E-WASTE MANAGEMENT OF DHAKA CITY

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A thesis submitted to the Department of Civil Engineering in partial fulfillment for the degree of Bachelor of Science in Civil Engineering



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Dedicated

To

"In the name of Allah, the Most Gracious, the Most Merciful.

We would like to dedicate this thesis, first of all, to the 2 martyrs of our university (AMT department student Md. Sajjad Hossain, ID No: AMT2102019040 and Bengali department student Md. Russel Mahmud, ID No: BAN2401009006) and seeking forgiveness for their souls and to all the many unnamed martyrs along with them. Those who, in return for their sacrifices, have shown the country the way to freedom and have freed the country from the hands of a monopolistic and oppressive group and given back our right to speak.

And to Allah, the Most Compassionate, the Most Merciful, I offer my deepest gratitude. Your guidance and blessings have sustained me in moments of doubt and celebration alike. May this work be a reflection of the knowledge imparted by my teachers, the love bestowed upon me by my family, and the divine wisdom granted by Allah.

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ABSTRACT

The rapid increase in electronic waste (e-waste) is emerging as a major environmental and public health issue, especially in urban areas like Dhaka City. This study examines the current situation of e-waste in Dhaka, focusing on its volume, management practices, and the related socio-environmental impacts. Our research shows that Dhaka produces around 4820 ton of e-waste each year, driven by factors such as urban growth, technological progress, and rising demand for electronic devices. However, the city lacks a comprehensive and sustainable system for managing e-waste, leading to informal recycling processes that pose serious risks to human health and the environment. This paper reviews the existing methods of generation of e-waste, e-waste collection method, collection, recycling and existing policies. It offers recommendations for creating a sustainable e-waste management system in Dhaka, focusing on the importance of regulations, technology, and community participation.

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CHAPTER 1
INTRODUCTION

1.1 Background and Motivations

In recent years, Bangladesh has witnessed significant growth in the use of electronics, microchips, and automated machinery across industries, businesses, transportation, and household appliances. As with the global trend, the country is experiencing rapid adoption of electronic devices in homes, offices, industries, vehicles, and communication systems. By 2018, e-waste was projected to reach around 50 million metric tons, growing at a rate of 4-5% annually[1]. E-waste, generated when devices and products reach the end of their life, is one of the fastest-growing waste types globally, threatening the environment and human health. Asia is the largest contributor, with the electrical and electronics industry producing 16 million metric tons of e-waste between 2014 and 2016. From 2010 to 2019, global e-waste grew from 33.8 million metric tons to 53.6 million metric tons. However, only 17.4% was properly recycled. By 2030, global e-waste is projected to reach 74.7 million metric tons. In 2010, Bangladesh generated an estimated 2.8 million tons of e-waste.[2]. All used electronic items, like computers, entertainment devices, mobile phones, medical and dental equipment, air conditioners, TVs, VCRs, stereos, copiers, fax machines, and refrigerators, that are sold, donated, or thrown away by their owners are considered electronic waste[3].

Both public and private sectors face challenges in managing e-waste, especially in resource-limited countries like Bangladesh. Proper e-waste management is crucial for achieving global Sustainable Development Goals (SDGs), including Goals 3, 6, 11, 12, and 14. Bangladesh is prioritizing e-waste through the Draft E-Waste Management Rules, 2017, and its National 3R Strategy (Reduce, Reuse, Recycle). E-waste is valuable, with an estimated worth of EUR 55 billion globally, and Bangladesh has an annual business potential of about 221 million USD. However, limited research restricts progress, and effective policies for e-waste management will bring social, environmental, and economic benefits.[1].

1.2 Research Objectives and Overview

The main objectives of the study are:

1. To determine the E-waste generation from households and various locations of Dhaka city.
2. To assess current methods of e-waste collection, recycling, and disposal in Dhaka.
3. Develop / recommended suitable method of e-waste management of Dhaka City.

1.3 Organization of the thesis

This report includes an incorporation, a list of references, and five chapters.

Chapter 1: Introduction and Objective. Background information, goals, and research scope is given in the introduction. The research focuses on understanding the issues related to electronic waste (e-waste) in Dhaka city. It explores how e-waste is generated, managed, and its impact on the environment and public health.

Chapter 2: Literature Review. This chapter discusses the projected future of Dhaka City's e-waste recycling. E-waste is both a great resource and a serious environmental and health risk.

Chapter 3: Methodology. In this chapter, we briefly mention how much waste is generated in Dhaka city every year, as shown by various surveys. We also highlight the methods of our research.

Chapter 4: Results and Discussion. In this chapter the present E-waste generation rate of Dhaka City is compared with other research data. It is also discussed whether any changes in the management system need to be made in the future.

Chapter 5: Conclusions and Future Work. This chapter summarizes the conclusions and major contributions of this study and provides recommendations for future studies.

CHAPTER 2
LITERATURE REVIEW

2.1 Introduction

The rapid advancement of technology and rising consumption have resulted in a major increase in electronic waste (e-waste) generation worldwide. E-waste is one of the fastest growing solid waste streams around today. According to a study conducted by European Union, e-waste is growing at a rate of 3.0 – 5.0% per annum or approximately three times faster than other individual waste streams in the solid waste sector[4]. Dhaka City, Bangladesh's capital, is no exception to the trend. The city's growing population, along with the increasing affordability of electronic gadgets, has resulted in a significant volume of e-waste being generated each day. This literature review will look at the current condition of e-waste management in Dhaka City, specifically on mobile phone, television, computer (desktop, laptop), battery, freezers, air conditioners, CFL bulbs and printers e-wastes that's collected from entire Dhaka City.

2.2 Composition of E-waste

E-waste contains a variety of harmful and valuable components, making it difficult to provide a standardized material composition for the entire waste stream. However, most studies look at five types of materials: ferrous metals, nonferrous metals, glass, plastics, and others (Figure 2.3). While bulk components such as iron, aluminum, plastic, and glass make for more than 80% of the total weight, valuable and hazardous materials are found in lesser quantities but are nonetheless extremely important. Appliances have similar material compositions; however, the percentage of different components varies significantly. Table 2.1 shows the most commonly discovered chemicals in e-waste [8].

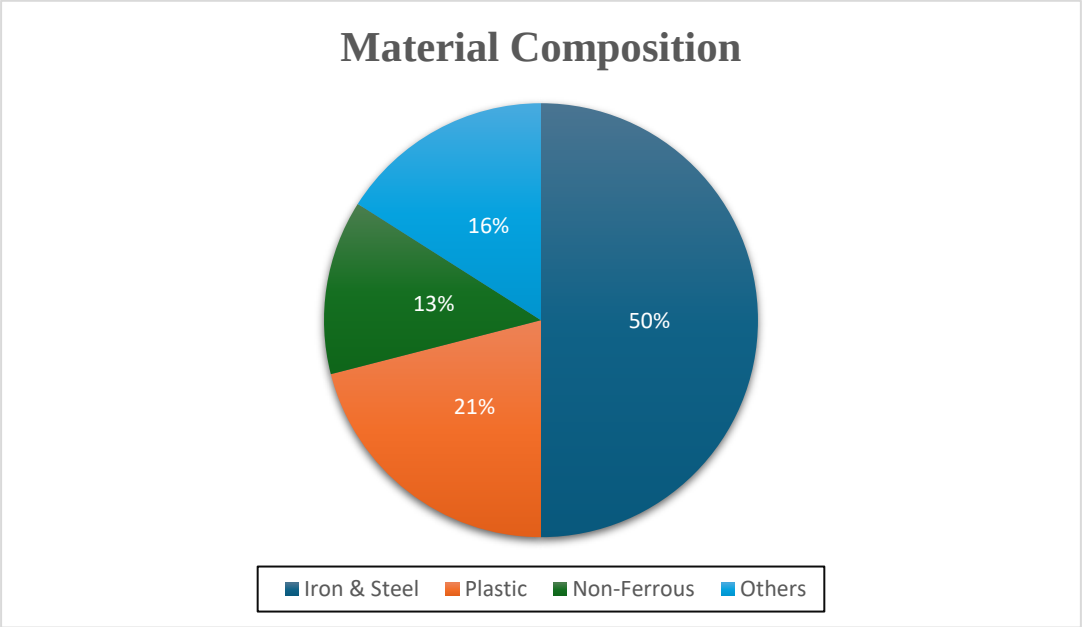


Figure 2-1. Material Composition in E-waste

Table 2-1. Main Compounds Commonly Found in E-waste

Category	Compounds
Precious metals	Gold (Au), Silver (Ag), Palladium (Pd), and to a lesser extent Platinum (Pt)
Base metals	Copper (Cu), Aluminum (Al), Nickel (Ni), Tin (Sn), Zinc (Zn), Iron (Fe)
Metals (toxic) of concern	Mercury (Hg), Beryllium (Be), Indium (In), Lead (Pb), Cadmium (Cd), Arsenic (As), Antimony (Sb
Halogens	Bromine (Br), Fluorine (F), Chlorine (Cl)
Combustibles	Plastic and organic fluids

2.3 Generation of E-Waste

2.3.1 World Scenario

Globally, the e-waste management system comprises both formal and informal sectors. Countries with strong regulatory frameworks, such as the EU and Japan, have implemented effective recycling methods. In contrast, developing countries have challenges due to poor rules, a lack of awareness, and reliance on the informal sector.

According to the Global E-Waste Monitor (2020), just 17.4% of e-waste is properly collected and recycled around the world[6].

The increasing volume of e-waste is driven by the rapid growth of the global information society, marked by more users and technological advancements. As people own multiple ICT devices, replacement cycles for items like mobile phones and laptops shorten. Rising disposable incomes in developing countries and a growing middle class are also contributing to more e-waste. Projections show e-waste generation will significantly increase in the coming decades, highlighting the need for better tracking. Estimates indicate e-waste grew from 44.7 million metric tons in 2014 to 50 million metric tons in 2018.[7].

Due to technological progress and higher consumer demand, electronics have become a major part of global waste. In 2014, e-waste included 12.8 million metric tons of small devices, 11.8 million metric tons of large devices, and 7 million metric tons of temperature control devices. The total e-waste was expected to reach 50 million metric tons by 2018, growing by 4-5% annually. In 2016, global e-waste was 44.7 million metric tons, or 6.1 kg per person, with 2017 projections exceeding 46 million metric tons. By 2021, it was expected to grow to 52.2 million metric tons, with a yearly increase of 3-4%. In 2022, a record 59 million metric tons were produced, an 82% increase from 2010, and it is predicted to rise to 74.7 million metric tons by 2030 [12].

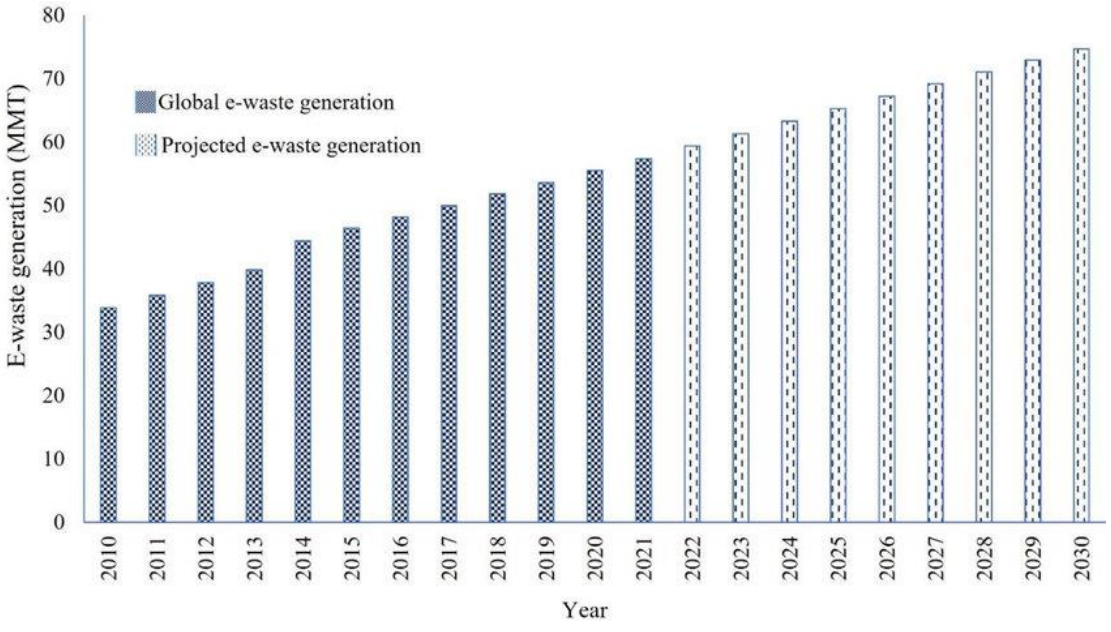


Figure 2-2. Global e-waste generation (year 2010 to 2019) and projected e-waste generation (year 2020 to 2030)

2.3.2 Dhaka Scenario

Dhaka, the main city, creates a substantial amount of Bangladesh's e-waste, estimated to be more than 400,000 tons each year. The informal sector handles the majority of e-waste, extracting valuable materials using crude processes like acid baths and open burning, resulting in serious environmental damage and health risks. A research conducted by the Bangladesh University of Engineering and Technology (BUET) found that less than 3% of e-waste is formally managed. However, few studies were carried out in small scale and location and item specific to estimate the generation of e-waste. According to Bangladesh Electrical Merchandise Manufactures Association (BEMMA), Bangladesh consumes around 3.2 million of electronics products each year[5] [8].

Table 2-1. Electronic Item Consumption and E-wastes for Dhaka

Item	**Dhaka Statistical Area (DSMA) (in million pieces)**				**Bangladesh (in million pieces)**
	Consumption in Dhaka (2009)	Consumption in Dhaka (2014)	Consumption in Dhaka (2020)	E-waste generation in DSMA (2014)	Secondary information on consumption in Bangladesh (2014)
Mobile phone	2.88 (considering growth of 20%)	7.16	21.37	1.32	18.00
Computer	0.24 (considering growth of 10%)	0.39	0.24 (considering growth of 10%)	0.10	0.30
Television	0.39 (considering growth of 20%)	0.97	2.90 (considering growth of 20%)	0.07	1.20

2.3.3 The report on e-waste exports in Bangladesh

From February 2023 to January 2024, Bangladesh exported 9 shipments of electronic waste (e-waste). These shipments were handled by three different exporters. E-waste management is a growing concern globally, and Bangladesh is working on improving its regulations and practices to handle e-waste more sustainably.

But we cannot identify the exact amount of e waste which were exported from Bangladesh.

2.4 Effect of E-waste on human health and environment

E-waste, or discarded electronics, is a growing global issue that harms both human health and the environment. Improper disposal or recycling releases harmful substances like arsenic, CFCs, and Persistent Organic Pollutants (POPs) such as PBDEs and PCBs. Without proper precautions, handling or reusing e-waste can cause serious health and environmental risks. Mixing e-waste with regular trash and sending it to landfills can lead to soil and water pollution as toxic elements seep into the environment [8].

Table 2-2. Toxic Constituents of E-waste

Components	Constituents
Printed Circuit Board (PCB)	Lead and Cadmium
Cathode Ray Tubes (CRTs)	Lead Oxide and Cadmium
Switches and Flat Screen Monitor	Mercury
Computer Batteries	Cadmium, Lithium
Capacitors and Transformers	Polychlorinated Biphenyls
Printed Circuit Board, plastic casing cables	Brominated Flame Retardant (BFR)
Cable insulation/coating	Polyvinyl chloride
Mercury bulb	Mercury
Wires, cables	Copper
Computer Motherboards	Beryllium

Occupational and local exposure poses significant risks to individuals involved in e-waste collection and recycling. This study used two approaches to evaluate the impacts:

- **Direct Survey:** Assessing e-waste impacts through direct data collection.
- **Risk Analysis:** Indirectly evaluating the risks faced by workers handling e-waste using USEPA guideline values.

2.4.1 Health Risk Assessment on Workers

E-waste contains toxic heavy metals like lead, cadmium, mercury, and chromium, which are damaging to human health. The current study analyzed the PCB of cell phones and discovered large amounts of heavy metals. Table 5.1 displays some of the heavy metals discovered during this investigation.

Table 2-3. Characterization of Cell Phones PCB

Parameters	Concentration Range (mg/l)
Cadmium (Cd)	< 0.01 - 0.18
Chromium (Cr)	6.5 – 278
Cobalt (Co)	9.04 – 32.5
Lead (Pb)	44 – 1270
Mercury (Hg)	< 0.01 – 6.29

Workers analyzing products may face exposure to harmful substances through ingestion or inhalation. To assess the risks associated with e-waste processing and recycling, workers are grouped into three age categories: i) W-A: Under 15 years old ii) W-B: Ages 15 to 25 iii) W-C: Over 25 years old. Workers are exposed to e-waste for about 10 hours a day, 300 days a year [8].

Table 2-4. General Information of Exposed Workers

Exposed Group	Type of Case	Years range	Avg. Height (BBS,2011)	Avg. Body Weight (kg)	Avg. Exposure Duration (hours/day)	Exposure Frequency (days/year)
Worker	W-A	Below 15 years old	4 ft. 6 in.	25	10	300
	W-B	15-25 years old	5 ft. 1 in.	50	10	300
	W-C	Above 25 years old	5 ft. 4 in.	60	10	300

2.4.2 E-waste in Environment and Food Chain

Pollutants can travel long distances, posing a risk of secondary exposure in remote areas. Atmospheric pollution from burning and dismantling activities is a primary cause of occupational and secondary exposure [9]. Informal e-waste practices also contribute to environmental contamination, affecting agricultural lands and grazing livestock. Many harmful chemicals accumulate in animal tissues and can transfer to edible products like milk and eggs [13].

