



**E-waste Management:  
A Study on Legal Framework and Institutional Preparedness  
in Bangladesh**

**By**

**Muhammad Anisur Rahman  
MPPG 5<sup>th</sup> Batch**

December 2016



**Public Policy & Governance Program  
North South University**



**E-waste Management:  
A Study on Legal Framework and Institutional Preparedness  
in Bangladesh**

**By**

**Muhammad Anisur Rahman  
MPPG 5th Batch**

**To**

**Professor Salahuddin M Aminuzzaman  
Adviser  
MPPG Program, NSU**

Thesis submitted to the  
Public Policy and Governance (PPG) Program  
in partial fulfillment for the award of

**Master in Public Policy and Governance (MPPG)**

December 2016



**Public Policy & Governance Program  
North South University**

**Dedicated to my beloved parents**

## **Declaration**

I declare that the dissertation entitled “E-waste Management: A Study on Legal Framework and Institutional Preparedness in Bangladesh” submitted to the PPG Program of North South University, Bangladesh for the Degree of Master in Public Policy and Governance (MPPG) is an original work of mine. No part of it, in any form, has been copied from other sources without acknowledgement or submitted to any other university or institute for any degree or diploma. Views and expressions of the thesis bear the responsibility of mine with the exclusion of PPG for any errors and omissions to it.

**Signature with Date**

**Full Name: Muhammad Anisur Rahman**

**ID No. 151 336 1085**

## Acknowledgement

I wish to express my deepest gratitude to my supervisor and MPPG course adviser Professor Salahuddin M Aminuzzaman for strongly supporting and trusting me since the beginning of my research.

I am very grateful to Professor Nurur Rahman, IBA, DU, Professor M. Habibur Rahman, Environmental Engineering Division, BUET, Professor Mujibur Rahman, Department of Civil Engineering, BUET, Professor Rowshan Mamtaz, Department of Civil Engineering of BUET, Professor Md. Khabir Uddin, Department of Environmental Sciences, JU, Professor Mufazzal Hossain, Department of Chemistry, DU for their support and generous advice to improve the quality of this work.

I wish to acknowledge the support and inputs of Ms. Zuena Aziz, Secretary, Member of Planning Commission, Dr. Sultan Ahmed, Joint Secretary, DoE, Ms. Rokhsana Tarannam, DS, MoEF, Md. Rahihan Akter, DS, MoPT&ICT, Mirza Shawkat Ali, Director DoE, Mr. Shamim, DD, DoE, Ms Rokshana, DD DoE, Mr. Mohammad Monzural Islam, Chief Revenue Officer, CCC, Ms Israt Jahan Panna, CEO, Ghatial Cantonment, Mr. Benzir Ahmed, Conservation Officer, DNCC, Dr. Satyajit Ghose, CSO, BAERA, and Mr. ASM Mamun, DD, BD Beter for their informative commentary and documentation support contributed to the integrity of the text as a whole.

I also thank To Mr. Abu Hasnat Md. Maqsood Shinha, ED, Waste Concern and Mr. Shahirar Hossain, Ph.D. Adviser, ESDO, Mr. Abul Kalam Azad, Chairman, Azizu Recycling & E-waste Company, Mr. Nazmul Hyder, ED, JR Enterprise for their continuous support and encouragement.

I want to express my gratitude to all of my MPPG course mate specially my thesis opponent Mr Abu Saleh Mahfuzul Alam, SAS and Mr. AHM Masum Billah, SIO for their supporting in reviewing this research.

I also want to acknowledge my parents, wife, brother and sister for the understanding they gave me during the harsh economic times during course of my study.

May Allah bless you All.

Date: 25 December 2016

Muhammad Anisur Rahman

## Abstract

The study aims at assessing the current status of e-waste management and proposing a policy framework for improving e-waste management in Bangladesh. Three independent variables— institutional preparedness, legal framework and citizens' awareness—have been analyzed in order to identify their relationships with the dependent variable such as the level of efficiency of e-waste management.

The study primarily used a survey method: a) a survey has been conducted to the citizens to know their level of awareness on e-waste equipment and their disposal system. b) a semi-structured interview has been directed to the service providers in order to assess their level of education, training, responsibility and skill; Extant literatures and policy documents have been reviewed to develop an understanding to the mandate and functions of government and non-government institutions to assess the capability of the government official. In addition, some private business workshops have been observed for gaining practical knowledge of e-waste management. The study also interviewed key informants to have ideas about specific institutional and policy issues. The study also examined Institutional preparedness of MoEF, DoE, LGI (City Corporation, Pawroshova, Union Parishad) and Cantonment Executive Boards, and their capacity in managing e-waste. It attempted to know organizational structure and its assigned roles and responsibility, to know institutional capacities in respect of performing their routine tasks, including enforcement of existing laws.

The study explores how e-waste is being managed in Bangladesh. The study finds that private sectors are gradually growing interest to build in entrepreneurship in this emerging sector of e-waste management. Private sectors have already started, but they are in an elementary stage. Mainly they collect office ICT equipment as e-waste from various sources and dismantle it. For extracting metals, they used chemical process and incinerated e-waste. These methods caused water and air pollution that leads to much concern of public health. It is also growing concern for adverse socio-economic, public health and environmental impacts of toxicity in e-waste. Private business owner are facing challenges for standard technology, infrastructure, trained people and financial constrain. At this moment they need e-waste management supportive rules/ guidelines to do business in an environmental friendly manner.

The study found that citizens' awareness level regarding knowledge and attitude of e-waste is low level. There are laws for environmental issues and solid waste management issues. But for e-waste management though there are some policy frameworks but no specific rules as such in operation. In 2011, MoEF and DoE had taken initiative to formulate e-waste management rules but the rule has

not get approval by the competent authority yet. Currently, MoEF and DoE has started to prepare guidelines for e-waste management. The guideline is still in under formulation procedure. From interview and document review, it is evident that the enforcement capacities of institutions / agencies concerned are weak. However for solid waste management it is found that existing policy and supplementary rules are supportive. All existing policy, except ICT policy 2015, Act, rules, regulation in general are supportive and or complementary to solid waste management.

Lack of knowledgeable trained and skilled personnel on e-waste management and clarity as regards environmental hazards as such on waste are found to be absent in such agencies. As there is no specific e-waste management policies, act, rules and thus e-waste management infrastructure and institutional capacity have not developed yet. The study therefore strongly argues that there is an urgent need for designing an e-waste management policy.

The study finally identifies some pressing policy issues such as imposing embargo on inferior products or maintaining international quality standards for importing electrical and electronic equipment. The citizens should be made aware of e-wastes with the support of print and electronic media. Economic incentive mechanism could inspire consumers to transfer used electronic equipment to the registered vendors after expiry of the life of the equipment. Imposing device mechanism (technology standards) process might also be a control mechanism to regulate incineration and informal recycling of the discarded electrical equipment. Recycling centers and e-waste dumping landfill should be located in a specific area for controlling environmental hazards.

**Keywords:** Institutional preparedness, citizens' awareness, institutional infrastructure, institutional capacity, e-waste management

## Table of Contents

Acknowledgement .....	iii
Abstract.....	iv
List of tables .....	x
Dependent and explanatory variables from Literature .....	x
List of figures and charts.....	xi
List of Abbreviation .....	xii
CHAPTER ONE .....	1
INTRODUCTION.....	1
1.1 General Overview .....	1
1.2 Background of the Study.....	2
1.3 Statement of the Problem: .....	3
1.3.1. E-waste quantity is increasing for the technological enhancement:.....	3
1.3.2. Lack of awareness of e-waste generation: .....	4
1.3.3. Lack of enforcement policy (rules and regulation) for reducing e-waste:.....	4
1.3.4. Increasing environmental pollution:.....	5
1.3.5. Negative impact on health:.....	5
1.3.6. Lack of technological preparedness/ disposal capacity (Poor design and complexity):.....	5
1.3.7. Labour issues:.....	6
1.4 Objective of the Study-general/ specific.....	6
1.5 Research Questions: .....	7
1.6 Significance of the Study:.....	7
1.7 Scope of the study: .....	8
1.8 Rational of the Study.....	8
1.9 Methodological Approach: .....	9
1.10: Limitation of the Study: .....	10
CHAPTER TWO .....	11

INTRODUCTION TO E-WASTE.....	11
2.1. Overview of E-waste .....	11
2.2. Definition of E-waste: .....	11
2.3. International laws relating to e-waste:.....	13
2.3.1. Basel Convention: .....	13
2.3.2. European Union Directives: .....	13
2.4. Categories of E-waste: .....	14
2.5. Scenario of E-waste in Global Perspective.....	15
2.5.1. Continent State of E-waste: .....	15
2.5.2 Regional Scenario:.....	16
2.6. Material Composition: .....	16
2.7. Potential effects of e-waste materials:.....	17
2.7.1. Evaluation of environmental pollution: .....	17
2.7.2. Hereditary effect:.....	18
2.7.3. Environmental concerns and chemical hazards: .....	18
2.7.4. Some other material effects on health and environment are as follows:.....	18
2.8 Conclusion:.....	20
CHAPTER THREE .....	22
LITERATURE REVIEW AND ANALITICAL FRAMEWORK .....	22
3.1 Literature Review: Concept.....	22
3.2 Over cap of the review of literature .....	25
3.3 Synthesis: .....	27
3.4 Literature Review: Theoretical.....	27
3.5 Definitions related problem.....	28
3.6 Policy options related problem:.....	29
3.7 Synopsis: .....	30
3.8 Literature from Empirical Study:.....	30

3.9 Operational Definition of E-Waste Management: .....	31
3.10 Curving out the Space (to make my space out): .....	31
3.11 Theoretical Framework: .....	31
3.12 Analytical Framework: .....	32
3.13 Dependent and Explanatory Variables from Theoretical Sources: .....	34
3.14 Overview of the Variables: .....	35
3.15 Variables and Measuring Indicators from Theoretical Sources: .....	38
CHAPTER FOUR .....	39
4.1 Introduction .....	39
4.2 Research Design: .....	39
4.3 Study Area .....	40
4.4 Sample and Sampling Technique: .....	40
4.5 Research Instruments .....	41
4.6 Secondary Research .....	41
4.7 Field Research .....	42
4.8 Field Level Questionnaire Survey .....	42
4.9 Key Informant Interview .....	42
4.10 Semi structured interview: .....	43
4.11 Institutional Case study: .....	43
4.12 Field and Site Visits .....	44
4.13 Data Analysis and Presentation .....	44
4.14 Mapping of the Study .....	45
CHAPTER FIVE .....	47
5.1 Results and Discussion .....	47
FIRST PART: .....	48
5.2 Institutional Preparedness for E-Waste Management .....	48
5.2.1 Institutional Infrastructure for Policy Formulation: .....	48

5.2.2. Policy formulation bodies: .....	49
5.2.4 An institutional Case Study of E-waste Management.....	54
5.2.5 Initiative of private entrepreneur to management e-waste: .....	57
5.2.6 Institutional Capacity: .....	58
SECOND PART .....	64
5.3.1 National Legal and Regulatory Framework with an Environmental Focus (Legal & Regulatory Regime) .....	64
5.3.2. Relevant Laws Influencing E-Waste Generation and Management: .....	71
5.3.3 Findings: .....	75
5.3.4. Gaps of current legislation and policy .....	75
THIRD PART (PURE EMPIRICAL) .....	76
5.4.1. Demographic Profile: .....	76
5.4.2. Usage of electronic gadgets:.....	77
CHAPTER SIX.....	91
CONCLUDING REMARKS .....	91
6.1. Conclusion and observation:.....	91
6.2. Extended Producer Responsibility (EPR):.....	95
6.3 Further research: .....	96
REFERENCES: .....	97
Lundgren, K., 2012. <i>The global impact of e-waste: Addressing the challenge</i> .....	99
Zainal, Z., 2007. Case study as a research method. <i>Jurnal Kemanusiaan</i> , (9), pp.1-6. ....	99
Annexure -A .....	100
Annexure- B .....	100
Annexure- C.....	100
Annexure- D .....	100

## List of tables

Table	No	Title	Page
Table:	1.1	Table Showing Summary Findings of Target Electronic Item Consumptions and E-Waste for DSMA	3
Table	1.2	Life span and weight of electronic equipment	4
Table	2.1	Global status and projection of e-waste	15
Table	2.2	Continent Scenario e-waste generation	16
Table	2.3	Regional Scenario of e-waste generation	16
Table	2.4	Metal concentration (wt%) of printed circuit boards reported in different studies	17
Table	2.5	Effect of E-waste constituents on human health and environment	18
Table	3.1	Summery literature review theory and concept	26
Table	3.2	Literature review on e-waste collection system	30
Table	3.3	Dependent and explanatory variables from Literature	34
Table	3.4	Variables and measuring indicators	38
Table	4.1	Mapping of objectives, variables/indicators, sources of data and data analysis of the study	46

## List of figures and charts

Figure	No	Title	Page
Figure	1.1	Conceptual Life Cycle of Electrical and Electronic product	1
Figure	3.1	Analytical Framework	34
Figure	5.1	Demographic profile of respondents	77
Figure	5.2	Possession of selected electronic gadget used by respondents	78
Figure	5.3	Number of obsolete selected electronic device per user for the last ten years	79
Figure	5.4	Average life time of used electronic gadgets	80
Figure	5.5	Citizens' knowledge & attitude on e-waste	82
Figure	5.6	Source of e-waste information	83
Figure	5.7	Awareness of e-waste harm	84
Figure	5.8	Impact of e-waste on environment	85
Figure	5.9	Disposal of discarded electronic equipment	86
Figure	5.10	Discarded electronic equipment collection method	87
Figure	5.11	Institution of e-waste management	88
Figure	5.12	Policy and Pay for e-waste management	89

## List of Abbreviation

BAN	Basal Action Network
CFC	Chlorofluorocarbon
CRT	Cathode Ray Tube
DoE	Department of Environment
DNA	Deoxyribonucleic Acid
DVD	Digital Video Disc
ECA	Environment Court Act
ECR	Environmental Conservation Rules
EC	European Commission
EEE	Electrical and Electronic Equipment
E-waste	Electronic Waste
EoL	End-of-Life
EPR	Extended Producer Responsibility
ESDO	Environment and Social Development organization
EU	European Union
ICT	Information and Communication Technology
ISO	International standards on environmental management
IT	Information Technology
KI	Key Informant
KII	Key Informant Interview
LCA	Life Cycle Assessment
LCD	Liquid Crystal Display
LCIA	Life Cycle Impact Assessment
LED	Light-emitting Diode
MFA	Mass Flow Analysis
MoEF	Ministry of Environment and Forest
Moi	Ministry of Industrialization
MOU	Memorandum of Understanding
MSW	Municipal Solid Waste
NEMAP	National Environmental Management Action Plan
n.d	Not Dated
NGO	Non-Governmental Organization
OECD	The Organization for Economic Co-operation and Development
PCB	Polychlorinated Biphenyl
PVC	Polyvinylchloride
RoHS	Restriction of Hazardous Substances
SPSS	Statistical Package for Social Science
TV	Television
UNDP	United Nations Development Program
UNEP	United Nation Environment Program
WEEE	Waste Electrical and Electronic Equipment
LGI	Local Government Institution

LGIs	Local Government Institutions
DNCC	Dhaka North City Corporation
DSCC	Dhaka South City Corporation
CCC	Chittagong City Corporation
KSP	Kishoregonj Sadar Paurushava
SUP	Sultanganj Union Parishad
CEB	Cantonment Executive Board



# CHAPTER ONE

## INTRODUCTION

### 1.1 General Overview

E-waste refers to all types of electrical and electronic equipment (EEE) that is discarded such as computers, cell phones etc. (Lieseltol Bisschop, 2014). E-waste has been recognized as the fastest growing waste stream in the globe at present (Nnorom and Osibanjo 2008, Jain 2008, Cui and Forssberg 2003). Rapid socio-economic growth and technological advancement are the main operators of this trend. The hazardous chemical elements of e-waste have potential opposing impacts on ecosystems and human health if not managed properly. This represents an imminent challenge to achieving sustainable development goals. Although technologically developed countries are the leading source of e-product production and e-waste generation, the generated size has also been increasing in developing countries and those in evolution due to transport and transfer from e-waste source countries. Subsequently, developing countries are in a vulnerable situation due to their lack of record data, waste management policies and progressive technology for environmentally sound management.

E-waste is categorized as hazardous waste, the cost of recycling it in an environmentally sound treatment plant is high; urging owners of e-waste recycling business to pick for cheaper replacements. One likely alternative is for e-waste to be recycled in less economically developed countries where the cost of labour is inexpensive. As e-waste recycling provides job opportunities and profitable business for many people in these countries, e-waste has become a sought after 'commodity'. This has prompted the explosion of Waste Electrical and Electronic Equipment (WEEE) or e-waste trading.

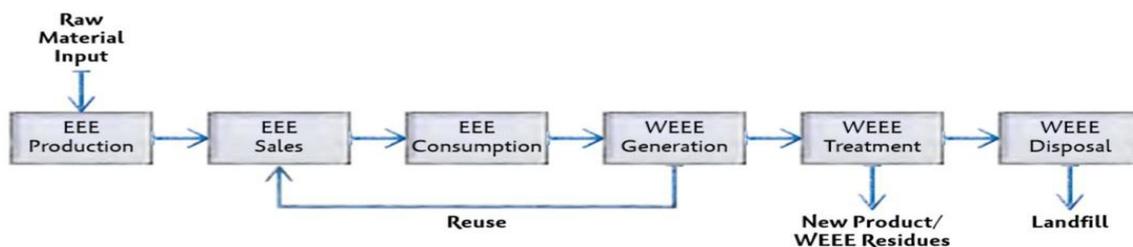


Figure 1.1: Life Cycle of Electrical and Electronic product (Source: UNEP, DTIE, 2007)

## 1.2 Background of the Study

Bangladesh's economy grew by 7% in the real GDP in 2016. Bangladesh has adopted expansionary monetary policy. It has reduced interest rates and increased broad money supply that is why the growth has increased in exports, demands (consumption and investment). For boosting up economic growth Present government is also committed to build an ICT-based society. Therefore, numerous ICT linked laws have been approved in last couple of years which are vital to standardize this sector. Digital Bangladesh is an indication that includes the IT use for management, administration and governance to ensure transparency, accountability and accountability at all levels of citizens and state. With the economic growth, generation of e-waste from overall consumption of the primary goods such as computers, televisions and mobile phones also increased in Bangladesh. The government has recognized the need to grow the country's capability in the information technology area.

Electrical and electronic equipment (EEE) have become indispensable to all aspects of people's daily lives. These goods have a diversity of characteristics, such as price, function, size, inner structure, components and material composition. The amount of e-waste has been increasing exponentially, with a global annual growth rate of 4 percent, due to fast technological development and ever-shortening product lifespans (Lundgren, 2012). From the perspective of proper waste management, collection schemes are needed to aggregate e-waste from individual consumers before sending waste appliances to professional facilities for treatment. Because of heterogeneous and complex characteristics, e-waste should preferably not be collected and treated together with the common solid wastes such as municipal waste, metal or plastic scraps. Conventional waste handling methods such as landfills, municipal incinerators and metal recyclers cannot fulfill the treatment requirements necessary to recover all e-waste materials and minimize environmental impacts( Feng Wang,2014, E-waste: collect more, treat better ).

Bangladesh is evolving with increasing technology usage. Ecological and safe of use technology can effort an economically developed country but wastes from these electronic goods can be extremely damaging. In Bangladesh, EEE's are consumed and then discarded without considering costs to the environment or sustainability (ESDO, 2012). E-waste dismantling or incineration is considered toxic. Therefore, they are targeted for reuse,

recovery or hazardous waste disposal. Environmental issues and trade associated with E-waste has driven the definition of E-waste both at nationwide and global level. In this context, it is important to understand the existing E-waste definition and its evolution, its drivers and barriers for its assessment and safe disposal.

### 1.3 Statement of the Problem:

The main issues posed by e-waste are as follows:

#### 1.3.1. E-waste quantity is increasing for the technological enhancement:

Encouraged by the production of low-priced electronics, rapidly enhancing technology, and the advent of popular electronic gadgets, the consumption of electronics is dramatically growing, while the lifetime of electronics is becoming comparatively short. Table 1.1 shows the Study on E-Waste in Bangladesh conducted by Japanese company Re-team Corporation with the assistance of Waste Concern Consultants in mid of 2015. The statistics is a compilation of information based on field survey carried out in Dhaka.

Table: 1.1 Table Showing Summary Findings of Target Electronic Item Consumptions and E-Waste for DSMA

Sl. No.	Item Name	Dhaka Statistical Metropolitan Area				Bangladesh
		Consumption In Dhaka (Piece/Year) (2009)	Consumption In Dhaka (Piece/Year) (2014) (Base Year)	Consumption In Dhaka (Piece/Year) (2020)	E-waste Generated in DSMA (Piece/Year) (2014)	
1	Mobile	2.88 million (considering growth of 20%)	7.16 million	21.37 million (considering growth of 20%)	1.32 million	18.00 million
2	Computer	0.24 million (considering growth of 10%)	0.39 million	0.68 million (considering growth of 10%)	0.10 million	0.30 million
3	Television	0.39 million (considering growth of 20%)	0.97 million	2.90 million (considering growth of 20%)	0.07 million	1.20 million

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

In the earlier, many electronic goods were designed in a way that it made monetary sense to repair them when they broke. Now, it is often low-priced to discard malfunctioning user electronics and change them with fresher and more technically advanced products. The EPA estimates the following short life spans for these products (Management of Electronic Waste in the United States: Approach Two. U.S. Environmental Protection Agency, April 2007. Washington, DC.).

Table 1.2: Life span and weight of electronic equipment

Item	Mass of Item (kg)	Estimated life (years)
Desktop Computer <sup>a</sup>	25	2-4
Laptop computer	2.15	2-3
Cell phone <sup>b</sup>	0.1	1-3
Television <sup>c</sup>	30	5-13

Data Source: a. K. Betts (2008), b. M. Cobbing (2008),c. J. H. Li at all(2009),

### **1.3.2. Lack of awareness of e-waste generation:**

Though new technology has made it more cheap to replace electronic gadget instead of repairing them, the query remains as to what should be done with the rising number of electronic items (computers and computer peripherals, televisions, stereos, DVD players and VCRs, video game consoles, digital cameras and camcorders, cell phones, and more) that are rapidly making their way from store shelves into landfills at an worrying and increasing rate. Excessive volumes are generated due to the rapid discarded of gadgets combined with the inflated demand for new technology (Basel Action Network [BAN], 2011).

### **1.3.3. Lack of enforcement policy (rules and regulation) for reducing e-waste:**

Discarded electronic gadgets, often referred to as “e-waste,” are exported overseas, often to emerging countries where worker and environmental laws tend to be lax and lightly enforced. E-waste recycling and disposal processes found in developing countries are more likely to use methods that are detrimental to the environment, such as incinerating uncontained plastic waste; throwing away acid into rivers and water supplies; and general omnipresent dumping. These methods not only contaminate the environment, they harm human health by exposing people to poisons. Many countries either lack acceptable

regulations applying to this moderately new waste stream, or lack potent enforcement of new e-waste rules (BAN, 2011).

#### **1.3.4. Increasing environmental pollution:**

Electronic waste is taking up a growing amount of space in landfills; electronic apparatus contains toxic materials that can have severe environmental and public health effects if they are not managed properly. An estimated show around 70 percent of the heavy metals (lead, mercury and cadmium) found in landfills derive from discarded electronics. These heavy metals and other environmentally sensitive elements can leach into the ground, contaminating water and other public health and environmental menaces. Cathode ray tubes (CRTs) that mean the glass picture tubes that are contained in computer monitors and televisions. This tube can contain roughly four to eight pounds of lead per unit. Moreover other environmentally sensitive substances include hexavalent chromium (chromium VI), polyvinyl chloride (PVC) and brominated flame retardants (Electrical and electronic waste: a global environmental problem: Explanatory Memorandum. July 1999, Brussels, 05.07.1999).

#### **1.3.5. Negative impact on health:**

E-waste is classified as hazardous waste (Tsydenova & Bengtsson, 2011) having adverse health and environmental implications because components are toxin design. Around 40 per cent of the heavy metals found in landfills derive from discarded electronic gadget (Montrose, 2011).

#### **1.3.6. Lack of technological preparedness/ disposal capacity (Poor design and complexity):**

E-waste foist many challenges on the recycling business (Smith, Sonnenfeld & Naguib Pellow, 2006) as it comprises many diverse materials that are mixed, bolted, screwed, snapped, glued or soldered together. Toxic materials are attached to non-toxic materials, which makes separation of materials for recovery challenging. Therefore, responsible recycling requires vigorous labour and/or modern and costly technologies that safely separate materials (BAN, 2011).

### **1.3.7. Labour issues:**

These include occupational exposures, informal sector domination causing health and environmental problems, lack of labour standards and rights.

**1.3.8. Lack of financing in formal disposal of e-waste:** Generally, there is not enough value in most e-waste to cover the costs of managing it in a responsible way. However, in line with EPR policies, new prospects can be realized with the rise in the value of many of the materials in electronics, such as gold and copper (Widmer, Oswald-Krapf, Sinha-Khetriwal, Schnellmann & Böni, 2005). Likewise, with the rising of e-waste quantities formal recyclers are increasingly entering the e-waste recycling business (Raghupathy, Krüger, Chaturvedi, Arora, Henzler, 2010).

