

Environmental Policy Instruments Use-design for Improving E-waste Management in Bangladesh

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A thesis submitted to the Department of Economics and Social Sciences in partial
fulfillment of the requirements for the degree of
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Declaration

It is hereby declared that

1. The thesis submitted is my own original work while completing degree at Brac University.
2. The thesis does not contain material previously published or written by a third party, except where this is appropriately cited through full and accurate referencing.
3. The thesis does not contain material which has been accepted, or submitted, for any other degree or diploma at a university or other institution.
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Approval

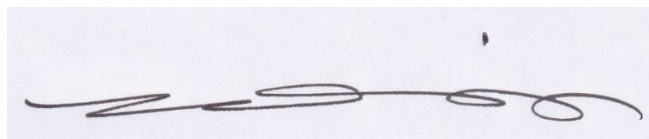
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Ethics Statement

I declare there is no conflict of interest related to this thesis.

Abstract

‘Electronic Waste’ or ‘E-waste’ management is a growing concern in Bangladesh, as the toxic components of E-waste have a severe effect on health and the environment. The existing policies for managing such environmental problems are largely based on regulatory measures ignoring the economic and ethical dimensions. With this view, the central objective of this study is to propose a policy package combining regulatory, economic, and persuasive measures. Together they are denoted as Environmental Policy Instruments (EPI).

For doing so, the research has been conducted in two phases. In the first phase, the study investigates the current E-waste situation in Bangladesh concerning (i) E-waste generation, collection, and disposal practices; (ii) the condition of workers engaged in E-waste recycling; (iii) consumer and public awareness on E-waste management; and (iv) the existing legal framework for its management. In the second phase, an EPI use-design is proposed to improve the E-waste management practices. In doing so, E-waste generators' feedback has been considered. The main database of the study, compiled through an online survey, includes information on E-device usage, its disposal, and consumer awareness. Secondary sources were the basis of compiling information on E-waste generation, recycling, condition of workers involved in E-waste recycling, and their corresponding legal framework in the country.

Findings of the study include that only 11.1% of the consumers dispose of their discarded E-device as waste, of which only 23% of E-waste is appropriately processed for recycling, and the rest is disposed of by either burning or dumping on the ground. Despite E-waste management being a highly hazardous occupation, the wage of the laborers in the E-waste recycling industry in Bangladesh is extremely low (3,000 taka a month). The awareness and concern among the consumers on E-waste generation, its effect on nature and life, and the importance of its sustainable management are limited regardless of respondents' education or profession. Concerning the legal framework, the study finds that the existing policies regarding E-waste management are largely based on environmental Acts and other regulatory frameworks. Although a guideline for E-waste management has been drafted, no exclusive guideline or policy for E-waste management is currently in practice in Bangladesh.

Finally, a target-specific EPI use-design is presented comprising (i) regulatory instruments (regulation, supervision, identification) to control the generation, recycling of E-waste, and ensure labor rights and safety, (ii) economic instruments (pollution tax, recognition, investment) to discourage the cheap and hazardous methods of recycling, disposal, and encourage research and development to transform E-waste recycling industry into a profitable business opportunity, and (iii) persuasive instruments (social engagement, awareness campaign, curriculum reform) to raise awareness of E-waste stakeholders on the importance and ways and means of its sustainable management.

Keywords: E-waste; E-waste Management; Environment Policy Instruments.

Dedication

To my parents, who have always encouraged me to nourish and pursue intellectual interests.

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I would like to express my profound gratitude to my supervisor Dr. ATM Nurul Amin, whose scholarly works have shaped the foundation of this thesis. His constant support, guidance, and encouragement have inspired and motivated me to undertake and finish the study.

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List of Acronyms

3R	Reduce, Reuse, Recycle
BBS	Bangladesh Bureau of Statistics
BILS	Bangladesh Institute of Labor Studies
DOE	Department of Environment
E- device	Electronic Device
E-waste	Electronic Waste
EI	Economic Instruments
EPI	Environmental Policy Instruments
EPR	Extensive Producer Responsibility
ESDO	Environmental and Social Development Organization
HIW	Hazardous Industrial Waste
MoEFCC	Ministry of Environment, Forest and Climate Change
OECD	Organization for Economic Cooperation and Development
RI	Regulatory Instruments
SDGs	Sustainable Development Goals
PI	Persuasive Instruments
WEEE	Waste Electrical and Electronic Equipment

Chapter 1

Introduction

1.1 Background and Motivation

'E-waste' or Electronic Waste denotes the discarded electronic devices and electrical devices such as computers, cellphones, photocopy machines. In the era of information technology, the usage and availability of electronic devices are increasing rapidly, which is causing unprecedented E-waste generation all over the world, making it the fastest-growing waste stream (Nnorom, 2008).

Being composed of several toxic and reactive elements such as Lead, Sulphur, and Plastic, E-waste is hazardous to the environment and lives. Disassembling and recycling of E-waste have many hazards on its various steps as well. Many developed countries have developed facilities and technology to process and recycle E-waste in a way that minimizes health and environmental threats. However, being a developing country, Bangladesh has yet no access to such technologies for E-waste recycling nor has the appropriate legal infrastructure to ensure proper E-waste management.

Similar to other solid waste streams, the informal sector involvement in Bangladesh is widespread. Lack of proper safety and training has made this a risky occupation. Dumping E-waste is damaging to the environment as it exposes the hazardous chemicals and materials in the ecosystem.

As managing E-waste is a complex process coupled with severe environmental and health issues, designing a policy set including a legal framework to approach proper E-waste management practice is crucial for Bangladesh. In most developing countries, the policies for managing environmental problems are primarily regulatory measures that are enforced by the authorities. Such policy instruments focus on the human mind's innate fear of punishment and loss, ignoring the fact that the human mind is a multi-dimensional entity not only comprised of fear element or motivation for personal gain but also ethical and cooperative aspects for collective good. Environmental Policy Instruments (EPI) thus need to be built targeting all the three major elements of the human mind which can result in a powerful set of environmental management measures comprising regulatory, economic, and persuasive measures (Amin, et. al., 2006).

This study thus seeks to propose a holistic approach to improve E-waste management practices by employing regulatory, economic, and persuasive measures, targeting the fear, economic interest, and ethical foundation of the human mind simultaneously as a policy package in an EPI use-design. With this background, the study was undertaken to compile necessary information on current E-waste management practices in Bangladesh and the scope of their improvement.

1.2 Problem Statement

Rapid E-waste generation has emerged as a major problem globally as well as in Bangladesh. Due to technological advancement, E-devices have become cheaper. As a result, electronic devices have become more and more available. Thus, the consumption of E-devices has been increasing. This is causing a high E-waste generation rate (3-4% globally and 20% in Bangladesh). E-waste consists of several hazardous elements and metals. Processing E-waste without proper safety and technology and dumping of E-waste pose a severe threat to health and the environment. Lack of public awareness, coupled with the business strategies of EEE device manufacturing companies, adds to the issue of E-waste generation and its management. Most consumers are oblivious to the regulations and issues regarding E-waste and its management processes.

In Bangladesh, the collection, salvage, and dumping of E-waste are conducted by the informal sector (Foraji, et al, 2019). It is highly hazardous for the workers engaged in E-waste management and the environment. Moreover, the lack of cutting-edge and environment-friendly technologies in treating E-waste is a concerning issue. While countries like China, India have adopted an exclusive E-waste management policy, Bangladesh has not undertaken such measures in this regard yet (UNCRD, IGES, and MoJ, 2018, pp. 1–3).

1.3 Research Rationale

This study sets out to understand and evaluate the current E-waste Management trends and practices conducted in Bangladesh. It also focuses on the issues and challenges that we are likely to face regarding E-waste management. Moreover, the study provides an understanding of environmental and health hazards possessed by E-waste and also provides strategies/recommendations to deal with these problems. Finally, based on the findings, it employs different environmental policy instruments (EPI) in a target-specific EPI use-design for improving the present E-waste management practices in Bangladesh.

1.4 Research Questions

The central question of this study is:

How to improve the present E-waste management practices in Bangladesh by using Environmental Policy Instruments?

The supplementary questions of the research include:

- (i) What is the present situation of E-waste generation and management practices in Bangladesh?
- (ii) What is the awareness level of E-device (Electronic Device) consumers on E-waste, its effect on health and environment, and the importance of its proper management?
- (iii) What are the existing legal frameworks and policies regarding E-waste management in Bangladesh, and what are their gaps?
- (iv) How effective and suitable will the environment policy instruments be in Bangladesh for improving E-waste management practices?

1.5 Research Objectives

The principal objective of this study has been to propose a systemic approach to improve the current E-waste management practices in Bangladesh, implementing various environmental policies in a use-design. The specific objectives are:

- (i) To explore the E-waste generation and management practice in Bangladesh.
- (ii) To address the level of awareness of the consumers of E-devices on the importance of Proper E-waste management.
- (iii) To study and analyze the existing legal framework concerning E-waste management in Bangladesh.
- (iv) To recommend an EPI use-design based on the findings/analysis to improve E-waste management practices.

1.6 Scope of the Study

The research identifies the current E-waste situation in Bangladesh concerning E-waste generation, collection, and disposal practices; the condition of workers engaged in E-waste scrapping; consumer and public awareness; and the existing legal framework for its management. Most reports and papers used for the research are concerning the two major cities of Bangladesh: Dhaka and Chittagong. There are different classification and types of E-waste; this study concerns primarily with the following types of E-waste:

- (i) Mobile Phones
- (ii) Personal Computer
- (iii) Television

Additionally, the author has surveyed different groups of people from various socio-economic and educational backgrounds to investigate their understanding and awareness about E-waste and its generation. This study is mainly conserved with discarded electronic devices and existing policies concerning their disassembling and management.

1.7 Limitations of the Study

The main limitations of this research are the inadequate availability of literature and data regarding E-waste in Bangladesh which made it challenging to portray an accurate and precise picture of the E-waste situation. In the primary data collection, all the data is collected from the consumers of E-devices through an online survey. No survey is conducted on the labor force engaged in E-waste management or the authority figures who monitor E-waste management. Moreover, technical details such as methods of disassembling E-waste or how to extract the valuable residuals of E-waste are not a part of this study.

1.8 Structure of the Study

The study has been arranged in different chapters and sections to build a comprehensive understanding of its contents. A short introduction to each of these are given below:

Introduction: Chapter 1 introduces the background and importance of this study. The research questions, objectives, rationale, scope, and limitations of the study are briefly addressed here.

Literature Review: In chapter 2, several research papers and reports relevant to E-waste and its management have been analyzed. These reviews serve as the background for this study. It also defines and explains several concepts and terms used in the study. It provides a foundation of the concepts this study concerns itself with as well as the potential contribution of proper E-waste management towards sustainable development

Research Methodology: The research method is described in chapter 3. An online survey is used as the primary data source of this study. Several research journals and reports are used as secondary data sources.

Data Analysis: The current legal framework for E-waste management, the trend of E-devices ownership and usages, the flow of E-waste, and labor issues related to E-waste are explored in

chapter 4. The awareness level of citizens about E-waste and issues related to it is also discussed in this chapter.

Policy Recommendation: In chapter 5, feedback on various policy instruments for E-waste management from the consumers has been presented. Finally, an EPI design for improving the E-waste management in Bangladesh is structured and presented based on the findings and analysis of this study.

Conclusion: Chapter 6 concludes the study by summing up the finding and understanding obtained through the research. It addresses several limitations in the research and presents some essential topics for the further exploration of the issue of E-waste management.

Chapter 2

Literature Review

This chapter reviews the available literature on E-waste related key topics such as the situation on global E-waste generation, the effect of E-waste on the environment and health, human rights, and labor issues related to E-waste management as well as the public policy of different countries for E-waste management. Also, the chapter discusses the concept of EPI and its success in resolving several environmental issues. This discussion works as the basis for implementing EPI in solving critical environmental issues such as E-waste management.

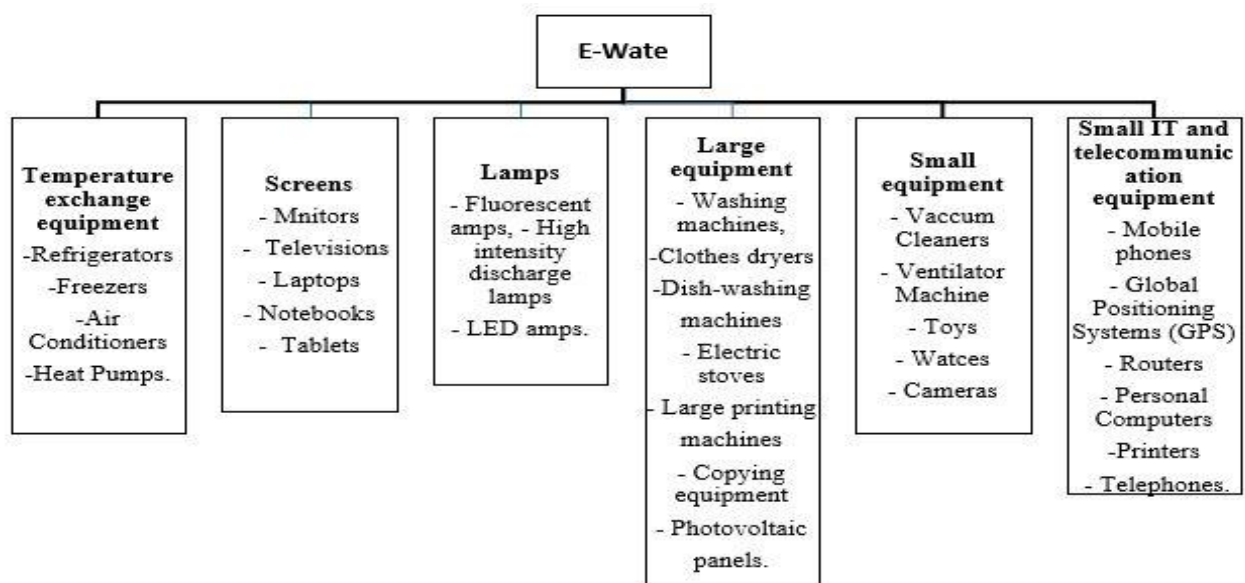
2.1 Electronic Waste (E-waste)

This section defines E-waste, its classification, and its sources.

