed theoretical evidence that educational improvement could leads to household's awareness about the impact of inappropriate solid and hazardous waste management on environment and human health.

Electronic and Electrical waste disposal site in the study area: -Perception of employees for disposal site had significant association with awareness of e-waste management. Disposal site was found to be statistically significant factor for awareness of e-waste management. As the multivariate analysis result indicate on table 4.21, respondent who perceive there is need of disposal site were 10.3 time more likely to have aware towards e-waste management as compared to those respondent perceive there is no need of disposal site. The employee's perception about disposal site and awareness of e-waste management in the model result was found to be significant relationship at 1%, level for awareness of e-waste management.

Result of logistic regression analysis of Attitude on E-waste management

In a similar way to awareness of e-waste management, here also multivariate analysis was applied to examine each effect of the independent variable on the attitude of household towards

e-waste management and to see the direction of its association. the dependent variable, attitude was dichotomized and coded as 0 for unfavorable attitude and 1 for favorable attitude. Multicollinearity effect among the included variable was tested and VIF (variance Inflation Factor) was less than the cut off value (≥ 4) the tolerance is greater than 0.2. Hosmer and Lemeshow goodness of fit test significant ($p > 0.05$) confirmed that the model adequately fit the data. The analysis test result revealed that the predictor variable that significant effect on attitude of e-waste management were found to be

- Education
- Distance from the Main Road (Location)
- Access to Electronic and Electrical waste disposal site Table:4.22 Logit result of attitude on e-waste management

Variable	Attitude		
	B	Sig	Exp(B)
Sex			
Male(RC)			
Female	-.308	.498	.735
Age	-.042	.081	.959
illiterate	-3.606	.000	.027
certificates	-2.455	.001	.086
diplomas	-2.577	.000	.076
degrees		.000	
masters		.000	
Fmis	.063	.646	1.065
Mainro	-.005	.000	.995
Private e-waste collectors	-1.062	.104	.346
Yes			
No(RC)			

Training			
Yes	.082	.933	1.085
No(RC)			
Government enforcement			
Yes	-1.104	.123	.331
No(RC)			
Access of disposal site			
Yes	2.376	.005	10.766
No(RC)			
Incomhh	.000	.560	1.000
Constant	5.457	.000	234.404

Source: survey result 2020

Sig at P<0.05 sig at P< 0.01 sig at P< 0.001

Education level of employees: -Education level was found to be statistically significant factor for awareness of e-waste management. As the multivariate analysis result indicate on table 4.2, the likelihood of e-waste management attitude among resident of illiterate was 86.3% less likely to be favorable attitude of e-waste management as compared to degrees and masters, the likelihood of e-waste management attitude among employees of certificates was 76.4% less likely to be favorable attitude of e-waste management as compared to degrees and masters, the likelihood of e-waste management attitude among employees of diplomas was 78.2% less likely to be favorable attitude of e-waste management as compared to degrees and masters. In other word, degrees and masters more likely to be favorable attitude as compared to illiterate, certificates, and diplomas on e-waste management. As respondent educational level is increases, the favorable attitude had improved among employees. Employees educational level in the model result was found significant at 1% level. It indicated that more educated employees are better favorable attitude in the management of their e-wastes than the rest. In other words, the level of education attained by the employees had a significant effect on the positive attitude of e-waste management at government offices.

Distance from the Main Road (Location): - Distance from the main road to office is the one that affect the e-waste management. In this study, distance was hypothesized as the employees could be encouraged to disposed-off their e-wastes in unauthorized place while the employees' living area near from the main road the attitude of the employees is better than far to the main road because according to the study area the nearest the office easily available to get by solid waste management expert and communication of society and The attitude, were negative relationship with distance from the main road. As expected, this variable is significant at 1%. Level with negative sign. It indicated that households who are living relatively near to the main road have a chance to favorable attitude their e-wastes management than the one who live relatively far from main road. Table 4.22 can be interpreted as increase the distance of household's residence from the main road by one meter increase the possibility of favorable attitude on e-wastes management at household level decreases by 0.5 %. Therefore, increase the probability of disposed-off e-wastes in unauthorized or inappropriate place by the office as the distance from the main road increase.