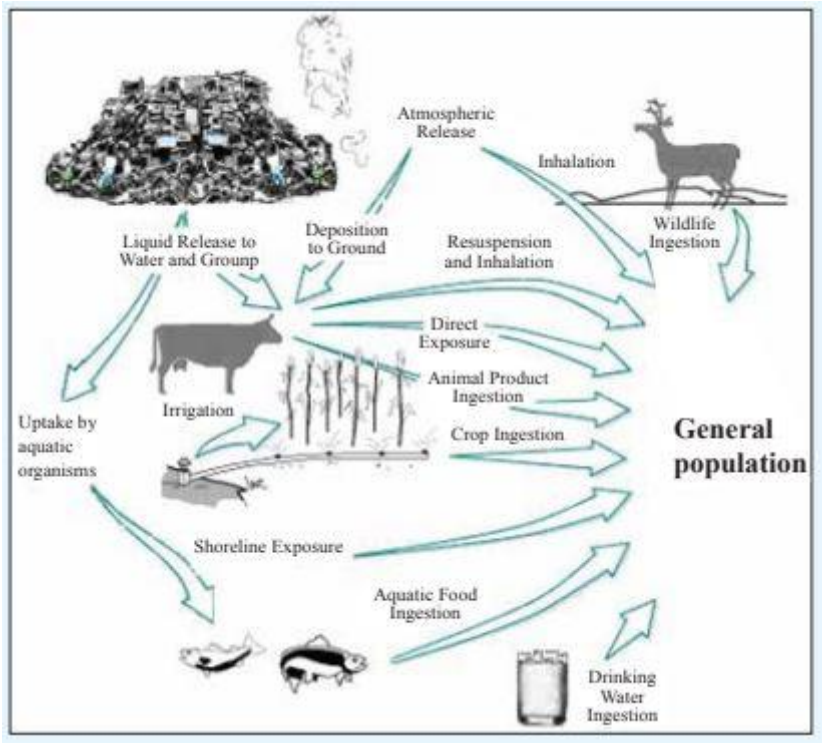


Figure 2-3. Exposure Routes and Fate of E-waste in Environment and Food Chain

2.5 General Framework of E-waste Management System

Bangladesh has implemented policies such as the Hazardous Waste Management Rules (2021) and is now developing specific e-waste management regulations. However, compliance remains a substantial difficulty due to limited resources and a lack of stakeholder collaboration. The Department of Environment (DoE) plays an important role; however, there are gaps in implementation and public-private partnerships.

In developing countries, e-waste is collected by informal workers like hawkers, with no records of its flow or regulation of environmental and worker safety standards. In contrast, industrialized countries track e-waste collection through producers or

consortiums, ensuring better data and control. Developing nations struggle to adopt e-waste policies from wealthier countries due to the dominance of the informal sector. While this sector provides jobs, it often lacks the resources and oversight for safe disposal. Governments need to consider local socioeconomic conditions and integrate the informal sector into formal systems to address e-waste effectively.

2.6 E-waste Management in Developed Countries

The UK e-waste management cycle involves key stages: collection through designated points and schemes, sorting and transporting to recycling facilities, and processing for recycling or refurbishment. Valuable materials like metals are extracted, while hazardous substances are safely treated. Refurbished devices are reused or sold, and non-recyclable waste is disposed of per environmental regulations. Compliance with the WEEE Directive ensures proper reporting, promoting recycling, minimizing landfill use, and ensuring safe handling of hazardous materials.[10], [11]

2.7 E-waste Management in Dhaka City

In Bangladesh, there is no systematic organization for e-waste management. Informal sectors collect, dismantle, recover, and recycle e-waste using manual and crude procedures (Figure 2.1). Due to a lack of laws and consumer awareness, e-waste often goes uncollected and ends up in landfills alongside other solid garbage. We found that 50% of fully broken electronic devices are discarded, while approximately 90% of partially damaged equipment is fixed (Figure 2.4) [8].



Figure 2-4. Workers Manually Dismantling Scrap Electronics

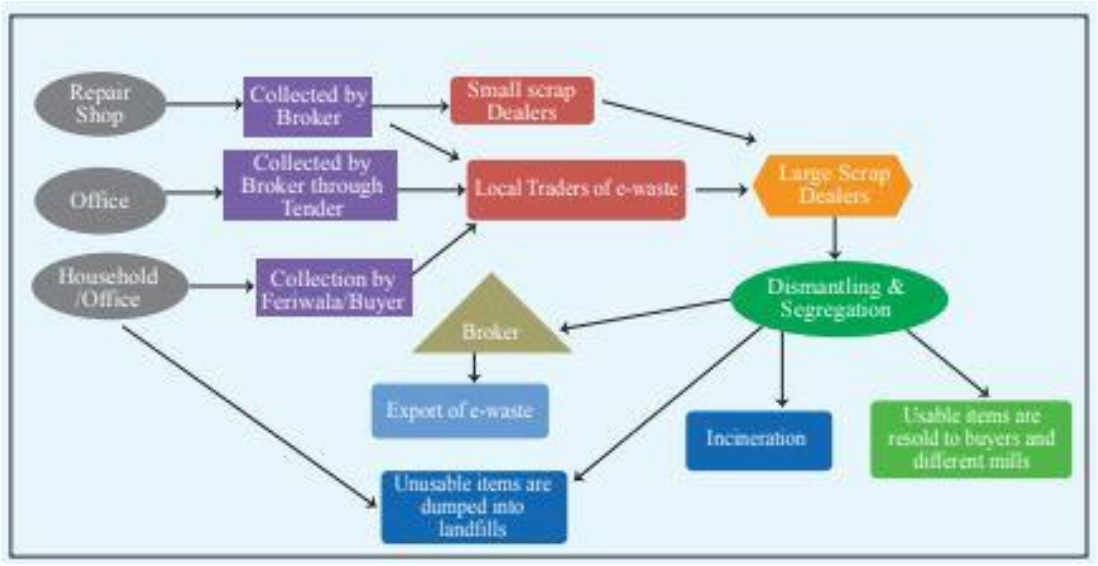


Figure 2-5. Pattern of E-waste Management Practice

In Dhaka, informal e-waste workers are the backbone of the recycling industry. Despite their assistance to resource recovery, their actions are risky because to a lack of safety procedures. According to Rahman et al. (2021), informal workers are exposed to heavy metals such as lead and mercury, which can cause respiratory problems and skin diseases [8].

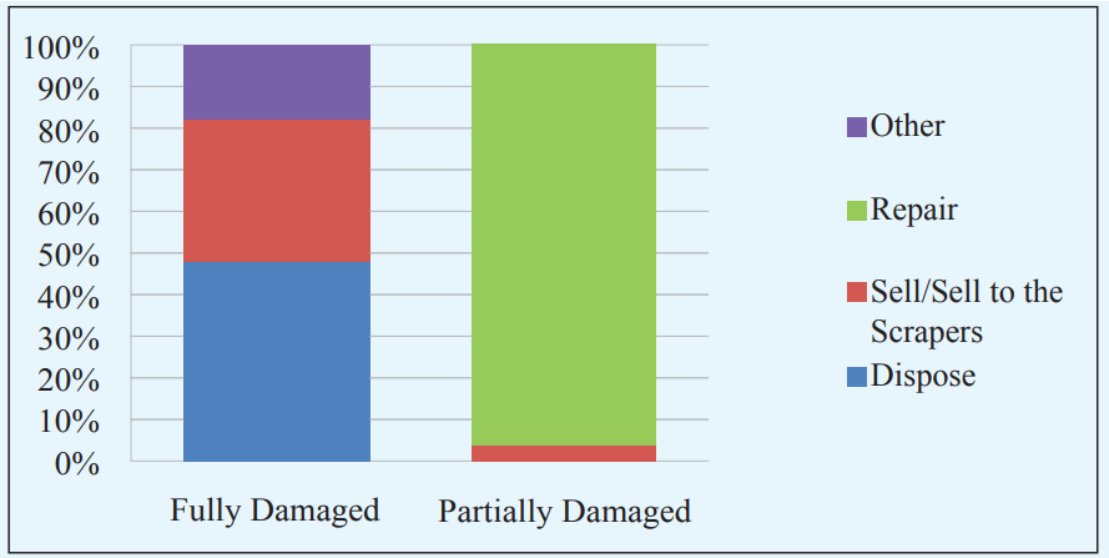


Figure 2-6. E-waste Flow Diagram in Bangladesh

The e-waste management system in Bangladesh, shown in Figure 2.5, involves importers sourcing cheap materials from abroad for the local market. Refurbishes salvage functional components to repair out-of-service electronics, while non-refurbishable items are dismantled, metals are extracted, and the rest is dumped in landfills (Lepawsky, 2011). The industry is centered in Dhaka, with dismantling in areas like Elephant Road, Gulistan, Kotwali, and Motijheel, and materials like metals, plastics, and glass reprocessed in Lalbagh and Kotwali into household goods such as containers and cutlery.

2.8 Challenges in E-Waste Management in Dhaka City

2.8.1 Lack of Awareness

Public knowledge of the consequences of inappropriate e-waste disposal is minimal in Dhaka. Many individuals are unaware that e-waste contains hazardous chemicals such as lead, mercury, and cadmium, which can impair both human health and the environment. As a result, most people dispose of e-waste among regular household rubbish or sell it to informal recyclers without realizing the risks involved.

2.8.2 Infrastructure Deficiency

Dhaka lacks a strong formal infrastructure for e-waste collection, sorting, and recycling. The city's present recycling facilities are insufficient to handle the constantly increasing volume of e-waste. As a result, the majority of e-waste is treated informally, often using hazardous methods such as open burning or acid baths, which increase environmental and health risks.

2.8.3 Economic Constraints

The informal sector dominates e-waste management in Dhaka due to reduced prices and a lack of economic incentives for formal recycling. Informal recyclers harvest valuable metals such as copper and gold using low-cost but dangerous methods. Formal recyclers, on the other hand, have substantial operational costs and receive little financial backing from the government or business sector, making it difficult to compete with the informal industry.

2.9 Our Research Summary

We have worked on E-waste management of entire Dhaka city. We visited different places of Dhaka city on field level and reviewed it. Collected information from there and reviewed the current situation and focused on how to manage it properly in the future. Since the amount of e-waste is increasing day by day, we have to take proper management from now on. How to re-use, recycle, recover and dispose this e-waste easily and at low cost without harming people is our main objective.

2.10 Conclusion

Effective e-waste management in Dhaka requires collaboration among the government, businesses, and civil society. The government should enforce laws, improve monitoring, and implement policies like Extended Producer Responsibility (EPR). The corporate sector should invest in formal recycling infrastructure and promote sustainable practices. Civil society, including NGOs and schools, should raise awareness about proper e-waste disposal. Integrating informal workers into the formal system through training is essential for safety and efficiency. By learning from successful models in cities like Bangalore and Guangzhou, Dhaka can develop a sustainable e-waste system that benefits the environment, public health, and economy.

CHAPTER 3
METHODOLOGY

3.1 Introduction

This research consists of four parts: estimating e-waste generation, current methods of e waste (collection, recycling & disposal) and recommend suitable method of e waste management of Dhaka City. The study employed various approaches to achieve its goals. Initially, a review of existing literature on e-waste in Bangladesh was conducted. However, it was found that few studies had been done, and those available had inconsistent data, often limited to certain areas like Dhaka or specific types of e-waste. As a result, the study decided to use both primary and secondary data to accurately estimate e-waste trends. The methodology and detailed approaches are outlined in the following chapters.

E-waste, once seen as regular trash, is now treated as a separate category with special steps for collection, processing, and recycling. Its recyclability has made e-waste collection more popular, as many parts can be reused. This study looks at how e-waste is collected, reused, recycled, and generated. E-waste is growing quickly worldwide due to technology and consumer needs. Poor management of e-waste can harm the environment and health, so proper handling is crucial for sustainability.

The methodology for e-waste management typically encompasses several key components:

1. Assessment and Inventory: Identifying the types and quantities of e-waste generated within a specific region or organization. This step helps in understanding the scale of the problem and planning appropriate interventions.

2. Collection and Transportation: Establishing efficient collection systems that encourage consumers to return unwanted electronics. This can include drop-off centers, collection events, and partnerships with retailers. Transportation must be safe and compliant with regulations to prevent environmental contamination.

3. Sorting and Processing: Once collected, e-waste is sorted into categories (e.g., metals, plastics, hazardous materials) for appropriate processing. This stage is critical for maximizing resource recovery and minimizing environmental impact.

4. Recycling and Recovery: Utilizing specialized technologies to recycle valuable materials, such as gold, copper, and rare earth elements, while safely disposing of hazardous components. This step not only conserves resources but also reduces the demand for new raw materials.

5. Disposal: For materials that cannot be recycled, environmentally sound disposal methods must be employed. This may include safe landfilling or incineration with energy recovery, adhering to local and international regulations.

6. Awareness and Education: Implementing campaigns to educate consumers about the importance of proper e-waste disposal and recycling. Engaging stakeholders, including manufacturers, consumers, and governments, is essential for fostering a culture of responsible e-waste management.

7. Regulatory Compliance and Policy Development: Establishing frameworks that promote sustainable e-waste management practices. This includes creating regulations that encourage manufacturers to design for recyclability and hold them accountable for the lifecycle of their products.

3.2 Methodology Overview

In our thesis paper, we have collected data in two ways, one is primary data collection and the other is secondary data collection. In primary data collection, we went to the field level and collected data from shop to shop, hawker to hawker and electric waste collectors about the amount of electric waste generated every day, collection route, recycling process, how much is disposal and what is the future of e-waste in Dhaka city.

3.2.1 Estimation of E-waste Generation

To estimate the e-waste amounts and establish a trend of generation, both primary data and secondary data have been collected for different EEE items. Eight such items have been selected for this study; electric fans, fridge, air conditioner, CFL bulbs, TV, IT equipment, cell phones and computer (Table 3.1)

Table 3-1. Selected Items for Waste flow Estimation

SI No.	ITEM
1	TV
2	COMPUTERS
3	MOBILE PHONE
4	CCTV
5	IT EQUIPMENT
6	FRIDGE

Dhaka city has been selected as the study area for collection of primary data on e-wastes. The study locations within Dhaka City have been selected considering the organized and unorganized market places and shops where e-waste items are unloaded, traded, dismantled, recycled, reused, repaired, processed and disposed of. These locations were identified through a transect walk and test surveys in the area. Primary data has been collected from these locations through questionnaire survey and interviews. These locations are Elephant Road, Nimtoli, Chankhar Pool, Tongi, Gulistan and Mirpur (Figure 3.1). Data have been collected from the e-waste collectors and the recycling shop owners, dealers and bhangari shops.



Figure 3-1. Field Survey and collecting data

3.2.2 Selection of the Study Area

The selection of the study area is an important factor that shapes the scope and relevance of the research. For this research we have identified Dhaka city. Because Dhaka is the capital of this country, where many people live. Not only that, the biggest and most important institutions of the country are located in this city. Dhaka is a megacity, and has a population of 10.2 million inhabitants as of 2022, and Greater Dhaka has a population of over 22.4 million inhabitants. It is widely considered to be the most

densely populated built-up urban area in the world. Due to which various devices containing technology are used the most in this city. For example: mobile phone, computer, laptop, home appliance etc. E-waste generation is highest in this city due to over consumption. And in view of this many other institutions have been developed starting from recycling center, storage, dumping site, enterprise etc.

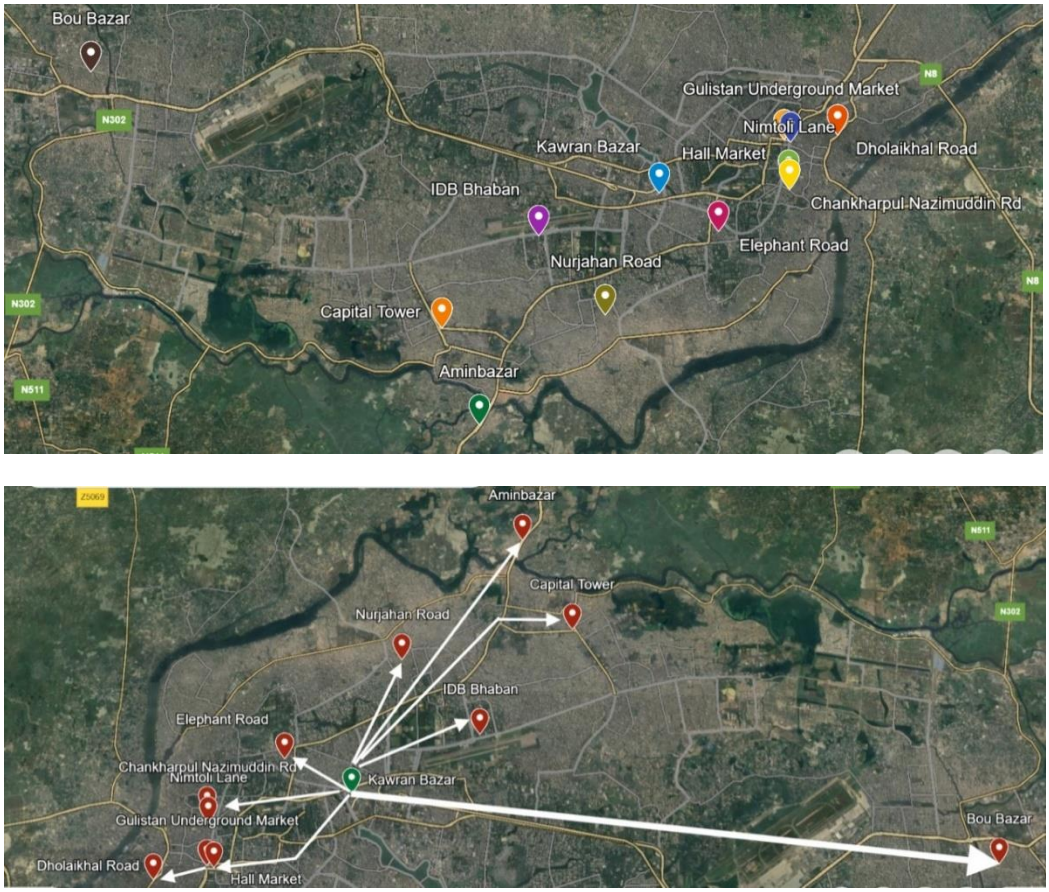


Figure 3-2. Survey locations within Dhaka city

How to approach the details of selection of study area is discussed here:

3.2.2.1 Justification for Choosing Dhaka City

- **Urbanization and Population Density:** Dhaka is one of the most densely populated cities globally, with rapid urbanization that contributes to increasing volumes of e-waste. Discuss why these factors make Dhaka a relevant study area for understanding e-waste issues.