## **1.4 Objective of the Study-general/ specific**

General Objective:

The core objective of this research is to explore the roles of stakeholders in e-waste management in Bangladesh. The inclusive goal of the article is to examine the existing policy gap and environmental management issues in terms of e-waste.

Specific Objective:

- a. To investigate the level of awareness of the general people regarding e-waste management
- b. To examine the present status of e-waste management system in Bangladesh.
- c. To identify the legal framework and institutional preparedness of e-waste management in Bangladesh
- d. To understand the roles of various stakeholders involved in sustainable e-waste management.
- e. To find out the barriers of e-waste management in Bangladesh

### **1.5 Research Questions:**

In order to address gaps in the literature identified that relate to e-waste management in Bangladesh and based on this objective, researcher will examine the following primary research questions:

- I. What is the level of awareness of the people on e-waste management?
- II. How e-waste is being managed in Bangladesh?
- III. To what extent present policies offer innocuous, effective and environmentally sound of e-waste management?
- IV. What are the barriers of e-waste management in Bangladesh?

### **1.6 Significance of the Study:**

E-waste is a valuable resource and a hazardous threat to human health and the environment at the same time. Three major reasons for the importance of e-waste policy. Firstly, e-waste is the fastest growing waste stream in most industrialized countries and it is growing at high speed also in emerging countries. Secondly, e-waste recycling causes massive ecological and human health problems particularly in developing countries if it is not conducted with proper methods and technologies. Thirdly, expected resource scarcity and rising raw material prices make e-waste recycling increasingly important.

E-waste can be a menacing threat to human health and the environment. This threat can result from two sources. Primarily it is the leaching of hazardous substances, in particular lead, into the environment from e-waste that is disposed of in landfills. Secondly, improper recycling techniques, which are in particular engaged in the informal recycling sector in developing countries and now, result mostly from the export of e-waste to these countries, but rising also from internal disposal. Electronics contain huge substances, various of which are toxic, such as lead, mercury, cadmium, hexavalent chromium and flame-retardants (Babu, Parande and Basha 2007: 309).

### **1.7 Scope of the study:**

The study is limited to four electronic products: desktop PC, laptop PC, cell phones and Television. There are many types of electronic gadgets that are contributing to e-wastes. But these four electron items are most frequent used.

The research is conducted in three city corporations (Dhaka North City Corporation, Dhaka South City Corporation and Chittagong City Corporation), one Union Parishad, one Paurashava and one Cantonment Executive Board. The three city corporations studied in this research generate the largest volume of e-wastes in Bangladesh. To pick up the scenario at rural level one Union Parishad, one Paurashava and one Cantonment Executive Board are also studied.

KIIs of government officials are taken to investigate the scenario of policy implementations and legal framework. The findings were further validated by KIIs of scholars and NGOs. Interviews of LGI representatives are not taken for shortage of time and not having direct involvement yet in e-waste management.

### **1.8 Rational of the Study**

In Bangladesh there is no specific policy, law and e-waste management rules yet not to be formulated. No inventory data of e-waste generation is available. Generally, common people's level of awareness towards e-waste generation and its impact is unknown. To disposed of e-waste technological preparedness needs to measure to handle e-waste management. Responsibility of stakeholder (consumer, producer) should be identified and needs to active participation by financing to reduce e-waste. Globally many researches on e-waste management have been done in different perspective way like Environmental Law/ Justice, Environmental Economics, Environmental engineering (technology development and implementation), Environmental Science (environmental chemistry, toxicology, environmental impact assessment etc.) Environmental management (reverse logistics, environmental policy, sustainable development etc.), Metallurgy, mechanics and material science (technological development), Policy studies Sociology and cultural studies. In Bangladesh perspective a few research have been done in this field. Environmental pollution has no political boundary so special zone is required for e-waste processing and dumping.

Land scarcity, public health and environment is concern. Therefore, this study will conduct to identify policy gap of legal and institutional framework of e-waste management.

### **1.9 Methodological Approach:**

#### **a. Data and methods**

The research will conduct both in quantitative and qualitative methods. The best Strategy to understand management is a combination of process tracing and qualitative methods. Data sources is include secondary published materials, grey document review but researcher will also conduct interview with Key Informant, semi structured interview and observation on storing, collection dismantling, segregation process, incineration, landfilling, institutional function and capacity.

#### **b. Empirical and theoretical contributions**

To ascertain patterns of e-waste generation and disposal system in Bangladesh focusing initially on how e-wastes are disposed of informal sectors and the management structure for e-waste at the local arena (regulators, informal recyclers, civil society and city corporation levels).

#### **c. Research methodology**

In terms of methodological approaches, research strategy focuses on:

- Gather information and data to map the landscape of e-waste management institutions and legal framework, particularly to get some leverage on informal sectors (or gray areas) and the relative capacity.
- Gather data on the extent of and specific items involved in e-waste trading the availability of existing information
- Identify e-waste management agencies and mechanisms, and points of Intervention /opportunity /obstruction in the interplay of state-society relations that help determine regulation

Researchers plan to undertake fieldwork in e-waste recycling locations to investigate current practices. Gaining an early understanding of management dynamics of electronic waste to undertake research in three main ways:

- i. In-depth document review and analysis. Sources will include international, regional and local regulatory documents, reports, articles, scholarly literature, newspapers, trade magazines
- ii. Preliminary site visits that will involve observation and gather spatial (publicly available) data.
- iii. Semi-structured and non-structured interviews with MoEF, DoE, LGIs and Private sector in their official capacity.

**1.10: Limitation of the Study:**

The study mostly analyzed legal documents of secondary information. The original documents were difficult to reach because of non-availability. As the study country perspective it will be difficult for various reasons to conduct survey to understand citizens' knowledge and attitude towards e-waste management in the remote area.

## CHAPTER TWO

### INTRODUCTION TO E-WASTE

#### 2.1. Overview of E-waste

Electronic waste (e-waste) is generally named discarded component of Electrical and Electronic Equipment (EEE). It also termed as Waste Electrical and Electronic Equipment (WEEE). E-waste is define that all used items of EEE and its parts which have been thrown out by its holder as waste without the intent of re-use (Bladé C.P.,Wang,F., Kuehr,R.,Huisman, 2015). E-waste comprises obsolete equipment like home appliance (television, radio, lamps, air conditioners, refrigerators, washing machines and heat pumps), IT equipment (desktops, laptops, tabs, note books, tab, and printers) and telecommunication equipment (cell Phone, cyber networking accessories). E-waste often contains heavy metals like lead, nickel, chromium and mercury, chemicals namely CFCs/ chlorofluorocarbon or flame retardants, valuable substances such as iron, copper, aluminium and plastic, precious metals for instance gold, silver, platinum and palladium (Bladé C.P.,Wang,F., Kuehr,R.,Huisman, 2015). It is considered hazardous and toxic waste as some of its substances has negative impact to the environment and/ or to human health when they are not disposed of with care (Lieselot Bisschop, 2014). It is intricate and costly to treat in environmental friendly way. There is also lack of regulation, practices, enforcement policies and institution for ensuring environmental governance of e-waste (UNEP, 2009).

#### 2.2. Definition of E-waste:

There is no standard definition of e-waste. Some international organization has derived e-waste definitions that are as follows:

*WEEE/E-waste is a complex mixture of hazardous and non-hazardous waste, which consists of items of economic value. Therefore, it requires specialized segregation, collection, transportation, treatment and disposal. (UNEP, E-waste Volume-II)*

*“Waste electrical and electronic equipment, including all components, subassemblies and consumables which are part of the product at the time of discarding”. The Directive 75/442/EEC, Article I (a), defines as “waste” “any substance or object which the holder*

*discards or is required to discard in compliance with the national legislative provisions". (European Directive 2002/96/EC)*

*"E-waste includes a wide and developing range of electronic appliances ranging from large household appliances, such as refrigerators, air-conditioners, cell phones, stereo systems and consumable electronic items to computers discarded by their users". (Basel Action Network [www.ban.org](http://www.ban.org))*

*"Any household appliance consuming electricity and reaching its life cycle end". (OECD [www.oecd.org](http://www.oecd.org))*

*E-waste is a term used to cover all items of electrical and electronic equipment (EEE) and its parts that have been discarded by its owner as waste without the intent of re-use ((Bladé C.P., Wang, F., Kuehr, R., Huisman, 2015).*

*E-waste is defined as the various forms of old electrical and electronic equipment (EEE) that no longer have any value to their possessors (Dharna Tiwari and Nidhi Gauba Dhawan, 2014).*

*Electronic waste (E-waste) illustrates discarded appliances that utilize electricity for their functioning such as computers and mobile phones.*

*Electronic waste which is commonly referred as "e-waste" is the new byproduct of the InfoTech society. It is a physical waste in the form of old discarded, end of life electronics. Alternatively, it can be defined as "E-waste is electronic waste. It includes a broad and growing range of electronic devices from large household appliances such as refrigerators, air conditioners, cellular phones, computers and other electronic goods" (Sanjay Rode, 2012)*

*Electronic Waste ('e-Waste') is any litter created by discarded electronic devices and components as well as discarded and degenerating substances involved in their manufacture or use. The other terms for e-Waste are or 'electronic waste' or 'waste of electronic goods' or WEE (wastefrom electrical and electronic equipment).( Nina Godbole, 2011)*

*Electronic waste (E-waste) illustrates discarded appliances that utilize electricity for their functioning. (2014)*

Therefore a summary of the above conventional / nonconventional definition derives following components/ features of E-waste:

- ✓ discard in compliance with the national legislative provisions
- ✓ complex mixture of hazardous and non-hazardous waste
- ✓ without intent of re-use
- ✓ electronic appliances discarded by their users
- ✓ household appliance reaching its life cycle end

**Operational Definition of E-waste:** The operational definition of e-waste for this research is “Electrical and Electronic Equipment (EEE) which cannot be further used or discarded termed as e-waste”.

### **2.3. International laws relating to e-waste:**

Various legal frameworks have been enacted and enforced to regulate e-waste globally. The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their disposal plays very important role to curb e-waste trade from Organization for Economic Co-operation and Development (OECD) countries to non OECD countries.

#### **2.3.1. Basel Convention:**

The Basel Convention on the Control of Trans-boundary Movements of Hazardous Wastes and their disposal is the most comprehensive international agreement on hazardous and other wastes. It has 170 member countries (parties). Its objective is to protect human health and the environment from the adverse effects resulting from the generation, management, trans-boundary movements, and disposal of hazardous and other wastes. To combat these practices, the Basel Convention was negotiated under the auspices of the United Nations Environment Programme (UNEP) in the late 1980s (UNEP). It was adopted in 1989 and entered into force in 1992. The convention calls for preventing the dumping of hazardous and other wastes from developed countries to developing countries. The United States of America (USA) has ratified the Basel Convention (M P Ram Mohan et. al., 2008 ).

#### **2.3.2. European Union Directives:**

European Union Parliament and the council were brought two important directives into force on 27 January 2003. One is the Waste Electrical and Electronic Equipment (WEEE) Directive and other is Restriction of the Use of Certain Hazardous Substance (RoHS) Directive. Both of these directives required the European member states to adopt national laws, implementing them 13 August 2004.

This directive has given to the principle of Extended Producer Responsibility (EPR), Where it requires the producers to set up take back system. The Directive also requires the producers

and the member states to spread awareness among the private household users. This Directive involves public participation and awareness while the information system provides for transparency in the implementation of the Directive (M P Ram Mohan et. al., 2008).

#### **2.4. Categories of E-waste:**

There is no specific definition of e-waste. The exact definition and classification of waste can vary both for various documents within a country and for similar documents in various countries (UNEP, 2015). Valuable materials extraction is the main driver for the recycling industry that is dependent on material purity. In the study of Global E-waste Monitor has classified discarded Electrical and Electronic Equipment into the following six categories and therefore also e-waste (*Bladé C.P., Wang, F., Kuehr, R., Huisman, 2015*):

- I. **Temperature exchange equipment:** Generally referred to as, cooling and freezing equipment. Such as refrigerators, freezers, air conditioners, heat pumps.
- II. **Screen Monitors:** Equipment comprises screen like televisions, monitors, laptops, notebooks, and tablets.
- III. **Lamps:** Typical equipment includes straight fluorescent lamps, compact fluorescent lamps, high intensity discharge, lamps and LED lamps.
- IV. **Large Equipment:** Basically apparatus involves washing machines, clothes dryers, dish washing machines, electric stoves, large printing machines, copying equipment and photovoltaic panels.
- V. **Small Equipment:** Electronic device comprises vacuum cleaners, microwaves, ventilation equipment, toasters, electric kettles, electric shavers, scales, calculators, radio sets, video cameras, electrical and electronic toys, small electrical and electronic tools, small medical devices, small monitoring and control instruments.
- VI. **Small IT and Telecommunication Equipment:** Electronic gadgets that consist of mobile phones, GPS, pocket calculators, routers, personal computers, printers, telephones.

## 2.5. Scenario of E-waste in Global Perspective

E-waste is the most crucial issue for environment in the contemporary society. Globally usage of digital gadgets is growing for its special feature. Similarly, because of shorten lifespan Used Electrical and Electronic Equipment (UEEE) is increasing parallel. Higher rate of consumption and shorten life time is generating e-waste. Due to that e-waste is fastest growing waste streams. Table 2.1 defines global status and projection of e-waste. In 2014, worldwide around 41.8 million metric tonnes (Mt) of e-waste was generated of them screens such as television, monitors, laptops, notebooks, and tablets is 6.3 Mt and small IT accessories like mobile phones telephones, printers, personal computers is 3.0 Mt . Official take back systems (municipalities and private collection companies) are collected at least 6.5 Mt and rest of e-waste are disposed unknowingly. It is expected that the amount of e-waste will grow about 49.8 Mt globally by 2018 with growth rate 4 to 5 per cent. Globally 4 out of every 7 people that are approximately 4 billion people are covered by national legislation (Bladé C.P.,Wang,F., Kuehr,R.,Huisman, 2015).

**Table 2.1: Global status and projection of e-waste**

Year	E-waste generated(Mt)	Population (billion)	E-waste generated (kg/ inh.)
2010	33.8	6.8	5.0
2011	35.8	6.9	5.2
2012	37.8	6.9	5.4
2013	39.8	7.0	5.7
2014	41.8	7.1	5.9
2015	43.8	7.2	6.1
2016	45.7	7.3	6.3
2017	47.8	7.4	6.5
2018	49.8	7.4	6.7

Data Source: The Global E-waste Monitor 2014, (Quantities, flows and resources)

### 2.5.1. Continent State of E-waste:

The table 2.2 shows the e-waste generation of six continents in 2014. Most of the e-waste was generated in Asia. This was 3.7 kg for each inhabitant. The highest per inhabitant e-waste quantity 15.6 kg was generated in Europe. The lowest amount of e-waste per inhabitant was generated in Africa. The amount was 1.7 kg/inch.

**Table 2.2: Continent Scenario e-waste generation**

E-waste generation in the year of 2014	Continent	Per Category Mt (Million tons)	Per Inhabitant kg/inh. (Kilogram/Inch)
	Africa	1.9	1.7
	Americas	11.7	12.2
	Asia	16.0	3.7
	Europe	11.6	15.6
	Oceania	0.6	15.2

Data Source: Bladé C.P., Wang, F., Kuehr, R., Huisman, 2015. The Global E-waste Monitor 2014

**Table 2.3: Regional Scenario of e-waste generation**

Region	Country	Kg/inch.	Kt (Kilotons)	National Regulation in force till 2013	Population (1000)
South Asia	Afghanistan	0.3	9	no	33967
	Bangladesh	0.8	126	no	153257
	Bhutan	3.7	3	yes	746
	India	1.3	1641	no	1255565
	Maldives	6.1	2	no	342
	Nepal	0.5	15	no	32010
	Pakistan	1.4	266	no	186279
	Sri Lanka	4.2	87	no	20964

Data Source: Bladé C.P., Wang, F., Kuehr, R., Huisman, 2015. The Global E-waste Monitor 2014

### 2.5.2 Regional Scenario:

The table 2.3 shows that domestic e-waste was generated in South Asian region in 2014. The highest quantity of e-waste producer was Maldives. It was 6.1 kg/inch. The lowest quantity w-waste producer was Afghanistan. Bangladesh was 6<sup>th</sup> position out of eight countries as e-waste producing countries in the region.

### 2.6. Material Composition:

E-waste may comprise around 60 metals for example a cell phone may contain over 40 elements like copper (Cu), tin (Sn), cobalt (Co), indium (In), antimony (Sb), precious metals, and rare earth elements. The precious metal in cell phone may consist of 250 mg Ag (silver), 24 mg Au (gold), 9 mg Pd (palladium), and 9 g Cu (copper), while PC and laptops may consist

of 1,000 mg Ag (silver), 220 mg Au (gold), 80 mg Pd (palladium), and 500 g Cu (copper) (Resources and Technology Transfer Industrial Sector Studies 2009).

The average contents of the primary sources (minerals), these values reveal a secondary source of high metal concentration. This stimulates the recovery of these metals, ensuring metallic resources for future use and avoiding all environmental impacts related to their primary extraction (Kim E,(2011)).

Table 2.4 shows the concentration of metals found by several authors in the Printed Circuit Boards from mobile phones. One can see that the values are not entirely similar, due to the reasons mentioned above.

Table 2.4: Metal concentration (wt%) of printed circuit boards reported in different studies

Wt(%)	Sum	Guo et al.	Yang et al.	Park and Fray	Yamane et al.	Tuncuk et al.
Gold	0.1	0.008	-	0.025	0.00	0.035
Silver	0.2	0.33	-	0.100	0.21	0.138
Copper	20	26.8	25.06	16..0	34.49	13
Nikel	2	0.47	0.0024	1	2.63	0.1
Tin	4	1.0	-	3.0	3.39	0.5

Source: Hugo Marcelo Veit and Andréa Moura Bernardes, 2015

## 2.7. Potential effects of e-waste materials:

### 2.7.1. Evaluation of environmental pollution:

The biological effects and the mechanisms of e-waste are highly complex. To enhance the protection of the exposed population, a detailed assessment of environmental exposure is necessary, including the assessment of environmental samples and biological samples and an assessment of the transportation of toxicants from the environment to organisms. This letter recommends that countries establish e-waste evaluation and management centers of excellence, building on existing organizations working in the areas of recycling and waste management.

### 2.7.2. Hereditary effect:

Cytogenetic damaged in populations exposed to e-waste these data may complement knowledge of the health stresses related to the processing of e-waste (Liu et al. 2009). Long-term hereditary effects are a crucial issue within the context of health risks in e-waste recycling areas. Most of these recycling sites have operated for more than 10 years, with long-term exposure to e-waste toxicants. The cumulative effect may be present both in the local environment and in humans.

### 2.7.3. Environmental concerns and chemical hazards:

Many types of EEE contain substantial amounts of hazardous substances such as heavy metals (e.g., mercury, lead, cadmium, chromium, etc.), halogenated compounds (chlorofluorocarbon/CFC, polychlorinated biphenyls/PCB, poly brominated di phenyl ethers/PBDEs, etc.), and others like toner and radioactive substances. If improperly managed, these substances can cause significant harm to human health and the environment (Tsydenova and Bengtsson, 2011). In addition to the direct emissions from hazardous substances contained in e-waste, uncontrolled disposal and crude recycling activities can generate secondary and tertiary emissions (Schluep et al., 2009). Hazardous reagents can be used and toxic substances can be formed through such processes (Sepúlveda et al., 2010), such as the cyanide and aqua regia used in the backyard leaching of circuit boards. (Feng Wang,2014.)

### 2.7.4. Some other material effects on health and environment are as follows:

Table 2.5: Effect of E-waste constituents on human health and environment

Metals/ Chemicals	Used in electronic device	Environmental/health effect	References
Arsenic (As)	Small quantities as gallium arsenide in light emitting diodes, transistor	Allergic reactions, nausea, vomiting, decreased red and white blood cell production, abnormal heart rhythm; inorganic arsenic is a known human carcinogen skin lesions, peripheral neuropathy, gastro-ntestinal	Pirzada and Pirzada (2010), Schmidt (2002) (WHO, 2010)

Barium (Ba)	Front panel of CRT	Cause vomiting, abdominal cramps, diarrhoea, difficulties in breathing, blood pressure, numbness and muscle weakness. Damage to heart, liver and spleen.	ATSDR (2007),,, Puckett et al. (2002) (Osuagwu & Ikerionwu, 2010).
Beryllium (Be)	Mother-boards as a copper beryllium alloy used to strengthen the tensile strength of connectors	Lung damage, carcinogen and inhalation of fumes allergic reactions, chronic beryllium disease and skin disease;	ATSDR (2002),,, Puckett et al. (2002), Schmidt (2002)
Cadmium (Cd)	Chip resistors, semiconductors, infrared detectors, rechargeable batteries	Gathers in the body, mostly in the kidneys and can lead to liver, lung and bone damage as well as renal failure. It is reasonably anticipated to be a human carcinogen	Puckett et al. (2002), Dyrud (2007), Schmidt (2002) (WHO,2010c)
Hexavalent Chromium (Cr IV)	Untreated and galvanized steel plates and as a decorative or hardener for steel housings	Causes asthmatic bronchitis and other allergic reactions. Also known to cause DNA, kidneys, and liver damage	Ramachandra and Saira (2004) (Osuagwu & Ikerionwu, 2010).
Lead (Pb)	Solder of printed circuited boards, Cathode ray tubes (CRTs), glass panels and gaskets in computer monitors	Amasses and perseveres in plants, animals and microorganisms. It neither biodegrades nor dissolves. Damage to central and peripheral nervous system, circulatory system and kidneys; effects on endocrine system, serious adverse effects on brain development,	Nakagawa (2006), Dyrud (2007) Osuagwu and Ikerionwu, 2010
Mercury (Hg)	Thermostats, sensors, relays and switches, discharge lamps, medical equipment, mobile phones, batteries, printed wiring	It inorganically spreads out in water and transformed to methylated mercury which gathers in living organisms especially fish and spreads over the food chain. It can cause chronic brain, kidney, lung and fetal damage;	Scanlon (2004), Silicon Valley Toxics Coalition (SVTC, 1999), Schmidt (2002) Osuagwu and Ikerionwu, (2010) (WHO, 2007)

	boards and circuit boards, data transmission and telecommunications	increases in blood pressure and heart rate, allergic reactions, effects on brain function and memory; a possible human carcinogen	
Ozone depleting substances (CFCs, HCFC, HFC, HCs)	Refrigerator and Coolers	Destroy the Ozone layer and is a potent greenhouse gas. Direct exposure can cause unconsciousness, shortness of breath and irregular heartbeat. Also cause coughing, difficulty in breathing, and eye redness and pain. Direct skin contact with some types of CFCs can cause frostbite or dry skin	(US. National Library of Medicine, n.d.)
Plastics [Poly-vinyl chloride (PVC)]	Cabling and computer housing plastics contain PVC for its fire-retardants properties	Incineration produces dioxin that causes reproductive and developmental problems; immune system damage; interfere with regulatory hormones	Ramachandra and Saira (2004) (Osugwu & Ikerionwu, 2010).
Poly-/Brominated Flame Retardants in plastic	Plastic housings of electronic equipment and in circuit boards to prevent flammability	Endocrine disruption; effects on fetal development; increased risk of cancers of the digestive and lymph systems. Hepatotoxicity and thyroid effects seem to be characteristics endpoints in animal toxicity.	Puckett et al. (2002), Schmidt (2002) (Darnerud, Eriksen, Jóhannesson, Larsen, & Vileksela. 2001).
Selenium (Se)	Photocopying machines (photo drums)	Loss of feeling and control in the limbs. Selenium poisoning can damage to lung tissue, increase blood pressure, headaches, diarrhoea and other disruptions in normal body function.	Agency for Toxic Substances and Disease Registry (ATSDR, 2003), Pirzada and Pirzada (2010)

## 2.8 Conclusion:

This chapter attempts to uphold e-waste definition, classification, relevant laws in global perspective. It also up raises some effects of e-waste on human health and environment. Table 2.1 to 2.5 provides information of international situation of e-waste. It aims to

understand the urgency of awareness building of e-waste impact. There are international laws for e-waste management. In this study, objectives and questions also have awareness and laws related issue to e-waste management. It implies that the developing country perspective like Bangladesh should have e-waste management policy. The study will explore e-waste related policy, the level of citizens' awareness, institutional laws on e-waste management.

## CHAPTER THREE

### LITERATURE REVIEW AND ANALITICAL FRAMEWORK

#### 3.1 Literature Review: Concept

Literature review that identifies the problem and its gravity and intensity. The following section presents an overview of some relevant studies of e-waste. Several books and publications have been accessed to help in this study. These books, publications, and articles serve as the theoretical background of the research.

The upcoming e-waste management in developing cities rely on not only on countrywide and global initiatives, but also on the successful practices of local governments functioning with the e-waste producers (citizens) and operators of recycling services (both formal and informal sectors) that pointed out by Dickella Gamaralalage Jagath Premakumara (2016), in the study titled *“Development of E-waste Management Policy at the Local Level: A case Study of Cebu City, Philippines”*. The study indicates that providing resources and building capacities of local governments is therefore essential to develop e-waste management systems in an environmentally sound manner through the establishment of public and private partnerships. In addition, International partners can play a vital role through city-to-city cooperation in providing technical know-how and aptitude building opportunities, facilitation of research and best practices, and provision of development assistance to improve the city’s e-waste management system.