Definition of E-waste: E-waste (Electronic Waste) denotes all the electronic and electric items or their components that have exceeded their life cycle and thus are discarded. According to Step Initiative (2014), electric or electronic devices and their parts that have been discarded by their owner as waste without the intention of reusing are referred to as E-waste or WEEE (Waste Electrical and Electronic Equipment).

Classification of E-waste Baldé, et al. (2017) classifies E-waste by dividing it into six waste categories.

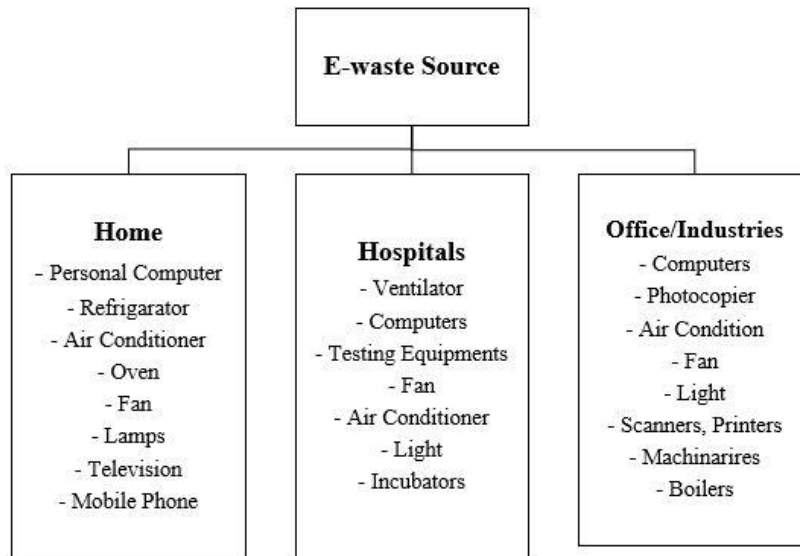
Figure 1 Classification of E-waste



Source: Baldé et al., 2017

Sources of E-waste: According to Kaushik (2018), all humans are the source of E-waste. Every household, office, factory, hospital, or other medical facilities contribute to E-waste generation on different scales. The accessibility of the latest technology also plays a big part in increasing the amount of E-waste.

Figure 2 Sources of E-waste



Reference: Kaushik (2018)

Global E-waste Generation: Baldé, et al (2017) reported that the global quantity of E-waste generation in 2016 was around 44.7 million tons with a yearly 3-4% growth (See table B1). At this rate, this quantity could reach up to 52.2 million tons by 2021.

2.2 Sustainable Development Goals (SDGs) and E-waste Management

‘Sustainable Development Goals’ or ‘SDGs’ is the agenda by the United Nations that aims at eradicating extreme poverty, protecting the planet, and ensuring that all people enjoy peace and prosperity by 2030. It consists of 17 goals and 169 targets. Baldé, et al (2017) has identified the relation between several targets and goals of SDGs with the necessity of proper E-waste management. The relevance of proper E-waste management is related to the following SDGs.

- (i) Goal 3: Good health and Well-being;
- (ii) Goal 6: Clean Water and Sanitation;

- (iii) Goal 11: Sustainable Cities and Communities;
- (iv) Goal 12: Responsible Consumption and Production;
- (v) Goal 14: Life Below Water;
- (vi) Goal 8: Decent Work and Economic Growth.

(Baldé, et al., 2017).

2.3 Environmental and Public Health Issues in E-waste and its Management

Perhaps the most alarming topic related to E-waste management is the impact of E-waste on nature and life. Kaushik (2018) discussed the rising environmental hazards related to E-waste and its management. Every year, a large number of electronic items are being discarded in landfills, which is the cause of growing pollution. Several sources and causes can pollute the environment through different channels such as air, water, and land which are described in the following table.

Table 1 Effect of E-waste on Environment

Pollution Type	Reason/Source
Air Pollution	<ul style="list-style-type: none"> - From burning the copper wires in the open air to extract copper from wires. - Hydrocarbons get released into the air by opening computer chips.
Water Pollution	<ul style="list-style-type: none"> - The electronic devices, dead cells, and batteries contain lead that easily blends with underground water and makes it unfit for direct drinking. - The water gets polluted by the cathode tubes of old computer monitors, video cameras, and televisions are broken apart. - Lead and barium in the shell cause soil to leach and then leads to contamination of groundwater. This poses a threat to the people as well as the local animals. - The rudimentary process of reprocessing E-waste also leads to heavy metals and other organic pollutants invading the human body upon inhaling the polluted air.
Land Pollution	<ul style="list-style-type: none"> - Heavy metals and elements from E-waste pass into the crops and later in the human body. - Being non-biodegradable, these elements remain intact in the environment indefinitely which increases the danger of exposure, which leads to very serious health problems.

Source: Based on Kaushik (2018)

E-waste consists of various substances and materials that are extremely harmful to the human body. Deng (2019) argued that E-devices on their own are not hazardous but disassembling and recycling these devices in an informal environment using manual labor exposes the hazardous element to the environment which can harm both environment and health acutely.

Table 2 Toxic Substances from E-waste and relate Health Hazard

Substance	Source	Health Hazard	Source
Lead	-Used for soldering and de-soldering. Cathode ray tube.	- Damage to kidneys and generative system. - Slow mental development in kids. - Disruption in cognitive function, irritation, ADD, and lowering of IQ.	Kaushik (2018)
Mercury	- Electronic circuit boards and switches. - Fluorescent tube - Doorbells - LCD screens.	- Methylated mercury can reduce fertility, slower growth, and the development of animals and even can cause death to animals.	Kaushik (2018)
Chromium	- Untreated and galvanized steel.	- Causes asthmatic bronchitis and other allergic reactions. - Can cause DNA, kidneys, and liver damage	Ramachandra and Saira (2004), Wu & Ikerionwu (2010)
Barium	- The front panel of the CRT.	- Cause vomiting, abdominal pain, diarrhea, breathing problems, high blood pressure. - Muscle numbness, heart and liver disease.	ATSDR (2007), Puckett et al. (2002), Wu & Ikerionwu (2010)
Sulfur	- lead-acid batteries.	- Can cause eye and throat irritation. - Damage to the liver, kidneys, and heart.	Kaushik (2018)
Cadmium	- Resistors. - Semiconductors. - Infrared detectors. - Rechargeable batteries.	- Gathers in the kidneys, and can lead to liver, lung, and bone damage as well as renal failure.	Puckett et al. (2002), Dyrud (2007)
Selenium	- Photo drums of Photocopy machine.	- Loss of feeling and control in the limbs. - Damage Lungs Tissue - Increase blood pressure, - Headaches - Diarrhea	ATSDR (2003)
Arsenic	- In LED and transistors as gallium arsenide.	- Allergic reactions, nausea, vomiting - A decrease in RBC and WBC production, - Abnormal heart rhythm.	Pirzada and Pirzada (2010), Schmidt (2002),

Plastic	<ul style="list-style-type: none"> - Plastics in circuit boards, cabinets, and cables - In the outer shell of screens and phones. 	<ul style="list-style-type: none"> - Burning PVC produces dioxins. - Dioxins have the potential to damage reproductive and immune systems. 	Kaushik (2018)
Ozone-depleting substances	<ul style="list-style-type: none"> - Refrigerators - AC 	<ul style="list-style-type: none"> - Can cause loss of consciousness, breathing problems, and heartbeat irregularities. - Coughing, breathing problems, and red-eye. 	The US. National Library of Medicine

2.4 Human Rights and Labor Issues in E-waste Management

According to Alam & Bahauddin (2015), scholars from different geo-cultural backgrounds have argued that a rights-based platform for environmental protection prioritizing the victims of environmental damage or pollution can be created by combining the concept of human rights with environmental issues. The relation between human rights and the environment implies that abusing human rights is sometimes followed by environmental harm. Similarly, environmental degradation can lead to a human right violation.

Shelton (2002) has given several strong validations for including a right-based approach to every discourse on environmental health which emphasizes rights of information, participation, and access to justice. According to her, another benefit of such an approach is the existence of international petition procedures that allows victims to bring international pressure to a local government that lacks the motivation to prevent or alleviate severe pollution and promote general well-being.

Ideally, E-waste can be a valuable resource of reusable materials and metals such as silicon, copper, silver, gold, and various electronic parts and circuits. Institutionalizing E-waste treatment facilities can open possibilities for the informal sector as well as create market opportunities for sustainable financing, cost recovery, and revenue. But in reality, there are no well-structured guidelines or policies for the labor and treatment sector of E-waste management in most developing countries which raises several labor issues in those countries where labor exploitation has become a common occurrence.

Kaushik (2018) observed that even though most global waste is produced by developed countries, developing countries are usually engaged in most waste management and reprocessing as these operations are more expensive and bounded by restricting environmental and labor laws in developed countries. For example, India imports 42% of total E-waste from

the United States of America which is followed by China and the European Union. Even though the import of E-waste for reprocessing is banned in India, according to a survey of MAIT GTZ around 50,000 tons of electronic waste is imported yearly through illegal channels by firms, making India one of the largest E-waste yards. E-waste management in India depends on the informal sector who accounts for 90% of the E-waste reprocessing industry. Unorganized systems usually employ low salaried laborers, including over 4.5 lakh children who are not expert enough to process E-waste. Working situations in these informal E-waste handling setups are dangerous. Disassembling of E-waste in the informal sector using simple and primeval procedures with bare hands and without any facemask, like acid stripping and open-air burning releases numerous toxic chemicals like polyvinyl chloride, chlorofluorocarbons, arsenic, nickel, and barium into the environment causing medical illnesses like cancer, asthma, bone ailments, and brain syndromes.

2.5 Public Policy for E-waste Management

Many countries have embraced full-fledged policies for E-waste management where other countries improvise their existing laws and legislation to cope with the situation (See table B2). Countries like China, Japan, and India have full implementation of E-waste management policies. Many countries such as Thailand, Vietnam have a partial implementation of relevant policies. In contrast, Bangladesh has undertaken neither full nor partial implementation of exclusive guidelines related to E-waste and its management. Rather E-waste is managed by existing regulations, therefore, no particular response against E-waste management.

2.6 Environmental Policy Instruments (EPI)

According to Field & Field (2017), in the early days of environmental concern, the main focus was on the end flow of discharged residuals by the producers and consumers. By treating these residuals and otherwise changing the time and place of discharge, their impacts on humans and the environment could be substantially changed. And thus, the perspective of “Environmental Management” has emerged. Environmental Policy Instruments (EPI) are measures/tools to design policies/legal infrastructures to reduce or resolve environmental issues/hazards through the “Environmental Management” approach. They classified EPI as such:

- (i) Decentralized Policies (Liability Laws, Property Rights, Voluntary actions);
- (ii) Command and Control Strategies (Standards);
- (iii) Incentive-Based Strategies (Emission Charges and subsidies).

Amin, et al (2006) classify Environmental Policy Instruments, also denoted as Environment Management Measures (EMM) into three sets of instruments/measures:

- (i) Regulatory Instruments (RI);
- (ii) Economic Instruments (EI);
- (iii) Persuasive instruments (PI).

These tools are used by governments and other organizations to implement their environmental policies. Regardless of the different names and definitions, the Environment Policy Instruments are a set of policy tools focused on the regulatory, economic and ethical stimulation that can be implemented in environment management measures to resolve a specific environmental problem.