- **High Levels of E-waste Generation:** As a commercial and technological hub, Dhaka generates significant amounts of e-waste. This includes waste from both consumers and businesses, making it ideal for studying various e-waste sources.
- **Challenges in E-waste Management**: Dhaka faces notable challenges in waste management infrastructure, regulatory enforcement, and public awareness around e-waste. This makes it a valuable area to study potential solutions.

3.2.2.2 Specific Locations within Dhaka for Focused Study

- **Selection of Key Areas/Neighborhoods:** Identify specific neighborhoods, markets, or industrial zones in Dhaka that are high contributors to e-waste. Examples may include areas with concentrations of electronics markets, repair shops, or e-waste collection points.
- **Consideration of Socioeconomic Diversity:** Choose areas representing diverse socioeconomic backgrounds, as different groups may have varied access to e-waste disposal or recycling options.
- **Accessibility and Availability of Data:** Focus on areas where data collection is feasible, with potential access to e-waste handlers, recyclers, and local communities for interviews, surveys, or observations.

3.2.2.3 Data Collection Strategy for the Study Area

- **Stakeholder Identification:** Describe how you will identify and select key stakeholders in each area, such as informal waste handlers, recycling companies, regulatory bodies, and residents.
- **Sampling Method:** Explain the sampling approach (e.g., purposive sampling, stratified sampling) used to select participants or data points from the selected areas.
- **Environmental and Social Factors:** Consider any environmental factors, like local pollution levels, that might affect or be affected by e-waste management in these areas.

3.2.2.4 Spatial Analysis Tools (If Applicable)

If using GIS or spatial analysis to map e-waste flows, disposal sites, or recycling facilities, describe the specific geospatial data and tools used to analyze patterns within Dhaka.

This section should make clear why Dhaka City is chosen, and how specific areas and stakeholders within the city contribute to an understanding of e-waste management challenges and opportunities.

E-waste collectors in Dhaka City operate across both formal and informal sectors, often dealing with challenges like limited infrastructure, regulatory oversight, and health risks. Here's an overview of the e-waste collection ecosystem in Dhaka:

3.3 Collector Sectors

3.3.1 Informal Sector Collectors

- **Waste Pickers:** Informal waste pickers (locally known as tokais) often collect discarded electronics from household garbage, roadsides, or landfills. They gather items like old phones, batteries, and small electronics, which they then sell to middlemen.
- **Middlemen and Scrap Dealers:** Middlemen, often based in markets such as Gulistan and parts of Old Dhaka, purchase collected e-waste from waste pickers. These middlemen sell or trade e-waste with recyclers who dismantle items for salvageable materials like metals.
- **Repair Shops and Electronics Markets:** Many repair shops in areas like Mirpur, Chawkbazar, and Gulistan buy discarded or broken electronics from pickers or customers, either to repair and resell or to harvest reusable parts.
- **Collection Hubs:** Informal e-waste trading hubs exist throughout Dhaka, particularly in densely populated areas with many repair shops and electronics markets.

3.3.2 Formal Sector Collectors

- **Registered Recycling Centers:** Dhaka has a limited number of formal recycling facilities authorized by the government. These centers, typically in industrial zones like Tejgaon, collect e-waste from businesses, institutions, and some residential areas.

- **Corporate Collection Programs:** Some larger electronics companies and telecom providers operate e-waste take-back programs, collecting old devices from customers for safe disposal or recycling.
- **NGOs and Initiatives:** NGOs and organizations, such as Waste Concern and others focused on waste management, sometimes run pilot projects or awareness programs for safe e-waste disposal, targeting residents, schools, and businesses.

3.4 Mapping E-Waste Collection Activity

Mapping e-waste collection in Dhaka could help visualize where and how e-waste flows between households, collection points, and recycling hubs. Areas of interest for mapping include:

- **Gulistan and Chawkbazar:** Dense areas with active informal e-waste trade.
- **Mirpur:** A residential and commercial area where informal e-waste collection is common.

By understanding these collection networks and the flow of e-waste through both formal and informal routes, stakeholders can better plan interventions and policies that support safer, more efficient e-waste management in Dhaka City. In Dhaka City, e-waste often does not have designated dumping sites due to the lack of formal infrastructure for handling and disposing of electronic waste. Instead, much of the e-waste is managed through informal channels and often ends up in general landfills or illegal dumping sites. However, here are some common areas where e-waste tends to accumulate or is improperly disposed of in Dhaka:

3.4.1 Formal Dumping and Processing Sites in Dhaka City

- **Matuail Landfill**

Location: Matuail, in the southern part of Dhaka.

Description: The Matuail landfill is Dhaka's primary dumpsite, receiving most of the city's solid waste. Although it's not a dedicated e-waste dumping site, e-waste frequently ends up here due to inadequate separation practices at the waste collection stage. This site poses significant environmental risks as the landfill was not designed to

handle the toxic materials present in e-waste, which can leach into the soil and groundwater.

- **Aminbazar Landfill**

Location: Aminbazar, on the outskirts of Dhaka, near the Turag River.

Description: Similar to Matuail, the Aminbazar landfill receives a large volume of general waste, including e-waste. Informal waste pickers often scavenge these sites to collect salvageable e-waste items, which they sell to scrap dealers. The presence of e-waste in this landfill increases the risk of environmental contamination, as it was also not designed for hazardous waste.

3.4.2 Informal Dumping and Processing Sites in Dhaka City

Areas: Chawkbazar, Lalbagh, and parts of Keraniganj.

Description: In Old Dhaka, there are informal sites where e-waste is accumulated and dismantled by informal workers. Although these sites are not officially designated as dumping grounds, they function as collection and initial processing points, where e-waste is stripped down for valuable parts. These areas are typically congested and lack safety protocols, resulting in potential harm to workers and local environments.

- **Riverside and Canal Dumping**
- **Locations:** Various canals and rivers, particularly near informal settlements and industrial areas.

Description: In the absence of formal disposal options, some e-waste is dumped into local waterways. Informal waste collectors sometimes use canals or riversides for dumping non-salvageable e-waste, which then contaminates these water bodies. The Buriganga River, in particular, is at risk due to improper waste disposal from nearby industrial and residential zones.

- **Temporary Storage Sites in Electronics Markets**

Locations: Gulistan, Mirpur, and Kawran Bazar.

Description: These busy electronics markets serve as informal hubs for e-waste accumulation. Traders and repair shop owners collect discarded electronics and parts before either reselling or moving them to recycling hubs. While not official dumping sites, these areas experience large amounts of e-waste turnover, and excess or non-usable waste is often disposed of improperly.

Besides, the research team visited and met relevant agencies, individuals and establishments dealing with repairing, assembling, dismantling and sale of e-wastes. Volumes of e-wastes for selected EEE items have been estimated by mathematical models based on past and historical sale/import data. The amount of wastes that go to bhangari shops, e-wastes dealers and recyclers have also been estimated using primary and secondary data. The flow chart (Figure 3.3) outlines the methodology adopted in estimation of e-waste volume and the forecast future trend in Bangladesh. Detailed description of the method of estimation is presented in Chapter 4.

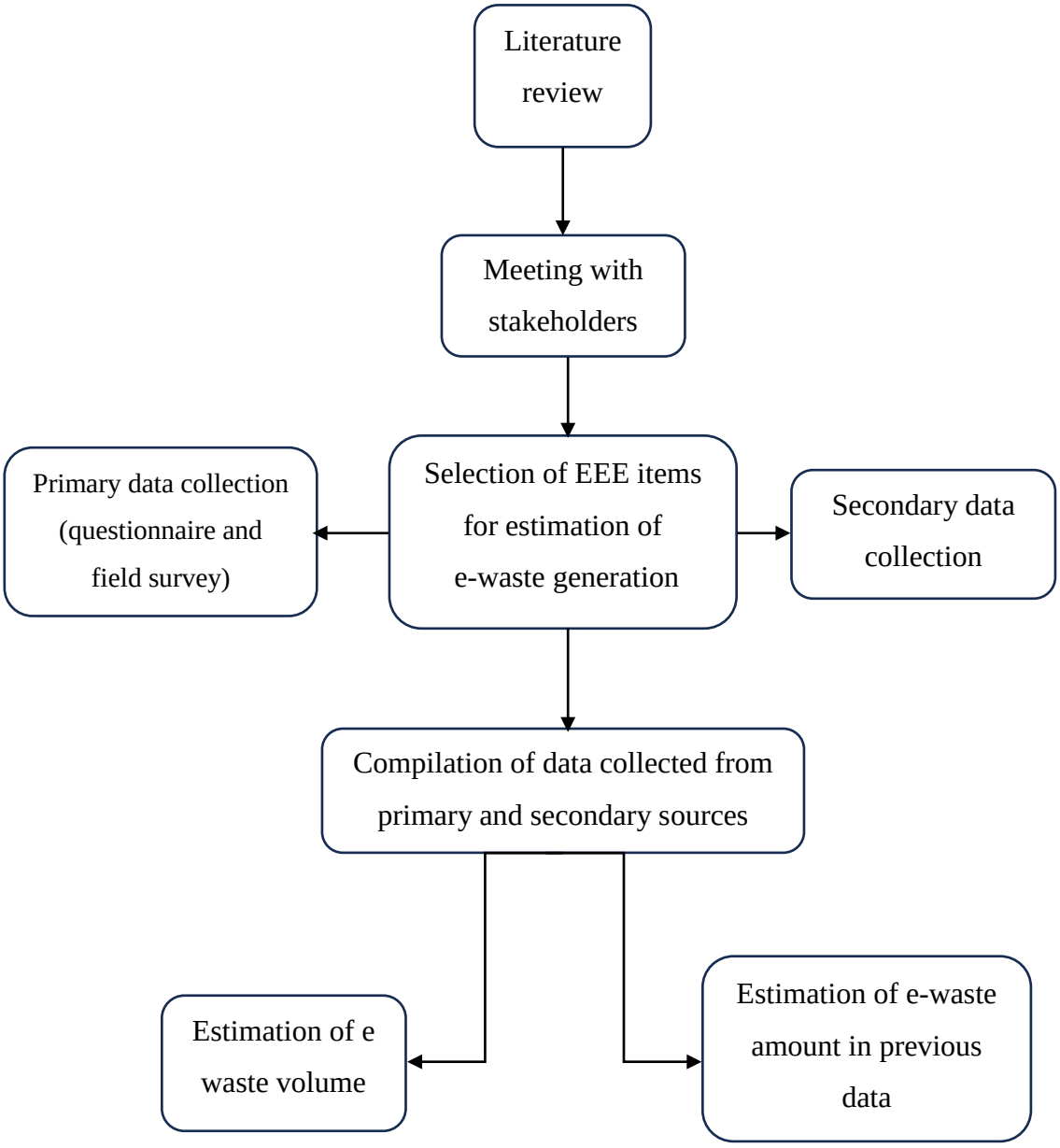


Figure 3-3. Flow Chart, The Methodology Adopted in E-waste Estimation

3.5 E-Waste Data Collection from Field Surveys

Collecting e-waste data from field servers means gathering details about old or unwanted electronic devices. This helps keep track of how much e-waste is created and makes sure it is recycled or thrown away safely. It protects the environment and saves resources by reducing harm from electronic waste. We use two methods of survey. Such as physical data collection and online data collection. We used Google Forms for online data collection.

3.5.1 Online Field Survey for Data Collection

Online field survey data collection is collecting data through surveys conducted over the google form. It helps to quickly gather feedback or information from people from different locations. This method is simple, fast and cost effective. We include all survey questions and data in the Appendix.

By researching the information from online and physical surveys, we have received several information from people. Are they aware of e-waste, collection methods, generation of e-waste, lifespan of electrical appliances, recycling, safe disposal, and health & environmental impact?

3.6 Collection Route, and Disposal of E-Waste in Dhaka City

3.6.1 Collection Route of E-Waste

Collection route information has been obtained from the field survey. The initial phase required the collection of details regarding the major wholesale marketplaces, which include IDB, Mirpur, Multiplan, Gulistan, Elephant Road, Chankharpul, Nimtali, and Tongi (Boubazar). The repair shops at these markets are located on various floors. These centers/shops generate or collect electronic waste from computers, mobile devices, batteries, air conditioners, CCTV systems, and televisions. Secondly, hawkers sell their waste to small scrap dealers. E-waste has been collected by hawkers from households and specific commercial buildings. E-waste is collected by small scrap dealers and then given to larger scrap dealers. They afterwards send to a processing Centre or recycling companies.

During the field survey, Cycle of e-waste collection route in Dhaka City is given below through the flow chart.

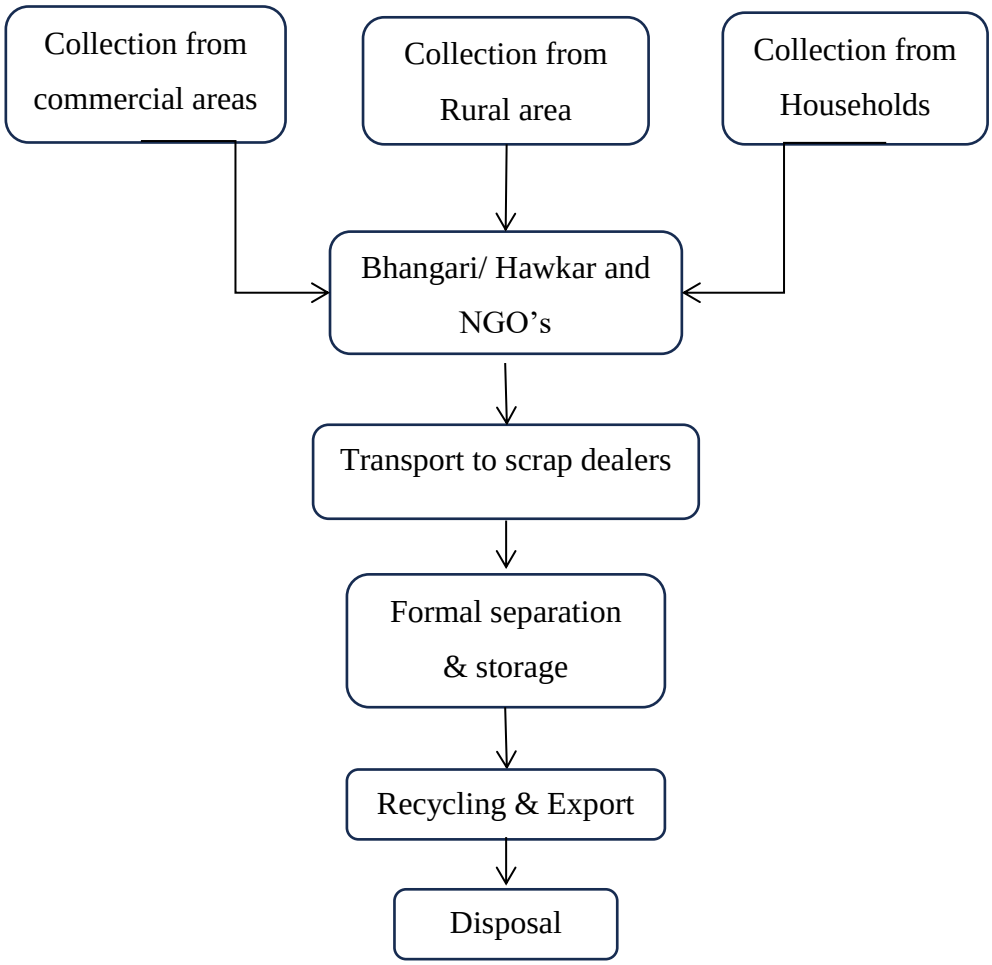


Figure 3-4 . Cycle of E-Waste Collection Route in Dhaka City

3.6.2 Recycling process of E-Waste

Collection route information was taken as secondary data from data obtained from Recycling Industry 1 and Recycling Industry 2. As of now, up to 97 per cent of the wastes are recycled in the informal sector. The recycling industry process key point in given below:

1. **Collection and Transportation**
2. **Reception and Sorting**
3. **Dismantling and Component Separation**
4. **Data Destruction**

5. **Further Sorting and Categorization**
6. **Processing and Refining**
7. **Recycling and Reuse**
8. **Proper Disposal of Non-Recyclable Materials**

3.6.2.1 Data from Recycler 1

Established in 2006, this recycling company has been exporting PCBs since 2008[8]. Their PCB processing capacity is 100 tons per month, and they export 30-50 tons of high-grade PCB each month[8]. Figure 3.5. depicts the actions that occur during the recycling process. Table 4.7 shows the amount of e-waste collected for processing and exporting by this recycler.