The awareness of public towards e-waste management is low explained by Supian. N. S et al.(2015) in their published journal *“Current waste generation of e-waste and challenges in developing countries: an overview”*. The study argued that maximum consumers were not aware of the accurate way to treat e-waste and for government and institution promises were low as stern and regular enforcement were lacking. Besides, informal sector plays a major role while low-cost machinery and manual segregation was prominent. The research recommended methodical policy and guideline of e-waste management in developing countries requires to be improved to achieve best practices in e-waste management. In

addition, lacks of financial support further intensify the challenges in these developing countries, as proper treatment requires a high capital and maintenance costs.

Hugo M. V. et al (2015) defines in their article *Electronic Waste: Generation and Management* that development affects the environment in two ways: 1. the growing amount of equipment is discarded annually very large and 2. Natural raw materials extract to supply the demand of the new equipment industry. Both can be measured by the amount of equipment that is produced and discarded annually by many countries. Moreover, they said two types of facilities are engaged in the recycling chain,. The first groups are principally involved in the dismantling and mechanical processing of e-waste for the recovery of raw materials and the other groups are uses metallurgical processes to recover metals. On the other hand, developing countries is largely unregulated, and e-waste is often treated to recover valuable materials in small workshops using rudimentary recycling methods. The informal e-waste recycling predominant in developing countries is related with dreadful environmental pollution and professional exposure to the e-waste-derived chemicals.

Khan S. S. et al. (2014), titled "*Challenges of waste of electric and electronic equipment (WEEE)*". The study proposes strategic guidelines for the WEEE management that will be beneficial in designing the future ecological policies on global scenario. The article explained that there is no standard definition of WEEE in the universe. In addition, existing policies are not very effective in controlling the trans-boundary movement. Establishment of regional agreements or regional-level committees is very essential to control the trans-boundary illegal movement of WEEE between countries. Moreover, developing countries should develop an appropriate legislative framework for WEEE management to safeguard environment. In particular, regarding the decentralization of capabilities and providing municipalities the authority in collaboration with the manufacturer to collect and manage electric and electronic wastes especially in EoL products. Policies should have all process for WEEE management, i.e. collection, sorting, recycling, recovery, dumping, etc., and for safe extraction of precious elements present in WEEE products. They emphasis on Knowledge and awareness program and highlighted the bad effects of WEEE on the society and on the environment.

Environmental sustainability should be the principal aim of all producer responsibility legislation the authors Anderson, K. et al (2014) explained in the article All Wired for E-

Waste. Furthermore, dependent on the EEE design of components as well as on the materials and substances that are in such EEE. At the same time, the management of e-waste collection entails a local solution in the markets where e-waste is generated. While the thorough dismantling of e-waste, pre-treatment of elements and end processing of easily recyclable parts can be performed locally, the effective recovery of precious metals from complex e-waste depends on access to global market specialists. In addition, the engagement of all stakeholders is essential in the e-waste management process.

There is a lack of awareness on concerns related to E-waste defines Anwesha Borthakur (2014) in his article titled *"Generation and Management of Electronic Waste in the City of Pune, India"*. Establishing ecological E-waste management performs, formulation and execution of applicable policy initiatives, transparency in the system, and enlightening people on their responsibility toward worldwide E-waste problem are vital in order to address the emerging concern of E-waste. The paper explained that there is urgent need legal framework and market based strategy initiatives in order to E-waste issues related handling. The paper argued to introduce distinct disposal facility for E-waste. In addition, An unified approach involving proper cooperation among different stakeholders like public and private agencies, research and development institution and common people is extremely essential for sustainable E-waste management practices.

The e-waste contaminant flows that end up in landfills are influenced by the amount of e-waste flow into the full recovery facilities, informal recyclers, public awareness, and government legislation related to e-waste explained by Vi. K. S. et al. (2013).in their article titled *"E-waste Assessment in Malaysia"*. The study suggested following driving factors were responsible to minimize waste generation. The variable impacts to decrease long term e-waste production in Malaysia were public awareness, incentives and law enforcement. Increased public awareness was a significant variable for reducing environmental harm caused by chemicals from mobile phones and their recycling processes.

The study *"Environmental and health challenges of the global growth of electronic waste"* define by Qiang L. et al. (2012), suggested paying attention on the hereditary effect namely cytogenetic damage in populations exposed to e-waste. Long-term hereditary effects are a vital issue within the situation of health risks in e-waste recycling areas. Most of these recycling sites have worked for more than 10 years, with long-term exposure to e-waste toxicants. The growing effect may be existent both in the local environment and in humans.

Furthermore the researcher recommends countries to establish e-waste evaluation and management centers of excellence, building on existing organizations working in the areas of recycling and waste management for reducing biological effects. Likewise rational policies should be established in both developing and developed countries to develop the management of e-waste, including the recycling process, exports, and imports. The study further claimed that the Integrated Waste Management in Western Africa (IWWA) project worked by empowering all stakeholders to participate in the waste management chain through the reinforcement of institutional and legal frameworks and the open transfer of knowledge and technology (Solving the e-waste problem 2010). In fine, to give urgency on the establishment of regulated processes for collecting and managing e-waste through the initiation of large, capable facilities in China and other developing nations.

A study conducted by Arif Reza, (2011) on *E-Waste management in Bangladesh: Present Trend and Future Implication*. The study suggests that to prepare e-waste legislation, increase awareness, establish recycling plants, and formulate extended Producers Responsibility (EPR), registration of producers, separation of garbage, Incentives.

Research performed by Mahbub Alam and Khalid Md. Bahauddin, (2015) on *Electronic Waste In Bangladesh: Evaluating the Situation, Legislation and Policy and Way Forward with Strategy and Approach*. The study found that the integration of e-waste into the national development agenda, the establishment of national e-waste database systems, the establishment of a phased national informal sector e-waste register with the purpose of registering and formally recognizing and tracking the informal sector.

*E-waste management in Bangladesh* researched by three renowned scholars M. H. Rahman, A. Al-Muyeed, and Zuene Aziz, (2014). The research revealed that regulatory agencies needs set up in each district, to prepare comprehensive law that provides e-waste regulation and management and proper disposal of hazardous wastes, enforce strict regulations against dumping e-waste, to adopt polluter pays principle and extended producer responsibility, encourage and support NGOs and private sector to solve the problem.

### **3.2 Over cap of the review of literature**

Due to the fact that these authors have personal view of their respective topic, their theories were adapted into this study in the manner that it meets the study objectives,

purpose, and mission. Furthermore, they were help in understanding and structuring the investigative questions and observations conducted during the field trip. Discretion and carefulness were implemented so as to maintain objective of the thesis, while explaining and providing the necessary and important information.

Table 3.1: Summery literature review theory and concept

Researcher	Article	Major Findings/ Observation
Premakumara D. G. J (2016),	Development of E-waste Management Policy at the Local Level: A case Study of Cebu City, Philippines	<ul style="list-style-type: none"> <li>• providing resources and building capacities of local governments is essential</li> <li>• establishment of public and private partnerships</li> </ul>
Supian. N. S et al. (2015)	Current waste generation of e-waste and challenges in developing countries: an overview	<ul style="list-style-type: none"> <li>• maximum consumers were unaware</li> <li>• regular enforcement were lacking</li> <li>• lacks of financial support further intensify the challenges</li> </ul>
Hugo M. V. et al (2015)	Electronic Waste: Generation and Management	<ul style="list-style-type: none"> <li>• discarded EEE amount is increasing annually very large</li> <li>• using rudimentary recycling methods in developing countries</li> </ul>
Khan S. S.et al. (2014)	Challenges of waste of electric and electronic equipment (WEEE)	<ul style="list-style-type: none"> <li>• Establishment of regional agreements for trans-boundary movement</li> <li>• legislative framework for safeguard environment</li> </ul>
Anderson, K. et al (2014)	All Wired for E-Waste	<ul style="list-style-type: none"> <li>• the engagement of all stakeholders is essential</li> </ul>
Borthakur. A. (2014)	Generation and Management of Electronic Waste in the City of Pune, India	<ul style="list-style-type: none"> <li>• There is a lack of awareness on concerns related to E-waste</li> <li>• urgent need legal framework and market based strategy initiatives</li> </ul>
Vi. K. S. et al. (2013)	<i>E-waste Assessment in Malaysia</i>	<ul style="list-style-type: none"> <li>• to decrease long term e-waste production in Malaysia are public awareness, incentives and law enforcement</li> </ul>
Qiang L. et al. (2012),	Environmental and health challenges of the global growth of electronic waste	<ul style="list-style-type: none"> <li>• the reinforcement of institutional and legal frameworks</li> <li>• the open transfer of knowledge and technology</li> </ul>
Arif Reza, (2011)	E-Waste management in Bangladesh: Present	<ul style="list-style-type: none"> <li>• to prepare e-waste legislation, increase awareness, establish</li> </ul>

	Trend and Future Implication	recycling plants, and formulate extended Producers Responsibility (EPR), registration of producers, separation of garbage, Incentives
Mahbub Alam and Khalid Md. Bahauddin, (2015)	Electronic waste in Bangladesh: Evaluating the situation, legislation and policy and way forward with strategy and approach	<ul style="list-style-type: none"> <li>• integration of e-waste into the national development agenda</li> <li>• establishment of national e-waste database systems</li> <li>• Register informal sector of e-waste</li> </ul>
M. H. Rahman, A. Al-Muyeed, and Zuene Aziz, (2014)	E-waste Management in Bangladesh	<ul style="list-style-type: none"> <li>• to prepare comprehensive law that provides e-waste regulation and management</li> <li>• enforce strict regulations against dumping e-waste</li> <li>• to adopt polluter pays principle</li> <li>• extended producer responsibility (EPR)</li> </ul>

### 3.3 Synthesis:

Based on above review of literature, the present study primarily focus on the following aspect of e-waste management.

- \* Develop door to door informal collection system
- \* Shared responsibility or consumer participation
- \* Lack of awareness is concern
- \* Legislation for enforcement
- \* Regulated e-waste collection system
- \* Strengths and incorporate more accountable in collection system
- \* Stakeholder's responsibility, financial responsibility,
- \* Enforcement capacity of institutions, monitoring, evaluation, capacity development policy,
- \* Landfill, incineration and labor policy

### 3.4 Literature Review: Theoretical

According to synopsis of Effect of waste legislation and of EEE destined for reuse (2016) the article defined legislation overview on transboundary movement of e-waste. The Basel

Convention, OECD Council Decisions C (2001)107/FINAL and the European waste shipment regulation (WSR) are the major agreements regulating the transboundary movement of e-waste. The Basel Convention is the maximum inclusive and important of these agreements, as it presents limits on the movement of hazardous waste between countries through controls and “hazardous waste” and “nonhazardous waste” lists (UNEP, 2011). The OECD Council and EU have then built on the convention, adapting and improving it to their own domestic positions through development of legislation with more detailed waste categories and control lists (Amber, Green and Prohibited) and stricter regulation on consignments intended for disposal/recovery to non OECD countries (EU).

These major pieces of regulation have also been influential in shaping laws in other advanced regions, for example a number of U.S. state governments and China. However the governments have their own programs and develop the legislation to meet their own necessities.

According to Solving the E-waste Problem (Step, 2015) Green Paper there are some challenges and loopholes in e-waste management.

### **3.5 Definitions related problem**

E-waste has dual nature like a potential toxic threat and a valuable resource. The major challenges are facing those seeking to minimize the e-waste in environmentally sound manner. E-waste definition is not clearly defined. For this businessman often miss declared e-waste as secondary goods or refurbish goods. In some cases it is happened illegal trade. Location is still not identified for imposing restriction on e-waste trade. is yet to be imposed in the

Policymakers have therefore pursued to focus on the intended drive of the shipment: reuse, recovery or disposal. There has been a resilient assumption that shipments for disposal should be deeply restricted. However it can be very complicated to ascertain from an objective point of view what specific purpose a consignment is being made for. This has meant that as national consultants have begun to hold down on freights for disposal, companies are starting to ship items under the appearance of being for reuse, when they were in fact intended to be disposed of in the endpoint country. Certainly, a saying statistic

may reveal this practice. This now signifies one of the extreme challenges to the regime put in place to stop the detrimental trade in hazardous waste.

Another snag is the inconsistency between state policy and global agreements with regard to the definition of e-waste and most significantly, the characterization of hazardous waste. For instance, the Basel Convention's clarification and classification of e-waste is not harmonized with how they are defined by many signatory nations leading to discrepancies and contradictions. Furthermore, the lack of uniformity on what is defined as hazardous is striking and again indications to an overly complex system.

### **3.6 Policy options related problem:**

Policy options in this part must be applied very prudently to ensure even an inadequate positive result. What has been obvious by many policy tools is that they sometimes produce unintentional consequences and only hold local symptoms rather than the worldwide problem. In developed countries, strategies that try to improve the handling of e-waste by improving environmental directive can lead to an export of the waste problem to the emerging world. Similarly in developing countries, efforts to ban the import of e-waste and refurbished goods can stifle an industry that provides real employment to a large number of people and merely shift and ecological and human health problem, through inappropriate treatment of e-waste, to a social problem of unemployment and lack of access to cheap used equipment.

There are only few options for effective unilateral policy decisions in this region, since operational harmonization of definitions and principles are best attained through multilateral conventions. So encouraging to see that the procedural guidelines on the definition and distinction of e-waste and refurbished goods are being discussed within the context of the Basel Convention.

### 3.7 Synopsis:

Weaknesses of e-waste management

- ☆ E-waste dispersed
- ☆ Illegal trade
- ☆ Assumption on compliance costs
- ☆ No perfect general definition
- ☆ Heterogeneous reporting requirements
- ☆ Lack of globally comparable data
- ☆ Lack of transparent management of funding
- ☆ Emerging country-specific criticalities

### 3.8 Literature from Empirical Study:

Table 3.2: Literature review on e-waste collection system

Literature	Research purpose	Findings
Gao, S et al (2015)	To investigate the adoption of the online household e-waste collection services in China.	The results indicated that the behavioral intention to use online household e-waste service was effort expectancy.
Chi, Wang, & Reuter, 2014	Investigate the collection channels of e-waste and household recycling behaviors in Taizhou city of China.	The authors suggested that rather than directly competing with the informal collection sector, a better solution was to harness its strengths and incorporate it into a more accountable and regulated e-waste collection system.
Environmental & Social Development Organization (ESDO 2014), Bangladesh	To assess hazards and risks during traditional waste handling process	The surveyed data displays that there was huge need of awareness on e-waste. The study further reveals that 15% child workers die in waste recycling.

### **3.9 Operational Definition of E-Waste Management:**

E-waste will be disposed through technology with the directives of extended producer responsibility (EPR).

### **3.10 Curving out the Space (to make my space out):**

In formal way Bangladesh has no inventory of e-waste both the government institutions and the private sector in nationwide. There is still significant growth of e-waste in Bangladesh and until now there is no policy framework to address the collection, carriage, handling, safe disposal and observing of e-waste flows in the country. Due to lack of an e-waste policy, regulatory framework, institutional preparedness various stakeholders are unaware of e-waste contamination. Therefore, they do not take up their responsibilities with regard to e-waste management consequently problem arises to disposal. Thus are poses severe danger to both human health and ecological. There are gaps in research findings like stakeholder's responsibility, financial responsibility, enforcement capacity of institutions, monitoring, evaluation, capacity development policy, landfill, incineration and labor policy. Though e-waste management and disposal continues to be driven by global forces, the specificities will be determined by local conditions. complex issue will necessitate a holistic as well as robust solution in favor of all the stakeholders not only from the economic point of view, but also have to take into account the environmental consideration into the decision making process.

### **3.11 Theoretical Framework:**

**Name of theory:** Re-Defining The Concepts of Waste And Waste Management (Evolving the Theory of Waste Management), by Eva Pongrácz (2002)

The theory defines the importance of the definition of waste and its impact on waste management, and the role of ownership in waste management. The study also discussed that there are numerous practices as how to deal with a particular type of waste, there is no theory of waste management. The concept of ownership is explained as rights and responsibilities of waste creators/owners: it is thus crucial to raising awareness about

waste. The study terms PSSP (Purpose, Structure, State, and Performance) language which explains creation of waste and a solution of problem. The study analyzed the role of legislation in producing monitoring systems for the transfer of ownership as well as abandonment of ownership. The study also explains that the role of waste management is controlling of all waste-related activities, with the aim of preventing, minimising or utilizing waste.

Variables derived from theory: Waste Definition, Ownership / Awareness, Legislation and Institution

**Name of Article:** Alternative Approaches to Pollution Control and Waste Management (Regulatory and Economic Instruments) Janis D. Bernstein, 1993

The study explored how regulatory and economic instruments are used to control air and water pollution, protect ground water, and manage solid and hazardous wastes. The command-and-control approach defines that direct regulation, along with monitoring and enforcement systems and relies primarily on applications of regulatory instruments, such as standards, permits and licenses, as well as land and water use controls. This approach has been criticized for being economically inefficient but strategies have made significant progress in meeting the objectives of environmental legislation and policies.

In theory, economic instruments have the capacity to regulate pollution according to market mechanisms and thus facilitate deregulation and a reduction in government involvement. In practice, however, they have not eliminated the need for standards, environmental monitoring, enforcement, and other forms of government participation.

Variables derived from theory: Waste management, Regulation, Economic instrument and Institutional infrastructure, Institutional capacity, enforcement, monitoring

### **3.12 Analytical Framework:**

The study based on the following analytical framework which argues that e-waste management is significantly affected by Institutional preparedness, legal framework and citizens' awareness.

Measuring indicators of dependent variables for e-waste managements are effective e-waste collection and supervisions systems linked to formal recyclers, comply with

occupational safety, maintaining sound environment and health standard, capacity development on inventory and technology adaptation, transforming and minimization of informal e-waste sector (The Labour, Human Health and Environmental Dimension of E-waste Management China, ILO research paper page 23, 2015).

Explanatory variable institutional framework and preparedness includes institutional capacity and institutional infrastructure. Stakeholder's participation associate with the system that includes from e-waste generation through storage, collection, transport, transfer, recycling, recovery, treatment, disposal and finance. Institutional capacity defines law enforcement, monitoring, evaluation and capacity development of e-waste management. Institutional infrastructure including Ministry of Environment and Forest, line ministry (Local Government division, ICT division), Department of Environment (DoE), Public Health Engineering, Bangladesh Police, Bangladesh Customs, City Corporation, Powroshova; Stakeholders responsibility, financial responsibility involved waste generators/service users (including industry, business, institutions and households); producers (those who put products on the market which become waste at the end of their life, including manufacturers, brand owners, importers and others in the supply chain); service providers (whether public or private sector, formal or informal, large or small); civil society and non-governmental organizations (NGOs) (which play a variety of roles, including facilitating the participation of other parties); international agencies; etc.

Legal framework means local regulation and initiatives on e-waste management like policies, law, ordinance, regulation, statutory regulatory order (SRO), directives, and administrative order.

The citizens' perception of discarded electronic goods is needed to understand whether they consider it to be a form of waste or not. An assessment of citizens' awareness at the individual and organizational level of knowledge and practice process on e-waste management is vital. Moreover to understand what is missing from management strategies, and to know the citizens' behavior towards e-waste. Indeed, building citizen awareness will be key to active and effective stakeholder participation in e-waste systems. This study will

focus on citizens' awareness, specifically in Dhaka city, of issues surrounding e-waste. The household electronics of interest will be desktop, laptop, television and cell phone. Dhaka is the capital and populous city of Bangladesh. The city is also commercial and business hub so ample scope of e-waste generation and informal processing.

### Analytical Framework

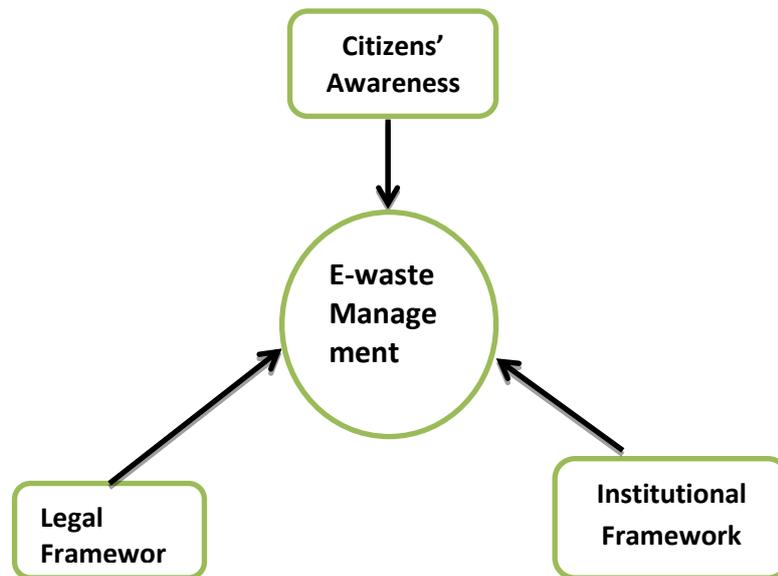


Fig 3.1: Analytical Framework

### 3.13 Dependent and Explanatory Variables from Theoretical Sources:

Table 3.3: Dependent and explanatory variables from Literature

Theoretical Sources	Dependent/ Explanatory variables
Alternative Approaches to Pollution Control and Waste Management (Regulatory and Economic Instruments) Janis D. Bernstein, 1993	E-waste Management (Dependent variable)
Re-Defining The Concepts of Waste And Waste Management (Evolving the Theory of Waste Management), by Eva Pongrácz (2002)	Institutional Framework (Independent Variable)
Re-Defining The Concepts of Waste And Waste Management (Evolving the Theory of Waste Management), by Eva Pongrácz (2002)	Legal Framework (Independent Variable)
Re-Defining The Concepts of Waste And Waste Management (Evolving the Theory of Waste Management), by Eva Pongrácz	Awareness (Independent Variable)

### 3.14 Overview of the Variables:

**E-waste Management:** Waste management includes waste operational methods that afford protection of human health and the environment at large, including: collection, carrying, treating, recycling, disposal, onsite handling, segregate, storage, treatment and monitoring of waste (Starkey, 1998, cited in Raili (2009)). As stated by UNEP (2010) management structure for WEEE / E- waste includes policies and regulations, institutions, financing mechanisms, technology for collection, storage, recycling and disposal and stakeholders' role. In this study e-waste management means e-waste collection, transportation, supervision and disposal systems that involve rules and regulation, institutional responsibility and accountability mechanisms, educated and trained official, knowledge and attitude of stakeholder.

**Institutional Preparedness:** Institutional preparedness involves measures that taken to ensure effective management of e-waste to prevent the impact of health and environment and reducing e-waste. For example, formal recyclers are managing e-waste with following the 3R (Reduce, Reuse and Recycling) principles. The legal framework including policies, laws, ordinances, rules, regulations, guidelines strategies covering pollution control and waste management should define the responsibilities of each institution in implementing relevant laws and the procedures by which the responsible agencies should carry out their functions. The country can be formulated new legislation intended to protect the environment, assign institutional responsibilities, and encourage public cooperation with pollution control and waste management objectives if present legal documents not covered (Janis D. Bernstein, 1993).

**Institution:** Some omnibus conceptions of institutions (W. Richard Scott) are:

- *Institutions are social structures that have attained a high degree of resilience.*

- *Institutions are composed of cultured-cognitive, normative, and regulative elements that together with associated activities and resources, provide stability and meaning of social life.*
- *Institutions are transmitted by various types of carries, including symbolic systems, relational systems, routines and artifacts.*
- *Institutions operate at multiple levels of jurisdiction, from the world system to localized interpersonal relationships.*
- *Institutions by definition connote stability but are the subject to change process, both incremental and discontinuous.*

**Institutional infrastructure:** According to Antipolis (2000), institutional infrastructure associated with efficient waste collection and disposal systems, raising public awareness, well-planned management, operating within an enabling institutional framework, and capability of generating the financial resources. According to DFID (1998), Institutional infrastructure defines that exist in an economy in order to undertake particular activities. It encompasses linkages among individual organizations, and the framework of law, policy, convention, ideology and culture in which they operate. Various studies such as Antipolis (2000), World Bank (2000) and DFID (1998) point to the strength of the institutional structure as a key underpinning factor to sustainable development of solid waste management. In this study, institutional infrastructure means that the organization those are exercising policy and laws for managing e-waste such as MoEF, DoE, Local Govt. Institutions (City Corporation, Pauroshova, Union Parishad) other relevant institution like Cantonment Executive Board, BAERA, BTRC. It includes organizational structure with clear tasks and responsibility, HRM, internal organizational structure to w-waste management.

**Institutional Capacity:** It involves detailed organizational chart of the agency, with a clear structure, tasks and internal accountability mechanisms such as enforcement, monitoring and evaluation mechanism. Performance of the institution also depends on the staffs education, training and knowledge. Role of government institution and other related bodies consider as stakeholders.