Electronic and Electrical waste disposal site in the study area: -Perception of employees for the need of disposal site had significant association with attitude of e-waste management. As respondent if there were disposal site the favorable attitude of e-waste management at the office can be improved. Because if there is a disposal site the household if there were no interest or feeling to dispose properly it is meaningless. According to the table:4.22, respondent who perceive there is need of disposal site were 12.6 time more likely to have favorable attitude towards e-waste management as compared to those respondent perceive there is no need of disposal site. The employees' perception about disposal site and attitude of e-waste management in the model result was found to be significant relationship at 1%, level for attitude of e-waste management

Result of logistic regression analysis of Practice on E-waste management

In a similar way to awareness and attitude of e-waste management, here also multivariate analysis was applied to examine each effect of the independent variable on the practice of employees towards e-waste management and to see the direction of its association. The dependent variable, practice was dichotomized and coded as 0 for poor practice and 1 for good

practice. Multicollinearity effect among the included variable was tested and VIF (variance Inflation Factor) was less than the cut off value (≥ 4) the tolerance is greater than 0.2. Hosmer and Lemeshow goodness of fit test significant ($p > 0.05$) confirmed that the model adequately fit the data.

The analysis test result revealed that the predictor variable that significant effect on practice of e-waste management were found to be

- Distance from the Main Road (Location)
- Electronic and Electrical waste disposal site
- Access to Private Electronic and Electrical Waste Collectors service

Table 4.23 Logit result of practice on e-waste management

Variable	Practice		
	B	Sig	Exp(B)
Sex			
Female	-.326	.527	.722
Male(RC)			
Age	.024	.530	1.014
illiterate	-1.523	.193	.218
certificates	-.320	.216	.538
diplomas	-.857	.181	.424
degrees	-.823	.407	
masters		.132	
Fmis	.061	.638	1.063
Mainro	-.004	.021	.996

Private e-waste collectors			
Yes	1.574	.003	4.827
No(RC)			
Training			
Yes	.303	.700	1.353
No(RC)			
Government enforcement			
Yes	.694	.283	2.003
No(RC)			
Access of disposal site			
Yes	1.400	.022	4.055
No(RC)			
Incomhh	.000	.495	1.000
Constant	-1.762	.105	.172

Source: survey result 2020

Sig at $P < 0.05$ sig at $P < 0.01$ sig at $P < 0.001$

Distance from the Main Road (Location): -Among the explanatory variables, distance of the office from the main road is the one that affect the e-waste management. In this study, distance was hypothesized as the could be encouraged to disposed-off their e-wastes in unauthorized place while the employees living area far from the main road The practice were negative relationship with distance from the main road. The far office building practice of e-waste management they were not access to manage the waste it is encouraged to disposed-off their e-wastes with municipal solid waste river and unauthorized place. As expected, this variable is significant at 2% with practice. Table 4.23 can be interpreted as increase the distance of office from the main road by one meter increase the possibility of good practice on e-wastes management at government office level decreases by 1 %. Therefore, increase the probability of disposed-off e-wastes in unauthorized or inappropriate place by the employees as the distance from the main road increase.

Electronic and Electrical waste disposal site in the study area: - Perception of employees for the need of disposal site had significant association with practice of e-waste management. As respondent if there were disposal site the proper practice of e-waste management at the government office can be improved. According to the table:4.23, respondent who perceive there is need of disposal site were 3.65 time more likely to have good practice towards e-waste management as compared to those respondent perceive there is no need of disposal site. The employee's perception about need of disposal site and practice of e-waste management in the model result was found to be significant relationship at 3% level.

Access to Private Electronic and Electrical Waste Collectors service: - Access to private e-waste collectors was statistically significant factor that determine respondent practice towards e-waste management. Access to private e- waste collectors, which defined as the accessibility of private door to door e-waste collector's services to the offices. It was hypothesized that the possibility of managing (good practice) e-wastes by employees the presence of accessibility of private e-waste collectors service. This finding give sense with the reality of the study area because, as stated in descriptive part, there is no collection system or container for e-waste, e-waste drop together with other municipal solid waste or simply stored in a store.

CHAPTER 5: CONCLUSION AND RECOMMENDATIONS

5.1 conclusion

In general, as per the objectives of the study and its results the following major findings were made. E-waste is generated because of the dynamic nature of the technology and the growing need for the application of science and technology in our everyday life. However, it is harmful if it is treated and discarded improperly. Hence, recycling of such wastes, thus assumes significant importance from the commercial standpoint while proper disposal is crucial from the health and environment point of view. The current trend of e-waste management of EEEs is not environmental friendly way. And it will result very enormous accumulation of e-waste and will contribute negative externality to the problem of solid waste in city of Addis Ababa. Electronic waste management is being a serious agenda in the world since it is a major cause for environmental pollution and human health risks.

Government institutions(offices) employees' awareness or understanding about e-wastes management is very small. Majority of the (69.2%) of the respondents lack awareness on e-waste management. The disposal knowledge of the was asked to the respondent only 35.4% the respondent of were know the disposal method of e-waste. About 7.7 % of the respondents replied as they got e-waste management related information sources from health institution, meetings, experts and other means. However, like, chi-square result also shows that the awareness of e-wastes management at government institution (office) is influenced by the understanding level of government employees in the city. It implies that government employees who disposed of wastes in unauthorized site have less understanding level than the one who manage wastes. This is because the government employees did not get relevant information that can improve their understanding and motivation. In other words, the solid waste management expert staff also did not provide information to the, particularly about the values of waste management and the negative consequence of improper disposal of e-wastes for environment and health; rather they simply provide information how to separate and dispose solid wastes from their home. If this is so, the government employees may not be initiated to do as per orientation through internalizing the issues because of lack of understanding about the consequences of improper disposal. Mode result of awareness age, education level, location and disposal site service factor that affect e-waste management.