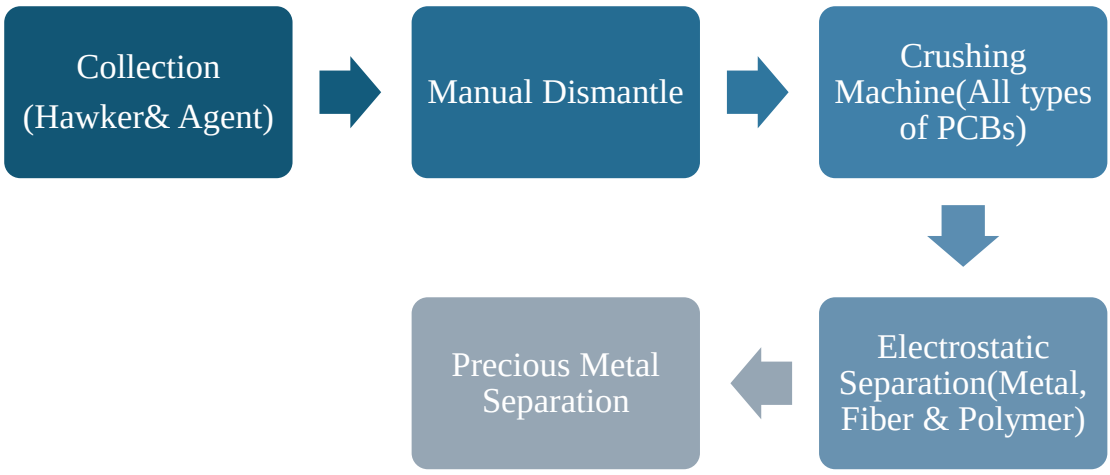


Figure 3-5. Flow diagram of Recycler-1



Figure 3-6. Recycling process (Recycler 1 & Recycler 2)

The key activities and other information gathered from the secondary data are summarized below:

- Monthly Processing: PCBs: 100 tons, Cable: 50 ton
- Machine capacity: 4-5 ton per day
- Export: 30-50 tons high grade PCBs
- Value Metal Recovery: Recycle 17 types of metal like Gold, Copper, Silver, Palladium etc. Recycled metal is 30% of PCB weight, of that Copper- 80%. Gold- 1%.
- Cable Recycling: Recover metals from zero (Teflon) cable. 30-40% copper is recovered from foreign cables. From local cable the percentage is 5-10%. The remaining is plastic.
- Active parts from waste equipment are resold or exported.

3.6.2.2 Data from Recycler 2

This factory, located near Hemayetpur Bus Stand in Savar, Dhaka, collects e-waste mainly from telecom industries, Bangladesh Police, and banks. Senior management reports they gather an average of 700 metric tons of e-waste from telecom companies, with 3-5% being printed circuit boards (PCBs). Between 2016 and 2017, they collected 300-400 metric tons of e-waste from telecom companies and 50 tons of communication devices from the police. In 2015-2016, they gathered 600 metric tons of metallic waste and 100 metric tons of PCB waste[8].

The company management expects that as the telecom sector has matured and stopped expanding, telecom companies will soon contribute less e-waste, while consumer electronics will become the main source. However, they predict that with the introduction of 5G technology in 2-3 years, existing telecom hardware will become outdated, creating around 20,000-50,000 metric tons of e-waste in the near future[8].

Cycle of e-waste collection route in Dhaka City is given below through the flow chart.

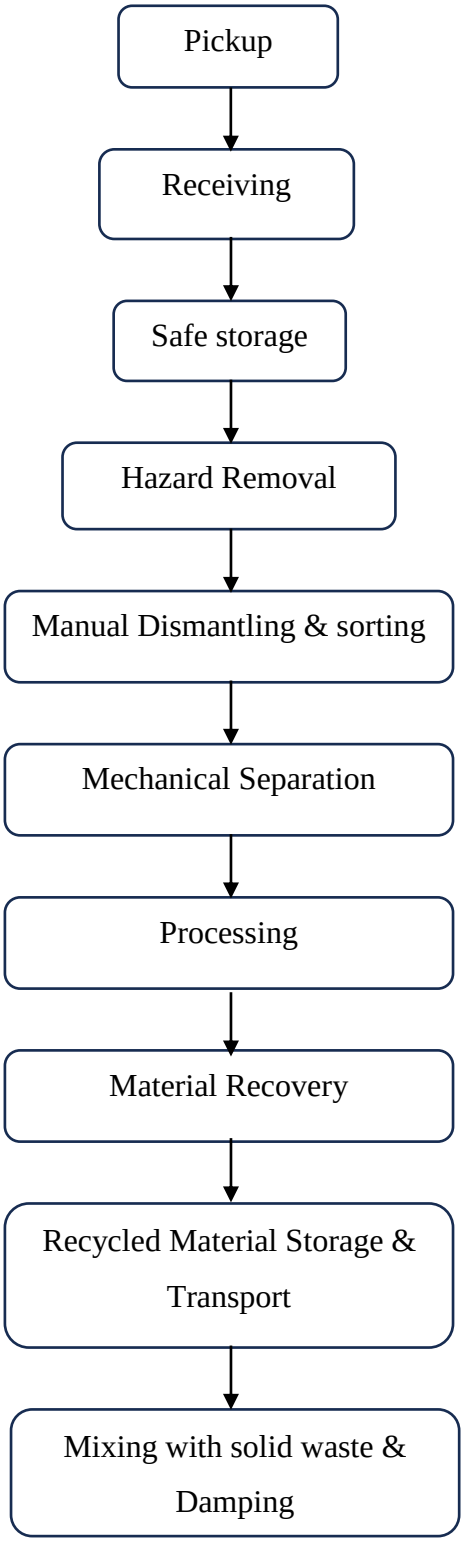


Figure 3-7. Cycle of E-Waste Recycling Route

3.6.3 Disposal of E-Waste

In this study, some e-waste is generated directly at disposal sites in the household and commercial sectors, and most of the unusable e-waste comes from the recycling industry. At the moment, just 5–10% of the entire amount of unused e-waste generated is disposed of.

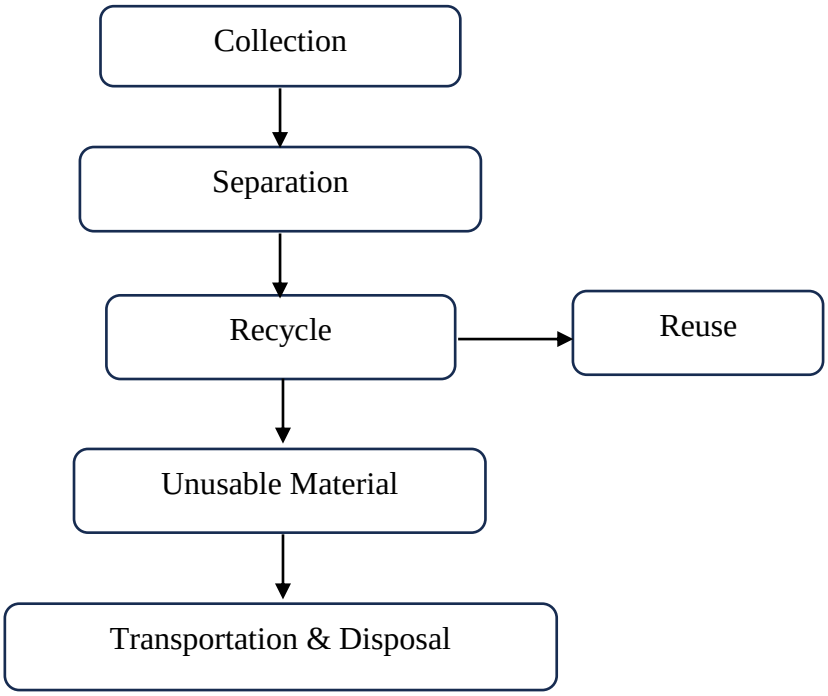


Figure 3-8. Cycle of E-Waste Disposal Route

3.7 Assessment of E-Waste Impacts on Human Health and the Environment

Improper handling, dismantling, recycling, and recovery of e-waste pose significant risks to both the environment and human health. Existing literature confirms that hazardous components in e-waste contribute to air, soil, and water pollution, as well as occupational health hazards (Chapter 2). However, establishing a definitive connection between e-waste exposure and adverse health outcomes requires clinical data on affected workers and populations. Collecting such data is highly complex, making it largely unavailable.

To address this challenge, the current study adopted two approaches to evaluate potential health impacts. The first is a direct approach involving questionnaires and field surveys conducted at selected locations (Figure 3.1). These surveys aimed to

assess workers' awareness of e-waste-related impacts and identify any health issues linked to their exposure.

The second approach is indirect, focusing on a health risk analysis for workers exposed to toxic chemicals through inhalation and ingestion. This analysis was conducted using the guidelines provided by USEPA (1989). Figure 3.3 illustrates the methodology flow for this impact assessment, with detailed information on the risk analysis method provided in Chapter 4

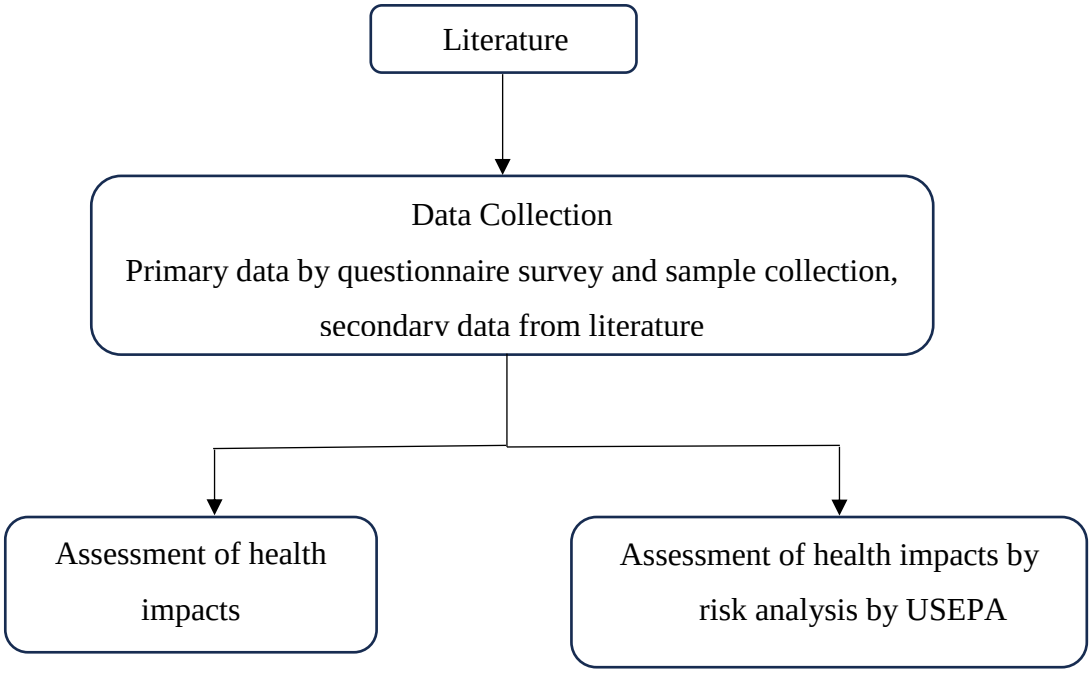


Figure 3-9. Flow Chart of Methods Adopted in Impact Assessment of E-wastes

3.8 Summary

This chapter discusses the research methodology. How data has been collected, how all research work has been done (including mapping) has been highlighted. The results and discussion of the data we got through the research are discussed in the next chapter i.e. Chapter-4.

CHAPTER 4
RESULTS AND DISCUSSION

4.1 Introduction

This research aims to evaluate existing data on e-waste in Bangladesh and predict future trends. While previous studies have looked at e-waste generation, none cover all items or the entire country comprehensively, and the data often shows significant differences. The chapter identifies major e-waste categories, reviews various data sources, and estimates e-waste quantities for 2020, 2025, 2030, and 2035. It combines secondary data on electronic consumption with a mathematical model and primary data from stakeholders to estimate e-waste within the waste stream.

4.2 Estimation of E-waste and its future trend

This text highlights the complexity of estimating e-waste generation due to diverse disposal behaviors and the lack of comprehensive data, particularly in developing countries. Here's a summary of the key points:

4.2.1 Methods of Estimation:

Several methodologies are employed to approximate e-waste generation, including:

- Market Supply Method
- Material Flow Analysis (MFA)
- Consumption Use Method
- Econometric Analysis

Each method varies in approach and accuracy, primarily due to differences in user behavior and end-of-life (EOL) scenarios for electronics.

4.2.2 Challenges in Estimation:

- Electronic goods like PCs have varied lifespans and disposal pathways (reuse, donation, storage, recycling, or component repurposing), making standardized estimation difficult.
- The absence of robust data, especially in developing countries, exacerbates the challenge.

4.2.3 Indicators for E-Waste Statistics:

- Total Electrical and Electronic Equipment (EEE) introduced into the market
- Total e-waste generated
- E-waste officially collected and recycled
- E-waste collection rate

While developed nations, especially EU countries with policies like Extended Producer Responsibility (EPR) and take-back systems, have reliable data on these indicators, countries like Bangladesh lack such frameworks and data.

4.3 Estimation of E-waste amount from primary data

The current study aimed to estimate the volume of e-waste generated in Dhaka City by gathering primary data from various stakeholders, including e-waste generators, collectors, recyclers, and exporters. To achieve this, questionnaires and field surveys were conducted with e-waste collectors, dealers, and owners of bhangari shops. According to information from the Department of Environment (DoE), nine registered recyclers and exporters are involved in e-waste recycling and export activities. Additionally, an approximate estimation of e-waste generation within educational institutions was carried out as part of this study.

4.3.1 E-wastes Data from Questionnaire and Field Survey

Primary data on e-waste generation was gathered through questionnaires and field surveys targeting e-waste collectors, dealers, bhangari shop owners, recyclers, and exporters. The surveys were conducted in five locations: Elephant Road, Nimtoli, Gulistan, Tongi, and Chankhar Pool. The findings revealed a significant number of shops in these areas that are involved in collecting, repairing, recycling, selling, and ultimately disposing of e-waste (Table 4.1).

Table 4-1. Number of Shops in Survey Areas Dealing with WEEE

Type of shop	Elephant Road	Chankhar Pool	Nimtoli	Tongi (Bou-Bazar)	Gulistan	Mirpur
Computer Repairing & Used Computer Collector Shops	600-700	--	--	--	--	20-25
Mobile Repairing & Used Mobile Collector Shops	600-650	--	--	20-25	5-6	--
Bhangari Shops (E-Waste Collector)	5-7	20-25	40-50	20-22	--	--
Refrigerator& AC Repairing Shop s	--	20-25	--	--	--	--
CCTV, TV, Printers & Battery Collector Shops	--	--	12-15	4-5	--	--

The survey revealed that shops at Elephant Road, Nimtoli, Tongi (Bou Bazar), Gulistan etc. primarily focus on collecting, repairing, recycling, and reselling used or obsolete computers, mobile phones, and their accessories. In contrast, shops in Nimtoli and Chankhar Pool mainly handle discarded items such as air conditioners, televisions, freezers, computers, cables, fans, toasters, and microwave ovens. A summary of the data collected during the field survey is presented in Table 4.1.

Table 4-2. Amount of E-wastes Collected by E-waste Collectors

Locations	Items	E-Waste Amount Average (kg/month)
Motalib Plaza and IDB	Computer and its accessories, Mobile phones, PCB of Computers and mobile phones, CRT Monitor, Sim Cards and others	4305
Mirpur	Computer and its accessories, PCB of Computers, CRT Monitor and others	60
Gulistan	Mobile phones, PCB of mobile phones, Sim Cards and others	1901

Table 4-3. Amount of E-wastes in Bhangari Shops, Dealers in Survey Locations

Locations	E-Waste Amount Average (kg/month)
Elephant Road	16145
Chankhar Pool	50400
Nimtoli	243750
Tongi (Bou Bazar)	85200

The survey findings show that there are number of Bhangari shops in those stated locations (Table 4.3). An approximate amount of e-waste has been calculated from this average amount multiplied by the number of shops and is presented in Table 4.4

Table 4-4. Total Amount of E-wastes in Studied Locations

Locations	Amount of E-waste's (kg/month)	Total Amount (kg/month)	Total Amount (kg/year)
IDB and Motalib Plaza	4305	401761	4821132 (4821.132) Ton/Year)
Mirpur	60		
Gulistan	1901		
Elephant Road	16145		
Chankhar Pool	50400		
Nimtoli	243750		
Tongi (Bou Bazar)	85200		

4.4 Evaluation of Generated E-wastes from Previous Studies

A review of existing data indicates that mobile phones, computers, TVs, freezers, air conditioners, and CFL bulbs are the primary contributors to e-waste [8]. The current study highlights an increasing contribution of IT servers to the e-waste stream, driven by the rapid evolution of telecommunication technologies, such as the transition from 3G to 4G and eventually 5G within a short timeframe. Other sources of e-waste, such as washing machines, medical and dental equipment, and microwave ovens, have a less significant impact, with limited data available on their contributions. Table 4.5 presents a comparison of available data on the major e-waste items reported in previous studies.