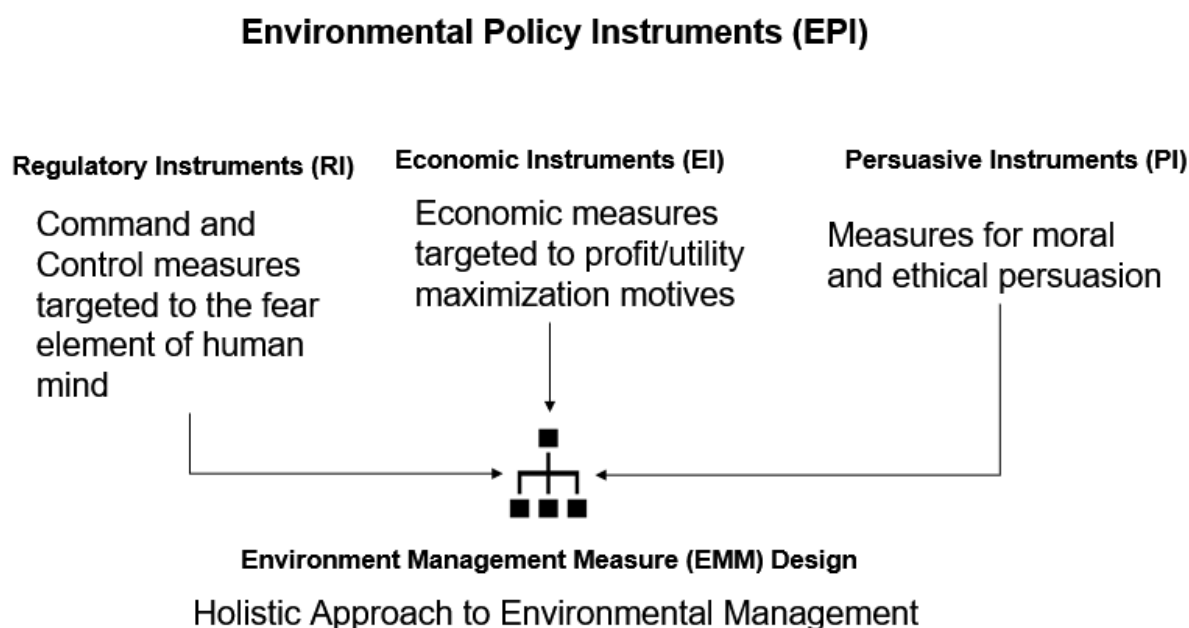
2.7 Policy Instruments for Environmental Management

Amin, et al (2006) suggested that Environmental Policy Instruments built targeting all three major elements of human minds such as fear, material interest, and moral sense can result in a powerful set of environmental management measures (EMM). Citizens are aware that they are subjected to some laws and restrictions as a member of the state and failing to oblige or choosing to disobey these laws can lead to prosecution and punishment. The Command and Control or Regulatory Instruments (RI) are designed to target this fear element of the human mind. The paper defined Human beings as an “Economic” entity. They are driven by their self-interest and motivation for personal gains. This aspect of the human mind has led economists to classify every consumer as “Utility Maximizer” and producer as “Profit Maximizer”. Economic Instruments (EI) are based on this materialistic aspect of the human mind.

The authors criticized the traditional approach of designing policy instruments entirely targeting an individual’s motivation for personal gains only. They argued that even though humans operated under the motivation of personal gain, they are also sentient beings, blessed with moral and ethical values. With proper education and influence, they also act on their moral judgment with a benevolent notion for social welfare. Therefore, Persuasive Instruments (PI) can be very powerful as these are designed around the ethical and cooperative aspects of individual minds.

According to the authors the aforementioned three sets of policy instruments combined: RI, EI, and PI can play a vital role in environmental protection and management. The study presents several empirical cases of successful EMM design by using EPI based on human mind elements.

Figure 3 Environmental Management using Environmental Policy Instruments



Source: Adapted from Amin (2009). pp. 29

Thailand is an example of a successful case of EMM design. They have switched to unleaded fuel from hazardous leaded fuel using the EMM framework. A report that said that leaded fuel can affect the intelligence level of children motivated the citizens to switch their fuel, a textbook example of PI implementation. Once people were aware and accepted the need for change, RI was used to phase out leaded fuel over time. The government increased tax on leaded fuel which made the price level of unleaded fuel the same if not less than leaded fuel. By utilizing RI, EI, and PI, Thailand successfully switched to unleaded gasoline from toxic leaded gasoline.

Vietnam was also successful in phasing out leaded cases utilizing EMM design. The government issued a directive to switch from leaded fuel to unleaded fuel. Workshops have been arranged to make people aware of the benefit of using unleaded fuel. Also, the government lowers the tax rate for the imported vehicles that use unleaded fuel. This combination of the EMM framework resulted in an “overnight success” for Vietnam in switching their fuel.

The study also describes the comprehensive EMM design of Bangkok for improving hazardous industrial waste (HIW) using EPI. Several studies have been conducted to analyze and understand the correlation between different factors involved in HIW production and

management as a particular regression analysis indicates that the cost of using the facility has a negative influence on factory decision to make use of the treatment facility. The government has taken these findings into account and implemented EMM specified to those sectors/factors in improving HIW conditions.

The study also presents another case, the EMM application design for reducing air pollution in Hanoi. The authority targeted different EMM choices on specific factors of pollution such as vehicles, fuel, and travel demand management (TDM) based on the finding of several theoretical analyses and setting priorities.

The cases presented by the authors make it evident that EMM design using EPI targeted to specific elements of the human mind is indeed highly effective for a feasible and sustainable solution to environmental problems. With this view, this study is focused on structuring an EPI-use design comprised of regulatory, economic, and persuasive policy measures to improve the E-waste management practices in Bangladesh.

Chapter 3

Research Methodology

Research is the systematic process of inquiry to find, describe, analyze, explain, and evaluate the pattern or the process of a real-life issue or a theory (Creswell, 2014). This chapter specifies the methods and procedures the study follows to complete its research objective. The research design and the data sources for this study have been defined here. Data collection and analyzing methods to realize the research objectives are also defined in this chapter.

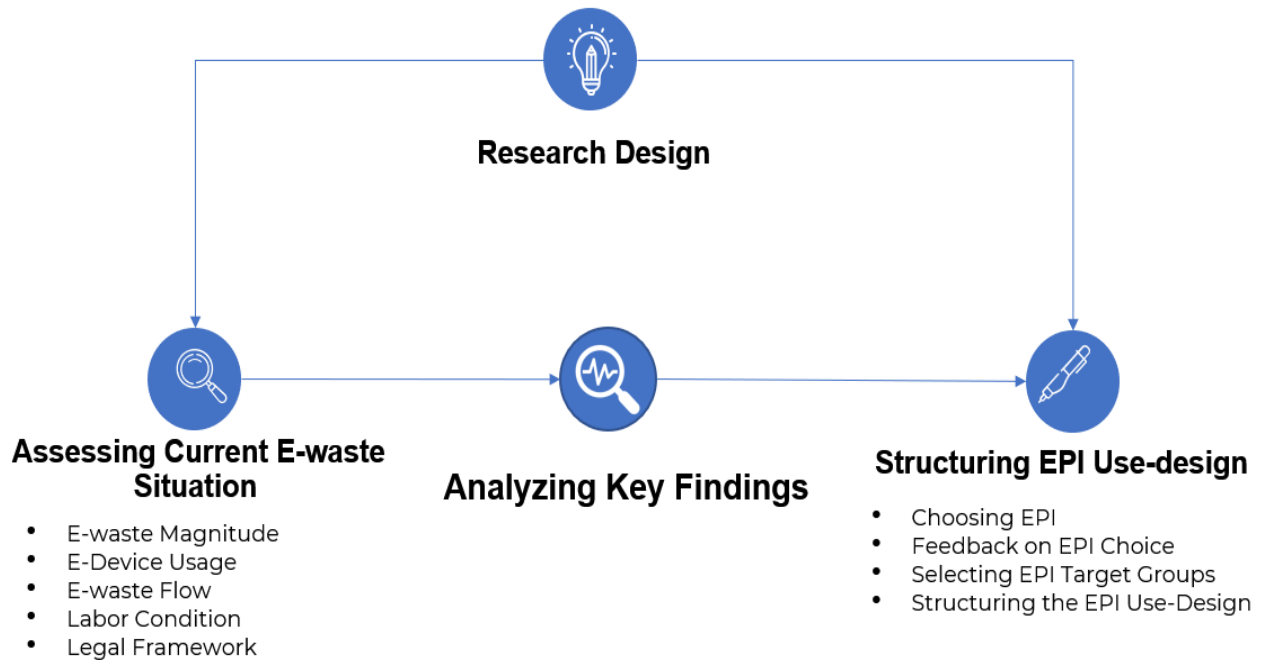
3.1 Research Process

This study aims at structuring an EPI use-design for improving E-waste management by using regulatory, economic, and persuasive policy measures. It uses qualitative analysis to answer its research question which has been divided into two phases:

- (i) Exploring the current practices and legal framework of E-waste generation and its management in Bangladesh.
- (ii) Structuring a target-based EPI use-design for appropriate E-waste management practices implementing policy instruments based on the findings.

These research steps are also divided into smaller sub-parts. The study uses primary data sources for information on the E-device users and the generation of E-waste and secondary data sources for information on the collection, disassembling, and disposal of E-waste. The following figure depicts the various steps of the research process to complete its objective.

Figure 4 The Research Design



Assessing Current Situation and Trends in E-waste and its Management: This step studies and analyzes the current status of E-waste and its management in Bangladesh. It comprises different topics such as the generation and magnitude of E-waste, E-waste flow, and related labor issues. Additionally, it also evaluates the citizen's awareness level on E-waste and related issues. Finally, this part discusses and scrutinizes the existing legal framework for E-waste management and its limitations/gaps. The sub-steps are described as the following:

- (i) Collecting and analyzing data on E-device usage and E-waste generation.
- (ii) Investigating the flow and the various steps of E-waste collecting, disassembling, and disposal.
- (iii) Identifying the labor issues related to managing E-waste.
- (iv) Evaluating public awareness on E-waste, its effect on health and environment, and the importance of its proper management.
- (v) Analyzing the existing legal framework for E-waste management and their shortcoming.

Structuring EPI Use-design for E-waste Management: After assessing the present situation and current policies, the research proposes an EPI Use-design for E-waste management that

implements regulatory, economic, and persuasive policy instruments. The use-design is structured so that these three categories complement each other and be effective in improving E-waste management. The process of implementing EPI consists of the following components:

- (i) Regulatory instruments or command and control methods that are enforced by the government or other appropriate authorities.
- (ii) Economic instruments for the vendors as well as consumers to make E-waste management financially attractive.
- (iii) Persuasive instruments for the general consumers to make them aware of E-waste, its harmful effects, and the importance of its proper management to encourage the culture of responsible usage and disposal of E-devices from consumers' side.

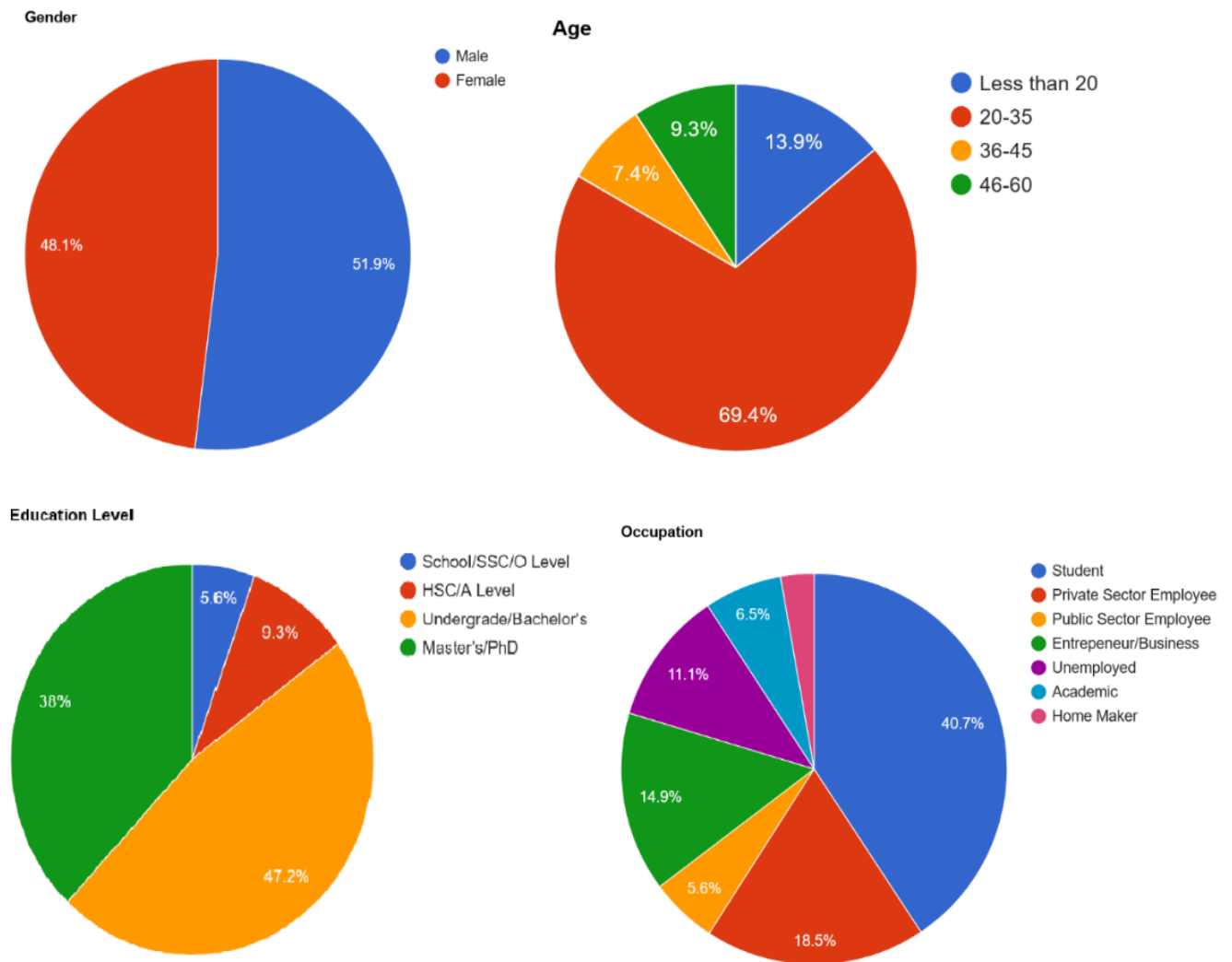
3.2 Data Sources

The study uses two types of data sources:

Primary Data Source: An online survey, conducted during 1-15 October 2020, is used as the primary data source (see Appendix B). The questionnaire was made in Google Form and circulated on several online communication media such as Whatsapp, Messenger, Telegram, and E-mail. The researcher invited family members, friends, and colleagues to take part in the survey. The respondents were requested to invite their friends and family members to take part in the survey. In total, 108 individuals from different age groups, educational backgrounds, and socioeconomic statuses responded to the survey. The study considers these E-device consumers as the primary generator of E-waste. The survey was conducted to identify the trends of E-device ownership, usage, as well as awareness on E-waste management issues and their effect on the environment and health. It estimated the active or passive engagement of these individuals as the primary generator of E-waste. Finally, through the survey, user feedback on the usage of regulatory, economic, and persuasive measures was obtained.