**Legal Framework:** Legal definitions and classifications of waste are vital for waste legislation. Preferably, they provide clear and explicit guidance such as (1) what types of materials are considered to be waste, what is hazardous, (2) who the actors are and to whom are the obliged to apply; (3) what are the waste handling processes, operations and facilities. If a chemical or a material is designated by law as waste, its handling and processing have to comply with pertinent waste legislation (UNEP, 2015). Legislation is to monitor waste management activities, proposing conditions by its regulations to avoid contamination of the environment. Legislation can thus be considered as a meta-level activity, which monitors the base level activity and sets targets for activities upon waste (Janis D. Bernstein, 1993). This study define legal framework for e-waste management as formulation, enactment, implementation and enforcement of legal document that includes policies, acts, rules, regulation, ordinance, SRO, and directives.

**Citizens' Awareness:** Awareness defines educating the public to make people fully aware of, the importance of source reduction and ways in which they can do it. There is a general lack of awareness by computer users and the public in general about the toxins contained in Information and Communication Technology (ICT) components, and the associated risks of contamination of air, water and soil caused by land filling and incineration of technology equipment at the end of its life (M. H. Rahman et. al., 2014). In the study citizens' awareness includes knowledge and attitudes on e-waste management.

### 3.15 Variables and Measuring Indicators from Theoretical Sources:

Table 3.4: Variables and measuring indicators

Variables	Indicators	How do I see data
E-waste Management (Dependent Variable)	<ul style="list-style-type: none"> <li>✱ E-waste collection , transportation and supervision/ disposal systems</li> <li>✱ Legal framework</li> <li>✱ Institutional framework and capacity</li> <li>✱ Stakeholder participation</li> <li>✱ Approaches to formal e-waste recycling</li> <li>✱ Minimized informal e-waste recycling</li> </ul>	<p>Document review Interview with KI Semi structured interview Observation</p>
Institutional Framework and Preparedness (Independent Variable)	<ul style="list-style-type: none"> <li>❖ Institutional Infrastructure (framework): MoEF, DoE, LGD (City corporation and Pouroshova), Cantonment Executive Board, BAERA, BTRC</li> <li>❖ Extent of Institutional Capacity: enforcement, monitoring, evaluation, capacity development, Stakeholder responsibility, financial responsibility</li> </ul>	<p>Document review Interview with KI Semi structure interview Case study Observation</p>
Legal Framework (Independent Variable)	<ul style="list-style-type: none"> <li>★ Policy, Act, Rules, Regulation, SRO, Multilateral Agreement, Action Plan, Directive (EPR)</li> </ul>	<p>Document review Interview with KI Observation</p>
Awareness (Independent Variable)	<ul style="list-style-type: none"> <li>☆ Individual level of knowledge , attitude and disposal process of e-waste</li> </ul>	<p>Survey, Document review</p>

## **CHAPTER FOUR**

### **RESEARCH DESIGN AND METHDOLOGY**

#### **4.1 Introduction**

This chapter specifies the methods and procedures for collecting and analyzing the required data in order to realize the research objectives. In this study the area and population have been selected in line with the objectives of the study. Secondly, the research methodology applied in this study is also described in this chapter. Since the study intends to gain insights on the extent of e-waste mismanagement, the overall nature of the study was mixed, encompassing qualitative and quantitative. Thirdly, the rationale of the study is outlined, and methods of sampling and data collection described, Besides, the limitations encountered during data collection and how they were dealt with are highlighted. Finally, methods of data analysis are presented.

#### **4.2 Research Design:**

The research was designed to assess present situation of e-waste management in Bangladesh with respect to:

- Legal framework
- Institutional infrastructure and institutional capacity
- Stakeholder participation.
- Usage of electronic gadgets: information regarding number of selected electronic gadgets ownership; Average number of obsoletes device used per person for last ten years and its lifespan.
- Citizens' awareness: understanding of e-waste, practice of disposal, health and environmental issues, and its management

Data were collected on each element of the study through a questionnaire survey, semi structured interview, key informant's interview (KII), documents review and field visit.

### **4.3 Study Area**

Dhaka is the capital and Chittagong is the commercial city of Bangladesh. Dhaka and Chittagong Metropolitan city are offers more employment opportunities and higher income levels, which lead to migration of population from different parts of the country to it. These two cities are the largest e-waste generator city in Bangladesh. For this reason, these areas have been selected as the study area.

It was essential to understand awareness level and present practices related to e-waste handling and management. The quantitative part of the study was conducted with the respondents of different educational backgrounds and professions in these study areas. A few of local level NGOs along with governmental institution carry out mass awareness campaigns related to the issue in the city. Also, some of national daily newspapers and television channels also broadcast menace of e-waste in these two cities. This makes it more interesting to indirectly evaluate the impact of such programs on people's perception over the issues associated with handling of e-waste.

### **4.4 Sample and Sampling Technique:**

90 respondents from different professional status (e.g. government service, private service, self-employed/ business and non-professional like retired, student, housewife, others) were selected purposively for the questionnaire survey. As the purpose of the survey was to know about the citizen's awareness about e-waste, the sample was selected purposively from those who use electronic gadgets. The number of the respondents was not increased more than 90 considering the practicability of collecting data. First, it was planned to conduct the survey only through e-mails. But a poor response of the respondents was observed from e-mails. Under the circumstance, data were also collected through direct interview later. During sampling, different socio-demographic characteristics of the respondents like gender, education and profession etc. were taken into the account. This was done with the aim to cover respondents of all socio-demographic status.

#### **4.5 Research Instruments**

The study is an explorative research that looks on present situation of e-waste management in Bangladesh. The study was seeking for more detailed and accurate information on e-wastes management practices to uncover the challenges and come up with sound and workable solutions to the challenges. It employed different approaches like secondary data analysis, field research, analysis of research findings and report writing.

The study focused on whether organizations have e-waste management plan disposal policy in place and whether asset disposal policy include electronic products, how do organizations store or treat end of use electronic products, whether waste management practitioners are trained on e-waste management practices and understand methods used by waste management companies or organizations to destroy e-wastes in damp sites. A research methodology framework was developed which guided the development of the research tools.

The research applied a mixed method. Both qualitative and quantitative research methods have been used here. Qualitative data were collected through interview with key informants, documents review, field notes, and pictures. On the other hand, in quantitative research method numerical data were adopted. Both types of data enquire into the area of interest to determine the flow of e-waste and subsequent disposal.

The research questions and theories composed of variables and the related objectives of the study were measured in a systematic way. A mapping on these is presented at the end of the chapter in a separate table.

#### **4.6 Secondary Research**

Secondary research provided background information and important insights and guidelines for the design of the research tools and the subsequent field research. It involved review of relevant literature, policy documents, industry reports, media publications, company reports where applicable as well as internet sources among other secondary sources of

information. All these sources and materials used in the research will be acknowledged and included in the list of references.

#### **4.7 Field Research**

Field research was conducted for collecting primary data. Both the primary and secondary data were collected in the field research. It includes using a combination of the following methods; interviews (both questionnaire and semi-structured open-ended), site visit, which provided the key primary data.

#### **4.8 Field Level Questionnaire Survey**

The survey was used for collecting quantitative primary data with structured questionnaire. A semi structured questionnaire was also developed to collect data from the key informant. The field level questionnaire survey focused on usage of electronic gadgets, citizen's knowledge and attitudes to e-waste, practice of e-waste disposed, health and environmental issues, and e-waste management.

Data collection was done at the institutional level that operates collection, transportation and disposal activities both in the public sector and at the community level. The end users were surveyed through questionnaires to assess the social acceptability and user satisfaction level. It also investigated the respective respondents' mode of disposal of e-waste as well as their awareness of the harmful nature of the waste. The details of the field questioner survey are listed in [Appendix-A](#).

#### **4.9 Key Informant Interview**

To complement available information on the secondary literatures, semi-structured interviews and email exchange were used to substantiate available information on e-waste. Key informants came from various organizations such as government agencies, private organization, non-government organization, trade bodies, academic scholar, non-government organizations, electrical and electronics companies, dismantling companies and shopping malls involved in e-waste market. The details of the key interviewees are listed in

**Appendix-B.** The interviews were conducted following a semi structured format and involved a series of open-ended questions. Professional from policy formulation and implementation organization, Academic scholar, experts on waste management, members of NGOs, trade organization were taken interview as key informant. According to their expertise structured question ware prepared.

For questionnaire survey, face-to-face interviews were thought to be more reliable for obtaining accurate information from respondents, as they hailed from a wide range of backgrounds and had different educational levels. This also helped to ensure that all questions were answered and that the answers were recorded in a consistent manner. Most of the questions utilized the checklist approach in order to reduce ambiguity and to facilitate quantitative analysis.

#### **4.10 Semi structured interview:**

Semi-structure interview is helpful to get 'reliable, comparable qualitative data' (Cohen 2006). It contains a set of open-ended questions in regards with the issue (Mathers et al. 1998). The interview is used when more number of respondents is interviewed (Cohen 2006). The researcher collected data by face-to-face interview for high quality data. The details of the Semi Structured interviewees are listed in **Appendix-C.**

#### **4.11 Institutional Case study:**

Case study method gives opportunity to look into an issue very closely. Case study is accepted as a very effective method for in-depth understanding on an issue. It helps to analyze and explore complex issues (Zainal 2007). In case studies both qualitative and quantitative data are analyzed. Tellis (1997) observed that case study explain processes and outcomes of an issue through 'complete observation, reconstruction and analysis of the cases under investigation' (Tellis, 1997).

Local Government Institutions mainly perform the responsibility of waste management in rural and urban areas. In urban area City Corporation, in rural areas Pauroshava and Union

Parishad have been working for waste management. Single unit of every tier of LGIs has chosen namely Sultangong union parishad, kishoreganj sadar pauroshava and Chittagong City Corporation for a institutional case study. These three institutions are located in a commercial area. The institution have been chosen by considering number of population, probability of ICT use. Therefore these has taken as a institutional case study. Mainly officials of these institution are target population. Random sampling have been used to determine. Semi structure interview had conduct to understand the institutional infrastructure, its capacity for managing e-waste.

#### **4.12 Field and Site Visits**

Field visits were conducted in various locations such as identified dumping ground for e-waste, unloading point of second-hand electronics, e-waste markets and junk shops, dismantling center and informal recycling. The biggest unloading points of second-hand electronics are the Fatullah, Dholikhal and Mirpur and iterant dumping sites of e-waste can also be found within the periphery Chittagong port area.

Considering the engagement in e-waste management and high use of e-devices and volume of e-waste collected areas for questionnaire survey were selected. These include some relevant offices and some areas where people are highly likely to use e-devices and where the e-wastes are collected together from different parts of the cities. In Dhaka, DoE office Agargoan, Atomic Energy Commission, Dhaka North and South City corporation area specially Banani, Gulshan, Tajgaon, Elephant Road, Nimtali, Gulistan, Dolaikhal, Golapbag, Mirpur, Islambag were visited. In Chittagong the areas are City Corporation office area, GEC circle and Sitakundu shopping dock yard were visited.

#### **4.13 Data Analysis and Presentation**

Data collected was sorted, organized, conceptualized, refined, and interpreted using methods drawn from the constant comparative analysis techniques, Quantitative and qualitative methods was used to collect and analyze data. Data on questions that are quantitative in nature such as number of discarded device, quantities of waste handled was analyzed using Microsoft word where charts and tables were generated. Qualitative data,

mainly obtained from interviews and document analysis, was categorized to allow for meaningful analysis. Quotes, individual remarks and case illustrations built from interviews were used to further lend valuable support to data. Public policy data and information were subjected to content analysis.

On the other hand, according to Keakopa (2006), amongst the many publications on analyzing qualitative data, Marshall and Rossman describe it as a messy, ambiguous, time-consuming, creative and fascinating process. There are no strict rules to follow in analyzing qualitative data (Williamson & Bow 2000, cited in Keakopa 2006). Qualitative assessment focuses on viewing the experiences from the perspective of those involved. It takes into consideration feelings and attitudes of respondents about a problem under investigation. According to Ambert *et al.* (1995), qualitative research seeks depth rather than breadth. Instead of drawing from a large, representative sample of an entire population of interest,

#### **4.14 Mapping of the Study**

Data to be collected was aimed at addressing the study objectives. With regard to the first objective on evaluation of existing policies and regulatory framework governing e-waste management, primary data and secondary data were collected with the aim of determining gaps in existing legal, policy and regulatory frameworks in waste management, institutional mandates and framework for sustainable development, the level of involvement all stakeholder in e-waste management.

In relation to the second objective on examining how e-waste is handled in manufacturing and processing industries, primary and secondary data were collected to determine the levels of stakeholder responsibilities on matters of e-waste management, evaluate effect of poor e-waste handling to the environment, how e-waste is disposed and determines how e-waste is handled in manufacturing and processing industries.

In relation to the third objective on examining critical challenges constraining e-waste management in manufacturing and processing industries, primary data was collected to evaluate level of compliance on environmental legislation by industries, effectiveness of monitoring and policy implementation the relevant key stakeholder, safety concerns during e-waste handling in manufacturing industries.

A mapping of objectives, variables or indicators, data sources used in the study and analysis techniques of the data is presented below.

Table 4.1: Mapping of objectives, variables/indicators, sources of data and data analysis of the study

Sl.	Objectives	Variables/indicators	Sources of Data	Data analysis
1.	To examine the present status of e-waste management system in Bangladesh.	Approaches of e-waste disposal E-waste collections and transportations Roles of various stakeholders in e-waste management Determine constrain of e-waste disposal	Books, Articles, Journals, Newspaper clippings, E-waste collectors, dismantler and citizens Site visit	Qualitative analysis Interview Field visit
2.	To identify the legal framework and institutional preparedness of e-waste management in Bangladesh	Existing legal framework in e-waste management Institutional preparedness for enforcement of e-waste management Effectiveness of various policies in addressing e-waste	Constitution of Bangladesh, Ministry of Forest and Environment, Commerce, Industries, ICT and Local Govt. Division, DoE, BTRC, BAERA, City Corporation and Pauroshova	Qualitative analysis
3.	To understand the roles and cooperation of various stakeholders involved in sustainable e-waste management.	Institutional framework and institutional capacity, roles various stakeholders	Ministry of Forest and Environment, Commerce, Industries, ICT and Local Govt. Division, DoE, BTRC, BAERA, City Corporation and Pouroshova Books, Articles, Journals, Newspaper clippings,	Qualitative analysis Interview KI
4.	To understand the level of awareness on e-waste of the citizens.	Citizens Awareness	Web Survey through e-mail and Field survey by hand	Quantitative Analysis

## **CHAPTER FIVE**

### **DATA RESENTATION, ANALYSIS AND INTERPRETATION**

#### **5.1 Results and Discussion**

This chapter tries to present empirical data and secondary data of the study. In the study there were three independent variables institutional preparedness, legal framework and citizens' awareness for e-waste management.

The chapter has categorically divided into three parts first part, second part and third part. First part has analyzed institutional preparedness, second part for legal framework and third part examined for citizens' awareness.

Independent variables have divided into two parts for interpretation one for primary research and the other two for secondary research.

First two parts has discussed secondary research. It attempts to present information of key informant interviews, semi structured interviews, document review and field based observations of the study. Institutional preparedness and legal framework were two variables of this research. It aims to examine with the observations in line with analytical framework. The following research questions have been addressed in this study:

- How e-waste is being managed in Bangladesh?
- To what extant present policies offer innocuous, effective and environmentally sound of e-waste management?
- What are the barriers of e-waste management in Bangladesh?

## **FIRST PART:**

### **5.2 Institutional Preparedness for E-Waste Management**

Institutional preparedness is a key instrument in e-waste management. It gives an idea on overall macro level status on policies and their execution. It encompasses a broad system to minimize the spread of e-waste in the environment. In the study on institutional framework and preparedness this research will look into two aspects. These are: institutional infrastructure and extent of institutional capacity.

#### **5.2.1 Institutional Infrastructure for Policy Formulation:**

In the terminology of 'institutional infrastructure', the word 'institution' covers a wide range of institutes in regards with e-waste management. It incorporates government organizations, private organization and other stakeholder related to environmental management in terms of e-waste management at both national level and local level.

To collect qualitative data of institutional infrastructures on e-waste management documents of concerned institutions and relevant acts and rules were studied. Besides, 10 academic scholar, professionals and NGO representatives were interviewed as Key Informants. Furthermore, 20 semi-structure interview were conducted among officials of various department of the government and private business institutes who have stake in e-waste management

It has been found that environment is a cross-sectoral issue. Various ministries and departments are working on policy level regarding this issue. Besides, as a key implementing body the role of different local government institutions has been identified as very important. Besides, 15 Cantonment Boards and Chittagong Hill Tracts Development Board work in their respective area for waste management. In addition to that private organization, business organizations and NGOs related with e-waste dealings and awareness building campaigns.

In the following part of the chapter some of the core institutions involved with e-waste management are discussed. Institutional framework can be divided into broad categories. In the first category, which comprises of different ministries and department of the government provides policy framework environmental issues. In the second category, as a

service providing agents different LGIs and similar bodies are included. These are discussed separately.

## **5.2.2. Policy formulation bodies:**

### **5.2.2.1. The Ministry of Environment and Forest (MoEF)**

According to Allocation of Business, 1996 (Amendment 2014) Ministry of Environment and Forest provides the key policy framework for environment and ecology. This ministry is mandated with planning, promoting, coordinating and overseeing the environmental issues in various sector of the country. As the most crucial ministry in the field of environment the ministry prepares all laws matters relating to environment pollution control. In line with this MoEF bears the responsibility for working with other ministries to safeguard the interest of environment. It cooperates with other ministries with clarifying the issues related with environment pollution and providing expert opinion so that no development program of the government can overlook the stake and interest of environment.

It has been found that the MoEF plays role in policy guidance and coordination of the execution of action plans across all sectors. It review and monitors the impact of development initiatives on the environment across all sectors (Aminuzzaman, 2010). However, to achieve this objective, the Ministry has a role to play through an enabling environment through policy and regulatory reforms for environmental and natural resources management.

However, regarding e-waste MoEF needs to prepare regulations and guidelines in the light of ECA and ECR. The guidelines should give emphasis on the negative impact on health and environment from the e-wastes.

MoEF has two departments. These are: Department of Environment and Department of Forest. Department of Environment looks after the implementation on the policies of e-waste management.

#### **5.2.2.2. Department of Environment (DoE)**

The Department of Environment (DoE) is the technical arm of the MoEF. The MoEF is responsible for environmental planning, management, monitoring and enforcement. DoE looks after the implementation side of these policy instruments. Besides, it provides technical support to MoEF. The mandate of the DoE includes: assessment and monitoring of tasks such as on-site surveillance of environmental improvement components of development projects; promoting environmental awareness through public information program; and controlling and monitoring i pollution; environmental impact assessment, and in formulating guidelines for line agencies. DoE has the legal authority to declare any ecosystem as Ecologically Critical Area (ECA) and so far 13 ECAs have been declared. However, it has been found that the management issue of declared ECAs has not been resolved. Furthermore, DoE has been unable to consistently respond to its complaints. However, inability is largely manifested by well positioned field resources (Aminuzzaman, 2010). Seventh five year plan has identified lack of field resources as the main reason for pr management of the department.

Along with MoEF and DoE there are some other ministries of government who have stake in the matters of e-wastes. The lead agencies that are also pertinent to e-waste management include the Ministry of Information and Communication Technology, Ministry of Science and Technology, Ministry of Commerce, Ministry of Education, Local Government Division, Ministry of Defense, Ministry of Power, Energy and Mineral Resources, Ministry of Health and Family welfare and Ministry of Finance.

However, there are some other expert departments of the government who have stakes in e-waste management. These organizations play critical roes in e-waste management. Functions and role of some of these institutions are described below.

#### **5.2.3 Service providing agencies:**

Among 64 administrative districts in Bangladesh, 61 have LGIs active in rural and urban areas. The rural LGIs are District Council (Zella parishad), Upazila Parishad, Union Parishad and Paurashavas. The urban LGIs are City Corporations and Ward Councils. The rest three districts are the hilly districts Rangamati, Khagrachari, Bandarban. These districts development work are done under Chittagong Hill tracts Development Board.

#### **5.2.3.2. Bangladesh Atomic Energy Regulatory Authority (BAERA):**

This institution provides license, permits, NOCs on radioactive substance and renders training on running radioactive instruments. The study found that if scrap metals does not contain radioactive elements in that case No Objection Certificate (NOC) is issued by following Bangladesh Atomic Energy Regulatory Act, 2012 from Bangladesh Atomic Energy Regulatory Authority. If radiation generation equipment contain radioactive within tolerance level or permissible limit NOC is also issued by following provisions of Nuclear Safety and Radiation Control Act, 1993 and Nuclear Safety and Radiation Control Rules, 1997 from the same institution for e-waste management.

#### **5.2.3.3 Bangladesh Telecommunication Regulatory Commission (BTRC):**

BTRC provides permission for recycling obsolete telecommunication equipment following the framework provide by Telecommunication Act, 2001 (Amendment, 2010). But there are other conditions involved in the process where DoE need to provide permission. Besides, the process of recycling should follow the import and export policy of the government.

A review of the key government organizations at the policy level shows that the institutional framework of e-waste management is big and complex. It's a multi discipline affair.

#### **5.2.3.4 Local Government Division:**

According to Allocation of Business 1996 (Amendment 2014), Local Government Division deals matters relating to local government including local government institution. Civic right is ensured through Local Government Institution (LGI) in Bangladesh. Two types of Local Government Institutions (LGI) in Bangladesh that function in the rural and the urban areas. There are 11 City Corporations, 324 Poursavas (municipality) in urban areas and 4,554 Union Parishads (UPs) in rural areas.

In addition to that military lands and civilian services of cantonment areas are deals Cantonment Executive Board (CEB) under the Ministry of Defense (MoD). In the cantonment area CEBs works for civil population. In Bangladesh, there are 15 Cantonment Executive Board which provide services to the civilian citizens.

By and large, City Corporations, Pourasavas, Union Parishads and Cantonment Executive Boards are responsible for managing waste in their respective jurisdiction. The role of Local Government Institutions (LGIs) is very important in the institutional framework from the standpoint of providing services to the people.

#### **5.2.3.5. Dhaka Metropolitan City:**

Dhaka became the capital of Bangladesh with the independence in the year 1971. The city area was divided into 50 wards and election of ward commissioners was held in 1977 with the introduction of "Pourashava Ordinance, 1977". From the ward commissioners one of the commissioners was selected as Chairman of the Municipality. In the year 1982, two municipalities Mirpur and Gulshan were merged with Dhaka Municipality. In 1990, Dhaka Municipal Corporation turned to Dhaka City Corporation and was divided into 10 zones. The Local Govt. (City Corporation) Act 2009, (Amendment-2011), Dhaka City Corporation has divided as Dhaka South City Corporation (DSCC) and Dhaka North City Corporation (DNCC).

##### **a) Dhaka North City Corporation (DNCC):**

Dhaka North City Corporation (DNCC) is one of the local govt. institutions that provide services to the citizens of the north part of Dhaka city. DNCC has an elected Mayor and 48 ward councilors of the 12 women councilors. Chief Executive Officer with the advised of Mayor runs the City Corporation.

There are 15 departments in DNCC that provide various services to the citizens namely road cutting permission, new holding number, procedure of holding tax service, transfer of holding name, new and renewal of trade licenses, birth certificate, burial ground booking / reservation, anti-tobacco guide line, community center booking, no objection certificate for multistoried building, purchase of GIS based map, entrepreneur of town information and service center.

**Waste management infrastructure of DNCC:** Waste management department functions on street sweeping; clean the roads, drains, and sewerage lines. DNCC also collect solid waste from domestic, business, hospital, street, public toilets, and drains. DNCC manage the private solid waste management and NGO based solid waste management.

Besides, for awareness raising activities, DNCC arrange community meeting at ward level, organize lots of program like rally, canvassing, distributing leaflets, stickers, conduct environmental education programs, publish quarterly newsletter, conduct training program for community people to develop the waste management system.

However, no special provision for managing e-waste has been found during the study.

**b) Dhaka South City Corporation (DSCC):**

**Introduction:** Dhaka South City Corporation (DSCC) works for the south part of the Dhaka City. The corporation area comprises with 57 wards for providing services to the citizens. DSCC has an elected Mayor, 57 ward councilors and 19 women councilors. Chief Executive Officer with the advised of Mayor runs the City Corporation.

There are 15 departments like engineering, health, revenue, waste management, urban planning, estate, transport, accounts, store and purchase information and communication technology cell, law, public relation, social welfare, internal audit, slum improvement development, security department. DSCC also provides services namely hospital service, street light, museum, burial/burning ground, road/drain/footpath, markets, gymnasium, maternity center, bus terminal, public toilet, playground, community center, street car parking, library, music and school, park, school and college

**Waste management infrastructure of DSCC:** The waste management department collects solid waste from domestic, business, hospital, street, public toilets and drains. The corporation provides dustbins and other receptacles for accumulating the waste. DSCC cleaners clean the roads, drains and sewerage lines. It also collect and transport medical waste and landfill the waste.

Besides, DSCC arranges community meeting for promoting community base solid waste management. DSCC started community based waste management activities in collaboration with JICA. Manage the private solid waste management and NGO based solid waste management.