Table 4-5. Amount of E-wastes in Previous Studies

Studies	Items	Total E-Waste Amount/Year
Reza & Yusuf, 2012	Mobile, Computer	25600 Ton
ESDO, 2014 (Million Ton)	Mobile, Computer, TV, AC, Freeze, CFL Bulb, Medical and Dental Equipment Waste and Ship Breaking Yard	9.81 Million Ton (0.94 MT excluding Ship breaking yard's e-wastes)
Choudhury, 2014	--	0.004 MT (309105 kg/month)
Re-Tem, 2015 (For DSMA, in piece)	Mobile, Computer, TV, AC, Freeze, CFL Bulb	70000 Ton
Balde et al, 2017	--	142000 Ton
CERM (BUET), 2019	Mobile, Computer, TV, AC, Freeze, CFL Bulb	6200 Ton

Table 4.5 shows varying e-waste amounts reported across studies. ESDO (2016) included more items than Re-Tem (2015), which focused only on Dhaka's metropolitan area, while ESDO covered Dhaka and Chittagong. Other studies provided data only for mobile phones and computers, with limited details on methods or locations.

According to ESDO, 8.86 metric tons of e-waste come from shipbreaking yards. Without this, the total e-waste is 955,000 tons, differing from Re-term's 7,000-ton estimate for DSMA. The Global E-Waste Monitor (2017) reported 142,000 tons of e-waste in Bangladesh in 2016. These differences show the difficulty in accurately estimating e-waste in Bangladesh.

A notable inconsistency in previous studies lies in the growth rates of certain items. For instance, ESDO used a uniform growth rate of 29% for CFL bulbs, while Re-Tem estimated a declining rate (15% to 2%), which aligns better with the current trend of decreasing CFL use due to the rise in LED bulb adoption.

The ESDO figure for e-waste from shipbreaking industries (8.86 MT) also raises concerns. Their calculation assumes that 200 ships annually bring 500 containers each, loaded with 1,200 computers—a claim that seems exaggerated and difficult to verify. Not all ships arriving at Bangladesh's shores are fully loaded with illegal computers.

In 2023, total e-waste generation in Asia was 30 MT, including 4.2 MT in China and 1710000 Ton in India [12]. Comparing these figures, ESDO's estimate for Bangladesh appears disproportionately high and unrealistic. However, excluding the shipbreaking yard contribution, the total of 955000 Ton aligns more reasonably with figures from neighboring countries like India.

4.5 Discussion On Assessment of E-Wastes Generation and Its Future Trend

This study used two methods to assess e-waste in Bangladesh. The first method analyzed market data on sales and imports to estimate waste generated when products become obsolete. The second method relied on field visits, interviews, surveys, and discussions with stakeholders to gather primary data.

Chapter 4's Figure 4.1 displays Bangladesh's expected e-waste growth. This data shows that the amount of e-waste is currently 0.40 million tons (2018) and is expected to reach 4.62 million tons by 2035, with an annual growth rate of almost 20%. This rate is really high. This growth that can be linked to Bangladesh's fast urbanization and industrialization as well as the widespread usage of electronic appliances in homes, businesses, and industries in line with the population's rising purchasing power.

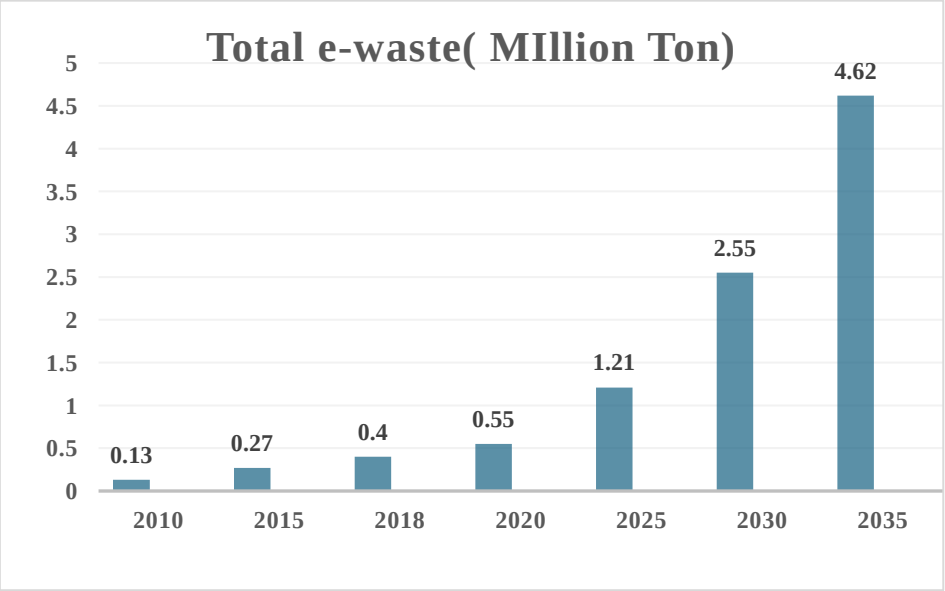


Figure 4-1. Estimated amount of E-wastes in Bangladesh up to Year 2035

Additionally, the outlook of the current manufacturing industry is to create inexpensive, short-lived items, which leads to an increase in waste. 'The Global E-Waste Monitor' report [12] states that in 2016, the world's total e-waste was 44.7 million tons, of which

18.2 million tons came from Asia (the 49 Asian countries). The estimate for Bangladesh in the current study (0.31 million tons) seems reasonable when compared to the amounts of China (7.21 million tons) and India (1.97 million tons) in 2016 [12]. The estimated quantity of e-waste in Bangladesh in 2016 as determined by the current study is compared with the results of earlier research in Table 4.6.

Table 4-6. Comparison of E-wastes in Bangladesh for Year 2016 among Different Studies

ESDO (2016)	Balde et al. (2017)	CERM, BUET (2019)	Present Study (2024, Dhaka)
9.81 Million Ton	142000 Ton	6200 Ton	4821.132 Ton

Table 4.6 shows significant variations in e-waste estimates across three studies. The difference between ESDO and the current study stems mainly from ESDO's inclusion of 8.86 million tons of e-waste allegedly from illegally imported ship recycling, while the current study is based on field data. Balde et al. (2017) used unclear methods, making comparisons difficult. The lack of a formal e-waste management system in Bangladesh means there are no reliable records on EEE usage, recycling, or exports. Previous estimates focus on specific items, regions, or years, making them incomparable to the current study.

4.6 E-waste Data from Recycling Industries

Recycling information was taken as secondary data from data obtained from Recycling Industry 1 and Recycling Industry 2 which is previous studies.

Table 4-7. Data collected from Recycler 1

Amount of E-waste (in ton)	2013	2014	2015	2016	2017	2018	Total e-waste	Avg. E-waste (Ton/Year)
E-waste Collection	3434.7	-	257.9	166.9	165.5	215.7	5729.9	1145.98
E-waste Export	647.9	113.2	90.5	17.5	108.9	-	978.1	195.6

Table 4-8. Data collected from Recycler 1

Amount of E-waste (in Ton)	2014	2015	2016	2017	Total e-waste	Avg. E-waste (Ton/Year)
E-waste Collection	225	180	200	450	1055	700

4.7 Field Survey

In direct method, questionnaire survey was conducted among the people who are involved in collection, dismantling, separation, processing and recycling of e-wastes to know about the health effects of e-wastes (Photos 5.1 and 5.2). The study locations are Elephant Road, Chankharpool, Gulistan, Toungi Bow bazar and Nimtoli.

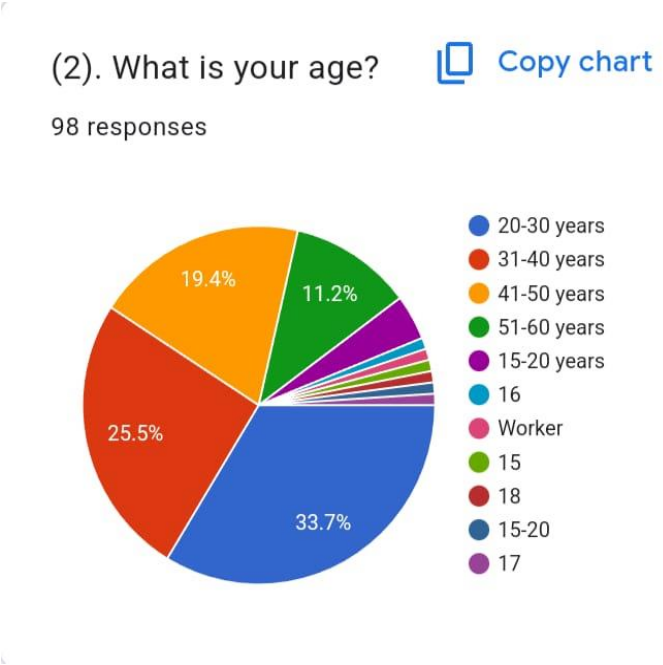
We asked some questions to common people while collecting data at the field level. Below is the question and its result in pie chart form.

1. What is your occupation?



Figure 4-2. Pie Chart of Survey Findings Question 1

2. What is your age?



3. What is your highest Level of Education?

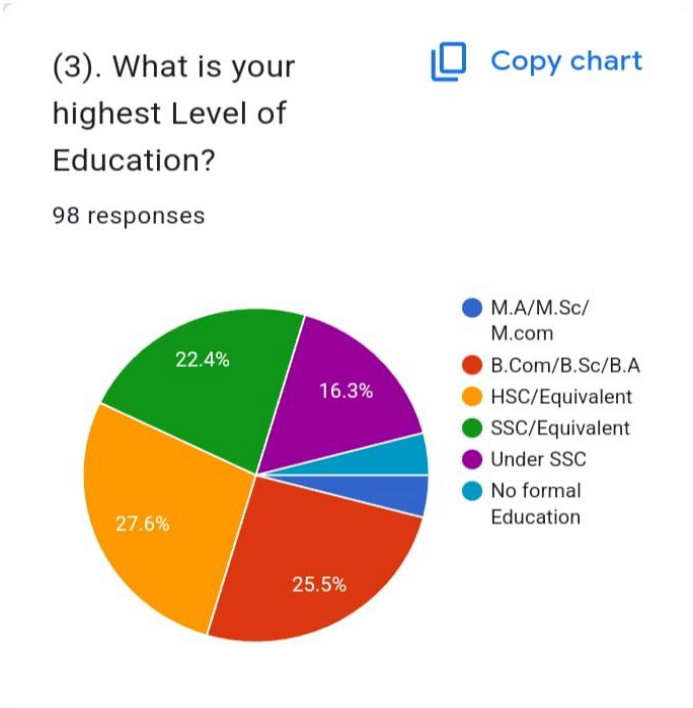
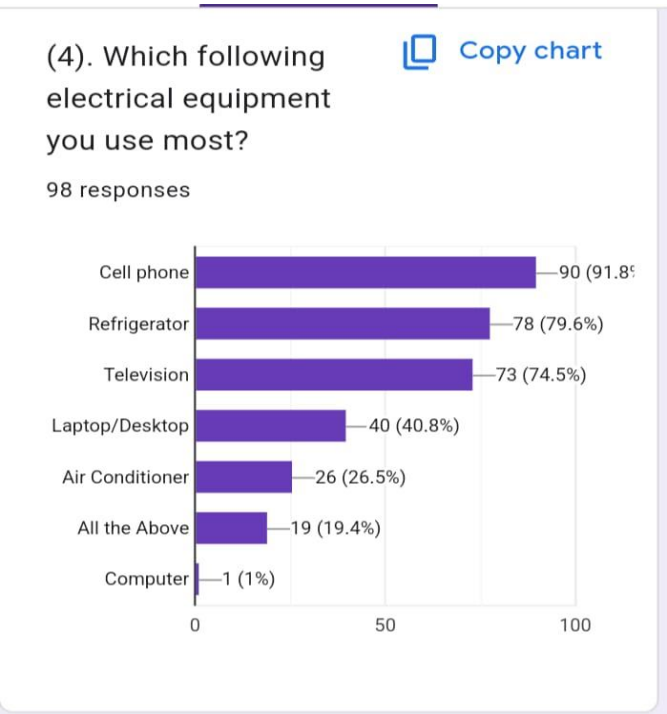


Figure 4-3. Pie Chart of Survey Findings Question 2&3

4. Which following electrical equipment you use most?



5. Do you know anything about E-waste?

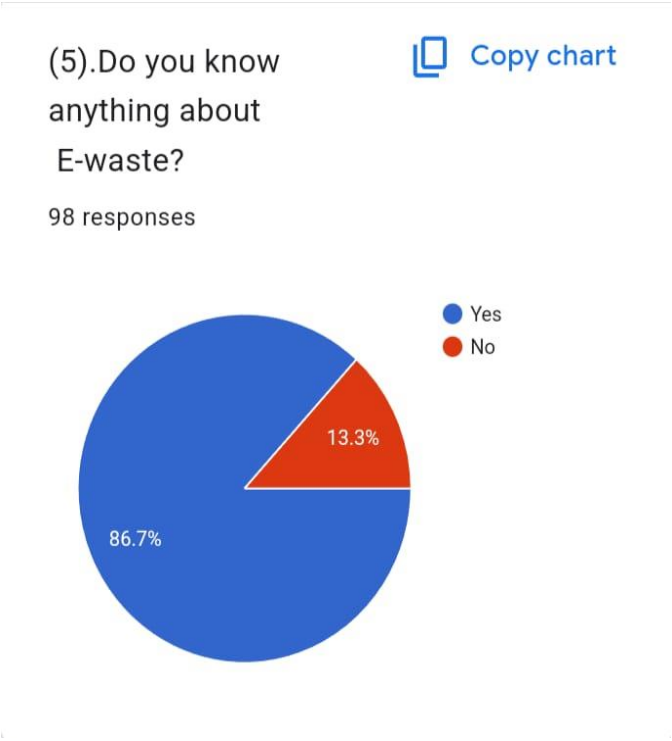
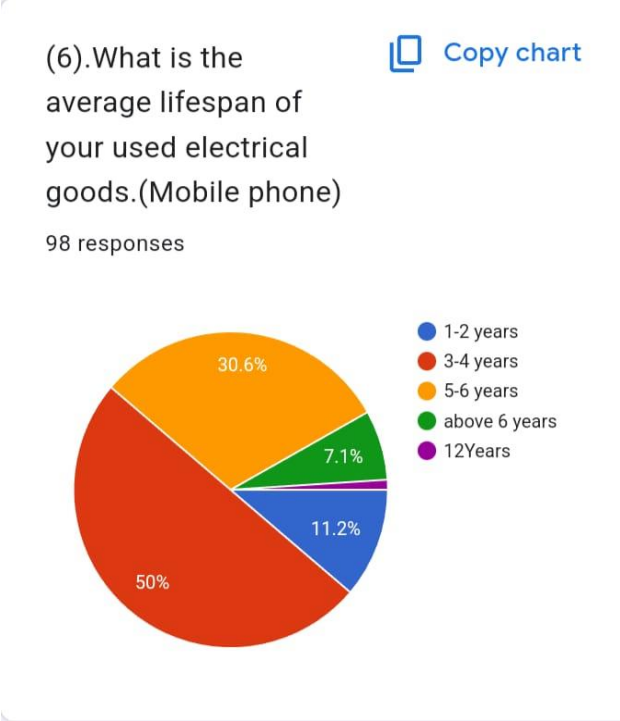


Figure 4-4. Pie Chart of Survey Findings Question 4&5

6. What is the average lifespan of your used electrical goods?

A. This pie chart for Mobile phone



B. This pie chart for Desktop & laptop

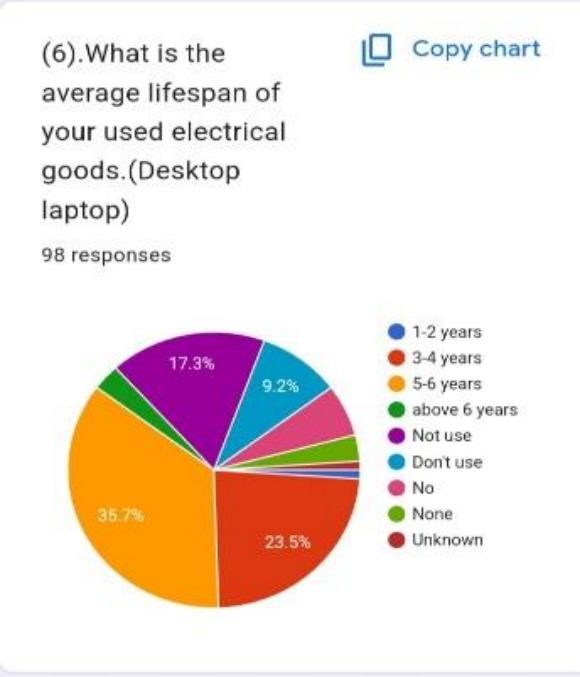
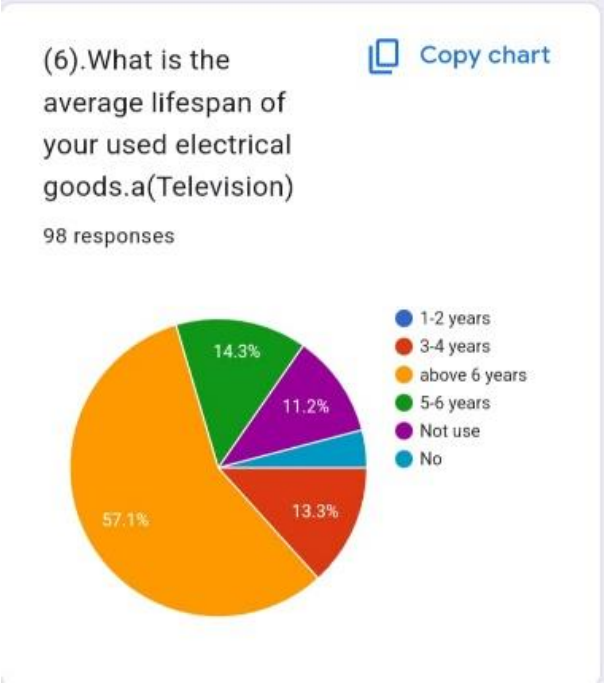