The summary profile of the respondents of the E-waste users' survey is shown in the following figure.

Figure 5 Profile of the Survey Respondents



According to the figure, of the 108 respondents, 51.9% were male, 48.1% were female. The respondents were also divided into different age groups. The majority of the respondents (69.4%) belong to the age group of 20-35 years old, followed by less than 20 (13.9%), 46-60 years old (9.3%), and the rest age between 36-45 years. The survey also gathered data about the education level and occupation of the respondents. About 47.2% of the respondents have completed a bachelor's degree or attending undergraduate level studies. 38% of the respondents hold a postgraduate degree. So, 85.2% of respondents in total are attending university or have a university degree ranging from bachelors to Ph.D. About 40.7% of the respondents are students, 18.5% are working in the private sector, 14.9% are doing business, and 11% of the respondents are unemployed, followed by public servants (5.6%), academicians (6.5%), and homemakers (2.8%).

From the profile, it is also evident that the respondents represent the formal sector of the socio-economic hierarchy of Bangladesh, who can also be considered as the primary user of E-devices and responsible for the generation of E-waste. Overall, considering the age, education, and occupation, the survey respondents are expected to be aware, concerned about E-waste related health, environmental, and labor issues, and the importance of its proper management.

Secondary Data Source: Various reports and publications such as research papers and conference papers on E-waste and its management in Bangladesh serve as the secondary data source of this study. The secondary data sources are used to collect and analyze information on E-waste circulation, labor issues, and the current legal infrastructure for E-waste management in Bangladesh.

Chapter 4

Present Situation of E-waste Management in Bangladesh

This chapter presents and interprets the primary and secondary data obtained to study and assess the present situation of E-waste generation, flow, management practices, labor conditions, and policies in Bangladesh. It also assesses the awareness level of E-waste users on E-waste, its impact on life and nature, and the importance of its proper management.

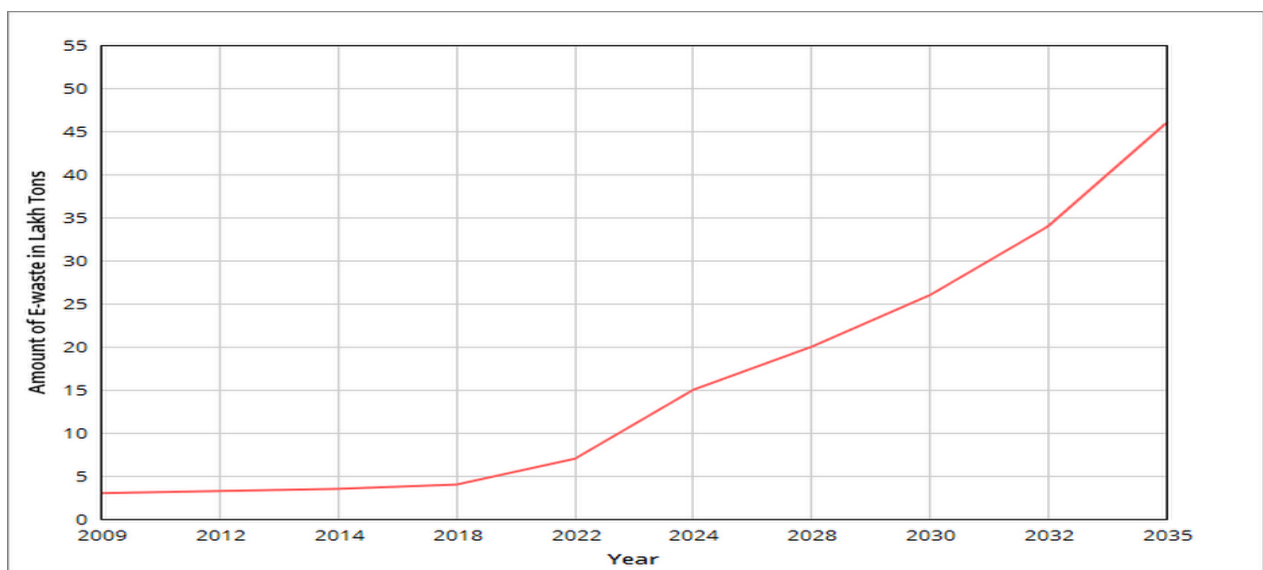
4.1 E-waste in Bangladesh: Present Trends and Practices

Topics that are studied and discussed in this section include the magnitude of E-waste, users' patterns, and trends of using E-devices, E-waste flow, and E-waste management's labor issues.

4.1.1 Magnitude of E-waste in Bangladesh

The quantity of E-devices adds to E-waste's growing pile after reaching its end of the life cycle. In 2009, the amount of estimated total generated E-waste in Bangladesh was 28,00,000 tons (UNCRD, IGES, MoJ, 2018). Of which, 25,00,000 tons were from shipbreaking. The latter component is wholly imported. Excluding that, the generated amount of E-waste in Bangladesh in 2009 was 3,00,000 tons. In 2018, the generated amount rose to 4,00,000 tons (Foraji, et al, 2019). According to the Bangladesh University of Engineering and Technology (BUET), E-waste generation, having a growth rate of 20%, will reach 46,20,000 tons per year by 2035. Using this information, the trend of E-waste generation is shown in the following graph.

Figure 6 E-waste Generation Trend Projection for Bangladesh



Source: Based on data presented above

4.1.2 E-device Usage by Type

A study on E-waste conducted by Re-team Corporation collaborating with Waste Concern Consultants collected primary information conducting a field study and secondary information from manufacturers, retailers, importers using interviews, collections of relevant reports, and data from Bangladesh Bureau of Statistics on Dhaka city's electronic device consumption. They found that small components like mobile phones, computers are consumed more in general. The consumption rate increases by 20% on mobile phones, 10% on computers, and 20% on television (See table A3). According to their report, mobile phones are the primary contributor to E-waste generation, followed by computers and television.

This finding is consistent with the data collected through the E-waste users survey in this study. In the survey, the respondents were asked about the types of E-devices they own. The questionnaire specified some common E-devices such as television, mobile phones, personal computer, fridge, and electric ovens. For the sake of simplicity and limited scope, the study primarily focuses on the three most common E-devices: television, mobile phones, and personal computers. Respondents are asked to select the device they own or have in their home as a common household appliance followed by the number of each type of device they own.

Figure 7 Types of E-devices owned by the respondent

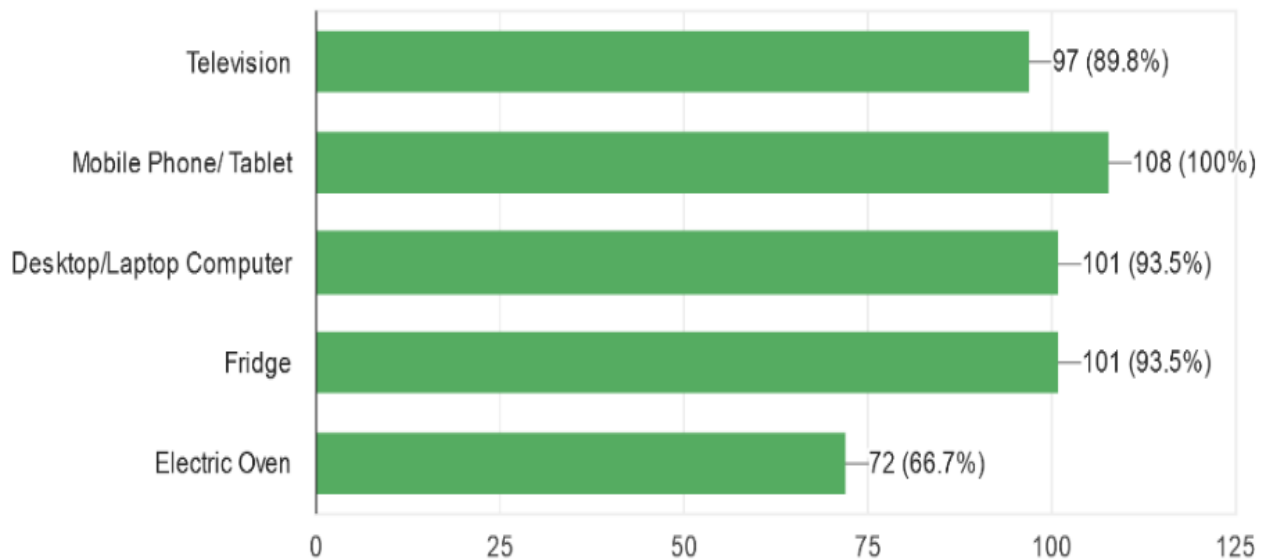
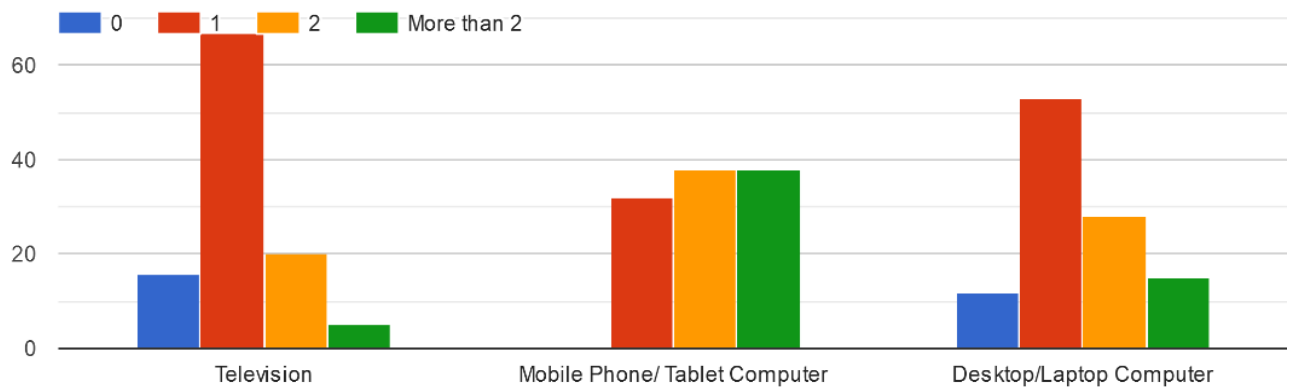
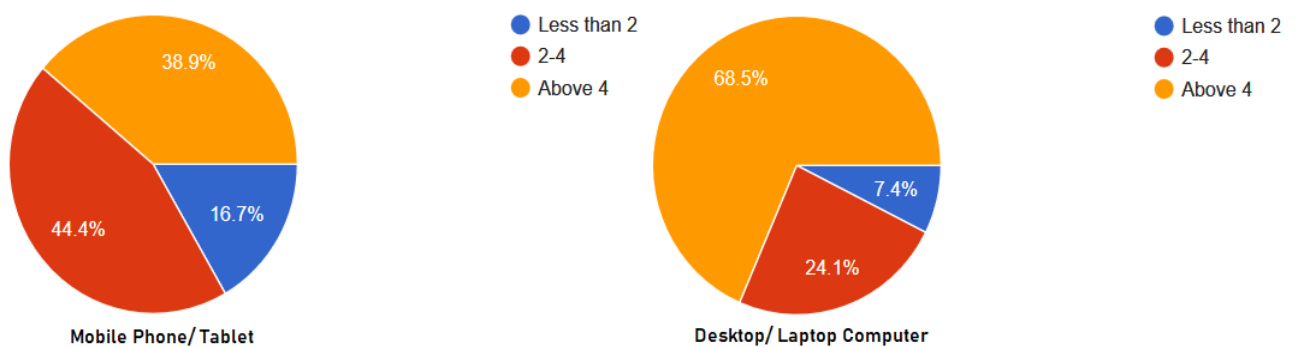


Figure 8 Number of devices owned by the respondents



The bar chart in the above figure shows that all the respondents own at least one mobile phone. Data on the number of devices owned by the respondents shows 82% own more than one mobile phone. About 90% own television and 72% own exactly one television. About 93% own computers of which 57% own exactly 1 unit, 43% own more than 1 unit. Among the respondents, 93.5% own a fridge, and 66.7% of them own an electric oven. From the data, it is evident that it is more common than a single individual who owns multiple mobile phones, and for computers, this number is almost half. Everyday household items like television and fridge are found in almost every home. However, the majority home has 1 unit of these. Electric oven is the least consumed device as only 66.7% of respondents own it.