In most case attitude of the people affects the waste management as well as the environment, significant number of government employees were positive attitude to protect the environment. But majority of respondent also not perceive as e-waste are toxic and hazardous to environment and human health and also they distinguish e-waste are useful material. In the cases of e-waste management responsibility 98.5% the EPA office, the government, the offices and dismantle factory in their level are responsible body. This implies that the attitude of the respondent in responsibility favorable. In the model result of attitude education level, location and disposal site service factor that affect e-waste management of the institutions (offices).

The major e-waste materials in government offices at Kirkos sub city includes photocopiers, printers, laptops, desktops, Computer accessories, TV/Radio, modems, UPS and its parts. It implies that, the rate and number of government institution e-waste production are varied depending on the size and type of office (institution) sectors. According to the result, all of the government institutions (offices) have temporary storage in their office or some were in rooms of government buildings for e-waste. However, only 18.5% of them are dispose of by selling to private collector or recyclers and 9.2% of government employees were preferred to burn with other wastes, whereas, 53.9% are kept it at store or designated place. the rest in open space, and dump in river. Thus, all the above discussions can be witnessed that the current situation of e-waste management in the city government institution is very poor and in need some sort of solution. Government employees' awareness or understanding about e-wastes management is very small. Besides, because of lack of understanding, not visualizing the importance of waste separation and assuming as municipality's responsibility, significant number of respondents (63.1%) did not apply solid waste separation at sources. In the model result of practice location, e-waste collection method and disposal site service factor that affect e-waste management of government office level.

From the variables, the employees educational level show significant relationship with e-waste management at government office level with a positive sign. It implies that, the employees who educated more, are better in awareness and favorable attitude to e-waste management than the uneducated ones.

Socio-cultural factors have a significant impact on employees to manage their e-waste management or lack of awareness, attitude and practice of e-waste management. Location

(distance of office building from the main road and warehouse) is significant at 5% level with negative sign. This is because, since the municipality did not assign in warehouse different parts of the city and also waste collectors do not have adequate facilities that help to serve each government institution equally, government employees who are working far from the store (center) are encouraged to dispose their wastes in unauthorized site.

Some the respondents are very interested to manage their e-wastes if they have an access to different e-waste disposal facilities like disposal site, collection service and etc. Most of respondents for not being a user of waste collectors and their office is near to river and road their reason was encourage to dispose on free space. It emanates from lack of awareness. Institutional factors: absence of the facilities, law and regulation with specific e-waste management, accessibility of e-waste collectors and law of enforcement have impact on the awareness, attitude and practice of employees' e-waste management.

Even, according to the study result, institutional factors are a base to the other factors. This is because, there is no storage or container in their compound, those employees who do not have an access of waste collectors, there were forced to dispose of their wastes in unauthorized sites and drop with municipal solid waste.

The staff members of solid waste management expert in Kirkos sub city did not have technical skill that help them to operate the given task and also did not get at least short term training on this specific issue(e-waste). Moreover, even though hazardous waste related law and regulation was designed with the detail procedures of application its enforceability is shown as one factor for the poor performance of the city waste management. Most of the government employees responded as they do not know whether the regulation is existed. This is because, since the government did not seriously follow up the real performance of the hazardous waste related sector and adjust training for staff to improve their skills and understanding by taking as main sector of the city.

The study shows that there are a numerous of issues that surround e-waste management that have not been considered or effectively done towards its proper management. Technological advancement in a rapidly modernizing world, e-waste is increasing rapidly. E-waste is also

imported into Ethiopia in form of second hand computers and finds its way mostly in cyber cafes and government institutions. Despite its fast growth, there are no clear mechanisms put in place by the Ethiopian government to handle it. The level of awareness among the general public on e-waste as well as its implications on the environment and human health is high as a professional but there is a gap in management level and general public. There is therefore the need for awareness creation, sensitization, and education for the general public. Despite the high value of some of the metals found in WEEE, Recycling has been minimal in Ethiopia. There is need for more investment in the business and support of such initiatives.