Figure 4-5. Pie Chart of Survey Findings Question 6(A&B)

C. This pie chart for Television



D. This pie chart for Air conditioner

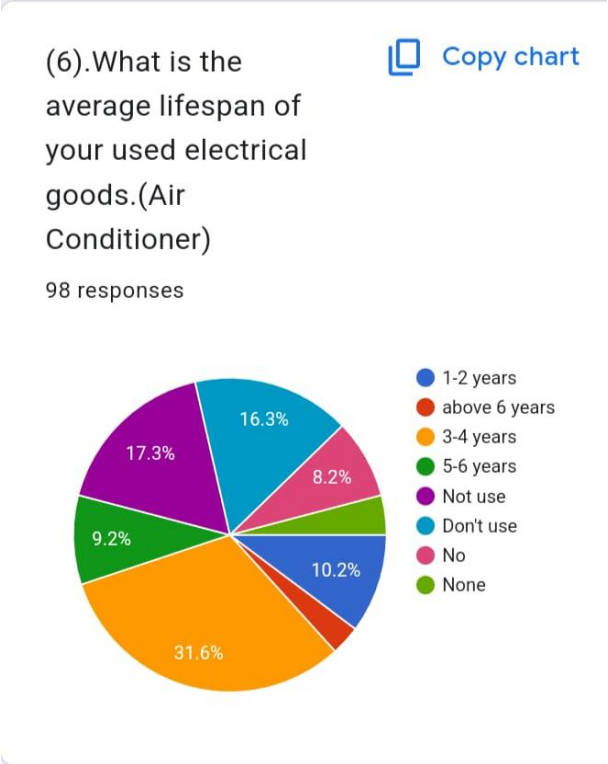
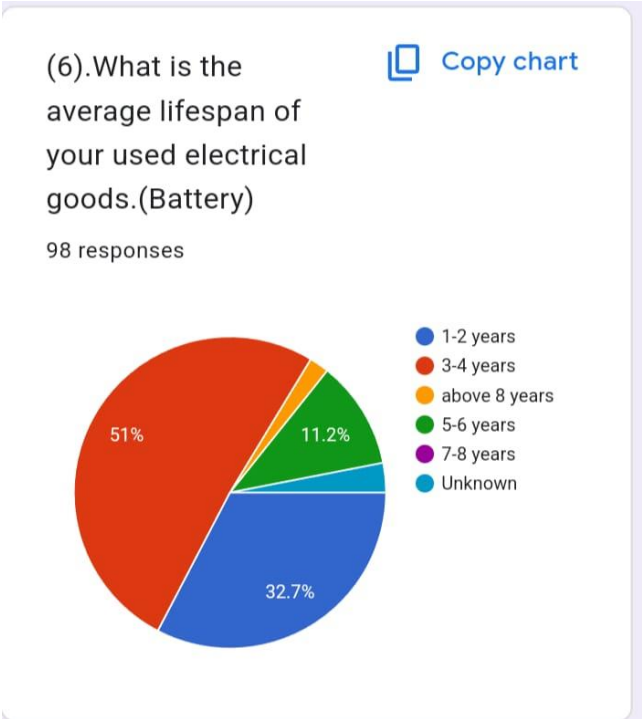


Figure 4-6. Pie Chart of Survey Findings Question 6(C&D)

E. This pie chart for Battery



F. This pie chart for Refrigerator

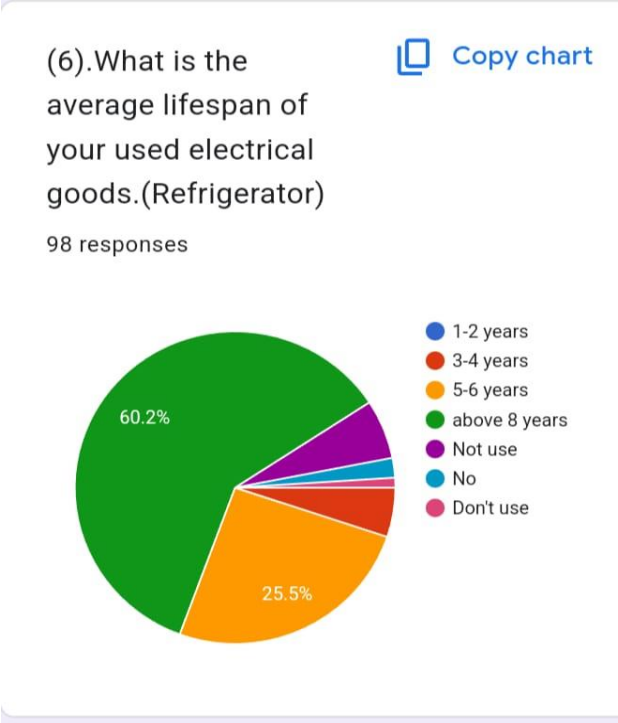
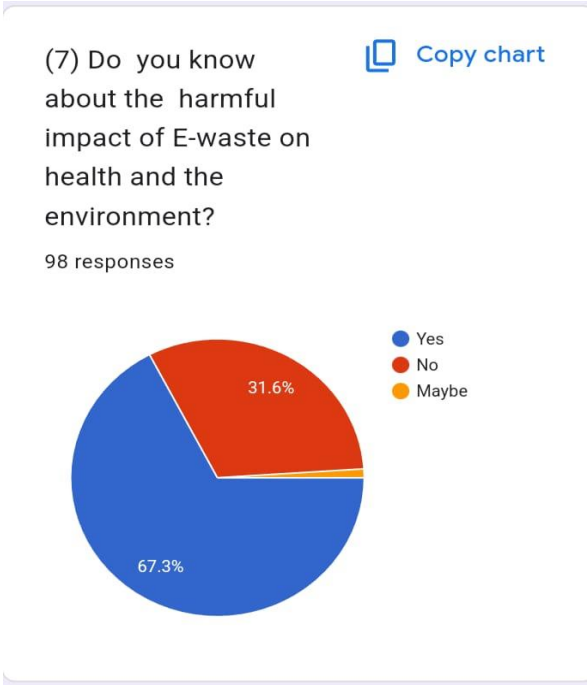


Figure 4-7. Pie Chart of Survey Findings Question 6(E&F)

7. Do you know about the harmful impact of e-waste on health and the environment?



8. Do you know anything about the recycling of e-waste?

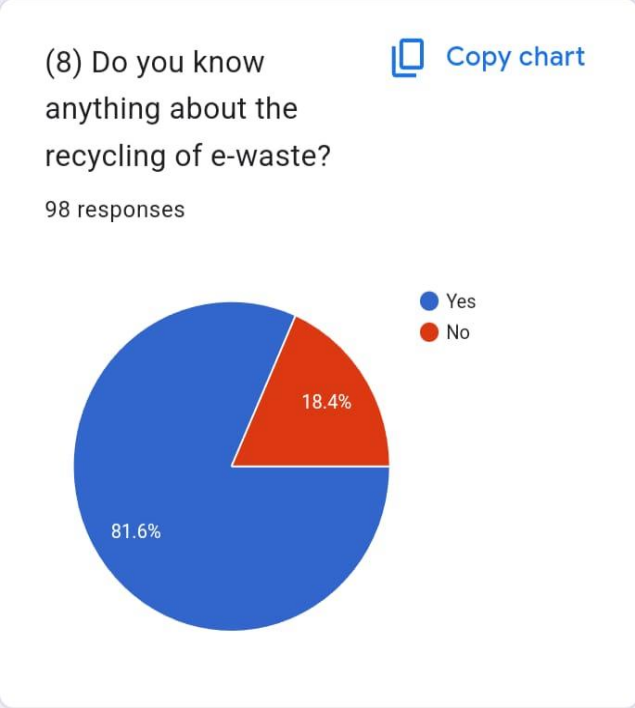
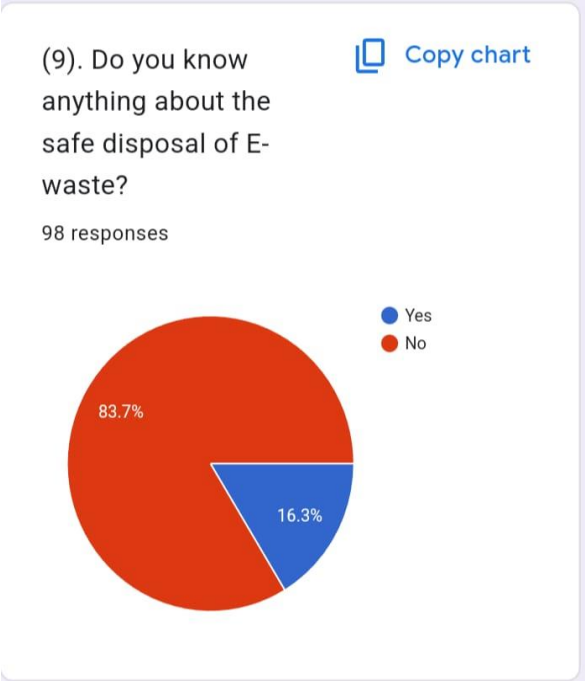


Figure 4-8. Pie Chart of Survey Findings Question 7&8

9. Do you know anything about the safe disposal of E-waste?



10. In your opinion, which of the following area affected most for unsafe disposal of E-waste?

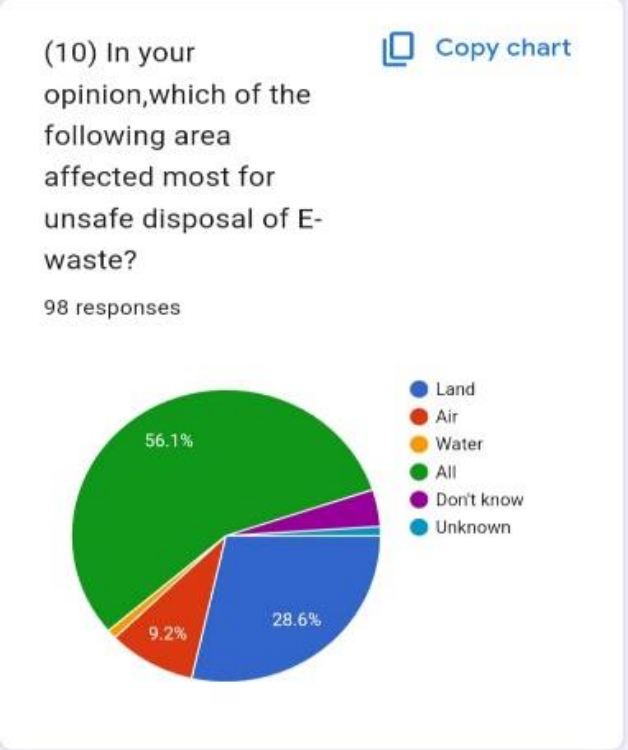


Figure 4-9. Pie Chart of Survey Findings Question 9&10

11. Is there any e-waste management policy in your institution?

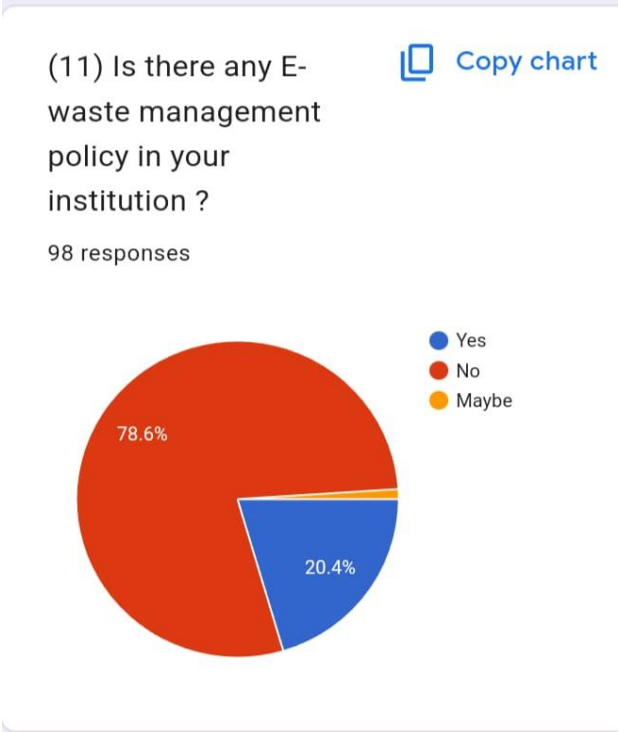


Figure 4-10. Pie Chart of Survey Findings Question 11

4.8 Discussion On Assessment of Impacts of E-Wastes

E-waste contains harmful substances that can damage human health and the environment. A study found high levels of toxic chemicals in computer and phone parts, which can cause diseases like cancer and neurological problems. In Bangladesh, poor handling of e-waste leads to pollution, with toxic metals contaminating soil, water, and air. This pollution affects nearby communities, the food chain, and wildlife. The study revealed that most e-waste in Bangladesh ends up in landfills, causing serious environmental harm.

4.9 Discussion On Draft E-Waste Guidelines

The 2016 draft E-waste Management Guidelines for Bangladesh promote Extended Producer Responsibility (EPR), which makes manufacturers responsible for managing products at the end of their lifecycle. While countries like Germany and France successfully use EPR, Bangladesh needs to evaluate its conditions, public acceptance,

and institutional capacity for implementation. EPR could raise consumer costs, so combining it with local government monitoring and public awareness campaigns is recommended. Incentives for recycling businesses and further stakeholder discussions are suggested to finalize the guidelines

4.10 Proposal Diagram of management system in Dhaka city

Our field research revealed that many e-waste has weaknesses from collection to processing. So, we created a proposed diagram, which, if followed, will make e-waste collection, recycling, and disposal much easier. This will significantly lower the risk of pollution and harm to human health.