However, like, DNCC no system yet developed for managing e-waste separately in DSCC.

### **5.2.3.5. Cantonment Executive Board:**

According to the Cantonment Act-1924, a cantonment is a place where "any part of the regular forces or the regular air force of Bangladesh is quartered. In the cantonment area, Cantonment Executive Board works for civil population and provides services to them. Existing Cantonment Boards are 15 in numbers based on civil population and classified in three class like class one Dhaka, Chittagong, class two Comilla, Jessore and class three Bogra, Rangpur, Sayedpur, Rajshahi, Kadirabad, Momenshahi, S.Salahuddin, Gazipur, Savar, Jahanabad, and Jalabad. Administrative framework of cantonment executive board is Military estates offices under Department of Military Lands and Cantonments, Ministry of Defense.

Cantonment board is headed by the Cantonment Executive Officer and board act as local govt. institution like Municipality or City Corporation. The Board comprises with six members. Station Commander is the president and Chief executive officer is the Secretary where other's members are Executive Magistrate nominated by the District Magistrate, Health Officer, Garrison Engineer, Civil or military officers nominated by the station commander. Functions of the cantonment executive board Ghatail, Tangil are lighting, cleaning, constructing/maintaining streets, markets, drains, planting/maintaining trees, maintaining public hospitals and dispensaries, establishing/maintaining public parks, gardens, watering, regulating offensive and dangerous trades, removing undesirable obstructions, maintaining burial/burning grounds, providing pure water supply system, registering births and deaths, establishing/maintaining dairies etc. The board does not provide any sorts of service to manage e-waste separately.

### **5.2.4 An institutional Case Study of E-waste Management**

#### **Institutional Case Study**

To understand the present scenario of e-waste management at field level a case study had taken to observe the situation of a single unit of every LGIs unit as one City Corporation, one Poaurashava and one Union Parishad. The empirical studies are as follows:-

#### **5.2.4.1 Chittagong City Corporation (CCC):**

**Introduction:** In 1983, Chittagong Municipality turned to Chittagong City Corporation with 6 sq. miles. Now the corporation works for 60 square miles consisting of 41 Wards which have been divided into 11 zones. Of the 41 wards 24 are conservancy and 17 are non-conservancy wards. There are seven departments for providing service to the citizens viz Secretariat, Engineering, Health, Education, Revenue, Conservancy and Accounts department.

**Waste management infrastructure of CCC:** The main responsibility of the Cleaning Department is to keep the city clean. The conservancy department has two branches one is cleaning and the other is mosquito eradication. There are number of cleaning workers as well as waste carriage vans and different instruments for cleaning drainage systems, roads and clear off the daily accumulated wastage.

Generally cleaning of city's main roads start from 5a.m. and 6a.m. for other roads this continues till 1p.m. Within this time span the workers usually complete their job for cleaning drainage systems, roads and evacuating daily accumulated wastages. There are officials, cleaning supervisors and inspectors who monitor the job proceedings and interchange information between them for better results.

Still no system has been exists in the corporation for managing special waste like e-waste.

Other than city corporations a Paurashavas and a Union Parishad were also studied regarding their role on e-waste collection. The Paurashavas are: Kishorgonj Sadar Paurashava and Sultangong Union Parishad.

#### **5.2.4.2 Kishorgonj Sadar Paurashava:**

Kishorgonj Sadar Paurashavais located in the heart of the Kishoregong District. Kishoregongsadarpaurashava provide services to the citizens. In the second chapter of Local Govt. (Municipality) Act, 2009 defined responsibilities and activities of a Paurashava. Section 50 (2) D of this act pronounces services of the Paurashava like water and sanitary management, planning for ensuring social and economic justice, development of roads and

communication system, birth registration, health and environmental management, education, sports, amusement park, cultural program and beautification of Paurashava area.

**Waste management infrastructure:** Waste management is one of the major activities of Paurashava. Kishoregong sadar paurashava handles local solid waste through collection, transportation and disposal from dustbin to landfill by garbage truck/hand trolley. They start collecting wastes daily from 6 am and finishes at 10am. A total of 20 cleaners (1 woman and 19 men) guided by only two employee of municipality are assigned for this purpose. Every truck carries six cleaners to collect solid waste. There is identified landfilling site in the Jelkhanamoore for dumping waste.

However, the paurashava has no system for collecting e-waste and its disposal.

#### **5.2.4.3 Sultangong Union Parishad:**

Sultangong Union Parishad is situated in the western part of Dhaka district under Karenigong upzila. The union is located beside Burigonga river. Generally, middle/ low income family live in this area. Easy communication, labour and transportation cost is cheap in this union. The Union Parishad runs by the Local Govt. (Union Parishad) Act, 2009. The union is divided into 9 wards. The Union Parishad consists of 13 elected person including 1Chairman, 9 members and 3 female members. The UP Chairman and members has elected for 5 years. There are some recruited employees at UP as well. Activities of Union Parishad defined in the second schedule of section 47 of the act. Some of the responsibilities of Union Parishad are preparing five years plan, village, fish and livestock development, education, primary and mass education related, collection of tax and fees. The provision 19 of the act that is union parishad will ensure collection, elimination and management of waste.

**Waste management infrastructure:** There is a provision of waste management in the act of Union Parishad. However it is found during the study Sultangong Union Parishad does have any arrangement for waste management in reality let alone e-waste management.

**Observation:** It was observe that Chittagong City Corporation, Kishoregonj Sadar Pauroshava and Sultangonj Union Parishad did not have any system to manage e-waste. All these institutions had collected e-waste with domestic waste. The official of these

institutions did not found adequate knowledge on e-waste. There were no systems found to segregate e-waste from mixed waste. The overall observations were that these institutions neither have practical knowledge nor have adequate institutional infrastructure and capacity to manage e-waste

#### **5.2.5 Initiative of private entrepreneur to management e-waste:**

The Azizu Recycling and E-waste Company Ltd. is located at Fatullah, Narayangong. The business center mainly collects e-waste from different parts of Bangladesh. Generally, the center largely collects telecommunication based frequency equipment. They purchase Printed Circuit board (PCB) per kilogram 10-150 BDT. The price varies on quality of PCB grade. Around 50 metric ton PCB can be purchased per month. After inventories, they segregated, sorting, dismantle and send it into waste stream. They sale some base materials to local market and export some components to other country.

One of the official of business center shared views that Japan uses Harmonized System (HS) Code (7112.99.00) for exporting printed circuit board (PCB). Whereas in Bangladesh, there is no specific HS code for exporting PCB. Now lower graded mobile phones have spread the whole country. Its life time is low and adding the volume of e-waste. For this, country gets fewer prices when exported lower graded PCB.

Some country uses this refurbish PCB and manufactured new products. These products are entering our local market at cheap price as a new product where its life average time is low. There is no definite specification or standard model for importing products.

They also emphasized on recycling and informed that we have cheap labor force. If recycling can ensure than employment will be generated. Recycling process can supply base metal in the local market as well as reduced pressure on mine extraction and import burden. The process can also contribute in national economy. Bangladesh has no base material mine. Therefore recycling should popularize for supplying base materials.

Some informal e-waste businessmen collect e-waste. They burn e-waste for extracting metal and keep way residue on the ground. Therefore incineration is creating pollution and rest of the waste damage the environment.

**Summary on institutional infrastructure:** In search of existent institutional infrastructure for e-waste management, the study surveyed different ministries, divisions, departments of government. It has found that in the policy making level MoEF and DoE played leading role. Some other ministries and department have also important stake in the field of e-waste management.

On the other hand, at the implementation stage, especially in terms of collecting e-waste no infrastructure is observed. Different LGI institutes like city corporations, union parishad and pourashava have been studied. Their legal framework and infrastructure for waste management were studied but not activities have been identified for collecting e-wastes.

However, private agencies are much ahead in this regard. Some private institutions are collecting e-waste and treating those in a formal way. They produce different materials including raw materials for making PCB of recycled e-products. Besides, some precious metals are recovered. These are contributing to the national economy in addition to saving environment and human health from toxic e-wastes.

On the other hand, some are recycling the e-wastes in informal ways. They usually burn the wastes and collect metal from that. But this process releases a huge quantity of toxic gas into the air, acid leaching contaminates water and soil. Also it degrades the quality of the metals.

## **5.2.6 Institutional Capacity:**

### **5.2.6.1. Monitoring, Evaluation and Enforcement:**

The Environmental Conservation Act 1995 (ECA), Environment Conservation Rules 1997 (ECR), and Environment Court Act 2000 outline the environmental regulatory regime to establish environmental administration in Bangladesh and give DoE mandate for their enforcement. DoE officials are responsible to enforce the provisions of laws and rules as provided in the ECA and ECR. In line with these acts and rules the DoE has published Inspection and Enforcement Manual -2008.

The field inspectors will enforce inspections and monitoring to verify compliance, investigate the suspected violators, and used enforcement tools to obtain compliance. A Conservancy Inspector is assigned for each ward to look after the waste management in the local government institution. He acts as City Corporation representative to hear the

problems of cleaners and city dwellers. The Inspector takes initiative to solve cleaners' problems by himself or with the support of Ward Councilor.

However, the study reveals that there were no budget allocations for e-waste management infrastructure like training, technological knowledge etc. Besides, associated infrastructure including countrywide Local Government Institution infrastructure didn't have collection center or designated place for temporary storage facilities.

Measurement of progress on the path to achieve set goals, objectives, strategies and targets in the implementation of the e-waste management requires consistent monitoring and evaluation of the outcome indicators. The Government together with other relevant stakeholders may carry out monitoring and evaluation at different levels. A monitoring and evaluation framework may therefore be developed to assess the impact of the implementation hence determining whether there is need for periodic reviews to incorporate emerging issues like; rapid changes in technology, changes in statistical data on e-waste generation and volumes etc. to enable effective or improvement in the e-waste management systems.

#### **5.2.6.2 Lack of resources and capacity:**

Interview with key informants namely academic scholars, professionals, representative of NGOs, government and private stakeholders, highlighted that local government institution are mainly responsible for managing e-wastes. There is also lack of citizens' knowledge and attitude to environment and health impact of e-waste.

It is also observed that some local Government Institutions like City Corporation, Pauroshava and Union Parishad do not have the rules, technical capacity (requisite skills and knowledge) and the capability (required human and financial resources) to adequately implement and enforce to disposal of e-waste separately.

KII informed that lack of technical capacities, human resources, and financial capabilities pose serious constraints to the ability of local officials to make a sustainable impact on environmental issues. E-waste repair center ensures reuse of some of the e-wastes. An overall capacity development is required for e-waste management.

### **5.2.6.3 Lack of regulatory and Institutional capacity:**

The legal framework for environmental protection has suggested various steps for conservation of the environment. But during the study it has been found lack of capacity of the enforcing agencies. As a result implementation of environmental policy is still weak. Coordination between MoEF and different departments under it and other stakeholder in the government is not strong. There is shortage of institutional capacity in other ministries and departments on the issue of environmental protection. Human, technological and financial resources scarcity in different ministries and department has been felt during the study.

Furthermore, it has been found that there is scarcity of baseline data on environmental resources and areas environmental concern. Though all development projects from different ministries of the government require clearance on environmental issue from MoEF, the ministry itself lacks skill for assessing and monitoring the impact on environment. Some basic skills on this are yet to develop. In addition to that the ministry falls short of required equipments and other logistics support. So far these areas are overlooked for the absence of monitoring authority of the ministry.

The ministry lacks information on inventory of e-wastes. For preparing a guideline on e-waste management a survey on inventory of e-wastes should be performed with the support from different LGIs and national and international consultants.

In the same way, DoE experiences all the problems like the ministry. The department lacks trained and skilled manpower. Besides, a strong information management system has not developed yet for monitoring and supervising activities of the department. Since environment is a very technical area and DoE is the only department in this regard, more skilled manpower should be recruited in this field.

Furthermore, the department faces some structural problems. The department has ten divisional or equivalent offices. There are district offices but the department is still very centralized. But it is regulatory and enforcement department. But due to centralization it cannot monitor and regulate throughout the country (Aminuzzaman, 2010).

#### **5.2.6.4 Limitations of the legal framework of environment:**

There are several acts and rules which have formed the legal framework of the environment. Following the environment policy the Environment Conservation Act 1995 was adopted for the conservation, improvement of environmental standard and controlling the pollution of environment. In addition Environment Conservation Rule 1997 was passed to supplement the Act. Another milestone in this regard was the Environment Court Act, 2000. This Act was passed for the purpose of trying cases involving offences regarding violation of environmental laws.

However, still there are some limitations of these environmental related laws. Evaluations of the legislation of environmental impact assessments show that the law has not been adequately implemented. Transparency and public consultation have been lacking in EIA implementation (ADB,2004).

Furthermore, some guidelines should be developed. There should be separate guidelines for formal recycling process and informal recycling process.

#### **5.2.6.5 Role of public agencies for managing e-waste:**

The Local Govt. (City Corporation) Act 2009, the Local Govt. (municipality) Act 2009, the Local Govt. (Union Parishad) Act 2009, and the Cantonment Board Act, 1924 endorses that the City Corporations, Pourasavas, Union Parishads and Cantonment Executive Boards are responsible for managing waste in their respective jurisdiction.

In real scenario, these institutions are providing service that is relating to only waste management. On the other hand, e-waste is different in nature than regular wastes. E-waste has special character that has economic value as well as in toxicity in nature. If properly treated e-wastes can be very resourceful for different products including some precious metals like gold. But, these institutions neither have any system for collecting, transporting, disposed of e-waste nor have any demarked place for its environmental-friendly disposal. Furthermore, there are no rules or guide lines have been formulated for managing e-waste in Bangladesh.

There are gaps in institutional policies, institutional infrastructure arrangement and institutional enforcement capacity for managing e-waste. In the quantitative analysis it is found that citizens' awareness on e-waste management is low.

At institutional level, there are limited investments in e-waste infrastructure, with most recycling activities done by the private sector that are largely informal. In order to establish a formal system for managing e-waste in Bangladesh, the informal sector has to be regularized. Experiences from countries like China already show that simply prohibiting or competing with the informal collectors and recyclers is not an effective solution. However, experience from other countries may not fit in our country. Environment and ecology differ from country to country. According to the scholars learning by doing is the best policy in this regard where we have no choice the technology suitable for environment.

The study found that the existing informal e-waste management sector needs to establish guidelines to improve recycling practices, working conditions and the efficiency of the involved informal players.

Furthermore, financial and non-financial incentives like training, transfer of technologies, linkages to international partners and buyers of parts, lobbying for extended producer responsibility and access to funding are proposed to encourage proper recycling activities and divert more of the e-waste into an established formal recycling sector. Organizing existing informal collectors into licensed e-waste collectors is proposed in this strategy.

#### **5.2.6.6 Summary on institutional capacity:**

There are different acts and rules which form the legal framework of environmental protection. DoE is implementing body of these acts and rules. But the department faces problems in terms of financial resources, logistics supports and human resources. These challenges create serious constraints to the ability of officials to make a sustainable impact on environmental issues.

Besides, other ministries related with environmental issues have shortage in knowledge and human, technical and finance resources. The institutional analysis broadly reveals that given the current context it is Local Government bodies and the Cantonment Boards are directly responsible for the operational aspects of addressing e-waste. On the other hand the Local Government Division of MLG, RD& Cooperative and Ministry of Defense provide the policy

support, infrastructure and financial aspects of overall waste management including e-waste. Another challenging area is the lack of information on environmental issues. The information management system in this regard is not sound. As a result there is shortage of baseline data on environmental resources and critical areas. In the same way, MoEF has lacks information on inventory of e-wastes spread across the country.

E-waste can be a critical resource if treated and recycled properly. If they are not properly treated they will spread toxic materials in the environment. But if they are properly treated they can good resources of different chemicals including some precious metal like gold. So recycling and treatment plants should be developed. Recycling should not be linear process. There should be a circular process so that the wastes a can be used again and again. This includes engaging the registered vendors, transporting to designated area, dismantling e-wastes and repair center to ensure reuse of some of the e-wastes. The institutional analysis broadly reveals that given the current context it is Local Government bodies and the and Cantonment Boards are directly responsible for the operational aspects of addressing e-waste. On the other hand the Local Government Division of MLG,RD& Cooperative and Ministry of Defense provide the policy support, infrastructure and financial aspects of overall waste management including e-waste.

## SECOND PART

### LEGAL FRAMEWORK FOR E-WASTE MANAGEMENT IN BANGLADESH

**Introduction:** In this part of the findings and analysis all the regulatory frameworks in regards with e-waste management have been studied. This part of the study is done on the basis of content analysis. It is divided into two sections. In the first section all the acts, rules, regulations and guidelines that exclusively cover environmental issues and particularly waste management and e-waste management. In the second section, other policy frameworks that have some relevance and stake on environment and waste management are discussed.

#### **5.3.1 National Legal and Regulatory Framework with an Environmental Focus (Legal & Regulatory Regime)**

Information and communication technology use is increasing day by day for providing better service. On the other hand, discarded and obsolete ICT equipments are also generating e-waste. Lack of e-waste management is leading to environmental pollution in many parts of the country. This is creating severe negative impact on ecosystems and the human health. However, Bangladesh has developed set of environmental policies, acts and rules that deal with solid waste management.

The policy framework for environment sector in Bangladesh consists of policies, guidelines, and action plans and supplemented by national capacity assessment exercise. Added to these Bangladesh has a number of laws and regulations pertaining to environmental issues (Khan 2009).

A brief synopsis of the contents and applicability of the policies, laws, rules that related to e-waste management is given below. This analysis covers the existing policies, acts, rules relevant to e-waste.

##### **5.3.1.1. Constitution:**

The Constitution of Bangladesh is the supreme law of the country. Article 18A provides a broad framework to the state regarding the conservation of the environment. The Article narrates that : “[t]he State shall endeavor to protect and improve the environment and to

preserve and safeguard the natural resources, bio-diversity, wetlands, forests and wild lives for the present and future citizens”.

Thus it is evident that the Constitution ensures environment protection and the pursuit of sustainable development.

#### **5.3.1.2. The Seventh Five Year Plan (2016-2020):**

The Seventh Five-Year Plan is development pan of the government that will executed in the next five years (2016-2020). This plan started its journey with beginning of period of SDG that will be executed in the next 15 years. That’s why sustainable development and environmental protection has got priority in the planning of development activities in Seventh Five-Year Plan.

It has been found that the plan has emphasized government’s environmental objectives for environmental sustainability. The plan has described government’s environmental objectives under three key themes. These are:

- (i) Climate Change Management and Resilience (comprised of adaptation and mitigation)
- (ii) Environmental Management; and
- (iii) Disaster Management.

However, in the sub-section of internal environment management, the Seventh Five Year Plan has given impetus on preparing a guideline of e-wastes based on a baseline survey. Besides, to provide the legal framework of e-waste management a firm foundation, the plan has suggested for enacting e-waste rules and regulations.

In addition to that the plan proposes some activities for e-waste management in plan.

Taking cognizance of the nature and scale of e-waste problem in the country, the plan suggests the following programs.

1. Initiating assessment / studies to understand the nature and magnitude of e-waste nationwide and developing an Action Plan accordingly.
2. Undertaking measures to implement the Action Plan.
3. Establish efficient collection system for selected electronic waste.

In line with that E-waste Management Rules (Draft) 2011 and Hazardous Waste Management Policy of Bangladesh (Draft) 2009 is under formulation. These laws have some clause regarding e-waste management but the laws are yet to be passed in the Parliament.

So it appears that the Sixth Five Year Plan, which is running now, gives emphasis and suggests some guidelines and measures for tackling the e-waste problems in the country.

#### **5.3.1.3. Basel convention:**

The Basel Convention provides embargo on trans-boundary movement of hazardous waste. It has been found that the embargo is given considering hazards of e-waste on human health and environment. The People's Republic of Bangladesh is a signatory to Basel convention and also has accessed to this Convention on April 01, 1993. The Convention asks the signatory countries to take measures on hazardous waste management.

So it is evident that Bangladesh is committed to international community for taking measures on e-waste management within its boundary.

#### **5.3.1.4. The National Environment Policy, 1992:**

The National Environment Policy (NEP), 1992 has set the policy framework for environmental action in combination with a set of sector-wise guidelines. The Policy embraces a number of related different sectors including ecological balance and overall development. It does so by protecting and improving the environment through protecting the country against natural disasters and identifying and regulating activities which pollute and degrade the environment.

The central theme of the policy is to ensure the protection and improvement of the environment. It also gave the direction of amending the existing laws, formulating the new laws and implementing the same. It also assigned the Ministry of Environment and Forests to coordinate the implementation of the policy and to constitute a high level National Environmental Committee (NEC) with the head of the government as the chairperson exercising the direction, supervision, and overseeing the implementation of the policy.

However, it is learnt from DoE that it has revised the Environment Policy'92 to make it updated and compatible with the current national and international situation. The Policy covers the environmental issues in a whole package. It does not give emphasis on any issues of the environment separately. Likewise, regarding e-waste the Policy does not suggest any guidelines or measures for e-waste management.

#### **5.3.1.5. Environment Conservation Act 1995 (Revision up to 2012):**

The Environment Conservation Act 1995 (ECA 1995) is currently the main act governing environmental protection in Bangladesh. The Act was designed to preserve the environment through improving environmental standards and controlling and mitigating environmental pollution. The major objectives of ECA'95 are: conservation of the natural environment and improvement of environmental standards, and control and mitigation of environmental pollution. The strategies of the act focus on promulgation of standard limit for discharging and emitting waste and hazardous waste import, transportation, storage etc.

Environment Conservation Act (ECA), 1995, authorized the DoE to undertake any activity necessary to conserve and enhance the quality of the environment and to control, prevent and mitigate pollution. The DoE was also mandated to give clearance on environmental issues for any new project.

The Act was subsequently amended 2000, 2002, and 2012. The amendments introduced definition like hazardous waste, restriction on carrying, transporting and importing hazardous waste in the Act. As said by the Act in its regulation number 20, the government can enact rules for the control of environment pollution. Subsequently, circulars and notifications were issued for implementing the Act.

However, some shortcomings of the Act, circulars and notifications have been observed during the study. Particularly, the Act failed to suggest any monitoring mechanism for the enforcement of its provisions (MOE&F, 2006:24).

#### **5.3.1.6. Environmental Conservation Rules 1997:**

The Environmental Conservation Rules (ECR) 1997 set by the government of Bangladesh for the protection of environment. ECR has the mandate for all industries to carry out Environmental Impact Assessment (EIA). The Rules instructs all industries to install waste/pollutant treatment plants for controlling environment pollution. In addition to that

all industries will conform to environmental quality standards, report accidents or unforeseen discharge of pollutants and take remedial measures under ECR (MOEF, 2006:24). Environment Conservation Rules of 1997, divided industries and projects into different categories depending upon the pollution load and likely impact on the environment. ECR gives mandate to DoE to issue 'No Objection Certificates' (NOC) to those e-waste management companies that conform to mandated ECR standard.

However, it has been found that no rules found in ECR to deal particularly with e-waste issue in Bangladesh.

#### **5.3.1.7. The Environment Court Act, 2000:**

The Environment Court Act (ECA), 2000 was subsequently amended in 2002. The Act provides frameworks for setting up one or more environmental courts with clear and specific terms of reference to deal with environmental offences (MOEF, 2006:25). Initially, in every division of the country a court will be established.

#### **5.3.1.8. Ozone Depleting Substance (Control) Rules 2004 (Amendment 2014):**

Ozone Depleting Substance (Control) Rules 2004 have been prepared under the Environmental Conservation Act 1995. Ozone depleting substances are prohibited to use under the schedule (1) column (2) of this rule. In addition to that according to regulation 4 of sub section 2 of the Rules, anybody could not produce, import, and export ozone depleting substance.

#### **5.3.1.9. Ship breaking and Hazardous Waste Management Rules, 2011:**

The rules have been formulated under Environmental Conservation Act 1995. In the rules described the process of hazardous waste safe management. It includes waste which is by nature physically reactive, toxic, flammable, explosive and corrosive or other waste properties that can damage health and environment.

#### **5.3.1.10. Medical Waste Management Rules, 2008:**

The rule is prepared under the environmental conservation act 1995. The rules described important definition; formation of authority and responsibility; license issue and cancelation; responsibility of registered vendors; segregation, packaging, transportation and hoarding; elimination and purification; classification waste for medical waste management. The rules address waste management issues mainly in the context of medical wastes.

#### **5.3.1.11. Clean Development Mechanism (CDM):**

Under the Kyoto Protocol, CDM is a mechanism that allows developed countries to achieve part of their greenhouse gas emissions reduction obligations through investment in projects in developing countries that reduce greenhouse gas, fix, or sequester carbondioxide from the atmosphere(Waste Concern Consultants, 2010). The strategy is promoting pro-poor through CDM projects on waste sector by harnessing carbon financing (ESDO, 2012).

#### **5.3.1.12. Lead Acid Battery Recycling and Management Rules, 2006:**

The rules have improved the collection and recycling lead acid battery (Waste Concern Consultants, 2010).

#### **5.3.1.13. National 3R Strategy for Waste Management, 2009:**

The solid waste management rules based on the 3R principle as well as hazardous waste management rule. 3R means reducing waste, reusing and recycling resources and products. The strategy clarifies the concepts of reducing, reusing and recycling. Reducing refers to choosing to use items with care to reduce the amount of waste generated. Reusing involves the repeated use of items or parts of items which still have usable aspects. Recycling means the use of waste itself as resources.