Figure 9 Usage period of E-devices



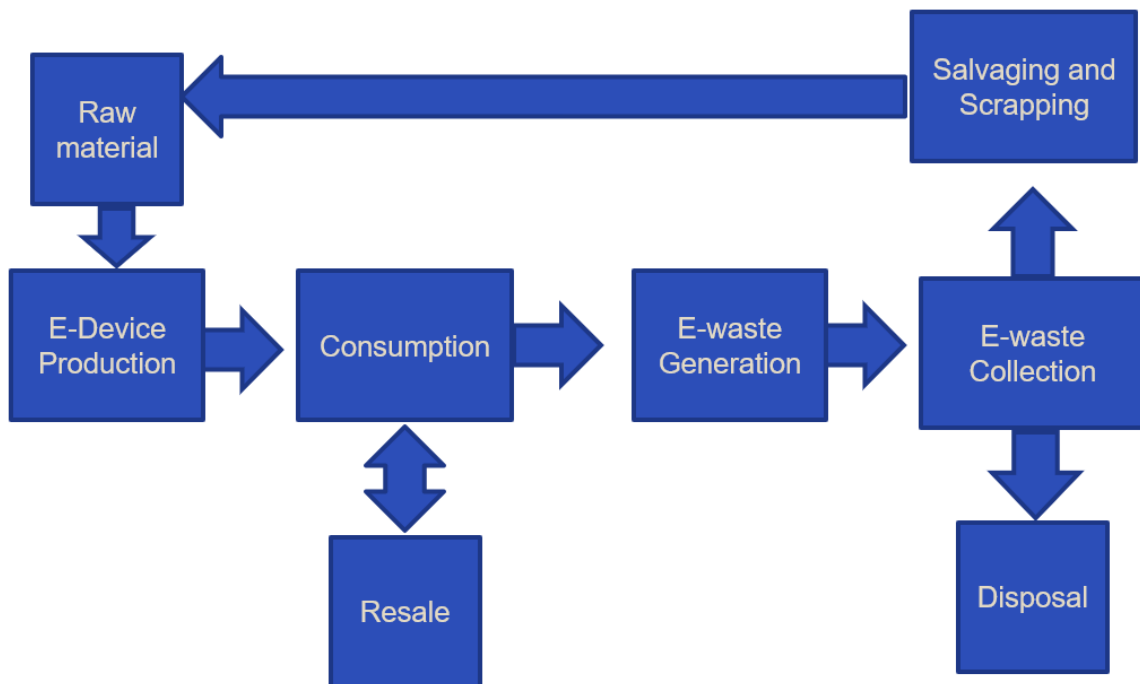
The respondents are also asked how long they keep a personal E-device such as a mobile phone or computer. For mobile phones, 16.7% of respondents have responded that they keep their devices for less than two years, 44.4% keep these 2-4 years, and 38.9% keep their mobile phone

for over four years. In the case of computers, 68.5% keep their device for above four years following 24.1% 2-4 years, and only 7.4 % keep their computers for less than two years. It seems that mobile phones usually have the least usage period but a higher number of ownerships, which might significantly contribute to E-waste's rapid growth, followed by computers/laptops. It is evident from the data that personal E-devices are consumed more in quantity than common household E-devices such as fridges or ovens

4.1.3 E-waste Flow in Bangladesh

E-waste flow begins from manufacturers and retailers. The E-devices are bought and used in the households and offices; then, the E-waste goes to the collectors' vendors. After disassembling, the residuals end up being disposed of in the landfill.

Figure 10 Flow of E-waste



Manufacturing and Circulation of E-devices: E-devices such as television, mobile phones, and personal computers are manufactured by the producers using raw material extracted from the deposits or salvaged and recycled from E-waste. The manufactured devices are imported by retailers worldwide and sold to consumers. According to an estimate of the Bangladesh Mobile Phone Importers Association in 2018, 40 million mobile phones were imported to Bangladesh, of which 30 million were imported through legal channels, and the rest

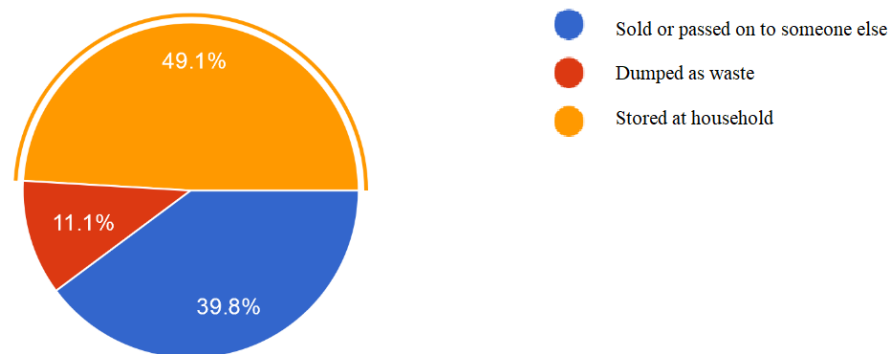
unofficially. These E-devices are used in households and offices by the consumers. After reaching the end-life, these E-devices start to flow as E-waste.

E-waste flow from Households and Institutions: E-waste flow starts with the production of E-devices. From manufacturers, E-devices reach retail stores, and from there, they are purchased and consumed by the households and corporate entities to the end of their life cycle. Thus, the primary sources of E-waste are households, offices, and businesses. The study finds that the owners use compact E-devices such as mobile phones for 2-4 years and moderate-sized devices such as personal computers for over four years. The respondents are asked what they do with their owned devices after the usage period.

Figure 11 Destination of Discarded E-devices

The destination of discarded E-device

108 responses



According to the above chart, 49.1% respondents store their old devices instead of reselling or dumping them, 39.8% pass these to someone else and only 11.1% claim to dump their devices as a waste product. As properly processed E-waste is a valuable source of reusable materials and recycled products, so storing E-waste at home instead of circulating it for recycling is a massive waste of resources.

The dumped E-waste is not managed properly for recycling. In this regard, an ESDO (2014) finding is notable. It reports that, of the dumped electrical household equipment, 23% is thrown to open space, and 77% is disposed of in the municipal bin.

E-waste Collection and Sale: The discarded E-devices are purchased by informal waste buyers from households and offices. These waste buyers usually come with a van and buy old phones, PC parts, fridges, IPS, and batteries directly from the households and offices. After

collecting the E-waste, the collectors sell these to the second-hand product vendors or the scrappers known as ‘vangari’ shops. Yousuf & Reza (2011) found that vangari shops buy personal computer parts from various organizations through auctions as well. There are several places in Dhaka and Chattogram city where these vendors are located.

Table 3 Major E-waste Vendors in Bangladesh

Location	Business Size	Type of Product	Type of Business	Approximate Money Transactions (in US \$)
Nimtoli, Old Dhaka	150 permanent and temporary vendors	<ul style="list-style-type: none"> • Motherboard • Power Supply unit • ROMs, • Monitors • Cables 	<ul style="list-style-type: none"> • Recovering raw materials such as copper, iron, plastic, cables, and selling them as scrap 	<ul style="list-style-type: none"> • Monthly Purchase: 1400 • Monthly Sale: 2000
Elephant Road, Dhaka	80-100 shops	<ul style="list-style-type: none"> • Desktop Computers • Laptop • Computer Components • Electronic Gadgets 	<ul style="list-style-type: none"> • Selling functional second-hand computer and components to the consumers • Selling steel, iron, bronze, and cable wires are sold as scrap 	<ul style="list-style-type: none"> • Monthly Purchase: 2000 • Monthly Sale: 3500
Vatiary, Chittagong	More than 100 shops	<ul style="list-style-type: none"> • Lights, • Horn, • Radio • Television • Refrigerators 	<ul style="list-style-type: none"> • Selling functional second-hand product • Selling non-salvageable products to the scrap dealers 	<ul style="list-style-type: none"> • Capital Investment: 50000 • Annual Income: 11000-12000
Kadamtali, Chattogrm	Approximately 30 shops	<ul style="list-style-type: none"> • Fans • Printer, • Fridge • Washing machine • IPS • Ship Components 	<ul style="list-style-type: none"> • Selling old fans, printer, fridge, washing machine, IPS, etc. electronic products. • Buys scraps and reusable materials from shipbreaking yards 	<ul style="list-style-type: none"> • Monthly Purchase: 5000 • Monthly Sale: 7000

Source: Adapted from Yousuf and Reza (2011)

According to the shop owners, 200-250 purchasing agents of these products bring PC parts as wastage. After purchasing a waste product, they first check whether the device is still functional. The functional products are sold directly to the consumers. The remaining products are broken and the reusable metals and other parts are salvaged and sold to raw material vendors (Yousuf & Reza, 2011). The disintegration of a particular device to extract reusable materials and disposing are mainly managed by informal recyclers. The whole process is done without proper safety supervision. Exposure to the gases and toxic materials from the opening of E-devices has severe health consequences for the involved informal sector workers.

Disposal: In the end, the residues that could not be repurposed end up being dumped on the landfill. The most common disposal method for the remaining E-waste is burning in open pits. It is an inexpensive disposal method. But it entails a salvaging process with social and environmental costs. For example, inhaling burnt waste fumes poses a severe threat to workers' and residents' health near the waste disposal. According to Schmidt (2002), dumping E-waste on landfills also causes groundwater contamination.

4.1.4 Condition of the E-waste Laborers in Bangladesh

Riyad, et al (2014) studied the E-waste labor condition in Bangladesh and found that approximately 1, 20,000 informal sector workers are engaged in the E-waste recycling industry in Dhaka. The table below compares the occupational risk and wage in E-waste salvaging with other informal sector jobs collected from BILS and Riad, et al (2014).

Table 4 Some Informal Occupations in Dhaka City and Associated Hazard Level

Occupation Type	Working Hours	Approximate Monthly Income in taka	Level of Occupational Hazard (based on author's observation)
Rickshaw-Puller	Indefinite	13,382	Moderate
Construction Worker	8-10 hours	10,000	High
Street Hawker	Indefinite	6,000	Low
E-waste Worker	12 Hours	3,000	High

Source: Prepared based on Bangladesh Institute of Labor Studies and Riyad, et al (2014)

The table shows that a rickshaw puller in Dhaka earns 13,382 taka per month, while rickshaw-pulling has a moderate occupational hazard level. In contrast, E-waste recycling workers are earning only 3,000 taka a month while being engaged in highly hazardous activities. According to Riyad, et al (2014), the labor force engaged in E-waste salvaging is not provided with appropriate safety gear. Even though this job has multiple health hazards, the workers do not get any health benefits or compensation for the damage to their health.

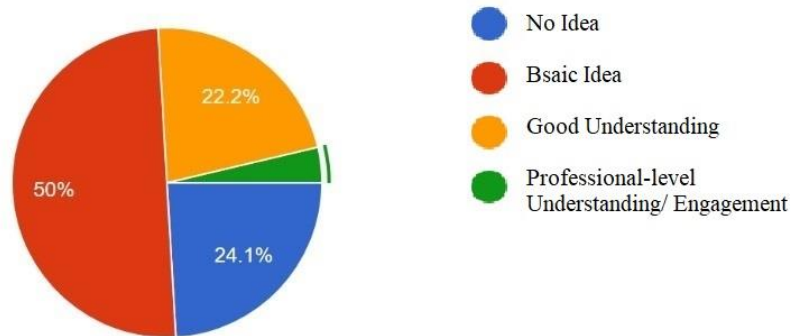
4.2 Public Awareness on E-waste Management

The study's findings on public awareness about E-waste are based on queries to the E-waste users about their understanding of various terms related to E-waste and its management. The respondents are asked to choose a response that matches their knowledge level on E-waste, the impact of E-devices' components on health and environment, and EPI.

E-waste: This study concerns itself with E-waste and its management. In the study, the respondents were evaluated on their familiarity with the term 'E-waste.'

Figure 12 Awareness on E-waste

E-Waste

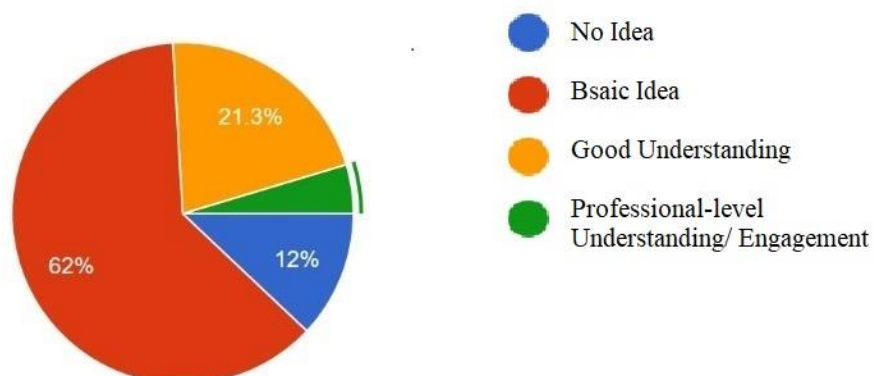


About 50% of respondents have responded that they have a basic idea about E-waste; 24.1% reported that they have 'no idea' about E-waste. About 22.2% have responded that they have a good understanding of the term. Only 3.7% of the respondents are engaged in E-waste related activities. These responses show that respondents' engagement in activities related to E-waste is limited.

Health and Environmental Hazard Related to E-devices: Manual and inexpensive E-waste management methods expose toxic materials to the environment that causes pollution and health problems. If the citizens were aware of these issues, the E-waste vendors and scrappers would have to find more environment and health-friendly E-waste disassembling and extracting methods.

Figure 13 Awareness on the health and environmental hazard of E-devices

Health and environmental hazards related to Electronic devices

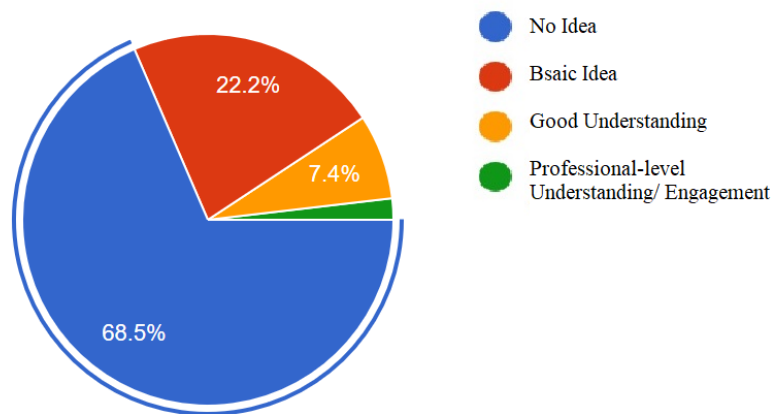


About 62% of the respondents have responded that they have a basic idea about this issue, 12% have no idea about the health and environmental hazards of E-device components. About 22.2% of respondents are aware of this issue, and only 4.6% of respondents are engaged in activities or professions related to this.