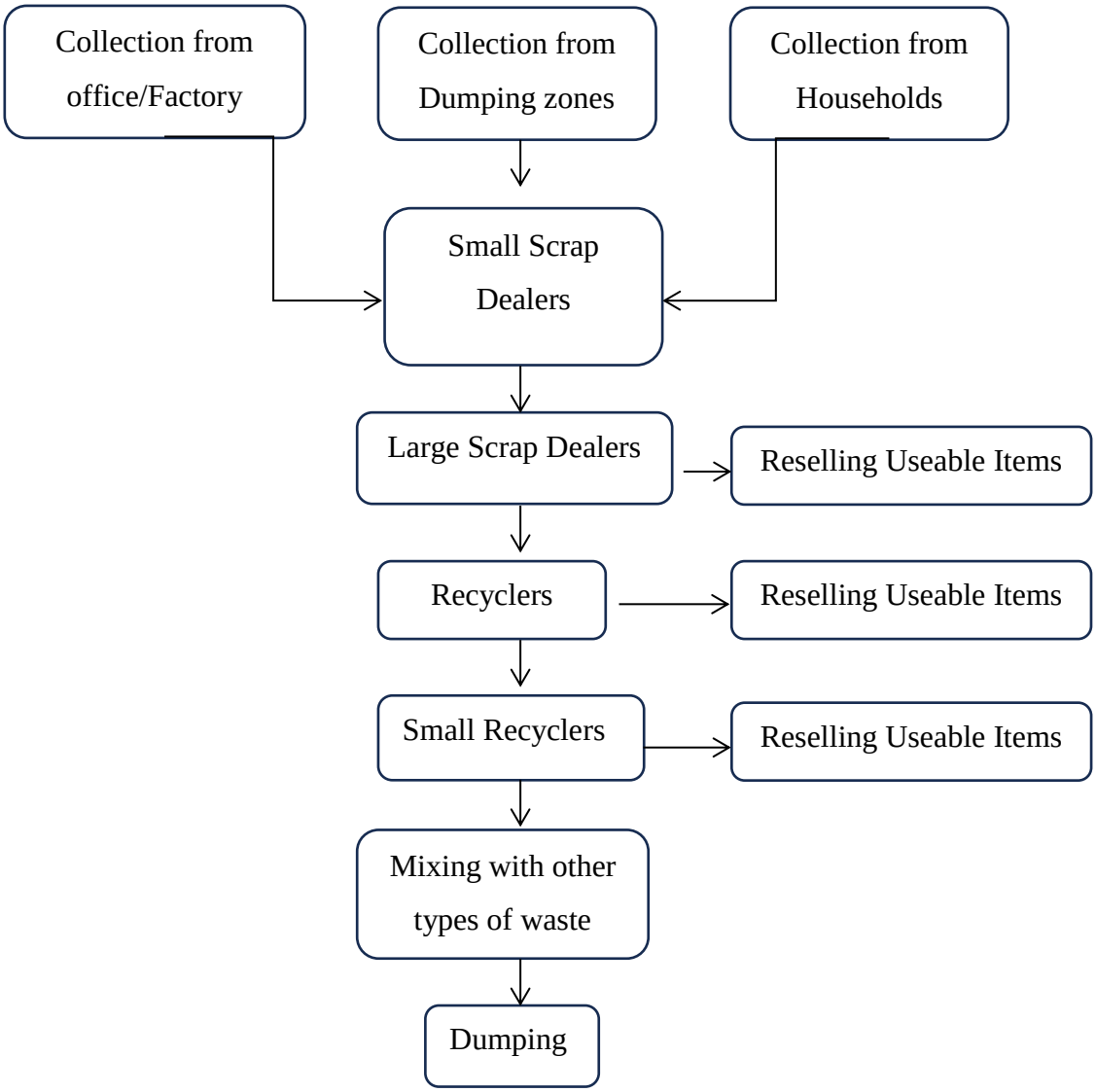


Figure 4-11. Existing E-Waste Management System in Dhaka City

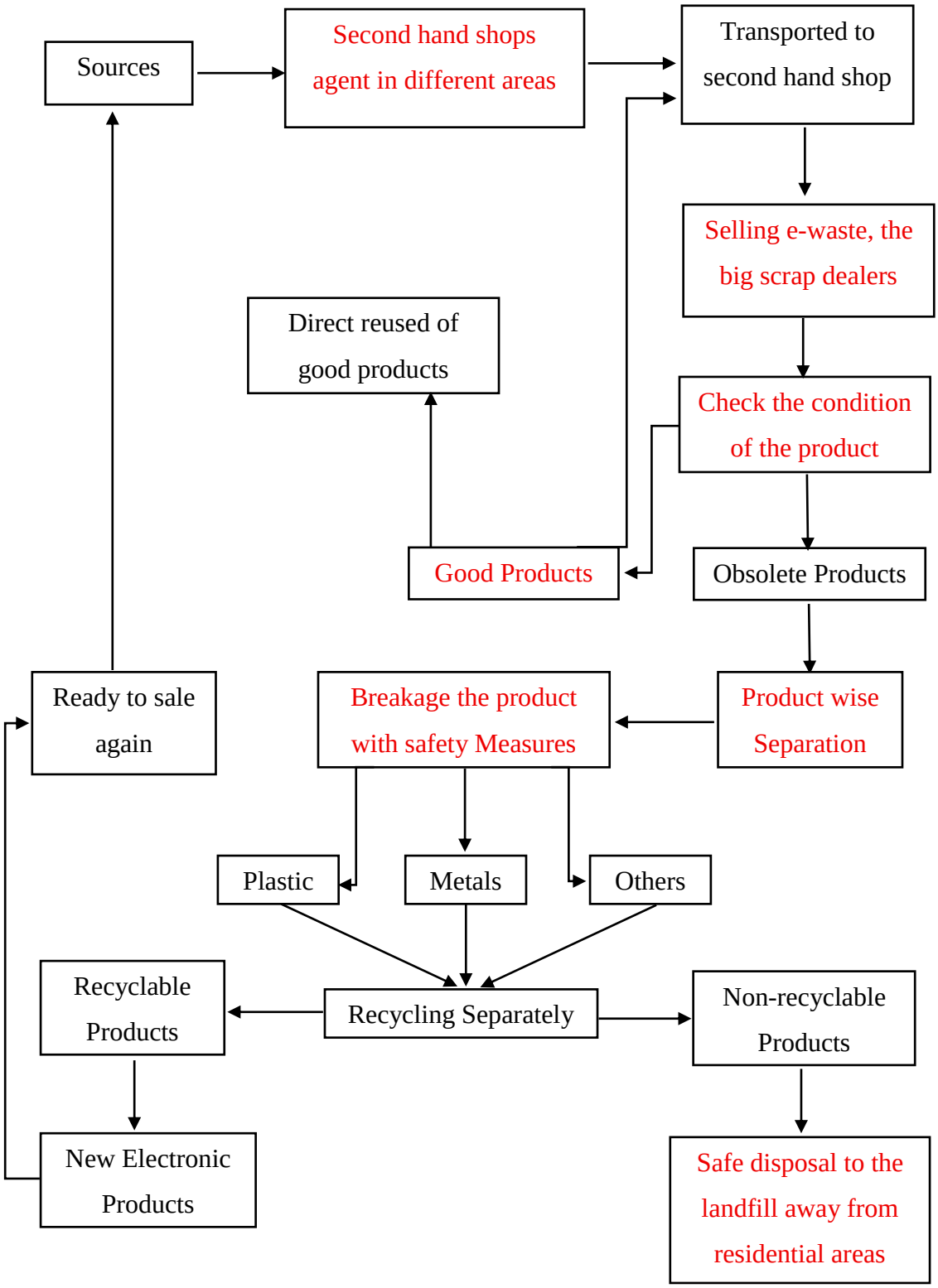


Figure 4-12. Proposal Diagram of management system in Dhaka city

4.11 Predicted E-Waste Generation of Dhaka City up to Year 2050

Our study reveals that the e-waste generation in Dhaka City for 2024 is estimated at 0.0048 million tons, which is 23% lower than the findings of a 2019 study conducted by CERM (BUET). According to the 2019 research, e-waste generation in the city was recorded at 0.0062 million tons. Despite the current reduction, e-waste generation is growing steadily at an approximate rate of 20% per year.

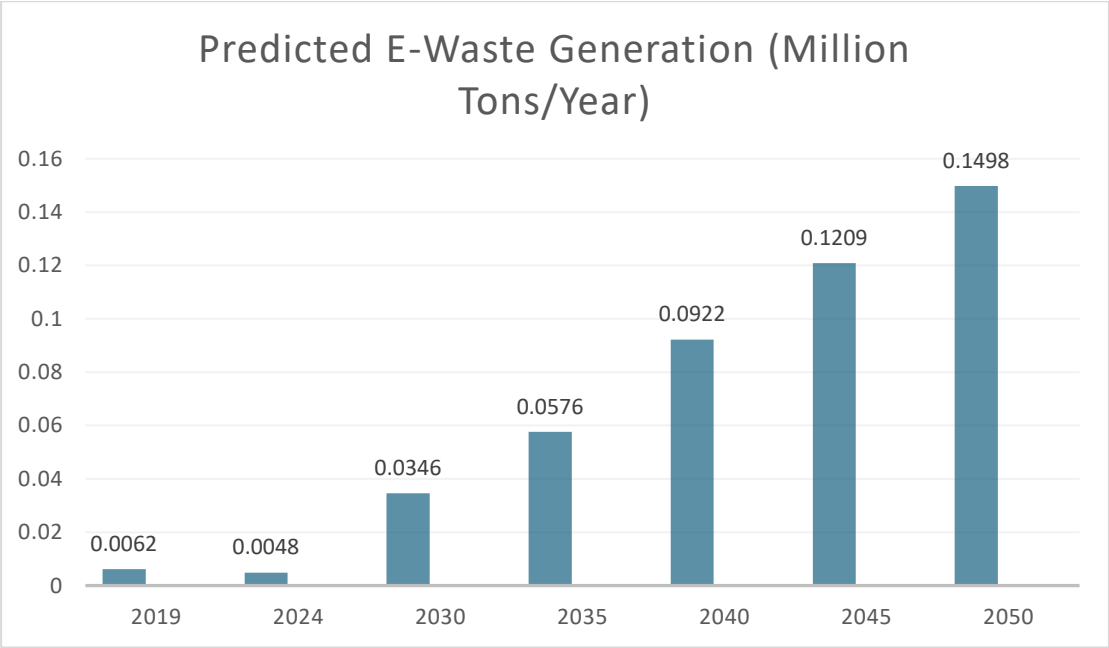


Figure 4-13. Predicted E-waste Generation Rate in Dhaka City Up to Year 2050

4.12 Summary

This chapter mentions the data obtained from the research and shows the results. The impact of the results on the research is discussed in detail. In the next chapter-5, some final discussions of the research and what else can be done on this research in the future will be discussed.

CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

This project has collected data from the field survey. By calculating the data provided from the survey, the amount of e-waste generation in Dhaka city in a year has been calculated. The amount is 4821.132 Ton/Year. We also discuss about existing collection route, recycling process and disposal information from secondary data. Currently, the e-waste collection route, recycling process, and finally the disposal diagram has been described. Each year, 0.0133 million tons of e-waste enter recycling[8]. By calculating the data obtained from the survey, the volume of e-waste generation is compared with the volume of e-waste generation in previous studies (CERM, BUET 2019). The amount of e-waste generation we obtained is 23% lower than the amount of e-waste in previous studies. As a result, that the main reason is the Corona pandemic and the annual economic recession. Therefore, this study includes a predicted e-waste generation chart for Dhaka City up to the year 2050. On the other hand, the amount of environmental and human health effects of e-waste has been discussed in details. A future recommendation diagram has been created by discussing the weaknesses in the management of e-waste. The diagram discusses e-waste collection, recycling, and disposal in a simpler way.

5.2 RECOMMENDATIONS

Electronic waste is the fastest growing type of waste in the modern world. Bangladesh's rapid economic growth and technology advancements have led to an increase in e-waste output. Managing this garbage sustainably is a significant concern for the country. Based on the research results and discussion, the following recommendations are made:

- An inventory and database of e-waste (at least for chosen items) should be created;
- To properly manage e-waste, separate facilities for collection, processing, recycling, recovery, and disposal should be developed.
- Priorities consumer awareness campaigns (e.g., posters, brochures, leaflets, and radio-TV advertisements) to ensure effective collecting systems.

- We should create more and more public awareness campaigns about properly utilized e-waste items.
- Workers' health and safety should be ensured in the recycling process.
- The government should encourage industrialists and businesses to establish recycling and recovery plants, promoting sustainable development.
- Collaboration or partnership with foreign countries who recycle, reuse and disposal the e-waste.

5.2.1 Possible Solutions and Future Direction

To manage e-waste more sustainably, Dhaka could benefit from establishing designated e-waste collection points, dedicated recycling facilities, and stricter regulations around e-waste handling. Additionally, public awareness and corporate responsibility programs would help divert e-waste from informal channels to proper recycling facilities, reducing the impact on the city's landfills and natural resources. Currently, the amount of e-waste being disposed of is relatively low. However, its volume is expected to increase in the future, necessitating the development of dedicated disposal routes.

5.3 CONSTRAINTS AND LIMITATIONS

The study team faced several limits and problems while carrying out the job. Some examples are as follows:

- Our team faced significant challenges when conducting the questionnaire and field survey. E-waste collectors, dealers, and bhangari shop proprietors were not cooperative in providing information due to unknown fear, insecurity, and a lack of awareness.
- Collecting sales/import statistics for EEE items was challenging due to the lack of a register system.
- Due to limited data, waste generation estimates depend on assumptions and approximations.

- The assessment of health risks from respiration was based on secondary data due to a lack of primary data.
- The main challenge in recovering desired metals was the need to use different technologies for processing different materials extracted during recycling.
- The complex nature of PCBs may hamper metal recovery in hydrometallurgical operations.
- E-waste recycling companies could not contact us, so that it could not include any recycling data in our thesis paper.

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APPENDIX

When we conducted the survey in the field, we asked the participants some simple questions. The questions are provided below.

Q-1

Part A: Information About Participants

1. What is your occupation?

    a) Service

    b) Business

    c) Self Employed

    d) Unemployed

    e) Housewife

    f) Student

    g) Others

2. What is your age?

a) 20-30 years

b) 31-40 years

c) 41-50 years

d) 51-60 years

3. What is your highest Level of Education?

    a) M.A/M.Sc/M.com

    b) B. Com/B.Sc/ B.A

    c) HSC/Equivalent

    d) SSC/Equivalent

    e) Under SSC

    f) No formal Education

4. Which following electrical equipment you use most?

    a) Cell phone

    b) Refrigerator

    c) Television

    d) Laptop/Desktop

    e) Air Conditioner

    f) All the above

5. Do you know anything about E-waste?

    a) Yes

    b) No

Q-2

Part B: Survey on Citizens Awareness

6. What is the average lifespan of your used electrical goods?

Mobile Phone: a) 1–2 years b) 3–4 years c) 5–6 years d) above 6 years

Desktop/Laptop: a) 1–2 years b) 3–4 years c) 5–6 years d) above 6 years

Refrigerator: a) 1–2-year b) 3–4-year c) 5–6-year d) 7–8-year e) above 8 years

Television: a) 1–2 years b) 3–4 years c) 5–6 years d) above 6 year

Air Conditioner: a) 1–2 years b) 3–4 years c) 5–6 years d) above 6 years

Battery: a) 1–2 years b) 3–4 years c) 5–6 years d) 7–8 years e) above 8 years

7. Do you know about the harmful impact of e-waste on health and the environment?

   a) Yes

   b) No

8. Do you know anything about the recycling of e-waste?

   a) Yes

   b) No

9. Do you know anything about the safe disposal of E-waste?

    a) Yes

    b) No

10. In your opinion, which of the following area affected most for unsafe disposal of E-waste?

    a) Land

    b) Air

    c) Water

    d) All

11. Is there any e-waste management policy in your institution?

    a) Yes

    b) No

Table 5-1. Online data survey first four question

Timestamp	(1) What is your occupation?	(2). What is your age?	(3). What is your highest Level of Education?
1/5/2025	Business	20-30 years	HSC/Equivalent
1/5/2025	Business	31-40 years	HSC/Equivalent
1/5/2025	Business	41-50 years	Under SSC

1/5/2025	Business	41-50 years	SSC/Equivalent
1/5/2025	Self Employed	20-30 years	B.Com/B.Sc/B.A
1/5/2025	Self Employed	31-40 years	B.Com/B.Sc/B.A
1/5/2025	Business	31-40 years	B.Com/B.Sc/B.A
1/5/2025	Service	51-60 years	HSC/Equivalent
1/5/2025	Business	31-40 years	SSC/Equivalent
1/5/2025	Service	20-30 years	SSC/Equivalent
1/5/2025	Worker	15-20	Under SSC
1/5/2025	Business	20-30 years	HSC/Equivalent
1/5/2025	Student	17	Under SSC
1/5/2025	Business	41-50 years	SSC/Equivalent
1/5/2025	Worker	15-20 years	Under SSC
1/5/2025	Service	20-30 years	HSC/Equivalent
1/5/2025	Business	31-40 years	SSC/Equivalent
1/5/2025	Unemployed	15	Under SSC
1/5/2025	Self Employed	20-30 years	B.Com/B.Sc/B.A
1/5/2025	Business	31-40 years	HSC/Equivalent
1/5/2025	Student	20-30 years	B.Com/B.Sc/B.A
1/5/2025	Self Employed	18	SSC/Equivalent
1/5/2025	Others	51-60 years	Under SSC
1/5/2025	Service	51-60 years	B.Com/B.Sc/B.A
1/5/2025	Service	31-40 years	HSC/Equivalent
1/5/2025	Business	41-50 years	HSC/Equivalent
1/5/2025	Service	20-30 years	HSC/Equivalent
1/5/2025	Business	41-50 years	B.Com/B.Sc/B.A
1/5/2025	Business	51-60 years	SSC/Equivalent
1/5/2025	Self Employed	20-30 years	SSC/Equivalent
1/5/2025	Self Employed	41-50 years	SSC/Equivalent
1/5/2025	Business	41-50 years	Under SSC
1/5/2025	Business	20-30 years	Under SSC
1/5/2025	Service	51-60 years	Under SSC
1/5/2025	Business	41-50 years	SSC/Equivalent
1/5/2025	Business	20-30 years	B.Com/B.Sc/B.A
1/5/2025	Service	41-50 years	Under SSC

1/5/2025	Self Employed	20-30 years	B.Com/B.Sc/B.A
1/5/2025	Business	51-60 years	B.Com/B.Sc/B.A
1/5/2025	Service	20-30 years	HSC/Equivalent
1/5/2025	Service	31-40 years	B.Com/B.Sc/B.A
1/5/2025	Business	41-50 years	SSC/Equivalent
1/5/2025	Employe	31-40 years	Under SSC
1/5/2025	Business	41-50 years	B.Com/B.Sc/B.A
1/5/2025	Business	51-60 years	B.Com/B.Sc/B.A
1/5/2025	Business	31-40 years	HSC/Equivalent
1/5/2025	Business	41-50 years	HSC/Equivalent
1/5/2025	Business	31-40 years	SSC/Equivalent
1/5/2025	Service	31-40 years	HSC/Equivalent
1/5/2025	Employee	20-30 years	SSC/Equivalent
1/5/2025	Self Employed	20-30 years	SSC/Equivalent
1/5/2025	Self Employed	20-30 years	HSC/Equivalent
1/5/2025	Business	51-60 years	B.Com/B.Sc/B.A
1/5/2025	Business	51-60 years	M.A/M.Sc/M.com
1/5/2025	Business	41-50 years	M.A/M.Sc/M.com
1/5/2025	Business	31-40 years	HSC/Equivalent
1/5/2025	Employee	20-30 years	HSC/Equivalent
1/5/2025	Service	20-30 years	B.Com/B.Sc/B.A
1/5/2025	Service	31-40 years	Under SSC
1/5/2025	Business	41-50 years	Under SSC
1/5/2025	Business	51-60 years	M.A/M.Sc/M.com
1/5/2025	Student	20-30 years	HSC/Equivalent
1/5/2025	Employee	31-40 years	SSC/Equivalent
1/5/2025	Worker	15-20 years	No formal Education
1/5/2025	Employee	41-50 years	Under SSC
1/5/2025	Employee	41-50 years	Under SSC
1/5/2025	Business	31-40 years	SSC/Equivalent
1/5/2025	Employee	31-40 years	SSC/Equivalent
1/5/2025	Service	20-30 years	HSC/Equivalent
1/5/2025	Worker	20-30 years	No formal Education
1/5/2025	Service	20-30 years	HSC/Equivalent