The Strategy facilitates four manuals on four different types of wastes: solid waste, bio-medical waste, industrial waste and agricultural waste. It does not address e-wastes, as a separate category of waste.

However, the recycling of e-waste is required to be regulated due to presence of hazardous constituents in the components of waste electrical and electronic assemblies. Governments should encourage e-waste recycling under public-private partnership mode, cleaner production and eco-design practice and environmental product labeling, etc.

#### **5.3.1.14. National Environmental Management Action Plan (NEMAP), 1992:**

National Environmental Management Action Plan (NEMAP) is an environmental planning exercise undertaken by the government through MOEF. In companion with NEP the Plan was carried out in three phases between 1992 and 1994.

During the first phase undergoing rapid environmental degradation was identified. The second phase saw prioritization of sectoral issues. Finally, the third phase witnessed elaborate public consultation exercise with assistance from NGO personnel, academicians, lawyers, journalists and other professionals. This exercise was intended to reflect people's concerns and priorities in the plan as well as raising public awareness about environmental issues (M.M. Khan, 2009).

However, e-waste issue was not addressed in it.

#### **5.3.1.15. Summary:**

Bangladesh has international commitment to take measures on e-waste management in terms of movement of hazardous wastes. But in the whole framework that categorically focuses on the environmental aspect of the country, it is found that only the Seventh Five Year Plan has provided some suggestions and measures and programs for e-waste management. The Plan suggests rules and regulations that will particularly look after the e-waste issues. Besides, it proposes some programs for e-waste management.

In addition to that National ICT Policy has addressed e-waste problem in a trivial manner. Other than these two policy instruments, the whole policy framework on environment lacks focus on the issue of e-waste in the country.

### **5.3.2. Relevant Laws Influencing E-Waste Generation and Management:**

In the following the policy instruments, that take on shoulder some issues of environment while working on its key area, are discussed below.

#### **5.3.2.1. National Information and Communication Technology (ICT) Policy 2015:**

The objective of the National ICT policy defines in the section D 9 that steps will be taken for the reduction of risk on climate change. By the innovation of environmental friendly green technology initiatives will also be taken for safe e-waste management, climate and disaster management.

In addition to that the policy in section E defines strategic themes. The section describes the five strategies for environment, climate and disaster management. Of this provision under sub-section E 9 clearly mentions about safe management of electronic waste. Action plan of this policy includes that industry ministry will establish a plant for reuse of extract metal from refurbish PC device and other ICT gadgets.

#### **5.3.2.2. National Information and Communication Technology Act, 2006 (Amendment up to 2013):**

Objectives of the National ICT Act 2006 that the relevancy to management of discarded ICT equipment or none of the clause regarding e-waste management has found in the Act.

#### **5.3.2.3. Import policy Order 2015-2018:**

In the *Kha* part of the policy describes list of import prohibited goods. Paragraph number (5) defines prohibition of import goods like recondition office equipment, photocopier, type writer machine, telex, phone, fax, old computer, and refurbished computer and electronics accessories.

It means that Bangladesh has banned import of all sorts of e-waste in the Import Policy Order.

#### **5.3.2.4. Export Policy 2015-2018:**

The policy has influence information and communication technology sector by providing various facilities to the citizens. The section 5.9 of this policy defines opportunities of ICT business.

No restriction has imposed to export refurbished goods including e-devices.

#### **5.3.2.5. Land Use Policy:**

The National Land Use Policy 2001 of the Ministry of Land focused on the necessity, the importance and modalities of land zoning for integrated planning and management of land resources of the country. Many other policies, strategies, plans of the government have also recommended for land zoning since long. The National Land use Policy 2001 also mentioned the need of formulating a Zoning Law and Village Improvement Act for materializing the identified land zoning area.

Provision of 3(Ka) of Non Agriculture *Khash* Land Management and Allocation Guideline 1995 has a provision that requiring body can purchase *khash* land from government to fulfill their objectives.

In this context a KI uttered that as e-waste is part of hazardous waste so establishing recycling center and dumping of its residue in specific location otherwise pollution will spread to the environment. Therefore identified location is required in every district for e-waste management and that should be a provision in the Non Agricultural *Khash* Land Management and Allocation Guidelines.

#### **5.3.2.6. National Science and Technology Policy-2011:**

The preamble of the National Science and Technology Policy paragraph number 1.4 highlighted that science and technology as an instrument of change can play a decisive and pivotal role in achieving the national goals on poverty reduction and ensuring sustainable development through value addition to resources, creation of jobs, reducing environmental pollution, control and mitigation of natural hazards, increasing production and improving life style of people belonging to different strata of the population.

One of the mission of this policy is to encourage research on green technology to harness natural resources; ecosystem which acts as a carbon sink and a buffer against climate change; information and communications technology, biotechnology, nanotechnology etc.

#### **5.3.2.7. National Industry Policy 2016:**

Chapter 14 of National Industry Policy 2016 highlighted environment friendly Industry management. The policy stated that Government will provide all sorts of co-operation and incentives to the local and foreign entrepreneur for managing and processing industry waste. Besides, industry entrepreneur has to be influenced to follow 3R (Reduce, Reuse and Recycle) strategy for waste management.

#### **5.3.2.8. National Renewable Energy Policy, 2008:**

This policy focuses on promoting production of biogas and other green energy from waste and also providing incentives for Clean Development Mechanism to encourage green energy projects.

#### **5.3.2.9. National Urban Policy 2006:**

The policy has given emphasis on following CDM and Recycling

#### **5.3.2.10. Income Tax Ordinance 1984:**

By providing tax rebate to the citizens, the ordinance encourages citizens for using new computer and its accessories that has defined in the sixth schedule, part B, paragraph 23 of this ordinance.

#### **5.3.2.11. Bangladesh Atomic Energy Regulatory Act 2012:**

Management and transportation of atomic waste define in the chapter 5, section 38.

#### **5.3.2.12. Telecommunication Act 2001 (Amendment, 2010):**

This Act focused on controlling of radiation

#### **5.3.2.13. Summary:**

The legal instruments having some stake on environmental issues, most of them do not specifically address the issue of e-waste, with few exceptions. National Information and Communication Technology (ICT) Policy 2015 has promoted the issue of safe e-waste management through green initiatives. By the innovation of environmental friendly green technology initiatives will also be taken for safe e-waste management, climate and disaster management.

Besides, Import policy Order 2015-2018 puts an embargo on importing all kinds of e-waste. In addition to that National Export Policy does not any embargo on exporting refurbished goods including e-devices.

However, some very important policy instruments those have significant bearing on the e-waste for the instrument's area of interest, do not address the issues of e-waste categorically. Some of them are Land Use Policy, National Urban Policy 2006, National Science and Technology Policy-2011, etc.

### **5.3.3 Findings:**

It is evident that Bangladesh has commitment to international community for adopting measuring against e-wastes within its boundary. DoE formulated draft policies like National Environmental Policy (Draft) 2015, E-waste Management Rules (Draft) 2011, and Hazardous Waste Management Policy of Bangladesh (Draft) 2009. These laws have some clause regarding e-waste management but the laws are yet passed. These to be key instruments of e-waste management are under consideration of Ministry of Laws and Parliament Affairs, according the attest information during the study.

Bangladesh has no specific Environmental Policy, Act, Rules or Guidelines on e-waste management. There is no specific definition of e-waste mentioning in the National Environment Conservation Act 1995 and Environment Conservation Rules 1997. But a number of existing policies have found that focused on safe e-waste management.

### **5.3.4. Gaps of current legislation and policy**

The study has covered all acts, rues, policies and guideline that broadly cover environmental issues in Bangladesh. Besides, other policy instruments those have some engagement with environmental issues have studied. After studying the legal framework on environment some gaps have been identified in it. These are presented below.

- 1) There is no legal permission in the rules of Bangladesh to trade off e-waste and its disposal and management. Bangladesh is a signatory to the Basel Convention prohibiting trans-boundary movement of hazardous waste. Import of any kind of waste requires government permission.
- 2) By and large, the policy framework does not comprehensively involve any instrument in regards with e-waste. This issue nominally gets a cove in the country's ICT policy through just being mentioned as an action item in the policy.
- 3) There are some provisions and mandatory rules to build a waste management system within the industry sectors. However, e-waste does not require any compliance under the Act or Rules. The government is now preparing a solid waste management policy which may cover e-waste. At the same time, the Medical Waste Management Rules, 2008, address waste management issues for the medical sector, including e-waste.

### **THIRD PART (PURE EMPIRICAL)**

#### **CITIZENS' AWARENESS ON E-WASTE MANAGEMENT**

This part has discussed primary research. It tries to present empirical data of the study. In the analytical framework citizens' awareness is the independent variable. It aims to analyze the empirical data in line with the analytical framework with the following research question which was raised in this study

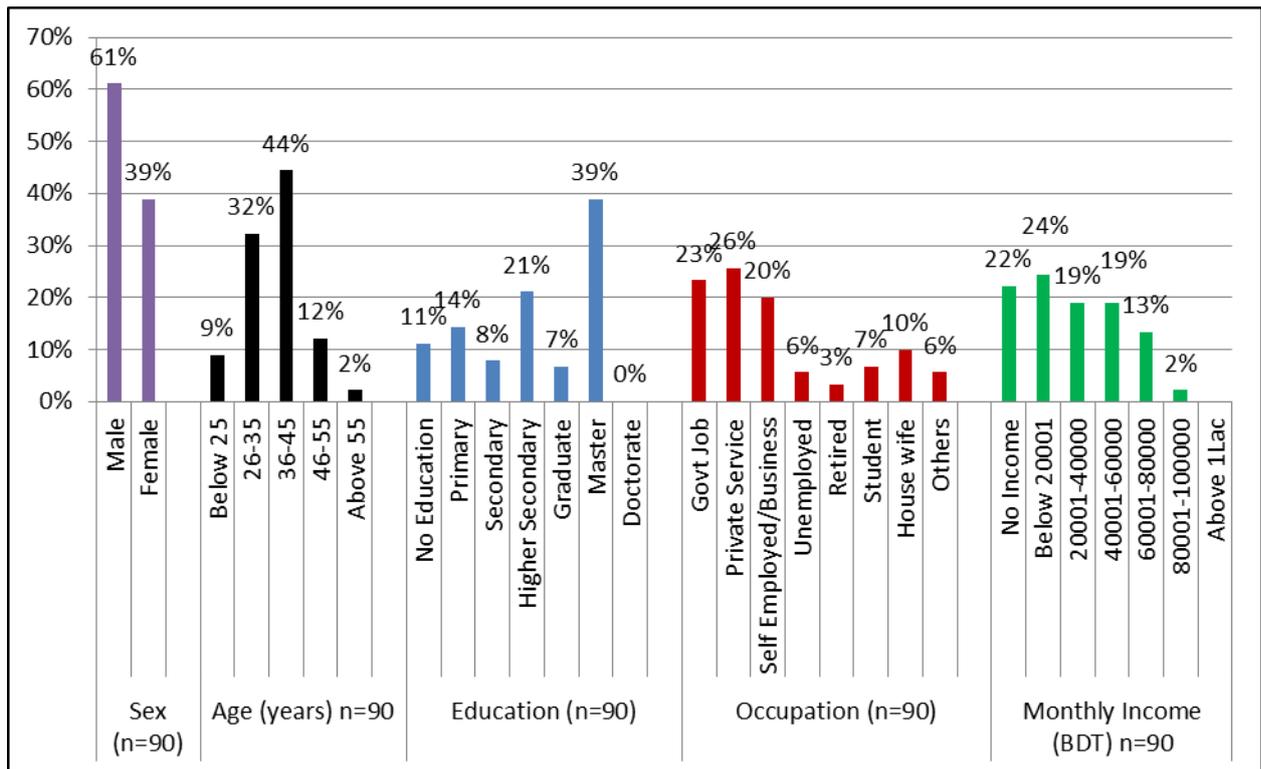
- What is the level of awareness of the people on e-waste management?

##### **5.4.1. Demographic Profile:**

Figure 5.1. illustrates the demographic profile of the respondents. As per as gender is concerned the larger percentage of respondents (61%) is male. Where age is concerned the majority of respondents (44%) belong to the middle age group of 36 to 45 years. The occupational trends of the respondents was observed as follow: 26% serve in the private sector, 23% in the govt. sector, 20% in the in self-employed/ business ,while respondents in unemployed made up 6%; 7% were students and 10% and 6% were housewives and others, respectively.

With regards to the income status (BDT per month) of the respondents, highest percentage of the respondents (24%) earned below 20000 BDT. This is followed by 22% respondents having no income. Both of the income ranges between BDT 20001 and 40000; and BDT 40001 to 60000 occupied 19% respondents. 13% have income between 60001 to 80000 and only 2% have income between BDT 80001 to 100000.

Regarding educational attainment of the respondents 39% of them were master degree holder, 7% are graduates and 21% obtained HSC degree. Primary and secondary education was received by 14% and 8% of the respondents. However, 11% percent of the respondents have no education. So it can be inferred that the study has tried to cover all the tiers of socio-demographic variables like gender, age, education, occupational trend and income status.



**Figure 5.1.: Demographic profile of respondents**

**Summary:** The overall of the picture of demographic profile shows that the study covers all the key demographic variables: gender, age, educational attainment, occupational status and income. Most of the respondents (61%) are male. 67% of the respondents belong to the age between 26 to 45 years. 42% of the respondents are highly educated (graduate and master). 59% respondents are employed. 62% respondents are low to middle income people (below 20000 to 60000). The distribution pattern of the respondents reflects that most of the respondents are likely to be intellectually matured. They are expected to be aware and concerned on different technical issues. So it is hoped that they will provide insightful inputs for the study.

#### 5.4.2. Usage of electronic gadgets:

##### 5.4.2.1. Ownership of selected electronic gadgets:

Four electronic devices have been chosen namely desktop PC, laptop PC, cell phone and television for knowing ownership pattern of the electronic gadgets of the respondents. It has been observed that these four electronic gadgets are most widely used in Bangladesh. Hence, these for electronic devices are likely to comprise the biggest bulk of e-waste in the

country. Figure 5.2 depicts information regarding the possession of selected electronic gadgets among the respondents. Cell Phone ownership is found to the highest number of the respondents. This is followed by the television ownership, which followed by the desktop ownership. Laptop owner is found to the least. Possession rates are cell phone 97%, television 84%, desktop 46% and laptop 46%. Among the respondents 22% poses all the four gadgets taken into account in the study.

The following bar chart shows that most (92%) of the respondents possessed cell phone than other electronic equipment. Taken into the population size of the country from the data it can be assumed that a huge number of mobiles phones are used by citizens are country. Furthermore, observation shows that these cell phone sets are cheap and low in quality. Summing up, it can be inferred that a huge number of cell phones are dumped which are accumulated with the bulk of e-wastes.

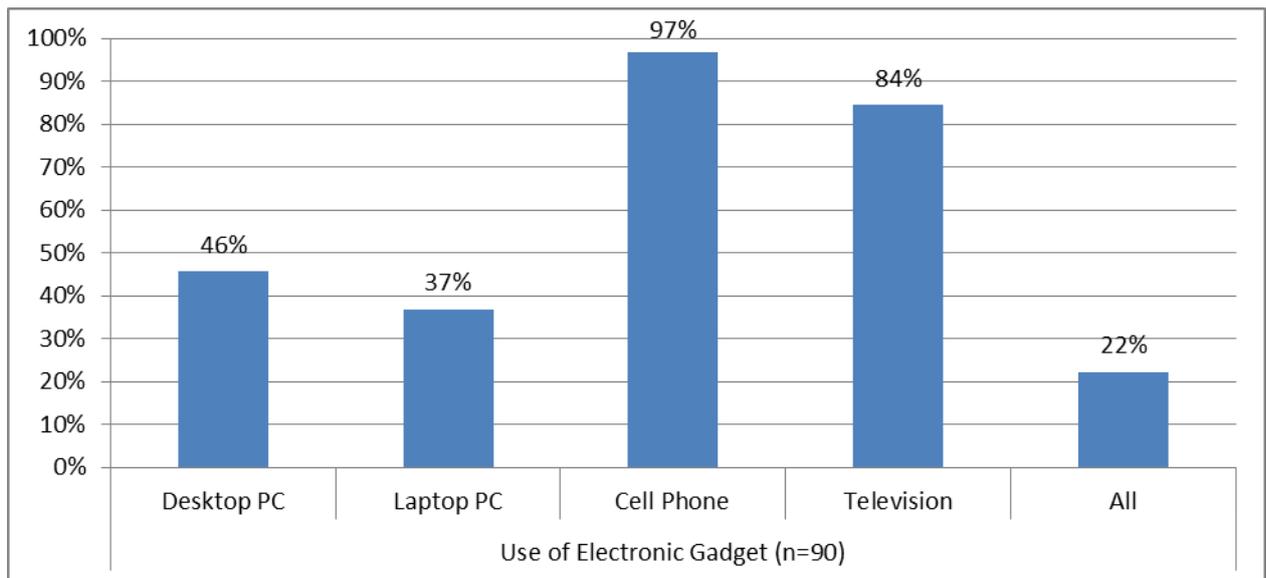


Figure 5.2: Possession of selected electronic gadget used by respondents

#### 5.4.2.2. Average number of obsolete selected electronic device for the last ten years:

Figure 5.3 represents the average number of obsolete selected electronic device for the last ten years. For last ten years, the average number of obsolete cell phone, television, desktop and laptop per user was 3.12, 1.64, 1.55, and 1.19 respectively. Number of cell phone damaged is higher than any other equipment. The obsolete devices are likely to be disposed to environment today or tomorrow.

So, it may indicate that among the e-wastes of the four electronic devices cell phone contributes much more than others. This finding may refer back the finding of the ownership of electronic gadgets (Figure- 5.2). Figure- 5.2 shows that the use of the cell phones is very high (97%). This finding can be related with Figure- 5.3 where it shows that cell phones are the highest number of damaged gadgets. It is observed that most of the cell phone sets in Bangladesh are cheap and low in quality. So they contribute very highly in e-waste bulk here.

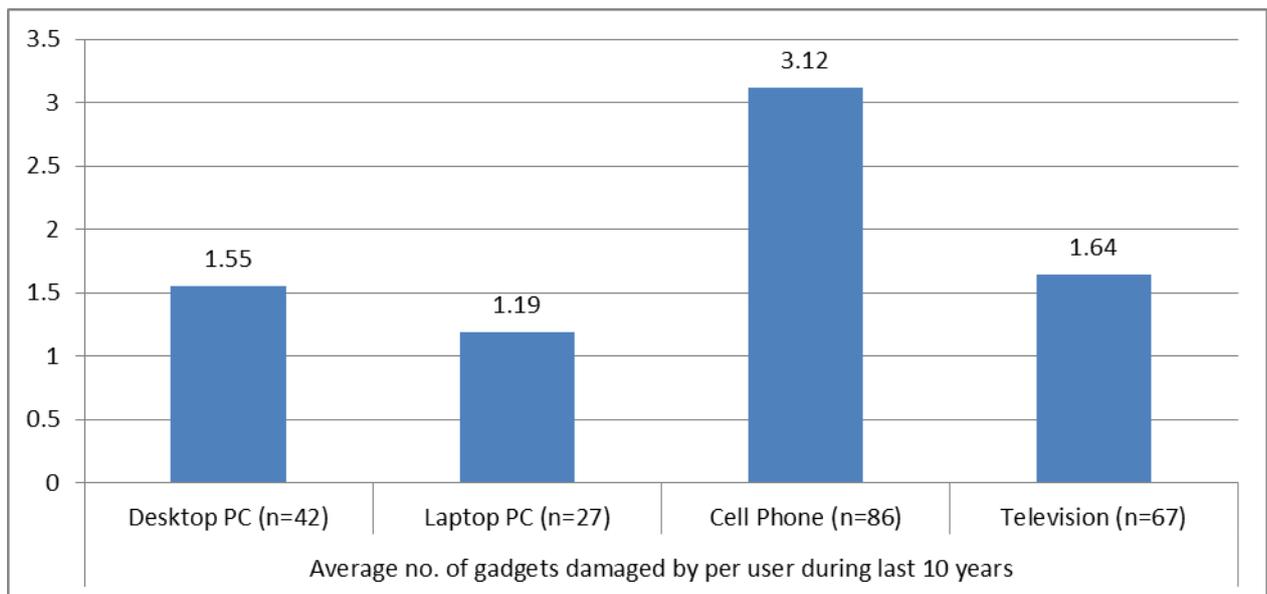


Figure 5.3: Number of obsolete selected electronic device per user for the last ten years

#### 5.4.2.3. Average life time of used electronic gadgets

Figure 5.4 shows the average life time of used Desktop PC, Laptop PC, Cell Phone and Television. Among the respondents of Desktop PC, 23% of them articulated that life time of desktop pc between 2-4 years which is the highest number of response. The majority number of respondents expressed that the lifespan of laptop PC between 2-4 years; the lifespan of cell phone below 2 years; and the lifespan of television between 8-10 years. So it is revealed that most of the respondents change e-devices after 2 to 4 years of use, except television. For television the maximum number of respondents (28%) said average life span of television is 8 to 10 years. So it is clear that a significant number of the respondents frequently change their cell phone sets. It can be concluded that the largest share of e-

waste is comprised with the cell phone. However, this conclusion can be further tested with the findings from what happens to the unused or obsolete e-devices. This is discussed in the later part of the study.

Findings from the Figure- 5.4 indicate that among all the four electronic gadgets cell phones of a significant number of the respondents (58%) have life span below 2 years. This finding fits the findings and assumptions in the previous figures [Figure-5.2 and Figure-5.3] that a high number of cell phone sets are used in Bangladesh. Most of them are low in quality.

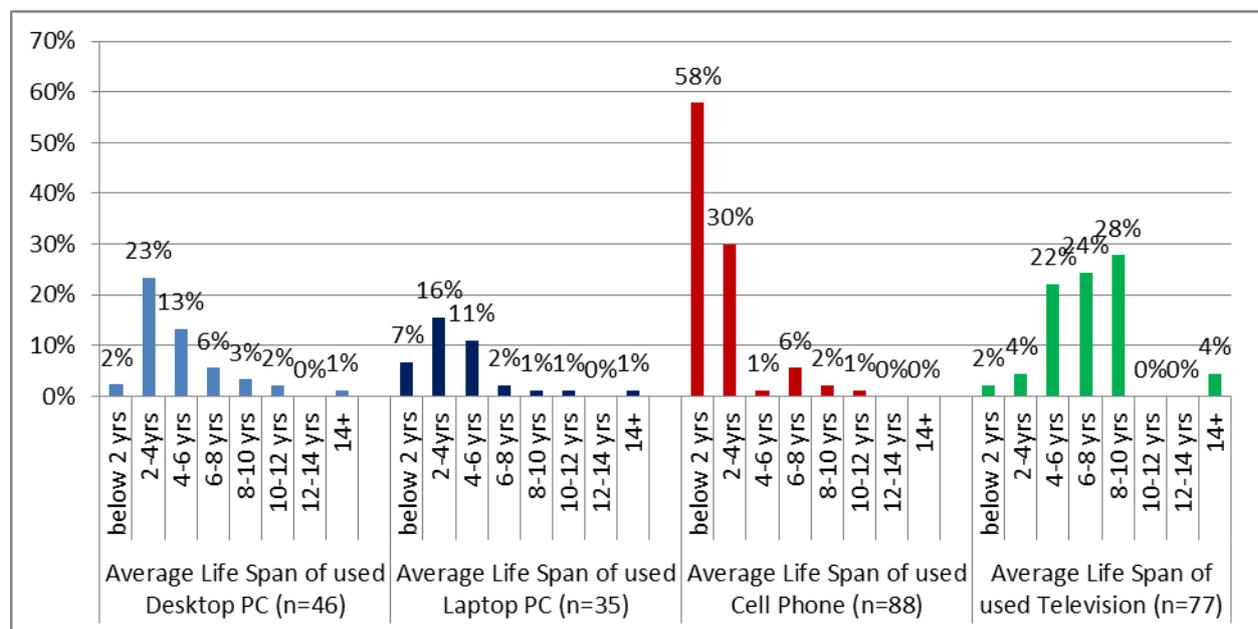


Figure 5.4: Average life time of used electronic gadgets

**Summary:** So overall it can be inferred that cell phones contributes much more than any other electronic devices in the e-waste bulk. Most of the cell phone sets have low life span. It can be translated that a high number of low quality and cheap cell phone sets are used in the country. On the other hand, frequency of using cell phone sets among the respondents is very high. Most (92%) of the respondents possessed cell phone sets. Summing up, the largest bulk of the e-wastes is comprised of discarded low quality and cheap mobile phone sets.

### **5.4.3. Citizens' awareness on e-waste:**

#### **5.4.3.1. Knowledge & Attitude:**

To know whether the respondents are aware of e-waste and its impacts on health and environment they were asked series of questions. Figure 5.5 shows awareness level of the respondents on knowledge and attitude.