EPR¹: In the study, the respondents were asked about their knowledge about EPR. More than two-thirds (68.5%) of the respondents have no idea about the EPR method. Only 1.9% of the respondents are actively engaged in activities related to EPR.

Figure 14 Awareness on EPR

Extensive Producer Responsibility (EPR)



These findings are of concern because most of the respondents are not aware of the E-devices producers' responsibility. This lack of awareness on EPR is not favorable either for the government to act or the producers to be responsible for salvaging their discarded products for material extraction and safe management of the residues. Legal Framework for E-waste Management.

4.3 Legal Framework for E-waste Management

Existing Legal Framework: The existing major environmental Acts in Bangladesh are the following:

- (i) National Environmental Policy, 1992;
- (ii) Environmental Conservation Act, 1995;

¹ According to the state of 3Rs in the Asia Pacific (2018), EPR is the most effective method for proper E-waste management as it holds the producers of the E-devices responsible for managing the end state of their products. In the developed world, it is the most widely applied E-waste management method.

(iii) Environmental Conservation Rules, 1997;

(iv) Environmental Court Act, 2000.

These Acts serve as the foundation for structuring policies related to the environment as well as provide guidelines for amending the existing laws. The following target-specific rules and policies for environmental management are based on the above Acts.

(i) Shipbreaking and Hazardous Waste Management Rules, 2011;

(ii) Medical Waste Management Rules, 2008;

(iii) Lead Acid Battery Recycling and Management Rules, 2006;

(iv) National 3R Strategy for Waste Management, 2009;

(v) National Information and Communication Technology (ICT) Policy 2015;

(vi) Import and Export Policy 2015-2018;

(vii) National Science and Technology Policy 2011;

(viii) National Industry Policy 2016.

(Rahman, 2016)

These policies recognize the importance of controlling E-device flow and its management as a waste product but provide is no exclusive guideline for E-waste management.

Status of the Exclusive Framework for E-waste Management: The Department of Environment prepared a draft titled, "E-waste Management Rules," under the Environment Conservation Act 1995 in 2011 which was returned by the law ministry citing some technical errors. In 2017, the Department of Environment prepared another draft titled, "E-waste Management Rules 2017," which was uploaded on the Ministry of Environment, Forest and Climate Change (MoEFCC) website, seeking input from stakeholders. (Amin, M. A., 2018). In 2019, DoE finalized the draft rules and sent them to MoEFCC after organizing several discussions/workshops with stakeholders.

According to the draft, every E-waste producer, manufacturer, importer, dismantler, recycler, trader, hoarder, transporter, collection center, auctioneer and exporter must be registered through DoE. The draft also specified some regulations on storing and transporting E-waste. The stakeholders are mandated to preserve their data and submit an annual report on their activities related to E-waste management. The draft rules prohibit the import of E-waste for salvaging but allow its export through legal channels.

One important highlight of this draft is the inclusion of external producer responsibility (EPR) as an economic measure and propose a plan to bring 50% of the total E-waste under the EPR

method in 5 years from the implementation of the rules. For violation of any provision, the penalty is applicable under section 15 (1) of the Environmental Conservation Act 1995. Depending on the offense, the Act mandates imprisonment up to 10 years or a fine of up to 10 lakh taka.

After including SDG in the national development plan, environment-related issues like recycling and E-waste management have been given some priority. Nevertheless, being a multi-ministerial issue, and the lack of coordination between the responsible sectors, the complete guideline for ensuring proper management still has not been finalized. The regulatory provisions of the current legal framework are explicit. However, the economic incentive measures for the E-waste management industry and provisions for ethical or social awareness in the existing policies are not included. As a result, a holistic approach combining regulatory, economic, and persuasive provisions is missing.

4.4 Findings Summary

The finding on the present situation of E-waste and its Management are summarized in this section.

E-waste Generation: The yearly E-waste generation in Bangladesh is 4,00,000 metric tons. With 20% growth, the rate will reach 46,20,000 tons per year by 2035. The study found that the high amount of E-device consumption (32,00,000 tons per year) in households and offices by the large population is the main factor behind E-waste's great magnitude in Bangladesh.

E-waste Flow: The study finds that the E-devices are mostly imported from China to Bangladesh. Only 11.1% of the consumers dispose of their discarded E-device as waste, of which only 23% of E-waste is appropriately processed for recycling. The hawkers buy discarded items directly from the consumers and sell them to the vendor. The vendors also buy used and discarded products through auctions from various offices and institutions. There are four major E-waste vendor markets in Bangladesh, Nimtoli and Elephant Road in Dhaka; Vatiary, and Kadamtali in Chattogram. These vendors sell the functional used devices to the consumers and sell the scraped and processed components and recycling materials. Finally, the residues are disposed of, mainly by dumping on the landfill or burning; both are inexpensive, primitive disposal methods with severe health and environmental consequences.

Labor Condition: There is no strict legal infrastructure for E-waste management, the labor force engaged in collecting and disassembling E-waste in Bangladesh. The study finds that the

labor force engaged in E-waste management has a monthly income of only 3,000 taka, with daily working hours of 12 hours, and engages in highly hazardous occupations. Compared to that, the rickshaw-pullers in Dhaka earn approximately 13,382 taka, which is much higher than E-waste laborers' income and rickshaw-pulling is a low hazard job as well.

Public Awareness on E-waste: Analyzing the respondents' profile of E-waste users' survey, it is anticipated that having a high level of education and versatile professions, the respondents will be well aware of environmental sustainability, recycling, E-waste management, etc. However, the study found that consumers' awareness and engagement in E-waste management and related issues are low regardless of their education level or profession. For example, 68.5% of the respondents are completely unaware of EPR, an E-waste management method that makes the producer responsible for the E-waste generated by their products.

Existing Legal Framework: The study has found that the exclusive guidelines or legal frameworks for E-waste management in Bangladesh are yet to be finalized. At present various environmental acts and rules are used as the guideline for E-waste management. Nevertheless, the existing acts do not specify any strict guidelines for producing, collecting, and salvaging E-waste. Moreover, most of the acts strictly consist of regulatory policies. Comprehensive and target specific implementation of any economic or persuasive policy instrument was not observed.

Chapter 5

EPI Use-Design for Improving E-waste Management Practices

This study's primary objective has been to structure a systemic approach to a use-design for improving E-waste management practices in Bangladesh, implementing various environmental policies.

In doing so, the study has taken a two-step approach. First, the study has collected feedback from the survey respondents on the efficacy of various EPI for improving E-waste management practices. This feedback provides a basic understanding of the effectiveness of various EPI on this issue. Finally, the study presents the complete EPI Use-design specifying the policies targeted to specific groups.

5.1 EPI Selection for E-waste Management and Public Feedback

In the E-waste users' survey, the respondents are given a few statements about various policy tools and asked whether they agree or disagree with a particular statement. The respondents can either strongly agree or if they think this is not the best policy, they can choose to somewhat agree, stay neutral if they cannot decide whether a particular policy tool is appropriate. The respondents can also somewhat disagree if they do not agree wholly with a particular statement and strongly disagree if they think a particular policy tool is entirely ineffective.

5.1.1 Regulatory Instruments (RI)

Regulatory Instruments (RI) are law and policy tools that enforce strict regulation and punishment for violating the rules. In this section, the study discusses the selection instrument for E-waste management and public feedback on it. The selected RI for E-waste management are:

Exclusive Guideline and Decentralized Regulation: The most appropriate regulatory policy is to structure a strict and separate guideline for E-waste management addressing its fast generation rate, existing amount, environmental and health hazards, and labor issues. The guideline should include instruction on collecting E-waste, salvaging the components, and dumping the residues. E-waste management should be decentralized and regulated by a particular area's local authority, as monitoring this vast process by a single organization or institute would be very difficult.

Regulation on Importing: Alam & Bahauddin (2015) found that the E-waste flow in the developing countries is partly due to the imported discarded E-devices from the developed

world. Due to the lack of regulation and safety requirements, salvaging E-waste is much cheaper in developing countries. The shipbreaking industry of Bangladesh generated 25,00,000 tons of E-waste in 2009 (State of 3Rs in Asia and the Pacific, 2018). Regulations and guidelines to limit the amounts of discarded E-devices and ship parts imported and strict monitoring on the import of toxic and hazardous materials are mandatory for improving E-waste management practices. Also, strict regulation and monitoring to ensure the importing of new E-devices through proper channels will provide sufficient estimation and identification to track and monitor the E-waste generation.

Identification: Identification is one of the key regulatory tools in the EPR method of E-waste management. Strict guideline to label and identify E-device, classify it to a specific category makes it easier to track its flow during recycling and disposal. A unique serial number or individual identification code can be put on the devices by the manufacturer for tracking their products in the E-waste management system.

Revised Labor Law and Safety Regulation: One of the most outstanding E-waste issues is the E-waste laborer's work condition and their health safety. It is to be noted that the health hazards caused by the lack of supervision and responsibility of the industry or firm engaged in salvaging toxic materials such as discarded E-devices are not just a labor issue but also a violation of human rights. The reformation of existing labor laws inclusive of strict guidelines for workplace safety, health security, and a standard wage rate is an important regulatory policy implication for E-waste management.

5.1.2 Feedback on RI

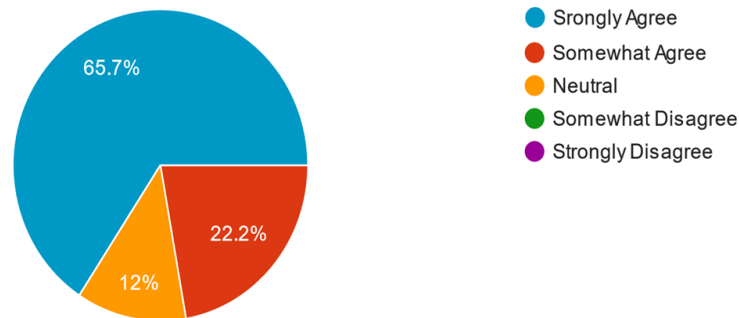
The respondents are given two statements about the policy implications of regulatory instruments. The first one is about imposing strict guidelines for E-waste disposal and recycling. The latter is about reforming labor laws to improve the E-waste laborers' financial condition and work safety.

The first statement is: "Strict policy or guideline for disposing of/recycling discarded electronic devices is essential for sustainable E-waste management." From the figure, it is seen that the majority of the respondents (65.7%) 'strongly agree' with this statement followed by 22.2% of respondents who 'somewhat agree' with this statement. Indeed, a separate and strict guideline for E-waste disposal and recycling is compulsory for proper E-waste management. Without strict rules and tight regulation, reforming E-waste management's current trends and practices is not possible.

Figure 15 Feedback on Regulatory Instruments (RI)

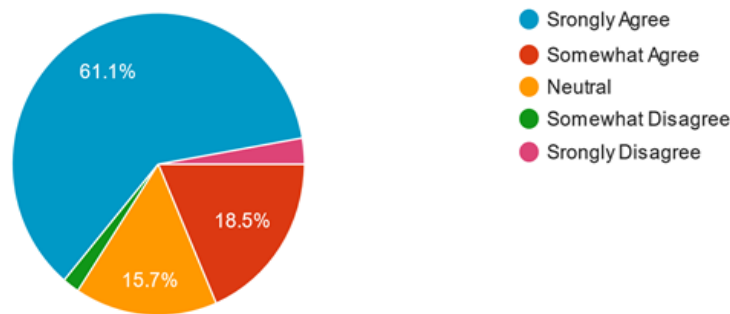
"Strict policy or guideline for disposing of/recycling discarded electronic devices is essential for sustainable E-waste management."

108 responses



"Strict labor laws/regulations will improve the financial condition and work safety for the labor force engaged in E-waste management."

108 responses



The second statement was: "Strict labor laws/regulations will improve the financial condition and work safety for the labor force engaged in E-waste management." The majority (61.1%) 'strongly agree' with this statement, followed by 18.5% who 'somewhat agree'. 15.7% of respondents stay 'neutral' on this topic. About 2.8% of the respondents 'somewhat disagree', and 1.9% 'strongly disagree' with this statement.

Labor issues need to be addressed and given priority. The informal sector engaged in E-waste collection and salvaging is getting comparatively lower wages than day laborers and suffering from many critical health hazards getting exposed to toxic materials and chemicals. The guideline for E-waste management needs to address these issues and implement regulatory instruments on the firms engaged in salvaging E-waste to ensure the labor force's financial and health safety in this sector. However, in isolation, the regulatory policy might not be the most

suitable approach; a participant stated that regulatory policies require supervision and sincere continuation, making these policies less likely to be successful in resolving the persisting issues.