5.2. Recommendations

Based on the result the following reducing mechanisms are recommended

- All stakeholders like Environment, Forest and climate change commission, Addis Ababa Environmental Protection Authority, Addis Ababa solid waste management organization, NGO and Development organization including the sub city should develop and focus on awareness creation program about the EEE have end of life, toxicity of e-waste for environment and human health and also proper handling on e-waste management by different mechanism such as television, radio, Kebele meeting and etc. Therefore, to solve this problem the responsible body should change means of awareness creation to mitigate negative consequences of improper handling and dumping wastes in unauthorized sites.
- Environment, Forest and Climate Change commission should to be strengthen developing the rule and regulation of e-waste management. The Addis Ababa EPA and other stakeholder also should to be develop a law, specific regulations and also the guideline on e-waste management. This should govern the handling process from collection, transportation, recycling and final disposal. The regulations should give each key stakeholders a clearly defined right and responsibility in the process.
- Promotion of recycling there is need to adopt and promote the 3R system in handling EEE in Ethiopia. This system has been successfully adopted in Asian countries and proved effective; this will enhance waste recycle and treatment. From the proposed cycle, producers sell e-wastes to small peddlers (informal sectors) and Second hand

products are then resold to the market for reuse. E-waste generating Institutions can be encouraging to store their waste for some time and have scheduled pick -ups by CRTC such as DMF. The government through the commission of environment, forest and climate change and environmental protection authority and education should support and increase the number and capacity of WEEE centers in every region especially in urban centers in order to cope with the expected growth of e-waste. This will ensure all the generated waste therefore finds its way into a recycling center. Recovery of valuable items and metals, such as steel and iron, waste plastics, waste metal will also be done.

- E-waste collection mechanisms should be put in place to facilitate the collection of all e-waste from the producer therefore ensuring that all e-waste finds its way to a recycling center.
- E-waste management e-waste management can be done by; the waste generating institutions, Government Entity, third party E-waste, Association of Electronics manufacturers, or Association of processors/Recyclers.as established; government institutions are among the top generators of e-waste. These institutions ought to take responsibility in managing their waste. Procurement procedures of EEE should be well laid out and emphasize on quality. Proper storage, collection, record keeping, and transportation of the generated WEEE should be well stipulated.

REFERENCES

Ajzen, I., and Fishbein, M. 2008, Understanding Attitudes and Predicting Social Behavior.

New Jersey: Prentice-Hall. Approaches (3rd ed.). London, UK: SAGE, Publications, Inc.

Andreas, M. (2013) the E-Waste Problem (StEP) Initiative Green Paper, E-waste Country Study Ethiopia, Öko-Institution. VSolving <http://www.step-initiative.org/publications/>.

Babu, B. R., Parande, A. K. & Basha, C.A. (2007). Electrical and electronic waste: a global environmental problem, *Waste Management & Research*, Vol. 25, 307-318.

Baldé, C.P.; Forti, V.; Gray, V.; Kuehr, R.; Stegmann, P. The Global E-Waste Monitor 2017: Quantities, Flows, and Resources; United Nations University: Bonn, Germany; Geneva, Switzerland; Vienna, Austria, 2017.

Basel Convention 1992, Basel Convention on the Control of Trans boundary Movements of Hazardous Wastes and their Disposal. Adopted on 22 March 1989, Entry into force May 1992. [<http://www.basel.int/text/con-e.pdf>]

Basel Convention 2011, Findings from the Basel Convention E waste Africa Program. Advance version: Executive summary. Available at: <http://www.basel.int/>

[Portals/4/Basel%20Convention/docs/pub/Where Are We In Africa](http://www.basel.int/Portals/4/Basel%20Convention/docs/pub/Where%20Are%20We%20In%20Africa.pdf). Accessed date: 18 Oct 2019)

Basel Convention on the control of Trans boundary Movements of Hazardous Wastes and Disposal website. Available from: <http://www.basel.int>. [Accessed 18 September 2018].

Buenker, M. (2007). The New Frontier: E-waste. *Environmental Policy and Law*, 37(1), 22-24

Cairns, C. N. (2005). E-waste and the consumer: improving options to reduce, reuse and recycle.

CEI (2005). E-waste. Available from: <http://www.cei.org/gencon/005,04527.cfm>

Central Statistical Agency 2013, Population Projection of Ethiopia for All Regions At Woreda

Level from 2014 2017. Federal Democratic Republic of Ethiopia Central Statistical Agency.

Cherutich, E. 2013, E-waste Management in Kenya: A Case Study of Mobile Phone Waste in Nairobi. Accessed date: 3 Nov 2015)

Chi, X. 2011, Informal electronic waste recycling. A sector review with special focus on China”, in *Waste Management*, Vol. 31, No. 4, p.731–742.

Cochran, W. G. 1963. *Sampling Techniques*, 2nd Ed., New York: John Wiley and Sons, Inc.

Cynthia S. and Kalyani P., “Study on awareness of e-waste management among medical students”, *International Journal of Community Medicine and Public Health*, Vol. 4, 2,pp. 506-510, 2017.