The term e-waste refers to the discarded electronic devices openly. One of the objectives of the study is to fathom the awareness level of the respondents about e-wastes. With regards to the question whether the respondents know the term e-waste, 74% answered that they do not know about it. To further check their understanding of e-waste the respondents were asked whether, according to them, the obsolete e-gadgets become e-waste. The answer pattern matches that of the previous question. 74% responded that they do not have any idea about it. Overall, answers to these two questions indicate a very low level of awareness about the term e-waste.

Awareness on environmental hazards of the e-wastes is one of the key elements of the study. In regards to the question on awareness of environmental hazards of the e-wastes 69% percent responded that they do not have any idea on it. This reveals some interesting finding as awareness level about hazards of e-wastes is a bit higher than that of concept of e-waste (69% to 74%). This indicates that respondents are more informed about environmental hazards of e-waste though some of them do not have understanding about the term e-waste itself.

Recycling of the e-wastes is a key element of e-waste management practiced globally. In this context awareness on recycling is included as an important aspect of the study. The respondents were asked about recycling of e-wastes. 64% responded that they have no idea about recycling of parts of obsolete e-gadgets. It is evident that awareness level on recycling is higher than that of the term e-waste (64% to 74%). In response to the question whether they now parts of e-waste need a special treatment in order to be safely disposed, 80 % of the respondents do not know about it. So, awareness level on special care of the obsolete wastes appears to be the least than other aspects of e-waste.

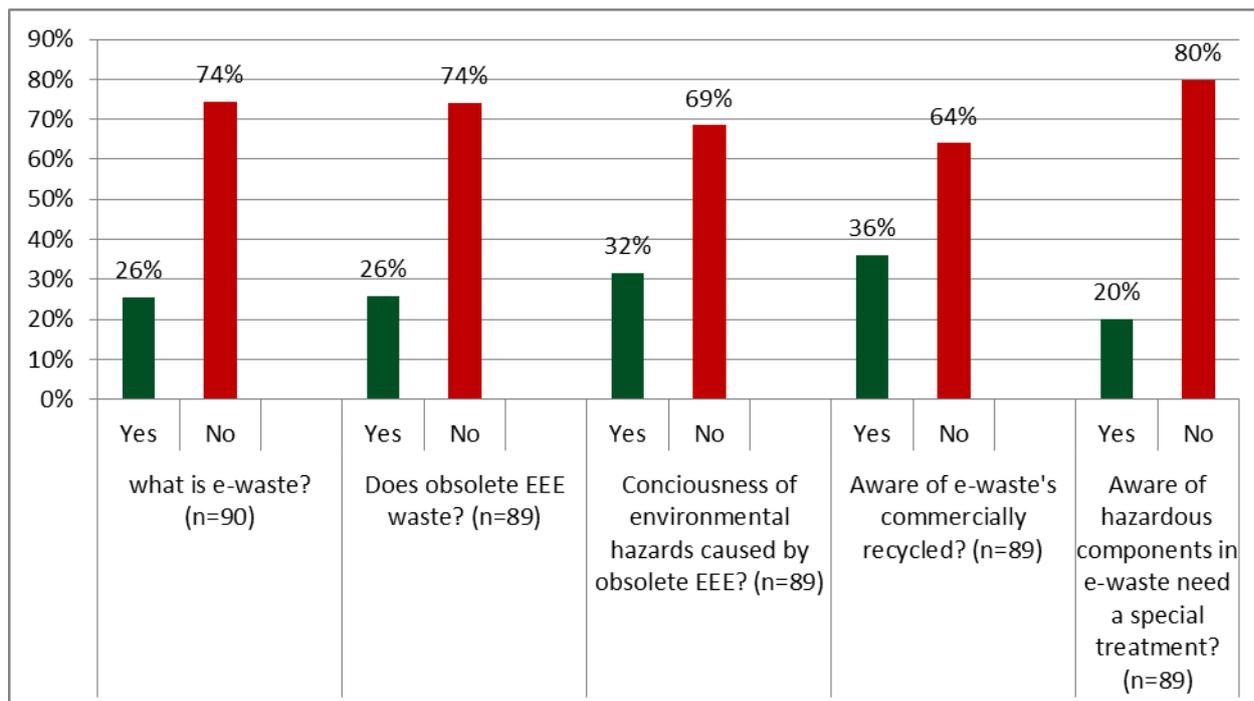


Figure 5.5: Citizens' knowledge & attitude on e-waste

**Summary:** So, regarding knowledge and attitudes of the respondents on e-waste, the respondents appear to be less informed about e-waste as a concept but they are more informed about different aspects of e-waste like, recycling or environmental hazards of e-waste. However, awareness on special care of the obsolete e-gadget that is to be taken by individual user of the gadget appears least

#### 5.4.3.2. Awareness regarding health and environmental issues:

Regarding awareness on health and environmental hazards of e-waste low awareness is observed among the respondents. Figure 5.6 describes the sources of receiving information of e-waste. It shows that 67% of the respondents are not aware of this issue. This data reflects a poor level of awareness on environmental and health hazards of e-wastes.

However, among those who are informed about health and environmental hazards (33% respondents), newspaper and internet worked as the biggest source of information for them. 37% of the aware respondents get information from newspapers and 33% from internet. So newspapers and internet based social media can be used to increase awareness of health and environmental hazards of e-waste among the masses. Other sources of information are peers (10%), TV (7%), radio (3%), books and journals (3%) and other (7%).

However, studying the demographic characteristics of the aware group of respondents finds that most of them have higher education background. So it can be inferred that education may have contributed to developing awareness on environmental and health hazards of e-wastes.

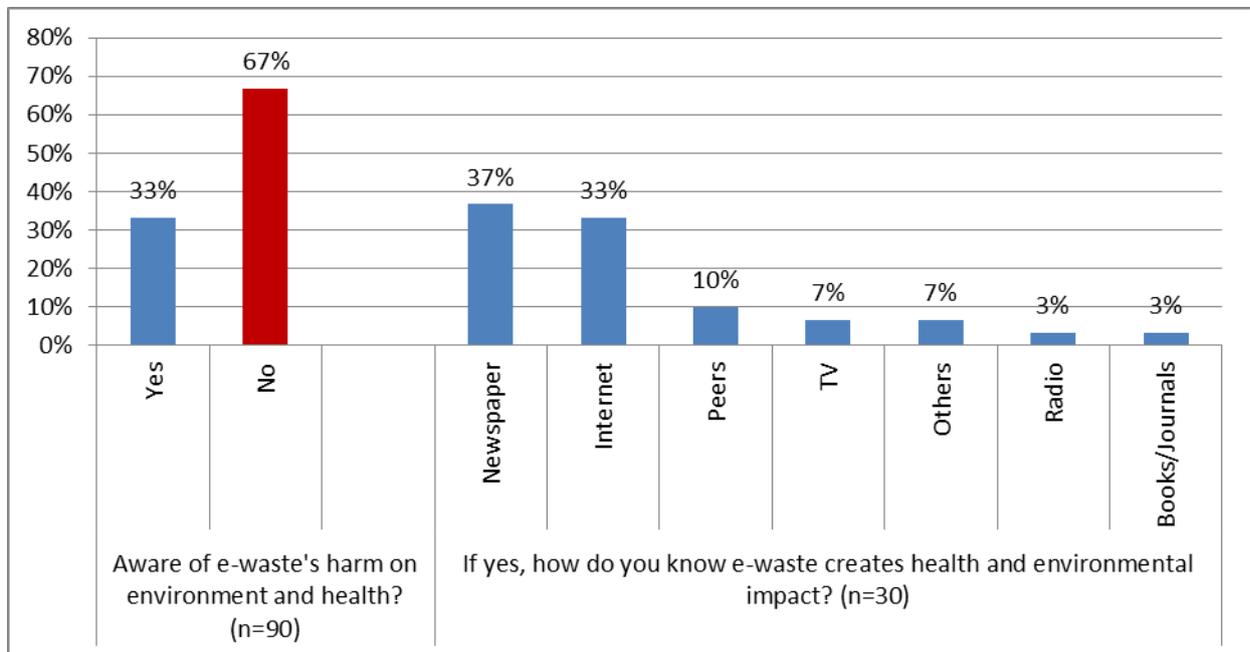


Figure 5.6: Source of e-waste information

In the following question awareness on hazards issues of e-wastes are further investigated. The objective of these questions is to know about their awareness on toxic elements in e-devices. Fig 5.7 presents the awareness level of the respondents about the harmful effect of e-waste. It shows that a low awareness level is observed in the matter. Only 69% percent respondents do not know about prevalence of toxic materials in the e-wastes. So it is likely that these respondents are likely to get exposed by the toxic substances inside the e-devices. At the same time, they may damage the environment through discarding these materials in a way that is unfriendly to environment. Examples of such behavior include braking, incinerating the device etc.

Furthermore, those who know (31%) a part of them (32%) does not know that these toxic materials need a prior and proper treatment for environmentally sound disposal. However, those who know all of them have higher education background.

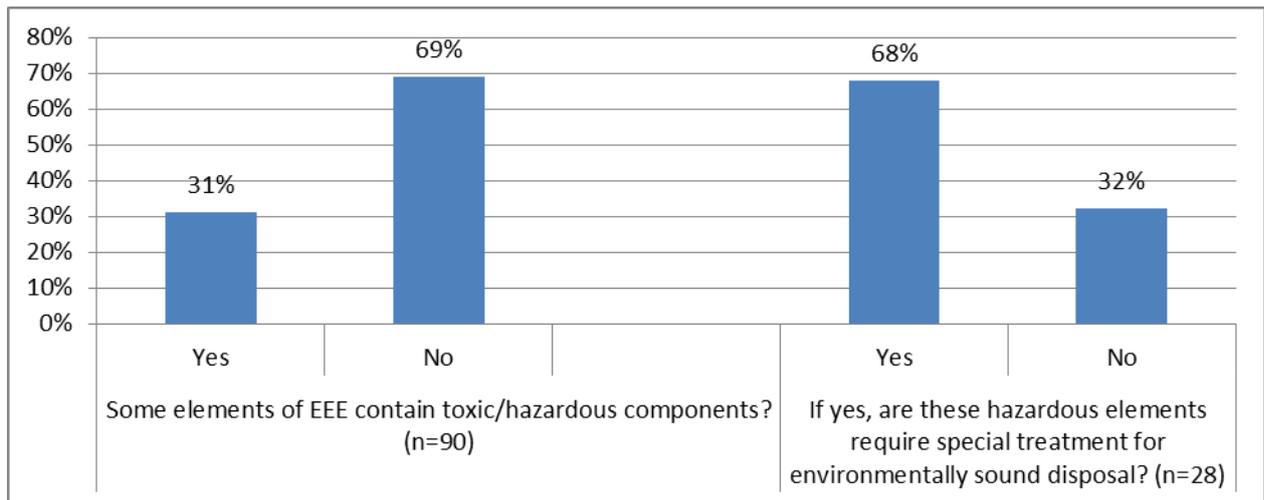


Figure 5.7: Awareness of e-waste harm

Those who answered yes were asked about which area(s) of the environment is affected by the disposal or treatment process of electronic wastes. The objective of this set of battery of questions is to fathom the depth of awareness of the aware respondents of the study. This is a closed ended question and perception related to four areas of environment like, land, air, water and vegetation is studied here.

Fig 5.8 presents the perception of the respondents about the impact of e-waste on environment. It is found that 64% respondents do not know that disposal/treatment method use for electronic waste have any impact on the environment. Lack of knowledge may contribute in shaping their attitude towards unused e-devices. Such attitudes may be harmful for the environment and health.

Regarding the extent of effect on the four areas of the environment the respondents observed that that the four areas (land, air, water and vegetation) are almost equally affected by the waste disposal or treatment method. However, the highest percentage of respondents (75%) said air is affected by disposal or treatment of e-waste. One of the possible means of causing air pollution is incinerating the e-devices. Incineration of the devices release huge toxic gas to the environment. However, the rest of the respondents (25%) think air is not affected by e-wastes.

Air is followed by land and water as the affected area of the-devices. Equal percentage of the respondents (72%) expressed their opinions for these two areas of the environment. So 28% respondents think these two areas are not affected.

Finally, 66% respondents said vegetation is affected by disposal and treatment of e-wastes and 34% said it is not.

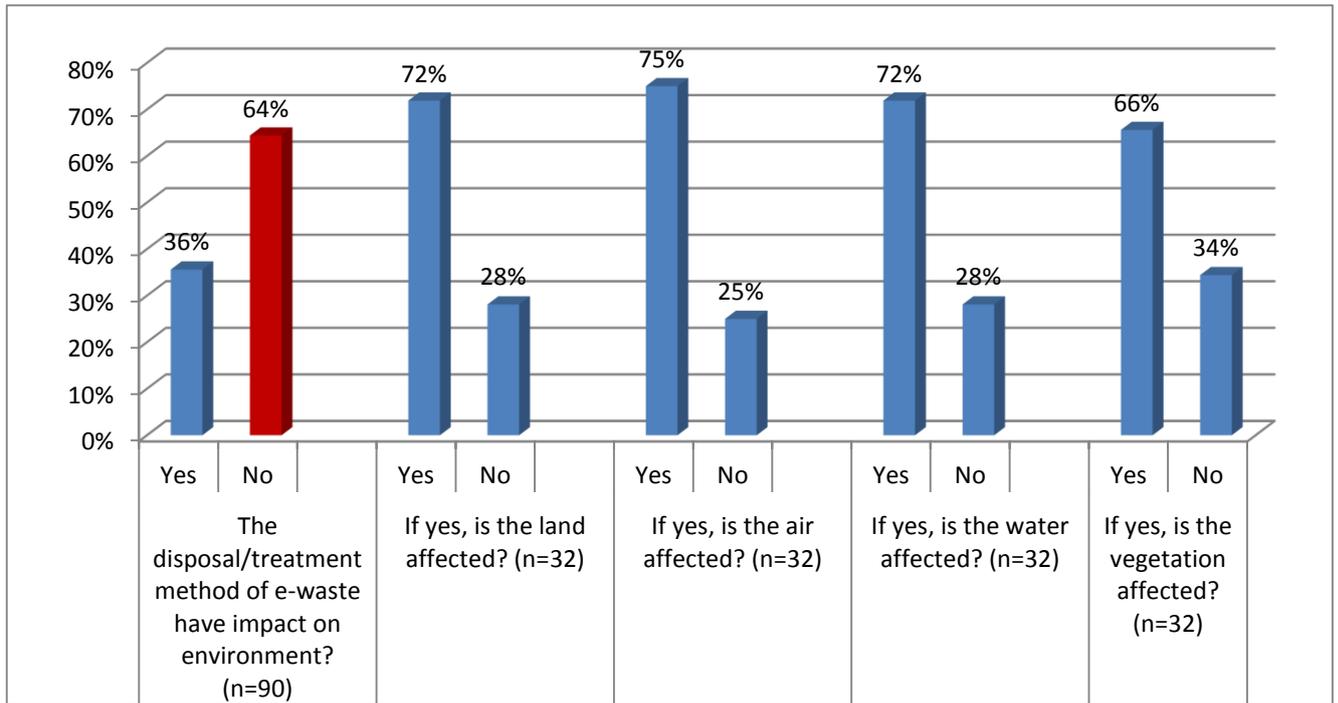


Figure 5.8: Impact of e-waste on environment

**Summary:** Awareness on environmental and health hazards of e-wastes is poor. Besides, awareness on the toxic elements and the hazards of treatment process of the electronic devices is also poor. Poor awareness among the respondents may shape their attitude towards the disposal of the e-devices, for example, incinerating the devices or breaking the device unscientifically. It has been observed that air, land, water and vegetation are almost equally affected by e-wastes. However, media appear to contribute in creating awareness among the respondents.

#### 5.4.3.3. Awareness on disposal and management:

The way personal e-devices are disposed matters significantly in producing e-wastes for the environment. Therefore, this study finds it necessary to know about how unused devices under the study are disposed after they become useless. Fig 5.9 shows what happens to the unused or obsolete electronic devices under the study. It is found that 60% of the respondents keep the device even after it becomes useless. Besides, 9% respondents give the unused devices to kid as a toy and 44% respondents throw the devices as a waste. The thrown devices are the largest source of e-waste in the environment. However, for the

devices kept to the users even after it becomes useless or given to the kids as toys, chances are there that these devices will also be thrown away as wastes one fine day.

So from the data we can guestimate the percentage of e-devices that turns into e-waste. It is calculated that 52%  $[(60\%+44\%)/2]$  of the e-devices contribute in the bulk of e-waste.

On the other hand, not-environmental-unfriendly disposal techniques are followed by some respondents. 29% responded that they use the unused devices for exchange. Furthermore, 7% respondents donate the devices to others. Thus the devices of 36% respondents (29%+7%) are saved from being e-wastes for the environment. Meanwhile, Fig- 5.4 shows that 58% respondents change their cell phones even before 2 years. Combing the findings from figure- 5.3 it can be inferred that cell phone sets comprise the largest share of e-wastes.

However study of demographical characteristics of the respondents those who discard the unused e-devices, most of them are low income people in the study. 60% of them are within the monthly income below BDT 20000.

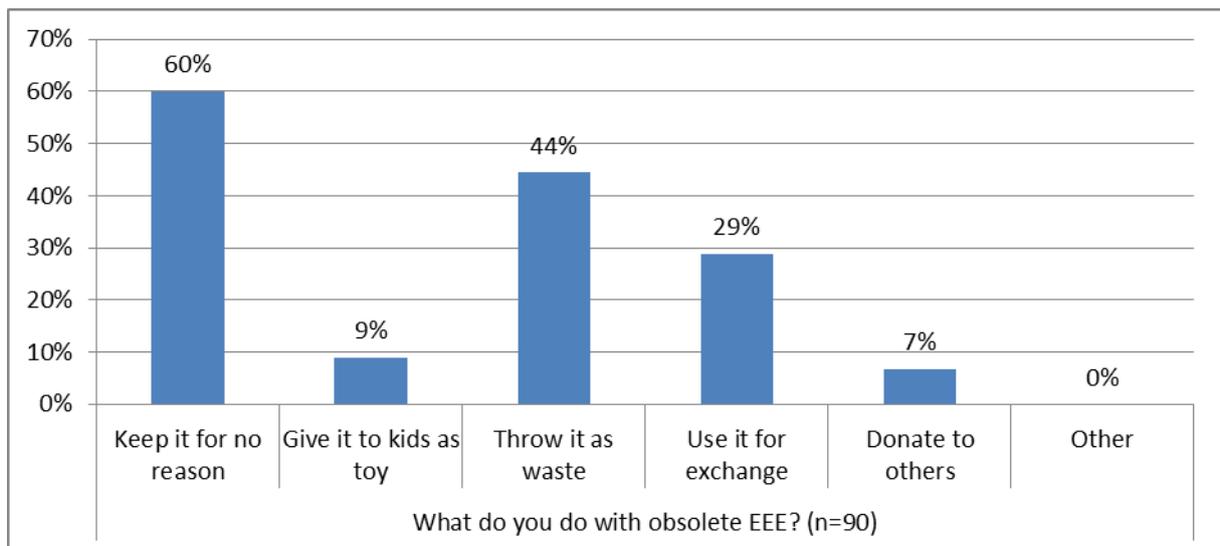


Figure 5.9: Disposal of discarded electronic equipment

In further investigation, the study delves into disposal arrangement or opportunity available for the respondents. Fig 5.10 describes discarded electronic equipment collection arrangement available for the respondents. It is found that a very poor disposal arrangement or opportunity is available to them. 79% of the respondents never encountered e-waste collectors in their locality. The rest of the respondents (21%) have

encountered different arrangements for collecting e-devices enterprise by some private bodies.

However, services provided by the public sector in this regard are almost absent. As an issue of cleanliness e-waste collection mostly goes on the shoulder of local government bodies. But 98% respondents observed no system of collecting e-wastes in their city corporations, pauroshovas or union parishads.

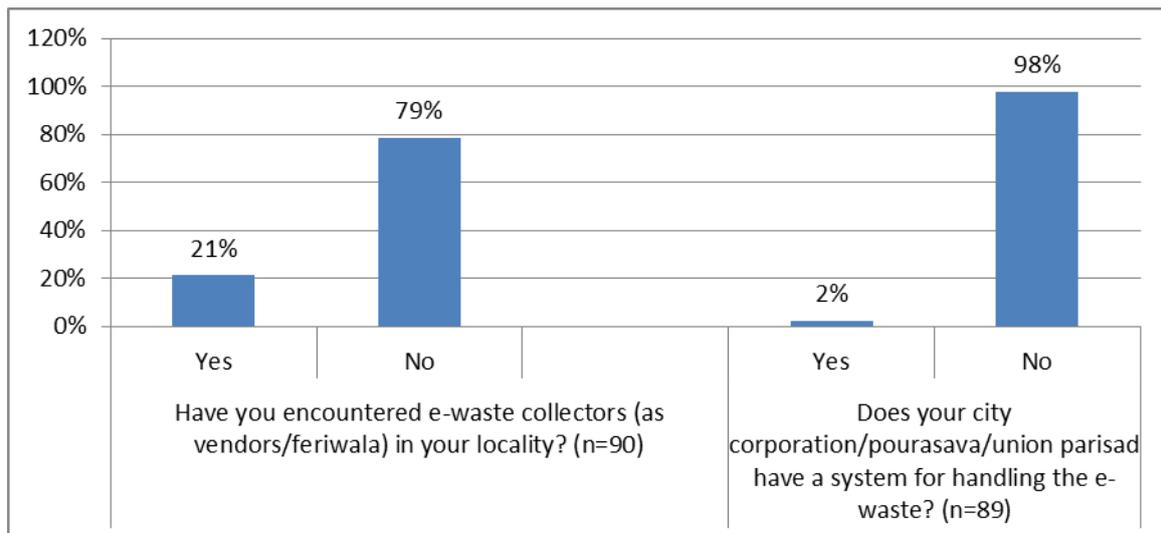


Figure 5.10: Discarded electronic equipment collection method

However, the respondents found local government bodies responsible for collecting e-waste. Fig 5.11 shows the institutions responsible for e-waste management according to the respondents. Surprisingly, a significant percentage of the respondents (39%) do not have any idea in this regard. Anyway, 42% opined that it is the responsibility of City Corporation. According to 14% of the respondents it is the responsibility of the Pourashavas. 3% of the respondents think it is the responsibility of Union Parishad. Besides, 1% percent of the respondents find that the responsibility of collecting e-wastes goes on the shoulder of cantonment board. But no one chose Zila Prishad.

It is mention worthy that City Corporation, pourashava and union parishad are the lowest tier of local government system in Bangladesh. Besides, cantonment board provides municipality services in the cantonment area. Summing up according to 60% (42%+14%+3%+1%) respondents find the lowest level of the local government responsible for collecting e-wastes. So it is evident that the lowest tier of the local government in the respective area should take the responsibility of collecting e-wastes.

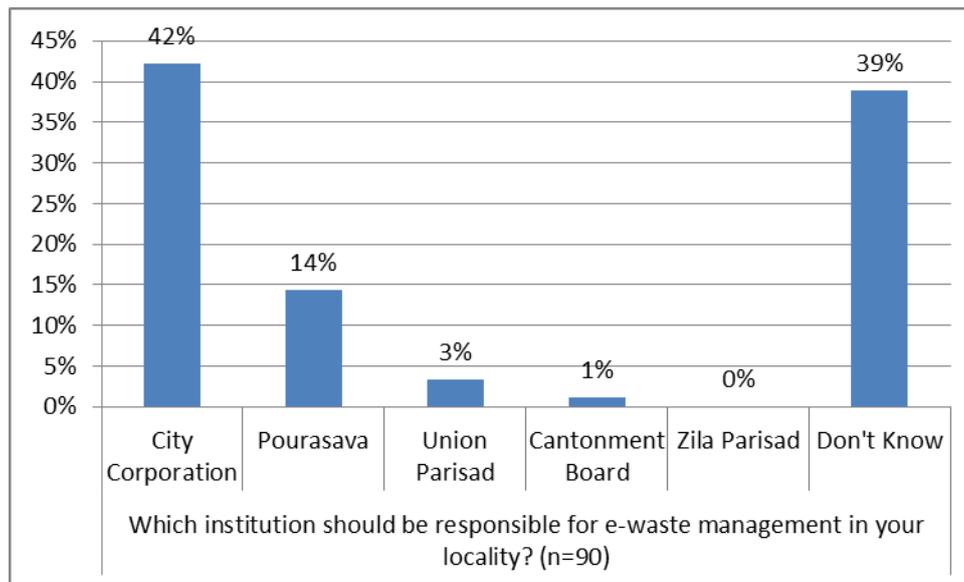


Figure 5.11: Institution of e-waste management

To go further into the issue of disposing e-wastes, the employed respondents were asked about the presence of e-waste management policy in their organizations. Only 11.3% responded that they have such arrangements.

However, the respondents were also asked about paying from themselves for e-waste management. It is found that 31.1% respondents are willing to pay for e-waste management. Though the percentage of those who are willing to pay, it is still motivating for citizens to be concerned about e-waste management. Fig 5.12 shows having policy for e-waste management in the working institution of the respondents and willingness to pay for e-waste management

**Summary:** Cell phones with low life span (below 2 years) contribute in the bulk of e-waste. It has been found that more than half of the used e-devices end up being discarded in different ways as e-wastes. However, a significant part of the devices (36%) are treated in not-environmental-unfriendly means. Regarding arrangement of collecting e-waste only 21% respondents encountered such arrangement, which is absolutely done by private initiatives. Provision of services from the public sector in this regard is almost absent. However, the respondents find that the lowest tier of local government system like city corporation, poroshava, union parishad and cantonment board should be entrusted with responsibility of collecting e-waste from door to door in proper way. On the other hand,

there is a thin existence of internal e-waste management policy in private organizations. But, small part of the respondents (31%) are interested to pay e-wastes produced personally.

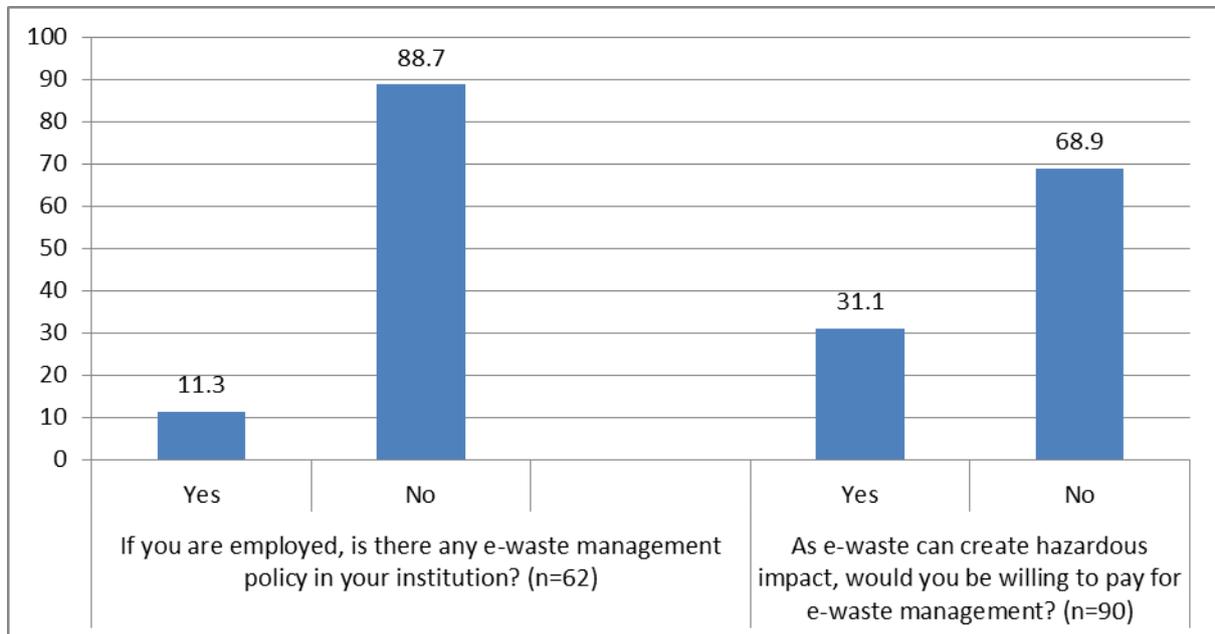


Figure 5.12: Policy and Pay for e-waste management

By and large, the respondents have very poor knowledge and attitude about e-waste and its negative impact on environment. Most of the respondents have no knowledge on e-waste, environmental and health hazards caused by e-wastes and recycling and special treatment for the discarded e-products. So it is evident that awareness on e-waste at personal level of the masses is very low.

On the other hand, arrangements of collecting e-wastes by the public institutions, like, local government bodies is very low. Besides, such arrangement by private bodies is not significant enough at all. Furthermore, private institutions do not have policies for e-waste management. So it is apparent that awareness on e-waste at personal level institutional level is very low.

It can be inferred that overall awareness level of the citizens on e-waste management is low.

Instead of bleak scenario of e-waste management, there are some bright sides which are revealed in the study. For example, a significant percentage of (36%) respondents adopt disposal practices of e-wastes those are not environment unfriendly like, using it for

exchange or donate it to others. Besides, there is awareness, in terms of willing to pay for e-waste management, among some of the respondents. From the study it can be pinpointed that a strong awareness building measurement may be helpful to growing awareness on e-waste among the citizen.

**Conclusion:** Cell phones are the biggest source of e-waste. Most of the cell phones of the respondents have low life span. But almost every respondents in the study has cell phones. But the awareness of the respondents in terms of knowledge and attitude on e-waste is not concrete. Though they may not have conceptual clarity on e-waste, they are informed about different aspects of e-waste. However, awareness on care required for unused and discarded gadgets is poor. Besides, low awareness among the respondents is observed environmental and health hazards of e-wastes. Likewise, awareness on toxic elements and hazards of treatment of the unused electronic devices are also low. Unaware citizens may behave environmental unfriendly regarding unused e-devices. Furthermore, the respondents find that air, land, water and the vegetation are equally affected by e-wastes. It is found that media can make significant role in making the citizens aware in this regard. On the other hand, arrangement for collecting obsolete devices is thinly observed by the respondents. The arrangement observed by the respondents is completely done by private organizations. Public sector is almost out of the area in this regard.

## **CHAPTER SIX**

### **CONCLUDING REMARKS**

#### **6.1. Conclusion and observation:**

Now a day's e-waste management is a major concern in developing country like Bangladesh. A high use of information and communication technology is contributing significantly in the country's economic growth. One of the weaknesses in ICT technology is that it is developing very quickly. As a result old technologies are replacing new technology regularly and rapidly. This in turn is creating a huge volume of obsolete products which are left mostly untreated and adding volumes of e-waste.

The key objective of this research is to investigate the roles of stakeholders in played in the e-waste management in Bangladesh. It'll also examine the existing policy gap and environmental management issues in terms of e-waste. In addition to that awareness of the general people about e-waste was also studied. Awareness of the people is important in e-waste management in the context that every citizen has some stake in e-waste management.

A questionnaire survey was conducted among 90 respondents. 40 respondents participated through e-mails. Besides, the researcher conducted survey by himself to the rest 50 respondents. Qualitative data collected KIIs. Scholars, professionals from government and private backgrounds NGO representatives participated in KIIs.

The dependent variable of the study is e-waste management and the independent variables are awareness of the citizens, institutional framework and preparedness and legal framework.

It has been observed that citizens have affinity to use electronic device and changing them frequently. It has also been found that low quality of e-devices is one of the main reasons for accumulating e-wastes in Bangladesh. On the other hand, statistics shows national literacy rate is not so aspiring. So, individual level of citizens' knowledge and attitude

towards e-waste is lower level. Majority of the respondents keep electronic device at home as they are unaware of its contamination of toxicity.

It is found that cell phones having life span less than 2 years are mostly responsible for increasing e-wastes in Bangladesh. The questionnaire survey also revealed that 21 % respondents have encountered arrangement for discarding e-wastes. However, these arrangements are fully organized by private bodies. However, the respondents opined that the lowest tier of local government system like City Corporation, Pauroshavas, Union Parishad and Cantonment Boards should collect e-waste from door to door in proper way.

The existence of counterfeit product in the market is alarming because of low life time. They increase the volume of e-wastes significantly. Thus electronic waste is introducing in the waste stream. Obsolete electrical and electronics equipment's contain toxic substances. These hazardous metals are harmful to human health and environment.

The research studied institutional frameworks of e-waste collection. In the national perspective, local government institutions namely City Corporations and Pauroshovas are responsible for managing waste in the urban areas and in the rural areas Union Parishad is liable for waste management. Beside these, cantonment executive board clean wastes for the civilian under cantonment areas. These local government institutions have institutional infrastructure for solid waste management. Since the inception LGIs have been collecting e-waste with domestic waste or mixed waste and dumping landfill without treatment.

However, in the countrywide all most all of the LGIs do not have e-waste collection, transport, and segregate system separately. For this reason, country is losing urban mine that could be potential source of pure base metal. If untreated, e-waste is hazardous in nature when dumped in the landfill with domestic waste it pollutes the environment. LGIs monitors, keep records and evaluates kitchen wastes collections, transportations and landfill. But for e-waste management no statistics has found in those institutions. So, information exchange platform and statistics is essential for reduction of e-waste.

Furthermore, it is found that LGIs officials do not have adequate knowledge, training and education on e-waste management. These institutions yet not develop any method of e-waste collection and disposal. As e-waste is different nature of waste so needs skilled manpower to safely manage.

Regarding recycling processes followed in Bangladesh it is found that e-waste has economic value as it contains valuable elements. These valuable elements are collected in a rudimentary process by the small business center. In some cases, they incinerate e-waste for extracting metals. The residue of e-waste dump in the landfill this creates air, water and soil pollution. In this process heavy metals may enter in food chain that causes health risk. By using informal recycling for e-waste management the residue of the e-waste also pollute the environment.

It is found in the study that most of the recycler does not have modern technology and knowledge for managing e-waste. Their main goal is extracting some metal but not properly manage e-waste. For this, real recyclers are losing business opportunity for the intervention middlemen informal recycler. On the hand, way informal recycler are contaminating the environment and producing waste.

Bangladesh is densely populated country. The countries have cheap labor but limited land. On the other hand e-waste contains toxic substances. There is a huge probability of polluting the environment if e-wastes are not managed safely. Recyclers' health has also at risks when e-waste recycled.

In addition to that the specific place is necessary for e-waste recycling. E-waste also needs special treatment and the cost is high of recycling. Therefore skilled manpower and modern technology is essential for its safe management. LGIs financial constrain is one of the significant factor for developing institutional capacity.

The legal framework for e-waste management is also studied. The countries have a number of policies, laws, rules, strategies for protecting environment. Some rules are executing for solid waste management under the national conservation act. There is no a specific rule or guidelines for e-waste management. As e-waste has different characteristics so needs specific rules or guidelines to manage e-waste.

Department of Environment had taken steps to prepare e-waste management rules in the year 2011. Due to mismatch of waste definition the rule did not get approval from the competent authority. In 2016, DoE has also taken another step to formulate e-waste guideline. The guideline is under process of formulation.

However, the study identifies some **barrier** to e-waste management. These are given below.

- Specific e-waste management policies , act, rules, is absent
- Inadequate e-waste management infrastructure
- Institutional capacity yet not developed
- Weak enforcement on the existing policies and regulation on e-waste management except ICT policy 2015 and also the relevant policies have recognized
- Lack of national statistics on e-waste generation
- Inadequate number of clarity of understand and lack of skilled personnel on e-waste management environmental hazards
- Lack of comprehensive awareness programs
- land policy does not have portion on dumping of e-waste
- Mushrooming of informal recycling center cutting
- E-waste management is not likely to attract private investors because of its economic non-viability

In addition, the findings of the study have some **policy implication**. These are as follows.

- Imposing embargo on inferior products or maintaining international quality standards for importing electrical and electronic equipment
- Economic incentive mechanism will inspire to transfer electronic equipment to the registered vendors after end of life
- Imposing device mechanism (technology standards) process to regulate incineration and informal recycling of the discarded electrical equipment
- The citizens should be made aware of e-wastes with the support of print and electronic media.
- Formulation of specific policy, act, rules is timely demand for sustainable e-waste management
- Policy should be formulated systematically having a just balance of control versus economic strategies as an instrumental for e-waste management
- Recycling centers and e-waste dumping landfill should be located in a specific area for controlling environmental hazards.
- Institutional role would be based on command and control mechanisms

## **6.2. Extended Producer Responsibility (EPR):**

The concept of EPR, as first coined by Lindhqvist (2000), referred to it as environmental policy principle. As a policy principle, it serves as a guide or gives direction to make informed choices of a policy mix from a set of policy instruments to reach certain objectives (Manomaivibool et al, 2007). It could also be understood as policy strategy, policy approach or policy paradigm (Manomaivibool, 2009).

EPR is also sometimes mistakenly referred to as 'take back', since producers are held responsible to take back and take charge of the final disposal of their products after they are discarded by the end-users. The EPR as a policy principle, however, goes beyond the 'take

back', as a policy instrument, but rather provides a basis for the selection or choice of combination of policy instruments, and does not by itself constitute a policy instrument.

Breaking out of the traditional paradigm of post-consumer waste management as government responsibility, extended producer responsibility (EPR) is an innovative policy approach focusing on products instead of waste,([www.Product ownership.us](http://www.Productownership.us)).

In a nutshell EPR features the following.

- ✳ It introduces consideration of the entire life-cycle of a product, thus also the product's design and production, instead of only its end-of-use stage and
- ✳ It transfers, fully or partly, physical and/or financial responsibility for discarded products and the costs involved with their collection and recycling from government authorities (and thereby the taxpayer) onto producers (brand owners, first importers and manufacturers).
- ✳ It aims to reduce waste and increase recycling rates.
- ✳ It establishes a new social norm of behavior

Besides environmental improvements, EPR also seeks to achieve economic benefits in terms of job creation in waste collection and the recycling industry. Developed Countries like USA, Canada and EU are practicing EPR concept for e-waste management.

### **6.3 Further research:**

The study found gaps in institutional policies such as inadequate e-waste management infrastructure, lack of institutional capacity to handle e-waste, weak enforcement capacity on existing rules, no statistics on e-waste, lack of trained and sound technical knowledgeable official to control pollution as e-waste. The study also found that developed countries practicing economic mechanism based policy to manage e-waste. But exercising this type of policy developing like Bangladesh does not exist. Therefore, further research should be how economic mechanism based policy will be implemented to manage e-waste in Bangladesh.

## REFERENCES:

Anderson, K. et al 2014, All Wired for E-Waste, Proceedings of the 20th WasteCon Conference 6-10 October 2014, Cape Town, < <http://www.infrastructurene.ws/wp-content/uploads/sites/4/2015/04/Anderson-K.-et-al-58.pdf>> date of access: 25 November 2016.

Anyango, J.T., 2011. *A framework for sustainable e-waste management in Kenya: the case of ICT* (Doctoral dissertation, University of Nairobi).

Baldé, C. P., et al. "The Global e-waste Monitor 2014, Institute for the Advanced Study of Sustainability (IAS) and Sustainable Cycles (SCYCLE)." (2015).

Bhutta, M.K.S., Omar, A. and Yang, X., 2011. Electronic waste: a growing concern in today's environment. *Economics Research International*, 2011.

Borthakur, A., 2014. Generation and management of electronic waste in the city of Pune, India. *Bulletin of Science, Technology & Society*, p.0270467614541242.

Cohen 2006, 'Semi-structured Interviews', [http://www.sswm.info/sites/default/files/reference\\_attachments/COHEN%202006%20Semi%20structured%20Interview.pdf](http://www.sswm.info/sites/default/files/reference_attachments/COHEN%202006%20Semi%20structured%20Interview.pdf), date of access: 25 June 2016

Dickella Gamaralalage, J P 2016, Development of e-waste management policy at the local level: a case study of Cebu City, Philippines, Institute for Global Environmental Strategies, < <https://pub.iges.or.jp/pub/development-e-waste-management-policy-local>> date of access: 25 April 2016

Donkor, E.A., Appiah Obeng, P. and Mensah, A., 2009. Assessment of institutional structures for solid waste management in Kumasi. *Management of Environmental Quality: An International Journal*, 20(2), pp.106-120.

East Asian Communication Organization (EACO) 2013, 'Model framework for e-waste management', < [http://www.eaco.int/docs/Policy\\_Model\\_Framework\\_June\\_2013.pdf](http://www.eaco.int/docs/Policy_Model_Framework_June_2013.pdf)>, date of access: 10 August 2016

Environmental Governance 2009, United Nations Environment Programme, < <http://www.unep.org/pdf/brochures/EnvironmentalGovernance.pdf>>, date of access: 29 June 2016

E-Waste Volume II 2007, 'E-Waste management manual UNEP-2007', < [http://www.unep.or.jp/ietc/publications/spc/ewastemanual\\_vol2.pdf](http://www.unep.or.jp/ietc/publications/spc/ewastemanual_vol2.pdf)> date of access: 10 June 2016

E-Waste and the Environment 2010 The case for electronics recycling legislation, Goodwill Industries International, Inc. ,< <http://www.goodwill.org/wp-content/uploads/2011/01/Ewaste-Paper.pdf>> date of access: 11 November 2016

Mathers, N.J., Fox, N.J. and Hunn, A., 1998. *Using interviews in a research project*. NHS Executive, Trent.

Muhani, D.A., 2014. *A framework for sustainable e-waste management in manufacturing and processing industries, Industrial area Nairobi County* (Doctoral dissertation, Kenyatta University).

Shah Khan, S., Aziz Lodhi, S., Akhtar, F. and Khokar, I., 2014. Challenges of waste of electric and electronic equipment (WEEE) Toward a better management in a global scenario. *Management of Environmental Quality: An International Journal*, 25(2), pp.166-185.

Tellis, W.M., 1997. Application of a case study methodology. *The qualitative report*, 3(3), pp.1-19.

Gaidajis, G., Angelakoglou, K. and Aktsoglou, D., 2010. E-waste: environmental problems and current management. *Journal of Engineering Science and Technology Review*, 3(1), pp.193-199.

International Waste Management Association, 2015. Global Waste Management Outlook, <  
[https://www.iswa.org/fileadmin/galleries/Publications/ISWA\\_Reports/GWMO\\_summary\\_w  
eb.pdf](https://www.iswa.org/fileadmin/galleries/Publications/ISWA_Reports/GWMO_summary_web.pdf)> , date of access: 18 October 2016

Liu, Q., Shi, S.J., Du, L.Q., Wang, Y., Cao, J., Xu, C., Fan, F.Y., Giesy, J.P. and Hecker, M., 2012.  
Environmental and health challenges of the global growth of electronic  
waste. *Environmental Science and Pollution Research*, pp.1-3.

Lundgren, K., 2012. *The global impact of e-waste: Addressing the challenge*

Zainal, Z., 2007. Case study as a research method. *Jurnal Kemanusiaan*, (9), pp.1-6.

**QUESTIONNAIRE**

**PART A: INFORMATION ABOUT THE CITIZENS (Personal Information):**

1. Location: District:.....Upzilla.....
2. Gender (Sex):
  1. Male
  2. Female
3. Age: ..... Years
4. Highest Level of Education:
  1. No formal education
  2. SSC/Equivalent
  3. HSC/Equivalent
  4. B.Com/B.Sc/B.A / Equivalent
  5. M.A/M.Sc/ M.Com
  6. PhD
5. Occupation:
  1. Govt. Service
  2. Private Service
  3. Self Employed/Business
  4. Unemployed
  5. Retired
  6. Student
  7. Housewife
  8. Others
6. Personal Income (Per month):
  1. No Income
  2. Below 20000/-
  3. 20001/- – 40000/-
  4. 41001/- – 60000/-
  5. 61001/- – 80000/-
  6. 81001/- – 100000/-
  7. Above 100000/-

**PART B: GENERAL QUESTIONS FOR THE CITIZEN'S AWARENESS**

7. which of the following electrical and electronic equipment do you use (multiple answers)?

1. Desktop
2. Laptop
3. Cell Phone
4. Television
5. All of the above

8. During last 10 years how many of the following appliances of yours have become completely useless/damaged (Please put number only)

Sl.	Electrical and Electronic Equipment	Useless/ Damaged Number of Equipment
1	Television	
2	Desktop	
3	Laptop	
4	Cell phone	

9. What do you generally do with those useless/obsolete electrical and electronics equipment?

1. Keep it for no reason
2. Give it to kids as toy
3. Through it as waste
4. Use it for exchange
5. Donate to others

10. What is the average lifespan of your used electrical and electronic equipment?

(a) Laptop's life:      1.      1-2 years      2.      3-4 years      3.      4-5 years

4.      5-6 years      5. Above 6 years      6.      Don't know

(b) Desktop's life:      1.      1-3 years      2.      4-6 years      3.      7-9 years

4.      10-12 years      5. Above 12 years      6.      Don't know

(c) Cell Phone's life:      1.      1-2 years      2.      2-3 years      3.      3-4 years

4.      4-5 years      5. Above 5 years      6.      Don't know

(d) Television's life:      1.      5-7 years      2.      8-10 years      3.      11-13 years

4.      14-16 years      5. Above 16 Years      6.      Don't know

**Please answer for the following questions**

Sl.	Question	Yes	No
11.a	Do you know what e-waste (waste electrical and electronic equipment) is?		
11.b	Do you think your obsolete electrical and electronics equipment as waste?		
11.c	Are you conscious of the environmental hazards caused by obsolete electrical and electronic equipment? (e.g. computers, cell phones, etc)		
11.d	Are you aware that some electrical and electronic equipment parts may be commercially recycled?		
11.e	Are you aware that some hazardous components in e-waste need a special treatment in order to be safely disposed off?		
11.f	Does your City Corporation/ Pouroshava have a system for handling the waste of electrical and electronic equipment?		
11.g	Have you encountered e-waste collectors (as Vendors/ Fariwala) in your locality?		

### **SECTION C: EFFECT ON THE HEALTH AND ENVIRONMENT**

12. (a) Are you aware that e-waste could be harmful to environment and health?

1. Yes
2. No

(b) If yes, how do you know that e-waste creates health and environmental impact?

1. Radio
2. Television
3. Newspaper
4. Internet
5. Word-of-mouth
6. Books/journal
7. Don't know

13. a) Do you know that some elements of electrical and electronic gadgets contain toxic/hazardous components?

1. Yes
2. No

b) If yes, are you aware that these toxic/hazardous elements require special treatment for environmentally sound disposal?

1. Yes
2. No

14. a) Does the disposal/treatment method use for electronic waste have any impact on the environment?

1. Yes
2. No

b) If yes, indicate the area(s) of the environment that is/are affected

**Effects:**

Area of Environment Affected	Yes	No
Land		
Air		
Underground water		
Vegetation		

15. In your opinion, which of the following institution is responsible for e-waste management in your locality?

1. City Corporation
2. Pouroshova
3. Union Parishad
4. Cantonment Board
5. ZilaParishad
6. Don't know

16. (a) If you are employed, do you have any knowledge of e-waste management policy in your institution?

1. Yes
2. No

(b) As e-waste can create hazardous impact given that you would be willing to show as a cost for e-waste management?

1. Yes
2. No

## **QUESTIONNAIRE FOR KEY INFORMANT**

(Question will be asked in relation to respondents profession)

### **General Questions**

1. How do you assess overall awareness of common people on e-waste? Do you think that level of awareness is all right or should it increase to minimize the volume of e-waste? What should be the approach to creating mass awareness on e-waste impact?

### **Policy implementation- Related**

2. How is e-waste being managed in your city corporation / Pouroshova? What are the barriers to e-waste management in your city corporation / Pourashova? What is your opinion to manage e-waste safely? Do you have a demarcated location for e-waste dumping?

### **Policy Formulation- Related**

3. Are there any specific legal frameworks for e-waste management in Bangladesh? If not, what types of regulation should be adopted for e-waste management? Do you think imposing high tax /duty can be introduced for importing secondhand electrical and electronics goods? Or, banning illegal imports of secondhand electrical and electronics goods needs applying mandatory/ forceful policy? What would you suggest in curtailing e-waste through tax or duties or import control mechanism?
4. Do you think safe and environment-friendly e-waste recycling facility should be set up to reduce e-waste? Or, Recycling of e-waste should not be established as it has the long term negative impact on health and environment?

### **For Expert Opinion**

5. What do you think institutional preparedness of e-waste management? What are the institutional challenges of e-waste management in Bangladesh? Which institutions are responsible for e-waste policy formulation and implementation of e-waste management? Which institution can play the key role to manage e-waste? Are there any losses at present that addresses e-waste? How do you see the present law, policy to address e-waste?

**SEMI STRUCTURED INTERVIEW**

1. In your institution, do you have official task to manage e-waste?
2. In your institution, do you have clear office organogram /structure to manage e-waste?
3. In your institution, do you have assigned duties to enforce laws on e-waste management?
4. Do you have any special training for managing e-waste?
5. How do you monitor e-waste collection / transportation/ disposal system?

**List of Key Informant (Maximum 10)**

**Executing Authority:**

1. Mayor/ CEO, Dhaka North City Corporation
2. Mayor/ CEO, Dhaka South City Corporation
3. Mayor/ CEO, Chittagong City Corporation
4. Director General, Department of Environment (DoE)

**Policy Formulation Directing Officer :**

1. Senior Secretary, Ministry of Commerce
2. Chairman, National Board of Revenue
3. Secretary, Ministry of Environment and Forests
4. Secretary, Local Government Division
5. Secretary, Information and Communication Technology Division
6. Secretary, Ministry of Land

**Scholar on Relevant Arena**

1. Ms Juena Aziz, Secretary, Industry and Energy Division, Planning Commission
2. Mr.M. Habibur Rahman, Professor, Environmental Engineering Division, BUET
3. Dr. Md. Kabir Uddin, Professor of Environmental Sciences, Jahangirnagar University
4. Dr. Mujibur Rahman, Professor of Civil Engineering, BUET

**NGOs and Private Owner**

1. Mr. ShahriarHossain, PhD, Journalist, Ecologist & Social Justice Advocate(ESDO)
2. Mr. Abu Hasnat Md. Maqsood Sinha, Executive Director and Co-Founder, Waste Concern
3. Mr. Zulfiquar Rahman, Five-R Associates
4. Mr. Nazmul Hyder, Managing Director, JR Enterprise
5. Mr. Md. Abul Kalam Azad, Chairman, Azizu group