5.1.3 Economic Instruments (EI)

Economic Instruments are laws and policy tools that mandate financial gain or loss on the target group for abiding by violating specific rules. This is also known as the “Market-based Incentive”. The selected EI for E-waste management are:

EPR: Extended Producer Responsibility is the best method for proper E-waste management. EPR is considered an innovative policy as it approaches E-waste as a product rather than waste and requires less government or enforcement supervision. The adoption of EPR could financially benefit the producers as they can recycle their old products to extract raw materials for their new products. The active involvement of E-device producers in E-waste recycling and extraction can reform E-waste management as a formalized industry and create a massive work opportunity for the people of Bangladesh. Also, formalized supervision will result in fewer environmental hazards and labor exploitation. The government can provide an incentive to the existing E-waste salvaging industry to formalize the industry's structure and make it more attractive for investment and involvement.

Certification and Recognition: Certification and recognition for sustainable management of end products can be a very effective tool for E-waste management. Manufacturers who track the E-waste produced from their product and successfully procure and recycle it in their own facility should be awarded high standard certification and recognition.

Imposing Pollution Tax/Fines: Most of the environmental and health hazards of E-waste management are caused by the quick and easy extraction and dumping methods by the vendors. If the negative externalities caused by the haphazard methods can be quantified and compensated by imposing pollution tax, the vendors will be interested in embracing the waste salvaging method that is less detrimental to the health and environment. E-waste salvaging vendors and firms should be regulated by the "Mobile Court" or a similar entity and should be fined if any misconduct such as lack of supply of proper safety gears for the laborers or improper dumping methods burning plastic is found.

Incentive for Research and Development: Environment-friendly waste management methods are usually more expensive and resource-intensive. Proper incentive and increased

investment in research and development for innovation and adoption of newer technologies can make environment-friendly waste salvaging cheaper, safer, and more efficient.

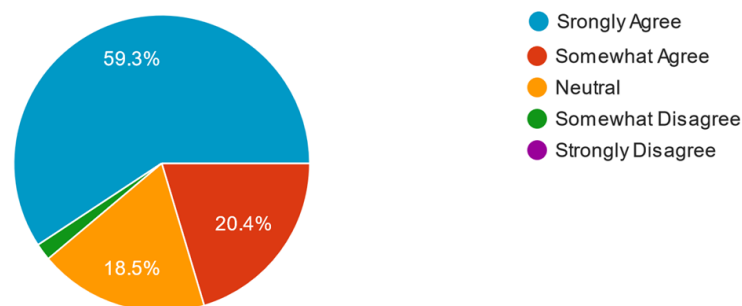
5.1.4 Feedback on EI

Next, the respondents are stated a policy implication using economic instruments. The statement is: "Charging pollution tax will encourage more environment-friendly E-waste salvaging approach by the firms/industries."

Figure 16 Feedback on Economic Instruments (EI)

"Charging pollution tax will encourage more environment-friendly E-waste processing approach by the firms/industries".

108 responses



The figure shows that 59.3% of respondents strongly agree with this statement, while 20.4% somewhat agree. 18.5% of respondents stay neutral on this topic, and about 2% somewhat disagree with this statement.

One of the significant reasons behind E-waste management's health and environmental hazards is the cheap and manual methods of waste disassembling and dumping. E-waste vendors in Bangladesh, like most other developing countries, have not adapted to the modern, automated, and environment-friendly methods for E-waste management. In most cases, the laborers open and scrap the reusable components of E-waste with their bare hands or minimum tools without any safety gear. While this method is cheaper and more profitable for the vendors, this is hazardous and often fatal for the laborers. After the valuable components are scrapped, the residue is either dumped on the landfill or burnt. This seemingly simple and cheap method of waste dumping causes severe environmental and public health damage. This is why implementing economic policy instruments, such as charging pollution tax or fining the vendors for using hazardous methods to recycle E-waste, will be remarkably effective for improving E-waste management practices. Some respondents added that creating

opportunities and providing incentives in an E-waste recycling industry can transform E-waste recycling into a profitable and attractive industry.

5.1.5 Persuasive Instruments (PI)

Persuasive Policy Instruments are tools to stimulate the target groups' ethical and moral values to minimize the tendency to violate the rules and encourage a positive attitude towards rules and regularities instead of enforcing them. The selected SI for E-waste management are discussed below:

Inclusion in Curriculum: One of the most effective ways to stimulate awareness on E-waste management is including topics related to this school's academic curriculum. Inclusion of topics such as SDG, the importance of environmental sustainability, recycling, the importance of proper E-waste management, etc. in the textbook can make children aware of the persisting environmental and economic issues and result in better engagement in the future.

Social Awareness Events: The study found that awareness about E-waste management and related issues is deficient regardless of age, education level of the profession. Organizing social awareness events or campaigns by the government or environmental activist organizations would significantly increase public concern and engagement. Campaigns and movements to make people more responsible for E-devices' consumption and their safe disposal can significantly impact the E-waste generation rate. If consumers thoughtfully buy their electronic gadgets and know their devices' end destination, E-waste's magnitude would significantly be reduced, and the collection would be more efficient.

Training Program/Workshop: Universities and organizations engaged in environment-related activities can offer a workshop or certificate course on the topic like E-waste management, environmental sustainability for students, and professionals. This type of initiative would significantly stimulate awareness among the formal sector of Bangladesh. Training programs on E-waste can be designed for the government officials by their institutes to enhance the understanding of this issue which would greatly influence the progress in designing the legal framework of E-waste management.

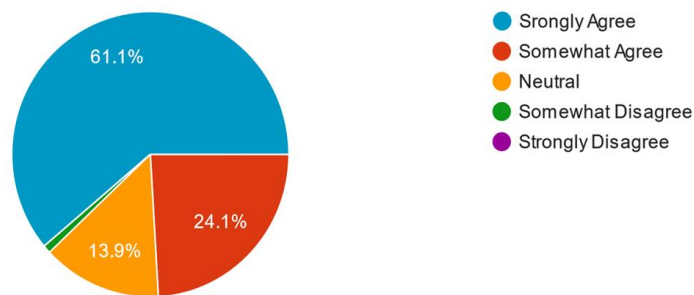
Online Engagement: In the age of information technology, the internet and social media platforms are the greatest meant to raise awareness or increase public engagement on persisting socio-economic issues, especially for the young population. Online events, competitions, vlogs, and websites on E-waste management would greatly increase the awareness and engagement of Bangladesh's young population.

5.1.6 Feedback on PI

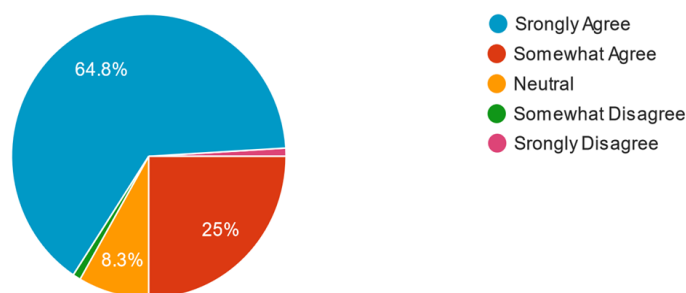
In environmental issues like E-waste management, social awareness is one of the most important keys to the proper solution. The study has found that awareness of E-waste and topics related to this issue is relatively low, and public engagement is virtually non-existent. To approach solutions such as limiting the generation of E-waste, ensuring financial and health safety for workers, embracing environment-friendly waste management systems, awareness on these issues are public engagement is crucial. The respondents are given two statements related to Persuasive policy implications and asked for feedback.

Figure 17 Feedback on Persuasive Instruments (PI)

"Topics related to E-waste and its impact should be added in the academic curriculum".
108 responses



"Activities like ads, School campaign will increase the general awareness about the importance of proper E-waste management".
108 responses



The first given statement is: "Topics related to E-waste and its impact should be added in the academic curriculum." 61.1% of respondents strongly agree with the statement, followed by 24.1% of respondents who somewhat agree with this statement. 13.9% of respondents remain

neutral, and about 1% of respondents somewhat disagree. A few respondents also think social media engagement, such as Facebook activity and organizing online events, can play a vast role in raising public awareness. On the other side, many respondents believe that due to people's economic status and social behavior, the ethical approach to tackle issues like E-waste management is not very effective.

5.2 Structuring EPI Use-Design

This section summarizes the overall findings and analysis of the various section of this thesis from Chapter 5 and identifies the target groups for the selected EPI analyzing the findings. Finally, presents the structured and comprehensive EPI Use-design for inducing proper E-waste management practices in Bangladesh, implementing the various EPI described in section 6.1.

5.2.1 Major Findings

The study has explored and analyzed the present situation of E-waste in Bangladesh. It analyzed E-waste's magnitude, the flow of E-waste from production to disposal, the E-waste salvaging vendors and their methods, and the labor issues related to E-waste management. These findings work as the basis of choosing a particular EPI for a target group. The findings of the present situation of E-waste in Bangladesh is the following:

- (i) The widespread use of E-device in households and offices by the large population is the main factor behind E-waste's great magnitude in Bangladesh.
- (ii) E-waste is managed and scrapped by the informal sector without adequate safety measures, and it is disposed of by incineration and dumping on landfills, which have significant negative implications on health and the environment.
- (iii) The E-waste laborers earn only 3000 taka per month while working for 12 hours a day in a very hazardous environment.
- (iv) Public awareness and engagement in E-waste management and related issues are low regardless of the age, education level, or profession among the consumers, irrespective of the age, education level, or profession among the consumers.
- (v) Exclusive, comprehensive, and target-specific legal framework or guidelines for E-waste management is not yet implemented.

5.2.2 Policy Target Groups Based on Findings

From the overview of the major findings, the target group of EPI Use-design is specified as the following:

- (i) E-device manufacturers/Importers;
- (ii) E-device Consumers/E-waste Generators;
- (iii) E-waste Collectors/Vendors;
- (iv) The operator of E-waste Recycling;
- (v) Public and Private Institutes;
- (vi) Environmental Organizations;
- (vii) Government Officials.

5.2.3 EPI Use-Design

This study's central objective has thus been to adopt an E-waste management approach by using environmental policy instruments such as regulatory, economic, and Persuasive instruments. The study concludes that a comprehensive, coherent, and inclusive approach using regulatory, economic, and Persuasive instruments is the most appropriate method to improve E-waste management practices in Bangladesh. Resolving the persisting issues related to proper and safe E-waste management requires strict regulations and enforcement. Focusing on E-waste management's financial and business aspects would attract more participation and investment in this industry. Furthermore, finally, public awareness can play a massive role in the long-term effectiveness of any policy implication, so initiations to increase public awareness and engagement will play a vital role in improving E-waste Management practices in Bangladesh. The key findings, which allowed to appropriately develop an EPI use-design for E-waste management, along with policy target and corresponding choice of a specific policy measure are presented in the following table.

Table 5 Proposed EPI Use-design for Improving E-waste Management

Major Findings	Target Group for Policy	Choice of EPI	Expected Result
<i>Exclusive, comprehensive, and target-specific legal framework or guidelines for E-waste management has not been finalized.</i>	Government Officials	Persuasive - Training and Program on E-waste and the importance of its management	<ul style="list-style-type: none"> ▪ Exclusive legal framework for E-waste Management ▪ Efficient E-waste collection and salvaging ▪ Safe E-waste salvaging ▪ Regulated E-waste flow and management
	E-waste Collectors/Vendors	Regulatory - Exclusive Guideline for E-waste collection - Decentralized Regulation	
	The operator of E-waste salvaging	Regulatory - Exclusive Guideline for E-waste handling and salvaging - Decentralized Regulation	
	Public and Private Institutes	Regulatory - Exclusive guidelines to resell or re-purpose used E-devices	
<i>The high amount of E-device in households and offices by the large population is the main factor behind E-waste's great magnitude in Bangladesh.</i>	E-device manufacturers/Importers	Regulatory - Identification - Regulation on Importing	<ul style="list-style-type: none"> ▪ Regulated E-device usage ▪ Regulated E-waste flow ▪ Formalization of E-waste management
		Economic - EPR - Certification and Recognition	
	E-device Consumers/E-waste Generators	Economic - Tax	
		Persuasive - Social Awareness Events - Online Engagement	
Public and Private Institutes	Regulatory - Identification		

		Economic <ul style="list-style-type: none"> - Certification and Recognition 	
<i>E-waste is managed and scrapped by the informal sector without adequate safety measures, and it is disposed of by incineration and dumping on landfills, which have a significant negative implication on health and the environment.</i>	E-waste Collectors/Vendors	Regulatory <ul style="list-style-type: none"> - Exclusive Guideline for safe waste salvaging - Safety Regulation 	<ul style="list-style-type: none"> ▪ The environment-friendly E-waste salvaging practice ▪ Increased health safety ▪ Increased labor safety ▪ Monetization and reduction of externalities ▪ Newer technology for E-waste management
		Economic <ul style="list-style-type: none"> - Imposing Pollution Tax/Fines - Incentive for Research and Development - Certification and Recognition - 	
	The operator of E-waste salvaging	Regulatory <ul style="list-style-type: none"> - Exclusive Guideline for safe waste salvaging - Safety Regulation 	
		Economic <ul style="list-style-type: none"> - Certification and Recognition - Imposing Pollution Tax/Fines - Incentive for Research and Development 	
<i>The E-waste laborers earn only 3000 taka per month while working for 12 hours a day in a very hazardous environment.</i>	E-waste Collectors/Vendors	Regulatory <ul style="list-style-type: none"> - Revised Labor Law - Safety Regulation 	<ul style="list-style-type: none"> ▪ Improvement of the financial condition of laborers ▪ Improvement in work conditions ▪ Increased occupational safety ▪ Reduction in health damage
		Economic <ul style="list-style-type: none"> - Incentive for Research and Development 	

<i>Public awareness and engagement in E-waste management and related issues are alarmingly low.</i>	E-device Consumers/E-waste Generators	Persuasive <ul style="list-style-type: none"> - Curriculum Reformation - Social Awareness Events - Online Engagement 	<ul style="list-style-type: none"> ▪ Increase in awareness ▪ Increase in stakeholder participation ▪ A better understanding of key environmental, development, and resource management issues ▪ Improved social behavior ▪ Higher success in policy implementation
	Public and Private Institutes	Persuasive <ul style="list-style-type: none"> - Training Program/Workshop 	
	Environmental Organizations	Persuasive <ul style="list-style-type: none"> - Social Awareness Events - Workshop/Training - Online Engagement 	

Chapter 6

Study Summary and Conclusion

Magnitude of E-waste and its proper management is one of the most critical health and environmental problems in Bangladesh. The large population of Bangladesh is consuming a huge number of E-devices in their households and workplaces. With the advancement of technology, the older E-devices are being replaced by the new ones. As a result, the older devices are discarded and piling up as waste rapidly. Without appropriate measures and proper policy use, this problem cannot be addressed satisfactorily.