1/5/2025	Self Employed	41-50 years	SSC/Equivalent
1/5/2025	Worker	15-20 years	No formal Education
1/5/2025	Unemployed	16	SSC/Equivalent
1/5/2025	Business	Worker	No formal Education
1/5/2025	Service	20-30 years	B.Com/B.Sc/B.A
1/5/2025	Business	20-30 years	HSC/Equivalent
1/5/2025	Business	51-60 years	B.Com/B.Sc/B.A
1/5/2025	Business	31-40 years	HSC/Equivalent
1/5/2025	Self Employed	31-40 years	HSC/Equivalent
1/5/2025	Worker	20-30 years	SSC/Equivalent
1/5/2025	Service	31-40 years	HSC/Equivalent
1/5/2025	Business	31-40 years	HSC/Equivalent
1/5/2025	Service	20-30 years	HSC/Equivalent
1/5/2025	Business	20-30 years	B.Com/B.Sc/B.A
1/5/2025	Service	31-40 years	B.Com/B.Sc/B.A
1/5/2025	Service	41-50 years	B.Com/B.Sc/B.A
1/5/2025	Service	20-30 years	SSC/Equivalent
1/5/2025	Business	20-30 years	Under SSC
1/5/2025	Employed	20-30 years	SSC/Equivalent

Online data survey second four question

(5).Do you know anything about E-waste?	(6).What is the average lifespan of your used electrical goods.(Mobile phone)	(6).What is the average lifespan of your used electrical goods.(Desktop laptop)	(6).What is the average lifespan of your used electrical goods.(Refrigerator)
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	1-2 years	above 8 years
Yes	5-6 years	5-6 years	above 8 years
Yes	1-2 years	3-4 years	5-6 years
Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	above 6 years	above 8 years
Yes	3-4 years	3-4 years	above 8 years
Yes	5-6 years	5-6 years	above 8 years

Yes	3-4 years	Not use	5-6 years
Yes	3-4 years	3-4 years	above 8 years
Yes	3-4 years	Don't use	above 8 years
Yes	1-2 years	3-4 years	3-4 years
No	1-2 years	No	No
Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	Don't use	Don't use
Yes	1-2 years	3-4 years	3-4 years
Yes	5-6 years	Don't use	5-6 years
No	1-2 years	No	No
Yes	3-4 years	5-6 years	above 8 years
Yes	1-2 years	Don't use	5-6 years
Yes	3-4 years	5-6 years	above 8 years
Yes	1-2 years	3-4 years	5-6 years
No	1-2 years	No	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	5-6 years
Yes	3-4 years	5-6 years	above 8 years
No	3-4 years	No	above 8 years
Yes	3-4 years	3-4 years	above 8 years
Yes	3-4 years	No	5-6 years
Yes	1-2 years	3-4 years	5-6 years
Yes	5-6 years	No	above 8 years
Yes	5-6 years	3-4 years	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	Not use	5-6 years
Yes	3-4 years	5-6 years	3-4 years
Yes	3-4 years	3-4 years	5-6 years
Yes	3-4 years	Not use	5-6 years
Yes	3-4 years	3-4 years	above 8 years
Yes	3-4 years	3-4 years	above 8 years
Yes	5-6 years	3-4 years	5-6 years
Yes	3-4 years	5-6 years	5-6 years
Yes	5-6 years	Don't use	above 8 years

Yes	3-4 years	Not use	Not use
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	5-6 years
Yes	5-6 years	5-6 years	above 8 years
Yes	5-6 years	3-4 years	5-6 years
Yes	above 6 years	Don't use	above 8 years
Yes	5-6 years	3-4 years	above 8 years
Yes	5-6 years	Not use	Not use
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	5-6 years
Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	5-6 years
Yes	3-4 years	5-6 years	above 8 years
Yes	1-2 years	3-4 years	5-6 years
No	above 6 years	Not use	above 8 years
Yes	5-6 years	Don't use	3-4 years
Yes	3-4 years	5-6 years	5-6 years
Yes	5-6 years	Not use	Not use
Yes	5-6 years	Not use	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	above 6 years	Not use	above 8 years
Yes	5-6 years	Not use	above 8 years
Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	Not use	above 8 years
Yes	5-6 years	Not use	Not use
Yes	5-6 years	5-6 years	above 8 years
No	3-4 years	Not use	above 8 years
Yes	5-6 years	Not use	above 8 years
Yes	5-6 years	Don't use	above 8 years
No	3-4 years	Not use	Not use
Yes	5-6 years	Don't use	above 8 years
Yes	3-4 years	5-6 years	above 8 years

Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	5-6 years
No	3-4 years	above 6 years	above 8 years
Yes	5-6 years	5-6 years	above 8 years
Yes	5-6 years	3-4 years	5-6 years
Yes	above 6 years	None	5-6 years
Yes	3-4 years	3-4 years	5-6 years
Yes	3-4 years	3-4 years	above 8 years
Yes	1-2 years	5-6 years	5-6 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	Not use	Not use
Yes	5-6 years	3-4 years	3-4 years
Yes	3-4 years	Not use	above 8 years

Online data survey third four question

(5).Do you know anything about E-waste?	(6).What is the average lifespan of your used electrical goods.(Mobile phone)	(6).What is the average lifespan of your used electrical goods.(Desktop laptop)	(6).What is the average lifespan of your used electrical goods.(Refrigerator)
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	1-2 years	above 8 years
Yes	5-6 years	5-6 years	above 8 years
Yes	1-2 years	3-4 years	5-6 years
Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	above 6 years	above 8 years
Yes	3-4 years	3-4 years	above 8 years
Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	Not use	5-6 years
Yes	3-4 years	3-4 years	above 8 years
Yes	3-4 years	Don't use	above 8 years

Yes	1-2 years	3-4 years	3-4 years
No	1-2 years	No	No
Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	Don't use	Don't use
Yes	1-2 years	3-4 years	3-4 years
Yes	5-6 years	Don't use	5-6 years
No	1-2 years	No	No
Yes	3-4 years	5-6 years	above 8 years
Yes	1-2 years	Don't use	5-6 years
Yes	3-4 years	5-6 years	above 8 years
Yes	1-2 years	3-4 years	5-6 years
No	1-2 years	No	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	5-6 years
Yes	3-4 years	5-6 years	above 8 years
No	3-4 years	No	above 8 years
Yes	3-4 years	3-4 years	above 8 years
Yes	3-4 years	No	5-6 years
Yes	1-2 years	3-4 years	5-6 years
Yes	5-6 years	No	above 8 years
Yes	5-6 years	3-4 years	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	Not use	5-6 years
Yes	3-4 years	5-6 years	3-4 years
Yes	3-4 years	3-4 years	5-6 years
Yes	3-4 years	Not use	5-6 years
Yes	3-4 years	3-4 years	above 8 years
Yes	3-4 years	3-4 years	above 8 years
Yes	5-6 years	3-4 years	5-6 years
Yes	3-4 years	5-6 years	5-6 years
Yes	5-6 years	Don't use	above 8 years
Yes	3-4 years	Not use	Not use
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	5-6 years

Yes	5-6 years	5-6 years	above 8 years
Yes	5-6 years	3-4 years	5-6 years
Yes	above 6 years	Don't use	above 8 years
Yes	5-6 years	3-4 years	above 8 years
Yes	5-6 years	Not use	Not use
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	5-6 years
Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	5-6 years
Yes	3-4 years	5-6 years	above 8 years
Yes	1-2 years	3-4 years	5-6 years
No	above 6 years	Not use	above 8 years
Yes	5-6 years	Don't use	3-4 years
Yes	3-4 years	5-6 years	5-6 years
Yes	5-6 years	Not use	Not use
Yes	5-6 years	Not use	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	above 6 years	Not use	above 8 years
Yes	5-6 years	Not use	above 8 years
Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	Not use	above 8 years
Yes	5-6 years	Not use	Not use
Yes	5-6 years	5-6 years	above 8 years
No	3-4 years	Not use	above 8 years
Yes	5-6 years	Not use	above 8 years
Yes	5-6 years	Don't use	above 8 years
No	3-4 years	Not use	Not use
Yes	5-6 years	Don't use	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	5-6 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	5-6 years	5-6 years

No	3-4 years	above 6 years	above 8 years
Yes	5-6 years	5-6 years	above 8 years
Yes	5-6 years	3-4 years	5-6 years
Yes	above 6 years	None	5-6 years
Yes	3-4 years	3-4 years	5-6 years
Yes	3-4 years	3-4 years	above 8 years
Yes	1-2 years	5-6 years	5-6 years
Yes	3-4 years	5-6 years	above 8 years
Yes	3-4 years	Not use	Not use
Yes	5-6 years	3-4 years	3-4 years
Yes	3-4 years	Not use	above 8 years

Online data survey fourth four question

(6).What is the average lifespan of your used electrical goods.a(Television)	(6).What is the average lifespan of your used electrical goods.(Air Conditioner)	(6).What is the average lifespan of your used electrical goods.(Battery)	(7) Do you know about the harmful impact of E-waste on health and the environment?
above 6 years	above 6 years	3-4 years	Yes
above 6 years	5-6 years	1-2 years	Yes
above 6 years	3-4 years	1-2 years	Yes
above 6 years	5-6 years	3-4 years	Yes
above 6 years	5-6 years	3-4 years	Yes
3-4 years	3-4 years	3-4 years	Yes
5-6 years	3-4 years	1-2 years	Yes
above 6 years	3-4 years	3-4 years	Yes
5-6 years	Not use	3-4 years	No
above 6 years	3-4 years	3-4 years	No
5-6 years	Don't use	3-4 years	No
3-4 years	3-4 years	1-2 years	Yes
No	No	1-2 years	Maybe
5-6 years	3-4 years	1-2 years	Yes
above 6 years	Don't use	1-2 years	No
above 6 years	3-4 years	1-2 years	Yes

3-4 years	Don't use	1-2 years	Yes
No	No	1-2 years	No
No	No	1-2 years	Yes
5-6 years	Don't use	3-4 years	Yes
No	No	1-2 years	Yes
above 6 years	3-4 years	1-2 years	Yes
above 6 years	No	1-2 years	No
above 6 years	5-6 years	3-4 years	Yes
above 6 years	3-4 years	1-2 years	Yes
above 6 years	5-6 years	3-4 years	No
above 6 years	No	1-2 years	No
above 6 years	3-4 years	3-4 years	Yes
above 6 years	No	1-2 years	Yes
above 6 years	3-4 years	1-2 years	Yes
above 6 years	No	3-4 years	Yes
5-6 years	Don't use	3-4 years	No
above 6 years	3-4 years	3-4 years	Yes
5-6 years	Not use	1-2 years	No
3-4 years	1-2 years	3-4 years	Yes
above 6 years	3-4 years	3-4 years	Yes
Not use	Not use	5-6 years	No
above 6 years	3-4 years	3-4 years	Yes
above 6 years	1-2 years	3-4 years	Yes
3-4 years	3-4 years	3-4 years	Yes
above 6 years	3-4 years	3-4 years	Yes
5-6 years	Don't use	5-6 years	Yes
Not use	Not use	1-2 years	Yes
3-4 years	3-4 years	3-4 years	Yes
above 6 years	1-2 years	3-4 years	Yes
above 6 years	Don't use	5-6 years	Yes
above 6 years	1-2 years	3-4 years	Yes
above 6 years	Don't use	5-6 years	Yes
above 6 years	3-4 years	1-2 years	Yes
Not use	Not use	3-4 years	Yes

3-4 years	3-4 years	3-4 years	Yes
3-4 years	3-4 years	3-4 years	Yes
above 6 years	5-6 years	1-2 years	Yes
above 6 years	3-4 years	1-2 years	Yes
above 6 years	3-4 years	1-2 years	Yes
above 6 years	Don't use	3-4 years	No
above 6 years	Not use	3-4 years	Yes
above 6 years	1-2 years	3-4 years	Yes
above 6 years	Not use	3-4 years	No
3-4 years	Don't use	3-4 years	No
3-4 years	1-2 years	1-2 years	Yes
Not use	Not use	3-4 years	Yes
5-6 years	Not use	3-4 years	No
above 6 years	Don't use	5-6 years	Yes
above 6 years	Not use	5-6 years	No
Not use	Not use	5-6 years	Yes
above 6 years	Don't use	5-6 years	Yes
Not use	Not use	5-6 years	Yes
Not use	Not use	3-4 years	Yes
above 6 years	Don't use	3-4 years	Yes
above 6 years	Not use	1-2 years	No
above 6 years	3-4 years	3-4 years	Yes
above 6 years	Don't use	5-6 years	Yes
Not use	Not use	1-2 years	No
5-6 years	Don't use	3-4 years	No
Not use	3-4 years	3-4 years	No
above 6 years	3-4 years	3-4 years	Yes
above 6 years	3-4 years	3-4 years	Yes
5-6 years	3-4 years	3-4 years	Yes
5-6 years	3-4 years	above 8 years	No
5-6 years	5-6 years	3-4 years	No
3-4 years	1-2 years	1-2 years	Yes
above 6 years	None	Unknown	No
above 6 years	3-4 years	3-4 years	Yes

3-4 years	5-6 years	1-2 years	Yes
3-4 years	3-4 years	1-2 years	Yes
above 6 years	1-2 years	1-2 years	Yes
Not use	Not use	3-4 years	Yes
above 6 years	Don't use	3-4 years	Yes
Not use	Not use	3-4 years	No

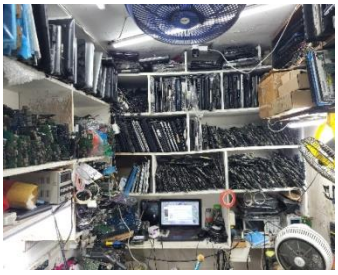
Online data survey last four question

(8) Do you know anything about the recycling of e-waste?	(9). Do you know anything about the safe disposal of E-waste?	(10) In your opinion, which of the following area affected most for unsafe disposal of E-waste?	(11) Is there any E-waste management policy in your institution ?
Yes	No	Land	No
Yes	No	Land	No
Yes	No	All	No
Yes	No	Land	No
Yes	Yes	All	Yes
Yes	Yes	All	Yes
Yes	Yes	All	Yes
Yes	No	Air	No
Yes	No	All	No
No	No	All	No
No	No	Don't know	No
Yes	No	Water	No
No	No	Air	No
Yes	No	All	No
No	No	Don't know	No
Yes	No	Land	No
Yes	Yes	All	Yes
No	No	Air	No
Yes	Yes	All	Yes
Yes	No	Land	No
Yes	Yes	All	Yes
Yes	No	All	No

Yes	No	All	Yes
Yes	No	All	No
Yes	No	Land	No
Yes	No	All	No
No	No	Air	No
Yes	No	All	No
Yes	No	All	No
Yes	No	All	No
Yes	No	All	No
Yes	No	Land	No
Yes	No	All	No
Yes	No	All	No
Yes	No	Air	No
Yes	Yes	All	Yes
Yes	No	Air	No
Yes	Yes	All	Yes
Yes	No	Land	No
Yes	No	All	No
Yes	No	All	No
Yes	No	Land	No
Yes	No	All	No
Yes	No	All	No
Yes	No	All	No
Yes	No	All	No
Yes	No	All	No
Yes	No	All	No
Yes	No	Air	No
Yes	No	Land	Yes
Yes	No	Land	No
Yes	No	Land	No
Yes	No	All	No
Yes	No	All	No
Yes	No	Land	No
Yes	No	All	No

Yes	No	All	Yes
Yes	No	Land	No
No	No	Air	No
No	No	Don't know	No
Yes	No	All	No
No	No	All	No
No	No	All	No
Yes	No	All	No
Yes	No	All	No
Yes	Yes	All	Yes
Yes	Yes	All	No
Yes	Yes	All	Yes
Yes	Yes	All	Yes
Yes	No	Land	Yes
Yes	No	All	Yes
Yes	Yes	All	Yes
Yes	No	Land	No
No	No	Air	No
No	No	Don't know	No
No	No	All	No
Yes	Yes	All	Yes
Yes	Yes	All	Yes
Yes	No	All	No
Yes	No	Land	Yes
Yes	No	Land	No
Yes	No	All	No
No	No	Land	No
Yes	No	Land	No
Yes	Yes	Land	No
Yes	No	All	No
Yes	No	All	No
Yes	No	All	No
Yes	No	Land	No
Yes	No	All	No

Some pictures during the survey








Some unrepairable electronics





E-waste (Mo Dismantling the Parts) Collector and Bhangari Shops








E-waste (Mobile Phone, Light, CCTV Parts) Collector and Bhangari Shop





E-waste (TV, Monitor and Household Item) Collector and Bhangari Shops




Dismantling the Parts





E-waste Stored in Open Road Side Area.