Davis, G., & Heart, S. (2007). Electronic waste: The local government perspective in Queensland, Australia. *Journal of Resources, Conservation and Recycling*, 52(8-9),

EU Directive. Directive 2002/96/EC, on WEEE (Waste Electrical and Electronic Equipment. Available from: http://ec.europa.eu/environment/waste/weee/legis_en.htm [Accessed 24September 18, 2018].

Edwards, S. 2011, E-waste Inventory in Four Cities of Ethiopian Bahirdar, Direedawa, Hawassa and Addis Ababa. Pesticide Action Nexus Association(PAN-Ethiopia) PAN-Ethiopia with Federal Environmental Protection Authority Addis Ababa. Ethiopia.

Environmental Protection Authority 1997, Environmental Policy, Federal Democracy Republic of Ethiopia.

EU Directive 2002/96/EC, European parliament and of the council of 27 January 2003 on waste electrical and electronic equipment (WEEE). Joint declaration of the European parliament, the council and the commission relating to article 9. Official Journal L037:0024-39 [13/02/2003; 2002a <http://europa.eu.int/eur-lex/en/>. Accessed date: 18 Oct 2019).

Federal Democratic Republic of Ethiopia 2002, Environmental Pollution Control Proclamation,

Pro. No.300/2002, Addis Ababa.

Federal Democratic Republic of Ethiopia 2007, solid waste management proclamation, Pro. No. 513/2007, Negarit Gazita <https://www.epa.gov.et/> Accessed date:10 Feb 2,2018).

Israel, Glenn D. 1992. *Sampling The Evidence of Extension Program Impact*. Program Evaluation and Organizational Development, IFAS, University of Florida. PEOD-5. October.

Gamba, R., and Oskamp, S. (2004). Factors Influencing Community Residents ‘Participation in Commingled Curbside Recycling Programs. Environment and behavior, 26: 587-612

Greenpeace. (2008). Switching on Green Electronics: E-waste-„not in my backyard. Retrieved March,2018,fromGreenpeace,website:<http://www.greenpeace.org/raw/content/international/press/reports/Switching-on- Green Electronics>.

Habtamu, E. 2006, Adoption of physical soil and water conservation structures in Anna watershed, Hadiya zone, Ethiopia.

Hannah 2009, An Assessment of knowledge Attitudes and Practice toward waste management among Ngombe Residents. The University of Zambia Lusaka. Accessed date: 15 Feb,2019)

Hischier, R., Wager, P., &Gauglhofer, J. (2005). Does WEEE recycling make sense from an environmental perspective? The environmental impacts of the Swiss take-back and recycling systems from waste electrical and electronic equipment (WEEE) Accessed date: 15 Oct 2018)

Joseph, K. (2006). Electronic waste management in India: Issues and strategies, paper presented at the Eleventh International Waste Management and Landfill Symposium, Cagliari, 1–5October.

LaDou, J. and Lovegrove, S. 2008, Export of electronics equipment waste. Int J Occup Environ Health 14:1–10.

MacDonald, E. & Amos, W. (2008). E-waste management programs and promotion of design for the environment: Assessing Canada’s contributions. RECIEL, 17: 3 319–334 1031–1039’.

Manhart, A., ÖkoInstitut, Tadesse Amera, and Mehari Belay 2013, E-waste Country Study

Ethiopia. Solving the E-Waste Problem (StEP) Green Paper.

Okoye, A., and Odoh, C. (2013), Assessment of the Level of Awareness of E-Waste Management and Concern for the Environment amongst the Populace in Onitsha, Southeastern Nigeria, Journal of Environmental Protection, 2014, 5, 120134 (<http://www.scirp.org/journal/jep>) Accessed date: 15 Oct 2018).

Pichtel, J. (2005). Waste Management Practices: Municipal, Hazardous, and Industrial. Boca Raton, FL: CRC Press.

Robinson, B. (2007), E-waste: an assessment of global production and environmental impacts. Sci Total Environ 408:183–191. Accessed date: 15 Nov 2019).

Robinson, B.H. (2009). “Review: E-waste: An assessment of global production and environmental impacts” in Science of the Total Environment, Vol. 408, pp. 183–191. Available: <http://kiwiscience.com/JournalArticles/STOTEN2009.pdf> [20 Dec, 2018].

Robinson, B., H. (2009). E-waste: An assessment of global production and environmental impacts. Science Rotterdam Convention. n.d. Overview. Available: <http://www.pic.int/TheConvention/Overview/tabid/1044/language/en-US/Default.aspx> [accessed 8 Dec. 2018].

Schluep Met. (2009), *Assessing the e-waste situation in Africa* 1 Sec Ironies Goes Green 2008*. 8-10 September 2008, Berlin/Germany. Accessed: 3rd Oct 2010.

StEP Initiative. One Global Definition of E-Waste; StEP Initiative: Bonn, Germany, 2014.

Sepulveda, A., Schluep, M., Fabrice, G., Strediger, R.M., Kuehr, R.C., Hagelucken, and Andreas C.G. (2009), A review of environmental fate and effects of hazardous substances released from electrical and electronic equipment during recycling: examples from China and India. Submitted to Environmental Impact Assessment Review.

Silicon Valley Toxics Coalition (2004), Poison PCs and Toxic TVs, www.stvc.org (last visited Apr 02, 2016).

Streicher-Porte, M., Widmer, R., Jain, A., Bader, H. P., Scheidegger, R., & Kytzia, S. (2005). Key drivers of the e-waste recycling system: Assessing and modeling e-waste processing in the informal sector in Delhi. *Environmental Impact Assessment*, 25(5), 472-491.

SVTC.(1999).from Greenpeace(2008)available from: www.greenpeace.org/international/campaigns/toxics/electronics:<http://www.svtc.org/clean/c/pubs/sayno.htm>

Schluep, M. (2009). E-waste management in Africa - Rising up the political agenda. Retrieved 28 February, 2019, from e-waste guide, Web site: http://ewasteguide.info/Schluep_2009_RI.

Tadesse Amare (2010), Awareness Raising On E- Waste Management in Ethiopia. Pesticide Action Nexus Association (Pan- Ethiopia) In Collaboration with the International POPs Elimination Network (IPEN). Accessed date: 28 Oct 2018).

Theodros Girma (2010), Assessment of Electronic Waste Management: Case study of some TVET Colleges in Addis Ababa. Addis Ababa University School of Graduate Studies College of Development Studies Institute of environment, water and development.

UNEP. (2005) E-waste, the hidden side of IT equipment's manufacturing and use. *Environment Alert Bulletin* 5.

UNEP. (2007). E-waste Volume II: E-Waste Management Osaka/Shiga, United Nations Environmental Program Division of Technology. Industry and Economics International Environmental Technology Centre. [Accessed October 18, 2018].

Whitney, M., and Webb, C. (2008). *Waste Bytes: Diverting Waste Electrical and Electronic Equipment in Ontario*. Toronto, ON: Canadian Institution for Environmental Law.

Widmer, R., Heidi Krapf, O., Khatriwal, D. S., Max, S., Heinz (2005), Global perspectives on e-waste. *Environmental Impact Assessment Review* 25 (2005) 436 – 458 Accessed date: 18 Oct. 2015) Policy. Management and Research 25, 489-501.

www.addisababa.gov.et/hi/web/guest/kirkos-sub-city (accessed mar.7, 2019)

Appendix I: Questionnaire for sample respondents

QUESTIONNAIRE PREPARED FOR SAMPLE GOVERNMENT INSTITUTIONS

General Guidelines

- I would like to thank you for your kind cooperation in advance

1. Gender: Male ☐ Female ☐
2. Education level: illiterate ☐ Certificate ☐ Diploma ☐ Degree ☐ Masters ☐ Ph.D. ☐
3. Work experience in the organization: (1 -3) years ☐ (4- 6) years ☐
(7 -10) years ☐ >10 years ☐
4. The number of employees in your institution.....
5. The distance between your office from the main road (meter).....

SECTION 2: Generation and Management practice on E- Waste

6. List some of the electronics mainly possessed in your institution

.....

7. In the last five years, have you discarded any of the following equipment (yes/no) if so how many and in what condition? (Tick appropriately)

Generation of electrical/ electronic wastes	Yes	No	Number	Reparable	Non reparable
Photocopiers					
Printers					
Fax machines					
Laptops					
Desktops					
Computer accessories (cables, cartridges, mouse key board)					
Television/radio					
Modems					
Others please specify.....					

8. Do you recover any of the electrical/electronic equipment/components from waste?

Yes ☐

No ☐

9. If your answer is yes, question #8 witch equipment?

Photocopiers ☐ Printers ☐ Fax machines ☐ Laptops ☐ Desktops ☐

Computer accessories ☐ Television/radio ☐ Modems ☐ others (please specify).....

10. Which component do you recycle /recover?

Circuit board ☐ battery ☐ Plastics ☐ switches and flat screens ☐

keyboard ☐ cartridges ☐ wires(cables) ☐ others (please specify).....

11. What do you do with the recovered equipment /component?

Sell to repairers ☐ reuse ☐ sell to collector ☐

12. Which of the following is the model of disposal of e-waste adopted in the institution?

Dump in designated places ☐ dump in river or sea ☐ sell to recycler or repairer ☐
☐ burning/incineration with other waste ☐ keep at store ☐ dump with other waste ☐

13. Does your institution practice waste separation?

Yes ☐ no ☐

14. If your answer is yes, for question #13, how do you separate it? Please specify _____

15. If your answer is, no for question #14, what do you think the reason behind?

I do not have the understanding about waste separation

I don't think as it is my responsibility

I don't know the importance of separation

If any other, please specify.....

16. The existing e-waste collectors are enough?

Yes ☐ no ☐

17. Do you observe any e-waste management problem in your sub city?

Yes ☐ no ☐

18. If your answer is no for question #17 where the institution dispose e-waste?

Please specify.....

19. If your answer is yes for question #17 where you observe? You can choose more than one

E-waste in road ☐ e-waste in river ☐ e-waste burning with other wastes ☐

all of the above ☐ others.....

SECTION 3: Awareness, and Attitude towards E- Waste Management

20. Are you aware of e-waste?

Yes ☐

No ☐

21. What does it mean e-waste? -----

22. How do you explain e-waste management? -----

23. Do you know how to dispose the e-waste?

Yes ☐

No ☐

24. Have you ever come across any form of lesson associated with e-waste management?

Yes ☐

no ☐

25. If your answer is yes for question #25 through what methods (means) did you get?

In health institution ☐

SWM experts ☐

In woreda meeting ☐

If any other.....

26. If your answer is yes for question #26 which one of the following taken the lesson and the level. Please circle your choice.

Lesson taking associated with e-waste management	yes	no	level					Level of transmitting
Importance of appropriate e-waste management			1	2	3	4	5	1=very low, 2=low, 3=medium, 4=high, 5=very high
Disease because of inappropriate waste disposal			1	2	3	4	5	1=very low, 2=low, 3=medium, 4=high, 5=very high
Methods to manage government institutions e-waste effectively			1	2	3	4	5	1=very low, 2=low, 3=medium, 4=high, 5=very

								high
Impact of e-waste on environment			1	2	3	4	5	1=very low, 2=low, 3=medium, 4=high, 5=very high
Any other (please specify).....			1	2	3	4	5	1=very low, 2=low, 3=medium, 4=high, 5=very high

27.What are the causes of e-waste management problem in the sub city? The highest number is the higher cause of e-waste management. Please circle your choice.

Cause of EWM	yes	no	score					Score description
Lack of awareness			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree
Lack of responsibility			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree
Weak controlling system			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree
carelessness			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree
Other, specify.....			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=neutral, 4=agree, 5=strongly agree

28. Did you discuss with others how can you reduce e-waste?

Yes ☐ no ☐

29. Do you know the advantage of reducing waste?

Yes ☐ no ☐

30. If your answer is yes for question #24 what are the advantages of reducing waste?.....
.....

31. Are you aware of policy of environment?

Yes ☐ no ☐

32. Are you aware of government regulation on e-waste management?

Yes ☐ no ☐

33. Do you have rules guiding your activities in the sub city (institution)?

Yes ☐ no ☐

34. If your answer is yes for question #33 are the rules compliance with government regulation for waste management?

Yes ☐ no ☐

35. How effectively are the rules enforced?

Very weak ☐ weak ☐ fair ☐ strong ☐ very strong ☐

36. Are you concerned about your environment like water, soil, vegetation, human health and others?

Not concerned ☐ concerned ☐ very concerned ☐

37. Are you aware of any danger inherent in improper handling and disposal of e-waste?

Yes ☐ no ☐

38. Do you know that some components of electronic devices contain toxic/hazardous materials?

Yes ☐ no ☐

39. If your answer is yes for question #38 are you aware that these toxic/hazardous materials require special treatment for environmentally sound disposal?

Yes ☐ no ☐

40. Does the disposal/ treatment method in use for electronic waste have any effect on the environment?

Yes ☐ no ☐ not sure ☐

41.If you answer is yes for question #40 indicate the part(s) of the environment affected and rate the effect. Highest number is higher effect on environment. Please circle your choice.

Effect on environment	yes	No	level					Level of effect
Effect on land			1	2	3	4	5	1=no effect, 2=weak, 3=fair, 4=strongly, 5=very strongly
Effect on air			1	2	3	4	5	1=no effect, 2=weak, 3=fair, 4=strongly, 5=very strongly
Effect on vegetable			1	2	3	4	5	1=no effect, 2=weak, 3=fair, 4=strongly, 5=very strongly
Effect on surface water			1	2	3	4	5	1=no effect, 2=weak, 3=fair, 4=strongly, 5=very strongly
Effect on ground water			1	2	3	4	5	1=no effect, 2=weak, 3=fair, 4=strongly, 5=very strongly
Effect on human health			1	2	3	4	5	1=no effect, 2=weak, 3=fair, 4=strongly, 5=very strongly
Other, specify----- -----			1	2	3	4	5	1=no effect, 2=weak, 3=fair, 4=strongly, 5=very strongly

41. Does your involvement in handling of/ being in contact with electronic waste have a negative effect on your health?

Yes ☐ no ☐ not sure ☐

42.If your answer is yes for question #41 what is the nature of health hazard? Rate severity.
Please circle your choice.

Nature of health effect	Yes	No	level					Level of severity
headache			1	2	3	4	5	1=very low, 2=low,3=medium 4=high, 5=very high
Body pain			1	2	3	4	5	1=very low, 2=low,3=medium 4=high, 5=very high
dizziness			1	2	3	4	5	1=very low, 2=low,3=medium 4=high, 5=very high
Others specify.....			1	2	3	4	5	1=very low, 2=low,3=medium 4=high, 5=very high

42. What source do you use to obtain information about EWM practice?

TV ☐ books ☐ radio ☐ EPA ☐

From the institution ☐ Training ☐ others, specify.....

43. From the above that you choose, which is the top one that you use the most? -----

44. For the following attitude question given in the table below, please circle your choice.

Attitude question	Yes	no	level					
Do you think E-waste management is useful?			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=fair, 4=agree, 5=strongly agree
AAEPA office is responsible for proper e-waste management			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=fair, 4=agree, 5=strongly agree

Gov't institutions are responsible for e-waste management			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=fair, 4=agree, 5=strongly agree
Repairer and e-waste collectors have responsibilities for e-waste management			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=fair, 4=agree, 5=strongly agree
Upset when you have seen people dumped the e-waste in the river, road and other place?			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=fair, 4=agree, 5=strongly agree
Improper waste disposal is a threat to the environment			1	2	3	4	5	1=strongly disagree, 2=disagree, 3=fair, 4=agree, 5=strongly agree

45.A separate e-waste disposal service need for e-waste?

Yes ☐ no ☐

In your opinion,

46. What do you think the strength of e-waste management in your institution?

.....
.....

47. What do you think the challenge of e-waste management in your institution?

.....
.....

48. What should be done to improve e-waste management?

.....
.....

Thank you!!

Appendix II: Interview open ended questions for the EPA officers

ADDIS ABABA UNIVERSITY
COLLEGE OF DEVELOPMENTAL STUDIES
CENTER FOR ENVIRONMENT AND SUSTAINABLE DEVELOPMENT

Interview schedule for EPA and EFCCC officers

The information given here under will be used for the academic purpose, should be given voluntarily, and will be treated with the confidentiality it warrants.

Questions

- Q1. What is the environmental status of Kirkos sub city?
- Q2. What are the priority areas in environmental planning and management?
- Q3. what measures are put in place to deal with pollution?
- Q4. How are you managing the pollution levels in Kirkos sub city?
- Q5. What are issues that you face in the enforcement of waste management the sub city?
- Q6. Does the sub city have any e-waste management policies?
- Q7. Who are the partners in e-waste management?
- Q8. Are there any mechanisms of e-waste management?
- Q9. How is e-waste disposed in the sub city?
- Q10. Are there any efforts in awareness creation?
- Q11. Is there a general national policy and regulatory framework in E-waste management?
- Q12. Is there a required e-waste disposal mechanism and who enforces it?
- Q13. How would you quantify electronic waste in the sub city?

Appendix III: logit results

Table:4.26 Test Multicollinearity test Result in the model through Tolerance and VIF Value

Independent Variable	Awareness		Attitude		Practice	
	Tolerance	VIF	Tolerance	VIF	Tolerance	VIF
(Constant)						
sex of employees	.887	1.127	.887	1.127	.887	1.127
Age of employees	.865	1.156	.865	1.156	.865	1.156
Family size of employees	.867	1.154	.867	1.154	.867	1.154
Main road from employees	.909	1.100	.909	1.100	.909	1.100
Income of employees	.821	1.218	.821	1.218	.821	1.218
Education states of employees	.796	1.257	.796	1.257	.796	1.257
private and small enterprises that collect e- wastes	.765	1.307	.765	1.307	.765	1.307
lesson associated with e-waste management	.883	1.133	.883	1.133	.883	1.133
Enforcement of government regulation on e-waste management	.751	1.332	.751	1.332	.751	1.332
e-waste disposal sit	.776	1.289	.776	1.289	.776	1.289

Model Summary

Step	2 Log likelihood	Cox & Snell R Square	Nagelkerke R Square
Awareness	81.203	.482	.690
Attitude	128.485	.352	.486
Practice	125.774	.293	.423

Table:4.27 Hosmer and Lemeshow Test

Step	Chi-square	df	Sig
Awareness	11.073	7	.198
Attitude	12.332	7	.137
Practice	6.431	7	.599