With the above background, the purpose of the study has been to design strategic use of various environmental policy instruments as a policy package -- targeting the fear, economic interest, and moral elements of the human mind -- for adopting a holistic approach to promote improved E-waste management practices in Bangladesh. In doing so, the study completed the following tasks.

First, the study has defined the term E-waste. It also discussed the various types and components of E-waste. It then explored the impact of its toxic components on the environment and life. Metals such as arsenic, lead, and chemicals such as CFC can disperse into the open environment and seriously damage the natural harmony of the environment as well as the health of the human and non-human habitats.

The study has analyzed the legal frameworks and rules of different countries regarding E-waste management in different countries. Most developed countries as well as several developing countries have addressed the threat of E-waste and formulated an exclusive and well-structured legal framework and guidance for E-waste management. In contrast, countries in South Asia and Africa such as Bangladesh and India are found to have no such exclusive policy for E-waste management.

The study has also analyzed the current laws and rules related to E-waste management in Bangladesh. The major environmental Acts and other rules are used as the guideline for E-waste management but no exclusive E-waste management policy has been implemented yet. The E-waste Management Rules 2017 under the Environmental Conservation Act 1995, which

is expected to be the first exclusive policy for E-waste management is found to be still in process.

An online survey was conducted for collecting data from the respondents concerning E-waste management. They were asked about the ownership and usage period of their E-devices. The data has shown that all respondents have multiple E-devices. This has been on the rise as income has been increasing. The magnitude of the problem however has to do with a huge population base. As a result, these devices, as discarded, add to the growing pile of E-waste. The discarded E-devices are mostly bought and collected by the informal sector for recovering reusable materials and later dumped on open space. As there is no strict legal framework for E-waste management, the labor force engaged in collecting and salvaging E-waste in Bangladesh works with very low wages and are exposed to health hazards. On E-device users, the study has found that the survey respondents' awareness of E-waste and its effect on health and the environment are limited.

The study has also captured the respondents' views on the environmental policy instruments for improving E-waste management. They had a mixed response in this regard. A few pointed out that forcing regulatory policies, without concerted efforts to enforce and raising social awareness, will not be successful. Some believe that considering the socio-economic condition of Bangladesh, ethical persuasion will be less effective. According to their view, regulatory measures and their enforcement are the best way for effective E-waste management. Some respondents think that economic measures such as incentives and investment in the E-waste recycling industry bear potential for E-waste management as a profitable business opportunity for an effective approach for proper E-waste management methods. Consumer or E-device user feedback thus can be considered as supportive of using EPI consists of RI, EI, and PI as a policy package.

The study's proposal of EPI Use-design is thus based on both theoretical and empirical considerations. The regulatory measures of the policy package are designed to control the E-waste recycling practices and ensure labor rights and safety for the workers engaged in E-waste recycling. These include product identification, supervision of E-waste management processes, revision of labor safety measures, and issuing guidelines for E-waste collection and disposal. E-device manufacturers and E-waste vendors are the primary targets of these policy instruments. Economic policies are primarily targeted towards E-device manufacturers and E-waste vendors. Proposed economic measures include pollution tax on the E-waste vendors, which would discourage the use of cheap and hazardous methods of disassembling. Also,

incentive measures are proposed to attract investment in the E-waste management sector and the growth of E-waste based businesses. Such incentive measures are expected to transform the E-waste management industry into a profitable business opportunity that would create better jobs than the current hazardous work of the E-waste related informal activities of the urban poor. Persuasive or moral suasion component of EPI use-design includes social engagement such as online events, campaigns, workshops; and curriculum provision in school syllabus and raising mass awareness on E-waste and the importance of its sustainable management which in the long run will be the key to ensure the continuation of proper E-waste management practices.

6.1 Limitations and Future Scope

Due to the unprecedented circumstance created by the COVID-19 pandemic, the study has been conducted in a very limited scope. The authorities concerning E-waste management and the labor force engaged in E-waste recycling have not been surveyed due to the restrictions imposed by the nationwide lockdown. Future scope of research in E-waste management include:

- (i) Studying the authorities concerning E-waste management;
- (ii) In-depth investigation of the economic potential of E-waste recycling as a profitable industry;
- (iii) Exploring E-waste management experiences in countries at different levels of economic development.

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Appendix A1

Table A1 E-waste generation, recycling, and disposal in some countries

Country	Generation (in million tons)	Disposal (in million tons)
Bangladesh	2.8 (2009)	-
China	10.98 (2013) 7.58(2012) 6.67 (2011) 5.84(2010) 5.15 (2009)	4.13 (2013) 2.54 (2012) 5.63 (2011) 1.91 (2010) 0.30 (2009)
India	1.7(2013) 1.4(2014)	0.12(2013-14)
Malaysia	0.152 (2011) 0.163 (2010)	-
Singapore	0.06 (2014)	-
Thailand	0.39 (2015)	-

Source: UNCRD, IGES, MoJ, 2018

Appendix A2

Table A2 Status of Policies and Guidelines for E-Waste Management in Some Countries

Policy Status	Country/Region
Full Implementation (<i>Full implementation of E-ware related policies for its recycling</i>)	China: Administration Regulation for the Collection and Treatment of Electric and Electronic Product waste.
	Japan: Home appliance recycling law and Small Home appliance recycling law.

	<p>India: EPR based E-waste (Management & Handling Rules) 2011 and revised as E-waste Management Rules 2016 has been initiated and the take-back system by the business houses is implemented.</p>
<p>Partial Implementation (<i>E-waste management policies exist but very limited practice</i>)</p>	<p>Pacific Island Countries (Only New Caledonia): EPR scheme is executed by a non-profit environmental organization (TRECODEC) that collects E-waste through voluntary drop-off receptacles and from authorized dumps.</p> <p>Thailand: E-waste management policy as a part of the National Integrated WEEE Management was approved by the cabinet in 2007. Draft Act was drafted in 2014 and the cabinet approved it in 2015.</p> <p>Vietnam: Decision (16/2015)/QD-TTG on EPR regulated E-waste such as TV, Refrigerator, washing machine, computers as discarded products that must be collected and treated by producers/importers.</p>
<p>Guideline (<i>No Policy only guideline exists</i>)</p>	<p>Cambodia: Guideline on Environmentally Sound Management of Waste Electrical and Electronic Equipment is established currently.</p> <p>Philippines: Guidelines on Environmentally Sound Management (ESM) of Waste Electric and Electronic Equipment (WEEE) under RA9003. E-waste is classified under a special type of waste.</p> <p>Pacific Island Countries: The Pacific E-waste: A regional Strategy and Action Plan 2012 (SPREP, 2012) identified strategic actions for E-waste management which are also considered in the Cleaner Pacific 2025 for sustainable management.</p>
<p>Managed by Existing Regulations (<i>E-waste is managed by existing</i>)</p>	<p>Indonesia: E-waste regulation follows the HW Management (Law no 32/2009)</p>

<i>policies therefore no particular response against E-waste management)</i>	Malaysia: Following the regulation stipulated under Environmental Quality Regulations 2005
	Singapore: No formal E-waste regulation. Active second-hand market and effective recycling initiatives.
	Bangladesh: The Bangladesh Environmental Conservation Act 1996, The Environment Conservation Rules 1997, and Environment Court Act of 2000 provide the basic regulatory framework that can be the basis of deriving rules for E-waste management.

Source: Based on UNCRD, IGES, MoJ (2018)

Appendix A3

Table A3 Electronic Item Consumptions in Dhaka City

Type	Consumption in Dhaka (million pieces/year)	
	2014 (base year)	2020 (projected)
Mobile Phone	7.16	21.37 (considering the growth of 20%)
Computer	0.39	0.68 (considering growth of 10%)
Television	0.97	2.90 (considering the growth of 20%)

Source: Based on Report on follow up research, Re-Team Corporation and Waste Concern Consultants, 2015

Appendix B

The Online Survey Questionnaire

[The online questionnaire survey is created using Google Forms. The Survey and its result can be found at

[<https://docs.google.com/forms/d/e/1FAIpQLSc8OS8wNC4vdCEnNbMIKmNkxowKTaZ864GqGtuKp5pWuJot1Q/viewanalytics>]

Section 1 of 4

Respondents' Profile

Hello! I am Ahmad Irthiza from BRAC University. I am researching E-waste Management in Bangladesh as a part of my Master's Thesis. Please consider spending 10 minutes on this survey. This anonymous survey aims at understanding the level of general awareness on E-waste and collecting feedback from the respondents on their thoughts on approaching proper E-waste management practices in Bangladesh. Your participation will be a great help to this research. The first section will collect participant's data on their gender, age, education, profession, etc.

- Gender:
 - Male
 - Female
 - Other
- Age Group:
 - Less than 20
 - 20-35
 - 36-45
 - Above 60
- Education Level:
 - School/SSC/O Level
 - HSC/A level
 - Undergraduate /Bachelor's
 - Master's/PhD
- Occupation
 - Student
 - Unemployed
 - Homemaker
 - Entrepreneur / Business
 - Academic
 - Public Servant
 - Private Sector Employee

Section 2 of 4

E-device Ownership/Usage

In this section, we shall collect information about the electronic devices you own. This will help us understand the general trends of electronic device usage.

- Type of device owned
 - Television
 - Mobile Phone/ Tablet
 - Desktop/Laptop Computer
 - Fridge
 - Electric Oven
- Number of devices owned
 - Television:
 - 0
 - 1
 - 2
 - More than 2

 - Mobile Phone/ Tablet Computer
 - 0
 - 1
 - 2
 - More than 2
 - Desktop/Laptop Computer
 - 0
 - 1
 - 2
 - More than 2
- The usage period of mobile phone/Tablet Computer:
 - Less than 2
 - 2-4 years
 - More than 4 Years
- The usage period of Desktop/Laptop Computer:
 - Less than 2
 - 2-4 years
 - More than 4 Years
- The destination of discarded E-device:
 - Sell or pass it to someone else
 - Dump it as waste
 - Keep it in your house/storage

Section 3 of 4

E-waste Awareness

This section is designed to assess your understanding and awareness of E-waste and the importance of its sustainable management. Please choose an option that best describes your level of understanding of the following terms.

- E-waste:
 - No idea
 - Basic Idea
 - Good understanding
 - Professional understanding/Engagement
- Health and environmental hazards related to Electronic devices:
 - No idea
 - Basic Idea
 - Good understanding
 - Professional understanding/Engagement
- Extensive producer Responsibility (EPR):
 - No idea
 - Basic Idea
 - Good understanding
 - Professional understanding/Engagement

Section 4 of 4

Feedback on Policy Instruments

This section is designed to collect general feedback on implementing various policy instruments for E-waste management. Please choose the option that best matches your response to the following statements.

- "Strict policy or guideline for disposing of/recycling discarded electronic devices is essential for sustainable E-waste management."
 - Strongly Agree
 - Somewhat Agree
 - Neutral
 - Somewhat Disagree
 - Strongly Disagree
- "Strict labor laws/regulations will improve the financial condition and work safety for the labor force engaged in E-waste management."
 - Strongly Agree
 - Somewhat Agree
 - Neutral
 - Somewhat Disagree
 - Strongly Disagree
- "Charging pollution tax will encourage a more environment-friendly E-waste salvaging approach by the firms/industries".
 - Strongly Agree
 - Somewhat Agree
 - Neutral

- Somewhat Disagree
- Strongly Disagree
- "Topics related to E-waste and its impact should be added in the academic curriculum".
 - Strongly Agree
 - Somewhat Agree
 - Neutral
 - Somewhat Disagree
 - Strongly Disagree
- "Promotional activities such as ads, School campaigns will increase the general awareness about the importance of proper E-waste management".
 - Strongly Agree
 - Somewhat Agree
 - Neutral
 - Somewhat Disagree
 - Strongly Disagree
- Finally, please choose which policy instrument will be most effective for ensuring proper E-waste management in your opinion. Regulatory policies are policies such as strict laws, regulations, and monitoring by the government. Economic policies are policies like imposing a tax, fine or providing incentives to buy used electronic devices instead of new ones. And lastly, Persuasive policies are policies such as awareness campaigns or teaching the children related topics such as the importance of sustainability, the harmful impact of toxic materials from E-waste, etc.

Regulatory Policies

- Very Effective
- Effective
- Less Effective

Economic Policies

- Very Effective
- Effective
- Less Effective

Persuasive Policies

- Very Effective
- Effective
- Less Effective

If you have any feedback or additional thoughts please share: